APPENDIX N

TRAFFIC REPORT FOR FINCH WEST AND STEELES WEST STATIONS

TRAFFIC IMPACT STUDY
TTC SPADINA SUBWAY EXTENSION
FINCH WEST STATION
CITY OF TORONTO

Prepared By:

URS Canada Inc.
75 Commerce Valley Drive East
Markham, Ontario
L3T 7N9

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33015347

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1.0 INTRODUCTION

This Traffic Impact Study has been prepared to document the study methodology, findings and evaluations associated with the proposed TTC Spadina Subway Extension and the proposed station concept at the Finch West Station. This is outlined herein.

The purpose of this memorandum was to:

- Review existing transportation conditions, opportunities, and constraints;
- Forecast and assess future traffic conditions associated with the proposed Finch West Station; and
- Identify operational concerns and proposed mitigation measures.

2.0 EXISTING TRAFFIC CONDITIONS

2.1. Boundary Road Network

Generally, in the vicinity of the Study Area, the lands are primarily for commercial and employment uses.

Figure 2-1 illustrates the existing arterial road system in the Study Area. In summary, they are:

- ***Dufferin Street*** is a north-south Major Arterial road with a posted speed limit of 60 km/h. It has 4-lanes from Glen Shields Avenue (north) to Finch Avenue. There are reserved High Occupancy Vehicle (H.O.V.) lanes on Dufferin Street between Finch Avenue and Sheppard Avenue. During the weekday morning and afternoon peak periods only buses, taxis and multi-person autos (three or more) are permitted to use these lanes. Dufferin Street is under the jurisdiction of York Region and the City of Toronto north and south of Steeles Avenue, respectively.
- ***Jane Street*** is a north-south Major Arterial road with a 4-lane cross-section. Jane Street is under the jurisdiction of York Region and the City of Toronto north and south of Steeles Avenue, respectively.
- ***Keele Street*** is a north-south Major Arterial road with a 4-lane cross-section. Keele Street is under the jurisdiction of York Region and the City of Toronto north and south of Steeles Avenue, respectively.
- ***Steeles Avenue*** is an east-west 6-lane Major Arterial road, under the jurisdiction of the City of Toronto, with a posted speed limit of 60 km/h.
- ***Finch Avenue*** is an east-west 4-lane Major Arterial road, under the jurisdiction of the City of Toronto, with a posted speed limit of 60 km/h.
- ***Sheppard Avenue West*** is an east-west 4-lane Major Arterial road, under the jurisdiction of the City of Toronto, with a posted speed limit of 60 km/h.

2.2. Existing Traffic

The existing traffic assessment for this study was based on a review of available turning movement data for the study area. Most recent available turning movement count data for the key intersections within the study area was obtained from the City of Toronto. This data was collected for the a.m. and p.m. peak hours. All observed turning movement counts were reviewed for consistency.

Signal timing information for the a.m. peak, p.m. peak and off peak hours was also obtained from the City of Toronto for key intersections within the study area. These signal timings along with most recent available traffic turning movement counts were incorporated in the analysis of existing traffic conditions.

Table 2-1 summarizes traffic data locations, survey dates and their sources.

TABLE 2-1. SUMMARY OF TRAFFIC DATA

INTERSECTION	DATE	SOURCE
Steeles Avenue / Jane Street	Tuesday, October 8, 2002	City of Toronto
Steeles Avenue / Murray Ross Parkway	Wednesday, October 29, 2003	City of Toronto
Steeles Avenue / Founders Road	Monday, January 22, 2001	City of Toronto
Steeles Avenue / Keele Street	Monday, December 15, 2003	City of Toronto
Steeles Avenue / Petrolia Road / Tandem Road	Wednesday, January 9, 2002	City of Toronto
Steeles Avenue / Shale Gate / Capstan Gate	Wednesday, December 5, 2001	City of Toronto
Steeles Avenue / Alness Street	Monday, October 27, 2003	City of Toronto
Steeles Avenue / Futurity Gate	Wednesday, December 6, 1995	City of Toronto
Steeles Avenue / Dufferin Street	Thursday, October 24, 2002	City of Toronto
Finch Avenue / Sentinel Road	Thursday, January 17, 2002	City of Toronto
Finch Avenue / Romfield Lane	Monday, December 8, 2003	City of Toronto
Finch Avenue / Keele Street	Tuesday, November 5, 2002	City of Toronto
Finch Avenue / Tangiers Road	Tuesday, September 14, 2004	City of Toronto
Finch Avenue / CNR Service Road	Tuesday, December 17, 2002	City of Toronto
Finch Avenue / Chesswood Drive	Wednesday, September 29, 2004	City of Toronto
Finch Avenue / Alness Street / Champagne Drive	Wednesday, January 16, 2002	City of Toronto
Finch Avenue / Dufferin Street	Monday, June 23, 2003	City of Toronto
Sheppard Avenue / Sentinel Road	Thursday, November 27, 2003	City of Toronto
Sheppard Avenue / Keele Street	Monday, December 16, 2002	City of Toronto
Sheppard Avenue / John Drury Crescent	Wednesday, June 27, 2001	City of Toronto
Sheppard Avenue / Tuscan Gate	Monday, November 24, 2003	City of Toronto
Sheppard Avenue / Chesswood Drive	Wednesday, June 27, 2001	City of Toronto
Sheppard Avenue / Kodiak Crescent / Yukon Lane	Tuesday, March 23, 2004	City of Toronto
Sheppard Avenue / W.R. Allen Road	Monday, May 12, 2003	City of Toronto
Keele Street / Canarctic Drive	Thursday, April 4, 2002	City of Toronto
Keele Street / The Pond Road	Thursday, April 4, 2002	City of Toronto
Keele Street / Murray Ross Parkway	Tuesday, December 17, 2002	City of Toronto
Keele Street / Toro Road	Wednesday, February 20, 2002	City of Toronto
Keele Street / Broadoaks Drive	Thursday, March 14, 2002	City of Toronto
Keele Street / St. Regis Crescent	Tuesday, August 27, 2002	City of Toronto
Keele Street / Grandravine Drive	Thursday, April 25, 2002	City of Toronto
Dufferin Street / 4400 Dufferin Street	Monday, December 8, 2003	City of Toronto
Dufferin Street / Dolomite Drive	Thursday, December 4, 2003	City of Toronto
Dufferin Street / Supertest Road	Wednesday, December 10, 2003	City of Toronto
Dufferin Street / Martin Ross Avenue	Wednesday, December 3, 2003	City of Toronto
W.R. Allen Road / Steeprock Drive / Overbrook Road	Thursday, March 13, 2003	City of Toronto
W.R. Allen Road / Kennard Avenue	Tuesday, March 5, 2002	City of Toronto
Alness Street / Supertest Road	Thursday, December 19, 2002	City of Toronto
Alness Street / Martin Ross Avenue	Thursday, December 19, 2002	City of Toronto
Sentinel Road / Murray Ross Parkway	Thursday, June 19, 2003	City of Toronto
Steeles Avenue / Northwest Gate	Tuesday, May 10, 2005	URS Canada Inc.
Keele Street / Four Winds Drive	Tuesday, May 3, 2005	URS Canada Inc.

The existing weekday a.m. and p.m. peak hour traffic volumes are illustrated in Figures 2-2 and 2-3, respectively.

2.3. Traffic Assessment

The traffic volumes in Figures 2-2 and 2-3 are for the broader area impacted by the Spadina Subway Extension. For the purpose of the evaluation of the impacts associated with the identified Finch West Station concept plan, a study area was identified within the immediate proximity of the proposed station.

The assessment for signalized intersection operations is based on the results of the Highway Capacity Software (HCS-2000), which is based on the methodology in the Highway Capacity Manual, 2000. The Highway Capacity Manual is produced by the Transportation Research Board.

Tables 6-1 summarizes the overall Level of Service (LOS), volume-to-capacity ratio (V/C), and average control delay for each of the key intersections during the a.m. and p.m. peak hours within the study area for the Finch West Station.

Level of Service definitions related to intersection operations are contained in ***Appendix A***. It is a qualifying measure of traffic operations at an intersection, relating the control delay per vehicle for a 15-minute analysis period. The volume-to-capacity ratio is a measure of the proportion of the calculated intersection capacity that is utilized by the modelled traffic volumes. At signalized intersections, movements with a v/c ratio greater than 0.85 or an average vehicle delay greater than 55 seconds (Level of Service 'E') are defined as critical. At unsignalized intersections, movements with a v/c ratio greater than 0.85 or an average vehicle delay of greater than 35 seconds (Level of Service 'E') are defined as critical movements. Detailed output for the existing traffic conditions are in ***Appendix B***.

The analyses of the existing intersection conditions reveal poor overall intersection levels of service at all major arterial-arterial intersections within the Study Area (at-capacity or over-capacity during the a.m. and p.m. peak hours). The intersections experience notably high delays and high volume-to-capacity ratios, with numerous critical movements.

The analyses of the existing intersection conditions confirm the existing traffic characteristics. Travel patterns by time-of-day show that traffic loading on all of the major arterials is very commuter-oriented. Significant queuing and traffic congestion exists on many of the arterial roads within the Study Area, in particular on:

- ***Dufferin Street, north of Finch Avenue;***
- ***Keele Street, south of Finch Avenue and north of Steeles Avenue; and***
- ***Finch Avenue, throughout the Study Area.***

These congested traffic conditions are significantly contributed to by high inter-regional traffic volumes and are typical conditions on regional arterial systems. The nature of such traffic congestion is mainly associated with the travellers' commuting peak hours during the morning and afternoon peak commuting periods (e.g. from 6:00 a.m. to 9:00 a.m., and from 4:00 p.m. to 7:00 p.m.). While congested operations (in terms of delays, queuing, and low reserved capacity) are encountered at the Major Arterial-Major Arterial intersections, acceptable operations at collector-arterial intersections are exhibited, despite relatively high inbound and outbound traffic turning movements at the gateways to significant traffic generators, such as the local industrial employment areas.

Figure 2-1A – Existing Lane Configurations

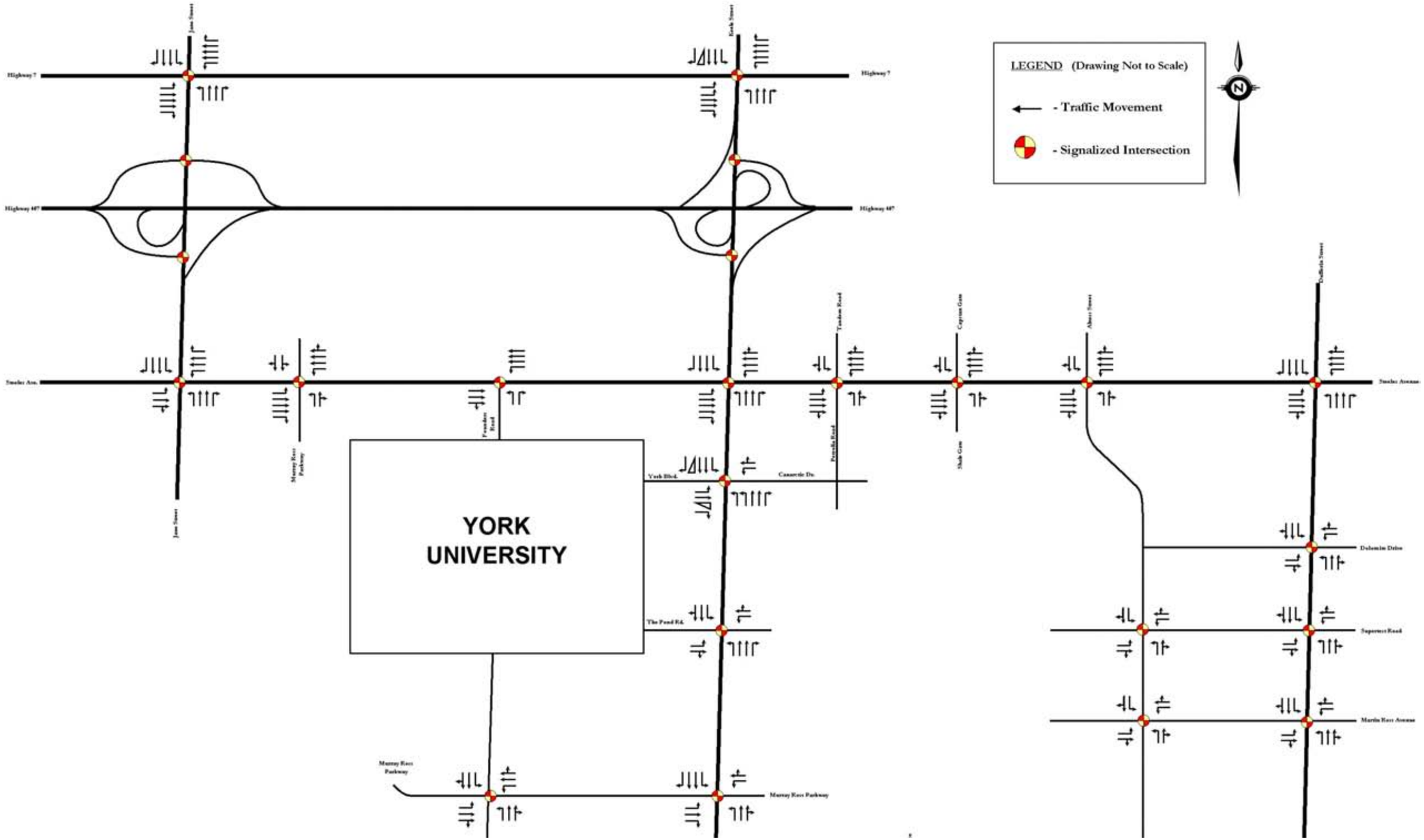


Figure 2-1B – Existing Lane Configurations

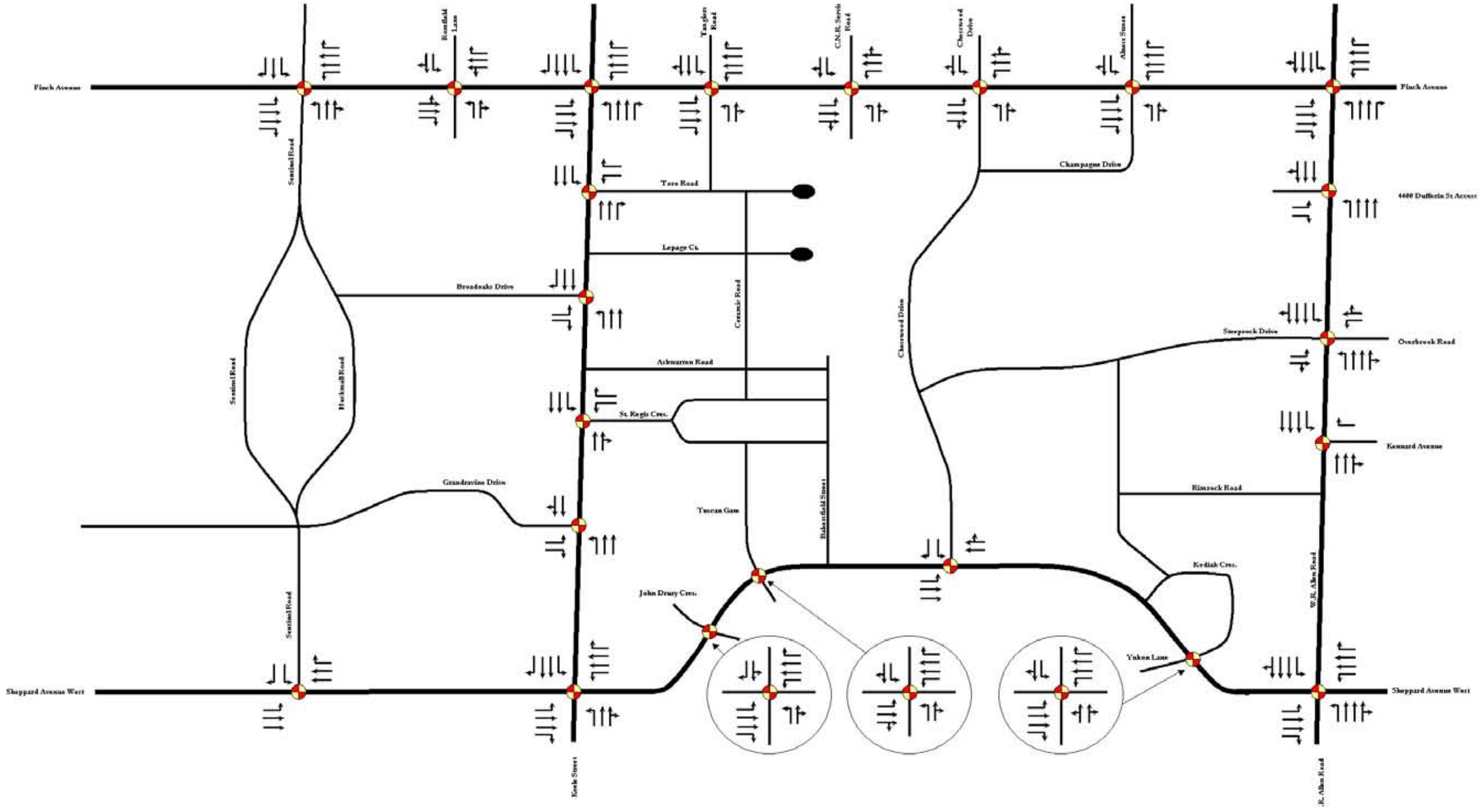


Figure 2-2A – Existing A.M. Peak Hour Traffic Volumes

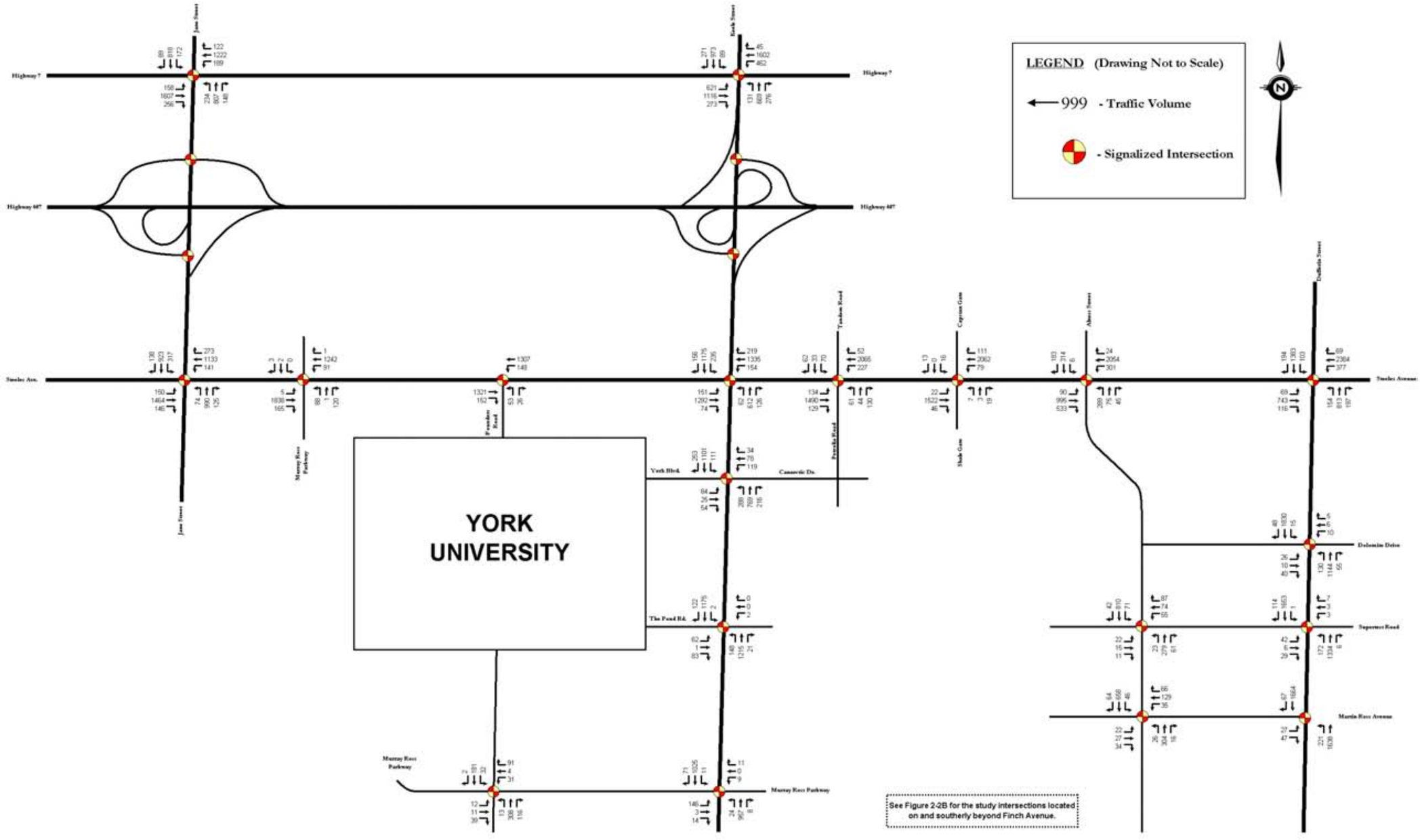


Figure 2-2B – Existing A.M. Peak Hour Traffic Volumes

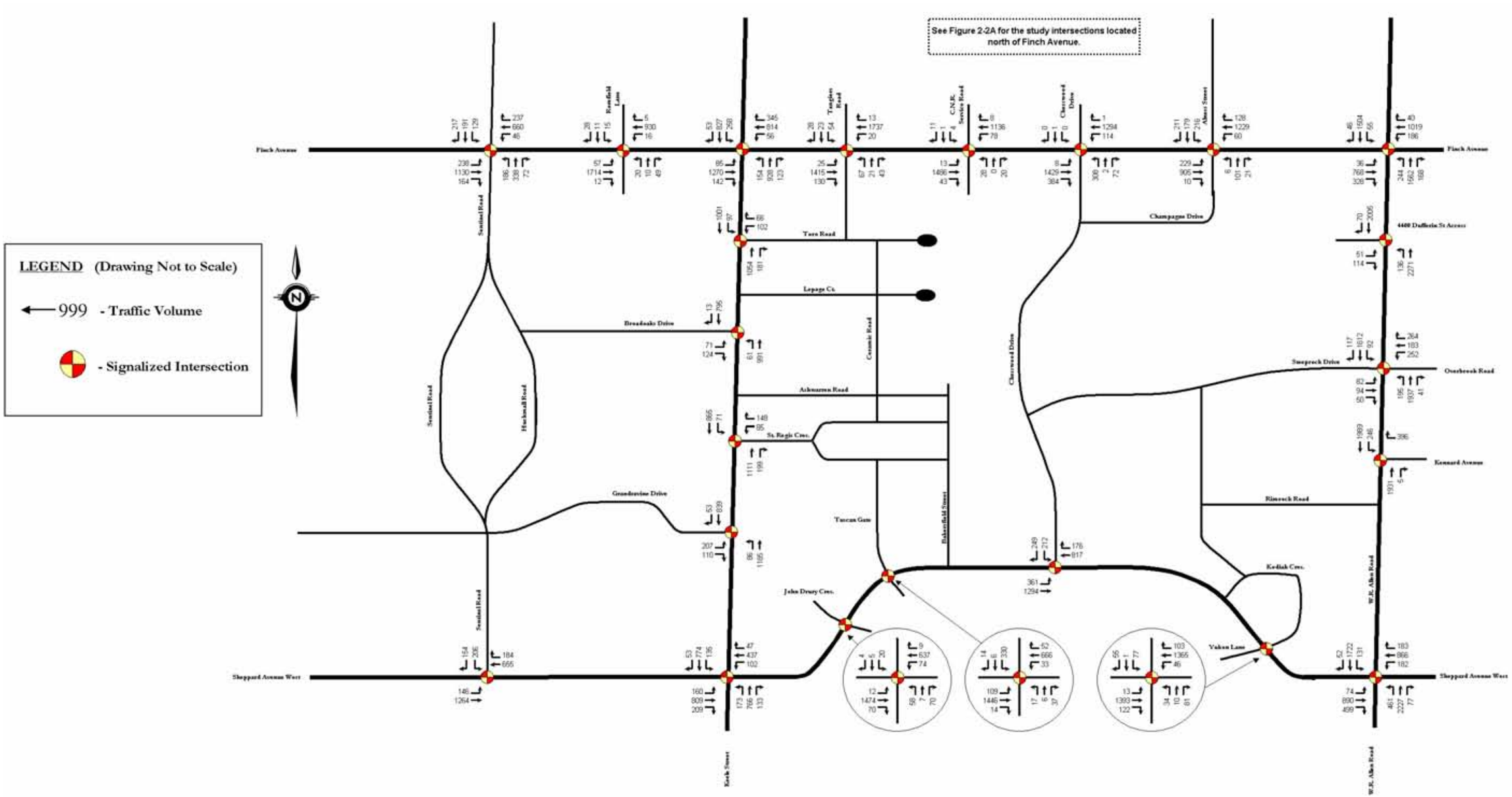


Figure 2-3A – Existing P.M. Peak Hour Traffic Volumes

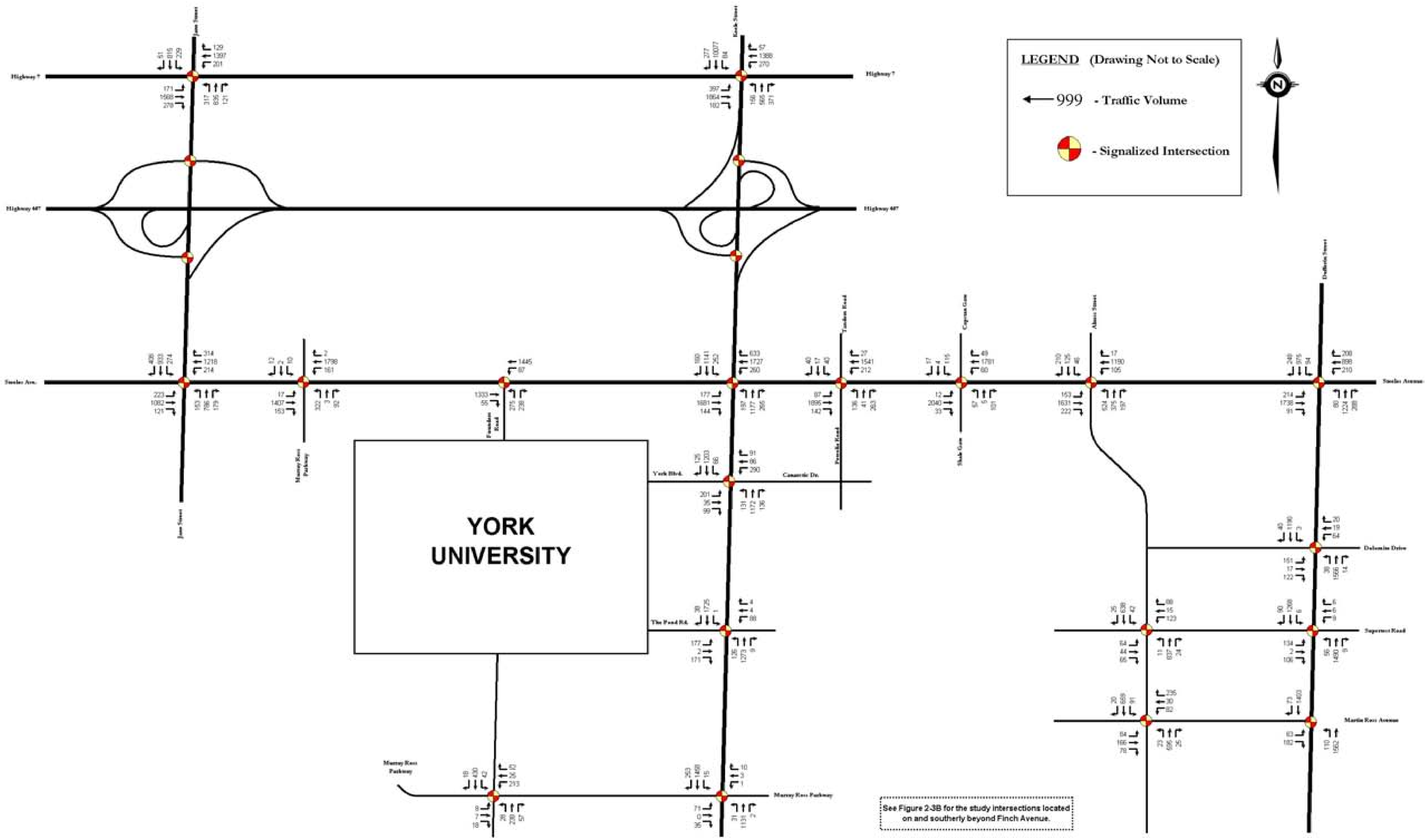
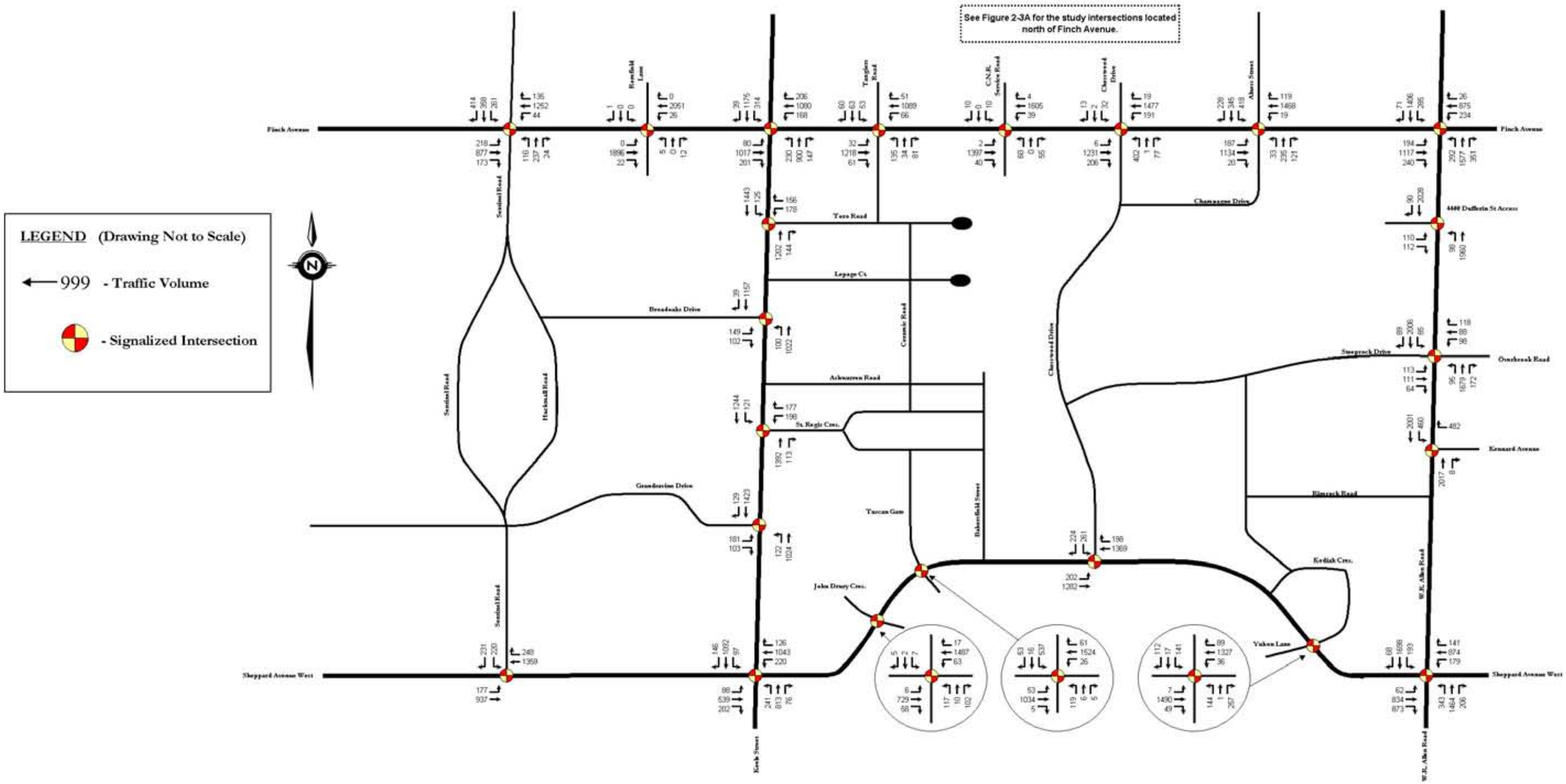


Figure 2-3B – Existing P.M. Peak Hour Traffic Volumes



3.0 PROPOSED STATION CONFIGURATION

The Finch West Station generalized access plan and assumed road configuration are illustrated in Figure 3-1. Figure 3-2 illustrates the layout plan for the Finch West Station. The internal circulation for the Finch West Station was based on a standard bus turning radius of 18.3m (outer turning) as per TTC Standard DM 0412-02 Fig 1.5. Internal bus circulation for the Finch West Station is also shown in Figure 3-2.

Key elements of the improved road network configuration include:

- The northerly extension of Tangiers Road to Murray Ross Parkway;
- The easterly extension of Four Winds Drive to Tangiers Road as a transit only facility; and
- Signalization and turn lane improvements at the Keele Street / Four Winds Drive intersection.

These road and intersection improvements have been identified as a means to provide access to the proposed Finch West Station. As noted for the analysis of existing and future traffic conditions within other sections of this report, there are some intersections and road link sections that are experiencing near or at-capacity conditions. While the City does not currently have planned major road or intersection improvements at any locations in the immediate study area, supplementary improvements have been identified in Section 6.3 as potential mechanisms to improve the existing and future traffic conditions beyond those reported in this study.

Figure 3-1 – Finch West Station

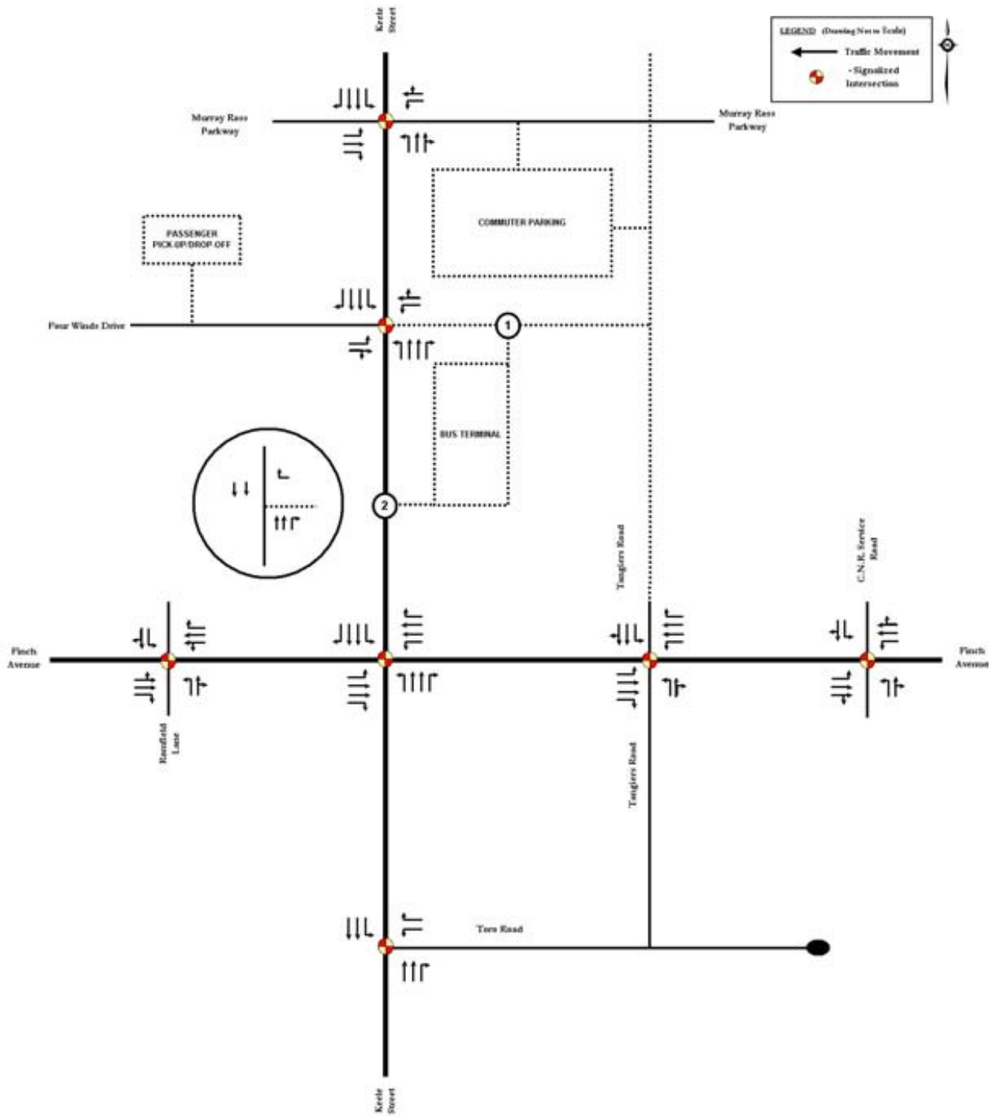
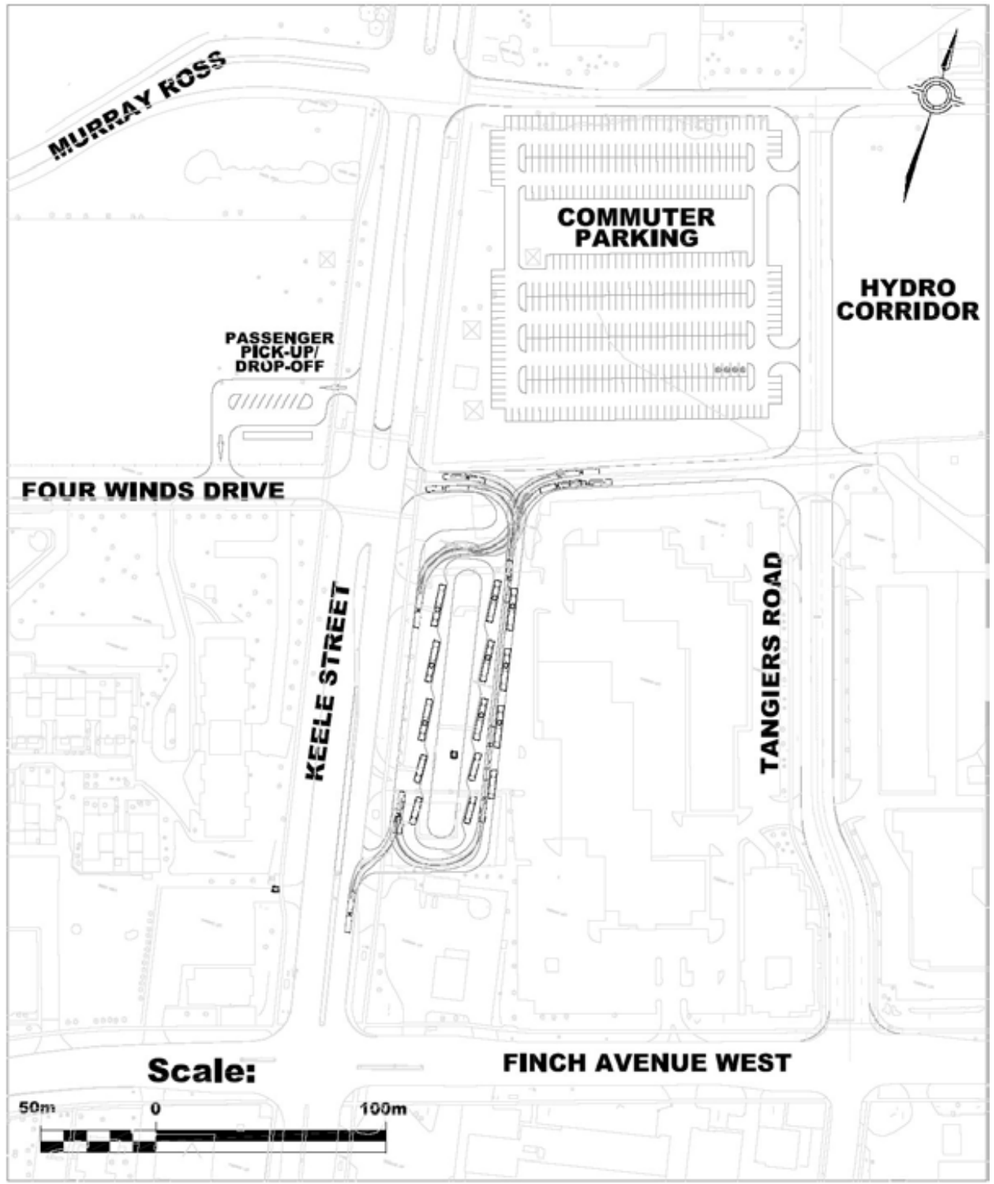


Figure 3-2 – Internal Bus Circulation



4.0 FUTURE BACKGROUND TRAFFIC CONDITIONS

4.1. Future Background Traffic

A 2021 development horizon was utilized to assess future traffic conditions. It is expected that the planning process and construction of the proposed TTC Spadina Subway Extension could be built and completed within the next ten years. For the purpose of the traffic assessment, a 2021 horizon year was selected to reflect this potential construction as well as several years of operation. It is acknowledged that 2021 is a very long-term horizon period, and is atypical for an analysis of this nature. Notwithstanding, the year 2021 has been selected to reflect conditions several years after subway construction and to be consistent with the comprehensive Transportation Impact Report prepared for the subway alternatives and evaluations phase of the study.

Future background traffic data for the study area was based on growth in through traffic due to developments outside of the study area (inter-regional through trips).

URS reviewed the existing boundary road network, existing traffic volumes and operations at the study intersections. Based on a review of recent turning movements counts at the study intersections, it was determined that inter-regional through flows have remained relatively static.

It is expected that the traffic volumes in the vicinity of the subject lands would not increase substantially since the existing traffic conditions are generally constrained by the relatively high-volume operations during the a.m. and p.m. peak hours at the study intersections along Keele Street and Finch Avenue. Since, for the most part, no increase in capacity of the boundary road network is anticipated within the study horizon period, it is expected that there will be minimal increase in future background traffic.

For analysis purpose, an annual growth rate of 0.5% was applied to forecast traffic in both directions for the a.m. and p.m. peak hours to reflect inter-regional through traffic growth within the study period along the arterial network within the study area for the 2021 horizon year. It should be noted that the existing traffic volumes were projected to reflect a common base year of 2005 for the calculation of future background traffic volumes.

The resultant weekday a.m. and p.m. peak hour 2021 future background traffic volumes for the Finch West Station are illustrated in Figures 4-1 and 4-2.

4.2. Traffic Assessment

The 2021 future background traffic operations at the study intersections were analyzed on the basis of the future lane configurations and the above noted traffic volumes in Figures 4-1 and 4-2.

Table 6-1 summarizes the overall Level of Service (LOS), control delay, and volume-to-capacity ratio (v/c) for the study area. Detailed outputs for the future background traffic conditions are in ***Appendix C***.

The analyses of future background traffic conditions revealed similar conditions to that determined for existing conditions. In general, there has been a minor degradation in traffic operations due to the increased background traffic growth.

Figure 4-1 – Future Background A.M. Peak Hour Traffic Volumes (Finch West Station)

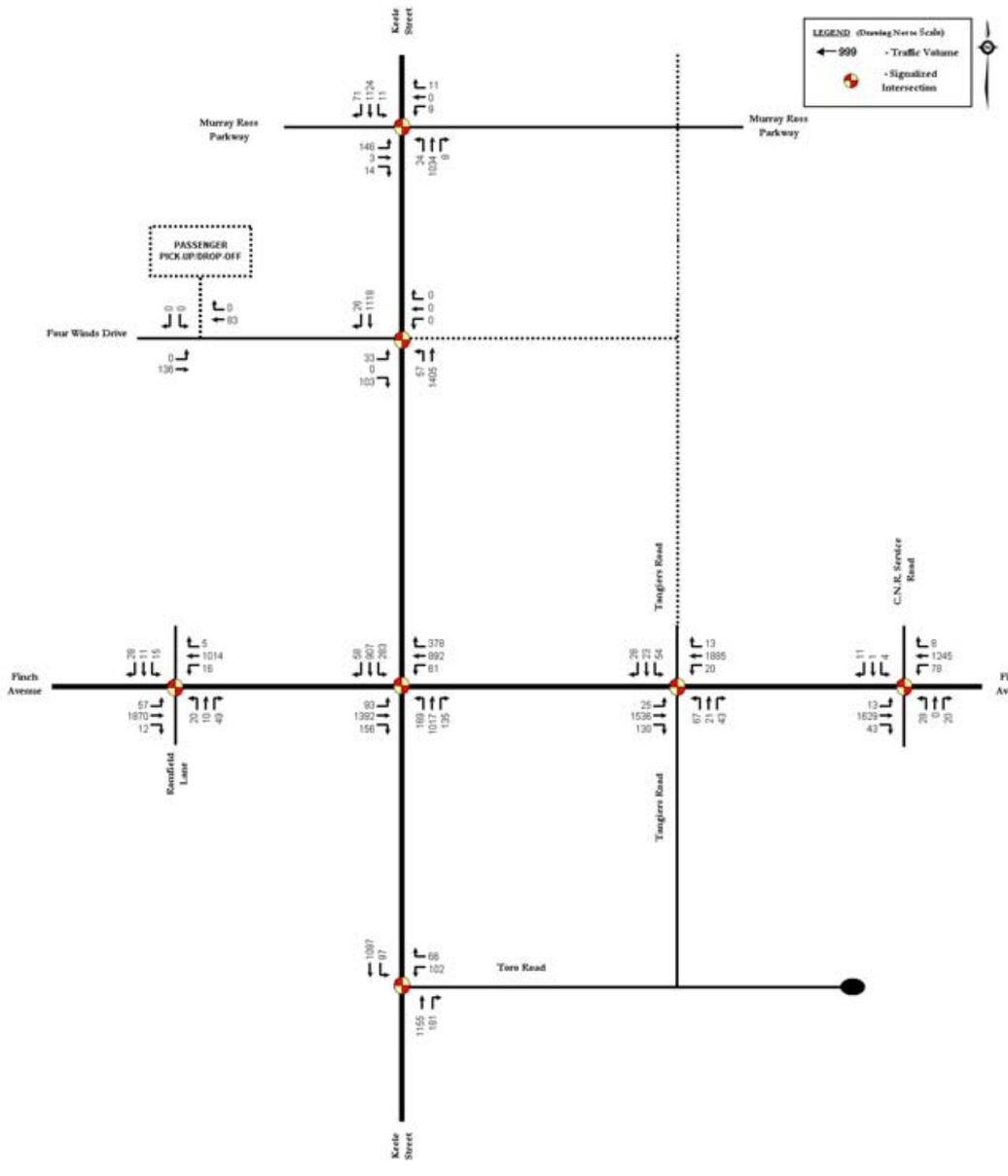
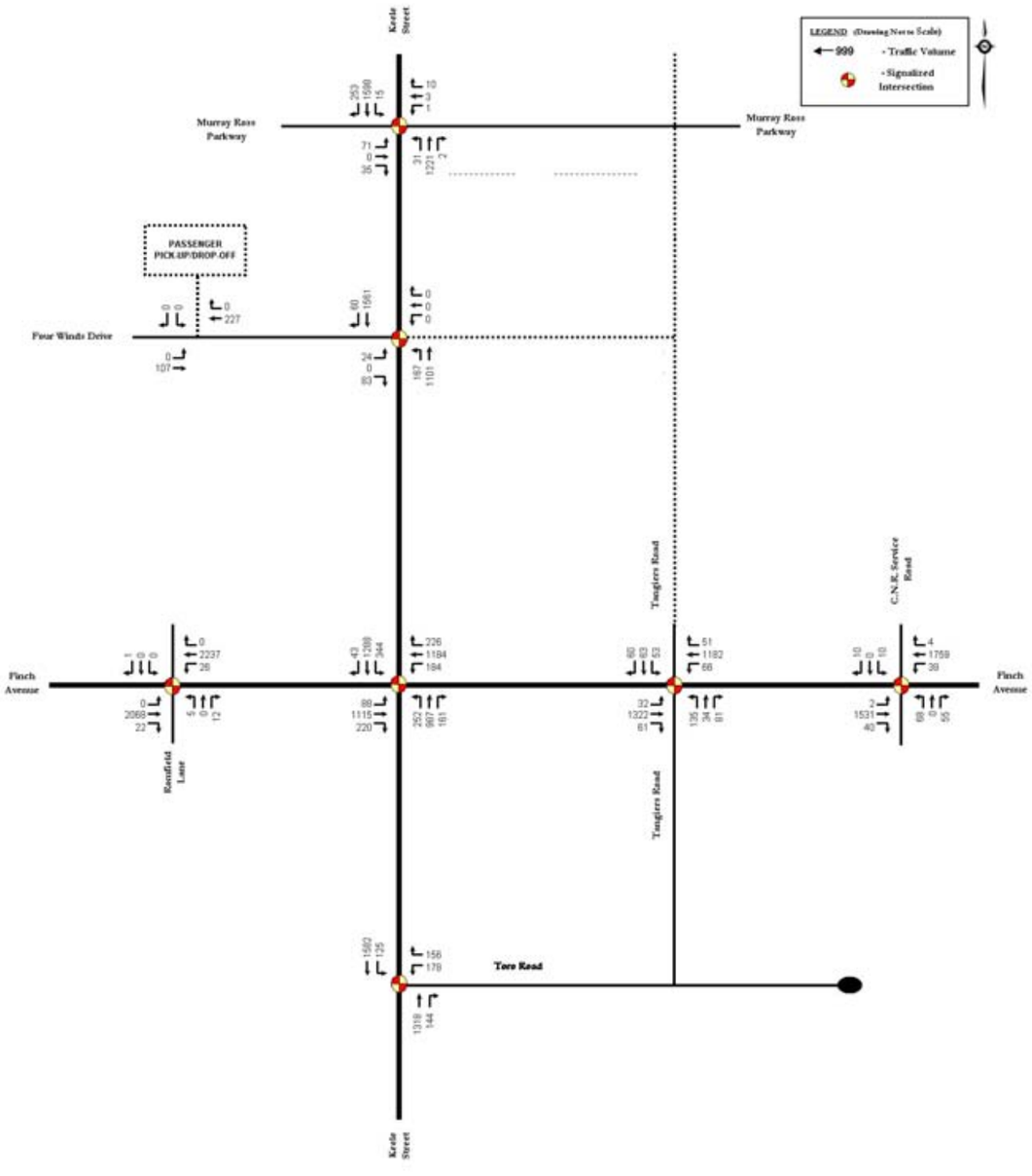


Figure 4-2 – Future Background P.M. Peak Hour Traffic Volumes (Finch West Station)



5.0 SITE TRAFFIC

5.1. Trip Generation

Trip generation for the Finch West Station was based on the sum of the passenger pick-up/drop-off (PPUDO) traffic, commuter parking lot (park'n'ride) traffic and transit traffic.

5.1.1. Passenger Pick-up/Drop-off (PPUDO)

The calculation methodology was provided by TTC in their planning guidelines for passenger pick-up/drop-off (PPUDO) facilities, illustrated in Figure 1.3.1 – Passenger Pick-up/Drop-off Capacity Requirements. Station usage and ridership information was also provided by TTC. Since the provided information is an a.m. peak hour forecast, the passenger pick-up/drop-off trip generation rate for p.m. peak hour traffic volumes was assumed to be the same as those for a.m. peak hour volumes, however in the opposite direction.

Tables 5-1 and 5-2 show the calculation and resultant traffic volumes associated with passenger pick-up/drop-off facilities for the Finch West Station.

TABLE 5-1. CALCULATION OF VEHICLE TRIPS - FINCH WEST STATION

Direction of Passengers	No. of Passengers	Passenger PU/DO Ratio	TTC Passengers	On-street PU/DO	Pass:Veh Ratio	No. of Vehicles Arriving
Pick-up	425	6-9%	26-38	0%	1.2	21-32
Drop-off	1,200	6-9%	72-108	0%	1.4	51-77
	1,625					73-109

It should be noted that the calculation of vehicle trips associated with the passenger pick-up/drop-off (PPUDO) facilities were based on PPUDO ratios ranging from 6% to 9% and yielding vehicle trips in the range of 73 to 109 vehicles. For the purpose of this study, the resultant of 105 vehicles arriving and departing was assessed in the traffic analyses.

TABLE 5-2. PASSENGER PICK-UP/DROP-OFF TRIP GENERATION - FINCH WEST STATION

AM Peak Hour		PM Peak Hour	
IN	OUT	IN	OUT
105	105	105	105

5.1.2. Commuter Parking Lot (Park'n'Ride)

The projected parking demand for the Finch West Station commuter parking lot is 400 stalls. This projection was provided by TTC in their station usage forecast.

It was assumed that 50% of the total park'n'ride commuters arrive and 5% depart during the a.m. peak hour. Since the assumption is an a.m. peak hour projection, the commuter parking trip generation rate for p.m. peak hour traffic volumes was reversed to reflect the p.m. peak hour traffic volumes associated with the park'n'ride facilities.

Table 5-3 shows the trip generation associated with the commuter parking lot for the Finch West Station.

TABLE 5-3. COMMUTER PARKING ARRIVAL AND DEPARTURE TRIP RATES -FINCH WEST STATION

Proposed Parking Stalls	AM Peak Hour			
400	50%	Arrival at Peak Hour	5%	Departure at Peak Hour
	200	Vehicular Trips	20	Vehicular Trips
	PM Peak Hour			
	5%	Arrival at Peak Hour	50%	Departure at Peak Hour
	20	Vehicular Trips	200	Vehicular Trips

TABLE 5-4. COMMUTER PARKING TRIP GENERATION - FINCH WEST STATION

AM Peak Hour		PM Peak Hour	
IN	OUT	IN	OUT
200	20	20	200

5.1.3. Transit (TTC Buses)

The future projections of the proposed transit routes and headways associated with the Finch West Station were provided by TTC. Since the provided information is an a.m. peak hour forecast, the transit route and frequencies for the p.m. peak hour transit traffic volumes was assumed to be the same as those for the a.m. peak hour.

Tables 5-5 summarizes the future transit routes and frequencies for the Finch West Station. Table 5-6 shows the total transit trip generation associated with the proposed transit facility for the Finch West Station.

TABLE 5-5. TRANSIT ROUTES AND FREQUENCIES

Finch West Station		Freq. (min)	Buses/Hr/Dir	Buses/Hr
GO Transit	N/A	-	-	-
York Region Transit	N/A	-	-	-
TTC Transit	41 Keele	6	10	20
	107 Chesswood	15	4	8
	36 Finch West (local)[1]	5.33	11.25	11.25
	36 Finch West (Humberwood)[2]	8	7.5	7.5
	36 Finch West C[3]	16	3.75	3.75
	36 Finch West D	16	3.75	7.5
	36 Finch West X[3]	8	7.5	7.5
	36 Finch West E[3]	8	7.5	7.5
			Total	73

[1] Eastbound only
[2] Westbound only
[3] Route terminus

TABLE 5-6. TRANSIT TRIP GENERATION – FINCH WEST STATION

AM Peak Hour		PM Peak Hour	
IN	OUT	IN	OUT
73	73	73	73

5.2. Trip Distribution and Assessment

The distribution of site traffic (station-related traffic) was based on a review of the boundary road network, an overview of the surrounding community uses, as well as a review of transit opportunities to identify trip paths and destinations.

The assignment of site traffic for the weekday a.m. and p.m. peak hour traffic volumes for the Finch West Station are illustrated in Figures 5-1 and 5-2.

The assignment of site traffic for the weekday a.m. and p.m. peak hour passenger pick-up/drop-off traffic volumes for the Finch West Station are illustrated in Figures A-1 and A-2 of ***Appendix D***, respectively.

The assignment of site traffic for the weekday a.m. and p.m. peak hour commuter parking traffic volumes for the Finch West Station are illustrated in Figures A-3 and A-4 of ***Appendix D***, respectively.

The assignment of site traffic for the weekday a.m. and p.m. peak hour transit traffic volumes for the Finch West Station are illustrated in Figure A-5 of ***Appendix D***.

Figure 5-1 – A.M. Peak Hour Site Traffic Volumes (Finch West Station)

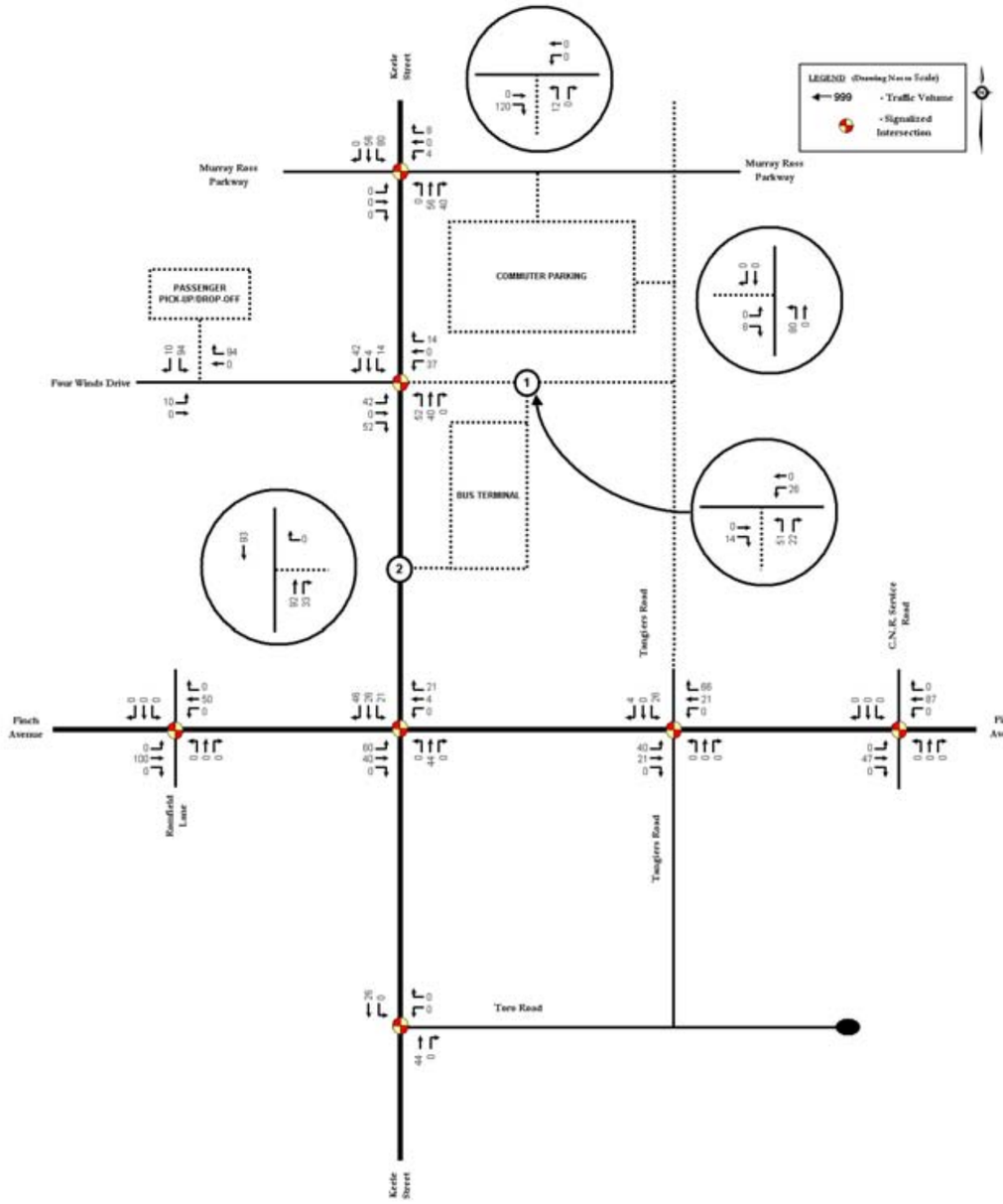
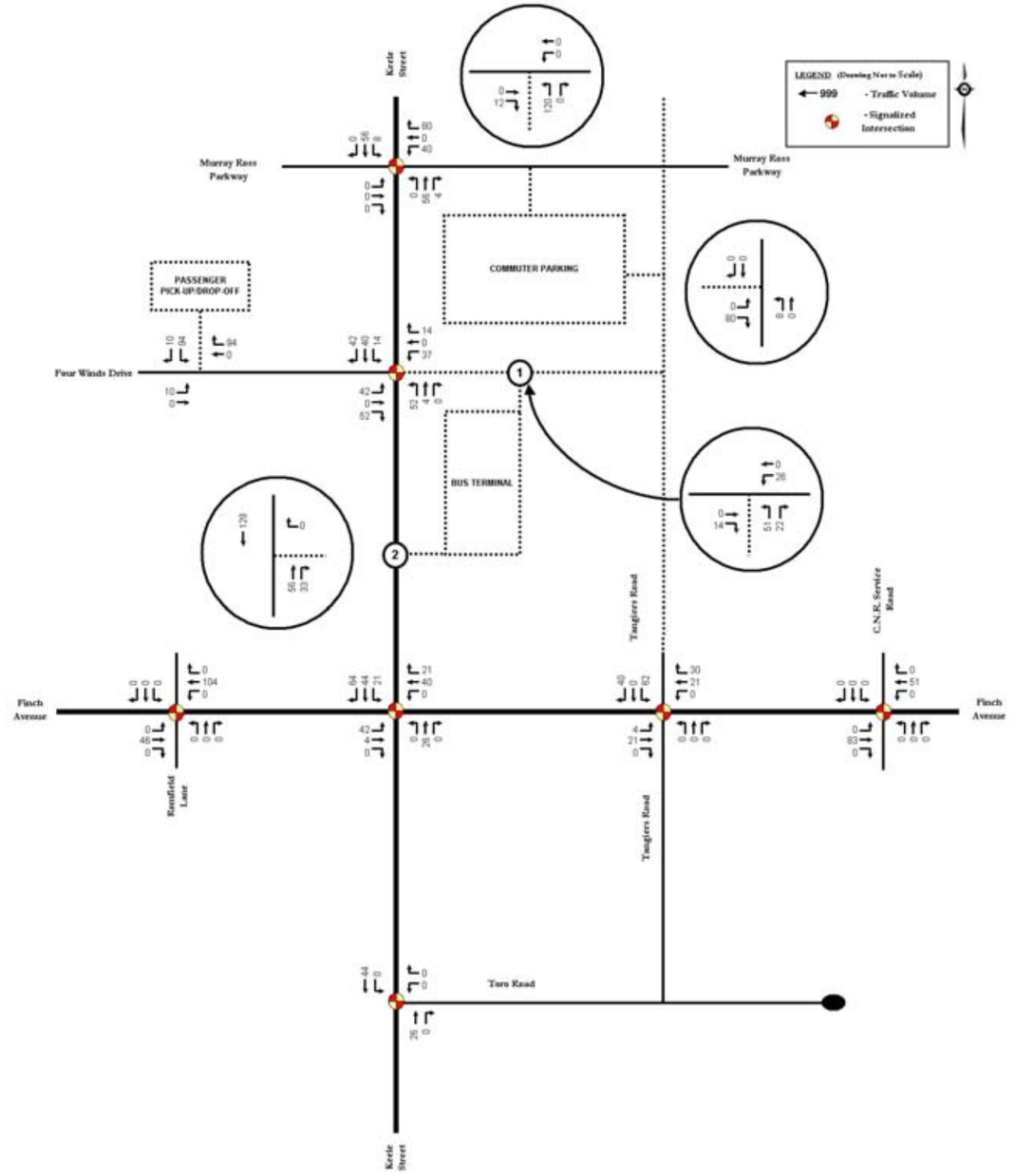


Figure 5-2 – P.M. Peak Hour Site Traffic Volumes (Finch West Station)



6.0 FUTURE TOTAL TRAFFIC CONDITIONS

6.1. Future Total Traffic

Future total traffic on the boundary road network was based on the sum of the future background traffic and the site traffic for the Finch West Station.

Figures 6-1 and 6-2 illustrate the future total traffic for the weekday a.m. and p.m. peak hours for Finch West Station.

Figure 3-1 illustrates the assumed future lane configurations at the key intersections within the study area for the Finch West Station.

6.2. Traffic Assessment

The future total traffic operations for the proposed station at the study intersections were analyzed on the basis of the assumed future lane configurations and the future total traffic volumes for the peak hours illustrated in Figures 6-1 and 6-2.

Table 6-1 summarizes the overall Level of Service (LOS), control delay, and volume-to-capacity ratio (v/c) for the study area. Detailed output for the future total traffic conditions for Finch West Station are in ***Appendix E***.

As with existing and future background conditions, the arterials in the study area, notably at the Keele Street / Finch Avenue intersection, continue to operate at/over-capacity with several critical movements. The intersecting collector roads typically operate well, although high through volumes on the arterials (Keele Street and Finch Avenue) result in congested operations at the Keele Street / Four Winds Drive and the Finch Avenue / Romfield Lane intersections. As noted previously, a key element of the future operations is the implementation of several road and intersection improvements that include; the northerly extension of Tangiers Road to Murray Ross Parkway; the easterly extension of Four Winds Drive to Tangiers Road as a transit only facility; and signalization and turn lane improvements at the Keele Street / Four Winds Drive intersection.

TABLE 6-1. FINCH WEST STATION: SUMMARY OF INTERSECTION OPERATIONS – ALL TRAFFIC CONDITIONS

INTERSECTIONS	OVERALL/ CRITICAL MOVEMENT	OPERATIONS (LOS, Delay, and V/C Ratio)*					
		EXISTING CONDITIONS		FUTURE BACKGROUND CONDITIONS		TOTAL FUTURE CONDITIONS	
		A.M. Peak Hour	P.M. Peak Hour	A.M. Peak Hour	P.M. Peak Hour	A.M. Peak Hour	P.M. Peak Hour
Keele St @ Murray Ross Pkwy	Intersection	B, 15 s, 0.49	D, 36 s, 0.83	B, 16 s, 0.52	D, 42 s, 0.91	B, 17 s, 0.68	D, 52 s, >1.0
	Critical Movement	-	SB T: E, 60 s, >1.0	-	SB T	SB L	WB L SB T
Keele St @ Four Winds Dr	Intersection	D, 26 s, 0.45	F, >120 s, >1.0	B, 15 s, 0.60	D, 48 s, >1.0	B, 18 s, 0.63	E, 69 s, >1.0
	Critical Movement	-	-	-	NB L SB T		NB L SB T
Keele St @ Finch Ave	Intersection	D, 40 s, 0.96	E, 69 s, >1.0	D, 48 s, >1.0	E, 68 s, >1.0	E, 60 s, >1.0	F, 106 s, >1.0
	Critical Movement	EB T: D, 39 s, 0.94 WB L: E, 69 s, 0.70 NB T: D, 44 s, 0.92 SB L: E, 74 s, 0.99	WB L: F, >120 s, >1.0 WB T: D, 48 s, 0.94 NB L: F, >120 s, >1.0 SB L: F, >120 s, >1.0 SB T: E, 76 s, >1.0	EB T WB L NB T SB L SB T	EB L EB T WB L WB T NB L NB T SB L SB T	EB T WB L NB L NB T SB L	EB T WB L WB T NB L NB T SB L SB T
Keele St @ Toro Rd	Intersection	B, 10 s, 0.42	B, 12 s, 0.60	B, 15 s, 0.46	B, 16 s, 0.67	B, 15 s, 0.48	B, 16 s, 0.70
	Critical Movement	-	-	-	-	-	-
Finch Ave @ Romfield Ln	Intersection	C, 22 s, 0.76	D, 43 s, 0.84	D, 42 s, 0.83	F, 87 s, 0.99	E, 57 s, 0.87	F, 110 s, >1.0
	Critical Movement	EB L: C, 29 s, 0.96	WB T: E, 68 s, >1.0	EB T	EB T WB T	EB T	EB T WB T
Finch Ave @ Tangiers Rd	Intersection	B, 18 s, 0.66	B, 14 s, 0.58	C, 22 s, 0.71	B, 15 s, 0.62	C, 23 s, 0.73	B, 16 s, 0.63
	Critical Movement	WB T: C, 20 s, 0.87	-	WB T	-	EB L WB T	-
Finch Ave @ CNR Service Rd	Intersection	A, 7 s, 0.58	A, 7 s, 0.60	B, 17 s, 0.69	B, 14 s, 0.66	B, 18 s, 0.74	B, 15 s, 0.67
	Critical Movement	-	-	WB L		EB T WB L	
Keele St @ Bus Station Entrance	Intersection	-	-	-	-	A, 10 s	A, 9 s
	Critical Movement	-	-	-	-	-	-

* At signalized intersections, movements with a v/c ratio greater than 0.85 or an average vehicle delay greater than 55 seconds are defined as critical. At unsignalized intersections, movements with a v/c ratio greater than 0.85 or an average vehicle delay of greater than 35 seconds are defined as critical movements.

** For unsignalized intersection operations, overall intersection level of service is based on the movement with the highest delay and poorest level of service.

6.3. Recommended Improvements

A review of the analyses results indicates that a general deficiency in through movement capacity exists along Keele Street within the study area. This finding is contrary to the City of Toronto's Keele Street Study (2001) which identified that no additional intersection improvements are required at the Keele Street/Finch Avenue intersection to accommodate the future traffic changes associated with the provision of a subway station at this intersection. In accordance with the findings of the EA study, it is recommended that consideration for additional capacity should be given during the design of the Spadina Subway Extension for improvements at this location. A potential remedy to the study roadway network is widening Keele Street from Finch Avenue to Murray Ross Parkway to accommodate three through lanes in each of

the northbound and southbound approaches. It is suggested that the widening begins north of Toro Road at a sufficient design distance south of Finch Avenue to effectively increase northbound through capacity and avoid weaving that may be caused by an immediate southbound lane drop south of the Finch Avenue intersection.

A westbound left turn lane is needed at the Finch Avenue / Romfield Lane intersection to improve the intersection operations. Due to the proximity of the Keele Street intersection and the existence of several driveways along Finch Avenue between the two intersections it is recommended that Finch Avenue be widened from Romfield Lane to Keele Street to accommodate a westbound left turn lane at Romfield Lane that continues as a centre two-way left turn lane to Keele Street. This additional centre lane will facilitate left turns to the school and other uses within this road segment. In addition, it is recommended that the widening of Finch Avenue continue west of Romfield Lane to include an eastbound left turn lane at the Finch Avenue / Romfield Lane intersection which will provide left turn vehicular storage for the school north of Finch Avenue. With the above mentioned recommendations the Finch Avenue / Romfield Lane intersection operations would improve to a Level of Service 'C' during the a.m. and the p.m. peak hours.

It should generally be noted that in reality the Four Winds Drive and the Murray Ross Parkway intersections along Keele Street would operate at better levels than those reflected in this analysis as the signal timing was conservatively assumed to accommodate a side street vehicular call and a pedestrian call every cycle. In reality, it is expected that there will be cycles that do not receive pedestrian or side street vehicular actuation, which would allow for an increase in the available north-south green time, thereby improving the overall intersection operations over the hour.

Detailed output for the supplementary traffic analyses including these geometric improvements for the Finch West Station are included in ***Appendix F.***

In summary, the following improvements are recommended to be implemented as part of the Spadina Subway Extension undertaking and the construction of Finch West Station at this location:

- ***Extend Tangiers Road northerly to Murray Ross Parkway;***
- ***Extend Murray Ross Parkway easterly to Tangiers Road;***
- ***Extend Four Winds Drive easterly to Tangiers Road as a transit only facility; and***
- ***Signalize the Keele Street / Four Winds Drive intersection and implement turn lane improvements;***

The following additional improvements should be considered during the design of the Spadina Subway Extension and the Finch West Station:

- ***The widening of Keele Street to a six-lane cross section from south of Finch Avenue to Murray Ross Parkway;***
- ***At the Finch Avenue / Romfield Lane intersection, construct a westbound left turn lane that extends to Keele Street as a continuous left turn lane, in addition to the construction of an eastbound left turn lane;***
- ***It is recommended that existing right turn lay-bys / bus-bays at the study intersections along Finch Avenue be upgraded to standard right turn lanes to allow more effective right turn capacity; and***
- ***It is recommended that signal timing at the study intersections be monitored in the future to continue to be optimized to accommodate traffic movement in the peak hours. Consideration should also be given to further optimization of traffic signal timing that may be accomplished by harmonizing the cycle lengths and coordinating the traffic signals along Keele Street and Finch Avenue to improve platooning and progression along these corridors.***

Figure 6-1 – Future Total A.M. Peak Hour Traffic Volumes (Finch West Station)

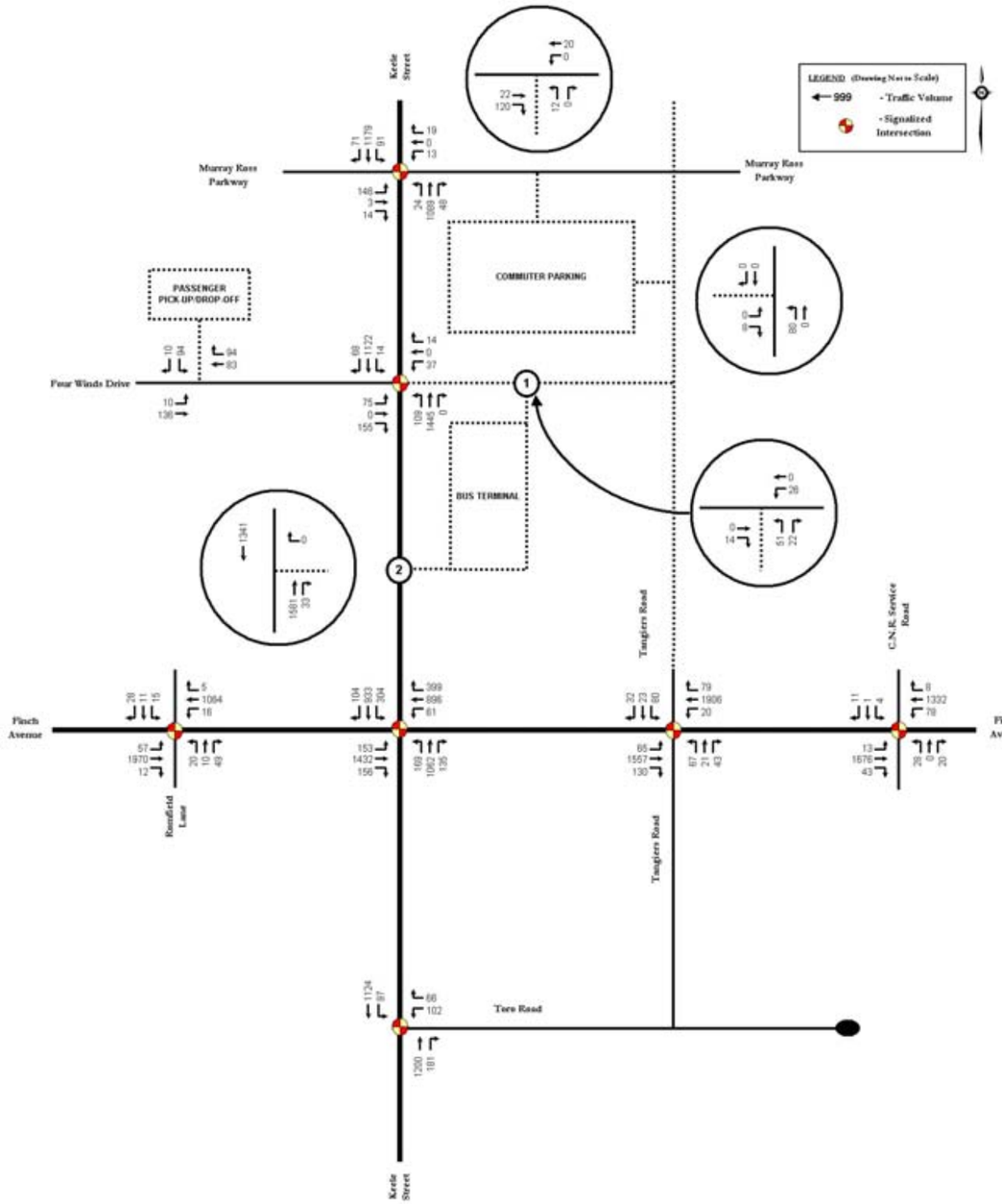
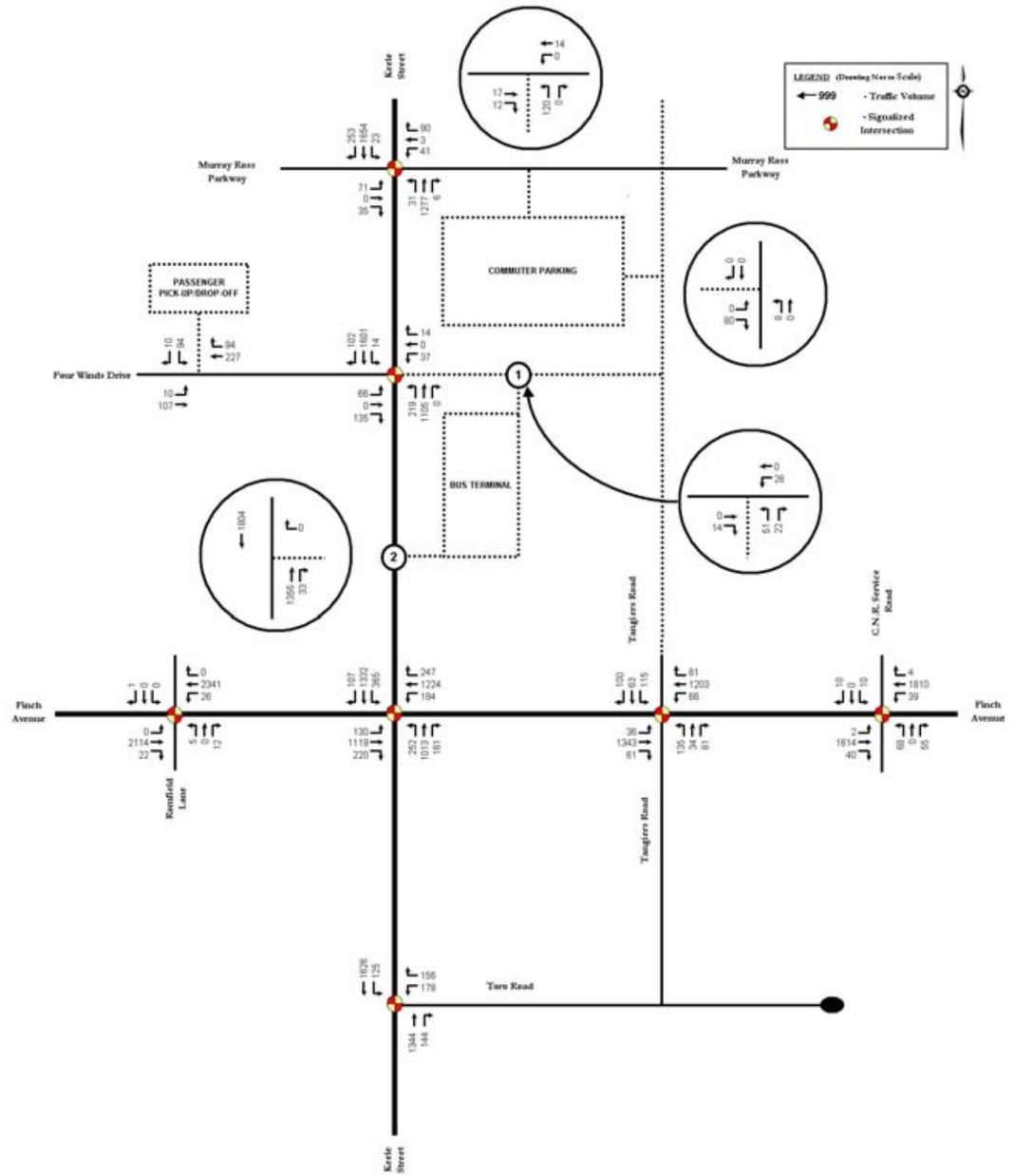


Figure 6-2 – Future Total P.M. Peak Hour Traffic Volumes (Finch West Station)



7.0 CONCLUSIONS AND RECOMMENDATIONS

This Traffic Impact Study has been prepared to document the study methodology, findings and evaluations associated with the proposed TTC Spadina Subway Extension and the proposed station concept at the Finch West Station.

The analyses of the existing intersection conditions reveal poor overall intersection levels of service at all major arterial-arterial intersections within the Study Area (at-capacity or over-capacity during the a.m. and p.m. peak hours). The analyses of the existing intersection conditions confirm the existing traffic characteristics. Travel patterns by time-of-day show that traffic loading on all of the major arterials is very commuter-oriented. Significant queuing and traffic congestion exists on many of the arterial roads within the Study Area, particularly on Keele Street south of Finch Avenue and Finch Avenue throughout the Study Area.

These congested traffic conditions are significantly contributed to by high inter-regional traffic volumes and are typical conditions on regional arterial systems. The nature of such traffic congestion is mainly associated with the travellers' commuting peak hours during the morning and afternoon peak commuting periods. While congested operations (in terms of delays, queuing, and low reserved capacity) are encountered at the Major Arterial-Major Arterial intersections, acceptable operations at collector-arterial intersections are exhibited, despite relatively high inbound and outbound traffic turning movements at the gateways to significant traffic generators, such as the local industrial employment areas.

The key elements of the improved road network configuration include the northerly extension of Tangiers Road to Murray Ross Parkway, the easterly extension of Murray Ross Parkway to Tangiers Road, the easterly extension of Four Winds Drive to Tangiers Road as a transit only facility, and the signalization and turn lane improvements at the Keele Street / Four Winds Drive intersection. These road and intersection improvements have been identified as a means to provide access to the proposed Finch West Station.

Trip generation for the Finch West Station was based on the sum of the passenger pick-up/drop-off (PPUDO) traffic, commuter parking lot (park'n'ride) traffic and transit traffic. The vehicular trip generation associated with the passenger PPUDO facility is expected to result in about 105 inbound and 105 outbound trips on the boundary road network during the weekday a.m. and p.m. peak hours. The vehicular trip generation associated with the commuter parking lot is expected to result in about 200 inbound and 20 outbound trips on the boundary road network during the weekday a.m. peak hour, and 20 inbound and 200 outbound trips during the p.m. peak hour. The transit trip generation associated with the transit facility is expected to result in about 73 inbound and 73 outbound trips on the boundary road network during the weekday a.m. and p.m. peak hours.

Based on a review of the future total analyses results, the arterials in the study area, notably at the Keele Street / Finch Avenue intersection, continue to operate at/over-capacity with several critical movements. The results indicate a general deficiency in through movement capacity exists along Keele Street within the study area. Notwithstanding this finding, the City of Toronto's Keele Street Study (2001) identified that no additional intersection improvements are required at the Keele Street/Finch Avenue intersection to accommodate the future traffic changes associated with the study area for the Keele Street Study, given the provision of a subway station at this intersection with access to all four quadrants and a bus terminal in the northeast quadrant, along with the completion of a north-south collector road on the east side of Keele Street between Finch and Steeles Avenues. However, it is recommended that consideration for additional capacity should be given during the detailed design stage of the Spadina Subway Extension for improvements at this location.

Since some of the study intersections are projected to continue to operate with critical turning movements, URS undertook some supplementary traffic analyses based on the contemplated road and intersection improvement considerations to identify the impact of these improvements. Based on the result of the supplementary analyses with those additional recommended improvements, if all the recommended improvements were to be implemented, this would result in improved operations in the study area and better findings than those reported in this study.

In summary, the following improvements are recommended to be implemented as part of the Spadina Subway Extension undertaking and the construction of Finch West Station at this location:

- ***Extend Tangiers Road northerly to Murray Ross Parkway;***
- ***Extend Murray Ross Parkway easterly to Tangiers Road;***
- ***Extend Four Winds Drive easterly to Tangiers Road as a transit only facility; and***
- ***Signalize the Keele Street / Four Winds Drive intersection and implement turn lane improvements;***

The following additional improvements should be considered during the design of the Spadina Subway Extension and the Finch West Station:

- ***The widening of Keele Street to a six-lane cross section from south of Finch Avenue to Murray Ross Parkway;***
- ***At the Finch Avenue / Romfield Lane intersection, construct a westbound left turn lane that extends to Keele Street as a continuous left turn lane, in addition to the construction of an eastbound left turn lane;***
- ***It is recommended that existing right turn lay-bys / bus-bays at the study intersections along Finch Avenue be upgraded to standard right turn lanes to allow more effective right turn capacity; and***
- ***It is recommended that signal timing at the study intersections be monitored in the future to continue to be optimized to accommodate traffic movement in the peak hours. Consideration should also be given to further optimization of traffic signal timing that may be accomplished by harmonizing the cycle lengths and coordinating the traffic signals along Keele Street and Finch Avenue to improve platooning and progression along these corridors.***

APPENDIX A

LEVEL OF SERVICE DEFINITIONS

LEVEL OF SERVICE
FOR
SIGNALIZED INTERSECTIONS
(Highway Capacity Manual, 2000)

The assessment of operations for signalized intersections is based on the results of the Highway Capacity Software (HCS), which is based on the methodology in the Highway Capacity Manual, 2000.

Level of service for signalized intersections is defined in terms of delay, which is a measure of driver discomfort and frustration, fuel consumption, and lost travel time. Specifically, level-of-service (LOS) criteria are stated in terms of the control delay per vehicle for a 15-minute analysis period.

LOS A described operations with very low delay, up to 10 seconds per vehicle. This level of service occurs when progression is extremely favourable and most vehicles arrive during the green phase. Most vehicles do not stop at all. Short cycle lengths may also contribute to low delay.

LOS B describes operations with delay greater than 10 and up to 20 seconds per vehicle. This level generally occurs with good progression, short cycle lengths, or both. More vehicles stop than with LOS A, causing higher levels of average delay.

LOS C describes operations with delay greater than 20 and up to 35 seconds per vehicle. These higher delays may result from fair progression, longer cycle lengths, or both. Individual cycle failures may begin to appear at this level. The number of vehicles stopping is significant at this level, though many still pass through the intersection without stopping.

LOS D describes operations with delay greater than 35 and up to 55 seconds per vehicle. At level D, the influence of congestion becomes more noticeable. Longer delays may result from some combination of unfavourable progression, long cycle lengths, or high v/c ratios. Many vehicles stop, and the proportion of vehicles not stopping declines. Individual cycle failures are noticeable.

LOS E describes operations with delay greater than 55 and up to 80 seconds per vehicle. This level is considered by many agencies to be the limit of acceptable delay. These high delay values generally indicate poor progression, long cycle lengths, and high v/c ratios. Individual cycle failures are frequent occurrences.

LOS F describes operations with delay in excess of 80 seconds per vehicle. This level, considered to be unacceptable to most drivers, often occurs with over-saturation, that is, when arrival flow rates exceed the capacity of the intersection. It may also occur at high v/c ratios below 1.0 with many individual cycle failures. Poor progression and long cycle lengths may also be major contributing causes to such delay levels.

Level of Service	Stopped Delay Per Vehicle (Seconds)
A	$\leq$ 10.0
B	> 10.0 and $\leq$ 20.0
C	> 20.0 and $\leq$ 35.0
D	> 35.0 and $\leq$ 55.0
E	> 55.0 and $\leq$ 80.0
F	> 80.0

LEVEL OF SERVICE
FOR
UNSIGNALIZED INTERSECTIONS
(TWO-WAY AND ALL-WAY STOP CONTROL)

The assessment of operations for unsignalized intersections is based on the results of the Highway Capacity Software (HCS), which is based on the methodology in the Highway Capacity Manual, 2000.

Level of service for two-way stop controlled intersections is defined in terms of delay, which is a measure of driver discomfort and frustration, fuel consumption, and lost travel time. Specifically, level-of-service (LOS) criteria are stated in terms of the average control delay per vehicle for a 15-minute analysis period.

Level of Service	Average Total Delay (Seconds/Vehicle)
A	$\leq$ 10
B	> 10 and $\leq$ 15
C	> 15 and $\leq$ 25
D	> 25 and $\leq$ 35
E	> 35 and $\leq$ 50
F	> 50

APPENDIX B

INTERSECTION ANALYSES

EXISTING TRAFFIC

HCS2000: Signalized Intersections Release 4.1e

Analyst: a.liu
Agency: URS Canada Inc.
Date: 12/9/2004
Period: AM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Murray Ross Pkwy

Inter.: Keele St / Murray Ross Pkwy
Area Type: All other areas
Jurisd: City of Toronto
Year: Existing Conditions
N/S St: Keele St

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	1	1	1	0	1	2	0	1	2	1
LGConfig	L	T	R	L	TR		L	TR		L	T	R
Volume	146	3	14	9	0	11	24	957	8	11	1025	71
Lane Width	3.6	3.6	3.6	3.6	3.6		3.6	3.6		3.6	3.6	3.6
RTOR Vol		0			0			0			0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	28.0				49.0			
Yellow	4.0				4.0			
All Red	3.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	444	1426	0.34	0.31	25.9	C		
T	445	1429	0.01	0.31	21.4	C	25.4	C
R	502	1615	0.03	0.31	21.6	C		
Westbound								
L	236	760	0.04	0.31	21.9	C		
TR	276	887	0.04	0.31	21.9	C	21.9	C
Northbound								
L	206	378	0.12	0.54	11.1	B		
TR	1812	3329	0.54	0.54	14.4	B	14.4	B
Southbound								
L	137	251	0.08	0.54	10.9	B		
T	1824	3350	0.57	0.54	14.9	B	14.5	B
R	879	1615	0.08	0.54	10.0-	A		

Intersection Delay = 15.3 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

Phone: Fax:
E-Mail:

OPERATIONAL ANALYSIS

Analyst: a.liu
Intersection: Keele St / Murray Ross Pkwy
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: AM Peak Hour
Analysis Year: Existing Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Murray Ross Pkwy
North/South Street: Keele St

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	146	3	14	9	0	11	24	957	8	11	1025	71
% Heavy Veh	0	33	0	89	0	82	4	8	75	73	8	0
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	37	1	4	3	0	3	6	244	2	3	261	18
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900	1900	1900	1900		1900	1900		1900	1900	1900
ParkExist												
NumPark												
No. Lanes	1	1	1	1	1	0	1	2	0	1	2	1
LGConfig	L	T	R	L	TR		L	TR		L	T	R
Lane Width	3.6	3.6	3.6	3.6	3.6		3.6	3.6		3.6	3.6	3.6
RTOR Vol		0			0			0			0	
Adj Flow	149	3	14	9	11		24	985		11	1046	72
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		1.000			0.008			0.000	1.000
Peds Bikes	0			0			0			0		
Buses	0	0	0	0	0		0	0		0	0	0
%InProtPhase												

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	0.0
Arriv. Type	3	3	3	3	3		3	3		3	3	3
Unit Ext.	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	2.0
Ext of g	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	2.0
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			

Green	28.0				49.0			
Yellow	4.0				4.0			
All Red	3.0				2.0			

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	146	3	14	9	0	11	24	957	8	11	1025	71
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	149	3	14	9	0	11	24	977	8	11	1046	72
No. Lanes	1	1	1	1	1	0	1	2	0	1	2	1
Lane group	L	T	R	L	TR		L	TR		L	T	R
Adj flow	149	3	14	9	11		24	985		11	1046	72
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		1.000			0.008			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	T	R	L	TR		L	TR		L	T	R
So	1900	1900	1900	1900	1900		1900	1900		1900	1900	1900
Lanes	1	3	1	1	2	0	1	2	0	1	2	1
fW	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	1.000
fHV	1.000	0.752	1.000	0.529	0.549		0.962	0.921		0.578	0.926	1.000
fG	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	1.000
fA	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	1.000
fLU	1.000	1.000	1.000	1.000	1.000		1.000	0.952		1.000	0.952	1.000
fRT		1.000	0.850		0.850			0.999			1.000	0.850
fLT	0.750	1.000		0.756	1.000		0.207	1.000		0.229	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000	1.000		1.000			1.000			1.000	1.000
S	1426	1429	1615	760	887		378	3329		251	3350	1615
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	149	1426	# 0.10	0.31	444	0.34
Prot							
Perm							
Thru	T	3	1429	0.00	0.31	445	0.01
Right	R	14	1615	0.01	0.31	502	0.03
Westbound							
Prot							
Perm							
Left	L	9	760	0.01	0.31	236	0.04
Prot							
Perm							
Thru	TR	11	887	0.01	0.31	276	0.04
Right							
Northbound							
Prot							
Perm							
Left	L	24	378	0.06	0.54	206	0.12
Prot							
Perm							
Thru	TR	985	3329	0.30	0.54	1812	0.54
Right							
Southbound							
Prot							
Perm							
Left	L	11	251	0.04	0.54	137	0.08
Prot							
Perm							
Thru	T	1046	3350	# 0.31	0.54	1824	0.57
Right	R	72	1615	0.04	0.54	879	0.08

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.42
Total lost time per cycle, L = 13.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.49

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.34	0.31	23.8	1.000	444	0.50	2.0	0.0	25.9	C		
T	0.01	0.31	21.4	1.000	445	0.50	0.0	0.0	21.4	C	25.4	C
R	0.03	0.31	21.5	1.000	502	0.50	0.1	0.0	21.6	C		
Westbound												
L	0.04	0.31	21.6	1.000	236	0.50	0.3	0.0	21.9	C		
TR	0.04	0.31	21.6	1.000	276	0.50	0.3	0.0	21.9	C	21.9	C
Northbound												
L	0.12	0.54	10.0	1.000	206	0.50	1.1	0.0	11.1	B		
TR	0.54	0.54	13.3	1.000	1812	0.50	1.2	0.0	14.4	B	14.4	B
Southbound												
L	0.08	0.54	9.8	1.000	137	0.50	1.1	0.0	10.9	B		
T	0.57	0.54	13.6	1.000	1824	0.50	1.3	0.0	14.9	B	14.5	B
R	0.08	0.54	9.8	1.000	879	0.50	0.2	0.0	10.0-	A		

Intersection Delay = 15.3 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	28.0	28.0	49.0	49.0
Effective permitted green time for LT lane group, g(s)	28.0	28.0	49.0	49.0
Opposing effective green time, go (s)	28.0	28.0	49.0	49.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	1	1	2	2
Adjusted LT flow rate, VLT (veh/h)	149	9	24	11
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	11	3	1046	985
Lost time for LT lane group, tL	7.00	7.00	6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600	3.73	0.23	0.60	0.28
Opposing lane util. factor, fLUo	1.000	1.000	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.28	0.08	13.73	12.93
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.69	0.69	0.46	0.46
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	12.01	10.54
gu=g-gq if gq>=gf, or = g-gf if gq<gf	28.00	28.00	36.99	38.46
n=Max(gq-gf)/2,0)	0.00	0.00	6.01	5.27
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	1.33	1.32	3.64	3.43
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.14	0.14	0.08	0.08
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.75	0.76	0.21	0.23
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.750	0.756	0.207	0.229

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time r=(C-g-gq-gu)				
Arrival rate, qa=v/(3600(max[X,1.0]))				
Protected ph. departure rate, Sp=s/3600				
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 15.3 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound TR	Northbound L	Northbound TR	Southbound L	Southbound T	Southbound R
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	149	3	14	9	11	24	517	11	549	72
So	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	1	1	1	1 0	1	2 0	1	2	1
SL	1426	1429	1615	760	887	378	1748	251	1759	1615
LnCapacity	444	445	502	236	276	206	951	137	957	879
Flow Ratio	0.10	0.00	0.01	0.01	0.01	0.06	0.30	0.04	0.31	0.04
v/c Ratio	0.34	0.01	0.03	0.04	0.04	0.12	0.54	0.08	0.57	0.08
Grn Ratio	0.31	0.31	0.31	0.31	0.31	0.54	0.54	0.54	0.54	0.54
I Factor		1.000			1.000		1.000		1.000	
AT or PVG	3	3	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	2.9	0.1	0.2	0.2	0.2	0.3	8.4	0.1	9.1	0.9
kB	0.6	0.6	0.7	0.4	0.5	0.4	1.1	0.3	1.1	1.0
Q2	0.3	0.0	0.0	0.0	0.0	0.0	1.3	0.0	1.4	0.1
Q Average	3.2	0.1	0.3	0.2	0.2	0.3	9.6	0.2	10.5	1.0
Q Spacing	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Q Storage	0	0	0	0	0	0	0	0	0	0
Q S Ratio										
70th Percentile Output:										
fB%	1.3	1.3	1.3	1.3	1.3	1.3	1.2	1.3	1.2	1.3
BOQ	4.0	0.1	0.3	0.2	0.3	0.4	11.7	0.2	12.8	1.2
QSRatio										
85th Percentile Output:										
fB%	1.6	1.7	1.7	1.7	1.7	1.7	1.4	1.7	1.4	1.6
BOQ	5.0	0.1	0.4	0.3	0.4	0.6	13.9	0.3	15.1	1.6
QSRatio										
90th Percentile Output:										
fB%	1.8	2.0	2.0	2.0	2.0	2.0	1.6	2.0	1.6	1.9
BOQ	5.6	0.1	0.5	0.3	0.4	0.7	15.2	0.3	16.5	1.8
QSRatio										
95th Percentile Output:										
fB%	2.1	2.6	2.5	2.6	2.6	2.5	1.7	2.6	1.7	2.4
BOQ	6.8	0.1	0.7	0.4	0.5	0.9	16.8	0.4	18.1	2.3
QSRatio										
98th Percentile Output:										
fB%	2.5	3.2	3.1	3.1	3.1	3.1	1.9	3.2	1.9	2.9
BOQ	7.9	0.2	0.8	0.5	0.7	1.1	18.5	0.5	19.8	2.8
QSRatio										

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: a.liu
Agency: URS Canada Inc.
Date: 12/9/2004
Period: PM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Murray Ross Pkwy

Inter.: Keele St / Murray Ross Pkwy
Area Type: All other areas
Jurisd: City of Toronto
Year: Existing Conditions
N/S St: Keele St

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes		1	1	1	1	0	1	2	0	1	2	1
LGConfig	L	T	R	L	TR		L	TR		L	T	R
Volume	71	0	35	1	3	10	31	1131	2	15	1458	253
Lane Width	3.6	3.6	3.6	3.6	3.6		3.6	3.6		3.6	3.6	3.6
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left		P			NB Left	P			
Thru		P			Thru	P			
Right		P			Right	P			
Peds					Peds				
WB Left		P			SB Left	P			
Thru		P			Thru	P			
Right		P			Right	P			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green		28.0				78.0			
Yellow		4.0				4.0			
All Red		3.0				3.0			

Cycle Length: 120.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	329	1409	0.22	0.23	38.7	D		
T	443	1900	0.00	0.23	35.3	D	38.0	D
R	377	1615	0.10	0.23	36.6	D		
Westbound								
L	60	136	0.02	0.23	35.9	D		
TR	268	1150	0.05	0.23	36.0	D	36.0	D
Northbound								
L	143	220	0.22	0.65	12.2	B		
TR	2215	3407	0.52	0.65	12.0	B	12.0	B
Southbound								
L	133	204	0.11	0.65	9.6	A		
T	1416	2179	1.05	0.65	59.5	E	51.7	D
R	1039	1599	0.25	0.65	9.3	A		

Intersection Delay = 35.8 (sec/veh) Intersection LOS = D

HCS2000: Signalized Intersections Release 4.1e

Phone: Fax:
E-Mail:

OPERATIONAL ANALYSIS

Analyst: a.liu
Intersection: Keele St / Murray Ross Pkwy
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: PM Peak Hour
Analysis Year: Existing Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Murray Ross Pkwy
North/South Street: Keele St

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	71	0	35	1	3	10	31	1131	2	15	1458	253
% Heavy Veh	1	0	0	100	0	60	3	6	100	87	66	1
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	18	0	9	1	1	3	8	289	1	4	372	65
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900	1900	1900	1900		1900	1900		1900	1900	1900
ParkExist												
NumPark												
No. Lanes		1	1	1		1	1	0		1	2	1
LGConfig	L		T	R	L		TR		L		T	R
Lane Width	3.6	3.6	3.6	3.6	3.6				3.6	3.6	3.6	3.6
RTOR Vol			0			0						0
Adj Flow	72	0	36	1	13		32	1156		15	1488	258
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.769			0.002			0.000	1.000
Peds Bikes	0			0			0			0		
Buses	0	0	0	0	0		0	0		0	0	0
%InProtPhase												

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	0.0
Arriv. Type	3	3	3	3	3		3	3		3	3	3
Unit Ext.	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	2.0
Ext of g	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	2.0
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left		P			NB Left	P			
Thru		P			Thru	P			
Right		P			Right	P			
Peds					Peds				
WB Left		P			SB Left	P			
Thru		P			Thru	P			
Right		P			Right	P			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	71	0	35	1	3	10	31	1131	2	15	1458	253
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	72	0	36	1	3	10	32	1154	2	15	1488	258
No. Lanes		1	1	1		1	1	2	0	1	2	1
Lane group	L		T	R	L	TR		L	TR		L	T R
Adj flow	72	0	36		1	13		32	1156		15	1488 258
Prop LTs	1.000	0.000			1.000	0.000		1.000	0.000		1.000	0.000
Prop RTs		0.000	1.000			0.769			0.002			0.000 1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	T	R	L	TR		L	TR		L	T	R
So	1900	1900	1900	1900	1900		1900	1900		1900	1900	1900
Lanes	1	1	1	1	1	0	1	2	0	1	2	1
fW	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	1.000
fHV	0.990	1.000	1.000	0.500	0.684		0.971	0.942		0.535	0.602	0.990
fG	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	1.000
fA	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	1.000
fLU	1.000	1.000	1.000	1.000	1.000		1.000	0.952		1.000	0.952	1.000
fRT		1.000	0.850		0.885			1.000			1.000	0.850
fLT	0.749	1.000		0.143	1.000		0.119	1.000		0.201	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000	1.000		1.000			1.000			1.000	1.000
S	1409	1900	1615	136	1150		220	3407		204	2179	1599
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	72	1409	# 0.05	0.23	329	0.22
Prot							
Perm							
Thru	T	0	1900	0.00	0.23	443	0.00
Right	R	36	1615	0.02	0.23	377	0.10
Westbound							
Prot							
Perm							
Left	L	1	136	0.01	0.23	60	0.02
Prot							
Perm							
Thru	TR	13	1150	0.01	0.23	268	0.05
Right							
Northbound							
Prot							
Perm							
Left	L	32	220	0.15	0.65	143	0.22
Prot							
Perm							
Thru	TR	1156	3407	0.34	0.65	2215	0.52
Right							
Southbound							
Prot							
Perm							
Left	L	15	204	0.07	0.65	133	0.11
Prot							
Perm							
Thru	T	1488	2179	# 0.68	0.65	1416	1.05
Right	R	258	1599	0.16	0.65	1039	0.25

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.73
Total lost time per cycle, L = 14.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.83

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.22	0.23	37.2	1.000	329	0.50	1.5	0.0	38.7	D		
T	0.00	0.23	35.3	1.000	443	0.50	0.0	0.0	35.3	D	38.0	D
R	0.10	0.23	36.1	1.000	377	0.50	0.5	0.0	36.6	D		
Westbound												
L	0.02	0.23	35.4	1.000	60	0.50	0.5	0.0	35.9	D		
TR	0.05	0.23	35.7	1.000	268	0.50	0.3	0.0	36.0	D	36.0	D
Northbound												
L	0.22	0.65	8.6	1.000	143	0.50	3.6	0.0	12.2	B		
TR	0.52	0.65	11.1	1.000	2215	0.50	0.9	0.0	12.0	B	12.0	B
Southbound												
L	0.11	0.65	7.9	1.000	133	0.50	1.7	0.0	9.6	A		
T	1.05	0.65	21.0	1.000	1416	0.50	38.5	0.0	59.5	E	51.7	D
R	0.25	0.65	8.8	1.000	1039	0.50	0.6	0.0	9.3	A		

Intersection Delay = 35.8 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)	28.0	28.0	78.0	78.0
Effective permitted green time for LT lane group, g(s)	28.0	28.0	78.0	78.0
Opposing effective green time, go (s)	28.0	28.0	78.0	78.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	1	1	2	2
Adjusted LT flow rate, VLT (veh/h)	72	1	32	15
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	13	0	1488	1156
Lost time for LT lane group, tL	7.00	7.00	7.00	7.00
Computation				
LT volume per cycle, LTC=VLTC/3600	2.40	0.03	1.07	0.50
Opposing lane util. factor, fLUo	1.000	1.000	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.43	0.00	26.05	20.24
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.77	0.77	0.35	0.35
gdiff=max(gq-gf,0) (see Exhibit C16-4,5,6,7,8)	0.00	0.00	25.23	14.38
gu=g-gq if gq>=gf, or = g-gf if gq<gf	28.00	28.00	52.77	63.62
n=Max(gq-gf)/2,0)	0.00	0.00	12.61	7.19
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	1.34	1440.00		5.68
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.14	0.14	0.05	0.05
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.75	0.14	0.12	0.20
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.749	0.143	0.119	0.201

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 120.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time r=(C-g-gq-gu)				
Arrival rate, qa=v/(3600(max[X,1.0]))				
Protected ph. departure rate, Sp=s/3600				
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Queue Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 35.8 sec/veh Intersection LOS D

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound TR	Northbound L	Northbound TR	Southbound L	Southbound T	Southbound R
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	72	0	36	1	13	32	607	15	781	258
So	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	1	1	1	0	1	2	1	2	1
SL	1409	1900	1615	136	1150	220	1789	204	1144	1599
LnCapacity	329	443	377	60	268	143	1163	133	743	1039
Flow Ratio	0.05	0.00	0.02	0.01	0.01	0.15	0.34	0.07	0.68	0.16
v/c Ratio	0.22	0.00	0.10	0.02	0.05	0.22	0.52	0.11	1.05	0.25
Grn Ratio	0.23	0.23	0.23	0.23	0.23	0.65	0.65	0.65	0.65	0.65
I Factor		1.000			1.000		1.000		1.000	
AT or PVG	3	3	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	1.9	0.0	0.9	0.0	0.3	0.4	10.7	0.2	26.0	3.6
kB	0.6	0.8	0.7	0.1	0.6	0.4	1.6	0.3	1.1	1.4
Q2	0.2	0.0	0.1	0.0	0.0	0.1	1.7	0.0	13.2	0.5
Q Average	2.1	0.0	1.0	0.0	0.4	0.5	12.4	0.2	39.2	4.1
Q Spacing	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Q Storage	0	0	0	0		0	0	0	0	0
Q S Ratio										
70th Percentile Output:										
fB%	1.3	1.3	1.3	1.3	1.3	1.3	1.2	1.3	1.2	1.2
BOQ	2.7	0.0	1.3	0.0	0.5	0.7	15.0	0.3	47.0	5.1
QSRatio										
85th Percentile Output:										
fB%	1.6	1.7	1.6	1.7	1.7	1.7	1.4	1.7	1.4	1.5
BOQ	3.4	0.0	1.7	0.0	0.6	0.9	17.6	0.4	54.9	6.2
QSRatio										
90th Percentile Output:										
fB%	1.8	2.0	1.9	2.0	2.0	1.9	1.5	2.0	1.5	1.7
BOQ	3.9	0.0	1.9	0.1	0.7	1.1	19.1	0.5	58.8	7.0
QSRatio										
95th Percentile Output:										
fB%	2.3	2.6	2.4	2.6	2.5	2.5	1.7	2.6	1.6	2.0
BOQ	4.8	0.0	2.5	0.1	0.9	1.3	20.8	0.6	62.7	8.3
QSRatio										
98th Percentile Output:										
fB%	2.7	3.2	2.9	3.2	3.1	3.0	1.8	3.1	1.7	2.4
BOQ	5.7	0.0	3.0	0.1	1.1	1.6	22.6	0.7	66.7	9.6
QSRatio										

ERROR MESSAGES

No errors to report.

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: NA
Agency/Co.: URS Canada Inc.
Date Performed: 5/17/2005
Analysis Time Period: AM Peak Hour
Intersection: Keele Street/Four Winds Drive
Jurisdiction: City of Toronto
Units: U. S. Metric
Analysis Year: Exisiting Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Four Winds Drive
North/South Street: Keele Street
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	57	1301			1035	26
Peak-Hour Factor, PHF	0.98	0.98			0.98	0.98
Hourly Flow Rate, HFR	58	1327			1056	26
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided		/			
RT Channelized?						
Lanes	1	2			2	0
Configuration	L	T			T	TR
Upstream Signal?		Yes			Yes	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				33		103
Peak Hour Factor, PHF				0.98		0.98
Hourly Flow Rate, HFR				33		105
Percent Heavy Vehicles				0		0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			No /
Lanes				0		0
Configuration					LR	

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L						LR	
v (vph)	58						138	
C(m) (vph)	764						307	
v/c	0.08						0.45	
95% queue length	0.25						2.22	
Control Delay	10.1						26.0	
LOS	B						D	
Approach Delay							26.0	
Approach LOS							D	

HCS2000: Unsignalized Intersections Release 4.1d

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: NA
Agency/Co.: URS Canada Inc.
Date Performed: 5/17/2005
Analysis Time Period: AM Peak Hour
Intersection: Keele Street/Four Winds Drive
Jurisdiction: City of Toronto
Units: U. S. Metric
Analysis Year: Exisiting Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Four Winds Drive
North/South Street: Keele Street
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	57	1301			1035	26
Peak-Hour Factor, PHF	0.98	0.98			0.98	0.98
Peak-15 Minute Volume	15	332			264	7
Hourly Flow Rate, HFR	58	1327			1056	26
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided		/			
RT Channelized?						
Lanes	1	2			2	0
Configuration	L	T			T	TR
Upstream Signal?		Yes			Yes	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				33		103
Peak Hour Factor, PHF				0.98		0.98
Peak-15 Minute Volume				8		26
Hourly Flow Rate, HFR				33		105
Percent Heavy Vehicles				0		0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			No /
RT Channelized						
Lanes				0		0
Configuration					LR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0
Lane Width (m)	3.6	3.6	3.6	3.6
Walking Speed (m/sec)	1.2	1.2	1.2	1.2
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed kph	Distance to Signal meters
S2	Left-Turn	85	1700	3	34	90	60	250
	Through	928	1700	3	27	90	60	250
S5	Left-Turn	9	1700	3	28	90	60	180
	Through	957	1700	3	49	90	60	180

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation									
Movement		1	4	7	8	9	10	11	12
		L	L	L	T	R	L	T	R
t(c,base)		4.1					7.5		6.9
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		0					0		0
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00					0.70		0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1					6.8		6.9
	2-stage								

Follow-Up Time Calculations									
Movement		1	4	7	8	9	10	11	12
		L	L	L	T	R	L	T	R
t(f,base)		2.20					3.50		3.30
t(f,HV)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)		0					0		0
t(f)		2.2					3.5		3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog	928	85	957	9
Total Saturation Flow Rate, s (vph)	3400	3400	3400	3400
Arrival Type	3	3	3	3
Effective Green, g (sec)	27	34	49	28
Cycle Length, C (sec)	90	90	90	90
Rp (from Exhibit 16-11)	1.000	1.000	1.000	1.000
Proportion vehicles arriving on green P	0.300	0.378	0.544	0.311
g(q1)	17.2	1.4	11.5	0.2
g(q2)	6.5	0.0	4.5	0.0
g(q)	23.7	1.4	16.1	0.2

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha		0.500		0.500
beta		0.667		0.667
Travel time, t(a) (sec)		14.988		10.791
Smoothing Factor, F		0.167		0.218
Proportion of conflicting flow, f	1.000	1.000	1.000	1.000
Max platooned flow, V(c,max)	3355	784	3334	135
Min platooned flow, V(c,min)	2000	2000	2000	2000
Duriion of blocked period, t(p)	22.1	0.0	15.8	0.0
Proportion time blocked, p		0.246		0.176

Computation 3-Platoon Event Periods	Result
p(2)	0.246
p(5)	0.176
p(dom)	0.246
p(subo)	0.176
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Stage II
p(1)	0.824		
p(4)			
p(7)			
p(8)			
p(9)			
p(10)	0.666		
p(11)			
p(12)	0.824		

Computation 4 and 5 Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x	1082					1848		541
s	3000					3000		3000
Px	0.824					0.666		0.824
V c,u,x	674					1271		17
C r,x	927					162		1064
C plat,x	764					108		877

Two-Stage Process

	7		8		10		11	
	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s					3000	3000		
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		541
Potential Capacity		877
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		877
Probability of Queue free St.	1.00	0.88

Step 2: LT from Major St.	4	1
Conflicting Flows		1082
Potential Capacity		764
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		764
Probability of Queue free St.	1.00	0.92
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.92	0.92
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows		1848
Potential Capacity		108
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.92	
Maj. L, Min T Adj. Imp Factor.	0.94	
Cap. Adj. factor due to Impeding mvmnt	0.83	0.92
Movement Capacity		100

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.92	0.92
Movement Capacity		
Result for 2 stage process:		
a		
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		1848
Potential Capacity		108
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.92	
Maj. L, Min T Adj. Imp Factor.	0.94	
Cap. Adj. factor due to Impeding mvmnt	0.83	0.92
Movement Capacity		100
Results for Two-stage process:		
a		
y		
C t		100

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)				33		105
Movement Capacity (vph)				100		877
Shared Lane Capacity (vph)					307	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep				100		877
Volume				33		105
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh					307	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L						LR	
v (vph)	58						138	
C(m) (vph)	764						307	
v/c	0.08						0.45	
95% queue length	0.25						2.22	
Control Delay	10.1						26.0	
LOS	B						D	
Approach Delay							26.0	
Approach LOS							D	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.92	1.00
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	10.1	
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: NA
Agency/Co.: URS Canada Inc.
Date Performed: 5/17/2005
Analysis Time Period: PM Peak Hour
Intersection: Keele Street/Four Winds Drive
Jurisdiction: City of Toronto
Units: U. S. Metric
Analysis Year: Exisiting Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Four Winds Drive
North/South Street: Keele Street
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach / Movement	Northbound 1	2	3	Southbound 4	5	6
	L	T	R	L	T	R
Volume	167	1019			1445	60
Peak-Hour Factor, PHF	0.98	0.98			0.98	0.98
Hourly Flow Rate, HFR	170	1039			1474	61
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided /					
RT Channelized?						
Lanes	1	2			2	0
Configuration	L	T			T	TR
Upstream Signal?		Yes			Yes	

Minor Street: Approach / Movement	Westbound 7	8	9	Eastbound 10	11	12
	L	T	R	L	T	R
Volume				24		83
Peak Hour Factor, PHF				0.98		0.98
Hourly Flow Rate, HFR				24		84
Percent Heavy Vehicles				0		0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			No /
Lanes				0		0
Configuration					LR	

Delay, Queue Length, and Level of Service

Approach / Movement / Lane Config	NB 1	SB 4	Westbound 7	8	9	Eastbound 10	11	12
	L						LR	
v (vph)	170						108	
C(m) (vph)	517						94	
v/c	0.33						1.15	
95% queue length	1.42						7.30	
Control Delay	15.3						221.5	
LOS	C						F	
Approach Delay							221.5	
Approach LOS							F	

HCS2000: Unsignalized Intersections Release 4.1d

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: NA
Agency/Co.: URS Canada Inc.
Date Performed: 5/17/2005
Analysis Time Period: PM Peak Hour
Intersection: Keele Street/Four Winds Drive
Jurisdiction: City of Toronto
Units: U. S. Metric
Analysis Year: Exisiting Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Four Winds Drive
North/South Street: Keele Street
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	167	1019			1445	60
Peak-Hour Factor, PHF	0.98	0.98			0.98	0.98
Peak-15 Minute Volume	43	260			369	15
Hourly Flow Rate, HFR	170	1039			1474	61
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided /					
RT Channelized?						
Lanes	1	2			2	0
Configuration	L	T			T	TR
Upstream Signal?		Yes			Yes	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume				24		83
Peak Hour Factor, PHF				0.98		0.98
Peak-15 Minute Volume				6		21
Hourly Flow Rate, HFR				24		84
Percent Heavy Vehicles				0		0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			No /
RT Channelized						
Lanes				0		0
Configuration					LR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0
Lane Width (m)	3.6	3.6	3.6	3.6
Walking Speed (m/sec)	1.2	1.2	1.2	1.2
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed kph	Distance to Signal meters
S2	Left-Turn	80	1700	3	40	100	60	250
	Through	900	1700	3	33	100	60	250
S5	Left-Turn	1	1700	3	28	120	60	180
	Through	1458	1700	3	78	120	60	180

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation / Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)	4.1					7.5		6.9
t(c,hv)	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)	0					0		0
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Grade/100			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)	0.00					0.70		0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage	4.1					6.8		6.9
2-stage								

Follow-Up Time Calculations / Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20					3.50		3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	0					0		0
t(f)	2.2					3.5		3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
V prog	900	80	1458	1
Total Saturation Flow Rate, s (vph)	3400	3400	3400	3400
Arrival Type	3	3	3	3
Effective Green, g (sec)	33	40	78	28
Cycle Length, C (sec)	100	100	120	120
Rp (from Exhibit 16-11)	1.000	1.000	1.000	1.000
Proportion vehicles arriving on green P	0.330	0.400	0.650	0.233
g(q1)	17.7	1.4	18.0	0.0
g(q2)	6.4	0.0	13.5	0.0
g(q)	24.1	1.4	31.5	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
alpha		0.500		0.500
beta		0.667		0.667
Travel time, t(a) (sec)		14.988		10.791
Smoothing Factor, F		0.167		0.218
Proportion of conflicting flow, f	1.000	1.000	1.000	1.000
Max platooned flow, V(c,max)	3358	788	3399	22
Min platooned flow, V(c,min)	2000	2000	2000	2000
Durion of blocked period, t(p)	23.7	0.0	33.1	0.0
Proportion time blocked, p		0.237		0.276

Computation 3-Platoon Event Periods	Result
p(2)	0.237
p(5)	0.276
p(dom)	0.276
p(subo)	0.237
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Stage II
p(1)	0.724		
p(4)			
p(7)			
p(8)			
p(9)			
p(10)	0.606		
p(11)			
p(12)	0.724		

Computation 4 and 5 Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	1535					2363		768
s	3000					3000		3000
Px	0.724					0.606		0.724
V c,u,x	977					1948		0
C r,x	714					58		1091
C plat,x	517					35		790

Two-Stage Process

	7 Stage1	7 Stage2	8 Stage1	8 Stage2	10 Stage1	10 Stage2	11 Stage1	11 Stage2
V(c,x)								
s					3000	3000		
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		768
Potential Capacity		790
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		790
Probability of Queue free St.	1.00	0.89

Step 2: LT from Major St.	4	1
Conflicting Flows		1535
Potential Capacity		517
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		517
Probability of Queue free St.	1.00	0.67
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.67	0.67
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows		2363
Potential Capacity		35
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.67	
Maj. L, Min T Adj. Imp Factor.	0.74	
Cap. Adj. factor due to Impeding mvmnt	0.67	0.67
Movement Capacity		23

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.67	0.67
Movement Capacity		
Result for 2 stage process:		
a		
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		2363
Potential Capacity		35
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.67	
Maj. L, Min T Adj. Imp Factor.	0.74	
Cap. Adj. factor due to Impeding mvmnt	0.67	0.67
Movement Capacity		23
Results for Two-stage process:		
a		
y		
C t		23

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)				24		84
Movement Capacity (vph)				23		790
Shared Lane Capacity (vph)					94	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep				23		790
Volume				24		84
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh					94	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement / Lane Config	1 L	4	7	8	9	10	11 LR	12
v (vph)	170						108	
C(m) (vph)	517						94	
v/c	0.33						1.15	
95% queue length	1.42						7.30	
Control Delay	15.3						221.5	
LOS	C						F	
Approach Delay							221.5	
Approach LOS							F	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.67	1.00
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	15.3	
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS2000: Signalized Intersections Release 4.1e

Analyst: a.liu
Agency: URS Canada Inc.
Date: 12/9/2004
Period: AM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Finch Avenue

Inter.: Finch Avenue / Keele Street
Area Type: All other areas
Jurisd: City of Toronto
Year: Existing Conditions
N/S St: Keele St

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes		1	2	1		1	2	1		1	2	1
LGConfig	L	T	R	L	T	R	L	T	R	L	T	R
Volume	85	1270	142	56	814	345	154	928	123	258	827	53
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
RTOR Vol		0			0			0			0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left		P	P		NB Left	P	P	
Thru		P	P		Thru		P	
Right		P	P		Right		P	
Peds					Peds			
WB Left			P		SB Left	P	P	
Thru			P		Thru		P	
Right			P		Right		P	
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green		6.0	28.0			10.0	27.0	
Yellow		3.0	4.0			2.0	4.0	
All Red		0.0	2.0			2.0	2.0	

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/c	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	194	1710	0.45	0.41	26.3	C		
T	1383	3364	0.94	0.41	38.6	D	36.0	D
R	617	1502	0.24	0.41	18.2	B		
Westbound								
L	81	259	0.70	0.31	67.8	E		
T	1052	3381	0.79	0.31	34.4	C	38.0	D
R	445	1429	0.79	0.31	41.7	D		
Northbound								
L	271	1719	0.58	0.46	26.5	C		
T	1034	3445	0.92	0.30	44.3	D	40.1	D
R	457	1524	0.28	0.30	25.5	C		
Southbound								
L	267	1687	0.99	0.46	74.1	E		
T	1014	3381	0.83	0.30	37.4	D	45.0	D
R	407	1357	0.13	0.30	23.6	C		

Intersection Delay = 39.5 (sec/veh) Intersection LOS = D

HCS2000: Signalized Intersections Release 4.1e

Phone: Fax:
E-Mail:

OPERATIONAL ANALYSIS

Analyst: a.liu
Intersection: Finch Avenue / Keele Street
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: AM Peak Hour
Analysis Year: Existing Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Finch Avenue
North/South Street: Keele St

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	85	1270	142	56	814	345	154	928	123	258	827	53
% Heavy Veh	5	7	7	5	7	13	5	5	6	7	7	19
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	22	324	36	14	208	88	39	237	31	66	211	14
Hi Ln Vol												
% Grade		1			0			0			0	
Ideal Sat	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
ParkExist												
NumPark												
No. Lanes		1	2	1		1	2	1		1	2	1
LGConfig	L	T	R	L	T	R	L	T	R	L	T	R
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
RTOR Vol			0			0			0			0
Adj Flow	87	1296	145	57	831	352	157	947	126	263	844	54
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.000	1.000		0.000	1.000
Peds	0			0			0			0		
Buses	0	0	0	0	0	0	0	0	0	0	0	0
%InProtPhase	0.0			0.0			0.0			0.0		
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Arriv. Type	3	3	3	3	3	3	3	3	3	3	3	3
Unit Ext.	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Ext of g	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left		P	P		NB Left	P	P	
Thru		P	P		Thru		P	
Right		P	P		Right		P	
Peds					Peds			
WB Left			P		SB Left	P	P	
Thru			P		Thru		P	
Right			P		Right		P	
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			

Phase Combination	1	2	3	4	5	6	7	8
Green		6.0	28.0			10.0	27.0	
Yellow		3.0	4.0			2.0	4.0	
All Red		0.0	2.0			2.0	2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	85	1270	142	56	814	345	154	928	123	258	827	53
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	87	1296	145	57	831	352	157	947	126	263	844	54
No. Lanes		1	2	1		1	2	1		1	2	1
Lane group	L	T	R	L	T	R	L	T	R	L	T	R
Adj flow	87	1296	145	57	831	352	157	947	126	263	844	54
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.000	1.000		0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	T	R	L	T	R	L	T	R	L	T	R
So	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lanes	1	2	1	1	2	1	1	2	1	1	2	1
fW	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fHV	0.952	0.935	0.935	0.952	0.935	0.885	0.952	0.952	0.943	0.935	0.935	0.840
fG	0.995	0.995	0.995	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fLU	1.000	0.952	1.000	1.000	0.952	1.000	1.000	0.952	1.000	1.000	0.952	1.000
fRT		1.000	0.850		1.000	0.850		1.000	0.850		1.000	0.850
fLT	0.950	1.000		0.143	1.000		0.950	1.000		0.950	1.000	
Sec.	0.129						0.129			0.129		
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000
S	1710	3364	1502	259	3381	1429	1719	3445	1524	1687	3381	1357
Sec.	232						233			229		

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		87	1710	0.05	0.067	114	0.76
Perm		0	232	0.00	0.344	80	0.00
Left	L	87			0.41	194	0.45
Prot							
Perm							
Thru	T	1296	3364	# 0.39	0.41	1383	0.94
Right	R	145	1502	0.10	0.41	617	0.24
Westbound							
Prot							
Perm							
Left	L	57	259	0.22	0.31	81	0.70
Prot							
Perm							
Thru	T	831	3381	0.25	0.31	1052	0.79
Right	R	352	1429	0.25	0.31	445	0.79
Northbound							
Prot		157	1719	0.09	0.111	191	0.82
Perm		0	233	0.00	0.344	80	0.00
Left	L	157			0.46	271	0.58
Prot							
Perm							
Thru	T	947	3445	0.27	0.30	1034	0.92
Right	R	126	1524	0.08	0.30	457	0.28
Southbound							
Prot		187	1687	# 0.11	0.111	187	1.00
Perm		76	229	# 0.33	0.344	80	0.95
Left	L	263			0.46	267	0.99
Prot							
Perm							
Thru	T	844	3381	0.25	0.30	1014	0.83
Right	R	54	1357	0.04	0.30	407	0.13

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.83
Total lost time per cycle, L = 12.00 Sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.96

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.45	0.41	19.0	1.000	194	0.50	7.3	0.0	26.3	C		
T	0.94	0.41	25.4	1.000	1383	0.50	13.2	0.0	38.6	D	36.0	D
R	0.24	0.41	17.3	1.000	617	0.50	0.9	0.0	18.2	B		
Westbound												
L	0.70	0.31	27.3	1.000	81	0.50	40.5	0.0	67.8	E		
T	0.79	0.31	28.3	1.000	1052	0.50	6.0	0.0	34.4	C	38.0	D
R	0.79	0.31	28.3	1.000	445	0.50	13.4	0.0	41.7	D		
Northbound												
L	0.58	0.46	17.7	1.000	271	0.50	8.7	0.0	26.5	C		
T	0.92	0.30	30.4	1.000	1034	0.50	13.9	0.0	44.3	D	40.1	D
R	0.28	0.30	24.0	1.000	457	0.50	1.5	0.0	25.5	C		
Southbound												
L	0.99	0.46	22.7	1.000	267	0.50	51.4	0.0	74.1	E		
T	0.83	0.30	29.4	1.000	1014	0.50	8.0	0.0	37.4	D	45.0	D
R	0.13	0.30	23.0	1.000	407	0.50	0.7	0.0	23.6	C		

Intersection Delay = 39.5 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C: 90.0 sec				
Total actual green time for LT lane group, G (s)	37.0	28.0	41.0	41.0
Effective permitted green time for LT lane group, g(s)	31.0	28.0	31.0	31.0
Opposing effective green time, go (s)	28.0	37.0	27.0	27.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	2	2	2	2
Adjusted LT flow rate, VLT (veh/h)	87	57	157	263
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	831	1296	844	947
Lost time for LT lane group, tL	6.00	6.00	6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600	2.17	1.43	3.93	6.58
Opposing lane util. factor, fLUo	0.952	0.952	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	10.91	17.02	11.08	12.43
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.69	0.59	0.70	0.70
gq, (see Exhibit C16-4,5,6,7,8)	19.85	17.23	20.58	24.05
gu=g-gq if gq>=gf, or = g-gf if gq<gf	11.15	10.77	10.42	6.95
n=Max(gq-gf)/2,0)	9.92	8.61	10.29	12.03
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	2.95	4.68	2.98	3.30
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.13	0.14	0.13	0.13
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.13	0.14	0.13	0.13
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.129	0.143	0.129	0.129

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C: 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C: 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	87		157	263
v/c ratio from Capacity Worksheet, X	0.45		0.58	0.99
Protected phase effective green interval, g (s)	6.0		10.0	10.0
Opposing queue effective green interval, gq	19.85		20.58	24.05
Unopposed green interval, gu	11.15		10.42	6.95
Red time r=(c-g-gq-gu)	53.0		49.0	49.0
Arrival rate, qa=v/(3600(max[X,1.0]))	0.02		0.04	0.07
Protected ph. departure rate, Sp=s/3600	0.475		0.478	0.469
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.18		0.19	0.28
XPerm	0.38		0.67	1.15
XProt	0.50		0.54	0.92
Case	1		1	3
Queue at beginning of green arrow, Qa	1.28		2.14	3.87
Queue at beginning of unsaturated green, Qu	0.48		0.90	1.76
Residual queue, Qr	0.00		0.00	0.29
Uniform Delay, d1	19.0		17.7	22.7

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 39.5 sec/veh Intersection LOS D

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	87	680	145	57	436	352	157	497	126	263	443	54
So	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	2	1	1	2	1	1	2	1	1	2	1
SL	472	1760	1502	259	1775	1429	595	1809	1524	585	1775	1357
LnCapacity	194	726	617	81	552	445	271	543	457	267	532	407
Flow Ratio	0.18	0.39	0.10	0.22	0.25	0.25	0.26	0.27	0.08	0.45	0.25	0.04
v/c Ratio	0.45	0.94	0.24	0.70	0.79	0.79	0.58	0.92	0.28	0.99	0.83	0.13
Grn Ratio	0.41	0.41	0.41	0.31	0.31	0.31	0.46	0.30	0.30	0.46	0.30	0.30
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3	3	3	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	1.3	16.3	2.4	1.3	10.0	8.0	2.3	12.0	2.4	4.0	10.3	1.0
kB	0.4	0.9	0.8	0.2	0.8	0.6	0.5	0.7	0.7	0.5	0.7	0.6
Q2	0.3	6.4	0.2	0.4	2.4	2.1	0.6	4.5	0.2	3.6	2.9	0.1
Q Average	1.6	22.7	2.6	1.7	12.4	10.1	2.9	16.5	2.7	7.6	13.2	1.1
Q Spacing	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Q Storage	0	0	0	0	0	0	0	0	0	0	0	0
Q S Ratio												
70th Percentile Output:												
fB%	1.3	1.2	1.3	1.3	1.2	1.2	1.3	1.2	1.3	1.2	1.2	1.3
BOQ	2.0	27.2	3.3	2.1	15.0	12.3	3.6	19.9	3.3	9.3	16.0	1.4
QSRatio												
85th Percentile Output:												
fB%	1.6	1.4	1.6	1.6	1.4	1.4	1.6	1.4	1.6	1.5	1.4	1.6
BOQ	2.6	31.8	4.1	2.7	17.6	14.6	4.5	23.3	4.2	11.2	18.8	1.8
QSRatio												
90th Percentile Output:												
fB%	1.9	1.5	1.8	1.9	1.5	1.6	1.8	1.5	1.8	1.6	1.5	1.9
BOQ	3.0	34.1	4.7	3.1	19.1	15.8	5.1	25.1	4.8	12.3	20.3	2.0
QSRatio												
95th Percentile Output:												
fB%	2.3	1.6	2.2	2.3	1.7	1.7	2.2	1.6	2.2	1.8	1.7	2.4
BOQ	3.7	36.5	5.7	3.9	20.9	17.5	6.2	27.0	5.8	13.9	22.1	2.6
QSRatio												
98th Percentile Output:												
fB%	2.8	1.7	2.6	2.8	1.8	1.9	2.5	1.8	2.6	2.0	1.8	2.9
BOQ	4.5	38.9	6.8	4.6	22.6	19.2	7.3	29.0	6.9	15.5	23.9	3.1
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: a.liu
Agency: URS Canada Inc.
Date: 12/9/2004
Period: PM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Finch Avenue

Inter.: Finch Avenue / Keele Street
Area Type: All other areas
Jurisd: City of Toronto
Year: Existing Conditions
N/S St: Keele St

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes		1	2	1		1	2	1		1	2	1
LGConfig	L		T	R	L		T	R	L		T	R
Volume	80	1017	201	168	1080	206	230	900	147	314	1175	39
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
RTOR Vol		0			0			0			0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left		P			NB Left	P		
Thru		P			Thru		P	
Right		P			Right		P	
Peds					Peds			
WB Left			P		SB Left	P		
Thru			P		Thru		P	
Right			P		Right		P	
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green		6.0	34.0			8.0	33.0	
Yellow		3.0	4.0			2.0	4.0	
All Red		0.0	2.0			2.0	2.0	

Cycle Length: 100.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	177	1727	0.46	0.43	30.8	C		
T	1474	3428	0.70	0.43	26.1	C	25.5	C
R	658	1530	0.31	0.43	20.0-	B		
Westbound								
L	125	367	1.37	0.34	241.2	F		
T	1171	3445	0.94	0.34	47.5	D	67.1	E
R	499	1468	0.42	0.34	28.0	C		
Northbound								
L	211	1719	1.11	0.45	120.9	F		
T	1126	3413	0.82	0.33	37.2	D	51.1	D
R	508	1538	0.30	0.33	26.3	C		
Southbound								
L	203	1641	1.58	0.45	305.5	F		
T	1137	3445	1.05	0.33	75.8	E	121.6	F
R	452	1369	0.09	0.33	23.5	C		

Intersection Delay = 68.7 (sec/veh) Intersection LOS = E

HCS2000: Signalized Intersections Release 4.1e

Phone: Fax:
E-Mail:

OPERATIONAL ANALYSIS

Analyst: a.liu
Intersection: Finch Avenue / Keele Street
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: PM Peak Hour
Analysis Year: Existing Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Finch Avenue
North/South Street: Keele St

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	80	1017	201	168	1080	206	230	900	147	314	1175	39
% Heavy Veh	4	5	5	2	5	10	5	6	5	10	5	18
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	20	259	51	43	276	53	59	230	37	80	300	10
Hi Ln Vol												
% Grade		1			0			0			0	
Ideal Sat	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
ParkExist												
NumPark												
No. Lanes		1	2	1		1	2	1		1	2	1
LGConfig	L		T	R	L		T	R	L		T	R
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
RTOR Vol			0			0			0			0
Adj Flow	82	1038	205	171	1102	210	235	918	150	320	1199	40
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.000	1.000		0.000	1.000
Peds	0			0			0			0		
Bikes												
Buses	0	0	0	0	0	0	0	0	0	0	0	0
%InProtPhase	0.0			0.0			0.0			0.0		
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Arriv. Type	3	3	3	3	3	3	3	3	3	3	3	3
Unit Ext.	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Ext of g	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left		P	P		NB Left	P	P	
Thru		P	P		Thru		P	
Right		P	P		Right		P	
Peds					Peds			
WB Left			P		SB Left	P	P	
Thru			P		Thru		P	
Right			P		Right		P	
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Green		6.0	34.0			8.0	33.0					
Yellow		3.0	4.0			2.0	4.0					
All Red		0.0	2.0			2.0	2.0					

Cycle Length: 100.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	80	1017	201	168	1080	206	230	900	147	314	1175	39
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	82	1038	205	171	1102	210	235	918	150	320	1199	40
No. Lanes		1	2	1		1	2	1		1	2	1
Lane group	L		T	R	L		T	R	L		T	R
Adj flow	82	1038	205		171	1102	210		235	918	150	
Prop LTs	1.000	0.000			1.000	0.000			1.000	0.000		
Prop RTs		0.000	1.000			0.000	1.000			0.000	1.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound				Westbound				Northbound				Southbound			
LG	L	T	R		L	T	R		L	T	R		L	T	R	
So	1900	1900	1900		1900	1900	1900		1900	1900	1900		1900	1900	1900	
Lanes	1	2	1		1	2	1		1	2	1		1	2	1	
fW	1.000	1.000	1.000		1.000	1.000	1.000		1.000	1.000	1.000		1.000	1.000	1.000	
fHV	0.962	0.952	0.952		0.980	0.952	0.909		0.952	0.943	0.952		0.909	0.952	0.847	
fG	0.995	0.995	0.995		1.000	1.000	1.000		1.000	1.000	1.000		1.000	1.000	1.000	
fP	1.000	1.000	1.000		1.000	1.000	1.000		1.000	1.000	1.000		1.000	1.000	1.000	
fBB	1.000	1.000	1.000		1.000	1.000	1.000		1.000	1.000	1.000		1.000	1.000	1.000	
fA	1.000	1.000	1.000		1.000	1.000	1.000		1.000	1.000	1.000		1.000	1.000	1.000	
fLU	1.000	0.952	1.000		1.000	0.952	1.000		1.000	0.952	1.000		1.000	0.952	1.000	
fRT		1.000	0.850			1.000	0.850			1.000	0.850			1.000	0.850	
fLT	0.950	1.000			0.197	1.000			0.950	1.000			0.950	1.000		
Sec.	0.108								0.108				0.108			
fLpb	1.000	1.000			1.000	1.000			1.000	1.000			1.000	1.000		
fRpb		1.000	1.000			1.000	1.000			1.000	1.000			1.000	1.000	
S	1727	3428	1530		367	3445	1468		1719	3413	1538		1641	3445	1369	
Sec.	197								196				187			

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Lane Mvmt	Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		82	1727	# 0.05	0.060	104	0.79
Perm		0	197	0.00	0.370	73	0.00
Left	L	82			0.43	177	0.46
Prot							
Perm							
Thru	T	1038	3428	0.30	0.43	1474	0.70
Right	R	205	1530	0.13	0.43	658	0.31
Westbound							
Prot							
Perm							
Left	L	171	367	# 0.47	0.34	125	1.37
Prot							
Perm							
Thru	T	1102	3445	0.32	0.34	1171	0.94
Right	R	210	1468	0.14	0.34	499	0.42
Northbound							
Prot		138	1719	# 0.08	0.080	138	1.00
Perm		97	196	0.49	0.370	73	1.33
Left	L	235			0.45	211	1.11
Prot							
Perm							
Thru	T	918	3413	0.27	0.33	1126	0.82
Right	R	150	1538	0.10	0.33	508	0.30
Southbound							
Prot		131	1641	0.08	0.080	131	1.00
Perm		189	187	# 1.01	0.370	72	2.63
Left	L	320			0.45	203	1.58
Prot							
Perm							
Thru	T	1199	3445	0.33	0.33	1137	1.05
Right	R	40	1369	0.03	0.33	452	0.09

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 1.60
Total lost time per cycle, L = 18.00 Sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.96

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.46	0.43	22.3	1.000	177	0.50	8.5	0.0	30.8	C		
T	0.70	0.43	23.3	1.000	1474	0.50	2.8	0.0	26.1	C	25.5	C
R	0.31	0.43	18.8	1.000	658	0.50	1.2	0.0	20.0-	B		
Westbound												
L	1.37	0.34	33.0	1.000	125	0.50	208.2	0.0	241.2	F		
T	0.94	0.34	32.0	1.000	1171	0.50	15.5	0.0	47.5	D	67.1	E
R	0.42	0.34	25.4	1.000	499	0.50	2.6	0.0	28.0	C		
Northbound												
L	1.11	0.45	25.1	1.000	211	0.50	95.8	0.0	120.9	F		
T	0.82	0.33	30.7	1.000	1126	0.50	6.5	0.0	37.2	D	51.1	D
R	0.30	0.33	24.9	1.000	508	0.50	1.5	0.0	26.3	C		
Southbound												
L	1.58	0.45	23.8	1.000	203	0.50	281.7	0.0	305.5	F		
T	1.05	0.33	33.5	1.000	1137	0.50	42.3	0.0	75.8	E	121.6	F
R	0.09	0.33	23.1	1.000	452	0.50	0.4	0.0	23.5	C		

Intersection Delay = 68.7 (sec/veh) Intersection LOS = E

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)	43.0	34.0	45.0	45.0
Effective permitted green time for LT lane group, g(s)	37.0	34.0	37.0	37.0
Opposing effective green time, go (s)	34.0	43.0	33.0	33.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	2	2	2	2
Adjusted LT flow rate, VLT (veh/h)	82	171	235	320
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	1102	1038	1199	918
Lost time for LT lane group, tL	6.00	6.00	6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600	2.28	4.75	6.53	8.89
Opposing lane util. factor, fLUo	0.952	0.952	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	16.08	15.14	17.49	13.39
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.66	0.57	0.67	0.67
gq, (see Exhibit C16-4,5,6,7,8)	31.28	9.76	33.00	24.51
gu=g-gq if gq>=gf, or = g-gf if gq<gf	5.72	24.24	4.00	12.49
n=Max(gq-gf)/2,0)	15.64	4.88	16.50	12.26
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	3.85	3.62	4.25	3.21
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.11	0.12	0.11	0.11
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.11	0.20	0.11	0.11
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.108	0.197	0.108	0.108

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 100.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	82		235	320
v/c ratio from Capacity Worksheet, X	0.46		1.11	1.58
Protected phase effective green interval, g (s)	6.0		8.0	8.0
Opposing queue effective green interval, gq	31.28		33.00	24.51
Unopposed green interval, gu	5.72		4.00	12.49
Red time r=(C-g-gq-gu)	57.0		55.0	55.0
Arrival rate, qa=v/(3600(max[X,1.0]))	0.02		0.06	0.06
Protected ph. departure rate, Sp=s/3600	0.480		0.478	0.456
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.35		0.50	0.15
XPerm	0.42		1.08	1.09
XProt	0.50		0.97	0.97
Case	1		3	3
Queue at beginning of green arrow, Qa	1.30		3.38	3.27
Queue at beginning of unsaturated green, Qu	0.71		1.93	1.38
Residual queue, Qr	0.00		0.15	0.16
Uniform Delay, d1	22.3		25.1	23.8

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 68.7 sec/veh Intersection LOS E

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound L	T	R	Westbound L	T	R	Northbound L	T	R	Southbound L	T	R
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	82	545	205	171	578	210	235	482	150	320	629	40
So	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	2	1	1	2	1	1	2	1	1	2	1
SL	410	1800	1530	367	1809	1468	467	1792	1538	445	1809	1369
LnCapacity	177	774	658	125	615	499	211	591	508	203	597	452
Flow Ratio	0.20	0.30	0.13	0.47	0.32	0.14	0.50	0.27	0.10	0.72	0.35	0.03
v/c Ratio	0.46	0.70	0.31	1.37	0.94	0.42	1.11	0.82	0.30	1.58	1.85	0.09
Grn Ratio	0.43	0.43	0.43	0.34	0.34	0.34	0.45	0.33	0.33	0.45	0.33	0.33
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3	3	3	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	1.3	12.4	3.7	4.8	15.6	4.5	3.9	12.3	3.1	5.3	17.5	0.8
kB	0.4	1.0	0.9	0.3	0.9	0.8	0.4	0.9	0.8	0.4	0.9	0.7
Q2	0.3	2.3	0.4	6.7	6.0	0.5	5.3	3.1	0.3	15.6	10.4	0.1
Q Average	1.6	14.6	4.2	11.4	21.5	5.0	9.2	15.3	3.4	21.0	27.9	0.8
Q Spacing	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Q Storage	0	0	0	0	0	0	0	0	0	0	0	0
Q S Ratio												
70th Percentile Output:												
fB%	1.3	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.3	1.2	1.2	1.3
BOQ	2.1	17.6	5.2	13.8	25.9	6.2	11.2	18.5	4.3	25.2	33.5	1.1
QSRatio												
85th Percentile Output:												
fB%	1.6	1.4	1.5	1.4	1.4	1.5	1.4	1.4	1.6	1.4	1.4	1.7
BOQ	2.7	20.7	6.4	16.3	30.2	7.6	13.3	21.7	5.3	29.4	39.1	1.4
QSRatio												
90th Percentile Output:												
fB%	1.9	1.5	1.7	1.6	1.5	1.7	1.6	1.5	1.8	1.5	1.5	1.9
BOQ	3.1	22.4	7.1	17.7	32.5	8.5	14.5	23.4	6.0	31.6	41.9	1.6
QSRatio												
95th Percentile Output:												
fB%	2.3	1.7	2.0	1.7	1.6	2.0	1.8	1.6	2.1	1.6	1.6	2.4
BOQ	3.8	24.2	8.5	19.4	34.8	9.9	16.2	25.3	7.2	33.9	44.8	2.0
QSRatio												
98th Percentile Output:												
fB%	2.8	1.8	2.4	1.9	1.7	2.2	1.9	1.8	2.5	1.7	1.7	3.0
BOQ	4.6	26.1	9.8	21.2	37.1	11.3	17.8	27.2	8.4	36.1	47.6	2.5
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: a.liu
Agency: URS Canada Inc.
Date: 12/9/2004
Period: AM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Toro Road

Inter.: Keele St / Toro Road
Area Type: All other areas
Jurisd: City of Toronto
Year: Existing Conditions
N/S St: Keele St

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	1	0	1	0	2	1	1	2	0
LGConfig				L		R		T	R	L	T	
Volume				102		66		1054	181	97	1001	
Lane Width				3.6		3.6		3.6	3.6	3.6	3.6	
RTOR Vol						0			0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru					Thru	P	P	
Right					Right	P	P	
Peds					Peds			
WB Left		A			SB Left		P	
Thru					Thru		P	
Right		A			Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green		15.0				7.0	63.0	
Yellow		3.0				3.0	4.0	
All Red		3.0				0.0	2.0	

Cycle Length: 100.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
Westbound								
L	253	1687	0.41	0.15	39.6	D		
							39.3	D
R	213	1417	0.31	0.15	38.8	D		
Northbound								
T	2515	3445	0.43	0.73	5.8	A	5.6	A
R	1145	1568	0.16	0.73	4.4	A		
Southbound								
L	309	491	0.32	0.63	11.3	B		
T	2191	3478	0.47	0.63	10.4	B	10.5	B

Intersection Delay = 10.0+ (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

Phone: Fax:
E-Mail:

OPERATIONAL ANALYSIS

Analyst: a.liu
Intersection: Keele St / Toro Road
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: AM Peak Hour
Analysis Year: Existing Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Toro Road
North/South Street: Keele St

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				102		66		1054	181	97	1001	
% Heavy Veh				7		14		5	3	3	4	
PHF				0.98		0.98		0.98	0.98	0.98	0.98	
PK 15 Vol				26		17		269	46	25	255	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat				1900		1900		1900	1900	1900	1900	
ParkExist												
NumPark												
No. Lanes	0	0	0	1	0	1	0	2	1	1	2	0
LGConfig				L		R		T	R	L	T	
Lane Width				3.6		3.6		3.6	3.6	3.6	3.6	
RTOR Vol						0			0			
Adj Flow				104		67		1076	185	99	1021	
%InSharedLn												
Prop LTs								0.000		1.000	0.000	
Prop RTs						1.000		0.000	1.000		0.000	
Peds Bikes	0				0			0				
Buses					0			0	0	0	0	
%InProtPhase												

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0		0.0		0.0	0.0	0.0	0.0	
Arriv. Type				3		3		3	3	3	3	
Unit Ext.				3.0		3.0		3.0	3.0	3.0	3.0	
I Factor					1.000			1.000			1.000	
Lost Time				2.0		2.0		2.0	2.0	2.0	2.0	
Ext of g				2.0		2.0		2.0	2.0	2.0	2.0	
Ped Min g		3.2			3.2			3.2				

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru					Thru	P	P	
Right					Right	P	P	
Peds					Peds			
WB Left		A			SB Left		P	
Thru					Thru		P	
Right		A			Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			

Green		15.0				7.0	63.0					
Yellow		3.0				3.0	4.0					
All Red		3.0				0.0	2.0					

Cycle Length: 100.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				102		66		1054	181	97	1001	
PHF				0.98		0.98		0.98	0.98	0.98	0.98	
Adj flow				104		67		1076	185	99	1021	
No. Lanes	0	0	0	1	0	1	0	2	1	1	2	0
Lane group				L		R		T	R	L	T	
Adj flow				104		67		1076	185	99	1021	
Prop LTs								0.000		1.000	0.000	
Prop RTs						1.000		0.000	1.000		0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG				L		R		T	R	L	T	
So				1900		1900		1900	1900	1900	1900	
Lanes	0	0	0	1	0	1	0	2	1	1	2	0
fW				1.000		1.000		1.000	1.000	1.000	1.000	
fHV				0.935		0.877		0.952	0.971	0.971	0.962	
fG				1.000		1.000		1.000	1.000	1.000	1.000	
fP				1.000		1.000		1.000	1.000	1.000	1.000	
fBB				1.000		1.000		1.000	1.000	1.000	1.000	
fA				1.000		1.000		1.000	1.000	1.000	1.000	
fLU				1.000		1.000		0.952	1.000	1.000	0.952	
fRT						0.850		1.000	0.850		1.000	
fLT								0.950		1.000	0.266	1.000
Sec.												
fLpb				1.000				1.000		1.000		
fRpb						1.000		1.000	1.000		1.000	
S				1687		1417		3445	1568	491	3478	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)		Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru								
Right								
Westbound								
Prot								
Perm								
Left	L	104	1687	#	0.06	0.15	253	0.41
Prot								
Perm								
Thru								
Right	R	67	1417		0.05	0.15	213	0.31
Northbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru	T	1076	3445	#	0.31	0.73	2515	0.43
Right	R	185	1568		0.12	0.73	1145	0.16
Southbound								
Prot								
Perm								
Left	L	99	491		0.20	0.63	309	0.32
Prot								
Perm								
Thru	T	1021	3478		0.29	0.63	2191	0.47
Right								

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.37
Total lost time per cycle, L = 12.00 Sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.42

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound												
Westbound												
L	0.41	0.15	38.5	1.000	253	0.11	1.1	0.0	39.6	D		
											39.3	D
R	0.31	0.15	37.9	1.000	213	0.11	0.9	0.0	38.8	D		
Northbound												
T	0.43	0.73	5.3	1.000	2515	0.50	0.5	0.0	5.8	A	5.6	A
R	0.16	0.73	4.1	1.000	1145	0.50	0.3	0.0	4.4	A		
Southbound												
L	0.32	0.63	8.6	1.000	309	0.50	2.7	0.0	11.3	B		
T	0.47	0.63	9.7	1.000	2191	0.50	0.7	0.0	10.4	B	10.5	B

Intersection Delay = 10.0+ (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				M
Cycle length, C	100.0 sec			
Total actual green time for LT lane group, G (s)				63.0
Effective permitted green time for LT lane group, g(s)				63.0
Opposing effective green time, go (s)				73.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				2
Adjusted LT flow rate, VLT (veh/h)				99
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.00
Adjusted opposing flow rate, Vo (veh/h)				1076
Lost time for LT lane group, tL				6.00
Computation				
LT volume per cycle, LTC=VLTC/3600				2.75
Opposing lane util. factor, fLUo			0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				15.70
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.27
gq, (see Exhibit C16-4,5,6,7,8)				0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf				63.00
n=Max(gq-gf)/2,0)				0.00
PTHo=1-PLTo				1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				3.76
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				0.06
gdiff=max(gq-gf,0)				0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.27
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.266

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	100.0 sec			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT			0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo			0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	100.0 sec			
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time r=(C-g-gq-gu)				
Arrival rate, qa=v/(3600(max[X,1.0]))				
Protected ph. departure rate, Sp=s/3600				
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Grp	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 10.0+ sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound	Westbound		Northbound		Southbound	
		L	R	T	R	L	T
Init Queue		0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate		104	67	565	185	99	536
So		1900	1900	1900	1900	1900	1900
No.Lanes	0 0 0	1	0 1	0 2	1	1	2 0
SL		1687	1417	1809	1568	491	1826
LnCapacity		253	213	1320	1145	309	1150
Flow Ratio		0.06	0.05	0.31	0.12	0.20	0.29
v/c Ratio		0.41	0.31	0.43	0.16	0.32	0.47
Grn Ratio		0.15	0.15	0.73	0.73	0.63	0.63
I Factor		1.000		1.000		1.000	
AT or PVG		3	3	3	3	3	3
Pltn Ratio		1.00	1.00	1.00	1.00	1.00	1.00
PF2		1.00	1.00	1.00	1.00	1.00	1.00
Q1		2.6	1.7	6.2	1.6	1.3	7.8
kB		0.3	0.3	1.5	1.4	0.5	1.4
Q2		0.2	0.1	1.1	0.3	0.3	1.2
Q Average		2.8	1.8	7.3	1.8	1.5	9.0
Q Spacing		7.6	7.6	7.6	7.6	7.6	7.6
Q Storage		0	0	0	0	0	0
Q S Ratio							
70th Percentile Output:							
fB%		1.2	1.2	1.2	1.3	1.3	1.2
BOQ		3.4	2.1	8.9	2.3	1.9	10.9
QSRatio							
85th Percentile Output:							
fB%		1.6	1.6	1.5	1.6	1.6	1.4
BOQ		4.5	2.8	10.7	2.9	2.5	13.0
QSRatio							
90th Percentile Output:							
fB%		1.7	1.8	1.6	1.8	1.9	1.6
BOQ		5.0	3.2	11.8	3.4	2.9	14.2
QSRatio							
95th Percentile Output:							
fB%		2.0	2.0	1.8	2.3	2.3	1.8
BOQ		5.7	3.7	13.3	4.2	3.6	15.8
QSRatio							
98th Percentile Output:							
fB%		2.5	2.6	2.1	2.7	2.8	1.9
BOQ		7.1	4.6	14.9	5.0	4.3	17.5
QSRatio							

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: a.liu
Agency: URS Canada Inc.
Date: 12/9/2004
Period: PM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Toro Road

Inter.: Keele St / Toro Road
Area Type: All other areas
Jurisd: City of Toronto
Year: Existing Conditions
N/S St: Keele St

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes		0	0	0	1	0	1	0	2	1	0	1	2	0
LGConfig					L		R		T	R		L	T	
Volume					178		156		1202	144		125	1443	
Lane Width					3.6		3.6		3.6	3.6		3.6	3.6	
RTOR Vol							0			0				

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru					Thru P			
Right					Right P			
Peds					Peds			
WB Left		A			SB Left P			
Thru					Thru P			
Right		A			Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green		18.0			70.0			
Yellow		3.0			4.0			
All Red		3.0			2.0			

Cycle Length: 100.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
Westbound								
L	319	1770	0.57	0.18	39.9	D		
							40.0	D
R	280	1553	0.57	0.18	40.2	D		
Northbound								
T	2435	3478	0.50	0.70	7.7	A	7.4	A
R	1098	1568	0.13	0.70	5.2	A		
Southbound								
L	241	344	0.53	0.70	15.3	B		
T	2435	3478	0.60	0.70	8.9	A	9.4	A

Intersection Delay = 11.8 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

Phone: Fax:
E-Mail:

OPERATIONAL ANALYSIS

Analyst: a.liu
Intersection: Keele St / Toro Road
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: PM Peak Hour
Analysis Year: Existing Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Toro Road
North/South Street: Keele St

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				178		156		1202	144	125	1443	
% Heavy Veh				2		4		4	3	7	4	
PHF				0.98		0.98		0.98	0.98	0.98	0.98	
PK 15 Vol				45		40		307	37	32	368	
Hi Ln Vol					0							
% Grade				1900		1900		0			0	
Ideal Sat								1900	1900	1900	1900	
ParkExist												
NumPark												
No. Lanes	0	0	0	1	0	1	0	2	1	1	2	0
LGConfig				L		R		T	R	L	T	
Lane Width				3.6		3.6		3.6	3.6	3.6	3.6	
RTOR Vol						0			0			
Adj Flow				182		159		1227	147	128	1472	
%InSharedLn												
Prop LTs								0.000		1.000	0.000	
Prop RTs						1.000		0.000	1.000		0.000	
Peds Bikes	0				0			0				
Buses				0		0		0	0	0	0	
%InProtPhase												

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0		0.0		0.0	0.0	0.0	0.0	
Arriv. Type				3		3		3	3	3	3	
Unit Ext.				3.0		3.0		3.0	3.0	3.0	3.0	
I Factor					1.000			1.000			1.000	
Lost Time				2.0		2.0		2.0	2.0	2.0	2.0	
Ext of g				2.0		2.0		2.0	2.0	2.0	2.0	
Ped Min g		3.2			3.2			3.2				

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru					Thru P			
Right					Right P			
Peds					Peds			
WB Left		A			SB Left P			
Thru					Thru P			
Right		A			Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			

Green		18.0			70.0			
Yellow		3.0			4.0			
All Red		3.0			2.0			

Cycle Length: 100.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				178		156		1202	144	125	1443	
PHF				0.98		0.98		0.98	0.98	0.98	0.98	
Adj flow				182		159		1227	147	128	1472	
No. Lanes	0	0	0	1	0	1	0	2	1	1	2	0
Lane group				L		R		T	R	L	T	
Adj flow				182		159		1227	147	128	1472	
Prop LTs								0.000		1.000	0.000	
Prop RTs						1.000		0.000	1.000		0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L		R				T		R	L	T	
So				1900		1900		1900	1900	1900	1900	
Lanes	0	0	0	1	0	1	0	2	1	1	2	0
fW				1.000		1.000		1.000	1.000	1.000	1.000	
fHV				0.980		0.962		0.962	0.971	0.935	0.962	
fG				1.000		1.000		1.000	1.000	1.000	1.000	
fP				1.000		1.000		1.000	1.000	1.000	1.000	
fBB				1.000		1.000		1.000	1.000	1.000	1.000	
fA				1.000		1.000		1.000	1.000	1.000	1.000	
fLU				1.000		1.000		0.952	1.000	1.000	0.952	
fRT						0.850		1.000	0.850		1.000	
fLT					0.950			1.000		0.194	1.000	
Sec.												
fLpb				1.000				1.000		1.000	1.000	
fRpb						1.000		1.000	1.000		1.000	
S				1770		1553		3478	1568	344	3478	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)		Flow Ratio (v/s)	Green Ratio (g/C)	Lane Capacity (c)	v/c Ratio
Eastbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru								
Right								
Westbound								
Prot								
Perm								
Left	L	182	1770	#	0.10	0.18	319	0.57
Prot								
Perm								
Thru								
Right	R	159	1553		0.10	0.18	280	0.57
Northbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru	T	1227	3478		0.35	0.70	2435	0.50
Right	R	147	1568		0.09	0.70	1098	0.13
Southbound								
Prot								
Perm								
Left	L	128	344		0.37	0.70	241	0.53
Prot								
Perm								
Thru	T	1472	3478	#	0.42	0.70	2435	0.60
Right								

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.53
Total lost time per cycle, L = 12.00 Sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.60

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound												
Westbound												
L	0.57	0.18	37.5	1.000	319	0.17	2.4	0.0	39.9	D		
											40.0	D
R	0.57	0.18	37.4	1.000	280	0.16	2.7	0.0	40.2	D		
Northbound												
T	0.50	0.70	7.0	1.000	2435	0.50	0.7	0.0	7.7	A	7.4	A
R	0.13	0.70	5.0	1.000	1098	0.50	0.3	0.0	5.2	A		
Southbound												
L	0.53	0.70	7.2	1.000	241	0.50	8.1	0.0	15.3	B		
T	0.60	0.70	7.8	1.000	2435	0.50	1.1	0.0	8.9	A	9.4	A

Intersection Delay = 11.8 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				M
Cycle length, C	100.0 sec			
Total actual green time for LT lane group, G (s)				70.0
Effective permitted green time for LT lane group, g(s)				70.0
Opposing effective green time, go (s)				70.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				2
Adjusted LT flow rate, VLT (veh/h)				128
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.00
Adjusted opposing flow rate, Vo (veh/h)				1227
Lost time for LT lane group, tL				6.00
Computation				
LT volume per cycle, LTC=VLTC/3600				3.56
Opposing lane util. factor, fLUo			0.952	0.952
Opposing flow, VoLc=VoC/[3600(No)fLUo] (veh/ln/cyc)				17.90
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.30
gq, (see Exhibit C16-4,5,6,7,8)				10.73
gu=g-gq if gq>=gf, or = g-gf if gq<gf				59.27
n=Max(gq-gf)/2,0)				5.37
PTHo=1-PLTo				1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				4.37
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				0.06
gdiff=max(gq-gf,0)				0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.19
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.194

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	100.0 sec			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT			0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo			0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.194

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	100.0 sec			
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time r=(C-g-gq-gu)				
Arrival rate, qa=v/(3600(max[X,1.0]))				
Protected ph. departure rate, Sp=s/3600				
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 11.8 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound		Westbound		Northbound		Southbound	
	L	R	T	R	L	T		
Init Queue			0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate			182	159	644	147	128	773
So			1900	1900	1900	1900	1900	1900
No.Lanes	0	0	1	0	2	1	1	2
SL			1770	1553	1826	1568	344	1826
LnCapacity			319	280	1278	1098	241	1278
Flow Ratio			0.10	0.10	0.35	0.09	0.37	0.42
v/c Ratio			0.57	0.57	0.50	0.13	0.53	0.60
Grn Ratio			0.18	0.18	0.70	0.70	0.70	0.70
I Factor				1.000		1.000		1.000
AT or PVG			3	3	3	3	3	3
Pltn Ratio			1.00	1.00	1.00	1.00	1.00	1.00
PF2			1.00	1.00	1.00	1.00	1.00	1.00
Q1			4.6	4.0	8.3	1.4	1.7	11.2
kB			0.4	0.3	1.5	1.3	0.5	1.5
Q2			0.5	0.4	1.5	0.2	0.5	2.2
Q Average			5.1	4.5	9.7	1.6	2.2	13.3
Q Spacing			7.6	7.6	7.6	7.6	7.6	7.6
Q Storage			0	0	0	0	0	0
Q S Ratio								
70th Percentile Output:								
fB%			1.2	1.2	1.2	1.3	1.3	1.2
BOQ			6.1	5.3	11.8	2.0	2.8	16.1
QSRatio								
85th Percentile Output:								
fB%			1.6	1.6	1.4	1.6	1.6	1.4
BOQ			7.9	7.0	14.1	2.5	3.5	18.9
QSRatio								
90th Percentile Output:								
fB%			1.7	1.7	1.6	1.9	1.8	1.5
BOQ			8.7	7.7	15.3	2.9	4.0	20.5
QSRatio								
95th Percentile Output:								
fB%			2.0	2.0	1.7	2.3	2.2	1.7
BOQ			10.0	8.8	17.0	3.6	4.9	22.3
QSRatio								
98th Percentile Output:								
fB%			2.4	2.4	1.9	2.8	2.7	1.8
BOQ			12.1	10.8	18.7	4.4	5.9	24.1
QSRatio								

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: a.liu
Agency: URS Canada Inc.
Date: 12/9/2004
Period: AM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Finch Avenue

Inter.: Finch Avenue / Romfield Lane
Area Type: All other areas
Jurisd: City of Toronto
Year: Existing Conditions
N/S St: Romfield Lane

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	1	0	2	1	1	1	0	1	1	0
LGConfig		LT	R		LT	R	L	TR		L	TR	
Volume	57	1714	12	16	930	5	20	10	49	0	36	7
Lane Width		3.6	3.6		3.6	3.6	3.6	3.6		3.6	3.6	
RTOR Vol		0			0		0		0		0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB	Left	P			NB	Left	A	
	Thru	P				Thru	A	
	Right	P				Right	A	
	Peds					Peds		
WB	Left	P			SB	Left	A	
	Thru	P				Thru	A	
	Right	P				Right	A	
	Peds					Peds		
NB	Right				EB	Right		
SB	Right				WB	Right		
Green		58.0				20.0		
Yellow		4.0				3.0		
All Red		2.0				3.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
LT	1876	2911	0.96	0.64	28.7	C	28.6	C
R	1036	1607	0.01	0.64	5.8	A		
Westbound								
LT	1922	2983	0.50	0.64	9.4	A	9.3	A
R	1041	1615	0.00	0.64	5.7	A		
Northbound								
L	293	1318	0.07	0.22	27.7	C		
TR	352	1583	0.17	0.22	28.5	C	28.3	C
Southbound								
L	303	1364	0.00	0.22	27.2	C		
TR	314	1412	0.14	0.22	28.3	C	28.3	C

Intersection Delay = 22.2 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

Phone: Fax:
E-Mail:

OPERATIONAL ANALYSIS

Analyst: a.liu
Intersection: Finch Avenue / Romfield Lane
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: AM Peak Hour
Analysis Year: Existing Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Finch Avenue
North/South Street: Romfield Lane

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	57	1714	12	16	930	5	20	10	49	0	36	7
% Heavy Veh	0	0	0	0	0	0	5	0	6	0	36	7
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	15	437	3	4	237	2	5	3	13	0	9	2
Hi Ln Vol												
% Grade		1			0			0			0	
Ideal Sat		1900	1900		1900	1900	1900	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	0	2	1	0	2	1	1	1	0	1	1	0
LGConfig		LT	R		LT	R	L	TR		L	TR	
Lane Width		3.6	3.6		3.6	3.6	3.6	3.6		3.6	3.6	
RTOR Vol		0			0				0			0
Adj Flow		1807	12		965	5	20	60		0	44	
%InSharedLn												
Prop LTs		0.032			0.017		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.833			0.159	
Peds Bikes		0			0			0			0	
Buses		0	0		0	0	0	0		0	0	
%InProtPhase												

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0		0.0	0.0	0.0	0.0		0.0	0.0	
Arriv. Type		3	3		3	3	3	3		3	3	
Unit Ext.		3.0	3.0		3.0	3.0	3.0	3.0		3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time		2.0	2.0		2.0	2.0	2.0	2.0		2.0	2.0	
Ext of g		2.0	2.0		2.0	2.0	2.0	2.0		2.0	2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB	Left	P			NB	Left	A	
	Thru	P				Thru	A	
	Right	P				Right	A	
	Peds					Peds		
WB	Left	P			SB	Left	A	
	Thru	P				Thru	A	
	Right	P				Right	A	
	Peds					Peds		
NB	Right				EB	Right		
SB	Right				WB	Right		

Green	58.0				20.0			
Yellow	4.0				3.0			
All Red	2.0				3.0			

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	57	1714	12	16	930	5	20	10	49	0	36	7
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	58	1749	12	16	949	5	20	10	50	0	37	7
No. Lanes	0	2	1	0	2	1	1	1	0	1	1	0
Lane group		LT	R		LT	R	L	TR		L	TR	
Adj flow		1807	12		965	5	20	60		0	44	
Prop LTs		0.032			0.017		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.833			0.159	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG		LT	R		LT	R	L	TR		L	TR	
So		1900	1900		1900	1900	1900	1900		1900	1900	
Lanes	0	2	1	0	2	1	1	1	0	1	1	0
fW		1.000	1.000		1.000	1.000	1.000	1.000		1.000	1.000	
fHV		0.928	1.000		0.919	1.000	0.952	0.952		1.000	0.761	
fG		0.995	0.995		1.000	1.000	1.000	1.000		1.000	1.000	
fP		1.000	1.000		1.000	1.000	1.000	1.000		1.000	1.000	
fBB		1.000	1.000		1.000	1.000	1.000	1.000		1.000	1.000	
fA		1.000	1.000		1.000	1.000	1.000	1.000		1.000	1.000	
fLU		0.952	1.000		0.952	1.000	1.000	1.000		1.000	1.000	
fRT		1.000	0.850		1.000	0.850		0.875			0.976	
fLT		0.871			0.897		0.728	1.000		0.718	1.000	
Sec.												
fLpb		1.000			1.000		1.000	1.000		1.000	1.000	
fRpb		1.000	1.000		1.000	1.000		1.000			1.000	
S		2911	1607		2983	1615	1318	1583		1364	1412	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	1807	2911	# 0.62	0.64	1876	0.96
Right	R	12	1607	0.01	0.64	1036	0.01
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	965	2983	0.32	0.64	1922	0.50
Right	R	5	1615	0.00	0.64	1041	0.00
Northbound							
Prot							
Perm							
Left	L	20	1318	0.02	0.22	293	0.07
Prot							
Perm							
Thru	TR	60	1583	# 0.04	0.22	352	0.17
Right							
Southbound							
Prot							
Perm							
Left	L	0	1364	0.00	0.22	303	0.00
Prot							
Perm							
Thru	TR	44	1412	0.03	0.22	314	0.14
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.66
Total lost time per cycle, L = 12.00 Sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.76

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
LT	0.96	0.64	15.0	1.000	1876	0.50	13.7	0.0	28.7	C	28.6	C
R	0.01	0.64	5.7	1.000	1036	0.50	0.0	0.0	5.8	A		
Westbound												
LT	0.50	0.64	8.4	1.000	1922	0.50	0.9	0.0	9.4	A	9.3	A
R	0.00	0.64	5.7	1.000	1041	0.50	0.0	0.0	5.7	A		
Northbound												
L	0.07	0.22	27.6	1.000	293	0.11	0.1	0.0	27.7	C		
TR	0.17	0.22	28.3	1.000	352	0.11	0.2	0.0	28.5	C	28.3	C
Southbound												
L	0.00	0.22	27.2	1.000	303	0.11	0.0	0.0	27.2	C		
TR	0.14	0.22	28.1	1.000	314	0.11	0.2	0.0	28.3	C	28.3	C

Intersection Delay = 22.2 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach			M	M
Cycle length, C	90.0	sec		
Total actual green time for LT lane group, G (s)			20.0	20.0
Effective permitted green time for LT lane group, g(s)			20.0	20.0
Opposing effective green time, go (s)			20.0	20.0
Number of lanes in LT lane group, N			1	1
Number of lanes in opposing approach, No			1	1
Adjusted LT flow rate, VLT (veh/h)			20	0
Proportion of LT in LT lane group, PLT			1.000	1.000
Proportion of LT in opposing flow, PLTo			0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)			44	60
Lost time for LT lane group, tL			6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.50	0.00
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			1.10	1.50
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g			0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.78	0.78
gq, (see Exhibit C16-4,5,6,7,8)			0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf			20.00	20.00
n=Max(gq-gf)/2,0)			0.00	0.00
PTHo=1-PLTo			1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	1.00
EL1 (refer to Exhibit C16-3)			1.37	1.39
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.20	0.20
gdiff=max(gq-gf,0)			0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.73	0.72
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.728	0.718

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach			M	M
Cycle length, C	90.0	sec		
Total actual green time for LT lane group, G (s)			58.0	58.0
Effective permitted green time for LT lane group, g(s)			58.0	58.0
Opposing effective green time, go (s)			58.0	58.0
Number of lanes in LT lane group, N			2	2
Number of lanes in opposing approach, No			2	2
Adjusted LT flow rate, VLT (veh/h)			58	16
Proportion of LT in LT lane group, PLT			0.032	0.017 0.000 0.000
Proportion of LT in opposing flow, PLTo			0.02	0.03
Adjusted opposing flow rate, Vo (veh/h)			965	1807
Lost time for LT lane group, tL			6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600			1.45	0.40
Opposing lane util. factor, fLUo			0.952	0.952 1.000 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			12.67	23.73
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g			12.3	30.7
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.36	0.36
gq, (see Exhibit C16-4,5,6,7,8)			6.54	29.69
gu=g-gq if gq>=gf, or = g-gf if gq<gf			45.66	27.28
n=Max(gq-gf)/2,0)			0.00	0.00
PTHo=1-PLTo			0.98	0.97
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.10	0.04
EL1 (refer to Exhibit C16-3)			3.78	8.74
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	1.00
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.04	0.04
gdiff=max(gq-gf,0)			0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.83	0.88
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.871	0.897

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time r=(C-g-gq-gu)				
Arrival rate, qa=v/(3600(max[X,1.0]))				
Protected ph. departure rate, Sp=s/3600				
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Final u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 22.2 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound LT	Eastbound R	Westbound LT	Westbound R	Northbound L	Northbound TR	Southbound L	Southbound TR
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	949	12	506	5	20	60	0	44
So	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	2	1	2	1	1	1	1	1
SL	1528	1607	1566	1615	1318	1583	1364	1412
LnCapacity	985	1036	1009	1041	293	352	303	314
Flow Ratio	0.62	0.01	0.32	0.00	0.02	0.04	0.00	0.03
v/c Ratio	0.96	0.01	0.50	0.00	0.07	0.17	0.00	0.14
Grn Ratio	0.64	0.64	0.64	0.64	0.22	0.22	0.22	0.22
I Factor	1.000		1.000			1.000		1.000
AT or PVG	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	22.3	0.1	6.6	0.0	0.4	1.2	0.0	0.9
kB	1.1	1.2	1.1	1.2	0.3	0.4	0.3	0.3
Q2	9.5	0.0	1.1	0.0	0.0	0.1	0.0	0.1
Q Average	31.8	0.1	7.8	0.1	0.4	1.3	0.0	0.9
Q Spacing	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Q Storage	0	0	0	0	0	0	0	0
Q S Ratio								
70th Percentile Output:								
fB%	1.2	1.3	1.2	1.3	1.2	1.2	1.2	1.2
BOQ	38.2	0.2	9.5	0.1	0.5	1.5	0.0	1.1
QSRatio								
85th Percentile Output:								
fB%	1.4	1.7	1.5	1.7	1.6	1.6	1.6	1.6
BOQ	44.5	0.2	11.4	0.1	0.7	2.0	0.0	1.5
QSRatio								
90th Percentile Output:								
fB%	1.5	2.0	1.6	2.0	1.8	1.8	1.8	1.8
BOQ	47.7	0.2	12.5	0.1	0.8	2.3	0.0	1.7
QSRatio								
95th Percentile Output:								
fB%	1.6	2.6	1.8	2.6	2.1	2.1	2.1	2.1
BOQ	50.9	0.3	14.1	0.1	0.9	2.7	0.0	1.9
QSRatio								
98th Percentile Output:								
fB%	1.7	3.2	2.0	3.2	2.7	2.6	2.7	2.6
BOQ	54.1	0.4	15.7	0.2	1.1	3.4	0.0	2.5
QSRatio								

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: a.liu
Agency: URS Canada Inc.
Date: 12/9/2004
Period: PM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Finch Avenue

Inter.: Finch Avenue / Romfield Lane
Area Type: All other areas
Jurisd: City of Toronto
Year: Existing Conditions
N/S St: Romfield Lane

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	1	0	2	1	1	1	0	1	1	0
LGConfig		LT	R		LT	R	L	TR		L	TR	
Volume	0	1896	22	26	2051	0	5	0	12	0	0	1
Lane Width		3.6	3.6		3.6	3.6	3.6	3.6		3.6	3.6	
RTOR Vol		0			0				0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	67.0				21.0			
Yellow	4.0				3.0			
All Red	2.0				3.0			

Cycle Length: 100.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
LT	2330	3478	0.83	0.67	15.9	B	15.8	B
R	1082	1615	0.02	0.67	5.6	A		
Westbound								
LT	1937	2891	1.09	0.67	67.9	E	67.9	E
R	1082	1615	0.00	0.67	5.4	A		
Northbound								
L	302	1439	0.02	0.21	31.4	C		
TR	339	1615	0.04	0.21	31.6	C	31.6	C
Southbound								
L	299	1424	0.00	0.21	31.2	C		
TR	339	1615	0.00	0.21	31.2	C	31.2	C

Intersection Delay = 42.8 (sec/veh) Intersection LOS = D

HCS2000: Signalized Intersections Release 4.1e

Phone: Fax:
E-Mail:

OPERATIONAL ANALYSIS

Analyst: a.liu
Intersection: Finch Avenue / Romfield Lane
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: PM Peak Hour
Analysis Year: Existing Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Finch Avenue
North/South Street: Romfield Lane

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	1896	22	26	2051	0	5	0	12	0	0	1
% Heavy Veh	0	4	0	0	3	0	0	0	0	0	0	0
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	0	484	6	7	523	0	2	0	3	0	0	1
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900	1900		1900	1900	1900	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	0	2	1	0	2	1	1	1	0	1	1	0
LGConfig		LT	R		LT	R	L	TR		L	TR	
Lane Width		3.6	3.6		3.6	3.6	3.6	3.6		3.6	3.6	
RTOR Vol		0			0				0			0
Adj Flow		1935	22		2120	0	5	12		0	1	
%InSharedLn												
Prop LTs		0.000			0.013		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.000	1.000		1.000			1.000	
Peds Bikes		0			0			0			0	
Buses		0	0		0	0	0	0		0	0	
%InProtPhase												

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0		0.0	0.0	0.0	0.0		0.0	0.0	
Arriv. Type		3	3		3	3	3	3		3	3	
Unit Ext.		3.0	3.0		3.0	3.0	3.0	3.0		3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time		2.0	2.0		2.0	2.0	2.0	2.0		2.0	2.0	
Ext of g		2.0	2.0		2.0	2.0	2.0	2.0		2.0	2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			

Phase Combination	1	2	3	4	5	6	7	8
Green	67.0				21.0			
Yellow	4.0				3.0			
All Red	2.0				3.0			

Cycle Length: 100.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	0	1896	22	26	2051	0	5	0	12	0	0	1
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	0	1935	22	27	2093	0	5	0	12	0	0	1
No. Lanes	0	2	1	0	2	1	1	1	0	1	1	0
Lane group		LT	R		LT	R	L	TR		L	TR	
Adj flow		1935	22		2120	0	5	12		0	1	
Prop LTs		0.000			0.013		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.000	1.000		1.000			1.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LT	R		LT	R	L	TR		L	TR		
So	1900	1900		1900	1900	1900	1900		1900	1900		
Lanes	0	2	1	0	2	1	1	0	1	1	0	
fW	1.000	1.000		1.000	1.000	1.000	1.000		1.000	1.000		
fHV	0.962	1.000		0.971	1.000	1.000	1.000		1.000	1.000		
fG	1.000	1.000		1.000	1.000	1.000	1.000		1.000	1.000		
fP	1.000	1.000		1.000	1.000	1.000	1.000		1.000	1.000		
fBB	1.000	1.000		1.000	1.000	1.000	1.000		1.000	1.000		
fA	1.000	1.000		1.000	1.000	1.000	1.000		1.000	1.000		
fLU	0.952	1.000		0.952	1.000	1.000	1.000		1.000	1.000		
fRT	1.000	0.850		1.000	0.850		0.850			0.850		
fLT	1.000			0.823		0.757	1.000		0.750	1.000		
Sec.												
fLpb	1.000			1.000		1.000	1.000		1.000	1.000		
fRpb	1.000	1.000		1.000	1.000		1.000			1.000		
S	3478	1615		2891	1615	1439	1615		1424	1615		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Prot							
Perm							
Thru	LT	1935	3478	0.56	0.67	2330	0.83
Right	R	22	1615	0.01	0.67	1082	0.02
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	2120	2891	# 0.73	0.67	1937	1.09
Right	R	0	1615	0.00	0.67	1082	0.00
Northbound							
Prot							
Perm							
Left	L	5	1439	0.00	0.21	302	0.02
Prot							
Perm							
Thru	TR	12	1615	# 0.01	0.21	339	0.04
Right							
Southbound							
Prot							
Perm							
Left	L	0	1424	0.00	0.21	299	0.00
Prot							
Perm							
Thru	TR	1	1615	0.00	0.21	339	0.00
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.74
Total lost time per cycle, L = 12.00 Sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.84

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
LT	0.83	0.67	12.3	1.000	2330	0.50	3.6	0.0	15.9	B	15.8	B
R	0.02	0.67	5.5	1.000	1082	0.50	0.0	0.0	5.6	A		
Westbound												
LT	1.09	0.67	16.5	1.000	1937	0.50	51.4	0.0	67.9	E	67.9	E
R	0.00	0.67	5.4	1.000	1082	0.50	0.0	0.0	5.4	A		
Northbound												
L	0.02	0.21	31.3	1.000	302	0.50	0.1	0.0	31.4	C		
TR	0.04	0.21	31.4	1.000	339	0.50	0.2	0.0	31.6	C	31.6	C
Southbound												
L	0.00	0.21	31.2	1.000	299	0.50	0.0	0.0	31.2	C		
TR	0.00	0.21	31.2	1.000	339	0.50	0.0	0.0	31.2	C	31.2	C

Intersection Delay = 42.8 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach			M	M
Cycle length, C	100.0 sec			
Total actual green time for LT lane group, G (s)			21.0	21.0
Effective permitted green time for LT lane group, g(s)			21.0	21.0
Opposing effective green time, go (s)			21.0	21.0
Number of lanes in LT lane group, N			1	1
Number of lanes in opposing approach, No			1	1
Adjusted LT flow rate, VLT (veh/h)			5	0
Proportion of LT in LT lane group, PLT			1.000	1.000
Proportion of LT in opposing flow, PLTo			0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)			1	12
Lost time for LT lane group, tL			6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.14	0.00
Opposing lane util. factor, fLUo		0.952	0.952	1.000 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			0.03	0.33
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g			0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.79	0.79
gq, (see Exhibit C16-4,5,6,7,8)			0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf			21.00	21.00
n=Max(gq-gf)/2,0)			0.00	0.00
PTHo=1-PLTo			1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	1.00
EL1 (refer to Exhibit C16-3)			1.32	1.33
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.19	0.19
gdiff=max(gq-gf,0)			0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.76	0.75
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.757	0.750

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach			M	M
Cycle length, C	100.0 sec			
Total actual green time for LT lane group, G (s)			67.0	67.0
Effective permitted green time for LT lane group, g(s)			67.0	67.0
Opposing effective green time, go (s)			67.0	67.0
Number of lanes in LT lane group, N			2	2
Number of lanes in opposing approach, No			2	2
Adjusted LT flow rate, VLT (veh/h)			0	27
Proportion of LT in LT lane group, PLT			0.000	0.013 0.000 0.000
Proportion of LT in opposing flow, PLTo			0.01	0.00
Adjusted opposing flow rate, Vo (veh/h)			2120	1935
Lost time for LT lane group, tL			6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.00	0.75
Opposing lane util. factor, fLUo			0.952	0.952 1.000 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			30.93	28.23
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g			0.0	26.7
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.33	0.33
gq, (see Exhibit C16-4,5,6,7,8)			47.52	36.79
gu=g-gq if gq>=gf, or = g-gf if gq<gf			19.48	30.21
n=Max(gq-gf)/2,0)			23.76	5.05
PTHo=1-PLTo			0.99	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.00	0.04
EL1 (refer to Exhibit C16-3)			11.95	9.93
EL2=Max((1-Ptho**n)/Plto, 1.0)			20.61	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.03	0.03
gdiff=max(gq-gf,0)			47.52	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.29	0.74
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			1.000	0.823

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	100.0 sec			
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time r=(C-g-gq-gu)				
Arrival rate, qa=v/(3600(max[X,1.0]))				
Protected ph. departure rate, Sp=s/3600				
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 42.8 sec/veh Intersection LOS D

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LT	R	LT	R	L	TR	L	TR
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	1016	22	1113	0	5	12	0	1
So	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	2	1	2	1	1	1	1	0
SL	1826	1615	1518	1615	1439	1615	1424	1615
LnCapacity	1223	1082	1017	1082	302	339	299	339
Flow Ratio	0.56	0.01	0.73	0.00	0.01	0.00	0.00	0.00
v/c Ratio	0.83	0.02	1.09	0.00	0.02	0.04	0.00	0.00
Grn Ratio	0.67	0.67	0.67	0.67	0.21	0.21	0.21	0.21
I Factor	1.000		1.000			1.000		1.000
AT or PVG	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	21.0	0.2	30.9	0.0	0.1	0.3	0.0	0.0
kB	1.4	1.3	1.2	1.3	0.5	0.6	0.5	0.6
Q2	5.7	0.0	20.5	0.0	0.0	0.0	0.0	0.0
Q Average	26.7	0.2	51.4	0.0	0.1	0.3	0.0	0.0
Q Spacing	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Q Storage	0	0	0	0	0	0	0	0
Q S Ratio								
70th Percentile Output:								
fB%	1.2	1.3	1.2	1.3	1.3	1.3	1.3	1.3
BOQ	32.1	0.3	61.7	0.0	0.2	0.4	0.0	0.0
QSRatio								
85th Percentile Output:								
fB%	1.4	1.7	1.4	1.7	1.7	1.7	1.7	1.7
BOQ	37.4	0.4	71.9	0.0	0.2	0.5	0.0	0.0
QSRatio								
90th Percentile Output:								
fB%	1.5	2.0	1.5	2.0	2.0	2.0	2.0	2.0
BOQ	40.1	0.5	77.1	0.0	0.2	0.6	0.0	0.0
QSRatio								
95th Percentile Output:								
fB%	1.6	2.6	1.6	2.6	2.6	2.5	2.6	2.6
BOQ	42.8	0.6	82.2	0.0	0.3	0.7	0.0	0.1
QSRatio								
98th Percentile Output:								
fB%	1.7	3.1	1.7	3.2	3.2	3.1	3.2	3.2
BOQ	45.6	0.7	87.3	0.0	0.4	0.9	0.0	0.1
QSRatio								

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: a.liu
Agency: URS Canada Inc.
Date: 12/9/2004
Period: AM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Finch Avenue

Inter.: Finch Avenue / Tangiers Rd
Area Type: All other areas
Jurisd: City of Toronto
Year: Existing Conditions
N/S St: Tangiers Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes		1	2 1		1	2 1		1 2	0		1	2 0
LGConfig	L		T R	L		T R	L		TR	L		TR
Volume	25	1415	130	20	1737	13	67	21	43	54	23	28
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6		3.6	3.6	
RTOR Vol		0			0			0			0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left		P			NB Left	A			
Thru		P			Thru	A			
Right		P			Right	A			
Peds					Peds				
WB Left		P			SB Left	A			
Thru		P			Thru	A			
Right		P			Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green		54.0				24.0			
Yellow		4.0				4.0			
All Red		2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/c	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	80	125	0.32	0.60	19.4	B		
T	2000	3333	0.72	0.60	15.0	B	14.5	B
R	861	1435	0.15	0.60	8.3	A		
Westbound								
L	131	219	0.15	0.60	10.4	B		
T	2048	3413	0.87	0.60	20.2	C	20.0-	B
R	897	1495	0.01	0.60	7.3	A		
Northbound								
L	342	1281	0.20	0.27	25.8	C		
TR	759	2845	0.09	0.27	24.8	C	25.3	C
Southbound								
L	361	1354	0.15	0.27	25.4	C		
TR	865	3243	0.06	0.27	24.6	C	25.0	C

Intersection Delay = 17.9 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

Phone: Fax:
E-Mail:

OPERATIONAL ANALYSIS

Analyst: a.liu
Intersection: Finch Avenue / Tangiers Rd
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: AM Peak Hour
Analysis Year: Existing Conditions
Project ID: TTC Spadina Station Extension

East/West Street: Finch Avenue
North/South Street: Tangiers Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	25	1415	130	20	1737	13	67	21	43	54	23	28
% Heavy Veh	12	0	12	0	6	8	7	19	12	0	0	4
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	7	361	33	5	443	4	17	6	11	14	6	7
Hi Ln Vol												
% Grade		1			0			0			0	
Ideal Sat	1900	1900	1900	1900	1900	1900	1900	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes		1	2 1		1	2 1		1	2 0		1	2 0
LGConfig	L		T R	L		T R	L		TR	L		TR
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6		3.6	3.6	
RTOR Vol		0			0				0			0
Adj Flow	26	1444	133	20	1772	13	68	65		55	52	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.677			0.558	
Peds Bikes	0				0			0			0	
Buses	0	0	0	0	0	0	0	0		0	0	
%InProtPhase												

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Arriv. Type	3	3	3	3	3	3	3	3		3	3	
Unit Ext.	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0		2.0	2.0	
Ext of g	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0		2.0	2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left		P			NB Left	A			
Thru		P			Thru	A			
Right		P			Right	A			
Peds					Peds				
WB Left		P			SB Left	A			
Thru		P			Thru	A			
Right		P			Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green		54.0				24.0			
Yellow		4.0				4.0			
All Red		2.0				2.0			

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	25	1415	130	20	1737	13	67	21	43	54	23	28
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	26	1444	133	20	1772	13	68	21	44	55	23	29
No. Lanes		1	2 1		1	2 1		1	2 0		1	2 0
Lane group	L		T R	L		T R	L		TR	L		TR
Adj flow	26	1444	133	20	1772	13	68	65		55	52	
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.677			0.558	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	T	R	L	T	R	L	TR		L	TR	
So	1900	1900	1900	1900	1900	1900	1900	1900		1900	1900	
Lanes	1	2	1	1	2	1	1	2	0	1	2	0
fW	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000	1.000	
fHV	0.893	0.926	0.893	1.000	0.943	0.926	0.935	0.875		1.000	0.978	
fG	0.995	0.995	0.995	1.000	1.000	1.000	1.000	1.000		1.000	1.000	
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000	1.000	
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000	1.000	
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000	1.000	
fLU	1.000	0.952	1.000	1.000	0.952	1.000	1.000	0.952		1.000	0.952	
fRT		1.000	0.850		1.000	0.850		0.898			0.916	
fLT	0.074	1.000		0.115	1.000		0.721	1.000		0.713	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000	1.000		1.000	1.000		1.000			1.000	
S	125	3333	1435	219	3413	1495	1281	2845		1354	3243	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	26	125	0.21	0.60	80	0.32
Prot							
Perm							
Thru	T	1444	3333	0.43	0.60	2000	0.72
Right	R	133	1435	0.09	0.60	861	0.15
Westbound							
Prot							
Perm							
Left	L	20	219	0.09	0.60	131	0.15
Prot							
Perm							
Thru	T	1772	3413	# 0.52	0.60	2048	0.87
Right	R	13	1495	0.01	0.60	897	0.01
Northbound							
Prot							
Perm							
Left	L	68	1281	# 0.05	0.27	342	0.20
Prot							
Perm							
Thru	TR	65	2845	0.02	0.27	759	0.09
Right							
Southbound							
Prot							
Perm							
Left	L	55	1354	0.04	0.27	361	0.15
Prot							
Perm							
Thru	TR	52	3243	0.02	0.27	865	0.06
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.57
Total lost time per cycle, L = 12.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.66

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.32	0.60	8.9	1.000	80	0.50	10.5	0.0	19.4	B		
T	0.72	0.60	12.7	1.000	2000	0.50	2.3	0.0	15.0	B	14.5	B
R	0.15	0.60	7.9	1.000	861	0.50	0.4	0.0	8.3	A		
Westbound												
L	0.15	0.60	7.9	1.000	131	0.50	2.5	0.0	10.4	B		
T	0.87	0.60	15.0	1.000	2048	0.50	5.2	0.0	20.2	C	20.0-	B
R	0.01	0.60	7.3	1.000	897	0.50	0.0	0.0	7.3	A		
Northbound												
L	0.20	0.27	25.6	1.000	342	0.11	0.3	0.0	25.8	C		
TR	0.09	0.27	24.8	1.000	759	0.11	0.0	0.0	24.8	C	25.3	C
Southbound												
L	0.15	0.27	25.2	1.000	361	0.11	0.2	0.0	25.4	C		
TR	0.06	0.27	24.6	1.000	865	0.11	0.0	0.0	24.6	C	25.0	C

Intersection Delay = 17.9 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	54.0	54.0	24.0	24.0
Effective permitted green time for LT lane group, g(s)	54.0	54.0	24.0	24.0
Opposing effective green time, go (s)	54.0	54.0	24.0	24.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	2	2	2	2
Adjusted LT flow rate, VLT (veh/h)	26	20	68	55
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	1772	1444	52	65
Lost time for LT lane group, tL	6.00	6.00	6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.65	0.50	1.70	1.38
Opposing lane util. factor, fLUo	0.952	0.952	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	23.27	18.96	0.68	0.85
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.40	0.40	0.73	0.73
gq, (see Exhibit C16-4,5,6,7,8)	32.54	20.21	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	21.46	33.79	24.00	24.00
n=Max(gq-gf)/2,0)	16.27	10.11	0.00	0.00
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	7.59	5.43	1.39	1.40
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07	0.07	0.17	0.17
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.07	0.12	0.72	0.71
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.074	0.115	0.721	0.713

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Adjusted Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time r=(C-g-gq-gu)				
Arrival rate, qa=v/(3600(max[X,1.0]))				
Protected ph. departure rate, Sp=s/3600				
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Final Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 17.9 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound L	T	R	Westbound L	T	R	Northbound L	TR	Southbound L	TR
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	26	758	133	20	930	13	68	34	55	27
So	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	2	1	1	2	1	1	2 0	1	2 0
SL	125	1750	1435	219	1792	1495	1281	1494	1354	1703
LnCapacity	80	1050	861	131	1075	897	342	398	361	454
Flow Ratio	0.21	0.43	0.09	0.09	0.52	0.01	0.05	0.02	0.04	0.02
v/c Ratio	0.32	0.72	0.15	0.15	0.87	0.01	0.20	0.09	0.15	0.06
Grn Ratio	0.60	0.60	0.60	0.60	0.60	0.60	0.27	0.27	0.27	0.27
I Factor		1.000			1.000			1.000		1.000
AT or PVG	3	3	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	0.3	13.4	1.5	0.2	19.3	0.1	1.3	0.6	1.1	0.5
kB	0.2	1.2	1.0	0.3	1.2	1.1	0.4	0.4	0.4	0.4
Q2	0.1	2.8	0.2	0.0	5.8	0.0	0.1	0.0	0.1	0.0
Q Average	0.4	16.2	1.7	0.3	25.2	0.1	1.4	0.7	1.1	0.5
Q Spacing	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Q Storage	0	0	0	0	0	0	0	0	0	0
Q S Ratio										
70th Percentile Output:										
fB%	1.3	1.2	1.3	1.3	1.2	1.3	1.2	1.2	1.2	1.2
BOQ	0.5	19.5	2.1	0.3	30.2	0.2	1.7	0.8	1.3	0.6
QSRatio										
85th Percentile Output:										
fB%	1.7	1.4	1.6	1.7	1.4	1.7	1.6	1.6	1.6	1.6
BOQ	0.7	22.9	2.7	0.5	35.3	0.2	2.2	1.1	1.8	0.8
QSRatio										
90th Percentile Output:										
fB%	2.0	1.5	1.9	2.0	1.5	2.0	1.8	1.8	1.8	1.8
BOQ	0.8	24.6	3.1	0.5	37.8	0.3	2.5	1.2	2.0	0.9
QSRatio										
95th Percentile Output:										
fB%	2.5	1.6	2.3	2.5	1.6	2.6	2.1	2.1	2.1	2.1
BOQ	1.0	26.6	3.8	0.7	40.4	0.4	2.9	1.4	2.3	1.1
QSRatio										
98th Percentile Output:										
fB%	3.1	1.8	2.8	3.1	1.7	3.2	2.6	2.6	2.6	2.7
BOQ	1.3	28.5	4.6	0.8	43.0	0.5	3.7	1.8	2.9	1.4
QSRatio										

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: a.liu
Agency: URS Canada Inc.
Date: 12/9/2004
Period: PM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Finch Avenue

Inter.: Finch Avenue / Tangiers Rd
Area Type: All other areas
Jurisd: City of Toronto
Year: Existing Conditions
N/S St: Tangiers Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	1	1	2	1	1	2	0	1	2	0
LGConfig	L	T	R	L	T	R	L	TR		L	TR	
Volume	32	1218	61	66	1089	51	135	34	81	53	63	60
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6		3.6	3.6	
RTOR Vol		0			0			0			0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	P				NB Left	A			
Thru	P				Thru	A			
Right	P				Right	A			
Peds					Peds				
WB Left	P				SB Left	A			
Thru	P				Thru	A			
Right	P				Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	64.0				24.0				
Yellow	4.0				4.0				
All Red	2.0				2.0				

Cycle Length: 100.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	230	359	0.15	0.64	8.5	A		
T	2057	3214	0.62	0.64	12.2	B	11.9	B
R	961	1502	0.07	0.64	6.9	A		
Westbound								
L	200	312	0.34	0.64	13.0	B		
T	2144	3350	0.53	0.64	10.8	B	10.8	B
R	1034	1615	0.05	0.64	6.8	A		
Northbound								
L	300	1249	0.47	0.24	33.8	C		
TR	753	3136	0.16	0.24	30.1	C	32.1	C
Southbound								
L	308	1283	0.18	0.24	30.5	C		
TR	805	3353	0.16	0.24	30.1	C	30.2	C

Intersection Delay = 14.2 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

Phone: Fax:
E-Mail:

OPERATIONAL ANALYSIS

Analyst: a.liu
Intersection: Finch Avenue / Tangiers Rd
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: PM Peak Hour
Analysis Year: Existing Conditions
Project ID: TTC Spadina Station Extension

East/West Street	North/South Street
Finch Avenue	Tangiers Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	32	1218	61	66	1089	51	135	34	81	53	63	60
% Heavy Veh	6	12	7	0	8	0	2	6	2	0	0	0
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
PK 15 Vol	8	321	16	17	287	13	36	9	21	14	17	16
Hi Ln Vol												
% Grade		1			0			0			0	
Ideal Sat	1900	1900	1900	1900	1900	1900	1900	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	2	1	1	2	1	1	2	0	1	2	0
LGConfig	L	T	R	L	T	R	L	T	TR	L	T	TR
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6		3.6	3.6	
RTOR Vol		0			0			0			0	
Adj Flow	34	1282	64	69	1146	54	142	121		56	129	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.702			0.488	
Peds Bikes	0				0			0			0	
Buses	0	0	0	0	0	0	0	0		0	0	
%InProtPhase												

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Arriv. Type	3	3	3	3	3	3	3	3		3	3	
Unit Ext.	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0		2.0	2.0	
Ext of g	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0		2.0	2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	P				NB Left	A			
Thru	P				Thru	A			
Right	P				Right	A			
Peds					Peds				
WB Left	P				SB Left	A			
Thru	P				Thru	A			
Right	P				Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				

Phase Combination	1	2	3	4		5	6	7	8
Green	64.0					24.0			
Yellow	4.0					4.0			
All Red	2.0					2.0			

Cycle Length: 100.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	32	1218	61	66	1089	51	135	34	81	53	63	60
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	34	1282	64	69	1146	54	142	121		56	129	
No. Lanes	1	2	1	1	2	1	1	2	0	1	2	0
Lane group	L	T	R	L	T	R	L	TR		L	TR	
Adj flow	34	1282	64	69	1146	54	142	121		56	129	
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.702			0.488	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	T	R	L	T	R	L	TR		L	TR	
So	1900	1900	1900	1900	1900	1900	1900	1900		1900	1900	
Lanes	1	2	1	1	2	1	1	2	0	1	2	0
fW	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000	1.000	
fHV	0.943	0.893	0.935	1.000	0.926	1.000	0.980	0.969		1.000	1.000	
fG	0.995	0.995	0.995	1.000	1.000	1.000	1.000	1.000		1.000	1.000	
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000	1.000	
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000	1.000	
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000	1.000	
fLU	1.000	0.952	1.000	1.000	0.952	1.000	1.000	0.952		1.000	0.952	
fRT		1.000	0.850		1.000	0.850		0.895			0.927	
fLT	0.201	1.000		0.164	1.000		0.670	1.000		0.676	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000	1.000		1.000	1.000		1.000			1.000	
S	359	3214	1502	312	3350	1615	1249	3136		1283	3353	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	34	359	0.09	0.64	230	0.15
Prot							
Perm							
Thru	T	1282	3214	# 0.40	0.64	2057	0.62
Right	R	64	1502	0.04	0.64	961	0.07
Westbound							
Prot							
Perm							
Left	L	69	312	0.22	0.64	200	0.34
Prot							
Perm							
Thru	T	1146	3350	0.34	0.64	2144	0.53
Right	R	54	1615	0.03	0.64	1034	0.05
Northbound							
Prot							
Perm							
Left	L	142	1249	# 0.11	0.24	300	0.47
Prot							
Perm							
Thru	TR	121	3136	0.04	0.24	753	0.16
Right							
Southbound							
Prot							
Perm							
Left	L	56	1283	0.04	0.24	308	0.18
Prot							
Perm							
Thru	TR	129	3353	0.04	0.24	805	0.16
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.51
Total lost time per cycle, L = 12.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.58

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.15	0.64	7.2	1.000	230	0.50	1.4	0.0	8.5	A		
T	0.62	0.64	10.8	1.000	2057	0.50	1.4	0.0	12.2	B	11.9	B
R	0.07	0.64	6.8	1.000	961	0.50	0.1	0.0	6.9	A		
Westbound												
L	0.34	0.64	8.3	1.000	200	0.50	4.7	0.0	13.0	B		
T	0.53	0.64	9.8	1.000	2144	0.50	1.0	0.0	10.8	B	10.8	B
R	0.05	0.64	6.7	1.000	1034	0.50	0.1	0.0	6.8	A		
Northbound												
L	0.47	0.24	32.6	1.000	300	0.11	1.2	0.0	33.8	C		
TR	0.16	0.24	30.0	1.000	753	0.11	0.1	0.0	30.1	C	32.1	C
Southbound												
L	0.18	0.24	30.2	1.000	308	0.11	0.3	0.0	30.5	C		
TR	0.16	0.24	30.0	1.000	805	0.11	0.1	0.0	30.1	C	30.2	C

Intersection Delay = 14.2 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)	64.0	64.0	24.0	24.0
Effective permitted green time for LT lane group, g(s)	64.0	64.0	24.0	24.0
Opposing effective green time, go (s)	64.0	64.0	24.0	24.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	2	2	2	2
Adjusted LT flow rate, VLT (veh/h)	34	69	142	56
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	1146	1282	129	121
Loss time for LT lane group, tL	6.00	6.00	6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.94	1.92	3.94	1.56
Opposing lane util. factor, fLUo	0.952	0.952	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	16.72	18.70	1.88	1.77
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.36	0.36	0.76	0.76
gq, (see Exhibit C16-4,5,6,7,8)	12.09	15.51	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	51.91	48.49	24.00	24.00
n=Max(gq-gf)/2,0)	6.04	7.76	0.00	0.00
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	4.03	4.61	1.49	1.48
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06	0.06	0.17	0.17
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.20	0.16	0.67	0.68
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.201	0.164	0.670	0.676

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 100.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time r=(C-g-gq-gu)				
Arrival rate, qa=v/(3600(max[X,1.0]))				
Protected ph. departure rate, Sp=s/3600				
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 14.2 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound L	T	R	Westbound L	T	R	Northbound L	TR	Southbound L	TR
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	34	673	64	69	601	54	142	63	56	67
So	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	2	1	1	2	1	1	2 0	1	2 0
SL	359	1688	1502	312	1759	1615	1249	1647	1283	1761
LnCapacity	230	1080	961	200	1126	1034	300	395	308	422
Flow Ratio	0.09	0.40	0.04	0.22	0.34	0.03	0.11	0.04	0.04	0.04
v/c Ratio	0.15	0.62	0.07	0.34	0.53	0.05	0.47	0.16	0.18	0.16
Grn Ratio	0.64	0.64	0.64	0.64	0.64	0.64	0.24	0.24	0.24	0.24
I Factor		1.000			1.000			1.000		1.000
AT or PVG	3	3	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	0.4	11.2	0.7	0.9	9.1	0.6	3.4	1.4	1.2	1.5
kB	0.4	1.3	1.2	0.4	1.3	1.3	0.4	0.4	0.4	0.4
Q2	0.1	2.1	0.1	0.2	1.5	0.1	0.3	0.1	0.1	0.1
Q Average	0.5	13.3	0.8	1.1	10.6	0.6	3.7	1.5	1.3	1.6
Q Spacing	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Q Storage	0	0	0	0	0	0	0	0	0	0
Q S Ratio										
70th Percentile Output:										
fB%	1.3	1.2	1.3	1.3	1.2	1.3	1.2	1.2	1.2	1.2
BOQ	0.6	16.0	1.0	1.4	12.9	0.8	4.4	1.7	1.6	1.9
QSRatio										
85th Percentile Output:										
fB%	1.7	1.4	1.7	1.4	1.7	1.4	1.6	1.6	1.6	1.6
BOQ	0.8	18.8	1.2	1.8	15.3	1.0	5.8	2.3	2.1	2.5
QSRatio										
90th Percentile Output:										
fB%	2.0	1.5	1.9	1.9	1.6	1.9	1.7	1.8	1.8	1.8
BOQ	0.9	20.4	1.5	2.1	16.6	1.2	6.4	2.6	2.3	2.7
QSRatio										
95th Percentile Output:										
fB%	2.5	1.7	2.5	2.4	1.7	2.5	2.0	2.1	2.1	2.1
BOQ	1.1	22.1	1.9	2.6	18.3	1.6	7.4	3.0	2.7	3.2
QSRatio										
98th Percentile Output:										
fB%	3.1	1.8	3.0	2.9	1.9	3.0	2.5	2.6	2.6	2.6
BOQ	1.4	23.9	2.3	3.2	20.0	1.9	9.1	3.8	3.4	4.0
QSRatio										

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: a.liu
Agency: URS Canada Inc.
Date: 12/9/2004
Period: AM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Finch Avenue

Inter.: Finch Avenue / CNR Service Rd
Area Type: All other areas
Jurisd: City of Toronto
Year: Existing Conditions
N/S St: CNR Service Rd

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	0	1	2	0	1	1	0	1	1	0
LGConfig	L	TR		L	TR		L	TR		L	TR	
Volume	13	1486	43	78	1136	8	28	0	20	4	1	11
Lane Width	3.6	3.6		3.6	3.6		3.6	3.6		3.6	3.6	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left		P	P		NB Left	A		
Thru		P	P		Thru	A		
Right		P	P		Right	A		
Peds					Peds			
WB Left			P		SB Left	A		
Thru			P		Thru	A		
Right			P		Right	A		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green		6.0	61.0		8.0			
Yellow		3.0	4.0		3.0			
All Red		0.0	2.0		3.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/c	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	210	1015	0.06	0.78	4.1	A		
TR	2536	3261	0.62	0.78	5.4	A	5.4	A
Westbound								
L	199	293	0.40	0.68	12.4	B		
TR	2220	3275	0.53	0.68	8.2	A	8.4	A
Northbound								
L	122	1370	0.24	0.09	39.2	D		
TR	130	1468	0.15	0.09	38.4	D	38.9	D
Southbound								
L	80	707	0.05	0.09	37.8	D		
TR	80	898	0.15	0.09	38.7	D	38.5	D

Intersection Delay = 7.4 (sec/veh) Intersection LOS = A

HCS2000: Signalized Intersections Release 4.1e

Phone: Fax:
E-Mail:

OPERATIONAL ANALYSIS

Analyst: a.liu
Intersection: Finch Avenue / CNR Service Rd
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: AM Peak Hour
Analysis Year: Existing Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Finch Avenue
North/South Street: CNR Service Rd

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	13	1486	43	78	1136	8	28	0	20	4	1	11
% Heavy Veh	77	10	7	3	10	63	4	0	10	100	0	90
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	4	379	11	20	290	2	7	0	5	1	1	3
Hi Ln Vol												
% Grade		1			0			0			0	
Ideal Sat	1900	1900		1900	1900		1900	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	2	0	1	2	0	1	1	0	1	1	0
LGConfig	L	TR		L	TR		L	TR		L	TR	
Lane Width	3.6	3.6		3.6	3.6		3.6	3.6		3.6	3.6	
RTOR Vol			0			0			0			0
Adj Flow	13	1560		80	1167		29	20		4	12	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs	0.028			0.007			1.000			0.917		
Peds Bikes	0			0			0			0		
Buses	0	0		0	0		0	0		0	0	
%InProtPhase	0.0											

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Arriv. Type	3	3		3	3		3	3		3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Ext of g	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left		P	P		NB Left	A		
Thru		P	P		Thru	A		
Right		P	P		Right	A		
Peds					Peds			
WB Left			P		SB Left	A		
Thru			P		Thru	A		
Right			P		Right	A		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			

Green		6.0	61.0		8.0			
Yellow		3.0	4.0		3.0			
All Red		0.0	2.0		3.0			

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	13	1486	43	78	1136	8	28	0	20	4	1	11
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	13	1516	44	80	1159	8	29	0	20	4	1	11
No. Lanes	1	2	0	1	2	0	1	1	0	1	1	0
Lane group	L	TR		L	TR		L	TR		L	TR	
Adj flow	13	1560		80	1167		29	20		4	12	
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs	0.028			0.007			1.000			0.917		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	TR		L	TR		L	TR		L	TR	
So	1900	1900		1900	1900		1900	1900		1900	1900	
Lanes	1	2	0	1	2	0	1	1	0	1	1	0
fW	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fHV	0.565	0.910		0.971	0.906		0.962	0.909		0.500	0.548	
fG	0.995	0.995		1.000	1.000		1.000	1.000		1.000	1.000	
fP	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fBB	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fA	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fLU	1.000	0.952		1.000	0.952		1.000	1.000		1.000	1.000	
fRT		0.996			0.999			0.850			0.863	
fLT	0.950	1.000		0.159	1.000		0.750	1.000		0.744	1.000	
Sec.	0.186											
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000			1.000			1.000			1.000	
S	1015	3261		293	3275		1370	1468		707	898	
Sec.	199											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		13	1015	0.01	0.067	68	0.19
Perm		0	199	0.00	0.711	142	0.00
Left	L	13			0.78	210	0.06
Prot							
Perm							
Thru	TR	1560	3261	# 0.48	0.78	2536	0.62
Right							
Westbound							
Prot							
Perm							
Left	L	80	293	0.27	0.68	199	0.40
Prot							
Perm							
Thru	TR	1167	3275	0.36	0.68	2220	0.53
Right							
Northbound							
Prot							
Perm							
Left	L	29	1370	# 0.02	0.09	122	0.24
Prot							
Perm							
Thru	TR	20	1468	0.01	0.09	130	0.15
Right							
Southbound							
Prot							
Perm							
Left	L	4	707	0.01	0.09	80	0.05
Prot							
Perm							
Thru	TR	12	898	0.01	0.09	80	0.15
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.50
Total lost time per cycle, L = 12.00 Sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.58

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.06	0.78	3.6	1.000	210	0.50	0.6	0.0	4.1	A		
TR	0.62	0.78	4.3	1.000	2536	0.50	1.1	0.0	5.4	A	5.4	A
Westbound												
L	0.40	0.68	6.4	1.000	199	0.50	5.9	0.0	12.4	B		
TR	0.53	0.68	7.3	1.000	2220	0.50	0.9	0.0	8.2	A	8.4	A
Northbound												
L	0.24	0.09	38.2	1.000	122	0.11	1.0	0.0	39.2	D		
TR	0.15	0.09	37.9	1.000	130	0.11	0.6	0.0	38.4	D	38.9	D
Southbound												
L	0.05	0.09	37.5	1.000	80	0.11	0.3	0.0	37.8	D		
TR	0.15	0.09	37.9	1.000	80	0.11	0.9	0.0	38.7	D	38.5	D

Intersection Delay = 7.4 (sec/veh) Intersection LOS = A

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C: 90.0 sec				
Total actual green time for LT lane group, G (s)	70.0	61.0	8.0	8.0
Effective permitted green time for LT lane group, g(s)	64.0	61.0	8.0	8.0
Opposing effective green time, go (s)	61.0	70.0	8.0	8.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	2	2	1	1
Adjusted LT flow rate, VLT (veh/h)	13	80	29	4
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	1167	1560	12	20
Lost time for LT lane group, tL	6.00	6.00	6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.33	2.00	0.73	0.10
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	15.32	20.48	0.30	0.50
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.32	0.22	0.91	0.91
gdiff=max(gq-gf,0) (see Exhibit C16-4,5,6,7,8)	14.97	1.71	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	49.03	59.29	8.00	8.00
n=Max(gq-gf)/2,0)	7.49	0.85	0.00	0.00
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	4.11	6.11	1.33	1.34
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06	0.07	0.50	0.50
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.19	0.16	0.75	0.74
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.186	0.159	0.750	0.744

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C: 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C: 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	13			
v/c ratio from Capacity Worksheet, X	0.06			
Protected phase effective green interval, g (s)	6.0			
Opposing queue effective green interval, gq	14.97			
Unopposed green interval, gu	49.03			
Red time r=(C-g-gq-gu)	20.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.00			
Protected ph. departure rate, Sp=s/3600	0.282			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.07			
XPerm	0.07			
XProt	0.06			
Case	1			
Queue at beginning of green arrow, Qa	0.07			
Queue at beginning of unsaturated green, Qu	0.05			
Residual queue, Qr	0.00			
Uniform Delay, d1	3.6			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 7.4 sec/veh Intersection LOS A

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound L	Eastbound TR	Westbound L	Westbound TR	Northbound L	Northbound TR	Southbound L	Southbound TR
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	13	819	80	612	29	20	4	12
So	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	2 0	1	2 0	1	1 0	1	1 0
SL	269	1712	293	1720	1370	1468	707	898
LnCapacity	210	1331	199	1165	122	130	80	80
Flow Ratio	0.05	0.48	0.27	0.36	0.02	0.01	0.01	0.01
v/c Ratio	0.06	0.62	0.40	0.53	0.24	0.15	0.05	0.15
Grn Ratio	0.78	0.78	0.68	0.68	0.09	0.09	0.09	0.09
I Factor		1.000		1.000		1.000		1.000
AT or PVG	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	0.1	8.7	0.9	7.7	0.7	0.5	0.1	0.3
kB	0.4	1.4	0.4	1.3	0.2	0.2	0.1	0.2
Q2	0.0	2.2	0.2	1.4	0.1	0.0	0.0	0.0
Q Average	0.1	10.9	1.1	9.0	0.7	0.5	0.1	0.3
Q Spacing	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Q Storage	0	0	0	0	0	0	0	0
Q S Ratio								
70th Percentile Output:								
fB%	1.3	1.2	1.3	1.2	1.2	1.2	1.2	1.2
BOQ	0.1	13.2	1.4	11.0	0.9	0.6	0.1	0.4
QSRatio								
85th Percentile Output:								
fB%	1.7	1.4	1.6	1.4	1.6	1.6	1.6	1.6
BOQ	0.2	15.6	1.9	13.1	1.2	0.8	0.2	0.5
QSRatio								
90th Percentile Output:								
fB%	2.0	1.6	1.9	1.6	1.8	1.8	1.8	1.8
BOQ	0.2	16.9	2.1	14.3	1.3	0.9	0.2	0.5
QSRatio								
95th Percentile Output:								
fB%	2.6	1.7	2.4	1.8	2.1	2.1	2.1	2.1
BOQ	0.3	18.7	2.7	15.9	1.5	1.0	0.2	0.6
QSRatio								
98th Percentile Output:								
fB%	3.2	1.9	2.9	1.9	2.6	2.7	2.7	2.7
BOQ	0.3	20.4	3.3	17.6	1.9	1.3	0.3	0.8
QSRatio								

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: a.liu
Agency: URS Canada Inc.
Date: 12/9/2004
Period: PM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Finch Avenue

Inter.: Finch Avenue / CNR Service Rd
Area Type: All other areas
Jurisd: City of Toronto
Year: Existing Conditions
N/S St: CNR Service Rd

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	0	1	2	0	1	1	0	1	1	0
LGConfig	L	TR		L	TR		L	TR		L	TR	
Volume	2	1397	40	39	1605	4	68	0	55	10	0	10
Lane Width	3.6	3.6		3.6	3.6		3.6	3.6		3.6	3.6	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB	Left		P					
	Thru		P					
	Right		P					
	Peds							
WB	Left		P					
	Thru		P					
	Right		P					
	Peds							
NB	Right							
SB	Right							
Green		80.0			8.0			
Yellow		4.0			3.0			
All Red		2.0			3.0			

Cycle Length: 100.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	128	160	0.02	0.80	2.2	A		
TR	2729	3411	0.54	0.80	4.3	A	4.3	A
Westbound								
L	225	281	0.18	0.80	4.1	A		
TR	2725	3406	0.60	0.80	4.9	A	4.8	A
Northbound								
L	111	1385	0.62	0.08	54.8	D		
TR	123	1538	0.46	0.08	46.6	D	51.1	D
Southbound								
L	72	856	0.14	0.08	43.7	D		
TR	99	1242	0.10	0.08	43.1	D	43.4	D

Intersection Delay = 6.6 (sec/veh) Intersection LOS = A

HCS2000: Signalized Intersections Release 4.1e

Phone: Fax:
E-Mail:

OPERATIONAL ANALYSIS

Analyst: a.liu
Intersection: Finch Avenue / CNR Service Rd
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: PM Peak Hour
Analysis Year: Existing Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Finch Avenue
North/South Street: CNR Service Rd

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	2	1397	40	39	1605	4	68	0	55	10	0	10
% Heavy Veh	50	5	8	8	6	75	3	0	5	60	0	30
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	1	356	10	10	409	1	17	0	14	3	0	3
Hi Ln Vol												
% Grade		1			0			0			0	
Ideal Sat	1900	1900		1900	1900		1900	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	2	0	1	2	0	1	1	0	1	1	0
LGConfig	L	TR		L	TR		L	TR		L	TR	
Lane Width	3.6	3.6		3.6	3.6		3.6	3.6		3.6	3.6	
RTOR Vol			0			0			0			0
Adj Flow	2	1467		40	1642		69	56		10	10	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.028			0.002			1.000			1.000	
Peds Bikes	0			0			0			0		
Buses	0	0		0	0		0	0		0	0	
%InProtPhase												

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Arriv. Type	3	3		3	3		3	3		3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Ext of g	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB	Left		P		NB	Left	A	
	Thru		P			Thru	A	
	Right		P			Right	A	
	Peds					Peds		
WB	Left		P		SB	Left	A	
	Thru		P			Thru	A	
	Right		P			Right	A	
	Peds					Peds		
NB	Right				EB	Right		
SB	Right				WB	Right		

Green	80.0		8.0	
Yellow	4.0		3.0	
All Red	2.0		3.0	

Cycle Length: 100.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	2	1397	40	39	1605	4	68	0	55	10	0	10
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	2	1426	41	40	1638	4	69	0	56	10	0	10
No. Lanes	1	2	0	1	2	0	1	1	0	1	1	0
Lane group	L	TR		L	TR		L	TR		L	TR	
Adj flow	2	1467		40	1642		69	56		10	10	
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.028			0.002			1.000			1.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	TR		L	TR		L	TR		L	TR	
So	1900	1900		1900	1900		1900	1900		1900	1900	
Lanes	1	2	0	1	2	0	1	1	0	1	1	0
fW	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fHV	0.667	0.952		0.926	0.942		0.971	0.952		0.625	0.769	
fG	0.995	0.995		1.000	1.000		1.000	1.000		1.000	1.000	
fP	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fBB	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fA	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fLU	1.000	0.952		1.000	0.952		1.000	1.000		1.000	1.000	
fRT		0.996			1.000			0.850			0.850	
fLT	0.127	1.000		0.160	1.000		0.751	1.000		0.720	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000			1.000			1.000			1.000	
S	160	3411		281	3406		1385	1538		856	1242	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	2	160	0.01	0.80	128	0.02
Prot							
Perm							
Thru	TR	1467	3411	0.43	0.80	2729	0.54
Right							
Westbound							
Prot							
Perm							
Left	L	40	281	0.14	0.80	225	0.18
Prot							
Perm							
Thru	TR	1642	3406	# 0.48	0.80	2725	0.60
Right							
Northbound							
Prot							
Perm							
Left	L	69	1385	# 0.05	0.08	111	0.62
Prot							
Perm							
Thru	TR	56	1538	0.04	0.08	123	0.46
Right							
Southbound							
Prot							
Perm							
Left	L	10	856	0.01	0.08	72	0.14
Prot							
Perm							
Thru	TR	10	1242	0.01	0.08	99	0.10
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.53
Total lost time per cycle, L = 12.00 Sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.60

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.02	0.80	2.0	1.000	128	0.50	0.2	0.0	2.2	A		
TR	0.54	0.80	3.5	1.000	2729	0.50	0.8	0.0	4.3	A	4.3	A
Westbound												
L	0.18	0.80	2.3	1.000	225	0.50	1.7	0.0	4.1	A		
TR	0.60	0.80	3.9	1.000	2725	0.50	1.0	0.0	4.9	A	4.8	A
Northbound												
L	0.62	0.08	44.5	1.000	111	0.20	10.3	0.0	54.8	D		
TR	0.46	0.08	43.9	1.000	123	0.11	2.7	0.0	46.6	D	51.1	D
Southbound												
L	0.14	0.08	42.8	1.000	72	0.11	0.9	0.0	43.7	D		
TR	0.10	0.08	42.7	1.000	99	0.11	0.4	0.0	43.1	D	43.4	D

Intersection Delay = 6.6 (sec/veh) Intersection LOS = A

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)	80.0	80.0	8.0	8.0
Effective permitted green time for LT lane group, g(s)	80.0	80.0	8.0	8.0
Opposing effective green time, go (s)	80.0	80.0	8.0	8.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	2	2	1	1
Adjusted LT flow rate, VLT (veh/h)	2	40	69	10
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	1642	1467	10	56
Lost time for LT lane group, tL	6.00	6.00	6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.06	1.11	1.92	0.28
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	23.96	21.40	0.28	1.56
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.20	0.20	0.92	0.92
gq, (see Exhibit C16-4,5,6,7,8)	12.40	8.97	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	67.60	71.03	8.00	8.00
n=Max(gq-gf)/2,0)	6.20	4.48	0.00	0.00
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	6.64	5.56	1.33	1.39
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.05	0.05	0.50	0.50
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.13	0.16	0.75	0.72
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.127	0.160	0.751	0.720

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 100.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time r=(C-g-gq-gu)				
Arrival rate, qa=v/(3600(max[X,1.0]))				
Protected ph. departure rate, Sp=s/3600				
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 6.6 sec/veh Intersection LOS A

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound L	Eastbound TR	Westbound L	Westbound TR	Northbound L	Northbound TR	Southbound L	Southbound TR
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	2	770	40	862	69	56	10	10
So	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	2 0	1	2 0	1	1 0	1	1 0
SL	160	1791	281	1788	1385	1538	856	1242
LnCapacity	128	1433	225	1431	111	123	72	99
Flow Ratio	0.01	0.43	0.14	0.48	0.05	0.04	0.01	0.01
v/c Ratio	0.02	0.54	0.18	0.60	0.62	0.46	0.14	0.10
Grn Ratio	0.80	0.80	0.80	0.80	0.08	0.08	0.08	0.08
I Factor		1.000		1.000		1.000		1.000
AT or PVG	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	0.0	7.5	0.3	9.2	1.9	1.5	0.3	0.3
kB	0.3	1.6	0.4	1.6	0.2	0.2	0.1	0.2
Q2	0.0	1.8	0.1	2.3	0.3	0.2	0.0	0.0
Q Average	0.0	9.3	0.4	11.6	2.2	1.7	0.3	0.3
Q Spacing	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Q Storage	0	0	0	0	0	0	0	0
Q S Ratio								
70th Percentile Output:								
fB%	1.3	1.2	1.3	1.2	1.2	1.2	1.2	1.2
BOQ	0.0	11.3	0.5	14.0	2.6	2.0	0.3	0.3
QSRatio								
85th Percentile Output:								
fB%	1.7	1.4	1.7	1.4	1.6	1.6	1.6	1.6
BOQ	0.0	13.5	0.6	16.5	3.4	2.6	0.5	0.4
QSRatio								
90th Percentile Output:								
fB%	2.0	1.6	2.0	1.5	1.8	1.8	1.8	1.8
BOQ	0.0	14.7	0.7	17.9	3.8	2.9	0.5	0.5
QSRatio								
95th Percentile Output:								
fB%	2.6	1.8	2.5	1.7	2.0	2.0	2.1	2.1
BOQ	0.0	16.3	0.9	19.6	4.4	3.4	0.6	0.6
QSRatio								
98th Percentile Output:								
fB%	3.2	1.9	3.1	1.8	2.5	2.6	2.7	2.7
BOQ	0.1	18.0	1.1	21.4	5.5	4.3	0.8	0.7
QSRatio								

ERROR MESSAGES

No errors to report.

APPENDIX C

INTERSECTION ANALYSES

FUTURE BACKGROUND TRAFFIC

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: AM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Murray Ross Pkwy

Inter.: Keele St / Murray Ross Pkwy
Area Type: All other areas
Jurisd: City of Toronto
Year: Future Background Conditions
N/S St: Keele St

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	1	1	1	0	1	2	0	1	2	1
LGConfig	L	T	R	L	TR		L	TR		L	T	R
Volume	146	3	14	9	0	11	24	1034	8	11	1124	71
Lane Width	3.6	3.6	3.6	3.6	3.6		3.6	3.6		3.6	3.6	3.6
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	P				NB Left	P			
Thru	P				Thru	P			
Right	P				Right	P			
Peds					Peds				
WB Left	P				SB Left	P			
Thru	P				Thru	P			
Right	P				Right	P			
Peds									
NB Right					EB Right				
SB Right					WB Right				
Green	28.0				49.0				
Yellow	4.0				4.0				
All Red	3.0				2.0				

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound								
L	444	1426	0.34	0.31	25.9	C		
T	445	1429	0.01	0.31	21.4	C	25.4	C
R	502	1615	0.03	0.31	21.6	C		
Westbound								
L	236	760	0.04	0.31	21.9	C		
TR	276	887	0.04	0.31	21.9	C	21.9	C
Northbound								
L	173	318	0.14	0.54	11.8	B		
TR	1813	3330	0.59	0.54	15.1	B	15.0	B
Southbound								
L	120	221	0.09	0.54	11.3	B		
T	1824	3350	0.63	0.54	15.9	B	15.5	B
R	879	1615	0.08	0.54	10.0-	A		

Intersection Delay = 16.0 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

Phone: Fax:
E-Mail:

OPERATIONAL ANALYSIS

Analyst: NA
Intersection: Keele St / Murray Ross Pkwy
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: AM Peak Hour
Analysis Year: Future Background Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Murray Ross Pkwy
North/South Street: Keele St

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	146	3	14	9	0	11	24	1034	8	11	1124	71
% Heavy Veh	0	33	0	89	0	82	4	8	75	73	8	0
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	37	1	4	3	0	3	6	264	2	3	287	18
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900	1900	1900	1900		1900	1900		1900	1900	1900
ParkExist												
NumPark												
No. Lanes	1	1	1	1	1	0	1	2	0	1	2	1
LGConfig	L	T	R	L	TR		L	TR		L	T	R
Lane Width	3.6	3.6	3.6	3.6	3.6		3.6	3.6		3.6	3.6	3.6
RTOR Vol			0			0			0			0
Adj Flow	149	3	14	9	11		24	1063		11	1147	72
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		1.000			0.008			0.000	1.000
Peds		0			0			0			0	
Buses	0	0	0	0	0		0	0		0	0	0
%InProtPhase												

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	0.0
Arriv. Type	3	3	3	3	3		3	3		3	3	3
Unit Ext.	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	2.0
Ext of g	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	2.0
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	P				NB Left	P			
Thru	P				Thru	P			
Right	P				Right	P			
Peds					Peds				
WB Left	P				SB Left	P			
Thru	P				Thru	P			
Right	P				Right	P			
Peds									
NB Right					EB Right				
SB Right					WB Right				
Green	28.0				49.0				
Yellow	4.0				4.0				
All Red	3.0				2.0				

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	146	3	14	9	0	11	24	1034	8	11	1124	71
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	149	3	14	9	0	11	24	1055	8	11	1147	72
No. Lanes	1	1	1	1	1	0	1	2	0	1	2	1
Lane group	L	T	R	L	TR		L	TR		L	T	R
Adj flow	149	3	14	9	11		24	1063		11	1147	72
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		1.000			0.008			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	T	R	L	TR		L	TR		L	T	R
So	1900	1900	1900	1900	1900		1900	1900		1900	1900	1900
Lanes	1	1	1	1	1	0	1	2	0	1	2	1
fW	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	1.000
fHV	1.000	0.752	1.000	0.529	0.549		0.962	0.922		0.578	0.926	1.000
fG	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	1.000
fA	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	1.000
fLU	1.000	1.000	1.000	1.000	1.000		1.000	0.952		1.000	0.952	1.000
fRT		1.000	0.850		0.850			0.999			1.000	0.850
fLT	0.750	1.000		0.756	1.000		0.174	1.000		0.201	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000	1.000		1.000			1.000			1.000	1.000
S	1426	1429	1615	760	887		318	3330		221	3350	1615
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	149	1426	# 0.10	0.31	444	0.34
Prot							
Perm							
Thru	T	3	1429	0.00	0.31	445	0.01
Right	R	14	1615	0.01	0.31	502	0.03
Westbound							
Prot							
Perm							
Left	L	9	760	0.01	0.31	236	0.04
Prot							
Perm							
Thru	TR	11	887	0.01	0.31	276	0.04
Right							
Northbound							
Prot							
Perm							
Left	L	24	318	0.08	0.54	173	0.14
Prot							
Perm							
Thru	TR	1063	3330	0.32	0.54	1813	0.59
Right							
Southbound							
Prot							
Perm							
Left	L	11	221	0.05	0.54	120	0.09
Prot							
Perm							
Thru	T	1147	3350	# 0.34	0.54	1824	0.63
Right	R	72	1615	0.04	0.54	879	0.08

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.45
Total lost time per cycle, L = 13.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.52

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.34	0.31	23.8	1.000	444	0.50	2.0	0.0	25.9	C		
T	0.01	0.31	21.4	1.000	445	0.50	0.0	0.0	21.4	C	25.4	C
R	0.03	0.31	21.5	1.000	502	0.50	0.1	0.0	21.6	C		
Westbound												
L	0.04	0.31	21.6	1.000	236	0.50	0.3	0.0	21.9	C		
TR	0.04	0.31	21.6	1.000	276	0.50	0.3	0.0	21.9	C	21.9	C
Northbound												
L	0.14	0.54	10.1	1.000	173	0.50	1.7	0.0	11.8	B		
TR	0.59	0.54	13.7	1.000	1813	0.50	1.4	0.0	15.1	B	15.0	B
Southbound												
L	0.09	0.54	9.8	1.000	120	0.50	1.5	0.0	11.3	B		
T	0.63	0.54	14.2	1.000	1824	0.50	1.7	0.0	15.9	B	15.5	B
R	0.08	0.54	9.8	1.000	879	0.50	0.2	0.0	10.0-	A		

Intersection Delay = 16.0 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	28.0	28.0	49.0	49.0
Effective permitted green time for LT lane group, g(s)	28.0	28.0	49.0	49.0
Opposing effective green time, go (s)	28.0	28.0	49.0	49.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	1	1	2	2
Adjusted LT flow rate, VLT (veh/h)	149	9	24	11
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	11	3	1147	1063
Lost time for LT lane group, tL	7.00	7.00	6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600	3.73	0.23	0.60	0.28
Opposing lane util. factor, fLUo	1.000	1.000	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.28	0.08	15.06	13.96
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.69	0.69	0.46	0.46
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	14.62	12.43
gu=g-gq if gq>=gf, or = g-gf if gq<gf	28.00	28.00	34.38	36.57
n=Max(gq-gf)/2,0)	0.00	0.00	7.31	6.22
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	1.33	1.32	4.03	3.71
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.14	0.14	0.08	0.08
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.75	0.76	0.17	0.20
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.750	0.756	0.174	0.201

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time r=(C-g-gq-gu)				
Arrival rate, qa=v/(3600(max[X,1.0]))				
Protected ph. departure rate, Sp=s/3600				
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Uniform Delay Unmet Demand t hrs.	Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 16.0 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound L	T	R	Westbound L	TR	Northbound L	TR	Southbound L	T	R
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	149	3	14	9	11	24	558	11	602	72
So	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	1	1	1	1 0	1	2 0	1	2	1
SL	1426	1429	1615	760	887	318	1748	221	1759	1615
LnCapacity	444	445	502	236	276	173	952	120	957	879
Flow Ratio	0.10	0.00	0.01	0.01	0.01	0.08	0.32	0.05	0.34	0.04
v/c Ratio	0.34	0.01	0.03	0.04	0.04	0.14	0.59	0.09	0.63	0.08
Grn Ratio	0.31	0.31	0.31	0.31	0.31	0.54	0.54	0.54	0.54	0.54
I Factor		1.000			1.000		1.000		1.000	
AT or PVG	3	3	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	2.9	0.1	0.2	0.2	0.2	0.3	9.3	0.1	10.4	0.9
kB	0.6	0.6	0.7	0.4	0.5	0.3	1.1	0.3	1.1	1.0
Q2	0.3	0.0	0.0	0.0	0.0	0.1	1.5	0.0	1.8	0.1
Q Average	3.2	0.1	0.3	0.2	0.2	0.3	10.8	0.2	12.2	1.0
Q Spacing	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Q Storage	0	0	0	0	0	0	0	0	0	0
Q S Ratio										
70th Percentile Output:										
f8%	1.3	1.3	1.3	1.3	1.3	1.3	1.2	1.3	1.2	1.3
BOQ	4.0	0.1	0.3	0.2	0.3	0.5	13.1	0.2	14.8	1.2
QSRatio										
85th Percentile Output:										
f8%	1.6	1.7	1.7	1.7	1.7	1.7	1.4	1.7	1.4	1.6
BOQ	5.0	0.1	0.4	0.3	0.4	0.6	15.6	0.3	17.4	1.6
QSRatio										
90th Percentile Output:										
f8%	1.8	2.0	2.0	2.0	2.0	2.0	1.6	2.0	1.5	1.9
BOQ	5.6	0.1	0.5	0.3	0.4	0.7	16.9	0.3	18.9	1.8
QSRatio										
95th Percentile Output:										
f8%	2.1	2.6	2.5	2.6	2.6	2.5	1.7	2.6	1.7	2.4
BOQ	6.8	0.1	0.7	0.4	0.5	0.9	18.6	0.4	20.6	2.3
QSRatio										
98th Percentile Output:										
f8%	2.5	3.2	3.1	3.1	3.1	3.1	1.9	3.2	1.8	2.9
BOQ	7.9	0.2	0.8	0.5	0.7	1.1	20.3	0.5	22.4	2.8
QSRatio										

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: AM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Four Winds Drive

Inter.: Keele St / Four Winds Drive
Area Type: All other areas
Jurisd: City of Toronto
Year: Future Background Conditions
N/S St: Keele St

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	1	1	1	0	1	2	0	1	2	1
LGConfig	L	T	R	L	TR		L	TR		L	T	R
Volume	33	0	103	0	0	10	57	1395	0	0	1118	26
Lane Width	3.6	3.6	3.6	3.6	3.6		3.6	3.6		3.6	3.6	3.6
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	P				NB Left	P			
Thru	P				Thru	P			
Right	P				Right	P			
Peds					Peds				
WB Left	P				SB Left	P			
Thru	P				Thru	P			
Right	P				Right	P			
Peds									
NB Right					EB Right				
SB Right					WB Right				
Green	24.0					53.0			
Yellow	4.0					4.0			
All Red	3.0					2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay LOS		Approach Delay LOS	
Eastbound								
L	381	1427	0.09	0.27	25.3	C		
T	381	1429	0.00	0.27	24.2	C	26.7	C
R	431	1615	0.24	0.27	27.2	C		
Westbound								
L	80	168	0.00	0.27	24.2	C		
TR	237	887	0.04	0.27	24.8	C	24.8	C
Northbound								
L	206	349	0.28	0.59	12.5	B		
TR	1973	3350	0.72	0.59	15.5	B	15.4	B
Southbound								
L	80	128	0.00	0.59	7.6	A		
T	1973	3350	0.58	0.59	12.8	B	12.7	B
R	951	1615	0.03	0.59	7.8	A		

Intersection Delay = 14.9 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: NA
Intersection: Keele St / Four Winds Drive
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: AM Peak Hour
Analysis Year: Future Background Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Four Winds Drive
North/South Street: Keele St

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	33	0	103	0	0	10	57	1395	0	0	1118	26
% Heavy Veh	0	33	0	89	0	82	4	8	75	73	8	0
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	9	0	26	0	0	3	15	356	0	0	285	7
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900	1900	1900	1900		1900	1900		1900	1900	1900
ParkExist												
NumPark												
No. Lanes	1	1	1	1	1	0	1	2	0	1	2	1
LGConfig	L	T	R	L	TR		L	TR		L	T	R
Lane Width	3.6	3.6	3.6	3.6	3.6		3.6	3.6		3.6	3.6	3.6
RTOR Vol			0			0			0			0
Adj Flow	34	0	105	0	10		58	1423		0	1141	27
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		1.000			0.000			0.000	1.000
Peds		0			0			0			0	
Buses	0	0	0	0	0		0	0		0	0	0
%InProtPhase												

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	0.0
Arriv. Type	3	3	3	3	3		3	3		3	3	3
Unit Ext.	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	2.0
Ext of g	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	2.0
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	P				NB Left	P			
Thru	P				Thru	P			
Right	P				Right	P			
Peds					Peds				
WB Left	P				SB Left	P			
Thru	P				Thru	P			
Right	P				Right	P			
Peds									
NB Right					EB Right				

SB Right			WB Right	
Green	24.0			53.0
Yellow	4.0			4.0
All Red	3.0			2.0

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	33	0	103	0	0	10	57	1395	0	0	1118	26
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	34	0	105	0	0	10	58	1423	0	0	1141	27
No. Lanes	1	1	1	1	1	0	1	2	0	1	2	1
Lane group	L	T	R	L	TR		L	TR		L	T	R
Adj flow	34	0	105	0	10		58	1423		0	1141	27
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		1.000			0.000			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	T	R	L	TR		L	TR		L	T	R
So	1900	1900	1900	1900	1900		1900	1900		1900	1900	1900
Lanes	1	1	1	1	1	0	1	2	0	1	2	1
fW	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	1.000
fHV	1.000	0.752	1.000	0.529	0.549		0.962	0.926		0.578	0.926	1.000
fG	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	1.000
fA	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	1.000
fLU	1.000	1.000	1.000	1.000	1.000		1.000	0.952		1.000	0.952	1.000
fRT		1.000	0.850		0.850			1.000			1.000	0.850
fLT	0.751	1.000		0.167	1.000		0.191	1.000		0.116	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000	1.000		1.000			1.000			1.000	1.000
S	1427	1429	1615	168	887		349	3350		128	3350	1615
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	34	1427	0.02	0.27	381	0.09
Prot							
Perm							
Thru	T	0	1429	0.00	0.27	381	0.00
Right	R	105	1615	# 0.07	0.27	431	0.24
Westbound							
Prot							
Perm							
Left	L	0	168	0.00	0.27	80	0.00
Prot							
Perm							
Thru	TR	10	887	0.01	0.27	237	0.04
Right							
Northbound							
Prot							
Perm							
Left	L	58	349	0.17	0.59	206	0.28
Prot							
Perm							
Thru	TR	1423	3350	# 0.42	0.59	1973	0.72
Right							
Southbound							
Prot							
Perm							
Left	L	0	128	0.00	0.59	80	0.00
Prot							
Perm							
Thru	T	1141	3350	0.34	0.59	1973	0.58
Right	R	27	1615	0.02	0.59	951	0.03

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.49
Total lost time per cycle, L = 13.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.57

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound												
L	0.09	0.27	24.8	1.000	381	0.50	0.5	0.0	25.3	C		
T	0.00	0.27	24.2	1.000	381	0.50	0.0	0.0	24.2	C	26.7	C
R	0.24	0.27	25.9	1.000	431	0.50	1.3	0.0	27.2	C		
Westbound												
L	0.00	0.27	24.2	1.000	80	0.50	0.0	0.0	24.2	C		
TR	0.04	0.27	24.5	1.000	237	0.50	0.3	0.0	24.8	C	24.8	C
Northbound												
L	0.28	0.59	9.1	1.000	206	0.50	3.4	0.0	12.5	B		
TR	0.72	0.59	13.2	1.000	1973	0.50	2.3	0.0	15.5	B	15.4	B
Southbound												
L	0.00	0.59	7.6	1.000	80	0.50	0.0	0.0	7.6	A		
T	0.58	0.59	11.5	1.000	1973	0.50	1.2	0.0	12.8	B	12.7	B
R	0.03	0.59	7.7	1.000	951	0.50	0.1	0.0	7.8	A		

Intersection Delay = 14.9 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	24.0	24.0	53.0	53.0
Effective permitted green time for LT lane group, g(s)	24.0	24.0	53.0	53.0
Opposing effective green time, go (s)	24.0	24.0	53.0	53.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	2	2	2	2
Adjusted LT flow rate, VLT (veh/h)	34	0	58	0
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	10	0	1141	1423
Lost time for LT lane group, tL	7.00	7.00	6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.85	0.00	1.45	0.00
Opposing lane util. factor, fLUo	1.000	1.000	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.25	0.00	14.98	18.68
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.73	0.73	0.41	0.41
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	12.47	20.27
gu=g-gq if gq>=gf, or = g-gf if gq<gf	24.00	24.00	40.53	32.73
n=Max(gq-gf)/2,0)	0.00	0.00	6.23	10.14
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	1.33	1440.00		4.01
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.17	0.17	0.08	0.08
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.75	0.17	0.19	0.12
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.751	0.167	0.191	0.116

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=i for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=i for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time r=(C-g-gq-gu)				
Arrival rate, qa=v/(3600(max[X,1.0]))				
Protected ph. departure rate, Sp=s/3600				
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 14.9 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	T	R	L	TR		L	TR		L	T	R
Init Queue	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	0.0
Flow Rate	34	0	105	0	10		58	747		0	599	27
So	1900	1900	1900	1900	1900		1900	1900		1900	1900	1900
No.Lanes	1	1	1	1	1	0	1	2	0	1	2	1
SL	1427	1429	1615	168	887		349	1759		128	1759	1615
LnCapacity	381	381	431	80	237		206	1036		80	1036	951
Flow Ratio	0.02	0.00	0.07	0.00	0.01		0.17	0.42		0.00	0.34	0.02
v/c Ratio	0.09	0.00	0.24	0.00	0.04		0.28	0.72		0.00	0.58	0.03
Grn Ratio	0.27	0.27	0.27	0.27	0.27		0.59	0.59		0.59	0.59	0.59
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3	3	3	3		3	3		3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Q1	0.6	0.0	2.1	0.0	0.2		0.7	13.3		0.0	9.3	0.3
kB	0.6	0.6	0.6	0.1	0.4		0.4	1.2		0.2	1.2	1.1
Q2	0.1	0.0	0.2	0.0	0.0		0.1	2.8		0.0	1.6	0.0
Q Average	0.7	0.0	2.3	0.0	0.2		0.9	16.2		0.0	10.9	0.3
Q Spacing	7.6	7.6	7.6	7.6	7.6		7.6	7.6		7.6	7.6	7.6
Q Storage	0	0	0	0	0		0	0		0	0	0
Q S Ratio												
70th Percentile Output:												
fB%	1.3	1.3	1.3	1.3	1.3		1.3	1.2		1.3	1.2	1.3
BOQ	0.9	0.0	2.9	0.0	0.3		1.1	19.4		0.0	13.2	0.4
QSRatio												
85th Percentile Output:												
fB%	1.7	1.7	1.7	1.7	1.7		1.7	1.4		1.7	1.4	1.7
BOQ	1.2	0.0	3.6	0.0	0.3		1.4	22.8		0.0	15.6	0.5
QSRatio												
90th Percentile Output:												
fB%	1.9	1.8	1.8	2.0	2.0		1.9	1.5		2.0	1.6	2.0
BOQ	1.3	0.0	4.1	0.0	0.4		1.7	24.5		0.0	17.0	0.6
QSRatio												
95th Percentile Output:												
fB%	2.5	2.6	2.2	2.6	2.6		2.4	1.6		2.6	1.7	2.5
BOQ	1.7	0.0	5.1	0.0	0.5		2.1	26.5		0.0	18.7	0.8
QSRatio												
98th Percentile Output:												
fB%	3.0	3.2	2.7	3.2	3.1		3.0	1.8		3.2	1.9	3.1
BOQ	2.1	0.0	6.0	0.0	0.6		2.6	28.4		0.0	20.4	1.0
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: AM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Finch Avenue

Inter.: Finch Avenue / Keele Street
Area Type: All other areas
Jurisd: City of Toronto
Year: Future Background Conditions
N/S St: Keele St

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	1	1	2	1	1	2	1	1	2	1
LGConfig	L	T	R	L	T	R	L	T	R	L	T	R
Volume	93	1392	156	61	892	368	169	1017	135	283	907	58
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1		2		3	4		5	6		7	8
EB	Left		P				NB	Left	P		P	
	Thru		P					Thru			P	
	Right		P					Right			P	
	Peds							Peds				
WB	Left		P				SB	Left	P		P	
	Thru		P					Thru			P	
	Right		P					Right			P	
	Peds							Peds				
NB	Right						EB	Right				
SB	Right						WB	Right				
Green		37.0						10.0	27.0			
Yellow		4.0						2.0	4.0			
All Red		2.0						2.0	2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	150	364	0.63	0.41	39.7	D		
T	1383	3364	1.03	0.41	57.8	E	53.0	D
R	617	1502	0.26	0.41	18.5	B		
Westbound								
L	81	196	0.77	0.41	72.2	E		
T	1390	3381	0.65	0.41	23.8	C	26.8	C
R	587	1429	0.64	0.41	26.5	C		
Northbound								
L	271	1719	0.63	0.46	29.3	C		
T	1034	3445	1.00	0.30	60.4	E	52.9	D
R	457	1524	0.30	0.30	25.9	C		
Southbound								
L	267	1687	1.08	0.46	102.2	F		
T	1014	3381	0.91	0.30	44.2	D	56.4	E
R	407	1357	0.14	0.30	23.8	C		

Intersection Delay = 47.5 (sec/veh) Intersection LOS = D

HCS2000: Signalized Intersections Release 4.1e

Phone: Fax:
E-Mail:

OPERATIONAL ANALYSIS

Analyst: NA
Intersection: Finch Avenue / Keele Street
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: AM Peak Hour
Analysis Year: Future Background Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Finch Avenue
North/South Street: Keele St

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	93	1392	156	61	892	368	169	1017	135	283	907	58
% Heavy Veh	5	7	7	5	7	13	5	5	6	7	7	19
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	24	355	40	16	228	94	43	259	34	72	231	15
Hi Ln Vol												
% Grade		1			0			0			0	
Ideal Sat	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
ParkExist												
NumPark												
No. Lanes	1	2	1	1	2	1	1	2	1	1	2	1
LGConfig	L	T	R	L	T	R	L	T	R	L	T	R
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
RTOR Vol			0			0			0			0
Adj Flow	95	1420	159	62	910	376	172	1038	138	289	926	59
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.000	1.000		0.000	1.000
Peds	Bikes	0			0			0			0	
Buses	0	0	0	0	0	0	0	0	0	0	0	0
%InProtPhase							0.0			0.0		

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Arriv. Type	3	3	3	3	3	3	3	3	3	3	3	3
Unit Ext.	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Ext of g	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1		2	3	4		5	6	7	8
EB	Left		P			NB	Left	P	P	
	Thru		P				Thru		P	
	Right		P				Right		P	
	Peds						Peds			
WB	Left		P			SB	Left	P	P	
	Thru		P				Thru		P	
	Right		P				Right		P	
	Peds						Peds			
NB	Right					EB	Right			
SB	Right					WB	Right			
Green		37.0					10.0	27.0		
Yellow		4.0					2.0	4.0		
All Red		2.0					2.0	2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	93	1392	156	61	892	368	169	1017	135	283	907	58
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	95	1420	159	62	910	376	172	1038	138	289	926	59
No. Lanes	1	2	1	1	2	1	1	2	1	1	2	1
Lane group	L	T	R	L	T	R	L	T	R	L	T	R
Adj flow	95	1420	159	62	910	376	172	1038	138	289	926	59
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.000	1.000		0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	T	R	L	T	R	L	T	R	L	T	R
So	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lanes	1	2	1	1	2	1	1	2	1	1	2	1
fW	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fHV	0.952	0.935	0.935	0.952	0.935	0.885	0.952	0.952	0.943	0.935	0.935	0.840
fG	0.995	0.995	0.995	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fLU	1.000	0.952	1.000	1.000	0.952	1.000	1.000	0.952	1.000	1.000	0.952	1.000
fRT		1.000	0.850		1.000	0.850		1.000	0.850		1.000	0.850
fLT	0.202	1.000		0.108	1.000		0.950	1.000		0.950	1.000	
Sec.							0.129			0.129		
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000
S	364	3364	1502	196	3381	1429	1719	3445	1524	1687	3381	1357
Sec.							233			229		

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	95	364	0.26	0.41	150	0.63
Prot							
Perm							
Thru	T	1420	3364	# 0.42	0.41	1383	1.03
Right	R	159	1502	0.11	0.41	617	0.26
Westbound							
Prot							
Perm							
Left	L	62	196	0.32	0.41	81	0.77
Prot							
Perm							
Thru	T	910	3381	0.27	0.41	1390	0.65
Right	R	376	1429	0.26	0.41	587	0.64
Northbound							
Prot		172	1719	0.10	0.111	191	0.90
Perm		0	233	0.00	0.344	80	0.00
Left	L	172			0.46	271	0.63
Prot							
Perm							
Thru	T	1038	3445	0.30	0.30	1034	1.00
Right	R	138	1524	0.09	0.30	457	0.30
Southbound							
Prot		187	1687	# 0.11	0.111	187	1.00
Perm		102	229	# 0.45	0.344	80	1.27
Left	L	289			0.46	267	1.08
Prot							
Perm							
Thru	T	926	3381	0.27	0.30	1014	0.91
Right	R	59	1357	0.04	0.30	407	0.14

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.98
Total lost time per cycle, L = 12.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.13

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.63	0.41	21.1	1.000	150	0.50	18.6	0.0	39.7	D		
T	1.03	0.41	26.5	1.000	1383	0.50	31.3	0.0	57.8	E	53.0	D
R	0.26	0.41	17.5	1.000	617	0.50	1.0	0.0	18.5	B		
Westbound												
L	0.77	0.41	22.8	1.000	81	0.50	49.4	0.0	72.2	E		
T	0.65	0.41	21.4	1.000	1390	0.50	2.4	0.0	23.8	C	26.8	C
R	0.64	0.41	21.2	1.000	587	0.50	5.3	0.0	26.5	C		
Northbound												
L	0.63	0.46	18.5	1.000	271	0.50	10.8	0.0	29.3	C		
T	1.00	0.30	31.5	1.000	1034	0.50	28.9	0.0	60.4	E	52.9	D
R	0.30	0.30	24.2	1.000	457	0.50	1.7	0.0	25.9	C		
Southbound												
L	1.08	0.46	23.5	1.000	267	0.50	78.8	0.0	102.2	F		
T	0.91	0.30	30.4	1.000	1014	0.50	13.8	0.0	44.2	D	56.4	E
R	0.14	0.30	23.1	1.000	407	0.50	0.7	0.0	23.8	C		

Intersection Delay = 47.5 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C	90.0 sec			
Total actual green time for LT lane group, G (s)	37.0	37.0	41.0	41.0
Effective permitted green time for LT lane group, g(s)	37.0	37.0	31.0	31.0
Opposing effective green time, go (s)	37.0	37.0	27.0	27.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	2	2	2	2
Adjusted LT flow rate, VLT (veh/h)	95	62	172	289
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	910	1420	926	1038
Lost time for LT lane group, tL	6.00	6.00	6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600	2.38	1.55	4.30	7.23
Opposing lane util. factor, fLUo	0.952	0.952	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	11.95	18.64	12.16	13.63
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.59	0.59	0.70	0.70
gq, (see Exhibit C16-4,5,6,7,8)	13.16	31.50	23.32	27.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	23.84	5.50	7.68	4.00
n=Max(gq-gf)/2,0)	6.58	15.75	11.66	13.50
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	3.19	5.30	3.24	3.62
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.11	0.11	0.13	0.13
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.20	0.11	0.13	0.13
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.202	0.108	0.129	0.129

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=i for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0 sec			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=i for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0 sec			
Adj. LT vol from Vol Adjustment Worksheet, v			172	289
v/c ratio from Capacity Worksheet, X			0.63	1.08
Protected phase effective green interval, g (s)			10.0	10.0
Opposing queue effective green interval, gq			23.32	27.00
Unopposed green interval, gu			7.68	4.00
Red time r=(C-g-gq-gu)			49.0	49.0
Arrival rate, qa=v/(3600(max[X,1.0]))			0.05	0.07
Protected ph. departure rate, Sp=s/3600			0.478	0.469
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)			0.26	0.49
XPerm			0.74	1.17
XProt			0.59	0.93
Case			1	3
Queue at beginning of green arrow, Qa			2.34	3.96
Queue at beginning of unsaturated green, Qu			1.11	2.00
Residual queue, Qr			0.00	0.33
Uniform Delay, d1			18.5	23.5

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Demand Unmet Demand Q veh	Initial Dur. Demand Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Demand Unmet Q veh	Initial Queue Delay d3 sec	Initial Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								

Southbound

Intersection Delay 47.5 sec/veh Intersection LOS D

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	T	R	L	T	R	L	T	R	L	T	R
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	95	745	159	62	477	376	172	545	138	289	486	59
So	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	2	1	1	2	1	1	2	1	1	2	1
SL	364	1766	1502	196	1775	1429	595	1809	1524	585	1775	1357
LnCapacity	150	726	617	81	730	587	271	543	457	267	532	407
Flow Ratio	0.26	0.42	0.11	0.32	0.27	0.26	0.29	0.30	0.09	0.49	0.27	0.04
v/c Ratio	0.63	1.03	0.26	0.77	0.65	0.64	0.63	1.00	0.30	1.08	0.91	0.14
Grn Ratio	0.41	0.41	0.41	0.41	0.41	0.41	0.46	0.30	0.30	0.46	0.30	0.30
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3	3	3	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	1.9	18.6	2.6	1.3	9.6	7.5	2.5	13.6	2.7	4.4	11.7	1.1
kB	0.3	0.9	0.8	0.2	0.9	0.8	0.5	0.7	0.7	0.5	0.7	0.6
Q2	0.5	10.5	0.3	0.5	1.6	1.3	0.8	7.2	0.3	5.6	4.4	0.1
Q Average	2.4	29.1	2.9	1.9	11.2	8.8	3.3	20.9	2.9	10.1	16.1	1.2
Q Spacing	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Q Storage	0	0	0	0	0	0	0	0	0	0	0	0
Q S Ratio												
70th Percentile Output:												
f8%	1.3	1.2	1.3	1.3	1.2	1.2	1.3	1.2	1.3	1.2	1.2	1.3
BOQ	3.0	34.9	3.6	2.4	13.6	10.8	4.1	25.1	3.7	12.2	19.4	1.5
QSRatio												
85th Percentile Output:												
f8%	1.6	1.4	1.6	1.6	1.4	1.5	1.6	1.4	1.6	1.4	1.4	1.6
BOQ	3.8	40.8	4.5	3.0	16.1	12.8	5.1	29.3	4.6	14.5	22.8	1.9
QSRatio												
90th Percentile Output:												
f8%	1.8	1.5	1.8	1.8	1.6	1.6	1.8	1.5	1.8	1.6	1.5	1.9
BOQ	4.3	43.7	5.2	3.4	17.5	14.0	5.8	31.5	5.2	15.8	24.5	2.2
QSRatio												
95th Percentile Output:												
f8%	2.2	1.6	2.2	2.3	1.7	1.8	2.1	1.6	2.2	1.7	1.6	2.4
BOQ	5.3	46.7	6.3	4.2	19.2	15.7	6.9	33.7	6.3	17.5	26.4	2.8
QSRatio												
98th Percentile Output:												
f8%	2.6	1.7	2.5	2.7	1.9	2.0	2.5	1.7	2.5	1.9	1.8	2.9
BOQ	6.3	49.6	7.4	5.1	20.9	17.3	8.1	36.0	7.4	19.1	28.4	3.4
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: AM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Toro Road

Inter.: Keele St / Toro Road
Area Type: All other areas
Jurisd: City of Toronto
Year: Future Background Conditions
N/S St: Keele St

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	1	0	1	0	2	1	1	2	0
LGConfig				L		R		T	R	L	T	
Volume				102		66		1155	181	97	1097	
Lane Width				3.6		3.6		3.6	3.6	3.6	3.6	
RTOR Vol						0			0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left				
Thru					Thru P	P			
Right					Right P	P			
Peds					Peds				
WB Left		A			SB Left		P		
Thru					Thru		P		
Right		A			Right				
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	25.0					7.0	53.0		
Yellow	3.0					3.0	4.0		
All Red	3.0					0.0	2.0		

Cycle Length: 100.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow (s)	Ratios v/c	Ratios g/C	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound								
Westbound								
L	422	1687	0.25	0.25	30.3	C		
							30.1	C
R	354	1417	0.19	0.25	29.8	C		
Northbound								
T	2170	3445	0.54	0.63	11.4	B	11.0	B
R	988	1568	0.19	0.63	8.2	A		
Southbound								
L	220	415	0.45	0.53	21.0	C		
T	1843	3478	0.61	0.53	17.8	B	18.0	B

Intersection Delay = 15.3 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: NA
Intersection: Keele St / Toro Road
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: AM Peak Hour
Analysis Year: Future Background Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Toro Road
North/South Street: Keele St

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				102		66		1155	181	97	1097	
% Heavy Veh				7		14		5	3	3	4	
PHF				0.98		0.98		0.98	0.98	0.98	0.98	
PK 15 Vol				26		17		295	46	25	280	
Hi Ln Vol												
% Grade			0					0			0	
Ideal Sat				1900		1900		1900	1900	1900	1900	
ParkExist												
NumPark												
No. Lanes	0	0	0	1	0	1	0	2	1	1	2	0
LGConfig				L		R		T	R	L	T	
Lane Width				3.6		3.6		3.6	3.6	3.6	3.6	
RTOR Vol						0			0			
Adj Flow				104		67		1179	185	99	1119	
%InSharedLn												
Prop LTs								0.000		1.000	0.000	
Prop RTs						1.000		0.000	1.000		0.000	
Peds Bikes	0				0			0				
Buses				0		0		0	0	0	0	
%InProtPhase												

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0		0.0		0.0	0.0	0.0	0.0	
Arriv. Type				3		3		3	3	3	3	
Unit Ext.				3.0		3.0		3.0	3.0	3.0	3.0	
I Factor					1.000			1.000			1.000	
Lost Time				2.0		2.0		2.0	2.0	2.0	2.0	
Ext of g				2.0		2.0		2.0	2.0	2.0	2.0	
Ped Min g		3.2			3.2			3.2				

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left				
Thru					Thru P	P			
Right					Right P	P			
Peds					Peds				
WB Left		A			SB Left		P		
Thru					Thru		P		
Right		A			Right				
Peds					Peds				
NB Right					EB Right				

SB Right					WB Right							
Green	25.0					7.0	53.0					
Yellow	3.0					3.0	4.0					
All Red	3.0					0.0	2.0					

Cycle Length: 100.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				102		66		1155	181	97	1097	
PHF				0.98		0.98		0.98	0.98	0.98	0.98	
Adj flow				104		67		1179	185	99	1119	
No. Lanes	0	0	0	1	0	1	0	2	1	1	2	0
Lane group				L		R		T	R	L	T	
Adj flow				104		67		1179	185	99	1119	
Prop LTs								0.000		1.000	0.000	
Prop RTs						1.000		0.000	1.000		0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG				L		R		T	R	L	T	
So				1900		1900		1900	1900	1900	1900	
Lanes	0	0	0	1	0	1	0	2	1	1	2	0
fW				1.000		1.000		1.000	1.000	1.000	1.000	
fHV				0.935		0.877		0.952	0.971	0.971	0.962	
fG				1.000		1.000		1.000	1.000	1.000	1.000	
fP				1.000		1.000		1.000	1.000	1.000	1.000	
fBB				1.000		1.000		1.000	1.000	1.000	1.000	
fA				1.000		1.000		1.000	1.000	1.000	1.000	
fLU				1.000		1.000		0.952	1.000	1.000	0.952	
fRT						0.850		1.000	0.850		1.000	
fLT				0.950				1.000		0.225	1.000	
Sec.												
fLpb				1.000				1.000		1.000	1.000	
fRpb						1.000		1.000	1.000		1.000	
S				1687		1417		3445	1568	415	3478	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Flow Rate (v)	Adj Flow Rate (s)	Adj Sat Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left	L	104	1687	# 0.06	0.25	422	0.25
Prot							
Perm							
Thru							
Right	R	67	1417	0.05	0.25	354	0.19
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	1179	3445	# 0.34	0.63	2170	0.54
Right	R	185	1568	0.12	0.63	988	0.19
Southbound							
Prot							
Perm							
Left	L	99	415	0.24	0.53	220	0.45
Prot							
Perm							
Thru	T	1119	3478	0.32	0.53	1843	0.61
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.40
Total lost time per cycle, L = 12.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.46

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound												
Westbound												
L	0.25	0.25	30.0	1.000	422	0.11	0.3	0.0	30.3	C		
											30.1	C
R	0.19	0.25	29.5	1.000	354	0.11	0.3	0.0	29.8	C		
Northbound												
T	0.54	0.63	10.4	1.000	2170	0.50	1.0	0.0	11.4	B	11.0	B
R	0.19	0.63	7.8	1.000	988	0.50	0.4	0.0	8.2	A		
Southbound												
L	0.45	0.53	14.5	1.000	220	0.50	6.5	0.0	21.0	C		
T	0.61	0.53	16.3	1.000	1843	0.50	1.5	0.0	17.8	B	18.0	B

Intersection Delay = 15.3 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				M
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)				53.0
Effective permitted green time for LT lane group, g(s)				53.0
Opposing effective green time, go (s)				63.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				2
Adjusted LT flow rate, VLT (veh/h)				99
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.00
Adjusted opposing flow rate, Vo (veh/h)				1179
Lost time for LT lane group, tL				6.00
Computation				
LT volume per cycle, LTC=VLTC/3600				2.75
Opposing lane util. factor, fLUo				0.952 0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				17.20
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.37
gq, (see Exhibit C16-4,5,6,7,8)				3.40
gu=g-gq if gq>=gf, or = g-gf if gq<gf				49.60
n=Max(gq-gf)/2,0)				1.70
PTHo=1-PLTo				1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				4.16
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				0.08
gdiff=max(gq-gf,0)				0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.22
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.225

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				0.000 0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
Opposing lane util. factor, fLUo				0.952 0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				4.16
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				0.08
gdiff=max(gq-gf,0)				0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.22
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 100.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time r=(C-g-gq-gu)				
Arrival rate, qa=v/(3600(max[X,1.0]))				
Protected ph. departure rate, Sp=s/3600				
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Grp	Initial Dur. Demand Q veh	Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 15.3 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound			Westbound		Northbound		Southbound	
				L	R	T	R	L	T
Init Queue				0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate				104	67	619	185	99	587
So				1900	1900	1900	1900	1900	1900
No.Lanes	0	0	0	1	1	2	1	1	2
SL				1687	1417	1809	1568	415	1826
LnCapacity				422	354	1139	988	220	967
Flow Ratio				0.06	0.05	0.34	0.12	0.24	0.32
v/c Ratio				0.25	0.19	0.54	0.19	0.45	0.61
Grn Ratio				0.25	0.25	0.63	0.63	0.53	0.53
I Factor					1.000		1.000		1.000
AT or PVG				3	3	3	3	3	3
Pltn Ratio				1.00	1.00	1.00	1.00	1.00	1.00
PF2				1.00	1.00	1.00	1.00	1.00	1.00
Q1				2.3	1.5	9.7	2.2	1.7	11.3
kB				0.4	0.4	1.3	1.2	0.4	1.2
Q2				0.1	0.1	1.6	0.3	0.3	1.8
Q Average				2.5	1.6	11.2	2.4	2.0	13.1
Q Spacing				7.6	7.6	7.6	7.6	7.6	7.6
Q Storage				0	0	0	0	0	0
Q S Ratio									
70th Percentile Output:									
f8%				1.2	1.2	1.2	1.3	1.3	1.2
BOQ				2.9	1.9	13.6	3.1	2.6	15.8
QSRatio									
85th Percentile Output:									
f8%				1.6	1.6	1.4	1.6	1.6	1.4
BOQ				3.9	2.5	16.1	3.9	3.3	18.6
QSRatio									
90th Percentile Output:									
f8%				1.8	1.8	1.6	1.8	1.8	1.5
BOQ				4.3	2.8	17.5	4.4	3.7	20.1
QSRatio									
95th Percentile Output:									
f8%				2.0	2.1	1.7	2.2	2.3	1.7
BOQ				5.0	3.2	19.2	5.4	4.6	21.9
QSRatio									
98th Percentile Output:									
f8%				2.5	2.6	1.9	2.6	2.7	1.8
BOQ				6.2	4.0	20.9	6.4	5.5	23.7
QSRatio									

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: AM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Finch Avenue

Inter.: Finch Avenue / Romfield Lane
Area Type: All other areas
Jurisd: City of Toronto
Year: Future Background Conditions
N/S St: Romfield Lane

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	1	0	2	1	1	1	0	1	1	0
LGConfig		LT	R		LT	R	L	TR		L	TR	
Volume	57	1870	12	16	1014	5	20	10	49	28	11	15
Lane Width		3.6	3.6		3.6	3.6	3.6	3.6		3.6	3.6	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB	Left	P			NB	Left	A		
	Thru	P				Thru	A		
	Right	P				Right	A		
	Peds					Peds			
WB	Left	P			SB	Left	A		
	Thru	P				Thru	A		
	Right	P				Right	A		
	Peds								
NB	Right				EB	Right			
SB	Right				WB	Right			
Green		57.0				21.0			
Yellow		4.0				3.0			
All Red		2.0				3.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
LT	1835	2898	1.07	0.63	59.6	E	59.3	E
R	1018	1607	0.01	0.63	6.1	A		
Westbound								
LT	1765	2787	0.60	0.63	11.2	B	11.2	B
R	1023	1615	0.00	0.63	6.1	A		
Northbound								
L	313	1340	0.06	0.23	26.9	C		
TR	369	1583	0.16	0.23	27.7	C	27.5	C
Southbound								
L	318	1364	0.09	0.23	27.1	C		
TR	340	1455	0.08	0.23	27.0	C	27.1	C

Intersection Delay = 41.9 (sec/veh) Intersection LOS = D

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: NA
Intersection: Finch Avenue / Romfield Lane
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: AM Peak Hour
Analysis Year: Future Background Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Finch Avenue
North/South Street: Romfield Lane

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	57	1870	12	16	1014	5	20	10	49	28	11	15
% Heavy Veh	0	8	0	0	9	0	5	0	6	0	36	7
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	15	477	3	4	259	2	5	3	13	7	3	4
Hi Ln Vol												
% Grade		1			0			0			0	
Ideal Sat		1900	1900		1900	1900	1900	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	0	2	1	0	2	1	1	1	0	1	1	0
LGConfig		LT	R		LT	R	L	TR		L	TR	
Lane Width		3.6	3.6		3.6	3.6	3.6	3.6		3.6	3.6	
RTOR Vol			0			0			0			0
Adj Flow		1966	12		1051	5	20	60		29	26	
%InSharedLn												
Prop LTs		0.030			0.015		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.833			0.577	
Peds	Bikes	0			0			0			0	
Buses		0	0		0	0	0	0		0	0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0		0.0	0.0	0.0	0.0		0.0	0.0	
Arriv. Type		3	3		3	3	3	3		3	3	
Unit Ext.		3.0	3.0		3.0	3.0	3.0	3.0		3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time		2.0	2.0		2.0	2.0	2.0	2.0		2.0	2.0	
Ext of g		2.0	2.0		2.0	2.0	2.0	2.0		2.0	2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB	Left	P			NB	Left	A		
	Thru	P				Thru	A		
	Right	P				Right	A		
	Peds					Peds			
WB	Left	P			SB	Left	A		
	Thru	P				Thru	A		
	Right	P				Right	A		
	Peds								
NB	Right				EB	Right			

SB Right		WB Right	
Green	57.0		21.0
Yellow	4.0		3.0
All Red	2.0		3.0

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	57	1870	12	16	1014	5	20	10	49	28	11	15
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	58	1908	12	16	1035	5	20	10	50	29	11	15
No. Lanes	0	2	1	0	2	1	1	1	0	1	1	0
Lane group		LT	R		LT	R	L	TR		L	TR	
Adj flow		1966	12		1051	5	20	60		29	26	
Prop LTs		0.030			0.015		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.833			0.577	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LT		R	LT		R	L	TR		L	TR	
So	1900	1900		1900	1900		1900	1900		1900	1900	
Lanes	0	2	1	0	2	1	1	1	0	1	1	0
fW	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fHV	0.928	1.000		0.919	1.000		0.952	0.952		1.000	0.838	
fG	0.995	0.995		1.000	1.000		1.000	1.000		1.000	1.000	
fP	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fBB	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fA	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fLU	0.952	1.000		0.952	1.000		1.000	1.000		1.000	1.000	
fRT	1.000	0.850		1.000	0.850			0.875			0.913	
fLT	0.867			0.839		0.740	1.000		0.718	1.000		
Sec.												
fLpb	1.000			1.000			1.000	1.000		1.000	1.000	
fRpb	1.000	1.000		1.000	1.000			1.000			1.000	
S	2898	1607		2787	1615	1340	1583		1364	1455		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Flow Rate (v)	Adj Sat Flow Rate (s)		Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru	LT	1966	2898	#	0.68	0.63	1835	1.07
Right	R	12	1607		0.01	0.63	1018	0.01
Westbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru	LT	1051	2787		0.38	0.63	1765	0.60
Right	R	5	1615		0.00	0.63	1023	0.00
Northbound								
Prot								
Perm								
Left	L	20	1340		0.01	0.23	313	0.06
Prot								
Perm								
Thru	TR	60	1583	#	0.04	0.23	369	0.16
Right								
Southbound								
Prot								
Perm								
Left	L	29	1364		0.02	0.23	318	0.09
Prot								
Perm								
Thru	TR	26	1455		0.02	0.23	340	0.08
Right								

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.72
Total lost time per cycle, L = 12.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.83

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
LT	1.07	0.63	16.5	1.000	1835	0.50	43.1	0.0	59.6	E	59.3	E
R	0.01	0.63	6.1	1.000	1018	0.50	0.0	0.0	6.1	A		
Westbound												
LT	0.60	0.63	9.7	1.000	1765	0.50	1.5	0.0	11.2	B	11.2	B
R	0.00	0.63	6.1	1.000	1023	0.50	0.0	0.0	6.1	A		
Northbound												
L	0.06	0.23	26.9	1.000	313	0.11	0.1	0.0	26.9	C		
TR	0.16	0.23	27.5	1.000	369	0.11	0.2	0.0	27.7	C	27.5	C
Southbound												
L	0.09	0.23	27.0	1.000	318	0.11	0.1	0.0	27.1	C		
TR	0.08	0.23	26.9	1.000	340	0.11	0.1	0.0	27.0	C	27.1	C

Intersection Delay = 41.9 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach			M	M
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)			21.0	21.0
Effective permitted green time for LT lane group, g(s)			21.0	21.0
Opposing effective green time, go (s)			21.0	21.0
Number of lanes in LT lane group, N			1	1
Number of lanes in opposing approach, No			1	1
Adjusted LT flow rate, VLT (veh/h)			20	29
Proportion of LT in LT lane group, PLT			1.000	1.000
Proportion of LT in opposing flow, PLTo			0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)			26	60
Lost time for LT lane group, tL			6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.50	0.73
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			0.65	1.50
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g			0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.77	0.77
gq, (see Exhibit C16-4,5,6,7,8)			0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf			21.00	21.00
n=Max(gq-gf)/2,0)			0.00	0.00
PTHo=1-PLTo			1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	1.00
EL1 (refer to Exhibit C16-3)			1.35	1.39
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.19	0.19
gdiff=max(gq-gf,0)			0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.74	0.72
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.740	0.718

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M		
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	57.0	57.0		
Effective permitted green time for LT lane group, g(s)	57.0	57.0		
Opposing effective green time, go (s)	57.0	57.0		
Number of lanes in LT lane group, N	2	2		
Number of lanes in opposing approach, No	2	2		
Adjusted LT flow rate, VLT (veh/h)	58	16		
Proportion of LT in LT lane group, PLT	0.030	0.015	0.000	0.000
Proportion of LT in opposing flow, PLTo	0.02	0.03		
Adjusted opposing flow rate, Vo (veh/h)	1051	1966		
Lost time for LT lane group, tL	6.00	6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	1.45	0.40		
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	13.80	25.81		
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	12.0	30.1		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.37	0.37		
gq, (see Exhibit C16-4,5,6,7,8)	8.60	38.40		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	44.97	18.60		
n=Max(gq-gf)/2,0)	0.00	4.16		
PTHo=1-PLTo	0.98	0.97		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.00	0.04		
EL1 (refer to Exhibit C16-3)	4.12	10.24		
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	3.97		
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.04	0.04		
gdiff=max(gq-gf,0)	0.00	8.32		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.82	0.77		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.867	0.839		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time r=(C-g-gq-gu)				
Arrival rate, qa=v/(3600(max[X,1.0]))				
Protected ph. departure rate, Sp=s/3600				
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 41.9 sec/veh Intersection LOS D

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound LT	Eastbound R	Westbound LT	Westbound R	Northbound L	Northbound TR	Southbound L	Southbound TR
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	1032	12	551	5	20	60	29	26
So	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	2	1	2	1	1	1	1	1
SL	1522	1607	1463	1615	1340	1583	1364	1455
LnCapacity	963	1018	926	1023	313	369	318	340
Flow Ratio	0.68	0.01	0.38	0.00	0.01	0.04	0.02	0.02
v/c Ratio	1.07	0.01	0.60	0.00	0.06	0.16	0.09	0.08
Grn Ratio	0.63	0.63	0.63	0.63	0.23	0.23	0.23	0.23
I Factor	1.000		1.000			1.000		1.000
AT or PVG	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	25.8	0.1	8.1	0.0	0.4	1.2	0.6	0.5
kB	1.1	1.2	1.1	1.2	0.3	0.4	0.3	0.4
Q2	17.0	0.0	1.5	0.0	0.0	0.1	0.0	0.0
Q Average	42.8	0.1	9.6	0.1	0.4	1.3	0.6	0.5
Q Spacing	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Q Storage	0	0	0	0	0	0	0	0
Q S Ratio								
70th Percentile Output:								
fB%	1.2	1.3	1.2	1.3	1.2	1.2	1.2	1.2
BOQ	51.4	0.2	11.7	0.1	0.5	1.5	0.7	0.6
QSRatio								
85th Percentile Output:								
fB%	1.4	1.7	1.4	1.7	1.6	1.6	1.6	1.6
BOQ	60.0	0.2	13.9	0.1	0.7	2.0	1.0	0.9
QSRatio								
90th Percentile Output:								
fB%	1.5	2.0	1.6	2.0	1.8	1.8	1.8	1.8
BOQ	64.3	0.2	15.2	0.1	0.7	2.3	1.1	1.0
QSRatio								
95th Percentile Output:								
fB%	1.6	2.6	1.7	2.6	2.1	2.1	2.1	2.1
BOQ	68.6	0.3	16.8	0.1	0.9	2.6	1.3	1.1
QSRatio								
98th Percentile Output:								
fB%	1.7	3.2	1.9	3.2	2.7	2.6	2.7	2.7
BOQ	72.9	0.4	18.5	0.2	1.1	3.3	1.6	1.4
QSRatio								

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: AM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Finch Avenue

Inter.: Finch Avenue / Tangiers Rd
Area Type: All other areas
Jurisd: City of Toronto
Year: Future Background Conditions
N/S St: Tangiers Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes		1	2	1	2	1		1	2 0		1	2 0
LGConfig	L		T	R	L	T	R	L	TR		L	TR
Volume	25	1536	130	20	1885	13	67	21	43	54	23	18
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6		3.6	3.6	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	P				NB Left	A			
Thru	P				Thru	A			
Right	P				Right	A			
Peds					Peds				
WB Left	P				SB Left	A			
Thru	P				Thru	A			
Right	P				Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	54.0					24.0			
Yellow	4.0					4.0			
All Red	2.0					2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay LOS		Approach Delay LOS	
Eastbound								
L	80	125	0.32	0.60	19.4	B		
T	2000	3333	0.78	0.60	16.7	B	16.1	B
R	861	1435	0.15	0.60	8.3	A		
Westbound								
L	102	170	0.20	0.60	12.4	B		
T	2048	3413	0.94	0.60	26.4	C	26.2	C
R	897	1495	0.01	0.60	7.3	A		
Northbound								
L	345	1294	0.20	0.27	25.8	C		
TR	759	2845	0.09	0.27	24.8	C	25.3	C
Southbound								
L	361	1354	0.15	0.27	25.4	C		
TR	886	3321	0.05	0.27	24.5	C	25.0	C

Intersection Delay = 21.7 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:
Fax:

OPERATIONAL ANALYSIS

Analyst: NA
Intersection: Finch Avenue / Tangiers Rd
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: AM Peak Hour
Analysis Year: Future Background Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Finch Avenue
North/South Street: Tangiers Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	25	1536	130	20	1885	13	67	21	43	54	23	18
% Heavy Veh	12	8	12	0	6	8	7	19	12	0	0	4
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	7	392	33	5	481	4	17	6	11	14	6	5
Hi Ln Vol												
% Grade		1			0			0			0	
Ideal Sat	1900	1900	1900	1900	1900	1900	1900	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes		1	2 1		1	2 1		1	2 0		1	2 0
LGConfig	L		T	R	L	T	R	L	TR		L	TR
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6		3.6	3.6	
RTOR Vol			0			0			0			0
Adj Flow	26	1567	133	20	1923	13	68	65		55	41	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.677			0.439	
Peds	0			0			0			0		
Bikes												
Buses	0	0	0	0	0	0	0	0		0	0	
%InProtPhase												

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Arriv. Type	3	3	3	3	3	3	3	3		3	3	
Unit Ext.	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0		2.0	2.0	
Ext of g	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0		2.0	2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	P				NB Left	A			
Thru	P				Thru	A			
Right	P				Right	A			
Peds					Peds				
WB Left	P				SB Left	A			
Thru	P				Thru	A			
Right	P				Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	54.0					24.0			
Yellow	4.0					4.0			
All Red	2.0					2.0			

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	25	1536	130	20	1885	13	67	21	43	54	23	18
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	26	1567	133	20	1923	13	68	21	44	55	23	18
No. Lanes		1	2 1		1	2 1		1	2 0		1	2 0
Lane group	L		T	R	L	T	R	L	TR		L	TR
Adj flow	26	1567	133		20	1923	13	68	65		55	41
Prop LTs	1.000	0.000			1.000	0.000		1.000	0.000		1.000	0.000
Prop RTs		0.000	1.000			0.000	1.000		0.677			0.439

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound				Westbound				Northbound				Southbound			
LG	L		T	R	L		T	R	L		TR		L		TR	
So	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900			1900	1900		
Lanes	1	2	1	1	2	1	1	2	0	1	2	0				
fW	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000	1.000					
fHV	0.893	0.926	0.893	1.000	0.943	0.926	0.935	0.875		1.000	0.983					
fG	0.995	0.995	0.995	1.000	1.000	1.000	1.000	1.000		1.000	1.000					
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000	1.000					
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000	1.000					
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000	1.000					
fLU	1.000	0.952	1.000	1.000	0.952	1.000	1.000	0.952		1.000	0.952					
fRT		1.000	0.850		1.000	0.850		0.898			0.934					
fLT	0.074	1.000		0.089	1.000		0.729	1.000		0.713	1.000					
Sec.																
fLpb	1.000	1.000			1.000	1.000			1.000	1.000						
fRpb		1.000	1.000			1.000	1.000			1.000						
S	125	3333	1435	170	3413	1495	1294	2845		1354	3321					
Sec.																

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	26	125	0.21	0.60	80	0.32
Prot							
Perm							
Thru	T	1567	3333	0.47	0.60	2000	0.78
Right	R	133	1435	0.09	0.60	861	0.15
Westbound							
Prot							
Perm							
Left	L	20	170	0.12	0.60	102	0.20
Prot							
Perm							
Thru	T	1923	3413	# 0.56	0.60	2048	0.94
Right	R	13	1495	0.01	0.60	897	0.01
Northbound							
Prot							
Perm							
Left	L	68	1294	# 0.05	0.27	345	0.20
Prot							
Perm							
Thru	TR	65	2845	0.02	0.27	759	0.09
Right							
Southbound							
Prot							
Perm							
Left	L	55	1354	0.04	0.27	361	0.15
Prot							
Perm							
Thru	TR	41	3321	0.01	0.27	886	0.05
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.62
Total lost time per cycle, L = 12.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.71

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.32	0.60	8.9	1.000	80	0.50	10.5	0.0	19.4	B		
T	0.78	0.60	13.6	1.000	2000	0.50	3.2	0.0	16.7	B	16.1	B
R	0.15	0.60	7.9	1.000	861	0.50	0.4	0.0	8.3	A		
Westbound												
L	0.20	0.60	8.2	1.000	102	0.50	4.3	0.0	12.4	B		
T	0.94	0.60	16.5	1.000	2048	0.50	9.9	0.0	26.4	C	26.2	C
R	0.01	0.60	7.3	1.000	897	0.50	0.0	0.0	7.3	A		
Northbound												
L	0.20	0.27	25.5	1.000	345	0.11	0.3	0.0	25.8	C		
TR	0.09	0.27	24.8	1.000	759	0.11	0.0	0.0	24.8	C	25.3	C
Southbound												
L	0.15	0.27	25.2	1.000	361	0.11	0.2	0.0	25.4	C		
TR	0.05	0.27	24.5	1.000	886	0.11	0.0	0.0	24.5	C	25.0	C

Intersection Delay = 21.7 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	54.0	54.0	24.0	24.0
Effective permitted green time for LT lane group, g(s)	54.0	54.0	24.0	24.0
Opposing effective green time, go (s)	54.0	54.0	24.0	24.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	2	2	2	2
Adjusted LT flow rate, VLT (veh/h)	26	20	68	55
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	1923	1567	41	65
Lost time for LT lane group, tL	6.00	6.00	6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.65	0.50	1.70	1.38
Opposing lane util. factor, fLUo	0.952	0.952	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	25.25	20.58	0.54	0.85
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.40	0.40	0.73	0.73
gq, (see Exhibit C16-4,5,6,7,8)	40.02	24.33	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	13.98	29.67	24.00	24.00
n=Max(gq-gf)/2,0)	20.01	12.16	0.00	0.00
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	8.86	6.15	1.37	1.40
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07	0.07	0.17	0.17
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.07	0.09	0.73	0.71
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.074	0.089	0.729	0.713

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=i for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=i for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time r=(C-g-gq-gu)				
Arrival rate, qa=v/(3600(max[X,1.0]))				
Protected ph. departure rate, Sp=s/3600				
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 21.7 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound L	T	R	Westbound L	T	R	Northbound L	TR	Southbound L	TR
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	26	823	133	20	1009	13	68	34	55	21
So	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	2	1	1	2	1	1	2 0	1	2 0
SL	125	1750	1435	170	1792	1495	1294	1494	1354	1744
LnCapacity	80	1050	861	102	1075	897	345	398	361	465
Flow Ratio	0.21	0.47	0.09	0.12	0.56	0.01	0.05	0.02	0.04	0.01
v/c Ratio	0.32	0.78	0.15	0.20	0.94	0.01	0.20	0.09	0.15	0.05
Grn Ratio	0.60	0.60	0.60	0.60	0.60	0.60	0.27	0.27	0.27	0.27
I Factor		1.000			1.000			1.000		1.000
AT or PVG	3	3	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	0.3	15.5	1.5	0.2	23.1	0.1	1.3	0.6	1.1	0.4
kB	0.2	1.2	1.0	0.2	1.2	1.1	0.4	0.4	0.4	0.4
Q2	0.1	3.8	0.2	0.1	8.9	0.0	0.1	0.0	0.1	0.0
Q Average	0.4	19.3	1.7	0.3	32.0	0.1	1.4	0.7	1.1	0.4
Q Spacing	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Q Storage	0	0	0	0	0	0	0	0	0	0
Q S Ratio										
70th Percentile Output:										
fB%	1.3	1.2	1.3	1.3	1.2	1.3	1.2	1.2	1.2	1.2
BOQ	0.5	23.2	2.1	0.4	38.4	0.2	1.7	0.8	1.3	0.5
QSRatio										
85th Percentile Output:										
fB%	1.7	1.4	1.6	1.7	1.4	1.7	1.6	1.6	1.6	1.6
BOQ	0.7	27.2	2.7	0.5	44.8	0.2	2.2	1.1	1.8	0.7
QSRatio										
90th Percentile Output:										
fB%	2.0	1.5	1.9	2.0	1.5	2.0	1.8	1.8	1.8	1.8
BOQ	0.8	29.2	3.1	0.6	48.0	0.3	2.5	1.2	2.0	0.7
QSRatio										
95th Percentile Output:										
fB%	2.5	1.6	2.3	2.5	1.6	2.6	2.1	2.1	2.1	2.1
BOQ	1.0	31.3	3.8	0.7	51.2	0.4	2.9	1.4	2.3	0.9
QSRatio										
98th Percentile Output:										
fB%	3.1	1.7	2.8	3.1	1.7	3.2	2.6	2.6	2.6	2.7
BOQ	1.3	33.4	4.6	0.9	54.4	0.5	3.6	1.8	2.9	1.1
QSRatio										

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: AM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Finch Avenue

Inter.: Finch Avenue / CNR Service Rd
Area Type: All other areas
Jurisd: City of Toronto
Year: Future Background Conditions
N/S St: CNR Service Rd

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	0	1	2	0	1	1	0	1	1	0
LGConfig	L	TR		L	TR		L	TR		L	TR	
Volume	13	1629	43	78	1245	8	28	0	20	4	1	11
Lane Width	3.6	3.6		3.6	3.6		3.6	3.6		3.6	3.6	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	P				NB Left	A			
Thru	P				Thru	A			
Right	P				Right	A			
Peds					Peds				
WB Left	P				SB Left	A			
Thru	P				Thru	A			
Right	P				Right	A			
Peds									
NB Right					EB Right				
SB Right					WB Right				
Green	57.0				21.0				
Yellow	4.0				3.0				
All Red	2.0				3.0				

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	112	177	0.12	0.63	8.6	A		
TR	2066	3262	0.83	0.63	16.6	B	16.6	B
Westbound								
L	87	138	0.92	0.63	90.7	F		
TR	2075	3276	0.62	0.63	11.3	B	16.0	B
Northbound								
L	320	1370	0.09	0.23	27.1	C		
TR	343	1468	0.06	0.23	26.9	C	27.0	C
Southbound								
L	165	707	0.02	0.23	26.7	C		
TR	210	898	0.06	0.23	26.9	C	26.9	C

Intersection Delay = 16.5 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: NA
Intersection: Finch Avenue / CNR Service Rd
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: AM Peak Hour
Analysis Year: Future Background Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Finch Avenue
North/South Street: CNR Service Rd

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	13	1629	43	78	1245	8	28	0	20	4	1	11
% Heavy Veh	77	10	7	3	10	63	4	0	10	100	0	90
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	4	416	11	20	318	2	7	0	5	1	1	3
Hi Ln Vol												
% Grade		1			0			0			0	
Ideal Sat	1900	1900		1900	1900		1900	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	2	0	1	2	0	1	1	0	1	1	0
LGConfig	L	TR		L	TR		L	TR		L	TR	
Lane Width	3.6	3.6		3.6	3.6		3.6	3.6		3.6	3.6	
RTOR Vol			0			0			0			0
Adj Flow	13	1706		80	1278		29	20		4	12	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs	0.026			0.006			1.000			0.917		
Peds	0			0			0			0		
Bikes	0											
Buses	0	0		0	0		0	0		0	0	
%InProtPhase												

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Arriv. Type	3	3		3	3		3	3		3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Ext of g	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	P				NB Left	A			
Thru	P				Thru	A			
Right	P				Right	A			
Peds					Peds				
WB Left	P				SB Left	A			
Thru	P				Thru	A			
Right	P				Right	A			
Peds									
NB Right					EB Right				

SB Right					WB Right				
Green	57.0				21.0				
Yellow	4.0				3.0				
All Red	2.0				3.0				

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	13	1629	43	78	1245	8	28	0	20	4	1	11
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	13	1662	44	80	1270	8	29	0	20	4	1	11
No. Lanes	1	2	0	1	2	0	1	1	0	1	1	0
Lane group	L	TR		L	TR		L	TR		L	TR	
Adj flow	13	1706		80	1278		29	20		4	12	
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs	0.026			0.006			1.000			0.917		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	TR		L	TR		L	TR		L	TR	
So	1900	1900		1900	1900		1900	1900		1900	1900	
Lanes	1	2	0	1	2	0	1	1	0	1	1	0
fW	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fHV	0.565	0.910		0.971	0.906		0.962	0.909		0.500	0.548	
fG	0.995	0.995		1.000	1.000		1.000	1.000		1.000	1.000	
fP	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fBB	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fA	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fLU	1.000	0.952		1.000	0.952		1.000	1.000		1.000	1.000	
fRT		0.996			0.999			0.850			0.863	
fLT	0.166	1.000		0.075	1.000		0.750	1.000		0.744	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000			1.000			1.000			1.000	
S	177	3262		138	3276		1370	1468		707	898	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	13	177	0.07	0.63	112	0.12
Prot							
Perm							
Thru	TR	1706	3262	0.52	0.63	2066	0.83
Right							
Westbound							
Prot							
Perm							
Left	L	80	138	# 0.58	0.63	87	0.92
Prot							
Perm							
Thru	TR	1278	3276	0.39	0.63	2075	0.62
Right							
Northbound							
Prot							
Perm							
Left	L	29	1370	# 0.02	0.23	320	0.09
Prot							
Perm							
Thru	TR	20	1468	0.01	0.23	343	0.06
Right							
Southbound							
Prot							
Perm							
Left	L	4	707	0.01	0.23	165	0.02
Prot							
Perm							
Thru	TR	12	898	0.01	0.23	210	0.06
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.60
Total lost time per cycle, L = 12.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.69

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.12	0.63	6.5	1.000	112	0.50	2.1	0.0	8.6	A		
TR	0.83	0.63	12.7	1.000	2066	0.50	3.9	0.0	16.6	B	16.6	B
Westbound												
L	0.92	0.63	14.5	1.000	87	0.50	76.2	0.0	90.7	F		
TR	0.62	0.63	9.9	1.000	2075	0.50	1.4	0.0	11.3	B	16.0	B
Northbound												
L	0.09	0.23	27.0	1.000	320	0.11	0.1	0.0	27.1	C		
TR	0.06	0.23	26.8	1.000	343	0.11	0.1	0.0	26.9	C	27.0	C
Southbound												
L	0.02	0.23	26.6	1.000	165	0.11	0.1	0.0	26.7	C		
TR	0.06	0.23	26.8	1.000	210	0.11	0.1	0.0	26.9	C	26.9	C

Intersection Delay = 16.5 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	57.0	57.0	21.0	21.0
Effective permitted green time for LT lane group, g(s)	57.0	57.0	21.0	21.0
Opposing effective green time, go (s)	57.0	57.0	21.0	21.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	2	2	1	1
Adjusted LT flow rate, VLT (veh/h)	13	80	29	4
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	1278	1706	12	20
Lost time for LT lane group, tL	6.00	6.00	6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.33	2.00	0.73	0.10
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	16.78	22.40	0.30	0.50
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.37	0.37	0.77	0.77
gq, (see Exhibit C16-4,5,6,7,8)	13.62	26.71	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	43.38	30.29	21.00	21.00
n=Max(gq-gf)/2,0)	6.81	13.35	0.00	0.00
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	4.60	7.09	1.33	1.34
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07	0.07	0.19	0.19
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.17	0.07	0.75	0.74
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.166	0.075	0.750	0.744

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time r=(C-g-gq-gu)				
Arrival rate, qa=v/(3600(max[X,1.0]))				
Protected ph. departure rate, Sp=s/3600				
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 16.5 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	TR		L	TR		L	TR		L	TR	
Init Queue	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Flow Rate	13	896		80	671		29	20		4	12	
So	1900	1900		1900	1900		1900	1900		1900	1900	
No.Lanes	1	2	0	1	2	0	1	1	0	1	1	0
SL	177	1713		138	1720		1370	1468		707	898	
LnCapacity	112	1085		87	1089		320	343		165	210	
Flow Ratio	0.07	0.52		0.58	0.39		0.02	0.01		0.01	0.01	
v/c Ratio	0.12	0.83		0.92	0.62		0.09	0.06		0.02	0.06	
Grn Ratio	0.63	0.63		0.63	0.63		0.23	0.23		0.23	0.23	
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3		3	3		3	3		3	3	
Pltn Ratio	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
PF2	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Q1	0.1	17.2		1.8	10.1		0.6	0.4		0.1	0.2	
kB	0.2	1.2		0.2	1.2		0.3	0.4		0.2	0.3	
Q2	0.0	4.8		1.1	1.9		0.0	0.0		0.0	0.0	
Q Average	0.2	22.0		2.8	12.0		0.6	0.4		0.1	0.2	
Q Spacing	7.6	7.6		7.6	7.6		7.6	7.6		7.6	7.6	
Q Storage	0	0		0	0		0	0		0	0	
Q S Ratio												
70th Percentile Output:												
f8%	1.3	1.2		1.3	1.2		1.2	1.2		1.2	1.2	
BOQ	0.2	26.4		3.5	14.5		0.7	0.5		0.1	0.3	
QSRatio												
85th Percentile Output:												
f8%	1.7	1.4		1.6	1.7		1.6	1.6		1.6	1.6	
BOQ	0.3	30.9		4.4	17.1		1.0	0.7		0.1	0.4	
QSRatio												
90th Percentile Output:												
f8%	2.0	1.5		1.8	1.5		1.8	1.8		1.8	1.8	
BOQ	0.3	33.1		5.0	18.5		1.1	0.7		0.1	0.4	
QSRatio												
95th Percentile Output:												
f8%	2.6	1.6		2.2	1.7		2.1	2.1		2.1	2.1	
BOQ	0.4	35.5		6.1	20.2		1.3	0.9		0.2	0.5	
QSRatio												
98th Percentile Output:												
f8%	3.2	1.7		2.6	1.8		2.7	2.7		2.7	2.7	
BOQ	0.5	37.8		7.2	22.0		1.6	1.1		0.2	0.7	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: PM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Murray Ross Pkwy

Inter.: Keele St / Murray Ross Pkwy
Area Type: All other areas
Jurisd: City of Toronto
Year: Future Background Conditions
N/S St: Keele St

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	1	1	1	0	1	2	0	1	2	1
LGConfig	L	T	R	L	TR		L	TR		L	T	R
Volume	71	0	35	1	3	10	31	1221	2	15	1598	253
Lane Width	3.6	3.6	3.6	3.6	3.6		3.6	3.6		3.6	3.6	3.6
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	P				NB Left	P			
Thru	P				Thru	P			
Right	P				Right	P			
Peds					Peds				
WB Left	P				SB Left	P			
Thru	P				Thru	P			
Right	P				Right	P			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	24.0					82.0			
Yellow	4.0					4.0			
All Red	3.0					3.0			

Cycle Length: 120.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound								
L	282	1409	0.26	0.20	42.6	D		
T	380	1900	0.00	0.20	38.4	D	41.8	D
R	323	1615	0.11	0.20	40.0	D		
Westbound								
L	60	158	0.02	0.20	39.0	D		
TR	230	1150	0.06	0.20	39.3	D	39.3	D
Northbound								
L	128	187	0.25	0.68	11.9	B		
TR	2328	3407	0.54	0.68	10.4	B	10.4	B
Southbound								
L	128	187	0.12	0.68	8.4	A		
T	1489	2179	1.10	0.68	73.0	E	63.6	E
R	1093	1599	0.24	0.68	7.7	A		

Intersection Delay = 42.2 (sec/veh) Intersection LOS = D

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: NA
Intersection: Keele St / Murray Ross Pkwy
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: PM Peak Hour
Analysis Year: Future Background Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Murray Ross Pkwy
North/South Street: Keele St

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	71	0	35	1	3	10	31	1221	2	15	1598	253
% Heavy Veh	1	0	0	100	0	60	3	6	100	87	66	1
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	18	0	9	1	1	3	8	311	1	4	408	65
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900	1900	1900	1900		1900	1900		1900	1900	1900
ParkExist												
NumPark												
No. Lanes	1	1	1	1	1	0	1	2	0	1	2	1
LGConfig	L	T	R	L	TR		L	TR		L	T	R
Lane Width	3.6	3.6	3.6	3.6	3.6		3.6	3.6		3.6	3.6	3.6
RTOR Vol			0			0			0			0
Adj Flow	72	0	36	1	13		32	1248		15	1631	258
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.769			0.002			0.000	1.000
Peds	Bikes	0			0			0			0	
Buses	0	0	0	0	0		0	0		0	0	0
%InProtPhase												

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	0.0
Arriv. Type	3	3	3	3	3		3	3		3	3	3
Unit Ext.	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	2.0
Ext of g	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	2.0
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	P				NB Left	P			
Thru	P				Thru	P			
Right	P				Right	P			
Peds					Peds				
WB Left	P				SB Left	P			
Thru	P				Thru	P			
Right	P				Right	P			
Peds					Peds				
NB Right					EB Right				

SB Right			WB Right	
Green	24.0			82.0
Yellow	4.0			4.0
All Red	3.0			3.0

Cycle Length: 120.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	71	0	35	1	3	10	31	1221	2	15	1598	253
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	72	0	36	1	3	10	32	1246	2	15	1631	258
No. Lanes	1	1	1	1	1	0	1	2	0	1	2	1
Lane group	L	T	R	L	TR		L	TR		L	T	R
Adj flow	72	0	36	1	13		32	1248		15	1631	258
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.769			0.002			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound				Westbound				Northbound				Southbound			
LG	L	T	R	L	TR			L	TR			L	T	R		
So	1900	1900	1900	1900	1900			1900	1900			1900	1900	1900		
Lanes	1	1	1	1	1	0		1	2	0		1	2	1		
fW	1.000	1.000	1.000	1.000	1.000			1.000	1.000			1.000	1.000	1.000		
fHV	0.990	1.000	1.000	0.500	0.684			0.971	0.942			0.535	0.602	0.990		
fG	1.000	1.000	1.000	1.000	1.000			1.000	1.000			1.000	1.000	1.000		
fP	1.000	1.000	1.000	1.000	1.000			1.000	1.000			1.000	1.000	1.000		
fBB	1.000	1.000	1.000	1.000	1.000			1.000	1.000			1.000	1.000	1.000		
fA	1.000	1.000	1.000	1.000	1.000			1.000	1.000			1.000	1.000	1.000		
fLU	1.000	1.000	1.000	1.000	1.000			1.000	0.952			1.000	0.952	1.000		
fRT		1.000	0.850		0.885				1.000				1.000	0.850		
fLT	0.749	1.000		0.167	1.000			0.101	1.000			0.184	1.000			
Sec.																
fLpb	1.000	1.000		1.000	1.000			1.000	1.000			1.000	1.000			
fRpb		1.000	1.000		1.000				1.000				1.000	1.000		
S	1409	1900	1615	158	1150			187	3407			187	2179	1599		
Sec.																

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	72	1409	# 0.05	0.20	282	0.26
Prot							
Perm							
Thru	T	0	1900	0.00	0.20	380	0.00
Right	R	36	1615	0.02	0.20	323	0.11
Westbound							
Prot							
Perm							
Left	L	1	158	0.01	0.20	60	0.02
Prot							
Perm							
Thru	TR	13	1150	0.01	0.20	230	0.06
Right							
Northbound							
Prot							
Perm							
Left	L	32	187	0.17	0.68	128	0.25
Prot							
Perm							
Thru	TR	1248	3407	0.37	0.68	2328	0.54
Right							
Southbound							
Prot							
Perm							
Left	L	15	187	0.08	0.68	128	0.12
Prot							
Perm							
Thru	T	1631	2179	# 0.75	0.68	1489	1.10
Right	R	258	1599	0.16	0.68	1093	0.24

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.80
Total lost time per cycle, L = 14.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.91

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.26	0.20	40.5	1.000	282	0.50	2.2	0.0	42.6	D		
T	0.00	0.20	38.4	1.000	380	0.50	0.0	0.0	38.4	D	41.8	D
R	0.11	0.20	39.3	1.000	323	0.50	0.7	0.0	40.0	D		
Westbound												
L	0.02	0.20	38.5	1.000	60	0.50	0.5	0.0	39.0	D		
TR	0.06	0.20	38.8	1.000	230	0.50	0.5	0.0	39.3	D	39.3	D
Northbound												
L	0.25	0.68	7.3	1.000	128	0.50	4.6	0.0	11.9	B		
TR	0.54	0.68	9.5	1.000	2328	0.50	0.9	0.0	10.4	B	10.4	B
Southbound												
L	0.12	0.68	6.5	1.000	128	0.50	1.9	0.0	8.4	A		
T	1.10	0.68	19.0	1.000	1489	0.50	54.0	0.0	73.0	E	63.6	E
R	0.24	0.68	7.2	1.000	1093	0.50	0.5	0.0	7.7	A		

Intersection Delay = 42.2 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)	24.0	24.0	82.0	82.0
Effective permitted green time for LT lane group, g(s)	24.0	24.0	82.0	82.0
Opposing effective green time, go (s)	24.0	24.0	82.0	82.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	1	1	2	2
Adjusted LT flow rate, VLT (veh/h)	72	1	32	15
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	13	0	1631	1248
Lost time for LT lane group, tL	7.00	7.00	7.00	7.00
Computation				
LT volume per cycle, LTC=VLTC/3600	2.40	0.03	1.07	0.50
Opposing lane util. factor, fLUo	1.000	1.000	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.43	0.00	28.55	21.85
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.80	0.80	0.32	0.32
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	27.51	14.76
gu=g-gq if gq>=gf, or = g-gf if gq<gf	24.00	24.00	54.49	67.24
n=Max(gq-gf)/2,0)	0.00	0.00	13.75	7.38
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	1.34	1440.00		6.57
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.17	0.17	0.05	0.05
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.75	0.17	0.10	0.18
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.749	0.167	0.101	0.184

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 120.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time r=(C-g-gq-gu)				
Arrival rate, qa=v/(3600(max[X,1.0]))				
Protected ph. departure rate, Sp=s/3600				
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 42.2 sec/veh Intersection LOS D

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound L	T	R	Westbound L	TR	Northbound L	TR	Southbound L	T	R
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	72	0	36	1	13	32	655	15	856	258
So	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	1	1	1	1 0	1	2 0	1	2	1
SL	1409	1900	1615	158	1150	187	1789	187	1144	1599
LnCapacity	282	380	323	60	230	128	1222	128	782	1093
Flow Ratio	0.05	0.00	0.02	0.01	0.01	0.17	0.37	0.08	0.75	0.16
v/c Ratio	0.26	0.00	0.11	0.02	0.06	0.25	0.54	0.12	1.09	0.24
Grn Ratio	0.20	0.20	0.20	0.20	0.20	0.68	0.68	0.68	0.68	0.68
I Factor		1.000			1.000		1.000		1.000	
AT or PVG	3	3	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	2.0	0.0	1.0	0.0	0.4	0.4	10.9	0.2	28.5	3.2
kB	0.6	0.7	0.6	0.1	0.5	0.3	1.6	0.3	1.2	1.5
Q2	0.2	0.0	0.1	0.0	0.0	0.1	1.8	0.0	16.8	0.5
Q Average	2.2	0.0	1.1	0.0	0.4	0.5	12.7	0.2	45.3	3.7
Q Spacing	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Q Storage	0	0	0	0	0	0	0	0	0	0
Q S Ratio										
70th Percentile Output:										
fB%	1.3	1.3	1.3	1.3	1.3	1.3	1.2	1.3	1.2	1.2
BOQ	2.8	0.0	1.4	0.0	0.5	0.7	15.4	0.3	54.3	4.6
QSRatio										
85th Percentile Output:										
fB%	1.6	1.7	1.6	1.7	1.7	1.7	1.4	1.7	1.4	1.5
BOQ	3.5	0.0	1.7	0.0	0.6	0.9	18.1	0.4	63.4	5.7
QSRatio										
90th Percentile Output:										
fB%	1.8	2.0	1.9	2.0	2.0	2.0	1.5	2.0	1.5	1.7
BOQ	4.0	0.0	2.0	0.1	0.7	1.0	19.6	0.4	67.9	6.4
QSRatio										
95th Percentile Output:										
fB%	2.2	2.6	2.4	2.6	2.5	2.5	1.7	2.6	1.6	2.1
BOQ	5.0	0.0	2.6	0.1	1.0	1.3	21.4	0.6	72.5	7.7
QSRatio										
98th Percentile Output:										
fB%	2.7	3.2	2.9	3.2	3.1	3.1	1.8	3.1	1.7	2.4
BOQ	5.9	0.0	3.1	0.1	1.2	1.6	23.1	0.7	77.0	8.9
QSRatio										

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: PM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Four Winds Drive

Inter.: Keele St / Four Winds Dr
Area Type: All other areas
Jurisd: City of Toronto
Year: Future Background Conditions
N/S St: Keele St

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes		1	1	1	1	0	1	2	0	1	2	1
LGConfig	L		T	R	L	TR	L		TR	L		T R
Volume	24	0	83	0	0	20	167	1081	0	0	1561	60
Lane Width	3.6	3.6	3.6	3.6	3.6		3.6	3.6		3.6	3.6	3.6
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	P				NB Left	P			
Thru	P				Thru	P			
Right	P				Right	P			
Peds					Peds				
WB Left	P				SB Left	P			
Thru	P				Thru	P			
Right	P				Right	P			
Peds									
NB Right					EB Right				
SB Right					WB Right				
Green	24.0				82.0				
Yellow	4.0				4.0				
All Red	3.0				3.0				

Cycle Length: 120.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	g/C	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound								
L	280	1400	0.09	0.20	39.7	D		
T	380	1900	0.00	0.20	38.4	D	41.9	D
R	323	1615	0.26	0.20	42.5	D		
Westbound								
L	60	158	0.00	0.20	38.4	D		
TR	202	1009	0.10	0.20	40.2	D	40.2	D
Northbound								
L	136	199	1.25	0.68	178.2	F		
TR	2332	3413	0.47	0.68	9.6	A	32.1	C
Southbound								
L	156	228	0.00	0.68	6.0	A		
T	1489	2179	1.07	0.68	63.5	E	61.4	E
R	1093	1599	0.06	0.68	6.4	A		

Intersection Delay = 48.4 (sec/veh) Intersection LOS = D

HCS2000: Signalized Intersections Release 4.1e

Phone: Fax:
E-Mail:

OPERATIONAL ANALYSIS

Analyst: NA
Intersection: Keele St / Four Winds Dr
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: PM Peak Hour
Analysis Year: Future Background Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Four Winds Drive
North/South Street: Keele St

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	24	0	83	0	0	20	167	1081	0	0	1561	60
% Heavy Veh	1	0	0	100	0	60	3	6	100	87	66	1
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	6	0	21	0	0	5	43	276	0	0	398	15
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900	1900	1900	1900		1900	1900		1900	1900	1900
ParkExist												
NumPark												
No. Lanes		1	1	1	1	0		1	2	0	1	2 1
LGConfig	L		T	R	L	TR	L		TR	L		T R
Lane Width	3.6	3.6	3.6	3.6	3.6		3.6	3.6		3.6	3.6	3.6
RTOR Vol			0			0			0			0
Adj Flow	24	0	85	0	20		170	1103		0	1593	61
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		1.000			0.000			0.000	1.000
Peds		0			0			0			0	
Buses	0	0	0	0	0		0	0		0	0	0
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	0.0
Arriv. Type	3	3	3	3	3		3	3		3	3	3
Unit Ext.	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	2.0
Ext of g	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	2.0
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	P				NB Left	P			
Thru	P				Thru	P			
Right	P				Right	P			
Peds					Peds				
WB Left	P				SB Left	P			
Thru	P				Thru	P			
Right	P				Right	P			
Peds									
NB Right					EB Right				

SB Right | WB Right

Green	24.0	82.0
Yellow	4.0	4.0
All Red	3.0	3.0

Cycle Length: 120.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	24	0	83	0	0	20	167	1081	0	0	1561	60
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	24	0	85	0	0	20	170	1103	0	0	1593	61
No. Lanes	1	1	1		1	1 0		1	2 0		1	2 1
Lane group	L		T R	L		TR	L		TR	L		T R
Adj flow	24	0	85	0	20		170	1103		0	1593	61
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		1.000			0.000			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound				Westbound				Northbound				Southbound			
LG	L		T	R	L		TR		L		TR		L		T	R
So	1900	1900	1900	1900	1900				1900	1900			1900	1900	1900	
Lanes	1		1	1	1		0		1		2	0	1		2	1
fW	1.000	1.000	1.000	1.000	1.000				1.000	1.000			1.000	1.000	1.000	
fHV	0.990	1.000	1.000	0.500	0.625				0.971	0.943			0.535	0.602	0.990	
fG	1.000	1.000	1.000	1.000	1.000				1.000	1.000			1.000	1.000	1.000	
fP	1.000	1.000	1.000	1.000	1.000				1.000	1.000			1.000	1.000	1.000	
fBB	1.000	1.000	1.000	1.000	1.000				1.000	1.000			1.000	1.000	1.000	
fA	1.000	1.000	1.000	1.000	1.000				1.000	1.000			1.000	1.000	1.000	
fLU	1.000	1.000	1.000	1.000	1.000				1.000	0.952			1.000	0.952	1.000	
fRT		1.000	0.850		0.850					1.000				1.000	0.850	
fLT	0.744	1.000		0.167	1.000				0.108	1.000			0.224	1.000		
Sec.																
fLpb	1.000	1.000			1.000				1.000	1.000			1.000	1.000		
fRpb		1.000	1.000		1.000					1.000				1.000	1.000	
S	1400	1900	1615	158	1009				199	3413			228	2179	1599	
Sec.																

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	24	1400	0.02	0.20	280	0.09
Prot							
Perm							
Thru	T	0	1900	0.00	0.20	380	0.00
Right	R	85	1615	# 0.05	0.20	323	0.26
Westbound							
Prot							
Perm							
Left	L	0	158	0.00	0.20	60	0.00
Prot							
Perm							
Thru	TR	20	1009	0.02	0.20	202	0.10
Right							
Northbound							
Prot							
Perm							
Left	L	170	199	# 0.85	0.68	136	1.25
Prot							
Perm							
Thru	TR	1103	3413	0.32	0.68	2332	0.47
Right							
Southbound							
Prot							
Perm							
Left	L	0	228	0.00	0.68	156	0.00
Prot							
Perm							
Thru	T	1593	2179	0.73	0.68	1489	1.07
Right	R	61	1599	0.04	0.68	1093	0.06

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.91
Total lost time per cycle, L = 14.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.03

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound												
L	0.09	0.20	39.1	1.000	280	0.50	0.6	0.0	39.7	D		
T	0.00	0.20	38.4	1.000	380	0.50	0.0	0.0	38.4	D	41.9	D
R	0.26	0.20	40.5	1.000	323	0.50	2.0	0.0	42.5	D		
Westbound												
L	0.00	0.20	38.4	1.000	60	0.50	0.0	0.0	38.4	D		
TR	0.10	0.20	39.2	1.000	202	0.50	1.0	0.0	40.2	D	40.2	D
Northbound												
L	1.25	0.68	19.0	1.000	136	0.50	159.2	0.0	178.2	F		
TR	0.47	0.68	8.9	1.000	2332	0.50	0.7	0.0	9.6	A	32.1	C
Southbound												
L	0.00	0.68	6.0	1.000	156	0.50	0.0	0.0	6.0	A		
T	1.07	0.68	19.0	1.000	1489	0.50	44.5	0.0	63.5	E	61.4	E
R	0.06	0.68	6.3	1.000	1093	0.50	0.1	0.0	6.4	A		

Intersection Delay = 48.4 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)	24.0	24.0	82.0	82.0
Effective permitted green time for LT lane group, g(s)	24.0	24.0	82.0	82.0
Opposing effective green time, go (s)	24.0	24.0	82.0	82.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	1	1	2	2
Adjusted LT flow rate, VLT (veh/h)	24	0	170	0
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	20	0	1593	1103
Lost time for LT lane group, tL	7.00	7.00	7.00	7.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.80	0.00	5.67	0.00
Opposing lane util. factor, fLUo	1.000	1.000	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.67	0.00	27.89	19.31
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.80	0.80	0.32	0.32
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	26.00	11.03
gu=g-gq if gq>=gf, or = g-gf if gq<gf	24.00	24.00	56.00	70.97
n=Max(gq-gf)/2,0)	0.00	0.00	13.00	5.52
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	1.34	1440.00		6.32
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.17	0.17	0.05	0.05
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.74	0.17	0.11	0.22
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.744	0.167	0.108	0.224

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=i for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	1.34	1440.00		6.32
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.17	0.17	0.05	0.05
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.74	0.17	0.11	0.22
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=i for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 120.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time r=(C-g-gq-gu)				
Arrival rate, qa=v/(3600(max[X,1.0]))				
Protected ph. departure rate, Sp=s/3600				
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Demand Unmet Q veh	Demand Unmet t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Demand Unmet Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 48.4 sec/veh Intersection LOS D

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound L	T	R	Westbound L	TR	Northbound L	TR	Southbound L	T	R
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	24	0	85	0	20	170	579	0	836	61
So	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	1	1	1	1 0	1	2 0	1	2	1
SL	1400	1900	1615	158	1009	199	1792	228	1144	1599
LnCapacity	280	380	323	60	202	136	1224	156	782	1093
Flow Ratio	0.02	0.00	0.05	0.00	0.02	0.85	0.32	0.00	0.73	0.04
v/c Ratio	0.09	0.00	0.26	0.00	0.10	1.25	0.47	0.00	1.07	0.06
Grn Ratio	0.20	0.20	0.20	0.20	0.20	0.68	0.68	0.68	0.68	0.68
I Factor		1.000			1.000		1.000		1.000	
AT or PVG	3	3	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	0.7	0.0	2.4	0.0	0.5	5.7	9.0	0.0	27.9	0.7
kB	0.6	0.7	0.6	0.1	0.5	0.3	1.6	0.4	1.2	1.5
Q2	0.1	0.0	0.2	0.0	0.0	5.6	1.4	0.0	15.0	0.1
Q Average	0.7	0.0	2.6	0.0	0.6	11.2	10.5	0.0	42.8	0.8
Q Spacing	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Q Storage	0	0	0	0	0	0	0	0	0	0
Q S Ratio										
70th Percentile Output:										
fB%	1.3	1.3	1.3	1.3	1.3	1.2	1.2	1.3	1.2	1.3
BOQ	0.9	0.0	3.3	0.0	0.8	13.6	12.7	0.0	51.4	1.0
QSRatio										
85th Percentile Output:										
fB%	1.7	1.7	1.6	1.7	1.7	1.4	1.4	1.7	1.4	1.7
BOQ	1.2	0.0	4.1	0.0	1.0	16.1	15.0	0.0	60.0	1.3
QSRatio										
90th Percentile Output:										
fB%	1.9	1.9	1.8	2.0	1.9	1.6	1.6	2.0	1.5	1.9
BOQ	1.4	0.0	4.7	0.0	1.2	17.4	16.3	0.0	64.2	1.5
QSRatio										
95th Percentile Output:										
fB%	2.5	2.6	2.2	2.6	2.5	1.7	1.7	2.6	1.6	2.5
BOQ	1.7	0.0	5.7	0.0	1.5	19.2	18.0	0.0	68.5	1.9
QSRatio										
98th Percentile Output:										
fB%	3.0	3.2	2.6	3.2	3.0	1.9	1.9	3.2	1.7	3.0
BOQ	2.1	0.0	6.8	0.0	1.8	20.9	19.7	0.0	72.8	2.3
QSRatio										

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: PM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Finch Avenue

Inter.: Finch Avenue / Keele Street
Area Type: All other areas
Jurisd: City of Toronto
Year: Future Background Conditions
N/S St: Keele St

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	1	1	2	1	1	2	1	1	2	1
LGConfig	L	T	R	L	T	R	L	T	R	L	T	R
Volume	88	1115	220	184	1184	206	252	987	161	344	1288	43
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination 1 2 3 4 5 6 7 8

EB	Left			P				NB	Left	P			P	
	Thru			P					Thru				P	
	Right			P					Right				P	
	Peds								Peds					
WB	Left		P		P			SB	Left	P		P		
	Thru		P		P				Thru		P	P		
	Right		P		P				Right		P	P		
NB	Right							EB	Right					
SB	Right							WB	Right					
Green		5.0	31.0					10.0	5.0	29.0				
Yellow		2.0	4.0					2.0	2.0	4.0				
All Red		0.0	2.0					2.0	0.0	2.0				

Cycle Length: 100.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	73	235	1.23	0.31	215.1	F		
T	1063	3428	1.07	0.31	83.1	F	83.2	F
R	474	1530	0.47	0.31	31.2	C		
Westbound								
L	164	1770	1.15	0.38	144.5	F		
T	1309	3445	0.92	0.38	41.8	D	51.5	D
R	558	1468	0.38	0.38	24.4	C		
Northbound								
L	244	1719	1.05	0.39	102.1	F		
T	990	3413	1.02	0.29	68.5	E	70.2	E
R	446	1538	0.37	0.29	30.5	C		
Southbound								
L	384	1641	0.91	0.50	56.3	E		
T	1240	3445	1.06	0.36	75.0	E	69.8	E
R	493	1369	0.09	0.36	21.5	C		

Intersection Delay = 68.3 (sec/veh) Intersection LOS = E

HCS2000: Signalized Intersections Release 4.1e

Phone: Fax:
E-Mail:

OPERATIONAL ANALYSIS

Analyst: NA
Intersection: Finch Avenue / Keele Street
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: PM Peak Hour
Analysis Year: Future Background Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Finch Avenue
North/South Street: Keele St

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	88	1115	220	184	1184	206	252	987	161	344	1288	43
% Heavy Veh	4	5	5	2	5	10	5	6	5	10	5	18
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	22	284	56	47	302	53	64	252	41	88	329	11
Hi Ln Vol												
% Grade		1			0			0			0	
Ideal Sat	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
ParkExist												
NumPark												
No. Lanes	1	2	1	1	2	1	1	2	1	1	2	1
LGConfig	L	T	R	L	T	R	L	T	R	L	T	R
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
RTOR Vol			0			0			0			0
Adj Flow	90	1138	224	188	1208	210	257	1007	164	351	1314	44
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.000	1.000		0.000	1.000
Peds	0			0			0			0		
Buses	0	0	0	0	0	0	0	0	0	0	0	0
%InProtPhase				0.0			0.0			0.0		

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Arriv. Type	3	3	3	3	3	3	3	3	3	3	3	3
Unit Ext.	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Ext of g	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination 1 2 3 4 5 6 7 8

EB	Left			P				NB	Left	P			P	
	Thru			P					Thru				P	
	Right			P					Right				P	
	Peds								Peds					
WB	Left		P		P			SB	Left	P		P		
	Thru		P		P				Thru		P	P		
	Right		P		P				Right		P	P		
	Peds								Peds					
NB	Right							EB	Right					

SB	Right							WB	Right					
Green		5.0	31.0					10.0	5.0	29.0				
Yellow		2.0	4.0					2.0	2.0	4.0				
All Red		0.0	2.0					2.0	0.0	2.0				

Cycle Length: 100.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	88	1115	220	184	1184	206	252	987	161	344	1288	43
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	90	1138	224	188	1208	210	257	1007	164	351	1314	44
No. Lanes	1	2	1	1	2	1	1	2	1	1	2	1
Lane group	L	T	R	L	T	R	L	T	R	L	T	R
Adj flow	90	1138	224	188	1208	210	257	1007	164	351	1314	44
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.000	1.000		0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	T	R	L	T	R	L	T	R	L	T	R
So	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lanes	1	2	1	1	2	1	1	2	1	1	2	1
fW	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fHV	0.962	0.952	0.952	0.980	0.952	0.909	0.952	0.943	0.952	0.909	0.952	0.847
fG	0.995	0.995	0.995	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fLU	1.000	0.952	1.000	1.000	0.952	1.000	1.000	0.952	1.000	1.000	0.952	1.000
fRT		1.000	0.850		1.000	0.850		1.000	0.850		1.000	0.850
fLT	0.129	1.000		0.950	1.000		0.950	1.000		0.950	1.000	
Sec.				0.121			0.138			0.129		
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000
S	235	3428	1530	1770	3445	1468	1719	3413	1538	1641	3445	1369
Sec.				226			250			223		

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Flow Rate (v)	Adj Flow Rate (s)	Adj Sat Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left L		90	235	0.38	0.31	73	1.23
Prot							
Perm							
Thru T		1138	3428	0.33	0.31	1063	1.07
Right R		224	1530	0.15	0.31	474	0.47
Westbound							
Prot		89	1770	# 0.05	0.050	89	1.00
Perm		99	226	# 0.44	0.330	75	1.32
Left L		188			0.38	164	1.15
Prot							
Perm							
Thru T		1208	3445	0.35	0.38	1309	0.92
Right R		210	1468	0.14	0.38	558	0.38
Northbound							
Prot		172	1719	0.10	0.100	172	1.00
Perm		85	250	# 0.34	0.290	72	1.18
Left L		257			0.39	244	1.05
Prot							
Perm							
Thru T		1007	3413	0.29	0.29	990	1.02
Right R		164	1538	0.11	0.29	446	0.37
Southbound							
Prot		312	1641	# 0.19	0.190	312	1.00
Perm		39	223	0.17	0.310	72	0.54
Left L		351			0.50	384	0.91
Prot							
Perm							
Thru T		1314	3445	0.36	0.36	1240	1.06
Right R		44	1369	0.03	0.36	493	0.09

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 1.02
Total lost time per cycle, L = 12.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.16

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	1.23	0.31	34.5	1.000	73	0.50	180.6	0.0	215.1	F		
T	1.07	0.31	34.5	1.000	1063	0.50	48.6	0.0	83.1	F	83.2	F
R	0.47	0.31	27.9	1.000	474	0.50	3.4	0.0	31.2	C		
Westbound												
L	1.15	0.38	29.4	1.000	164	0.50	115.1	0.0	144.5	F		
T	0.92	0.38	29.6	1.000	1309	0.50	12.2	0.0	41.8	D	51.5	D
R	0.38	0.38	22.4	1.000	558	0.50	1.9	0.0	24.4	C		
Northbound												
L	1.05	0.39	29.8	1.000	244	0.50	72.3	0.0	102.1	F		
T	1.02	0.29	35.5	1.000	990	0.50	33.0	0.0	68.5	E	70.2	E
R	0.37	0.29	28.2	1.000	446	0.50	2.3	0.0	30.5	C		
Southbound												
L	0.91	0.50	27.7	1.000	384	0.50	28.6	0.0	56.3	E		
T	1.06	0.36	32.0	1.000	1240	0.50	43.0	0.0	75.0	E	69.8	E
R	0.09	0.36	21.2	1.000	493	0.50	0.4	0.0	21.5	C		

Intersection Delay = 68.3 (sec/veh) Intersection LOS = E

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)	31.0	38.0	39.0	50.0
Effective permitted green time for LT lane group, g(s)	31.0	33.0	29.0	31.0
Opposing effective green time, go (s)	38.0	31.0	36.0	29.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	2	2	2	2
Adjusted LT flow rate, VLT (veh/h)	90	188	257	351
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	1208	1138	1314	1007
Lost time for LT lane group, tL	6.00	6.00	10.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600	2.50	5.22	7.14	9.75
Opposing lane util. factor, fLUo	0.952	0.952	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	17.62	16.60	19.17	14.69
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.62	0.69	0.64	0.71
gq, (see Exhibit C16-4,5,6,7,8)	20.75	29.00	22.80	27.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	10.25	4.00	6.20	4.00
n=Max(gq-gf)/2,0)	10.37	14.50	11.40	13.50
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	4.28	3.99	4.76	3.51
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.13	0.12	0.14	0.13
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.13	0.12	0.14	0.13
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.129	0.121	0.138	0.129

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=i for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=i for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 100.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v		188	257	351
v/c ratio from Capacity Worksheet, X		1.15	1.05	0.91
Protected phase effective green interval, g (s)		5.0	10.0	19.0
Opposing queue effective green interval, gq		29.00	22.80	27.00
Unopposed green interval, gu		4.00	6.20	4.00
Red time r=(C-g-gq-gu)		62.0	61.0	50.0
Arrival rate, qa=v/(3600(max[X,1.0]))		0.05	0.07	0.10
Protected ph. departure rate, Sp=s/3600		0.492	0.478	0.456
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)		0.52	0.32	0.48
XPerm		0.73	0.98	1.57
XProt		1.24	1.01	0.78
Case		2	2	3
Queue at beginning of green arrow, Qa		2.82	4.13	5.98
Queue at beginning of unsaturated green, Qu		1.78	3.11	2.63
Residual queue, Qr		0.59	0.04	1.10
Uniform Delay, d1		29.4	29.8	27.7

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Initial Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 68.3 sec/veh Intersection LOS E

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	90	597	224	188	634	210	257	528	164	351	690	44
So	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	2	1	1	2	1	1	2	1	1	2	1
SL	235	1800	1530	429	1809	1468	627	1792	1538	762	1809	1369
LnCapacity	73	558	474	164	687	558	244	519	446	384	651	493
Flow Ratio	0.38	0.33	0.15	0.44	0.35	0.14	0.41	0.29	0.11	0.46	0.38	0.03
v/c Ratio	1.23	1.07	0.47	1.15	0.92	0.38	1.05	1.02	0.37	0.91	1.06	0.09
Grn Ratio	0.31	0.31	0.31	0.38	0.38	0.38	0.39	0.29	0.29	0.50	0.36	0.36
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3	3	3	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	2.5	16.6	5.0	3.4	16.8	4.2	4.8	14.7	3.6	5.9	19.2	0.8
kB	0.2	0.8	0.7	0.3	0.9	0.8	0.5	0.8	0.7	0.6	0.9	0.7
Q2	2.9	10.6	0.6	4.7	6.0	0.5	4.7	7.7	0.4	3.6	11.6	0.1
Q Average	5.4	27.2	5.7	8.1	22.8	4.7	9.6	22.4	4.0	9.5	30.8	0.9
Q Spacing	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Q Storage	0	0	0	0	0	0	0	0	0	0	0	0
Q S Ratio												
70th Percentile Output:												
f8%	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.3
BOQ	6.7	32.7	7.0	9.9	27.4	5.8	11.6	26.9	5.0	11.5	37.0	1.1
QSRatio												
85th Percentile Output:												
f8%	1.5	1.4	1.5	1.5	1.4	1.5	1.4	1.4	1.4	1.4	1.4	1.7
BOQ	8.1	38.1	8.5	11.9	32.0	7.1	13.8	31.5	6.2	13.7	43.1	1.5
QSRatio												
90th Percentile Output:												
f8%	1.7	1.5	1.7	1.6	1.5	1.7	1.6	1.5	1.7	1.6	1.5	1.9
BOQ	9.0	40.9	9.4	13.0	34.3	8.0	15.1	33.7	6.9	14.9	46.2	1.7
QSRatio												
95th Percentile Output:												
f8%	1.9	1.6	1.9	1.8	1.6	2.0	1.7	1.6	2.4	1.8	1.6	2.4
BOQ	10.5	43.6	10.9	14.6	36.7	9.4	16.7	36.1	8.2	16.6	49.3	2.1
QSRatio												
98th Percentile Output:												
f8%	2.2	1.7	2.2	2.0	1.7	2.3	1.9	1.7	2.4	1.9	1.7	3.0
BOQ	11.9	46.4	12.4	16.2	39.1	10.8	18.4	38.5	9.5	18.2	52.5	2.6
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: PM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Toro Road

Inter.: Keele St / Toro Road
Area Type: All other areas
Jurisd: City of Toronto
Year: Future Background Conditions
N/S St: Keele St

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes		0	0	0	1	0	1	0	2	1	1	2	0
LGConfig					L		R		T	R	L	T	
Volume				178		156		1318	144		125	1582	
Lane Width				3.6		3.6		3.6	3.6		3.6	3.6	
RTOR Vol						0			0				

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination 1 2 3 4 5 6 7 8

EB	Left				NB	Left				
	Thru					Thru	P			
	Right					Right	P			
	Peds					Peds				
WB	Left		A		SB	Left	P			
	Thru					Thru	P			
	Right		A			Right				
	Peds					Peds				
NB	Right				EB	Right				
SB	Right				WB	Right				

Green	24.0		64.0
Yellow	3.0		4.0
All Red	3.0		2.0

Cycle Length: 100.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
Westbound								
L	425	1770	0.43	0.24	32.9	C		
							32.9	C
R	373	1553	0.43	0.24	33.0	C		
Northbound								
T	2226	3478	0.60	0.64	11.8	B	11.4	B
R	1004	1568	0.15	0.64	7.5	A		
Southbound								
L	169	264	0.76	0.64	39.3	D		
T	2226	3478	0.73	0.64	14.2	B	16.0	B

Intersection Delay = 15.7 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

Phone: Fax:
E-Mail:

OPERATIONAL ANALYSIS

Analyst: NA
Intersection: Keele St / Toro Road
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: PM Peak Hour
Analysis Year: Future Background Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Toro Road
North/South Street: Keele St

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				178		156		1318	144	125	1582	
% Heavy Veh				2		4		4	3	7	4	
PHF				0.98		0.98		0.98	0.98	0.98	0.98	
PK 15 Vol				45		40		336	37	32	404	
Hi Ln Vol												
% Grade			0				0				0	
Ideal Sat				1900		1900		1900	1900	1900	1900	
ParkExist												
NumPark												
No. Lanes	0	0	0	1	0	1	0	2	1	1	2	0
LGConfig				L		R		T	R	L	T	
Lane Width				3.6		3.6		3.6	3.6	3.6	3.6	
RTOR Vol						0			0			
Adj Flow				182		159		1345	147	128	1614	
%InSharedLn												
Prop LTs								0.000		1.000	0.000	
Prop RTs						1.000		0.000	1.000		0.000	
Peds Bikes	0				0			0				
Buses				0		0		0	0	0	0	
%InProtPhase												

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0		0.0		0.0	0.0	0.0	0.0	
Arriv. Type				3		3		3	3	3	3	
Unit Ext.				3.0		3.0		3.0	3.0	3.0	3.0	
I Factor					1.000			1.000			1.000	
Lost Time				2.0		2.0		2.0	2.0	2.0	2.0	
Ext of g				2.0		2.0		2.0	2.0	2.0	2.0	
Ped Min g		3.2			3.2			3.2				

PHASE DATA

Phase Combination 1 2 3 4 5 6 7 8

EB	Left				NB	Left				
	Thru					Thru	P			
	Right					Right	P			
	Peds					Peds				
WB	Left		A		SB	Left	P			
	Thru					Thru	P			
	Right		A			Right				
	Peds					Peds				
NB	Right				EB	Right				
SB	Right				WB	Right				

Green	24.0		64.0
Yellow	3.0		4.0
All Red	3.0		2.0

Cycle Length: 100.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				178		156		1318	144	125	1582	
PHF				0.98		0.98		0.98	0.98	0.98	0.98	
Adj flow				182		159		1345	147	128	1614	
No. Lanes	0	0	0	1	0	1	0	2	1	1	2	0
Lane group				L		R		T	R	L	T	
Adj flow				182		159		1345	147	128	1614	
Prop LTs								0.000		1.000	0.000	
Prop RTs						1.000		0.000	1.000		0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG				L		R		T	R	L	T	
So				1900		1900		1900	1900	1900	1900	
Lanes	0	0	0	1	0	1	0	2	1	1	2	0
fW				1.000		1.000		1.000	1.000	1.000	1.000	
fHV				0.980		0.962		0.962	0.971	0.935	0.962	
fG				1.000		1.000		1.000	1.000	1.000	1.000	
fP				1.000		1.000		1.000	1.000	1.000	1.000	
fBB				1.000		1.000		1.000	1.000	1.000	1.000	
fA				1.000		1.000		1.000	1.000	1.000	1.000	
fLU				1.000		1.000		0.952	1.000	1.000	0.952	
fRT						0.850		1.000	0.850		1.000	
fLT				0.950				1.000		0.149	1.000	
Sec.												
fLpb				1.000				1.000		1.000	1.000	
fRpb						1.000		1.000	1.000		1.000	
S				1770		1553		3478	1568	264	3478	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Flow Rate (v)	Adj Sat Flow Rate (s)	v/s Ratio	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left	L	182	1770	# 0.10	0.24	425	0.43
Prot							
Perm							
Thru							
Right	R	159	1553	0.10	0.24	373	0.43
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	1345	3478	0.39	0.64	2226	0.60
Right	R	147	1568	0.09	0.64	1004	0.15
Southbound							
Prot							
Perm							
Left	L	128	264	# 0.48	0.64	169	0.76
Prot							
Perm							
Thru	T	1614	3478	0.46	0.64	2226	0.73
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.59
Total lost time per cycle, L = 12.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.67

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Adj Fact	Prog Cap	Lane Grp k	Incremental Factor d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
Westbound												
L	0.43	0.24	32.2	1.000	425	0.11	0.7	0.0	32.9	C		
											32.9	C
R	0.43	0.24	32.2	1.000	373	0.11	0.8	0.0	33.0	C		
Northbound												
T	0.60	0.64	10.6	1.000	2226	0.50	1.2	0.0	11.8	B	11.4	B
R	0.15	0.64	7.1	1.000	1004	0.50	0.3	0.0	7.5	A		
Southbound												
L	0.76	0.64	12.6	1.000	169	0.50	26.7	0.0	39.3	D		
T	0.73	0.64	12.1	1.000	2226	0.50	2.1	0.0	14.2	B	16.0	B

Intersection Delay = 15.7 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				M
Cycle length, C	100.0 sec			
Total actual green time for LT lane group, G (s)				64.0
Effective permitted green time for LT lane group, g(s)				64.0
Opposing effective green time, go (s)				64.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				2
Adjusted LT flow rate, VLT (veh/h)				128
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.00
Adjusted opposing flow rate, Vo (veh/h)				1345
Lost time for LT lane group, tL				6.00
Computation				
LT volume per cycle, LTC=VLTC/3600				3.56
Opposing lane util. factor, fLUo			0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				19.62
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.36
gq, (see Exhibit C16-4,5,6,7,8)				17.25
gu=g-gq if gq>=gf, or = g-gf if gq<gf				46.75
n=Max(gq-gf)/2,0)				8.63
PTHo=1-PLTo				1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				4.92
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				0.06
gdiff=max(gq-gf,0)				0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.15
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.149

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	100.0 sec			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				0.000 0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo				0.952 0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				4.92
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				0.06
gdiff=max(gq-gf,0)				0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.15
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.149

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	100.0 sec			
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time r=(C-g-gq-gu)				
Arrival rate, qa=v/(3600(max[X,1.0]))				
Protected ph. departure rate, Sp=s/3600				
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Uniform Delay Unmet Demand t hrs.	Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 15.7 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup				L		R		T	R	L	T	
Init Queue				0.0		0.0		0.0	0.0	0.0	0.0	
Flow Rate				182		159		706	147	128	847	
So				1900		1900		1900	1900	1900	1900	
No.Lanes	0	0	0	1	0	1	0	2	1	1	2	0
SL				1770		1553		1826	1568	264	1826	
LnCapacity				425		373		1169	1004	169	1169	
Flow Ratio				0.10		0.10		0.39	0.09	0.48	0.46	
v/c Ratio				0.43		0.43		0.60	0.15	0.76	0.72	
Grn Ratio				0.24		0.24		0.64	0.64	0.64	0.64	
I Factor			1.000				1.000				1.000	
AT or PVG				3		3		3	3	3	3	
Pltn Ratio				1.00		1.00		1.00	1.00	1.00	1.00	
PF2				1.00		1.00		1.00	1.00	1.00	1.00	
Q1				4.3		3.7		11.5	1.6	2.5	15.8	
kB				0.4		0.4		1.4	1.2	0.4	1.4	
Q2				0.3		0.3		2.0	0.2	0.9	3.3	
Q Average				4.6		4.0		13.5	1.8	3.4	19.1	
Q Spacing				7.6		7.6		7.6	7.6	7.6	7.6	
Q Storage				0		0		0	0	0	0	
Q S Ratio												
70th Percentile Output:												
fB%				1.2		1.2		1.2	1.3	1.3	1.2	
BOQ				5.5		4.8		16.3	2.3	4.3	23.0	
QSRatio												
85th Percentile Output:												
fB%				1.6		1.6		1.4	1.6	1.6	1.4	
BOQ				7.2		6.3		19.2	2.9	5.3	26.9	
QSRatio												
90th Percentile Output:												
fB%				1.7		1.7		1.5	1.8	1.8	1.5	
BOQ				7.9		7.0		20.7	3.4	6.0	28.9	
QSRatio												
95th Percentile Output:												
fB%				2.0		2.0		1.7	2.3	2.1	1.6	
BOQ				9.1		8.0		22.5	4.2	7.2	31.0	
QSRatio												
98th Percentile Output:												
fB%				2.4		2.4		1.8	2.7	2.5	1.7	
BOQ				11.1		9.8		24.4	5.0	8.4	33.1	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: PM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Finch Avenue

Inter.: Finch Avenue / Romfield Lane
Area Type: All other areas
Jurisd: City of Toronto
Year: Future Background Conditions
N/S St: Romfield Lane

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	1	0	2	1	1	1	0	1	1	0
LGConfig		LT	R		LT	R	L	TR		L	TR	
Volume	0	2068	22	26	2237	0	5	0	12	0	0	1
Lane Width		3.6	3.6		3.6	3.6	3.6	3.6		3.6	3.6	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	P				NB Left	P			
Thru	P				Thru	P			
Right	P				Right	P			
Peds					Peds				
WB Left	P				SB Left	P			
Thru	P				Thru	P			
Right	P				Right	P			
Peds									
NB Right					EB Right				
SB Right					WB Right				
Green	67.0					21.0			
Yellow	4.0					3.0			
All Red	2.0					3.0			

Cycle Length: 100.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound								
LT	2330	3478	0.91	0.67	20.3	C	20.1	C
R	1082	1615	0.02	0.67	5.6	A		
Westbound								
LT	1795	2679	1.29	0.67	150.0	F	150.0	F
R	1082	1615	0.00	0.67	5.4	A		
Northbound								
L	302	1439	0.02	0.21	31.4	C		
TR	339	1615	0.04	0.21	31.6	C	31.6	C
Southbound								
L	299	1424	0.00	0.21	31.2	C		
TR	339	1615	0.00	0.21	31.2	C	31.2	C

Intersection Delay = 87.4 (sec/veh) Intersection LOS = F

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: NA
Intersection: Finch Avenue / Romfield Lane
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: PM Peak Hour
Analysis Year: Future Background Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Finch Avenue
North/South Street: Romfield Lane

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	2068	22	26	2237	0	5	0	12	0	0	1
% Heavy Veh	0	4	0	0	3	0	0	0	0	0	0	0
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	0	528	6	7	571	0	2	0	3	0	0	1
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900	1900		1900	1900	1900	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	0	2	1	0	2	1	1	1	0	1	1	0
LGConfig		LT	R		LT	R	L	TR		L	TR	
Lane Width		3.6	3.6		3.6	3.6	3.6	3.6		3.6	3.6	
RTOR Vol			0			0			0			0
Adj Flow		2110	22		2310	0	5	12		0	1	
%InSharedLn												
Prop LTs		0.000			0.012		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.000	1.000		1.000			1.000	
Peds	Bikes	0			0			0			0	
Buses		0	0		0	0	0	0		0	0	
%InProtPhase												

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0		0.0	0.0	0.0	0.0		0.0	0.0	
Arriv. Type		3	3		3	3	3	3		3	3	
Unit Ext.		3.0	3.0		3.0	3.0	3.0	3.0		3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time		2.0	2.0		2.0	2.0	2.0	2.0		2.0	2.0	
Ext of g		2.0	2.0		2.0	2.0	2.0	2.0		2.0	2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	P				NB Left	P			
Thru	P				Thru	P			
Right	P				Right	P			
Peds					Peds				
WB Left	P				SB Left	P			
Thru	P				Thru	P			
Right	P				Right	P			
Peds									
NB Right					EB Right				

SB Right			WB Right	
Green	67.0			21.0
Yellow	4.0			3.0
All Red	2.0			3.0

Cycle Length: 100.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	0	2068	22	26	2237	0	5	0	12	0	0	1
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	0	2110	22	27	2283	0	5	0	12	0	0	1
No. Lanes	0	2	1	0	2	1	1	1	0	1	1	0
Lane group		LT	R		LT	R	L	TR		L	TR	
Adj flow		2110	22		2310	0	5	12		0	1	
Prop LTs		0.000			0.012		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.000	1.000		1.000			1.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LT		R	LT		R	L	TR		L	TR	
So	1900	1900		1900	1900	1900	1900			1900	1900	
Lanes	0	2	1	0	2	1	1	1	0	1	1	0
fW	1.000	1.000		1.000	1.000	1.000	1.000	1.000		1.000	1.000	
fHV	0.962	1.000		0.971	1.000	1.000	1.000			1.000	1.000	
fG	1.000	1.000		1.000	1.000	1.000	1.000			1.000	1.000	
fP	1.000	1.000		1.000	1.000	1.000	1.000			1.000	1.000	
fBB	1.000	1.000		1.000	1.000	1.000	1.000			1.000	1.000	
fA	1.000	1.000		1.000	1.000	1.000	1.000			1.000	1.000	
fLU	0.952	1.000		0.952	1.000	1.000	1.000			1.000	1.000	
fRT	1.000	0.850		1.000	0.850		0.850				0.850	
fLT	1.000			0.763		0.757	1.000			0.750	1.000	
Sec.												
fLpb	1.000			1.000		1.000	1.000			1.000	1.000	
fRpb	1.000	1.000		1.000	1.000		1.000				1.000	
S	3478	1615		2679	1615	1439	1615			1424	1615	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Sat Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	2110	3478	0.61	0.67	2330	0.91
Right	R	22	1615	0.01	0.67	1082	0.02
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	2310	2679	# 0.86	0.67	1795	1.29
Right	R	0	1615	0.00	0.67	1082	0.00
Northbound							
Prot							
Perm							
Left	L	5	1439	0.00	0.21	302	0.02
Prot							
Perm							
Thru	TR	12	1615	# 0.01	0.21	339	0.04
Right							
Southbound							
Prot							
Perm							
Left	L	0	1424	0.00	0.21	299	0.00
Prot							
Perm							
Thru	TR	1	1615	0.00	0.21	339	0.00
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.87
Total lost time per cycle, L = 12.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.99

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound												
LT	0.91	0.67	13.8	1.000	2330	0.50	6.4	0.0	20.3	C	20.1	C
R	0.02	0.67	5.5	1.000	1082	0.50	0.0	0.0	5.6	A		
Westbound												
LT	1.29	0.67	16.5	1.000	1795	0.50	133.5	0.0	150.0	F	150.0	F
R	0.00	0.67	5.4	1.000	1082	0.50	0.0	0.0	5.4	A		
Northbound												
L	0.02	0.21	31.3	1.000	302	0.50	0.1	0.0	31.4	C		
TR	0.04	0.21	31.4	1.000	339	0.50	0.2	0.0	31.6	C	31.6	C
Southbound												
L	0.00	0.21	31.2	1.000	299	0.50	0.0	0.0	31.2	C		
TR	0.00	0.21	31.2	1.000	339	0.50	0.0	0.0	31.2	C	31.2	C

Intersection Delay = 87.4 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach			M	M
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)			21.0	21.0
Effective permitted green time for LT lane group, g(s)			21.0	21.0
Opposing effective green time, go (s)			21.0	21.0
Number of lanes in LT lane group, N			1	1
Number of lanes in opposing approach, No			1	1
Adjusted LT flow rate, VLT (veh/h)			5	0
Proportion of LT in LT lane group, PLT			1.000	1.000
Proportion of LT in opposing flow, PLTo			0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)			1	12
Lost time for LT lane group, tL			6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.14	0.00
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			0.03	0.33
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g			0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.79	0.79
gq, (see Exhibit C16-4,5,6,7,8)			0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf			21.00	21.00
n=Max(gq-gf)/2,0)			0.00	0.00
PTHo=1-PLTo			1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	1.00
EL1 (refer to Exhibit C16-3)			1.32	1.33
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.19	0.19
gdiff=max(gq-gf,0)			0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.76	0.75
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.757	0.750

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M		
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)	67.0	67.0		
Effective permitted green time for LT lane group, g(s)	67.0	67.0		
Opposing effective green time, go (s)	67.0	67.0		
Number of lanes in LT lane group, N	2	2		
Number of lanes in opposing approach, No	2	2		
Adjusted LT flow rate, VLT (veh/h)	0	27		
Proportion of LT in LT lane group, PLT	0.000	0.012	0.000	0.000
Proportion of LT in opposing flow, PLTo	0.01	0.00		
Adjusted opposing flow rate, Vo (veh/h)	2310	2110		
Lost time for LT lane group, tL	6.00	6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	0.00	0.75		
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	33.70	30.78		
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	0.0	26.7		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.33	0.33		
gq, (see Exhibit C16-4,5,6,7,8)	62.23	46.86		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	4.77	20.14		
n=Max(gq-gf)/2,0)	31.12	10.09		
PTHo=1-PLTo	0.99	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.00	0.04		
EL1 (refer to Exhibit C16-3)	14.47	11.83		
EL2=Max((1-Ptho**n)/Plto, 1.0)	26.21			
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.03	0.03		
gdiff=max(gq-gf,0)	62.23	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.07	0.62		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	1.000	0.763		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 100.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time r=(C-g-gq-gu)				
Arrival rate, qa=v/(3600(max[X,1.0]))				
Protected ph. departure rate, Sp=s/3600				
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 87.4 sec/veh Intersection LOS F

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LT		R	LT		R	L	TR		L	TR	
Init Queue	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Flow Rate	1108	22		1213	0		5	12		0	1	
So	1900	1900		1900	1900		1900	1900		1900	1900	
No.Lanes	2	1	0	2	1	0	1	1	0	1	1	0
SL	1826	1615		1407	1615		1439	1615		1424	1615	
LnCapacity	1223	1082		942	1082		302	339		299	339	
Flow Ratio	0.61	0.01		0.86	0.00		0.00	0.01		0.00	0.00	
v/c Ratio	0.91	0.02		1.29	0.00		0.02	0.04		0.00	0.00	
Grn Ratio	0.67	0.67		0.67	0.67		0.21	0.21		0.21	0.21	
I Factor	1.000			1.000			1.000			1.000		
AT or PVG	3	3		3	3		3	3		3	3	
Pltn Ratio	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
PF2	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Q1	25.8	0.2		33.7	0.0		0.1	0.3		0.0	0.0	
kB	1.4	1.3		1.2	1.3		0.5	0.6		0.5	0.6	
Q2	8.6	0.0		38.5	0.0		0.0	0.0		0.0	0.0	
Q Average	34.4	0.2		72.2	0.0		0.1	0.3		0.0	0.0	
Q Spacing	7.6	7.6		7.6	7.6		7.6	7.6		7.6	7.6	
Q Storage	0	0		0	0		0	0		0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.3		1.2	1.3		1.3	1.3		1.3	1.3	
BOQ	41.3	0.3		86.7	0.0		0.2	0.4		0.0	0.0	
QSRatio												
85th Percentile Output:												
fB%	1.4	1.7		1.4	1.7		1.7	1.7		1.7	1.7	
BOQ	48.2	0.4		101	0.0		0.2	0.5		0.0	0.0	
QSRatio												
90th Percentile Output:												
fB%	1.5	2.0		1.5	2.0		2.0	2.0		2.0	2.0	
BOQ	51.6	0.5		108	0.0		0.2	0.6		0.0	0.0	
QSRatio												
95th Percentile Output:												
fB%	1.6	2.6		1.6	2.6		2.6	2.5		2.6	2.6	
BOQ	55.1	0.6		116	0.0		0.3	0.7		0.0	0.1	
QSRatio												
98th Percentile Output:												
fB%	1.7	3.1		1.7	3.2		3.2	3.1		3.2	3.2	
BOQ	58.5	0.7		123	0.0		0.4	0.9		0.0	0.1	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: PM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Finch Avenue

Inter.: Finch Avenue / Tangiers Rd
Area Type: All other areas
Jurisd: City of Toronto
Year: Future Background Conditions
N/S St: Tangiers Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes		1	2	1		1	2	1		1	2	0
LGConfig	L		T	R	L		T	R	L		TR	
Volume	32	1322	61	66	1182	51	135	34	81	53	63	40
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6		3.6	3.6	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	P				NB Left	A			
Thru	P				Thru	A			
Right	P				Right	A			
Peds					Peds				
WB Left	P				SB Left	A			
Thru	P				Thru	A			
Right	P				Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	64.0				24.0				
Yellow	4.0				4.0				
All Red	2.0				2.0				

Cycle Length: 100.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	g/C	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound								
L	199	311	0.17	0.64	9.1	A		
T	2057	3214	0.68	0.64	13.2	B	12.9	B
R	961	1502	0.07	0.64	6.9	A		
Westbound								
L	167	261	0.41	0.64	16.2	B		
T	2144	3350	0.58	0.64	11.5	B	11.5	B
R	1034	1615	0.05	0.64	6.8	A		
Northbound								
L	306	1274	0.46	0.24	33.6	C		
TR	753	3136	0.16	0.24	30.1	C	32.0	C
Southbound								
L	308	1283	0.18	0.24	30.5	C		
TR	818	3407	0.13	0.24	29.9	C	30.1	C

Intersection Delay = 14.7 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: NA
Intersection: Finch Avenue / Tangiers Rd
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: PM Peak Hour
Analysis Year: Future Background Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Finch Avenue
North/South Street: Tangiers Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	32	1322	61	66	1182	51	135	34	81	53	63	40
% Heavy Veh	6	12	7	0	8	0	2	6	2	0	0	0
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
PK 15 Vol	8	348	16	17	311	13	36	9	21	14	17	11
Hi Ln Vol												
% Grade		1			0			0			0	
Ideal Sat	1900	1900	1900	1900	1900	1900	1900	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes		1	2	1		1	2	1		1	2	0
LGConfig	L		T	R	L		T	R	L		TR	
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6		3.6	3.6	
RTOR Vol			0			0			0			0
Adj Flow	34	1392	64	69	1244	54	142	121		56	108	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.702			0.389	
Peds		0			0			0			0	
Buses	0	0	0	0	0	0	0	0		0	0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Arriv. Type	3	3	3	3	3	3	3	3		3	3	
Unit Ext.	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0		2.0	2.0	
Ext of g	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0		2.0	2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	P				NB Left	A			
Thru	P				Thru	A			
Right	P				Right	A			
Peds					Peds				
WB Left	P				SB Left	A			
Thru	P				Thru	A			
Right	P				Right	A			
Peds					Peds				
NB Right					EB Right				

SB Right			WB Right	
Green	64.0		24.0	
Yellow	4.0		4.0	
All Red	2.0		2.0	

Cycle Length: 100.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	32	1322	61	66	1182	51	135	34	81	53	63	40
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	34	1392	64	69	1244	54	142	36	85	56	66	42
No. Lanes		1	2	1		1		1	2	0	1	2	0
Lane group	L		T	R	L		T	R	L		TR		L		TR	
Adj flow	34	1392	64		69	1244	54		142	121		56	108	
Prop LTs	1.000	0.000			1.000	0.000			1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000			0.000	1.000			0.702			0.389	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound				Westbound				Northbound				Southbound			
LG	L		T	R	L		T	R	L		TR		L		TR	
So	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900			1900	1900		
Lanes	1	2	1	1	2	1	1		2	0			1	2	0	
fW	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000	1.000			1.000	1.000		
fHV	0.943	0.893	0.935	1.000	0.926	1.000	0.980		0.969				1.000	1.000		
fG	0.995	0.995	0.995	1.000	1.000	1.000	1.000		1.000				1.000	1.000		
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000				1.000	1.000		
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000				1.000	1.000		
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000				1.000	1.000		
fLU	1.000	0.952	1.000	1.000	0.952	1.000	1.000		0.952				1.000	0.952		
fRT		1.000	0.850		1.000	0.850			0.895					0.942		
fLT	0.174	1.000		0.138	1.000		0.684		1.000				0.676	1.000		
Sec.																
fLpb	1.000	1.000			1.000	1.000			1.000	1.000			1.000	1.000		
fRpb		1.000	1.000			1.000	1.000			1.000				1.000		
S	311	3214	1502	261	3350	1615	1274		3136				1283	3407		
Sec.																

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	34	311	0.11	0.64	199	0.17
Prot							
Perm							
Thru	T	1392	3214	# 0.43	0.64	2057	0.68
Right	R	64	1502	0.04	0.64	961	0.07
Westbound							
Prot							
Perm							
Left	L	69	261	0.26	0.64	167	0.41
Prot							
Perm							
Thru	T	1244	3350	0.37	0.64	2144	0.58
Right	R	54	1615	0.03	0.64	1034	0.05
Northbound							
Prot							
Perm							
Left	L	142	1274	# 0.11	0.24	306	0.46
Prot							
Perm							
Thru	TR	121	3136	0.04	0.24	753	0.16
Right							
Southbound							
Prot							
Perm							
Left	L	56	1283	0.04	0.24	308	0.18
Prot							
Perm							
Thru	TR	108	3407	0.03	0.24	818	0.13
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.54
Total lost time per cycle, L = 12.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.62

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound												
L	0.17	0.64	7.3	1.000	199	0.50	1.9	0.0	9.1	A		
T	0.68	0.64	11.4	1.000	2057	0.50	1.8	0.0	13.2	B	12.9	B
R	0.07	0.64	6.8	1.000	961	0.50	0.1	0.0	6.9	A		
Westbound												
L	0.41	0.64	8.8	1.000	167	0.50	7.4	0.0	16.2	B		
T	0.58	0.64	10.3	1.000	2144	0.50	1.2	0.0	11.5	B	11.5	B
R	0.05	0.64	6.7	1.000	1034	0.50	0.1	0.0	6.8	A		
Northbound												
L	0.46	0.24	32.5	1.000	306	0.11	1.1	0.0	33.6	C		
TR	0.16	0.24	30.0	1.000	753	0.11	0.1	0.0	30.1	C	32.0	C
Southbound												
L	0.18	0.24	30.2	1.000	308	0.11	0.3	0.0	30.5	C		
TR	0.13	0.24	29.8	1.000	818	0.11	0.1	0.0	29.9	C	30.1	C

Intersection Delay = 14.7 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)	64.0	64.0	24.0	24.0
Effective permitted green time for LT lane group, g(s)	64.0	64.0	24.0	24.0
Opposing effective green time, go (s)	64.0	64.0	24.0	24.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	2	2	2	2
Adjusted LT flow rate, VLT (veh/h)	34	69	142	56
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	1244	1392	108	121
Lost time for LT lane group, tL	6.00	6.00	6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.94	1.92	3.94	1.56
Opposing lane util. factor, fLUo	0.952	0.952	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	18.15	20.31	1.58	1.77
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.36	0.36	0.76	0.76
gq, (see Exhibit C16-4,5,6,7,8)	14.51	18.62	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	49.49	45.38	24.00	24.00
n=Max(gq-gf)/2,0)	7.26	9.31	0.00	0.00
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	4.44	5.15	1.46	1.48
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06	0.06	0.17	0.17
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.17	0.14	0.68	0.68
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.174	0.138	0.684	0.676

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=i for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=i for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 100.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time r=(C-g-gq-gu)				
Arrival rate, qa=v/(3600(max[X,1.0]))				
Protected ph. departure rate, Sp=s/3600				
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 14.7 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound		Southbound	
LaneGroup	L	T	R	L	T	R	L	TR	L	TR
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	34	731	64	69	653	54	142	63	56	56
So	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	2	1	1	2	1	1	2 0	1	2 0
SL	311	1688	1502	261	1759	1615	1274	1647	1283	1789
LnCapacity	199	1080	961	167	1126	1034	306	395	308	429
Flow Ratio	0.11	0.43	0.04	0.26	0.37	0.03	0.11	0.04	0.04	0.03
v/c Ratio	0.17	0.68	0.07	0.41	0.58	0.05	0.46	0.16	0.18	0.13
Grn Ratio	0.64	0.64	0.64	0.64	0.64	0.64	0.24	0.24	0.24	0.24
I Factor		1.000			1.000			1.000		1.000
AT or PVG	3	3	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	0.4	12.9	0.7	0.9	10.4	0.6	3.4	1.4	1.2	1.2
kB	0.4	1.3	1.2	0.4	1.3	1.3	0.4	0.4	0.4	0.4
Q2	0.1	2.6	0.1	0.2	1.8	0.1	0.3	0.1	0.1	0.1
Q Average	0.5	15.5	0.8	1.2	12.2	0.6	3.7	1.5	1.3	1.3
Q Spacing	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Q Storage	0	0	0	0	0	0	0	0	0	0
Q S Ratio										
70th Percentile Output:										
f8%	1.3	1.2	1.3	1.3	1.2	1.3	1.2	1.2	1.2	1.2
BOQ	0.6	18.6	1.0	1.5	14.7	0.8	4.4	1.7	1.6	1.5
QSRatio										
85th Percentile Output:										
f8%	1.7	1.4	1.7	1.6	1.4	1.7	1.6	1.6	1.6	1.6
BOQ	0.8	21.9	1.2	1.9	17.4	1.0	5.8	2.3	2.1	2.0
QSRatio										
90th Percentile Output:										
f8%	2.0	1.5	1.9	1.9	1.5	1.9	1.7	1.8	1.8	1.8
BOQ	0.9	23.5	1.5	2.2	18.8	1.2	6.4	2.6	2.3	2.3
QSRatio										
95th Percentile Output:										
f8%	2.5	1.6	2.5	2.4	1.7	2.5	2.0	2.1	2.1	2.1
BOQ	1.2	25.4	1.9	2.8	20.5	1.6	7.3	3.0	2.7	2.6
QSRatio										
98th Percentile Output:										
f8%	3.1	1.8	3.0	2.9	1.8	3.0	2.5	2.6	2.6	2.6
BOQ	1.4	27.3	2.3	3.4	22.3	1.9	9.0	3.8	3.4	3.4
QSRatio										

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: PM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Finch Avenue

Inter.: Finch Avenue / CNR Service Rd
Area Type: All other areas
Jurisd: City of Toronto
Year: Future Background Conditions
N/S St: CNR Service Rd

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	0	1	2	0	1	1	0	1	1	0
LGConfig	L	TR		L	TR		L	TR		L	TR	
Volume	2	1531	40	39	1759	4	68	0	55	10	0	10
Lane Width	3.6	3.6		3.6	3.6		3.6	3.6		3.6	3.6	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	P				NB Left	A			
Thru	P				Thru	A			
Right	P				Right	A			
Peds					Peds				
WB Left	P				SB Left	A			
Thru	P				Thru	A			
Right	P				Right	A			
Peds									
NB Right					EB Right				
SB Right					WB Right				
Green	67.0					21.0			
Yellow	4.0					3.0			
All Red	2.0					3.0			

Cycle Length: 100.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	72	88	0.03	0.67	6.3	A		
TR	2286	3412	0.70	0.67	12.1	B	12.1	B
Westbound								
L	121	181	0.33	0.67	14.2	B		
TR	2283	3407	0.79	0.67	14.4	B	14.4	B
Northbound								
L	291	1385	0.24	0.21	33.3	C		
TR	323	1538	0.17	0.21	32.6	C	33.0	C
Southbound								
L	180	856	0.06	0.21	31.7	C		
TR	261	1242	0.04	0.21	31.5	C	31.6	C

Intersection Delay = 14.1 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:
Fax:

OPERATIONAL ANALYSIS

Analyst: NA
Intersection: Finch Avenue / CNR Service Rd
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: PM Peak Hour
Analysis Year: Future Background Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Finch Avenue
North/South Street: CNR Service Rd

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	2	1531	40	39	1759	4	68	0	55	10	0	10
% Heavy Veh	50	5	8	8	6	75	3	0	5	60	0	30
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	1	391	10	10	449	1	17	0	14	3	0	3
Hi Ln Vol												
% Grade		1			0			0			0	
Ideal Sat	1900	1900		1900	1900		1900	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	2	0	1	2	0	1	1	0	1	1	0
LGConfig	L	TR		L	TR		L	TR		L	TR	
Lane Width	3.6	3.6		3.6	3.6		3.6	3.6		3.6	3.6	
RTOR Vol			0			0			0			0
Adj Flow	2	1603		40	1799		69	56		10	10	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs	0.026			0.002			1.000			1.000		
Peds	0			0			0			0		
Buses	0	0		0	0		0	0		0	0	
%InProtPhase												

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Arriv. Type	3	3		3	3		3	3		3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Ext of g	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	P				NB Left	A			
Thru	P				Thru	A			
Right	P				Right	A			
Peds					Peds				
WB Left	P				SB Left	A			
Thru	P				Thru	A			
Right	P				Right	A			
Peds									
NB Right					EB Right				

SB Right		WB Right	
Green	67.0		21.0
Yellow	4.0		3.0
All Red	2.0		3.0

Cycle Length: 100.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	2	1531	40	39	1759	4	68	0	55	10	0	10
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	2	1562	41	40	1795	4	69	0	56	10	0	10
No. Lanes	1	2	0	1	2	0	1	1	0	1	1	0
Lane group	L	TR		L	TR		L	TR		L	TR	
Adj flow	2	1603		40	1799		69	56		10	10	
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs	0.026			0.002			1.000			1.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	TR		L	TR		L	TR		L	TR	
So	1900	1900		1900	1900		1900	1900		1900	1900	
Lanes	1	2	0	1	2	0	1	1	0	1	1	0
fW	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fHV	0.667	0.952		0.926	0.942		0.971	0.952		0.625	0.769	
fG	0.995	0.995		1.000	1.000		1.000	1.000		1.000	1.000	
fP	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fBB	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fA	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fLU	1.000	0.952		1.000	0.952		1.000	1.000		1.000	1.000	
fRT		0.996			1.000			0.850			0.850	
fLT	0.070	1.000		0.103	1.000		0.751	1.000		0.720	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000			1.000			1.000			1.000	
S	88	3412		181	3407		1385	1538		856	1242	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	2	88	0.02	0.67	72	0.03
Prot							
Perm							
Thru	TR	1603	3412	0.47	0.67	2286	0.70
Right							
Westbound							
Prot							
Perm							
Left	L	40	181	0.22	0.67	121	0.33
Prot							
Perm							
Thru	TR	1799	3407	# 0.53	0.67	2283	0.79
Right							
Northbound							
Prot							
Perm							
Left	L	69	1385	# 0.05	0.21	291	0.24
Prot							
Perm							
Thru	TR	56	1538	0.04	0.21	323	0.17
Right							
Southbound							
Prot							
Perm							
Left	L	10	856	0.01	0.21	180	0.06
Prot							
Perm							
Thru	TR	10	1242	0.01	0.21	261	0.04
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.58
Total lost time per cycle, L = 12.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.66

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.03	0.67	5.5	1.000	72	0.50	0.7	0.0	6.3	A		
TR	0.70	0.67	10.3	1.000	2286	0.50	1.8	0.0	12.1	B	12.1	B
Westbound												
L	0.33	0.67	7.0	1.000	121	0.50	7.2	0.0	14.2	B		
TR	0.79	0.67	11.5	1.000	2283	0.50	2.8	0.0	14.4	B	14.4	B
Northbound												
L	0.24	0.21	32.8	1.000	291	0.11	0.4	0.0	33.3	C		
TR	0.17	0.21	32.4	1.000	323	0.11	0.3	0.0	32.6	C	33.0	C
Southbound												
L	0.06	0.21	31.6	1.000	180	0.11	0.1	0.0	31.7	C		
TR	0.04	0.21	31.5	1.000	261	0.11	0.1	0.0	31.5	C	31.6	C

Intersection Delay = 14.1 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)	67.0	67.0	21.0	21.0
Effective permitted green time for LT lane group, g(s)	67.0	67.0	21.0	21.0
Opposing effective green time, go (s)	67.0	67.0	21.0	21.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	2	2	1	1
Adjusted LT flow rate, VLT (veh/h)	2	40	69	10
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	1799	1603	10	56
Lost time for LT lane group, tL	6.00	6.00	6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.06	1.11	1.92	0.28
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	26.25	23.39	0.28	1.56
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.33	0.33	0.79	0.79
gq, (see Exhibit C16-4,5,6,7,8)	30.46	23.00	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	36.54	44.00	21.00	21.00
n=Max(gq-gf)/2,0)	15.23	11.50	0.00	0.00
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	7.80	6.38	1.33	1.39
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06	0.06	0.19	0.19
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.07	0.10	0.75	0.72
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.070	0.103	0.751	0.720

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 100.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time r=(C-g-gq-gu)				
Arrival rate, qa=v/(3600(max[X,1.0]))				
Protected ph. departure rate, Sp=s/3600				
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								

Southbound

Intersection Delay 14.1 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	TR		L	TR		L	TR		L	TR	
Init Queue	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Flow Rate	2	841		40	944		69	56		10	10	
So	1900	1900		1900	1900		1900	1900		1900	1900	
No.Lanes	1	2	0	1	2	0	1	1	0	1	1	0
SL	88	1792		181	1789		1385	1538		856	1242	
LnCapacity	72	1200		121	1199		291	323		180	261	
Flow Ratio	0.02	0.47		0.22	0.53		0.05	0.04		0.01	0.01	
v/c Ratio	0.03	0.70		0.33	0.79		0.24	0.17		0.06	0.04	
Grn Ratio	0.67	0.67		0.67	0.67		0.21	0.21		0.21	0.21	
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3		3	3		3	3		3	3	
Pltn Ratio	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
PF2	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Q1	0.0	14.5		0.5	18.3		1.6	1.3		0.2	0.2	
kB	0.2	1.4		0.3	1.4		0.4	0.4		0.3	0.3	
Q2	0.0	3.1		0.1	4.5		0.1	0.1		0.0	0.0	
Q Average	0.0	17.6		0.6	22.8		1.7	1.4		0.2	0.2	
Q Spacing	7.6	7.6		7.6	7.6		7.6	7.6		7.6	7.6	
Q Storage	0	0		0	0		0	0		0	0	
Q S Ratio												
70th Percentile Output:												
fB%		1.3	1.2		1.2	1.2		1.2	1.2		1.2	1.2
BOQ		0.0	21.2		0.8	27.4		2.0	1.6		0.3	0.3
QSRatio												
85th Percentile Output:												
fB%		1.7	1.4		1.7	1.4		1.6	1.6		1.6	1.6
BOQ		0.0	24.8		1.0	32.0		2.7	2.1		0.4	0.4
QSRatio												
90th Percentile Output:												
fB%		2.0	1.5		1.9	1.5		1.8	1.8		1.8	1.8
BOQ		0.0	26.7		1.2	34.4		3.0	2.4		0.4	0.4
QSRatio												
95th Percentile Output:												
fB%		2.6	1.6		2.5	1.6		2.0	2.1		2.1	2.1
BOQ		0.1	28.7		1.5	36.8		3.5	2.8		0.5	0.5
QSRatio												
98th Percentile Output:												
fB%		3.2	1.7		3.0	1.7		2.6	2.6		2.7	2.7
BOQ		0.1	30.7		1.8	39.2		4.4	3.5		0.6	0.6
QSRatio												

ERROR MESSAGES

No errors to report.

Figure A-1 – A.M. Peak Hour Passenger Pick-up/Drop-off Traffic Volumes

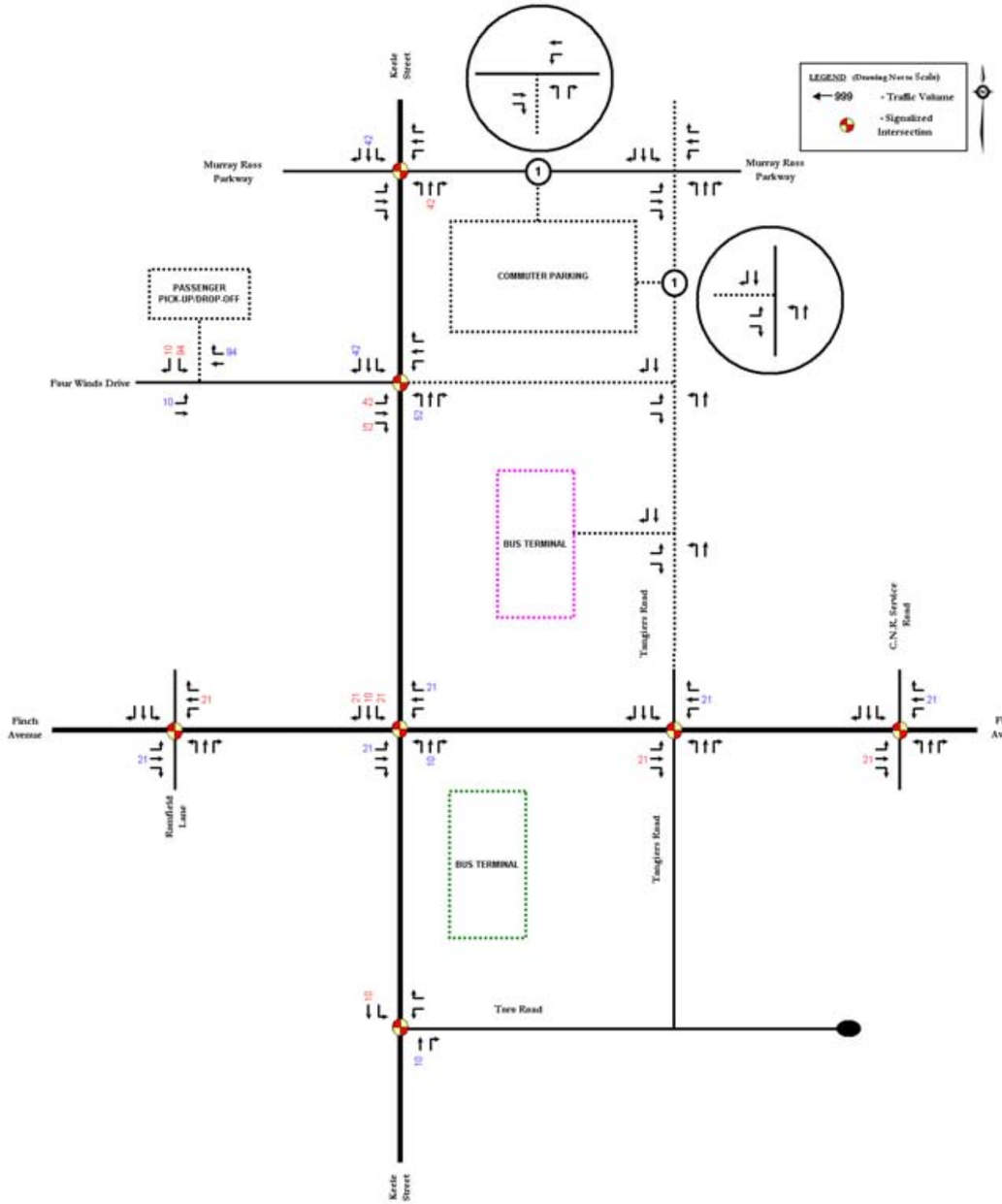


Figure A-2 – P.M. Peak Hour Passenger Pick-up/Drop-off Traffic Volumes

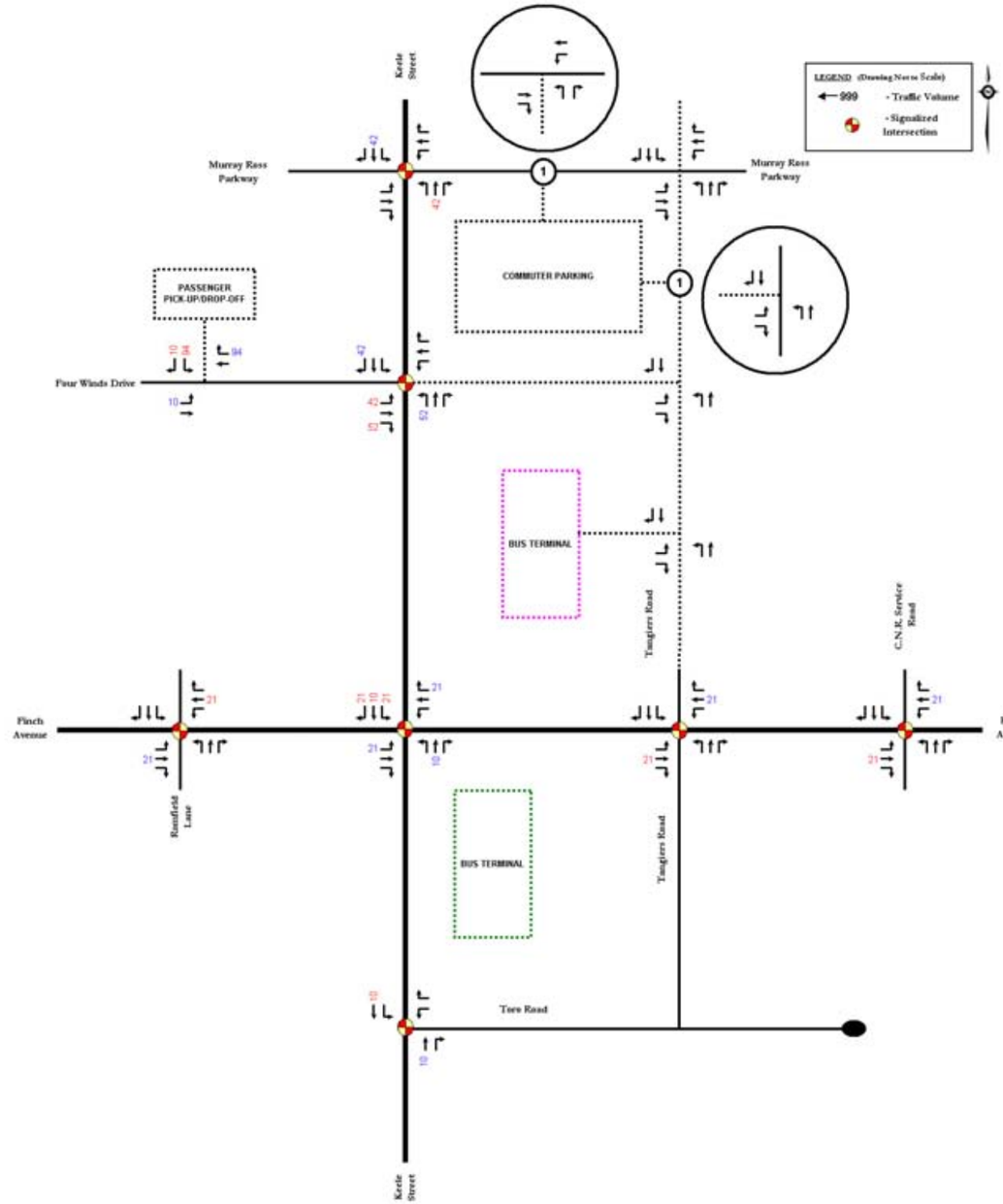


Figure A-3 – A.M. Peak Hour Commuter Parking Traffic Volumes

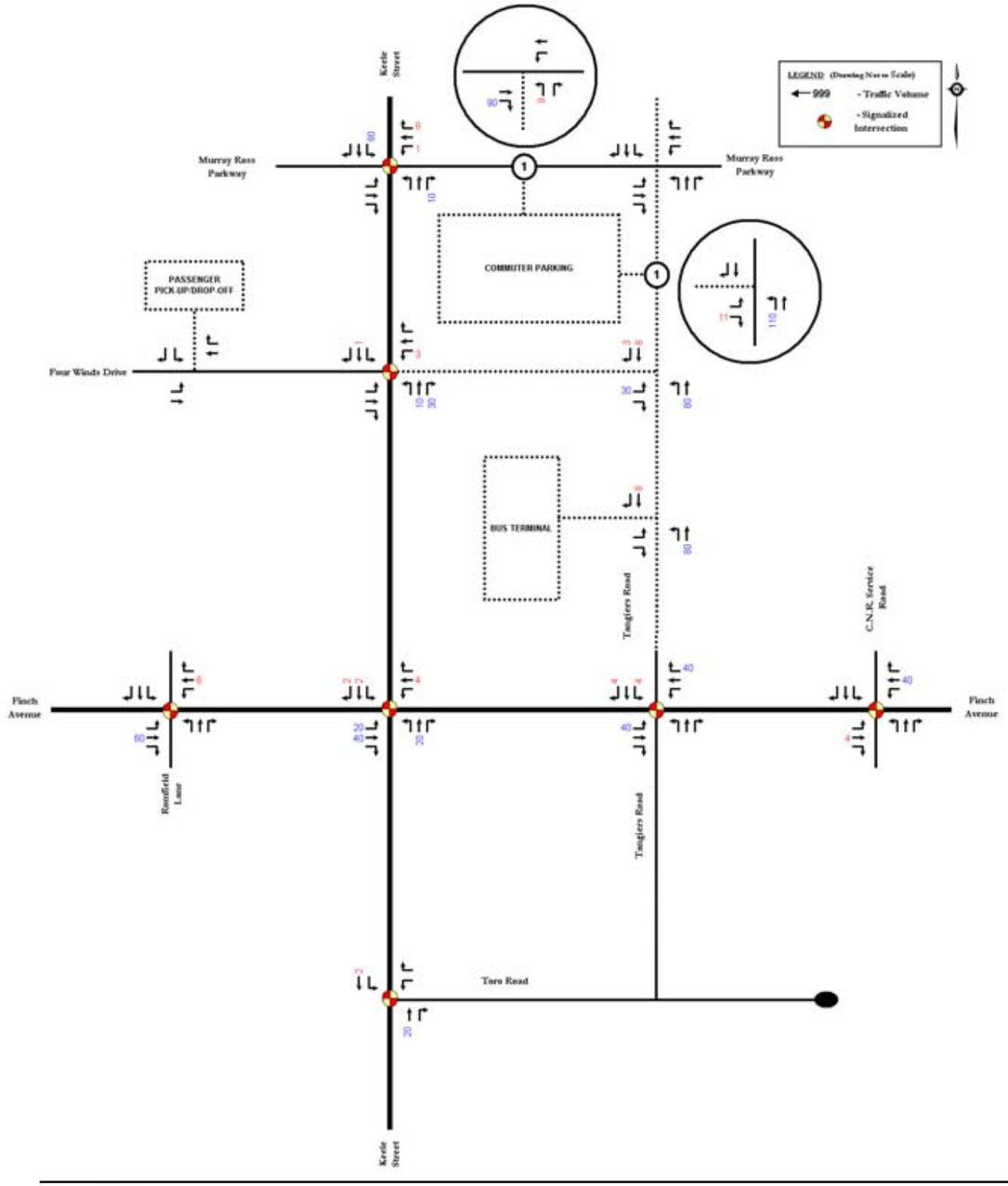


Figure A-4 – P.M. Peak Hour Commuter Parking Traffic Volumes

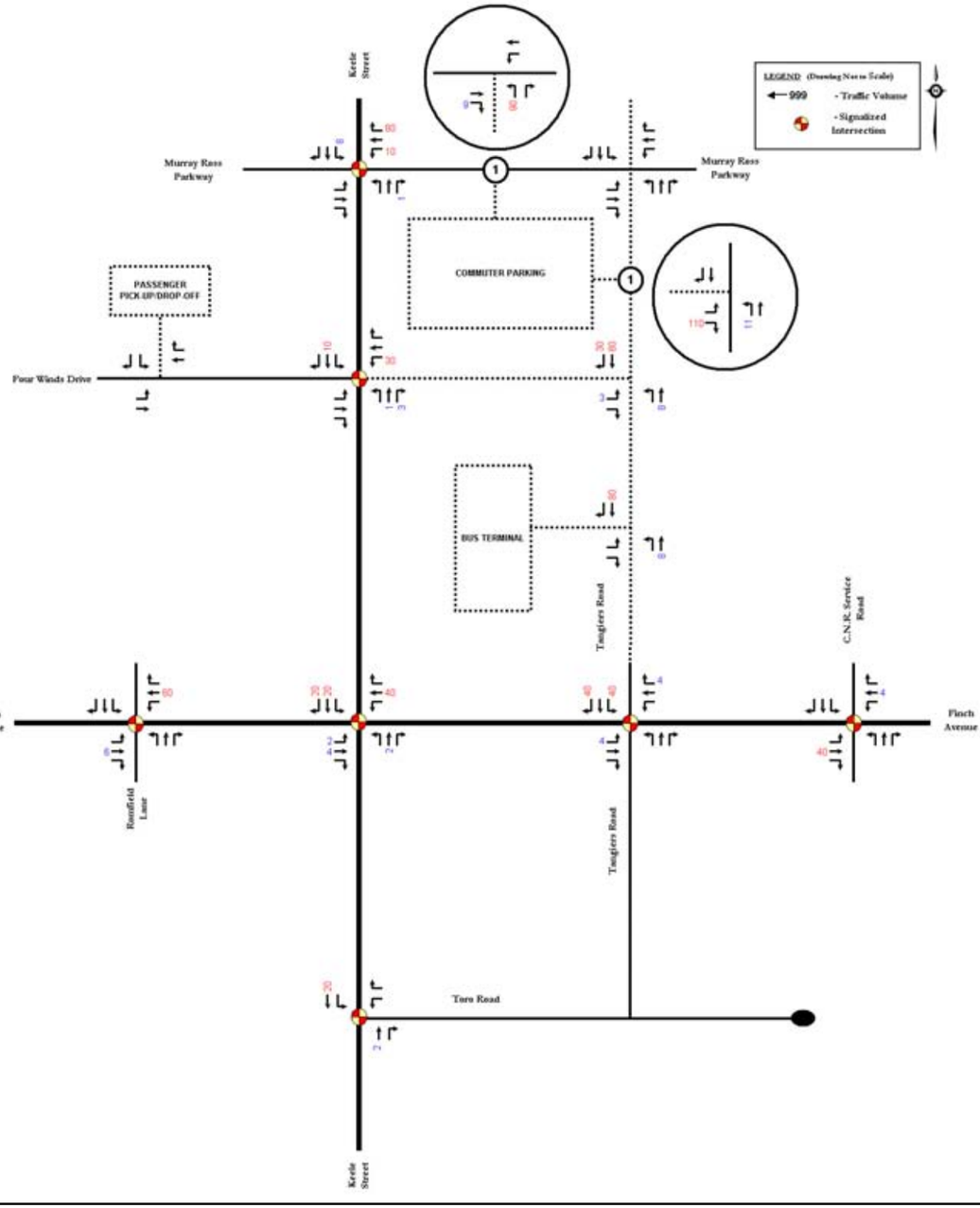
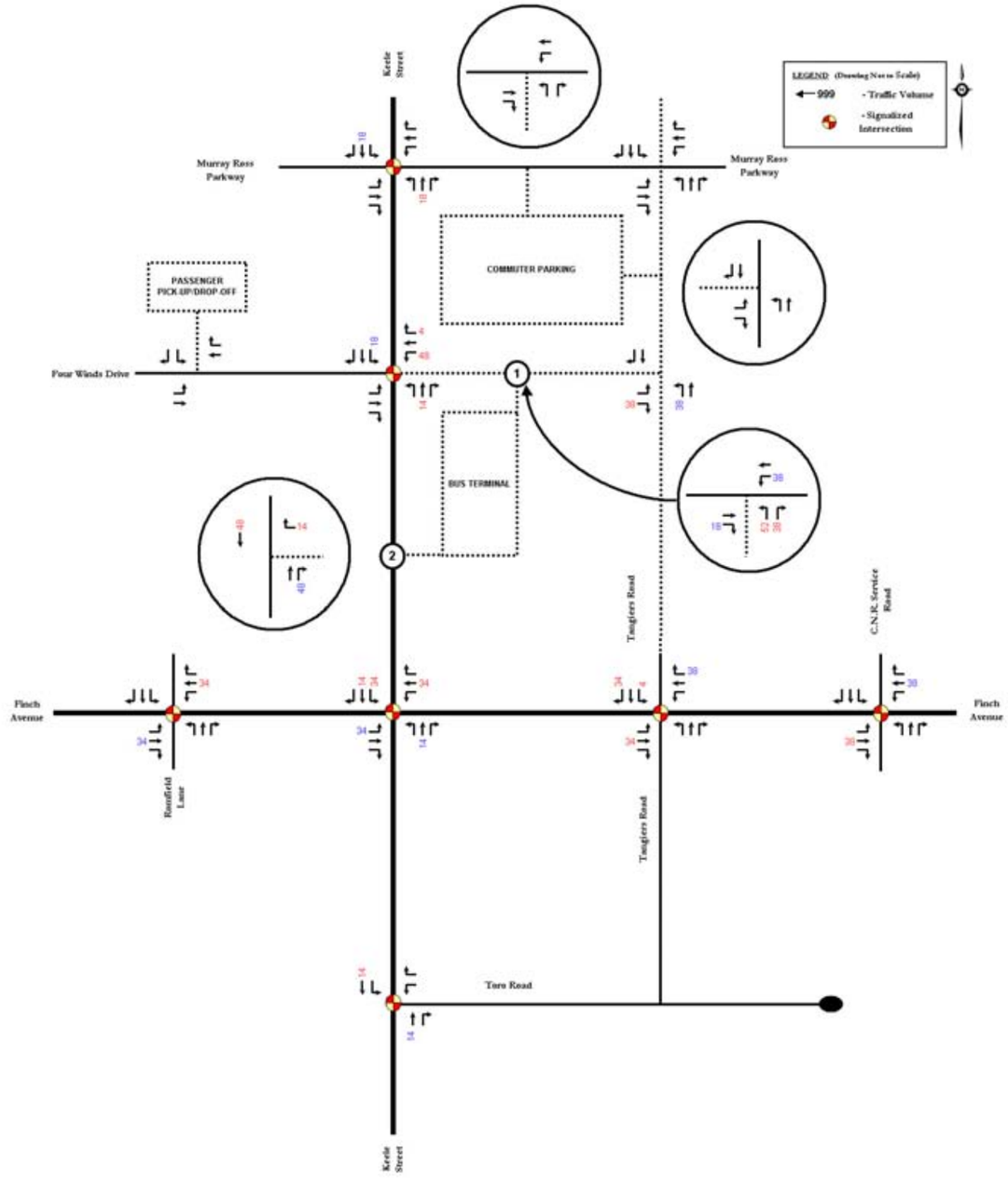


Figure A-5 – A.M. and P.M. Peak Hour Transit Traffic Volumes



APPENDIX D

PPUDO, PARK'N'RIDE AND TRANSIT TRAFFIC VOLUMES FOR FINCH WEST STATION

APPENDIX E

INTERSECTION ANALYSES

FUTURE TOTAL TRAFFIC

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: AM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Murray Ross Pkwy
Inter.: Keele St / Murray Ross Pkwy
Area Type: All other areas
Jurisd: City of Toronto
Year: Total Future Conditions
N/S St: Keele St

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	1	1	1	0	1	2	0	1	2	1
LGConfig	L	T	R	L	TR		L	TR		L	T	R
Volume	146	3	14	13	0	19	24	1093	48	91	1183	71
Lane Width	3.6	3.6	3.6	3.6	3.6		3.6	3.6		3.6	3.6	3.6
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	26.0				51.0			
Yellow	4.0				4.0			
All Red	3.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	409	1416	0.36	0.29	27.9	C		
T	413	1429	0.01	0.29	22.8	C	27.4	C
R	467	1615	0.03	0.29	23.1	C		
Westbound								
L	220	760	0.06	0.29	23.7	C		
TR	256	887	0.07	0.29	23.8	C	23.8	C
Northbound								
L	170	300	0.14	0.57	10.9	B		
TR	1838	3244	0.63	0.57	14.9	B	14.8	B
Southbound								
L	110	194	0.85	0.57	67.7	E		
T	1898	3350	0.64	0.57	14.9	B	18.1	B
R	915	1615	0.08	0.57	9.0	A		

Intersection Delay = 17.3 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:
Fax:

OPERATIONAL ANALYSIS

Analyst: NA
Intersection: Keele St / Murray Ross Pkwy
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: AM Peak Hour
Analysis Year: Total Future Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Murray Ross Pkwy
North/South Street: Keele St

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	146	3	14	13	0	19	24	1093	48	91	1183	71
% Heavy Veh	0	33	0	89	0	82	4	8	75	73	8	0
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	37	1	4	4	0	5	6	279	12	23	302	18
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900	1900	1900	1900		1900	1900		1900	1900	1900
ParkExist												
NumPark												
No. Lanes	1	1	1	1	1	0	1	2	0	1	2	1
LGConfig	L	T	R	L	TR		L	TR		L	T	R
Lane Width	3.6	3.6	3.6	3.6	3.6		3.6	3.6		3.6	3.6	3.6
RTOR Vol		0				0			0			0
Adj Flow	149	3	14	13	19		24	1164		93	1207	72
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		1.000			0.042			0.000	1.000
Peds Bikes	0			0			0			0		
Buses	0	0	0	0	0		0	0		0	0	0
%InProtPhase												

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	0.0
Arriv. Type	3	3	3	3	3		3	3		3	3	3
Unit Ext.	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	2.0
Ext of g	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	2.0
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	26.0				51.0			
Yellow	4.0				4.0			
All Red	3.0				2.0			

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	146	3	14	13	0	19	24	1093	48	91	1183	71
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	149	3	14	13	0	19	24	1115	49	93	1207	72
No. Lanes	1	1	1	1	1	0	1	2	0	1	2	1
Lane group	L	T	R	L	TR		L	TR		L	T	R
Adj flow	149	3	14	13	19		24	1164		93	1207	72
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		1.000			0.042			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	T	R	L	TR		L	TR		L	T	R
So	1900	1900	1900	1900	1900		1900	1900		1900	1900	1900
Lanes	1	3	1	1	1	0	1	2	0	1	2	1
fW	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	1.000
fHV	1.000	0.752	1.000	0.529	0.549		0.962	0.902		0.578	0.926	1.000
fG	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	1.000
fA	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	1.000
fLU	1.000	1.000	1.000	1.000	1.000		1.000	0.952		1.000	0.952	1.000
fRT		1.000	0.850		0.850			0.994			1.000	0.850
fLT	0.745	1.000		0.756	1.000		0.164	1.000		0.177	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000	1.000		1.000			1.000			1.000	1.000
S	1416	1429	1615	760	887		300	3244		194	3350	1615
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	149	1416	# 0.11	0.29	409	0.36
Prot							
Perm							
Thru	T	3	1429	0.00	0.29	413	0.01
Right	R	14	1615	0.01	0.29	467	0.03
Westbound							
Prot							
Perm							
Left	L	13	760	0.02	0.29	220	0.06
Prot							
Perm							
Thru	TR	19	887	0.02	0.29	256	0.07
Right							
Northbound							
Prot							
Perm							
Left	L	24	300	0.08	0.57	170	0.14
Prot							
Perm							
Thru	TR	1164	3244	0.36	0.57	1838	0.63
Right							
Southbound							
Prot							
Perm							
Left	L	93	194	# 0.48	0.57	110	0.85
Prot							
Perm							
Thru	T	1207	3350	0.36	0.57	1898	0.64
Right	R	72	1615	0.04	0.57	915	0.08

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.58
Total lost time per cycle, L = 13.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.68

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.36	0.29	25.4	1.000	409	0.50	2.5	0.0	27.9	C		
T	0.01	0.29	22.8	1.000	413	0.50	0.0	0.0	22.8	C	27.4	C
R	0.03	0.29	23.0	1.000	467	0.50	0.1	0.0	23.1	C		
Westbound												
L	0.06	0.29	23.2	1.000	220	0.50	0.5	0.0	23.7	C		
TR	0.07	0.29	23.3	1.000	256	0.50	0.6	0.0	23.8	C	23.8	C
Northbound												
L	0.14	0.57	9.2	1.000	170	0.50	1.7	0.0	10.9	B		
TR	0.63	0.57	13.2	1.000	1838	0.50	1.7	0.0	14.9	B	14.8	B
Southbound												
L	0.85	0.57	16.2	1.000	110	0.50	51.5	0.0	67.7	E		
T	0.64	0.57	13.2	1.000	1898	0.50	1.6	0.0	14.9	B	18.1	B
R	0.08	0.57	8.8	1.000	915	0.50	0.2	0.0	9.0	A		

Intersection Delay = 17.3 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C: 90.0 sec				
Total actual green time for LT lane group, G (s)	26.0	26.0	51.0	51.0
Effective permitted green time for LT lane group, g(s)	26.0	26.0	51.0	51.0
Opposing effective green time, go (s)	26.0	26.0	51.0	51.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	1	1	2	2
Adjusted LT flow rate, VLT (veh/h)	149	13	24	93
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	19	3	1207	1164
Lost time for LT lane group, tL	7.00	7.00	6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600	3.73	0.33	0.60	2.33
Opposing lane util. factor, fLUo	1.000	1.000	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.47	0.08	15.85	15.28
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.71	0.71	0.43	0.43
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	15.20	14.06
gu=g-gq if gq>=gf, or = g-gf if gq<gf	26.00	26.00	35.80	36.94
n=Max(gq-gf)/2,0)	0.00	0.00	7.60	7.03
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	1.34	1.32	4.28	4.10
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.15	0.15	0.08	0.08
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.75	0.76	0.16	0.18
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.745	0.756	0.164	0.177

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C: 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C: 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time r=(C-g-gq-gu)				
Arrival rate, qa=v/(3600(max[X,1.0]))				
Protected ph. departure rate, Sp=s/3600				
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 17.3 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound L	T	R	Westbound L	TR		Northbound L	TR		Southbound L	T	R
Init Queue	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	0.0
Flow Rate	149	3	14	13	19		24	611		93	633	72
So	1900	1900	1900	1900	1900		1900	1900		1900	1900	1900
No.Lanes	1	1	1	1	1	0	1	2	0	1	2	1
SL	1416	1429	1615	760	887		300	1703		194	1759	1615
LnCapacity	409	413	467	220	256		170	965		110	996	915
Flow Ratio	0.11	0.00	0.01	0.02	0.02		0.08	0.36		0.48	0.36	0.04
v/c Ratio	0.36	0.01	0.03	0.06	0.07		0.14	0.63		0.85	0.64	0.08
Grn Ratio	0.29	0.29	0.29	0.29	0.29		0.57	0.57		0.57	0.57	0.57
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3	3	3	3		3	3		3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Q1	3.0	0.1	0.3	0.2	0.3		0.3	10.3		1.9	10.7	0.8
kB	0.6	0.6	0.7	0.4	0.4		0.3	1.1		0.2	1.1	1.1
Q2	0.3	0.0	0.0	0.0	0.0		0.1	1.8		0.9	1.9	0.1
Q Average	3.3	0.1	0.3	0.3	0.4		0.3	12.2		2.9	12.6	0.9
Q Spacing	7.6	7.6	7.6	7.6	7.6		7.6	7.6		7.6	7.6	7.6
Q Storage	0	0	0	0	0		0	0		0	0	0
Q S Ratio												
70th Percentile Output:												
fB%	1.3	1.3	1.3	1.3	1.3		1.3	1.2		1.3	1.2	1.3
BOQ	4.1	0.1	0.4	0.3	0.5		0.4	14.7		3.6	15.3	1.2
QSRatio												
85th Percentile Output:												
fB%	1.6	1.7	1.7	1.7	1.7		1.7	1.4		1.6	1.4	1.7
BOQ	5.1	0.1	0.5	0.4	0.6		0.6	17.4		4.5	18.0	1.5
QSRatio												
90th Percentile Output:												
fB%	1.8	2.0	2.0	2.0	2.0		2.0	1.5		1.8	1.5	1.9
BOQ	5.8	0.1	0.5	0.5	0.7		0.7	18.8		5.1	19.4	1.7
QSRatio												
95th Percentile Output:												
fB%	2.1	2.6	2.5	2.5	2.5		2.5	1.7		2.2	1.7	2.4
BOQ	7.0	0.1	0.7	0.7	1.0		0.9	20.5		6.2	21.2	2.2
QSRatio												
98th Percentile Output:												
fB%	2.5	2.2	3.1	3.1	3.1		3.1	1.8		2.5	1.8	3.0
BOQ	8.2	0.2	0.8	0.8	1.2		1.0	22.3		7.3	23.0	2.7
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: AM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Four Winds Drive

Inter.: Keele St / Four Winds Dr
Area Type: All other areas
Jurisd: City of Toronto
Year: Total Future Conditions
N/S St: Keele St

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	1	0	1	2	1	1	2	1
LGConfig	L	TR		L	TR		L	T	R	L	T	R
Volume	75	0	155	37	0	14	109	1445	0	14	1122	68
Lane Width	3.6	3.6		3.6	3.6		3.6	3.6	3.6	3.6	3.6	3.6
RTOR Vol		0			0			0			0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P	P	
Thru	P				Thru	P	P	
Right	P				Right	P	P	
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	24.0				5.0	46.0		
Yellow	4.0				2.0	4.0		
All Red	3.0				0.0	2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	379	1422	0.20	0.27	26.8	C		
TR	431	1615	0.37	0.27	29.2	C	28.4	C
Westbound								
L	176	660	0.22	0.27	28.5	C		
TR	237	887	0.06	0.27	25.1	C	27.6	C
Northbound								
L	227	1736	0.49	0.59	19.1	B		
T	1973	3350	0.75	0.59	16.2	B	16.4	B
R	544	923	0.00	0.59	7.6	A		
Southbound								
L	80	133	0.17	0.51	16.5	B		
T	1712	3350	0.67	0.51	18.4	B	18.0	B
R	825	1615	0.08	0.51	11.4	B		

Intersection Delay = 18.1 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:
Fax:

OPERATIONAL ANALYSIS

Analyst: NA
Intersection: Keele St / Four Winds Dr
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: AM Peak Hour
Analysis Year: Total Future Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Four Winds Drive
North/South Street: Keele St

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	75	0	155	37	0	14	109	1445	0	14	1122	68
% Heavy Veh	0	33	0	89	0	82	4	8	75	73	8	0
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	19	0	40	10	0	4	28	369	0	4	286	17
Hi Ln Vol		0			0			0			0	
% Grade												
Ideal Sat	1900	1900		1900	1900		1900	1900	1900	1900	1900	1900
ParkExist												
NumPark												
No. Lanes	1	1	0	1	1	0	1	2	1	1	2	1
LGConfig	L	TR		L	TR		L	T	R	L	T	R
Lane Width	3.6	3.6		3.6	3.6		3.6	3.6	3.6	3.6	3.6	3.6
RTOR Vol		0			0			0			0	
Adj Flow	77	158		38	14		111	1474	0	14	1145	69
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs	1.000			1.000			0.000	1.000		0.000	1.000	
Peds	0			0			0			0		
Bikes	0			0			0			0		
Buses	0	0		0	0		0	0	0	0	0	0
%InProtPhase							0.0					

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Arriv. Type	3	3		3	3		3	3	3	3	3	3
Unit Ext.	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0
Ext of g	2.0	2.0		2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P	P	
Thru	P				Thru	P	P	
Right	P				Right	P	P	
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	24.0				5.0	46.0		
Yellow	4.0				2.0	4.0		
All Red	3.0				0.0	2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	75	0	155	37	0	14	109	1445	0	14	1122	68
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	77	0	158	38	0	14	111	1474	0	14	1145	69
No. Lanes	1	1	0	1	1	0	1	2	1	1	2	1
Lane group	L	TR		L	TR		L	T	R	L	T	R
Adj flow	77	158		38	14		111	1474	0	14	1145	69
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs	1.000			1.000			0.000	1.000		0.000	1.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	TR		L	TR		L	T	R	L	T	R
So	1900	1900		1900	1900		1900	1900	1900	1900	1900	1900
Lanes	1	1	0	1	1	0	1	2	1	1	2	1
fW	1.000	1.000		1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000
fHV	1.000	1.000		0.529	0.549		0.962	0.926	0.571	0.578	0.926	1.000
fG	1.000	1.000		1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000
fP	1.000	1.000		1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000
fBB	1.000	1.000		1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000
fA	1.000	1.000		1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000
fLU	1.000	1.000		1.000	1.000		1.000	0.952	1.000	1.000	0.952	1.000
fRT		0.850			0.850			1.000	0.850		1.000	0.850
fLT	0.748	1.000		0.657	1.000		0.950	1.000		0.121	1.000	
Sec.							0.134					
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000			1.000			1.000	1.000		1.000	1.000
S	1422	1615		660	887		1736	3350	923	133	3350	1615
Sec.							245					

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	77	1422	0.05	0.27	379	0.20
Prot							
Perm							
Thru	TR	158	1615	# 0.10	0.27	431	0.37
Right							
Westbound							
Prot							
Perm							
Left	L	38	660	0.06	0.27	176	0.22
Prot							
Perm							
Thru	TR	14	887	0.02	0.27	237	0.06
Right							
Northbound							
Prot		96	1736	0.06	0.056	96	1.00
Perm		15	245	0.06	0.533	131	0.11
Left	L	111			0.59	227	0.49
Prot							
Perm							
Thru	T	1474	3350	# 0.44	0.59	1973	0.75
Right	R	0	923	0.00	0.59	544	0.00
Southbound							
Prot							
Perm							
Left	L	14	133	0.11	0.51	80	0.17
Prot							
Perm							
Thru	T	1145	3350	0.34	0.51	1712	0.67
Right	R	69	1615	0.04	0.51	825	0.08

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.54
Total lost time per cycle, L = 13.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.63

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.20	0.27	25.6	1.000	379	0.50	1.2	0.0	26.8	C		
TR	0.37	0.27	26.8	1.000	431	0.50	2.4	0.0	29.2	C	28.4	C
Westbound												
L	0.22	0.27	25.7	1.000	176	0.50	2.8	0.0	28.5	C		
TR	0.06	0.27	24.6	1.000	237	0.50	0.5	0.0	25.1	C	27.6	C
Northbound												
L	0.49	0.59	11.7	1.000	227	0.50	7.4	0.0	19.1	B		
T	0.75	0.59	13.6	1.000	1973	0.50	2.6	0.0	16.2	B	16.4	B
R	0.00	0.59	7.6	1.000	544	0.50	0.0	0.0	7.6	A		
Southbound												
L	0.17	0.51	11.8	1.000	80	0.50	4.7	0.0	16.5	B		
T	0.67	0.51	16.3	1.000	1712	0.50	2.1	0.0	18.4	B	18.0	B
R	0.08	0.51	11.2	1.000	825	0.50	0.2	0.0	11.4	B		

Intersection Delay = 18.1 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	24.0	24.0	53.0	46.0
Effective permitted green time for LT lane group, g(s)	24.0	24.0	48.0	46.0
Opposing effective green time, go (s)	24.0	24.0	46.0	53.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	1	1	2	2
Adjusted LT flow rate, VLT (veh/h)	77	38	111	14
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	14	158	1145	1474
Lost time for LT lane group, tL	7.00	7.00	6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600	1.93	0.95	2.78	0.35
Opposing lane util. factor, fLUo	1.000	1.000	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.35	3.95	15.03	19.35
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.73	0.73	0.49	0.41
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	22.08	14.92
gu=g-gq if gq>=gf, or = g-gf if gq<gf	24.00	24.00	25.92	31.08
n=Max(gq-gf)/2,0)	0.00	0.00	11.04	7.46
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	1.34	1.52	4.02	5.60
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.17	0.17	0.08	0.09
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.75	0.66	0.13	0.12
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.748	0.657	0.134	0.121

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v			111	
v/c ratio from Capacity Worksheet, X			0.49	
Protected phase effective green interval, g (s)			5.0	
Opposing queue effective green interval, gq			22.08	
Unopposed green interval, gu			25.92	
Red time r=(C-g-gq-gu)			37.0	
Arrival rate, qa=v/(3600(max[X,1.0]))			0.03	
Protected ph. departure rate, Sp=s/3600			0.482	
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)			0.13	
XPerm			0.45	
XProt			0.54	
Case			1	
Queue at beginning of green arrow, Qa			1.14	
Queue at beginning of unsaturated green, Qu			0.68	
Residual queue, Qr			0.00	
Uniform Delay, d1			11.7	

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 18.1 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound L	TR	Westbound L	TR	Northbound L	T	R	Southbound L	T	R
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	77	158	38	14	111	774	0	14	601	69
So	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	1 0	1	1 0	1	2	1	1	2	1
SL	1422	1615	660	887	386	1759	923	133	1759	1615
LnCapacity	379	431	176	237	227	1036	544	80	899	825
Flow Ratio	0.05	0.10	0.06	0.02	0.29	0.44	0.00	0.11	0.34	0.04
v/c Ratio	0.20	0.37	0.22	0.06	0.49	0.75	0.00	0.17	0.67	0.08
Grn Ratio	0.27	0.27	0.27	0.27	0.59	0.59	0.59	0.51	0.51	0.51
I Factor		1.000		1.000		1.000			1.000	
AT or PVG	3	3	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	1.5	3.2	0.7	0.3	1.2	14.2	0.0	0.2	11.2	0.9
kB	0.6	0.6	0.3	0.4	0.4	1.2	0.7	0.2	1.1	1.0
Q2	0.1	0.4	0.1	0.0	0.4	3.2	0.0	0.0	2.0	0.1
Q Average	1.6	3.6	0.8	0.3	1.6	17.4	0.0	0.2	13.2	1.0
Q Spacing	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Q Storage	0	0	0	0	0	0	0	0	0	0
Q S Ratio										
70th Percentile Output:										
fB%			1.3	1.3	1.3	1.2	1.3	1.3	1.2	1.3
BOQ			2.1	4.5	1.1	0.4	2.0	20.9	0.0	0.3	15.9	1.2
QSRatio										
85th Percentile Output:										
fB%			1.7	1.7	1.6	1.4	1.7	1.7	1.4	1.6
BOQ			2.6	5.5	1.4	0.5	2.5	24.5	0.0	0.4	18.7	1.6
QSRatio										
90th Percentile Output:										
fB%			1.9	2.0	1.9	1.5	2.0	2.0	1.5	1.9
BOQ			3.1	6.2	1.6	0.6	2.9	26.3	0.0	0.4	20.3	1.9
QSRatio										
95th Percentile Output:										
fB%			2.3	2.1	2.4	2.5	2.6	2.6	1.7	2.4
BOQ			3.8	7.5	2.0	0.7	3.6	28.3	0.0	0.6	22.0	2.4
QSRatio										
98th Percentile Output:										
fB%			2.8	2.4	3.0	3.1	2.8	1.7	3.2	3.1	1.8	2.9
BOQ			4.6	8.7	2.5	0.9	4.3	30.3	0.0	0.7	23.8	2.9
QSRatio										

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: AM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Finch Avenue

Inter.: Finch Avenue / Keele Street
Area Type: All other areas
Jurisd: City of Toronto
Year: Total Future Conditions
N/S St: Keele St

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	1	1	2	1	1	2	1	1	2	1
LGConfig	L	T	R	L	T	R	L	T	R	L	T	R
Volume	153	1432	156	61	896	399	169	1066	135	304	937	104
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
RTOR Vol			0			175			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left		P			NB Left	P		
Thru		P			Thru		P	
Right		P			Right		P	
Peds					Peds			
WB Left			P		SB Left	P		
Thru			P		Thru		P	
Right			P		Right		P	
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green		6.0	29.0			6.0	31.0	
Yellow		2.0	4.0			2.0	4.0	
All Red		0.0	2.0			2.0	2.0	

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group	Adj Sat Flow Rate (s)	Ratios v/c	g/C	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound								
L	194	1710	0.80	0.41	49.3	D		
T	1383	3364	1.06	0.41	67.1	E	61.2	E
R	617	1502	0.26	0.41	18.5	B		
Westbound								
L	81	250	0.77	0.32	76.8	E		
T	1089	3381	0.84	0.32	36.1	D	36.8	D
R	460	1429	0.50	0.32	28.4	C		
Northbound								
L	196	1719	0.88	0.46	57.6	E		
T	1187	3445	0.92	0.34	40.8	D	41.0	D
R	525	1524	0.26	0.34	22.5	C		
Southbound								
L	192	1687	1.61	0.46	326.8	F		
T	1165	3381	0.82	0.34	33.5	C	98.9	F
R	467	1357	0.23	0.34	22.1	C		

Intersection Delay = 60.2 (sec/veh) Intersection LOS = E

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:
Fax:

OPERATIONAL ANALYSIS

Analyst: NA
Intersection: Finch Avenue / Keele Street
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: AM Peak Hour
Analysis Year: Total Future Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Finch Avenue
North/South Street: Keele St

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	153	1432	156	61	896	399	169	1066	135	304	937	104
% Heavy Veh	5	7	7	5	7	13	5	5	6	7	7	19
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	39	365	40	16	229	102	43	272	34	78	239	27
Hi Ln Vol		1			0			0			0	
% Grade												
Ideal Sat	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
ParkExist												
NumPark												
No. Lanes	1	2	1	1	2	1	1	2	1	1	2	1
LGConfig	L	T	R	L	T	R	L	T	R	L	T	R
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
RTOR Vol			0			175			0			0
Adj Flow	156	1461	159	62	914	229	172	1088	138	310	956	106
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.000	1.000		0.000	1.000
Peds	Bikes	0			0			0			0	
Buses	0	0	0	0	0	0	0	0	0	0	0	0
%InProtPhase	0.0						0.0			0.0		

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Arriv. Type	3	3	3	3	3	3	3	3	3	3	3	3
Unit Ext.	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Ext of g	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left		P	P		NB Left	P	P	
Thru		P	P		Thru		P	
Right		P	P		Right		P	
Peds					Peds			
WB Left			P		SB Left	P	P	
Thru			P		Thru		P	
Right			P		Right		P	
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green			6.0	29.0		6.0	31.0	
Yellow			2.0	4.0		2.0	4.0	
All Red			0.0	2.0		2.0	2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	153	1432	156	61	896	399	169	1066	135	304	937	104
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	156	1461	159	62	914	229	172	1088	138	310	956	106
No. Lanes	1	2	1	1	2	1	1	2	1	1	2	1
Lane group	L	T	R	L	T	R	L	T	R	L	T	R
Adj flow	156	1461	159	62	914	229	172	1088	138	310	956	106
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.000	1.000		0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	T	R	L	T	R	L	T	R	L	T	R
So	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lanes	1	2	1	1	2	1	1	2	1	1	2	1
fW	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fHV	0.952	0.935	0.935	0.952	0.935	0.885	0.952	0.952	0.943	0.935	0.935	0.840
fG	0.995	0.995	0.995	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fLU	1.000	0.952	1.000	1.000	0.952	1.000	1.000	0.952	1.000	1.000	0.952	1.000
fRT		1.000	0.850		1.000	0.850		1.000	0.850		1.000	0.850
fLT	0.950	1.000		0.138	1.000		0.950	1.000		0.950	1.000	
Sec.	0.129						0.114			0.114		
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000
S	1710	3364	1502	250	3381	1429	1719	3445	1524	1687	3381	1357
Sec.	232						207			203		

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Flow Rate (v)	Adj Sat Flow Rate (s)	Adj Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		114	1710	0.07	0.067	114	1.00
Perm		42	232	0.18	0.344	80	0.52
Left	L	156			0.41	194	0.80
Prot							
Perm							
Thru	T	1461	3364	# 0.41	0.41	1383	1.06
Right	R	159	1502	0.11	0.41	617	0.26
Westbound							
Prot							
Perm							
Left	L	62	250	0.25	0.32	81	0.77
Prot							
Perm							
Thru	T	914	3381	0.27	0.32	1089	0.84
Right	R	229	1429	0.16	0.32	460	0.50
Northbound							
Prot		115	1719	# 0.07	0.067	115	1.00
Perm		57	207	0.28	0.389	81	0.70
Left	L	172			0.46	196	0.88
Prot							
Perm							
Thru	T	1088	3445	0.32	0.34	1187	0.92
Right	R	138	1524	0.09	0.34	525	0.26
Southbound							
Prot		112	1687	0.07	0.067	112	1.00
Perm		198	203	# 0.98	0.389	80	2.47
Left	L	310			0.46	192	1.61
Prot							
Perm							
Thru	T	956	3381	0.28	0.34	1165	0.82
Right	R	106	1357	0.08	0.34	467	0.23

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 1.45
Total lost time per cycle, L = 12.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.68

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound												
L	0.80	0.41	20.6	1.000	194	0.50	28.7	0.0	49.3	D		
T	1.06	0.41	26.5	1.000	1383	0.50	40.6	0.0	67.1	E	61.2	E
R	0.26	0.41	17.5	1.000	617	0.50	1.0	0.0	18.5	B		
Westbound												
L	0.77	0.32	27.4	1.000	81	0.50	49.4	0.0	76.8	E		
T	0.84	0.32	28.3	1.000	1089	0.50	7.8	0.0	36.1	D	36.8	D
R	0.50	0.32	24.6	1.000	460	0.50	3.8	0.0	28.4	C		
Northbound												
L	0.88	0.46	18.9	1.000	196	0.50	38.7	0.0	57.6	E		
T	0.92	0.34	28.3	1.000	1187	0.50	12.5	0.0	40.8	D	41.0	D
R	0.26	0.34	21.3	1.000	525	0.50	1.2	0.0	22.5	C		
Southbound												
L	1.61	0.46	27.5	1.000	192	0.50	299.3	0.0	326.8	F		
T	0.82	0.34	27.0	1.000	1165	0.50	6.5	0.0	33.5	C	98.9	F
R	0.23	0.34	21.0	1.000	467	0.50	1.1	0.0	22.1	C		

Intersection Delay = 60.2 (sec/veh) Intersection LOS = E

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	37.0	29.0	41.0	41.0
Effective permitted green time for LT lane group, g(s)	31.0	29.0	35.0	35.0
Opposing effective green time, go (s)	29.0	37.0	31.0	31.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	2	2	2	2
Adjusted LT flow rate, VLT (veh/h)	156	62	172	310
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	914	1461	956	1088
Lost time for LT lane group, tL	6.00	6.00	6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600	3.90	1.55	4.30	7.75
Opposing lane util. factor, fLUo	0.952	0.952	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	12.00	19.18	12.55	14.29
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.68	0.59	0.66	0.66
gq, (see Exhibit C16-4,5,6,7,8)	22.18	25.00	22.82	27.44
gu=g-gq if gq>=gf, or = g-gf if gq<gf	8.82	4.00	12.18	7.56
n=Max(gq-gf)/2,0)	11.09	12.50	11.41	13.72
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	3.20	5.53	3.33	3.80
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.13	0.14	0.11	0.11
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.13	0.14	0.11	0.11
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.129	0.138	0.114	0.114

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	3.20	5.53	3.33	3.80
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.13	0.14	0.11	0.11
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.13	0.14	0.11	0.11
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.129	0.138	0.114	0.114

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	156		172	310
v/c ratio from Capacity Worksheet, X	0.80		0.88	1.61
Protected phase effective green interval, g (s)	6.0		6.0	6.0
Opposing queue effective green interval, gq	22.18		22.82	27.44
Unopposed green interval, gu	8.82		12.18	7.56
Red time r=(C-g-gq-gu)	53.0		49.0	49.0
Arrival rate, qa=v/(3600(max[X,1.0]))	0.04		0.05	0.05
Protected ph. departure rate, Sp=s/3600	0.475		0.478	0.469
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.23		0.17	0.26
XPerm	0.67		0.83	0.95
XProt	0.90		0.92	1.04
Case	1		1	2
Queue at beginning of green arrow, Qa	2.30		2.34	2.61
Queue at beginning of unsaturated green, Qu	0.96		1.09	2.83
Residual queue, Qr	0.00		0.00	0.12
Uniform Delay, d1	20.6		18.9	27.5

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Demand Q veh	Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 60.2 sec/veh Intersection LOS E

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound L	T	R	Westbound L	T	R	Northbound L	T	R	Southbound L	T	R
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	156	767	159	62	480	229	172	571	138	310	502	106
So	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	2	1	1	2	1	1	2	1	1	2	1
SL	472	1766	1502	250	1775	1429	428	1809	1524	420	1775	1357
LnCapacity	194	726	617	81	571	460	196	623	525	192	611	467
Flow Ratio	0.33	0.43	0.11	0.25	0.27	0.16	0.40	0.32	0.09	0.74	0.28	0.08
v/c Ratio	0.80	1.06	0.26	0.77	0.84	0.50	0.88	0.92	0.26	1.61	0.82	0.23
Grn Ratio	0.41	0.41	0.41	0.32	0.32	0.32	0.46	0.34	0.34	0.46	0.34	0.34
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3	3	3	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	2.4	19.2	2.6	1.4	11.2	4.6	2.5	13.7	2.5	4.5	11.5	1.9
KB	0.4	0.9	0.8	0.2	0.8	0.7	0.4	0.8	0.7	0.4	0.8	0.7
Q2	1.2	12.3	0.3	0.5	3.2	0.6	1.7	5.1	0.3	15.6	3.0	0.2
Q Average	3.6	31.4	2.9	1.9	14.3	5.3	4.2	18.7	2.7	20.2	14.5	2.1
Q Spacing	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Q Storage	0	0	0	0	0	0	0	0	0	0	0	0
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2	1.3	1.3	1.2	1.2	1.2	1.2	1.3	1.2	1.2	1.3
BOQ	4.5	37.7	3.6	2.4	17.3	6.5	5.2	22.5	3.5	24.2	17.5	2.6
QSRatio												
85th Percentile Output:												
fB%	1.5	1.4	2.6	1.6	1.4	1.5	1.5	1.4	1.6	1.4	1.4	1.6
BOQ	5.6	44.0	4.5	3.1	20.3	7.9	6.4	26.4	4.3	28.3	20.6	3.3
QSRatio												
90th Percentile Output:												
fB%	1.7	1.5	1.8	1.8	1.5	1.7	1.7	1.5	1.8	1.5	1.5	1.8
BOQ	6.3	47.2	5.2	3.5	21.9	8.8	7.1	28.3	4.9	30.4	22.2	3.8
QSRatio												
95th Percentile Output:												
fB%	2.1	1.6	2.2	2.3	1.7	1.9	2.0	1.6	2.2	1.6	1.7	2.3
BOQ	7.5	50.4	6.3	4.4	23.8	10.3	8.5	30.4	6.0	32.6	24.0	4.7
QSRatio												
98th Percentile Output:												
fB%	2.4	1.7	2.5	2.7	1.8	2.2	2.4	1.7	2.6	1.7	1.8	2.7
BOQ	8.8	53.5	7.4	5.2	25.6	11.7	9.8	32.5	7.0	34.8	25.9	5.6
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: AM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Toro Road

Inter.: Keele St / Toro Road
Area Type: All other areas
Jurisd: City of Toronto
Year: Total Future Conditions
N/S St: Keele St

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	1	0	1	0	2	1	1	2	0
LGConfig				L		R		T	R	L	T	
Volume				102		66		1204	181	97	1128	
Lane Width				3.6		3.6		3.6	3.6	3.6	3.6	
RTOR Vol						0			0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left				
Thru					Thru	P	P		
Right					Right	P	P		
Peds					Peds				
WB Left		A			SB Left		P		
Thru					Thru		P		
Right		A			Right				
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	24.0					7.0	54.0		
Yellow	3.0					3.0	4.0		
All Red	3.0					0.0	2.0		

Cycle Length: 100.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
Westbound								
L	405	1687	0.26	0.24	31.1	C		
R	340	1417	0.20	0.24	30.6	C	30.9	C
Northbound								
T	2205	3445	0.56	0.64	11.1	B	10.7	B
R	1004	1568	0.18	0.64	7.8	A		
Southbound								
L	210	389	0.47	0.54	21.6	C		
T	1878	3478	0.61	0.54	17.3	B	17.7	B

Intersection Delay = 15.0 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:
Fax:

OPERATIONAL ANALYSIS

Analyst: NA
Intersection: Keele St / Toro Road
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: AM Peak Hour
Analysis Year: Total Future Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Toro Road
North/South Street: Keele St

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				102		66		1204	181	97	1128	
% Heavy Veh				7		14		5	3	3	4	
PHF				0.98		0.98		0.98	0.98	0.98	0.98	
PK 15 Vol				26		17		307	46	25	288	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat				1900		1900		1900	1900	1900	1900	
ParkExist												
NumPark												
No. Lanes	0	0	0	1	0	1	0	2	1	1	2	0
LGConfig				L		R		T	R	L	T	
Lane Width				3.6		3.6		3.6	3.6	3.6	3.6	
RTOR Vol						0			0			
Adj Flow				104		67		1229	185	99	1151	
%InSharedLn												
Prop LTs								0.000		1.000	0.000	
Prop RTs						1.000		0.000	1.000		0.000	
Peds Bikes	0				0			0				
Buses				0		0		0	0	0	0	
%InProtPhase												

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0		0.0		0.0	0.0	0.0	0.0	
Arriv. Type				3		3		3	3	3	3	
Unit Ext.				3.0		3.0		3.0	3.0	3.0	3.0	
I Factor					1.000			1.000			1.000	
Lost Time				2.0		2.0		2.0	2.0	2.0	2.0	
Ext of g				2.0		2.0		2.0	2.0	2.0	2.0	
Ped Min g		3.2			3.2			3.2				

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left				
Thru					Thru	P	P		
Right					Right	P	P		
Peds					Peds				
WB Left		A			SB Left		P		
Thru					Thru		P		
Right		A			Right				
Peds					Peds				
NB Right					EB Right				

SB Right					WB Right							
Green	24.0					7.0	54.0					
Yellow	3.0					3.0	4.0					
All Red	3.0					0.0	2.0					

Cycle Length: 100.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				102		66		1204	181	97	1128	
PHF				0.98		0.98		0.98	0.98	0.98	0.98	
Adj flow				104		67		1229	185	99	1151	
No. Lanes	0	0	0	1	0	1	0	2	1	1	2	0
Lane group				L		R		T	R	L	T	
Adj flow				104		67		1229	185	99	1151	
Prop LTs								0.000		1.000	0.000	
Prop RTs						1.000		0.000	1.000		0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG				L		R		T	R	L	T	
So				1900		1900		1900	1900	1900	1900	
Lanes	0	0	0	1	0	1	0	2	1	1	2	0
fW				1.000		1.000		1.000	1.000	1.000	1.000	
fHV				0.935		0.877		0.952	0.971	0.971	0.962	
fG				1.000		1.000		1.000	1.000	1.000	1.000	
fP				1.000		1.000		1.000	1.000	1.000	1.000	
fBB				1.000		1.000		1.000	1.000	1.000	1.000	
fA				1.000		1.000		1.000	1.000	1.000	1.000	
fLU				1.000		1.000		0.952	1.000	1.000	0.952	
fRT						0.850		1.000	0.850		1.000	
fLT				0.950				1.000		0.211	1.000	
Sec.												
fLpb				1.000				1.000		1.000	1.000	
fRpb						1.000		1.000	1.000		1.000	
S				1687		1417		3445	1568	389	3478	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Flow Rate (v)	Adj Flow Rate (s)	Adj Sat Flow Ratio (v/s)	Green Ratio (g/C)	Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left	L	104	1687	# 0.06	0.24	405	0.26
Prot							
Perm							
Thru							
Right	R	67	1417	0.05	0.24	340	0.20
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	1229	3445	# 0.36	0.64	2205	0.56
Right	R	185	1568	0.12	0.64	1004	0.18
Southbound							
Prot							
Perm							
Left	L	99	389	0.25	0.54	210	0.47
Prot							
Perm							
Thru	T	1151	3478	0.33	0.54	1878	0.61
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.42
Total lost time per cycle, L = 12.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.48

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
Westbound												
L	0.26	0.24	30.8	1.000	405	0.11	0.3	0.0	31.1	C		
											30.9	C
R	0.20	0.24	30.3	1.000	340	0.11	0.3	0.0	30.6	C		
Northbound												
T	0.56	0.64	10.1	1.000	2205	0.50	1.0	0.0	11.1	B	10.7	B
R	0.18	0.64	7.3	1.000	1004	0.50	0.4	0.0	7.8	A		
Southbound												
L	0.47	0.54	14.2	1.000	210	0.50	7.4	0.0	21.6	C		
T	0.61	0.54	15.8	1.000	1878	0.50	1.5	0.0	17.3	B	17.7	B

Intersection Delay = 15.0 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				M
Cycle length, C	100.0 sec			
Total actual green time for LT lane group, G (s)				54.0
Effective permitted green time for LT lane group, g(s)				54.0
Opposing effective green time, go (s)				64.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				2
Adjusted LT flow rate, VLT (veh/h)				99
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.00
Adjusted opposing flow rate, Vo (veh/h)				1229
Lost time for LT lane group, tL				6.00
Computation				
LT volume per cycle, LTC=VLTC/3600				2.75
Opposing lane util. factor, fLUo			0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				17.93
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.36
gq, (see Exhibit C16-4,5,6,7,8)				4.13
gu=g-gq if gq>=gf, or = g-gf if gq<gf				49.87
n=Max(gq-gf)/2,0)				2.06
PTHo=1-PLTo				1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				4.38
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				0.07
gdiff=max(gq-gf,0)				0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.21
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.211

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	100.0 sec			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				0.000 0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo				0.952 0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				4.38
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				0.07
gdiff=max(gq-gf,0)				0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.21
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.211

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	100.0 sec			
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time r=(C-g-gq-gu)				
Arrival rate, qa=v/(3600(max[X,1.0]))				
Protected ph. departure rate, Sp=s/3600				
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 15.0 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound			Westbound			Northbound			Southbound		
				L		R		T	R	L	T	
Init Queue				0.0		0.0		0.0	0.0	0.0	0.0	
Flow Rate				104		67		645	185	99	604	
So				1900		1900		1900	1900	1900	1900	
No.Lanes	0	0	0	1	0	1	0	2	1	1	2	0
SL				1687		1417		1809	1568	389	1826	
LnCapacity				405		340		1158	1004	210	986	
Flow Ratio				0.06		0.05		0.36	0.12	0.25	0.33	
v/c Ratio				0.26		0.20		0.56	0.18	0.47	0.61	
Grn Ratio				0.24		0.24		0.64	0.64	0.54	0.54	
I Factor					1.000			1.000			1.000	
AT or PVG				3		3		3	3	3	3	
Pltn Ratio				1.00		1.00		1.00	1.00	1.00	1.00	
PF2				1.00		1.00		1.00	1.00	1.00	1.00	
Q1				2.3		1.5		10.0	2.1	1.7	11.5	
kB				0.4		0.4		1.4	1.2	0.4	1.2	
Q2				0.1		0.1		1.7	0.3	0.4	1.9	
Q Average				2.5		1.6		11.7	2.4	2.1	13.4	
Q Spacing				7.6		7.6		7.6	7.6	7.6	7.6	
Q Storage				0		0		0	0	0	0	
Q S Ratio												
70th Percentile Output:												
fB%				1.2		1.2		1.2	1.3	1.3	1.2	
BOQ				3.0		1.9		14.1	3.0	2.6	16.2	
QSRatio												
85th Percentile Output:												
fB%				1.6		1.6		1.4	1.6	1.6	1.4	
BOQ				3.9		2.5		16.7	3.8	3.3	19.0	
QSRatio												
90th Percentile Output:												
fB%				1.8		1.8		1.5	1.8	1.8	1.5	
BOQ				4.4		2.8		18.1	4.3	3.8	20.5	
QSRatio												
95th Percentile Output:												
fB%				2.0		2.0		1.7	2.2	2.3	1.7	
BOQ				5.0		3.2		19.8	5.3	4.7	22.3	
QSRatio												
98th Percentile Output:												
fB%				2.5		2.6		1.8	2.6	2.7	1.8	
BOQ				6.3		4.1		21.6	6.3	5.5	24.1	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: AM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Finch Avenue

Inter.: Finch Avenue / Romfield Lane
Area Type: All other areas
Jurisd: City of Toronto
Year: Total Future Conditions
N/S St: Romfield Lane

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	1	0	2	1	1	1	0	1	1	0
LGConfig		LT	R		LT	R	L	TR		L	TR	
Volume	57	1970	12	16	1064	5	20	10	49	15	11	28
Lane Width		3.6	3.6		3.6	3.6	3.6	3.6		3.6	3.6	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left		P			NB Left	A			
Thru		P			Thru	A			
Right		P			Right	A			
Peds					Peds				
WB Left		P			SB Left	A			
Thru		P			Thru	A			
Right		P			Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	57.0					21.0			
Yellow	4.0					3.0			
All Red	2.0					3.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
LT	1830	2890	1.13	0.63	82.6	F	82.2	F
R	1018	1607	0.01	0.63	6.1	A		
Westbound								
LT	1683	2657	0.65	0.63	12.3	B	12.3	B
R	1023	1615	0.00	0.63	6.1	A		
Northbound								
L	309	1323	0.06	0.23	26.9	C		
TR	369	1583	0.16	0.23	27.7	C	27.5	C
Southbound								
L	318	1364	0.05	0.23	26.8	C		
TR	344	1473	0.12	0.23	27.3	C	27.2	C

Intersection Delay = 56.7 (sec/veh) Intersection LOS = E

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:
Fax:

OPERATIONAL ANALYSIS

Analyst: NA
Intersection: Finch Avenue / Romfield Lane
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: AM Peak Hour
Analysis Year: Total Future Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Finch Avenue
North/South Street: Romfield Lane

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	57	1970	12	16	1064	5	20	10	49	15	11	28
% Heavy Veh	0	8	0	0	9	0	5	0	6	0	36	7
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	15	503	3	4	271	2	5	3	13	4	3	7
Hi Ln Vol												
% Grade		1			0			0			0	
Ideal Sat		1900	1900		1900	1900	1900	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	0	2	1	0	2	1	1	1	0	1	1	0
LGConfig		LT	R		LT	R	L	TR		L	TR	
Lane Width		3.6	3.6		3.6	3.6	3.6	3.6		3.6	3.6	
RTOR Vol			0			0			0			0
Adj Flow		2068	12		1102	5	20	60		15	40	
%InSharedLn												
Prop LTs		0.028			0.015		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.833			0.725	
Peds Bikes		0			0			0			0	
Buses		0	0		0	0	0	0		0	0	
%InProtPhase												

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0		0.0	0.0	0.0	0.0		0.0	0.0	
Arriv. Type		3	3		3	3	3	3		3	3	
Unit Ext.		3.0	3.0		3.0	3.0	3.0	3.0		3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time		2.0	2.0		2.0	2.0	2.0	2.0		2.0	2.0	
Ext of g		2.0	2.0		2.0	2.0	2.0	2.0		2.0	2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left		P			NB Left	A			
Thru		P			Thru	A			
Right		P			Right	A			
Peds					Peds				
WB Left		P			SB Left	A			
Thru		P			Thru	A			
Right		P			Right	A			
Peds					Peds				
NB Right					EB Right				

SB Right							WB Right					
Green	57.0					21.0						
Yellow	4.0					3.0						
All Red	2.0					3.0						

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	57	1970	12	16	1064	5	20	10	49	15	11	28
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	58	2010	12	16	1086	5	20	10	50	15	11	29
No. Lanes	0	2	1	0	2	1	1	1	0	1	1	0
Lane group		LT	R		LT	R	L	TR		L	TR	
Adj flow		2068	12		1102	5	20	60		15	40	
Prop LTs		0.028			0.015		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.833			0.725	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LT	R		LT	R	L	TR		L	TR		
So	1900	1900		1900	1900	1900	1900		1900	1900		
Lanes	0 2	1	0	2	1	1	1	0	1	1	0	
fW	1.000	1.000		1.000	1.000	1.000	1.000		1.000	1.000		
fHV	0.928	1.000		0.919	1.000	0.952	0.952		1.000	0.870		
fG	0.995	0.995		1.000	1.000	1.000	1.000		1.000	1.000		
fP	1.000	1.000		1.000	1.000	1.000	1.000		1.000	1.000		
fBB	1.000	1.000		1.000	1.000	1.000	1.000		1.000	1.000		
fA	1.000	1.000		1.000	1.000	1.000	1.000		1.000	1.000		
fLU	0.952	1.000		0.952	1.000	1.000	1.000		1.000	1.000		
fRT	1.000	0.850		1.000	0.850		0.875			0.891		
fLT	0.865			0.800		0.731	1.000		0.718	1.000		
Sec.												
fLpb	1.000			1.000		1.000	1.000		1.000	1.000		
fRpb	1.000	1.000		1.000	1.000		1.000			1.000		
S	2890	1607		2657	1615	1323	1583		1364	1473		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	Lane Group Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	2068	2890	# 0.72	0.63	1830	1.13
Right	R	12	1607	0.01	0.63	1018	0.01
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	1102	2657	0.41	0.63	1683	0.65
Right	R	5	1615	0.00	0.63	1023	0.00
Northbound							
Prot							
Perm							
Left	L	20	1323	0.02	0.23	309	0.06
Prot							
Perm							
Thru	TR	60	1583	# 0.04	0.23	369	0.16
Right							
Southbound							
Prot							
Perm							
Left	L	15	1364	0.01	0.23	318	0.05
Prot							
Perm							
Thru	TR	40	1473	0.03	0.23	344	0.12
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.75
Total lost time per cycle, L = 12.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.87

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	g/C	Unf Del d1	Adj Fact	Prog Cap	Lane Grp	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound													
LT	1.13	0.63	16.5	1.000	1830	0.50	66.1	0.0	82.6	F		82.2	F
R	0.01	0.63	6.1	1.000	1018	0.50	0.0	0.0	6.1	A			
Westbound													
LT	0.65	0.63	10.3	1.000	1683	0.50	2.0	0.0	12.3	B		12.3	B
R	0.00	0.63	6.1	1.000	1023	0.50	0.0	0.0	6.1	A			
Northbound													
L	0.06	0.23	26.9	1.000	309	0.11	0.1	0.0	26.9	C			
TR	0.16	0.23	27.5	1.000	369	0.11	0.2	0.0	27.7	C		27.5	C
Southbound													
L	0.05	0.23	26.7	1.000	318	0.11	0.1	0.0	26.8	C			
TR	0.12	0.23	27.2	1.000	344	0.11	0.2	0.0	27.3	C		27.2	C

Intersection Delay = 56.7 (sec/veh) Intersection LOS = E

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach			M	M
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)			21.0	21.0
Effective permitted green time for LT lane group, g(s)			21.0	21.0
Opposing effective green time, go (s)			21.0	21.0
Number of lanes in LT lane group, N			1	1
Number of lanes in opposing approach, No			1	1
Adjusted LT flow rate, VLT (veh/h)			20	15
Proportion of LT in LT lane group, PLT			1.000	1.000
Proportion of LT in opposing flow, PLTo			0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)			40	60
Lost time for LT lane group, tL			6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.50	0.38
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			1.00	1.50
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.77	0.77
gq, (see Exhibit C16-4,5,6,7,8)			0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf			21.00	21.00
n=Max(gq-gf)/2,0)			0.00	0.00
PTHo=1-PLTo			1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	1.00
EL1 (refer to Exhibit C16-3)			1.37	1.39
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.19	0.19
gdiff=max(gq-gf,0)			0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.73	0.72
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.731	0.718

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=i for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M		
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	57.0	57.0		
Effective permitted green time for LT lane group, g(s)	57.0	57.0		
Opposing effective green time, go (s)	57.0	57.0		
Number of lanes in LT lane group, N	2	2		
Number of lanes in opposing approach, No	2	2		
Adjusted LT flow rate, VLT (veh/h)	58	46		
Proportion of LT in LT lane group, PLT	0.028	0.015	0.000	0.000
Proportion of LT in opposing flow, PLTo	0.01	0.03		
Adjusted opposing flow rate, Vo (veh/h)	1102	2068		
Lost time for LT lane group, tL	6.00	6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	1.45	0.40		
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	14.47	27.15		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	12.0	30.1		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.37	0.37		
gq, (see Exhibit C16-4,5,6,7,8)	9.64	44.21		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	44.97	12.79		
n=Max(gq-gf)/2,0)	0.00	7.06		
PTHo=1-PLTo	0.99	0.97		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.00	0.04		
EL1 (refer to Exhibit C16-3)	4.33	11.34		
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	6.49		
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.04	0.04		
gdiff=max(gq-gf,0)	0.00	14.13		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.82	0.69		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.865	0.800		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=i for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time r=(C-g-gq-gu)				
Arrival rate, qa=v/(3600(max[X,1.0]))				
Protected ph. departure rate, Sp=s/3600				
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 56.7 sec/veh Intersection LOS E

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound LT	R	Westbound LT	R	Northbound L	TR	Southbound L	TR
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	1086	12	578	5	20	60	15	40
So	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	2	1	2	1	1	0	1	0
SL	1517	1607	1395	1615	1323	1583	1364	1473
LnCapacity	961	1018	883	1023	309	369	318	344
Flow Ratio	0.72	0.01	0.41	0.00	0.02	0.04	0.01	0.03
v/c Ratio	1.13	0.01	0.65	0.00	0.06	0.16	0.05	0.12
Grn Ratio	0.63	0.63	0.63	0.63	0.23	0.23	0.23	0.23
I Factor	1.000		1.000		1	1.000		1.000
AT or PVG	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	27.1	0.1	9.1	0.0	0.4	1.2	0.3	0.8
kB	1.1	1.2	1.0	1.2	0.3	0.4	0.3	0.4
Q2	22.4	0.0	1.9	0.0	0.0	0.1	0.0	0.0
Q Average	49.5	0.1	10.9	0.1	0.4	1.3	0.3	0.8
Q Spacing	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Q Storage	0	0	0	0	0	0	0	0
Q S Ratio								
70th Percentile Output:								
fB%	1.2	1.3	1.2	1.3	1.2	1.2	1.2	1.2
BOQ	59.4	0.2	13.3	0.1	0.5	1.5	0.4	1.0
QSRatio								
85th Percentile Output:								
fB%	1.4	2.7	1.4	1.7	1.6	1.6	1.6	1.6
BOQ	69.3	0.2	15.7	0.1	0.7	2.0	0.5	1.3
QSRatio								
90th Percentile Output:								
fB%	1.5	2.0	1.6	2.0	1.8	1.8	1.8	1.8
BOQ	74.3	0.2	17.0	0.1	0.7	2.3	0.6	1.5
QSRatio								
95th Percentile Output:								
fB%	1.6	2.6	1.7	2.6	2.1	2.1	2.1	2.1
BOQ	79.2	0.3	18.7	0.1	0.9	2.6	0.6	1.7
QSRatio								
98th Percentile Output:								
fB%	1.7	3.2	1.9	3.2	2.7	2.6	2.7	2.6
BOQ	84.2	0.4	20.4	0.2	1.1	3.3	0.8	2.2
QSRatio								

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: AM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Finch Avenue

Inter.: Finch Avenue / Tangiers Rd
Area Type: All other areas
Jurisd: City of Toronto
Year: Total Future Conditions
N/S St: Tangiers Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes		1	2	1		1	2	1			1	2	0
LGConfig	L		T	R	L		T	R	L	TR		L	TR	
Volume	65	1557	130	20	1906	79	67	21	43	80	23	32	
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6		3.6	3.6		
RTOR Vol			0			0			0			0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left		P			NB Left	A		
Thru		P			Thru	A		
Right		P			Right	A		
Peds					Peds			
WB Left		P			SB Left	A		
Thru		P			Thru	A		
Right		P			Peds			
Peds								
NB Right					EB Right			
SB Right					WB Right			
Green	54.0				24.0			
Yellow	4.0				4.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	80	125	0.82	0.60	74.4	E		
T	2000	3333	0.79	0.60	17.1	B	18.6	B
R	861	1435	0.15	0.60	8.3	A		
Westbound								
L	97	161	0.21	0.60	13.0	B		
T	2048	3413	0.95	0.60	27.9	C	26.9	C
R	897	1495	0.09	0.60	7.8	A		
Northbound								
L	340	1276	0.20	0.27	25.9	C		
TR	759	2845	0.09	0.27	24.8	C	25.3	C
Southbound								
L	361	1354	0.23	0.27	26.1	C		
TR	859	3222	0.07	0.27	24.7	C	25.5	C

Intersection Delay = 23.2 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

Phone: Fax:
E-Mail:

OPERATIONAL ANALYSIS

Analyst: NA
Intersection: Finch Avenue / Tangiers Rd
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: AM Peak Hour
Analysis Year: Total Future Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Finch Avenue North/South Street: Tangiers Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	65	1557	130	20	1906	79	67	21	43	80	23	32
% Heavy Veh	12	8	12	0	6	8	7	19	12	0	0	4
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	17	397	33	5	486	20	17	6	11	20	6	8
Hi Ln Vol		1			0			0			0	
% Grade												
Ideal Sat	1900	1900	1900	1900	1900	1900	1900	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes		1	2	1		1	2	1			1	2	0
LGConfig	L		T	R	L		T	R	L	TR		L	TR	
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6		3.6	3.6		
RTOR Vol			0			0			0			0	
Adj Flow	66	1589	133	20	1945	81	68	65		82	56		
%InSharedLn													
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000		
Prop RTs		0.000	1.000		0.000	1.000		0.677			0.589		
Peds Bikes		0			0			0			0		
Buses	0	0	0	0	0	0	0	0		0	0		
%InProtPhase													
Duration	0.25			Area Type: All other areas									

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Arriv. Type	3	3	3	3	3	3	3	3		3	3	
Unit Ext.	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0		2.0	2.0	
Ext of g	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0		2.0	2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left		P			NB Left	A		
Thru		P			Thru	A		
Right		P			Right	A		
Peds					Peds			
WB Left		P			SB Left	A		
Thru		P			Thru	A		
Right		P			Right	A		
Peds					Peds			
NB Right					EB Right			

SB Right					WB Right			
Green	54.0				24.0			
Yellow	4.0				4.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	65	1557	130	20	1906	79	67	21	43	80	23	32
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	66	1589	133	20	1945	81	68	21	44	82	23	33
No. Lanes		1	2	1		1	2	1			1	2	0
Lane group	L		T	R	L		T	R	L	TR		L	TR	
Adj flow	66	1589	133		20	1945	81		68	65		82	56	
Prop LTs	1.000	0.000			1.000	0.000			1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000			0.000	1.000			0.677			0.589	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound				Westbound				Northbound				Southbound			
LG	L		T	R	L		T	R	L		TR		L		TR	
So	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900			1900	1900		
Lanes	1	2	1	1	2	1	1	2	0	1	2	0				
fW	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fHV	0.893	0.926	0.893	1.000	0.943	0.926	0.935	0.875		1.000	0.977					
fG	0.995	0.995	0.995	1.000	1.000	1.000	1.000	1.000		1.000	1.000					
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000	1.000					
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000	1.000					
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000	1.000					
fLU	1.000	0.952	1.000	1.000	0.952	1.000	1.000	0.952		1.000	0.952					
fRT		1.000	0.850		1.000	0.850		0.898			0.912					
fLT	0.074	1.000		0.085	1.000		0.719	1.000		0.713	1.000					
Sec.																
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000					
fRpb		1.000	1.000		1.000	1.000		1.000			1.000					
S	125	3333	1435	161	3413	1495	1276	2845		1354	3222					
Sec.																

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	66	125	0.53	0.60	80	0.82
Prot							
Perm							
Thru	T	1589	3333	0.48	0.60	2000	0.79
Right	R	133	1435	0.09	0.60	861	0.15
Westbound							
Prot							
Perm							
Left	L	20	161	0.12	0.60	97	0.21
Prot							
Perm							
Thru	T	1945	3413	# 0.57	0.60	2048	0.95
Right	R	81	1495	0.05	0.60	897	0.09
Northbound							
Prot							
Perm							
Left	L	68	1276	0.05	0.27	340	0.20
Prot							
Perm							
Thru	TR	65	2845	0.02	0.27	759	0.09
Right							
Southbound							
Prot							
Perm							
Left	L	82	1354	# 0.06	0.27	361	0.23
Prot							
Perm							
Thru	TR	56	3222	0.02	0.27	859	0.07
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.63
Total lost time per cycle, L = 12.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.73

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.82	0.60	14.3	1.000	80	0.50	60.1	0.0	74.4	E		
T	0.79	0.60	13.8	1.000	2000	0.50	3.4	0.0	17.1	B	18.6	B
R	0.15	0.60	7.9	1.000	861	0.50	0.4	0.0	8.3	A		
Westbound												
L	0.21	0.60	8.2	1.000	97	0.50	4.8	0.0	13.0	B		
T	0.95	0.60	16.7	1.000	2048	0.50	11.1	0.0	27.9	C	26.9	C
R	0.09	0.60	7.6	1.000	897	0.50	0.2	0.0	7.8	A		
Northbound												
L	0.20	0.27	25.6	1.000	340	0.11	0.3	0.0	25.9	C		
TR	0.09	0.27	24.8	1.000	759	0.11	0.0	0.0	24.8	C	25.3	C
Southbound												
L	0.23	0.27	25.8	1.000	361	0.11	0.3	0.0	26.1	C		
TR	0.07	0.27	24.6	1.000	859	0.11	0.0	0.0	24.7	C	25.5	C

Intersection Delay = 23.2 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	54.0	54.0	24.0	24.0
Effective permitted green time for LT lane group, g(s)	54.0	54.0	24.0	24.0
Opposing effective green time, go (s)	54.0	54.0	24.0	24.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	2	2	2	2
Adjusted LT flow rate, VLT (veh/h)	66	20	68	82
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	1945	1589	56	65
Lost time for LT lane group, tL	6.00	6.00	6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600	1.65	0.50	1.70	2.05
Opposing lane util. factor, fLUo	0.952	0.952	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	25.54	20.86	0.74	0.85
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.40	0.40	0.73	0.73
gq, (see Exhibit C16-4,5,6,7,8)	41.24	25.12	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	12.76	28.88	24.00	24.00
n=Max(gq-gf)/2,0)	20.62	12.56	0.00	0.00
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	9.06	6.29	1.39	1.40
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07	0.07	0.17	0.17
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.07	0.08	0.72	0.71
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.074	0.085	0.719	0.713

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time r=(C-g-gq-gu)				
Arrival rate, qa=v/(3600(max[X,1.0]))				
Protected ph. departure rate, Sp=s/3600				
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 23.2 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	T	R	L	T	R	L	TR		L	TR	
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Flow Rate	66	834	133	20	1021	81	68	34		82	29	
So	1900	1900	1900	1900	1900	1900	1900	1900		1900	1900	
No.Lanes	1	2	1	1	2	1	1	2	0	1	2	0
SL	125	1750	1435	161	1792	1495	1276	1494		1354	1692	
LnCapacity	80	1050	861	97	1075	897	340	398		361	451	
Flow Ratio	0.53	0.48	0.09	0.12	0.57	0.05	0.05	0.02		0.06	0.02	
v/c Ratio	0.82	0.79	0.15	0.21	0.95	0.09	0.20	0.09		0.23	0.06	
Grn Ratio	0.60	0.60	0.60	0.60	0.60	0.60	0.27	0.27		0.27	0.27	
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3	3	3	3	3	3	3		3	3	
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Q1	1.3	15.9	1.5	0.2	23.7	0.9	1.3	0.6		1.6	0.5	
kB	0.2	1.2	1.0	0.2	1.2	1.1	0.4	0.4		0.4	0.4	
Q2	0.6	4.0	0.2	0.1	9.5	0.1	0.1	0.0		0.1	0.0	
Q Average	1.9	19.9	1.7	0.3	33.2	1.0	1.4	0.7		1.7	0.6	
Q Spacing	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6		7.6	7.6	
Q Storage	0	0	0	0	0	0	0	0		0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.3	1.2	1.3	1.3	1.2	1.3	1.2	1.2		1.2	1.2	
BOQ	2.5	23.9	2.1	0.4	39.8	1.2	1.7	0.8		2.0	0.7	
QSRatio												
85th Percentile Output:												
fB%	1.6	1.4	1.6	1.7	1.4	1.6	1.6	1.6		1.6	1.6	
BOQ	3.1	28.0	2.7	0.5	46.5	1.6	2.2	1.1		2.7	0.9	
QSRatio												
90th Percentile Output:												
fB%	1.8	1.5	1.9	2.0	1.5	1.9	1.8	1.8		1.8	1.8	
BOQ	3.6	30.1	3.1	0.6	49.8	1.8	2.5	1.2		3.0	1.0	
QSRatio												
95th Percentile Output:												
fB%	2.3	1.6	2.3	2.5	1.6	2.4	2.1	2.1		2.0	2.1	
BOQ	4.4	32.2	3.8	0.7	53.2	2.3	2.9	1.4		3.5	1.2	
QSRatio												
98th Percentile Output:												
fB%	2.7	1.7	2.8	3.1	1.7	2.9	2.6	2.6		2.6	2.7	
BOQ	5.3	34.4	4.6	0.9	56.5	2.8	3.7	1.8		4.4	1.5	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: AM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Finch Avenue

Inter.: Finch Avenue / CNR Service Rd
Area Type: All other areas
Jurisd: City of Toronto
Year: Total Future Conditions
N/S St: CNR Service Rd

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	0	1	2	0	1	1	0	1	1	0
LGConfig	L	TR		L	TR		L	TR		L	TR	
Volume	13	1676	43	78	1332	8	28	0	20	4	1	11
Lane Width	3.6	3.6		3.6	3.6		3.6	3.6		3.6	3.6	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left		P			NB Left	A			
Thru		P			Thru	A			
Right		P			Right	A			
Peds					Peds				
WB Left		P			SB Left	A			
Thru		P			Thru	A			
Right		P			Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green		57.0				21.0			
Yellow		4.0				3.0			
All Red		2.0				3.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	97	153	0.13	0.63	9.5	A		
TR	2066	3262	0.85	0.63	17.7	B	17.6	B
Westbound								
L	82	129	0.98	0.63	108.7	F		
TR	2075	3277	0.66	0.63	12.0	B	17.4	B
Northbound								
L	320	1370	0.09	0.23	27.1	C		
TR	343	1468	0.06	0.23	26.9	C	27.0	C
Southbound								
L	165	707	0.02	0.23	26.7	C		
TR	210	898	0.06	0.23	26.9	C	26.9	C

Intersection Delay = 17.7 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:
Fax:

OPERATIONAL ANALYSIS

Analyst: NA
Intersection: Finch Avenue / CNR Service Rd
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: AM Peak Hour
Analysis Year: Total Future Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Finch Avenue
North/South Street: CNR Service Rd

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	13	1676	43	78	1332	8	28	0	20	4	1	11
% Heavy Veh	77	10	7	3	10	63	4	0	10	100	0	90
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	4	428	11	20	340	2	7	0	5	1	1	3
Hi Ln Vol												
% Grade		1			0			0			0	
Ideal Sat	1900	1900		1900	1900		1900	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	2	0	1	2	0	1	1	0	1	1	0
LGConfig	L	TR		L	TR		L	TR		L	TR	
Lane Width	3.6	3.6		3.6	3.6		3.6	3.6		3.6	3.6	
RTOR Vol			0			0			0			0
Adj Flow	13	1754		80	1367		29	20		4	12	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs	0.025			0.006			1.000			0.917		
Peds Bikes	0			0			0			0		
Buses	0	0		0	0		0	0		0	0	
%InProtPhase												

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Arriv. Type	3	3		3	3		3	3		3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Ext of g	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left		P			NB Left	A			
Thru		P			Thru	A			
Right		P			Right	A			
Peds					Peds				
WB Left		P			SB Left	A			
Thru		P			Thru	A			
Right		P			Right	A			
Peds					Peds				
NB Right					EB Right				

SB Right			WB Right	
Green	57.0			21.0
Yellow	4.0			3.0
All Red	2.0			3.0

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	13	1676	43	78	1332	8	28	0	20	4	1	11
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	13	1710	44	80	1359	8	29	0	20	4	1	11
No. Lanes	1	2	0	1	2	0	1	1	0	1	1	0
Lane group	L	TR		L	TR		L	TR		L	TR	
Adj flow	13	1754		80	1367		29	20		4	12	
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs	0.025			0.006			1.000			0.917		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	TR		L	TR		L	TR		L	TR	
So	1900	1900		1900	1900		1900	1900		1900	1900	
Lanes	1	2	0	1	2	0	1	1	0	1	1	0
fW	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fHV	0.565	0.910		0.971	0.907		0.962	0.909		0.500	0.548	
fG	0.995	0.995		1.000	1.000		1.000	1.000		1.000	1.000	
fP	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fBB	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fA	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fLU	1.000	0.952		1.000	0.952		1.000	1.000		1.000	1.000	
fRT		0.996			0.999			0.850			0.863	
fLT	0.143	1.000		0.070	1.000		0.750	1.000		0.744	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000			1.000			1.000			1.000	
S	153	3262		129	3277		1370	1468		707	898	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	13	153	0.08	0.63	97	0.13
Prot							
Perm							
Thru	TR	1754	3262	0.54	0.63	2066	0.85
Right							
Westbound							
Prot							
Perm							
Left	L	80	129	# 0.62	0.63	82	0.98
Prot							
Perm							
Thru	TR	1367	3277	0.42	0.63	2075	0.66
Right							
Northbound							
Prot							
Perm							
Left	L	29	1370	# 0.02	0.23	320	0.09
Prot							
Perm							
Thru	TR	20	1468	0.01	0.23	343	0.06
Right							
Southbound							
Prot							
Perm							
Left	L	4	707	0.01	0.23	165	0.02
Prot							
Perm							
Thru	TR	12	898	0.01	0.23	210	0.06
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.64
Total lost time per cycle, L = 12.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.74

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.13	0.63	6.6	1.000	97	0.50	2.9	0.0	9.5	A		
TR	0.85	0.63	13.1	1.000	2066	0.50	4.6	0.0	17.7	B	17.6	B
Westbound												
L	0.98	0.63	15.8	1.000	82	0.50	92.8	0.0	108.7	F		
TR	0.66	0.63	10.4	1.000	2075	0.50	1.7	0.0	12.0	B	17.4	B
Northbound												
L	0.09	0.23	27.0	1.000	320	0.11	0.1	0.0	27.1	C		
TR	0.06	0.23	26.8	1.000	343	0.11	0.1	0.0	26.9	C	27.0	C
Southbound												
L	0.02	0.23	26.6	1.000	165	0.11	0.1	0.0	26.7	C		
TR	0.06	0.23	26.8	1.000	210	0.11	0.1	0.0	26.9	C	26.9	C

Intersection Delay = 17.7 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	57.0	57.0	21.0	21.0
Effective permitted green time for LT lane group, g(s)	57.0	57.0	21.0	21.0
Opposing effective green time, go (s)	57.0	57.0	21.0	21.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	2	2	1	1
Adjusted LT flow rate, VLT (veh/h)	13	80	29	4
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	1367	1754	12	20
Lost time for LT lane group, tL	6.00	6.00	6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.33	2.00	0.73	0.10
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	17.95	23.03	0.30	0.50
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.37	0.37	0.77	0.77
gq, (see Exhibit C16-4,5,6,7,8)	15.90	28.59	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	41.10	28.41	21.00	21.00
n=Max(gq-gf)/2,0)	7.95	14.30	0.00	0.00
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	5.03	7.45	1.33	1.34
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07	0.07	0.19	0.19
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.14	0.07	0.75	0.74
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.143	0.070	0.750	0.744

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=i for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=i for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time r=(C-g-gq-gu)				
Arrival rate, qa=v/(3600(max[X,1.0]))				
Protected ph. departure rate, Sp=s/3600				
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 17.7 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound L	Eastbound TR	Westbound L	Westbound TR	Northbound L	Northbound TR	Southbound L	Southbound TR
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	13	921	80	717	29	20	4	12
So	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	2 0	1	2 0	1	1 0	1	1 0
SL	153	1713	129	1721	1370	1468	707	898
LnCapacity	97	1085	82	1089	320	343	165	210
Flow Ratio	0.08	0.54	0.62	0.42	0.02	0.01	0.01	0.01
v/c Ratio	0.13	0.85	0.98	0.66	0.09	0.06	0.02	0.06
Grn Ratio	0.63	0.63	0.63	0.63	0.23	0.23	0.23	0.23
I Factor		1.000		1.000		1.000		1.000
AT or PVG	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	0.1	18.3	1.9	11.3	0.6	0.4	0.1	0.2
kB	0.2	1.2	0.2	1.2	0.3	0.4	0.2	0.3
Q2	0.0	5.4	1.3	2.2	0.0	0.0	0.0	0.0
Q Average	0.2	23.6	3.2	13.5	0.6	0.4	0.1	0.2
Q Spacing	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Q Storage	0	0	0	0	0	0	0	0
Q S Ratio								
70th Percentile Output:								
fB%			1.3	1.2	1.2	1.2	1.2	1.2
BOQ	0.2	28.4	4.0	16.3	0.7	0.5	0.1	0.3
QSRatio								
85th Percentile Output:								
fB%			1.6	1.4	1.6	1.6	1.6	1.6
BOQ	0.3	33.2	5.0	19.2	1.0	0.7	0.1	0.4
QSRatio								
90th Percentile Output:								
fB%			1.8	1.5	1.8	1.8	1.8	1.8
BOQ	0.3	35.6	5.7	20.7	1.1	0.7	0.1	0.4
QSRatio								
95th Percentile Output:								
fB%			2.1	1.7	2.1	2.1	2.1	2.1
BOQ	0.4	38.0	6.8	22.5	1.3	0.9	0.2	0.5
QSRatio								
98th Percentile Output:								
fB%			3.2	1.7	2.5	1.8	2.7	2.7
BOQ	0.5	40.5	8.0	24.3	1.6	1.1	0.2	0.7
QSRatio								

ERROR MESSAGES

No errors to report.

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst:	NA
Agency/Co.:	URS Canada Inc.
Date Performed:	5/17/2005
Analysis Time Period:	AM Peak Hour
Intersection:	Keele Street/Bus Terminal
Jurisdiction:	City of Toronto
Units: U. S. Metric	
Analysis Year:	Total Future Conditions
Project ID: TTC Spadina Station Extension	
East/West Street:	Bus Terminal Access
North/South Street:	Keele Street
Intersection Orientation: NS	Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		1581	37		1345	
Peak-Hour Factor, PHF		0.98	0.90		0.98	
Hourly Flow Rate, HFR		1613	41		1372	
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Undivided		/			
RT Channelized?						
Lanes		2	0		2	
Configuration		T	TR		T	
Upstream Signal?		Yes			Yes	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume			0			
Peak Hour Factor, PHF			0.98			
Hourly Flow Rate, HFR			0			
Percent Heavy Vehicles			0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
Lanes			1			
Configuration			R			

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config					R			
v (vph)					0			
C(m) (vph)					781			
v/c					0.00			
95% queue length					0.00			
Control Delay					9.6			
LOS					A			
Approach Delay								
Approach LOS								

HCS2000: Unsignalized Intersections Release 4.1d

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst:	NA
Agency/Co.:	URS Canada Inc.
Date Performed:	5/17/2005
Analysis Time Period:	AM Peak Hour
Intersection:	Keele Street/Bus Terminal
Jurisdiction:	City of Toronto
Units: U. S. Metric	
Analysis Year:	Total Future Conditions
Project ID: TTC Spadina Station Extension	
East/West Street:	Bus Terminal Access
North/South Street:	Keele Street
Intersection Orientation: NS	Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		1581	37		1345	
Peak-Hour Factor, PHF		0.98	0.90		0.98	
Peak-15 Minute Volume		403	10		343	
Hourly Flow Rate, HFR		1613	41		1372	
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Undivided		/			
RT Channelized?						
Lanes		2	0		2	
Configuration		T	TR		T	
Upstream Signal?		Yes			Yes	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume			0			
Peak Hour Factor, PHF			0.98			
Peak-15 Minute Volume			0			
Hourly Flow Rate, HFR			0			
Percent Heavy Vehicles			0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
RT Channelized			No			
Lanes			1			
Configuration			R			

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0
Lane Width (m)	3.6	3.6	3.6	3.6
Walking Speed (m/sec)	1.2	1.2	1.2	1.2
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed kph	Distance to Signal meters
S2 Left-Turn	168	1700	3	34	90	60	130
Through	1062	1700	3	27	90	60	130
S5 Left-Turn	51	1700	3	28	90	60	125
Through	1119	1700	3	49	90	60	125

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)					6.9			
t(c,hv)	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)					0			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Grade/100			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)					0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage					6.9			
2-stage								

Follow-Up Time Calculations

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)					3.30			
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)					0			
t(f)					3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog	1062	168	1119	51
Total Saturation Flow Rate, s (vph)	3400	3400	3400	3400
Arrival Type	3	3	3	3
Effective Green, g (sec)	27	34	49	28
Cycle Length, C (sec)	90	90	90	90
Rp (from Exhibit 16-11)	1.000	1.000	1.000	1.000
Proportion vehicles arriving on green P	0.300	0.378	0.544	0.311
g(q1)	19.7	2.8	13.5	0.9
g(q2)	8.9	0.1	6.6	0.0
g(q)	28.6	2.9	20.1	0.9

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha		0.500		0.500
beta		0.667		0.667
Travel time, t(a) (sec)		7.794		7.494
Smoothing Factor, F		0.278		0.286
Proportion of conflicting flow, f	1.000	1.000	1.000	1.000
Max platooned flow, V(c,max)	3400	2082	3396	926
Min platooned flow, V(c,min)	2000	2000	2000	2000
Duration of blocked period, t(p)	24.3	0.3	20.3	0.0
Proportion time blocked, p		0.273		0.226

Computation 3-Platoon Event Periods	Result
p(2)	0.273
p(5)	0.226
p(dom)	0.273
p(subo)	0.226
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)	0.727		
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x					827			
s					3000			
Px					0.727			
V c,u,x					10			
C r,x					1075			
C plat,x					781			

Two-Stage Process

	7		8		10		11	
	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s								
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	827	
Potential Capacity	781	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	781	
Probability of Queue free St.	1.00	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Result for 2 stage process:		
a		
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Results for Two-stage process:		
a		
y		
C t		

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)			0			
Movement Capacity (vph)			781			
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep			781			
Volume			0			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config					R			
v (vph)					0			
C(m) (vph)					781			
v/c					0.00			
95% queue length					0.00			
Control Delay					9.6			
LOS					A			
Approach Delay								
Approach LOS								

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: PM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Murray Ross Pkwy
Inter.: Keele St / Murray Ross Pkwy
Area Type: All other areas
Jurisd: City of Toronto
Year: Total Future Conditions
N/S St: Keele St

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	1	1	1	0	1	2	0	1	2	1
LGConfig	L	T	R	L	TR		L	TR		L	T	R
Volume	71	0	35	41	3	90	31	1281	6	23	1658	253
Lane Width	3.6	3.6	3.6	3.6	3.6		3.6	3.6		3.6	3.6	3.6
RTOR Vol			17			45			2			126

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	24.0				82.0			
Yellow	4.0				4.0			
All Red	3.0				3.0			

Cycle Length: 120.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	273	1364	0.26	0.20	42.9	D		
T	380	1900	0.00	0.20	38.4	D	42.1	D
R	323	1615	0.06	0.20	39.2	D		
Westbound								
L	60	158	0.70	0.20	95.5	F		
TR	209	1044	0.23	0.20	42.9	D	67.2	E
Northbound								
L	114	167	0.28	0.68	13.5	B		
TR	2325	3402	0.56	0.68	10.8	B	10.8	B
Southbound								
L	117	171	0.20	0.68	10.7	B		
T	1489	2179	1.14	0.68	89.2	F	82.4	F
R	1093	1599	0.12	0.68	6.8	A		

Intersection Delay = 52.4 (sec/veh) Intersection LOS = D

HCS2000: Signalized Intersections Release 4.1e

Phone: Fax:
E-Mail:

OPERATIONAL ANALYSIS

Analyst: NA
Intersection: Keele St / Murray Ross Pkwy
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: PM Peak Hour
Analysis Year: Total Future Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Murray Ross Pkwy
North/South Street: Keele St

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	71	0	35	41	3	90	31	1281	6	23	1658	253
% Heavy Veh	1	0	0	100	0	60	3	6	100	87	66	1
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	18	0	9	11	1	23	8	327	2	6	423	65
Hi Ln Vol		0			0			0			0	
% Grade												
Ideal Sat	1900	1900	1900	1900	1900		1900	1900		1900	1900	1900
ParkExist												
NumPark												
No. Lanes	1	1	1	1	1	0	1	2	0	1	2	1
LGConfig	L	T	R	L	TR		L	TR		L	T	R
Lane Width	3.6	3.6	3.6	3.6	3.6		3.6	3.6		3.6	3.6	3.6
RTOR Vol			17			45			2			126
Adj Flow	72	0	18	42	49		32	1311		23	1692	130
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.939			0.003			0.000	1.000
Peds Bikes	0			0			0			0		
Buses	0	0	0	0	0		0	0		0	0	0
%InProtPhase												

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	0.0
Arriv. Type	3	3	3	3	3		3	3		3	3	3
Unit Ext.	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	2.0
Ext of g	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	2.0
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	24.0				82.0			
Yellow	4.0				4.0			
All Red	3.0				3.0			

Cycle Length: 120.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	71	0	35	41	3	90	31	1281	6	23	1658	253
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	72	0	18	42	3	46	32	1307	4	23	1692	130
No. Lanes	1	1	1	1	1	0	1	2	0	1	2	1
Lane group	L	T	R	L	TR		L	TR		L	T	R
Adj flow	72	0	18	42	49		32	1311		23	1692	130
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.939			0.003			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	T	R	L	T	R	L	T	R	L	T	R
So	1900	1900	1900	1900	1900		1900	1900		1900	1900	1900
Lanes	1	1	1	1	1	0	1	2	0	1	2	1
fW	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	1.000
fHV	0.990	1.000	1.000	0.500	0.640		0.971	0.941		0.535	0.602	0.990
fG	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	1.000
fA	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	1.000
fLU	1.000	1.000	1.000	1.000	1.000		1.000	0.952		1.000	0.952	1.000
fRT		1.000	0.850		0.859			1.000			1.000	0.850
fLT	0.725	1.000		0.167	1.000		0.091	1.000		0.168	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000	1.000		1.000			1.000			1.000	1.000
S	1364	1900	1615	158	1044		167	3402		171	2179	1599
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	72	1364	0.05	0.20	273	0.26
Prot							
Perm							
Thru	T	0	1900	0.00	0.20	380	0.00
Right	R	18	1615	0.01	0.20	323	0.06
Westbound							
Prot							
Perm							
Left	L	42	158	# 0.27	0.20	60	0.70
Prot							
Perm							
Thru	TR	49	1044	0.05	0.20	209	0.23
Right							
Northbound							
Prot							
Perm							
Left	L	32	167	0.19	0.68	114	0.28
Prot							
Perm							
Thru	TR	1311	3402	0.39	0.68	2325	0.56
Right							
Southbound							
Prot							
Perm							
Left	L	23	171	0.13	0.68	117	0.20
Prot							
Perm							
Thru	T	1692	2179	# 0.78	0.68	1489	1.14
Right	R	130	1599	0.08	0.68	1093	0.12

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 1.04
Total lost time per cycle, L = 14.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.18

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.26	0.20	40.5	1.000	273	0.50	2.3	0.0	42.9	D		
T	0.00	0.20	38.4	1.000	380	0.50	0.0	0.0	38.4	D	42.1	D
R	0.06	0.20	38.8	1.000	323	0.50	0.3	0.0	39.2	D		
Westbound												
L	0.70	0.20	44.7	1.000	60	0.50	50.8	0.0	95.5	F		
TR	0.23	0.20	40.3	1.000	209	0.50	2.6	0.0	42.9	D	67.2	E
Northbound												
L	0.28	0.68	7.4	1.000	114	0.50	6.0	0.0	13.5	B		
TR	0.56	0.68	9.8	1.000	2325	0.50	1.0	0.0	10.8	B	10.8	B
Southbound												
L	0.20	0.68	7.0	1.000	117	0.50	3.7	0.0	10.7	B		
T	1.14	0.68	19.0	1.000	1489	0.50	70.2	0.0	89.2	F	82.4	F
R	0.12	0.68	6.5	1.000	1093	0.50	0.2	0.0	6.8	A		

Intersection Delay = 52.4 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)	24.0	24.0	82.0	82.0
Effective permitted green time for LT lane group, g(s)	24.0	24.0	82.0	82.0
Opposing effective green time, go (s)	24.0	24.0	82.0	82.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	1	1	2	2
Adjusted LT flow rate, VLT (veh/h)	72	42	32	23
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	49	0	1692	1311
Lost time for LT lane group, tL	7.00	7.00	7.00	7.00
Computation				
LT volume per cycle, LTC=VLTC/3600	2.40	1.40	1.07	0.77
Opposing lane util. factor, fLUo	1.000	1.000	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	1.63	0.00	29.62	22.95
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.80	0.80	0.32	0.32
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	30.05	16.54
gu=g-gq if gq>=gf, or = g-gf if gq<gf	24.00	24.00	51.95	65.46
n=Max(gq-gf)/2,0)	0.00	0.00	15.03	8.27
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	1.38	1440.00		6.99
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.17	0.17	0.05	0.05
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.73	0.17	0.09	0.17
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.725	0.167	0.091	0.168

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=i for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=i for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 120.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time r=(C-g-gq-gu)				
Arrival rate, qa=v/(3600(max[X,1.0]))				
Protected ph. departure rate, Sp=s/3600				
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 52.4 sec/veh Intersection LOS D

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound L	T	R	Westbound L	TR	Northbound L	TR	Southbound L	T	R
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	72	0	18	42	49	32	688	23	888	130
So	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	1	1	1	1 0	1	2 0	1	2	1
SL	1364	1900	1615	158	1044	167	1786	171	1144	1599
LnCapacity	273	380	323	60	209	114	1221	117	782	1093
Flow Ratio	0.05	0.00	0.01	0.27	0.05	0.19	0.39	0.13	0.78	0.08
v/c Ratio	0.26	0.00	0.06	0.70	0.23	0.28	0.56	0.20	1.14	0.12
Grn Ratio	0.20	0.20	0.20	0.20	0.20	0.68	0.68	0.68	0.68	0.68
I Factor					1.000		1.000			
AT or PVG	3	3	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	2.0	0.0	0.5	1.3	1.4	0.4	11.8	0.3	29.6	1.5
kB	0.6	0.7	0.6	0.1	0.5	0.3	1.6	0.3	1.2	1.5
Q2	0.2	0.0	0.0	0.3	0.1	0.1	2.0	0.1	19.8	0.2
Q Average	2.2	0.0	0.5	1.6	1.5	0.5	13.8	0.4	49.4	1.7
Q Spacing	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Q Storage	0	0	0	0	0	0	0	0	0	0
Q S Ratio										
70th Percentile Output:										
fB%	1.3	1.3	1.3	1.3	1.3	1.3	1.2	1.3	1.2	1.3
BOQ	2.8	0.0	0.7	2.0	1.9	0.7	16.7	0.5	59.3	2.2
QSRatio										
85th Percentile Output:										
fB%	1.6	1.7	1.7	1.6	1.6	1.7	1.4	1.7	1.4	1.6
BOQ	3.5	0.0	0.9	2.5	2.5	0.9	19.6	0.6	69.2	2.7
QSRatio										
90th Percentile Output:										
fB%	1.8	2.2	2.0	1.9	1.9	1.9	1.5	2.0	1.5	1.9
BOQ	4.1	0.0	1.0	2.9	2.8	1.0	21.2	0.7	74.1	3.1
QSRatio										
95th Percentile Output:										
fB%	2.2	2.6	2.5	2.3	2.3	2.5	1.7	2.5	1.6	2.3
BOQ	5.0	0.0	1.3	3.6	3.5	1.3	23.0	0.9	79.1	3.9
QSRatio										
98th Percentile Output:										
fB%	2.7	3.2	3.1	2.8	2.8	3.0	1.8	3.1	1.7	2.8
BOQ	5.9	0.0	1.6	4.4	4.2	1.6	24.8	1.1	84.0	4.7
QSRatio										

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: PM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Four Winds Drive

Inter.: Keele St / Four Winds Dr
Area Type: All other areas
Jurisd: City of Toronto
Year: Total Future Conditions
N/S St: Keele St

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	1	0	1	2	1	1	2	1
LGConfig	L	TR		L	TR		L	T	R	L	T	R
Volume	66	0	135	37	0	14	219	1105	0	14	1601	102
Lane Width	3.6	3.6		3.6	3.6		3.6	3.6	3.6	3.6	3.6	3.6
RTOR Vol		0			0			0			0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	24.0				82.0			
Yellow	4.0				4.0			
All Red	3.0				3.0			

Cycle Length: 120.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	282	1408	0.24	0.20	42.3	D		
TR	323	1615	0.43	0.20	46.1	D	44.8	D
Westbound								
L	122	610	0.31	0.20	47.5	D		
TR	202	1009	0.07	0.20	39.6	D	45.4	D
Northbound								
L	127	186	1.76	0.68	389.4	F		
T	2332	3413	0.48	0.68	9.7	A	72.4	E
R	552	808	0.00	0.68	6.0	A		
Southbound								
L	150	220	0.09	0.68	7.7	A		
T	1489	2179	1.10	0.68	73.7	E	69.2	E
R	1093	1599	0.10	0.68	6.6	A		

Intersection Delay = 68.6 (sec/veh) Intersection LOS = E

HCS2000: Signalized Intersections Release 4.1e

Phone: Fax:
E-Mail:

OPERATIONAL ANALYSIS

Analyst: NA
Intersection: Keele St / Four Winds Dr
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: PM Peak Hour
Analysis Year: Total Future Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Four Winds Drive North/South Street: Keele St

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	66	0	135	37	0	14	219	1105	0	14	1601	102
% Heavy Veh	1	0	0	100	0	60	3	6	100	87	66	1
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	17	0	34	10	0	4	56	282	0	4	408	26
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900		1900	1900	1900	1900	1900	1900
ParkExist												
NumPark												
No. Lanes	1	1	0	1	1	0	1	2	1	1	2	1
LGConfig	L	TR		L	TR		L	T	R	L	T	R
Lane Width	3.6	3.6		3.6	3.6		3.6	3.6	3.6	3.6	3.6	3.6
RTOR Vol			0			0		0			0	
Adj Flow	67	138		38	14		223	1128	0	14	1634	104
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs	1.000			1.000			0.000	1.000		0.000	1.000	
Peds	0			0			0			0		
Bikes												
Buses	0	0		0	0		0	0	0	0	0	0
%InProtPhase												

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Arriv. Type	3	3		3	3		3	3	3	3	3	3
Unit Ext.	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0
Ext of g	2.0	2.0		2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	24.0				82.0			
Yellow	4.0				4.0			
All Red	3.0				3.0			

Cycle Length: 120.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	66	0	135	37	0	14	219	1105	0	14	1601	102
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	67	0	138	38	0	14	223	1128	0	14	1634	104
No. Lanes	1	1	0	1	1	0	1	2	1	1	2	1
Lane group	L	TR		L	TR		L	T	R	L	T	R
Adj flow	67	138		38	14		223	1128	0	14	1634	104
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs	1.000			1.000			0.000	1.000		0.000	1.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	TR		L	TR		L	T	R	L	T	R
So	1900	1900		1900	1900		1900	1900	1900	1900	1900	1900
Lanes	1	1	0	1	1	0	1	2	1	1	2	1
fW	1.000	1.000		1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000
fHV	0.990	1.000		0.500	0.625		0.971	0.943	0.500	0.535	0.602	0.990
fG	1.000	1.000		1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000
fP	1.000	1.000		1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000
fBb	1.000	1.000		1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000
fA	1.000	1.000		1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000
fLU	1.000	1.000		1.000	1.000		1.000	0.952	1.000	1.000	0.952	1.000
fRT		0.850			0.850			1.000	0.850		1.000	0.850
fLT	0.748	1.000		0.642	1.000		0.101	1.000		0.217	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000			1.000			1.000	1.000		1.000	1.000
S	1408	1615		610	1009		186	3413	808	220	2179	1599
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Flow Rate (v)	Adj Flow Rate (s)	Adj Sat Flow Ratio (v/s)	Green Ratio (g/C)	Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	67	1408	0.05	0.20	282	0.24
Prot							
Perm							
Thru	TR	138	1615	# 0.09	0.20	323	0.43
Right							
Westbound							
Prot							
Perm							
Left	L	38	610	0.06	0.20	122	0.31
Prot							
Perm							
Thru	TR	14	1009	0.01	0.20	202	0.07
Right							
Northbound							
Prot							
Perm							
Left	L	223	186	# 1.20	0.68	127	1.76
Prot							
Perm							
Thru	T	1128	3413	0.33	0.68	2332	0.48
Right	R	0	808	0.00	0.68	552	0.00
Southbound							
Prot							
Perm							
Left	L	14	220	0.06	0.68	150	0.09
Prot							
Perm							
Thru	T	1634	2179	0.75	0.68	1489	1.10
Right	R	104	1599	0.07	0.68	1093	0.10

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 1.28
Total lost time per cycle, L = 14.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.45

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.24	0.20	40.3	1.000	282	0.50	2.0	0.0	42.3	D		
TR	0.43	0.20	42.0	1.000	323	0.50	4.1	0.0	46.1	D	44.8	D
Westbound												
L	0.31	0.20	41.0	1.000	122	0.50	6.5	0.0	47.5	D		
TR	0.07	0.20	38.9	1.000	202	0.50	0.7	0.0	39.6	D	45.4	D
Northbound												
L	1.76	0.68	19.0	1.000	127	0.50	370.4	0.0	389.4	F		
T	0.48	0.68	9.0	1.000	2332	0.50	0.7	0.0	9.7	A	72.4	E
R	0.00	0.68	6.0	1.000	552	0.50	0.0	0.0	6.0	A		
Southbound												
L	0.09	0.68	6.4	1.000	150	0.50	1.2	0.0	7.7	A		
T	1.10	0.68	19.0	1.000	1489	0.50	54.7	0.0	73.7	E	69.2	E
R	0.10	0.68	6.4	1.000	1093	0.50	0.2	0.0	6.6	A		

Intersection Delay = 68.6 (sec/veh) Intersection LOS = E

SUPPLEMENTAL PERMITTED LT WORKSHEET for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)	24.0	24.0	82.0	82.0
Effective permitted green time for LT lane group, g(s)	24.0	24.0	82.0	82.0
Opposing effective green time, go (s)	24.0	24.0	82.0	82.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	1	1	2	2
Adjusted LT flow rate, VLT (veh/h)	67	38	223	14
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	14	138	1634	1128
Lost time for LT lane group, tL	7.00	7.00	7.00	7.00
Computation				
LT volume per cycle, LTC=VLTC/3600	2.23	1.27	7.43	0.47
Opposing lane util. factor, fLUo	1.000	1.000	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.47	4.60	28.61	19.75
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.00	0.00	0.32	0.32
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.97	27.63	11.64
gu=g-gq if gq>=gf, or = g-gf if gq<gf	24.00	23.03	54.37	70.36
n=Max(gq-gf)/2,0)	0.00	0.49	13.81	5.82
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	1.34	1.50	6.59	3.95
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.17	0.17	0.05	0.05
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.75	0.64	0.10	0.22
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.748	0.642	0.101	0.217

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 120.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time r=(C-g-gq-gu)				
Arrival rate, qa=v/(3600(max[X,1.0]))				
Protected ph. departure rate, Sp=s/3600				
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 68.6 sec/veh Intersection LOS E

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	TR		L	TR		L	T	R	L	T	R
Init Queue	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	67	138		38	14		223	592	0	14	858	104
So	1900	1900		1900	1900		1900	1900	1900	1900	1900	1900
No.Lanes	1	1	0	1	1	0	1	2	1	1	2	1
SL	1408	1615		610	1009		186	1792	808	220	1144	1599
LnCapacity	282	323		122	202		127	1224	552	150	782	1093
Flow Ratio	0.05	0.09		0.06	0.01		1.20	0.33	0.00	0.06	0.75	0.07
v/c Ratio	0.24	0.43		0.31	0.07		1.76	0.48	0.00	0.09	1.10	0.10
Grn Ratio	0.20	0.20		0.20	0.20		0.68	0.68	0.68	0.68	0.68	0.68
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3		3	3		3	3	3	3	3	3
Pltn Ratio	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Q1	1.9	4.0		1.1	0.4		7.4	9.3	0.0	0.2	28.6	1.2
kB	0.6	0.6		0.3	0.5		0.3	1.6	0.9	0.4	1.2	1.5
Q2	0.2	0.5		0.1	0.0		12.7	1.5	0.0	0.0	16.9	0.2
Q Average	2.1	4.5		1.2	0.4		20.2	10.8	0.0	0.2	45.5	1.3
Q Spacing	7.6	7.6		7.6	7.6		7.6	7.6	7.6	7.6	7.6	7.6
Q Storage	0	0		0	0		0	0	0	0	0	0
Q S Ratio												
70th Percentile Output:												
fB%		1.3	1.3		1.2	1.2	1.3		1.3	1.2	1.3	
BOQ		2.6	5.6		1.6	0.5		24.2	13.1	0.0	0.3	54.7	1.7
QSRatio												
85th Percentile Output:												
fB%		1.6	1.5		1.6	1.7		1.4	1.4	1.7	1.7	1.4	1.6
BOQ		3.3	6.8		2.0	0.7		28.3	15.5	0.0	0.3	63.8	2.2
QSRatio												
90th Percentile Output:												
fB%		1.9	2.0		1.5	1.6	2.0		2.0	1.5	1.9	
BOQ		3.8	7.6		2.3	0.8		30.4	16.8	0.0	0.4	68.3	2.5
QSRatio												
95th Percentile Output:												
fB%		2.3	2.0		1.6	1.7	2.6		2.6	1.6	2.4	
BOQ		4.6	9.0		2.9	1.0		32.6	18.5	0.0	0.5	72.9	3.1
QSRatio												
98th Percentile Output:												
fB%		2.7	2.3		2.9	3.1		1.7	1.9	3.2	3.1	1.7	2.8
BOQ		5.5	10.4		3.5	1.3		34.8	20.2	0.0	0.6	77.4	3.8
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: PM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Finch Avenue

Inter.: Finch Avenue / Keele Street
Area Type: All other areas
Jurisd: City of Toronto
Year: Total Future Conditions
N/S St: Keele St

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	1	1	2	1	1	2	1	1	2	1
LGConfig	L	T	R	L	T	R	L	T	R	L	T	R
Volume	130	1119	220	184	1224	247	252	1017	161	365	1336	107
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
RTOR Vol			0			0			20			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left		P		P			P	
Thru				P			P	
Right				P			P	
Peds								
WB Left		P		P			P	
Thru				P			P	
Right				P			P	
Peds								
NB Right								
SB Right								
Green		6.0	33.0			10.0	5.0	24.0
Yellow		2.0	4.0			2.0	2.0	4.0
All Red		2.0	2.0			2.0	0.0	2.0

Cycle Length: 100.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	177	1727	0.75	0.43	48.6	D		
T	1131	3428	1.01	0.33	62.7	E	56.4	E
R	505	1530	0.44	0.33	29.1	C		
Westbound								
L	180	1770	1.04	0.43	104.3	F		
T	1137	3445	1.10	0.33	91.4	F	83.8	F
R	484	1468	0.52	0.33	31.1	C		
Northbound								
L	244	1719	1.05	0.34	100.8	F		
T	819	3413	1.27	0.24	168.0	F	142.7	F
R	369	1538	0.39	0.24	35.0-	C		
Southbound								
L	384	1641	0.97	0.45	66.6	E		
T	1068	3445	1.28	0.31	166.1	F	137.9	F
R	424	1369	0.26	0.31	27.3	C		

Intersection Delay = 105.9 (sec/veh) Intersection LOS = F

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: NA
Intersection: Finch Avenue / Keele Street
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: PM Peak Hour
Analysis Year: Total Future Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Finch Avenue
North/South Street: Keele St

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	130	1119	220	184	1224	247	252	1017	161	365	1336	107
% Heavy Veh	4	5	5	2	5	10	5	6	5	10	5	18
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	33	285	56	47	312	63	64	259	41	93	341	27
Hi Ln Vol												
% Grade		1			0			0			0	
Ideal Sat	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
ParkExist												
NumPark												
No. Lanes	1	2	1	1	2	1	1	2	1	1	2	1
LGConfig	L	T	R	L	T	R	L	T	R	L	T	R
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
RTOR Vol			0			0			20			0
Adj Flow	133	1142	224	188	1249	252	257	1038	144	372	1363	109
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.000	1.000		0.000	1.000
Peds	0			0			0			0		
Bikes												
Buses	0	0	0	0	0	0	0	0	0	0	0	0
%InProtPhase	0.0			0.0			0.0			0.0		

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Arriv. Type	3	3	3	3	3	3	3	3	3	3	3	3
Unit Ext.	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Ext of g	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left		P		P			P	
Thru				P			P	
Right				P			P	
Peds								
WB Left		P		P			P	
Thru				P			P	
Right				P			P	
Peds								
NB Right								
SB Right								
Green		6.0	33.0			10.0	5.0	24.0
Yellow		2.0	4.0			2.0	2.0	4.0
All Red		2.0	2.0			2.0	0.0	2.0

Cycle Length: 100.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	130	1119	220	184	1224	247	252	1017	161	365	1336	107
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	133	1142	224	188	1249	252	257	1038	144	372	1363	109
No. Lanes	1	2	1	1	2	1	1	2	1	1	2	1
Lane group	L	T	R	L	T	R	L	T	R	L	T	R
Adj flow	133	1142	224	188	1249	252	257	1038	144	372	1363	109
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.000	1.000		0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	T	R	L	T	R	L	T	R	L	T	R
So	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lanes	1	2	1	1	2	1	1	2	1	1	2	1
fW	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fHV	0.962	0.952	0.952	0.980	0.952	0.909	0.952	0.943	0.952	0.909	0.952	0.847
fG	0.995	0.995	0.995	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fLU	1.000	0.952	1.000	1.000	0.952	1.000	1.000	0.952	1.000	1.000	0.952	1.000
fRT		1.000	0.850		1.000	0.850		1.000	0.850		1.000	0.850
fLT	0.950	1.000		0.950	1.000		0.950	1.000		0.950	1.000	
Sec.	0.108			0.108			0.167			0.154		
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000
S	1727	3428	1530	1770	3445	1468	1719	3413	1538	1641	3445	1369
Sec.	197			201			302			266		

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		104	1727	# 0.06	0.060	104	1.00
Perm		29	197	0.15	0.370	73	0.40
Left	L	133			0.43	177	0.75
Prot							
Perm							
Thru	T	1142	3428	0.33	0.33	1131	1.01
Right	R	224	1530	0.15	0.33	505	0.44
Westbound							
Prot		106	1770	0.06	0.060	106	1.00
Perm		82	201	# 0.41	0.370	74	1.11
Left	L	188			0.43	180	1.04
Prot							
Perm							
Thru	T	1249	3445	0.33	0.33	1137	1.10
Right	R	252	1468	0.17	0.33	484	0.52
Northbound							
Prot		172	1719	0.10	0.100	172	1.00
Perm		85	302	# 0.28	0.240	72	1.18
Left	L	257			0.34	244	1.05
Prot							
Perm							
Thru	T	1038	3413	0.24	0.24	819	1.27
Right	R	144	1538	0.09	0.24	369	0.39
Southbound							
Prot		312	1641	# 0.19	0.190	312	1.00
Perm		60	266	0.23	0.260	72	0.83
Left	L	372			0.45	384	0.97
Prot							
Perm							
Thru	T	1363	3445	0.31	0.31	1068	1.28
Right	R	109	1369	0.08	0.31	424	0.26

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.94
Total lost time per cycle, L = 12.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.07

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.75	0.43	23.5	1.000	177	0.50	25.1	0.0	48.6	D		
T	1.01	0.33	33.5	1.000	1131	0.50	29.2	0.0	62.7	E	56.4	E
R	0.44	0.33	26.3	1.000	505	0.50	2.8	0.0	29.1	C		
Westbound												
L	1.04	0.43	25.0	1.000	180	0.50	79.3	0.0	104.3	F		
T	1.10	0.33	33.5	1.000	1137	0.50	57.9	0.0	91.4	F	83.8	F
R	0.52	0.33	27.1	1.000	484	0.50	4.0	0.0	31.1	C		
Northbound												
L	1.05	0.34	28.5	1.000	244	0.50	72.3	0.0	100.8	F		
T	1.27	0.24	38.0	1.000	819	0.50	130.0	0.0	168.0	F	142.7	F
R	0.39	0.24	31.9	1.000	369	0.50	3.1	0.0	35.0-	C		
Southbound												
L	0.97	0.45	27.9	1.000	384	0.50	38.7	0.0	66.6	E		
T	1.28	0.31	34.5	1.000	1068	0.50	131.6	0.0	166.1	F	137.9	F
R	0.26	0.31	25.9	1.000	424	0.50	1.5	0.0	27.3	C		

Intersection Delay = 105.9 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)	43.0	43.0	34.0	45.0
Effective permitted green time for LT lane group, g(s)	37.0	37.0	24.0	26.0
Opposing effective green time, go (s)	33.0	33.0	31.0	24.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	2	2	2	2
Adjusted LT flow rate, VLT (veh/h)	133	188	257	372
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	1249	1142	1363	1038
Lost time for LT lane group, tL	6.00	6.00	10.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600	3.69	5.22	7.14	10.33
Opposing lane util. factor, fLUo	0.952	0.952	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	18.22	16.66	19.89	15.14
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.67	0.67	0.69	0.76
gq, (see Exhibit C16-4,5,6,7,8)	33.00	33.00	20.00	22.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	4.00	4.00	4.00	4.00
n=Max(gq-gf)/2,0)	16.50	16.50	10.00	11.00
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	4.46	4.01	5.01	3.62
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.11	0.11	0.17	0.15
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.11	0.11	0.17	0.15
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.108	0.108	0.167	0.154

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 100.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	133	188	257	372
v/c ratio from Capacity Worksheet, X	0.75	1.04	1.05	0.97
Protected phase effective green interval, g (s)	6.0	6.0	10.0	19.0
Opposing queue effective green interval, gq	33.00	33.00	20.00	22.00
Unopposed green interval, gu	4.00	4.00	4.00	4.00
Red time r=(C-g-gq-gu)	57.0	57.0	66.0	55.0
Arrival rate, qa=v/(3600(max[X,1.0]))	0.04	0.05	0.07	0.10
Protected ph. departure rate, Sp=s/3600	0.480	0.492	0.478	0.456
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.51	0.52	0.50	0.48
XPerm	0.68	0.90	0.81	1.40
XProt	0.81	1.07	1.08	0.88
Case	1	2	2	3
Queue at beginning of green arrow, Qa	2.11	2.85	4.47	6.45
Queue at beginning of unsaturated green, Qu	1.22	1.70	1.47	2.27
Residual queue, Qr	0.00	0.20	0.38	0.77
Uniform Delay, d1	23.5	25.0	28.5	27.9

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Demand Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Demand Unmet Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound							
Westbound							
Northbound							
Southbound							

Intersection Delay 105.9 sec/veh Intersection LOS F

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	T	R	L	T	R	L	T	R	L	T	R
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	133	599	224	188	655	252	257	545	144	372	715	109
So	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	2	1	1	2	1	1	2	1	1	2	1
SL	410	1800	1530	420	1809	1468	719	1792	1538	847	1809	1369
LnCapacity	177	594	505	180	597	484	244	430	369	384	560	424
Flow Ratio	0.32	0.33	0.15	0.45	0.36	0.17	0.36	0.30	0.09	0.44	0.40	0.08
v/c Ratio	0.75	1.01	0.44	1.04	1.10	0.52	1.05	1.27	0.39	0.97	1.28	0.26
Grn Ratio	0.43	0.33	0.33	0.43	0.33	0.33	0.34	0.24	0.24	0.45	0.31	0.31
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3	3	3	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	2.2	16.6	4.9	3.2	18.2	5.7	5.2	15.1	3.4	7.0	19.9	2.3
kB	0.4	0.9	0.8	0.4	0.9	0.7	0.5	0.7	0.6	0.6	0.8	0.7
Q2	0.9	8.3	0.6	3.5	12.8	0.8	4.7	17.1	0.4	4.7	22.6	0.2
Q Average	3.1	25.0	5.5	6.7	30.9	6.4	10.0	32.2	3.7	11.7	42.5	2.5
Q Spacing	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Q Storage	0	0	0	0	0	0	0	0	0	0	0	0
Q S Ratio												
70th Percentile Output:												
fB%	1.3	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.3
BOQ	3.9	30.0	6.8	8.2	37.1	7.9	12.1	38.7	4.7	14.1	51.0	3.2
QSRatio												
85th Percentile Output:												
fB%	1.6	1.4	1.5	1.4	1.5	1.4	1.4	1.4	1.4	1.4	1.4	1.6
BOQ	4.9	35.0	8.2	9.9	43.3	9.6	14.4	45.1	5.8	16.7	59.5	4.0
QSRatio												
90th Percentile Output:												
fB%	1.8	1.5	1.7	1.6	1.5	1.6	1.6	1.5	1.7	1.5	1.5	1.8
BOQ	5.6	37.5	9.1	10.9	46.5	10.6	15.6	48.4	6.5	18.1	63.7	4.5
QSRatio												
95th Percentile Output:												
fB%	2.1	1.6	1.9	1.9	1.6	1.9	1.7	1.6	2.1	1.7	1.6	2.2
BOQ	6.7	40.1	10.6	12.4	49.6	12.1	17.3	51.6	7.8	19.8	68.0	5.5
QSRatio												
98th Percentile Output:												
fB%	2.5	1.7	2.2	2.1	1.7	2.1	1.9	1.7	2.4	1.8	1.7	2.6
BOQ	7.9	42.7	12.1	14.0	52.7	13.6	19.0	54.9	9.0	21.5	72.2	6.5
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: PM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Toro Road

Inter.: Keele St / Toro Road
Area Type: All other areas
Jurisd: City of Toronto
Year: Total Future Conditions
N/S St: Keele St

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	1	0	1	0	2	1	1	2	0
LGConfig				L		R		T	R	L	T	
Volume				178		156		1348	144	125	1630	
Lane Width				3.6		3.6		3.6	3.6	3.6	3.6	
RTOR Vol						0			0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru					Thru P			
Right					Right P			
Peds					Peds			
WB Left		A			SB Left	P		
Thru					Thru P			
Right		A			Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	24.0				64.0			
Yellow	3.0				4.0			
All Red	3.0				2.0			

Cycle Length: 100.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
Westbound								
L	425	1770	0.43	0.24	32.9	C		
							32.9	C
R	373	1553	0.43	0.24	33.0	C		
Northbound								
T	2226	3478	0.62	0.64	12.0	B	11.6	B
R	1004	1568	0.15	0.64	7.5	A		
Southbound								
L	161	251	0.80	0.64	45.3	D		
T	2226	3478	0.75	0.64	14.8	B	16.9	B

Intersection Delay = 16.2 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: NA
Intersection: Keele St / Toro Road
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: PM Peak Hour
Analysis Year: Total Future Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Toro Road
North/South Street: Keele St

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				178		156		1348	144	125	1630	
% Heavy Veh				2		4		4	3	7	4	
PHF				0.98		0.98		0.98	0.98	0.98	0.98	
PK 15 Vol				45		40		344	37	32	416	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat				1900		1900		1900	1900	1900	1900	
ParkExist												
NumPark												
No. Lanes	0	0	0	1	0	1	0	2	1	1	2	0
LGConfig				L		R		T	R	L	T	
Lane Width				3.6		3.6		3.6	3.6	3.6	3.6	
RTOR Vol						0			0			
Adj Flow				182		159		1376	147	128	1663	
%InSharedLn												
Prop LTs								0.000		1.000	0.000	
Prop RTs						1.000		0.000	1.000		0.000	
Peds Bikes	0				0			0				
Buses				0		0		0	0	0	0	
%InProtPhase												

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0		0.0		0.0	0.0	0.0	0.0	
Arriv. Type				3		3		3	3	3	3	
Unit Ext.				3.0		3.0		3.0	3.0	3.0	3.0	
I Factor					1.000			1.000			1.000	
Lost Time				2.0		2.0		2.0	2.0	2.0	2.0	
Ext of g				2.0		2.0		2.0	2.0	2.0	2.0	
Ped Min g		3.2			3.2			3.2				

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru					Thru P			
Right					Right P			
Peds					Peds			
WB Left		A			SB Left P			
Thru					Thru P			
Right		A			Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green								
Yellow								
All Red								

Cycle Length: 100.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				178		156		1348	144	125	1630	
PHF				0.98		0.98		0.98	0.98	0.98	0.98	
Adj flow				182		159		1376	147	128	1663	
No. Lanes	0	0	0	1	0	1	0	2	1	1	2	0
Lane group				L		R		T	R	L	T	
Adj flow				182		159		1376	147	128	1663	
Prop LTs								0.000		1.000	0.000	
Prop RTs						1.000		0.000	1.000		0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG				L		R		T	R	L	T	
So				1900		1900		1900	1900	1900	1900	
Lanes	0	0	0	1	0	1	0	2	1	1	2	0
fW				1.000		1.000		1.000	1.000	1.000	1.000	
fHV				0.980		0.962		0.962	0.971	0.935	0.962	
fG				1.000		1.000		1.000	1.000	1.000	1.000	
fP				1.000		1.000		1.000	1.000	1.000	1.000	
fBB				1.000		1.000		1.000	1.000	1.000	1.000	
fA				1.000		1.000		1.000	1.000	1.000	1.000	
fLU				1.000		1.000		0.952	1.000	1.000	0.952	
fRT						0.850		1.000	0.850		1.000	
fLT				0.950				1.000		0.141	1.000	
Sec.												
fLpb				1.000				1.000		1.000	1.000	
fRpb						1.000		1.000	1.000		1.000	
S				1770		1553		3478	1568	251	3478	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Flow Rate (v)	Adj Flow Rate (s)	Adj Sat Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left	L	182	1770	# 0.10	0.24	425	0.43
Prot							
Perm							
Thru							
Right	R	159	1553	0.10	0.24	373	0.43
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	1376	3478	0.40	0.64	2226	0.62
Right	R	147	1568	0.09	0.64	1004	0.15
Southbound							
Prot							
Perm							
Left	L	128	251	# 0.51	0.64	161	0.80
Prot							
Perm							
Thru	T	1663	3478	0.48	0.64	2226	0.75
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.61
Total lost time per cycle, L = 12.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.70

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	g/C	Unf Del d1	Adj Fact	Prog Cap	Lane Grp k	Incremental Factor	Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound													
Westbound													
L	0.43	0.24	32.2	1.000	425		0.11	0.7	0.0	32.9	C		
												32.9	C
R	0.43	0.24	32.2	1.000	373		0.11	0.8	0.0	33.0	C		
Northbound													
T	0.62	0.64	10.7	1.000	2226		0.50	1.3	0.0	12.0	B	11.6	B
R	0.15	0.64	7.1	1.000	1004		0.50	0.3	0.0	7.5	A		
Southbound													
L	0.80	0.64	13.2	1.000	161		0.50	32.2	0.0	45.3	D		
T	0.75	0.64	12.4	1.000	2226		0.50	2.3	0.0	14.8	B	16.9	B

Intersection Delay = 16.2 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				M
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)				64.0
Effective permitted green time for LT lane group, g(s)				64.0
Opposing effective green time, go (s)				64.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				2
Adjusted LT flow rate, VLT (veh/h)				128
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.00
Adjusted opposing flow rate, Vo (veh/h)				1376
Lost time for LT lane group, tL				6.00
Computation				
LT volume per cycle, LTC=VLTC/3600				3.56
Opposing lane util. factor, fLUo			0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				20.07
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.36
gq, (see Exhibit C16-4,5,6,7,8)				18.15
gu=g-gq if gq>=gf, or = g-gf if gq<gf				45.85
n=Max(gq-gf)/2,0)				9.07
PTHo=1-PLTo				1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				5.07
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				0.06
gdiff=max(gq-gf,0)				0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.14
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.141

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT			0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo			0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 100.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time r=(C-g-gq-gu)				
Arrival rate, qa=v/(3600(max[X,1.0]))				
Protected ph. departure rate, Sp=s/3600				
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 16.2 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound			Westbound			Northbound			Southbound		
				L		R		T	R	L	T	
Init Queue				0.0		0.0		0.0	0.0	0.0	0.0	
Flow Rate				182		159		722	147	128	873	
So				1900		1900		1900	1900	1900	1900	
No.Lanes	0	0	0	1	0	1	0	2	1	1	2	0
SL				1770		1553		1826	1568	251	1826	
LnCapacity				425		373		1169	1004	161	1169	
Flow Ratio				0.10		0.10		0.40	0.09	0.51	0.48	
v/c Ratio				0.43		0.43		0.62	0.15	0.80	0.75	
Grn Ratio				0.24		0.24		0.64	0.64	0.64	0.64	
I Factor					1.000			1.000			1.000	
AT or PVG				3		3		3	3	3	3	
Pltn Ratio				1.00		1.00		1.00	1.00	1.00	1.00	
PF2				1.00		1.00		1.00	1.00	1.00	1.00	
Q1				4.3		3.7		11.9	1.6	2.6	16.7	
kB				0.4		0.4		1.4	1.2	0.3	1.4	
Q2				0.3		0.3		2.1	0.2	1.1	3.7	
Q Average				4.6		4.0		14.1	1.8	3.7	20.4	
Q Spacing				7.6		7.6		7.6	7.6	7.6	7.6	
Q Storage				0		0		0	0	0	0	
Q S Ratio												
70th Percentile Output:												
fB%				1.2		1.2		1.2	1.3	1.2	1.2	
BOQ				5.5		4.8		17.0	2.3	4.6	24.5	
QSRatio												
85th Percentile Output:												
fB%				1.6		1.6		1.4	1.6	1.5	1.4	
BOQ				7.2		6.3		20.0	2.9	5.7	28.7	
QSRatio												
90th Percentile Output:												
fB%				1.7		1.7		1.5	1.8	1.7	1.5	
BOQ				7.9		7.0		21.5	3.4	6.4	30.8	
QSRatio												
95th Percentile Output:												
fB%				2.0		2.0		1.7	2.3	2.1	1.6	
BOQ				9.1		8.0		23.4	4.2	7.6	33.0	
QSRatio												
98th Percentile Output:												
fB%				2.4		2.4		1.8	2.7	2.4	1.7	
BOQ				11.1		9.8		25.2	5.0	8.9	35.2	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: PM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Finch Avenue

Inter.: Finch Avenue / Romfield Lane
Area Type: All other areas
Jurisd: City of Toronto
Year: Total Future Conditions
N/S St: Romfield Lane

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	1	0	2	1	1	1	0	1	1	0
LGConfig		LT	R		LT	R	L	TR		L	TR	
Volume	0	2114	22	26	2341	0	5	0	12	0	0	1
Lane Width		3.6	3.6		3.6	3.6	3.6	3.6		3.6	3.6	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	67.0				21.0			
Yellow	4.0				3.0			
All Red	2.0				3.0			

Cycle Length: 100.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
LT	2330	3478	0.93	0.67	22.1	C	22.0	C
R	1082	1615	0.02	0.67	5.6	A		
Westbound								
LT	1754	2618	1.38	0.67	190.0	F	190.0	F
R	1082	1615	0.00	0.67	5.4	A		
Northbound								
L	302	1439	0.02	0.21	31.4	C		
TR	339	1615	0.04	0.21	31.6	C	31.6	C
Southbound								
L	299	1424	0.00	0.21	31.2	C		
TR	339	1615	0.00	0.21	31.2	C	31.2	C

Intersection Delay = 110.0 (sec/veh) Intersection LOS = F

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:
Fax:

OPERATIONAL ANALYSIS

Analyst: NA
Intersection: Finch Avenue / Romfield Lane
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: PM Peak Hour
Analysis Year: Total Future Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Finch Avenue
North/South Street: Romfield Lane

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	2114	22	26	2341	0	5	0	12	0	0	1
% Heavy Veh	0	4	0	0	3	0	0	0	0	0	0	0
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	0	539	6	7	597	0	2	0	3	0	0	1
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900	1900		1900	1900	1900	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	0	2	1	0	2	1	1	1	0	1	1	0
LGConfig		LT	R		LT	R	L	TR		L	TR	
Lane Width		3.6	3.6		3.6	3.6	3.6	3.6		3.6	3.6	
RTOR Vol			0			0			0			0
Adj Flow		2157	22		2416	0	5	12	0	0	1	
%InSharedLn												
Prop LTs		0.000			0.011		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.000	1.000		1.000			1.000	
Peds	Bikes	0			0			0			0	
Buses		0	0		0	0	0	0		0	0	
%InProtPhase												

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0		0.0	0.0	0.0	0.0		0.0	0.0	
Arriv. Type		3	3		3	3	3	3		3	3	
Unit Ext.		3.0	3.0		3.0	3.0	3.0	3.0		3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time		2.0	2.0		2.0	2.0	2.0	2.0		2.0	2.0	
Ext of g		2.0	2.0		2.0	2.0	2.0	2.0		2.0	2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
NB Right					EB Right			

SB Right		WB Right	
Green	67.0	21.0	
Yellow	4.0	3.0	
All Red	2.0	3.0	

Cycle Length: 100.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	0	2114	22	26	2341	0	5	0	12	0	0	1
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	0	2157	22	27	2389	0	5	0	12	0	0	1
No. Lanes	0	2	1		2	1	1	1	0	1	1	0
Lane group		LT	R		LT	R	L	TR		L	TR	
Adj flow		2157	22		2416	0	5	12		0	1	
Prop LTs		0.000			0.011		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.000	1.000		1.000			1.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	T	R	L	T	R	L	T	R	L	T	R
So	1900	1900		1900	1900		1900	1900		1900	1900	
Lanes	0	2	1	0	2	1	1	1	0	1	1	0
fW		1.000	1.000		1.000	1.000	1.000	1.000		1.000	1.000	
fHV		0.962	1.000		0.971	1.000	1.000	1.000		1.000	1.000	
fG		1.000	1.000		1.000	1.000	1.000	1.000		1.000	1.000	
fP		1.000	1.000		1.000	1.000	1.000	1.000		1.000	1.000	
fBB		1.000	1.000		1.000	1.000	1.000	1.000		1.000	1.000	
fA		1.000	1.000		1.000	1.000	1.000	1.000		1.000	1.000	
fLU		0.952	1.000		0.952	1.000	1.000	1.000		1.000	1.000	
fRT		1.000	0.850		1.000	0.850		0.850			0.850	
fLT		1.000			0.745		0.757	1.000		0.750	1.000	
Sec.												
fLpb		1.000			1.000		1.000	1.000		1.000	1.000	
fRpb		1.000	1.000		1.000	1.000		1.000			1.000	
S		3478	1615		2618	1615	1439	1615		1424	1615	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	2157	3478	0.62	0.67	2330	0.93
Right	R	22	1615	0.01	0.67	1082	0.02
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	2416	2618	# 0.92	0.67	1754	1.38
Right	R	0	1615	0.00	0.67	1082	0.00
Northbound							
Prot							
Perm							
Left	L	5	1439	0.00	0.21	302	0.02
Prot							
Perm							
Thru	TR	12	1615	# 0.01	0.21	339	0.04
Right							
Southbound							
Prot							
Perm							
Left	L	0	1424	0.00	0.21	299	0.00
Prot							
Perm							
Thru	TR	1	1615	0.00	0.21	339	0.00
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.93
Total lost time per cycle, L = 12.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.06

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
LT	0.93	0.67	14.3	1.000	2330	0.50	7.8	0.0	22.1	C	22.0	C
R	0.02	0.67	5.5	1.000	1082	0.50	0.0	0.0	5.6	A		
Westbound												
LT	1.38	0.67	16.5	1.000	1754	0.50	173.5	0.0	190.0	F	190.0	F
R	0.00	0.67	5.4	1.000	1082	0.50	0.0	0.0	5.4	A		
Northbound												
L	0.02	0.21	31.3	1.000	302	0.50	0.1	0.0	31.4	C		
TR	0.04	0.21	31.4	1.000	339	0.50	0.2	0.0	31.6	C	31.6	C
Southbound												
L	0.00	0.21	31.2	1.000	299	0.50	0.0	0.0	31.2	C		
TR	0.00	0.21	31.2	1.000	339	0.50	0.0	0.0	31.2	C	31.2	C

Intersection Delay = 110.0 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach			M	M
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)			21.0	21.0
Effective permitted green time for LT lane group, g(s)			21.0	21.0
Opposing effective green time, go (s)			21.0	21.0
Number of lanes in LT lane group, N			1	1
Number of lanes in opposing approach, No			1	1
Adjusted LT flow rate, VLT (veh/h)			5	0
Proportion of LT in LT lane group, PLT			1.000	1.000
Proportion of LT in opposing flow, PLTo			0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)			1	12
Lost time for LT lane group, tL			6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.14	0.00
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			0.03	0.33
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.79	0.79
gq, (see Exhibit C16-4,5,6,7,8)			0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf			21.00	21.00
n=Max(gq-gf)/2,0)			0.00	0.00
PTHo=1-PLTo			1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	1.00
EL1 (refer to Exhibit C16-3)			1.32	1.33
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.19	0.19
gdiff=max(gq-gf,0)			0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.76	0.75
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.757	0.750

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M		
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)	67.0	67.0		
Effective permitted green time for LT lane group, g(s)	67.0	67.0		
Opposing effective green time, go (s)	67.0	67.0		
Number of lanes in LT lane group, N	2	2		
Number of lanes in opposing approach, No	2	2		
Adjusted LT flow rate, VLT (veh/h)	0	27		
Proportion of LT in LT lane group, PLT	0.000	0.011	0.000	0.000
Proportion of LT in opposing flow, PLTo	0.01	0.00		
Adjusted opposing flow rate, Vo (veh/h)	2416	2157		
Lost time for LT lane group, tL	6.00	6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	0.00	0.75		
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	35.25	31.47		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	26.7		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.33	0.33		
gq, (see Exhibit C16-4,5,6,7,8)	63.00	50.04		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	4.00	16.96		
n=Max(gq-gf)/2,0)	31.50	11.67		
PTHo=1-PLTo	0.99	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.00	0.03		
EL1 (refer to Exhibit C16-3)	16.12	12.40		
EL2=Max((1-Ptho**n)/Plto, 1.0)	26.68			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.03	0.03		
gdiff=max(gq-gf,0)	63.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.06	0.58		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	1.000	0.745		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 100.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time r=(C-g-gq-gu)				
Arrival rate, qa=v/(3600(max[X,1.0]))				
Protected ph. departure rate, Sp=s/3600				
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 110.0 sec/veh Intersection LOS F

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound LT	Eastbound R	Westbound LT	Westbound R	Northbound L	Northbound TR	Southbound L	Southbound TR
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	1132	22	1268	0	5	12	0	1
So	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	2	1	2	1	1	1	1	0
SL	1826	1615	1374	1615	1439	1615	1424	1615
LnCapacity	1223	1082	921	1082	302	339	299	339
Flow Ratio	0.62	0.01	0.92	0.00	0.00	0.01	0.00	0.00
v/c Ratio	0.93	0.02	1.38	0.00	0.02	0.04	0.00	0.00
Grn Ratio	0.67	0.67	0.67	0.67	0.21	0.21	0.21	0.21
I Factor	1.000		1.000		1.000		1.000	
AT or PVG	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	27.3	0.2	35.2	0.0	0.1	0.3	0.0	0.0
kB	1.4	1.3	1.2	1.3	0.5	0.6	0.5	0.6
Q2	9.6	0.0	47.3	0.0	0.0	0.0	0.0	0.0
Q Average	36.9	0.2	82.5	0.0	0.1	0.3	0.0	0.0
Q Spacing	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Q Storage	0	0	0	0	0	0	0	0
Q S Ratio								
70th Percentile Output:								
fB%	1.2	1.3	1.2	1.3	1.3	1.3	1.3	1.3
BOQ	44.3	0.3	99.0	0.0	0.2	0.4	0.0	0.0
QSRatio								
85th Percentile Output:								
fB%	1.4	2.7	1.4	1.7	1.7	1.7	1.7	1.7
BOQ	51.6	0.4	115	0.0	0.2	0.5	0.0	0.0
QSRatio								
90th Percentile Output:								
fB%	1.5	2.0	1.5	2.0	2.0	2.0	2.0	2.0
BOQ	55.3	0.5	124	0.0	0.2	0.6	0.0	0.0
QSRatio								
95th Percentile Output:								
fB%	1.6	2.6	1.6	2.6	2.6	2.5	2.6	2.6
BOQ	59.0	0.6	132	0.0	0.3	0.7	0.0	0.1
QSRatio								
98th Percentile Output:								
fB%	1.7	3.1	1.7	3.2	3.2	3.1	3.2	3.2
BOQ	62.7	0.7	140	0.0	0.4	0.9	0.0	0.1
QSRatio								

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: PM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Finch Avenue

Inter.: Finch Avenue / Tangiers Rd
Area Type: All other areas
Jurisd: City of Toronto
Year: Total Future Conditions
N/S St: Tangiers Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	1	1	2	1	1	2	0	1	2	0
LGConfig	L	T	R	L	T	R	L	TR		L	TR	
Volume	36	1343	61	66	1203	81	135	34	81	115	63	100
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6		3.6	3.6	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	A		
Thru	P				Thru	A		
Right	P				Right	A		
Peds					Peds			
WB Left	P				SB Left	A		
Thru	P				Thru	A		
Right	P				Right	A		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	64.0				24.0			
Yellow	4.0				4.0			
All Red	2.0				2.0			

Cycle Length: 100.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	192	300	0.20	0.64	9.7	A		
T	2057	3214	0.69	0.64	13.5	B	13.1	B
R	961	1502	0.07	0.64	6.9	A		
Westbound								
L	161	252	0.43	0.64	17.1	B		
T	2144	3350	0.59	0.64	11.6	B	11.6	B
R	1034	1615	0.08	0.64	7.0	A		
Northbound								
L	288	1200	0.49	0.24	34.1	C		
TR	753	3136	0.16	0.24	30.1	C	32.3	C
Southbound								
L	308	1283	0.39	0.24	32.7	C		
TR	788	3284	0.22	0.24	30.6	C	31.5	C

Intersection Delay = 15.5 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:
Fax:

OPERATIONAL ANALYSIS

Analyst: NA
Intersection: Finch Avenue / Tangiers Rd
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: PM Peak Hour
Analysis Year: Total Future Conditions
Project ID: TTC Spadina Station Extension

East/West Street	North/South Street
Finch Avenue	Tangiers Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	36	1343	61	66	1203	81	135	34	81	115	63	100
% Heavy Veh	6	12	7	0	8	0	2	6	2	0	0	0
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
PK 15 Vol	9	353	16	17	317	21	36	9	21	30	17	26
Hi Ln Vol		1			0			0			0	
% Grade												
Ideal Sat	1900	1900	1900	1900	1900	1900	1900	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	2	1	1	2	1	1	2	0	1	2	0
LGConfig	L	T	R	L	T	R	L	TR		L	TR	
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6		3.6	3.6	
RTOR Vol			0			0			0			0
Adj Flow	38	1414	64	69	1266	85	142	121		121	171	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.702			0.614	
Peds Bikes		0			0			0			0	
Buses	0	0	0	0	0	0	0	0		0	0	
%InProtPhase												

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Arriv. Type	3	3	3	3	3	3	3	3		3	3	
Unit Ext.	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0		2.0	2.0	
Ext of g	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0		2.0	2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	A		
Thru	P				Thru	A		
Right	P				Right	A		
Peds					Peds			
WB Left	P				SB Left	A		
Thru	P				Thru	A		
Right	P				Right	A		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	64.0				24.0			
Yellow	4.0				4.0			
All Red	2.0				2.0			

Cycle Length: 100.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	36	1343	61	66	1203	81	135	34	81	115	63	100
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	38	1414	64	69	1266	85	142	121		121	171	
No. Lanes	1	2	1	1	2	1	1	2	0	1	2	0
Lane group	L	T	R	L	T	R	L	TR		L	TR	
Adj flow	38	1414	64	69	1266	85	142	121		121	171	
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.702			0.614	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	T	R	L	T	R	L	TR		L	TR	
So	1900	1900	1900	1900	1900	1900	1900	1900		1900	1900	
Lanes	1	2	1	1	2	1	1	2	0	1	2	0
fW	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000	1.000	
fHV	0.943	0.893	0.935	1.000	0.926	1.000	0.980	0.969		1.000	1.000	
fG	0.995	0.995	0.995	1.000	1.000	1.000	1.000	1.000		1.000	1.000	
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000	1.000	
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000	1.000	
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000	1.000	
fLU	1.000	0.952	1.000	1.000	0.952	1.000	1.000	0.952		1.000	0.952	
fRT		1.000	0.850		1.000	0.850		0.895			0.908	
fLT	0.168	1.000		0.133	1.000		0.644	1.000		0.676	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000	1.000		1.000	1.000		1.000			1.000	
S	300	3214	1502	252	3350	1615	1200	3136		1283	3284	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	38	300	0.13	0.64	192	0.20
Prot							
Perm							
Thru	T	1414	3214	# 0.44	0.64	2057	0.69
Right	R	64	1502	0.04	0.64	961	0.07
Westbound							
Prot							
Perm							
Left	L	69	252	0.27	0.64	161	0.43
Prot							
Perm							
Thru	T	1266	3350	0.38	0.64	2144	0.59
Right	R	85	1615	0.05	0.64	1034	0.08
Northbound							
Prot							
Perm							
Left	L	142	1200	# 0.12	0.24	288	0.49
Prot							
Perm							
Thru	TR	121	3136	0.04	0.24	753	0.16
Right							
Southbound							
Prot							
Perm							
Left	L	121	1283	0.09	0.24	308	0.39
Prot							
Perm							
Thru	TR	171	3284	0.05	0.24	788	0.22
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.56
Total lost time per cycle, L = 12.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.63

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.20	0.64	7.4	1.000	192	0.50	2.3	0.0	9.7	A		
T	0.69	0.64	11.6	1.000	2057	0.50	1.9	0.0	13.5	B	13.1	B
R	0.07	0.64	6.8	1.000	961	0.50	0.1	0.0	6.9	A		
Westbound												
L	0.43	0.64	8.9	1.000	161	0.50	8.1	0.0	17.1	B		
T	0.59	0.64	10.4	1.000	2144	0.50	1.2	0.0	11.6	B	11.6	B
R	0.08	0.64	6.8	1.000	1034	0.50	0.2	0.0	7.0	A		
Northbound												
L	0.49	0.24	32.8	1.000	288	0.11	1.3	0.0	34.1	C		
TR	0.16	0.24	30.0	1.000	753	0.11	0.1	0.0	30.1	C	32.3	C
Southbound												
L	0.39	0.24	31.9	1.000	308	0.11	0.8	0.0	32.7	C		
TR	0.22	0.24	30.5	1.000	788	0.11	0.1	0.0	30.6	C	31.5	C

Intersection Delay = 15.5 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)	64.0	64.0	24.0	24.0
Effective permitted green time for LT lane group, g(s)	64.0	64.0	24.0	24.0
Opposing effective green time, go (s)	64.0	64.0	24.0	24.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	2	2	2	2
Adjusted LT flow rate, VLT (veh/h)	38	69	142	121
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	1266	1414	171	121
Lost time for LT lane group, tL	6.00	6.00	6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600	1.06	1.92	3.94	3.36
Opposing lane util. factor, fLUo	0.952	0.952	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	18.47	20.63	2.49	1.77
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.36	0.36	0.76	0.76
gq, (see Exhibit C16-4,5,6,7,8)	15.09	19.29	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	48.91	44.71	24.00	24.00
n=Max(gq-gf)/2,0)	7.54	9.64	0.00	0.00
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	4.54	5.27	1.55	1.48
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06	0.06	0.17	0.17
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.17	0.13	0.64	0.68
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.168	0.133	0.644	0.676

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=i for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=i for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 100.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time r=(C-g-gq-gu)				
Arrival rate, qa=v/(3600(max[X,1.0]))				
Protected ph. departure rate, Sp=s/3600				
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 15.5 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound L	T	R	Westbound L	T	R	Northbound L	TR		Southbound L	TR	
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Flow Rate	38	742	64	69	664	85	142	63		121	89	
So	1900	1900	1900	1900	1900	1900	1900	1900		1900	1900	
No.Lanes	1	2	1	1	2	1	1	2	0	1	2	0
SL	300	1688	1502	252	1759	1615	1200	1647		1283	1724	
LnCapacity	192	1080	961	161	1126	1034	288	395		308	413	
Flow Ratio	0.13	0.44	0.04	0.27	0.38	0.05	0.12	0.04		0.09	0.05	
v/c Ratio	0.20	0.69	0.07	0.43	0.59	0.08	0.49	0.16		0.39	0.22	
Grn Ratio	0.64	0.64	0.64	0.64	0.64	0.64	0.24	0.24		0.24	0.24	
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3	3	3	3	3	3	3		3	3	
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Q1	0.4	13.2	0.7	1.0	10.7	0.9	3.4	1.4		2.8	2.0	
kB	0.4	1.3	1.2	0.3	1.3	1.3	0.3	0.4		0.4	0.4	
Q2	0.1	2.7	0.1	0.3	1.9	0.1	0.3	0.1		0.2	0.1	
Q Average	0.5	15.9	0.8	1.2	12.5	1.0	3.7	1.5		3.1	2.1	
Q Spacing	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6		7.6	7.6	
Q Storage	0	0	0	0	0	0	0	0		0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.3	1.2	1.3	1.3	1.2	1.3	1.2	1.2		1.2	1.2	
BOQ	0.7	19.2	1.0	1.5	15.1	1.3	4.4	1.7		3.6	2.5	
QSRatio												
85th Percentile Output:												
fB%	1.7	1.4	1.7	1.6	1.4	1.6	1.6	1.6		1.6	1.6	
BOQ	0.9	22.5	1.2	2.0	17.8	1.7	5.8	2.3		4.8	3.3	
QSRatio												
90th Percentile Output:												
fB%	1.9	1.5	1.9	1.9	1.5	1.9	1.7	1.8		1.7	1.8	
BOQ	1.0	24.2	1.5	2.3	19.3	1.9	6.5	2.6		5.3	3.7	
QSRatio												
95th Percentile Output:												
fB%	2.5	1.6	2.5	2.4	1.7	2.4	2.0	2.1		2.0	2.0	
BOQ	1.3	26.1	1.9	2.9	21.1	2.4	7.4	3.0		6.1	4.3	
QSRatio												
98th Percentile Output:												
fB%	3.0	1.8	3.0	2.9	1.8	2.9	2.5	2.6		2.5	2.6	
BOQ	1.6	28.1	2.3	3.5	22.8	3.0	9.1	3.8		7.6	5.4	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: PM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Finch Avenue

Inter.: Finch Avenue / CNR Service Rd
Area Type: All other areas
Jurisd: City of Toronto
Year: Total Future Conditions
N/S St: CNR Service Rd

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	0	1	2	0	1	1	0	1	1	0
LGConfig	L	TR		L	TR		L	TR		L	TR	
Volume	2	1614	40	39	1810	4	68	0	55	10	0	10
Lane Width	3.6	3.6		3.6	3.6		3.6	3.6		3.6	3.6	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	A		
Thru	P				Thru	A		
Right	P				Right	A		
Peds					Peds			
WB Left	P				SB Left	A		
Thru	P				Thru	A		
Right	P				Right	A		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	67.0				21.0			
Yellow	4.0				3.0			
All Red	2.0				3.0			

Cycle Length: 100.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	72	78	0.03	0.67	6.3	A		
TR	2287	3413	0.74	0.67	12.9	B	12.9	B
Westbound								
L	104	155	0.38	0.67	17.8	B		
TR	2283	3407	0.81	0.67	15.2	B	15.2	B
Northbound								
L	291	1385	0.24	0.21	33.3	C		
TR	323	1538	0.17	0.21	32.6	C	33.0	C
Southbound								
L	180	856	0.06	0.21	31.7	C		
TR	261	1242	0.04	0.21	31.5	C	31.6	C

Intersection Delay = 14.9 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:
Fax:

OPERATIONAL ANALYSIS

Analyst: NA
Intersection: Finch Avenue / CNR Service Rd
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: PM Peak Hour
Analysis Year: Total Future Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Finch Avenue
North/South Street: CNR Service Rd

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	2	1614	40	39	1810	4	68	0	55	10	0	10
% Heavy Veh	50	5	8	8	6	75	3	0	5	60	0	30
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	1	412	10	10	462	1	17	0	14	3	0	3
Hi Ln Vol												
% Grade		1			0			0			0	
Ideal Sat	1900	1900		1900	1900		1900	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	2	0	1	2	0	1	1	0	1	1	0
LGConfig	L	TR		L	TR		L	TR		L	TR	
Lane Width	3.6	3.6		3.6	3.6		3.6	3.6		3.6	3.6	
RTOR Vol			0			0			0			0
Adj Flow	2	1688		40	1851		69	56		10	10	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs	0.024			0.002			1.000			1.000		
Peds Bikes	0			0			0			0		
Buses	0	0		0	0		0	0		0	0	
%InProtPhase												

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Arriv. Type	3	3		3	3		3	3		3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Ext of g	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	A		
Thru	P				Thru	A		
Right	P				Right	A		
Peds					Peds			
WB Left	P				SB Left	A		
Thru	P				Thru	A		
Right	P				Right	A		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	67.0				21.0			
Yellow	4.0				3.0			
All Red	2.0				3.0			

Cycle Length: 100.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	2	1614	40	39	1810	4	68	0	55	10	0	10
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	2	1647	41	40	1847	4	69	0	56	10	0	10
No. Lanes	1	2	0	1	2	0	1	1	0	1	1	0
Lane group	L	TR		L	TR		L	TR		L	TR	
Adj flow	2	1688		40	1851		69	56		10	10	
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs	0.024			0.002			1.000			1.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	TR		L	TR		L	TR		L	TR	
So	1900	1900		1900	1900		1900	1900		1900	1900	
Lanes	1	2	0	1	2	0	1	1	0	1	1	0
fW	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fHV	0.667	0.952		0.926	0.942		0.971	0.952		0.625	0.769	
fG	0.995	0.995		1.000	1.000		1.000	1.000		1.000	1.000	
fP	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fBB	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fA	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fLU	1.000	0.952		1.000	0.952		1.000	1.000		1.000	1.000	
fRT		0.996			1.000			0.850			0.850	
fLT	0.062	1.000		0.088	1.000		0.751	1.000		0.720	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000			1.000			1.000			1.000	
S	78	3413		155	3407		1385	1538		856	1242	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	2	78	0.03	0.67	72	0.03
Prot							
Perm							
Thru	TR	1688	3413	0.49	0.67	2287	0.74
Right							
Westbound							
Prot							
Perm							
Left	L	40	155	0.26	0.67	104	0.38
Prot							
Perm							
Thru	TR	1851	3407	# 0.54	0.67	2283	0.81
Right							
Northbound							
Prot							
Perm							
Left	L	69	1385	# 0.05	0.21	291	0.24
Prot							
Perm							
Thru	TR	56	1538	0.04	0.21	323	0.17
Right							
Southbound							
Prot							
Perm							
Left	L	10	856	0.01	0.21	180	0.06
Prot							
Perm							
Thru	TR	10	1242	0.01	0.21	261	0.04
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.59
Total lost time per cycle, L = 12.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.67

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.03	0.67	5.5	1.000	72	0.50	0.7	0.0	6.3	A		
TR	0.74	0.67	10.8	1.000	2287	0.50	2.2	0.0	12.9	B	12.9	B
Westbound												
L	0.38	0.67	7.3	1.000	104	0.50	10.4	0.0	17.8	B		
TR	0.81	0.67	11.9	1.000	2283	0.50	3.3	0.0	15.2	B	15.2	B
Northbound												
L	0.24	0.21	32.8	1.000	291	0.11	0.4	0.0	33.3	C		
TR	0.17	0.21	32.4	1.000	323	0.11	0.3	0.0	32.6	C	33.0	C
Southbound												
L	0.06	0.21	31.6	1.000	180	0.11	0.1	0.0	31.7	C		
TR	0.04	0.21	31.5	1.000	261	0.11	0.1	0.0	31.5	C	31.6	C

Intersection Delay = 14.9 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)	67.0	67.0	21.0	21.0
Effective permitted green time for LT lane group, g(s)	67.0	67.0	21.0	21.0
Opposing effective green time, go (s)	67.0	67.0	21.0	21.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	2	2	1	1
Adjusted LT flow rate, VLT (veh/h)	2	40	69	10
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	1851	1688	10	56
Lost time for LT lane group, tL	6.00	6.00	6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.06	1.11	1.92	0.28
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	27.00	24.63	0.28	1.56
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.33	0.33	0.79	0.79
gq, (see Exhibit C16-4,5,6,7,8)	32.75	26.03	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	34.25	40.97	21.00	21.00
n=Max(gq-gf)/2,0)	16.38	13.01	0.00	0.00
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	8.23	6.96	1.33	1.39
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06	0.06	0.19	0.19
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.06	0.09	0.75	0.72
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.062	0.088	0.751	0.720

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=i for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=i for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 100.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time r=(C-g-gq-gu)				
Arrival rate, qa=v/(3600(max[X,1.0]))				
Protected ph. departure rate, Sp=s/3600				
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 14.9 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound L	Eastbound TR	Westbound L	Westbound TR	Northbound L	Northbound TR	Southbound L	Southbound TR
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	2	886	40	972	69	56	10	10
So	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	2 0	1	2 0	1	1 0	1	1 0
SL	78	1792	155	1789	1385	1538	856	1242
LnCapacity	72	1201	104	1199	291	323	180	261
Flow Ratio	0.03	0.49	0.26	0.54	0.05	0.04	0.01	0.01
v/c Ratio	0.03	0.74	0.38	0.81	0.24	0.17	0.06	0.04
Grn Ratio	0.67	0.67	0.67	0.67	0.21	0.21	0.21	0.21
I Factor		1.000		1.000		1.000		1.000
AT or PVG	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	0.0	16.1	0.5	19.5	1.6	1.3	0.2	0.2
kB	0.2	1.4	0.3	1.4	0.4	0.4	0.3	0.3
Q2	0.0	3.6	0.2	5.1	0.1	0.1	0.0	0.0
Q Average	0.0	19.7	0.6	24.6	1.7	1.4	0.2	0.2
Q Spacing	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Q Storage	0	0	0	0	0	0	0	0
Q S Ratio								
70th Percentile Output:								
fB%	1.3	1.2	1.2	1.2	1.2	1.2	1.2	1.2
BOQ	0.0	23.6	0.8	29.5	2.0	1.6	0.3	0.3
QSRatio								
85th Percentile Output:								
fB%	1.7	1.4	1.7	1.4	1.6	1.6	1.6	1.6
BOQ	0.0	27.6	1.1	34.5	2.7	2.1	0.4	0.4
QSRatio								
90th Percentile Output:								
fB%	1.9	1.5	1.9	1.5	1.8	1.8	1.8	1.8
BOQ	0.0	29.7	1.3	37.0	3.0	2.4	0.4	0.4
QSRatio								
95th Percentile Output:								
fB%	2.6	1.6	2.5	1.6	2.0	2.1	2.1	2.1
BOQ	0.1	31.8	1.6	39.5	3.5	2.8	0.5	0.5
QSRatio								
98th Percentile Output:								
fB%	3.2	1.7	3.0	1.7	2.6	2.6	2.7	2.7
BOQ	0.1	34.0	2.0	42.0	4.4	3.5	0.6	0.6
QSRatio								

ERROR MESSAGES

No errors to report.

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TWO-WAY STOP CONTROL SUMMARY

Analyst:	NA
Agency/Co.:	URS Canada Inc.
Date Performed:	5/17/2005
Analysis Time Period:	PM Peak Hour
Intersection:	Keele Street/Bus Terminal
Jurisdiction:	City of Toronto
Units: U. S. Metric	
Analysis Year:	Total Future Conditions
Project ID: TTC Spadina Station Extension	
East/West Street:	Bus Terminal Access
North/South Street:	Keele Street
Intersection Orientation: NS	Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		1356	37		1808	
Peak-Hour Factor, PHF		0.98	0.90		0.98	
Hourly Flow Rate, HFR		1383	41		1844	
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Undivided		/			
RT Channelized?						
Lanes		2	0		2	
Configuration		T	TR		T	
Upstream Signal?		Yes			Yes	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume			0			
Peak Hour Factor, PHF			0.98			
Hourly Flow Rate, HFR			0			
Percent Heavy Vehicles			0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
Lanes			1			
Configuration			R			

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config					R			
v (vph)					0			
C(m) (vph)					822			
v/c					0.00			
95% queue length					0.00			
Control Delay					9.4			
LOS					A			
Approach Delay								
Approach LOS								

HCS2000: Unsignalized Intersections Release 4.1d

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst:	NA
Agency/Co.:	URS Canada Inc.
Date Performed:	5/17/2005
Analysis Time Period:	PM Peak Hour
Intersection:	Keele Street/Bus Terminal
Jurisdiction:	City of Toronto
Units: U. S. Metric	
Analysis Year:	Total Future Conditions
Project ID: TTC Spadina Station Extension	
East/West Street:	Bus Terminal Access
North/South Street:	Keele Street
Intersection Orientation: NS	Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		1356	37		1808	
Peak-Hour Factor, PHF		0.98	0.90		0.98	
Peak-15 Minute Volume		346	10		461	
Hourly Flow Rate, HFR		1383	41		1844	
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Undivided		/			
RT Channelized?						
Lanes		2	0		2	
Configuration		T	TR		T	
Upstream Signal?		Yes			Yes	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume			0			
Peak Hour Factor, PHF			0.98			
Peak-15 Minute Volume			0			
Hourly Flow Rate, HFR			0			
Percent Heavy Vehicles			0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
RT Channelized			No			
Lanes			1			
Configuration			R			

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0
Lane Width (m)	3.6	3.6	3.6	3.6
Walking Speed (m/sec)	1.2	1.2	1.2	1.2
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed kph	Distance to Signal meters
S2 Left-Turn	145	1700	3	34	100	60	130
Through	1013	1700	3	27	100	60	130
S5 Left-Turn	78	1700	3	28	120	60	125
Through	1571	1700	3	49	120	60	125

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)					6.9			
t(c,hv)	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)					0			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Grade/100			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)					0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage					6.9			
2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)					3.30			
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)					0			
t(f)					3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
V prog	1013	145	1571	78
Total Saturation Flow Rate, s (vph)	3400	3400	3400	3400
Arrival Type	3	3	3	3
Effective Green, g (sec)	27	34	49	28
Cycle Length, C (sec)	100	100	120	120
Rp (from Exhibit 16-11)	1.000	1.000	1.000	1.000
Proportion vehicles arriving on green P	0.270	0.340	0.408	0.233
g(q1)	21.7	2.8	32.8	2.1
g(q2)	9.2	0.1	28.2	0.0
g(q)	31.0	2.9	61.0	2.2

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
alpha		0.500		0.500
beta		0.667		0.667
Travel time, t(a) (sec)		7.794		7.494
Smoothing Factor, F		0.278		0.286
Proportion of conflicting flow, f	1.000	1.000	1.000	1.000
Max platooned flow, V(c,max)	3400	2095	3400	1757
Min platooned flow, V(c,min)	2000	2000	2000	2000
Duration of blocked period, t(p)	24.3	0.4	46.4	0.0
Proportion time blocked, p		0.246		0.386

Computation 3-Platoon Event Periods	Result
p(2)	0.246
p(5)	0.386
p(dom)	0.386
p(subo)	0.246
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)	0.754		
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x					712			
s					3000			
Px					0.754			
V c,u,x					0			
C r,x					1091			
C plat,x					822			

Two-Stage Process

	7 Stage1	7 Stage2	8 Stage1	8 Stage2	10 Stage1	10 Stage2	11 Stage1	11 Stage2
V(c,x)								
s								
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	712	
Potential Capacity	822	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	822	
Probability of Queue free St.	1.00	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Result for 2 stage process:		
a		
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Results for Two-stage process:		
a		
y		
C t		

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)			0			
Movement Capacity (vph)			822			
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep			822			
Volume			0			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config					R			
v (vph)					0			
C(m) (vph)					822			
v/c					0.00			
95% queue length					0.00			
Control Delay					9.4			
LOS					A			
Approach Delay								
Approach LOS								

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

APPENDIX F

SUPPLEMENTARY ANALYSES

Finch West Station – Supplementary Analyses

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: AM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Finch Avenue

Inter.: Finch Avenue / Romfield Lane
Area Type: All other areas
Jurisd: City of Toronto
Year: Total Future Conditions
N/S St: Romfield Lane

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes		1	2 1		1	2 1		1	1 0		1	1 0
LGConfig	L		T R	L		T R	L		TR	L		TR
Volume	57	1970	12	16	1064	5	20	10	49	15	11	28
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6		3.6	3.6	
RTOR Vol		0			0				0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left		P			NB Left	A			
Thru		P			Thru	A			
Right		P			Right	A			
Peds					Peds				
WB Left		P			SB Left	A			
Thru		P			Thru	A			
Right		P			Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	57.0					21.0			
Yellow	4.0					3.0			
All Red	2.0					3.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	264	417	0.22	0.63	8.9	A		
T	2111	3333	0.95	0.63	26.4	C	25.8	C
R	1018	1007	0.01	0.63	6.1	A		
Westbound								
L	84	133	0.19	0.63	11.9	B		
T	2102	3319	0.52	0.63	9.9	A	9.9	A
R	1023	1615	0.00	0.63	6.1	A		
Northbound								
L	309	1323	0.06	0.23	26.9	C		
TR	369	1583	0.16	0.23	27.7	C	27.5	C
Southbound								
L	318	1364	0.05	0.23	26.8	C		
TR	344	1473	0.12	0.23	27.3	C	27.2	C

Intersection Delay = 20.6 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: NA
Intersection: Finch Avenue / Romfield Lane
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: AM Peak Hour
Analysis Year: Total Future Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Finch Avenue
North/South Street: Romfield Lane

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	57	1970	12	16	1064	5	20	10	49	15	11	28
% Heavy Veh	0	8	0	0	9	0	5	0	6	0	36	7
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	15	503	3	4	271	2	5	3	13	4	3	7
Hi Ln Vol												
% Grade		1			0			0			0	
Ideal Sat	1900	1900	1900	1900	1900	1900	1900	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes		1	2 1		1	2 1		1	1 0		1	1 0
LGConfig	L		T R	L		T R	L		TR	L		TR
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6		3.6	3.6	
RTOR Vol		0			0				0			0
Adj Flow	58	2010	12	16	1086	5	20	60		15	40	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.833			0.725	
Peds Bikes	0			0			0			0		
Buses	0	0	0	0	0	0	0	0		0	0	
%InProtPhase												

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Arriv. Type	3	3	3	3	3	3	3	3		3	3	
Unit Ext.	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0		2.0	2.0	
Ext of g	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0		2.0	2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left		P			NB Left	A			
Thru		P			Thru	A			
Right		P			Right	A			
Peds					Peds				
WB Left		P			SB Left	A			
Thru		P			Thru	A			
Right		P			Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	57.0					21.0			
Yellow	4.0					3.0			
All Red	2.0					3.0			

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	57	1970	12	16	1064	5	20	10	49	15	11	28
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	58	2010	12	16	1086	5	20	10	50	15	11	29
No. Lanes		1	2 1		1	2 1		1	1 0		1	1 0
Lane group	L		T R	L		T R	L		TR	L		TR
Adj flow	58	2010	12	16	1086	5	20	60		15	40	
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.833			0.725	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	T	R	L	T	R	L	T	R	L	T	R
So	1900	1900	1900	1900	1900	1900	1900	1900		1900	1900	
Lanes	1	2	1	1	2	1	1	1	0	1	1	0
fW	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000	1.000	
fHV	1.000	0.926	1.000	1.000	0.917	1.000	0.952	0.952		1.000	0.870	
fG	0.995	0.995	0.995	1.000	1.000	1.000	1.000	1.000		1.000	1.000	
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000	1.000	
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000	1.000	
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000	1.000	
fLU	1.000	0.952	1.000	1.000	0.952	1.000	1.000	1.000		1.000	1.000	
fRT		1.000	0.850		1.000	0.850		0.875			0.891	
fLT	0.221	1.000		0.070	1.000		0.731	1.000		0.718	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000	1.000		1.000	1.000		1.000			1.000	
S	417	3333	1607	133	3319	1615	1323	1583		1364	1473	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	58	417	0.14	0.63	264	0.22
Prot							
Perm							
Thru	T	2010	3333	# 0.60	0.63	2111	0.95
Right	R	12	1607	0.01	0.63	1018	0.01
Westbound							
Prot							
Perm							
Left	L	16	133	0.12	0.63	84	0.19
Prot							
Perm							
Thru	T	1086	3319	0.33	0.63	2102	0.52
Right	R	5	1615	0.00	0.63	1023	0.00
Northbound							
Prot							
Perm							
Left	L	20	1323	0.02	0.23	309	0.06
Prot							
Perm							
Thru	TR	60	1583	# 0.04	0.23	369	0.16
Right							
Southbound							
Prot							
Perm							
Left	L	15	1364	0.01	0.23	318	0.05
Prot							
Perm							
Thru	TR	40	1473	0.03	0.23	344	0.12
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.64
Total lost time per cycle, L = 12.00 Sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.74

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.22	0.63	7.0	1.000	264	0.50	1.9	0.0	8.9	A		
T	0.95	0.63	15.2	1.000	2111	0.50	11.2	0.0	26.4	C	25.8	C
R	0.01	0.63	6.1	1.000	1018	0.50	0.0	0.0	6.1	A		
Westbound												
L	0.19	0.63	6.9	1.000	84	0.50	5.0	0.0	11.9	B		
T	0.52	0.63	9.0	1.000	2102	0.50	0.9	0.0	9.9	A	9.9	A
R	0.00	0.63	6.1	1.000	1023	0.50	0.0	0.0	6.1	A		
Northbound												
L	0.06	0.23	26.9	1.000	309	0.11	0.1	0.0	26.9	C		
TR	0.16	0.23	27.5	1.000	369	0.11	0.2	0.0	27.7	C	27.5	C
Southbound												
L	0.05	0.23	26.7	1.000	318	0.11	0.1	0.0	26.8	C		
TR	0.12	0.23	27.2	1.000	344	0.11	0.2	0.0	27.3	C	27.2	C

Intersection Delay = 20.6 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	57.0	57.0	21.0	21.0
Effective permitted green time for LT lane group, g(s)	57.0	57.0	21.0	21.0
Opposing effective green time, go (s)	57.0	57.0	21.0	21.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	2	2	1	1
Adjusted LT flow rate, VLT (veh/h)	58	16	20	15
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	1086	2010	40	60
Lost time for LT lane group, tL	6.00	6.00	6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600	1.45	0.40	0.50	0.38
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	14.26	26.39	1.00	1.50
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.37	0.37	0.77	0.77
gq, (see Exhibit C16-4,5,6,7,8)	9.31	40.80	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	47.69	16.20	21.00	21.00
n=Max(gq-gf)/2,0)	4.65	20.40	0.00	0.00
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	3.79	9.69	1.37	1.39
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07	0.07	0.19	0.19
gdiff=max(gq-gf, 0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.22	0.07	0.73	0.72
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.221	0.070	0.731	0.718

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600	0.952	0.952	1.000	1.000
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+Pl)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time r=(C-g-gq-gu)				
Arrival rate, qa=v/(3600(max[X,1.0]))				
Protected ph. departure rate, Sp=s/3600				
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Grp	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Lane Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 20.6 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	T	R	L	T	R	L	TR		L	TR	
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Flow Rate	58	1055	12	16	570	5	20	60		15	40	
So	1900	1900	1900	1900	1900	1900	1900	1900		1900	1900	
No.Lanes	1	2	1	1	2	1	1	1	0	1	1	0
SL	417	1750	1607	133	1743	1615	1323	1583		1364	1473	
LnCapacity	264	1108	1018	84	1103	1023	309	369		318	344	
Flow Ratio	0.14	0.60	0.01	0.12	0.33	0.00	0.02	0.04		0.01	0.03	
v/c Ratio	0.22	0.95	0.01	0.19	0.52	0.00	0.06	0.16		0.05	0.12	
Grn Ratio	0.63	0.63	0.63	0.63	0.63	0.63	0.23	0.23		0.23	0.23	
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3	3	3	3	3	3	3		3	3	
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Q1	0.6	24.4	0.1	0.2	7.8	0.0	0.4	1.2		0.3	0.8	
kB	0.4	1.2	1.2	0.2	1.2	1.2	0.3	0.4		0.3	0.4	
Q2	0.1	9.8	0.0	0.0	1.3	0.0	0.0	0.1		0.0	0.0	
Q Average	0.7	34.2	0.1	0.2	9.1	0.1	0.4	1.3		0.3	0.8	
Q Spacing	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6		7.6	7.6	
Q Storage	0	0	0	0	0	0	0	0		0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.3	1.2	1.3	1.3	1.2	1.3	1.2	1.2		1.2	1.2	
BOQ	1.0	41.0	0.2	0.3	11.0	0.1	0.5	1.5		0.4	1.0	
QSRatio												
85th Percentile Output:												
fB%	1.7	1.4	1.7	1.7	1.4	1.7	1.6	1.6		1.6	1.6	
BOQ	1.2	47.9	0.2	0.4	13.1	0.1	0.7	2.0		0.5	1.3	
QSRatio												
90th Percentile Output:												
fB%	1.9	1.5	2.0	2.0	1.6	2.0	1.8	1.8		1.8	1.8	
BOQ	1.4	51.3	0.2	0.4	14.3	0.1	0.7	2.3		0.6	1.5	
QSRatio												
95th Percentile Output:												
fB%	2.5	1.6	2.6	2.6	1.8	2.6	2.1	2.1		2.1	2.1	
BOQ	1.8	54.8	0.3	0.5	16.0	0.1	0.9	2.6		0.6	1.7	
QSRatio												
98th Percentile Output:												
fB%	3.0	1.7	3.2	3.1	1.9	3.2	2.7	2.6		2.7	2.6	
BOQ	2.2	58.2	0.4	0.7	17.6	0.2	1.1	3.3		0.8	2.2	
QSRatio												

ERROR MESSAGES

No errors to report.

Finch West Station – Supplementary Analyses

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: PM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Finch Avenue

Inter.: Finch Avenue / Romfield Lane
Area Type: All other areas
Jurisd: City of Toronto
Year: Total Future Conditions
N/S St: Romfield Lane

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes		1	2	1		1	2	1		1	1	0
LGConfig	L		T	R	L		T	R	L		TR	
Volume	0	2114	22	26	2341	0	5	0	12	0	0	1
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6		3.6	3.6	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left		P			NB Left	P			
Thru		P			Thru	P			
Right		P			Right	P			
Peds					Peds				
WB Left		P			SB Left	P			
Thru		P			Thru	P			
Right		P			Right	P			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green		67.0				21.0			
Yellow		4.0				3.0			
All Red		2.0				3.0			

Cycle Length: 100.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	76	113	0.00	0.67	5.4	A		
T	2330	3478	0.93	0.67	22.1	C	22.0	C
R	1082	1615	0.02	0.67	5.6	A		
Westbound								
L	76	113	0.36	0.67	19.7	B		
T	2353	3512	1.02	0.67	39.0	D	38.7	D
R	1082	1615	0.00	0.67	5.4	A		
Northbound								
L	302	1439	0.02	0.21	31.4	C		
TR	339	1615	0.04	0.21	31.6	C	31.6	C
Southbound								
L	299	1424	0.00	0.21	31.2	C		
TR	339	1615	0.00	0.21	31.2	C	31.2	C

Intersection Delay = 30.8 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:
Fax:

OPERATIONAL ANALYSIS

Analyst: NA
Intersection: Finch Avenue / Romfield Lane
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: PM Peak Hour
Analysis Year: Total Future Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Finch Avenue
North/South Street: Romfield Lane

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	2114	22	26	2341	0	5	0	12	0	0	1
% Heavy Veh	0	4	0	0	3	0	0	0	0	0	0	0
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	0	539	6	7	597	0	2	0	3	0	0	1
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900	1900	1900	1900	1900	1900	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes		1	2	1		1	2	1		1	1	0
LGConfig	L		T	R	L		T	R	L		TR	
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6		3.6	3.6	
RTOR Vol			0			0			0			0
Adj Flow %InSharedLn	0	2157	22	27	2389	0	5	12		0	1	
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.000	1.000		1.000			1.000	
Peds Bikes	0			0			0			0		
Buses	0	0	0	0	0	0	0	0		0	0	
%InProtPhase												

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Arriv. Type	3	3	3	3	3	3	3	3		3	3	
Unit Ext.	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0		2.0	2.0	
Ext of g	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0		2.0	2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left		P			NB Left	P			
Thru		P			Thru	P			
Right		P			Right	P			
Peds					Peds				
WB Left		P			SB Left	P			
Thru		P			Thru	P			
Right		P			Right	P			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green		67.0				21.0			
Yellow		4.0				3.0			
All Red		2.0				3.0			

Cycle Length: 100.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	0	2114	22	26	2341	0	5	0	12	0	0	1
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	0	2157	22	27	2389	0	5	0	12	0	0	1
No. Lanes		1	2	1		1	2	1		1	1	0
Lane group	L		T	R	L		T	R	L		TR	
Adj flow	0	2157	22		27	2389	0		5	12		0	1	
Prop LTs	1.000	0.000			1.000	0.000			1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000			0.000	1.000			1.000			1.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	T	R	L	T	R	L	T	R	L	T	R
So	1900	1900	1900	1900	1900	1900	1900	1900		1900	1900	
Lanes	1	2	1	1	2	1	1	1	0	1	1	0
fW	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000	1.000	
fHV	1.000	0.962	1.000	1.000	0.971	1.000	1.000	1.000		1.000	1.000	
fG	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000	1.000	
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000	1.000	
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000	1.000	
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000	1.000	
fLU	1.000	0.952	1.000	1.000	0.952	1.000	1.000	1.000		1.000	1.000	
fRT		1.000	0.850		1.000	0.850		0.850			0.850	
fLT	0.060	1.000		0.060	1.000		0.757	1.000		0.750	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000	1.000		1.000	1.000		1.000			1.000	
S	113	3478	1615	113	3512	1615	1439	1615		1424	1615	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	0	113	0.00	0.67	76	0.00
Prot							
Perm							
Thru	T	2157	3478	0.62	0.67	2330	0.93
Right	R	22	1615	0.01	0.67	1082	0.02
Westbound							
Prot							
Perm							
Left	L	27	113	0.24	0.67	76	0.36
Prot							
Perm							
Thru	T	2389	3512	# 0.68	0.67	2353	1.02
Right	R	0	1615	0.00	0.67	1082	0.00
Northbound							
Prot							
Perm							
Left	L	5	1439	0.00	0.21	302	0.02
Prot							
Perm							
Thru	TR	12	1615	# 0.01	0.21	339	0.04
Right							
Southbound							
Prot							
Perm							
Left	L	0	1424	0.00	0.21	299	0.00
Prot							
Perm							
Thru	TR	1	1615	0.00	0.21	339	0.00
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.69
Total lost time per cycle, L = 12.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.78

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.00	0.67	5.4	1.000	76	0.50	0.0	0.0	5.4	A		
T	0.93	0.67	14.3	1.000	2330	0.50	7.8	0.0	22.1	C	22.0	C
R	0.02	0.67	5.5	1.000	1082	0.50	0.0	0.0	5.6	A		
Westbound												
L	0.36	0.67	7.1	1.000	76	0.50	12.5	0.0	19.7	B		
T	1.02	0.67	16.5	1.000	2353	0.50	22.5	0.0	39.0	D	38.7	D
R	0.00	0.67	5.4	1.000	1082	0.50	0.0	0.0	5.4	A		
Northbound												
L	0.02	0.21	31.3	1.000	302	0.50	0.1	0.0	31.4	C		
TR	0.04	0.21	31.4	1.000	339	0.50	0.2	0.0	31.6	C	31.6	C
Southbound												
L	0.00	0.21	31.2	1.000	299	0.50	0.0	0.0	31.2	C		
TR	0.00	0.21	31.2	1.000	339	0.50	0.0	0.0	31.2	C	31.2	C

Intersection Delay = 30.8 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)	67.0	67.0	21.0	21.0
Effective permitted green time for LT lane group, g(s)	67.0	67.0	21.0	21.0
Opposing effective green time, go (s)	67.0	67.0	21.0	21.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	2	2	1	1
Adjusted LT flow rate, VLT (veh/h)	0	27	5	0
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	2389	2157	1	12
Lost time for LT lane group, tL	6.00	6.00	6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.00	0.75	0.14	0.00
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	34.85	31.47	0.003	0.33
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.33	0.33	0.79	0.79
gq, (see Exhibit C16-4,5,6,7,8)	63.00	50.04	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	4.00	16.96	21.00	21.00
n=Max(gq-gf)/2,0)	31.50	25.02	0.00	0.00
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	14.38	11.29	1.32	1.33
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06	0.06	0.19	0.19
gdiff=max(gq-gf,0) fm=[gf/g)+[gu/g)/(1+PL(EL1-1)], (min=fmin;max=1.00)	0.00	0.00	0.00	0.00
flt=fm=[gf/g)+[gu/g)/(1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**	0.06	0.06	0.76	0.75
Left-turn adjustment, fLT	0.060	0.060	0.757	0.750

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600	0.952	0.952	1.000	1.000
Opposing lane util. factor, fLUo				
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+Pl)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0) fm=[gf/g)+[gu/g)/(1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g)+[gu/g)/(1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 100.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time r=(C-g-gq-gu)				
Arrival rate, qa=v/(3600(max[X,1.0]))				
Protected ph. departure rate, Sp=s/3600				
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Lane Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 30.8 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	T	R	L	T	R	L	TR		L	TR	
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Flow Rate	0	1132	22	27	1254	0	5	12		0	1	
So	1900	1900	1900	1900	1900	1900	1900	1900		1900	1900	
No.Lanes	1	2	1	1	2	1	1	1	0	1	1	0
SL	113	1826	1615	113	1844	1615	1439	1615		1424	1615	
LnCapacity	76	1223	1082	76	1235	1082	302	339		299	339	
Flow Ratio	0.00	0.62	0.01	0.24	0.68	0.00	0.00	0.01		0.00	0.00	
v/c Ratio	0.00	0.93	0.02	0.36	1.02	0.00	0.02	0.04		0.00	0.00	
Grn Ratio	0.67	0.67	0.67	0.67	0.67	0.67	0.21	0.21		0.21	0.21	
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3	3	3	3	3	3	3		3	3	
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Q1	0.0	27.3	0.2	0.3	34.8	0.0	0.1	0.3		0.0	0.0	
kB	0.2	1.4	1.3	0.2	1.4	1.3	0.5	0.6		0.5	0.6	
Q2	0.0	9.6	0.0	0.1	16.2	0.0	0.0	0.0		0.0	0.0	
Q Average	0.0	36.9	0.2	0.4	51.0	0.0	0.1	0.3		0.0	0.0	
Q Spacing	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6		7.6	7.6	
Q Storage	0	0	0	0	0	0	0	0		0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.3	1.2	1.3	1.3	1.2	1.3	1.3	1.3		1.3	1.3	
BOQ	0.0	44.3	0.3	0.6	61.2	0.0	0.2	0.4		0.0	0.0	
QSRatio												
85th Percentile Output:												
fB%	1.7	1.4	1.7	1.7	1.4	1.7	1.7	1.7		1.7	1.7	
BOQ	0.0	51.6	0.4	0.7	71.4	0.0	0.2	0.5		0.0	0.0	
QSRatio												
90th Percentile Output:												
fB%	2.0	1.5	2.0	2.0	1.5	2.0	2.0	2.0		2.0	2.0	
BOQ	0.0	55.3	0.5	0.9	76.5	0.0	0.2	0.6		0.0	0.0	
QSRatio												
95th Percentile Output:												
fB%	2.6	1.6	2.6	2.5	1.6	2.6	2.6	2.5		2.6	2.6	
BOQ	0.0	59.0	0.6	1.1	81.6	0.0	0.3	0.7		0.0	0.1	
QSRatio												
98th Percentile Output:												
fB%	3.2	1.7	3.1	3.1	1.7	3.2	3.2	3.1		3.2	3.2	
BOQ	0.0	62.7	0.7	1.3	86.7	0.0	0.4	0.9		0.0	0.1	
QSRatio												

ERROR MESSAGES

No errors to report.

TRAFFIC IMPACT STUDY
TTC SPADINA SUBWAY EXTENSION
STEELES WEST STATION
CITY OF TORONTO

Prepared By:

URS Canada Inc.
75 Commerce Valley Drive East
Markham, Ontario
L3T 7N9

February 14, 2006
33015347

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APPENDICES

1.0 INTRODUCTION

This Traffic Impact Study has been prepared to document the study methodology, findings and evaluations associated with the proposed TTC Spadina Subway Extension and the proposed station concept at the Steeles West Station. This is outlined herein.

The purpose of this memorandum was to:

- Review existing transportation conditions, opportunities, and constraints;
- Forecast and assess future traffic conditions associated with the proposed Steeles West Station; and
- Identify operational concerns and proposed mitigation measures.

2.0 EXISTING TRAFFIC CONDITIONS

2.1. Boundary Road Network

Generally, in the vicinity of the Study Area, the lands are primarily for commercial and employment uses.

Figure 2-1 illustrates the existing arterial road system in the Study Area. In summary, they are:

- ***Dufferin Street*** is a north-south Major Arterial road with a posted speed limit of 60 km/h. It has 4-lanes from Glen Shields Avenue (north) to Finch Avenue. There are reserved High Occupancy Vehicle (H.O.V.) lanes on Dufferin Street between Finch Avenue and Sheppard Avenue. During the weekday morning and afternoon peak periods only buses, taxis and multi-person autos (three or more) are permitted to use these lanes. Dufferin Street is under the jurisdiction of York Region and the City of Toronto north and south of Steeles Avenue, respectively.

- ***Jane Street*** is a north-south Major Arterial road with a 4-lane cross-section. Jane Street is under the jurisdiction of York Region and the City of Toronto north and south of Steeles Avenue, respectively.

- ***Keele Street*** is a north-south Major Arterial road with a 4-lane cross-section. Keele Street is under the jurisdiction of York Region and the City of Toronto north and south of Steeles Avenue, respectively.

- ***Steeles Avenue*** is an east-west 6-lane Major Arterial road, under the jurisdiction of the City of Toronto, with a posted speed limit of 60 km/h.

- ***Finch Avenue*** is an east-west 4-lane Major Arterial road, under the jurisdiction of the City of Toronto, with a posted speed limit of 60 km/h.

- ***Sheppard Avenue West*** is an east-west 4-lane Major Arterial road, under the jurisdiction of the City of Toronto, with a posted speed limit of 60 km/h.

2.2. Existing Traffic

The existing traffic assessment for this study was based on a review of available turning movement data for the study area. Most recent available turning movement count data for the key intersections within the study area was obtained from the City of Toronto. This data was collected for the a.m. and p.m. peak hours. All observed turning movement counts were reviewed for consistency.

Signal timing information for the a.m. peak, p.m. peak and off peak hours was also obtained from the City of Toronto for key intersections within the study area. These signal timings along with most recent available traffic turning movement counts were incorporated in the analysis of existing traffic conditions.

Table 2-1 summarizes traffic data locations, survey dates and their sources.

TABLE 2-1. SUMMARY OF TRAFFIC DATA

INTERSECTION	DATE	SOURCE
Steeles Avenue / Jane Street	Tuesday, October 8, 2002	City of Toronto
Steeles Avenue / Murray Ross Parkway	Wednesday, October 29, 2003	City of Toronto
Steeles Avenue / Founders Road	Monday, January 22, 2001	City of Toronto
Steeles Avenue / Keele Street	Monday, December 15, 2003	City of Toronto
Steeles Avenue / Petrolia Road / Tandem Road	Wednesday, January 9, 2002	City of Toronto
Steeles Avenue / Shale Gate / Capstan Gate	Wednesday, December 5, 2001	City of Toronto
Steeles Avenue / Alness Street	Monday, October 27, 2003	City of Toronto
Steeles Avenue / Futurity Gate	Wednesday, December 6, 1995	City of Toronto
Steeles Avenue / Dufferin Street	Thursday, October 24, 2002	City of Toronto
Finch Avenue / Sentinel Road	Thursday, January 17, 2002	City of Toronto
Finch Avenue / Romfield Lane	Monday, December 8, 2003	City of Toronto
Finch Avenue / Keele Street	Tuesday, November 5, 2002	City of Toronto
Finch Avenue / Tangiers Road	Tuesday, September 14, 2004	City of Toronto
Finch Avenue / CNR Service Road	Tuesday, December 17, 2002	City of Toronto
Finch Avenue / Chesswood Drive	Wednesday, September 29, 2004	City of Toronto
Finch Avenue / Alness Street / Champagne Drive	Wednesday, January 16, 2002	City of Toronto
Finch Avenue / Dufferin Street	Monday, June 23, 2003	City of Toronto
Sheppard Avenue / Sentinel Road	Thursday, November 27, 2003	City of Toronto
Sheppard Avenue / Keele Street	Monday, December 16, 2002	City of Toronto
Sheppard Avenue / John Drury Crescent	Wednesday, June 27, 2001	City of Toronto
Sheppard Avenue / Tuscan Gate	Monday, November 24, 2003	City of Toronto
Sheppard Avenue / Chesswood Drive	Wednesday, June 27, 2001	City of Toronto
Sheppard Avenue / Kodiak Crescent / Yukon Lane	Tuesday, March 23, 2004	City of Toronto
Sheppard Avenue / W.R. Allen Road	Monday, May 12, 2003	City of Toronto
Keele Street / Canarctic Drive	Thursday, April 4, 2002	City of Toronto
Keele Street / The Pond Road	Thursday, April 4, 2002	City of Toronto
Keele Street / Murray Ross Parkway	Tuesday, December 17, 2002	City of Toronto
Keele Street / Toro Road	Wednesday, February 20, 2002	City of Toronto
Keele Street / Broadoaks Drive	Thursday, March 14, 2002	City of Toronto
Keele Street / St. Regis Crescent	Tuesday, August 27, 2002	City of Toronto
Keele Street / Grandravine Drive	Thursday, April 25, 2002	City of Toronto
Dufferin Street / 4400 Dufferin Street	Monday, December 8, 2003	City of Toronto
Dufferin Street / Dolomite Drive	Thursday, December 4, 2003	City of Toronto
Dufferin Street / Supertest Road	Wednesday, December 10, 2003	City of Toronto
Dufferin Street / Martin Ross Avenue	Wednesday, December 3, 2003	City of Toronto
W.R. Allen Road / Steeprock Drive / Overbrook Road	Thursday, March 13, 2003	City of Toronto
W.R. Allen Road / Kennard Avenue	Tuesday, March 5, 2002	City of Toronto
Alness Street / Supertest Road	Thursday, December 19, 2002	City of Toronto
Alness Street / Martin Ross Avenue	Thursday, December 19, 2002	City of Toronto
Sentinel Road / Murray Ross Parkway	Thursday, June 19, 2003	City of Toronto
Steeles Avenue / Northwest Gate	Tuesday, May 10, 2005	URS Canada Inc.
Keele Street / Four Winds Drive	Tuesday, May 3, 2005	URS Canada Inc.

The existing weekday a.m. and p.m. peak hour traffic volumes are illustrated in Figures 2-2 and 2-3, respectively.

2.3. Traffic Assessment

The traffic volumes in Figures 2-2 and 2-3 are for the broader area impacted by the Spadina Subway Extension. For the purpose of the evaluation of the impacts associated with the identified Steeles West Station concept plan, a study area was identified within the immediate proximity of the proposed station.

Assessment of the existing traffic at the study intersections was based on the existing traffic volumes for the a.m. and p.m. peak hours. This analysis reflects the existing lane configurations illustrated in Figure 2-1.

The assessment for signalized intersection operations is based on the results of the Highway Capacity Software (HCS-2000), which is based on the methodology in the Highway Capacity Manual, 2000. The Highway Capacity Manual is produced by the Transportation Research Board.

Tables 6-1 summarizes the overall Level of Service (LOS), volume-to-capacity ratio (V/C), and average control delay for each of the key intersections during the a.m. and p.m. peak hours within the study area for the Steeles West Station.

Level of Service definitions related to intersection operations are contained in ***Appendix A***. It is a qualifying measure of traffic operations at an intersection, relating the control delay per vehicle for a 15-minute analysis period. The volume-to-capacity ratio is a measure of the proportion of the calculated intersection capacity that is utilized by the modelled traffic volumes. At signalized intersections, movements with a v/c ratio greater than 0.85 or an average vehicle delay greater than 55 seconds (Level of Service 'E') are defined as critical. At unsignalized intersections, movements with a v/c ratio greater than 0.85 or an average vehicle delay of greater than 35 seconds (Level of Service 'E') are defined as critical movements. Detailed output for the existing traffic conditions are in ***Appendix B***.

The analyses of the existing intersection conditions reveal poor overall intersection levels of service at all major arterial-arterial intersections within the Study Area (at-capacity or over-capacity during the a.m. and p.m. peak hours). The intersections experience notably high delays and high volume-to-capacity ratios, with numerous critical movements.

These congested traffic conditions are significantly contributed to by high inter-regional traffic volumes and are typical conditions on regional arterial systems. The nature of such traffic congestion is mainly associated with the travellers' commuting peak hours during the morning and afternoon peak commuting periods (e.g. from 6:00 a.m. to 9:00 a.m., and from 4:00 p.m. to 7:00 p.m.). While congested operations (in terms of delays, queuing, and low reserved capacity) are encountered at the Major Arterial-Major Arterial intersections, acceptable operations at collector-arterial intersections are exhibited, despite relatively high inbound and outbound traffic turning movements at the gateways to significant traffic generators, such as York University.

Figure 2-1A – Existing Lane Configurations

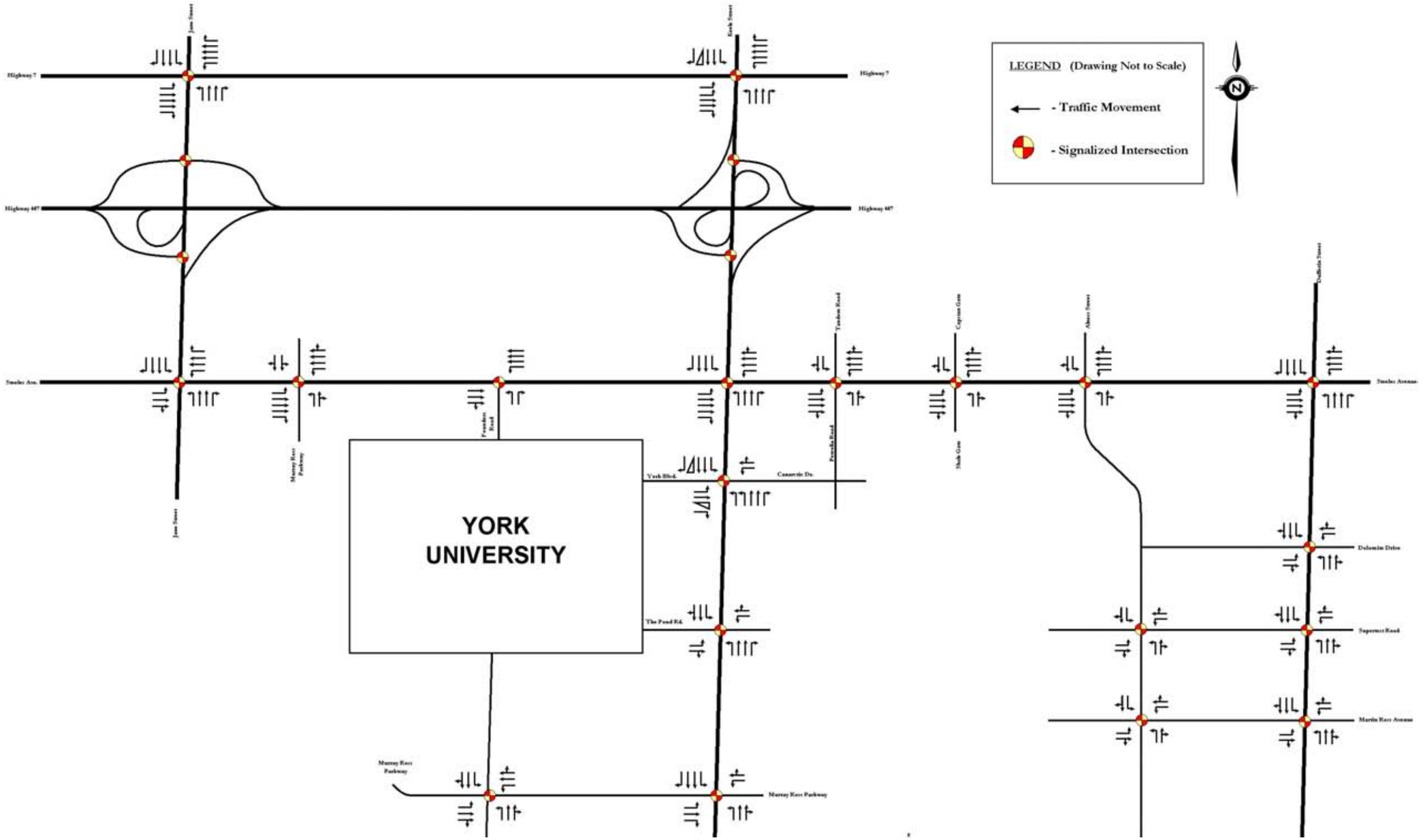


Figure 2-1B – Existing Lane Configurations

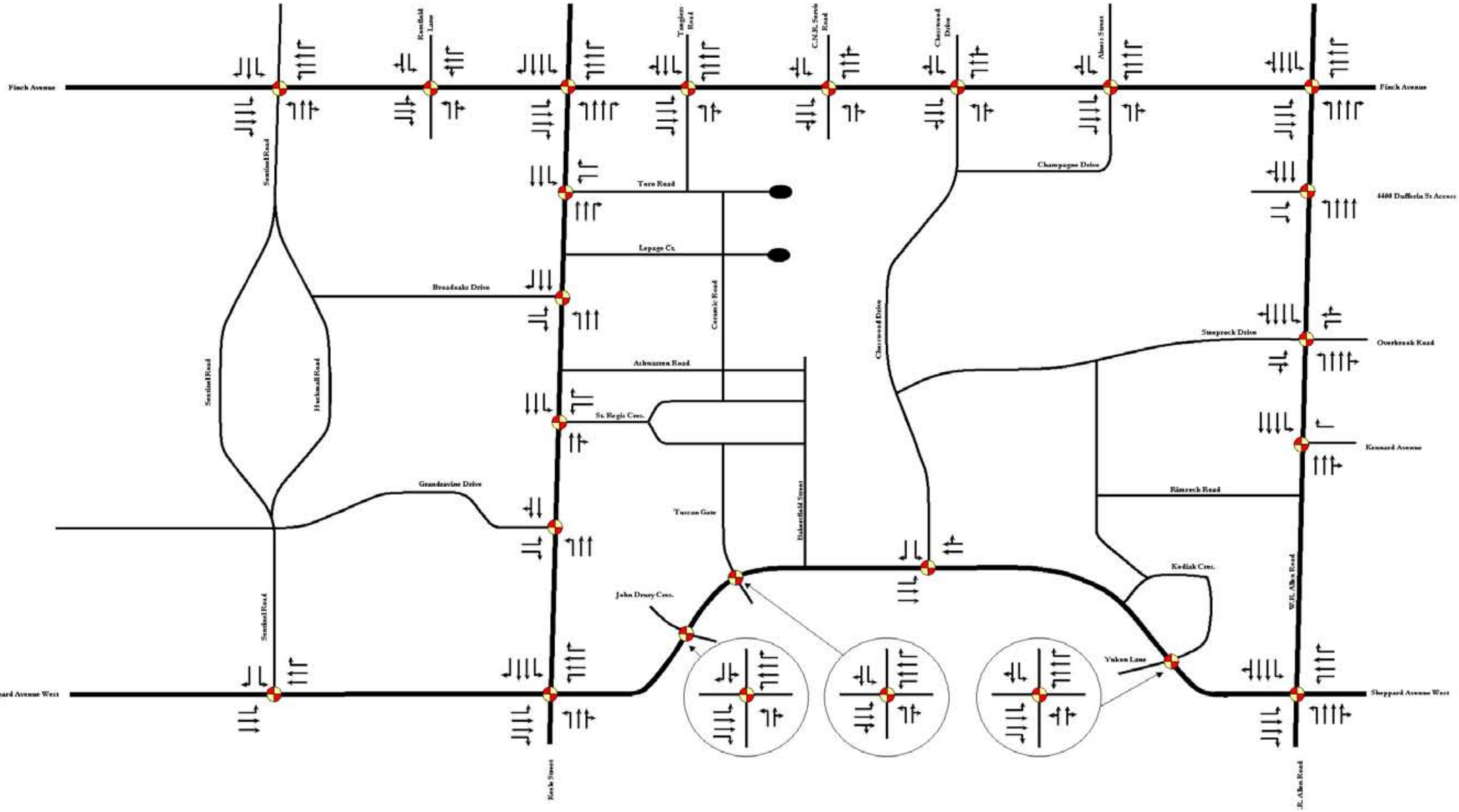


Figure 2-2A – Existing A.M. Peak Hour Traffic Volumes

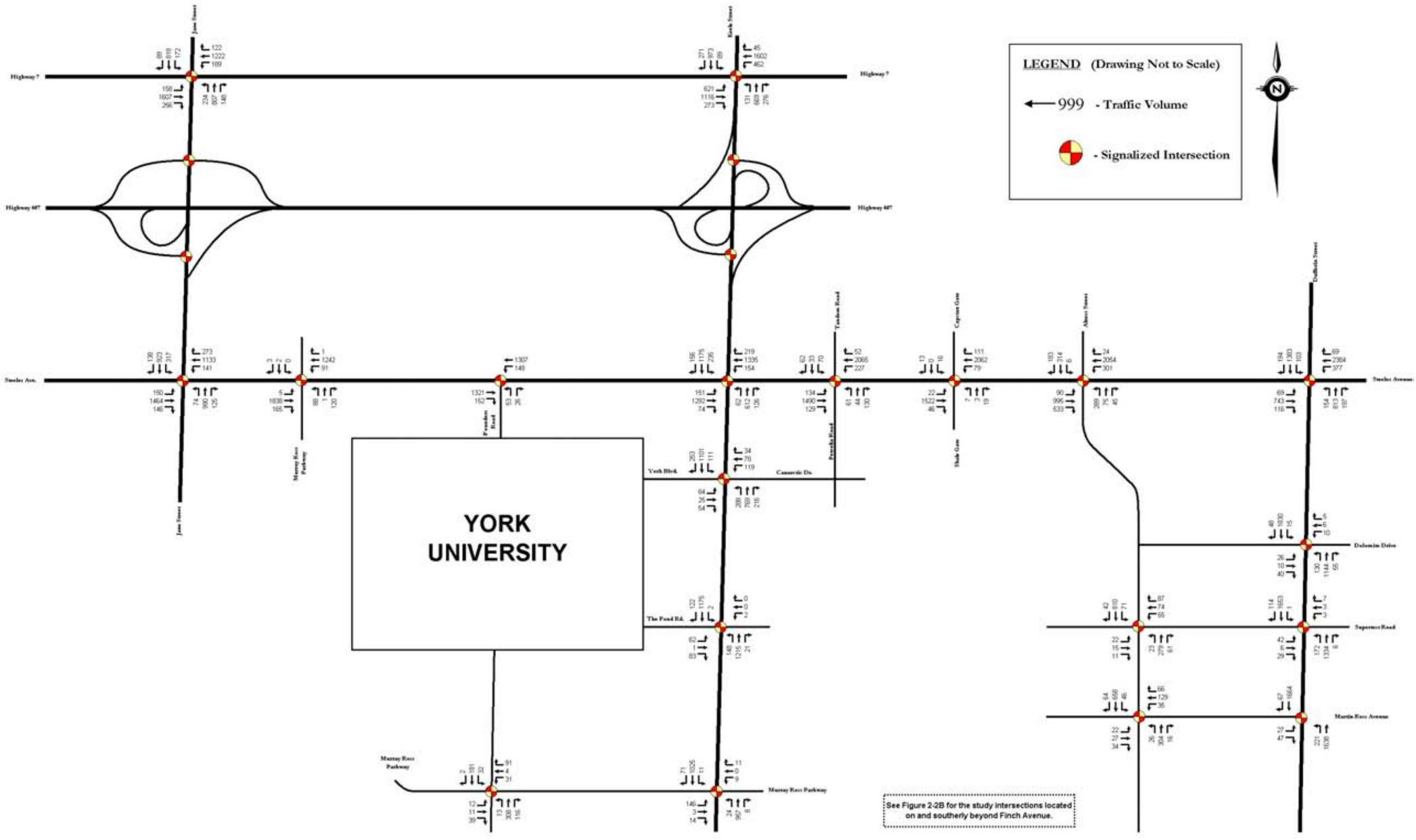


Figure 2-2B – Existing A.M. Peak Hour Traffic Volumes

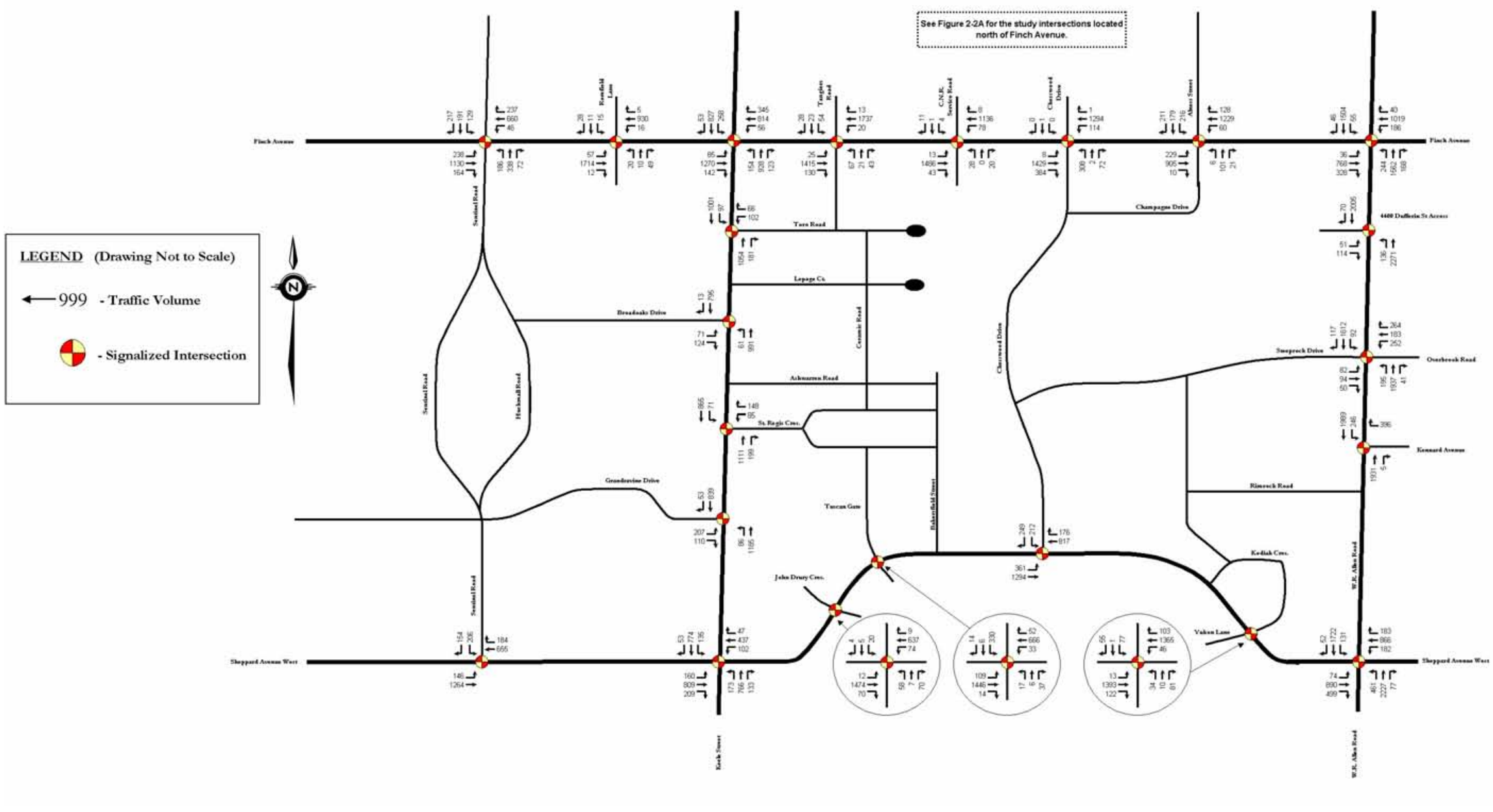


Figure 2-3A – Existing P.M. Peak Hour Traffic Volumes

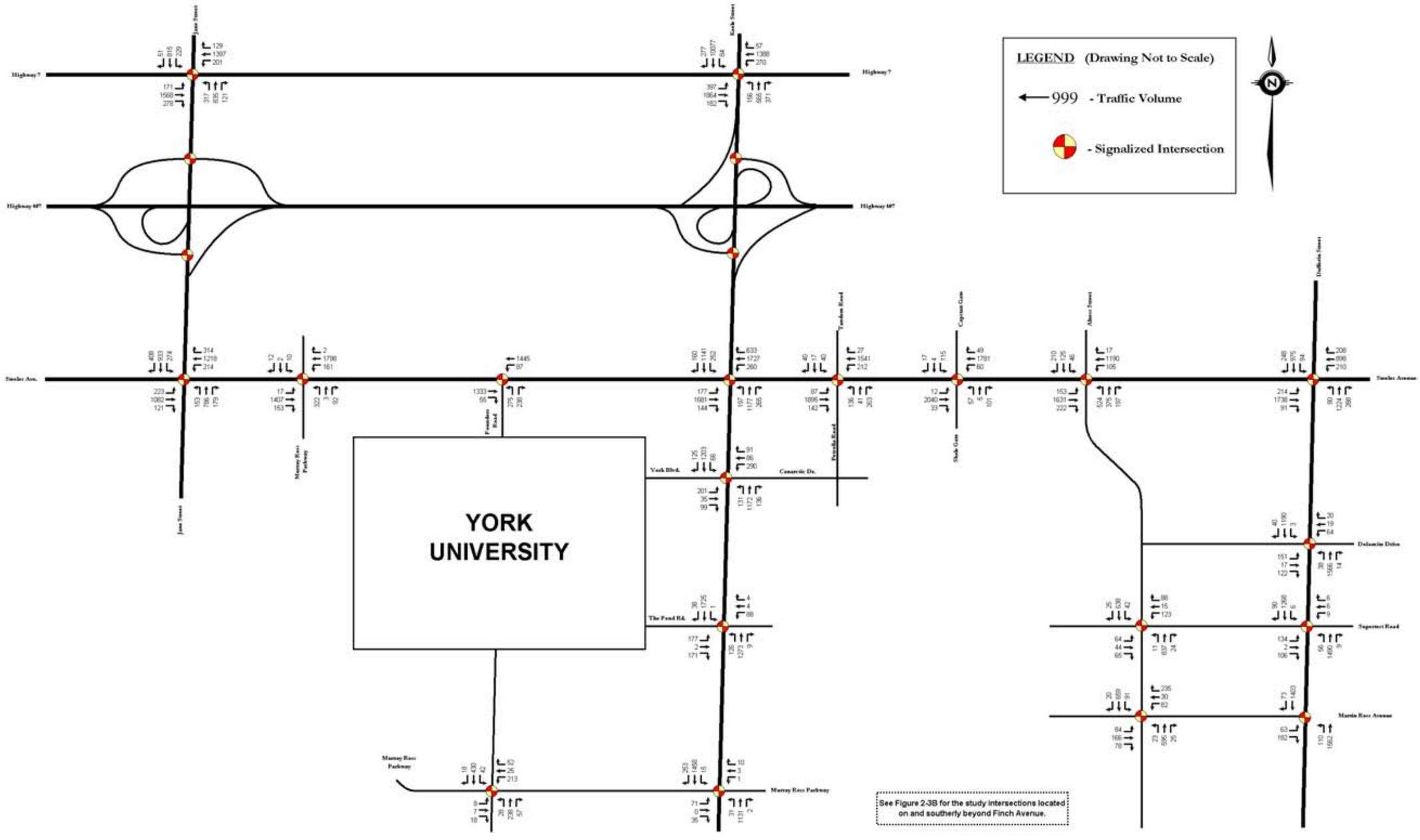
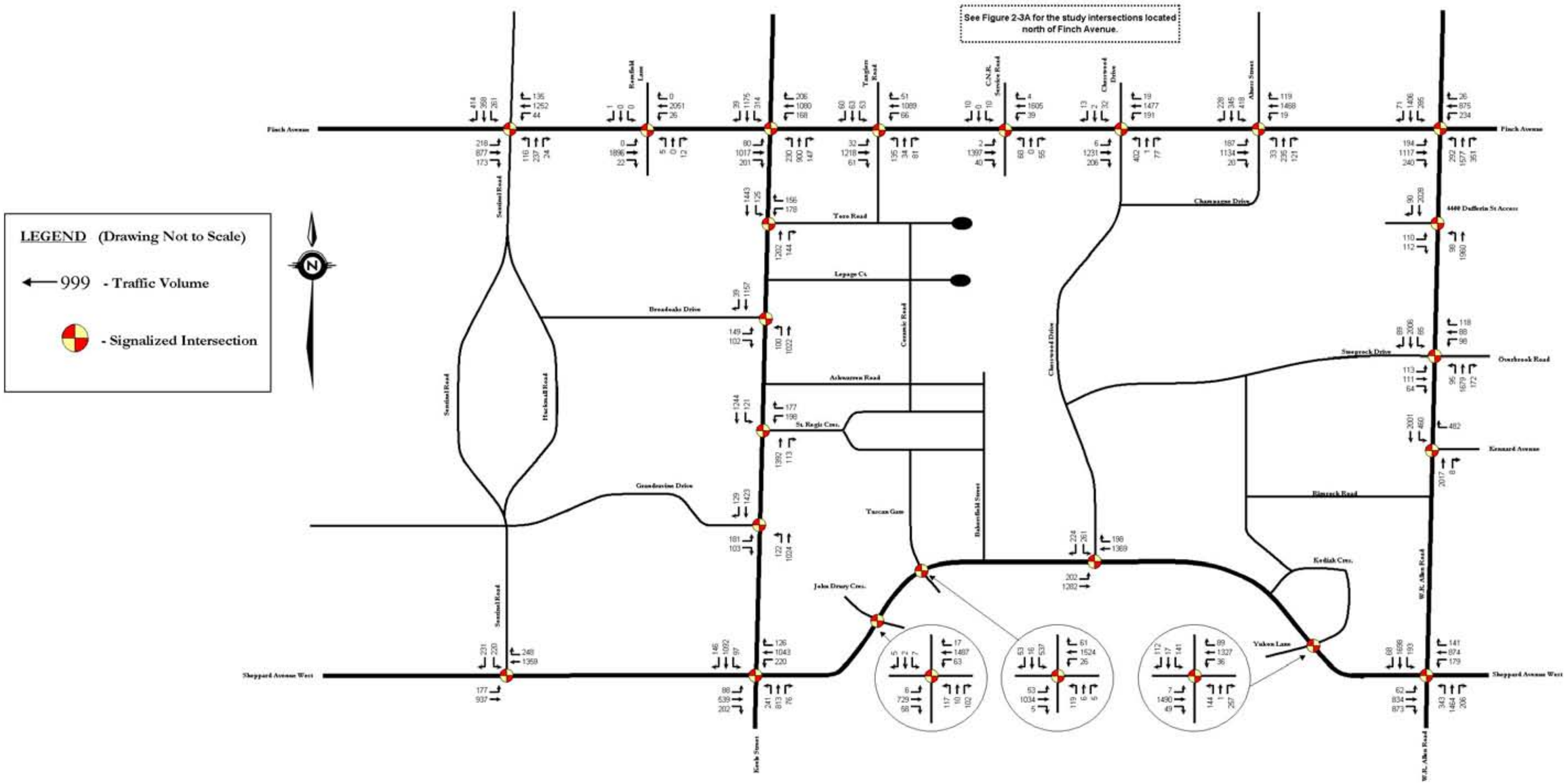


Figure 2-3B – Existing P.M. Peak Hour Traffic Volumes



3.0 PROPOSED STATION CONFIGURATION

The Steeles West Station generalized access plan and assumed road configuration are illustrated in Figure 3-1. Figure 3-2 illustrates the layout plan for the Steeles West Station. The internal circulation for the Steeles West Station was based on a standard bus turning radius of 18.3m (outer turning) as per TTC Standard DM 0412-02 Fig 1.5. Internal bus circulation for the Steeles West Station is also shown in Figure 3-2.

Key elements of the improved road network configuration include:

- Easterly extension of a new east-west road (Future Street A) beyond Jane Street through to the Steeles West Station.
- Northerly extension of Northwest Gate (Future Street C) to the new east-west road.
- A new north-south road as a transit only facility (Future Street B) located just west of the northerly Steeles West Station.
- Signal and turn lane improvements at the proposed Jane Street / East-West Road and the Steeles Avenue / Northwest Gate intersections.

These road and intersection improvements have been identified as a means to provide access to the proposed Steeles West Station. As noted for the analysis of existing and future traffic conditions within other sections of this report, there are some intersections and road link sections that are experiencing near or at-capacity conditions. While the City does not currently have planned major road or intersection improvements at any locations in the immediate study area, supplementary improvements have been identified in Section 6.3 as potential mechanisms to improve the existing and future traffic conditions beyond those reported in this study.

Figure 3-1 – Steeles West Station

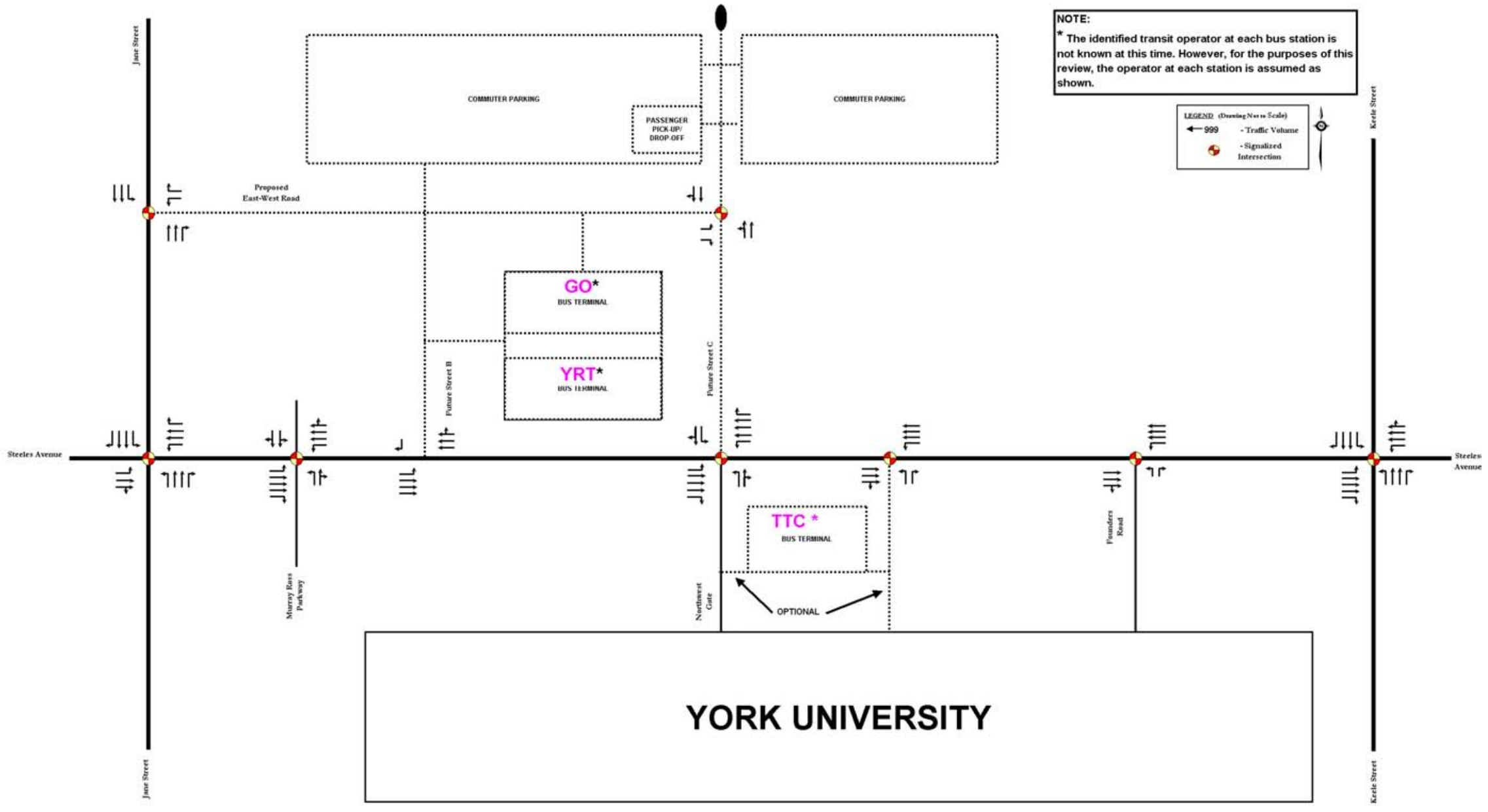
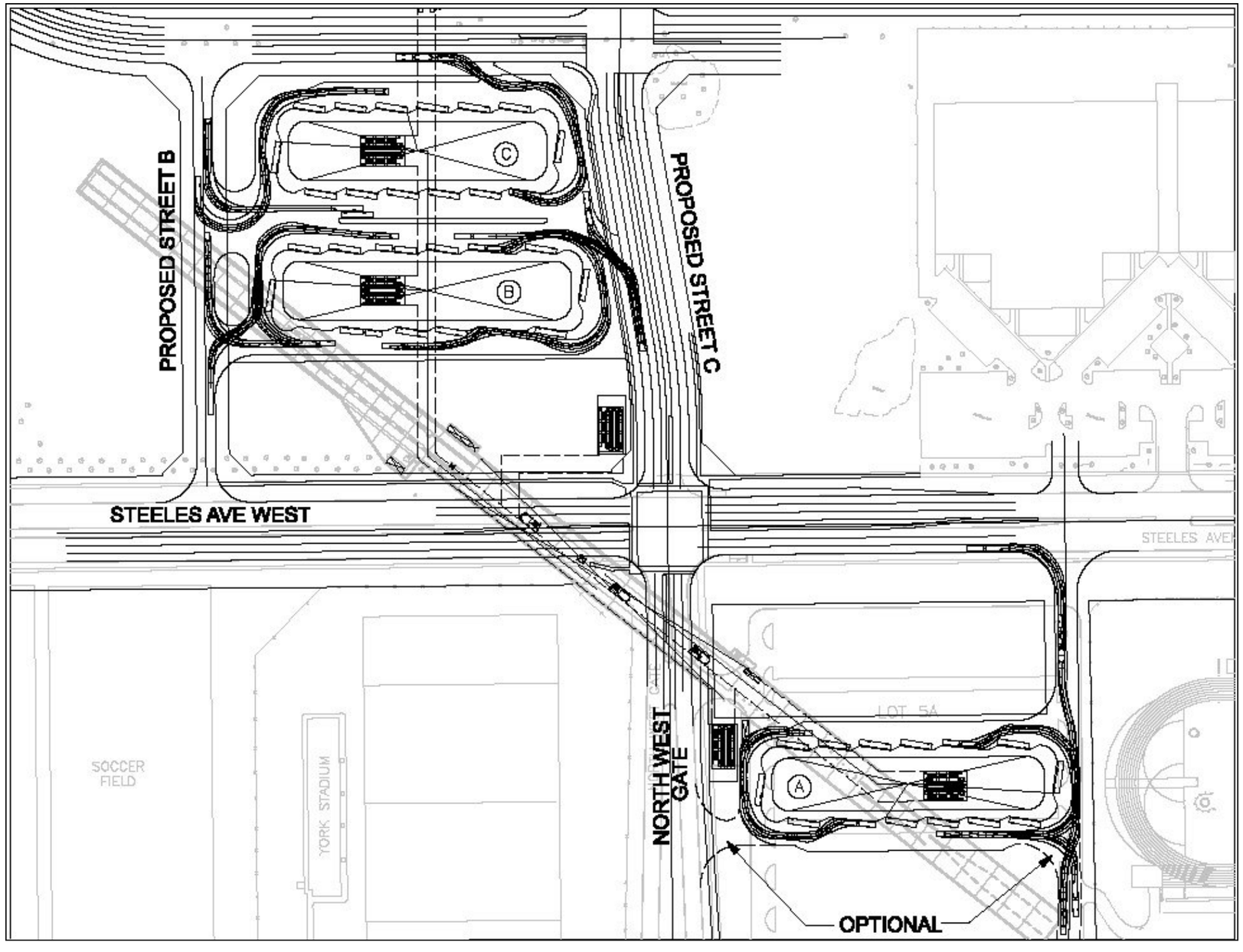


Figure 3-2 – Internal Bus Circulation



4.0 FUTURE BACKGROUND TRAFFIC CONDITIONS

4.1. Future Background Traffic

A 2021 development horizon was utilized to assess future traffic conditions. It is expected that the planning process and construction of the proposed TTC Spadina Subway Extension could be built and completed within the next ten years. For the purpose of the traffic assessment, a 2021 horizon year was selected to reflect this potential construction as well as several years of operation. It is acknowledged that 2021 is a very long term horizon period, and is atypical for an analysis of this nature. Notwithstanding, the year 2021 has been selected to reflect conditions several years after subway construction and to be consistent with the comprehensive Transportation Impact Report prepared for the subway alternatives and evaluations phase of the study.

Future background traffic data for the study area was based on growth in through traffic due to developments outside of the study area (inter-regional through trips).

URS reviewed the existing boundary road network, existing traffic volumes and operations at the study intersections. Based on a review of recent turning movements counts at the study intersections, it was determined that inter-regional through flows have remained relatively static.

It is expected that the traffic volumes in the vicinity of the subject lands would not increase substantially since the existing traffic conditions are generally constrained by the relatively high-volume operations during the a.m. and p.m. peak hours at the study intersections along Steeles Avenue. Since, for the most part, no increase in capacity of the boundary road network is anticipated within the study horizon period, it is expected that there will be minimal increase in future background traffic.

For analysis purpose, an annual growth rate of 0.5% was applied to forecast traffic in both directions for the a.m. and p.m. peak hours to reflect inter-regional through traffic growth within the study period along the arterial network within the study area for the 2021 horizon year. It should be noted that the existing traffic volumes were projected to reflect a common base year of 2005 for the calculation of future background traffic volumes.

The resultant weekday a.m. and p.m. peak hour 2021 future background traffic volumes for the Steeles West Station are illustrated in Figures 4-1 and 4-2.

4.2. Traffic Assessment

The 2021 future background traffic operations at the study intersections were analyzed on the basis of the future lane configurations and the above noted traffic volumes in Figures 4-1 and 4-2.

Table 6-1 summarizes the overall Level of Service (LOS), control delay, and volume-to-capacity ratio (v/c) for the study area. Detailed outputs for the future background traffic conditions are in ***Appendix C***.

The analyses of future background traffic conditions revealed similar conditions to that determined for existing conditions. In general, there has been a minor degradation in traffic operations due to the increased background traffic growth.

Figure 4-1 – Future Background A.M. Peak Hour Traffic Volumes (Steeles West Station)

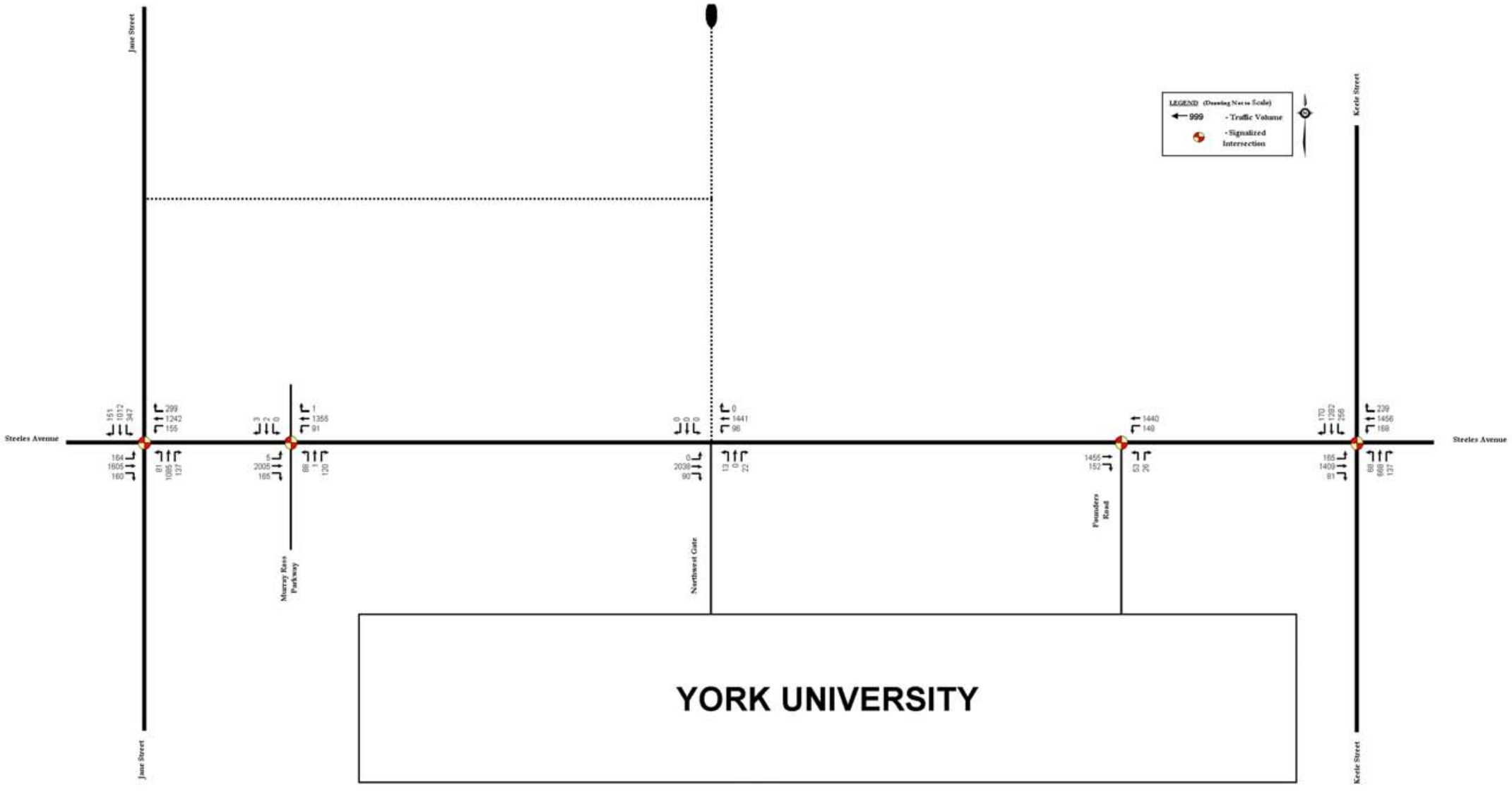
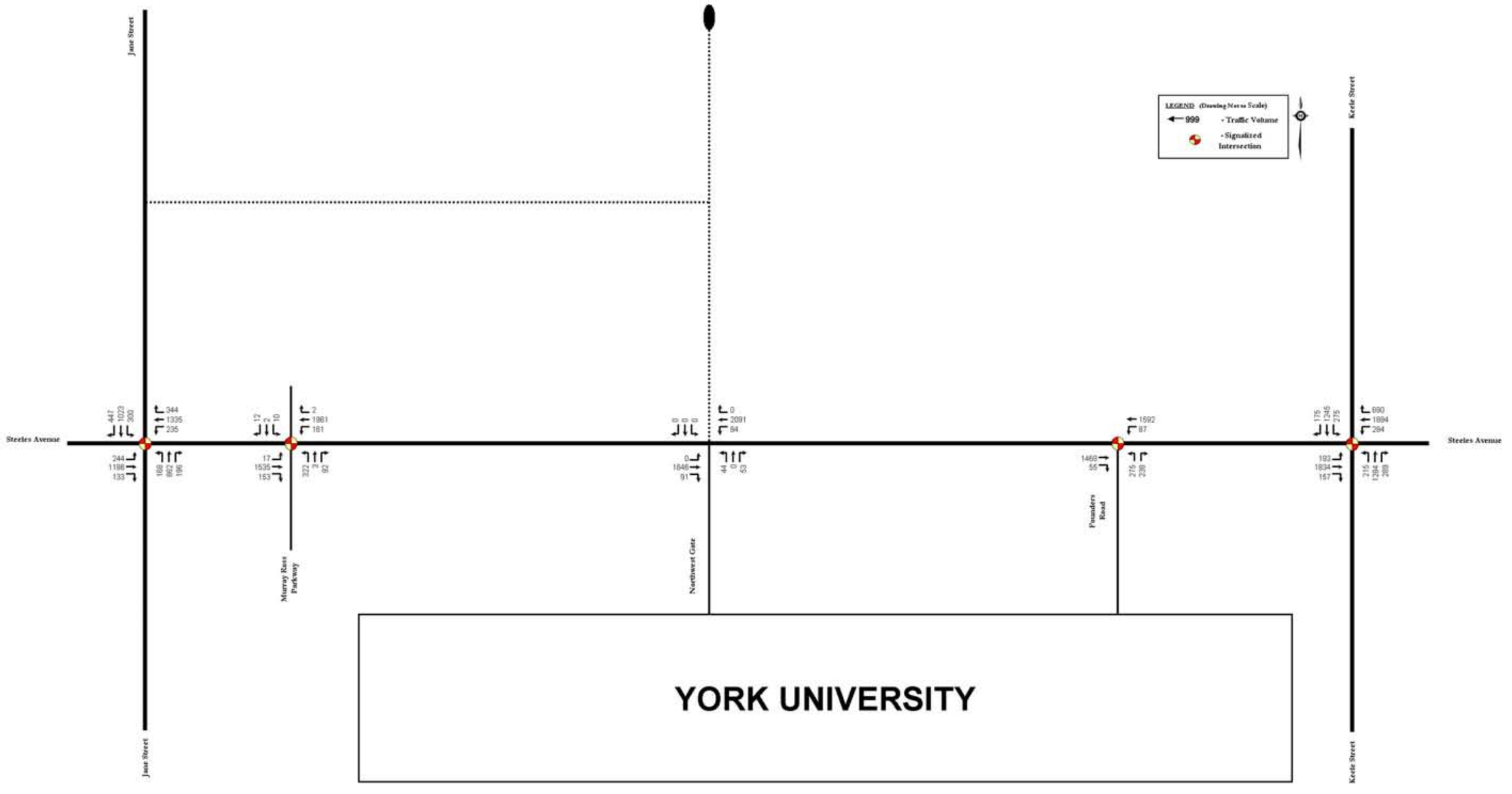


Figure 4-2 – Future Background P.M. Peak Hour Traffic Volumes (Steeles West Station)



5.0 SITE TRAFFIC

5.1. Trip Generation

Trip generation for the Steeles West Station was based on the sum of the passenger pick-up/drop-off (PPUDO) traffic, commuter parking lot (park'n'ride) traffic and transit traffic.

5.1.1. Passenger Pick-up/Drop-off (PPUDO)

The calculation methodology was provided by TTC in their planning guidelines for passenger pick-up/drop-off (PPUDO) facilities, illustrated in Figure 1.3.1 – Passenger Pick-up/Drop-off Capacity Requirements. Station usage and ridership information was also provided by TTC. Since the provided information is an a.m. peak hour forecast, the passenger pick-up/drop-off trip generation rate for p.m. peak hour traffic volumes was assumed to be the same as those for a.m. peak hour volumes, however in the opposite direction.

Tables 5-1 and 5-2 show the calculation and resultant traffic volumes associated with passenger pick-up/drop-off facilities for the Steeles West Station.

Given the significant emphasis on the bus transfers and feeder bus lines at this station, it is unrealistic to assume a high percentage of passenger PU/DO ratio. In comparison, the transit 'transfer' passenger volume destined to the station is 79% of the total number of passengers at the Steeles West Station, while it is only 46% at the Finch West Station. Thus, for the purpose of this study, the calculation of PPUDO vehicle trips based on a lower ratio range from 5% to 9% is an appropriate estimation. A resultant projection of 459 inbound and 459 outbound vehicles during the a.m. and p.m. peak hour was assessed in the traffic analyses.

TABLE 5-1. CALCULATION OF VEHICLE TRIPS - STEELES WEST STATION

Direction of Passengers	No. of Passengers	Passenger PU/DO Ratio	TTC Passengers	On-street PU/DO	Pass:Veh Ratio	No. of Vehicles Arriving
Pick-up	4125	5-9%	248-371	0%	1.2	172-309
Drop-off	6575	5-9%	395-592	0%	1.4	235-423
	10,700					407-732

TABLE 5-2. PASSENGER PICK-UP/DROP-OFF TRIP GENERATION - STEELES WEST STATION

AM Peak Hour		PM Peak Hour	
IN	OUT	IN	OUT
459	459	459	459

5.1.2. Commuter Parking Lot (Park'n'Ride)

The projected parking demand for the Steeles West Station commuter parking lot is 1,459 vehicles. This projection was provided by TTC in their station usage forecast extracted from the EMME/2 transportation model.

It was assumed that 50% of the total park'n'ride commuters arrive and 5% depart during the a.m. peak hour. Since the assumption is an a.m. peak hour projection, the commuter parking trip generation rate for p.m. peak hour traffic volumes was reversed to reflect the p.m. peak hour traffic volumes associated with the park'n'ride facilities.

Table 5-3 shows the trip generation associated with the commuter parking lot for the Steeles West Station.

TABLE 5-3. COMMUTER PARKING ARRIVAL AND DEPARTURE TRIP RATES - STEELES WEST STATION

Proposed Parking Demand	AM Peak Hour			
1459	50%	Arrival at Peak Hour	5%	Departure at Peak Hour
	730	Vehicular Trips	73	Vehicular Trips
	PM Peak Hour			
	5%	Arrival at Peak Hour	50%	Departure at Peak Hour
	73	Vehicular Trips	730	Vehicular Trips

TABLE 5-4. COMMUTER PARKING TRIP GENERATION - STEELES WEST STATION

AM Peak Hour		PM Peak Hour	
IN	OUT	IN	OUT
730	73	73	730

The ultimate potential projected parking supply for the Steeles West Station commuter parking lot is 2,500 stalls. In the event where the ultimate provision of 2,500 parking stalls are fully occupied, the arrival and departure characteristics of the parking lot would be somewhat different to that of a 1,459-capacity parking lot.

Based on the report Origin-Destination Survey of Existing TTC Commuter Parking Lots, prepared by iTRANS for TTC, it was determined that the greater the capacity of the parking lot, the peak period of vehicle arrival and departures occurs over a longer duration. This is evident in the vehicle accumulations survey results for the Finch Subway Station and the Wilson Subway Station, of which the total lot capacity for these two stations are 3,214 and 2,185 stalls, respectively. It was concluded that for a parking lot with greater capacity, the time at which commuters arrive to the parking lot spreads out longer than the typical one-hour peak period. The travellers tend to be destination-oriented instead of parking lot-oriented since they recognize the availability of surplus parking stalls and no significant circulation (searching for parking spaces) is anticipated.

Thus, based on this conclusion and given that not all 50% of the park'n'ride commuters would arrive within the a.m. peak hour for a parking lot with large capacity, the projected 730 vehicular trips, which is approximately 30% of the ultimate 2,500 proposed parking stalls, is an appropriate estimation of the number of total park'n'ride commuters arriving during the a.m. peak hour.

5.1.3. Transit (TTC, YRT and GO Buses)

The future projections of the proposed transit routes and headways associated with the Steeles West Station were provided by TTC and other transit operators. Since the provided information is an a.m. peak

hour forecast, the transit route and frequencies for the p.m. peak hour transit traffic volumes was assumed to be the same as those for the a.m. peak hour.

Tables 5-5 summarizes the future transit routes and frequencies for the Steeles West Station.

Table 5-6 shows the total transit trip generation associated with the proposed transit facility for the Steeles West Station.

TABLE 5-5. TRANSIT ROUTES AND FREQUENCIES

Steeles West Station		Freq. (min)	Buses/Hr/Dir	Buses/Hr
GO Transit	Route 33 - Guelph	20	3	6
	Route 35 - Brampton	10	6	12
	Route 36 - Brampton	10	6	12
	Route 42 - Bolton	30	2	4
	Route 66 - Newmarket	20	3	6
	Route 68 - Bradford	20	3	6
	Route 44 - Mount Joy*	10	6	6
	Route 46 - Oakville*	15	4	4
	Route 47 - Hamilton*	15	4	4
	Route 48 - Meadowvale*	15	4	4
	Route 49 - Pickering*	10	6	6
	Route 49 - Scarborough*	7.5	8	8
	Route 52 - Oshawa*	15	4	4
	Route 53 - Streetsville*	7.5	8	8
	Route 55 - Bramalea*	10	6	6
	Route 65 - Barrie*	20	3	3
			Subtotal	**99**
York Region Transit (YRT)	Route 3*	10	6	6
	Route 20*	15	4	4
	proposed Route 360*	20	3	3
	proposed 35D Jane*	5	12	12
	proposed 107 Keele N*	5	12	12
	YRTP	3	20	40
			Subtotal	**77**
TTC Transit	35 Jane*	3.67	16	16
	35E Jane*	10	6	6
	41 Keele*	6	10	10
	107 Chesswood*	15	4	4
	108 Driftwood*	7.25	8	8
	106 Sentinel*	10	6	6
	60B,D,E Steeles West	12	5	10
	60C,F Steeles West*	6.33	9	9
	60X Steeles West*	10	6	6
	84D Sheppard West*	21	3	3
			Subtotal	**78**
	*Route Terminus		**Grand Total**	**254**

AM Peak Hour		PM Peak Hour	
IN	**OUT**	**IN**	**OUT**
254	254	254	254

5.2. Trip Distribution and Assignment

The distribution of site traffic (station-related traffic) was based on a review of the boundary road network, an overview of the surrounding community uses, as well as a review of transit opportunities to identify trip paths and destinations.

The assignment of site traffic for the weekday a.m. and p.m. peak hour traffic volumes for the Steeles West Station are illustrated in Figures 5-1 and 5-2.

The assignment of site traffic for the weekday a.m. and p.m. peak hour passenger pick-up/drop-off traffic volumes for the Steeles West Station are illustrated in Figures A-1 and A-2 of ***Appendix D***, respectively.

The assignment of site traffic for the weekday a.m. and p.m. peak hour commuter parking traffic volumes for the Steeles West Station are illustrated in Figures A-3 to A-4 of ***Appendix D***.

The assignment of site traffic for the weekday peak hour transit traffic volumes for the Steeles West Station are illustrated in Figure A-5 of ***Appendix D***.

TABLE 5-6. TRANSIT TRIP GENERATION - STEELES WEST STATION

Figure 5-1 – A.M. Peak Hour Site Traffic Volumes (Steeles West Station)

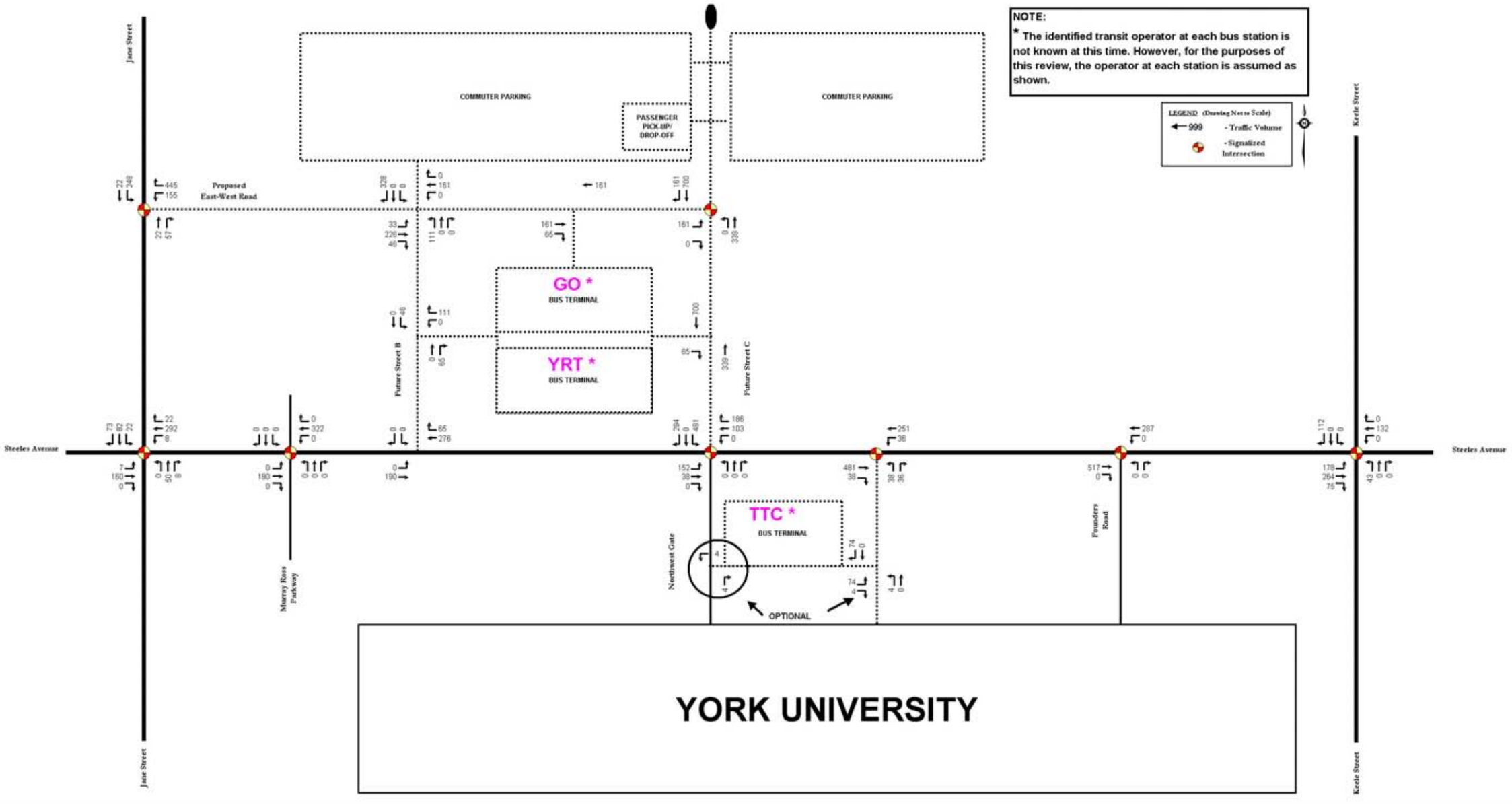
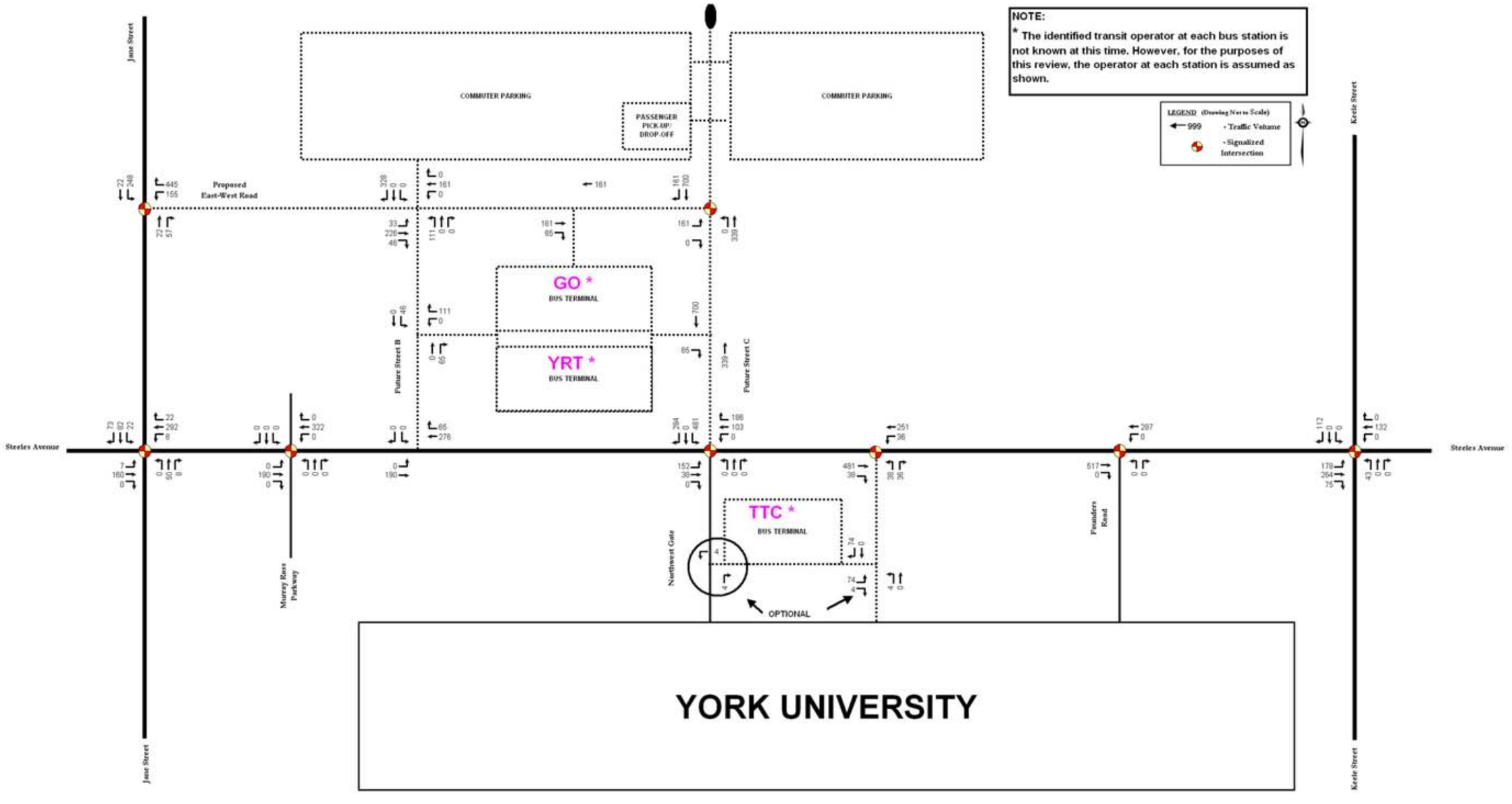


Figure 5-2 – P.M. Peak Hour Site Traffic Volumes (Steeles West Station)



6.0 FUTURE TOTAL TRAFFIC CONDITIONS

6.1. Future Total Traffic

Future total traffic on the boundary road network was based on the sum of the future background traffic and the site traffic for the Steeles West Station.

Figures 6-1 and 6-2 illustrate the future total traffic for the weekday a.m. and p.m. peak hours for Steeles West Station.

Figure 3-1 illustrates the assumed future lane configurations at the key intersections within the study area for the Steeles West Station.

6.2. Traffic Assessment

The future total traffic operations for the proposed station at the study intersections were analyzed on the basis of the assumed future lane configurations and the future total traffic volumes for the peak hours illustrated in Figures 6-1 and 6-2.

Table 6-1 summarizes the overall Level of Service (LOS), control delay, and volume-to-capacity ratio (v/c) for the study area. Detailed output for the future total traffic conditions for the Steeles West Station are in ***Appendix E – Intersection Analyses, Future Total Traffic (Steeles West Station)***.

As with existing and future background conditions, the arterials in the study area notably at the Steeles Avenue / Jane Street and the Steeles Avenue / Keele Street intersections continue to operate at/over capacity with several critical movements. The intersecting collector roads typically operate well, although high through volumes on the arterials (Steeles Avenue) result in congested operations at the Steeles Avenue / Northwest Gate intersection. As noted previously, a key element of the future operations is the implementation of several road and intersection improvements that include; the easterly extension of a new east-west road (Future Street A) beyond Jane Street through to the Steeles West Station; the northerly extension of Northwest Gate (Future Street C) to the new East-West Road; the new north-south road (Future Street B) located just west of the northerly Steeles West Station as a transit only facility; and signal and turn lane improvements at the proposed Jane Street / Future Street A and the Steeles Avenue / Northwest Gate intersections.

TABLE 6-1. STEELES WEST STATION: SUMMARY OF INTERSECTION OPERATIONS – ALL TRAFFIC CONDITIONS

INTERSECTIONS	OVERALL/ CRITICAL MOVEMENT	OPERATIONS (LOS, Delay, and V/C Ratio)*					
		EXISTING CONDITIONS		FUTURE BACKGROUND CONDITIONS		TOTAL FUTURE CONDITIONS	
		A.M. Peak Hour	P.M. Peak Hour	A.M. Peak Hour	P.M. Peak Hour	A.M. Peak Hour	P.M. Peak Hour
Steeles Ave @ Jane St	Intersection	F, >120 s, >1.0	E, 72 s, >1.0	F, >120 s, >1.0	F, 96 s, >1.0	F, >120 s, >1.0	F, >120 s, >1.0
	Critical Movement	EB T: F, >120 s, >1.0 WB T: E, 69 s, >1.0 NB T: F, >120 s, >1.0 SB L: F, 114 s, >1.0 SB T: F, 119 s, >1.0	EB L: F, >120 s, 1.12 WB L: F, 103 s, >1.0 WB T: D, 50 s, 0.95 NB L: F, >120 s, >1.0 NB T: D, 51 s, 0.85 SB L: F, >120 s, >1.0	EB L EB T WB L WB T NB T SB L SB T	EB L EB T WB L WB T NB L NB T SB L SB T	EB L EB T WB L WB T NB T SB L SB T	EB L EB T WB L WB T NB L NB T NB R SB L SB T SB R
Steeles Ave @ Murray Ross Pkwy	Intersection	B, 11 s, 0.70	B, 16 s, 0.84	B, 19 s, 0.66	C, 27 s, 0.79	B, 18 s, 0.73	C, 27 s, 0.81
	Critical Movement		NB T: E, 61 s, 0.84	-	-	-	-
Steeles Ave @ Northwest Gate	Intersection			F, >120 s	F, >120 s	C, 30 s, 0.81	D, 51, >1.0
	Critical Movement			-	-		EB L WB L WBT SBL
Steeles Ave @ Founders Road	Intersection	B, 12 s, 0.53	C, 21 s, 0.71	B, 17 s, 0.57	B, 20 s, 0.68	B, 18 s, 0.63	B, 18 s, 0.81
	Critical Movement		NB R: E, 63 s, 0.87	-	-	-	-
Steeles Ave @ Keele St	Intersection	E, 58 s, >1.0	F, >120 s, >1.0	E, 61 s, >1.0	F, >120 s, >1.0	F, 103 s, >1.0	F, >120 s, >1.0
	Critical Movement	EB T: D, 43 s, 0.87 WB T: E, 80 s, >1.0 SB L: E, 73 s, 0.92 SB T: E, 73 s, >1.0	EB L: F, 93 s, 0.98 EB T: E, 66 s, 1.02 WB L: F, >120 s, >1.0 WB T: F, >120 s, >1.0 NB L: F, >120 s, >1.0 NB T: D, 53 s, 0.95 SB L: F, >120 s, >1.0 SB T: D, 49 s, 0.92	EB L EB T WB L WB T SB T	EB L EB T WB L WB T NB L NB T SB L SB T	EB L EB T WB TR NB L SB L SB T	EB L EB T WB L WB R NB L NB T SB L SB T
Jane St @ Street A	Intersection	-	-	-	-	D, 47 s, 0.89	C, 25 s, 0.81
	Critical Movement	-	-	-	-	NB T SB L	NB T SB L
Street A @ Future Street C	Intersection	-	-	-	-	B, 14 s, 0.34	B, 16 s, 0.40
	Critical Movement	-	-	-	-	-	-
Steeles Ave @ TTC Bus Terminal	Intersection	-	-	-	-	B, 14 s, 0.70	B, 11 s, 0.67
	Critical Movement	-	-	-	-	-	-

* At signalized intersections, movements with a v/c ratio greater than 0.85 or an average vehicle delay greater than 55 seconds are defined as critical. At unsignalized intersections, movements with a v/c ratio greater than 0.85 or an average vehicle delay of greater than 35 seconds are defined as critical movements.

** For unsignalized intersections, the overall intersection operations are stated for the approach or movement with the worst level of service and highest delay.

6.2.1. Proposed East-West Road (Future Street A)

The need for extending the Proposed East-West Road (Future Street A) easterly beyond Future Street C to Keele Street was reviewed. (Notwithstanding that congested conditions are maintained in the future at the

major arterial-arterial intersections, the gateway intersections for the Steeles West Station (i.e. Jane Street/Proposed East-West Road and Steeles Avenue/Northwest Gate provide for route selection flexibility. In addition, the use of this segment of the contemplated East-West Road from Keele Street to reach the Steeles West Station through this route is roughly equal to the distance to the next station further south; Finch West Station along Keele Street. It is therefore anticipated that motorists would generally continue south along Keele Street to reach the Finch West Station, which seems to be more easily accessible for southbound Keele Street motorists. Also, it is noted that the primary orientation of commuter parking and PPUDO traffic from the north is via Jane Street. Finally, it is noted that the primary route for transit vehicles from the north is also via Jane Street. Thus, it is unlikely that a significant traffic associated with the Steeles West Station would divert to this link if it were to be constructed. As such, it is not a vital link for the network and not necessary to be constructed in step with the Steeles West Station.

6.2.2. Recommended Improvements

A review of the analyses results indicates that a general deficiency in through movement capacity exists along Keele Street and Jane Street, both at Steeles Avenue within the study area. The main required improvement to the study roadway network therefore is widening Jane Street and Keele Street through Steeles Avenue to improve traffic operations at the heavily travelled Steeles Avenue / Jane Street and Steeles Avenue / Keele Street intersections. It is suggested that the widening extends to a sufficient design distance south of Steeles Avenue to effectively increase northbound through capacity and avoid merging friction that may be caused by an immediate southbound lane drop south of the Steeles Avenue / Jane Street and Steeles Avenue / Keele Street intersections. The widening of Keele Street and Jane Street north of Steeles Avenue in the future is consistent with the Region of York road widening plans to widen both streets to six-lane cross sections. Although the extension of future Street A is not required nor recommended to be constructed at the current time, nevertheless, future operational improvements would be realized if Street A were extended from Steeles West Station easterly to Keele Street providing for additional network flexibility.

In addition to the proposed road widening on Jane Street, it is recommended to extend the 6-lane cross-section on Steeles Avenue through Jane Street to improve the overall intersection operation. The provision of auxiliary right turn lanes on all approaches where property limits and other constraints allow should also be considered.

At the Steeles Avenue / Keele Street intersection along with the proposed Keele Street road widening, it is suggested that auxiliary right turn lanes be provided on all approaches where property limits and other constraints allow. This would decrease delays, and improve the intersection operations. Further intersection improvements to include dual-left turn lanes on all approaches could be considered in the long term to further improve operations, however the feasibility and cost of this type of improvement potentially preclude it is a viable solution in an urban environment.

The Jane Street / Street A intersection experiences delays due to high southbound left turn volumes. With the above mentioned road widening of Jane Street to six lanes, the overall Level of Service would improve to ‘C’ during both peak hours with no further improvements required. However, dual southbound left turn lanes in the future are required since there is a significant southbound left-turn volume at this location. The dual southbound left turn lanes, with the inside left turn lane for general purpose traffic and the outside for transit vehicles only, are recommended to improve the overall intersection operations at this location and to reduce the southbound left-turn queue arising from the high subject volume, and to reduce delay for transit vehicles undertaking this manoeuvre. The resultant overall intersection LOS with the dual left turn lane is ‘C’ for both a.m. and p.m. peak hours.

During the p.m. peak hour the Steeles Avenue / Northwest Gate intersection experiences delays on the southbound approach mainly due to high southbound left turn volumes. Although southbound dual left turn lanes do not significantly improve the overall intersection operations at this location, nonetheless, dual southbound left turn lanes should be considered to reduce the high southbound left turn queue arising from the significant subject volume. The resultant overall intersection LOS with the improvements are ‘C’ and ‘D’ during the a.m. and p.m. peak hours, respectively. The southbound left turn queue was determined to be 17 vehicles with the provision of dual left turn lanes in comparing with a queue length of 60 vehicles without the provision of the dual left turn lanes. As a further consideration, should high southbound left turn queues arise in the future, it is recommended that the dual southbound left turn lanes be configured with the inside left turn lane for general purpose traffic and the outside for transit vehicles only to reduce delay for transit vehicles undertaking this manoeuvre.

It is recommended that signal timing at the study intersections be optimized to accommodate traffic movement in the peak hours. Consideration should also be given to further optimization of traffic signal timing that may be accomplished by harmonizing the cycle lengths and coordinating the traffic signals along Steeles Avenue to improve platooning and progression along the corridor.

Detailed output for the supplementary traffic analyses including these geometric improvements for the Steeles West Station are included in ***Appendix F.***

In summary, there are additional road improvements that are currently being planned by other agencies. They are:

- ***Construct a new east-west road (Future Street A) easterly beyond Jane Street through to the Steeles West Station. This is a previously proposed improvement noted within the Highway 7 Corridor and Vaughan North-South Link Public Transit Improvements EA study by the Region of York;***

- ***Extend Northwest Gate (Future Street C) northerly to the new east-west road (Future Street A) as noted within the Highway 7 Corridor and Vaughan North-South Link Public Transit Improvements EA study by the Region of York;***

- ***Construct a new north-south road as a transit only facility (Future Street B) located just west of the northerly Steeles West Station, as noted within the Highway 7 Corridor and Vaughan North-South Link Public Transit Improvements EA study by the Region of York;***

- ***As part of the Region of York’s Transportation and Works 10-Year Construction Program, it is proposed to widen Keele Street to a six-lane cross-section from Highway 407 to Steeles Avenue in 2008. It is recommended that additional consideration to extend the widening of Keele Street to just south of Steeles Avenue; and***

- ***As part of the Region of York’s Transportation and Works 10-Year Construction Program, it is proposed to widen Jane Street to a six-lane cross-section from Highway 7 to south of Steeles Avenue in 2012. It is recommended that additional consideration to extend the widening of Jane Street to just south of Steeles Avenue.***

Further to the above improvements, the following improvements are recommended to be implemented as part of the Spadina Subway Extension undertaking and the construction of Steeles West Station at this location:

- ***Signalize the proposed Jane Street / East-West Road and the Steeles Avenue / Northwest Gate intersections and implement turn lane improvements;***

- ***At the Jane Street / East-West Road (Street A) intersection, construct dual southbound left turn lanes with the provision of an inside left turn lane for general purpose traffic and an outside left turn lane for transit vehicles only;***

- ***At the Steeles Avenue / Northwest Gate / Street C intersection, construct dual southbound left turn lanes. In the future, should high southbound left turn queues arise, configure the dual southbound left turn lanes with an inside left turn lane for general purpose traffic and an outside left turn lane for transit vehicles only;***

The following additional improvements should be considered during the design of the Spadina Subway Extension and the Steeles West Station:

- ***At the Steeles Avenue / Jane Street intersection, extend the 6-lane cross-section on Steeles Avenue westerly through Jane Street and consider auxiliary right turn lanes where feasible;***

- ***At the Steeles Avenue / Keele Street intersection, consider auxiliary right turn lanes where feasible;***

- ***It is recommended that existing right turn lay-bys / bus-bays at the study intersections be upgraded to standard right turn lanes to allow more effective right turn capacity; and***

- ***It is recommended that signal timing at the study intersections be monitored in the future to continue to be optimized to accommodate traffic movement in the peak hours. Consideration should also be given to further optimization of traffic signal timing that may be accomplished by harmonizing the cycle lengths and coordinating the traffic signals along Jane Street, Keele Street and Steeles Avenue to improve platooning and progression along these corridors.***

Figure 6-1 – Future Total A.M. Peak Hour Traffic Volumes (Steeles West Station)

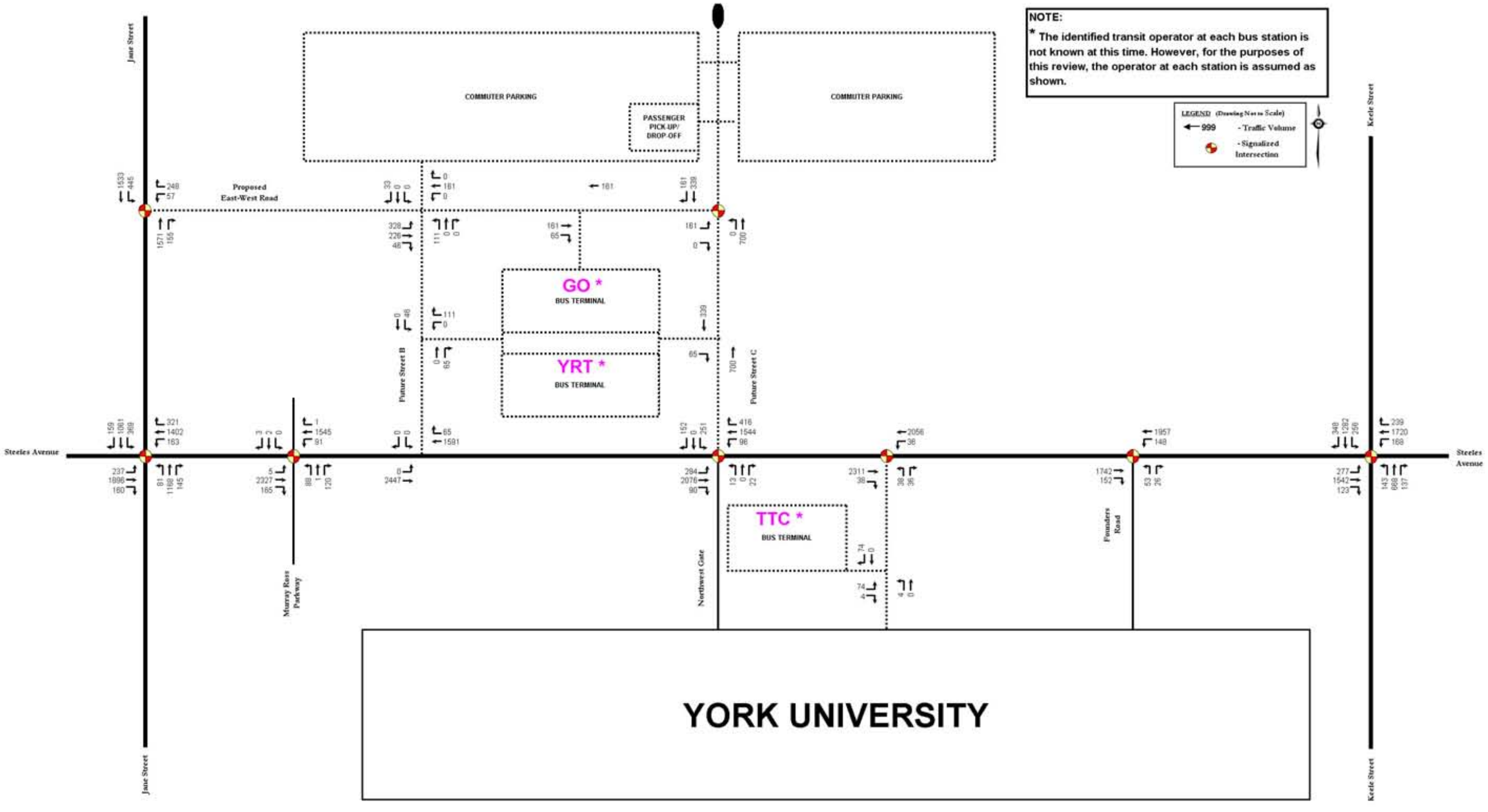
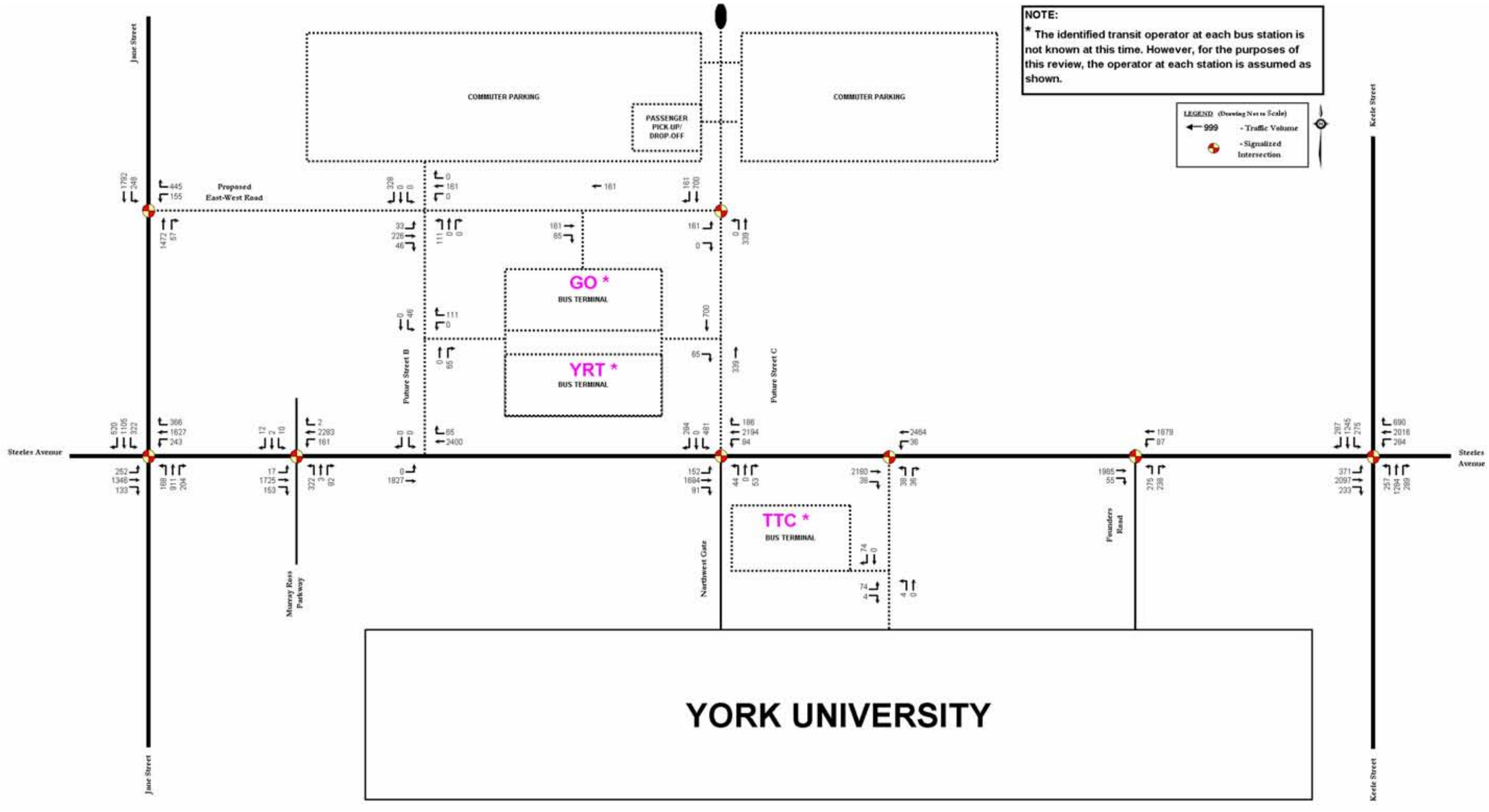


Figure 6-2 – Future Total P.M. Peak Hour Traffic Volumes (Steeles West Station)



7.0 CONCLUSION AND RECOMMENDATIONS

This Traffic Impact Study has been prepared to document the study methodology, findings and evaluations associated with the proposed TTC Spadina Subway Extension and the proposed station concept at the Steeles West Station.

The analyses of the existing intersection conditions reveal poor overall intersection levels of service at all major arterial-arterial intersections within the Study Area (at-capacity or over-capacity during the a.m. and p.m. peak hours). The analyses of the existing intersection conditions confirm the existing traffic characteristics. Travel patterns by time-of-day show that traffic loading on all of the major arterials is very commuter-oriented. Significant queuing and traffic congestion exists on many of the arterial roads within the Study Area, particularly on Keele Street north of Steeles Avenue.

These congested traffic conditions are significantly contributed to by high inter-regional traffic volumes and are typical conditions on regional arterial systems. The nature of such traffic congestion is mainly associated with the travellers' commuting peak hours during the morning and afternoon peak commuting periods. While congested operations (in terms of delays, queuing, and low reserved capacity) are encountered at the Major Arterial-Major Arterial intersections, acceptable operations at collector-arterial intersections are exhibited, despite relatively high inbound and outbound traffic turning movements at the gateways to significant traffic generators, such as at York University.

The key elements of the improved road network configuration include an easterly extension of a new east-west road (Future Street A) beyond Jane Street through to the Steeles West Station, a northerly extension of Northwest Gate (Future Street C) to the new East-West Road, a new north-south road as a transit only facility (Future Street B) located just west of the northerly Steeles West Station, as well as a signal and turn lane improvements at the proposed Jane Street / East-West Road and the Steeles Avenue / Northwest Gate intersections. These road and intersection improvements have been identified as a means to provide access to the proposed Steeles West Station.

Trip generation for the Steeles West Station was based on the sum of the passenger pick-up/drop-off (PPUDO) traffic, commuter parking lot (park'n'ride) traffic and transit traffic. The vehicular trip generation associated with the passenger pick-up/drop-off facility is expected to result in about 459 inbound and 459 outbound trips on the boundary road network during the weekday a.m. and p.m. peak hours. The vehicular trip generation associated with the commuter parking lot is expected to result in about 730 inbound and 73 outbound trips on the boundary road network during the weekday a.m. peak hour, and 73 inbound and 730 outbound trips during the p.m. peak hour. The transit trip generation associated with the transit facility is expected to result in about 254 inbound and 254 outbound trips on the boundary road network during the weekday a.m. and p.m. peak hours.

Based on a review of the future total analyses results, the arterials in the study area, notably at the Steeles Avenue / Jane Street and the Steeles Avenue / Keele Street intersections continue to operate at/over-capacity with several critical movements.

URS also undertook some supplementary traffic analyses based on the contemplated road and intersection improvement considerations to identify the impact of these improvements. Based on the result of the supplementary analyses with those additional recommended improvements, if all the recommended improvements were to be implemented, this would result in improved operations in the study area and better findings than those reported in this study. The results generally revealed improvement of overall intersection delays at the Steeles Avenue / Keele Street and Steeles Avenue / Jane Street intersections.

In summary, there are additional road improvements that are currently being planned by other agencies. They are:

- ***Construct a new east-west road (Future Street A) easterly beyond Jane Street through to the Steeles West Station. This is a previously proposed improvement noted within the Highway 7 Corridor and Vaughan North-South Link Public Transit Improvements EA study by the Region of York;***

- ***Extend Northwest Gate (Future Street C) northerly to the new east-west road (Future Street A) as noted within the Highway 7 Corridor and Vaughan North-South Link Public Transit Improvements EA study by the Region of York;***

- ***Construct a new north-south road as a transit only facility (Future Street B) located just west of the northerly Steeles West Station, as noted within the Highway 7 Corridor and Vaughan North-South Link Public Transit Improvements EA study by the Region of York;***

- ***As part of the Region of York's Transportation and Works 10-Year Construction Program, it is proposed to widen Keele Street to a six-lane cross-section from Highway 407 to Steeles Avenue in 2008. It is recommended that additional consideration to extend the widening of Keele Street to just south of Steeles Avenue; and***

- ***As part of the Region of York's Transportation and Works 10-Year Construction Program, it is proposed to widen Jane Street to a six-lane cross-section from Highway 7 to south of Steeles Avenue in 2012. It is recommended that additional consideration to extend the widening of Jane Street to just south of Steeles Avenue.***

Further to the above improvements, the following improvements are recommended to be implemented as part of the Spadina Subway Extension undertaking and the construction of Steeles West Station at this location:

- ***Signalize the proposed Jane Street / East-West Road and the Steeles Avenue / Northwest Gate intersections and implement turn lane improvements;***

- ***At the Jane Street / East-West Road (Street A) intersection, construct dual southbound left turn lanes with the provision of an inside left turn lane for general purpose traffic and an outside left turn lane for transit vehicles only; and***

- ***At the Steeles Avenue / Northwest Gate / Street C intersection, construct dual southbound left turn lanes. In the future, should high southbound left turn queues arise, configure the dual southbound left turn lanes with an inside left turn lane for general purpose traffic and an outside left turn lane for transit vehicles only;***

The following additional improvements should be considered during the design of the Spadina Subway Extension and the Steeles West Station:

- ***At the Steeles Avenue / Jane Street intersection, extend the 6-lane cross-section on Steeles Avenue westerly through Jane Street and consider auxiliary right turn lanes where feasible;***

- ***At the Steeles Avenue / Keele Street intersection, consider auxiliary right turn lanes where feasible;***

- ***It is recommended that existing right turn lay-bys / bus-bays at the study intersections be upgraded to standard right turn lanes to allow more effective right turn capacity; and***

- ***It is recommended that signal timing at the study intersections be monitored in the future to continue to be optimized to accommodate traffic movement in the peak hours. Consideration should also be given to further optimization of traffic signal timing that may be accomplished by harmonizing the cycle lengths and coordinating the traffic signals along Jane Street, Keele Street and Steeles Avenue to improve platooning and progression along these corridors.***

APPENDIX A

LEVEL OF SERVICE DEFINITIONS

LEVEL OF SERVICE
FOR
SIGNALIZED INTERSECTIONS
(Highway Capacity Manual, 2000)

The assessment of operations for signalized intersections is based on the results of the Highway Capacity Software (HCS), which is based on the methodology in the Highway Capacity Manual, 2000.

Level of service for signalized intersections is defined in terms of delay, which is a measure of driver discomfort and frustration, fuel consumption, and lost travel time. Specifically, level-of-service (LOS) criteria are stated in terms of the control delay per vehicle for a 15-minute analysis period.

LOS A described operations with very low delay, up to 10 seconds per vehicle. This level of service occurs when progression is extremely favourable and most vehicles arrive during the green phase. Most vehicles do not stop at all. Short cycle lengths may also contribute to low delay.

LOS B describes operations with delay greater than 10 and up to 20 seconds per vehicle. This level generally occurs with good progression, short cycle lengths, or both. More vehicles stop than with LOS A, causing higher levels of average delay.

LOS C describes operations with delay greater than 20 and up to 35 seconds per vehicle. These higher delays may result from fair progression, longer cycle lengths, or both. Individual cycle failures may begin to appear at this level. The number of vehicles stopping is significant at this level, though many still pass through the intersection without stopping.

LOS D describes operations with delay greater than 35 and up to 55 seconds per vehicle. At level D, the influence of congestion becomes more noticeable. Longer delays may result from some combination of unfavourable progression, long cycle lengths, or high v/c ratios. Many vehicles stop, and the proportion of vehicles not stopping declines. Individual cycle failures are noticeable.

LOS E describes operations with delay greater than 55 and up to 80 seconds per vehicle. This level is considered by many agencies to be the limit of acceptable delay. These high delay values generally indicate poor progression, long cycle lengths, and high v/c ratios. Individual cycle failures are frequent occurrences.

LOS F describes operations with delay in excess of 80 seconds per vehicle. This level, considered to be unacceptable to most drivers, often occurs with over-saturation, that is, when arrival flow rates exceed the capacity of the intersection. It may also occur at high v/c ratios below 1.0 with many individual cycle failures. Poor progression and long cycle lengths may also be major contributing causes to such delay levels.

Level of Service	Stopped Delay Per Vehicle (Seconds)
A	$\leq$ 10.0
B	> 10.0 and $\leq$ 20.0
C	> 20.0 and $\leq$ 35.0
D	> 35.0 and $\leq$ 55.0
E	> 55.0 and $\leq$ 80.0
F	> 80.0

LEVEL OF SERVICE
FOR
UNSIGNALIZED INTERSECTIONS
(TWO-WAY AND ALL-WAY STOP CONTROL)

The assessment of operations for unsignalized intersections is based on the results of the Highway Capacity Software (HCS), which is based on the methodology in the Highway Capacity Manual, 2000.

Level of service for two-way stop controlled intersections is defined in terms of delay, which is a measure of driver discomfort and frustration, fuel consumption, and lost travel time. Specifically, level-of-service (LOS) criteria are stated in terms of the average control delay per vehicle for a 15-minute analysis period.

Level of Service	Average Total Delay (Seconds/Vehicle)
A	$\leq$ 10
B	> 10 and $\leq$ 15
C	> 15 and $\leq$ 25
D	> 25 and $\leq$ 35
E	> 35 and $\leq$ 50
F	> 50

APPENDIX B

INTERSECTION ANALYSES

EXISTING TRAFFIC

HCS2000: Signalized Intersections Release 4.1e

Analyst: a.liu
Agency: URS Canada Inc.
Date: 12/9/2004
Period: AM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Steeles Avenue

Inter.: Steeles Avenue / Jane Street
Area Type: All other areas
Jurisd: City of Toronto
Year: Existing Conditions
N/S St: Jane Street

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	0	1	2	1	1	2	1	1	2	1
LGConfig	L	TR		L	T	R	L	T	R	L	T	R
Volume	150	1464	146	141	1133	273	74	990	125	317	923	138
Lane Width	3.6	3.6		3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left		P			NB Left	P		
Thru		P			Thru	P		
Right		P			Right	P		
Peds					Peds			
WB Left		P			SB Left	P		
Thru		P			Thru	P		
Right		P			Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green		12.0	41.0			16.0	29.0	
Yellow		2.0	4.0			2.0	4.0	
All Red		2.0	3.0			2.0	3.0	

Cycle Length: 120.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	232	1719	0.66	0.47	39.4	D		
TR	1163	3404	1.41	0.34	230.4	F	214.1	F
Westbound								
L	242	1787	0.60	0.47	35.9	D		
T	1145	3350	1.01	0.34	68.5	E	59.6	E
R	546	1599	0.51	0.34	34.9	C		
Northbound								
L	292	1736	0.26	0.41	27.8	C		
T	833	3445	1.21	0.24	152.2	F	132.6	F
R	372	1538	0.34	0.24	40.2	D		
Southbound								
L	296	1752	1.09	0.41	114.1	F		
T	833	3445	1.13	0.24	119.3	F	110.2	F
R	386	1599	0.37	0.24	40.5	D		

Intersection Delay = 132.5 (sec/veh) Intersection LOS = F

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:
Fax:

OPERATIONAL ANALYSIS

Analyst: a.liu
Intersection: Steeles Avenue / Jane Street
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: AM Peak Hour
Analysis Year: Existing Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Steeles Avenue
North/South Street: Jane Street

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	150	1464	146	141	1133	273	74	990	125	317	923	138
% Heavy Veh	5	5	3	1	8	1	4	5	5	3	5	1
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	38	373	37	36	289	70	19	253	32	81	235	35
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900	1900	1900	1900	1900	1900	1900	1900
ParkExist												
NumPark												
No. Lanes	1	2	0	1	2	1	1	2	1	1	2	1
LGConfig	L	TR		L	T	R	L	T	R	L	T	R
Lane Width	3.6	3.6		3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
RTOR Vol			0			0			0			0
Adj Flow	153	1643		144	1156	279	76	1010	128	323	942	141
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.091			0.000	1.000		0.000	1.000		0.000	1.000
Peds Bikes		0			0			0			0	
Buses	0	0		0	0	0	0	0	0	0	0	0
%InProtPhase	0.0			0.0			0.0			0.0		

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Arriv. Type	3	3		3	3	3	3	3	3	3	3	3
Unit Ext.	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Ext of g	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left		P			NB Left	P		
Thru		P			Thru	P		
Right		P			Right	P		
Peds					Peds			
WB Left		P			SB Left	P		
Thru		P			Thru	P		
Right		P			Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			

Green	12.0	41.0			16.0	29.0		
Yellow	2.0	4.0			2.0	4.0		
All Red	2.0	3.0			2.0	3.0		

Cycle Length: 120.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	150	1464	146	141	1133	273	74	990	125	317	923	138
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	153	1494	149	144	1156	279	76	1010	128	323	942	141
No. Lanes	1	2	0	1	2	1	1	2	1	1	2	1
Lane group	L	TR		L	T	R	L	T	R	L	T	R
Adj flow	153	1643		144	1156	279	76	1010	128	323	942	141
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.091			0.000	1.000		0.000	1.000		0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	TR		L	T	R	L	T	R	L	T	R
So	1900	1900		1900	1900	1900	1900	1900	1900	1900	1900	1900
Lanes	1	2	0	1	2	1	1	2	1	1	2	1
fW	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fHV	0.952	0.954		0.990	0.926	0.990	0.962	0.952	0.952	0.971	0.952	0.990
fG	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fP	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fBB	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fA	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fLU	1.000	0.952		1.000	0.952	1.000	1.000	0.952	1.000	1.000	0.952	1.000
fRT		0.986			1.000	0.850		1.000	0.850		1.000	0.850
fLT	0.950	1.000		0.950	1.000		0.950	1.000		0.950	1.000	
Sec.	0.089			0.089			0.121			0.121		
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000			1.000	1.000		1.000	1.000		1.000	1.000
S	1719	3404		1787	3350	1599	1736	3445	1538	1752	3445	1599
Sec.	161			167			221			224		

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		153	1719	# 0.09	0.100	172	0.89
Perm		0	161	0.00	0.375	60	0.00
Left	L	153			0.47	232	0.66
Prot							
Perm							
Thru	TR	1643	3404	0.34	0.34	1163	1.41
Right							
Westbound							
Prot		144	1787	0.08	0.100	179	0.80
Perm		0	167	0.00	0.375	63	0.00
Left	L	144			0.47	242	0.60
Prot							
Perm							
Thru	T	1156	3350	# 0.34	0.34	1145	1.01
Right	R	279	1599	0.17	0.34	546	0.51
Northbound							
Prot		76	1736	0.04	0.133	231	0.33
Perm		0	221	0.00	0.275	61	0.00
Left	L	76			0.41	292	0.26
Prot							
Perm							
Thru	T	1010	3445	0.24	0.24	833	1.21
Right	R	128	1538	0.08	0.24	372	0.34
Southbound							
Prot		234	1752	# 0.13	0.133	234	1.00
Perm		89	224	# 0.40	0.275	62	1.44
Left	L	323			0.41	296	1.09
Prot							
Perm							
Thru	T	942	3445	0.24	0.24	833	1.13
Right	R	141	1599	0.09	0.24	386	0.37

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.96
Total lost time per cycle, L = 21.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.17

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.66	0.47	25.6	1.000	232	0.50	13.8	0.0	39.4	D		
TR	1.41	0.34	39.5	1.000	1163	0.50	190.9	0.0	230.4	F	214.1	F
Westbound												
L	0.60	0.47	25.6	1.000	242	0.50	10.3	0.0	35.9	D		
T	1.01	0.34	39.5	1.000	1145	0.50	29.0	0.0	68.5	E	59.6	E
R	0.51	0.34	31.5	1.000	546	0.50	3.4	0.0	34.9	C		
Northbound												
L	0.26	0.41	25.6	1.000	292	0.50	2.2	0.0	27.8	C		
T	1.21	0.24	45.5	1.000	833	0.50	106.7	0.0	152.2	F	132.6	F
R	0.34	0.24	37.6	1.000	372	0.50	2.5	0.0	40.2	D		
Southbound												
L	1.09	0.41	35.2	1.000	296	0.50	78.9	0.0	114.1	F		
T	1.13	0.24	45.5	1.000	833	0.50	73.8	0.0	119.3	F	110.2	F
R	0.37	0.24	37.8	1.000	386	0.50	2.7	0.0	40.5	D		

Intersection Delay = 132.5 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)	57.0	57.0	49.0	49.0
Effective permitted green time for LT lane group, g(s)	45.0	45.0	33.0	33.0
Opposing effective green time, go (s)	41.0	41.0	29.0	29.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	2	2	2	2
Adjusted LT flow rate, VLT (veh/h)	153	144	76	323
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	1156	1643	942	1010
Lost time for LT lane group, tL	7.00	7.00	7.00	7.00
Computation				
LT volume per cycle, LTC=VLTC/3600	5.10	4.80	2.53	10.77
Opposing lane util. factor, fLUo	0.952	0.952	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	20.24	28.76	16.49	17.68
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.66	0.66	0.76	0.76
gf, (see Exhibit C16-4,5,6,7,8)	40.21	41.00	29.00	29.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	4.79	4.00	4.00	4.00
n=Max(gq-gf)/2,0)	20.10	20.50	14.50	14.50
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	4.07	6.65	3.29	3.52
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.09	0.12	0.12
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.09	0.09	0.12	0.12
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.089	0.089	0.121	0.121

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 120.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	153	144	76	323
v/c ratio from Capacity Worksheet, X	0.66	0.60	0.26	1.09
Protected phase effective green interval, g (s)	12.0	12.0	16.0	16.0
Opposing queue effective green interval, gq	40.21	41.00	29.00	29.00
Unopposed green interval, gu	4.79	4.00	4.00	4.00
Red time r=(C-g-gq-gu)	63.0	63.0	71.0	71.0
Arrival rate, qa=v/(3600(max[X,1.0]))	0.04	0.04	0.02	0.08
Protected ph. departure rate, Sp=s/3600	0.478	0.496	0.482	0.487
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.42	0.52	0.51	0.51
XPerm	0.95	0.86	0.34	1.32
XProt	0.56	0.50	0.24	0.92
Case	1	1	1	3
Queue at beginning of green arrow, Qa	2.68	2.52	1.50	6.50
Queue at beginning of unsaturated green, Qu	1.71	1.64	0.61	2.38
Residual queue, Qr	0.00	0.00	0.00	0.66
Uniform Delay, d1	25.6	25.6	25.6	35.2

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 132.5 sec/veh Intersection LOS F

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound L	Eastbound TR	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	153	862	144	607	279	76	530	128	323	494	141
So	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	2 0	1	2	1	1	2	1	1	2	1
SL	489	1787	508	1759	1599	716	1809	1538	723	1809	1599
LnCapacity	232	610	242	601	546	292	437	372	296	437	386
Flow Ratio	0.31	0.48	0.28	0.35	0.17	0.11	0.29	0.08	0.45	0.27	0.09
v/c Ratio	0.66	1.41	0.60	1.01	0.51	0.26	1.21	0.34	1.09	1.13	0.37
Grn Ratio	0.47	0.34	0.47	0.34	0.34	0.41	0.24	0.24	0.41	0.24	0.24
I Factor		1.000		1.000			1.000			1.000	
AT or PVG	3	3	3	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	2.9	28.7	2.7	20.2	7.4	1.6	17.7	3.5	7.4	16.5	3.9
kB	0.5	1.0	0.5	1.0	0.9	0.6	0.8	0.7	0.6	0.8	0.7
Q2	0.9	34.6	0.7	9.0	0.9	0.2	15.1	0.4	6.9	11.4	0.4
Q Average	3.8	63.3	3.4	29.2	8.3	1.8	32.7	3.9	14.2	27.8	4.3
Q Spacing	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Q Storage	0	0	0	0	0	0	0	0	0	0	0
Q S Ratio											
70th Percentile Output:											
fB%	1.2	1.2	1.3	1.2	1.2	1.3	1.2	1.2	1.2	1.2	1.2
BOQ	4.7	76.0	4.2	35.1	10.2	2.2	39.3	4.8	17.1	33.4	5.4
QSRatio											
85th Percentile Output:											
fB%	1.5	1.4	1.6	1.4	1.5	1.6	1.4	1.5	1.4	1.4	1.5
BOQ	5.8	88.6	5.3	40.9	12.2	2.8	45.8	6.0	20.2	39.0	6.6
QSRatio											
90th Percentile Output:											
fB%	1.7	1.5	1.8	1.5	1.6	1.9	1.5	1.7	1.5	1.5	1.7
BOQ	6.5	95.0	6.0	43.9	13.3	3.3	49.1	6.7	21.7	41.8	7.4
QSRatio											
95th Percentile Output:											
fB%	2.1	1.6	2.1	1.6	1.8	2.3	1.6	2.1	1.7	1.6	2.0
BOQ	7.8	101	7.2	46.9	14.9	4.1	52.4	8.0	23.6	44.7	8.7
QSRatio											
98th Percentile Output:											
fB%	2.4	1.7	2.5	1.7	2.0	2.8	1.7	2.4	1.8	1.7	2.3
BOQ	9.1	108	8.4	49.8	16.5	4.8	55.7	9.3	25.4	47.5	10.1
QSRatio											

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: a.liu
Agency: URS Canada Inc.
Date: 12/9/2004
Period: PM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Steeles Avenue

Inter.: Steeles Avenue / Jane Street
Area Type: All other areas
Jurisd: City of Toronto
Year: Existing Conditions
N/S St: Jane Street

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	0	1	2	1	1	2	1	1	2	1
LGConfig	L	TR		L	T	R	L	T	R	L	T	R
Volume	223	1082	121	214	1218	314	153	786	179	274	933	408
Lane Width	3.6	3.6		3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB	Left	P	P		NB	Left		P		
	Thru		P			Thru		P		
	Right		P			Right		P		
	Peds					Peds				
WB	Left	P	P		SB	Left	P	P		
	Thru		P			Thru	P	P		
	Right		P			Right	P	P		
	Peds					Peds				
NB	Right				EB	Right				
SB	Right				WB	Right				
Green		10.0	49.0				8.0	33.0		
Yellow		2.0	4.0				2.0	4.0		
All Red		2.0	3.0				0.0	3.0		

Cycle Length: 120.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	204	1719	1.12	0.52	132.9	F		
TR	1329	3254	0.92	0.41	45.8	D	59.4	E
Westbound								
L	213	1805	1.02	0.52	102.5	F		
T	1307	3201	0.95	0.41	50.0	D	52.6	D
R	646	1583	0.50	0.41	29.0	C		
Northbound								
L	94	340	1.66	0.28	382.5	F		
T	939	3413	0.85	0.28	51.0	D	94.4	F
R	427	1553	0.43	0.28	38.9	D		
Southbound								
L	177	1736	1.58	0.36	328.9	F		
T	1246	3478	0.76	0.36	38.5	D	89.4	F
R	536	1495	0.78	0.36	44.8	D		

Intersection Delay = 72.2 (sec/veh) Intersection LOS = E

HCS2000: Signalized Intersections Release 4.1e

Phone: Fax:
E-Mail:

OPERATIONAL ANALYSIS

Analyst: a.liu
Intersection: Steeles Avenue / Jane Street
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: PM Peak Hour
Analysis Year: Existing Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Steeles Avenue
North/South Street: Jane Street

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	223	1082	121	214	1218	314	153	786	179	274	933	408
% Heavy Veh	5	10	5	0	13	2	4	6	4	4	4	8
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	57	276	31	55	311	80	39	201	46	70	238	104
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900	1900	1900	1900	1900	1900	1900	1900
ParkExist												
NumPark												
No. Lanes	1	2	0	1	2	1	1	2	1	1	2	1
LGConfig	L	TR		L	T	R	L	T	R	L	T	R
Lane Width	3.6	3.6		3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
RTOR Vol			0			0			0			0
Adj Flow	228	1227		218	1243	320	156	802	183	280	952	416
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.100			0.000	1.000		0.000	1.000		0.000	1.000
Peds Bikes	0				0			0			0	
Buses	0	0		0	0	0	0	0	0	0	0	0
%InProtPhase	0.0			0.0			0			0.0		

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Arriv. Type	3	3		3	3	3	3	3	3	3	3	3
Unit Ext.	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Ext of g	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB	Left	P	P		NB	Left		P		
	Thru		P			Thru		P		
	Right		P			Right		P		
	Peds					Peds				
WB	Left	P	P		SB	Left	P	P		
	Thru		P			Thru	P	P		
	Right		P			Right	P	P		
	Peds					Peds				
NB	Right				EB	Right				
SB	Right				WB	Right				

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Green		10.0	49.0				8.0	33.0				
Yellow		2.0	4.0				2.0	4.0				
All Red		2.0	3.0				0.0	3.0				

Cycle Length: 120.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	223	1082	121	214	1218	314	153	786	179	274	933	408
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	228	1104	123	218	1243	320	156	802	183	280	952	416
No. Lanes	1	2	0	1	2	1	1	2	1	1	2	1
Lane group	L	TR		L	T	R	L	T	R	L	T	R
Adj flow	228	1227		218	1243	320	156	802	183	280	952	416
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.100			0.000	1.000		0.000	1.000		0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	TR		L	T	R	L	T	R	L	T	R
So	1900	1900		1900	1900	1900	1900	1900	1900	1900	1900	1900
Lanes	1	2	0	1	2	1	1	2	1	1	2	1
fW	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fHV	0.952	0.913		1.000	0.885	0.980	0.962	0.943	0.962	0.962	0.962	0.926
fG	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fP	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fBB	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fA	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fLU	1.000	0.952		1.000	0.952	1.000	1.000	0.952	1.000	1.000	0.952	1.000
fRT		0.985			1.000	0.850		1.000	0.850		1.000	0.850
fLT	0.950	1.000		0.950	1.000		0.186	1.000		0.950	1.000	
Sec.	0.075			0.075						0.114		
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000			1.000	1.000		1.000	1.000		1.000	1.000
S	1719	3254		1805	3201	1583	340	3413	1553	1736	3478	1495
Sec.	137			143						209		

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		143	1719	# 0.08	0.083	143	1.00
Perm		85	137	# 0.62	0.442	61	1.39
Left	L	228			0.52	204	1.12
Prot							
Perm							
Thru	TR	1227	3254	0.38	0.41	1329	0.92
Right							
Westbound							
Prot		150	1805	0.08	0.083	150	1.00
Perm		68	143	0.48	0.442	63	1.08
Left	L	218			0.52	213	1.02
Prot							
Perm							
Thru	T	1243	3201	0.39	0.41	1307	0.95
Right	R	320	1583	0.20	0.41	646	0.50
Northbound							
Prot							
Perm							
Left	L	156	340	0.46	0.28	94	1.66
Prot							
Perm							
Thru	T	802	3413	0.23	0.28	939	0.85
Right	R	183	1553	0.12	0.28	427	0.43
Southbound							
Prot		116	1736	# 0.07	0.067	116	1.00
Perm		164	209	# 0.78	0.292	61	2.69
Left	L	280			0.36	177	1.58
Prot							
Perm							
Thru	T	952	3478	0.27	0.36	1246	0.76
Right	R	416	1495	0.28	0.36	536	0.78

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 1.56
Total lost time per cycle, L = 14.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.76

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	1.12	0.52	34.7	1.000	204	0.50	98.2	0.0	132.9	F		
TR	0.92	0.41	33.7	1.000	1329	0.50	12.1	0.0	45.8	D	59.4	E
Westbound												
L	1.02	0.52	34.6	1.000	213	0.50	67.9	0.0	102.5	F		
T	0.95	0.41	34.3	1.000	1307	0.50	15.6	0.0	50.0	D	52.6	D
R	0.50	0.41	26.3	1.000	646	0.50	2.7	0.0	29.0	C		
Northbound												
L	1.66	0.28	43.5	1.000	94	0.50	339.0	0.0	382.5	F		
T	0.85	0.28	41.2	1.000	939	0.50	9.8	0.0	51.0	D	94.4	F
R	0.43	0.28	35.8	1.000	427	0.50	3.1	0.0	38.9	D		
Southbound												
L	1.58	0.36	41.8	1.000	177	0.50	287.1	0.0	328.9	F		
T	0.76	0.36	34.0	1.000	1246	0.50	4.5	0.0	38.5	D	89.4	F
R	0.78	0.36	34.2	1.000	536	0.50	10.5	0.0	44.8	D		

Intersection Delay = 72.2 (sec/veh) Intersection LOS = E

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)	63.0	63.0	33.0	43.0
Effective permitted green time for LT lane group, g(s)	53.0	53.0	33.0	35.0
Opposing effective green time, go (s)	49.0	49.0	43.0	33.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	2	2	2	2
Adjusted LT flow rate, VLT (veh/h)	228	218	156	280
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	1243	1227	952	802
Lost time for LT lane group, tL	7.00	7.00	7.00	7.00
Computation				
LT volume per cycle, LTC=VLTC/3600	7.60	7.27	5.20	9.33
Opposing lane util. factor, fLUo	0.952	0.952	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	21.76	21.48	16.67	14.04
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.59	0.59	0.64	0.73
gq, (see Exhibit C16-4,5,6,7,8)	40.41	39.60	12.62	26.58
gu=g-gq if gq>=gf, or = g-gf if gq<gf	12.59	13.40	20.38	8.42
n=Max(gq-gf)/2,0)	20.20	19.80	6.31	13.29
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL'=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	4.44	4.37	3.32	2.86
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.08	0.08	0.12	0.11
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.08	0.08	0.19	0.11
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.075	0.075	0.186	0.114

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL'=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 120.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	228	218		280
v/c ratio from Capacity Worksheet, X	1.12	1.02		1.58
Protected phase effective green interval, g (s)	10.0	10.0		8.0
Opposing queue effective green interval, gq	40.41	39.60		26.58
Unopposed green interval, gu	12.59	13.40		8.42
Red time r=(c-g-gq-gu)	57.0	57.0		77.0
Arrival rate, qa=v/(3600(max[X,1.0]))	0.06	0.06		0.05
Protected ph. departure rate, Sp=s/3600	0.478	0.501		0.482
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.16	0.16		0.24
XPerm	1.49	1.49		0.85
XProt	0.80	0.79		1.08
Case	3	3		2
Queue at beginning of green arrow, Qa	4.22	4.40		3.79
Queue at beginning of unsaturated green, Qu	2.29	2.34		3.56
Residual queue, Qr	0.99	1.03		0.32
Uniform Delay, d1	34.7	34.6		41.8

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 72.2 sec/veh Intersection LOS E

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound L	Eastbound TR	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	228	644	218	652	320	156	421	183	280	499	416
So	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	2 0	1	2	1	1	2	1	1	2	1
SL	388	1709	407	1681	1583	340	1792	1553	493	1826	1495
LnCapacity	204	698	213	686	646	94	493	427	177	654	536
Flow Ratio	0.59	0.38	0.54	0.39	0.20	0.46	0.23	0.12	0.57	0.27	0.28
v/c Ratio	1.12	0.92	1.02	0.95	0.50	1.66	0.85	0.43	1.58	0.76	0.78
Grn Ratio	0.52	0.41	0.52	0.41	0.41	0.28	0.28	0.28	0.36	0.36	0.36
I Factor		1.000		1.000			1.000			1.000	
AT or PVG	3	3	3	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	3.9	20.4	3.8	21.0	7.9	5.2	13.3	5.0	6.4	14.7	12.3
kB	0.5	1.1	0.5	1.1	1.0	0.3	0.9	0.8	0.4	1.0	0.9
Q2	5.4	6.6	3.9	7.5	1.0	8.4	3.6	0.6	13.9	2.9	2.7
Q Average	9.4	26.9	7.7	28.5	8.9	13.6	16.9	5.6	20.3	17.6	15.0
Q Spacing	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Q Storage	0	0	0	0	0	0	0	0	0	0	0
Q S Ratio											
70th Percentile Output:											
fB%	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
BOQ	11.4	32.3	9.4	34.2	10.8	16.4	20.3	6.9	24.4	21.2	18.1
QSRatio											
85th Percentile Output:											
fB%	1.4	1.4	1.5	1.4	1.5	1.4	1.4	1.5	1.4	1.4	1.4
BOQ	13.5	37.8	11.3	39.9	12.9	19.3	23.8	8.4	28.6	24.8	21.2
QSRatio											
90th Percentile Output:											
fB%	1.6	1.5	1.6	1.5	1.6	1.5	1.5	1.7	1.5	1.5	1.5
BOQ	14.7	40.5	12.4	42.8	14.1	20.8	25.6	9.3	30.7	26.7	22.8
QSRatio											
95th Percentile Output:											
fB%	1.8	1.6	1.8	1.6	1.8	1.7	1.6	1.9	1.6	1.6	1.6
BOQ	16.4	43.2	14.0	45.7	15.7	22.6	27.6	10.8	32.9	28.7	24.7
QSRatio											
98th Percentile Output:											
fB%	1.9	1.7	2.0	1.7	2.0	1.8	1.8	2.2	1.7	1.7	1.8
BOQ	18.1	46.0	15.5	48.6	17.4	24.4	29.5	12.2	35.1	30.7	26.6
QSRatio											

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: a.liu
Agency: URS Canada Inc.
Date: 12/9/2004
Period: AM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Steeles Avenue

Inter.: Steeles Ave / MurrayRoss Pkwy
Area Type: All other areas
Jurisd: City of Toronto
Year: Existing Conditions
N/S St: Murray Ross Parkway

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes		1	3	1		1	3	0	1	1	0		0	2	0
LGConfig	L		T	R	L		TR		L		TR			LTR	
Volume	5		1838	165	91		1242	1	88	1	120		0	2	3
Lane Width	3.6		3.6	3.6	3.6		3.6		3.6	3.6				3.6	
RTOR Vol			0				0				0				0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left			P		NB Left	A		
Thru			P		Thru	A		
Right			P		Right	A		
Peds					Peds			
WB Left			P		SB Left	A		
Thru			P		Thru	A		
Right			P		Right	A		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green		87.0			19.0			
Yellow		4.0			4.0			
All Red		3.0			3.0			

Cycle Length: 120.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	270	372	0.02	0.73	4.7	A		
T	3574	4929	0.52	0.73	7.9	A	7.7	A
R	1159	1599	0.14	0.73	5.3	A		
Westbound								
L	125	173	0.74	0.73	42.5	D		
TR	3507	4837	0.36	0.73	6.4	A	8.9	A
Northbound								
L	216	1365	0.42	0.16	46.8	D		
TR	249	1571	0.49	0.16	47.7	D	47.3	D
Southbound								
LTR	435	2748	0.01	0.16	42.6	D	42.6	D

Intersection Delay = 10.5 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

Phone: Fax:
E-Mail:

OPERATIONAL ANALYSIS

Analyst: a.liu
Intersection: Steeles Ave / MurrayRoss Pkwy
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: AM Peak Hour
Analysis Year: Existing Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Steeles Avenue
North/South Street: Murray Ross Parkway

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	5	1838	165	91	1242	1	88	1	120	0	2	3
% Heavy Veh	0	5	1	0	7	0	5	0	3	0	0	33
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	2	469	42	23	317	1	22	1	31	0	1	1
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900	1900	1900	1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes		1	3	1		1	3	0		1	1	0		0	2	0
LGConfig	L		T	R	L		TR		L		TR			LTR	
Lane Width	3.6	3.6	3.6	3.6	3.6				3.6	3.6				3.6		
RTOR Vol			0				0				0				0	
Adj Flow	5		1876	168	93		1268		90	123				5		
%InSharedLn																
Prop LTs	1.000	0.000			1.000	0.000			1.000	0.000				0.000		
Prop RTs		0.000	1.000			0.001				0.992				0.600		
Peds Bikes	0				0				0				0			
Buses	0	0	0		0	0			0	0				0		
%InProtPhase																

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0		0.0	0.0			0.0	
Arriv. Type	3	3	3	3	3		3	3			3.0	
Unit Ext.	3.0	3.0	3.0	3.0	3.0		3.0	3.0			3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0		2.0	2.0			2.0	
Ext of g	2.0	2.0	2.0	2.0	2.0		2.0	2.0			2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left			P		NB Left	A		
Thru			P		Thru	A		
Right			P		Right	A		
Peds					Peds			
WB Left			P		SB Left	A		
Thru			P		Thru	A		
Right			P		Right	A		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			

Green		87.0			19.0			
Yellow		4.0			4.0			
All Red		3.0			3.0			

Cycle Length: 120.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	5	1838	165	91	1242	1	88	1	120	0	2	3
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	5	1876	168	93	1267	1	90	1	122	0	2	3
No. Lanes	1	3	1	1	3	0	1	1	0	0	2	0
Lane group	L	T	R	L	TR		L	TR			LTR	
Adj flow	5	1876	168	93	1268		90	123			5	
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000			0.000	
Prop RTs		0.000	1.000		0.001			0.992			0.600	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound				Westbound				Northbound				Southbound			
LG	L	T	R		L	TR			L	TR				LTR		
So	1900	1900	1900		1900	1900			1900	1900				1900		
Lanes	1	3	1		1	3	0		1	1	0		0	2	0	
fW	1.000	1.000	1.000		1.000	1.000			1.000	1.000				1.000		
fHV	1.000	0.952	0.990		1.000	0.935			0.952	0.971				0.835		
fG	1.000	1.000	1.000		1.000	1.000			1.000	1.000				1.000		
fP	1.000	1.000	1.000		1.000	1.000			1.000	1.000				1.000		
fBB	1.000	1.000	1.000		1.000	1.000			1.000	1.000				1.000		
fA	1.000	1.000	1.000		1.000	1.000			1.000	1.000				1.000		
fLU	1.000	0.908	1.000		1.000	0.908			1.000	1.000				0.952		
fRT		1.000	0.850			1.000				0.851				0.910		
fLT	0.196	1.000			0.091	1.000			0.754	1.000				1.000		
Sec.																
fLpb	1.000	1.000			1.000	1.000			1.000	1.000				1.000		
fRpb		1.000	1.000			1.000				1.000				1.000		
S	372	4929	1599		173	4837			1365	1571				2748		
Sec.																

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	5	372	0.01	0.73	270	0.02
Prot							
Perm							
Thru	T	1876	4929	0.38	0.73	3574	0.52
Right	R	168	1599	0.11	0.73	1159	0.14
Westbound							
Prot							
Perm							
Left	L	93	173	# 0.54	0.73	125	0.74
Prot							
Perm							
Thru	TR	1268	4837	0.26	0.73	3507	0.36
Right							
Northbound							
Prot							
Perm							
Left	L	90	1365	0.07	0.16	216	0.42
Prot							
Perm							
Thru	TR	123	1571	# 0.08	0.16	249	0.49
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	5	2748	0.00	0.16	435	0.01
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.62
Total lost time per cycle, L = 14.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.70

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.02	0.73	4.6	1.000	270	0.50	0.1	0.0	4.7	A		
T	0.52	0.73	7.3	1.000	3574	0.50	0.6	0.0	7.9	A	7.7	A
R	0.14	0.73	5.1	1.000	1159	0.50	0.3	0.0	5.3	A		
Westbound												
L	0.74	0.73	9.9	1.000	125	0.50	32.6	0.0	42.5	D		
TR	0.36	0.73	6.1	1.000	3507	0.50	0.3	0.0	6.4	A	8.9	A
Northbound												
L	0.42	0.16	45.5	1.000	216	0.11	1.3	0.0	46.8	D		
TR	0.49	0.16	46.1	1.000	249	0.11	1.5	0.0	47.7	D	47.3	D
Southbound												
LTR	0.01	0.16	42.6	1.000	435	0.11	0.0	0.0	42.6	D	42.6	D

Intersection Delay = 10.5 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	
Cycle length, C	120.0 sec			
Total actual green time for LT lane group, G (s)	87.0	87.0	19.0	
Effective permitted green time for LT lane group, g(s)	87.0	87.0	19.0	
Opposing effective green time, go (s)	87.0	87.0	19.0	
Number of lanes in LT lane group, N	1	1	1	
Number of lanes in opposing approach, No	3	3	2	
Adjusted LT flow rate, VLT (veh/h)	5	93	90	
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	
Adjusted opposing flow rate, Vo (veh/h)	1268	1876	5	
Lost time for LT lane group, tL	7.00	7.00	7.00	
Computation				
LT volume per cycle, LTC=VLTC/3600	0.17	3.10	3.00	
Opposing lane util. factor, fLUo	0.908	0.908	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	15.52	22.96	0.09	
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	0.0	0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.28	0.28	0.84	
gq, (see Exhibit C16-4,5,6,7,8)	4.51	13.45	0.00	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	82.49	73.55	19.00	
n=Max(gq-gf)/2,0)	2.26	6.73	0.00	
PTHo=1-PLTo	1.00	1.00	1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	
EL1 (refer to Exhibit C16-3)	4.84	9.27	1.33	
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.05	0.05	0.21	
gdiff=max(gq-gf,0)	0.00	0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.20	0.09	0.75	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.196	0.091	0.754	

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				M
Cycle length, C	120.0 sec			
Total actual green time for LT lane group, G (s)				19.0
Effective permitted green time for LT lane group, g(s)				19.0
Opposing effective green time, go (s)				19.0
Number of lanes in LT lane group, N				2
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				0
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				0.00
Adjusted opposing flow rate, Vo (veh/h)				123
Lost time for LT lane group, tL				7.00
Computation				
LT volume per cycle, LTC=VLTC/3600				0.00
Opposing lane util. factor, fLUo	0.908	0.908	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				4.10
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.84
gq, (see Exhibit C16-4,5,6,7,8)				0.41
gu=g-gq if gq>=gf, or = g-gf if gq<gf				18.59
n=Max(gq-gf)/2,0)				0.20
PTHo=1-PLTo				1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				0.00
EL1 (refer to Exhibit C16-3)				1.57
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				0.11
gdiff=max(gq-gf,0)				0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.98
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				1.000

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	120.0 sec			
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time r=(C-g-gq-gu)				
Arrival rate, qa=v/(3600(max[X,1.0]))				
Protected ph. departure rate, Sp=s/3600				
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 10.5 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound TR	Northbound L	Northbound TR	Southbound LTR
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	5	688	168	93	465	90	123	2
So	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	3	1	1	3	0	1	1	0	2	0
SL	372	1809	1599	173	1775	1365	1571	1443
LnCapacity	270	1312	1159	125	1287	216	249	228
Flow Ratio	0.01	0.38	0.11	0.54	0.26	0.07	0.08	0.00
v/c Ratio	0.02	0.52	0.14	0.74	0.36	0.42	0.49	0.01
Grn Ratio	0.73	0.73	0.73	0.73	0.73	0.16	0.16	0.16
I Factor		1.000			1.000		1.000	1.000
AT or PVG	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	0.0	10.2	1.7	1.9	5.8	2.7	3.7	0.1
kB	0.6	1.7	1.5	0.3	1.7	0.3	0.4	0.3
Q2	0.0	1.8	0.3	0.8	0.9	0.2	0.3	0.0
Q Average	0.1	12.0	2.0	2.6	6.7	2.9	4.1	0.1
Q Spacing	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Q Storage	0	0	0	0	0	0	0	0
Q S Ratio								
70th Percentile Output:								
fB%	1.3	1.2	1.3	1.3	1.2	1.2	1.2	1.2
BOQ	0.1	14.5	2.5	3.3	8.2	3.5	4.9	0.1
QSRatio								
85th Percentile Output:								
fB%	1.7	1.4	1.6	1.6	1.5	1.6	1.6	1.6
BOQ	0.1	17.1	3.2	4.2	9.9	4.6	6.4	0.1
QSRatio								
90th Percentile Output:								
fB%	2.0	1.5	1.8	1.8	1.6	1.7	1.7	1.8
BOQ	0.1	18.5	3.6	4.7	10.9	5.1	7.0	0.1
QSRatio								
95th Percentile Output:								
fB%	2.6	1.7	2.3	2.2	1.9	2.0	2.0	2.1
BOQ	0.1	20.3	4.5	5.8	12.5	5.9	8.1	0.1
QSRatio								
98th Percentile Output:								
fB%	3.2	1.8	2.7	2.6	2.1	2.5	2.4	2.7
BOQ	0.2	22.0	5.4	6.8	14.0	7.3	9.9	0.2
QSRatio								

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: a.liu
Agency: URS Canada Inc.
Date: 12/9/2004
Period: PM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Steeles Avenue

Inter.: Steeles Ave / MurrayRoss Pkwy
Area Type: All other areas
Jurisd: City of Toronto
Year: Existing Conditions
N/S St: Murray Ross Parkway

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	3	1	1	3	0	1	1	0	0	2	0
LGConfig	L	T	R	L	TR		L	TR			LTR	
Volume	17	1407	153	161	1798	2	22	322	3	10	2	12
Lane Width	3.6	3.6	3.6	3.6	3.6		3.6	3.6			3.6	
RTOR Vol		0				0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left		P			NB Left	A			
Thru		P			Thru	A			
Right		P			Right	A			
Peds					Peds				
WB Left		P			SB Left	A			
Thru		P			Thru	A			
Right		P			Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green		81.0				25.0			
Yellow		4.0				4.0			
All Red		3.0				3.0			

Cycle Length: 120.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	115	171	0.15	0.68	9.7	A		
T	3296	4883	0.44	0.68	9.4	A	9.2	A
R	1079	1599	0.14	0.68	7.3	A		
Westbound								
L	195	289	0.84	0.68	48.0	D		
TR	3295	4882	0.56	0.68	10.8	B	13.9	B
Northbound								
L	290	1394	0.08	0.21	38.3	D		
TR	395	1897	0.84	0.21	60.5	E	59.1	E
Southbound								
LTR	509	2443	0.05	0.21	38.0	D	38.0	D

Intersection Delay = 16.2 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

Phone: Fax:
E-Mail:

OPERATIONAL ANALYSIS

Analyst: a.liu
Intersection: Steeles Ave / MurrayRoss Pkwy
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: PM Peak Hour
Analysis Year: Existing Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Steeles Avenue
North/South Street: Murray Ross Parkway

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	17	1407	153	161	1798	2	22	322	3	10	2	12
% Heavy Veh	0	6	1	1	6	0	1	0	0	0	50	0
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	5	359	39	41	459	1	6	82	1	3	1	3
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900	1900	1900	1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	1	3	1	1	3	0	1	1	0	0	2	0
LGConfig	L	T	R	L	TR		L	TR			LTR	
Lane Width	3.6	3.6	3.6	3.6	3.6		3.6	3.6			3.6	
RTOR Vol		0				0			0			0
Adj Flow	17	1436	156	164	1837		22	332			24	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000			0.417	
Prop RTs		0.000	1.000		0.001			0.009		0.500		
Peds Bikes	0			0			0			0		
Buses	0	0	0	0	0		0	0			0	
%InProtPhase												

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0		0.0	0.0			0.0	
Arriv. Type	3	3	3	3	3		3	3			3	
Unit Ext.	3.0	3.0	3.0	3.0	3.0		3.0	3.0			3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0		2.0	2.0			2.0	
Ext of g	2.0	2.0	2.0	2.0	2.0		2.0	2.0			2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left		P			NB Left	A			
Thru		P			Thru	A			
Right		P			Right	A			
Peds					Peds				
WB Left		P			SB Left	A			
Thru		P			Thru	A			
Right		P			Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				

Green	81.0	25.0
Yellow	4.0	4.0
All Red	3.0	3.0

Cycle Length: 120.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	17	1407	153	161	1798	2	22	322	3	10	2	12
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	17	1436	156	164	1835	2	22	329	3	10	2	12
No. Lanes	1	3	1	1	3	0	1	1	0	0	2	0
Lane group	L	T	R	L	TR		L	TR			LTR	
Adj flow	17	1436	156	164	1837		22	332			24	
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000			0.417	
Prop RTs		0.000	1.000		0.001			0.009		0.500		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	T	R	L	TR		L	TR			LTR	
So	1900	1900	1900	1900	1900		1900	1900			1900	
Lanes	1	3	1	1	3	0	1	1	0	0	2	0
fW	1.000	1.000	1.000	1.000	1.000		1.000	1.000			1.000	
fHV	1.000	0.943	0.990	0.990	0.943		0.990	1.000			0.960	
fG	1.000	1.000	1.000	1.000	1.000		1.000	1.000			1.000	
fP	1.000	1.000	1.000	1.000	1.000		1.000	1.000			1.000	
fBB	1.000	1.000	1.000	1.000	1.000		1.000	1.000			1.000	
fA	1.000	1.000	1.000	1.000	1.000		1.000	1.000			1.000	
fLU	1.000	0.908	1.000	1.000	0.908		1.000	1.000			0.952	
fRT		1.000	0.850		1.000			0.999			0.925	
fLT	0.090	1.000		0.153	1.000		0.741	1.000			0.760	
Sec.												
fLpb	1.000	1.000		1.000	1.000		1.000	1.000			1.000	
fRpb		1.000	1.000		1.000			1.000			1.000	
S	171	4883	1599	289	4882		1394	1897			2443	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	17	171	0.10	0.68	115	0.15
Prot							
Perm							
Thru	T	1436	4883	0.29	0.68	3296	0.44
Right	R	156	1599	0.10	0.68	1079	0.14
Westbound							
Prot							
Perm							
Left	L	164	289	# 0.57	0.68	195	0.84
Prot							
Perm							
Thru	TR	1837	4882	0.38	0.68	3295	0.56
Right							
Northbound							
Prot							
Perm							
Left	L	22	1394	0.02	0.21	290	0.08
Prot							
Perm							
Thru	TR	332	1897	# 0.18	0.21	395	0.84
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	24	2443	0.01	0.21	509	0.05
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.74
Total lost time per cycle, L = 14.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.84

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.15	0.68	7.0	1.000	115	0.50	2.7	0.0	9.7	A		
T	0.44	0.68	9.0	1.000	3296	0.50	0.4	0.0	9.4	A	9.2	A
R	0.14	0.68	7.0	1.000	1079	0.50	0.3	0.0	7.3	A		
Westbound												
L	0.84	0.68	14.7	1.000	195	0.50	33.3	0.0	48.0	D		
TR	0.56	0.68	10.2	1.000	3295	0.50	0.7	0.0	10.8	B	13.9	B
Northbound												
L	0.08	0.21	38.2	1.000	290	0.11	0.1	0.0	38.3	D		
TR	0.84	0.21	45.6	1.000	395	0.38	14.9	0.0	60.5	E	59.1	E
Southbound												
LTR	0.05	0.21	38.0	1.000	509	0.11	0.0	0.0	38.0	D	38.0	D

Intersection Delay = 16.2 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	
Cycle length, C	120.0 sec			
Total actual green time for LT lane group, G (s)	81.0	81.0	25.0	
Effective permitted green time for LT lane group, g(s)	81.0	81.0	25.0	
Opposing effective green time, go (s)	81.0	81.0	25.0	
Number of lanes in LT lane group, N	1	1	1	
Number of lanes in opposing approach, No	3	3	2	
Adjusted LT flow rate, VLT (veh/h)	17	164	22	
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.42	
Adjusted opposing flow rate, Vo (veh/h)	1837	1436	24	
Lost time for LT lane group, tL	7.00	7.00	7.00	
Computation				
LT volume per cycle, LTC=VLTC/3600	0.57	5.47	0.73	
Opposing lane util. factor, fLUo	0.908	0.908	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	22.48	17.57	0.42	
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	0.0	0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.32	0.32	0.79	
gq, (see Exhibit C16-4,5,6,7,8)	16.37	9.15	0.00	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	64.63	71.85	25.00	
n=Max(gq-gf)/2,0)	8.18	4.58	0.00	
PTHo=1-PLTo	1.00	1.00	0.58	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	
EL1 (refer to Exhibit C16-3)	8.89	5.78	1.35	
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.05	0.05	0.16	
gdiff=max(gq-gf,0)	0.00	0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.09	0.15	0.74	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.090	0.153	0.741	

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				M
Cycle length, C	120.0 sec			
Total actual green time for LT lane group, G (s)				25.0
Effective permitted green time for LT lane group, g(s)				25.0
Opposing effective green time, go (s)				25.0
Number of lanes in LT lane group, N				2
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				10
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.417
Proportion of LT in opposing flow, PLTo				0.00
Adjusted opposing flow rate, Vo (veh/h)				332
Lost time for LT lane group, tL				7.00
Computation				
LT volume per cycle, LTC=VLTC/3600				0.33
Opposing lane util. factor, fLUo	0.908	0.908	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				11.07
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				9.7
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.79
gq, (see Exhibit C16-4,5,6,7,8)				14.49
gu=g-gq if gq>=gf, or = g-gf if gq<gf				10.51
n=Max(gq-gf)/2,0)				2.37
PTHo=1-PLTo				1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				0.95
EL1 (refer to Exhibit C16-3)				1.94
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				0.16
gdiff=max(gq-gf,0)				0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.61
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.760

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	120.0 sec			
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time r=(C-g-gq-gu)				
Arrival rate, qa=v/(3600(max[X,1.0]))				
Protected ph. departure rate, Sp=s/3600				
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Grp	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 16.2 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound TR	Northbound L	Northbound TR	Southbound LTR
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	17	527	156	164	674	22	332	12
So	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	3	1	1	3 0	1	1 0	0 2 0
SL	171	1792	1599	289	1792	1394	1897	1283
LnCapacity	115	1209	1079	195	1209	290	395	267
Flow Ratio	0.10	0.29	0.10	0.57	0.38	0.02	0.18	0.01
v/c Ratio	0.15	0.44	0.14	0.84	0.56	0.08	0.84	0.04
Grn Ratio	0.68	0.68	0.68	0.68	0.68	0.21	0.21	0.21
I Factor		1.000			1.000		1.000	1.000
AT or PVG	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	0.2	8.1	1.9	4.1	11.7	0.6	10.6	0.3
kB	0.3	1.6	1.5	0.4	1.6	0.4	0.5	0.4
Q2	0.1	1.2	0.2	1.7	2.0	0.0	2.0	0.0
Q Average	0.3	9.3	2.1	5.8	13.7	0.6	12.6	0.3
Q Spacing	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Q Storage	0	0	0	0	0	0	0	0
Q S Ratio								
70th Percentile Output:								
fB%	1.3	1.2	1.3	1.2	1.2	1.2	1.2	1.2
BOQ	0.3	11.3	2.7	7.1	16.5	0.7	14.8	0.4
QSRatio								
85th Percentile Output:								
fB%	1.7	1.4	1.6	1.5	1.4	1.6	1.5	1.6
BOQ	0.4	13.5	3.4	8.6	19.4	1.0	18.9	0.5
QSRatio								
90th Percentile Output:								
fB%	2.0	1.6	1.8	1.7	1.5	1.8	1.6	1.8
BOQ	0.5	14.7	3.9	9.6	20.9	1.1	20.3	0.6
QSRatio								
95th Percentile Output:								
fB%	2.5	1.8	2.3	1.9	1.7	2.1	1.8	2.1
BOQ	0.7	16.3	4.8	11.0	22.7	1.3	22.7	0.7
QSRatio								
98th Percentile Output:								
fB%	3.1	1.9	2.7	2.2	1.8	2.7	2.1	2.7
BOQ	0.8	18.0	5.7	12.5	24.6	1.7	26.2	0.9
QSRatio								

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: a.liu
Agency: URS Canada Inc.
Date: 12/9/2004
Period: AM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Steeles Avenue

Inter.: Steeles Avenue / Founders Rd
Area Type: All other areas
Jurisd: City of Toronto
Year: Existing Conditions
N/S St: Founders Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	3	0		1	3	0	1	0	1	0	0	0
LGConfig		TR			L	T			R				
Volume		1321	152	148	1307		53		26				
Lane Width		3.6		3.6	3.6				3.6				
RTOR Vol			0						0				

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB	Left				NB	Left	A		
	Thru		P			Thru			
	Right		P			Right	A		
	Peds					Peds			
WB	Left	P	P		SB	Left			
	Thru	P	P			Thru			
	Right					Right			
	Peds					Peds			
NB	Right				EB	Right			
SB	Right				WB	Right			
Green		20.0	61.0			13.0			
Yellow		3.0	4.0			3.0			
All Red		0.0	3.0			3.0			

Cycle Length: 110.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
TR	2619	4723	0.57	0.55	16.9	B	16.9	B
Westbound								
L	441	1787	0.34	0.76	9.7	A		
T	3729	4883	0.36	0.76	4.5	A	5.0	A
Northbound								
L	186	1570	0.29	0.12	45.2	D		
R	121	1022	0.22	0.12	44.9	D	45.1	D
Southbound								

Intersection Delay = 11.9 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

Phone: Fax:
E-Mail:

OPERATIONAL ANALYSIS

Analyst: a.liu
Intersection: Steeles Avenue / Founders Rd
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: AM Peak Hour
Analysis Year: Existing Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Steeles Avenue
North/South Street: Founders Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		1321	152	148	1307		53		26			
% Heavy Veh		0	7	1	6		15		58			
PHF		0.98	0.98	0.98	0.98		0.98		0.98			
PK 15 Vol		337	39	38	333		14		7			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900		1900	1900		1900		1900			
ParkExist												
NumPark												
No. Lanes	0	3	0		1	3	0	1	0	1	0	0	0
LGConfig		TR			L	T			R				
Lane Width		3.6		3.6	3.6		3.6		3.6				
RTOR Vol			0						0				
Adj Flow		1503		151	1334		54		27				
%InSharedLn													
Prop LTs		0.000		1.000	0.000								
Prop RTs		0.103			0.000				1.000				
Peds Bikes		0					0			0			
Buses		0		0			0		0				
%InProtPhase				0.0									

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0		0.0		0.0			
Arriv. Type		3		3	3		3		3			
Unit Ext.		3.0		3.0	3.0		3.0		3.0			
I Factor		1.000			1.000			1.000				
Lost Time		2.0		2.0	2.0		2.0		2.0			
Ext of g		2.0		2.0	2.0		2.0		2.0			
Ped Min g		3.2						3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB	Left				NB	Left	A		
	Thru		P			Thru			
	Right		P			Right	A		
	Peds					Peds			
WB	Left		P	P	SB	Left			
	Thru		P	P		Thru			
	Right					Right			
	Peds					Peds			
NB	Right				EB	Right			
SB	Right				WB	Right			

Green		20.0	61.0			13.0			
Yellow		3.0	4.0			3.0			
All Red		0.0	3.0			3.0			

Cycle Length: 110.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		1321	152	148	1307		53		26			
PHF		0.98	0.98	0.98	0.98		0.98		0.98			
Adj flow		1348	155	151	1334		54		27			
No. Lanes	0	3	0		1	3	0	1	0	1	0	0	0
Lane group		TR			L	T		L		R			
Adj flow		1503		151	1334		54		27				
Prop LTs		0.000		1.000	0.000								
Prop RTs		0.103			0.000				1.000				

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG		TR			L	T		L		R		
So		1900		1900	1900		1900		1900			
Lanes	0	3	0		1	3	0	1	0	1	0	0	0
fW		1.000		1.000	1.000		1.000		1.000			
fHV		0.927		0.990	0.943		0.870		0.633			
fG		1.000		1.000	1.000		1.000		1.000			
fP		1.000		1.000	1.000		1.000		1.000			
fBB		1.000		1.000	1.000		1.000		1.000			
fA		1.000		1.000	1.000		1.000		1.000			
fLU		0.908		1.000	0.908		1.000		1.000			
fRT		0.985			1.000				0.850			
fLT		1.000		0.950	1.000		0.950					
Sec.				0.107								
fLpb		1.000		1.000	1.000		1.000					
fRpb		1.000			1.000				1.000			
S		4723		1787	4883		1570		1022			
Sec.				200								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	1503	4723	# 0.32	0.55	2619	0.57
Right							
Westbound							
Prot		151	1787	# 0.08	0.182	325	0.46
Perm		0	200	0.00	0.582	116	0.00
Left	L	151			0.76	441	0.34
Prot							
Perm							
Thru	T	1334	4883	0.27	0.76	3729	0.36
Right							
Northbound							
Prot							
Perm							
Left	L	54	1570	# 0.03	0.12	186	0.29
Prot							
Perm							
Thru							
Right	R	27	1022	0.03	0.12	121	0.22
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.44
Total lost time per cycle, L = 20.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.53

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
TR	0.57	0.55	16.0	1.000	2619	0.50	0.9	0.0	16.9	B	16.9	B
Westbound												
L	0.34	0.76	7.6	1.000	441	0.50	2.1	0.0	9.7	A		
T	0.36	0.76	4.2	1.000	3729	0.50	0.3	0.0	4.5	A	5.0	A
Northbound												
L	0.29	0.12	44.3	1.000	186	0.11	0.9	0.0	45.2	D		
R	0.22	0.12	43.9	1.000	121	0.11	0.9	0.0	44.9	D	45.1	D
Southbound												

Intersection Delay = 11.9 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach		M		
Cycle length, C	110.0 sec			
Total actual green time for LT lane group, G (s)		84.0		
Effective permitted green time for LT lane group, g(s)		64.0		
Opposing effective green time, go (s)		61.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		3		
Adjusted LT flow rate, VLT (veh/h)		151		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		1503		
Lost time for LT lane group, tL		7.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		4.61		
Opposing lane util. factor, fLUo		0.908	0.908	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			16.86	
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.45	
gq, (see Exhibit C16-4,5,6,7,8)			21.66	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			42.34	
n=Max(gq-gf)/2,0)			10.83	
PTHo=1-PLTo			1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			6.21	
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.06	
gdiff=max(gq-gf,0)			0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.11	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.107		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	110.0 sec			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT		0.000	0.000	
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo		0.908	0.908	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.107		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	110.0 sec			
Adj. LT vol from Vol Adjustment Worksheet, v		151		
v/c ratio from Capacity Worksheet, X		0.34		
Protected phase effective green interval, g (s)		20.0		
Opposing queue effective green interval, gq		21.66		
Unopposed green interval, gu		42.34		
Red time r=(C-g-gq-gu)		26.0		
Arrival rate, qa=v/(3600(max[X,1.0]))		0.04		
Protected ph. departure rate, Sp=s/3600		0.496		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)		0.08		
XPerm		0.75		
XProt		0.19		
Case		1		
Queue at beginning of green arrow, Qa		1.09		
Queue at beginning of unsaturated green, Qu		0.91		
Residual queue, Qr		0.00		
Uniform Delay, d1		7.6		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Final Unmet Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 11.9 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound TR	Westbound L	Westbound T	Northbound L	Northbound R	Southbound	
Init Queue	0.0	0.0	0.0	0.0	0.0		
Flow Rate	551	151	489	54	27		
So	1900	1900	1900	1900	1900		
No.Lanes	3	1	3	1	1		
SL	1733	578	1792	1570	1022		
LnCapacity	961	441	1368	186	121		
Flow Ratio	0.32	0.26	0.27	0.03	0.03		
v/c Ratio	0.57	0.34	0.36	0.29	0.22		
Grn Ratio	0.55	0.76	0.76	0.12	0.12		
I Factor	1.000		1.000	1.000			
AT or PVG	3	3	3	3			
Pltn Ratio	1.00	1.00	1.00	1.00	1.00		
PF2	1.00	1.00	1.00	1.00	1.00		
Q1	11.0	1.2	4.9	1.5	0.7		
kB	1.3	0.7	1.6	0.3	0.2		
Q2	1.7	0.4	0.9	0.1	0.1		
Q Average	12.7	1.5	5.8	1.6	0.8		
Q Spacing	7.6	7.6	7.6	7.6	7.6		
Q Storage	0	0	0	0	0		
Q S Ratio							
70th Percentile Output:							
fB%	1.2	1.3	1.2	1.2	1.2		
BOQ	15.3	2.0	7.1	1.9	1.0		
QSRatio							
85th Percentile Output:							
fB%	1.4	1.6	1.5	1.6	1.6		
BOQ	18.0	2.5	8.6	2.6	1.3		
QSRatio							
90th Percentile Output:							
fB%	1.5	1.9	1.7	1.8	1.8		
BOQ	19.5	2.9	9.6	2.9	1.4		
QSRatio							
95th Percentile Output:							
fB%	1.7	2.3	1.9	2.0	2.1		
BOQ	21.3	3.6	11.0	3.3	1.7		
QSRatio							
98th Percentile Output:							
fB%	1.8	2.8	2.2	2.6	2.6		
BOQ	23.0	4.3	12.5	4.2	2.1		
QSRatio							

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: a.liu
Agency: URS Canada Inc.
Date: 12/9/2004
Period: PM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Steeles Avenue

Inter.: Steeles Avenue / Founders Rd
Area Type: All other areas
Jurisd: City of Toronto
Year: Existing Conditions
N/S St: Founders Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	3	0		1	3	0	1	0	1	0	0	0
LGConfig		TR		L		T		L		R			
Volume		1333	55	87		1445		275		238			
Lane Width		3.6		3.6	3.6			3.6		3.6			
RTOR Vol			0							0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	A		
Thru		P			Thru			
Right		P			Right	A		
Peds					Peds			
WB Left		P	P		SB Left			
Thru		P	P		Thru			
Right					Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green		6.0	58.0		30.0			
Yellow		3.0	4.0		3.0			
All Red		0.0	3.0		3.0			

Cycle Length: 110.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/c	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
TR	2513	4766	0.56	0.53	18.4	B	18.4	B
Westbound								
L	217	1787	0.41	0.61	17.3	B		
T	2974	4883	0.50	0.61	12.6	B	12.9	B
Northbound								
L	428	1570	0.66	0.27	39.1	D		
R	279	1022	0.87	0.27	62.6	E	50.0	D
Southbound								

Intersection Delay = 20.7 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

Phone: Fax:
E-Mail:

OPERATIONAL ANALYSIS

Analyst: a.liu
Intersection: Steeles Avenue / Founders Rd
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: PM Peak Hour
Analysis Year: Existing Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Steeles Avenue
North/South Street: Founders Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		1333	55	87		1445		275		238		
% Heavy Veh		0	7	1		6		15		58		
PHF		0.98	0.98	0.98		0.98		0.98		0.98		
PK 15 Vol		340	14	22		369		70		61		
Hi Ln Vol												
% Grade		0				0			0			
Ideal Sat		1900		1900	1900			1900		1900		
ParkExist												
NumPark												
No. Lanes	0	3	0		1	3	0	1	0	1	0	0	0
LGConfig		TR		L		T		L		R			
Lane Width		3.6		3.6	3.6			3.6		3.6			
RTOR Vol			0							0			
Adj Flow		1416		89		1474		281		243			
%InSharedLn													
Prop LTs		0.000		1.000	0.000								
Prop RTs		0.040			0.000					1.000			
Peds Bikes		0						0				0	
Buses		0		0		0		0		0			
%InProtPhase					0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0		0.0		0.0			
Arriv. Type		3		3	3		3		3			
Unit Ext.		3.0		3.0	3.0		3.0		3.0			
I Factor		1.000			1.000			1.000				
Lost Time		2.0		2.0	2.0		2.0		2.0			
Ext of g		2.0		2.0	2.0		2.0		2.0			
Ped Min g		3.2						3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	A		
Thru		P			Thru			
Right		P			Right	A		
Peds					Peds			
WB Left		P	P		SB Left			
Thru		P	P		Thru			
Right					Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			

Green		6.0	58.0		30.0			
Yellow		3.0	4.0		3.0			
All Red		0.0	3.0		3.0			

Cycle Length: 110.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		1333	55	87	1445		275		238			
PHF		0.98	0.98	0.98	0.98		0.98		0.98			
Adj flow		1360	56	89	1474		281		243			
No. Lanes	0	3	0		1	3	0	1	0	1	0	0	0
Lane group		TR		L		T	L			R			
Adj flow		1416		89	1474		281		243			
Prop LTs		0.000		1.000	0.000							
Prop RTs		0.040			0.000				1.000			

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG		TR		L	T		L		R			
So		1900		1900	1900		1900		1900			
Lanes	0	3	0	1	3	0	1	0	1	0	0	0
fW		1.000		1.000	1.000		1.000		1.000			
fHV		0.926		0.990	0.943		0.870		0.633			
fG		1.000		1.000	1.000		1.000		1.000			
fP		1.000		1.000	1.000		1.000		1.000			
fBB		1.000		1.000	1.000		1.000		1.000			
fA		1.000		1.000	1.000		1.000		1.000			
fLU		0.908		1.000	0.908		1.000		1.000			
fRT		0.994			1.000				0.850			
fLT		1.000		0.950	1.000		0.950					
Sec.				0.116								
fLpb		1.000		1.000	1.000		1.000					
fRpb		1.000			1.000				1.000			
S		4766		1787	4883		1570		1022			
Sec.				217								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	1416	4766	# 0.30	0.53	2513	0.56
Right							
Westbound							
Prot		89	1787	# 0.05	0.055	97	0.92
Perm		0	217	0.00	0.555	120	0.00
Left	L	89			0.61	217	0.41
Prot							
Perm							
Thru	T	1474	4883	0.30	0.61	2974	0.50
Right							
Northbound							
Prot							
Perm							
Left	L	281	1570	0.18	0.27	428	0.66
Prot							
Perm							
Thru							
Right	R	243	1022	# 0.24	0.27	279	0.87
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.58
Total lost time per cycle, L = 20.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.71

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
TR	0.56	0.53	17.5	1.000	2513	0.50	0.9	0.0	18.4	B	18.4	B
Westbound												
L	0.41	0.61	11.6	1.000	217	0.50	5.6	0.0	17.3	B		
T	0.50	0.61	12.0	1.000	2974	0.50	0.6	0.0	12.6	B	12.9	B
Northbound												
L	0.66	0.27	35.4	1.000	428	0.23	3.6	0.0	39.1	D		
R	0.87	0.27	38.2	1.000	279	0.40	24.5	0.0	62.6	E	50.0	D
Southbound												

Intersection Delay = 20.7 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach		M		
Cycle length, C	110.0 sec			
Total actual green time for LT lane group, G (s)		67.0		
Effective permitted green time for LT lane group, g(s)		61.0		
Opposing effective green time, go (s)		58.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		3		
Adjusted LT flow rate, VLT (veh/h)		89		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		1416		
Lost time for LT lane group, tL		7.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		2.72		
Opposing lane util. factor, fLUo		0.908	0.908	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		15.88		
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.47		
gq, (see Exhibit C16-4,5,6,7,8)		21.11		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		39.89		
n=Max(gq-gf)/2,0)		10.56		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		5.66		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.07		
gdiff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.12		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.116		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	110.0 sec			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT		0.000	0.000	
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo		0.908	0.908	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	110.0 sec			
Adj. LT vol from Vol Adjustment Worksheet, v		89		
v/c ratio from Capacity Worksheet, X		0.41		
Protected phase effective green interval, g (s)		6.0		
Opposing queue effective green interval, gq		21.11		
Unopposed green interval, gu		39.89		
Red time r=(C-g-gq-gu)		43.0		
Arrival rate, qa=v/(3600(max[X,1.0]))		0.02		
Protected ph. departure rate, Sp=s/3600		0.496		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)		0.09		
XPerm		0.41		
XProt		0.41		
Case		1		
Queue at beginning of green arrow, Qa		1.06		
Queue at beginning of unsaturated green, Qu		0.52		
Residual queue, Qr		0.00		
Uniform Delay, d1		11.6		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 20.7 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound TR	Westbound L	Westbound T	Northbound L	Northbound R	Southbound	
Init Queue	0.0	0.0	0.0	0.0	0.0		
Flow Rate	519	89	541	281	243		
So	1900	1900	1900	1900	1900		
No.Lanes	0 3 0	1	3 0	1	0 1	0 0 0	
SL	1749	358	1792	1570	1022		
LnCapacity	922	217	1091	428	279		
Flow Ratio	0.30	0.25	0.30	0.18	0.24		
v/c Ratio	0.56	0.41	0.50	0.66	0.87		
Grn Ratio	0.53	0.61	0.61	0.27	0.27		
I Factor	1.000		1.000	1.000			
AT or PVG	3	3	3	3			
Pltn Ratio	1.00	1.00	1.00	1.00	1.00		
PF2	1.00	1.00	1.00	1.00	1.00		
Q1	10.7	1.1	9.3	7.6	7.1		
kB	1.2	0.5	1.4	0.5	0.4		
Q2	1.6	0.3	1.3	0.9	1.8		
Q Average	12.2	1.4	10.6	8.5	8.8		
Q Spacing	7.6	7.6	7.6	7.6	7.6		
Q Storage	0	0	0	0	0		
Q S Ratio							
70th Percentile Output:							
fB%	1.2	1.3	1.2	1.2	1.2		
BOQ	14.8	1.8	12.9	10.0	10.4		
QSRatio							
85th Percentile Output:							
fB%	1.4	1.6	1.4	1.5	1.5		
BOQ	17.4	2.3	15.2	12.9	13.5		
QSRatio							
90th Percentile Output:							
fB%	1.5	1.9	1.6	1.7	1.7		
BOQ	18.8	2.6	16.5	14.1	14.6		
QSRatio							
95th Percentile Output:							
fB%	1.7	2.4	1.7	1.9	1.9		
BOQ	20.6	3.3	18.2	15.9	16.5		
QSRatio							
98th Percentile Output:							
fB%	1.8	2.8	1.9	2.2	2.2		
BOQ	22.4	4.0	19.9	18.8	19.5		
QSRatio							

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: a.liu
Agency: URS Canada Inc.
Date: 12/9/2004
Period: AM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Steeles Avenue

Inter.: Steeles Avenue / Keele St
Area Type: All other areas
Jurisd: City of Toronto
Year: Existing Conditions
N/S St: Keele Street

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes		1	3	1		1	3	0	1	2	1	
LGConfig	L		T	R	L		TR		L	T	R	
Volume	151	1292	74		154	1335	219		62	612	126	
Lane Width	3.6	3.6	3.6		3.6	3.6			3.6	3.6	3.6	
RTOR Vol			0				0				0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left		A	P		NB Left	A	P	
Thru			P		Thru		P	
Right			P		Right		P	
Peds					Peds			
WB Left		A	P		SB Left	A	P	
Thru			P		Thru		P	
Right			P		Right		P	
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green		12.0	34.0			6.0	38.0	
Yellow		3.0	4.0			3.0	4.0	
All Red		1.0	2.0			1.0	2.0	

Cycle Length: 110.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	233	1543	0.66	0.45	30.8	C		
T	1509	4883	0.87	0.31	43.3	D	41.3	D
R	462	1495	0.16	0.31	28.4	C		
Westbound								
L	241	1612	0.65	0.45	28.9	C		
TR	1492	4826	1.06	0.31	79.8	E	75.2	E
Northbound								
L	148	1530	0.43	0.44	27.0	C		
T	1136	3289	0.55	0.35	31.0	C	30.0	C
R	531	1538	0.24	0.35	26.8	C		
Southbound								
L	260	1641	0.92	0.44	72.5	E		
T	1157	3350	1.04	0.35	72.3	E	68.0	E
R	454	1313	0.35	0.35	28.9	C		

Intersection Delay = 57.5 (sec/veh) Intersection LOS = E

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:
Fax:

OPERATIONAL ANALYSIS

Analyst: a.liu
Intersection: Steeles Avenue / Keele St
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: AM Peak Hour
Analysis Year: Existing Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Steeles Avenue
North/South Street: Keele Street

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	151	1292	74	154	1335	219	62	612	126	235	1175	156
% Heavy Veh	17	6	8	12	4	11	18	10	5	10	8	23
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	39	330	19	39	341	56	16	156	32	60	300	40
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900	1900	1900	1900		1900	1900	1900	1900	1900	1900
ParkExist												
NumPark												
No. Lanes		1	3	1		1	3	0		1	2	1
LGConfig	L		T	R	L		TR		L		T	R
Lane Width	3.6	3.6	3.6	3.6	3.6				3.6	3.6	3.6	
RTOR Vol			0				0				0	
Adj Flow	154	1318	76	157	1585		63	624	129	240	1199	159
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.141			0.000	1.000		0.000	1.000
Peds Bikes	0			0			0			0		
Buses	0	0	0	0	0		0	0	0	0	0	0
%InProtPhase	0.0			0.0			0.0			0.0		
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Arriv. Type	3	3	3	3	3		3	3	3	3	3	3
Unit Ext.	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0
Ext of g	2.0	2.0	2.0	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left		A	P		NB Left	A	P	
Thru			P		Thru		P	
Right			P		Right		P	
Peds					Peds			
WB Left		A	P		SB Left	A	P	
Thru			P		Thru		P	
Right			P		Right		P	
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			

Green		12.0	34.0			6.0	38.0	
Yellow		3.0	4.0			3.0	4.0	
All Red		1.0	2.0			1.0	2.0	

Cycle Length: 110.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	151	1292	74	154	1335	219	62	612	126	235	1175	156
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	154	1318	76	157	1362	223	63	624	129	240	1199	159
No. Lanes		1	3	1		1	3	0	1	2	1	
Lane group	L		T	R	L		TR		L	T	R	
Adj flow	154	1318	76		157	1585			63	624	129	
Prop LTs	1.000	0.000			1.000	0.000			1.000	0.000		
Prop RTs		0.000	1.000			0.141				0.000	1.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	T	R	L	TR		L	T	R	L	T	R
So	1900	1900	1900	1900	1900		1900	1900	1900	1900	1900	1900
Lanes	1	3	1	1	3	0	1	2	1	1	2	1
fW	1.000	1.000	1.000	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000
fHV	0.855	0.943	0.926	0.893	0.953		0.847	0.909	0.952	0.909	0.926	0.813
fG	1.000	1.000	1.000	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000
fA	1.000	1.000	1.000	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000
fLU	1.000	0.908	1.000	1.000	0.908		1.000	0.952	1.000	1.000	0.952	1.000
fRT		1.000	0.850		0.979			1.000	0.850		1.000	0.850
fLT	0.950	1.000		0.950	1.000		0.950	1.000		0.950	1.000	
Sec.	0.105			0.105			0.095			0.257		
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000	1.000		1.000			1.000	1.000		1.000	1.000
S	1543	4883	1495	1612	4826		1530	3289	1538	1641	3350	1313
Sec.	171			179			153			444		

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		154	1543	# 0.10	0.109	168	0.92
Perm		0	171	0.00	0.345	65	0.00
Left	L	154			0.45	233	0.66
Prot							
Perm							
Thru	T	1318	4883	0.27	0.31	1509	0.87
Right	R	76	1495	0.05	0.31	462	0.16
Westbound							
Prot		157	1612	0.10	0.109	176	0.89
Perm		0	179	0.00	0.345	65	0.00
Left	L	157			0.45	241	0.65
Prot							
Perm							
Thru	TR	1585	4826	# 0.31	0.31	1492	1.06
Right							
Northbound							
Prot		63	1530	0.04	0.055	83	0.76
Perm		0	153	0.00	0.382	65	0.00
Left	L	63			0.44	148	0.43
Prot							
Perm							
Thru	T	624	3289	0.19	0.35	1136	0.55
Right	R	129	1538	0.08	0.35	531	0.24
Southbound							
Prot		90	1641	# 0.05	0.055	90	1.00
Perm		150	444	0.34	0.382	170	0.88
Left	L	240			0.44	260	0.92
Prot							
Perm							
Thru	T	1199	3350	# 0.35	0.35	1157	1.04
Right	R	159	1313	0.12	0.35	454	0.35

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.81
Total lost time per cycle, L = 24.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.04

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.66	0.45	24.0	1.000	233	0.24	6.8	0.0	30.8	C		
T	0.87	0.31	36.0	1.000	1509	0.50	7.3	0.0	43.3	D	41.3	D
R	0.16	0.31	27.7	1.000	462	0.50	0.8	0.0	28.4	C		
Westbound												
L	0.65	0.45	22.8	1.000	241	0.23	6.1	0.0	28.9	C		
TR	1.06	0.31	38.0	1.000	1492	0.50	41.8	0.0	79.8	E	75.2	E
Northbound												
L	0.43	0.44	25.1	1.000	148	0.11	2.0	0.0	27.0	C		
T	0.55	0.35	29.1	1.000	1136	0.50	1.9	0.0	31.0	C	30.0	C
R	0.24	0.35	25.7	1.000	531	0.50	1.1	0.0	26.8	C		
Southbound												
L	0.92	0.44	36.6	1.000	260	0.44	35.9	0.0	72.5	E		
T	1.04	0.35	36.0	1.000	1157	0.50	36.3	0.0	72.3	E	68.0	E
R	0.35	0.35	26.8	1.000	454	0.50	2.1	0.0	28.9	C		

Intersection Delay = 57.5 (sec/veh) Intersection LOS = E

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)	50.0	50.0	48.0	48.0
Effective permitted green time for LT lane group, g(s)	38.0	38.0	42.0	42.0
Opposing effective green time, go (s)	34.0	34.0	38.0	38.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	3	3	2	2
Adjusted LT flow rate, VLT (veh/h)	154	157	63	240
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	1585	1318	1199	624
Lost time for LT lane group, tL	6.00	6.00	6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600	4.71	4.80	1.93	7.33
Opposing lane util. factor, fLUo	0.908	0.908	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	17.78	14.78	19.24	10.01
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.69	0.69	0.65	0.65
a, b (see Exhibit C16-4,5,6,7,8)	34.00	27.94	38.00	16.03
gu=g-gq if gq>=gf, or = g-gf if gq<gf	4.00	10.06	4.00	25.97
n=Max(gq-gf)/2,0)	17.00	13.97	19.00	8.01
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	6.78	5.10	4.25	2.41
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.11	0.11	0.10	0.10
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.11	0.11	0.10	0.26
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.105	0.105	0.095	0.257

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.908	0.908	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 110.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	154	157	63	240
v/c ratio from Capacity Worksheet, X	0.66	0.65	0.43	0.92
Protected phase effective green interval, g (s)	12.0	12.0	6.0	6.0
Opposing queue effective green interval, gq	34.00	27.94	38.00	16.03
Unopposed green interval, gu	4.00	10.06	4.00	25.97
Red time r=(C-g-gq-gu)	60.0	60.0	62.0	62.0
Arrival rate, qa=v/(3600(max[X,1.0]))	0.04	0.04	0.02	0.07
Protected ph. departure rate, Sp=s/3600	0.429	0.448	0.425	0.456
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.45	0.19	0.45	0.20
XPerm	0.90	0.88	0.41	0.54
XProt	0.60	0.58	0.47	1.66
Case	1	1	1	2
Queue at beginning of green arrow, Qa	2.57	2.62	1.09	4.13
Queue at beginning of unsaturated green, Qu	1.45	1.22	0.67	4.41
Residual queue, Qr	0.00	0.00	0.00	1.80
Uniform Delay, d1	24.0	22.8	25.1	36.6

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Grp	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 57.5 sec/veh Intersection LOS E

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound L	Eastbound T	Eastbound R	Westbound TR	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	154	483	76	157	581	63	327	129	240	629	159
So	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	3	1	1	3	0	1	2	1	1	2	1
SL	500	1792	1495	523	1771		325	1727	1538	594	1759	1313
LnCapacity	233	553	462	241	547		148	596	531	260	607	454
Flow Ratio	0.31	0.27	0.05	0.30	0.33		0.19	0.19	0.08	0.40	0.36	0.12
v/c Ratio	0.66	0.87	0.16	0.65	1.06		0.43	0.55	0.24	0.92	1.04	0.35
Grn Ratio	0.45	0.31	0.31	0.45	0.31		0.44	0.35	0.35	0.44	0.35	0.35
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3	3	3	3		3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Q1	2.8	14.0	1.7	2.8	17.8		1.1	8.1	2.8	4.4	19.2	3.6
kB	0.3	0.9	0.8	0.3	0.9		0.2	0.9	0.8	0.3	0.9	0.8
Q2	0.6	4.1	0.2	0.6	10.3		0.2	1.1	0.3	2.2	10.0	0.4
Q Average	3.4	18.1	1.8	3.4	28.1		1.3	9.1	3.1	6.6	29.2	4.0
Q Spacing	7.6	7.6	7.6	7.6	7.6		7.6	7.6	7.6	7.6	7.6	7.6
Q Storage	0	0	0	0	0		0	0	0	0	0	0
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2	1.3	1.2	1.2		1.2	1.2	1.3	1.2	1.2	1.2
BOQ	4.0	21.7	2.3	4.1	33.7		1.5	11.1	3.9	7.8	35.1	5.0
QSRatio												
85th Percentile Output:												
fB%	1.6	1.4	1.6	1.6	1.4		1.6	1.4	1.6	1.5	1.4	1.5
BOQ	5.3	25.4	3.0	5.3	39.3		2.0	13.2	4.8	10.1	41.0	6.2
QSRatio												
90th Percentile Output:												
fB%	1.7	1.5	1.8	1.7	1.5		1.8	1.6	1.8	1.7	1.5	1.7
BOQ	5.8	27.3	3.4	5.9	42.2		2.3	14.5	5.5	11.1	43.9	6.9
QSRatio												
95th Percentile Output:												
fB%	2.0	1.6	2.3	2.0	1.6		2.1	1.8	2.1	1.9	1.6	2.0
BOQ	6.7	29.4	4.2	6.8	45.0		2.6	16.1	6.6	12.6	46.9	8.2
QSRatio												
98th Percentile Output:												
fB%	2.5	1.7	2.7	2.5	1.7		2.6	1.9	2.5	2.3	1.7	2.4
BOQ	8.3	31.4	5.0	8.4	47.9		3.4	17.8	7.7	15.1	49.8	9.5
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: a.liu
Agency: URS Canada Inc.
Date: 12/9/2004
Period: PM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Steeles Avenue

Inter.: Steeles Avenue / Keele Street
Area Type: All other areas
Jurisd: City of Toronto
Year: Existing Conditions
N/S St: Keele Street

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	3	1	1	3	0	1	2	1	1	2	1
LGConfig	L	T	R	L	TR		L	T	R	L	T	R
Volume	177	1681	144	260	1727	633	197	1177	265	252	1141	160
Lane Width	3.6	3.6	3.6	3.6	3.6		3.6	3.6	3.6	3.6	3.6	3.6
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left		P		P	NB Left		P		
Thru				P	Thru		P		
Right				P	Right		P		
Peds					Peds				
WB Left		P		P	SB Left		P		P
Thru				P	Thru				P
Right				P	Right				P
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green		9.0	41.0				6.0	44.0	
Yellow		3.0	4.0				3.0	4.0	
All Red		1.0	2.0				1.0	2.0	

Cycle Length: 120.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	185	1671	0.98	0.45	92.8	F		
T	1684	4929	1.02	0.34	66.2	E	65.9	E
R	536	1568	0.27	0.34	30.0	C		
Westbound								
L	189	1719	1.40	0.45	242.0	F		
TR	1659	4857	1.45	0.34	246.1	F	245.7	F
Northbound								
L	148	1736	1.36	0.45	237.0	F		
T	1263	3445	0.95	0.37	53.0	D	71.6	E
R	580	1583	0.47	0.37	31.7	C		
Southbound								
L	148	1736	1.74	0.45	393.6	F		
T	1263	3445	0.92	0.37	48.7	D	102.7	F
R	502	1369	0.32	0.37	29.0	C		

Intersection Delay = 134.7 (sec/veh) Intersection LOS = F

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:
Fax:

OPERATIONAL ANALYSIS

Analyst: a.liu
Intersection: Steeles Avenue / Keele Street
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: PM Peak Hour
Analysis Year: Existing Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Steeles Avenue
North/South Street: Keele Street

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	177	1681	144	260	1727	633	197	1177	265	252	1141	160
% Heavy Veh	8	5	3	5	2	3	4	5	2	4	5	18
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	45	429	37	66	441	161	50	300	68	64	291	41
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900	1900	1900	1900		1900	1900	1900	1900	1900	1900
ParkExist												
NumPark												
No. Lanes	1	3	1	1	3	0	1	2	1	1	2	1
LGConfig	L	T	R	L	TR		L	T	R	L	T	R
Lane Width	3.6	3.6	3.6	3.6	3.6		3.6	3.6	3.6	3.6	3.6	3.6
RTOR Vol			0			0			0			0
Adj Flow	181	1715	147	265	2408		201	1201	270	257	1164	163
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.268			0.000	1.000		0.000	1.000
Peds Bikes	0			0			0			0		
Buses	0	0	0	0	0		0	0	0	0	0	0
%InProtPhase	0.0			0.0			0.0			0.0		
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Arriv. Type	3	3	3	3	3		3	3	3	3	3	3
Unit Ext.	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0
Ext of g	2.0	2.0	2.0	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left		P		P	NB Left		P		
Thru				P	Thru		P		
Right				P	Right		P		
Peds					Peds				
WB Left		P		P	SB Left		P		
Thru				P	Thru		P		
Right				P	Right		P		
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Green		9.0	41.0				6.0	44.0				
Yellow		3.0	4.0				3.0	4.0				
All Red		1.0	2.0				1.0	2.0				

Cycle Length: 120.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	177	1681	144	260	1727	633	197	1177	265	252	1141	160
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	181	1715	147	265	1762	646	201	1201	270	257	1164	163
No. Lanes	1	3	1	1	3	0	1	2	1	1	2	1
Lane group	L	T	R	L	TR		L	T	R	L	T	R
Adj flow	181	1715	147	265	2408		201	1201	270	257	1164	163
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.268			0.000	1.000		0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound					Westbound					Northbound					Southbound				
LG	L	T	R	L	TR	L	T	R	L	TR	L	T	R	L	TR	L	T	R	L	TR
So	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lanes	1	3	1	1	3	1	2	1	1	2	1	2	1	1	2	1	2	1	1	2
fW	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fHV	0.926	0.952	0.971	0.952	0.978	0.962	0.952	0.980	0.962	0.952	0.847	0.962	0.952	0.980	0.962	0.952	0.847	0.962	0.952	0.847
fG	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fLU	1.000	0.908	1.000	1.000	0.908	1.000	0.952	1.000	1.000	0.952	1.000	1.000	0.952	1.000	1.000	0.952	1.000	1.000	0.952	1.000
fRT		1.000	0.850		0.960		1.000	0.850		1.000	0.850		1.000	0.850		1.000	0.850		1.000	0.850
fLT	0.950	1.000		0.950	1.000	0.950	1.000		0.950	1.000		0.950	1.000		0.950	1.000		0.950	1.000	
Sec.	0.089			0.089		0.083			0.083			0.083								
fLpb	1.000	1.000		1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000							
fRpb		1.000	1.000		1.000		1.000	1.000		1.000	1.000		1.000	1.000						
S	1671	4929	1568	1719	4857	1736	3445	1583	1736	3445	1369	1736	3445	1583	1736	3445	1369	1736	3445	1369
Sec.	156			161		152			152											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		125	1671	0.07	0.075	125	1.00
Perm		56	156	0.36	0.375	60	0.93
Left	L	181			0.45	185	0.98
Prot							
Perm							
Thru	T	1715	4929	0.34	0.34	1684	1.02
Right	R	147	1568	0.09	0.34	536	0.27
Westbound							
Prot		129	1719	# 0.08	0.075	129	1.00
Perm		136	161	# 0.84	0.375	60	2.27
Left	L	265			0.45	189	1.40
Prot							
Perm							
Thru	TR	2408	4857	0.34	0.34	1659	1.45
Right							
Northbound							
Prot		87	1736	# 0.05	0.050	87	1.00
Perm		114	152	0.75	0.400	61	1.87
Left	L	201			0.45	148	1.36
Prot							
Perm							
Thru	T	1201	3445	0.35	0.37	1263	0.95
Right	R	270	1583	0.17	0.37	580	0.47
Southbound							
Prot		87	1736	0.05	0.050	87	1.00
Perm		170	152	# 1.12	0.400	61	2.79
Left	L	257			0.45	148	1.74
Prot							
Perm							
Thru	T	1164	3445	0.34	0.37	1263	0.92
Right	R	163	1369	0.12	0.37	502	0.32

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 2.09
Total lost time per cycle, L = 12.00 Sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 2.32

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.98	0.45	32.0	1.000	185	0.50	60.8	0.0	92.8	F		
T	1.02	0.34	39.5	1.000	1684	0.50	26.7	0.0	66.2	E	65.9	E
R	0.27	0.34	28.7	1.000	536	0.50	1.3	0.0	30.0	C		
Westbound												
L	1.40	0.45	32.3	1.000	189	0.50	209.6	0.0	242.0	F		
TR	1.45	0.34	39.5	1.000	1659	0.50	206.6	0.0	246.1	F	245.7	F
Northbound												
L	1.36	0.45	38.4	1.000	148	0.50	198.6	0.0	237.0	F		
T	0.95	0.37	36.9	1.000	1263	0.50	16.0	0.0	53.0	D	71.6	E
R	0.47	0.37	29.0	1.000	580	0.50	2.7	0.0	31.7	C		
Southbound												
L	1.74	0.45	35.7	1.000	148	0.50	358.0	0.0	393.6	F		
T	0.92	0.37	36.4	1.000	1263	0.50	12.4	0.0	48.7	D	102.7	F
R	0.32	0.37	27.3	1.000	502	0.50	1.7	0.0	29.0	C		

Intersection Delay = 134.7 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)	54.0	54.0	54.0	54.0
Effective permitted green time for LT lane group, g(s)	45.0	45.0	48.0	48.0
Opposing effective green time, go (s)	41.0	41.0	44.0	44.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	3	3	2	2
Adjusted LT flow rate, VLT (veh/h)	181	265	201	257
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	2408	1715	1164	1201
Lost time for LT lane group, tL	6.00	6.00	6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600	6.03	8.83	6.70	8.57
Opposing lane util. factor, fLUo	0.908	0.908	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	29.47	20.99	20.38	21.03
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.66	0.66	0.63	0.63
gq, (see Exhibit C16-4,5,6,7,8)	41.00	41.00	39.09	41.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	4.00	4.00	8.91	7.00
n=Max(gq-gf)/2,0)	20.50	20.50	19.54	20.50
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	16.59	7.79	4.10	4.25
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.09	0.08	0.08
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.09	0.09	0.08	0.08
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.089	0.089	0.083	0.083

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.908	0.908	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo	1.000	1.000	1.000	1.000
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 120.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	181	265	201	257
v/c ratio from Capacity Worksheet, X	0.98	1.40	1.36	1.74
Protected phase effective green interval, g (s)	9.0	9.0	6.0	6.0
Opposing queue effective green interval, gq	41.00	41.00	39.09	41.00
Unopposed green interval, gu	4.00	4.00	8.91	7.00
Red time r=(c-g-gq-gu)	66.0	66.0	66.0	66.0
Arrival rate, qa=v/(3600(max[X,1.0]))	0.05	0.05	0.04	0.04
Protected ph. departure rate, Sp=s/3600	0.464	0.478	0.482	0.482
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.49	0.50	0.23	0.29
XPerm	1.16	1.17	0.97	0.97
XProt	0.90	0.92	1.02	1.02
Case	3	3	2	2
Queue at beginning of green arrow, Qa	3.63	3.81	2.71	2.71
Queue at beginning of unsaturated green, Qu	2.06	2.15	3.20	2.91
Residual queue, Qr	0.31	0.35	0.07	0.07
Uniform Delay, d1	32.0	32.3	38.4	35.7

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 134.7 sec/veh Intersection LOS F

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound TR	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	181	629	147	265	883	201	630	270	257	611	163
So	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	3	1	1	3	0	1	2	1	2	1
SL	409	1809	1568	421	1783	0	328	1809	1583	328	1809	1369
LnCapacity	185	618	536	189	609		148	663	580	148	663	502
Flow Ratio	0.44	0.35	0.09	0.63	0.50		0.61	0.35	0.17	0.78	0.34	0.12
v/c Ratio	0.98	1.02	0.27	1.40	1.45		1.36	0.95	0.47	1.74	0.92	0.32
Grn Ratio	0.45	0.34	0.34	0.45	0.34		0.45	0.37	0.37	0.45	0.37	0.37
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3	3	3	3		3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Q1	3.6	21.0	3.6	5.3	29.4		3.9	20.4	6.9	5.0	19.5	3.9
kB	0.4	1.0	0.9	0.4	1.0		0.4	1.0	1.0	0.4	1.0	0.9
Q2	2.9	9.6	0.3	10.8	37.2		7.8	7.3	0.8	14.4	6.3	0.4
Q Average	6.5	30.5	3.9	16.1	66.6		11.7	27.7	7.7	19.4	25.8	4.3
Q Spacing	7.6	7.6	7.6	7.6	7.6		7.6	7.6	7.6	7.6	7.6	7.6
Q Storage	0	0	0	0			0	0	0	0	0	0
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2	1.2	1.2	1.2		1.2	1.2	1.2	1.2	1.2	1.2
BOQ	7.9	36.7	4.9	19.4	79.9		14.1	33.2	9.4	23.3	30.9	5.4
QSRatio												
85th Percentile Output:												
fB%	1.5	1.4	1.5	1.4	1.4		1.4	1.4	1.5	1.4	1.4	1.5
BOQ	9.6	42.8	6.0	22.7	93.3		16.7	38.8	11.3	27.3	36.1	6.6
QSRatio												
90th Percentile Output:												
fB%	1.6	1.5	1.7	1.5	1.5		1.5	1.5	1.6	1.5	1.5	1.7
BOQ	10.6	45.8	6.7	24.5	99.9		18.1	41.6	12.4	29.3	38.7	7.4
QSRatio												
95th Percentile Output:												
fB%	1.9	1.6	2.1	1.6	1.6		1.7	1.6	1.8	1.6	1.6	2.0
BOQ	12.1	48.9	8.0	26.4	107		19.8	44.4	14.0	31.4	41.4	8.7
QSRatio												
98th Percentile Output:												
fB%	2.1	1.7	2.4	1.8	1.7		1.8	1.7	2.0	1.7	1.7	2.3
BOQ	13.6	52.0	9.3	28.3	113		21.6	47.2	15.5	33.6	44.0	10.1
QSRatio												

ERROR MESSAGES

No errors to report.

APPENDIX C

INTERSECTION ANALYSES

FUTURE BACKGROUND TRAFFIC

Steeles West Station - Future Background Traffic Conditions

HCS2000: Signalized Intersections Release 4.1e

Analyst:
Agency: URS Canada Inc.
Date: 12/9/2004
Period: AM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Steeles Avenue

Inter.: Sessions Avenue / Jane Street
Area Type: All other areas
Jurisd: City of Toronto
Year: Future Background Conditions
N/S St: Jane Street

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	0	1	2	1	1	2	1	1	2	1
LGConfig	L	TR		L	T	R	L	T	R	L	T	R
Volume	164	1605	160	155	1242	299	81	1085	137	347	1012	151
Lane Width	3.6	3.6		3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
RTOR Vol			0			0			0			0
Duration	0.25		Area Type: All other areas									

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left		P			NB Left	P	P		
Thru		P			Thru		P		
Right		P			Right		P		
Peds					Peds				
WB Left		P			SB Left	P	P		
Thru		P			Thru		P		
Right		P			Right		P		
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green		6.0	46.0			15.0	31.0		
Yellow		2.0	4.0			2.0	4.0		
All Red		2.0	3.0			2.0	3.0		

Cycle Length: 120.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	146	1719	1.25	0.47	183.9	F		
TR	1305	3404	1.50	0.38	267.3	F	260.2	F
Westbound								
L	151	1787	1.14	0.47	143.9	F		
T	1284	3350	1.07	0.38	84.8	F	80.9	F
R	613	1599	0.54	0.38	32.2	C		
Northbound								
L	278	1736	0.32	0.42	28.8	C		
T	890	3445	1.36	0.26	211.7	F	182.2	F
R	397	1538	0.38	0.26	39.4	D		
Southbound								
L	281	1752	1.37	0.42	224.2	F		
T	890	3445	1.26	0.26	171.8	F	170.7	F
R	413	1599	0.41	0.26	39.8	D		

Intersection Delay = 176.2 (sec/veh) Intersection LOS = F

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:
Fax:

OPERATIONAL ANALYSIS

Analyst:
Intersection: Steeles Avenue / Jane Street
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: AM Peak Hour
Analysis Year: Future Background Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Steeles Avenue
North/South Street: Jane Street

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	164	1605	160	155	1242	299	81	1085	137	347	1012	151
% Heavy Veh	5	5	5	1	8	1	4	5	5	3	5	1
PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
PK 15 Vol	46	446	44	43	345	83	23	301	38	96	281	42
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900	1900	1900	1900	1900	1900	1900	1900
ParkExist												
NumPark												
No. Lanes	1	2	0	1	2	1	1	2	1	1	2	1
LGConfig	L	TR		L	T	R	L	T	R	L	T	R
Lane Width	3.6	3.6		3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
RTOR Vol			0			0			0			0
Adj Flow	182	1961		172	1380	332	90	1206	152	386	1124	168
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.091			0.000	1.000		0.000	1.000		0.000	1.000
Peds	Bikes	0			0			0			0	
Buses	0	0		0	0	0	0	0	0	0	0	0
%InProtPhase	0.0			0.0			0.0			0.0		

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Arriv. Type	3	3		3	3	3	3	3	3	3	3	3
Unit Ext.	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Ext of g	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left		P			NB Left	P	P		
Thru		P			Thru		P		
Right		P			Right		P		
Peds					Peds				
WB Left		P			SB Left	P	P		
Thru		P			Thru		P		
Right		P			Right		P		
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green		6.0	46.0			15.0	31.0		
Yellow		2.0	4.0			2.0	4.0		
All Red		2.0	3.0			2.0	3.0		

Cycle Length: 120.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	164	1605	160	155	1242	299	81	1085	137	347	1012	151
PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj flow	182	1783	178	172	1380	332	90	1206	152	386	1124	168
No. Lanes	1	2	0	1	2	1	1	2	1	1	2	1
Lane group	L	TR		L	T	R	L	T	R	L	T	R
Adj flow	182	1961		172	1380	332	90	1206	152	386	1124	168
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.091			0.000	1.000		0.000	1.000		0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	TR		L	T	R	L	T	R	L	T	R
So	1900	1900		1900	1900	1900	1900	1900	1900	1900	1900	1900
Lanes	1	2	0	1	2	1	1	2	1	1	2	1
fW	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fHV	0.952	0.954		0.990	0.926	0.990	0.962	0.952	0.952	0.971	0.952	0.990
fG	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fP	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fBB	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fA	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fLU	1.000	0.952		1.000	0.952	1.000	1.000	0.952	1.000	1.000	0.952	1.000
fRT		0.986			1.000	0.850		1.000	0.850		1.000	0.850
fLT	0.950	1.000		0.950	1.000		0.950	1.000		0.950	1.000	
Sec.	0.080			0.080			0.114			0.114		
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000			1.000	1.000		1.000	1.000		1.000	1.000
S	1719	3404		1787	3350	1599	1736	3445	1538	1752	3445	1599
Sec.	145			150			209			211		

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		86	1719	# 0.05	0.050	86	1.00
Perm		96	145	# 0.66	0.417	60	1.60
Left	L	182			0.47	146	1.25
Prot							
Perm							
Thru	TR	1961	3404	0.38	0.38	1305	1.50
Right							
Westbound							
Prot		89	1787	0.05	0.050	89	1.00
Perm		83	150	0.55	0.417	62	1.34
Left	L	172			0.47	151	1.14
Prot							
Perm							
Thru	T	1380	3350	0.38	0.38	1284	1.07
Right	R	332	1599	0.21	0.38	613	0.54
Northbound							
Prot		90	1736	0.05	0.125	217	0.41
Perm		0	209	0.00	0.292	61	0.00
Left	L	90			0.42	278	0.32
Prot							
Perm							
Thru	T	1206	3445	0.26	0.26	890	1.36
Right	R	152	1538	0.10	0.26	397	0.38
Southbound							
Prot		219	1752	# 0.13	0.125	219	1.00
Perm		167	211	# 0.79	0.292	62	2.69
Left	L	386			0.42	281	1.37
Prot							
Perm							
Thru	T	1124	3445	0.26	0.26	890	1.26
Right	R	168	1599	0.11	0.26	413	0.41

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 1.63
Total lost time per cycle, L = 14.00 Sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.84

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Adj Fact	Prog Cap	Lane Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	1.25	0.47	28.4	1.000	146	0.50	155.4	0.0	183.9	F		
TR	1.50	0.38	37.0	1.000	1305	0.50	230.3	0.0	267.3	F	260.2	F
Westbound												
L	1.14	0.47	28.4	1.000	151	0.50	115.5	0.0	143.9	F		
T	1.07	0.38	37.0	1.000	1284	0.50	47.8	0.0	84.8	F	80.9	F
R	0.54	0.38	28.8	1.000	613	0.50	3.4	0.0	32.2	C		
Northbound												
L	0.32	0.42	25.7	1.000	278	0.50	3.1	0.0	28.8	C		
T	1.36	0.26	44.5	1.000	890	0.50	167.2	0.0	211.7	F	182.2	F
R	0.38	0.26	36.6	1.000	397	0.50	2.8	0.0	39.4	D		
Southbound												
L	1.37	0.42	35.1	1.000	281	0.50	189.1	0.0	224.2	F		
T	1.26	0.26	44.5	1.000	890	0.50	127.3	0.0	171.8	F	170.7	F
R	0.41	0.26	36.9	1.000	413	0.50	3.0	0.0	39.8	D		

Intersection Delay = 176.2 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)	56.0	56.0	50.0	50.0
Effective permitted green time for LT lane group, g(s)	50.0	50.0	35.0	35.0
Opposing effective green time, go (s)	46.0	46.0	31.0	31.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	2	2	2	2
Adjusted LT flow rate, VLT (veh/h)	182	172	90	386
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	1380	1961	1124	1206
Lost time for LT lane group, tL	7.00	7.00	7.00	7.00
Computation				
LT volume per cycle, LTC=VLTC/3600	6.07	5.73	3.00	12.87
Opposing lane util. factor, fLUo	0.952	0.952	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	24.16	34.33	19.68	21.11
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.62	0.62	0.74	0.74
gq, (see Exhibit C16-4,5,6,7,8)	46.00	46.00	31.00	31.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	4.00	4.00	4.00	4.00
n=Max(gq-gf)/2,0)	23.00	23.00	15.50	15.50
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	5.09	9.21	3.94	4.28
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.08	0.08	0.11	0.11
qdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.08	0.08	0.11	0.11
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.080	0.080	0.114	0.114

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
qdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 120.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	182	172	90	386
v/c ratio from Capacity Worksheet, X	1.25	1.14	0.32	1.37
Protected phase effective green interval, g (s)	6.0	6.0	15.0	15.0
Opposing queue effective green interval, gq	46.00	46.00	31.00	31.00
Unopposed green interval, gu	4.00	4.00	4.00	4.00
Red time r=(C-g-gq-gu)	64.0	64.0	70.0	70.0
Arrival rate, qa=v/(3600(max[X,1.0]))	0.04	0.04	0.03	0.08
Protected ph. departure rate, Sp=s/3600	0.478	0.496	0.482	0.487
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.50	0.52	0.51	0.51
XPerm	1.01	1.01	0.43	1.33
XProt	0.99	0.99	0.29	0.91
Case	3	3	1	3
Queue at beginning of green arrow, Qa	2.61	2.70	1.75	6.14
Queue at beginning of unsaturated green, Qu	1.87	1.93	0.78	2.42
Residual queue, Qr	0.01	0.01	0.00	0.68
Uniform Delay, d1	28.4	28.4	25.7	35.1

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Final Queue Delay d3 sec	Initial Lane Group d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 176.2 sec/veh Intersection LOS F

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	TR		L	T	R	L	T	R	L	T	R
Init Queue	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	182	1029		172	724	332	90	633	152	386	590	168
So	1900	1900		1900	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	2	0	1	2	1	1	2	1	1	2	1
SL	314	1787		325	1759	1599	667	1809	1538	673	1809	1599
LnCapacity	146	685		151	674	613	278	467	397	281	467	413
Flow Ratio	0.58	0.58		0.53	0.41	0.21	0.13	0.35	0.10	0.57	0.33	0.11
v/c Ratio	1.25	1.50		1.14	1.07	0.54	0.32	1.36	0.38	1.37	1.26	0.41
Grn Ratio	0.47	0.38		0.47	0.38	0.38	0.42	0.26	0.26	0.42	0.26	0.26
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3		3	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	3.4	34.3		3.2	24.1	8.6	1.8	21.1	4.2	8.6	19.7	4.6
KB	0.4	1.1		0.4	1.1	1.0	0.6	0.8	0.7	0.6	0.8	0.8
Q2	5.9	46.0		4.4	13.4	1.1	0.3	23.5	0.4	15.0	18.6	0.5
Q Average	9.3	80.3		7.7	37.5	9.7	2.1	44.6	4.6	23.6	38.3	5.1
Q Spacing	7.6	7.6		7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Q Storage	0	0		0	0	0	0	0	0	0	0	0
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2		1.2	1.2	1.2	1.3	1.2	1.2	1.2	1.2	1.2
BOQ	11.3	96.4		9.3	45.1	11.8	2.7	53.5	5.7	28.3	45.9	6.4
QSRatio												
85th Percentile Output:												
fB%	1.4	1.4		1.5	1.4	1.4	1.6	1.4	1.5	1.4	1.4	1.5
BOQ	13.5	112		11.2	52.6	14.1	3.3	62.5	7.0	33.0	53.6	7.8
QSRatio												
90th Percentile Output:												
fB%	1.6	1.5		1.6	1.5	1.6	1.8	1.5	1.7	1.5	1.5	1.7
BOQ	14.7	120		12.3	56.3	15.3	3.8	66.9	7.8	35.4	57.4	8.6
QSRatio												
95th Percentile Output:												
fB%	1.8	1.6		1.8	1.6	1.7	2.3	1.6	2.0	1.6	1.6	2.0
BOQ	16.3	128		13.9	60.1	17.0	4.7	71.4	9.2	37.9	61.3	10.1
QSRatio												
98th Percentile Output:												
fB%	1.9	1.7		2.0	1.7	1.9	2.7	1.7	2.3	1.7	1.7	2.2
BOQ	18.0	137		15.5	63.8	18.7	5.6	75.8	10.6	40.4	65.1	11.5
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: AM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Steeles Avenue

Inter.: Steeles Ave / MurrayRoss Pkwy
Area Type: All other areas
Jurisd: City of Toronto
Year: Future Background Conditions
N/S St: Murray Ross Parkway

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes		1	3	1		1	3	0		1	1	0
LGConfig		L	T	R		L	TR			L	TR	
Volume	5	2005	165	91	1355	1	88	1	120	0	2	3
Lane Width	3.6	3.6	3.6	3.6	3.6		3.6	3.6			3.6	
RTOR Vol			0			0			0			0
Duration	0.25			Area Type: All other areas								

Phase Combination	1	2	3	4		5	6	7	8
EB	Left		P		NB	Left	A		
	Thru		P			Thru	A		
	Right		P			Right	A		
	Peds					Peds			
WB	Left	P			SB	Left	A		
	Thru	P	P			Thru	A		
	Right	P	P			Right	A		
	Peds					Peds			
NB	Right				EB	Right			
SB	Right				WB	Right			
Green		6.0	68.0			30.0			
Yellow		2.0	4.0			4.0			
All Red		0.0	3.0			3.0			

Cycle Length: 120.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	190	336	0.03	0.57	11.7	B		
T	2793	4929	0.73	0.57	21.0	C	20.4	C
R	906	1599	0.19	0.57	13.0	B		
Westbound								
L	154	1805	0.60	0.63	34.4	C		
TR	3063	4837	0.45	0.63	11.8	B	13.2	B
Northbound								
L	341	1365	0.26	0.25	36.6	D		
TR	393	1571	0.31	0.25	37.1	D	36.9	D
Southbound								
LTR	687	2748	0.01	0.25	33.8	C	33.8	C

Intersection Delay = 18.6 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:
Fax:

OPERATIONAL ANALYSIS

Analyst:	NA
Intersection:	Steeles Ave / MurrayRoss Pkwy
Agency/Co.:	URS Canada Inc.
Area Type:	All other areas
Date Performed:	12/9/2004
Jurisdiction:	City of Toronto
Analysis Time Period:	AM Peak Hour
Analysis Year:	Future Background Conditions
Project ID:	TTC Spadina Station Extension
East/West Street:	North/South Street
Steeles Avenue	Murray Ross Parkway

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	5	2005	165	91	1355	1	88	1	120	0	2	3
% Heavy Veh	0	5	1	0	7	0	5	0	3	0	0	33
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	2	511	42	23	346	1	22	1	31	0	1	1
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900	1900	1900	1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes		1	3	1		1	3	0		1	1	0
LGConfig		L	T	R		L	TR			L	TR	
Lane Width	3.6	3.6	3.6	3.6	3.6		3.6	3.6			3.6	
RTOR Vol			0			0			0			0
Adj Flow	5	2046	168	93	1384		90	123			5	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000			0.000	
Prop RTs		0.000	1.000		0.001			0.992		0.600		
Peds	Bikes	0			0			0		0		
Buses	0	0	0	0	0		0	0			0	
%InProtPhase					0.0							
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0		0.0	0.0			0.0	
Arriv. Type	3	3	3	3	3		3	3			3	
Unit Ext.	3.0	3.0	3.0	3.0	3.0		3.0	3.0			3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0		2.0	2.0			2.0	
Ext of g	2.0	2.0	2.0	2.0	2.0		2.0	2.0			2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB	Left		P		NB	Left	A		
	Thru		P			Thru	A		
	Right		P			Right	A		
	Peds					Peds			
WB	Left	P	P		SB	Left	A		
	Thru	P	P			Thru	A		
	Right	P	P			Right	A		
	Peds					Peds			
NB	Right				EB	Right			
SB	Right				WB	Right			
Green		6.0	68.0			30.0			
Yellow		2.0	4.0			4.0			
All Red		0.0	3.0			3.0			

Cycle Length: 120.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	5	2005	165	91	1355	1	88	1	120	0	2	3
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	5	2046	168	93	1383	1	90	1	122	0	2	3
No. Lanes		1	3	1		1	3	0		1	1	0
Lane group		L	T	R		L	TR			L	TR	
Adj flow	5	2046	168	93	1384		90	123			5	
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000			0.000	
Prop RTs		0.000	1.000		0.001			0.992		0.600		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound				Westbound				Northbound				Southbound			
LG	L	T	R		L	T	R		L	T	R		L	T	R	
So	1900	1900	1900	1900	1900				1900	1900					LTR	1900
Lanes	1	3		1	3	0			1		0	0	2			0
fW	1.000	1.000	1.000	1.000	1.000				1.000	1.000						1.000
fHV	1.000	0.952	0.990	1.000	0.935				0.952	0.971						0.835
fG	1.000	1.000	1.000	1.000	1.000				1.000	1.000						1.000
fP	1.000	1.000	1.000	1.000	1.000				1.000	1.000						1.000
fBB	1.000	1.000	1.000	1.000	1.000				1.000	1.000						1.000
fA	1.000	1.000	1.000	1.000	1.000				1.000	1.000						1.000
fLU	1.000	0.908	1.000	1.000	0.908				1.000	1.000						0.952
fRT		1.000	0.850		1.000					0.851						0.910
fLT	0.177	1.000		0.950	1.000				0.754	1.000						1.000
Sec.				0.057												
fLpb	1.000	1.000		1.000	1.000				1.000	1.000						1.000
fRpb		1.000	1.000		1.000					1.000						1.000
S	336	4929	1599	1805	4837				1365	1571						2748
Sec.				109												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	5	336	0.01	0.57	190	0.03
Prot							
Perm							
Thru	T	2046	4929	# 0.42	0.57	2793	0.73
Right	R	168	1599	0.11	0.57	906	0.19
Westbound							
Prot		90	1805	# 0.05	0.050	90	1.00
Perm		3	109	0.03	0.583	64	0.05
Left	L	93			0.63	154	0.60
Prot							
Perm							
Thru	TR	1384	4837	0.29	0.63	3063	0.45
Right							
Northbound							
Prot							
Perm							
Left	L	90	1365	0.07	0.25	341	0.26
Prot							
Perm							
Thru	TR	123	1571	# 0.08	0.25	393	0.31
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	5	2748	0.00	0.25	687	0.01
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.54
Total lost time per cycle, L = 21.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.66

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Adj Fact	Prog Cap	Lane Grp k	Incremental Factor	Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound													
L	0.03	0.57	11.4	1.000	190	0.50	0.3	0.0	11.7	B			
T	0.73	0.57	19.3	1.000	2793	0.50	1.7	0.0	21.0	C	20.4	C	
R	0.19	0.57	12.6	1.000	906	0.50	0.5	0.0	13.0	B			
Westbound													
L	0.60	0.63	18.1	1.000	154	0.50	16.3	0.0	34.4	C			
TR	0.45	0.63	11.3	1.000	3063	0.50	0.5	0.0	11.8	B	13.2	B	
Northbound													
L	0.26	0.25	36.1	1.000	341	0.11	0.4	0.0	36.6	D			
TR	0.31	0.25	36.6	1.000	393	0.11	0.5	0.0	37.1	D	36.9	D	
Southbound													
LTR	0.01	0.25	33.8	1.000	687	0.11	0.0	0.0	33.8	C	33.8	C	

Intersection Delay = 18.6 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)	68.0	76.0	30.0	
Effective permitted green time for LT lane group, g(s)	68.0	70.0	30.0	
Opposing effective green time, go (s)	76.0	68.0	30.0	
Number of lanes in LT lane group, N	1	1	1	
Number of lanes in opposing approach, No	3	3	2	
Adjusted LT flow rate, VLT (veh/h)	5	93	90	
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	
Adjusted opposing flow rate, Vo (veh/h)	1384	2046	5	
Lost time for LT lane group, tL	7.00	7.00	7.00	
Computation				
LT volume per cycle, LTC=VLTC/3600	0.17	3.10	3.00	
Opposing lane util. factor, fLUo	0.908	0.908	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	16.94	25.04	0.09	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.37	0.43	0.75	
gq, (see Exhibit C16-4,5,6,7,8)	2.30	37.24	0.00	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	65.70	32.76	30.00	
n=Max(gq-gf)/2,0)	1.15	18.62	0.00	
PTHo=1-PLTo	1.00	1.00	1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	
EL1 (refer to Exhibit C16-3)	5.47	11.15	1.33	
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06	0.06	0.13	
gdiff=max(gq-gf,0)	0.00	0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.18	0.06	0.75	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.177	0.057	0.754	

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				M
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)				30.0
Effective permitted green time for LT lane group, g(s)				30.0
Opposing effective green time, go (s)				30.0
Number of lanes in LT lane group, N				2
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				0
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				0.00
Adjusted opposing flow rate, Vo (veh/h)				123
Lost time for LT lane group, tL				7.00
Computation				
LT volume per cycle, LTC=VLTC/3600				0.00
Opposing lane util. factor, fLUo	0.908	0.908	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				4.10
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.75
gq, (see Exhibit C16-4,5,6,7,8)				0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf				30.00
n=Max(gq-gf)/2,0)				0.00
PTHo=1-PLTo				1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				0.00
EL1 (refer to Exhibit C16-3)				1.57
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				0.07
gdiff=max(gq-gf,0)				0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				1.00
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				1.000

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 120.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	93			
v/c ratio from Capacity Worksheet, X	0.60			
Protected phase effective green interval, g (s)	6.0			
Opposing queue effective green interval, gq	37.24			
Unopposed green interval, gu	32.76			
Red time r=(C-g-gq-gu)	44.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.03			
Protected ph. departure rate, Sp=s/3600	0.501			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.06			
XPerm	0.85			
XProt	0.43			
Case	1			
Queue at beginning of green arrow, Qa	1.14			
Queue at beginning of unsaturated green, Qu	0.96			
Residual queue, Qr	0.00			
Uniform Delay, d1	18.1			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Final Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 18.6 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
LaneGroup		L	T	R		L	TR				LTR	
Init Queue	0.0	0.0	0.0	0.0	0.0		0.0	0.0			0.0	
Flow Rate	5	751	168	93	508		90	123			2	
So	1900	1900	1900	1900	1900		1900	1900			1900	
No.Lanes	1	3	1	1	3	0	1	1	0	0	2	0
SL	336	1809	1599	243	1775		1365	1571			1443	
LnCapacity	190	1025	906	154	1124		341	393			360	
Flow Ratio	0.01	0.42	0.11	0.38	0.29		0.07	0.08			0.00	
v/c Ratio	0.03	0.73	0.19	0.60	0.45		0.26	0.31			0.01	
Grn Ratio	0.57	0.57	0.57	0.63	0.63		0.25	0.25			0.25	
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3	3	3	3		3	3			3	
Pltn Ratio	1.00	1.00	1.00	1.00	1.00		1.00	1.00			1.00	
PF2	1.00	1.00	1.00	1.00	1.00		1.00	1.00			1.00	
Q1	0.1	18.5	2.7	1.2	8.7		2.4	3.3			0.1	
kB	0.4	1.4	1.3	0.4	1.5		0.4	0.5			0.4	
Q2	0.0	3.5	0.3	0.5	1.2		0.2	0.2			0.0	
Q Average	0.1	22.1	3.0	1.7	9.9		2.6	3.5			0.1	
Q Spacing	7.6	7.6	7.6	7.6	7.6		7.6	7.6			7.6	
Q Storage	0	0	0	0	0		0	0			0	
Q S Ratio												
70th Percentile Output:												
fB%	1.3	1.2	1.3	1.3	1.2		1.2	1.2			1.2	
BOQ	0.1	26.5	3.8	2.2	12.1		3.1	4.2			0.1	
QSRatio												
85th Percentile Output:												
fB%	1.7	1.4	1.6	1.6	1.4		1.6	1.6			1.6	
BOQ	0.1	31.0	4.7	2.8	14.3		4.0	5.6			0.1	
QSRatio												
90th Percentile Output:												
fB%	2.0	1.5	1.8	1.9	1.6		1.8	1.7			1.8	
BOQ	0.2	33.3	5.3	3.2	15.6		4.5	6.2			0.1	
QSRatio												
95th Percentile Output:												
fB%	2.6	1.6	2.1	2.3	1.7		2.0	2.0			2.1	
BOQ	0.2	35.6	6.5	3.9	17.3		5.2	7.1			0.1	
QSRatio												
98th Percentile Output:												
fB%	3.2	1.7	2.5	2.8	1.9		2.5	2.5			2.7	
BOQ	0.3	37.9	7.6	4.7	18.9		6.5	8.7			0.1	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: NA
Agency/Co.: URS Canada Inc.
Date Performed: 5/17/2005
Analysis Time Period: AM Peak Hour
Intersection: Steeles Ave / Northwest Gate
Jurisdiction: City of Toronto
Units: U. S. Metric
Analysis Year: Future Background Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Steeles Ave
North/South Street: Northwest Gate
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		2038	90	96	1441	
Peak-Hour Factor, PHF		0.98	0.98	0.98	0.98	
Hourly Flow Rate, HFR		2079	91	97	1470	
Percent Heavy Vehicles		--	--	0	--	--
Median Type/Storage	Undivided		/			
RT Channelized?			No			
Lanes		2	1		1	2
Configuration		T	R		L	T
Upstream Signal?		No				No

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume		13			22	
Peak Hour Factor, PHF		0.98			0.98	
Hourly Flow Rate, HFR		13			22	
Percent Heavy Vehicles		0			0	
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
Lanes		1			1	
Configuration		L	R			

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config		L	L		R			
v (vph)		97	13		22			
C(m) (vph)		250	7		231			
v/c		0.39	1.86		0.10			
95% queue length		1.74	2.61		0.31			
Control Delay		28.2	1396		22.2			
LOS		D	F		C			
Approach Delay			532.3					
Approach LOS			F					

HCS2000: Unsignalized Intersections Release 4.1d

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: NA
Agency/Co.: URS Canada Inc.
Date Performed: 5/17/2005
Analysis Time Period: AM Peak Hour
Intersection: Steeles Ave / Northwest Gate
Jurisdiction: City of Toronto
Units: U. S. Metric
Analysis Year: Future Background Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Steeles Ave
North/South Street: Northwest Gate
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		2038	90	96	1441	
Peak-Hour Factor, PHF		0.98	0.98	0.98	0.98	
Peak-15 Minute Volume		520	23	24	368	
Hourly Flow Rate, HFR		2079	91	97	1470	
Percent Heavy Vehicles		--	--	0	--	--
Median Type/Storage	Undivided		/			
RT Channelized?			No			
Lanes		2	1		1	2
Configuration		T	R		L	T
Upstream Signal?		No				No

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume		13			22	
Peak Hour Factor, PHF		0.98			0.98	
Peak-15 Minute Volume		3			6	
Hourly Flow Rate, HFR		13			22	
Percent Heavy Vehicles		0			0	
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
RT Channelized			No			
Lanes		1			1	
Configuration		L	R			

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0
Lane Width (m)	3.6	3.6	3.6	3.6
Walking Speed (m/sec)	1.2	1.2	1.2	1.2
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed kph	Distance to Signal meters
S2	Left-Turn Through						
S5	Left-Turn Through						

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)		4.1	7.5		6.9			
t(c,hv)	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		0	0		0			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Grade/100			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.70		0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.1	6.8		6.9			
2-stage								

Follow-Up Time Calculations

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)		0	0		0			
t(f)		2.2	3.5		3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				
g(q1)				
g(q2)				
g(q)				

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods

	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)

	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x		2170	3008		1040			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process

	7		8		10		11	
	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		3000						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	1040	
Potential Capacity	231	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	231	
Probability of Queue free St.	0.90	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows	2170	
Potential Capacity	250	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	250	
Probability of Queue free St.	0.61	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.61	0.61
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows	3008	
Potential Capacity	11	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.61
Maj. L, Min T Adj. Imp Factor.		0.70
Cap. Adj. factor due to Impeding mvmnt	0.61	0.63
Movement Capacity	7	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.61	0.61
Movement Capacity		
Result for 2 stage process:		
a		
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	3008	
Potential Capacity	11	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.61
Maj. L, Min T Adj. Imp Factor.		0.70
Cap. Adj. factor due to Impeding mvmnt	0.61	0.63
Movement Capacity	7	
Results for Two-stage process:		
a		
y		
C t	7	

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)	13		22			
Movement Capacity (vph)	7		231			
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep	7		231			
Volume	13		22			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		L	L		R			
v (vph)		97	13		22			
C(m) (vph)		250	7		231			
v/c		0.39	1.86		0.10			
95% queue length		1.74	2.61		0.31			
Control Delay		28.2	1396		22.2			
LOS		D	F		C			
Approach Delay			532.3					
Approach LOS			F					

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.61
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		28.2
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: AM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Steeles Avenue

Inter.: Steeles Avenue / Founders Rd
Area Type: All other areas
Jurisd: City of Toronto
Year: Future Background Conditions
N/S St: Founders Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	3	0	1	3	0	1	0	1	0	0	0
LGConfig		TR		L	T		L		R			
Volume		1455	152	148	1440		53		26			
Lane Width		3.6		3.6	3.6		3.6		3.6			
RTOR Vol			0						0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left	A			
Thru		P			Thru				
Right		P			Right	A			
Peds					Peds				
WB Left	P	P			SB Left				
Thru	P	P			Thru				
Right					Right				
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	10.0	57.0				27.0			
Yellow	3.0	4.0				3.0			
All Red	0.0	3.0				3.0			

Cycle Length: 110.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
TR	2450	4728	0.67	0.52	21.0	C	21.0	C
Westbound								
L	242	1787	0.62	0.64	27.9	C		
T	3107	4883	0.47	0.64	10.9	B	12.5	B
Northbound								
L	385	1570	0.14	0.25	32.6	C		
R	251	1022	0.11	0.25	32.4	C	32.5	C
Southbound								

Intersection Delay = 17.2 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:
Fax:

OPERATIONAL ANALYSIS

Analyst:	NA
Intersection:	Steeles Avenue / Founders Rd
Agency/Co.:	URS Canada Inc.
Area Type:	All other areas
Date Performed:	12/9/2004
Jurisdiction:	City of Toronto
Analysis Time Period:	AM Peak Hour
Analysis Year:	Future Background Conditions
Project ID:	TTC Spadina Station Extension
East/West Street:	Steeles Avenue
North/South Street:	Founders Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		1455	152	148	1440		53		26			
% Heavy Veh		8	7	1	6		15		58			
PHF		0.98	0.98	0.98	0.98		0.98		0.98			
PK 15 Vol		371	39	38	367		14		7			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900		1900	1900		1900		1900			
ParkExist												
NumPark												
No. Lanes	0	3	0		1	3	0	1	0	1	0	0	0
LGConfig		TR			L	T		L		R			
Lane Width		3.6			3.6	3.6		3.6		3.6			
RTOR Vol			0							0			
Adj Flow		1640			151	1469		54		27			
%InSharedLn													
Prop LTs		0.000			1.000	0.000							
Prop RTs		0.095				0.000				1.000			
Peds Bikes		0						0					
Buses		0			0	0		0		0			
%InProtPhase						0.0							

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0		0.0		0.0			
Arriv. Type		3		3	3		3		3			
Unit Ext.		3.0		3.0	3.0		3.0		3.0			
I Factor		1.000			1.000		1.000					
Lost Time		2.0		2.0	2.0		2.0		2.0			
Ext of g		2.0		2.0	2.0		2.0		2.0			
Ped Min g		3.2					3.2			3.2		

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left	A			
Thru		P			Thru				
Right		P			Right	A			
Peds					Peds				
WB Left	P	P			SB Left				
Thru	P	P			Thru				
Right					Right				
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	10.0	57.0				27.0			
Yellow	3.0	4.0				3.0			
All Red	0.0	3.0				3.0			

Cycle Length: 110.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		1455	152	148	1440		53		26			
PHF		0.98	0.98	0.98	0.98		0.98		0.98			
Adj flow		1485	155	151	1469		54		27			
No. Lanes	0	3	0	1	3	0	1	0	1	0	0	0
Lane group		TR		L	T		L		R			
Adj flow		1640		151	1469		54		27			
Prop LTs		0.000		1.000	0.000							
Prop RTs		0.095			0.000				1.000			

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG		TR		L	T		L		R			
So		1900		1900	1900		1900		1900			
Lanes	0	3	0	1	3	0	1	0	1	0	0	0
fW		1.000		1.000	1.000		1.000		1.000			
fHV		0.927		0.990	0.943		0.870		0.633			
fG		1.000		1.000	1.000		1.000		1.000			
fP		1.000		1.000	1.000		1.000		1.000			
fBB		1.000		1.000	1.000		1.000		1.000			
fA		1.000		1.000	1.000		1.000		1.000			
fLU		0.908		1.000	0.908		1.000		1.000			
fRT		0.986			1.000				0.850			
fLT		1.000		0.950	1.000		0.950					
Sec.				0.077								
fLpb		1.000		1.000	1.000		1.000					
fRpb		1.000			1.000				1.000			
S		4728		1787	4883		1570		1022			
Sec.				146								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	1640	4728	# 0.35	0.52	2450	0.67
Right							
Westbound							
Prot		151	1787	# 0.08	0.091	162	0.93
Perm		0	146	0.00	0.545	80	0.00
Left	L	151			0.64	242	0.62
Prot							
Perm							
Thru	T	1469	4883	0.30	0.64	3107	0.47
Right							
Northbound							
Prot							
Perm							
Left	L	54	1570	# 0.03	0.25	385	0.14
Prot							
Perm							
Thru							
Right	R	27	1022	0.03	0.25	251	0.11
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.47
Total lost time per cycle, L = 20.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.57

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay LOS	Approach Delay LOS
Eastbound										
TR	0.67	0.52	19.5	1.000	2450	0.50	1.5	0.0	21.0 C	21.0 C
Westbound										
L	0.62	0.64	16.3	1.000	242	0.50	11.6	0.0	27.9 C	
T	0.47	0.64	10.4	1.000	3107	0.50	0.5	0.0	10.9 B	12.5 B
Northbound										
L	0.14	0.25	32.4	1.000	385	0.11	0.2	0.0	32.6 C	
R	0.11	0.25	32.2	1.000	251	0.11	0.2	0.0	32.4 C	32.5 C
Southbound										

Intersection Delay = 17.2 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach		M		
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)		70.0		
Effective permitted green time for LT lane group, g(s)		60.0		
Opposing effective green time, go (s)		57.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		3		
Adjusted LT flow rate, VLT (veh/h)		151		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		1640		
Lost time for LT lane group, tL		7.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		4.61		
Opposing lane util. factor, fLUo		0.908	0.908	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		18.40		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.48		
gq, (see Exhibit C16-4,5,6,7,8)		26.64		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		33.36		
n=Max(gq-gf)/2,0)		13.32		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		7.19		
EL2=Max((1-Ptho**n)/Plto, 1.0)		0.07		
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.00		
gdiff=max(gq-gf,0)		0.08		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.08		
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.077		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				0.000 0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo				0.908 0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vb1c (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 110.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	151			
v/c ratio from Capacity Worksheet, X	0.62			
Protected phase effective green interval, g (s)	10.0			
Opposing queue effective green interval, gq	26.64			
Unopposed green interval, gu	33.36			
Red time r=(C-g-gq-gu)	40.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.04			
Protected ph. departure rate, Sp=s/3600	0.496			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.07			
XPerm	1.03			
XProt	0.42			
Case	3			
Queue at beginning of green arrow, Qa	1.76			
Queue at beginning of unsaturated green, Qu	1.12			
Residual queue, Qr	0.08			
Uniform Delay, d1	16.3			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Final Queue Delay d3 sec	Initial Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 17.2 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

	Eastbound	Westbound	Northbound	Southbound
LaneGroup	TR	L T	L R	
Init Queue	0.0	0.0 0.0	0.0 0.0	
Flow Rate	602	151 539	54 27	
So	1900	1900 1900	1900 1900	
No.Lanes	3	1 3	1 1	0 0 0
SL	1735	380 1792	1570 1022	
LnCapacity	899	242 1140	385 251	
Flow Ratio	0.35	0.40 0.30	0.03 0.03	
v/c Ratio	0.67	0.62 0.47	0.14 0.11	
Grn Ratio	0.52	0.64 0.64	0.25 0.25	
I Factor	1.000	1.000	1.000	
AT or PVG	3	3 3	3 3	
Pltn Ratio	1.00	1.00 1.00	1.00 1.00	
PF2	1.00	1.00 1.00	1.00 1.00	
Q1	13.6	1.8 0.6	1.3 0.6	
kB	1.2	0.5 1.4	0.4 0.3	
Q2	2.3	0.8 1.3	0.1 0.0	
Q Average	15.9	2.5 9.8	1.4 0.7	
Q Spacing	7.6	7.6 7.6	7.6 7.6	
Q Storage	0	0 0	0 0	
Q S Ratio				
70th Percentile Output:				
fB%	1.2	1.3 1.2	1.2 1.2	
BOQ	19.1	3.2 11.9	1.6 0.8	
QSRatio				
85th Percentile Output:				
fB%	1.4	1.6 1.4	1.6 1.6	
BOQ	22.5	4.0 14.2	2.2 1.1	
QSRatio				
90th Percentile Output:				
fB%	1.5	1.8 1.6	1.8 1.8	
BOQ	24.2	4.6 15.4	2.4 1.2	
QSRatio				
95th Percentile Output:				
fB%	1.6	2.2 1.7	2.1 2.1	
BOQ	26.1	5.6 17.1	2.8 1.4	
QSRatio				
98th Percentile Output:				
fB%	1.8	2.6 1.9	2.6 2.6	
BOQ	28.0	6.6 18.8	3.5 1.8	
QSRatio				

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: AM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Steeles Avenue

Inter.: Sessions Avenue / Keele St
Area Type: All other areas
Jurisd: City of Toronto
Year: Future Background Conditions
N/S St: Keele Street

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes		1	3	1		1	3	0		1	2	1
LGConfig	L	T	R	L	TR		L	T	R	L	T	R
Volume	165	1409	81	168	1456	239	68	668	137	256	1282	170
Lane Width	3.6	3.6	3.6	3.6	3.6		3.6	3.6	3.6	3.6	3.6	3.6
RTOR Vol			0			40			0			0
Duration	0.25	Area Type: All other areas										
Signal Operations												
Phase Combination	1	2	3	4			5	6	7	8		
EB Left		A			NB Left		P			P		
Thru			P		Thru					P		
Right			P		Right					P		
Peds					Peds							
WB Left		A			SB Left		P		P		P	
Thru			P		Thru				P		P	
Right			P		Right				P		P	
Peds					Peds							
NB Right					EB Right							
SB Right					WB Right							
Green		7.0	36.0					6.0	5.0	34.0		
Yellow		3.0	4.0					2.0	2.0	4.0		
All Red		1.0	2.0					2.0	0.0	2.0		

Cycle Length: 110.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	163	1543	1.03	0.43	105.7	F		
T	1598	4883	0.90	0.33	43.8	D	49.1	D
R	489	1495	0.17	0.33	27.1	C		
Westbound								
L	168	1612	1.02	0.43	111.2	F		
TR	1587	4848	1.06	0.33	78.9	E	81.9	F
Northbound								
L	148	1530	0.47	0.36	36.8	D		
T	1017	3289	0.67	0.31	36.6	D	35.7	D
R	475	1538	0.29	0.31	30.5	C		
Southbound								
L	330	1641	0.79	0.46	38.9	D		
T	1249	3350	1.05	0.37	73.3	E	63.5	E
R	489	1313	0.35	0.37	26.0	C		

Intersection Delay = 61.1 (sec/veh) Intersection LOS = E

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst:	NA
Intersection:	Steeles Avenue / Keele St
Agency/Co.:	URS Canada Inc.
Area Type:	All other areas
Date Performed:	12/9/2004
Jurisdiction:	City of Toronto
Analysis Time Period:	AM Peak Hour
Analysis Year:	Future Background Conditions
Project ID:	TTC Spadina Station Extension
East/West Street:	North/South Street
Steeles Avenue	Keele Street

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	165	1409	81	168	1456	239	68	668	137	256	1282	170
% Heavy Veh	17	6	8	12	4	11	18	10	5	10	8	23
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	42	359	21	43	371	61	17	170	35	65	327	43
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900	1900	1900	1900		1900	1900	1900	1900	1900	1900
ParkExist												
NumPark												
No. Lanes		1	3	1		1	3	0		1	2	1
LGConfig	L		T	R	L	TR			L	T	R	
Lane Width	3.6	3.6	3.6	3.6	3.6		3.6	3.6	3.6	3.6	3.6	3.6
RTOR Vol			0			40			0			0
Adj Flow	168	1438	83	171	1689		69	682	140	261	1308	173
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.120			0.000	1.000		0.000	1.000
Peds	Bikes	0			0			0			0	
Buses	0	0	0	0	0		0	0	0	0	0	0
%InProtPhase	0.0			0.0			0.0			0.0		
Duration	0.25	Area Type: All other areas										

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Arriv. Type	3	3	3	3	3		3	3	3	3	3	3
Unit Ext.	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0
Ext of g	2.0	2.0	2.0	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left		A		P	NB Left	P		P	
Thru				P	Thru			P	
Right				P	Right			P	
Peds					Peds				
WB Left		A		P	SB Left	P	P	P	
Thru				P	Thru		P	P	
Right				P	Right		P	P	
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green		7.0	36.0			6.0	5.0	34.0	
Yellow		3.0	4.0			2.0	2.0	4.0	
All Red		1.0	2.0			2.0	0.0	2.0	

Cycle Length: 110.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	165	1409	81	168	1456	239	68	668	137	256	1282	170
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	168	1438	83	171	1486	203	69	682	140	261	1308	173
No. Lanes	1	3	1	1	3	0	1	2	1	1	2	1
Lane group	L	T	R	L	TR		L	T	R	L	T	R
Adj flow	168	1438	83	171	1689		69	682	140	261	1308	173
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.120			0.000	1.000		0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound						Westbound						Northbound						Southbound					
LG	L		T		R		L		T		R		L		T		R		L		T		R	
So	1900		1900		1900		1900		1900				1900		1900		1900		1900		1900		1900	
Lanes	1		3		1		1		3		0		1		2		1		1		2		1	
fW	1.000		1.000		1.000		1.000		1.000				1.000		1.000		1.000		1.000		1.000		1.000	
fHV	0.855		0.943		0.926		0.893		0.954				0.847		0.909		0.952		0.909		0.926		0.813	
fG	1.000		1.000		1.000		1.000		1.000				1.000		1.000		1.000		1.000		1.000		1.000	
fP	1.000		1.000		1.000		1.000		1.000				1.000		1.000		1.000		1.000		1.000		1.000	
fBB	1.000		1.000		1.000		1.000		1.000				1.000		1.000		1.000		1.000		1.000		1.000	
fA	1.000		1.000		1.000		1.000		1.000				1.000		1.000		1.000		1.000		1.000		1.000	
fLU	1.000		0.908		1.000		1.000		0.908				1.000		0.952		1.000		1.000		0.952		1.000	
fRT			1.000		0.850				0.982						1.000		0.850				1.000		0.850	
fLT	0.950		1.000				0.950		1.000				0.950		1.000				0.950		1.000			
Sec.	0.100						0.100						0.118						0.187					
fLpb	1.000		1.000				1.000		1.000				1.000		1.000				1.000		1.000			
fRpb			1.000		1.000				1.000						1.000		1.000				1.000		1.000	
S	1543		4883		1495		1612		4848				1530		3289		1538		1641		3350		1313	
Sec.	162						170						189						323					

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		98	1543	0.06	0.064	98	1.00
Perm		70	162	# 0.43	0.364	65	1.08
Left	L	168			0.43	163	1.03
Prot							
Perm							
Thru	T	1438	4883	0.29	0.33	1598	0.90
Right	R	83	1495	0.06	0.33	489	0.17
Westbound							
Prot		103	1612	# 0.06	0.064	103	1.00
Perm		68	170	0.40	0.364	65	1.05
Left	L	171			0.43	168	1.02
Prot							
Perm							
Thru	TR	1689	4848	0.33	0.33	1587	1.06
Right							
Northbound							
Prot		69	1530	# 0.05	0.055	83	0.83
Perm		0	189	0.00	0.309	65	0.00
Left	L	69			0.36	148	0.47
Prot							
Perm							
Thru	T	682	3289	0.21	0.31	1017	0.67
Right	R	140	1538	0.09	0.31	475	0.29
Southbound							
Prot		224	1641	0.14	0.136	224	1.00
Perm		37	323	0.11	0.327	106	0.35
Left	L	261			0.46	330	0.79
Prot							
Perm							
Thru	T	1308	3350	# 0.37	0.37	1249	1.05
Right	R	173	1313	0.13	0.37	489	0.35

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.91
Total lost time per cycle, L = 22.00 Sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.14

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Adj Fact	Prog Cap	Lane Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	1.03	0.43	26.9	1.000	163	0.50	78.8	0.0	105.7	F		
T	0.90	0.33	35.3	1.000	1598	0.50	8.5	0.0	43.8	D	49.1	D
R	0.17	0.33	26.4	1.000	489	0.50	0.8	0.0	27.1	C		
Westbound												
L	1.02	0.43	37.0	1.000	168	0.50	74.2	0.0	111.2	F		
TR	1.06	0.33	37.0	1.000	1587	0.50	41.9	0.0	78.9	E	81.9	F
Northbound												
L	0.47	0.36	26.6	1.000	148	0.50	10.2	0.0	36.8	D		
T	0.67	0.31	33.1	1.000	1017	0.50	3.5	0.0	36.6	D	35.7	D
R	0.29	0.31	28.9	1.000	475	0.50	1.6	0.0	30.5	C		
Southbound												
L	0.79	0.46	21.4	1.000	330	0.50	17.4	0.0	38.9	D		
T	1.05	0.37	34.5	1.000	1249	0.50	38.8	0.0	73.3	E	63.5	E
R	0.35	0.37	24.9	1.000	489	0.50	2.0	0.0	26.9	C		

Intersection Delay = 61.1 (sec/veh) Intersection LOS = E

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)	47.0	47.0	40.0	51.0
Effective permitted green time for LT lane group, g(s)	40.0	40.0	34.0	36.0
Opposing effective green time, go (s)	36.0	36.0	41.0	34.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	3	3	2	2
Adjusted LT flow rate, VLT (veh/h)	168	171	69	261
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	1689	1438	1308	682
Lost time for LT lane group, tL	6.00	6.00	10.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600	5.13	5.22	2.11	7.98
Opposing lane util. factor, fLUo	0.908	0.908	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	18.95	16.13	20.99	10.94
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.67	0.67	0.63	0.69
gq, (see Exhibit C16-4,5,6,7,8)	36.00	30.71	25.59	18.88
gu=g-gq if gq>=gf, or = g-gf if gq<gf	4.00	9.29	8.41	17.12
n=Max(gq-gf)/2,0)	18.00	15.35	12.79	9.44
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	7.58	5.79	4.74	2.55
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.10	0.10	0.12	0.11
gdiff=max(gq-gf, 0)	1.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.10	0.10	0.12	0.19
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.100	0.100	0.118	0.187

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.908	0.908	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 110.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	168	171	69	261
v/c ratio from Capacity Worksheet, X	1.03	1.02	0.47	0.79
Protected phase effective green interval, g (s)	7.0	7.0	6.0	15.0
Opposing queue effective green interval, gq	36.00	30.71	25.59	18.88
Unopposed green interval, gu	4.00	9.29	8.41	17.12
Red time r=(C-g-gq-gu)	63.0	63.0	70.0	59.0
Arrival rate, qa=v/(3600(max[X,1.0]))	0.05	0.05	0.02	0.07
Protected ph. departure rate, Sp=s/3600	0.429	0.448	0.425	0.456
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.45	0.20	0.21	0.19
XPerm	1.01	0.99	0.37	0.81
XProt	1.06	1.04	0.57	0.78
Case	3	2	1	1
Queue at beginning of green arrow, Qa	2.86	2.94	1.34	4.28
Queue at beginning of unsaturated green, Qu	1.63	3.28	0.49	1.37
Residual queue, Qr	0.01	0.13	0.00	0.00
Uniform Delay, d1	26.9	37.0	26.6	21.4

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 61.1 sec/veh Intersection LOS E

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	T	R	L	TR		L	T	R	L	T	R
Init Queue	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	168	527	83	171	620		69	358	140	261	686	173
So	1900	1900	1900	1900	1900		1900	1900	1900	1900	1900	1900
No.Lanes	1	3	1	1	3	0	1	2	1	1	2	1
SL	368	1792	1495	385	1779		390	1727	1538	711	1759	1313
LnCapacity	163	586	489	168	582		148	534	475	330	655	489
Flow Ratio	0.46	0.29	0.06	0.44	0.35		0.18	0.21	0.09	0.37	0.39	0.13
v/c Ratio	1.03	0.90	0.17	1.02	1.07		0.47	0.67	0.29	0.79	1.05	0.35
Grn Ratio	0.43	0.33	0.33	0.43	0.33		0.36	0.31	0.31	0.46	0.37	0.37
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3	3	3	3		3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Q1	3.1	15.4	1.8	3.2	18.9		1.4	9.5	3.3	4.8	21.0	3.8
KB	0.3	0.9	0.8	0.3	0.9		0.3	0.8	0.8	0.6	1.0	0.8
Q2	2.7	4.9	0.2	2.6	11.1		0.3	1.6	0.3	1.9	11.3	0.4
Q Average	5.8	20.2	2.0	5.8	30.0		1.7	11.1	3.6	6.7	32.3	4.3
Q Spacing	7.6	7.6	7.6	7.6	7.6		7.6	7.6	7.6	7.6	7.6	7.6
Q Storage	0	0	0	0	0		0	0	0	0	0	0
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2	1.3	1.2	1.2		1.3	1.2	1.2	1.2	1.2	1.2
BOQ	6.9	24.3	2.5	6.8	36.0		2.1	13.5	4.5	8.2	38.7	5.3
QSRatio												
85th Percentile Output:												
fB%	1.5	1.4	1.6	1.5	1.4		1.6	1.4	1.5	1.5	1.4	1.5
BOQ	9.0	28.4	3.2	8.9	42.0		2.7	16.0	5.5	9.9	45.2	6.5
QSRatio												
90th Percentile Output:												
fB%	1.7	1.5	1.8	1.7	1.5		1.9	1.6	1.7	1.6	1.5	1.7
BOQ	9.8	30.5	3.6	9.8	45.0		3.1	17.3	6.2	10.9	48.4	7.3
QSRatio												
95th Percentile Output:												
fB%	1.9	1.6	2.3	1.9	1.6		2.3	1.7	2.1	1.9	1.6	2.0
BOQ	11.2	32.7	4.5	11.2	48.1		3.8	19.0	7.5	12.4	51.7	8.6
QSRatio												
98th Percentile Output:												
fB%	2.3	1.7	2.7	2.3	1.7		2.8	1.9	2.4	2.1	1.7	2.3
BOQ	13.6	34.9	5.3	13.5	51.1		4.6	20.7	8.7	14.0	54.9	10.0
QSRatio												

ERROR MESSAGES

No errors to report.

Steeles West Station - Future Background Traffic Conditions

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: PM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Steeles Avenue

Inter.: Sessions Avenue / Jane Street
Area Type: All other areas
Jurisd: City of Toronto
Year: Future Background Conditions
N/S St: Jane Street

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	0	1	2	1	1	2	1	1	2	1
LGConfig	L	TR		L	T	R	L	T	R	L	T	R
Volume	244	1186	123	235	1335	344	168	862	196	300	1023	447
Lane Width	3.6	3.6		3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
RTOR Vol			0			0			0			120

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left		P			NB Left	P		P	
Thru		P			Thru			P	
Right		P			Right			P	
Peds					Peds				
WB Left		P			SB Left	P	P		
Thru		P			Thru		P	P	
Right		P			Right		P	P	
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green		11.0	45.0			8.0	5.0	27.0	
Yellow		2.0	4.0			2.0	2.0	4.0	
All Red		2.0	3.0			2.0	0.0	3.0	

Cycle Length: 120.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	218	1719	1.14	0.50	140.4	F		
TR	1221	3256	1.09	0.38	93.0	F	100.4	F
Westbound								
L	228	1805	1.05	0.50	109.9	F		
T	1200	3201	1.13	0.38	109.0	F	95.7	F
R	594	1583	0.59	0.38	34.4	C		
Northbound								
L	177	1736	0.97	0.29	102.7	F		
T	768	3413	1.15	0.22	127.1	F	111.1	F
R	349	1553	0.57	0.22	48.1	D		
Southbound								
L	307	1736	1.00	0.38	85.2	F		
T	985	3478	1.06	0.28	88.9	F	81.2	F
R	424	1495	0.79	0.28	53.4	D		

Intersection Delay = 96.1 (sec/veh) Intersection LOS = F

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:
Fax:

OPERATIONAL ANALYSIS

Analyst: NA
Intersection: Steeles Avenue / Jane Street
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: PM Peak Hour
Analysis Year: Future Background Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Steeles Avenue
North/South Street: Jane Street

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	244	1186	123	235	1335	344	168	862	196	300	1023	447
% Heavy Veh	5	10	5	0	13	2	4	6	4	4	4	8
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	62	303	31	60	341	88	43	220	50	77	261	114
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900	1900	1900	1900	1900	1900	1900	1900
ParkExist												
NumPark												
No. Lanes	1	2	0	1	2	1	1	2	1	1	2	1
LGConfig	L	TR		L	T	R	L	T	R	L	T	R
Lane Width	3.6	3.6		3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
RTOR Vol			0			0			0			120
Adj Flow	249	1336		240	1362	351	171	880	200	306	1044	334
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.094			0.000	1.000		0.000	1.000		0.000	1.000
Peds	Bikes	0			0			0			0	
Buses	0	0		0	0	0	0	0	0	0	0	0
%InProtPhase	0.0			0.0			0.0			0.0		

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Arriv. Type	3	3		3	3	3	3	3	3	3	3	3
Unit Ext.	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Ext of g	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left		P			NB Left	P		P	
Thru		P			Thru			P	
Right		P			Right			P	
Peds					Peds				
WB Left		P			SB Left	P	P	P	
Thru		P			Thru		P	P	
Right		P			Right		P	P	
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green		11.0	45.0			8.0	5.0	27.0	
Yellow		2.0	4.0			2.0	2.0	4.0	
All Red		2.0	3.0			2.0	0.0	3.0	

Cycle Length: 120.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	244	1186	123	235	1335	344	168	862	196	300	1023	447
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	249	1210	126	240	1362	351	171	880	200	306	1044	334
No. Lanes	1	2	0	1	2	1	1	2	1	1	2	1
Lane group	L	TR		L	T	R	L	T	R	L	T	R
Adj flow	249	1336		240	1362	351	171	880	200	306	1044	334
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs	0.094			0.000	1.000		0.000	1.000		0.000	1.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	TR		L	T	R	L	T	R	L	T	R
So	1900	1900		1900	1900	1900	1900	1900	1900	1900	1900	1900
Lanes	1	2	0	1	2	1	1	2	1	1	2	1
fW	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fHV	0.952	0.913		1.000	0.885	0.980	0.962	0.943	0.962	0.962	0.962	0.926
fG	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fP	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fBB	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fA	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fLU	1.000	0.952		1.000	0.952	1.000	1.000	0.952	1.000	1.000	0.952	1.000
fRT		0.986			1.000	0.850		1.000	0.850		1.000	0.850
fLT	0.950	1.000		0.950	1.000		0.950	1.000		0.950	1.000	
Sec.	0.082			0.082			0.148			0.138		
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000			1.000	1.000		1.000	1.000		1.000	1.000
S	1719	3256		1805	3201	1583	1736	3413	1553	1736	3478	1495
Sec.	148			155			271			252		

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		158	1719	# 0.09	0.092	158	1.00
Perm		91	148	# 0.61	0.408	60	1.52
Left	L	249			0.50	218	1.14
Prot							
Perm							
Thru	TR	1336	3256	0.38	0.38	1221	1.09
Right							
Westbound							
Prot		165	1805	0.09	0.092	165	1.00
Perm		75	155	0.48	0.408	63	1.19
Left	L	240			0.50	228	1.05
Prot							
Perm							
Thru	T	1362	3201	0.37	0.38	1200	1.13
Right	R	351	1583	0.22	0.38	594	0.59
Northbound							
Prot		116	1736	0.07	0.067	116	1.00
Perm		55	271	0.20	0.225	61	0.90
Left	L	171			0.29	177	0.97
Prot							
Perm							
Thru	T	880	3413	0.23	0.22	768	1.15
Right	R	200	1553	0.13	0.22	349	0.57
Southbound							
Prot		246	1736	# 0.14	0.142	246	1.00
Perm		68	252	# 0.24	0.242	61	0.98
Left	L	306			0.38	307	1.00
Prot							
Perm							
Thru	T	1044	3478	0.28	0.28	985	1.06
Right	R	334	1495	0.22	0.28	424	0.79

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 1.09
Total lost time per cycle, L = 14.00 Sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.23

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	1.14	0.50	35.8	1.000	218	0.50	104.6	0.0	140.4	F		
TR	1.09	0.38	37.5	1.000	1221	0.50	55.5	0.0	93.0	F	100.4	F
Westbound												
L	1.05	0.50	35.7	1.000	228	0.50	74.1	0.0	109.9	F		
T	1.13	0.38	37.5	1.000	1200	0.50	71.5	0.0	109.0	F	95.7	F
R	0.59	0.38	30.1	1.000	594	0.50	4.3	0.0	34.4	C		
Northbound												
L	0.97	0.29	43.4	1.000	177	0.50	59.3	0.0	102.7	F		
T	1.15	0.22	46.5	1.000	768	0.50	80.6	0.0	127.1	F	111.1	F
R	0.57	0.22	41.4	1.000	349	0.50	6.7	0.0	48.1	D		
Southbound												
L	1.00	0.38	34.7	1.000	307	0.50	50.6	0.0	85.2	F		
T	1.06	0.28	43.0	1.000	985	0.50	45.9	0.0	88.9	F	81.2	F
R	0.79	0.28	39.7	1.000	424	0.50	13.8	0.0	53.4	D		

Intersection Delay = 96.1 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)	60.0	60.0	35.0	46.0
Effective permitted green time for LT lane group, g(s)	49.0	49.0	27.0	29.0
Opposing effective green time, go (s)	45.0	45.0	34.0	27.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	2	2	2	2
Adjusted LT flow rate, VLT (veh/h)	249	240	171	306
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	1362	1336	1044	880
Lost time for LT lane group, tL	7.00	7.00	11.00	7.00
Computation				
LT volume per cycle, LTC=VLTC/3600	8.30	8.00	5.70	10.20
Opposing lane util. factor, fLUo	0.952	0.952	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	23.84	23.39	18.28	15.41
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.63	0.63	0.72	0.77
gq, (see Exhibit C16-4,5,6,7,8)	45.00	45.00	19.67	25.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	4.00	4.00	7.33	4.00
n=Max(gq-gf)/2,0)	20.50	22.50	9.84	12.50
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	5.00	4.87	3.64	3.09
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.08	0.08	0.15	0.14
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.08	0.08	0.15	0.14
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.082	0.082	0.148	0.138

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 120.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	249	240	171	306
v/c ratio from Capacity Worksheet, X	1.14	1.05	0.97	1.00
Protected phase effective green interval, g (s)	11.0	11.0	8.0	17.0
Opposing queue effective green interval, gq	45.00	45.00	19.67	25.00
Unopposed green interval, gu	4.00	4.00	7.33	4.00
Red time r=(C-g-gq-gu)	60.0	60.0	85.0	74.0
Arrival rate, qa=v/(3600(max[X,1.0]))	0.06	0.06	0.05	0.09
Protected ph. departure rate, Sp=s/3600	0.478	0.501	0.482	0.482
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.50	0.53	0.28	0.51
XPerm	1.47	1.47	0.63	1.21
XProt	0.82	0.82	1.15	0.94
Case	3	3	2	3
Queue at beginning of green arrow, Qa	4.59	4.79	4.04	6.72
Queue at beginning of unsaturated green, Qu	2.73	2.85	3.13	2.13
Residual queue, Qr	0.95	0.99	0.56	0.44
Uniform Delay, d1	35.8	35.7	43.4	34.7

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 96.1 sec/veh Intersection LOS F

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	TR		L	T	R	L	T	R	L	T	R
Init Queue	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	249	701		240	715	351	171	462	200	306	548	334
So	1900	1900		1900	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	2	0	1	2	1	1	2	1	1	2	1
SL	436	1710		468	1681	1583	606	1792	1553	800	1826	1495
LnCapacity	218	641		228	630	594	177	403	349	307	517	424
Flow Ratio	0.57	0.41		0.52	0.43	0.22	0.28	0.26	0.13	0.38	0.30	0.22
v/c Ratio	1.14	1.09		1.05	1.13	0.59	0.97	1.15	0.57	1.00	1.06	0.79
Grn Ratio	0.50	0.38		0.50	0.38	0.38	0.29	0.22	0.22	0.38	0.28	0.28
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3		3	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	4.6	23.4		4.4	23.8	9.4	4.3	15.4	5.9	7.3	18.3	10.3
KB	0.5	1.0		0.5	1.0	1.0	0.4	0.7	0.7	0.6	0.9	0.8
Q2	6.3	13.9		4.7	16.2	1.3	2.6	11.2	0.9	4.8	9.9	2.4
Q Average	10.8	37.3		9.1	40.0	10.7	6.9	26.6	6.8	12.1	28.2	12.6
Q Spacing	7.6	7.6		7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Q Storage	0	0		0	0	0	0	0	0	0	0	0
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2		1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
BOQ	13.1	44.8		11.1	48.0	13.0	8.5	31.9	8.3	14.6	33.9	15.2
QSRatio												
85th Percentile Output:												
fB%	1.4	1.4		1.4	1.4	1.4	1.5	1.4	1.5	1.4	1.4	1.4
BOQ	15.5	52.2		13.2	56.1	15.4	10.2	37.3	10.0	17.3	39.5	18.0
QSRatio												
90th Percentile Output:												
fB%	1.6	1.5		1.6	1.5	1.6	1.6	1.5	1.6	1.5	1.5	1.5
BOQ	16.9	56.0		14.4	60.1	16.7	11.3	40.0	11.1	18.7	42.4	19.4
QSRatio												
95th Percentile Output:												
fB%	1.7	1.6		1.8	1.6	1.7	1.8	1.6	1.9	1.7	1.6	1.7
BOQ	18.6	59.7		16.0	64.1	18.4	12.8	42.7	12.6	20.4	45.2	21.2
QSRatio												
98th Percentile Output:												
fB%	1.9	1.7		1.9	1.7	1.9	2.1	1.7	2.1	1.8	1.7	1.8
BOQ	20.3	63.4		17.7	68.1	20.1	14.4	45.4	14.2	22.2	48.1	23.0
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: PM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Steeles Avenue

Inter.: Steeles Ave / MurrayRoss Pkwy
Area Type: All other areas
Jurisd: City of Toronto
Year: Future Bacground Conditions
N/S St: Murray Ross Parkway

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes		1	3	1		1	3	0		1	1	0
LGConfig		T		R		L	TR			L	TR	
Volume		17	1535	153		161	1961	2		322	3	92
Lane Width		3.6	3.6	3.6		3.6	3.6			3.6	3.6	
RTOR Vol				0				0				0

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes		0	2	0		1	3	0		1	2	0
LGConfig		LTR				L	TR			L	T	R
Volume		10	2	12		17	1566	156		164	2003	
Lane Width		3.6				3.6	3.6			3.6	3.6	
RTOR Vol				0				0				0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8		
EB Left		P			NB Left	A					
Thru		P			Thru	A					
Right		P			Right	A					
Peds					Peds						
WB Left	P	P			SB Left	A					
Thru	P	P			Thru	A					
Right	P	P			Right	A					
Peds					Peds						
NB Right					EB Right						
SB Right					WB Right						
Green	13.0	52.0				39.0					
Yellow	2.0	4.0				4.0					
All Red	0.0	3.0				3.0					

Cycle Length: 120.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	63	146	0.27	0.43	32.1	C		
T	2116	4883	0.74	0.43	30.7	C	30.0	C
R	693	1599	0.23	0.43	22.1	C		
Westbound								
L	257	1787	0.64	0.56	36.4	D		
TR	2726	4882	0.73	0.56	21.6	C	22.8	C
Northbound								
L	453	1394	0.73	0.32	41.6	D		
TR	528	1624	0.18	0.32	29.2	C	38.8	D
Southbound								
LTR	914	2812	0.03	0.32	27.6	C	27.6	C

Intersection Delay = 27.2 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:
Fax:

OPERATIONAL ANALYSIS

Analyst: NA
Intersection: Steeles Ave / MurrayRoss Pkwy
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: PM Peak Hour
Analysis Year: Future Bacground Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Steeles Avenue
North/South Street: Murray Ross Parkway

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	17	1535	153	161	1961	2	322	3	92	10	2	12
% Heavy Veh	0	6	1	1	6	0	1	0	0	0	50	0
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	5	392	39	41	500	1	82	1	23	3	1	3
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900	1900	1900	1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes		1	3	1		1	3	0		1	1	0
LGConfig		L	T	R		L	TR			L	TR	
Lane Width	3.6	3.6	3.6	3.6	3.6		3.6	3.6			3.6	
RTOR Vol			0			0			0			0
Adj Flow	17	1566	156	164	2003		329	97			24	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000			0.417	
Prop RTs		0.000	1.000		0.001			0.969		0.500		
Peds Bikes	0			0			0			0		
Buses	0	0	0	0	0		0	0			0	
%InProtPhase				0.0								
Duration 0.25	Area Type: All other areas											

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0		0.0	0.0			0.0	
Arriv. Type	3	3	3	3	3		3	3			3	
Unit Ext.	3.0	3.0	3.0	3.0	3.0		3.0	3.0			3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0		2.0	2.0			2.0	
Ext of g	2.0	2.0	2.0	2.0	2.0		2.0	2.0			2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8		
EB Left		P			NB Left	A					
Thru		P			Thru	A					
Right		P			Right	A					
Peds					Peds						
WB Left	P	P			SB Left	A					
Thru	P	P			Thru	A					
Right	P	P			Right	A					
Peds					Peds						
NB Right					EB Right						
SB Right					WB Right						
Green	13.0	52.0				39.0					
Yellow	2.0	4.0				4.0					
All Red	0.0	3.0				3.0					

Cycle Length: 120.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		17	1535	153		161	1961	2		322	3	92
PHF		0.98	0.98	0.98		0.98	0.98	0.98		0.98	0.98	0.98
Adj flow		17	1566	156		164	2001	2		329	3	94
No. Lanes		1	3	1		1	3	0		1	1	0
Lane group		L	T	R		L	TR			L	TR	
Adj flow		17	1566	156		164	2003			329	97	
Prop LTs		1.000	0.000			1.000	0.000			1.000	0.000	
Prop RTs		0.000	1.000			0.001				0.969		

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		10	2	12								
PHF		0.98	0.98	0.98								
Adj flow		10	2	12								
No. Lanes		0	2	0								
Lane group			LTR									
Adj flow			24									
Prop LTs			0.417									
Prop RTs		0.500										

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound					Westbound					Northbound					Southbound				
LG	L	T		R		L	T		R		L	T		R		L	T		R	
So	1900	1900	1900	1900	1900						1900	1900							1900	
Lanes	1	3		1	3	0					1		0	0	2	0				
fW	1.000	1.000	1.000	1.000	1.000						1.000	1.000							1.000	
fHV	1.000	0.943	0.990	0.990	0.943						0.990	1.000							0.960	
fG	1.000	1.000	1.000	1.000	1.000						1.000	1.000							1.000	
fP	1.000	1.000	1.000	1.000	1.000						1.000	1.000							1.000	
fBB	1.000	1.000	1.000	1.000	1.000						1.000	1.000							1.000	
fA	1.000	1.000	1.000	1.000	1.000						1.000	1.000							1.000	
fLU	1.000	0.908	1.000	1.000	0.908						1.000	1.000							0.952	
fRT			1.000	0.850				1.000					0.855						0.925	
fLT	0.077	1.000			0.950	1.000			0.741	1.000									0.875	
Sec.					0.074															
fLpb	1.000	1.000			1.000	1.000			1.000	1.000									1.000	
fRpb		1.000	1.000			1.000				1.000									1.000	
S	146	4883	1599		1787	4882			1394	1624									2812	
Sec.					139															

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	17	146	0.12	0.43	63	0.27
Prot							
Perm							
Thru	T	1566	4883	# 0.32	0.43	2116	0.74
Right	R	156	1599	0.10	0.43	693	0.23
Westbound							
Prot		164	1787	# 0.09	0.108	194	0.85
Perm		0	139	0.00	0.450	63	0.00
Left	L	164			0.56	257	0.64
Prot							
Perm							
Thru	TR	2003	4882	0.41	0.56	2726	0.73
Right							
Northbound							
Prot							
Perm							
Left	L	329	1394	# 0.24	0.32	453	0.73
Prot							
Perm							
Thru	TR	97	1624	0.06	0.32	528	0.18
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	24	2812	0.01	0.32	914	0.03
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.65
Total lost time per cycle, L = 21.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.79

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Adj Fact	Prog Cap	Lane Factor	Incremental Del k	Res Del d2	Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound													
L	0.27	0.43	21.8	1.000	63	0.50	10.2	0.0	32.1	C			
T	0.74	0.43	28.4	1.000	2116	0.50	2.4	0.0	30.7	C	30.0	C	
R	0.23	0.43	21.3	1.000	693	0.50	0.8	0.0	22.1	C			
Westbound													
L	0.64	0.56	24.9	1.000	257	0.50	11.5	0.0	36.4	D			
TR	0.73	0.56	19.8	1.000	2726	0.50	1.8	0.0	21.6	C	22.8	C	
Northbound													
L	0.73	0.32	35.8	1.000	453	0.29	5.8	0.0	41.6	D			
TR	0.18	0.32	29.1	1.000	528	0.11	0.2	0.0	29.2	C	38.8	D	
Southbound													
LTR	0.03	0.32	27.6	1.000	914	0.11	0.0	0.0	27.6	C	27.6	C	

Intersection Delay = 27.2 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)	52.0	67.0	39.0	
Effective permitted green time for LT lane group, g(s)	52.0	54.0	39.0	
Opposing effective green time, go (s)	67.0	52.0	39.0	
Number of lanes in LT lane group, N	1	1	1	
Number of lanes in opposing approach, No	3	3	2	
Adjusted LT flow rate, VLT (veh/h)	17	164	329	
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.42	
Adjusted opposing flow rate, Vo (veh/h)	2003	1566	24	
Lost time for LT lane group, tL	7.00	7.00	7.00	
Computation				
LT volume per cycle, LTC=VLTC/3600	0.57	5.47	10.97	
Opposing lane util. factor, fLUo	0.908	0.908	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	24.51	19.16	0.42	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.44	0.57	0.68	
gq, (see Exhibit C16-4,5,6,7,8)	14.60	31.91	0.00	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	37.40	22.09	39.00	
n=Max(gq-gf)/2,0)	7.30	15.95	0.00	
PTHo=1-PLTo	1.00	1.00	0.58	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	
EL1 (refer to Exhibit C16-3)	10.64	6.64	1.35	
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.08	0.07	0.10	
gdiff=max(gq-gf,0)	0.00	0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.08	0.07	0.74	
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.077	0.074	0.741	

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				M
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)				39.0
Effective permitted green time for LT lane group, g(s)				39.0
Opposing effective green time, go (s)				39.0
Number of lanes in LT lane group, N				2
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				10
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.417
Proportion of LT in opposing flow, PLTo				0.00
Adjusted opposing flow rate, Vo (veh/h)				97
Lost time for LT lane group, tL				7.00
Computation				
LT volume per cycle, LTC=VLTC/3600				0.33
Opposing lane util. factor, fLUo	0.908	0.908	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				3.23
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				19.1
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.68
gq, (see Exhibit C16-4,5,6,7,8)				0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf				19.89
n=Max(gq-gf)/2,0)				0.00
PTHo=1-PLTo				1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				0.86
EL1 (refer to Exhibit C16-3)				1.52
EL2=Max((1-Ptho**n)/Plto, 1.0)				1.000
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				0.10
gdiff=max(gq-gf,0)				0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.84
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.875

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 120.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	164			
v/c ratio from Capacity Worksheet, X	0.64			
Protected phase effective green interval, g (s)	13.0			
Opposing queue effective green interval, gq	31.91			
Unopposed green interval, gu	22.09			
Red time r=(C-g-gq-gu)	53.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.05			
Protected ph. departure rate, Sp=s/3600	0.496			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.09			
XPerm	1.18			
XProt	0.47			
Case	3			
Queue at beginning of green arrow, Qa	2.79			
Queue at beginning of unsaturated green, Qu	1.45			
Residual queue, Qr	0.38			
Uniform Delay, d1	24.9			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Final Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 27.2 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	T	R	L	TR		L	TR			LTR	
Init Queue	0.0	0.0	0.0	0.0	0.0		0.0	0.0			0.0	
Flow Rate	17	574	156	164	735		329	97			12	
So	1900	1900	1900	1900	1900		1900	1900			1900	
No.Lanes	1	3	1	1	3	0	1	1	0	0	2	0
SL	146	1792	1599	459	1792		1394	1624			1476	
LnCapacity	63	776	693	257	1000		453	528			480	
Flow Ratio	0.12	0.32	0.10	0.36	0.41		0.24	0.06			0.01	
v/c Ratio	0.27	0.74	0.23	0.64	0.74		0.73	0.18			0.03	
Grn Ratio	0.43	0.43	0.43	0.56	0.56		0.32	0.32			0.32	
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3	3	3	3		3	3			3	
Pltn Ratio	1.00	1.00	1.00	1.00	1.00		1.00	1.00			1.00	
PF2	1.00	1.00	1.00	1.00	1.00		1.00	1.00			1.00	
Q1	0.4	16.0	3.3	2.6	18.4		9.7	2.3			0.3	
kB	0.2	1.2	1.1	0.5	1.4		0.5	0.6			0.5	
Q2	0.1	3.0	0.3	0.9	3.5		1.3	0.1			0.0	
Q Average	0.4	18.9	3.6	3.5	21.9		10.9	2.4			0.3	
Q Spacing	7.6	7.6	7.6	7.6	7.6		7.6	7.6			7.6	
Q Storage	0	0	0	0	0		0	0			0	
Q S Ratio												
70th Percentile Output:												
fB%	1.3	1.2	1.2	1.2	1.2		1.2	1.2			1.2	
BOQ	0.6	22.8	4.5	4.3	26.3		12.9	2.9			0.3	
QSRatio												
85th Percentile Output:												
fB%	1.7	1.4	1.5	1.5	1.4		1.5	1.6			1.6	
BOQ	0.7	26.6	5.5	5.4	30.7		16.5	3.9			0.5	
QSRatio												
90th Percentile Output:												
fB%	2.0	1.5	1.7	1.7	1.5		1.6	1.8			1.8	
BOQ	0.9	28.6	6.2	6.1	32.9		17.9	4.3			0.5	
QSRatio												
95th Percentile Output:												
fB%	2.5	1.6	2.1	2.1	1.6		1.8	2.0			2.1	
BOQ	1.1	30.7	7.5	7.3	35.2		20.0	5.0			0.6	
QSRatio												
98th Percentile Output:												
fB%	3.1	1.7	2.4	2.4	1.7		2.1	2.5			2.7	
BOQ	1.3	32.8	8.7	8.5	37.6		23.3	6.2			0.8	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: NA
Agency/Co.: URS Canada Inc.
Date Performed: 5/17/2005
Analysis Time Period: PM Peak Hour
Intersection: Steeles Ave / Northwest Gate
Jurisdiction: City of Toronto
Units: U. S. Metric
Analysis Year: Future Background Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Steeles Ave
North/South Street: Northwest Gate
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		1646	91	84	2091	
Peak-Hour Factor, PHF		0.98	0.98	0.98	0.98	
Hourly Flow Rate, HFR		1679	92	85	2133	
Percent Heavy Vehicles		--	--	0	--	--
Median Type/Storage	Undivided		/			
RT Channelized?			No			
Lanes		2	1		1	2
Configuration		T	R		L	T
Upstream Signal?		No				No

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume		44	53			
Peak Hour Factor, PHF		0.98	0.98			
Hourly Flow Rate, HFR		44	54			
Percent Heavy Vehicles		0	0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
Lanes		1	1			
Configuration		L	R			

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound		Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config		L	L		R			
v (vph)		85	44		54			
C(m) (vph)		356	10		313			
v/c		0.24	4.40		0.17			
95% queue length		0.92	6.71		0.61			
Control Delay		18.3	2269		18.9			
LOS		C	F		C			
Approach Delay				1029				
Approach LOS				F				

HCS2000: Unsignalized Intersections Release 4.1d

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: NA
Agency/Co.: URS Canada Inc.
Date Performed: 5/17/2005
Analysis Time Period: PM Peak Hour
Intersection: Steeles Ave / Northwest Gate
Jurisdiction: City of Toronto
Units: U. S. Metric
Analysis Year: Future Background Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Steeles Ave
North/South Street: Northwest Gate
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		1646	91	84	2091	
Peak-Hour Factor, PHF		0.98	0.98	0.98	0.98	
Peak-15 Minute Volume		420	23	21	533	
Hourly Flow Rate, HFR		1679	92	85	2133	
Percent Heavy Vehicles		--	--	0	--	--
Median Type/Storage	Undivided		/			
RT Channelized?			No			
Lanes		2	1		1	2
Configuration		T	R		L	T
Upstream Signal?		No				No

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume		44	53			
Peak Hour Factor, PHF		0.98	0.98			
Peak-15 Minute Volume		11	14			
Hourly Flow Rate, HFR		44	54			
Percent Heavy Vehicles		0	0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
RT Channelized			No			
Lanes		1	1			
Configuration		L	R			

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0
Lane Width (m)	3.6	3.6	3.6	3.6
Walking Speed (m/sec)	1.2	1.2	1.2	1.2
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed kph	Distance to Signal meters
S2	Left-Turn						
	Through						
S5	Left-Turn						
	Through						

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)		4.1	7.5		6.9			
t(c,hv)	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		0	0		0			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Grade/100			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.70		0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.1	6.8		6.9			
2-stage								

Follow-Up Time Calculations

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)		0	0		0			
t(f)		2.2	3.5		3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				
g(q1)				
g(q2)				
g(q)				

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x		1771	2915		840			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process

	7		8		10		11	
	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		3000						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	840	
Potential Capacity	313	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	313	
Probability of Queue free St.	0.83	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows	1771	
Potential Capacity	356	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	356	
Probability of Queue free St.	0.76	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.76	0.76
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows	2915	
Potential Capacity	13	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.76
Maj. L, Min T Adj. Imp Factor.		0.82
Cap. Adj. factor due to Impeding mvmnt	0.76	0.68
Movement Capacity	10	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	2915	
Potential Capacity	13	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.76
Maj. L, Min T Adj. Imp Factor.		0.82
Cap. Adj. factor due to Impeding mvmnt	0.76	0.68
Movement Capacity	10	

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.76	0.76
Movement Capacity		

Result for 2 stage process:		
a		
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	2915	
Potential Capacity	13	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.76
Maj. L, Min T Adj. Imp Factor.		0.82
Cap. Adj. factor due to Impeding mvmnt	0.76	0.68
Movement Capacity	10	

Results for Two-stage process:	
a	
y	
C t	10

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)	44		54			
Movement Capacity (vph)	10		313			
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep	10		313			
Volume	44		54			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		L	L		R			
v (vph)		85	44		54			
C(m) (vph)		356	10		313			
v/c		0.24	4.40		0.17			
95% queue length		0.92	6.71		0.61			
Control Delay		18.3	2269		18.9			
LOS		C	F		C			
Approach Delay				1029				
Approach LOS				F				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.76
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		18.3
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

Steeles West Station - Future Background Traffic Conditions

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: PM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Steeles Avenue

Inter.: Steeles Avenue / Founders Rd
Area Type: All other areas
Jurisd: City of Toronto
Year: Future Background Conditions
N/S St: Founders Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	3	0	1	3	0	1	0	1	0	0	0
LGConfig		TR		L	T		L		R			
Volume		1468	55	87	1592		275		238			
Lane Width		3.6		3.6	3.6		3.6		3.6			
RTOR Vol			0						119			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left	A			
Thru		P			Thru				
Right		P			Right	A			
Peds					Peds				
WB Left	P	P			SB Left				
Thru	P	P			Thru				
Right					Right				
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	6.0	56.0				32.0			
Yellow	3.0	4.0				3.0			
All Red	0.0	3.0				3.0			

Cycle Length: 110.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
TR	2427	4768	0.64	0.51	21.0	C	21.0	C
Westbound								
L	186	1787	0.48	0.59	22.4	C		
T	2885	4883	0.56	0.59	14.6	B	15.0	B
Northbound								
L	457	1570	0.61	0.29	36.2	D		
R	297	1022	0.41	0.29	32.3	C	35.0-	C
Southbound								

Intersection Delay = 19.7 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:
Fax:

OPERATIONAL ANALYSIS

Analyst: NA
Intersection: Steeles Avenue / Founders Rd
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: PM Peak Hour
Analysis Year: Future Background Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Steeles Avenue
North/South Street: Founders Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		1468	55	87	1592		275		238			
% Heavy Veh		8	7	1	6		15		58			
PHF		0.98	0.98	0.98	0.98		0.98		0.98			
PK 15 Vol		374	14	22	406		70		61			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900		1900	1900		1900		1900			
ParkExist												
NumPark												
No. Lanes	0	3	0		1	3	0	1	0	1	0	0	0
LGConfig		TR			L	T		L		R			
Lane Width		3.6			3.6	3.6		3.6		3.6			
RTOR Vol			0							119			
Adj Flow		1554			89	1624		281		121			
%InSharedLn													
Prop LTs		0.000			1.000	0.000							
Prop RTs		0.036				0.000				1.000			
Peds Bikes		0						0			0		
Buses		0			0	0		0		0			
%InProtPhase					0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0		0.0		0.0			
Arriv. Type		3		3	3		3		3			
Unit Ext.		3.0		3.0	3.0		3.0		3.0			
I Factor		1.000			1.000		1.000					
Lost Time		2.0		2.0	2.0		2.0		2.0			
Ext of g		2.0		2.0	2.0		2.0		2.0			
Ped Min g		3.2					3.2			3.2		

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left	A			
Thru		P			Thru				
Right		P			Right	A			
Peds					Peds				
WB Left	P	P			SB Left				
Thru	P	P			Thru				
Right					Right				
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	6.0	56.0				32.0			
Yellow	3.0	4.0				3.0			
All Red	0.0	3.0				3.0			

Cycle Length: 110.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		1468	55	87	1592		275		238			
PHF		0.98	0.98	0.98	0.98		0.98		0.98			
Adj flow		1498	56	89	1624		281		121			
No. Lanes	0	3	0	1	3	0	1	0	1	0	0	0
Lane group		TR		L	T		L		R			
Adj flow		1554		89	1624		281		121			
Prop LTs		0.000		1.000	0.000							
Prop RTs		0.036			0.000				1.000			

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG		TR		L	T		L		R			
So		1900		1900	1900		1900		1900			
Lanes	0	3	0	1	3	0	1	0	1	0	0	0
fW		1.000		1.000	1.000		1.000		1.000			
fHV		0.926		0.990	0.943		0.870		0.633			
fG		1.000		1.000	1.000		1.000		1.000			
fP		1.000		1.000	1.000		1.000		1.000			
fBB		1.000		1.000	1.000		1.000		1.000			
fA		1.000		1.000	1.000		1.000		1.000			
fLU		0.908		1.000	0.908		1.000		1.000			
fRT		0.995			1.000				0.850			
fLT		1.000		0.950	1.000		0.950					
Sec.				0.088								
fLpb		1.000		1.000	1.000		1.000					
fRpb		1.000			1.000				1.000			
S		4768		1787	4883		1570		1022			
Sec.				165								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	1554	4768	# 0.33	0.51	2427	0.64
Right							
Westbound							
Prot		89	1787	# 0.05	0.055	97	0.92
Perm		0	165	0.00	0.536	89	0.00
Left	L	89			0.59	186	0.48
Prot							
Perm							
Thru	T	1624	4883	0.33	0.59	2885	0.56
Right							
Northbound							
Prot							
Perm							
Left	L	281	1570	# 0.18	0.29	457	0.61
Prot							
Perm							
Thru							
Right	R	121	1022	0.12	0.29	297	0.41
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.55
Total lost time per cycle, L = 20.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.68

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay LOS	Approach Delay LOS
Eastbound										
TR	0.64	0.51	19.7	1.000	2427	0.50	1.3	0.0	21.0 C	21.0 C
Westbound										
L	0.48	0.59	13.8	1.000	186	0.50	8.6	0.0	22.4 C	
T	0.56	0.59	13.8	1.000	2885	0.50	0.8	0.0	14.6 B	15.0 B
Northbound										
L	0.61	0.29	33.7	1.000	457	0.20	2.5	0.0	36.2 D	
R	0.41	0.29	31.4	1.000	297	0.11	0.9	0.0	32.3 C	35.0- C
Southbound										

Intersection Delay = 19.7 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach		M		
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)		65.0		
Effective permitted green time for LT lane group, g(s)		59.0		
Opposing effective green time, go (s)		56.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		3		
Adjusted LT flow rate, VLT (veh/h)		89		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		1554		
Lost time for LT lane group, tL		7.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		2.72		
Opposing lane util. factor, fLUo		0.908	0.908	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		17.43		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.49		
gq, (see Exhibit C16-4,5,6,7,8)		25.06		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		33.94		
n=Max(gq-gf)/2,0)		12.53		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		6.56		
EL2=Max((1-Ptho**n)/PLto, 1.0)		0.07		
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.00		
gdiff=max(gq-gf,0)		0.09		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.088		
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT			0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo			0.908	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/PLto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vb1c (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 110.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	89			
v/c ratio from Capacity Worksheet, X	0.48			
Protected phase effective green interval, g (s)	6.0			
Opposing queue effective green interval, gq	25.06			
Unopposed green interval, gu	33.94			
Red time r=(C-g-gq-gu)	45.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.02			
Protected ph. departure rate, Sp=s/3600	0.496			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.08			
XPerm	0.54			
XProt	0.42			
Case	1			
Queue at beginning of green arrow, Qa	1.11			
Queue at beginning of unsaturated green, Qu	0.62			
Residual queue, Qr	0.00			
Uniform Delay, d1	13.8			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Final Queue Delay d3 sec	Initial Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 19.7 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

	Eastbound	Westbound	Northbound	Southbound
LaneGroup	TR	L T	L R	
Init Queue	0.0	0.0 0.0	0.0 0.0	
Flow Rate	570	89 596	281 121	
So	1900	1900 1900	1900 1900	
No.Lanes	3	1 3	1 1	0 0 0
SL	1750	215 1792	1570 1022	
LnCapacity	890	186 1059	457 297	
Flow Ratio	0.33	0.28 0.33	0.18 0.12	
v/c Ratio	0.64	0.48 0.56	0.61 0.41	
Grn Ratio	0.51	0.59 0.59	0.29 0.29	
I Factor	1.000	1.000	1.000	
AT or PVG	3	3 3	3 3	
Pltn Ratio	1.00	1.00 1.00	1.00 1.00	
PF2	1.00	1.00 1.00	1.00 1.00	
Q1	12.7	1.1 11.2	7.4 3.0	
kB	1.2	0.4 1.4	0.5 0.4	
Q2	2.1	0.4 1.7	0.8 0.3	
Q Average	14.7	1.5 12.9	8.2 3.2	
Q Spacing	7.6	7.6 7.6	7.6 7.6	
Q Storage	0	0 0	0 0	
Q S Ratio				
70th Percentile Output:				
fB%	1.2	1.3 1.2	1.2 1.2	
BOQ	17.8	1.9 15.5	9.6 3.9	
QSRatio				
85th Percentile Output:				
fB%	1.4	1.6 1.4	1.5 1.6	
BOQ	20.9	2.4 18.3	12.5 5.1	
QSRatio				
90th Percentile Output:				
fB%	1.5	1.9 1.5	1.7 1.7	
BOQ	22.5	2.8 19.8	13.6 5.6	
QSRatio				
95th Percentile Output:				
fB%	1.7	2.3 1.7	1.9 2.0	
BOQ	24.4	3.5 21.6	15.4 6.5	
QSRatio				
98th Percentile Output:				
fB%	1.8	2.8 1.8	2.2 2.5	
BOQ	26.2	4.2 23.4	18.2 8.0	
QSRatio				

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: PM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Steeles Avenue

Inter.: Steeles Avenue / Keele Street
Area Type: All other areas
Jurisd: City of Toronto
Year: Future Backgound Conditions
N/S St: Keele Street

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes		1	3	1		3	0		1	2	1		1	2	1	
LGConfig	L	T	R	L		TR		L	T	R		L	T	R	
Volume	193	1834	157	284	1884	690		215	1284	289		275	1245	175	
Lane Width	3.6	3.6	3.6	3.6	3.6			3.6	3.6	3.6		3.6	3.6	3.6	
RTOR Vol			0			120				0				0	

Duration 0.25 Area Type: All other areas

Phase Combination	1	2	3	4		5	6	7	8
EB Left		P			NB Left	P	P		
Thru		P			Thru		P		
Right		P			Right		P		
Peds					Peds				
WB Left		P			SB Left	P	P		
Thru		P			Thru		P		
Right		P			Right		P		
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green		11.0	45.0			11.0	33.0		
Yellow		3.0	4.0			3.0	4.0		
All Red		1.0	2.0			1.0	2.0		

Cycle Length: 120.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	213	1671	0.92	0.50	78.7	E		
T	1848	4929	1.01	0.38	61.6	E	60.6	E
R	588	1568	0.27	0.38	27.2	C		
Westbound								
L	218	1719	1.33	0.50	212.4	F		
TR	1832	4886	1.37	0.38	206.1	F	206.8	F
Northbound								
L	220	1736	1.00	0.40	91.8	F		
T	947	3445	1.38	0.28	222.6	F	178.5	F
R	435	1583	0.68	0.28	47.0	D		
Southbound								
L	220	1736	1.28	0.40	187.5	F		
T	947	3445	1.34	0.28	204.1	F	184.5	F
R	376	1369	0.48	0.28	40.6	D		

Intersection Delay = 158.3 (sec/veh) Intersection LOS = F

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:
Fax:

OPERATIONAL ANALYSIS

Analyst:	NA
Intersection:	Steeles Avenue / Keele Street
Agency/Co.:	URS Canada Inc.
Area Type:	All other areas
Date Performed:	12/9/2004
Jurisdiction:	City of Toronto
Analysis Time Period:	PM Peak Hour
Analysis Year:	Future Backgound Conditions
Project ID:	TTC Spadina Station Extension
East/West Street:	North/South Street
Steeles Avenue	Keele Street

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	193	1834	157	284	1884	690	215	1284	289	275	1245	175
% Heavy Veh	8	5	3	5	2	3	4	5	2	4	5	18
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	49	468	40	72	481	176	55	328	74	70	318	45
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900	1900	1900	1900		1900	1900	1900	1900	1900	1900
ParkExist												
NumPark												
No. Lanes		1	3	1		3	0		1	2	1		1	2	1
LGConfig	L		T	R	L		TR	L		T	R	L		T	R
Lane Width	3.6	3.6	3.6		3.6	3.6		3.6	3.6	3.6		3.6	3.6	3.6	
RTOR Vol			0				120			0				0	
Adj Flow	197	1871	160		290	2504		219	1310	295		281	1270	179	
%InSharedLn															
Prop LTs	1.000	0.000			1.000	0.000		1.000	0.000			1.000	0.000		
Prop RTs		0.000	1.000			0.232			0.000	1.000			0.000	1.000	
Peds	Bikes	0				0			0				0		
Buses	0	0	0		0	0		0	0	0		0	0	0	
%InProtPhase	0.0				0.0			0.0				0.0			

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Arriv. Type	3	3	3	3	3		3	3	3	3	3	3
Unit Ext.	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0
Ext of g	2.0	2.0	2.0	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left		P			NB Left	P	P		
Thru		P			Thru		P		
Right		P			Right		P		
Peds					Peds				
WB Left		P			SB Left	P	P		
Thru		P			Thru		P		
Right		P			Right		P		
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green		11.0	45.0			11.0	33.0		
Yellow		3.0	4.0			3.0	4.0		
All Red		1.0	2.0			1.0	2.0		

Cycle Length: 120.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	193	1834	157	284	1884	690	215	1284	289	275	1245	175
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	197	1871	160	290	1922	582	219	1310	295	281	1270	179
No. Lanes	1	3	1	1	3	0	1	2	1	1	2	1
Lane group	L	T	R	L	TR		L	T	R	L	T	R
Adj flow	197	1871	160	290	2504		219	1310	295	281	1270	179
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.232			0.000	1.000		0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound						Westbound						Northbound						Southbound					
LG	L		T		R		L		T		R		L		T		R		L		T		R	
So	1900		1900		1900		1900		1900				1900		1900		1900		1900		1900		1900	
Lanes	1		3		1		3		0				1		2		1		1		2		1	
fW	1.000		1.000		1.000		1.000		1.000				1.000		1.000		1.000		1.000		1.000		1.000	
fHV	0.926		0.952		0.971		0.952		0.978				0.962		0.952		0.980		0.962		0.952		0.847	
fG	1.000		1.000		1.000		1.000		1.000				1.000		1.000		1.000		1.000		1.000		1.000	
fP	1.000		1.000		1.000		1.000		1.000				1.000		1.000		1.000		1.000		1.000		1.000	
fBB	1.000		1.000		1.000		1.000		1.000				1.000		1.000		1.000		1.000		1.000		1.000	
fA	1.000		1.000		1.000		1.000		1.000				1.000		1.000		1.000		1.000		1.000		1.000	
fLU	1.000		0.908		1.000		1.000		0.908				1.000		0.952		1.000		1.000		0.952		1.000	
fRT			1.000		0.850				0.965						1.000		0.850				1.000		0.850	
fLT	0.950		1.000				0.950		1.000				0.950		1.000				0.950		1.000			
Sec.	0.082						0.082						0.108						0.108					
fLpb	1.000		1.000				1.000		1.000				1.000		1.000				1.000		1.000			
fRpb			1.000		1.000				1.000						1.000		1.000				1.000		1.000	
S	1671		4929		1568		1719		4886				1736		3445		1583		1736		3445		1369	
Sec.	144						148						198						198					

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		153	1671	0.09	0.092	153	1.00
Perm		44	144	0.31	0.408	60	0.73
Left	L	197			0.50	213	0.92
Prot							
Perm							
Thru	T	1871	4929	0.37	0.38	1848	1.01
Right	R	160	1568	0.10	0.38	588	0.27
Westbound							
Prot		158	1719	# 0.09	0.092	158	1.00
Perm		132	148	# 0.89	0.408	60	2.20
Left	L	290			0.50	218	1.33
Prot							
Perm							
Thru	TR	2504	4886	0.37	0.38	1832	1.37
Right							
Northbound							
Prot		159	1736	0.09	0.092	159	1.00
Perm		60	198	0.30	0.308	61	0.98
Left	L	219			0.40	220	1.00
Prot							
Perm							
Thru	T	1310	3445	0.27	0.28	947	1.38
Right	R	295	1583	0.19	0.28	435	0.68
Southbound							
Prot		159	1736	# 0.09	0.092	159	1.00
Perm		122	198	# 0.62	0.308	61	2.00
Left	L	281			0.40	220	1.28
Prot							
Perm							
Thru	T	1270	3445	0.27	0.28	947	1.34
Right	R	179	1369	0.13	0.28	376	0.48

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 1.69
Total lost time per cycle, L = 12.00 Sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.88

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.92	0.50	34.0	1.000	213	0.50	44.8	0.0	78.7	E		
T	1.01	0.38	37.5	1.000	1848	0.50	24.1	0.0	61.6	E	60.6	E
R	0.27	0.38	26.1	1.000	588	0.50	1.1	0.0	27.2	C		
Westbound												
L	1.33	0.50	35.8	1.000	218	0.50	176.6	0.0	212.4	F		
TR	1.37	0.38	37.5	1.000	1832	0.50	168.6	0.0	206.1	F	206.8	F
Northbound												
L	1.00	0.40	32.3	1.000	220	0.50	59.5	0.0	91.8	F		
T	1.38	0.28	43.5	1.000	947	0.50	179.1	0.0	222.6	F	178.5	F
R	0.68	0.28	38.8	1.000	435	0.50	8.2	0.0	47.0	D		
Southbound												
L	1.28	0.40	32.4	1.000	220	0.50	155.1	0.0	187.5	F		
T	1.34	0.28	43.5	1.000	947	0.50	160.6	0.0	204.1	F	184.5	F
R	0.48	0.28	36.3	1.000	376	0.50	4.3	0.0	40.6	D		

Intersection Delay = 158.3 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)	60.0	60.0	48.0	48.0
Effective permitted green time for LT lane group, g(s)	49.0	49.0	37.0	37.0
Opposing effective green time, go (s)	45.0	45.0	33.0	33.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	3	3	2	2
Adjusted LT flow rate, VLT (veh/h)	197	290	219	281
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	2504	1871	1270	1310
Lost time for LT lane group, tL	6.00	6.00	6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600	6.57	9.67	7.30	9.37
Opposing lane util. factor, fLUo	0.908	0.908	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	30.64	22.90	22.23	22.93
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.63	0.63	0.73	0.73
gq, (see Exhibit C16-4,5,6,7,8)	45.00	45.00	33.00	33.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	4.00	4.00	4.00	4.00
n=Max(gq-gf)/2,0)	22.50	22.50	16.50	16.50
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	18.45	9.22	4.56	4.75
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.08	0.08	0.11	0.11
gdiff=max(gq-gf, 0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.08	0.08	0.11	0.11
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.082	0.082	0.108	0.108

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.908	0.908	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 120.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	197	290	219	281
v/c ratio from Capacity Worksheet, X	0.92	1.33	1.00	1.28
Protected phase effective green interval, g (s)	11.0	11.0	11.0	11.0
Opposing queue effective green interval, gq	45.00	45.00	33.00	33.00
Unopposed green interval, gu	4.00	4.00	4.00	4.00
Red time r=(C-g-gq-gu)	60.0	60.0	72.0	72.0
Arrival rate, qa=v/(3600(max[X,1.0]))	0.05	0.06	0.06	0.06
Protected ph. departure rate, Sp=s/3600	0.464	0.478	0.482	0.482
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.49	0.50	0.51	0.51
XPerm	1.37	1.47	1.11	1.11
XProt	0.76	0.82	0.95	0.96
Case	3	3	3	3
Queue at beginning of green arrow, Qa	4.00	4.59	4.60	4.63
Queue at beginning of unsaturated green, Qu	2.46	2.73	2.01	2.02
Residual queue, Qr	0.72	0.95	0.22	0.23
Uniform Delay, d1	34.0	35.8	32.3	32.4

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Final Queue Delay d3 sec	Initial Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 158.3 sec/veh Intersection LOS F

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	T	R	L	TR		L	T	R	L	T	R
Init Queue	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	197	686	160	290	919		219	688	295	281	667	179
So	1900	1900	1900	1900	1900		1900	1900	1900	1900	1900	1900
No.Lanes	1	3	1	1	3	0	1	2	1	1	2	1
SL	424	1809	1568	496	1793		550	1809	1583	550	1809	1369
LnCapacity	213	678	588	218	672		220	497	435	220	497	376
Flow Ratio	0.46	0.38	0.10	0.67	0.51		0.40	0.38	0.19	0.51	0.37	0.13
v/c Ratio	0.92	1.01	0.27	1.33	1.37		1.00	1.38	0.68	1.28	1.34	0.48
Grn Ratio	0.50	0.38	0.38	0.50	0.38		0.40	0.28	0.28	0.40	0.28	0.28
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3	3	3	3		3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Q1	3.6	22.9	3.7	5.3	30.6		4.8	22.9	9.8	6.2	22.2	5.0
KB	0.5	1.1	1.0	0.5	1.1		0.5	0.9	0.8	0.5	0.9	0.7
Q2	2.6	10.1	0.4	10.6	34.4		3.6	26.6	1.5	9.4	24.2	0.6
Q Average	6.1	32.9	4.1	16.0	65.0		8.4	49.6	10.3	15.6	46.4	5.6
Q Spacing	7.6	7.6	7.6	7.6	7.6		7.6	7.6	7.6	7.6	7.6	7.6
Q Storage	0	0	0	0	0		0	0	0	0	0	0
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2	1.2	1.2	1.2		1.2	1.2	1.2	1.2	1.2	1.2
BOQ	7.5	39.5	5.1	19.2	78.0		10.2	59.5	12.5	18.8	55.7	6.9
QSRatio												
85th Percentile Output:												
fB%	1.5	1.4	1.5	1.4	1.4		1.5	1.4	1.4	1.4	1.4	1.5
BOQ	9.1	46.1	6.2	22.5	91.1		12.2	69.4	14.8	22.1	65.0	8.4
QSRatio												
90th Percentile Output:												
fB%	1.6	1.5	1.7	1.5	1.5		1.6	1.5	1.6	1.5	1.5	1.7
BOQ	10.1	49.4	7.0	24.3	97.6		13.4	74.4	16.1	23.8	69.7	9.3
QSRatio												
95th Percentile Output:												
fB%	1.9	1.6	2.0	1.6	1.6		1.8	1.6	1.7	1.6	1.6	1.9
BOQ	11.6	52.7	8.3	26.2	104		15.0	79.3	17.8	25.7	74.3	10.8
QSRatio												
98th Percentile Output:												
fB%	2.1	1.7	2.4	1.8	1.7		2.0	1.7	1.9	1.8	1.7	2.2
BOQ	13.1	56.1	9.6	28.1	111		16.6	84.3	19.4	27.6	78.9	12.3
QSRatio												

ERROR MESSAGES

No errors to report.

APPENDIX D

PPUDO, PARK'N'RIDE AND TRANSIT TRAFFIC VOLUMES FOR STEELES WEST STATION

Figure A-1 – A.M. Peak Hour Passenger Pick-up/Drop-off Traffic Volumes

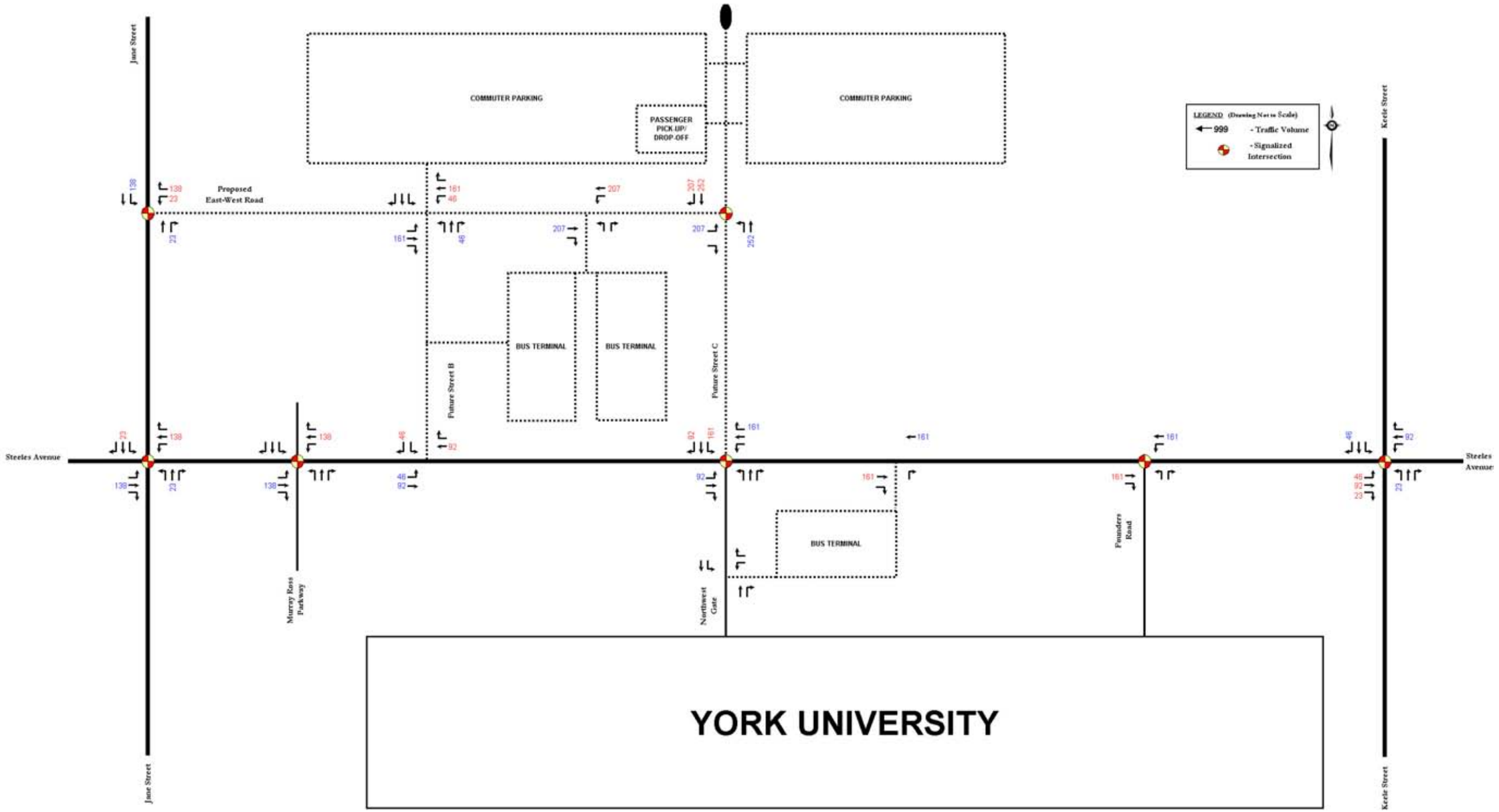


Figure A-2 – P.M. Peak Hour Passenger Pick-up/Drop-off Traffic Volumes

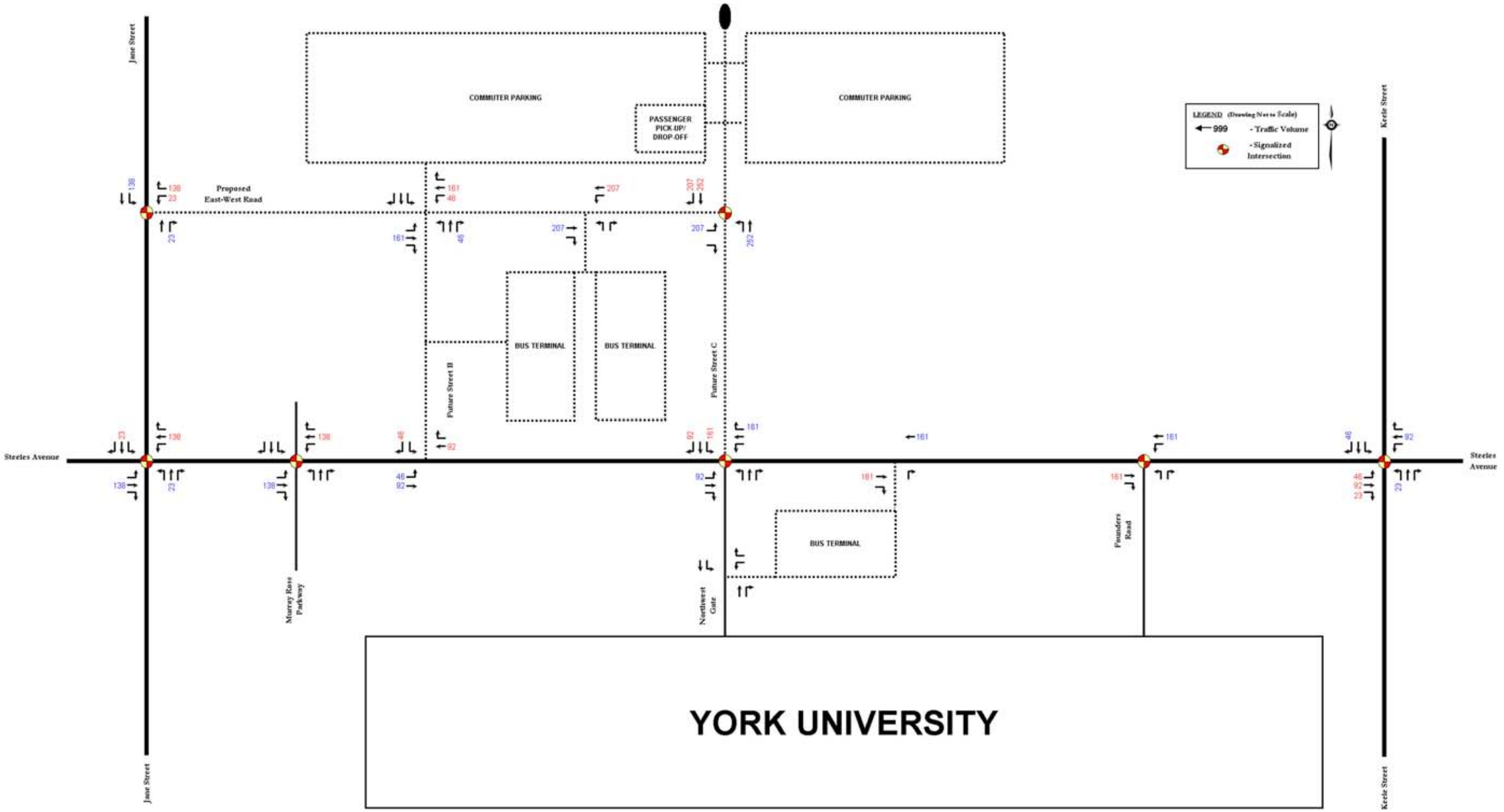


Figure A-3 – A.M. Peak Hour Commuter Parking Traffic Volumes

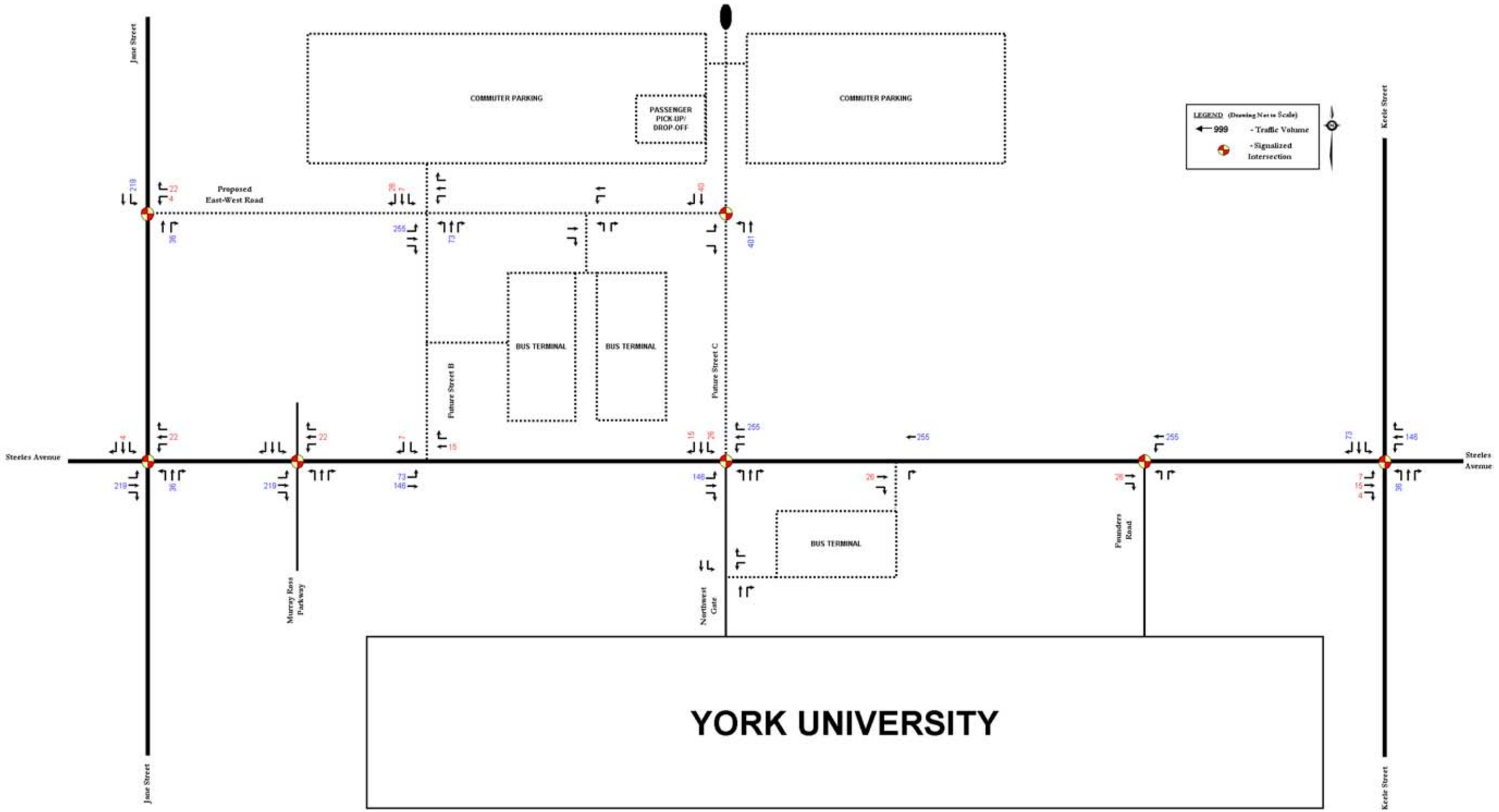


Figure A-4 – P.M. Peak Hour Commuter Parking Traffic Volumes

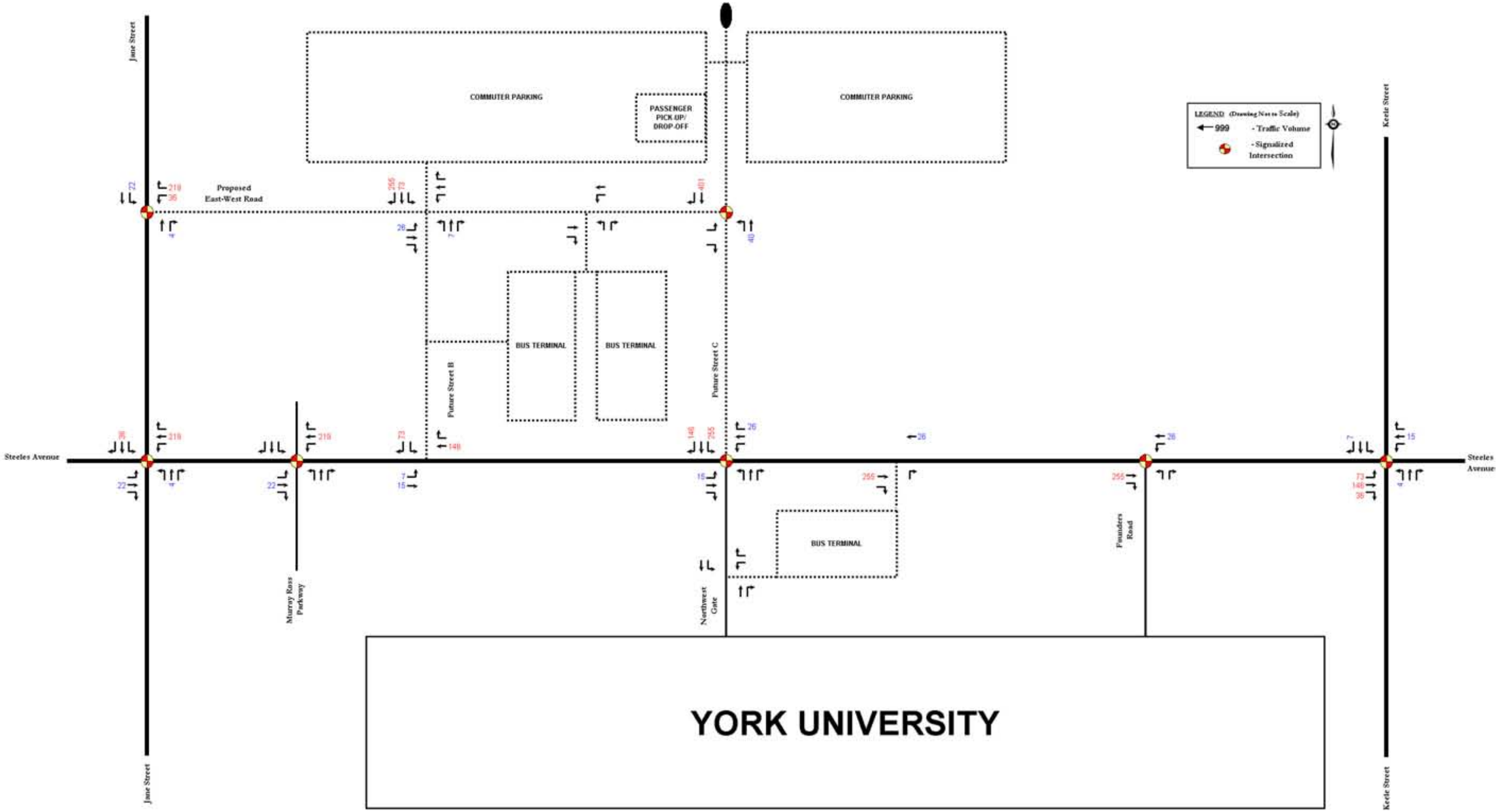
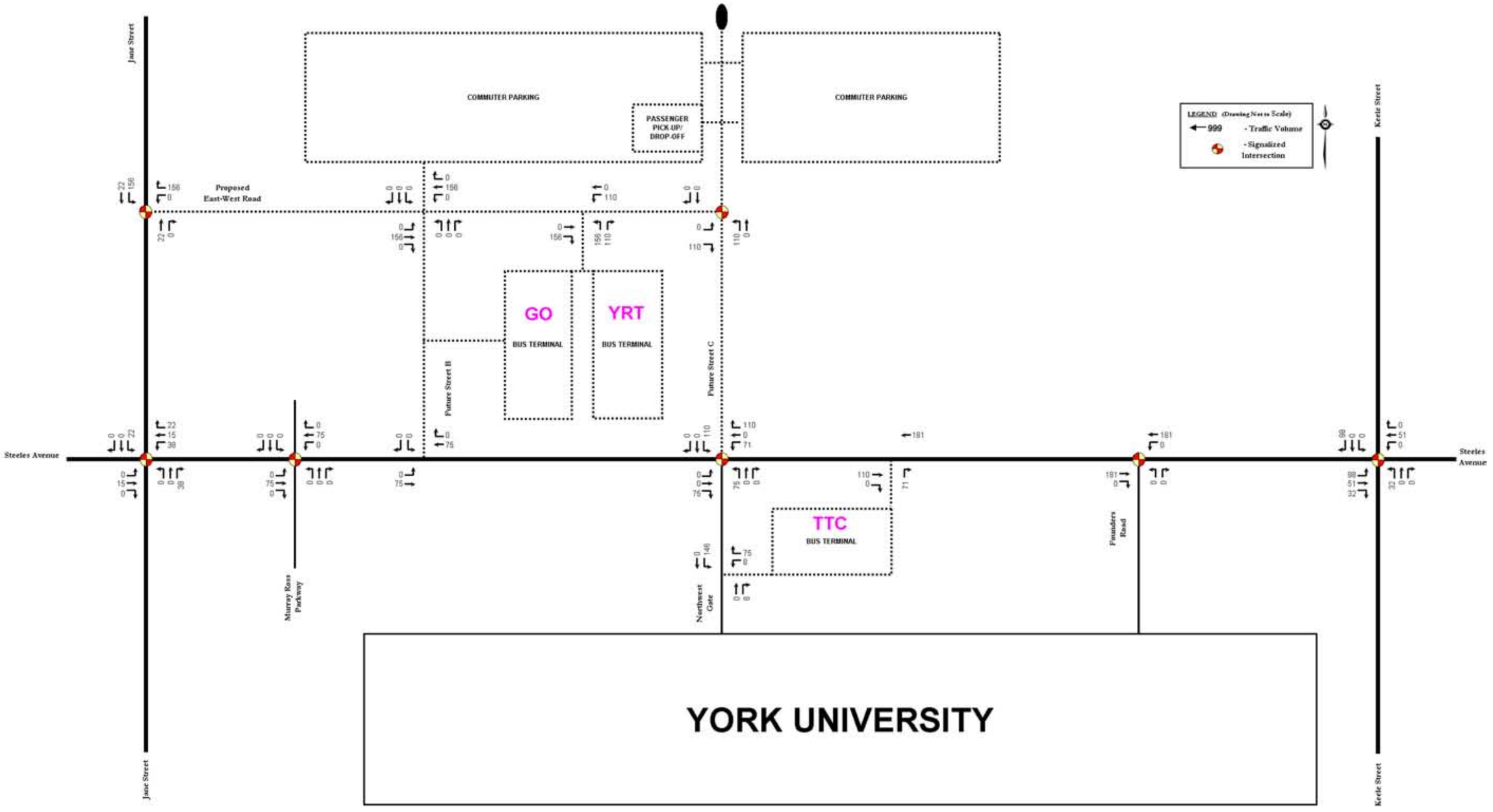


Figure A-5 – A.M. and P.M. Peak Hour Transit Traffic Volumes



APPENDIX E

INTERSECTION ANALYSES

FUTURE TOTAL TRAFFIC

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: AM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Steeles Avenue

Inter.: Sessions Avenue / Jane Street
Area Type: All other areas
Jurisd: City of Toronto
Year: Total Future Conditions
N/S St: Jane Street

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	0	1	2	1	1	2	1	1	2	1
LGConfig	L	TR		L	T	R	L	T	R	L	T	R
Volume	237	1896	160	163	1402	321	81	1168	145	369	1061	159
Lane Width	3.6	3.6		3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left		P			NB Left	P		P	
Thru		P			Thru			P	
Right		P			Right			P	
Peds					Peds				
WB Left		P			SB Left	P	P	P	
Thru		P			Thru		P	P	
Right		P			Right		P	P	
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green		6.0	48.0			6.0	6.0	30.0	
Yellow		2.0	4.0			2.0	2.0	4.0	
All Red		2.0	3.0			2.0	0.0	3.0	

Cycle Length: 120.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	146	1719	1.80	0.48	415.8	F		
TR	1364	3410	1.68	0.40	343.1	F	350.6	F
Westbound								
L	152	1787	1.19	0.48	162.7	F		
T	1340	3350	1.16	0.40	117.8	F	106.9	F
R	640	1599	0.56	0.40	31.3	C		
Northbound								
L	148	1736	0.61	0.30	50.8	D		
T	861	3445	1.51	0.25	279.4	F	241.4	F
R	385	1538	0.42	0.25	41.0	D		
Southbound								
L	296	1752	1.39	0.40	227.9	F		
T	1091	3445	1.08	0.32	92.8	F	118.2	F
R	506	1599	0.35	0.32	33.4	C		

Intersection Delay = 213.6 (sec/veh) Intersection LOS = F

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:
Fax:

OPERATIONAL ANALYSIS

Analyst: NA
Intersection: Steeles Avenue / Jane Street
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: AM Peak Hour
Analysis Year: Total Future Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Steeles Avenue
North/South Street: Jane Street

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	237	1896	160	163	1402	321	81	1168	145	369	1061	159
% Heavy Veh	5	5	5	1	8	1	4	5	5	3	5	1
PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
PK 15 Vol	66	527	44	45	389	89	23	324	40	103	295	44
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900	1900	1900	1900	1900	1900	1900	1900
ParkExist												
NumPark												
No. Lanes	1	2	0	1	2	1	1	2	1	1	2	1
LGConfig	L	TR		L	T	R	L	T	R	L	T	R
Lane Width	3.6	3.6		3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
RTOR Vol			0			0			0			0
Adj Flow	263	2285		181	1558	357	90	1298	161	410	1179	177
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.078			0.000	1.000		0.000	1.000		0.000	1.000
Peds	Bikes	0			0			0			0	
Buses	0	0		0	0	0	0	0	0	0	0	0
%InProtPhase	0.0			0.0			0.0			0.0		

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Arriv. Type	3	3		3	3	3	3	3	3	3	3	3
Unit Ext.	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Ext of g	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left		P			NB Left	P		P	
Thru		P			Thru			P	
Right		P			Right			P	
Peds					Peds				
WB Left		P			SB Left	P	P	P	
Thru		P			Thru		P	P	
Right		P			Right		P	P	
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green		6.0	48.0			6.0	6.0	30.0	
Yellow		2.0	4.0			2.0	2.0	4.0	
All Red		2.0	3.0			2.0	0.0	3.0	

Cycle Length: 120.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	237	1896	160	163	1402	321	81	1168	145	369	1061	159
PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj flow	263	2107	178	181	1558	357	90	1298	161	410	1179	177
No. Lanes	1	2	0	1	2	1	1	2	1	1	2	1
Lane group	L	TR		L	T	R	L	T	R	L	T	R
Adj flow	263	2285		181	1558	357	90	1298	161	410	1179	177
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.078			0.000	1.000		0.000	1.000		0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	TR		L	T	R	L	T	R	L	T	R
So	1900	1900		1900	1900	1900	1900	1900	1900	1900	1900	1900
Lanes	1	2	0	1	2	1	1	2	1	1	2	1
fW	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fHV	0.952	0.954		0.990	0.926	0.990	0.962	0.952	0.952	0.971	0.952	0.990
fG	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fP	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fBB	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fA	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fLU	1.000	0.952		1.000	0.952	1.000	1.000	0.952	1.000	1.000	0.952	1.000
fRT		0.988			1.000	0.850		1.000	0.850		1.000	0.850
fLT	0.950	1.000		0.950	1.000		0.950	1.000		0.950	1.000	
Sec.	0.077			0.077			0.133			0.125		
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000			1.000	1.000		1.000	1.000		1.000	1.000
S	1719	3410		1787	3350	1599	1736	3445	1538	1752	3445	1599
Sec.	139			145			244			231		

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		86	1719	# 0.05	0.050	86	1.00
Perm		177	139	# 1.27	0.433	60	2.95
Left	L	263			0.48	146	1.80
Prot							
Perm							
Thru	TR	2285	3410	0.40	0.40	1364	1.68
Right							
Westbound							
Prot		89	1787	0.05	0.050	89	1.00
Perm		92	145	0.63	0.433	63	1.46
Left	L	181			0.48	152	1.19
Prot							
Perm							
Thru	T	1558	3350	0.40	0.40	1340	1.16
Right	R	357	1599	0.22	0.40	640	0.56
Northbound							
Prot		87	1736	0.05	0.050	87	1.00
Perm		3	244	0.01	0.250	61	0.05
Left	L	90			0.30	148	0.61
Prot							
Perm							
Thru	T	1298	3445	0.25	0.25	861	1.51
Right	R	161	1538	0.10	0.25	385	0.42
Southbound							
Prot		234	1752	# 0.13	0.133	234	1.00
Perm		176	231	# 0.76	0.267	62	2.84
Left	L	410			0.40	296	1.39
Prot							
Perm							
Thru	T	1179	3445	0.32	0.32	1091	1.08
Right	R	177	1599	0.11	0.32	506	0.35

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 2.22
Total lost time per cycle, L = 14.00 Sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 2.51

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	1.80	0.48	29.4	1.000	146	0.50	386.5	0.0	415.8	F		
TR	1.68	0.40	36.0	1.000	1364	0.50	307.1	0.0	343.1	F	350.6	F
Westbound												
L	1.19	0.48	29.3	1.000	152	0.50	133.4	0.0	162.7	F		
T	1.16	0.40	36.0	1.000	1340	0.50	81.8	0.0	117.8	F	106.9	F
R	0.56	0.40	27.8	1.000	640	0.50	3.5	0.0	31.3	C		
Northbound												
L	0.61	0.30	33.6	1.000	148	0.50	17.2	0.0	50.8	D		
T	1.51	0.25	45.0	1.000	861	0.50	234.4	0.0	279.4	F	241.4	F
R	0.42	0.25	37.7	1.000	385	0.50	3.3	0.0	41.0	D		
Southbound												
L	1.39	0.40	35.0	1.000	296	0.50	193.0	0.0	227.9	F		
T	1.08	0.32	41.0	1.000	1091	0.50	51.8	0.0	92.8	F	118.2	F
R	0.35	0.32	31.5	1.000	506	0.50	1.9	0.0	33.4	C		

Intersection Delay = 213.6 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)	58.0	58.0	36.0	48.0
Effective permitted green time for LT lane group, g(s)	52.0	52.0	30.0	32.0
Opposing effective green time, go (s)	48.0	48.0	38.0	30.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	2	2	2	2
Adjusted LT flow rate, VLT (veh/h)	263	181	90	410
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	1558	2285	1179	1298
Lost time for LT lane group, tL	7.00	7.00	11.00	7.00
Computation				
LT volume per cycle, LTC=VLTC/3600	8.77	6.03	3.00	13.67
Opposing lane util. factor, fLUo	0.952	0.952	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	27.28	40.00	20.64	22.72
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.00	0.00	0.00	0.75
gq, (see Exhibit C16-4,5,6,7,8)	48.00	48.00	24.00	28.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	4.00	4.00	6.00	4.00
n=Max(gu-gf)/2,0)	24.00	24.00	12.00	14.00
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	6.10	12.90	4.16	4.69
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.08	0.08	0.13	0.13
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.08	0.08	0.13	0.13
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.077	0.077	0.133	0.125

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gu-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 120.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	263	181	90	410
v/c ratio from Capacity Worksheet, X	1.80	1.19	0.61	1.39
Protected phase effective green interval, g (s)	6.0	6.0	6.0	16.0
Opposing queue effective green interval, gq	48.00	48.00	24.00	28.00
Unopposed green interval, gu	4.00	4.00	6.00	4.00
Red time r=(C-g-gq-gu)	62.0	62.0	84.0	72.0
Arrival rate, qa=v/(3600(max[X,1.0]))	0.04	0.04	0.03	0.08
Protected ph. departure rate, Sp=s/3600	0.478	0.496	0.482	0.487
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.50	0.52	0.34	0.51
XPerm	1.05	1.05	0.37	1.28
XProt	0.96	0.96	0.78	0.93
Case	3	3	1	3
Queue at beginning of green arrow, Qa	2.62	2.72	2.10	6.50
Queue at beginning of unsaturated green, Qu	1.95	2.03	0.60	2.30
Residual queue, Qr	0.10	0.10	0.00	0.58
Uniform Delay, d1	29.4	29.3	33.6	35.0

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Final Queue Delay d3 sec	Initial Lane Group d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 213.6 sec/veh Intersection LOS F

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	TR		L	T	R	L	T	R	L	T	R
Init Queue	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	263	1200		181	818	357	90	681	161	410	619	177
So	1900	1900		1900	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	2	0	1	2	1	1	2	1	1	2	1
SL	302	1790		915	1759	1599	493	1809	1538	738	1809	1599
LnCapacity	146	716		152	703	640	148	452	385	296	573	506
Flow Ratio	0.87	0.67		0.57	0.47	0.22	0.18	0.38	0.10	0.56	0.34	0.11
v/c Ratio	1.80	1.68		1.19	1.16	0.56	0.61	1.51	0.42	1.39	1.08	0.35
Grn Ratio	0.48	0.40		0.48	0.40	0.40	0.30	0.25	0.25	0.40	0.32	0.32
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3		3	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	4.8	40.0		3.3	27.3	9.2	2.2	22.7	4.5	9.5	20.6	4.5
kB	0.4	1.1		0.4	1.1	1.0	0.4	0.8	0.7	0.6	0.9	0.9
Q2	15.4	63.1		5.2	20.0	1.2	0.5	30.8	0.5	16.1	11.9	0.5
Q Average	20.2	103.1			8.5	47.2	10.4	2.7	53.5	5.0	25.6	32.5
Q Spacing	7.6	7.6		7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Q Storage	0	0		0	0	0	0	0	0	0	0	0
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2		1.2	1.2	1.2	1.3	1.2	1.2	1.2	1.2	1.2
BOQ	24.2	124		10.4	56.7	12.7	3.4	64.2	6.2	30.7	39.0	6.2
QSRatio												
85th Percentile Output:												
fB%	1.4	1.4		1.5	1.4	1.4	1.6	1.4	1.5	1.4	1.4	1.5
BOQ	28.3	144		12.4	66.1	15.0	4.2	75.0	7.6	35.9	45.6	7.5
QSRatio												
90th Percentile Output:												
fB%	1.5	1.5		1.6	1.5	1.6	1.8	1.5	1.7	1.5	1.5	1.7
BOQ	30.4	155		13.6	70.9	16.3	4.8	80.3	8.4	38.5	48.8	8.4
QSRatio												
95th Percentile Output:												
fB%	1.6	1.6		1.8	1.6	1.7	2.2	1.6	2.0	1.6	1.6	2.0
BOQ	32.6	165		15.2	75.6	18.0	5.9	85.7	9.8	41.1	52.1	9.8
QSRatio												
98th Percentile Output:												
fB%	1.7	1.7		2.0	1.7	1.9	2.6	1.7	2.3	1.7	1.7	2.3
BOQ	34.8	175		16.8	80.3	19.7	6.9	91.0	11.3	43.7	55.4	11.3
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: AM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Steeles Avenue
Inter.: Steeles Ave / MurrayRoss Pkwy
Area Type: All other areas
Jurisd: City of Toronto
Year: Total Future Conditions
N/S St: Murray Ross Parkway

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes		1	3	1		1	3	0		1	1	0
LGConfig		L	T	R		L	TR			L	TR	
Volume	5	2327	165	91	1545	1	88	1	120	0	2	3
Lane Width	3.6	3.6	3.6	3.6	3.6		3.6	3.6			3.6	
RTOR Vol			0			0			0			0
Duration	0.25	Area Type: All other areas										

Phase Combination	1	2	3	4		5	6	7	8
EB Left		P			NB Left	A			
Thru		P			Thru	A			
Right		P			Right	A			
Peds					Peds				
WB Left		P	P		SB Left	A			
Thru		P	P		Thru	A			
Right		P	P		Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green		5.0	72.0			27.0			
Yellow		2.0	4.0			4.0			
All Red		0.0	3.0			3.0			

Cycle Length: 120.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	157	261	0.03	0.60	10.2	B		
T	2957	4929	0.80	0.60	20.9	C	20.3	C
R	959	1599	0.18	0.60	11.1	B		
Westbound								
L	139	1805	0.67	0.66	43.2	D		
TR	3184	4837	0.50	0.66	11.0	B	12.7	B
Northbound								
L	307	1365	0.29	0.22	39.1	D		
TR	353	1571	0.35	0.22	39.7	D	39.5	D
Southbound								
LTR	618	2748	0.01	0.22	36.1	D	36.1	D

Intersection Delay = 18.4 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:
Fax:

OPERATIONAL ANALYSIS

Analyst: NA
Intersection: Steeles Ave / MurrayRoss Pkwy
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: AM Peak Hour
Analysis Year: Total Future Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Steeles Avenue
North/South Street: Murray Ross Parkway

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	5	2327	165	91	1545	1	88	1	120	0	2	3
% Heavy Veh	0	5	1	0	7	0	5	0	3	0	0	33
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	2	594	42	23	394	1	22	1	31	0	1	1
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900	1900	1900	1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes		1	3	1		1	3	0		1	1	0
LGConfig		L	T	R		L	TR			L	TR	
Lane Width	3.6	3.6	3.6	3.6	3.6		3.6	3.6			3.6	
RTOR Vol			0			0			0			0
Adj Flow	5	2374	168	93	1578		90	123			5	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000			0.000	
Prop RTs		0.000	1.000		0.001			0.992		0.600		
Peds Bikes	0			0			0			0		
Buses	0	0	0	0	0		0	0			0	
%InProtPhase				0.0								
Duration	0.25	Area Type: All other areas										

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0		0.0	0.0			0.0	
Arriv. Type	3	3	3	3	3		3	3			3	
Unit Ext.	3.0	3.0	3.0	3.0	3.0		3.0	3.0			3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0		2.0	2.0			2.0	
Ext of g	2.0	2.0	2.0	2.0	2.0		2.0	2.0			2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left		P			NB Left	A			
Thru		P			Thru	A			
Right		P			Right	A			
Peds					Peds				
WB Left		P	P		SB Left	A			
Thru		P	P		Thru	A			
Right		P	P		Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green		5.0	72.0			27.0			
Yellow		2.0	4.0			4.0			
All Red		0.0	3.0			3.0			

Cycle Length: 120.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	5	2327	165	91	1545	1	88	1	120	0	2	3
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	5	2374	168	93	1577	1	90	1	122	0	2	3
No. Lanes		1	3	1		1	3	0		1	1	0
Lane group		L	T	R		L	TR			L	TR	
Adj flow	5	2374	168	93	1578		90	123			5	
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000			0.000	
Prop RTs		0.000	1.000		0.001			0.992		0.600		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound					Westbound					Northbound					Southbound				
LG	L	T		R		L	T		R		L	T		R		L	T		R	
So	1900	1900	1900	1900	1900						1900	1900							1900	
Lanes	1	3		1	3	0					1	1	0	0	2	0			2	0
fW	1.000	1.000	1.000	1.000	1.000						1.000	1.000							1.000	
fHV	1.000	0.952	0.990	1.000	0.935						0.952	0.971							0.835	
fG	1.000	1.000	1.000	1.000	1.000						1.000	1.000							1.000	
fP	1.000	1.000	1.000	1.000	1.000						1.000	1.000							1.000	
fBB	1.000	1.000	1.000	1.000	1.000						1.000	1.000							1.000	
fA	1.000	1.000	1.000	1.000	1.000						1.000	1.000							1.000	
fLU	1.000	0.908	1.000	1.000	0.908						1.000	1.000							0.952	
fRT		1.000	0.850		1.000							0.851							0.910	
fLT	0.137	1.000		0.950	1.000						0.754	1.000							1.000	
Sec.				0.054																
fLpb	1.000	1.000		1.000	1.000						1.000	1.000							1.000	
fRpb		1.000	1.000		1.000							1.000							1.000	
S	261	4929	1599	1805	4837						1365	1571							2748	
Sec.				103																

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	5	261	0.02	0.60	157	0.03
Prot							
Perm							
Thru	T	2374	4929	# 0.48	0.60	2957	0.80
Right	R	168	1599	0.11	0.60	959	0.18
Westbound							
Prot		75	1805	# 0.04	0.042	75	1.00
Perm		18	103	0.17	0.617	64	0.28
Left	L	93			0.66	139	0.67
Prot							
Perm							
Thru	TR	1578	4837	0.33	0.66	3184	0.50
Right							
Northbound							
Prot							
Perm							
Left	L	90	1365	0.07	0.22	307	0.29
Prot							
Perm							
Thru	TR	123	1571	# 0.08	0.22	353	0.35
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	5	2748	0.00	0.22	618	0.01
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.60
Total lost time per cycle, L = 21.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.73

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	g/C	Unf Del d1	Adj Fact	Prog Cap	Lane Grp k	Incremental Factor	Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound													
L	0.03	0.60	9.8	1.000	157	0.50	0.4	0.0	10.2	B			
T	0.80	0.60	18.5	1.000	2957	0.50	2.4	0.0	20.9	C	20.3	C	
R	0.18	0.60	10.7	1.000	959	0.50	0.4	0.0	11.1	B			
Westbound													
L	0.67	0.66	20.5	1.000	139	0.50	22.7	0.0	43.2	D			
TR	0.50	0.66	10.4	1.000	3184	0.50	0.6	0.0	11.0	B	12.7	B	
Northbound													
L	0.29	0.22	38.6	1.000	307	0.11	0.5	0.0	39.1	D			
TR	0.35	0.22	39.1	1.000	353	0.11	0.6	0.0	39.7	D	39.5	D	
Southbound													
LTR	0.01	0.22	36.1	1.000	618	0.11	0.0	0.0	36.1	D	36.1	D	

Intersection Delay = 18.4 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)	72.0	79.0	27.0	
Effective permitted green time for LT lane group, g(s)	72.0	74.0	27.0	
Opposing effective green time, go (s)	79.0	72.0	27.0	
Number of lanes in LT lane group, N	1	1	1	
Number of lanes in opposing approach, No	3	3	2	
Adjusted LT flow rate, VLT (veh/h)	5	93	90	
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	
Adjusted opposing flow rate, Vo (veh/h)	1578	2374	5	
Lost time for LT lane group, tL	7.00	7.00	7.00	
Computation				
LT volume per cycle, LTC=VLTC/3600	0.17	3.10	3.00	
Opposing lane util. factor, fLUo	0.908	0.908	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	19.31	29.05	0.09	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.34	0.40	0.77	
gq, (see Exhibit C16-4,5,6,7,8)	5.46	45.05	0.00	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	66.54	28.95	27.00	
n=Max(gq-gf)/2,0)	2.73	22.53	0.00	
PTHo=1-PLTo	1.00	1.00	1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	
EL1 (refer to Exhibit C16-3)	6.73	15.98	1.33	
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06	0.05	0.15	
gdiff=max(gq-gf,0)	0.00	0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.14	0.05	0.75	
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.137	0.054	0.754	

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				M
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)				27.0
Effective permitted green time for LT lane group, g(s)				27.0
Opposing effective green time, go (s)				27.0
Number of lanes in LT lane group, N				2
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				0
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				0.00
Adjusted opposing flow rate, Vo (veh/h)				123
Lost time for LT lane group, tL				7.00
Computation				
LT volume per cycle, LTC=VLTC/3600				0.00
Opposing lane util. factor, fLUo	0.908	0.908	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				4.10
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.77
gq, (see Exhibit C16-4,5,6,7,8)				0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf				27.00
n=Max(gq-gf)/2,0)				0.00
PTHo=1-PLTo				1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				0.00
EL1 (refer to Exhibit C16-3)				1.57
EL2=Max((1-Ptho**n)/Plto, 1.0)				1.000
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				0.07
gdiff=max(gq-gf,0)				0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				1.00
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				1.000

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vb1c (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 120.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	93			
v/c ratio from Capacity Worksheet, X	0.67			
Protected phase effective green interval, g (s)	5.0			
Opposing queue effective green interval, gq	45.05			
Unopposed green interval, gu	28.95			
Red time r=(C-g-gq-gu)	41.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.03			
Protected ph. departure rate, Sp=s/3600	0.501			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.07			
XPerm	0.90			
XProt	0.47			
Case	1			
Queue at beginning of green arrow, Qa	1.06			
Queue at beginning of unsaturated green, Qu	1.16			
Residual queue, Qr	0.00			
Uniform Delay, d1	20.5			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Initial Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 18.4 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	T	R	L	TR		L	TR			LTR	
Init Queue	0.0	0.0	0.0	0.0	0.0		0.0	0.0			0.0	
Flow Rate	5	871	168	93	579		90	123			2	
So	1900	1900	1900	1900	1900		1900	1900			1900	
No.Lanes	1	3	1	1	3	0	1	1	0	0	2	0
SL	261	1809	1599	211	1775		1365	1571			1443	
LnCapacity	157	1085	959	139	1168		307	353			324	
Flow Ratio	0.02	0.48	0.11	0.44	0.33		0.07	0.08			0.00	
v/c Ratio	0.03	0.80	0.18	0.67	0.50		0.29	0.35			0.01	
Grn Ratio	0.60	0.60	0.60	0.66	0.66		0.22	0.22			0.22	
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3	3	3	3		3	3			3	
Pltn Ratio	1.00	1.00	1.00	1.00	1.00		1.00	1.00			1.00	
PF2	1.00	1.00	1.00	1.00	1.00		1.00	1.00			1.00	
Q1	0.1	22.4	2.5	1.1	9.8		2.5	3.4			0.1	
kB	0.4	1.5	1.4	0.4	1.6		0.4	0.4			0.4	
Q2	0.0	5.1	0.3	0.6	1.5		0.2	0.2			0.0	
Q Average	0.1	27.5	2.8	1.7	11.3		2.7	3.7			0.1	
Q Spacing	7.6	7.6	7.6	7.6	7.6		7.6	7.6			7.6	
Q Storage	0	0	0	0	0		0	0			0	
Q S Ratio												
70th Percentile Output:												
fB%	1.3	1.2	1.3	1.3	1.2		1.2	1.2			1.2	
BOQ	0.1	33.0	3.5	2.2	13.7		3.2	4.4			0.1	
QSRatio												
85th Percentile Output:												
fB%	1.7	1.4	1.6	1.6	1.4		1.6	1.6			1.6	
BOQ	0.1	38.5	4.4	2.8	16.2		4.2	5.8			0.1	
QSRatio												
90th Percentile Output:												
fB%	2.0	1.5	1.8	1.9	1.6		1.8	1.7			1.8	
BOQ	0.2	41.3	5.0	3.2	17.5		4.6	6.4			0.1	
QSRatio												
95th Percentile Output:												
fB%	2.6	1.6	2.2	2.3	1.7		2.0	2.0			2.1	
BOQ	0.2	44.1	6.1	4.0	19.2		5.4	7.3			0.1	
QSRatio												
98th Percentile Output:												
fB%	3.2	1.7	2.6	2.8	1.9		2.5	2.5			2.7	
BOQ	0.3	46.9	7.1	4.8	21.0		6.7	9.0			0.1	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: AM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Steeles Avenue
Inter.: Steeles Ave / Northwest Gate
Area Type: All other areas
Jurisd: City of Toronto
Year: Total Future Conditions
N/S St: Northwest Gate

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes		1	3	1		1	3	1		1	1	0		1	1	0
LGConfig	L	T	R	L	T	R	L	TR		L	TR		L	T	R
Volume	284	2076	90	96	1544	416	13	0	22	251	0	152
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6		3.6	3.6	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas
Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left		P	P		NB Left	A			
Thru			P	P	Thru	A			
Right			P	P	Right	A			
Peds					Peds				
WB Left		P			SB Left	A			
Thru			P		Thru	A			
Right			P		Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green		6.0	12.0	52.0		30.0			
Yellow		2.0	2.0	4.0		4.0			
All Red		2.0	0.0	3.0		3.0			

Cycle Length: 120.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	394	1805	0.74	0.63	43.7	D		
T	2711	4929	0.78	0.55	23.6	C	25.6	C
R	879	1599	0.10	0.55	13.1	B		
Westbound								
L	153	1805	0.64	0.48	37.7	D		
T	2096	4837	0.75	0.43	31.1	C	31.2	C
R	700	1615	0.61	0.43	30.0	C		
Northbound								
L	283	1133	0.05	0.25	34.2	C		
TR	392	1568	0.06	0.25	34.3	C	34.3	C
Southbound								
L	353	1412	0.73	0.25	48.5	D		
TR	304	1214	0.51	0.25	40.1	D	45.3	D

Intersection Delay = 29.6 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:
Fax:

OPERATIONAL ANALYSIS

Analyst: NA
Intersection: Steeles Ave / Northwest Gate
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: AM Peak Hour
Analysis Year: Total Future Conditions
Project ID: TTC Spadina Station Extension
East/West Street: North/South Street
Steeles Avenue Northwest Gate

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	284	2076	90	96	1544	416	13	0	22	251	0	152
% Heavy Veh	0	5	1	0	7	0	5	0	3	0	0	33
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	72	530	23	24	394	106	4	0	6	64	0	39
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900	1900	1900	1900	1900	1900	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes		1	3	1		1	3	1		1	1	0		1	1	0
LGConfig	L	T	R	L	T	R	L	TR		L	TR		L	T	R
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6		3.6	3.6	
RTOR Vol			0			0			0			0
Adj Flow	290	2118	92	98	1576	424	13	22		256	155	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.000	1.000		1.000			1.000	
Peds	Bikes	0			0			0			0	
Buses	0	0	0	0	0	0	0	0		0	0	
%InProtPhase	0.0			0.0								
Duration	0.25	Area Type: All other areas										

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Arriv. Type	3	3	3	3	3	3	3	3		3	3	
Unit Ext.	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0		2.0	2.0	
Ext of g	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0		2.0	2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left		P	P	P	NB Left	A			
Thru			P	P	Thru	A			
Right			P	P	Right	A			
Peds					Peds				
WB Left		P		P	SB Left	A			
Thru				P	Thru	A			
Right				P	Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green		6.0	12.0	52.0		30.0			
Yellow		2.0	2.0	4.0		4.0			
All Red		2.0	0.0	3.0		3.0			

Cycle Length: 120.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	284	2076	90	96	1544	416	13	0	22	251	0	152
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	290	2118	92	98	1576	424	13	0	22	256	0	155
No. Lanes	1	3	1	1	3	1	1	1	0	1	1	0
Lane group	L	T	R	L	T	R	L	TR		L	TR	
Adj flow	290	2118	92	98	1576	424	13	22		256	155	
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.000	1.000		1.000			1.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	T	R	L	T	R	L	TR		L	TR	
So	1900	1900	1900	1900	1900	1900	1900	1900		1900	1900	
Lanes	1	3	1	1	3	1	1	1	0	1	1	0
fW	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000	1.000	
fHV	1.000	0.952	0.990	1.000	0.935	1.000	0.952	0.971		1.000	0.752	
fG	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000	1.000	
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000	1.000	
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000	1.000	
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000	1.000	
fLU	1.000	0.908	1.000	1.000	0.908	1.000	1.000	1.000		1.000	1.000	
fRT		1.000	0.850		1.000	0.850		0.850			0.850	
fLT	0.950	1.000		0.950	1.000		0.626	1.000		0.743	1.000	
Sec.	0.074			0.077								
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000	1.000		1.000	1.000		1.000			1.000	
S	1805	4929	1599	1805	4837	1615	1133	1568		1412	1214	
Sec.	141			146								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		290	1805	# 0.16	0.183	331	0.88
Perm		0	141	0.00	0.450	63	0.00
Left	L	290			0.63	394	0.74
Prot							
Perm							
Thru	T	2118	4929	0.43	0.55	2711	0.78
Right	R	92	1599	0.06	0.55	879	0.10
Westbound							
Prot		90	1805	0.05	0.050	90	1.00
Perm		8	146	0.05	0.433	63	0.13
Left	L	98			0.48	153	0.64
Prot							
Perm							
Thru	T	1576	4837	# 0.33	0.43	2096	0.75
Right	R	424	1615	0.26	0.43	700	0.61
Northbound							
Prot							
Perm							
Left	L	13	1133	0.01	0.25	283	0.05
Prot							
Perm							
Thru	TR	22	1568	0.01	0.25	392	0.06
Right							
Southbound							
Prot							
Perm							
Left	L	256	1412	# 0.18	0.25	353	0.73
Prot							
Perm							
Thru	TR	155	1214	0.13	0.25	304	0.51
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.67
Total lost time per cycle, L = 21.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.81

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.74	0.63	32.1	1.000	394	0.50	11.6	0.0	43.7	D		
T	0.78	0.55	21.3	1.000	2711	0.50	2.3	0.0	23.6	C	25.6	C
R	0.10	0.55	12.9	1.000	879	0.50	0.2	0.0	13.1	B		
Westbound												
L	0.64	0.48	18.9	1.000	153	0.50	18.8	0.0	37.7	D		
T	0.75	0.43	28.6	1.000	2096	0.50	2.5	0.0	31.1	C	31.2	C
R	0.61	0.43	26.1	1.000	700	0.50	3.9	0.0	30.0	C		
Northbound												
L	0.05	0.25	34.1	1.000	283	0.11	0.1	0.0	34.2	C		
TR	0.06	0.25	34.2	1.000	392	0.11	0.1	0.0	34.3	C	34.3	C
Southbound												
L	0.73	0.25	41.2	1.000	353	0.29	7.3	0.0	48.5	D		
TR	0.51	0.25	38.7	1.000	304	0.12	1.4	0.0	40.1	D	45.3	D

Intersection Delay = 29.6 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)	76.0	58.0	30.0	30.0
Effective permitted green time for LT lane group, g(s)	54.0	52.0	30.0	30.0
Opposing effective green time, go (s)	52.0	66.0	30.0	30.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	3	3	1	1
Adjusted LT flow rate, VLT (veh/h)	290	98	13	256
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	1576	2118	155	22
Lost time for LT lane group, tL	7.00	11.00	7.00	7.00
Computation				
LT volume per cycle, LTC=VLTC/3600	9.67	3.27	0.43	8.53
Opposing lane util. factor, fLUo	0.908	0.908	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	19.29	25.92	5.17	0.73
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.57	0.45	0.75	0.75
gq, (see Exhibit C16-4,5,6,7,8)	32.21	16.06	1.48	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	21.79	35.94	28.52	30.00
n=Max(gq-gf)/2,0)	16.10	8.03	0.74	0.00
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	6.71	12.06	1.52	1.35
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07	0.08	0.13	0.13
qdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.07	0.08	0.63	0.74
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.074	0.077	0.626	0.743

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.908	0.908	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
qdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 120.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	290	98		
v/c ratio from Capacity Worksheet, X	0.74	0.64		
Protected phase effective green interval, g (s)	22.0	6.0		
Opposing queue effective green interval, gq	32.21	16.06		
Unopposed green interval, gu	21.79	35.94		
Red time r=(C-g-gq-gu)	44.0	62.0		
Arrival rate, qa=v/(3600(max[X,1.0]))	0.08	0.03		
Protected ph. departure rate, Sp=s/3600	0.501	0.501		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.10	0.06		
XPerm	2.06	0.67		
XProt	0.48	0.62		
Case	3	1		
Queue at beginning of green arrow, Qa	5.78	1.69		
Queue at beginning of unsaturated green, Qu	2.59	0.44		
Residual queue, Qr	2.24	0.00		
Uniform Delay, d1	32.1	18.9		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 29.6 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	T	R	L	T	R	L	TR		L	TR	
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Flow Rate	290	777	92	98	578	424	13	22		256	155	
So	1900	1900	1900	1900	1900	1900	1900	1900		1900	1900	
No.Lanes	1	3	1	1	3	1	1	1	0	1	1	0
SL	623	1809	1599	1318	1775	1615	1133	1568		1412	1214	
LnCapacity	394	995	879	153	769	700	283	392		353	304	
Flow Ratio	0.47	0.43	0.06	0.31	0.33	0.26	0.01	0.01		0.18	0.13	
v/c Ratio	0.74	0.78	0.10	0.64	0.75	0.61	0.05	0.06		0.73	0.51	
Grn Ratio	0.63	0.55	0.55	0.48	0.43	0.43	0.25	0.25		0.25	0.25	
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3	3	3	3	3	3	3		3	3	
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Q1	4.1	20.4	1.5	1.7	16.2	10.9	0.3	0.6		7.8	4.4	
KB	0.7	1.4	1.3	0.4	1.2	1.1	0.4	0.5		0.4	0.4	
Q2	1.8	4.3	0.1	0.6	3.1	1.6	0.0	0.0		1.1	0.4	
Q Average	5.9	24.7	1.6	2.4	19.3	12.5	0.3	0.6		8.9	4.8	
Q Spacing	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6		7.6	7.6	
Q Storage	0	0	0	0	0	0	0	0		0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2	1.3	1.3	1.2	1.2	1.2	1.2		1.2	1.2	
BOQ	7.2	29.7	2.1	3.0	23.2	15.1	0.4	0.7		10.5	5.8	
QSRatio												
85th Percentile Output:												
fB%	1.5	1.4	1.6	1.6	1.4	1.4	1.6	1.6		1.5	1.6	
BOQ	8.8	34.7	2.6	3.7	27.1	17.7	0.6	0.9		13.5	7.5	
QSRatio												
90th Percentile Output:												
fB%	1.7	1.5	1.9	1.8	1.5	1.5	1.8	1.8		1.7	1.7	
BOQ	9.7	37.2	3.0	4.3	29.2	19.2	0.6	1.0		14.7	8.3	
QSRatio												
95th Percentile Output:												
fB%	1.9	1.6	2.3	2.2	1.6	1.7	2.1	2.1		1.9	2.0	
BOQ	11.2	39.7	3.7	5.2	31.3	21.0	0.7	1.2		16.6	9.5	
QSRatio												
98th Percentile Output:												
fB%	2.2	1.7	2.8	2.6	1.7	1.8	2.7	2.7		2.2	2.4	
BOQ	12.7	42.3	4.5	6.2	33.4	22.7	0.9	1.6		19.6	11.6	
QSRatio												

ERROR MESSAGES

No errors to report.

Steeles West Station - Future Total Traffic Conditions

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: AM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Steeles Avenue

Inter.: Steeles Avenue / Founders Rd
Area Type: All other areas
Jurisd: City of Toronto
Year: Total Future Conditions
N/S St: Founders Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	3	0	1	3	0	1	0	1	0	0	0
LGConfig		TR		L	T		L		R			
Volume		1742	152	148	1957		53		26			
Lane Width		3.6		3.6	3.6		3.6		3.6			
RTOR Vol			0						0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left	A			
Thru		P			Thru				
Right		P			Right	A			
Peds					Peds				
WB Left	P	P			SB Left				
Thru	P	P			Thru				
Right					Right				
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	8.0	61.0				25.0			
Yellow	3.0	4.0				3.0			
All Red	0.0	3.0				3.0			

Cycle Length: 110.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
TR	2627	4738	0.74	0.55	20.3	C	20.3	C
Westbound								
L	199	1787	0.76	0.65	47.3	D		
T	3196	4883	0.62	0.65	12.0	B	14.5	B
Northbound								
L	357	1570	0.15	0.23	34.2	C		
R	232	1022	0.12	0.23	34.0	C	34.1	C
Southbound								

Intersection Delay = 17.6 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:
Fax:

OPERATIONAL ANALYSIS

Analyst:	NA
Intersection:	Steeles Avenue / Founders Rd
Agency/Co.:	URS Canada Inc.
Area Type:	All other areas
Date Performed:	12/9/2004
Jurisdiction:	City of Toronto
Analysis Time Period:	AM Peak Hour
Analysis Year:	Total Future Conditions
Project ID:	TTC Spadina Station Extension
East/West Street:	North/South Street
Steeles Avenue	Founders Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		1742	152	148	1957		53		26			
% Heavy Veh		8	7	1	6		15		58			
PHF		0.98	0.98	0.98	0.98		0.98		0.98			
PK 15 Vol		444	39	38	499		14		7			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900		1900	1900		1900		1900			
ParkExist												
NumPark												
No. Lanes	0	3	0		1	3	0	1	0	1	0	0	0
LGConfig		TR			L	T		L		R			
Lane Width		3.6			3.6	3.6		3.6		3.6			
RTOR Vol			0							0			
Adj Flow		1933			151	1997		54		27			
%InSharedLn													
Prop LTs		0.000			1.000	0.000							
Prop RTs		0.080				0.000				1.000			
Peds Bikes		0						0					
Buses		0			0	0		0		0			
%InProtPhase					0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0		0.0		0.0			
Arriv. Type		3		3	3		3		3			
Unit Ext.		3.0		3.0	3.0		3.0		3.0			
I Factor		1.000			1.000		1.000					
Lost Time		2.0		2.0	2.0		2.0		2.0			
Ext of g		2.0		2.0	2.0		2.0		2.0			
Ped Min g		3.2					3.2			3.2		

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left	A			
Thru		P			Thru				
Right		P			Right	A			
Peds					Peds				
WB Left	P	P			SB Left				
Thru	P	P			Thru				
Right					Right				
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	8.0	61.0				25.0			
Yellow	3.0	4.0				3.0			
All Red	0.0	3.0				3.0			

Cycle Length: 110.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		1742	152	148	1957		53	26				
PHF		0.98	0.98	0.98	0.98		0.98	0.98				
Adj flow		1778	155	151	1997		54	27				
No. Lanes	0	3	0	1	3	0	1	0	1	0	0	0
Lane group		TR		L	T		L	R				
Adj flow		1933		151	1997		54	27				
Prop LTs		0.000		1.000	0.000							
Prop RTs	0.080				0.000			1.000				

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG		TR		L	T		L	R				
So		1900		1900	1900		1900	1900				
Lanes	0	3	0	1	3	0	1	0	1	0	0	0
fW		1.000		1.000	1.000		1.000	1.000				
fHV		0.927		0.990	0.943		0.870	0.633				
fG		1.000		1.000	1.000		1.000	1.000				
fP		1.000		1.000	1.000		1.000	1.000				
fBB		1.000		1.000	1.000		1.000	1.000				
fA		1.000		1.000	1.000		1.000	1.000				
fLU		0.908		1.000	0.908		1.000	1.000				
fRT		0.988			1.000			0.850				
fLT		1.000		0.950	1.000		0.950					
Sec.				0.063								
fLpb		1.000		1.000	1.000		1.000					
fRpb		1.000			1.000			1.000				
S		4738		1787	4883		1570	1022				
Sec.				118								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	1933	4738	# 0.41	0.55	2627	0.74
Right							
Westbound							
Prot		130	1787	# 0.07	0.073	130	1.00
Perm		21	118	0.18	0.582	69	0.30
Left	L	151			0.65	199	0.76
Prot							
Perm							
Thru	T	1997	4883	0.41	0.65	3196	0.62
Right							
Northbound							
Prot							
Perm							
Left	L	54	1570	# 0.03	0.23	357	0.15
Prot							
Perm							
Thru							
Right	R	27	1022	0.03	0.23	232	0.12
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.52
Total lost time per cycle, L = 20.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.63

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay LOS	Approach Delay LOS
Eastbound										
TR	0.74	0.55	18.4	1.000	2627	0.50	1.9	0.0	20.3 C	20.3 C
Westbound										
L	0.76	0.65	23.8	1.000	199	0.50	23.4	0.0	47.3 D	
T	0.62	0.65	11.1	1.000	3196	0.50	0.9	0.0	12.0 B	14.5 B
Northbound										
L	0.15	0.23	34.0	1.000	357	0.11	0.2	0.0	34.2 C	
R	0.12	0.23	33.7	1.000	232	0.11	0.2	0.0	34.0 C	34.1 C
Southbound										

Intersection Delay = 17.6 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach		M		
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)		72.0		
Effective permitted green time for LT lane group, g(s)		64.0		
Opposing effective green time, go (s)		61.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		3		
Adjusted LT flow rate, VLT (veh/h)		151		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		1933		
Lost time for LT lane group, tL		7.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		4.61		
Opposing lane util. factor, fLUo		0.908	0.908	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		21.68		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.45		
gq, (see Exhibit C16-4,5,6,7,8)		31.89		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		32.11		
n=Max(gq-gf)/2,0)		15.94		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		9.86		
EL2=Max((1-Ptho**n)/Plto, 1.0)		0.06		
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.00		
gdiff=max(gq-gf,0)		0.06		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.063		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				0.000 0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo				0.908 0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vb1c (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 110.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	151			
v/c ratio from Capacity Worksheet, X	0.76			
Protected phase effective green interval, g (s)	8.0			
Opposing queue effective green interval, gq	31.89			
Unopposed green interval, gu	32.11			
Red time r=(C-g-gq-gu)	38.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.04			
Protected ph. departure rate, Sp=s/3600	0.496			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.07			
XPerm	1.28			
XProt	0.49			
Case	3			
Queue at beginning of green arrow, Qa	2.18			
Queue at beginning of unsaturated green, Qu	1.34			
Residual queue, Qr	0.59			
Uniform Delay, d1	23.8			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Final Queue Delay d3 sec	Initial Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 17.6 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

	Eastbound	Westbound	Northbound	Southbound
LaneGroup	TR	L T	L R	
Init Queue	0.0	0.0 0.0	0.0 0.0	
Flow Rate	709	151 733	54 27	
So	1900	1900 1900	1900 1900	
No.Lanes	0 3 0	1 3 0	1 1 0	0 0 0
SL	1739	303 1792	1570 1022	
LnCapacity	964	199 1173	357 232	
Flow Ratio	0.41	0.50 0.41	0.03 0.03	
v/c Ratio	0.74	0.76 0.62	0.15 0.12	
Grn Ratio	0.55	0.65 0.65	0.23 0.23	
I Factor	1.000	1.000	1.000	
AT or PVG	3	3 3	3 3	
Pltn Ratio	1.00	1.00 1.00	1.00 1.00	
PF2	1.00	1.00 1.00	1.00 1.00	
Q1	16.3	1.7 13.1	1.3 0.7	
kB	1.3	0.4 1.5	0.4 0.3	
Q2	3.2	1.1 2.3	0.1 0.0	
Q Average	19.5	2.8 15.4	1.4 0.7	
Q Spacing	7.6	7.6 7.6	7.6 7.6	
Q Storage	0	0 0	0 0	
Q S Ratio				
70th Percentile Output:				
fB%	1.2	1.3 1.2	1.2 1.2	
BOQ	23.5	3.5 18.6	1.7 0.8	
QSRatio				
85th Percentile Output:				
fB%	1.4	1.6 1.4	1.6 1.6	
BOQ	27.5	4.4 21.8	2.2 1.1	
QSRatio				
90th Percentile Output:				
fB%	1.5	1.8 1.5	1.8 1.8	
BOQ	29.5	5.0 23.5	2.5 1.2	
QSRatio				
95th Percentile Output:				
fB%	1.6	2.2 1.6	2.1 2.1	
BOQ	31.6	6.1 25.4	2.9 1.4	
QSRatio				
98th Percentile Output:				
fB%	1.7	2.6 1.8	2.6 2.6	
BOQ	33.8	7.2 27.3	3.6 1.8	
QSRatio				

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: AM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Steeles Avenue

Inter.: Steeles Avenue / Keele St
Area Type: All other areas
Jurisd: City of Toronto
Year: Total Future Conditions
N/S St: Keele Street

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	3	1	1	3	0	1	2	1	1	2	1
LGConfig	L	T	R	L	TR		L	T	R	L	T	R
Volume	277	1542	123	168	1720	239	143	668	137	256	1282	348
Lane Width	3.6	3.6	3.6	3.6	3.6		3.6	3.6	3.6	3.6	3.6	3.6
RTOR Vol			0			40			0			40

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left		A			NB Left	P			
Thru		P			Thru		P		
Right		P			Right		P		
Peds					Peds				
WB Left		A			SB Left	P			
Thru		P			Thru		P		
Right		P			Right		P		
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green		13.0	36.0				6.0	35.0	
Yellow		3.0	4.0				2.0	4.0	
All Red		1.0	2.0				2.0	2.0	

Cycle Length: 110.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	247	1543	1.15	0.48	135.3	F		
T	1598	4883	0.98	0.33	55.8	E	65.4	E
R	489	1495	0.26	0.33	28.5	C		
Westbound								
L	256	1612	0.67	0.48	29.5	C		
TR	1592	4865	1.23	0.33	146.2	F	136.8	F
Northbound								
L	148	1530	0.99	0.41	100.1	F		
T	1046	3289	0.65	0.32	35.4	D	44.3	D
R	489	1538	0.29	0.32	29.6	C		
Southbound								
L	216	1641	1.21	0.41	169.4	F		
T	1066	3350	1.23	0.32	148.1	F	133.9	F
R	418	1313	0.75	0.32	45.4	D		

Intersection Delay = 102.8 (sec/veh) Intersection LOS = F

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:
Fax:

OPERATIONAL ANALYSIS

Analyst:	NA
Intersection:	Steeles Avenue / Keele St
Agency/Co.:	URS Canada Inc.
Area Type:	All other areas
Date Performed:	12/9/2004
Jurisdiction:	City of Toronto
Analysis Time Period:	AM Peak Hour
Analysis Year:	Total Future Conditions
Project ID:	TTC Spadina Station Extension
East/West Street:	North/South Street
Steeles Avenue	Keele Street

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	277	1542	123	168	1720	239	143	668	137	256	1282	348
% Heavy Veh	17	6	8	12	4	11	18	10	5	10	8	23
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	71	393	31	43	439	61	36	170	35	65	327	89
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900	1900	1900	1900		1900	1900	1900	1900	1900	1900
ParkExist												
NumPark												
No. Lanes	1	3	1	1	3	0	1	2	1	1	2	1
LGConfig	L	T	R	L	TR		L	T	R	L	T	R
Lane Width	3.6	3.6	3.6	3.6	3.6		3.6	3.6	3.6	3.6	3.6	3.6
RTOR Vol			0			40			0			40
Adj Flow	283	1573	126	171	1958		146	682	140	261	1308	314
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.104			0.000	1.000		0.000	1.000
Peds	Bikes	0			0			0			0	
Buses	0	0	0	0	0		0	0	0	0	0	0
%InProtPhase	0.0			0.0			0.0			0.0		

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Arriv. Type	3	3	3	3	3		3	3	3	3	3	3
Unit Ext.	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0
Ext of g	2.0	2.0	2.0	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left		A			NB Left	P			
Thru			P			Thru		P	
Right			P			Right		P	
Peds						Peds			
WB Left		A		P	SB Left	P		P	
Thru				P		Thru		P	
Right				P		Right		P	
Peds						Peds			
NB Right					EB Right				
SB Right					WB Right				
Green		13.0	36.0				6.0	35.0	
Yellow		3.0	4.0				2.0	4.0	
All Red		1.0	2.0				2.0	2.0	

Cycle Length: 110.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	277	1542	123	168	1720	239	143	668	137	256	1282	348
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	283	1573	126	171	1755	203	146	682	140	261	1308	314
No. Lanes	1	3	1	1	3	0	1	2	1	1	2	1
Lane group	L	T	R	L	T	R	L	T	R	L	T	R
Adj flow	283	1573	126	171	1958		146	682	140	261	1308	314
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.104			0.000	1.000		0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound						Westbound						Northbound						Southbound					
LG	L	T	R	L	T	R	L	T	R	L	T	R	L	T	R	L	T	R	L	T	R	L	T	R
So	1900	1900	1900	1900	1900		1900	1900	1900	1900	1900		1900	1900	1900	1900	1900		1900	1900	1900	1900	1900	
Lanes	1	3	1	1	3	0	1	2	1	1	3	0	1	2	1	1	2	1	1	2	1	1	2	1
fW	1.000	1.000	1.000	1.000	1.000		1.000	1.000	1.000	1.000	1.000		1.000	1.000	1.000	1.000	1.000		1.000	1.000	1.000	1.000	1.000	
fHV	0.855	0.943	0.926	0.893	0.955		0.847	0.909	0.952	0.909	0.926	0.813												
fG	1.000	1.000	1.000	1.000	1.000		1.000	1.000	1.000	1.000	1.000		1.000	1.000	1.000	1.000	1.000		1.000	1.000	1.000	1.000	1.000	
fP	1.000	1.000	1.000	1.000	1.000		1.000	1.000	1.000	1.000	1.000		1.000	1.000	1.000	1.000	1.000		1.000	1.000	1.000	1.000	1.000	
fBB	1.000	1.000	1.000	1.000	1.000		1.000	1.000	1.000	1.000	1.000		1.000	1.000	1.000	1.000	1.000		1.000	1.000	1.000	1.000	1.000	
fA	1.000	1.000	1.000	1.000	1.000		1.000	1.000	1.000	1.000	1.000		1.000	1.000	1.000	1.000	1.000		1.000	1.000	1.000	1.000	1.000	
fLU	1.000	0.908	1.000	1.000	0.908		1.000	0.952	1.000	1.000	0.952													
fRT		1.000	0.850		0.984			1.000	0.850		1.000	0.850												
fLT	0.950	1.000		0.950	1.000		0.950	1.000		0.950	1.000													
Sec.	0.100			0.100			0.103			0.205														
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000													
fRpb		1.000	1.000		1.000			1.000	1.000		1.000	1.000												
S	1543	4883	1495	1612	4865		1530	3289	1538	1641	3350	1313												
Sec.	162			170			165			354														

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Lane Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		182	1543	# 0.12	0.118	182	1.00
Perm		101	162	# 0.62	0.364	65	1.55
Left	L	283			0.48	247	1.15
Prot							
Perm							
Thru	T	1573	4883	0.32	0.33	1598	0.98
Right	R	126	1495	0.08	0.33	489	0.26
Westbound							
Prot		171	1612	0.11	0.118	191	0.90
Perm		0	170	0.00	0.364	65	0.00
Left	L	171			0.48	256	0.67
Prot							
Perm							
Thru	TR	1958	4865	0.33	0.33	1592	1.23
Right							
Northbound							
Prot		83	1530	0.05	0.055	83	1.00
Perm		63	165	0.38	0.355	65	0.97
Left	L	146			0.41	148	0.99
Prot							
Perm							
Thru	T	682	3289	0.21	0.32	1046	0.65
Right	R	140	1538	0.09	0.32	489	0.29
Southbound							
Prot		90	1641	# 0.05	0.055	90	1.00
Perm		171	354	# 0.48	0.355	126	1.36
Left	L	261			0.41	216	1.21
Prot							
Perm							
Thru	T	1308	3350	0.32	0.32	1066	1.23
Right	R	314	1313	0.24	0.32	418	0.75

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 1.28
Total lost time per cycle, L = 12.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.44

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Adj Fact	Prog Cap	Lane Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	1.15	0.48	33.0	1.000	247	0.50	102.3	0.0	135.3	F		
T	0.98	0.33	36.7	1.000	1598	0.50	19.1	0.0	55.8	E	65.4	E
R	0.26	0.33	27.2	1.000	489	0.50	1.3	0.0	28.5	C		
Westbound												
L	0.67	0.48	23.0	1.000	256	0.24	6.5	0.0	29.5	C		
TR	1.23	0.33	37.0	1.000	1592	0.50	109.2	0.0	146.2	F	136.8	F
Northbound												
L	0.99	0.41	29.6	1.000	148	0.50	70.5	0.0	100.1	F		
T	0.65	0.32	32.3	1.000	1046	0.50	3.2	0.0	35.4	D	44.3	D
R	0.29	0.32	28.1	1.000	489	0.50	1.5	0.0	29.6	C		
Southbound												
L	1.21	0.41	40.5	1.000	216	0.50	128.9	0.0	169.4	F		
T	1.23	0.32	37.5	1.000	1066	0.50	110.6	0.0	148.1	F	133.9	F
R	0.75	0.32	33.6	1.000	418	0.50	11.8	0.0	45.4	D		

Intersection Delay = 102.8 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)	53.0	53.0	45.0	45.0
Effective permitted green time for LT lane group, g(s)	40.0	40.0	39.0	39.0
Opposing effective green time, go (s)	36.0	36.0	35.0	35.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	3	3	2	2
Adjusted LT flow rate, VLT (veh/h)	283	171	146	261
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	1958	1573	1308	682
Lost time for LT lane group, tL	6.00	6.00	6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600	8.65	5.22	4.46	7.98
Opposing lane util. factor, fLUo	0.908	0.908	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	21.96	17.64	20.99	10.94
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.67	0.67	0.68	0.68
gq, (see Exhibit C16-4,5,6,7,8)	36.00	34.95	35.00	18.63
gu=g-gq if gq>=gf, or = g-gf if gq<gf	4.00	5.05	4.00	20.37
n=Max(gq-gf)/2,0)	18.00	17.48	17.50	9.32
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	10.13	6.69	4.74	2.55
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.10	0.10	0.10	0.10
gdiff=max(gq-gu, 0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.10	0.10	0.10	0.21
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.100	0.100	0.103	0.205

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.908	0.908	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 110.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	283	171	146	261
v/c ratio from Capacity Worksheet, X	1.15	0.67	0.99	1.21
Protected phase effective green interval, g (s)	13.0	13.0	6.0	6.0
Opposing queue effective green interval, gq	36.00	34.95	35.00	18.63
Unopposed green interval, gu	4.00	5.05	4.00	20.37
Red time r=(C-g-gq-gu)	57.0	57.0	65.0	65.0
Arrival rate, qa=v/(3600(max[X,1.0]))	0.07	0.05	0.04	0.06
Protected ph. departure rate, Sp=s/3600	0.429	0.448	0.425	0.456
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.45	0.37	0.45	0.19
XPerm	1.52	1.01	0.88	0.61
XProt	0.86	0.57	1.13	1.56
Case	3	3	2	2
Queue at beginning of green arrow, Qa	4.86	2.72	2.64	3.90
Queue at beginning of unsaturated green, Qu	2.47	1.66	1.62	4.25
Residual queue, Qr	0.94	0.01	0.33	1.52
Uniform Delay, d1	33.0	23.0	29.6	40.5

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Final Queue Delay d3 sec	Initial Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 102.8 sec/veh Intersection LOS F

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	T	R	L	T	R	L	T	R	L	T	R
Init Queue	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	283	577	126	171	718		146	358	140	261	686	314
So	1900	1900	1900	1900	1900		1900	1900	1900	1900	1900	1900
No.Lanes	1	3	1	1	3	0	1	2	1	1	2	1
SL	501	1792	1495	524	1785		347	1727	1538	526	1759	1313
LnCapacity	247	586	489	256	584		148	549	489	216	559	418
Flow Ratio	0.56	0.32	0.08	0.33	0.40		0.42	0.21	0.09	0.50	0.39	0.24
v/c Ratio	1.15	0.98	0.26	0.67	1.23		0.99	0.65	0.29	1.21	1.23	0.75
Grn Ratio	0.48	0.33	0.33	0.48	0.33		0.41	0.32	0.32	0.41	0.32	0.32
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3	3	3	3		3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Q1	5.1	17.5	2.8	2.9	21.9		2.8	9.4	3.2	5.0	21.0	8.6
KB	0.3	0.9	0.8	0.3	0.9		0.3	0.9	0.8	0.4	0.9	0.7
Q2	6.3	7.5	0.3	0.6	20.7		2.4	1.5	0.3	7.6	19.7	1.9
Q Average	11.4	25.0	3.1	3.6	42.6		5.1	10.9	3.5	12.5	40.6	10.5
Q Spacing	7.6	7.6	7.6	7.6	7.6		7.6	7.6	7.6	7.6	7.6	7.6
Q Storage	0	0	0	0	0		0	0	0	0	0	0
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2	1.3	1.2	1.2		1.2	1.2	1.2	1.2	1.2	1.2
BOQ	13.4	30.1	3.9	4.3	51.1		6.3	13.2	4.4	15.2	48.8	12.7
QSRatio												
85th Percentile Output:												
fB%	1.5	1.4	1.6	1.6	1.4		1.5	1.4	1.5	1.4	1.4	1.4
BOQ	17.2	35.1	4.8	5.6	59.7		7.7	15.7	5.5	17.9	56.9	15.1
QSRatio												
90th Percentile Output:												
fB%	1.6	1.5	1.8	1.7	1.5		1.7	1.6	1.7	1.5	1.5	1.6
BOQ	18.6	37.6	5.5	6.2	63.9		8.6	17.0	6.2	19.3	61.0	16.4
QSRatio												
95th Percentile Output:												
fB%	1.8	1.6	2.1	2.0	1.6		2.0	1.7	2.1	1.7	1.6	1.7
BOQ	20.8	40.2	6.6	7.1	68.2		10.1	18.7	7.4	21.1	65.1	18.1
QSRatio												
98th Percentile Output:												
fB%	2.1	1.7	2.5	2.5	1.7		2.2	1.9	2.4	1.8	1.7	1.9
BOQ	24.2	42.8	7.8	8.8	72.4		11.5	20.4	8.6	22.9	69.1	19.7
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: AM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Proposed East-West Road

Inter.: Jane Street / Prop E-W Rd
Area Type: All other areas
Jurisd: City of Toronto
Year: Total Future Conditions
N/S St: Jane Street

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	1	0	1	0	2	1	1	2	0
LGConfig				L		R		T	R	L	T	
Volume				57		248		1571	155	445	1533	
Lane Width				3.6		3.6		3.6	3.6	3.6	3.6	
RTOR Vol						60			0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left				
Thru					Thru		P		
Right					Right		P		
Peds					Peds				
WB Left		P			SB Left	P	P		
Thru					Thru	P	P		
Right		P			Right				
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right	P			
Green	24.0					28.0	52.0		
Yellow	4.0					2.0	4.0		
All Red	3.0					0.0	3.0		

Cycle Length: 120.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
Westbound								
L	357	1787	0.16	0.20	40.7	D		
R	786	1599	0.24	0.49	18.4	B	23.5	C
Northbound								
T	1493	3445	1.07	0.43	79.9	E	74.7	E
R	666	1538	0.24	0.43	22.3	C		
Southbound								
L	471	1752	0.96	0.68	71.6	E		
T	2354	3445	0.66	0.68	12.5	B	25.8	C

Intersection Delay = 47.0 (sec/veh) Intersection LOS = D

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:
Fax:

OPERATIONAL ANALYSIS

Analyst: NA
Intersection: Jane Street / Prop E-W Rd
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: AM Peak Hour
Analysis Year: Total Future Conditions
Project ID: TTC Spadina Station Extension
East/West Street: North/South Street
Proposed East-West Road Jane Street

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				57		248		1571	155	445	1533	
% Heavy Veh				1		1		5	5	3	5	
PHF				0.98		0.98		0.98	0.98	0.98	0.98	
PK 15 Vol				15		63		401	40	114	391	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat				1900		1900		1900	1900	1900	1900	
ParkExist												
NumPark												
No. Lanes	0	0	0	1	0	1	0	2	1	1	2	0
LGConfig				L		R		T	R	L	T	
Lane Width				3.6		3.6		3.6	3.6	3.6	3.6	
RTOR Vol						60			0			
Adj Flow				58		192		1603	158	454	1564	
%InSharedLn												
Prop LTs								0.000		1.000	0.000	
Prop RTs						1.000		0.000	1.000		0.000	
Peds Bikes	0				0			0				
Buses				0		0		0	0	0	0	
%InProtPhase										0.0		

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0		0.0		0.0	0.0	0.0	0.0	
Arriv. Type				3		3		3	3	3	3	
Unit Ext.				3.0		3.0		3.0	3.0	3.0	3.0	
I Factor					1.000			1.000			1.000	
Lost Time				2.0		2.0		2.0	2.0	2.0	2.0	
Ext of g				2.0		2.0		2.0	2.0	2.0	2.0	
Ped Min g		3.2			3.2			3.2				

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left				
Thru					Thru		P		
Right					Right		P		
Peds					Peds				
WB Left		P			SB Left	P	P		
Thru					Thru	P	P		
Right		P			Right				
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right	P			
Green	24.0					28.0	52.0		
Yellow	4.0					2.0	4.0		
All Red	3.0					0.0	3.0		

Cycle Length: 120.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				57		248		1571	155	445	1533	
PHF				0.98		0.98		0.98	0.98	0.98	0.98	
Adj flow				58		192		1603	158	454	1564	
No. Lanes	0	0	0	1	0	1	0	2	1	1	2	0
Lane group				L		R		T	R	L	T	
Adj flow				58		192		1603	158	454	1564	
Prop LTs								0.000		1.000	0.000	
Prop RTs						1.000		0.000	1.000		0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG				L		R		T	R	L	T	
So				1900		1900		1900	1900	1900	1900	
Lanes	0	0	0	1	0	1	0	2	1	1	2	0
fW				1.000		1.000		1.000	1.000	1.000	1.000	
fHV				0.990		0.990		0.952	0.952	0.971	0.952	
fG				1.000		1.000		1.000	1.000	1.000	1.000	
fP				1.000		1.000		1.000	1.000	1.000	1.000	
fBB				1.000		1.000		1.000	1.000	1.000	1.000	
fA				1.000		1.000		1.000	1.000	1.000	1.000	
fLU				1.000		1.000		0.952	1.000	1.000	0.952	
fRT						0.850		1.000	0.850		1.000	
fLT				0.950				1.000		0.950	1.000	
Sec.										0.074		
fLpb				1.000				1.000		1.000	1.000	
fRpb						1.000		1.000	1.000	1.000	1.000	
S				1787		1599		3445	1538	1752	3445	
Sec.										137		

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left	L	58	1787	# 0.03	0.20	357	0.16
Prot							
Perm							
Thru							
Right	R	192	1599	0.12	0.49	786	0.24
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	1603	3445	# 0.47	0.43	1493	1.07
Right	R	158	1538	0.10	0.43	666	0.24
Southbound							
Prot		409	1752	# 0.23	0.233	409	1.00
Perm		45	137	0.33	0.450	62	0.73
Left	L	454			0.68	471	0.96
Prot							
Perm							
Thru	T	1564	3445	0.45	0.68	2354	0.66
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.73
Total lost time per cycle, L = 21.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.89

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Adj Fact	Prog Cap	Lane Factor k	Incremental Del d2	Res Del d3	Lane Group Delay LOS	Approach Delay LOS
Eastbound										
Westbound										
L	0.16	0.20	39.7	1.000	357	0.50	1.0	0.0	40.7 D	
R	0.24	0.49	17.6	1.000	786	0.50	0.7	0.0	18.4 B	23.5 C
Northbound										
T	1.07	0.43	34.0	1.000	1493	0.50	45.9	0.0	79.9 E	74.7 E
R	0.24	0.43	21.5	1.000	666	0.50	0.8	0.0	22.3 C	
Southbound										
L	0.96	0.68	38.2	1.000	471	0.50	33.4	0.0	71.6 E	
T	0.66	0.68	11.0	1.000	2354	0.50	1.5	0.0	12.5 B	25.8 C

Intersection Delay = 47.0 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				M
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)				82.0
Effective permitted green time for LT lane group, g(s)				54.0
Opposing effective green time, go (s)				52.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				2
Adjusted LT flow rate, VLT (veh/h)				454
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.00
Adjusted opposing flow rate, Vo (veh/h)				1603
Lost time for LT lane group, tL				7.00
Computation				
LT volume per cycle, LTC=VLTC/3600				15.13
Opposing lane util. factor, fLUo				0.952 0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				28.06
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.57
gq, (see Exhibit C16-4,5,6,7,8)				50.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf				4.00
n=Max(gq-gf)/2,0)				25.00
PTHo=1-PLTo				1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				6.38
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				0.07
gdiff=max(gq-gf,0)				0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.07
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.074

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				0.000 0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo				0.952 0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vb1c (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 120.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v				454
v/c ratio from Capacity Worksheet, X				0.96
Protected phase effective green interval, g (s)				28.0
Opposing queue effective green interval, gq				50.00
Unopposed green interval, gu				4.00
Red time r=(C-g-gq-gu)				38.0
Arrival rate, qa=v/(3600(max[X,1.0]))				0.13
Protected ph. departure rate, Sp=s/3600				0.487
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)				0.51
XPerm				3.31
XProt				0.61
Case				3
Queue at beginning of green arrow, Qa				9.55
Queue at beginning of unsaturated green, Qu				6.31
Residual queue, Qr				4.76
Uniform Delay, d1				38.2

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Queue Delay d3 sec	Initial Lane Group d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 47.0 sec/veh Intersection LOS D

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup				L		R		T	R	L	T	
Init Queue				0.0		0.0		0.0	0.0	0.0	0.0	
Flow Rate				58		192		841	158	454	821	
So				1900		1900		1900	1900	1900	1900	
No.Lanes	0	0	0	1	0	1	0	2	1	1	2	0
SL				1787		1599		1809	1538	688	1809	
LnCapacity				357		786		784	666	471	1236	
Flow Ratio				0.03		0.12		0.46	0.10	0.66	0.45	
v/c Ratio				0.16		0.24		1.07	0.24	0.96	0.66	
Grn Ratio				0.20		0.49		0.43	0.43	0.68	0.68	
I Factor					1.000			1.000			1.000	
AT or PVG				3		3		3	3	3	3	
Pltn Ratio				1.00		1.00		1.00	1.00	1.00	1.00	
PF2				1.00		1.00		1.00	1.00	1.00	1.00	
Q1				1.6		3.7		28.0	3.3	6.2	15.9	
kB				0.7		1.2		1.2	1.1	0.8	1.6	
Q2				0.1		0.4		15.2	0.3	5.9	3.0	
Q Average				1.7		4.1		43.3	3.7	12.0	18.9	
Q Spacing				7.6		7.6		7.6	7.6	7.6	7.6	
Q Storage				0		0		0	0	0	0	
Q S Ratio												
70th Percentile Output:												
fB%				1.3		1.2		1.2	1.2	1.2	1.2	
BOQ				2.2		5.1		51.9	4.6	14.6	22.7	
QSRatio												
85th Percentile Output:												
fB%				1.6		1.5		1.4	1.5	1.4	1.4	
BOQ				2.8		6.2		60.6	5.6	17.2	26.6	
QSRatio												
90th Percentile Output:												
fB%				1.9		1.7		1.5	1.7	1.5	1.5	
BOQ				3.2		7.0		64.9	6.4	18.6	28.6	
QSRatio												
95th Percentile Output:												
fB%				2.3		2.0		1.6	2.1	1.7	1.6	
BOQ				4.0		8.3		69.3	7.6	20.3	30.7	
QSRatio												
98th Percentile Output:												
fB%				2.8		2.4		1.7	2.4	1.8	1.7	
BOQ				4.8		9.6		73.6	8.8	22.1	32.8	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: AM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Proposed East-West Road
Inter.: Prop E-W Rd / Fut Street C
Area Type: All other areas
Jurisd: City of Toronto
Year: Total Future Conditions
N/S St: Future Street C

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Volume	161		0				0	700			339	161
Lane Width	3.6		3.6					3.6			3.6	
RTOR Vol			0									0

Duration 0.25 Area Type: All other areas

Phase Combination 1 2 3 4 5 6 7 8

EB	Left		P			NB	Left	P	
	Thru						Thru	P	
	Right		P				Right		
	Peds						Peds		
WB	Left					SB	Left		
	Thru						Thru	P	
	Right						Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		31.0					75.0		
Yellow		4.0					4.0		
All Red		3.0					3.0		

Cycle Length: 120.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	444	1719	0.37	0.26	38.8	D		
							38.8	D
R	405	1568	0.00	0.26	33.0	C		
Westbound								
Northbound								
LT	2153	3445	0.33	0.63	11.1	B	11.1	B
Southbound								
TR	2075	3320	0.25	0.63	10.3	B	10.3	B

Intersection Delay = 14.0 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:
Fax:

OPERATIONAL ANALYSIS

Analyst:	NA
Intersection:	Prop E-W Rd / Fut Street C
Agency/Co.:	URS Canada Inc.
Area Type:	All other areas
Date Performed:	12/9/2004
Jurisdiction:	City of Toronto
Analysis Time Period:	AM Peak Hour
Analysis Year:	Total Future Conditions
Project ID:	TTC Spadina Station Extension
East/West Street:	North/South Street
Proposed East-West Road	Future Street C

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	161		0				0	700			339	161
% Heavy Veh	5		3				4	5			5	1
PHF	0.98		0.98				0.98	0.98			0.98	0.98
PK 15 Vol	41		0				0	179			86	41
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat	1900		1900					1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Lane Width	3.6		3.6					3.6			3.6	
RTOR Vol			0									0
Adj Flow	164		0					714			510	
%InSharedLn												
Prop LTs								0.000			0.000	
Prop RTs			1.000					0.000			0.322	
Peds	Bikes	0		0				0			0	
Buses	0		0					0			0	
%InProtPhase												
Duration	0.25		Area Type: All other areas									

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0					0.0			0.0	
Arriv. Type	3		3					3			3	
Unit Ext.	3.0		3.0					3.0			3.0	
I Factor		1.000						1.000			1.000	
Lost Time	2.0		2.0					2.0			2.0	
Ext of g	2.0		2.0					2.0			2.0	
Ped Min g		3.2			3.2						3.2	

PHASE DATA

Phase Combination 1 2 3 4 5 6 7 8

EB	Left		P			NB	Left	P	
	Thru						Thru	P	
	Right		P				Right		
	Peds						Peds		
WB	Left					SB	Left		
	Thru						Thru	P	
	Right						Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		31.0					75.0		
Yellow		4.0					4.0		
All Red		3.0					3.0		

Cycle Length: 120.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	161		0				0	700			339	161
PHF	0.98		0.98				0.98	0.98			0.98	0.98
Adj flow	164		0				0	714			346	164
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
Lane group	L		R					LT			TR	
Adj flow	164		0					714			510	
Prop LTs								0.000			0.000	
Prop RTs			1.000					0.000			0.322	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L		R					LT			TR	
So	1900		1900					1900			1900	
Lanes	1	0	1	0	0	0	0	2	0	0	2	0
fW	1.000		1.000					1.000			1.000	
fHV	0.952		0.971					0.952			0.964	
fG	1.000		1.000					1.000			1.000	
fP	1.000		1.000					1.000			1.000	
fBB	1.000		1.000					1.000			1.000	
fA	1.000		1.000					1.000			1.000	
fLU	1.000		1.000					0.952			0.952	
fRT			0.850					1.000			0.952	
fLT	0.950							1.000			1.000	
Sec.												
fLpb	1.000							1.000			1.000	
fRpb			1.000					1.000			1.000	
S	1719		1568					3445			3320	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	164	1719	# 0.10	0.26	444	0.37
Prot							
Perm							
Thru							
Right	R	0	1568	0.00	0.26	405	0.00
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	714	3445	# 0.21	0.63	2153	0.33
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	510	3320	0.15	0.63	2075	0.25
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.30
Total lost time per cycle, L = 14.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.34

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay LOS	Approach Delay LOS
Eastbound										
L	0.37	0.26	36.5	1.000	444	0.50	2.4	0.0	38.8 D	
										38.8 D
R	0.00	0.26	33.0	1.000	405	0.50	0.0	0.0	33.0 C	
Westbound										
Northbound										
LT	0.33	0.63	10.6	1.000	2153	0.50	0.4	0.0	11.1 B	11.1 B
Southbound										
TR	0.25	0.63	10.0	1.000	2075	0.50	0.3	0.0	10.3 B	10.3 B

Intersection Delay = 14.0 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo				0.952 0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1*4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach			M	
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)			75.0	
Effective permitted green time for LT lane group, g(s)			75.0	
Opposing effective green time, go (s)			75.0	
Number of lanes in LT lane group, N			2	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			0	
Proportion of LT in LT lane group, PLT			0.000	0.000
Proportion of LT in opposing flow, PLTo			0.00	
Adjusted opposing flow rate, Vo (veh/h)			510	
Lost time for LT lane group, tL			7.00	
Computation				
LT volume per cycle, LTC=VLTC/3600			0.00	
Opposing lane util. factor, fLUo			0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			8.93	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.38	
gq, (see Exhibit C16-4,5,6,7,8)			0.87	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			74.13	
n=Max(gq-gf)/2,0)			0.43	
PTHo=1-PLTo			1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1*4.24)]			0.00	
EL1 (refer to Exhibit C16-3)			2.38	
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.000	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.03	
gdiff=max(gq-gf,0)			0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.99	
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			1.000	

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 120.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time r=(C-g-gq-gu)				
Arrival rate, qa=v/(3600(max[X,1.0]))				
Protected ph. departure rate, Sp=s/3600				
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Final Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 14.0 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L		R					LT			TR	
Init Queue	0.0		0.0					0.0			0.0	
Flow Rate	164		0					374			267	
So	1900		1900					1900			1900	
No.Lanes	1	0	1	0	0	0	0	2	0	0	2	0
SL	1719		1568					1809			1743	
LnCapacity	444		405					1130			1089	
Flow Ratio	0.10		0.00					0.21			0.15	
v/c Ratio	0.37		0.00					0.33			0.25	
Grn Ratio	0.26		0.26					0.63			0.63	
I Factor		1.000						1.000			1.000	
AT or PVG	3		3					3			3	
Pltn Ratio	1.00		1.00					1.00			1.00	
PF2	1.00		1.00					1.00			1.00	
Q1	4.5		0.0					5.9			3.9	
kB	0.8		0.7					1.5			1.5	
Q2	0.5		0.0					0.7			0.5	
Q Average	4.9		0.0					6.6			4.4	
Q Spacing	7.6		7.6					7.6			7.6	
Q Storage	0		0					0			0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2		1.3					1.2			1.2	
BOQ	6.1		0.0					8.1			5.5	
QSRatio												
85th Percentile Output:												
fB%	1.5		1.7					1.5			1.5	
BOQ	7.5		0.0					9.8			6.7	
QSRatio												
90th Percentile Output:												
fB%	1.7		2.0					1.6			1.7	
BOQ	8.3		0.0					10.8			7.5	
QSRatio												
95th Percentile Output:												
fB%	2.0		2.6					1.9			2.0	
BOQ	9.7		0.0					12.4			8.9	
QSRatio												
98th Percentile Output:												
fB%	2.3		3.2					2.1			2.3	
BOQ	11.2		0.0					13.9			10.3	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: AM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Steeles Ave

Inter.: Steeles Ave / TTCBusTermAcc
Area Type: All other areas
Jurisd: City of Toronto
Year: Total Future Conditions
N/S St: TTCBusTermAccess

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	3	0	1	3	0	1	0	1	0	0	0
LGConfig		TR		L	T		L		R			
Volume		2311	38	36	2056		38		36			
Lane Width		3.6		3.6	3.6		3.6		3.6			
RTOR Vol			0						0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left	A			
Thru		P			Thru				
Right		P			Right	A			
Peds					Peds				
WB Left	P	P			SB Left				
Thru	P	P			Thru				
Right					Right				
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	10.0	78.0				15.0			
Yellow	3.0	4.0				4.0			
All Red	0.0	3.0				3.0			

Cycle Length: 120.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
TR	3197	4919	0.82	0.65	18.1	B	18.1	B
Westbound								
L	212	1787	0.17	0.76	16.7	B		
T	3634	4792	0.63	0.76	7.5	A	7.7	A
Northbound								
L	217	1736	0.18	0.13	47.4	D		
R	192	1538	0.19	0.13	47.6	D	47.5	D
Southbound								

Intersection Delay = 13.7 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:
Fax:

OPERATIONAL ANALYSIS

Analyst: NA
Intersection: Steeles Ave / TTCBusTermAcc
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: AM Peak Hour
Analysis Year: Total Future Conditions
Project ID: TTC Spadina Station Extension
East/West Street: East/West Street
North/South Street: Steeles Ave
TTCBusTermAccess

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		2311	38	36	2056		38		36			
% Heavy Veh		5	3	1	8		4		5			
PHF		0.90	0.98	0.98	0.90		0.98		0.98			
PK 15 Vol		642	10	9	571		10		9			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900		1900	1900		1900		1900			
ParkExist												
NumPark												
No. Lanes	0	3	0		1	3	0	1	0	1	0	0	0
LGConfig		TR			L	T		L		R			
Lane Width		3.6			3.6	3.6		3.6		3.6			
RTOR Vol			0					0					
Adj Flow		2607			37	2284		39		37			
%InSharedLn													
Prop LTs		0.000			1.000	0.000							
Prop RTs		0.015			0.000				1.000				
Peds Bikes		0						0			0		
Buses		0			0	0		0		0			
%InProtPhase					0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0		0.0		0.0			
Arriv. Type		3		3	3		3		3			
Unit Ext.		3.0		3.0	3.0		3.0		3.0			
I Factor		1.000			1.000			1.000				
Lost Time		2.0		2.0	2.0		2.0		2.0			
Ext of g		2.0		2.0	2.0		2.0		2.0			
Ped Min g		3.2				3.2				3.2		

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left	A			
Thru		P			Thru				
Right		P			Right	A			
Peds					Peds				
WB Left	P	P			SB Left				
Thru	P	P			Thru				
Right					Right				
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	10.0	78.0				15.0			
Yellow	3.0	4.0				4.0			
All Red	0.0	3.0				3.0			

Cycle Length: 120.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		2311	38	36	2056		38		36			
PHF		0.90	0.98	0.98	0.90		0.98		0.98			
Adj flow		2568	39	37	2284		39		37			
No. Lanes	0	3	0	1	3	0	1	0	1	0	0	0
Lane group		TR		L	T		L		R			
Adj flow		2607		37	2284		39		37			
Prop LTs		0.000		1.000	0.000							
Prop RTs		0.015			0.000				1.000			

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG		TR		L	T		L		R			
So		1900		1900	1900		1900		1900			
Lanes	0	3	0	1	3	0	1	0	1	0	0	0
fW		1.000		1.000	1.000		1.000		1.000			
fHV		0.953		0.990	0.926		0.962		0.952			
fG		1.000		1.000	1.000		1.000		1.000			
fP		1.000		1.000	1.000		1.000		1.000			
fBB		1.000		1.000	1.000		1.000		1.000			
fA		1.000		1.000	1.000		1.000		1.000			
fLU		0.908		1.000	0.908		1.000		1.000			
fRT		0.998			1.000				0.850			
fLT		1.000		0.950	1.000		0.950					
Sec.				0.049								
fLpb		1.000		1.000	1.000		1.000					
fRpb		1.000			1.000				1.000			
S		4919		1787	4792		1736		1538			
Sec.				93								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	2607	4919	# 0.53	0.65	3197	0.82
Right							
Westbound							
Prot		37	1787	# 0.02	0.083	149	0.25
Perm		0	93	0.00	0.675	63	0.00
Left	L	37			0.76	212	0.17
Prot							
Perm							
Thru	T	2284	4792	0.48	0.76	3634	0.63
Right							
Northbound							
Prot							
Perm							
Left	L	39	1736	0.02	0.13	217	0.18
Prot							
Perm							
Thru							
Right	R	37	1538	# 0.02	0.13	192	0.19
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.57
Total lost time per cycle, L = 21.00 Sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.70

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay LOS	Approach Delay LOS
Eastbound										
TR	0.82	0.65	15.6	1.000	3197	0.50	2.4	0.0	18.1 B	18.1 B
Westbound										
L	0.17	0.76	14.9	1.000	212	0.50	1.8	0.0	16.7 B	
T	0.63	0.76	6.7	1.000	3634	0.50	0.8	0.0	7.5 A	7.7 A
Northbound										
L	0.18	0.13	47.0	1.000	217	0.11	0.4	0.0	47.4 D	
R	0.19	0.13	47.1	1.000	192	0.11	0.5	0.0	47.6 D	47.5 D
Southbound										

Intersection Delay = 13.7 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach		M		
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)		91.0		
Effective permitted green time for LT lane group, g(s)		81.0		
Opposing effective green time, go (s)		78.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		3		
Adjusted LT flow rate, VLT (veh/h)		37		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		2607		
Lost time for LT lane group, tL		7.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		1.23		
Opposing lane util. factor, fLUo		0.908	0.908	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		31.90		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.35		
gq, (see Exhibit C16-4,5,6,7,8)		47.68		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		33.32		
n=Max(gq-gf)/2,0)		23.84		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		20.69		
EL2=Max((1-Ptho**n)/Plto, 1.0)		0.05		
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.00		
gdiff=max(gq-gf,0)		0.05		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**		0.049		
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT			0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo			0.908	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vb1c (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 120.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	37			
v/c ratio from Capacity Worksheet, X	0.17			
Protected phase effective green interval, g (s)	10.0			
Opposing queue effective green interval, gq	47.68			
Unopposed green interval, gu	33.32			
Red time r=(C-g-gq-gu)	29.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.01			
Protected ph. departure rate, Sp=s/3600	0.496			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.06			
XPerm	0.40			
XProt	0.08			
Case	1			
Queue at beginning of green arrow, Qa	0.30			
Queue at beginning of unsaturated green, Qu	0.49			
Residual queue, Qr	0.00			
Uniform Delay, d1	14.9			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Final Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 13.7 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		TR		L	T		L		R			
Init Queue		0.0		0.0	0.0		0.0		0.0			
Flow Rate		957		37	838		39		37			
So		1900		1900	1900		1900		1900			
No.Lanes	0	3	0	1	3	0	1	0	1	0	0	0
SL		1805		279	1759		1736		1538			
LnCapacity		1173		212	1334		217		192			
Flow Ratio		0.53		0.13	0.48		0.02		0.02			
v/c Ratio		0.82		0.17	0.63		0.18		0.19			
Grn Ratio		0.65		0.76	0.76		0.13		0.13			
I Factor		1.000			1.000			1.000				
AT or PVG		3		3	3		3		3			
Pltn Ratio		1.00		1.00	1.00		1.00		1.00			
PF2		1.00		1.00	1.00		1.00		1.00			
Q1		23.8		0.3	12.9		1.2		1.1			
kB		1.6		0.5	1.7		0.3		0.3			
Q2		5.7		0.1	2.8		0.1		0.1			
Q Average		29.5		0.4	15.7		1.2		1.2			
Q Spacing		7.6		7.6	7.6		7.6		7.6			
Q Storage		0		0	0		0		0			
Q S Ratio												
70th Percentile Output:												
fB%		1.2		1.3	1.2		1.2		1.2			
BOQ		35.4		0.5	18.9		1.5		1.4			
QSRatio												
85th Percentile Output:												
fB%		1.4		1.7	1.4		1.6		1.6			
BOQ		41.3		0.7	22.1		2.0		1.9			
QSRatio												
90th Percentile Output:												
fB%		1.5		2.0	1.5		1.8		1.8			
BOQ		44.3		0.8	23.8		2.2		2.1			
QSRatio												
95th Percentile Output:												
fB%		1.6		2.5	1.6		2.1		2.1			
BOQ		47.3		1.0	25.7		2.5		2.4			
QSRatio												
98th Percentile Output:												
fB%		1.7		3.1	1.8		2.6		2.6			
BOQ		50.2		1.2	27.6		3.2		3.1			
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: PM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Steeles Avenue

Inter.: Steeles Avenue / Jane Street
Area Type: All other areas
Jurisd: City of Toronto
Year: Total Future Conditions
N/S St: Jane Street

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	0	1	2	1	1	2	1	1	2	1
LGConfig	L	TR		L	T	R	L	T	R	L	T	R
Volume	252	1346	133	243	1627	366	168	911	204	322	1105	520
Lane Width	3.6	3.6		3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
RTOR Vol			0			0			0			120

Duration 0.25 Area Type: All other areas

Phase Combination 1 2 3 4 | 5 6 7 8

EB	Left		P			NB	Left	P			P	
	Thru		P				Thru				P	
	Right		P				Right				P	
	Peds						Peds					
WB	Left		P			SB	Left	P		P		P
	Thru		P				Thru			P		P
	Right		P				Right			P		P
	Peds						Peds					
NB	Right					EB	Right					
SB	Right					WB	Right					
Green		10.0	47.0					8.0	7.0	24.0		
Yellow		2.0	4.0					2.0	2.0	4.0		
All Red		2.0	3.0					2.0	0.0	3.0		

Cycle Length: 120.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	203	1719	1.27	0.51	188.1	F		
TR	1276	3258	1.18	0.39	127.0	F	135.9	F
Westbound								
L	213	1805	1.16	0.51	148.5	F		
T	1254	3201	1.32	0.39	187.8	F	158.3	F
R	620	1583	0.60	0.39	33.3	C		
Northbound								
L	177	1736	0.97	0.27	99.2	F		
T	683	3413	1.36	0.20	220.1	F	178.1	F
R	311	1553	0.67	0.20	55.2	E		
Southbound								
L	336	1736	0.98	0.38	78.4	E		
T	956	3478	1.18	0.28	135.3	F	114.5	F
R	411	1495	0.99	0.28	86.0	F		

Intersection Delay = 145.1 (sec/veh) Intersection LOS = F

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst:	NA
Intersection:	Steeles Avenue / Jane Street
Agency/Co.:	URS Canada Inc.
Area Type:	All other areas
Date Performed:	12/9/2004
Jurisdiction:	City of Toronto
Analysis Time Period:	PM Peak Hour
Analysis Year:	Total Future Conditions
Project ID:	TTC Spadina Station Extension
East/West Street:	North/South Street
	Steeles Avenue Jane Street

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	252	1346	133	243	1627	366	168	911	204	322	1105	520
% Heavy Veh	5	10	5	0	13	2	4	6	4	4	4	8
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	64	343	34	62	415	93	43	232	52	82	282	133
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900	1900	1900	1900	1900	1900	1900	1900
ParkExist												
NumPark												
No. Lanes	1	2	0	1	2	1	1	2	1	1	2	1
LGConfig	L	TR		L	T	R	L	T	R	L	T	R
Lane Width	3.6	3.6		3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
RTOR Vol			0			0			0			120
Adj Flow	257	1509		248	1660	373	171	930	208	329	1128	408
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.090			0.000	1.000		0.000	1.000		0.000	1.000
Peds	Bikes	0			0			0			0	
Buses	0	0		0	0	0	0	0	0	0	0	0
%InProtPhase	0.0			0.0			0.0			0.0		

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Arriv. Type	3	3		3	3	3	3	3	3	3	3	3
Unit Ext.	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Ext of g	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination 1 2 3 4 | 5 6 7 8

EB	Left		P			NB	Left	P			P	
	Thru		P				Thru				P	
	Right		P				Right				P	
	Peds						Peds					
WB	Left		P			SB	Left	P		P		P
	Thru		P				Thru			P		P
	Right		P				Right			P		P
	Peds						Peds					
NB	Right					EB	Right					
SB	Right					WB	Right					
Green		10.0	47.0					8.0	7.0	24.0		
Yellow		2.0	4.0					2.0	2.0	4.0		
All Red		2.0	3.0					2.0	0.0	3.0		

Cycle Length: 120.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	252	1346	133	243	1627	366	168	911	204	322	1105	520
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	257	1373	136	248	1660	373	171	930	208	329	1128	408
No. Lanes	1	2	0	1	2	1	1	2	1	1	2	1
Lane group	L	TR		L	T	R	L	T	R	L	T	R
Adj flow	257	1509		248	1660	373	171	930	208	329	1128	408
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.090			0.000	1.000		0.000	1.000		0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	TR		L	T	R	L	T	R	L	T	R
So	1900	1900		1900	1900	1900	1900	1900	1900	1900	1900	1900
Lanes	1	2	0	1	2	1	1	2	1	1	2	1
fW	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fHV	0.952	0.913		1.000	0.885	0.980	0.962	0.943	0.962	0.962	0.962	0.926
fG	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fP	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fBB	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fA	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fLU	1.000	0.952		1.000	0.952	1.000	1.000	0.952	1.000	1.000	0.952	1.000
fRT		0.986			1.000	0.850		1.000	0.850		1.000	0.850
fLT	0.950	1.000		0.950	1.000		0.950	1.000		0.950	1.000	
Sec.	0.078			0.078			0.167			0.154		
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000			1.000	1.000		1.000	1.000		1.000	1.000
S	1719	3258		1805	3201	1583	1736	3413	1553	1736	3478	1495
Sec.	142			149			304			281		

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		143	1719	# 0.08	0.083	143	1.00
Perm		114	142	# 0.80	0.425	60	1.90
Left	L	257			0.51	203	1.27
Prot							
Perm							
Thru	TR	1509	3258	0.39	0.39	1276	1.18
Right							
Westbound							
Prot		150	1805	0.08	0.083	150	1.00
Perm		98	149	0.66	0.425	63	1.56
Left	L	248			0.51	213	1.16
Prot							
Perm							
Thru	T	1660	3201	0.39	0.39	1254	1.32
Right	R	373	1583	0.24	0.39	620	0.60
Northbound							
Prot		116	1736	0.07	0.067	116	1.00
Perm		55	304	0.18	0.200	61	0.90
Left	L	171			0.27	177	0.97
Prot							
Perm							
Thru	T	930	3413	# 0.20	0.20	683	1.36
Right	R	208	1553	0.13	0.20	311	0.67
Southbound							
Prot		275	1736	# 0.16	0.158	275	1.00
Perm		54	281	0.19	0.217	61	0.89
Left	L	329			0.38	336	0.98
Prot							
Perm							
Thru	T	1128	3478	0.27	0.28	956	1.18
Right	R	408	1495	0.27	0.28	411	0.99

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 1.24
Total lost time per cycle, L = 21.00 Sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.51

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	1.27	0.51	35.4	1.000	203	0.50	152.8	0.0	188.1	F		
TR	1.18	0.39	36.5	1.000	1276	0.50	90.5	0.0	127.0	F	135.9	F
Westbound												
L	1.16	0.51	35.4	1.000	213	0.50	113.1	0.0	148.5	F		
T	1.32	0.39	36.5	1.000	1254	0.50	151.3	0.0	187.8	F	158.3	F
R	0.60	0.39	29.0	1.000	620	0.50	4.3	0.0	33.3	C		
Northbound												
L	0.97	0.27	39.9	1.000	177	0.50	59.3	0.0	99.2	F		
T	1.36	0.20	48.0	1.000	683	0.50	172.1	0.0	220.1	F	178.1	F
R	0.67	0.20	44.3	1.000	311	0.50	10.9	0.0	55.2	E		
Southbound												
L	0.98	0.38	34.3	1.000	336	0.50	44.1	0.0	78.4	E		
T	1.18	0.28	43.5	1.000	956	0.50	91.8	0.0	135.3	F	114.5	F
R	0.99	0.28	43.4	1.000	411	0.50	42.6	0.0	86.0	F		

Intersection Delay = 145.1 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)	61.0	61.0	32.0	45.0
Effective permitted green time for LT lane group, g(s)	51.0	51.0	24.0	26.0
Opposing effective green time, go (s)	47.0	47.0	33.0	24.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	2	2	2	2
Adjusted LT flow rate, VLT (veh/h)	257	248	171	329
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	1660	1509	1128	930
Lost time for LT lane group, tL	7.00	7.00	11.00	7.00
Computation				
LT volume per cycle, LTC=VLTC/3600	8.57	8.27	5.70	10.97
Opposing lane util. factor, fLUo	0.952	0.952	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	29.06	26.42	19.75	16.28
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.61	0.61	0.73	0.80
gq, (see Exhibit C16-4,5,6,7,8)	47.00	47.00	20.00	22.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	4.00	4.00	4.00	4.00
n=Max(gq-gf)/2,0)	23.50	23.50	10.00	11.00
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	6.76	5.80	3.95	3.25
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.08	0.08	0.17	0.15
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.08	0.08	0.17	0.15
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.078	0.078	0.167	0.154

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 120.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	257	248	171	329
v/c ratio from Capacity Worksheet, X	1.27	1.16	0.97	0.98
Protected phase effective green interval, g (s)	10.0	10.0	8.0	19.0
Opposing queue effective green interval, gq	47.00	47.00	20.00	22.00
Unopposed green interval, gu	4.00	4.00	4.00	4.00
Red time r=(C-g-gq-gu)	59.0	59.0	88.0	75.0
Arrival rate, qa=v/(3600(max[X,1.0]))	0.06	0.06	0.05	0.09
Protected ph. departure rate, Sp=s/3600	0.478	0.501	0.482	0.482
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.50	0.53	0.51	0.51
XPerm	1.43	1.43	0.56	1.17
XProt	0.81	0.81	1.18	0.94
Case	3	3	2	3
Queue at beginning of green arrow, Qa	4.19	4.40	4.18	7.20
Queue at beginning of unsaturated green, Qu	2.65	2.78	1.46	2.01
Residual queue, Qr	0.86	0.91	0.70	0.35
Uniform Delay, d1	35.4	35.4	39.9	34.3

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Final Queue Delay d3 sec	Initial Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 145.1 sec/veh Intersection LOS F

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	TR		L	T	R	L	T	R	L	T	R
Init Queue	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	257	792		248	871	373	171	488	208	329	592	408
So	1900	1900		1900	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	2	0	1	2	1	1	2	1	1	2	1
SL	401	1711		420	1681	1583	662	1792	1553	895	1826	1495
LnCapacity	203	670		213	658	620	177	358	311	336	502	411
Flow Ratio	0.64	0.46		0.59	0.52	0.24	0.26	0.27	0.13	0.37	0.32	0.27
v/c Ratio	1.27	1.18		1.16	1.32	0.60	0.97	1.36	0.67	0.98	1.18	0.99
Grn Ratio	0.51	0.39		0.51	0.39	0.39	0.27	0.20	0.20	0.38	0.28	0.28
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3		3	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	4.6	26.4		4.4	29.0	9.9	4.5	16.3	6.4	8.1	19.7	13.6
kB	0.5	1.1		0.5	1.0	1.0	0.4	0.7	0.6	0.7	0.9	0.7
Q2	8.5	20.4		6.6	30.4	1.4	2.6	18.5	1.1	4.8	15.4	6.0
Q Average	13.1	46.8		11.0	59.4	11.3	7.1	34.8	7.5	12.9	35.1	19.6
Q Spacing	7.6	7.6		7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Q Storage	0	0		0	0	0	0	0	0	0	0	0
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2		1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
BOQ	15.8	56.1		13.4	71.3	13.7	8.7	41.7	9.2	15.5	42.2	23.5
QSRatio												
85th Percentile Output:												
fB%	1.4	1.4		1.4	1.4	1.4	1.5	1.4	1.5	1.4	1.4	1.4
BOQ	18.6	65.5		15.8	83.2	16.2	10.4	48.7	11.1	18.3	49.2	27.5
QSRatio												
90th Percentile Output:												
fB%	1.5	1.5		1.6	1.5	1.6	1.6	1.5	1.6	1.5	1.5	1.5
BOQ	20.1	70.2		17.2	89.1	17.6	11.5	52.2	12.2	19.8	52.7	29.5
QSRatio												
95th Percentile Output:												
fB%	1.7	1.6		1.7	1.6	1.7	1.8	1.6	1.8	1.7	1.6	1.6
BOQ	21.9	74.8		18.9	95.0	19.3	13.1	55.7	13.7	21.6	56.2	31.7
QSRatio												
98th Percentile Output:												
fB%	1.8	1.7		1.9	1.7	1.9	2.1	1.7	2.0	1.8	1.7	1.7
BOQ	23.7	79.5		20.6	101	21.0	14.6	59.1	15.3	23.3	59.8	33.8
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: PM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Steeles Avenue

Inter.: Steeles Ave / MurrayRoss Pkwy
Area Type: All other areas
Jurisd: City of Toronto
Year: Total Future Conditions
N/S St: Murray Ross Parkway

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes		1	3	1		1	3	0		1	1	0
LGConfig		L	T	R		L	TR			L	TR	
Volume		17	1725	153		161	2283	2		322	3	92
Lane Width		3.6	3.6	3.6		3.6	3.6			3.6	3.6	
RTOR Vol				0				0				0

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes		0	2	0		1	2	0		1	1	0
LGConfig			TR			L	TR			L	TR	
Volume		10	2	12		24	1	2		17	1725	153
Lane Width			3.6			3.6	3.6			3.6	3.6	3.6
RTOR Vol				0				0				0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left		P			NB Left	A			
Thru		P			Thru	A			
Right		P			Right	A			
Peds					Peds				
WB Left	P	P			SB Left	A			
Thru	P	P			Thru	A			
Right	P	P			Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	13.0	57.0				34.0			
Yellow	2.0	4.0				4.0			
All Red	0.0	3.0				3.0			

Cycle Length: 120.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	63	133	0.27	0.47	29.2	C		
T	2319	4883	0.76	0.47	28.3	C	27.5	C
R	760	1599	0.21	0.47	18.9	B		
Westbound								
L	257	1787	0.64	0.60	37.8	D		
TR	2929	4882	0.80	0.60	20.7	C	21.8	C
Northbound								
L	395	1394	0.83	0.28	54.5	D		
TR	460	1624	0.21	0.28	33.0	C	49.6	D
Southbound								
LTR	793	2800	0.03	0.28	31.1	C	31.1	C

Intersection Delay = 26.6 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:
Fax:

OPERATIONAL ANALYSIS

Analyst:	NA
Intersection:	Steeles Ave / MurrayRoss Pkwy
Agency/Co.:	URS Canada Inc.
Area Type:	All other areas
Date Performed:	12/9/2004
Jurisdiction:	City of Toronto
Analysis Time Period:	PM Peak Hour
Analysis Year:	Total Future Conditions
Project ID:	TTC Spadina Station Extension
East/West Street:	North/South Street
Steeles Avenue	Murray Ross Parkway

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	17	1725	153	161	2283	2	322	3	92	10	2	12
% Heavy Veh	0	6	1	1	6	0	1	0	0	0	50	0
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	5	440	39	41	582	1	82	1	23	3	1	3
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900	1900	1900	1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes		1	3	1		1	3	0		1	1	0
LGConfig		L	T	R		L	TR			L	TR	
Lane Width	3.6	3.6	3.6	3.6	3.6		3.6	3.6			3.6	
RTOR Vol			0			0			0			0
Adj Flow	17	1760	156	164	2332		329	97			24	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000			0.417	
Prop RTs		0.000	1.000		0.001			0.969		0.500		
Peds	Bikes	0			0			0		0		
Buses	0	0	0	0	0		0	0			0	
%InProtPhase				0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0		0.0	0.0			0.0	
Arriv. Type	3	3	3	3	3		3	3			3	
Unit Ext.	3.0	3.0	3.0	3.0	3.0		3.0	3.0			3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0		2.0	2.0			2.0	
Ext of g	2.0	2.0	2.0	2.0	2.0		2.0	2.0			2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left		P			NB Left	A			
Thru		P			Thru	A			
Right		P			Right	A			
Peds					Peds				
WB Left	P	P			SB Left	A			
Thru	P	P			Thru	A			
Right	P	P			Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	13.0	57.0				34.0			
Yellow	2.0	4.0				4.0			
All Red	0.0	3.0				3.0			

Cycle Length: 120.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		17	1725	153		161	2283	2		322	3	92
PHF		0.98	0.98	0.98		0.98	0.98	0.98		0.98	0.98	0.98
Adj flow		17	1760	156		164	2330	2		329	3	94
No. Lanes		1	3	1		1	3	0		1	1	0
Lane group		L	T	R		L	TR			L	TR	
Adj flow		17	1760	156		164	2332			329	97	
Prop LTs		1.000	0.000			1.000	0.000			1.000	0.000	
Prop RTs			0.000	1.000			0.001				0.969	

Volume, V		10	2	12
PHF		0.98	0.98	0.98
Adj flow		10	2	12
No. Lanes		0	2	0
Lane group			LTR	
Adj flow			24	
Prop LTs			0.417	
Prop RTs		0.500		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	T	R	L	T	R	L	T	R	L	T	R
So	1900	1900	1900	1900	1900		1900	1900			1900	
Lanes	1	3		1	3	0	1		0	0	2	0
fW	1.000	1.000	1.000	1.000	1.000		1.000	1.000			1.000	
fHV	1.000	0.943	0.990	0.990	0.943		0.990	1.000			0.960	
fG	1.000	1.000	1.000	1.000	1.000		1.000	1.000			1.000	
fP	1.000	1.000	1.000	1.000	1.000		1.000	1.000			1.000	
fBB	1.000	1.000	1.000	1.000	1.000		1.000	1.000			1.000	
fA	1.000	1.000	1.000	1.000	1.000		1.000	1.000			1.000	
fLU	1.000	0.908	1.000	1.000	0.908		1.000	1.000			0.952	
fRT		1.000	0.850		1.000			0.855			0.925	
fLT	0.070	1.000		0.950	1.000		0.741	1.000			0.872	
Sec.				0.068								
fLpb	1.000	1.000		1.000	1.000		1.000	1.000			1.000	
fRpb		1.000	1.000		1.000			1.000			1.000	
S	133	4883	1599	1787	4882		1394	1624			2800	
Sec.				128								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	Lane Group Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	17	133	0.13	0.47	63	0.27
Prot							
Perm							
Thru	T	1760	4883	0.36	0.47	2319	0.76
Right	R	156	1599	0.10	0.47	760	0.21
Westbound							
Prot		164	1787	0.09	0.108	194	0.85
Perm		0	128	0.00	0.492	63	0.00
Left	L	164			0.60	257	0.64
Prot							
Perm							
Thru	TR	2332	4882	# 0.48	0.60	2929	0.80
Right							
Northbound							
Prot							
Perm							
Left	L	329	1394	# 0.24	0.28	395	0.83
Prot							
Perm							
Thru	TR	97	1624	0.06	0.28	460	0.21
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	24	2800	0.01	0.28	793	0.03
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.71
Total lost time per cycle, L = 14.00 Sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.81

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Adj Fact	Prog Cap	Lane Grp k	Incremental Factor	Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound													
L	0.27	0.47	19.0	1.000	63	0.50		10.2	0.0	29.2	C		
T	0.76	0.47	25.9	1.000	2319	0.50		2.4	0.0	28.3	C	27.5	C
R	0.21	0.47	18.3	1.000	760	0.50		0.6	0.0	18.9	B		
Westbound													
L	0.64	0.60	26.3	1.000	257	0.50		11.5	0.0	37.8	D		
TR	0.80	0.60	18.4	1.000	2929	0.50		2.3	0.0	20.7	C	21.8	C
Northbound													
L	0.83	0.28	40.3	1.000	395	0.37		14.1	0.0	54.5	D		
TR	0.21	0.28	32.8	1.000	460	0.11		0.2	0.0	33.0	C	49.6	D
Southbound													
LTR	0.03	0.28	31.1	1.000	793	0.11		0.0	0.0	31.1	C	31.1	C

Intersection Delay = 26.6 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)	57.0	72.0	34.0	
Effective permitted green time for LT lane group, g(s)	57.0	59.0	34.0	
Opposing effective green time, go (s)	72.0	57.0	34.0	
Number of lanes in LT lane group, N	1	1	1	
Number of lanes in opposing approach, No	3	3	2	
Adjusted LT flow rate, VLT (veh/h)	17	164	329	
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.42	
Adjusted opposing flow rate, Vo (veh/h)	2332	1760	24	
Lost time for LT lane group, tL	7.00	7.00	7.00	
Computation				
LT volume per cycle, LTC=VLTC/3600	0.57	5.47	10.97	
Opposing lane util. factor, fLUo	0.908	0.908	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	28.54	21.54	0.42	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.40	0.52	0.72	
gq, (see Exhibit C16-4,5,6,7,8)	21.53	35.28	0.00	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	35.47	23.72	34.00	
n=Max(gq-gf)/2,0)	10.77	17.64	0.00	
PTHo=1-PLTo	1.00	1.00	0.58	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	
EL1 (refer to Exhibit C16-3)	15.26	0.18	1.35	
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07	0.07	0.12	
gdiff=max(gq-gf,0)	0.00	0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.07	0.07	0.74	
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.070	0.068	0.741	

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				M
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)				34.0
Effective permitted green time for LT lane group, g(s)				34.0
Opposing effective green time, go (s)				34.0
Number of lanes in LT lane group, N				2
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				10
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.417
Proportion of LT in opposing flow, PLTo				0.00
Adjusted opposing flow rate, Vo (veh/h)				97
Lost time for LT lane group, tL				7.00
Computation				
LT volume per cycle, LTC=VLTC/3600				0.33
Opposing lane util. factor, fLUo	0.908	0.908	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				3.23
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				15.8
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.72
gq, (see Exhibit C16-4,5,6,7,8)				0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf				18.24
n=Max(gq-gf)/2,0)				0.00
PTHo=1-PLTo				1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				0.86
EL1 (refer to Exhibit C16-3)				1.52
EL2=Max((1-Ptho**n)/Plto, 1.0)				1.000
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				0.11
gdiff=max(gq-gf,0)				0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.83
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.872

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 120.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	164			
v/c ratio from Capacity Worksheet, X	0.64			
Protected phase effective green interval, g (s)	13.0			
Opposing queue effective green interval, gq	35.28			
Unopposed green interval, gu	23.72			
Red time r=(C-g-gq-gu)	48.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.05			
Protected ph. departure rate, Sp=s/3600	0.496			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.09			
XPerm	1.28			
XProt	0.43			
Case	3			
Queue at beginning of green arrow, Qa	2.78			
Queue at beginning of unsaturated green, Qu	1.61			
Residual queue, Qr	0.59			
Uniform Delay, d1	26.3			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Final Queue Delay d3 sec	Initial Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 26.6 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	T	R	L	TR		L	TR			LTR	
Init Queue	0.0	0.0	0.0	0.0	0.0		0.0	0.0			0.0	
Flow Rate	17	646	156	164	856		329	97			12	
So	1900	1900	1900	1900	1900		1900	1900			1900	
No.Lanes	1	3	1	1	3	0	1	1	0	0	2	0
SL	133	1792	1599	428	1792		1394	1624			1470	
LnCapacity	63	851	760	257	1075		395	460			416	
Flow Ratio	0.13	0.36	0.10	0.38	0.48		0.24	0.06			0.01	
v/c Ratio	0.27	0.76	0.21	0.64	0.80		0.83	0.21			0.03	
Grn Ratio	0.47	0.47	0.47	0.60	0.60		0.28	0.28			0.28	
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3	3	3	3		3	3			3	
Pltn Ratio	1.00	1.00	1.00	1.00	1.00		1.00	1.00			1.00	
PF2	1.00	1.00	1.00	1.00	1.00		1.00	1.00			1.00	
Q1	0.3	17.7	3.0	2.3	21.9		10.3	2.5			0.3	
kB	0.2	1.2	1.2	0.5	1.5		0.5	0.5			0.5	
Q2	0.1	3.5	0.3	0.9	4.9		1.9	0.1			0.0	
Q Average	0.4	21.1	3.3	3.2	26.7		12.2	2.6			0.3	
Q Spacing	7.6	7.6	7.6	7.6	7.6		7.6	7.6			7.6	
Q Storage	0	0	0	0	0		0	0			0	
Q S Ratio												
70th Percentile Output:												
fB%	1.3	1.2	1.3	1.3	1.2		1.2	1.2			1.2	
BOQ	0.5	25.4	4.2	4.0	32.1		14.3	3.1			0.4	
QSRatio												
85th Percentile Output:												
fB%	1.7	1.4	1.6	1.6	1.4		1.5	1.6			1.6	
BOQ	0.7	29.7	5.2	5.0	37.5		18.3	4.1			0.5	
QSRatio												
90th Percentile Output:												
fB%	2.0	1.5	1.8	1.8	1.5		1.6	1.8			1.8	
BOQ	0.8	31.9	5.8	5.7	40.2		19.7	4.6			0.5	
QSRatio												
95th Percentile Output:												
fB%	2.5	1.6	2.1	2.1	1.6		1.8	2.0			2.1	
BOQ	1.0	34.1	7.0	6.9	42.9		22.0	5.3			0.6	
QSRatio												
98th Percentile Output:												
fB%	3.1	1.7	2.5	2.5	1.7		2.1	2.5			2.7	
BOQ	1.3	36.4	8.2	8.0	45.6		25.5	6.6			0.8	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: PM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Steeles Avenue

Inter.: Steeles Ave / Northwest Gate
Area Type: All other areas
Jurisd: City of Toronto
Year: Total Future Conditions
N/S St: Northwest Gate

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes		1	3	1	1	3	1	1	1	0	1	1	0
LGConfig	L	T	R	L	T	R	L	TR			L	TR	
Volume	152	1684	91	84	2194	186	44	0	53		481	0	284
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6			3.6	3.6	
RTOR Vol			0			0			0				60

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left		A			NB Left	A			
Thru		A			Thru	A			
Right		A			Right	A			
Peds					Peds				
WB Left			P		SB Left	A			
Thru			P		Thru	A			
Right			P		Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green		6.0	64.0			34.0			
Yellow		2.0	4.0			4.0			
All Red		0.0	3.0			3.0			

Cycle Length: 120.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	153	1805	1.10	0.60	137.3	F		
T	2957	4929	0.63	0.60	15.9	B	25.2	C
R	959	1599	0.11	0.60	10.3	B		
Westbound								
L	85	159	1.09	0.53	153.5	F		
T	2580	4837	0.94	0.53	35.2	D	37.7	D
R	861	1615	0.24	0.53	15.6	B		
Northbound								
L	248	875	0.20	0.28	33.0	C		
TR	444	1568	0.13	0.28	32.2	C	32.6	C
Southbound								
L	387	1365	1.38	0.28	229.4	F		
TR	344	1214	0.72	0.28	46.1	D	171.1	F

Intersection Delay = 51.1 (sec/veh) Intersection LOS = D

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:
Fax:

OPERATIONAL ANALYSIS

Analyst:	NA
Intersection:	Steeles Ave / Northwest Gate
Agency/Co.:	URS Canada Inc.
Area Type:	All other areas
Date Performed:	12/9/2004
Jurisdiction:	City of Toronto
Analysis Time Period:	PM Peak Hour
Analysis Year:	Total Future Conditions
Project ID:	TTC Spadina Station Extension
East/West Street:	North/South Street
Steeles Avenue	Northwest Gate

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	152	1684	91	84	2194	186	44	0	53	481	0	284
% Heavy Veh	0	5	1	0	7	0	5	0	3	0	0	33
PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
PK 15 Vol	42	468	25	23	609	52	12	0	15	134	0	79
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900	1900	1900	1900	1900	1900	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes		1	3	1	1	3	1	1	0		1	1	0
LGConfig	L	T	R	L	T	R	L	TR			L	TR	
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6			3.6	3.6	
RTOR Vol			0			0			0				60
Adj Flow	169	1871	101	93	2438	207	49	59			534	249	
%InSharedLn													
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000			1.000	0.000	
Prop RTs		0.000	1.000		0.000	1.000		1.000				1.000	
Peds	Bikes	0			0			0				0	
Buses	0	0	0	0	0	0	0	0			0	0	
%InProtPhase	0.0												
Duration	0.25	Area Type: All other areas											

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Arriv. Type	3	3	3	3	3	3	3	3		3	3	
Unit Ext.	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0		2.0	2.0	
Ext of g	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0		2.0	2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left		A			NB Left	A			
Thru		A			Thru	A			
Right		A			Right	A			
Peds					Peds				
WB Left			P		SB Left	A			
Thru			P		Thru	A			
Right			P		Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green		6.0	64.0			34.0			
Yellow		2.0	4.0			4.0			
All Red		0.0	3.0			3.0			

Cycle Length: 120.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	152	1684	91	84	2194	186	44	0	53	481	0	284
PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj flow	169	1871	101	93	2438	207	49	0	59	534	0	249
No. Lanes	1	3	1	1	3	1	1	1	0	1	1	0
Lane group	L	T	R	L	T	R	L	TR		L	TR	
Adj flow	169	1871	101	93	2438	207	49	59		534	249	
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.000	1.000		1.000			1.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound				Westbound				Northbound				Southbound			
LG	L	T		R	L	T		R	L	T		R	L	T		R
So	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900			1900	1900		
Lanes	1	3		1	1	3		1	1		0		1	1		0
fW	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000			1.000	1.000		
fHV	1.000	0.952	0.990	1.000	0.935	1.000	0.952	0.971		1.000			1.000	0.752		
fG	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000			1.000	1.000		
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000			1.000	1.000		
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000			1.000	1.000		
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000			1.000	1.000		
fLU	1.000	0.908	1.000	1.000	0.908	1.000	1.000	1.000		1.000			1.000	1.000		
fRT		1.000	0.850		1.000	0.850		0.850						0.850		
fLT	0.959	1.000		0.084	1.000		0.484	1.000		0.719			1.000			
Sec.	0.061															
fLpb	1.000	1.000			1.000	1.000		1.000		1.000			1.000	1.000		
fRpb		1.000	1.000		1.000	1.000		1.000						1.000		
S	1805	4929	1599	159	4837	1615	875	1568		1365			1214			
Sec.	115															

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		90	1805	# 0.05	0.050	90	1.00
Perm		79	115	# 0.69	0.550	63	1.25
Left	L	169			0.60	153	1.10
Prot							
Perm							
Thru	T	1871	4929	0.38	0.60	2957	0.63
Right	R	101	1599	0.06	0.60	959	0.11
Westbound							
Prot							
Perm							
Left	L	93	159	0.58	0.53	85	1.09
Prot							
Perm							
Thru	T	2438	4837	0.50	0.53	2580	0.94
Right	R	207	1615	0.13	0.53	861	0.24
Northbound							
Prot							
Perm							
Left	L	49	875	0.06	0.28	248	0.20
Prot							
Perm							
Thru	TR	59	1568	0.04	0.28	444	0.13
Right							
Southbound							
Prot							
Perm							
Left	L	534	1365	# 0.39	0.28	387	1.38
Prot							
Perm							
Thru	TR	249	1214	0.21	0.28	344	0.72
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 1.13
Total lost time per cycle, L = 14.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.28

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Adj Fact	Prog Cap	Lane Grp k	Incremental Factor	Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound													
L	1.10	0.60	33.7	1.000	153	0.50	103.5	0.0	0.0	137.3	F		
T	0.63	0.60	15.5	1.000	2957	0.21	0.4	0.0	0.0	15.9	B	25.2	C
R	0.11	0.60	10.2	1.000	959	0.11	0.0	0.0	0.0	10.3	B		
Westbound													
L	1.09	0.53	28.0	1.000	85	0.50	125.5	0.0	0.0	153.5	F		
T	0.94	0.53	26.3	1.000	2580	0.50	8.8	0.0	0.0	35.2	D	37.7	D
R	0.24	0.53	15.0	1.000	861	0.50	0.7	0.0	0.0	15.6	B		
Northbound													
L	0.20	0.28	32.6	1.000	248	0.11	0.4	0.0	0.0	33.0	C		
TR	0.13	0.28	32.0	1.000	444	0.11	0.1	0.0	0.0	32.2	C	32.6	C
Southbound													
L	1.38	0.28	43.0	1.000	387	0.50	186.4	0.0	0.0	229.4	F		
TR	0.72	0.28	38.8	1.000	344	0.28	7.4	0.0	0.0	46.1	D	171.1	F

Intersection Delay = 51.1 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)	72.0	64.0	34.0	34.0
Effective permitted green time for LT lane group, g(s)	66.0	64.0	34.0	34.0
Opposing effective green time, go (s)	64.0	72.0	34.0	34.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	3	3	1	1
Adjusted LT flow rate, VLT (veh/h)	169	93	49	534
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	2438	1871	249	59
Lost time for LT lane group, tL	7.00	7.00	7.00	7.00
Computation				
LT volume per cycle, LTC=VLTC/3600	5.63	3.10	1.63	17.80
Opposing lane util. factor, fLUo	0.908	0.908	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	29.83	22.90	8.30	1.97
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.47	0.40	0.72	0.72
gq, (see Exhibit C16-4,5,6,7,8)	55.38	14.62	6.81	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	10.62	49.38	27.19	34.00
n=Max(gq-gf)/2,0)	27.69	7.31	3.40	0.00
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	17.15	9.22	1.65	1.39
EL2=Max((1-Ptho**n)/PLto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06	0.06	0.12	0.12
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.06	0.08	0.48	0.72
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.061	0.084	0.484	0.719

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.908	0.908	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/PLto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 120.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	169			
v/c ratio from Capacity Worksheet, X	1.10			
Protected phase effective green interval, g (s)	6.0			
Opposing queue effective green interval, gq	55.38			
Unopposed green interval, gu	10.62			
Red time r=(C-g-gq-gu)	48.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.04			
Protected ph. departure rate, Sp=s/3600	0.501			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.20			
XPerm	1.33			
XProt	0.76			
Case	3			
Queue at beginning of green arrow, Qa	2.74			
Queue at beginning of unsaturated green, Qu	2.35			
Residual queue, Qr	0.70			
Uniform Delay, d1	33.7			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Final Queue Delay d3 sec	Initial Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 51.1 sec/veh Intersection LOS D

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	T	R	L	T	R	L	TR		L	TR	
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Flow Rate	169	686	101	93	895	207	49	59		534	249	
So	1900	1900	1900	1900	1900	1900	1900	1900		1900	1900	
No.Lanes	1	3	1	1	3	1	1	1	0	1	1	0
SL	256	1809	1599	159	1775	1615	875	1568		1365	1214	
LnCapacity	153	1085	959	85	947	861	248	444		387	344	
Flow Ratio	0.66	0.38	0.06	0.58	0.50	0.13	0.06	0.04		0.39	0.21	
v/c Ratio	1.10	0.63	0.11	1.00	0.95	0.24	0.20	0.13		1.38	0.72	
Grn Ratio	0.60	0.60	0.60	0.53	0.53	0.53	0.28	0.28		0.28	0.28	
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3	3	3	3	3	3	3		3	3	
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Q1	2.4	14.7	1.4	3.1	28.1	3.7	1.2	1.5		17.8	7.5	
KB	0.3	0.9	0.8	0.2	1.3	1.3	0.4	0.5		0.5	0.4	
Q2	3.6	1.4	0.1	2.3	9.4	0.4	0.1	0.1		19.9	1.0	
Q Average	5.9	16.2	1.5	5.4	37.5	4.1	1.3	1.5		37.7	8.5	
Q Spacing	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6		7.6	7.6	
Q Storage	0	0	0	0	0	0	0	0		0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2		1.1	1.2	
BOQ	7.1	18.9	1.8	6.6	45.0	5.1	1.6	1.8		43.0	10.1	
QSRatio												
85th Percentile Output:												
fB%	1.5	1.5	1.6	1.5	1.4	1.5	1.6	1.6		1.4	1.5	
BOQ	9.2	23.9	2.4	8.1	52.5	6.3	2.1	2.4		52.3	13.0	
QSRatio												
90th Percentile Output:												
fB%	1.7	1.6	1.8	1.7	1.5	1.7	1.8	1.8		1.5	1.7	
BOQ	10.1	25.5	2.7	9.0	56.3	7.0	2.4	2.7		55.1	14.2	
QSRatio												
95th Percentile Output:												
fB%	1.9	1.7	2.1	1.9	1.6	2.0	2.1	2.1		1.6	1.9	
BOQ	11.5	28.2	3.1	10.4	60.0	8.3	2.7	3.2		59.4	16.0	
QSRatio												
98th Percentile Output:												
fB%	2.3	2.0	2.6	2.2	1.7	2.4	2.6	2.6		1.8	2.2	
BOQ	13.9	32.2	4.0	11.9	63.8	9.7	3.5	4.0		66.2	18.9	
QSRatio												

ERROR MESSAGES

No errors to report.

Steeles West Station - Future Total Traffic Conditions

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: PM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Steeles Avenue

Inter.: Steeles Avenue / Founders Rd
Area Type: All other areas
Jurisd: City of Toronto
Year: Total Future Conditions
N/S St: Founders Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	3	0	1	3	0	1	0	1	0	0	0
LGConfig		TR		L	T		L		R			
Volume		1985	55	87	1879		275		238			
Lane Width		3.6		3.6	3.6		3.6		3.6			
RTOR Vol			0						119			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left	A			
Thru		P			Thru				
Right		P			Right	A			
Peds					Peds				
WB Left	P	P			SB Left				
Thru	P	P			Thru				
Right					Right				
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	5.0	65.0				25.0			
Yellow	2.0	4.0				3.0			
All Red	0.0	3.0				3.0			

Cycle Length: 110.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
TR	2821	4774	0.74	0.59	18.1	B	18.1	B
Westbound								
L	149	1787	0.60	0.65	31.7	C		
T	3196	4883	0.60	0.65	11.6	B	12.5	B
Northbound								
L	357	1570	0.79	0.23	51.1	D		
R	232	1022	0.52	0.23	39.4	D	47.6	D
Southbound								

Intersection Delay = 18.3 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:
Fax:

OPERATIONAL ANALYSIS

Analyst:	NA
Intersection:	Steeles Avenue / Founders Rd
Agency/Co.:	URS Canada Inc.
Area Type:	All other areas
Date Performed:	12/9/2004
Jurisdiction:	City of Toronto
Analysis Time Period:	PM Peak Hour
Analysis Year:	Total Future Conditions
Project ID:	TTC Spadina Station Extension
East/West Street:	North/South Street
Steeles Avenue	Founders Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		1985	55	87	1879		275		238			
% Heavy Veh		8	7	1	6		15		58			
PHF		0.98	0.98	0.98	0.98		0.98		0.98			
PK 15 Vol		506	14	22	479		70		61			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900		1900	1900		1900		1900			
ParkExist												
NumPark												
No. Lanes	0	3	0		1	3	0	1	0	1	0	0	0
LGConfig		TR			L	T		L		R			
Lane Width		3.6			3.6	3.6		3.6		3.6			
RTOR Vol			0							119			
Adj Flow		2082			89	1917		281		121			
%InSharedLn													
Prop LTs		0.000			1.000	0.000							
Prop RTs		0.027				0.000				1.000			
Peds Bikes		0						0			0		
Buses		0			0	0		0		0			
%InProtPhase					0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0		0.0		0.0			
Arriv. Type		3		3	3		3		3			
Unit Ext.		3.0		3.0	3.0		3.0		3.0			
I Factor		1.000			1.000		1.000					
Lost Time		2.0		2.0	2.0		2.0		2.0			
Ext of g		2.0		2.0	2.0		2.0		2.0			
Ped Min g		3.2					3.2			3.2		

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left	A			
Thru		P			Thru				
Right		P			Right	A			
Peds					Peds				
WB Left	P	P			SB Left				
Thru	P	P			Thru				
Right					Right				
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	5.0	65.0				25.0			
Yellow	2.0	4.0				3.0			
All Red	0.0	3.0				3.0			

Cycle Length: 110.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		1985	55	87	1879		275		238			
PHF		0.98	0.98	0.98	0.98		0.98		0.98			
Adj flow		2026	56	89	1917		281		121			
No. Lanes	0	3	0	1	3	0	1	0	1	0	0	0
Lane group		TR		L	T		L		R			
Adj flow		2082		89	1917		281		121			
Prop LTs		0.000		1.000	0.000							
Prop RTs		0.027			0.000				1.000			

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG		TR		L	T		L		R			
So		1900		1900	1900		1900		1900			
Lanes	0	3	0	1	3	0	1	0	1	0	0	0
fW		1.000		1.000	1.000		1.000		1.000			
fHV		0.926		0.990	0.943		0.870		0.633			
fG		1.000		1.000	1.000		1.000		1.000			
fP		1.000		1.000	1.000		1.000		1.000			
fBB		1.000		1.000	1.000		1.000		1.000			
fA		1.000		1.000	1.000		1.000		1.000			
fLU		0.908		1.000	0.908		1.000		1.000			
fRT		0.996			1.000				0.850			
fLT		1.000		0.950	1.000		0.950					
Sec.				0.060								
fLpb		1.000		1.000	1.000		1.000					
fRpb		1.000			1.000				1.000			
S		4774		1787	4883		1570		1022			
Sec.				112								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	2082	4774	# 0.44	0.59	2821	0.74
Right							
Westbound							
Prot		81	1787	# 0.05	0.045	81	1.00
Perm		8	112	0.07	0.609	68	0.12
Left	L	89			0.65	149	0.60
Prot							
Perm							
Thru	T	1917	4883	0.39	0.65	3196	0.60
Right							
Northbound							
Prot							
Perm							
Left	L	281	1570	# 0.18	0.23	357	0.79
Prot							
Perm							
Thru							
Right	R	121	1022	0.12	0.23	232	0.52
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.66
Total lost time per cycle, L = 20.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.81

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
TR	0.74	0.59	16.3	1.000	2821	0.50	1.8	0.0	18.1	B	18.1	B
Westbound												
L	0.60	0.65	15.3	1.000	149	0.50	16.4	0.0	31.7	C		
T	0.60	0.65	10.8	1.000	3196	0.50	0.8	0.0	11.6	B	12.5	B
Northbound												
L	0.79	0.23	40.0	1.000	357	0.33	11.2	0.0	51.1	D		
R	0.52	0.23	37.3	1.000	232	0.13	2.1	0.0	39.4	D	47.6	D
Southbound												

Intersection Delay = 18.3 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach		M		
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)		72.0		
Effective permitted green time for LT lane group, g(s)		67.0		
Opposing effective green time, go (s)		65.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		3		
Adjusted LT flow rate, VLT (veh/h)		89		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		2082		
Lost time for LT lane group, tL		7.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		2.72		
Opposing lane util. factor, fLUo		0.908	0.908	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		23.35		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.41		
gq, (see Exhibit C16-4,5,6,7,8)		33.21		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		33.79		
n=Max(gq-gf)/2,0)		16.60		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		11.60		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.06		
gdiff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.06		
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.060		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT			0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo			0.908	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vb1c (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 110.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	89			
v/c ratio from Capacity Worksheet, X	0.60			
Protected phase effective green interval, g (s)	5.0			
Opposing queue effective green interval, gq	33.21			
Unopposed green interval, gu	33.79			
Red time r=(C-g-gq-gu)	38.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.02			
Protected ph. departure rate, Sp=s/3600	0.496			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.06			
XPerm	0.79			
XProt	0.43			
Case	1			
Queue at beginning of green arrow, Qa	0.94			
Queue at beginning of unsaturated green, Qu	0.82			
Residual queue, Qr	0.00			
Uniform Delay, d1	15.3			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Final Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 18.3 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	TR		L	T	L	R		
Init Queue	0.0		0.0	0.0	0.0	0.0		
Flow Rate	764		89	703	281	121		
So	1900		1900	1900	1900	1900		
No.Lanes	0 3	0	1	3	0 1	0	0 0	0
SL	1752		228	1792	1570	1022		
LnCapacity	1035		149	1173	357	232		
Flow Ratio	0.44		0.39	0.39	0.18	0.12		
v/c Ratio	0.74		0.60	0.60	0.79	0.52		
Grn Ratio	0.59		0.65	0.65	0.23	0.23		
I Factor	1.000			1.000		1.000		
AT or PVG	3		3	3	3	3		
Pltn Ratio	1.00		1.00	1.00	1.00	1.00		
PF2	1.00		1.00	1.00	1.00	1.00		
Q1	16.9		1.0	12.2	8.1	3.2		
kB	1.3		0.3	1.5	0.4	0.3		
Q2	3.4		0.5	2.1	1.4	0.3		
Q Average	20.4		1.4	14.3	9.4	3.6		
Q Spacing	7.6		7.6	7.6	7.6	7.6		
Q Storage	0		0	0	0	0		
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.3	1.2	1.2	1.2		
BOQ	24.5		1.8	17.3	11.1	4.3		
QSRatio								
85th Percentile Output:								
fB%	1.4		1.6	1.4	1.5	1.6		
BOQ	28.6		2.4	20.3	14.3	5.6		
QSRatio								
90th Percentile Output:								
fB%	1.5		1.9	1.5	1.6	1.7		
BOQ	30.7		2.7	21.9	15.6	6.2		
QSRatio								
95th Percentile Output:								
fB%	1.6		2.3	1.7	1.9	2.0		
BOQ	33.0		3.4	23.7	17.5	7.1		
QSRatio								
98th Percentile Output:								
fB%	1.7		2.8	1.8	2.2	2.5		
BOQ	35.2		4.1	25.6	20.6	8.8		
QSRatio								

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: PM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Steeles Avenue

Inter.: Steeles Avenue / Keele Street
Area Type: All other areas
Jurisd: City of Toronto
Year: Total Future Conditions
N/S St: Keele Street

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	3	1	1	3	0	1	2	1	1	2	1
LGConfig	L	T	R	L	TR		L	T	R	L	T	R
Volume	371	2097	233	284	2016	690	257	1284	289	275	1245	287
Lane Width	3.6	3.6	3.6	3.6	3.6		3.6	3.6	3.6	3.6	3.6	3.6
RTOR Vol			0			120			0			40

Duration 0.25 Area Type: All other areas
Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left		P			NB Left	P	P		
Thru		P			Thru		P		
Right		P			Right		P		
Peds					Peds				
WB Left		P			SB Left	P	P		
Thru		P			Thru		P		
Right		P			Right		P		
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green		15.0	41.0				10.0	34.0	
Yellow		3.0	4.0				3.0	4.0	
All Red		1.0	2.0				1.0	2.0	

Cycle Length: 120.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	269	1671	1.41	0.50	242.2	F		
T	1684	4929	1.27	0.34	166.2	F	165.2	F
R	536	1568	0.44	0.34	33.3	C		
Westbound								
L	275	1719	1.05	0.50	106.6	F		
TR	1673	4896	1.58	0.34	302.2	F	282.9	F
Northbound								
L	206	1736	1.27	0.40	186.4	F		
T	976	3445	1.34	0.28	203.9	F	176.4	F
R	449	1583	0.66	0.28	45.2	D		
Southbound								
L	206	1736	1.36	0.40	223.5	F		
T	976	3445	1.30	0.28	186.1	F	172.3	F
R	388	1369	0.65	0.28	45.9	D		

Intersection Delay = 205.6 (sec/veh) Intersection LOS = F

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:
Fax:

OPERATIONAL ANALYSIS

Analyst:	NA
Intersection:	Steeles Avenue / Keele Street
Agency/Co.:	URS Canada Inc.
Area Type:	All other areas
Date Performed:	12/9/2004
Jurisdiction:	City of Toronto
Analysis Time Period:	PM Peak Hour
Analysis Year:	Total Future Conditions
Project ID:	TTC Spadina Station Extension
East/West Street:	North/South Street
Steeles Avenue	Keele Street

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	371	2097	233	284	2016	690	257	1284	289	275	1245	287
% Heavy Veh	8	5	3	5	2	3	4	5	2	4	5	18
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	95	535	59	72	514	176	66	328	74	70	318	73
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900	1900	1900	1900		1900	1900	1900	1900	1900	1900
ParkExist												
NumPark												
No. Lanes	1	3	1	1	3	0	1	2	1	1	2	1
LGConfig	L	T	R	L	TR		L	T	R	L	T	R
Lane Width	3.6	3.6	3.6	3.6	3.6		3.6	3.6	3.6	3.6	3.6	3.6
RTOR Vol			0			120			0			40
Adj Flow	379	2140	238	290	2639		262	1310	295	281	1270	252
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.221			0.000	1.000		0.000	1.000
Peds	Bikes	0			0			0			0	
Buses	0	0	0	0	0		0	0	0	0	0	0
%InProtPhase	0.0			0.0			0.0			0.0		

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Arriv. Type	3	3	3	3	3		3	3	3	3	3	3
Unit Ext.	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0
Ext of g	2.0	2.0	2.0	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left		P			NB Left	P	P		
Thru		P			Thru		P		
Right		P			Right		P		
Peds					Peds				
WB Left		P			SB Left	P	P		
Thru		P			Thru		P		
Right		P			Right		P		
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green		15.0	41.0				10.0	34.0	
Yellow		3.0	4.0				3.0	4.0	
All Red		1.0	2.0				1.0	2.0	

Cycle Length: 120.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	371	2097	233	284	2016	690	257	1284	289	275	1245	287
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	379	2140	238	290	2639		262	1310	295	281	1270	252
No. Lanes	1	3	1	1	3	0	1	2	1	1	2	1
Lane group	L	T	R	L	TR		L	T	R	L	T	R
Adj flow	379	2140	238	290	2639		262	1310	295	281	1270	252
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.221			0.000	1.000		0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound						Westbound						Northbound						Southbound					
LG	L	T		R	L		T		R	L	T		R	L	T		R	L	T		R	L	T	R
So	1900	1900	1900		1900	1900				1900	1900	1900		1900	1900	1900		1900	1900	1900				
Lanes	1	3	1		1	3		0		1	2	1		1	2	1		1	2	1				
fW	1.000	1.000	1.000		1.000	1.000				1.000	1.000	1.000		1.000	1.000	1.000		1.000	1.000	1.000				
fHV	0.926	0.952	0.971		0.952	0.978				0.962	0.952	0.980		0.962	0.952	0.962		0.962	0.952	0.847				
fG	1.000	1.000	1.000		1.000	1.000				1.000	1.000	1.000		1.000	1.000	1.000		1.000	1.000	1.000				
fP	1.000	1.000	1.000		1.000	1.000				1.000	1.000	1.000		1.000	1.000	1.000		1.000	1.000	1.000				
fBB	1.000	1.000	1.000		1.000	1.000				1.000	1.000	1.000		1.000	1.000	1.000		1.000	1.000	1.000				
fA	1.000	1.000	1.000		1.000	1.000				1.000	1.000	1.000		1.000	1.000	1.000		1.000	1.000	1.000				
fLU	1.000	0.908	1.000		1.000	0.908				1.000	0.952	1.000		1.000	0.952	1.000		1.000	0.952	1.000				
fRT		1.000	0.850			0.967					1.000	0.850			1.000	0.850			1.000	0.850				
fLT	0.950	1.000			0.950	1.000				0.950	1.000			0.950	1.000									
Sec.	0.089				0.089					0.105				0.105										
fLpb	1.000	1.000			1.000	1.000				1.000	1.000			1.000	1.000									
fRpb		1.000	1.000			1.000					1.000	1.000			1.000	1.000								
S	1671	4929	1568		1719	4896				1736	3445	1583		1736	3445	1369								
Sec.	156				161					192				192										

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		209	1671	# 0.13	0.125	209	1.00
Perm		170	156	# 1.09	0.375	60	2.83
Left	L	379			0.50	269	1.41
Prot							
Perm							
Thru	T	2140	4929	0.34	0.34	1684	1.27
Right	R	238	1568	0.15	0.34	536	0.44
Westbound							
Prot		215	1719	0.13	0.125	215	1.00
Perm		75	161	0.47	0.375	60	1.25
Left	L	290			0.50	275	1.05
Prot							
Perm							
Thru	TR	2639	4896	0.34	0.34	1673	1.58
Right							
Northbound							
Prot		145	1736	# 0.08	0.083	145	1.00
Perm		117	192	0.61	0.317	61	1.92
Left	L	262			0.40	206	1.27
Prot							
Perm							
Thru	T	1310	3445	0.28	0.28	976	1.34
Right	R	295	1583	0.19	0.28	449	0.66
Southbound							
Prot		145	1736	0.08	0.083	145	1.00
Perm		136	192	# 0.71	0.317	61	2.23
Left	L	281			0.40	206	1.36
Prot							
Perm							
Thru	T	1270	3445	0.28	0.28	976	1.30
Right	R	252	1369	0.18	0.28	388	0.65

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 2.01
Total lost time per cycle, L = 12.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 2.23

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	1.41	0.50	37.4	1.000	269	0.50	204.7	0.0	242.2	F		
T	1.27	0.34	39.5	1.000	1684	0.50	126.7	0.0	166.2	F	165.2	F
R	0.44	0.34	30.7	1.000	536	0.50	2.7	0.0	33.3	C		
Westbound												
L	1.05	0.50	37.2	1.000	275	0.50	69.3	0.0	106.6	F		
TR	1.58	0.34	39.5	1.000	1673	0.50	262.7	0.0	302.2	F	282.9	F
Northbound												
L	1.27	0.40	31.7	1.000	206	0.50	154.7	0.0	186.4	F		
T	1.34	0.28	43.0	1.000	976	0.50	160.9	0.0	203.9	F	176.4	F
R	0.66	0.28	37.9	1.000	449	0.50	7.3	0.0	45.2	D		
Southbound												
L	1.36	0.40	31.7	1.000	206	0.50	191.8	0.0	223.5	F		
T	1.30	0.28	43.0	1.000	976	0.50	143.1	0.0	186.1	F	172.3	F
R	0.65	0.28	37.8	1.000	388	0.50	8.2	0.0	45.9	D		

Intersection Delay = 205.6 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)	60.0	60.0	48.0	48.0
Effective permitted green time for LT lane group, g(s)	45.0	45.0	38.0	38.0
Opposing effective green time, go (s)	41.0	41.0	34.0	34.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	3	3	2	2
Adjusted LT flow rate, VLT (veh/h)	379	290	262	281
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	2639	2140	1270	1310
Lost time for LT lane group, tL	6.00	6.00	6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600	12.63	9.67	8.73	9.37
Opposing lane util. factor, fLUo	0.908	0.908	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	32.29	26.19	22.23	22.93
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.66	0.66	0.72	0.72
gq, (see Exhibit C16-4,5,6,7,8)	41.00	41.00	34.00	34.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	4.00	4.00	4.00	4.00
n=Max(gq-gf)/2,0)	20.50	20.50	17.00	17.00
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	21.44	12.36	4.56	4.75
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.09	0.11	0.11
gdiff=max(gq-gf, 0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.09	0.09	0.11	0.11
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.089	0.089	0.105	0.105

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.908	0.908	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 120.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	379	290	262	281
v/c ratio from Capacity Worksheet, X	1.41	1.05	1.27	1.36
Protected phase effective green interval, g (s)	15.0	15.0	10.0	10.0
Opposing queue effective green interval, gq	41.00	41.00	34.00	34.00
Unopposed green interval, gu	4.00	4.00	4.00	4.00
Red time r=(C-g-gq-gu)	60.0	60.0	72.0	72.0
Arrival rate, qa=v/(3600(max[X,1.0]))	0.07	0.08	0.06	0.06
Protected ph. departure rate, Sp=s/3600	0.464	0.478	0.482	0.482
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.49	0.50	0.51	0.51
XPerm	1.72	1.71	1.07	1.07
XProt	0.80	0.80	0.97	0.97
Case	3	3	3	3
Queue at beginning of green arrow, Qa	5.90	6.01	4.27	4.27
Queue at beginning of unsaturated green, Qu	3.06	3.13	1.95	1.95
Residual queue, Qr	1.41	1.43	0.15	0.15
Uniform Delay, d1	37.4	37.2	31.7	31.7

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Final Queue Delay d3 sec	Initial Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 205.6 sec/veh Intersection LOS F

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound L	T	R	Westbound L	TR	Northbound L	T	R	Southbound L	T	R
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	379	785	238	290	968	262	688	295	281	667	252
So	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	3	1	1	3 0	1	2	1	1	2	1
SL	535	1809	1568	290	1797	514	1809	1583	514	1809	1369
LnCapacity	269	618	536	275	614	206	512	449	206	512	388
Flow Ratio	0.71	0.43	0.15	0.53	0.54	0.51	0.38	0.19	0.55	0.37	0.18
v/c Ratio	1.41	1.27	0.44	1.05	1.58	1.27	1.34	0.66	1.36	1.30	0.65
Grn Ratio	0.50	0.34	0.34	0.50	0.34	0.40	0.28	0.28	0.40	0.28	0.28
I Factor		1.000			1.000		1.000			1.000	
AT or PVG	3	3	3	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	7.2	26.2	6.2	5.5	32.3	5.7	22.9	8.7	6.1	22.2	7.4
kB	0.6	1.0	0.9	0.6	1.0	0.5	0.9	0.8	0.5	0.9	0.7
Q2	15.5	24.8	0.7	5.6	46.8	8.7	25.0	1.4	10.9	22.6	1.2
Q Average	22.7	51.0	6.9	11.1	79.1	14.4	47.9	10.1	17.0	44.8	8.6
Q Spacing	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Q Storage	0	0	0	0	0	0	0	0	0	0	0
Q S Ratio											
70th Percentile Output:											
fB%	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
BOQ	27.2	61.2	8.4	13.4	94.9	17.4	57.5	12.2	20.5	53.8	10.5
QSRatio											
85th Percentile Output:											
fB%	1.4	1.4	1.5	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.5
BOQ	31.8	71.4	10.1	15.9	111	20.5	67.1	14.5	24.0	62.8	12.5
QSRatio											
90th Percentile Output:											
fB%	1.5	1.5	1.6	1.6	1.5	1.5	1.5	1.6	1.5	1.5	1.6
BOQ	34.1	76.5	11.2	17.2	119	22.1	71.9	15.8	25.8	67.3	13.7
QSRatio											
95th Percentile Output:											
fB%	1.6	1.6	1.9	1.7	1.6	1.7	1.6	1.7	1.6	1.6	1.8
BOQ	36.5	81.6	12.7	18.9	127	23.9	76.7	17.5	27.8	71.7	15.3
QSRatio											
98th Percentile Output:											
fB%	1.7	1.7	2.1	1.9	1.7	1.8	1.7	1.9	1.8	1.7	2.0
BOQ	38.9	86.7	14.3	20.7	134	25.8	81.5	19.2	29.7	76.2	17.0
QSRatio											

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: PM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Proposed East-West Road

Inter.: Jane Street / Prop E-W Rd
Area Type: All other areas
Jurisd: City of Toronto
Year: Total Future Conditions
N/S St: Jane Street

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	1	0	1	0	2	1	1	2	0
LGConfig				L		R		T	R	L	T	
Volume				155		445		1472	57	248	1792	
Lane Width				3.6		3.6		3.6	3.6	3.6	3.6	
RTOR Vol						180			0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left				
Thru					Thru		P		
Right					Right		P		
Peds					Peds				
WB Left		P			SB Left	P	P		
Thru					Thru	P	P		
Right		P			Right				
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right		P		
Green		24.0				21.0	59.0		
Yellow		4.0				2.0	4.0		
All Red		3.0				0.0	3.0		

Cycle Length: 120.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
Westbound								
L	357	1787	0.44	0.20	46.1	D		
							20.1	C
R	1199	1599	0.23	0.75	4.9	A		
Northbound								
T	1694	3445	0.89	0.49	34.8	C	34.1	C
R	756	1538	0.08	0.49	16.3	B		
Southbound								
L	369	1752	0.69	0.68	43.3	D		
T	2354	3445	0.78	0.68	15.4	B	18.8	B

Intersection Delay = 24.8 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst:	NA
Intersection:	Jane Street / Prop E-W Rd
Agency/Co.:	URS Canada Inc.
Area Type:	All other areas
Date Performed:	12/9/2004
Jurisdiction:	City of Toronto
Analysis Time Period:	PM Peak Hour
Analysis Year:	Total Future Conditions
Project ID:	TTC Spadina Station Extension
East/West Street:	North/South Street
Proposed East-West Road	Jane Street

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				155		445		1472	57	248	1792	
% Heavy Veh				1		1		5	5	3	5	
PHF				0.98		0.98		0.98	0.98	0.98	0.98	
PK 15 Vol				40		114		376	15	63	457	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat				1900		1900		1900	1900	1900	1900	
ParkExist												
NumPark												
No. Lanes	0	0	0	1	0	1	0	2	1	1	2	0
LGConfig				L		R		T	R	L	T	
Lane Width				3.6		3.6		3.6	3.6	3.6	3.6	
RTOR Vol						180			0			
Adj Flow				158		270		1502	58	253	1829	
%InSharedLn												
Prop LTs								0.000		1.000	0.000	
Prop RTs						1.000		0.000	1.000		0.000	
Peds	Bikes	0			0			0				
Buses				0		0		0	0	0	0	
%InProtPhase										0.0		

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0		0.0		0.0	0.0	0.0	0.0	
Arriv. Type				3		3		3	3	3	3	
Unit Ext.				3.0		3.0		3.0	3.0	3.0	3.0	
I Factor					1.000			1.000			1.000	
Lost Time				2.0		2.0		2.0	2.0	2.0	2.0	
Ext of g				2.0		2.0		2.0	2.0	2.0	2.0	
Ped Min g		3.2			3.2			3.2				

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left				
Thru					Thru		P		
Right					Right		P		
Peds					Peds				
WB Left		P			SB Left	P	P		
Thru					Thru	P	P		
Right		P			Right				
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right		P		
Green		24.0				21.0	59.0		
Yellow		4.0				2.0	4.0		
All Red		3.0				0.0	3.0		

Cycle Length: 120.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				155	445		1472	57		248	1792	
PHF				0.98	0.98		0.98	0.98		0.98	0.98	
Adj flow				158	270		1502	58		253	1829	
No. Lanes	0	0	0	1	0 1		0	2	1	1	2	0
Lane group				L	R			T	R	L	T	
Adj flow				158	270			1502	58	253	1829	
Prop LTs								0.000		1.000	0.000	
Prop RTs					1.000		0.000	1.000		0.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG				L		R		T	R	L	T	
So				1900		1900		1900	1900	1900	1900	
Lanes	0	0	0	1	0	1	0	2	1	1	2	0
fW				1.000		1.000		1.000	1.000	1.000	1.000	
fHV				0.990		0.990		0.952	0.952	0.971	0.952	
fG				1.000		1.000		1.000	1.000	1.000	1.000	
fP				1.000		1.000		1.000	1.000	1.000	1.000	
fBB				1.000		1.000		1.000	1.000	1.000	1.000	
fA				1.000		1.000		1.000	1.000	1.000	1.000	
fLU				1.000		1.000		0.952	1.000	1.000	0.952	
fRT						0.850		1.000	0.850		1.000	
fLT				0.950				1.000		0.950	1.000	
Sec.										0.066		
fLpb				1.000				1.000		1.000	1.000	
fRpb						1.000		1.000	1.000		1.000	
S				1787		1599		3445	1538	1752	3445	
Sec.										121		

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left	L	158	1787	# 0.09	0.20	357	0.44
Prot							
Perm							
Thru							
Right	R	270	1599	0.17	0.75	1199	0.23
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	1502	3445	# 0.44	0.49	1694	0.89
Right	R	58	1538	0.04	0.49	756	0.08
Southbound							
Prot		253	1752	# 0.14	0.175	307	0.82
Perm		0	121	0.00	0.508	62	0.00
Left	L	253			0.68	369	0.69
Prot							
Perm							
Thru	T	1829	3445	0.53	0.68	2354	0.78
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.67
Total lost time per cycle, L = 21.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.81

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Adj Fact	Prog Grp Cap	Lane Factor k	Incremental Del d2	Res Del d3	Lane Group Delay LOS	Approach Delay LOS
Eastbound										
Westbound										
L	0.44	0.20	42.1	1.000	357	0.50	3.9	0.0	46.1 D	
									20.1 C	
R	0.23	0.75	4.5	1.000	1199	0.50	0.4	0.0	4.9 A	
Northbound										
T	0.89	0.49	27.5	1.000	1694	0.50	7.3	0.0	34.8 C	34.1 C
R	0.08	0.49	16.1	1.000	756	0.50	0.2	0.0	16.3 B	
Southbound										
L	0.69	0.68	33.4	1.000	369	0.50	9.9	0.0	43.3 D	
T	0.78	0.68	12.8	1.000	2354	0.50	2.6	0.0	15.4 B	18.8 B

Intersection Delay = 24.8 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				M
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)				82.0
Effective permitted green time for LT lane group, g(s)				61.0
Opposing effective green time, go (s)				59.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				2
Adjusted LT flow rate, VLT (veh/h)				253
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.00
Adjusted opposing flow rate, Vo (veh/h)				1502
Lost time for LT lane group, tL				7.00
Computation				
LT volume per cycle, LTC=VLTC/3600				8.43
Opposing lane util. factor, fLUo				0.952 0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				26.30
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.51
gq, (see Exhibit C16-4,5,6,7,8)				47.59
gu=g-gq if gq>=gf, or = g-gf if gq<gf				13.41
n=Max(gq-gf)/2,0)				23.80
PTHo=1-PLTo				1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				5.76
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				0.07
gdiff=max(gq-gf,0)				0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.07
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.066

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				0.000 0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo				0.952 0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Proportion of LT in LT lane group, PLT										0.000	0.000	
Proportion of LT in opposing flow, PLTo												
Adjusted opposing flow rate, Vo (veh/h)												
Lost time for LT lane group, tL												
Computation												
LT volume per cycle, LTC=VLTC/3600												
Opposing lane util. factor, fLUo										0.952	0.952	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)												
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g												
Opposing platoon ratio, Rpo (refer Exhibit 16-11)												
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]												
gq, (see Exhibit C16-4,5,6,7,8)												
gu=g-gq if gq>=gf, or = g-gf if gq<gf												
n=Max(gq-gf)/2,0)												
PTHo=1-PLTo												
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]												
EL1 (refer to Exhibit C16-3)												
EL2=Max((1-Ptho**n)/Plto, 1.0)												
fmin=2(1+PL)/g or fmin=2(1+Pl)/g												
gdiff=max(gq-gf,0)												
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)												
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)												
or flt=[fm+0.91(N-1)]/N**												
Left-turn adjustment, fLT												

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vb1c (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 120.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v				253
v/c ratio from Capacity Worksheet, X				0.69
Protected phase effective green interval, g (s)				21.0
Opposing queue effective green interval, gq				47.59
Unopposed green interval, gu				13.41
Red time r=(C-g-gq-gu)				38.0
Arrival rate, qa=v/(3600(max[X,1.0]))				0.07
Protected ph. departure rate, Sp=s/3600				0.487
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)				0.15
XPerm				2.09
XProt				0.41
Case				3
Queue at beginning of green arrow, Qa				4.91
Queue at beginning of unsaturated green, Qu				3.34
Residual queue, Qr				2.24
Uniform Delay, d1				33.4

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Queue Delay d3 sec	Initial Lane Group d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 24.8 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
LaneGroup				L		R		T	R	L	T	
Init Queue				0.0		0.0		0.0	0.0	0.0	0.0	
Flow Rate				158		270		788	58	253	960	
So				1900		1900		1900	1900	1900	1900	
No.Lanes	0	0	0	1	0	1	0	2	1	1	2	0
SL				1787		1599		1809	1538	539	1809	
LnCapacity				357		1199		889	756	369	1236	
Flow Ratio				0.09		0.17		0.44	0.04	0.47	0.53	
v/c Ratio				0.44		0.23		0.89	0.08	0.69	0.78	
Grn Ratio				0.20		0.75		0.49	0.49	0.68	0.68	
I Factor					1.000			1.000			1.000	
AT or PVG				3		3		3	3	3	3	
Pltn Ratio				1.00		1.00		1.00	1.00	1.00	1.00	
PF2				1.00		1.00		1.00	1.00	1.00	1.00	
Q1				4.6		2.7		23.7	1.0	3.0	21.6	
kB				0.7		1.6		1.3	1.1	0.7	1.6	
Q2				0.5		0.5		6.6	0.1	1.4	4.9	
Q Average				5.2		3.2		30.3	1.1	4.4	26.5	
Q Spacing				7.6		7.6		7.6	7.6	7.6	7.6	
Q Storage				0		0		0	0	0	0	
Q S Ratio												
70th Percentile Output:												
fB%				1.2		1.3		1.2	1.3	1.2	1.2	
BOQ				6.4		4.0		36.3	1.4	5.5	31.8	
QSRatio												
85th Percentile Output:												
fB%				1.5		1.6		1.4	1.6	1.5	1.4	
BOQ				7.8		4.9		42.4	1.8	6.7	37.2	
QSRatio												
90th Percentile Output:												
fB%				1.7		1.8		1.5	1.9	1.7	1.5	
BOQ				8.6		5.6		45.4	2.1	7.5	39.9	
QSRatio												
95th Percentile Output:												
fB%				2.0		2.1		1.6	2.4	2.0	1.6	
BOQ				10.1		6.7		48.5	2.7	8.9	42.6	
QSRatio												
98th Percentile Output:												
fB%				2.2		2.5		1.7	2.9	2.3	1.7	
BOQ				11.5		7.9		51.6	3.2	10.2	45.3	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: PM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Proposed East-West Road

Inter.: Prop E-W Rd / Fut Street C
Area Type: All other areas
Jurisd: City of Toronto
Year: Total Future Conditions
N/S St: Future Street C

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Volume	161		0				0	339			700	161
Lane Width	3.6		3.6					3.6			3.6	
RTOR Vol			0									0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left		P			NB Left	P			
Thru					Thru	P			
Right	P				Right				
Peds					Peds				
WB Left					SB Left				
Thru					Thru	P			
Right					Right	P			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	34.0					72.0			
Yellow	4.0					4.0			
All Red	3.0					3.0			

Cycle Length: 120.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	487	1719	0.34	0.28	35.9	D		
							35.9	D
R	444	1568	0.00	0.28	30.8	C		
Westbound								
Northbound								
LT	2067	3445	0.17	0.60	10.8	B	10.8	B
Southbound								
TR	2024	3373	0.43	0.60	13.7	B	13.7	B

Intersection Delay = 15.6 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:
Fax:

OPERATIONAL ANALYSIS

Analyst:	NA
Intersection:	Prop E-W Rd / Fut Street C
Agency/Co.:	URS Canada Inc.
Area Type:	All other areas
Date Performed:	12/9/2004
Jurisdiction:	City of Toronto
Analysis Time Period:	PM Peak Hour
Analysis Year:	Total Future Conditions
Project ID:	TTC Spadina Station Extension
East/West Street	North/South Street
Proposed East-West Road	Future Street C

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	161		0				0	339			700	161
% Heavy Veh	5		3				4	5			5	1
PHF	0.98		0.98				0.98	0.98			0.98	0.98
PK 15 Vol	41		0				0	86			179	41
Hi Ln Vol												
% Grade	0							0			0	
Ideal Sat	1900		1900					1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Lane Width	3.6		3.6					3.6			3.6	
RTOR Vol			0									0
Adj Flow	164		0					346			878	
%InSharedLn												
Prop LTs								0.000			0.000	
Prop RTs			1.000					0.000			0.187	
Peds	Bikes	0		0				0			0	
Buses	0		0					0			0	
%InProtPhase												
Duration	0.25		Area Type: All other areas									

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0					0.0			0.0	
Arriv. Type	3		3					3			3	
Unit Ext.	3.0		3.0					3.0			3.0	
I Factor		1.000						1.000			1.000	
Lost Time	2.0		2.0					2.0			2.0	
Ext of g	2.0		2.0					2.0			2.0	
Ped Min g		3.2			3.2						3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left		P			NB Left	P			
Thru					Thru	P			
Right	P				Right				
Peds					Peds				
WB Left					SB Left				
Thru					Thru	P			
Right					Right	P			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	34.0					72.0			
Yellow	4.0					4.0			
All Red	3.0					3.0			

Cycle Length: 120.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	161		0				0	339			700	161
PHF	0.98		0.98				0.98	0.98			0.98	0.98
Adj flow	164		0				0	346			714	164
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
Lane group	L		R					LT			TR	
Adj flow	164		0					346			878	
Prop LTs								0.000			0.000	
Prop RTs			1.000					0.000			0.187	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L		R					LT			TR	
So	1900			1900				1900			1900	
Lanes	1	0		1	0	0	0	2	0	0	2	0
fW	1.000			1.000				1.000			1.000	
fHV	0.952			0.971				0.952			0.959	
fG	1.000			1.000				1.000			1.000	
fP	1.000			1.000				1.000			1.000	
fBB	1.000			1.000				1.000			1.000	
fA	1.000			1.000				1.000			1.000	
fLU	1.000			1.000				0.952			0.952	
fRT				0.850				1.000			0.972	
fLT	0.950							1.000			1.000	
Sec.												
fLpb	1.000							1.000			1.000	
fRpb				1.000				1.000			1.000	
S	1719			1568				3445			3373	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	164	1719	# 0.10	0.28	487	0.34
Prot							
Perm							
Thru							
Right	R	0	1568	0.00	0.28	444	0.00
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	346	3445	0.10	0.60	2067	0.17
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	878	3373	# 0.26	0.60	2024	0.43
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.36
Total lost time per cycle, L = 14.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.40

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay LOS	Approach Delay LOS
Eastbound										
L	0.34	0.28	34.1	1.000	487	0.50	1.9	0.0	35.9 D	
										35.9 D
R	0.00	0.28	30.8	1.000	444	0.50	0.0	0.0	30.8 C	
Westbound										
Northbound										
LT	0.17	0.60	10.7	1.000	2067	0.50	0.2	0.0	10.8 B	10.8 B
Southbound										
TR	0.43	0.60	13.0	1.000	2024	0.50	0.7	0.0	13.7 B	13.7 B

Intersection Delay = 15.6 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo				0.952 0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1*4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/PLto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach			M	
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)			72.0	
Effective permitted green time for LT lane group, g(s)			72.0	
Opposing effective green time, go (s)			72.0	
Number of lanes in LT lane group, N			2	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			0	
Proportion of LT in LT lane group, PLT			0.000	0.000
Proportion of LT in opposing flow, PLTo			0.00	
Adjusted opposing flow rate, Vo (veh/h)			878	
Lost time for LT lane group, tL			7.00	
Computation				
LT volume per cycle, LTC=VLTC/3600			0.00	
Opposing lane util. factor, fLUo			0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			15.37	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]			0.40	
gq, (see Exhibit C16-4,5,6,7,8)			9.53	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			62.47	
n=Max(gq-gf)/2,0)			4.77	
PTHo=1-PLTo			1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1*4.24)]			0.00	
EL1 (refer to Exhibit C16-3)			3.46	
EL2=Max((1-Ptho**n)/PLto, 1.0)			1.000	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.03	
gdiff=max(gq-gf,0)			0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.87	
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			1.000	

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vb1c (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 120.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time r=(C-g-gq-gu)				
Arrival rate, qa=v/(3600(max[X,1.0]))				
Protected ph. departure rate, Sp=s/3600				
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Final Queue Delay d3 sec	Initial Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 15.6 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L		R					LT			TR	
Init Queue	0.0		0.0					0.0			0.0	
Flow Rate	164		0					181			461	
So	1900		1900					1900			1900	
No.Lanes	1	0	1	0	0	0	0	2	0	0	2	0
SL	1719		1568					1809			1771	
LnCapacity	487		444					1085			1063	
Flow Ratio	0.10		0.00					0.10			0.26	
v/c Ratio	0.34		0.00					0.17			0.43	
Grn Ratio	0.28		0.28					0.60			0.60	
I Factor		1.000						1.000			1.000	
AT or PVG	3		3					3			3	
Pltn Ratio	1.00		1.00					1.00			1.00	
PF2	1.00		1.00					1.00			1.00	
Q1	4.3		0.0					2.7			8.3	
KB	0.8		0.8					1.5			1.5	
Q2	0.4		0.0					0.3			1.1	
Q Average	4.8		0.0					3.0			9.4	
Q Spacing	7.6		7.6					7.6			7.6	
Q Storage	0		0					0			0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2		1.3					1.3			1.2	
BOQ	5.9		0.0					3.7			11.4	
QSRatio												
85th Percentile Output:												
fB%	1.5		1.7					1.6			1.4	
BOQ	7.2		0.0					4.7			13.6	
QSRatio												
90th Percentile Output:												
fB%	1.7		2.0					1.8			1.6	
BOQ	8.1		0.0					5.3			14.8	
QSRatio												
95th Percentile Output:												
fB%	2.0		2.6					2.2			1.8	
BOQ	9.4		0.0					6.4			16.5	
QSRatio												
98th Percentile Output:												
fB%	2.3		3.2					2.5			1.9	
BOQ	10.8		0.0					7.5			18.1	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: PM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Steeles Ave

Inter.: Steeles Ave / TTCBusTermAcc
Area Type: All other areas
Jurisd: City of Toronto
Year: Total Future Conditions
N/S St: TTCBusTermAccess

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	3	0	1	3	0	1	0	1	0	0	0
LGConfig		TR		L	T		L		R			
Volume		2180	38	36	2464		38		36			
Lane Width		3.6		3.6	3.6		3.6		3.6			
RTOR Vol			0						0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	A		
Thru		P			Thru			
Right		P			Right	A		
Peds					Peds			
WB Left		P	P		SB Left			
Thru		P	P		Thru			
Right					Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green		8.0	83.0			12.0		
Yellow		3.0	4.0			4.0		
All Red		0.0	3.0			3.0		

Cycle Length: 120.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
TR	3402	4919	0.72	0.69	12.8	B	12.8	B
Westbound								
L	181	1787	0.20	0.78	13.0	B		
T	3754	4792	0.73	0.78	7.8	A	7.9	A
Northbound								
L	174	1736	0.22	0.10	50.4	D		
R	154	1538	0.24	0.10	50.6	D	50.5	D
Southbound								

Intersection Delay = 10.8 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:
Fax:

OPERATIONAL ANALYSIS

Analyst: NA
Intersection: Steeles Ave / TTCBusTermAcc
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: PM Peak Hour
Analysis Year: Total Future Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Steeles Ave
North/South Street: TTCBusTermAccess

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		2180	38	36	2464		38		36			
% Heavy Veh		5	3	1	8		4		5			
PHF		0.90	0.98	0.98	0.90		0.98		0.98			
PK 15 Vol		606	10	9	684		10		9			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900		1900	1900		1900		1900			
ParkExist												
NumPark												
No. Lanes	0	3	0		1	3	0	1	0	1	0	0	0
LGConfig		TR			L	T		L		R			
Lane Width		3.6			3.6	3.6		3.6		3.6			
RTOR Vol			0							0			
Adj Flow		2461			37	2738		39		37			
%InSharedLn													
Prop LTs		0.000			1.000	0.000							
Prop RTs		0.016				0.000			1.000				
Peds Bikes		0						0			0		
Buses		0			0	0		0		0			
%InProtPhase					0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0		0.0		0.0			
Arriv. Type		3		3	3		3		3			
Unit Ext.		3.0		3.0	3.0		3.0		3.0			
I Factor		1.000			1.000		1.000					
Lost Time		2.0		2.0	2.0		2.0		2.0			
Ext of g		2.0		2.0	2.0		2.0		2.0			
Ped Min g		3.2					3.2			3.2		

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	A		
Thru		P			Thru			
Right		P			Right	A		
Peds					Peds			
WB Left		P	P		SB Left			
Thru		P	P		Thru			
Right					Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green		8.0	83.0			12.0		
Yellow		3.0	4.0			4.0		
All Red		0.0	3.0			3.0		

Cycle Length: 120.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		2180	38	36	2464		38		36			
PHF		0.90	0.98	0.98	0.90		0.98		0.98			
Adj flow		2422	39	37	2738		39		37			
No. Lanes	0	3	0		1	3	0		1	0	0	0
Lane group		TR			L	T			R			
Adj flow		2461			37	2738			37			
Prop LTs		0.000			1.000	0.000						
Prop RTs		0.016				0.000			1.000			

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG		TR			L	T		L			R	
So		1900			1900	1900		1900			1900	
Lanes	0	3	0		1	3	0	1	0	0	1	0
fW		1.000			1.000	1.000		1.000			1.000	
fHV		0.953			0.990	0.926		0.962			0.952	
fG		1.000			1.000	1.000		1.000			1.000	
fP		1.000			1.000	1.000		1.000			1.000	
fBB		1.000			1.000	1.000		1.000			1.000	
fA		1.000			1.000	1.000		1.000			1.000	
fLU		0.908			1.000	0.908		1.000			1.000	
fRT		0.998				1.000					0.850	
fLT		1.000			0.950	1.000		0.950				
Sec.					0.047							
fLpb		1.000			1.000	1.000		1.000				
fRpb		1.000				1.000					1.000	
S		4919			1787	4792		1736			1538	
Sec.					87							

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	2461	4919	0.50	0.69	3402	0.72
Right							
Westbound							
Prot		37	1787	0.02	0.067	119	0.31
Perm		0	87	0.00	0.717	62	0.00
Left	L	37			0.78	181	0.20
Prot							
Perm							
Thru	T	2738	4792	# 0.57	0.78	3754	0.73
Right							
Northbound							
Prot							
Perm							
Left	L	39	1736	0.02	0.10	174	0.22
Prot							
Perm							
Thru							
Right	R	37	1538	# 0.02	0.10	154	0.24
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.60
Total lost time per cycle, L = 14.00 Sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.67

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay LOS	Approach Delay LOS
Eastbound										
TR	0.72	0.69	11.4	1.000	3402	0.50	1.4	0.0	12.8 B	12.8 B
Westbound										
L	0.20	0.78	10.5	1.000	181	0.50	2.5	0.0	13.0 B	
T	0.73	0.78	6.6	1.000	3754	0.50	1.3	0.0	7.8 A	7.9 A
Northbound										
L	0.22	0.10	49.7	1.000	174	0.11	0.7	0.0	50.4 D	
R	0.24	0.10	49.8	1.000	154	0.11	0.8	0.0	50.6 D	50.5 D
Southbound										

Intersection Delay = 10.8 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach		M		
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)		94.0		
Effective permitted green time for LT lane group, g(s)		86.0		
Opposing effective green time, go (s)		83.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		3		
Adjusted LT flow rate, VLT (veh/h)		37		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		2461		
Lost time for LT lane group, tL		7.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		1.23		
Opposing lane util. factor, fLUo		0.908	0.908	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		30.12		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.31		
gq, (see Exhibit C16-4,5,6,7,8)		37.28		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		48.72		
n=Max(gq-gf)/2,0)		18.64		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		17.59		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.05		
gdiff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.05		
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.047		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT		0.000	0.000	
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo		0.908	0.908	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vb1c (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 120.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	37			
v/c ratio from Capacity Worksheet, X	0.20			
Protected phase effective green interval, g (s)	8.0			
Opposing queue effective green interval, gq	37.28			
Unopposed green interval, gu	48.72			
Red time r=(C-g-gq-gu)	26.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.01			
Protected ph. departure rate, Sp=s/3600	0.496			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.04			
XPerm	0.43			
XProt	0.09			
Case	1			
Queue at beginning of green arrow, Qa	0.27			
Queue at beginning of unsaturated green, Qu	0.38			
Residual queue, Qr	0.00			
Uniform Delay, d1	10.5			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Final Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 10.8 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		TR		L	T		L		R			
Init Queue		0.0		0.0	0.0		0.0		0.0			
Flow Rate		903		37	1005		39		37			
So		1900		1900	1900		1900		1900			
No.Lanes	0	3	0	1	3	0	1	0	1	0	0	0
SL		1805		232	1759		1736		1538			
LnCapacity		1248		181	1378		174		154			
Flow Ratio		0.50		0.16	0.57		0.02		0.02			
v/c Ratio		0.72		0.20	0.73		0.22		0.24			
Grn Ratio		0.69		0.78	0.78		0.10		0.10			
I Factor		1.000			1.000			1.000				
AT or PVG		3		3	3		3		3			
Pltn Ratio		1.00		1.00	1.00		1.00		1.00			
PF2		1.00		1.00	1.00		1.00		1.00			
Q1		18.6		0.3	16.9		1.2		1.1			
kB		1.6		0.4	1.7		0.3		0.3			
Q2		3.9		0.1	4.3		0.1		0.1			
Q Average		22.5		0.4	21.2		1.3		1.2			
Q Spacing		7.6		7.6	7.6		7.6		7.6			
Q Storage		0		0	0		0		0			
Q S Ratio												
70th Percentile Output:												
fB%		1.2		1.3	1.2		1.2		1.2			
BOQ		27.0		0.5	25.5		1.5		1.5			
QSRatio												
85th Percentile Output:												
fB%		1.4		1.7	1.4		1.6		1.6			
BOQ		31.6		0.6	29.8		2.0		1.9			
QSRatio												
90th Percentile Output:												
fB%		1.5		2.0	1.5		1.8		1.8			
BOQ		33.9		0.7	32.0		2.3		2.2			
QSRatio												
95th Percentile Output:												
fB%		1.6		2.5	1.6		2.1		2.1			
BOQ		36.2		1.0	34.3		2.6		2.5			
QSRatio												
98th Percentile Output:												
fB%		1.7		3.1	1.7		2.6		2.6			
BOQ		38.6		1.2	36.6		3.3		3.2			
QSRatio												

ERROR MESSAGES

No errors to report.

APPENDIX F

SUPPLEMENTARY ANALYSES

Steeles West Station - Future Total Traffic Conditions With Improvements

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: AM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Steeles Avenue

Inter.: Steeles Avenue / Jane Street
Area Type: All other areas
Jurisd: City of Toronto
Year: Total Future Conditions
N/S St: Jane Street

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	3	1	1	3	1	1	3	1	1	3	1
LGConfig	L	T	R	L	T	R	L	T	R	L	T	R
Volume	237	1896	160	163	1402	321	81	1168	145	369	1061	159
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left		P			NB Left	P		P	
Thru		P			Thru			P	
Right		P			Right			P	
Peds					Peds				
WB Left		P			SB Left	P	P	P	
Thru		P			Thru		P	P	
Right		P			Right		P	P	
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green		7.0	48.0			6.0	5.0	30.0	
Yellow		2.0	4.0			2.0	2.0	4.0	
All Red		2.0	3.0			2.0	0.0	3.0	

Cycle Length: 120.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	160	1719	1.64	0.49	344.8	F		
T	1972	4929	1.07	0.40	77.4	E	101.4	F
R	627	1568	0.28	0.40	25.5	C		
Westbound								
L	167	1787	1.08	0.49	125.3	F		
T	1917	4792	0.81	0.40	35.9	D	42.8	D
R	640	1599	0.56	0.40	31.3	C		
Northbound								
L	162	1736	0.56	0.30	44.4	D		
T	1232	4929	1.05	0.25	86.0	F	78.9	E
R	385	1538	0.42	0.25	41.0	D		
Southbound								
L	281	1752	1.46	0.39	259.7	F		
T	1520	4929	0.78	0.31	41.7	D	91.5	F
R	493	1599	0.36	0.31	34.3	C		

Intersection Delay = 79.4 (sec/veh) Intersection LOS = E

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst:	NA
Intersection:	Steeles Avenue / Jane Street
Agency/Co.:	URS Canada Inc.
Area Type:	All other areas
Date Performed:	12/9/2004
Jurisdiction:	City of Toronto
Analysis Time Period:	AM Peak Hour
Analysis Year:	Total Future Conditions
Project ID:	TTC Spadina Station Extension
East/West Street:	North/South Street
Steeles Avenue	Jane Street

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	237	1896	160	163	1402	321	81	1168	145	369	1061	159
% Heavy Veh	5	5	3	1	8	1	4	5	5	3	5	1
PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
PK 15 Vol	66	527	44	45	389	89	23	324	40	103	295	44
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
ParkExist												
NumPark												
No. Lanes	1	3	1	1	3	1	1	3	1	1	3	1
LGConfig	L	T	R	L	T	R	L	T	R	L	T	R
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
RTOR Vol			0			0			0			0
Adj Flow	263	2107	178	181	1558	357	90	1298	161	410	1179	177
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.000	1.000		0.000	1.000
Peds	Bikes	0			0			0			0	
Buses	0	0	0	0	0	0	0	0	0	0	0	0
%InProtPhase	0.0			0.0			0.0			0.0		

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Arriv. Type	3	3	3	3	3	3	3	3	3	3	3	3
Unit Ext.	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Ext of g	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left		P			NB Left	P		P	
Thru		P			Thru			P	
Right		P			Right			P	
Peds					Peds				
WB Left		P			SB Left	P	P	P	
Thru		P			Thru		P	P	
Right		P			Right		P	P	
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green		7.0	48.0			6.0	5.0	30.0	
Yellow		2.0	4.0			2.0	2.0	4.0	
All Red		2.0	3.0			2.0	0.0	3.0	

Cycle Length: 120.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	237	1896	160	163	1402	321	81	1168	145	369	1061	159
PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj flow	263	2107	178	181	1558	357	90	1298	161	410	1179	177
No. Lanes	1	3	1	1	3	1	1	3	1	1	3	1
Lane group	L	T	R	L	T	R	L	T	R	L	T	R
Adj flow	263	2107	178	181	1558	357	90	1298	161	410	1179	177
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.000	1.000		0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	T	R	L	T	R	L	T	R	L	T	R
So	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lanes	1	3	1	1	3	1	1	3	1	1	3	1
fW	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fHV	0.952	0.952	0.971	0.990	0.926	0.990	0.962	0.952	0.952	0.971	0.952	0.990
fG	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fLU	1.000	0.908	1.000	1.000	0.908	1.000	1.000	0.908	1.000	1.000	0.908	1.000
fRT		1.000	0.850		1.000	0.850		1.000	0.850		1.000	0.850
fLT	0.950	1.000		0.950	1.000		0.950	1.000		0.950	1.000	
Sec.	0.077			0.077			0.164			0.125		
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000
S	1719	4929	1568	1787	4792	1599	1736	4929	1538	1752	4929	1599
Sec.	139			145			300			231		

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		100	1719	0.06	0.058	100	1.00
Perm		163	139	# 1.17	0.433	60	2.72
Left	L	263			0.49	160	1.64
Prot							
Perm							
Thru	T	2107	4929	0.40	0.40	1972	1.07
Right	R	178	1568	0.11	0.40	627	0.28
Westbound							
Prot		104	1787	# 0.06	0.058	104	1.00
Perm		77	145	0.53	0.433	63	1.22
Left	L	181			0.49	167	1.08
Prot							
Perm							
Thru	T	1558	4792	0.33	0.40	1917	0.81
Right	R	357	1599	0.22	0.40	640	0.56
Northbound							
Prot		87	1736	0.05	0.050	87	1.00
Perm		3	300	0.01	0.250	75	0.04
Left	L	90			0.30	162	0.56
Prot							
Perm							
Thru	T	1298	4929	0.25	0.25	1232	1.05
Right	R	161	1538	0.10	0.25	385	0.42
Southbound							
Prot		219	1752	# 0.13	0.125	219	1.00
Perm		191	231	# 0.83	0.267	62	3.08
Left	L	410			0.39	281	1.46
Prot							
Perm							
Thru	T	1179	4929	0.24	0.31	1520	0.78
Right	R	177	1599	0.11	0.31	493	0.36

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 2.18
Total lost time per cycle, L = 14.00 Sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 2.47

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	1.64	0.49	28.7	1.000	160	0.50	316.0	0.0	344.8	F		
T	1.07	0.40	36.0	1.000	1972	0.50	41.4	0.0	77.4	E	101.4	F
R	0.28	0.40	24.4	1.000	627	0.50	1.1	0.0	25.5	C		
Westbound												
L	1.08	0.49	31.5	1.000	167	0.50	93.8	0.0	125.3	F		
T	0.81	0.40	32.0	1.000	1917	0.50	3.9	0.0	35.9	D	42.8	D
R	0.56	0.40	27.8	1.000	640	0.50	3.5	0.0	31.3	C		
Northbound												
L	0.56	0.30	31.4	1.000	162	0.50	13.0	0.0	44.4	D		
T	1.05	0.25	45.0	1.000	1232	0.50	41.0	0.0	86.0	F	78.9	E
R	0.42	0.25	37.7	1.000	385	0.50	3.3	0.0	41.0	D		
Southbound												
L	1.46	0.39	34.4	1.000	281	0.50	225.3	0.0	259.7	F		
T	0.78	0.31	37.7	1.000	1520	0.50	3.9	0.0	41.7	D	91.5	F
R	0.36	0.31	32.3	1.000	493	0.50	2.0	0.0	34.3	C		

Intersection Delay = 79.4 (sec/veh) Intersection LOS = E

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)	59.0	59.0	36.0	47.0
Effective permitted green time for LT lane group, g(s)	52.0	52.0	30.0	32.0
Opposing effective green time, go (s)	48.0	48.0	37.0	30.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	3	3	3	3
Adjusted LT flow rate, VLT (veh/h)	263	181	90	410
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	1558	2107	1179	1298
Lost time for LT lane group, tL	7.00	7.00	11.00	7.00
Computation				
LT volume per cycle, LTC=VLTC/3600	8.77	6.03	3.00	13.67
Opposing lane util. factor, fLUo	0.908	0.908	0.908	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	19.07	25.78	14.43	15.88
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.00	0.00	0.00	0.75
gq, (see Exhibit C16-4,5,6,7,8)	33.53	48.00	8.28	28.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	18.47	4.00	21.72	4.00
n=Max(gq-gf)/2,0)	16.77	24.00	4.14	14.00
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	6.58	11.92	4.41	5.00
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.08	0.08	0.13	0.13
gdiff=max(gq-gf, 0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.08	0.08	0.16	0.13
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.077	0.077	0.164	0.125

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.908	0.908	0.908	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 120.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	263	181	90	410
v/c ratio from Capacity Worksheet, X	1.64	1.08	0.56	1.46
Protected phase effective green interval, g (s)	7.0	7.0	6.0	15.0
Opposing queue effective green interval, gq	33.53	48.00	8.28	28.00
Unopposed green interval, gu	18.47	4.00	21.72	4.00
Red time r=(C-g-gq-gu)	61.0	61.0	84.0	73.0
Arrival rate, qa=v/(3600(max[X,1.0]))	0.04	0.05	0.03	0.08
Protected ph. departure rate, Sp=s/3600	0.478	0.496	0.482	0.487
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.11	0.52	0.12	0.51
XPerm	1.15	1.15	0.30	1.22
XProt	0.90	0.91	0.78	0.94
Case	3	3	1	3
Queue at beginning of green arrow, Qa	3.01	3.15	2.10	6.14
Queue at beginning of unsaturated green, Qu	1.49	2.23	0.21	2.19
Residual queue, Qr	0.30	0.32	0.00	0.44
Uniform Delay, d1	28.7	31.5	31.4	34.4

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Final Queue Delay d3 sec	Initial Lane Group d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 79.4 sec/veh Intersection LOS E

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	T	R	L	T	R	L	T	R	L	T	R
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	263	773	178	181	571	357	90	476	161	410	432	177
So	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	3	1	1	3	1	1	3	1	1	3	1
SL	326	1809	1568	340	1759	1599	539	1809	1538	716	1809	1599
LnCapacity	160	723	627	167	703	640	162	452	385	281	558	493
Flow Ratio	0.81	0.43	0.11	0.53	0.32	0.22	0.17	0.26	0.10	0.57	0.24	0.11
v/c Ratio	1.64	1.07	0.28	1.08	0.81	0.56	0.56	1.05	0.42	1.46	0.77	0.36
Grn Ratio	0.49	0.40	0.40	0.49	0.40	0.40	0.30	0.25	0.25	0.39	0.31	0.31
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3	3	3	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	4.7	25.8	4.0	3.3	16.9	9.2	2.2	15.9	4.5	9.5	13.1	4.6
kB	0.4	1.1	1.0	0.4	1.1	1.0	0.4	0.8	0.7	0.6	0.9	0.9
Q2	13.8	14.0	0.4	4.0	3.8	1.2	0.5	8.6	0.5	17.8	2.7	0.5
Q Average	18.5	39.7	4.4	7.3	20.7	10.4	2.6	24.4	5.0	27.3	15.8	5.1
Q Spacing	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Q Storage	0	0	0	0	0	0	0	0	0	0	0	0
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2	1.2	1.2	1.2	1.2	1.3	1.2	1.2	1.2	1.2	1.2
BOQ	22.3	47.7	5.5	8.9	24.9	12.7	3.3	29.3	6.2	32.7	19.0	6.3
QSRatio												
85th Percentile Output:												
fB%	1.4	1.4	1.5	1.5	1.4	1.4	1.6	1.4	1.5	1.4	1.4	1.5
BOQ	26.1	55.6	6.7	10.7	29.1	15.0	4.1	34.3	7.6	38.2	22.3	7.6
QSRatio												
90th Percentile Output:												
fB%	1.5	1.5	1.7	1.6	1.5	1.6	1.8	1.5	1.7	1.5	1.5	1.7
BOQ	28.0	59.6	7.5	11.7	31.3	16.3	4.7	36.7	8.4	41.0	24.0	8.5
QSRatio												
95th Percentile Output:												
fB%	1.6	1.6	2.0	1.8	1.6	1.7	2.2	1.6	2.0	1.6	1.6	2.0
BOQ	30.1	63.6	8.9	13.3	33.5	18.0	5.8	39.3	9.8	43.8	25.9	9.9
QSRatio												
98th Percentile Output:												
fB%	1.7	1.7	2.3	2.1	1.7	1.9	2.6	1.7	2.3	1.7	1.8	2.2
BOQ	32.2	67.6	10.2	14.9	35.8	19.7	6.8	41.8	11.3	46.6	27.9	11.4
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: PM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Steeles Avenue

Inter.: Sessions Avenue / Jane Street
Area Type: All other areas
Jurisd: City of Toronto
Year: Total Future Conditions
N/S St: Jane Street

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	3	1	1	3	1	1	3	1	1	3	1
LGConfig	L	T	R	L	T	R	L	T	R	L	T	R
Volume	252	1346	133	243	1627	366	168	911	204	322	1105	520
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
RTOR Vol			0			0			0			120

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left		P			NB Left	P		P	
Thru		P			Thru			P	
Right		P			Right			P	
Peds					Peds				
WB Left		P			SB Left	P	P	P	
Thru		P			Thru		P	P	
Right		P			Right		P	P	
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green		12.0	45.0			8.0	7.0	24.0	
Yellow		2.0	4.0			2.0	2.0	4.0	
All Red		2.0	3.0			2.0	0.0	3.0	

Cycle Length: 120.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	232	1719	1.11	0.51	126.7	F		
T	1764	4705	0.78	0.38	36.6	D	48.9	D
R	577	1538	0.24	0.38	26.7	C		
Westbound								
L	244	1805	1.02	0.51	96.5	F		
T	1718	4580	0.97	0.38	51.8	D	54.0	D
R	594	1583	0.63	0.38	35.6	D		
Northbound								
L	182	1736	0.94	0.27	108.4	F		
T	977	4883	0.95	0.20	66.7	E	70.3	E
R	311	1553	0.67	0.20	55.2	E		
Southbound								
L	336	1736	0.98	0.38	78.4	E		
T	1369	4977	0.82	0.28	46.5	D	60.8	E
R	411	1495	0.99	0.28	86.0	F		

Intersection Delay = 57.5 (sec/veh) Intersection LOS = E

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:
Fax:

OPERATIONAL ANALYSIS

Analyst:	NA
Intersection:	Steeles Avenue / Jane Street
Agency/Co.:	URS Canada Inc.
Area Type:	All other areas
Date Performed:	12/9/2004
Jurisdiction:	City of Toronto
Analysis Time Period:	PM Peak Hour
Analysis Year:	Total Future Conditions
Project ID:	TTC Spadina Station Extension
East/West Street:	North/South Street
Steeles Avenue	Jane Street

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	252	1346	133	243	1627	366	168	911	204	322	1105	520
% Heavy Veh	5	10	5	0	13	2	4	6	4	4	4	8
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	64	343	34	62	415	93	43	232	52	82	282	133
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
ParkExist												
NumPark												
No. Lanes	1	3	1	1	3	1	1	3	1	1	3	1
LGConfig	L	T	R	L	T	R	L	T	R	L	T	R
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
RTOR Vol			0			0			0			120
Adj Flow	257	1373	136	248	1660	373	171	930	208	329	1128	408
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.000	1.000		0.000	1.000
Peds	0			0			0			0		
Buses	0	0	0	0	0	0	0	0	0	0	0	0
%InProtPhase	0.0			0.0			0.0			0.0		

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Arriv. Type	3	3	3	3	3	3	3	3	3	3	3	3
Unit Ext.	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Ext of g	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left		P			NB Left	P		P	
Thru		P			Thru			P	
Right		P			Right			P	
Peds					Peds				
WB Left		P			SB Left	P	P	P	
Thru		P			Thru		P	P	
Right		P			Right		P	P	
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green		12.0	45.0			8.0	7.0	24.0	
Yellow		2.0	4.0			2.0	2.0	4.0	
All Red		2.0	3.0			2.0	0.0	3.0	

Cycle Length: 120.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	252	1346	133	243	1627	366	168	911	204	322	1105	520
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	257	1373	136	248	1660	373	171	930	208	329	1128	408
No. Lanes	1	3	1	1	3	1	1	3	1	1	3	1
Lane group	L	T	R	L	T	R	L	T	R	L	T	R
Adj flow	257	1373	136	248	1660	373	171	930	208	329	1128	408
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.000	1.000		0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound						Westbound						Northbound						Southbound					
LG	L	T		R			L	T		R			L	T		R			L	T		R		
So	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lanes	1	3		1			1	3		1			1	3		1			1	3		1		
fW	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fHV	0.952	0.909	0.952	1.000	0.885	0.980	0.962	0.943	0.962	0.962	0.962	0.926	0.962	0.943	0.962	0.962	0.962	0.926	0.962	0.943	0.962	0.962	0.962	0.926
fG	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fLU	1.000	0.908	1.000	1.000	0.908	1.000	1.000	0.908	1.000	1.000	0.908	1.000	1.000	0.908	1.000	1.000	0.908	1.000	1.000	0.908	1.000	1.000	0.908	1.000
fRT		1.000	0.850		1.000	0.850		1.000	0.850		1.000	0.850		1.000	0.850		1.000	0.850		1.000	0.850		1.000	0.850
fLT	0.950	1.000		0.950	1.000		0.950	1.000		0.950	1.000		0.950	1.000		0.950	1.000		0.950	1.000		0.950	1.000	
Sec.	0.082			0.082			0.180			0.154			0.082			0.180			0.082			0.180		
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000
S	1719	4705	1538	1805	4580	1583	1736	4883	1553	1736	4977	1495	1736	4883	1553	1736	4977	1495	1736	4883	1553	1736	4977	1495
Sec.	148			155			328			281			148			155			328			281		

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		172	1719	0.10	0.100	172	1.00
Perm		85	148	# 0.57	0.408	60	1.42
Left	L	257			0.51	232	1.11
Prot							
Perm							
Thru	T	1373	4705	0.29	0.38	1764	0.78
Right	R	136	1538	0.09	0.38	577	0.24
Westbound							
Prot		181	1805	# 0.10	0.100	181	1.00
Perm		67	155	0.43	0.408	63	1.06
Left	L	248			0.51	244	1.02
Prot							
Perm							
Thru	T	1660	4580	0.36	0.38	1718	0.97
Right	R	373	1583	0.24	0.38	594	0.63
Northbound							
Prot		116	1736	0.07	0.067	116	1.00
Perm		55	328	0.17	0.200	66	0.83
Left	L	171			0.27	182	0.94
Prot							
Perm							
Thru	T	930	4883	0.19	0.20	977	0.95
Right	R	208	1553	0.13	0.20	311	0.67
Southbound							
Prot		275	1736	# 0.16	0.158	275	1.00
Perm		54	281	# 0.19	0.217	61	0.89
Left	L	329			0.38	336	0.98
Prot							
Perm							
Thru	T	1128	4977	0.23	0.28	1369	0.82
Right	R	408	1495	0.27	0.28	411	0.99

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 1.03
Total lost time per cycle, L = 14.00 Sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.16

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	1.11	0.51	35.7	1.000	232	0.50	91.0	0.0	126.7	F		
T	0.78	0.38	33.1	1.000	1764	0.50	3.5	0.0	36.6	D	48.9	D
R	0.24	0.38	25.7	1.000	577	0.50	1.0	0.0	26.7	C		
Westbound												
L	1.02	0.51	34.6	1.000	244	0.50	61.9	0.0	96.5	F		
T	0.97	0.38	36.8	1.000	1718	0.50	15.1	0.0	51.8	D	54.0	D
R	0.63	0.38	30.7	1.000	594	0.50	5.0	0.0	35.6	D		
Northbound												
L	0.94	0.27	55.9	1.000	182	0.50	52.5	0.0	108.4	F		
T	0.95	0.20	47.4	1.000	977	0.50	19.3	0.0	66.7	E	70.3	E
R	0.67	0.20	44.3	1.000	311	0.50	10.9	0.0	55.2	E		
Southbound												
L	0.98	0.38	34.3	1.000	336	0.50	44.1	0.0	78.4	E		
T	0.82	0.28	40.8	1.000	1369	0.50	5.7	0.0	46.5	D	60.8	E
R	0.99	0.28	43.4	1.000	411	0.50	42.6	0.0	86.0	F		

Intersection Delay = 57.5 (sec/veh) Intersection LOS = E

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)	61.0	61.0	32.0	45.0
Effective permitted green time for LT lane group, g(s)	49.0	49.0	24.0	26.0
Opposing effective green time, go (s)	45.0	45.0	33.0	24.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	3	3	3	3
Adjusted LT flow rate, VLT (veh/h)	257	248	171	329
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	1660	1373	1128	930
Lost time for LT lane group, tL	7.00	7.00	11.00	7.00
Computation				
LT volume per cycle, LTC=VLTC/3600	8.57	8.27	5.70	10.97
Opposing lane util. factor, fLUo	0.908	0.908	0.908	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	20.31	16.80	13.80	11.38
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.63	0.63	0.73	0.80
gq, (see Exhibit C16-4,5,6,7,8)	38.39	29.17	5.99	22.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	10.61	19.83	18.01	4.00
n=Max(gq-gf)/2,0)	19.19	14.58	3.00	11.00
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	7.34	5.41	4.18	3.40
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.08	0.08	0.17	0.15
gdiff=max(gq-gf,0)	1.00	1.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.08	0.08	0.18	0.15
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.082	0.082	0.180	0.154

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.908	0.908	0.908	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 120.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	257	248	171	329
v/c ratio from Capacity Worksheet, X	1.11	1.02	0.94	0.98
Protected phase effective green interval, g (s)	12.0	12.0	8.0	19.0
Opposing queue effective green interval, gq	38.39	29.17	5.99	22.00
Unopposed green interval, gu	10.61	19.83	18.01	4.00
Red time r=(C-g-gq-gu)	59.0	59.0	88.0	75.0
Arrival rate, qa=v/(3600(max[X,1.0]))	0.06	0.07	0.05	0.09
Protected ph. departure rate, Sp=s/3600	0.478	0.501	0.482	0.482
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.19	0.11	0.12	0.51
XPerm	1.57	1.57	0.52	1.17
XProt	0.80	0.80	1.18	0.94
Case	3	3	2	3
Queue at beginning of green arrow, Qa	4.95	5.21	4.18	7.20
Queue at beginning of unsaturated green, Qu	2.47	1.98	3.87	2.01
Residual queue, Qr	1.14	1.21	0.70	0.35
Uniform Delay, d1	35.7	34.6	55.9	34.3

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Final Queue Delay d3 sec	Initial Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 57.5 sec/veh Intersection LOS E

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
LaneGroup												
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	257	504	136	248	609	373	171	341	208	329	414	408
So	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	3	1	1	3	1	1	3	1	1	3	1
SL	457	1727	1538	1240	1681	1583	680	1792	1553	895	1827	1495
LnCapacity	232	647	577	244	630	594	182	358	311	336	502	411
Flow Ratio	0.56	0.29	0.09	0.52	0.36	0.24	0.25	0.19	0.13	0.37	0.23	0.27
v/c Ratio	1.11	0.78	0.24	1.02	0.97	0.63	0.94	0.95	0.67	0.98	0.82	0.99
Grn Ratio	0.51	0.38	0.38	0.51	0.38	0.38	0.27	0.20	0.20	0.38	0.28	0.28
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3	3	3	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	4.7	14.8	3.1	4.5	19.9	10.2	4.5	11.2	6.4	8.1	12.9	13.6
KB	0.5	1.0	1.0	0.5	1.0	1.0	0.4	0.7	0.6	0.7	0.9	0.7
Q2	5.9	3.1	0.3	4.3	7.6	1.5	2.4	4.4	1.1	4.8	3.2	6.0
Q Average	10.6	17.9	3.4	8.8	27.5	11.7	6.9	15.7	7.5	12.9	16.1	19.6
Q Spacing	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Q Storage	0	0	0	0	0	0	0	0	0	0	0	0
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2	1.3	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
BOQ	12.8	21.6	4.3	10.7	33.0	14.2	8.4	18.9	9.2	15.5	19.4	23.5
QSRatio												
85th Percentile Output:												
fB%	1.4	1.4	1.6	1.5	1.4	1.4	1.5	1.4	1.5	1.4	1.4	1.4
BOQ	15.2	25.2	5.3	12.8	38.5	16.7	10.1	22.1	11.1	18.3	22.7	27.5
QSRatio												
90th Percentile Output:												
fB%	1.6	1.5	1.8	1.6	1.5	1.5	1.6	1.5	1.6	1.5	1.5	1.5
BOQ	16.5	27.1	6.0	13.9	41.2	18.1	11.2	23.8	12.2	19.8	24.5	29.5
QSRatio												
95th Percentile Output:												
fB%	1.7	1.6	2.1	1.8	1.6	1.7	1.9	1.6	1.8	1.7	1.6	1.6
BOQ	18.2	29.2	7.2	15.6	44.1	19.9	12.7	25.7	13.7	21.6	26.4	31.7
QSRatio												
98th Percentile Output:												
fB%	1.9	1.7	2.5	2.0	1.7	1.8	2.1	1.8	2.0	1.8	1.8	1.7
BOQ	19.9	31.2	8.4	17.2	46.9	21.6	14.3	27.7	15.3	23.3	28.3	33.8
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: AM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Steeles Avenue

Inter.: Steeles Ave / Northwest Gate
Area Type: All other areas
Jurisd: City of Toronto
Year: Total Future Conditions
N/S St: Northwest Gate

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	3	1	1	3	1	1	1	0	2	1	0
LGConfig	L	T	R	L	T	R	L	TR		L	TR	
Volume	284	2076	90	96	1544	416	13	0	22	251	0	152
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6		3.6	3.6	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left		P	P		NB Left		A		
Thru			P	P	Thru		A		
Right			P	P	Right		A		
Peds					Peds				
WB Left		P		P	SB Left	P			
Thru				P	Thru	P	A		
Right				P	Right	P	A		
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green		6.0	12.0	52.0		30.0	6.0		
Yellow		2.0	2.0	4.0		2.0	4.0		
All Red		2.0	0.0	3.0		0.0	3.0		

Cycle Length: 128.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	369	1805	0.79	0.59	51.6	D		
T	2542	4929	0.83	0.52	29.7	C	31.7	C
R	824	1599	0.11	0.52	16.2	B		
Westbound								
L	144	1805	0.68	0.45	46.3	D		
T	1965	4837	0.80	0.41	37.0	D	37.2	D
R	656	1615	0.65	0.41	35.5	D		
Northbound								
L	57	1206	0.23	0.05	60.8	E		
TR	74	1568	0.30	0.05	61.2	E	61.1	E
Southbound								
L	821	3505	0.31	0.23	41.5	D		
TR	360	1214	0.43	0.30	37.1	D	39.8	D

Intersection Delay = 34.9 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:
Fax:

OPERATIONAL ANALYSIS

Analyst:	NA
Intersection:	Steeles Ave / Northwest Gate
Agency/Co.:	URS Canada Inc.
Area Type:	All other areas
Date Performed:	12/9/2004
Jurisdiction:	City of Toronto
Analysis Time Period:	AM Peak Hour
Analysis Year:	Total Future Conditions
Project ID:	TTC Spadina Station Extension
East/West Street:	North/South Street
Steeles Avenue	Northwest Gate

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	284	2076	90	96	1544	416	13	0	22	251	0	152
% Heavy Veh	0	5	1	0	7	0	5	0	5	0	0	33
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	72	530	23	24	394	106	4	0	6	64	0	39
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900	1900	1900	1900	1900	1900	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	3	1	1	3	1	1	1	0	2	1	0
LGConfig	L	T	R	L	T	R	L	TR		L	TR	
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6		3.6	3.6	
RTOR Vol			0			0			0			0
Adj Flow	290	2118	92	98	1576	424	13	22		256	155	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000			0.000	
Prop RTs		0.000	1.000		0.000	1.000		1.000		1.000		
Peds Bikes	0			0			0			0		
Buses	0	0	0	0	0	0	0	0		0	0	
%InProtPhase	0.0			0.0								
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Arriv. Type	3	3	3	3	3	3	3	3		3	3	
Unit Ext.	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0		2.0	2.0	
Ext of g	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0		2.0	2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left		P	P	P	NB Left		A		
Thru			P	P	Thru		A		
Right			P	P	Right		A		
Peds					Peds				
WB Left		P		P	SB Left	P			
Thru				P	Thru	P	A		
Right				P	Right	P	A		
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green		6.0	12.0	52.0		30.0	6.0		
Yellow		2.0	2.0	4.0		2.0	4.0		
All Red		2.0	0.0	3.0		0.0	3.0		

Cycle Length: 128.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	284	2076	90	96	1544	416	13	0	22	251	0	152
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	290	2118	92	98	1576	424	13	0	22	256	0	155
No. Lanes	1	3	1	1	3	1	1	1	0	2	1	0
Lane group	L	T	R	L	T	R	L	TR		L	TR	
Adj flow	290	2118	92	98	1576	424	13	22		256	155	
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000			0.000	
Prop RTs		0.000	1.000		0.000	1.000		1.000		1.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound				Westbound				Northbound				Southbound			
LG	L	T		R	L	T		R	L	T		R	L	T		R
So	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900			1900	1900		
Lanes	1	3		1	1	3		1	1		0		2	1		0
fW	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000			1.000	1.000		
fHV	1.000	0.952	0.990	1.000	0.935	1.000	0.952	0.971		1.000			1.000	0.752		
fG	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000			1.000	1.000		
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000			1.000	1.000		
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000			1.000	1.000		
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000			1.000	1.000		
fLU	1.000	0.908	1.000	1.000	0.908	1.000	1.000	1.000		0.971			1.000	1.000		
fRT		1.000	0.850		1.000	0.850		0.850						0.850		
fLT	0.950	1.000		0.950	1.000		0.667	1.000		0.950			1.000			
Sec.	0.074			0.077												
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000			1.000	1.000		
fRpb		1.000	1.000		1.000	1.000		1.000						1.000		
S	1805	4929	1599	1805	4837	1615	1206	1568		3505			1214			
Sec.	141			146												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		290	1805	# 0.16	0.172	310	0.94
Perm		0	141	0.00	0.422	59	0.00
Left	L	290			0.59	369	0.79
Prot							
Perm							
Thru	T	2118	4929	0.43	0.52	2542	0.83
Right	R	92	1599	0.06	0.52	824	0.11
Westbound							
Prot		85	1805	0.05	0.047	85	1.00
Perm		13	146	0.09	0.406	59	0.22
Left	L	98			0.45	144	0.68
Prot							
Perm							
Thru	T	1576	4837	# 0.33	0.41	1965	0.80
Right	R	424	1615	0.26	0.41	656	0.65
Northbound							
Prot							
Perm							
Left	L	13	1206	0.01	0.05	57	0.23
Prot							
Perm							
Thru	TR	22	1568	0.01	0.05	74	0.30
Right							
Southbound							
Prot							
Perm							
Left	L	256	3505	0.07	0.23	821	0.31
Prot							
Perm							
Thru	TR	155	1214	# 0.13	0.30	360	0.43
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.61
Total lost time per cycle, L = 21.00 Sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.73

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.79	0.59	36.1	1.000	369	0.50	15.4	0.0	51.6	D		
T	0.83	0.52	26.3	1.000	2542	0.50	3.4	0.0	29.7	C	31.7	C
R	0.11	0.52	15.9	1.000	824	0.50	0.3	0.0	16.2	B		
Westbound												
L	0.68	0.45	23.4	1.000	144	0.50	23.0	0.0	46.3	D		
T	0.80	0.41	33.5	1.000	1965	0.50	3.6	0.0	37.0	D	37.2	D
R	0.65	0.41	30.6	1.000	656	0.50	4.9	0.0	35.5	D		
Northbound												
L	0.23	0.05	58.8	1.000	57	0.11	2.0	0.0	60.8	E		
TR	0.30	0.05	59.0	1.000	74	0.11	2.2	0.0	61.2	E	61.1	E
Southbound												
L	0.31	0.23	40.5	1.000	821	0.50	1.0	0.0	41.5	D		
TR	0.43	0.30	36.3	1.000	360	0.11	0.8	0.0	37.1	D	39.8	D

Intersection Delay = 34.9 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	
Cycle length, C = 128.0 sec				
Total actual green time for LT lane group, G (s)	76.0	58.0	6.0	
Effective permitted green time for LT lane group, g(s)	54.0	52.0	6.0	
Opposing effective green time, go (s)	52.0	66.0	38.0	
Number of lanes in LT lane group, N	1	1	1	
Number of lanes in opposing approach, No	3	3	1	
Adjusted LT flow rate, VLT (veh/h)	290	98	13	
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	
Adjusted opposing flow rate, Vo (veh/h)	1576	2118	155	
Lost time for LT lane group, tL	7.00	11.00	7.00	
Computation				
LT volume per cycle, LTC=VLTC/3600	10.31	3.48	0.46	
Opposing lane util. factor, fLUo	0.908	0.908	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	20.57	27.65	5.51	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.59	0.48	0.70	
gq, (see Exhibit C16-4,5,6,7,8)	36.00	22.15	0.00	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	18.00	29.85	6.00	
n=Max(gq-gf)/2,0)	18.00	11.07	0.00	
PTHo=1-PLTo	1.00	1.00	1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	
EL1 (refer to Exhibit C16-3)	6.71	12.06	1.52	
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07	0.08	0.67	
gdiff=max(gq-gf,0)	0.00	0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.07	0.08	0.67	
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.074	0.077	0.667	

For special case of single-lane approach opposed by multilane approach,
see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C = 128.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.908	0.908	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach,
see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vb1c (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C = 128.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	290	98		
v/c ratio from Capacity Worksheet, X	0.79	0.68		
Protected phase effective green interval, g (s)	22.0	6.0		
Opposing queue effective green interval, gq	36.00	22.15		
Unopposed green interval, gu	18.00	29.85		
Red time r=(C-g-gq-gu)	52.0	70.0		
Arrival rate, qa=v/(3600(max[X,1.0]))	0.08	0.03		
Protected ph. departure rate, Sp=s/3600	0.501	0.501		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.12	0.07		
XPerm	2.06	0.67		
XProt	0.54	0.69		
Case	3	1		
Queue at beginning of green arrow, Qa	6.42	1.91		
Queue at beginning of unsaturated green, Qu	2.90	0.00		
Residual queue, Qr	2.24	0.00		
Uniform Delay, d1	36.1	23.4		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Final Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 34.9 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	T	R	L	T	R	L	TR		L	TR	
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Flow Rate	290	777	92	98	578	424	13	22		131	155	
So	1900	1900	1900	1900	1900	1900	1900	1900		1900	1900	
No.Lanes	1	3	1	1	3	1	1	1	0	2	1	0
SL	623	1809	1599	318	1775	1615	1206	1568		1805	1214	
LnCapacity	369	933	824	144	721	656	57	74		422	360	
Flow Ratio	0.47	0.43	0.06	0.31	0.33	0.26	0.01	0.01		0.07	0.13	
v/c Ratio	0.79	0.83	0.11	0.68	0.80	0.65	0.23	0.30		0.31	0.43	
Grn Ratio	0.59	0.52	0.52	0.45	0.41	0.41	0.05	0.05		0.23	0.30	
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3	3	3	3	3	3	3		3	3	
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Q1	4.8	23.5	1.7	2.0	18.1	12.1	0.4	0.8		3.8	4.4	
kB	0.7	1.4	1.3	0.4	1.2	1.1	0.2	0.2		0.8	0.5	
Q2	2.2	5.4	0.2	0.7	3.9	1.9	0.0	0.1		0.4	0.3	
Q Average	7.0	28.9	1.8	2.7	22.0	14.0	0.5	0.8		4.2	4.8	
Q Spacing	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6		7.6	7.6	
Q Storage	0	0	0	0	0	0	0	0		0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2	1.3	1.3	1.2	1.2	1.2	1.2		1.2	1.2	
BOQ	8.6	34.7	2.3	3.4	26.4	16.9	0.6	1.0		5.2	5.7	
QSRatio												
85th Percentile Output:												
fB%	1.5	1.4	1.6	1.6	1.4	1.4	1.6	1.6		1.5	1.6	
BOQ	10.4	40.5	3.0	4.2	30.8	19.9	0.8	1.3		6.4	7.4	
QSRatio												
90th Percentile Output:												
fB%	1.6	1.5	1.8	1.8	1.5	1.5	1.8	1.8		1.7	1.7	
BOQ	11.4	43.4	3.4	4.8	33.1	21.4	0.9	1.5		7.2	8.2	
QSRatio												
95th Percentile Output:												
fB%	1.8	1.6	2.3	2.2	1.6	1.7	2.1	2.1		2.0	2.0	
BOQ	13.0	46.3	4.2	5.9	35.4	23.3	1.0	1.7		8.5	9.4	
QSRatio												
98th Percentile Output:												
fB%	2.1	1.7	2.7	2.6	1.7	1.8	2.7	2.6		2.3	2.4	
BOQ	14.5	49.2	5.0	6.9	37.7	25.1	1.3	2.2		9.9	11.5	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: PM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Steeles Avenue
Inter.: Steeles Ave / Northwest Gate
Area Type: All other areas
Jurisd: City of Toronto
Year: Total Future Conditions
N/S St: Northwest Gate

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	3	1	1	3	1	1	1	0	2	1	0
LGConfig	L	T	R	L	T	R	L	TR		L	TR	
Volume	152	1684	91	84	2194	186	44	0	53	481	0	284
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6		3.6	3.6	
RTOR Vol			0			0			0			60

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left		P			NB Left		A		
Thru		P			Thru		A		
Right		P			Right		A		
Peds					Peds				
WB Left			P		SB Left	P			
Thru			P		Thru	P	A		
Right			P		Right	P	A		
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green		5.0	60.0			30.0	7.0		
Yellow		2.0	4.0			2.0	4.0		
All Red		0.0	3.0				3.0		

Cycle Length: 120.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	139	1805	1.22	0.56	177.0	F		
T	2752	4929	0.68	0.56	20.2	C	32.3	C
R	893	1599	0.11	0.56	12.7	B		
Westbound								
L	71	142	1.31	0.50	240.4	F		
T	2419	4837	1.01	0.50	50.2	D	54.2	D
R	808	1615	0.26	0.50	18.0	B		
Northbound								
L	64	1094	0.77	0.06	97.4	F		
TR	91	1568	0.65	0.06	70.3	E	82.6	F
Southbound								
L	876	3505	0.61	0.25	43.0	D		
TR	395	1214	0.63	0.32	37.6	D	41.3	D

Intersection Delay = 44.9 (sec/veh) Intersection LOS = D

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:
Fax:

OPERATIONAL ANALYSIS

Analyst:
Intersection:
Agency/Co.:
Area Type:
Date Performed:
Jurisdiction:
Analysis Time Period:
Analysis Year:
Project ID: TTC Spadina Station Extension
East/West Street: Steeles Avenue
North/South Street: Northwest Gate

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	152	1684	91	84	2194	186	44	0	53	481	0	284
% Heavy Veh	0	5	1	0	7	0	5	0	3	0	0	33
PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
PK 15 Vol	42	468	25	23	609	52	12	0	15	134	0	79
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900	1900	1900	1900	1900	1900	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	3	1	1	3	1	1	1	0	2	1	0
LGConfig	L	T	R	L	T	R	L	TR		L	TR	
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6		3.6	3.6	
RTOR Vol			0			0			0			60
Adj Flow	169	1871	101	93	2438	207	49	59		534	249	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000			0.000	
Prop RTs		0.000	1.000		0.000	1.000		1.000		1.000		
Peds	Bikes	0			0			0		0		
Buses	0	0	0	0	0	0	0	0		0	0	
%InProtPhase	0.0											
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Arriv. Type	3	3	3	3	3	3	3	3		3	3	
Unit Ext.	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0		2.0	2.0	
Ext of g	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0		2.0	2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left		P	P		NB Left		A		
Thru		P	P		Thru		A		
Right		P	P		Right		A		
Peds					Peds				
WB Left			P		SB Left	P			
Thru			P		Thru	P	A		
Right			P		Right	P	A		
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green		5.0	60.0			30.0	7.0		
Yellow		2.0	4.0			2.0	4.0		
All Red		0.0	3.0				3.0		

Cycle Length: 120.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	152	1684	91	84	2194	186	44	0	53	481	0	284
PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj flow	169	1871	101	93	2438	207	49	0	59	534	0	249
No. Lanes	1	3	1	1	3	1	1	1	0	2	1	0
Lane group	L	T	R	L	T	R	L	TR		L	TR	
Adj flow	169	1871	101	93	2438	207	49	59		534	249	
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000			0.000	
Prop RTs		0.000	1.000		0.000	1.000		1.000		1.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound				Westbound				Northbound				Southbound			
LG	L	T	R		L	T	R		L	T	R		L	TR		
So	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900			1900	1900		
Lanes	1	3		1	1	3		1	1		0		2	1	0	
fW	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000			1.000	1.000		
fHV	1.000	0.952	0.990	1.000	0.935	1.000	0.952	0.971		1.000			1.000	0.752		
fG	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000			1.000	1.000		
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000			1.000	1.000		
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000			1.000	1.000		
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000			1.000	1.000		
fLU	1.000	0.908	1.000	1.000	0.908	1.000	1.000	1.000		0.971	1.000					
fRT		1.000	0.850		1.000	0.850		0.850			0.850					
fLT	0.959	1.000		0.075	1.000		0.605	1.000		0.950	1.000					
Sec.	0.065															
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000					
fRpb		1.000	1.000		1.000	1.000		1.000			1.000					
S	1805	4929	1599	142	4837	1615	1094	1568		3505	1214					
Sec.	123															

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		75	1805	# 0.04	0.042	75	1.00
Perm		94	123	# 0.76	0.517	64	1.47
Left	L	169			0.56	139	1.22
Prot							
Perm							
Thru	T	1871	4929	0.38	0.56	2752	0.68
Right	R	101	1599	0.06	0.56	893	0.11
Westbound							
Prot							
Perm							
Left	L	93	142	0.65	0.50	71	1.31
Prot							
Perm							
Thru	T	2438	4837	0.50	0.50	2419	1.01
Right	R	207	1615	0.13	0.50	808	0.26
Northbound							
Prot							
Perm							
Left	L	49	1094	0.04	0.06	64	0.77
Prot							
Perm							
Thru	TR	59	1568	0.04	0.06	91	0.65
Right							
Southbound							
Prot							
Perm							
Left	L	534	3505	0.15	0.25	876	0.61
Prot							
Perm							
Thru	TR	249	1214	# 0.21	0.32	395	0.63
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 1.01
Total lost time per cycle, L = 14.00 Sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.14

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	1.22	0.56	31.2	1.000	139	0.50	145.7	0.0	177.0	F		
T	0.68	0.56	18.9	1.000	2752	0.50	1.4	0.0	20.2	C	32.3	C
R	0.11	0.56	12.5	1.000	893	0.50	0.3	0.0	12.7	B		
Westbound												
L	1.31	0.50	30.0	1.000	71	0.50	210.4	0.0	240.4	F		
T	1.01	0.50	30.0	1.000	2419	0.50	20.2	0.0	50.2	D	54.2	D
R	0.26	0.50	17.2	1.000	808	0.50	0.8	0.0	18.0	B		
Northbound												
L	0.77	0.06	55.7	1.000	64	0.32	41.8	0.0	97.4	F		
TR	0.65	0.06	55.3	1.000	91	0.23	15.0	0.0	70.3	E	82.6	F
Southbound												
L	0.61	0.25	39.8	1.000	876	0.50	3.2	0.0	43.0	D		
TR	0.63	0.32	34.4	1.000	395	0.21	3.2	0.0	37.6	D	41.3	D

Intersection Delay = 44.9 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)	67.0	60.0	7.0	
Effective permitted green time for LT lane group, g(s)	62.0	60.0	7.0	
Opposing effective green time, go (s)	60.0	67.0	39.0	
Number of lanes in LT lane group, N	1	1	1	
Number of lanes in opposing approach, No	3	3	1	
Adjusted LT flow rate, VLT (veh/h)	169	93	49	
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	
Adjusted opposing flow rate, Vo (veh/h)	2438	1871	249	
Lost time for LT lane group, tL	7.00	7.00	7.00	
Computation				
LT volume per cycle, LTC=VLTC/3600	5.63	3.10	1.63	
Opposing lane util. factor, fLUo	0.908	0.908	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	29.83	22.90	8.30	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.50	0.44	0.68	
gq, (see Exhibit C16-4,5,6,7,8)	58.00	18.70	0.00	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	4.00	41.30	7.00	
n=Max(gq-gf)/2,0)	29.00	9.35	0.00	
PTHo=1-PLTo	1.00	1.00	1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	
EL1 (refer to Exhibit C16-3)	17.15	9.22	1.65	
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06	0.07	0.57	
gdiff=max(gq-gf,0)	0.00	0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.06	0.07	0.60	
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.065	0.075	0.605	

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.908	0.908	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 120.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	169			
v/c ratio from Capacity Worksheet, X	1.22			
Protected phase effective green interval, g (s)	5.0			
Opposing queue effective green interval, gq	58.00			
Unopposed green interval, gu	4.00			
Red time r=(C-g-gq-gu)	53.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.04			
Protected ph. departure rate, Sp=s/3600	0.501			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.53			
XPerm	1.13			
XProt	0.89			
Case	3			
Queue at beginning of green arrow, Qa	2.32			
Queue at beginning of unsaturated green, Qu	2.24			
Residual queue, Qr	0.28			
Uniform Delay, d1	31.2			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Final Queue Delay d3 sec	Initial Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 44.9 sec/veh Intersection LOS D

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	T	R	L	T	R	L	TR		L	TR	
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Flow Rate	169	686	101	93	895	207	49	59		274	249	
So	1900	1900	1900	1900	1900	1900	1900	1900		1900	1900	
No.Lanes	1	3	1	1	3	1	1	1	0	2	1	0
SL	249	1809	1599	142	1775	1615	1094	1568		1805	1214	
LnCapacity	139	1010	893	71	888	808	64	91		451	395	
Flow Ratio	0.68	0.38	0.06	0.65	0.50	0.13	0.04	0.04		0.15	0.21	
v/c Ratio	1.22	0.68	0.11	1.31	1.01	0.26	0.77	0.65		0.61	0.63	
Grn Ratio	0.56	0.56	0.56	0.50	0.50	0.50	0.06	0.06		0.25	0.32	
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3	3	3	3	3	3	3		3	3	
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Q1	2.6	16.3	1.6	3.1	29.8	4.0	1.6	1.9		8.1	7.0	
kB	0.4	1.4	1.3	0.2	1.3	1.2	0.2	0.2		0.8	0.5	
Q2	5.2	2.8	0.2	3.5	12.4	0.4	0.4	0.3		1.2	0.8	
Q Average	7.8	19.1	1.8	6.6	42.3	4.4	2.0	2.3		9.3	7.8	
Q Spacing	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6		7.6	7.6	
Q Storage	0	0	0	0	0	0	0	0		0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2	1.3	1.2	1.2	1.2	1.2	1.2		1.2	1.2	
BOQ	9.5	22.9	2.2	8.1	50.7	5.4	2.4	2.7		11.2	9.2	
QSRatio												
85th Percentile Output:												
fB%	1.5	1.4	1.6	1.5	1.4	1.5	1.6	1.6		1.4	1.5	
BOQ	11.4	26.8	2.8	9.7	59.2	6.7	3.2	3.6		13.4	12.0	
QSRatio												
90th Percentile Output:												
fB%	1.6	1.5	1.9	1.6	1.5	1.7	1.8	1.8		1.6	1.7	
BOQ	12.5	28.8	3.2	10.8	63.4	7.5	3.6	4.0		14.6	13.1	
QSRatio												
95th Percentile Output:												
fB%	1.8	1.6	2.3	1.9	1.6	2.0	2.0	2.0		1.8	1.9	
BOQ	14.1	30.9	4.0	12.3	67.6	8.8	4.1	4.6		16.3	14.8	
QSRatio												
98th Percentile Output:												
fB%	2.0	1.7	2.8	2.1	1.7	2.3	2.6	2.5		1.9	2.2	
BOQ	15.7	33.0	4.8	13.8	71.9	10.2	5.2	5.7		17.9	17.6	
QSRatio												

ERROR MESSAGES

No errors to report.

Steeles West Station - Future Total Traffic Conditions With Improvements

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: AM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Steeles Avenue

Area Type: All other areas
Jurisd: City of Toronto
Year: Total Future Conditions
N/S St: Keele Street

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes		1	3 1		1	3 1		1	3 1		1	3 1
LGConfig	L	T	R	L	T	R	L	T	R	L	T	R
Volume	277	1542	123	168	1720	239	143	668	137	256	1282	348
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
RTOR Vol			0			40			0			40
Duration	0.25		Area Type: All other areas									
Signal Operations												
Phase Combination	1		2	3	4			5	6	7	8	
EB Left			A				NB Left		P			
Thru				P			Thru		P			
Right				P			Right		P			
Peds							Peds					
WB Left			A		P		SB Left		P		P	
Thru					P		Thru				P	
Right					P		Right				P	
Peds							Peds					
NB Right							EB Right					
SB Right							WB Right					
Green			13.0	36.0					6.0	35.0		
Yellow			3.0	4.0					2.0	4.0		
All Red			1.0	2.0					2.0	2.0		

Cycle Length: 110.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	247	1543	1.15	0.48	135.3	F		
T	1598	4883	0.98	0.33	55.8	E	65.4	E
R	489	1495	0.26	0.33	28.5	C		
Westbound								
L	256	1612	0.67	0.48	29.5	C		
T	1629	4977	1.08	0.33	83.4	F	74.1	E
R	476	1455	0.43	0.33	31.7	C		
Northbound								
L	148	1530	0.99	0.41	111.5	F		
T	1497	4705	0.46	0.32	30.9	C	42.9	D
R	489	1538	0.29	0.32	29.6	C		
Southbound								
L	251	1641	1.04	0.41	107.7	F		
T	1525	4792	0.86	0.32	41.6	D	51.4	D
R	418	1313	0.75	0.32	45.4	D		

Intersection Delay = 61.2 (sec/veh) Intersection LOS = E

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:
Fax:

OPERATIONAL ANALYSIS

Analyst: NA
Intersection: Steeles Avenue / Keele St
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: AM Peak Hour
Analysis Year: Total Future Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Steeles Avenue
North/South Street: Keele Street

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	277	1542	123	168	1720	239	143	668	137	256	1282	348
% Heavy Veh	17	6	8	12	4	11	18	10	5	10	8	23
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	71	393	31	43	439	61	36	170	35	65	327	89
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
ParkExist												
NumPark												
No. Lanes		1	3 1		1	3 1		1	3 1		1	3 1
LGConfig	L	T	R	L	T	R	L	T	R	L	T	R
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
RTOR Vol			0			40			0			40
Adj Flow	283	1573	126	171	1755	203	146	682	140	261	1308	314
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.000	1.000		0.000	1.000
Peds	Bikes	0			0			0			0	
Buses	0	0	0	0	0	0	0	0	0	0	0	0
%InProtPhase	0.0			0.0			0.0			0.0		
Duration	0.25		Area Type: All other areas									

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Arriv. Type	3	3	3	3	3	3	3	3	3	3	3	3
Unit Ext.	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Ext of g	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left	A	P			NB Left	P	P	
Thru		P			Thru		P	
Right		P			Right		P	
Peds					Peds			
WB Left	A	P			SB Left	P	P	
Thru		P			Thru		P	
Right		P			Right		P	
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	13.0	36.0			6.0	35.0		
Yellow	3.0	4.0			2.0	4.0		
All Red	1.0	2.0			2.0	2.0		

Cycle Length: 110.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	277	1542	123	168	1720	239	143	668	137	256	1282	348
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	283	1573	126	171	1755	203	146	682	140	261	1308	314
No. Lanes	1	3	1	1	3	1	1	3	1	1	3	1
Lane group	L	T	R	L	T	R	L	T	R	L	T	R
Adj flow	283	1573	126	171	1755	203	146	682	140	261	1308	314
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.000	1.000		0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound				Westbound				Northbound				Southbound			
LG	L	T		R	L	T		R	L	T		R	L	T		R
So	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lanes	1	3		1	1	3		1	1	3		1	1	3		1
fW	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fHV	0.855	0.943	0.926	0.893	0.962	0.901	0.847	0.909	0.952	0.909	0.926	0.813				
fG	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000				
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000				
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000				
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000				
fLU	1.000	0.908	1.000	1.000	0.908	1.000	1.000	0.908	1.000	1.000	0.908	1.000				
fRT		1.000	0.850		1.000	0.850		1.000	0.850		1.000	0.850				
fLT	0.950	1.000		0.950	1.000		0.950	1.000		0.950	1.000					
Sec.	0.100			0.100			0.103			0.262						
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000					
fRpb		1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000				
S	1543	4883	1495	1612	4977	1455	1530	4705	1538	1641	4792	1313				
Sec.	162			170			165			453						

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		182	1543	# 0.12	0.118	182	1.00
Perm		101	162	# 0.62	0.364	65	1.55
Left	L	283			0.48	247	1.15
Prot							
Perm							
Thru	T	1573	4883	0.32	0.33	1598	0.98
Right	R	126	1495	0.08	0.33	489	0.26
Westbound							
Prot		171	1612	0.11	0.118	191	0.90
Perm		0	170	0.00	0.364	65	0.00
Left	L	171			0.48	256	0.67
Prot							
Perm							
Thru	T	1755	4977	0.33	0.33	1629	1.08
Right	R	203	1455	0.14	0.33	476	0.43
Northbound							
Prot		83	1530	0.05	0.055	83	1.00
Perm		63	165	# 0.38	0.355	65	0.97
Left	L	146			0.41	148	0.99
Prot							
Perm							
Thru	T	682	4705	0.14	0.32	1497	0.46
Right	R	140	1538	0.09	0.32	489	0.29
Southbound							
Prot		90	1641	# 0.05	0.055	90	1.00
Perm		171	453	0.38	0.355	161	1.06
Left	L	261			0.41	251	1.04
Prot							
Perm							
Thru	T	1308	4792	0.27	0.32	1525	0.86
Right	R	314	1313	0.24	0.32	418	0.75

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 1.18
Total lost time per cycle, L = 12.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.32

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Adj Fact	Prog Cap	Lane Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	1.15	0.48	33.0	1.000	247	0.50	102.3	0.0	135.3	F		
T	0.98	0.33	36.7	1.000	1598	0.50	19.1	0.0	55.8	E	65.4	E
R	0.26	0.33	27.2	1.000	489	0.50	1.3	0.0	28.5	C		
Westbound												
L	0.67	0.48	23.0	1.000	256	0.24	6.5	0.0	29.5	C		
T	1.08	0.33	37.0	1.000	1629	0.50	46.4	0.0	83.4	F	74.1	E
R	0.43	0.33	28.9	1.000	476	0.50	2.8	0.0	31.7	C		
Northbound												
L	0.99	0.41	41.0	1.000	148	0.50	70.5	0.0	111.5	F		
T	0.46	0.32	29.9	1.000	1497	0.50	1.0	0.0	30.9	C	42.9	D
R	0.29	0.32	28.1	1.000	489	0.50	1.5	0.0	29.6	C		
Southbound												
L	1.04	0.41	40.1	1.000	251	0.50	67.6	0.0	107.7	F		
T	0.86	0.32	35.2	1.000	1525	0.50	6.5	0.0	41.6	D	51.4	D
R	0.75	0.32	33.6	1.000	418	0.50	11.8	0.0	45.4	D		

Intersection Delay = 61.2 (sec/veh) Intersection LOS = E

SUPPLEMENTAL PERMITTED LT WORKSHEET for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)	53.0	53.0	45.0	45.0
Effective permitted green time for LT lane group, g(s)	40.0	40.0	39.0	39.0
Opposing effective green time, go (s)	36.0	36.0	35.0	35.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	3	3	3	3
Adjusted LT flow rate, VLT (veh/h)	283	171	146	261
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	1755	1573	1308	682
Lost time for LT lane group, tL	6.00	6.00	6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600	8.65	5.22	4.46	7.98
Opposing lane util. factor, fLUo	0.908	0.908	0.908	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	19.69	17.64	14.67	7.65
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.67	0.67	0.68	0.68
gq, (see Exhibit C16-4,5,6,7,8)	36.00	34.95	27.29	12.12
gu=g-gq if gq>=gf, or = g-gf if gq<gf	4.00	5.05	11.71	26.88
n=Max(gq-gf)/2,0)	18.00	17.48	13.64	6.06
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	0.13	6.69	5.05	2.63
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.10	0.10	0.10	0.10
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.10	0.10	0.10	0.26
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.100	0.100	0.103	0.262

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.908	0.908	0.908	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 110.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	283	171	146	261
v/c ratio from Capacity Worksheet, X	1.15	0.67	0.99	1.04
Protected phase effective green interval, g (s)	13.0	13.0	6.0	6.0
Opposing queue effective green interval, gq	36.00	34.95	27.29	12.12
Unopposed green interval, gu	4.00	5.05	11.71	26.88
Red time r=(C-g-gq-gu)	57.0	57.0	65.0	65.0
Arrival rate, qa=v/(3600(max[X,1.0]))	0.07	0.05	0.04	0.07
Protected ph. departure rate, Sp=s/3600	0.429	0.448	0.425	0.456
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.45	0.37	0.15	0.18
XPerm	1.52	1.01	0.88	0.55
XProt	0.86	0.57	1.13	1.81
Case	3	3	2	2
Queue at beginning of green arrow, Qa	4.86	2.72	2.64	4.53
Queue at beginning of unsaturated green, Qu	2.47	1.66	3.07	4.70
Residual queue, Qr	0.94	0.01	0.33	2.22
Uniform Delay, d1	33.0	23.0	41.0	40.1

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Queue Delay d3 sec	Initial Lane Group d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 61.2 sec/veh Intersection LOS E

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
LaneGroup												
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	283	577	126	171	644	203	146	250	140	261	480	314
So	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	3	1	1	3	1	1	3	1	1	3	1
SL	501	1792	1495	524	1827	1455	347	1727	1538	611	1759	1313
LnCapacity	247	586	489	256	598	476	148	549	489	251	559	418
Flow Ratio	0.56	0.32	0.08	0.33	0.35	0.14	0.42	0.14	0.09	0.43	0.27	0.24
v/c Ratio	1.15	0.98	0.26	0.67	1.08	0.43	0.99	0.46	0.29	1.04	0.86	0.75
Grn Ratio	0.48	0.33	0.33	0.48	0.33	0.33	0.41	0.32	0.32	0.41	0.32	0.32
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3	3	3	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	5.1	17.5	2.8	2.9	19.7	4.8	2.8	6.1	3.2	5.0	13.8	8.6
kB	0.3	0.9	0.8	0.3	0.9	0.8	0.3	0.9	0.8	0.5	0.9	0.7
Q2	6.3	7.5	0.3	0.6	11.9	0.6	2.4	0.7	0.3	4.7	3.8	1.9
Q Average	11.4	25.0	3.1	3.6	31.6	5.4	5.1	6.8	3.5	9.7	17.6	10.5
Q Spacing	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Q Storage	0	0	0	0	0	0	0	0	0	0	0	0
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2	1.3	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
BOQ	13.4	30.1	3.9	4.3	37.9	6.7	6.3	8.3	4.4	11.8	21.2	12.7
QSRatio												
85th Percentile Output:												
fB%	1.5	1.4	1.6	1.6	1.4	1.5	1.5	1.5	1.5	1.4	1.4	1.4
BOQ	17.2	35.1	4.8	5.6	44.3	8.1	7.7	10.0	5.5	14.0	24.8	15.1
QSRatio												
90th Percentile Output:												
fB%	1.6	1.5	1.8	1.7	1.5	1.7	1.7	1.6	1.7	1.6	1.5	1.6
BOQ	18.6	37.6	5.5	6.2	47.4	9.0	8.6	11.1	6.2	15.2	26.6	16.4
QSRatio												
95th Percentile Output:												
fB%	1.8	1.6	2.1	2.0	1.6	1.9	2.0	1.9	2.1	1.7	1.6	1.7
BOQ	20.8	40.2	6.6	7.1	50.6	10.5	10.1	12.6	7.4	16.9	28.7	18.1
QSRatio												
98th Percentile Output:												
fB%	2.1	1.7	2.5	2.5	1.7	2.2	2.2	2.1	2.4	1.9	1.7	1.9
BOQ	24.2	42.8	7.8	8.8	53.8	12.0	11.5	14.2	8.6	18.6	30.7	19.7
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: PM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Steeles Avenue

Inter.: Sessions Avenue / Keele Street
Area Type: All other areas
Jurisd: City of Toronto
Year: Total Future Conditions
N/S St: Keele Street

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	3	1	1	3	1	1	3	1	1	3	1
LGConfig	L	T	R	L	T	R	L	T	R	L	T	R
Volume	371	2097	233	284	2016	690	257	1284	289	275	1245	287
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
RTOR Vol			0			120			0			40

Duration 0.25 Area Type: All other areas

Phase Combination	1	2	3	4		5	6	7	8
EB Left		P			NB Left	P	P		
Thru		P			Thru		P		
Right		P			Right		P		
Peds					Peds				
WB Left		P			SB Left	P	P		
Thru		P			Thru		P		
Right		P			Right		P		
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green		15.0	41.0			10.0	34.0		
Yellow		3.0	4.0			3.0	4.0		
All Red		1.0	2.0			1.0	2.0		

Cycle Length: 120.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	269	1671	1.41	0.50	242.2	F		
T	1684	4929	1.27	0.34	166.2	F	165.2	F
R	536	1568	0.44	0.34	33.3	C		
Westbound								
L	275	1719	1.05	0.50	106.6	F		
T	1734	5074	1.19	0.34	129.5	F	122.1	F
R	536	1568	1.09	0.34	103.7	F		
Northbound								
L	206	1736	1.27	0.40	185.8	F		
T	1397	4929	0.94	0.28	55.2	E	71.9	E
R	449	1583	0.66	0.28	45.2	D		
Southbound								
L	206	1736	1.36	0.40	223.1	F		
T	1397	4929	0.91	0.28	51.8	D	77.7	E
R	388	1369	0.65	0.28	45.9	D		

Intersection Delay = 116.2 (sec/veh) Intersection LOS = F

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:
Fax:

OPERATIONAL ANALYSIS

Analyst: NA
Intersection: Steeles Avenue / Keele Street
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: PM Peak Hour
Analysis Year: Total Future Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Steeles Avenue
North/South Street: Keele Street

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	371	2097	233	284	2016	690	257	1284	289	275	1245	287
% Heavy Veh	8	5	3	5	2	3	4	5	2	4	5	18
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	95	535	59	72	514	176	66	328	74	70	318	73
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
ParkExist												
NumPark												
No. Lanes	1	3	1	1	3	1	1	3	1	1	3	1
LGConfig	L	T	R	L	T	R	L	T	R	L	T	R
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
RTOR Vol			0			120			0			40
Adj Flow	379	2140	238	290	2057	582	262	1310	295	281	1270	252
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.000	1.000		0.000	1.000
Peds	Bikes	0			0			0			0	
Buses	0	0	0	0	0	0	0	0	0	0	0	0
%InProtPhase	0.0			0.0			0.0			0.0		

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Arriv. Type	3	3	3	3	3	3	3	3	3	3	3	3
Unit Ext.	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Ext of g	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left		P			NB Left	P	P		
Thru		P			Thru		P		
Right		P			Right		P		
Peds					Peds				
WB Left		P			SB Left	P	P		
Thru		P			Thru		P		
Right		P			Right		P		
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green		15.0	41.0			10.0	34.0		
Yellow		3.0	4.0			3.0	4.0		
All Red		1.0	2.0			1.0	2.0		

Cycle Length: 120.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	371	2097	233	284	2016	690	257	1284	289	275	1245	287
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	379	2140	238	290	2057	582	262	1310	295	281	1270	252
No. Lanes	1	3	1	1	3	1	1	3	1	1	3	1
Lane group	L	T	R	L	T	R	L	T	R	L	T	R
Adj flow	379	2140	238	290	2057	582	262	1310	295	281	1270	252
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.000	1.000		0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound				Westbound				Northbound				Southbound			
LG	L	T		R	L	T		R	L	T		R	L	T		R
So	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lanes	1	3	1		1	3	1		1	3	1		1	3	1	
fW	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fHV	0.926	0.952	0.971	0.952	0.980	0.971	0.962	0.952	0.980	0.962	0.952	0.847				
fG	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000				
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000				
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000				
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000				
fLU	1.000	0.908	1.000	1.000	0.908	1.000	1.000	0.908	1.000	1.000	0.908	1.000				
fRT		1.000	0.850		1.000	0.850		1.000	0.850		1.000	0.850				
fLT	0.950	1.000		0.950	1.000		0.950	1.000		0.950	1.000					
Sec.	0.089			0.089			0.105			0.105						
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000					
fRpb		1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000				
S	1671	4929	1568	1719	5074	1568	1736	4929	1583	1736	4929	1369				
Sec.	156			161			192			192						

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		209	1671	# 0.13	0.125	209	1.00
Perm		170	156	# 1.09	0.375	60	2.83
Left	L	379			0.50	269	1.41
Prot							
Perm							
Thru	T	2140	4929	0.34	0.34	1684	1.27
Right	R	238	1568	0.15	0.34	536	0.44
Westbound							
Prot		215	1719	0.13	0.125	215	1.00
Perm		75	161	0.47	0.375	60	1.25
Left	L	290			0.50	275	1.05
Prot							
Perm							
Thru	T	2057	5074	0.34	0.34	1734	1.19
Right	R	582	1568	0.37	0.34	536	1.09
Northbound							
Prot		145	1736	# 0.08	0.083	145	1.00
Perm		117	192	0.61	0.317	61	1.92
Left	L	262			0.40	206	1.27
Prot							
Perm							
Thru	T	1310	4929	0.27	0.28	1397	0.94
Right	R	295	1583	0.19	0.28	449	0.66
Southbound							
Prot		145	1736	0.08	0.083	145	1.00
Perm		136	192	# 0.71	0.317	61	2.23
Left	L	281			0.40	206	1.36
Prot							
Perm							
Thru	T	1270	4929	0.26	0.28	1397	0.91
Right	R	252	1369	0.18	0.28	388	0.65

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 2.01
Total lost time per cycle, L = 12.00 Sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 2.23

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	1.41	0.50	37.4	1.000	269	0.50	204.7	0.0	242.2	F		
T	1.27	0.34	39.5	1.000	1684	0.50	126.7	0.0	166.2	F	165.2	F
R	0.44	0.34	30.7	1.000	536	0.50	2.7	0.0	33.3	C		
Westbound												
L	1.05	0.50	37.2	1.000	275	0.50	69.3	0.0	106.6	F		
T	1.19	0.34	39.5	1.000	1734	0.50	90.0	0.0	129.5	F	122.1	F
R	1.09	0.34	39.5	1.000	536	0.50	64.2	0.0	103.7	F		
Northbound												
L	1.27	0.40	31.1	1.000	206	0.50	154.7	0.0	185.8	F		
T	0.94	0.28	42.0	1.000	1397	0.50	13.2	0.0	55.2	E	71.9	E
R	0.66	0.28	37.9	1.000	449	0.50	7.3	0.0	45.2	D		
Southbound												
L	1.36	0.40	31.3	1.000	206	0.50	191.8	0.0	223.1	F		
T	0.91	0.28	41.5	1.000	1397	0.50	10.3	0.0	51.8	D	77.7	E
R	0.65	0.28	37.8	1.000	388	0.50	8.2	0.0	45.9	D		

Intersection Delay = 116.2 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)	60.0	60.0	48.0	48.0
Effective permitted green time for LT lane group, g(s)	45.0	45.0	38.0	38.0
Opposing effective green time, go (s)	41.0	41.0	34.0	34.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	3	3	3	3
Adjusted LT flow rate, VLT (veh/h)	379	290	262	281
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	2057	2140	1270	1310
Lost time for LT lane group, tL	6.00	6.00	6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600	12.63	9.67	8.73	9.37
Opposing lane util. factor, fLUo	0.908	0.908	0.908	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	25.17	26.19	15.54	16.03
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.66	0.66	0.72	0.72
gq, (see Exhibit C16-4,5,6,7,8)	41.00	41.00	30.06	31.35
gu=g-gq if gq>=gf, or = g-gf if gq<gf	4.00	4.00	7.94	6.65
n=Max(gq-gf)/2,0)	20.50	20.50	15.03	15.68
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	11.28	12.36	4.85	5.06
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.09	0.11	0.11
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.09	0.09	0.11	0.11
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.089	0.089	0.105	0.105

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 120.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.908	0.908	0.908	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 120.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	379	290	262	281
v/c ratio from Capacity Worksheet, X	1.41	1.05	1.27	1.36
Protected phase effective green interval, g (s)	15.0	15.0	10.0	10.0
Opposing queue effective green interval, gq	41.00	41.00	30.06	31.35
Unopposed green interval, gu	4.00	4.00	7.94	6.65
Red time r=(C-g-gq-gu)	60.0	60.0	72.0	72.0
Arrival rate, qa=v/(3600(max[X,1.0]))	0.07	0.08	0.06	0.06
Protected ph. departure rate, Ss=s/3600	0.464	0.478	0.482	0.482
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.49	0.50	0.26	0.30
XPerm	1.72	1.71	1.07	1.07
XProt	0.80	0.80	0.97	0.97
Case	3	3	3	3
Queue at beginning of green arrow, Qa	5.90	6.01	4.27	4.27
Queue at beginning of unsaturated green, Qu	3.06	3.13	1.72	1.79
Residual queue, Qr	1.41	1.43	0.15	0.15
Uniform Delay, d1	37.4	37.2	31.1	31.3

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Final Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 116.2 sec/veh Intersection LOS F

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
LaneGroup												
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	379	785	238	290	755	582	262	480	295	281	466	252
So	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	3	1	1	3	1	1	3	1	1	3	1
SL	535	1809	1568	290	1862	1568	514	1809	1583	514	1809	1369
LnCapacity	269	618	536	275	636	536	206	512	449	206	512	388
Flow Ratio	0.71	0.43	0.15	0.53	0.41	0.37	0.51	0.27	0.19	0.55	0.26	0.18
v/c Ratio	1.41	1.27	0.44	1.05	1.19	1.09	1.27	0.94	0.66	1.36	0.91	0.65
Grn Ratio	0.50	0.34	0.34	0.50	0.34	0.34	0.40	0.28	0.28	0.40	0.28	0.28
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3	3	3	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	7.2	26.2	6.2	5.5	25.2	19.4	5.7	15.6	8.7	6.1	15.9	7.4
kB	0.6	1.0	0.9	0.6	1.0	0.9	0.5	0.9	0.8	0.5	0.9	0.7
Q2	15.5	24.8	0.7	5.6	19.7	11.5	8.7	5.5	1.4	10.9	4.8	1.2
Q Average	22.7	51.0	6.9	11.1	44.9	30.9	14.4	21.1	10.1	17.0	19.8	8.6
Q Spacing	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Q Storage	0	0	0	0	0	0	0	0	0	0	0	0
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
BOQ	27.2	61.2	8.4	13.4	53.9	37.1	17.4	25.4	12.2	20.5	23.8	10.5
QSRatio												
85th Percentile Output:												
fB%	1.4	1.4	1.5	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.5
BOQ	31.8	71.4	10.1	15.9	62.9	43.2	20.5	29.7	14.5	24.0	27.9	12.5
QSRatio												
90th Percentile Output:												
fB%	1.5	1.5	1.6	1.6	1.5	1.5	1.5	1.5	1.6	1.5	1.5	1.6
BOQ	34.1	76.5	11.2	17.2	67.4	46.3	22.1	31.9	15.8	25.8	29.9	13.7
QSRatio												
95th Percentile Output:												
fB%	1.6	1.6	1.9	1.7	1.6	1.6	1.7	1.6	1.7	1.6	1.6	1.8
BOQ	36.5	81.6	12.7	18.9	71.9	49.5	23.9	34.1	17.5	27.8	32.1	15.3
QSRatio												
98th Percentile Output:												
fB%	1.7	1.7	2.1	1.9	1.7	1.7	1.8	1.7	1.9	1.8	1.7	2.0
BOQ	38.9	86.7	14.3	20.7	76.4	52.6	25.8	36.4	19.2	29.7	34.3	17.0
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: AM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Steeles Avenue

Inter.: Sessions Avenue / Keele St
Area Type: All other areas
Jurisd: City of Toronto
Year: Total Future Conditions
N/S St: Keele Street

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes		2	3 1		2	3 1		2	3 1		2	3 1
LGConfig	L		R	L		R	L		R	L		R
Volume	277	1542	123	168	1720	239	143	668	137	256	1282	348
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
RTOR Vol			0			40			0			40

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left		A			NB Left	P			
Thru			P		Thru		P		
Right			P		Right		P		
Peds					Peds				
WB Left		A			SB Left	P			
Thru			P		Thru		P		
Right			P		Right		P		
Peds					Peds				
NB Right		P			EB Right	P			
SB Right		P			WB Right	P			
Green		12.0	37.0			10.0	31.0		
Yellow		3.0	4.0			2.0	4.0		
All Red		1.0	2.0			2.0	2.0		

Cycle Length: 110.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	327	2996	0.87	0.11	69.0	E		
T	1642	4883	0.96	0.34	50.0	D	50.6	D
R	720	1495	0.17	0.48	16.7	B		
Westbound								
L	341	3130	0.50	0.11	47.4	D		
T	1674	4977	1.05	0.34	72.4	E	65.2	E
R	701	1455	0.29	0.48	18.2	B		
Northbound								
L	270	2971	0.54	0.09	55.4	E		
T	1326	4705	0.51	0.28	34.6	C	35.5	D
R	685	1538	0.20	0.45	19.3	B		
Southbound								
L	290	3187	0.90	0.09	82.0	F		
T	1350	4792	0.97	0.28	57.1	E	55.3	E
R	585	1313	0.54	0.45	25.7	C		

Intersection Delay = 54.3 (sec/veh) Intersection LOS = D

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:
Fax:

OPERATIONAL ANALYSIS

Analyst: NA
Intersection: Steeles Avenue / Keele St
Agency/Co.: URS Canada Inc.
Area Type: All other areas
Date Performed: 12/9/2004
Jurisdiction: City of Toronto
Analysis Time Period: AM Peak Hour
Analysis Year: Total Future Conditions
Project ID: TTC Spadina Station Extension
East/West Street: Steeles Avenue North/South Street: Keele Street

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	277	1542	123	168	1720	239	143	668	137	256	1282	348
% Heavy Veh	17	6	8	12	4	11	18	10	5	10	8	23
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	71	393	31	43	439	61	36	170	35	65	327	89
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
ParkExist												
NumPark												
No. Lanes		2	3 1		2	3 1		2	3 1		2	3 1
LGConfig	L		T R	L		T R	L		T R	L		T R
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
RTOR Vol			0			40			0			40
Adj Flow	283	1573	126	171	1755	203	146	682	140	261	1308	314
%InSharedLn												
Prop LTs		0.000			0.000			0.000			0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.000	1.000		0.000	1.000
Peds	Bikes	0			0			0			0	
Buses	0	0	0	0	0	0	0	0	0	0	0	0
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Arriv. Type	3	3	3	3	3	3	3	3	3	3	3	3
Unit Ext.	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Ext of g	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left		A			NB Left	P			
Thru			P		Thru		P		
Right			P		Right		P		
Peds					Peds				
WB Left		A			SB Left	P			
Thru			P		Thru		P		
Right			P		Right		P		
Peds					Peds				
NB Right		P			EB Right	P			
SB Right		P			WB Right	P			
Green		12.0	37.0			10.0	31.0		
Yellow		3.0	4.0			2.0	4.0		
All Red		1.0	2.0			2.0	2.0		

Cycle Length: 110.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	277	1542	123	168	1720	239	143	668	137	256	1282	348
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj flow	283	1573	126	171	1755	203	146	682	140	261	1308	314
No. Lanes		2	3 1		2	3 1		2	3 1		2	3 1
Lane group	L		T R	L		T R	L		T R	L		T R
Adj flow	283	1573	126	171	1755	203	146	682	140	261	1308	314
Prop LTs		0.000			0.000			0.000			0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.000	1.000		0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound				Westbound				Northbound				Southbound			
LG	L		T	R	L		T	R	L		T	R	L		T	R
So	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lanes	2	3		1	2	3		1	2	3		1	2	3		1
fW	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fHV	0.855	0.943	0.926	0.893	0.962	0.901	0.847	0.909	0.952	0.909	0.926	0.813				
fG	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000				
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000				
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000				
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000				
fLU	0.971	0.908	1.000	0.971	0.908	1.000	0.971	0.908	1.000	0.971	0.908	1.000				
fRT		1.000	0.850		1.000	0.850		1.000	0.850		1.000	0.850				
fLT	0.950	1.000		0.950	1.000		0.950	1.000		0.950	1.000					
Sec.																
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000					
fRpb		1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000				
S	2996	4883	1495	3130	4977	1455	2971	4705	1538	3187	4792	1313				
Sec.																

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	283	2996	# 0.09	0.11	327	0.87
Prot							
Perm							
Thru	T	1573	4883	0.32	0.34	1642	0.96
Right	R	126	1495	0.08	0.48	720	0.17
Westbound							
Prot							
Perm							
Left	L	171	3130	0.05	0.11	341	0.50
Prot							
Perm							
Thru	T	1755	4977	# 0.35	0.34	1674	1.05
Right	R	203	1455	0.14	0.48	701	0.29
Northbound							
Prot							
Perm							
Left	L	146	2971	0.05	0.09	270	0.54
Prot							
Perm							
Thru	T	682	4705	0.14	0.28	1326	0.51
Right	R	140	1538	0.09	0.45	685	0.20
Southbound							
Prot							
Perm							
Left	L	261	3187	# 0.08	0.09	290	0.90
Prot							
Perm							
Thru	T	1308	4792	# 0.27	0.28	1350	0.97
Right	R	314	1313	0.24	0.45	585	0.54

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.80
Total lost time per cycle, L = 20.00 Sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.98

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Unf Adj Fact	Prog Grp Cap	Lane Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.87	0.11	48.2	1.000	327	0.40	20.8	0.0	69.0	E		
T	0.96	0.34	35.7	1.000	1642	0.50	14.3	0.0	50.0	D	50.6	D
R	0.17	0.48	16.1	1.000	720	0.50	0.5	0.0	16.7	B		
Westbound												
L	0.50	0.11	46.2	1.000	341	0.11	1.2	0.0	47.4	D		
T	1.05	0.34	36.5	1.000	1674	0.50	35.9	0.0	72.4	E	65.2	E
R	0.29	0.48	17.2	1.000	701	0.50	1.0	0.0	18.2	B		
Northbound												
L	0.54	0.09	47.8	1.000	270	0.50	7.6	0.0	55.4	E		
T	0.51	0.28	33.2	1.000	1326	0.50	1.4	0.0	34.6	C	35.5	D
R	0.20	0.45	18.6	1.000	685	0.50	0.7	0.0	19.3	B		
Southbound												
L	0.90	0.09	49.5	1.000	290	0.50	32.5	0.0	82.0	F		
T	0.97	0.28	39.0	1.000	1350	0.50	18.1	0.0	57.1	E	55.3	E
R	0.54	0.45	22.2	1.000	585	0.50	3.5	0.0	25.7	C		

Intersection Delay = 54.3 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	110.0 sec			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.908	0.908	0.908	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/PLto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	110.0 sec			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.908	0.908	0.908	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/PLto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	110.0 sec			
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time r=(C-g-gq-gu)				
Arrival rate, qa=v/(3600(max[X,1.0]))				
Protected ph. departure rate, Sp=s/3600				
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Lane Queue Delay d3 sec	Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 54.3 sec/veh Intersection LOS D

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
LaneGroup	L	T	R	L	T	R	L	T	R	L	T	R
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	145	577	126	88	644	203	75	250	140	134	480	314
So	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	2	3	1	2	3	1	2	3	1	2	3	1
SL	1543	1792	1495	1612	1827	1455	1530	1727	1538	1641	1759	1313
LnCapacity	168	602	720	175	614	701	139	486	685	149	495	585
Flow Ratio	0.09	0.32	0.08	0.05	0.35	0.14	0.05	0.14	0.09	0.08	0.27	0.24
v/c Ratio	0.86	0.96	0.17	0.50	1.05	0.29	0.54	0.51	0.20	0.90	0.97	0.54
Grn Ratio	0.11	0.34	0.48	0.11	0.34	0.48	0.09	0.28	0.45	0.09	0.28	0.45
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3	3	3	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	4.4	17.3	2.2	2.5	19.7	3.7	2.2	6.4	2.6	4.1	14.5	7.0
kB	0.3	0.9	1.0	0.3	0.9	1.0	0.3	0.8	1.0	0.3	0.8	0.9
Q2	1.2	6.7	0.2	0.3	10.8	0.4	0.4	0.8	0.3	1.6	6.1	1.0
Q Average	5.5	24.0	2.4	2.8	30.4	4.2	2.6	7.2	2.9	5.7	20.6	8.0
Q Spacing	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Q Storage	0	0	0	0	0	0	0	0	0	0	0	0
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2	1.3	1.2	1.2	1.2	1.3	1.2	1.3	1.2	1.2	1.2
BOQ	6.6	28.8	3.0	3.3	36.5	5.2	3.2	8.9	3.6	7.0	24.7	9.8
QSRatio												
85th Percentile Output:												
fB%	1.5	1.4	1.6	1.6	1.4	1.5	1.6	1.5	1.6	1.5	1.4	1.5
BOQ	8.6	33.7	3.8	4.4	42.6	6.4	4.0	10.6	4.5	8.5	28.9	11.7
QSRatio												
90th Percentile Output:												
fB%	1.7	1.5	1.8	1.7	1.5	1.7	1.8	1.6	1.8	1.7	1.5	1.6
BOQ	9.4	36.1	4.3	4.9	45.7	7.1	4.6	11.7	5.1	9.5	31.0	12.8
QSRatio												
95th Percentile Output:												
fB%	1.9	1.6	2.2	2.0	1.6	2.0	2.2	1.8	2.2	1.9	1.6	1.8
BOQ	10.8	38.6	5.3	5.6	48.8	8.5	5.6	13.3	6.2	10.9	33.2	14.4
QSRatio												
98th Percentile Output:												
fB%	2.4	1.7	2.6	2.5	1.7	2.4	2.6	2.1	2.5	2.2	1.7	2.0
BOQ	13.1	41.1	6.3	7.0	51.8	9.8	6.7	14.9	7.3	12.4	35.5	16.0
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: PM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Steeles Avenue

Inter.: Steeles Avenue / Keele Street
Area Type: All other areas
Jurisd: City of Toronto
Year: Total Future Conditions
N/S St: Keele Street

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes		2	3 1		2	3 1		2	3 1		2	3 1
LGConfig	L	T	R	L	T	R	L	T	R	L	T	R
Volume	371	2097	233	284	2016	690	257	1284	289	275	1245	287
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
RTOR Vol			0			120			0			40

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left		P			NB Left	P			
Thru			P		Thru		P		
Right		P			Right		P		
Peds					Peds				
WB Left		P			SB Left	P			
Thru			P		Thru		P		
Right		P			Right		P		
Peds					Peds				
NB Right		P			EB Right	P			
SB Right		P			WB Right	P			
Green		13.0	47.0			10.0	30.0		
Yellow		3.0	4.0			3.0	4.0		
All Red		1.0	2.0			1.0	2.0		

Cycle Length: 120.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Flow Rate Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	352	3246	1.08	0.11	123.4	F		
T	1931	4929	1.11	0.39	93.4	F	90.9	F
R	823	1568	0.29	0.52	16.8	B		
Westbound								
L	362	3338	0.80	0.11	69.1	E		
T	1987	5074	1.04	0.39	66.4	E	58.8	E
R	823	1568	0.71	0.52	26.6	C		
Northbound								
L	281	3370	0.93	0.08	93.5	F		
T	1232	4929	1.06	0.25	89.3	F	80.2	F
R	646	1583	0.46	0.41	28.1	C		
Southbound								
L	281	3370	1.00	0.08	108.7	F		
T	1232	4929	1.03	0.25	78.9	E	76.5	E
R	559	1369	0.45	0.41	28.4	C		

Intersection Delay = 75.9 (sec/veh) Intersection LOS = E

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:
Fax:

OPERATIONAL ANALYSIS

Analyst:	NA
Intersection:	Steeles Avenue / Keele Street
Agency/Co.:	URS Canada Inc.
Area Type:	All other areas
Date Performed:	12/9/2004
Jurisdiction:	City of Toronto
Analysis Time Period:	PM Peak Hour
Analysis Year:	Total Future Conditions
Project ID:	TTC Spadina Station Extension
East/West Street:	North/South Street
Steeles Avenue	Keele Street

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	371	2097	233	284	2016	690	257	1284	289	275	1245	287
% Heavy Veh	8	5	3	5	2	3	4	5	2	4	5	18
PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PK 15 Vol	95	535	59	72	514	176	66	328	74	70	318	73
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
ParkExist												
NumPark												
No. Lanes		2	3 1		2	3 1		2	3 1		2	3 1
LGConfig	L	T	R	L	T	R	L	T	R	L	T	R
Lane Width	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
RTOR Vol			0			120			0			40
Adj Flow	379	2140	238	290	2057	582	262	1310	295	281	1270	252
%InSharedLn												
Prop LTs		0.000			0.000			0.000			0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.000	1.000		0.000	1.000
Peds	Bikes	0			0			0			0	
Buses	0	0	0	0	0	0	0	0	0	0	0	0
%InProtPhase												

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Arriv. Type	3	3	3	3	3	3	3	3	3	3	3	3
Unit Ext.	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Ext of g	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left		P			NB Left	P			
Thru			P		Thru		P		
Right		P			Right		P		
Peds					Peds				
WB Left		P			SB Left	P			
Thru			P		Thru		P		
Right		P			Right		P		
Peds					Peds				
NB Right		P			EB Right	P			
SB Right		P			WB Right	P			
Green		13.0	47.0			10.0	30.0		
Yellow		3.0	4.0			3.0	4.0		
All Red		1.0	2.0			1.0	2.0		

Cycle Length: 120.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	371	2097	233	284	2016	690	257	1284	289	275	1245	287
Adj flow	379	2140	238	290	2057	582	262	1310	295	281	1270	252
No. Lanes	2	3	1	2	3	1	2	3	1	2	3	1
Lane group	L	T	R	L	T	R	L	T	R	L	T	R
Adj flow	379	2140	238	290	2057	582	262	1310	295	281	1270	252
Prop LTs		0.000			0.000			0.000			0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.000	1.000		0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	T	R	L	T	R	L	T	R	L	T	R
So	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lanes	2	3	1	2	3	1	2	3	1	2	3	1
fW	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fHV	0.926	0.952	0.971	0.952	0.980	0.971	0.962	0.952	0.980	0.962	0.952	0.847
fG	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fLU	0.971	0.908	1.000	0.971	0.908	1.000	0.971	0.908	1.000	0.971	0.908	1.000
fRT		1.000	0.850		1.000	0.850		1.000	0.850		1.000	0.850
fLT	0.950	1.000		0.950	1.000		0.950	1.000		0.950	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000
S	3246	4929	1568	3338	5074	1568	3370	4929	1583	3370	4929	1369
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Lane Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	379	3246	# 0.12	0.11	352	1.08
Prot							
Perm							
Thru	T	2140	4929	# 0.43	0.39	1931	1.11
Right	R	238	1568	0.15	0.52	823	0.29
Westbound							
Prot							
Perm							
Left	L	290	3338	0.09	0.11	362	0.80
Prot							
Perm							
Thru	T	2057	5074	0.41	0.39	1987	1.04
Right	R	582	1568	0.37	0.52	823	0.71
Northbound							
Prot							
Perm							
Left	L	262	3370	0.08	0.08	281	0.93
Prot							
Perm							
Thru	T	1310	4929	# 0.27	0.25	1232	1.06
Right	R	295	1583	0.19	0.41	646	0.46
Southbound							
Prot							
Perm							
Left	L	281	3370	# 0.08	0.08	281	1.00
Prot							
Perm							
Thru	T	1270	4929	0.26	0.25	1232	1.03
Right	R	252	1369	0.18	0.41	559	0.45

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.90
Total lost time per cycle, L = 20.00 Sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.08

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Unf Adj Fact	Prog Grp Cap	Lane Incremental Factor k	Lane Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	1.08	0.11	53.5	1.000	352	0.50	69.9	0.0	123.4	F		
T	1.11	0.39	36.5	1.000	1931	0.50	56.9	0.0	93.4	F	90.9	F
R	0.29	0.52	16.0	1.000	823	0.50	0.9	0.0	16.8	B		
Westbound												
L	0.80	0.11	52.2	1.000	362	0.50	16.9	0.0	69.1	E		
T	1.04	0.39	36.5	1.000	1987	0.50	29.9	0.0	66.4	E	58.8	E
R	0.71	0.52	21.5	1.000	823	0.50	5.1	0.0	26.6	C		
Northbound												
L	0.93	0.08	54.7	1.000	281	0.50	38.8	0.0	93.5	F		
T	1.06	0.25	45.0	1.000	1232	0.50	44.3	0.0	89.3	F	80.2	F
R	0.46	0.41	25.8	1.000	646	0.50	2.3	0.0	28.1	C		
Southbound												
L	1.00	0.08	55.0	1.000	281	0.50	53.7	0.0	108.7	F		
T	1.03	0.25	45.0	1.000	1232	0.50	33.9	0.0	78.9	E	76.5	E
R	0.45	0.41	25.7	1.000	559	0.50	2.6	0.0	28.4	C		

Intersection Delay = 75.9 (sec/veh) Intersection LOS = E

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	120.0 sec			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.908	0.908	0.908	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	120.0 sec			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.908	0.908	0.908	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	120.0 sec			
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time r=(C-g-gq-gu)				
Arrival rate, qa=v/(3600(max[X,1.0]))				
Protected ph. departure rate, Sp=s/3600				
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Final Queue Delay d3 sec	Initial Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 75.9 sec/veh Intersection LOS E

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	T	R	L	T	R	L	T	R	L	T	R
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	195	785	238	149	755	582	134	480	295	144	466	252
So	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	2	3	1	2	3	1	2	3	1	2	3	1
SL	1671	1809	1568	1719	1862	1568	1735	1809	1583	1735	1809	1369
LnCapacity	181	708	823	186	729	823	144	452	646	144	452	559
Flow Ratio	0.12	0.43	0.15	0.09	0.41	0.37	0.08	0.27	0.19	0.08	0.26	0.18
v/c Ratio	1.08	1.11	0.29	0.80	1.04	0.71	0.93	1.06	0.46	1.00	1.03	0.45
Grn Ratio	0.11	0.39	0.52	0.11	0.39	0.52	0.08	0.25	0.41	0.08	0.25	0.41
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3	3	3	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	6.5	26.2	4.4	4.8	25.2	14.7	4.4	16.0	7.2	4.8	15.5	6.1
kB	0.4	1.1	1.2	0.4	1.1	1.2	0.4	0.8	1.0	0.4	0.8	0.9
Q2	4.2	16.3	0.5	1.3	12.0	2.7	1.9	8.9	0.8	2.5	7.8	0.7
Q Average	10.7	42.4	4.9	6.2	37.2	17.4	6.4	24.9	8.0	7.3	23.3	6.8
Q Spacing	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Q Storage	0	0	0	0	0	0	0	0	0	0	0	0
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
BOQ	13.0	50.9	6.1	7.6	44.6	20.9	7.8	29.9	9.8	9.0	28.0	8.4
QSRatio												
85th Percentile Output:												
fB%	1.4	1.4	1.5	1.5	1.4	1.4	1.5	1.4	1.5	1.5	1.4	1.5
BOQ	15.4	59.4	7.5	9.2	52.1	24.5	9.4	34.9	11.7	10.8	32.7	10.1
QSRatio												
90th Percentile Output:												
fB%	1.6	1.5	1.7	1.6	1.5	1.5	1.6	1.5	1.6	1.6	1.5	1.6
BOQ	16.7	63.6	8.3	10.2	55.8	26.3	10.4	37.4	12.8	11.9	35.1	11.1
QSRatio												
95th Percentile Output:												
fB%	1.7	1.6	2.0	1.9	1.6	1.6	1.9	1.6	1.8	1.8	1.6	1.9
BOQ	18.4	67.9	9.7	11.7	59.5	28.3	11.9	40.0	14.4	13.4	37.5	12.7
QSRatio												
98th Percentile Output:												
fB%	1.9	1.7	2.3	2.1	1.7	1.7	2.1	1.7	2.0	2.0	1.7	2.1
BOQ	20.1	72.1	11.1	13.2	63.3	30.3	13.5	42.6	16.0	15.0	39.9	14.2
QSRatio												

ERROR MESSAGES

No errors to report.

Steeles West Station - Future Total Traffic Conditions With Improvements

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: AM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Proposed East-West Road

Inter.: Jane Street / Prop E-W Rd
Area Type: All other areas
Jurisd: City of Toronto
Year: Total Future Conditions
N/S St: Jane Street

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	1	0	1	0	3	1	2	3	0
LGConfig				L		R		T	R	L	T	
Volume				57		248		1571	155	445	1533	
Lane Width				3.6		3.6		3.6	3.6	3.6	3.6	
RTOR Vol						60			0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left				
Thru					Thru		P		
Right					Right		P		
Peds					Peds				
WB Left		P			SB Left	P			
Thru					Thru	P	P		
Right		P			Right				
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right	P			
Green		30.0				26.0	48.0		
Yellow		4.0				2.0	4.0		
All Red		3.0				0.0	3.0		

Cycle Length: 120.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
Westbound								
L	447	1787	0.13	0.25	35.5	D		
							20.5	C
R	839	1599	0.23	0.52	16.0	B		
Northbound								
T	1972	4929	0.81	0.40	35.8	D	34.8	C
R	615	1538	0.26	0.40	25.1	C		
Southbound								
L	588	2716	0.77	0.22	53.7	D		
T	3122	4929	0.50	0.63	12.4	B	21.7	C

Intersection Delay = 27.4 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:
Fax:

OPERATIONAL ANALYSIS

Analyst:	NA
Intersection:	Jane Street / Prop E-W Rd
Agency/Co.:	URS Canada Inc.
Area Type:	All other areas
Date Performed:	12/9/2004
Jurisdiction:	City of Toronto
Analysis Time Period:	AM Peak Hour
Analysis Year:	Total Future Conditions
Project ID:	TTC Spadina Station Extension
	East/West Street: North/South Street
	Proposed East-West Road: Jane Street

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				57		248		1571	155	445	1533	
% Heavy Veh				1		1		5	5	3	5	
PHF				0.98		0.98		0.98	0.98	0.98	0.98	
PK 15 Vol				15		63		401	40	114	391	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat				1900		1900		1900	1900	1900	1900	
ParkExist												
NumPark												
No. Lanes	0	0	0	1	0	1	0	3	1	2	3	0
LGConfig				L		R		T	R	L	T	
Lane Width				3.6		3.6		3.6	3.6	3.6	3.6	
RTOR Vol						60			0			
Adj Flow				58		192		1603	158	454	1564	
%InSharedLn												
Prop LTs								0.000			0.000	
Prop RTs						1.000		0.000	1.000		0.000	
Peds	Bikes	0			0			0				
Buses				0		0		0	0	0	0	
%InProtPhase												

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0		0.0		0.0	0.0	0.0	0.0	
Arriv. Type				3		3		3	3	3	3	
Unit Ext.				3.0		3.0		3.0	3.0	3.0	3.0	
I Factor					1.000			1.000			1.000	
Lost Time				2.0		2.0		2.0	2.0	2.0	2.0	
Ext of g				2.0		2.0		2.0	2.0	2.0	2.0	
Ped Min g		3.2			3.2			3.2				

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left				
Thru					Thru		P		
Right					Right		P		
Peds					Peds				
WB Left		P			SB Left	P			
Thru					Thru	P	P		
Right		P			Right				
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right	P			
Green		30.0				26.0	48.0		
Yellow		4.0				2.0	4.0		
All Red		3.0				0.0	3.0		

Cycle Length: 120.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				57		248		1571	155	445	1533	
PHF				0.98		0.98		0.98	0.98	0.98	0.98	
Adj flow				58		192		1603	158	454	1564	
No. Lanes	0	0	0	1	0	1	0	3	1	2	3	0
Lane group				L		R		T	R	L	T	
Adj flow				58		192		1603	158	454	1564	
Prop LTs								0.000			0.000	
Prop RTs						1.000		0.000	1.000		0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG				L		R		T	R	L	T	
So				1900		1900		1900	1900	1900	1900	
Lanes	0	0	0	1	0	1	0	3	1	2	3	0
fW				1.000		1.000		1.000	1.000	1.000	1.000	
fHV				0.990		0.990		0.952	0.952	0.971	0.952	
fG				1.000		1.000		1.000	1.000	1.000	1.000	
fP				1.000		1.000		1.000	1.000	1.000	1.000	
fBB				1.000		1.000		1.000	1.000	1.000	1.000	
fA				1.000		1.000		1.000	1.000	1.000	1.000	
fLU				1.000		1.000		0.908	1.000	0.775	0.908	
fRT						0.850		1.000	0.850		1.000	
fLT				0.950				1.000		0.950	1.000	
Sec.												
fLpb				1.000				1.000		1.000	1.000	
fRpb						1.000		1.000	1.000		1.000	
S				1787		1599		4929	1538	2716	4929	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left	L	58	1787	# 0.03	0.25	447	0.13
Prot							
Perm							
Thru							
Right	R	192	1599	0.12	0.52	839	0.23
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	1603	4929	# 0.33	0.40	1972	0.81
Right	R	158	1538	0.10	0.40	615	0.26
Southbound							
Prot							
Perm							
Left	L	454	2716	# 0.17	0.22	588	0.77
Prot							
Perm							
Thru	T	1564	4929	0.32	0.63	3122	0.50
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.52
Total lost time per cycle, L = 16.00 Sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.61

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay LOS	Approach Delay LOS
Eastbound										
Westbound										
L	0.13	0.25	34.9	1.000	447	0.50	0.6	0.0	35.5 D	
									20.5	C
R	0.23	0.52	15.4	1.000	839	0.50	0.6	0.0	16.0 B	
Northbound										
T	0.81	0.40	32.0	1.000	1972	0.50	3.8	0.0	35.8 D	34.8 C
R	0.26	0.40	24.1	1.000	615	0.50	1.0	0.0	25.1 C	
Southbound										
L	0.77	0.22	44.2	1.000	588	0.50	9.5	0.0	53.7 D	
T	0.50	0.63	11.8	1.000	3122	0.50	0.6	0.0	12.4 B	21.7 C

Intersection Delay = 27.4 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C: 120.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo			0.908	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1*4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C: 120.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT			0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo			0.908	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1*4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C: 120.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time r=(C-g-gq-gu)				
Arrival rate, qa=v/(3600(max[X,1.0]))				
Protected ph. departure rate, Sp=s/3600				
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Queue Delay d3 sec	Initial Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 27.4 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
LaneGroup				L		R		T	R	L	T	
Init Queue				0.0		0.0		0.0	0.0	0.0	0.0	
Flow Rate				58		192		580	158	292	574	
So				1900		1900		1900	1900	1900	1900	
No.Lanes	0	0	0	1	0	1	0	3	1	2	3	0
SL				1787		1599		1809	1538	1752	1809	
LnCapacity				447		839		723	615	379	1146	
Flow Ratio				0.03		0.12		0.33	0.10	0.17	0.32	
v/c Ratio				0.13		0.23		0.81	0.26	0.77	0.50	
Grn Ratio				0.25		0.52		0.40	0.40	0.22	0.63	
I Factor					1.000			1.000			1.000	
AT or PVG				3		3		3	3	3	3	
Pltn Ratio				1.00		1.00		1.00	1.00	1.00	1.00	
PF2				1.00		1.00		1.00	1.00	1.00	1.00	
Q1				1.5		3.5		17.4	3.5	9.2	10.3	
kB				0.8		1.2		1.1	1.0	0.7	1.5	
Q2				0.1		0.4		3.9	0.3	2.0	1.5	
Q Average				1.6		3.8		21.4	3.9	11.2	11.8	
Q Spacing				7.6		7.6		7.6	7.6	7.6	7.6	
Q Storage				0		0		0	0	0	0	
Q S Ratio												
70th Percentile Output:												
fB%				1.3		1.2		1.2	1.2	1.2	1.2	
BOQ				2.1		4.8		25.7	4.8	13.5	14.3	
QSRatio												
85th Percentile Output:												
fB%				1.6		1.5		1.4	1.5	1.4	1.4	
BOQ				2.6		5.9		30.0	5.9	16.0	16.8	
QSRatio												
90th Percentile Output:												
fB%				1.9		1.7		1.5	1.7	1.6	1.5	
BOQ				3.0		6.6		32.2	6.7	17.3	18.2	
QSRatio												
95th Percentile Output:												
fB%				2.3		2.1		1.6	2.1	1.7	1.7	
BOQ				3.8		7.9		34.5	8.0	19.1	20.0	
QSRatio												
98th Percentile Output:												
fB%				2.8		2.4		1.7	2.4	1.9	1.8	
BOQ				4.5		9.2		36.8	9.2	20.8	21.7	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: NA
Agency: URS Canada Inc.
Date: 12/9/2004
Period: PM Peak Hour
Project ID: TTC Spadina Station Extension
E/W St: Proposed East-West Road

Inter.: Jane Street / Prop E-W Rd
Area Type: All other areas
Jurisd: City of Toronto
Year: Total Future Conditions
N/S St: Jane Street

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	1	0	1	0	3	1	2	3	0
LGConfig				L		R		T	R	L	T	
Volume				155		445		1472	57	248	1792	
Lane Width				3.6		3.6		3.6	3.6	3.6	3.6	
RTOR Vol						180			0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left				
Thru					Thru		P		
Right					Right		P		
Peds					Peds				
WB Left		P			SB Left	P			
Thru					Thru	P	P		
Right		P			Right				
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right	P			
Green		30.0				18.0	56.0		
Yellow		4.0				2.0	4.0		
All Red		3.0				0.0	3.0		

Cycle Length: 120.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
Westbound								
L	447	1787	0.35	0.25	39.2	D		
							28.7	C
R	733	1599	0.37	0.46	22.6	C		
Northbound								
T	2300	4929	0.65	0.47	26.0	C	25.7	C
R	718	1538	0.08	0.47	18.0	B		
Southbound								
L	413	2751	0.61	0.15	54.4	D		
T	3122	4929	0.59	0.63	13.6	B	18.6	B

Intersection Delay = 22.4 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

Phone:
E-Mail:
Fax:

OPERATIONAL ANALYSIS

Analyst:	NA
Intersection:	Jane Street / Prop E-W Rd
Agency/Co.:	URS Canada Inc.
Area Type:	All other areas
Date Performed:	12/9/2004
Jurisdiction:	City of Toronto
Analysis Time Period:	PM Peak Hour
Analysis Year:	Total Future Conditions
Project ID:	TTC Spadina Station Extension
East/West Street	North/South Street
Proposed East-West Road	Jane Street

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				155		445		1472	57	248	1792	
% Heavy Veh				1		1		5	5	3	5	
PHF				0.98		0.98		0.98	0.98	0.98	0.98	
PK 15 Vol				40		114		376	15	63	457	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat				1900		1900		1900	1900	1900	1900	
ParkExist												
NumPark												
No. Lanes	0	0	0	1	0	1	0	3	1	2	3	0
LGConfig				L		R		T	R	L	T	
Lane Width				3.6		3.6		3.6	3.6	3.6	3.6	
RTOR Vol						180			0			
Adj Flow				158		270		1502	58	253	1829	
%InSharedLn												
Prop LTs								0.000			0.000	
Prop RTs						1.000		0.000	1.000		0.000	
Peds	Bikes	0			0			0				
Buses				0		0		0	0	0	0	
%InProtPhase												

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0		0.0		0.0	0.0	0.0	0.0	
Arriv. Type				3		3		3	3	3	3	
Unit Ext.				3.0		3.0		3.0	3.0	3.0	3.0	
I Factor					1.000			1.000			1.000	
Lost Time				2.0		2.0		2.0	2.0	2.0	2.0	
Ext of g				2.0		2.0		2.0	2.0	2.0	2.0	
Ped Min g		3.2			3.2			3.2				

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left				
Thru					Thru		P		
Right					Right		P		
Peds					Peds				
WB Left		P			SB Left	P			
Thru					Thru	P	P		
Right		P			Right				
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right	P			
Green		30.0				18.0	56.0		
Yellow		4.0				2.0	4.0		
All Red		3.0				0.0	3.0		

Cycle Length: 120.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				155	445			1472	57	248	1792	
PHF				0.98	0.98			0.98	0.98	0.98	0.98	
Adj flow				158	270			1502	58	253	1829	
No. Lanes	0	0	0	1	0	1	0	3	1	2	3	0
Lane group				L		R		T	R	L	T	
Adj flow				158		270		1502	58	253	1829	
Prop LTs								0.000			0.000	
Prop RTs						1.000		0.000	1.000		0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG				L		R		T	R	L	T	
So				1900		1900		1900	1900	1900	1900	
Lanes	0	0	0	1	0	1	0	3	1	2	3	0
fW				1.000		1.000		1.000	1.000	1.000	1.000	
fHV				0.990		0.990		0.952	0.952	0.971	0.952	
fG				1.000		1.000		1.000	1.000	1.000	1.000	
fP				1.000		1.000		1.000	1.000	1.000	1.000	
fBB				1.000		1.000		1.000	1.000	1.000	1.000	
fA				1.000		1.000		1.000	1.000	1.000	1.000	
fLU				1.000		1.000		0.908	1.000	0.785	0.908	
fRT						0.850		1.000	0.850		1.000	
fLT				0.950				1.000		0.950	1.000	
Sec.												
fLpb				1.000				1.000		1.000	1.000	
fRpb						1.000		1.000	1.000	1.000	1.000	
S				1787		1599		4929	1538	2751	4929	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left	L	158	1787	# 0.09	0.25	447	0.35
Prot							
Perm							
Thru							
Right	R	270	1599	0.17	0.46	733	0.37
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	1502	4929	# 0.30	0.47	2300	0.65
Right	R	58	1538	0.04	0.47	718	0.08
Southbound							
Prot							
Perm							
Left	L	253	2751	# 0.09	0.15	413	0.61
Prot							
Perm							
Thru	T	1829	4929	0.37	0.63	3122	0.59
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.49
Total lost time per cycle, L = 16.00 Sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.56

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Adj Fact	Prog Cap	Lane Factor k	Incremental Del d2	Res Del d3	Lane Group Delay LOS	Approach Delay LOS
Eastbound										
Westbound										
L	0.35	0.25	37.0	1.000	447	0.50	2.2	0.0	39.2 D	
										28.7 C
R	0.37	0.46	21.2	1.000	733	0.50	1.4	0.0	22.6 C	
Northbound										
T	0.65	0.47	24.5	1.000	2300	0.50	1.5	0.0	26.0 C	25.7 C
R	0.08	0.47	17.7	1.000	718	0.50	0.2	0.0	18.0 B	
Southbound										
L	0.61	0.15	47.7	1.000	413	0.50	6.6	0.0	54.4 D	
T	0.59	0.63	12.8	1.000	3122	0.50	0.8	0.0	13.6 B	18.6 B

Intersection Delay = 22.4 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	120.0 sec			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo				
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	120.0 sec			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				0.000 0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo				0.908 0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g)/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	120.0 sec			
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time r=(C-g-gq-gu)				
Arrival rate, qa=v/(3600(max[X,1.0]))				
Protected ph. departure rate, Sp=s/3600				
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Final Queue Delay d3 sec	Initial Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 22.4 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
LaneGroup				L		R		T	R	L	T	
Init Queue				0.0		0.0		0.0	0.0	0.0	0.0	
Flow Rate				158		270		551	58	161	671	
So				1900		1900		1900	1900	1900	1900	
No.Lanes	0	0	0	1	0	1	0	3	1	2	3	0
SL				1787		1599		1809	1538	1752	1809	
LnCapacity				447		733		844	718	263	1146	
Flow Ratio				0.09		0.17		0.30	0.04	0.09	0.37	
v/c Ratio				0.35		0.37		0.65	0.08	0.61	0.59	
Grn Ratio				0.25		0.46		0.47	0.47	0.15	0.63	
I Factor					1.000			1.000			1.000	
AT or PVG				3		3		3	3	3	3	
Pltn Ratio				1.00		1.00		1.00	1.00	1.00	1.00	
PF2				1.00		1.00		1.00	1.00	1.00	1.00	
Q1				4.3		5.9		14.1	1.1	5.0	13.0	
kB				0.8		1.1		1.2	1.1	0.5	1.5	
Q2				0.4		0.6		2.2	0.1	0.8	2.1	
Q Average				4.8		6.5		16.3	1.2	5.8	15.1	
Q Spacing				7.6		7.6		7.6	7.6	7.6	7.6	
Q Storage				0		0		0	0	0	0	
Q S Ratio												
70th Percentile Output:												
fB%				1.2		1.2		1.2	1.3	1.2	1.2	
BOQ				5.9		8.0		19.6	1.5	7.2	18.2	
QSRatio												
85th Percentile Output:												
fB%				1.5		1.5		1.4	1.6	1.5	1.4	
BOQ				7.2		9.6		23.0	1.9	8.7	21.4	
QSRatio												
90th Percentile Output:												
fB%				1.7		1.6		1.5	1.9	1.7	1.5	
BOQ				8.1		10.7		24.7	2.2	9.7	23.1	
QSRatio												
95th Percentile Output:												
fB%				2.0		1.9		1.6	2.4	1.9	1.6	
BOQ				9.5		12.2		26.7	2.8	11.2	24.9	
QSRatio												
98th Percentile Output:												
fB%				2.3		2.1		1.8	2.9	2.2	1.8	
BOQ				10.9		13.7		28.6	3.4	12.6	26.8	
QSRatio												

ERROR MESSAGES

No errors to report.