SANDS BETHWORKS

Phase 1 – Casino/Retail Development

TRAFFIC IMPACT STUDY
&
ACCESS IMPROVEMENTS EVALUATION

City of Bethlehem
Northampton County
Pennsylvania

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INTRODUCTION

The proposed Sands Bethworks Phase 1 Casino/Retail Development located in the City of Bethlehem, Northampton County, Pennsylvania will consist of two separate components. The casino component, to be located primarily to the east of the Minsi Trail Bridge between Daly Avenue, State Route (SR) 412, and the Lehigh River, will include, in addition to the main casino, several support uses. A hotel of approximately three hundred rooms is planned for this component of the development in addition to food and beverage establishments, light retail, a parking garage and bus station facilities. The retail component, to be located to the west of the Minsi Trail Bridge and north of Daly Avenue will also include several uses. In addition to a department store and general retail, several high-end quality restaurants, a cimema and a multipurpose area are also planned. For project location see Figure 1.

The casino component of the Sands Bethworks Phase 1 development will be served by two access roads intersecting Daly Avenue (SR 412) to the east of the Minsi Trail Bridge. For the purposes of this study they are designated East Casino Access Road and West Casino Access Road. The West Casino Access Road will intersect Daly Avenue approximately 400 feet east of the Minsi Trail Bridge and the East Casino Access Road will intersect Daly Avenue approximately 500 feet east of the West Casino Access Road. The retail component of the development will be served by one main access road intersecting Daly Avenue approximately 1,200. west of the Minsi Trail Bridge. For the purposes of this study it is designated as Bethworks Retail Center Access Road.

The purpose of the study is to evaluate the traffic impact of the Sands Bethworks Phase 1 Casino/Retail Development focusing on the section of Daly Avenue between East Fourth Street and East Third Street, including the intersection of East Third Street and Hayes Avenue, and also focusing on the section of Stefko Boulevard between Daly Avenue and East Broad Street. In addition the recommended access schemes for both components of the site will be evaluated as well as all proposed new intersections. The traffic impact study and access improvements evaluation were accomplished by performing the following tasks:

1. A field investigation of the study area including Daly Avenue (SR 412) from East 4th Street to the intersection of East 3rd Street and Hayes Avenue and Stefko Boulevard from Daly Avenue to East Broad Street.

2. Manual turning movement counts conducted on weekdays from 4:00 PM to 6:00 PM and Saturdays from 11:00 AM to 3:00 PM at the following locations:

   Daly Avenue (SR 412) and Stefko Boulevard (Minsi Trail Bridge)
   Daly Avenue (SR 412) and East 4th Street
   East 3rd Street and Hayes Avenue

Stefko Boulevard and East Broad Street - Municipal Driveway

3. Investigation of traffic generated by the Sands Bethworks, Phase 1 Casino/Retail Development.

4. Determination of the directional distribution of the traffic generated by the Sands Bethworks, Phase 1 Casino/Retail Development and assignment of that traffic to the surrounding roadway system.

5. Analyses of the following intersections for existing, no-build and build conditions;

   Daly Avenue (SR 412) and Stefko Boulevard (Minsi Trail Bridge)
   Daly Avenue (SR 412) and East 4th Street
   East 3rd Street and Hayes Avenue
   Stefko Boulevard and East Broad Street - Municipal Driveway

   and analysis of the following future intersections for build conditions.

   Daly Avenue (SR 412) and East Casino Access Road
   Daly Avenue (SR 412) and West Casino Access Road
   Daly Avenue and Bethworks Retail Center Access Road

6. Drawing of conclusions as to the traffic impact of the proposed Sands Bethworks Phase 1 - Casino/Retail Development and the evaluation of the access scheme.

EXISTING CONDITIONS

State Route (SR) 412 is an urban minor arterial running from Bucks County through Hellertown and into the City of Bethlehem. It functions as a connector roadway between Interstate Highway 78 and State Route 378. From I-78 to East Third Street SR 412 is named Daly Avenue and serves most of the local streets through at-grade intersections. In the vicinity of the proposed Sands Bethworks site it is primarily a two-lane roadway with turning lanes at the various intersections. The posted speed limit on Daly Avenue is 35 miles per hour. The section of SR 412 that runs along East Third Street from the end of Daly Avenue to SR-378 is also a two-lane roadway with several signalized intersections.

Stefko Boulevard is also a minor urban arterial running from its intersection with Daly Avenue (SR 412) across the Minsi Trail Bridge and connecting to Easton Avenue and the William Penn Highway. Stefko Boulevard is generally a wider roadway with two through lanes in each direction and left turn lanes at the intersections.

The following are descriptions of the existing signalized intersections in the study area:

Daly Avenue (SR 412) and Stefko Boulevard

The intersection of Daly Avenue (SR 412) and Stefko Boulevard is a skewed angle tee intersection with Stefko Boulevard forming the stem of the tee. The intersection is signalized utilizing a three-phase operation (Daly Avenue Eastbound lead, Daly Avenue right-of-way without eastbound left turn and Stefko Boulevard right-of-way). The lane configuration of the intersection is as follows:

Daly Avenue east leg - two westbound approach lanes, one through lane and one right turn lane, - one eastbound receiving lane.

Daly Avenue west leg - three eastbound approach lanes, two left turn lanes and one through lane, - one westbound receiving lane.

Stefko Boulevard north leg - two southbound approach lanes, one left turn lane and one right turn lane, - two northbound receiving lanes.

Total approach peak hour traffic volumes for this intersection are as follows:

Intersection of Daly Avenue (SR 412) and Stefko Boulevard
Existing Approach Peak Hour Traffic Volumes

Approach	Weekday PM	Saturday
Daly Avenue E.B.	753	613
Daly Avenue W.B.	604	467
Stefko Boulevard S.B.	920	704

Daly Avenue (SR 412) and East Fourth Street

The intersection of Daly Avenue (SR 412) and East Fourth Street is a skewed angle tee intersection with East Fourth Street forming the stem of the tee. The angle of the intersection is so severe that right turns into Fourth Street and left turns out of Fourth Street are prohibited. The intersection is signalized utilizing a two-phase operation (Daly Avenue right-of-way and Daly Avenue westbound left turn with East Fourth Street right turn). The lane configuration of the intersection is as follows:

Daly Avenue east leg - two westbound approach lanes, one left turn lane and one through lane, - two eastbound receiving lanes.

Daly Avenue west leg - two eastbound through lanes, - one westbound receiving lane.

East Fourth Street south leg - one right turn lane (due to the angle of the intersection this lane is aligned as a through lane), - one southbound receiving lane.

Total approach peak hour traffic volumes for this intersection are as follows:

Intersection of Daly Avenue (SR 412) and East Fourth Street
Existing Approach Peak Hour Traffic Volumes

Approach	Weekday PM	Saturday
Daly Avenue E.B.	780	481
Daly Avenue W.B.	731	619
East Fourth Street N.B.	146	109

East Third Street (SR 412) and Hayes Avenue

The intersection of East Third Street (SR 412) and Hayes Avenue is a right angle tee intersection with Hayes Avenue forming the stem of the tee. The intersection is signalized utilizing a three-phase operation (East Third Street Westbound lead, East Third Street right-of-way and Hayes Avenue right-of-way). The lane configuration of the intersection is as follows:

East Third Street east leg - two westbound approach lanes, one left turn lane and one through lane, - one eastbound receiving lane.

East Third Street west leg - two eastbound approach lanes, one through lane and one right turn lane, - one westbound receiving lane.

Hayes Avenue south leg - two northbound approach lanes, one left turn lane and one right turn lane, - one southbound receiving lane.

Total approach peak hour traffic volumes for this intersection are as follows:

Intersection of East Third Street (SR 412) and Hayes Avenue
Existing Approach Peak Hour Traffic Volumes

Approach	Weekday PM	Saturday
East Third Street E.B.	591	462
East Third Street W.B.	627	590
Hayes Avenue N.B.	424	410

Stefko Boulevard and East Broad Street - Municipal Driveway

The intersection of Stefko Boulevard and East Broad Street - Municipal Driveway (Municipal Service Center of the City of Bethlehem) is a four-way right angle signalized intersection utilizing a three-phase operation (Stefko Boulevard Northbound lead, Stefko Boulevard right-of-way without northbound left turn and East Broad Street - Municipal Driveway right-of-way). The lane configuration of the intersection is as follows:

Stefko Boulevard north leg - three southbound approach lanes, one left turn lane, one through lane and one shared through/right turn lane, - two northbound receiving lanes.

Stefko Boulevard south leg - three northbound approach lanes, one left turn lane, one through lane and one shared through/right turn lane, - two southbound receiving lanes.

Municipal Driveway east leg - one westbound approach lane, - one eastbound receiving lane.

East Broad Street west leg - two eastbound approach lanes, one shared through/left turn lane and one right turn lane, - one westbound receiving lane.

Total approach peak hour traffic volumes for this intersection are as follows:

Intersection of Stefko Boulevard and East Broad Street - Municipal Driveway
Existing Approach Peak Hour Traffic Volumes

Approach	Weekday PM	Saturday
Stefko Boulevard N.B.	802	665
Stefko Boulevard S.B.	751	683
East Broad Street E.B.	530	318
Municipal Driveway W.B.	4	6

Existing weekday PM peak hour and Saturday peak hour traffic volumes are presented in Figures 2 and 3, respectively.

BACKGROUND TRAFFIC GROWTH

Future no-build weekday PM peak hour and Saturday peak hour traffic volumes were determined by applying a regional traffic growth factor to existing volumes. The formula for the regional traffic growth factor is as follows:

$$GF = (1 + GR)^{n}$$

Where:

GF = Regional Traffic Growth Factor
GR = Regional Yearly Traffic Growth Rate
n = number of years to full build-out

The regional yearly traffic growth rate was obtained from the Pennsylvania Department of Transportation, District 5 office. As previously mentioned the Pennsylvania Department of Transportation classifies Daly Avenue (SR 412) in this area as an urban minor arterial. The Pennsylvania Department of Transportation's current growth rate for urban minor arterials in this region is 1.8%. It is assumed that the Sands Bethworks Phase 1 - Casino/Retail Development will be fully built out and occupied by 2008, three years.

Therefore, the regional traffic growth factor is:

$$GF = (1 + .018)^{3} = 1.055$$

The existing weekday PM peak hour and Saturday peak hour traffic volumes were grown to the build year of 2008 by multiplying by the regional traffic growth factor. No-build weekday PM and Saturday peak hour traffic volumes are presented in Figures 4 and 5, respectively.

SITE TRIP GENERATION

Casino Component

Site Trip Generation for the casino component of the Sands Bethworks Phase 1 Casino/Retail Development was determined by the use of a patronage model. The patronage model determines total annual person visits to the casino complex, and segregates the data by peaks (seasonal, monthly, daily and hourly), modal splits, vehicle occupancy and trip purpose (patron, employee and service). It should be noted that a substantial charter bus program is planned for the casino site, therefore, the auto/bus modal split in terms of patrons is 85%/15%. The patronage model is primarily used to determine the economic feasibility of the site; however, it can be used as an accurate and precise measure of trip generation. The following are the results of the patronage model.

Sands Bethworks Casino Patronage Model
Input Assumptions

Parameter	Weekday	Saturday
Modal Split: Auto/Bus	85%/15%	85%/15%
Auto Vehicle Load Factor in persons/Veh.	2.0/Veh.	2.2/Veh.
Bus Vehicle Load Factor in persons/Veh.	38/Veh.	38/Veh.
Peak Hour Time Period	PM	Mid-Day
Peak Hour Traffic as percent of Daily	6%	5.5%
Peak Hour Directional Split: In/Out	52%/48%	50%/50%

Sands Bethworks Casino Patronage Model
Trips - Gaming Visits

Type/Period	Weekday	Saturday
Average Daily Person Trip	11806	29516
Peak Daily Person Trip	14167	35419
Average Daily Auto Trip	10035	22807
Peak Daily Auto Trip	12042	27369
Average Daily Bus Trip	101	253
Peak Daily Bus Trip	121	304
Peak Hour Auto Trip	723	1505
Peak Hour Bus Trip	12	30
Total Peak Hour Trips	735	1535
Peak Hour Directional Split: In/Out	382/353	768/768

The peak hours in the above tables refer to the weekday PM peak hour of adjacent street traffic and the Saturday mid-day peak hour. The weekday AM peak hour is significantly less than the PM peak hour (the weekday AM peak hour is approximately one third of the PM peak hour) and therefore is not included in the analysis.

Retail Component

Site Trip Generation for the retail component of the development was determined by using the seventh edition of the "Trip Generation Manual" published by the Institute of Transportation Engineers as a guide in estimating the number of trips expected to be generated by the various uses. Three types of uses are proposed for the retail component. The uses are department store and general retail, high-end quality restaurants, and a theater complex consisting of a cinema and a multipurpose space. Land Use Code 820 – Shopping Center was selected as best representing the department store and general retail; Land Use Code 931 - Quality Restaurant was selected as best representing the

high-end restaurants; and Land Use Code 445 - Multiplex Movie Theater was selected as best representing the cimema. The multipurpose space will function as a meeting area, banquet hall, or as a performance theater. The primary purpose of this area is to support the casino component of the site, including the hotel, and therefore it is assumed that most of the trips, especially peak hour trips, would originate in the casino component.

It should be noted that in an effort to develop conservative site generated traffic volumes (that is more site trips than expected) and to account for possible design changes approximately 20,000 square feet of the planned retail space is assumed to be cinema, which generates more traffic than retail, and approximately 17,000 square feet of the planned multipurpose space is assumed to be restaurants. The assigning of 17,000 square feet of multipurpose space as restaurants will more than account for the number of peak hour trips that may be generated by the multipurpose space. Overall these conservative assumptions are in line with the type of modification of the retail component that may occur due to the dynamics of the retail leasing market.

Trips were determined for the weekday PM peak hour of adjacent street traffic and the Saturday peak hour of generator as well as for a typical weekday and Saturday. As in the case of the Casino component the weekday AM peak hour is significantly less than the PM peak hour and is not included in the analysis. The estimated trip generation for each land use is as follows:

Department Store/General Retail
(146,500 SF)
Estimated Site Trip Generation

Time Period	Relationship T = total vehicle trips x = GLA in 1000 SF	Vehicle Trips		
		Total	Entering	Exiting
PM Peak Hour Adj. Street	Ln(T) = 0.66Ln(x) + 3.40 Entering = 48%, Exiting = 52%	805	386	419
Saturday Peak Hour Generator	Ln(T) = 0.65Ln(x) + 3.77 Entering = 52%, Exiting = 48%	1,109	577	532
Weekday	Ln(T) = 0.65Ln(x) + 5.83 Entering = 50%, Exiting = 50%	8,704	4,352	4,352
Saturday	Ln(T) = 0.63Ln(x) + 6.23 Entering = 50%, Exiting = 50%	11,752	5,876	5,876

High End/Quality Restaurant
(54,100 SF)
Estimated Site Trip Generation

Time Period	Relationship T = total vehicle trips x = GLA in 1000 SF	Vehicle Trips		
		Total	Entering	Exiting
PM Peak Hour Adj. Street	T = 7.49(x) Entering = 67%, Exiting = 33%	405	271	134
Saturday Peak Hour Generator	T = 10.87(x) - 0.46 Entering = 59%, Exiting = 41%	588	347	241
Weekday	T = 89.95(x) Entering = 50%, Exiting = 50%	4,866	2,433	2,433
Saturday	Ln(T) = 1.037Ln(x) + 4.410 Entering = 50%, Exiting = 50%	5,158	2,579	2,579

Cinema
(81,500 SF)
Estimated Site Trip Generation

Time Period	Relationship T = total vehicle trips x = GLA in 1000 SF	Vehicle Trips		
		Total	Entering	Exiting
PM Peak Hour Adj. Street	Ln(T) = 1.35Ln(x) + 0.11 Entering = 64%, Exiting = 36%	424	271	153
Saturday Peak Hour Generator	Ln(T) = 1.20Ln(x) + 1.96 Entering = 52%, Exiting = 48%	1,395	725	670
Weekday	T = 66.11(x) * Entering = 50%, Exiting = 50%	5,388	2,694	2,694
Saturday	T = 77.72(x) * Entering = 50%, Exiting = 50%	6,334	3,167	3,167

* Daily relationships were derived using the ratios of data based on movie screens.

The retail component of the Sands Bethworks Phase 1 Development is unique in that the various uses will function as support to the casino component of the development. The majority of the trips generated by the high-end quality restaurants will have their origin and destination in the casino component. The department store and general retail and the

cinema will attract more outside customers; however, even with retail and cimema a significant number of the trips generated will originate in the casino component. It is therefore assumed that 75% of the peak hour trips generated by the restaurants will be internal originating in the casino component, and 50% of the peak hour trips generated by the department store and general retail and cinema will also be internal originating in the casino component. Based on these assumptions the following is the estimated external site trips generated by the retail component of the Sands Bethworks Phase 1 Development.

Sands Bethworks Phase 1 Retail Component
Estimated External Site Trip Generation

Time Period	Use	Vehicle Trips		
		Total	Entering	Exiting
PM Peak Hour Adj. Street	Department Store/General Retail	403	193	210
	High End/Quality Restaurant	101	68	33
	Cinema	212	136	76
	Total PM Peak Hour Adj. Street	716	397	319
Saturday Peak Hour Generator	Department Store/General Retail	555	289	266
	High End/Quality Restaurant	147	87	60
	Cinema	698	363	335
	Total Saturday Peak Hour Generator	1,400	739	661
Weekday Total	Department Store/General Retail	8,704	4,352	4,352
	High End/Quality Restaurant	4,866	2,433	2,433
	Cinema	5,388	2,694	2,694
	Total Weekday	18,958	9,479	9,479
Saturday Total	Department Store/General Retail	11,752	5,876	5,876
	High End/Quality Restaurant	5,158	2,579	2,579
	Cinema	6,334	3,167	3,167
	Total Weekday	23,244	11,622	11,622

SITE TRIP DISTRIBUTION

The site trips generated by the Sands Bethworks Phase 1 Casino/Retail Development were assigned to the surrounding roadway system using the traffic assignment patterns presented in the SR 412 Section 001 study report, dated June 15, 2005, prepared by Orth - Rodgers Associates, Inc. and submitted to the Pennsylvania Department of Transportation. As part of the SR 412 Section 001 study Orth - Rodgers developed a distribution and traffic assignment pattern for the ultimate Sands Bethworks future development. The traffic assignment pattern is as follows:

Sands Bethworks Ultimate Development
Traffic Assignment Pattern
(by per cent)

Roadway	Percent of Site Trips
Interstate 78 to the east and west	40%
SR 412 south of I-78	15%
SR 412 between I-78 and Shimersville Road	55%
Shimersville Road to the north	5%
SR 412 between Shimersville Rd. and Site	60%
Stefko Boulevard to the north	5%
SR 378 to the north	20%
SR 378 to the south	10%
Fahy Bridge to the north	5%
SR 412 between Fahy Bridge and Site	35%

These distributions seem reasonable for the external trips of the retail component of the Sands Bethworks site. For the casino component of the site the area of influence is much greater extending into North Jersey. The traffic assignment pattern presented above does not account for this attraction to the east. In order to account for this change in area of attraction the percent of traffic oriented to the east on I-78 is increased significantly as the percent of traffic oriented to the west on I-78 is decreased. Overall the total percent of traffic from I-78 passing through the SR 412 interchange is increased by 5% for the casino component with the majority of traffic oriented to east. In addition the percent of traffic on Stefko Boulevard is also increased by 5% for the casino component to account for the North Jersey attraction. The percent of traffic from the north on SR 378 is decreased from 20% to 10%. The following are the traffic assignment patterns for both the retail and casino components of the site.

Sands Bethworks Phase 1 Casino/Retail Development
Traffic Assignment Patterns
(by per cent)

Roadway	Percent of Site Trips	
	Casino	Retail
Interstate 78 to the east and west	55%	40%
SR 412 south of I-78	5%	15%
SR 412 between I-78 and Shimersville Rd.	60%	55%
Shimersville Road to the north	5%	5%
SR 412 between Shimersville Rd. and Site	65%	60%
Stefko Boulevard to the north	10%	5%
SR 378 to the north	10%	20%
SR 378 to the south	10%	10%
Fahy Bridge to the north	5%	5%
SR 412 between Fahy Bridge and Site	25%	35%

Using these traffic assignment patterns and the site generated peak hour traffic volumes developed in the previous section, traffic was assigned to the study area as follows.

Sands Bethworks Phase 1 Casino/Retail Development
Peak Hour Site Trip Distribution

Direction/Roadway	PM PHAS				Saturday PH Gen			
	Casino		Retail		Casino		Retail	
	Ent.	Exit	Ent.	Exit	Ent.	Exit	Ent.	Exit
North/Stefko Boulevard	38	35	20	16	77	77	37	33
East/Daly Ave. (SR 412)	248	230	238	191	499	499	443	397
West/E. 3rd St. (SR 412)	96	88	139	112	192	192	259	231
Totals	382	353	397	319	768	768	739	661

The site trips were then assigned to the intersections of East Third Street and Hayes Avenue and Stefko Boulevard and East Broad Street based on existing traffic patterns at these intersections. The weekday PM and Saturday peak hour site generated traffic volumes are presented in Figures 6 and 7, respectively.

Build weekday PM and Saturday peak hour traffic volumes were determined by adding the site generated peak hour traffic volumes to the no-build volumes. Build weekday PM and Saturday peak hour traffic volumes are presented in Figures 8 and 9, respectively.

The regional traffic network is illustrated in Figure 10. The traffic assignment patterns for site generated traffic for both the casino component and the retail component of the site are illustrated on an aerial map of the region presented in Figure 11.

ACCESS IMPROVEMENTS

Extensive improvements to Daly Avenue (SR 412) are proposed to accommodate the projected Sands Bethworks Development site traffic and provide for the safe and efficient flow of all traffic through the area. SR 412 will be widened to two through lanes in each direction in the vicinity of the site with additional turning lanes at the intersections. There will be two access roads serving the casino component of the development and one access road serving the retail component. The two proposed casino access roads named West Casino Access Road and East Casino Access Road intersect Daly Avenue approximately 400 feet and 900 feet east of the Minsi Trail Bridge, respectively. The proposed retail access road named Bethworks Retail Center Access Road intersects Daly Avenue approximately 1200 feet west of the Minsi Trail Bridge. The following are descriptions of the proposed access road intersections with Daly Avenue including a description of the proposed improvements to the intersection of Daly Avenue and Stefko Boulevard (Minsi Trail Bridge). The proposed access improvements are shown in Figures 12A-12C.

Daly Avenue (SR 412) and East Casino Access Road

The proposed intersection of Daly Avenue (SR 412) and East Casino Access Road will be a skewed angle tee intersection with East Casino Access Road forming the stem of the tee. Signalization is proposed utilizing a two-phase operation (Daly Avenue right-of-way and East Casino Access Road right-of-way). The eastbound left turn movement from Daly Avenue is prohibited. The lane configuration of the intersection is as follows:

> **Daly Avenue east leg** - three westbound approach lanes, two through lanes and one right turn lane, - two eastbound receiving lanes.
>
> **Daly Avenue west leg** - two eastbound through lanes - two westbound receiving lanes.
>
> **East Casino Access Road north leg** - three southbound approach lanes, two left turn lanes and one right turn lane, - two northbound receiving lanes.

Daly Avenue (SR 412) and West Casino Access Road

The proposed intersection of Daly Avenue (SR 412) and West Casino Access Road will be a skewed angle tee intersection with West Casino Access Road forming the stem of the tee. Signalization is proposed utilizing a two-phase operation (Daly Avenue westbound right-of-way and Daly Avenue eastbound left turn with West Casino Access Road right turn; Daly Avenue eastbound through movement will not be signal controlled) The southbound left turn movement from West Casino Access Road is prohibited. The lane configuration of the intersection is as follows:

> **Daly Avenue east leg** - three westbound approach lanes, two through lanes and one right turn lane, - two eastbound receiving lanes.
>
> **Daly Avenue west leg** - three eastbound approach lanes, two through lanes and one left turn lane - three westbound receiving lanes.
>
> **West Casino Access Road north leg** - two southbound right turn lanes, - two northbound receiving lanes.

Daly Avenue (SR 412) and Bethworks Retail Center Access Road

The proposed intersection of Daly Avenue (SR 412) and Bethworks Retail Center Access Road will be a right angle tee intersection with Bethworks Retail Center Access Road forming the stem of the tee. Signalization is proposed utilizing a three-phase operation (Daly Avenue Eastbound lead, Daly Avenue right-of-way with eastbound left turn movement permitted and Bethworks Retail Center Access Road right-of-way). The lane configuration of the intersection is as follows:

> **Daly Avenue east leg** - three westbound approach lanes, two through lanes and one right turn lane, - two eastbound receiving lanes.
>
> **Daly Avenue west leg** - three eastbound approach lanes, one left turn lane and two through lanes, - two westbound receiving lanes.
>
> **Bethworks Retail Center Access Road north leg** - three southbound approach lanes, two left turn lanes and one right turn lane, - one northbound receiving lane.

Daly Avenue (SR 412) and Stefko Boulevard (Proposed Improvements)

The existing intersection of Daly Avenue (SR 412) and Stefko Boulevard is a skewed angle tee intersection with Stefko Boulevard forming the stem of the tee. The intersection is signalized utilizing a three-phase operation. The proposed intersection signalization will also utilize a three-phase operation with enhancements (Daly Avenue Eastbound lead with Stefko Boulevard southbound right turn movement, Daly Avenue right-of-way

without eastbound left turn and Stefko Boulevard right-of-way with Daly Avenue westbound right turn). The lane configuration of the intersection with proposed improvements is as follows:

Daly Avenue east leg - three westbound approach lanes, two through lanes and one right turn lane, - two eastbound receiving lanes.

Daly Avenue west leg - four eastbound approach lanes, two left turn lanes and two through lanes, - two westbound receiving lanes.

Stefko Boulevard north leg - two southbound approach lanes, one left turn lane and one right turn lane, - two northbound receiving lanes.

The signalization at the intersections of Daly Avenue and Stefko Boulevard, Daly Avenue and West Casino Access Road and Daly Avenue and East Casino Access Road will be coordinated (with a hard wire interconnect) to provide for the efficient flow of through traffic on Daly Avenue. Due to the fact that at the West Casino Access Road only the Daly Avenue westbound through movement and eastbound left turn movement are signalized, the signal will be coordinated exclusively to accommodate the flow of westbound traffic.

The close proximity of the casino access road intersections with the intersection of Daly Avenue and Stefko Boulevard requires signal preemption devices for the Daly Avenue westbound approaches at Stefko Boulevard and West Casino Access Road, and the Daly Avenue eastbound left turn at West Casino Access Road. The signal preemption devices (force off loops) will prevent blockage of the casino access road intersections and the intersection of Daly Avenue and Stefko Boulevard. The traffic signal coordination system on Daly Avenue will insure the efficient flow of traffic through these intersections.

TRANSIT

There are several public transit bus routes that serve the general South Bethlehem area in the vicinity of the Sands Bethworks Development site. Currently, bus routes are the only form of mass transportation serving Bethlehem. There is no passenger train service within the City of Bethlehem or surrounding area. The bus routes are part of a network known as the Metro System operated by the Lehigh and Northampton Transportation Authority (LANTA). The Metro System, which provides daily, evening and weekend service, consists of 26 bus routes serving the Lehigh Valley. Within this urban area it is estimated that almost 400,000 people live within walking distance of one of the bus routes. Bus ridership has been growing in the area and it is approaching four million trips per year. The existing LANTA bus routes that would be impacted positively by the proposed Bethworks Development are described as follows:

Route F (Westgate - South Bethlehem)

Route F, known as the Westgate Route, connects the "park & ride" facility at the interchange of I-78 and SR 412 with the north west part of Bethlehem and Westgate Mall. The route includes SR 412 to East Fourth Street, across the Fahy Bridge, through Center City to West Broad Street, and then to Eighth Avenue and Schoenersville Road to Westgate Mall.

Route G (Union Boulevard - Susquehanna Street)

Route G, known as the Union Boulevard Route, connects Lynnfield with Allentown and Bethlehem Center City. The route also includes East Fourth Street just to the south of the Bethworks site, to Broadway and Susquehanna Street into Allentown. From the Westbrook Park area of Allentown the Route proceeds north through the City Center and then east on Union Boulevard passing the Lehigh Shopping Center to Bethlehem Center City.

Route B (East Hills/Freemansburg Avenue - Fountain Hill)

Route B, known as the East Hills/Freemansburg Avenue Route, connects the Route 33 and William Penn Highway "park & ride" facility with Bethlehem Center City and Fountain Hill. The route includes Freemansburg Avenue to Stefko Boulevard and East Broad Street in the vicinity of the Bethworks site, through Bethlehem Center City and across the Fahy Bridge to Third Street near the Bethlehem bus terminal and down Broadway to Fountain Hill.

Starlight 2 (Lehigh Valley Mall/Susquehanna Street)

Starlight 2, known as Lehigh Valley Mall/Susquehanna Street, is an evening route that connects Bethlehem Center City with Allentown and the Lehigh Valley Mall and Whitehall Mall. The Route includes East Broad Street to Stefko Boulevard across the Minsi Trail Bridge, down Daly Avenue in front of the Bethworks Site to Hayes Street, then on East Fourth Street to Broadway and Susquehanna Street into Allentown and ultimately the two malls.

In addition to these routes there are several routes connecting the City of Easton with the City of Bethlehem that include William Penn Highway and Easton Avenue to Stefko Boulevard. These routes could be modified to include the intersection of Stefko Boulevard and East Broad Street and even Daly Avenue across the Minsi Trail Bridge to the Sands Bethworks site.

Overall the development of the Sands Bethworks Phase 1 site will have a positive impact on the area's public transit in that bus ridership should increase significantly on the LANTA routes that serve the South Bethlehem area. Bus stop areas for public transit buses will be provided in both the casino and retail components of the development to provide for easy access in and out of the sites. It is anticipated that a significant number of casino employees in addition to the restaurant and retail store employees will use buses for transportation to the site. The evening routes that LANTA provides should prove to be convenient transportation to accommodate the various employees and their schedules.

TRAFFIC ANALYSIS

Capacity analyses were performed for the intersections of Daly Avenue (SR 412) and Stefko Boulevard (Minsi Trail Bridge), Daly Avenue (SR 412) and East 4th Street, East 3rd Street and Hayes Avenue, and Stefko Boulevard and East Broad Street - Municipal Driveway for the existing, future no-build and future build conditions. Capacity analyses were also performed for the future intersections of Daly Avenue (SR 412) and the East Casino Access Road, Daly Avenue (SR 412) and the West Casino Access Road, and Daly Avenue and the Bethworks Retail Center Access Road for the future build condition. The results of the capacity analyses for the weekday PM and Saturday peak hours are as follows:

Intersection of Daly Avenue (SR 412) and Stefko Boulevard (Minsi Trail Bridge)
Weekday PM Peak Hour Levels of Service

Approach	Existing		No - Build		Build	
	Level of Service	Average Control Delay (sec/veh)	Level of Service	Average Control Delay (sec/veh)	Level of Service	Average Control Delay (sec/veh)
Daly Avenue Eastbound	C	24.5	C	26.3	C	30.9
Daly Ave. (SR 412) Westbound	B	17.0	B	17.9	C	23.9
Stefko Boulevard Southbound	B	19.3	C	22.2	C	30.5
Intersection Overall	C	20.5	C	22.4	C	28.6

Intersection of Daly Avenue (SR 412) and Stefko Boulevard (Minsi Trail Bridge)
Saturday Peak Hour Levels of Service

Approach	Existing		No - Build		Build	
	Level of Service	Average Control Delay (sec/veh)	Level of Service	Average Control Delay (sec/veh)	Level of Service	Average Control Delay (sec/veh)
Daly Avenue Eastbound	B	19.6	C	20.1	C	23.9
Daly Ave. (SR 412) Westbound	B	13.1	B	13.4	C	20.4
Stefko Boulevard Southbound	B	15.5	B	16.2	D	35.6
Intersection Overall	B	16.3	B	16.8	C	25.6

Intersection of Daly Avenue (SR 412) and East 4th Street
Weekday PM Peak Hour Levels of Service

Approach	Existing		No - Build		Build	
	Level of Service	Average Control Delay (sec/veh)	Level of Service	Average Control Delay (sec/veh)	Level of Service	Average Control Delay (sec/veh)
Daly Ave. (SR 412) Eastbound	B	11.4	B	11.7	B	14.9
Daly Ave. (SR 412) Westbound	A	3.5	A	3.5	A	4.0
East 4th Street Eastbound	B	16.9	B	17.1	B	18.8
Intersection Overall	A	8.5	A	8.7	B	10.1

Intersection of Daly Avenue (SR 412) and East 4th Street
Saturday Peak Hour Levels of Service

Approach	Existing		No - Build		Build	
	Level of Service	Average Control Delay (sec/veh)	Level of Service	Average Control Delay (sec/veh)	Level of Service	Average Control Delay (sec/veh)
Daly Ave. (SR 412) Eastbound	A	9.4	A	9.5	B	17.3
Daly Ave. (SR 412) Westbound	A	4.1	A	4.2	B	11.4
East 4th Street Eastbound	B	16.2	B	16.3	B	17.9
Intersection Overall	A	7.2	A	7.3	B	14.2

Intersection of Stefko Boulevard and East Broad Street - Municipal Driveway
Weekday PM Peak Hour Levels of Service

Approach	Existing		No - Build		Build	
	Level of Service	Average Control Delay (sec/veh)	Level of Service	Average Control Delay (sec/veh)	Level of Service	Average Control Delay (sec/veh)
East Broad Street Eastbound	C	28.4	C	30.8	C	34.0
Municipal Driveway Westbound	B	19.4	B	19.4	B	19.4
Stefko Boulevard Northbound	B	13.4	B	13.9	B	14.4
Stefko Boulevard Southbound	C	29.2	C	33.1	D	37.9
Intersection Overall	C	22.9	C	25.2	C	28.0

Intersection of Stefko Boulevard and East Broad Street - Municipal Driveway
Saturday Peak Hour Levels of Service

Approach	Existing		No - Build		Build	
	Level of Service	Average Control Delay (sec/veh)	Level of Service	Average Control Delay (sec/veh)	Level of Service	Average Control Delay (sec/veh)
East Broad Street Eastbound	C	25.1	C	26.2	C	26.0
Municipal Driveway Westbound	B	18.7	B	18.7	B	18.7
Stefko Boulevard Northbound	B	12.0	B	12.2	B	12.9
Stefko Boulevard Southbound	C	23.3	C	24.4	C	28.0
Intersection Overall	B	19.0	B	19.7	C	21.3

Intersection of East 3rd Street and Hayes Avenue
Weekday PM Peak Hour Levels of Service

Approach	Existing		No - Build		Build	
	Level of Service	Average Control Delay (sec/veh)	Level of Service	Average Control Delay (sec/veh)	Level of Service	Average Control Delay (sec/veh)
East 3rd Street Eastbound	C	21.6	C	25.4	D	46.5
East 3rd Street Westbound	B	16.8	B	20.0	D	39.7
Hayes Avenue Northbound	C	28.4	C	30.8	D	40.7
Intersection Overall	C	21.1	C	24.3	D	42.5

Intersection of East 3rd Street and Hayes Avenue
Saturday Peak Hour Levels of Service

Approach	Existing		No - Build		Build	
	Level of Service	Average Control Delay (sec/veh)	Level of Service	Average Control Delay (sec/veh)	Level of Service	Average Control Delay (sec/veh)
East 3rd Street Eastbound	C	21.4	C	22.5	D	52.9
East 3rd Street Westbound	B	10.4	B	11.5	C	32.2
Hayes Avenue Northbound	C	21.8	C	22.1	C	33.5
Intersection Overall	B	16.7	B	17.7	D	39.2

Intersection of Daly Avenue (SR 412) and East Casino Access Road
Peak Hour Levels of Service
(Build Condition)

Approach - Movement	Weekday PM Peak Hour		Saturday Peak Hour	
	Level of Service	Average Control Delay (sec./veh.)	Level of Service	Average Control Delay (sec./veh.)
Daly Ave. (SR 412) Eastbound	B	19.3	B	18.4
Daly Ave. (SR 412) Westbound	B	14.6	B	13.7
Casino East Access Rd Southbound	B	19.0	C	21.3
Intersection Overall	B	17.1	B	16.9

Intersection of Daly Avenue (SR 412) and West Casino Access Road
Peak Hour Levels of Service
(Build Condition)

Approach - Movement	Weekday PM Peak Hour		Saturday Peak Hour	
	Level of Service	Average Control Delay (sec./veh.)	Level of Service	Average Control Delay (sec./veh.)
Daly Ave. (SR 412) Eastbound Left Turn	C	23.9	C	32.9
Daly Ave. (SR 412) Eastbound Through	A	0.3	A	0.3
Daly Ave. (SR 412) Westbound	B	14.0	B	13.1
Casino West Access Rd Southbound Right Turn	C	21.8	C	24.5
Intersection Overall	A	8.5	B	10.8

Intersection of Daly Avenue and Bethworks Retail Center Access Road
Peak Hour Levels of Service
(Build Condition)

Approach - Movement	Weekday PM Peak Hour		Saturday Peak Hour	
	Level of Service	Average Control Delay (sec./veh.)	Level of Service	Average Control Delay (sec./veh.)
Daly Ave. Eastbound	B	11.5	B	14.3
Daly Ave. Westbound	C	21.9	C	24.3
Retail Access Rd Southbound	C	23.6	C	28.3
Intersection Overall	B	17.5	C	21.5

Levels of service for a signalized intersection are determined by the computed or measured control delay and are defined for lane groups, intersection approaches and the

intersections as a whole. The Highway Capacity Manual published by the Transportation Research Board of the National Research Council, defines control delay as:

"The component of delay that results when a control signal causes a lane group to reduce speed or to stop; it is measured by comparison with the uncontrolled condition."

Control delay is the portion of the total delay attributed to traffic signal operation for signalized intersections. Control delay includes initial deceleration delay, queue move-up time, stopped delay and final acceleration delay.

Level of service criteria as defined by the Highway Capacity Manual is as follows:

Level of Service Criteria
Signalized Intersections

Level of Service	Average Control Delay (sec./veh.)
A	0-10
B	>10-20
C	>20-35
D	>35-55
E	>55-80
F	>80

Capacity analyses summary sheets are presented in the appendix of this report.

CONCLUSIONS

Traffic Impacts

Site traffic generated by the Sands Bethworks Phase 1 Casino/Retail Development will utilize three main corridors to gain access to the site. Traffic from the north, east and south especially traffic originating in New Jersey, will use for the most part the I-78 corridor to Daly Avenue (SR 412). Traffic from the west will use SR 378 to East Third Street (SR 412) and some traffic from the north and east will use Stefko Boulevard to access the site.

SR 412 from I-78

The main access corridor into the site is SR 412 from its interchange with I-78 to the site access roads. At least 65% of the site traffic generated by the casino component of the site will utilize this corridor to gain access to the site; and at least 60% of the site traffic generated by the retail component will utilize this corridor. This section of SR 412 for the

most part consists of one through lane in each direction with some turning lanes at the intersections. Several of the intersections with the local roads are signalized. At the interchange with I-78, SR 412 is widened to accommodate the various turning lanes to and from the I-78 ramps.

The Pennsylvania Department of Transportation has initiated an improvement project for this section of SR 412. A traffic study has been conducted for SR 412 by Orth Rodgers Associates, Inc. taking into consideration the Sands Bethworks Development and other developments that are planned for the near future. The overall concept plan is to widen SR 412 from the I-78 interchange to Stefko Boulevard (Minsi Trail Bridge) to at least two through lanes in each direction. Left turn lanes and right turn lanes will be provided at the intersections as needed and the major intersections with the I- 78 Ramps will be improved to increase capacity.

As can be seen from the results of the capacity analyses for the intersection of Daly Avenue (SR 412) and East Fourth Street, this intersection will still operate in the build condition at levels-of-service "B" during both peak hours. Site traffic will have an impact on the Daly Avenue (SR 412) eastbound approach to the intersection; however, the two through lanes are more than adequate to accommodate the increase in traffic from the Bethworks site. Accordingly the addition of another through lane in each direction on SR 412 should provide more than the capacity needed to mitigate the impact of the site traffic on the various signalized intersections.

East Third Street (SR 412)

The capacity analyses for the intersection of East Third Street and Hayes Avenue indicate an impact due to site traffic. A level-of-service "D" can be maintained at this intersection during both the weekday PM and Saturday peak hours with some upgrading of the signalization. During the weekday PM peak hour the overall level-of-service for the intersection drops from a "C" to a "D" and during the Saturday peak hour from a "B" to a "D" due to site traffic.

East Third Street to the west of Hayes Avenue provides the connection for site traffic destined to the Fahy Bridge or SR 378. East Third Street, also shown as SR 412 on most maps continues with one through lane in each direction with some turning lanes at the signalized intersections. Improvements to the traffic signalization at some of the intersections on East Third Street will be necessary to mitigate the impacts from the Sands Bethworks Phase 1 site generated traffic.

Stefko Boulevard

As can be seen from the results of the capacity analyses of the intersection of Stefko Boulevard and East Broad Street site generated traffic has a minimal impact on this intersection. During the weekday PM peak hour the overall change in level-of-service is from a "C" with an average control delay of 25.2 seconds in the no-build condition to a

"C" with an average control delay of 28.0 seconds in the build condition. During the Saturday peak hour the overall change in level-of-service is from a "B" with an average control delay of 19.7 seconds in the no-build condition to a "C' with an average control delay of 21.3 seconds in the build condition. Overall the average control delay for the intersection increases only 2.8 seconds during the weekday PM peak hour and 1.6 seconds during the Saturday peak hour due to site generated traffic.

As site generated traffic begins to dissipate down the various local streets intersecting with Stefko Boulevard the impact of site traffic becomes less and less the further away from the site. It is therefore concluded that site generated traffic from the Sands Bethworks Phase 1 Development will have a minimal impact on the Stefko Boulevard corridor.

Access Improvements

The results of the capacity analyses indicate that the proposed site access roads and their intersections with Daly Avenue are more than adequate to accommodate the site traffic that will be generated by the Sands Bethworks Phase 1 development. The casino access road intersections with Daly Avenue will function at level-of-service "B" or better during both the weekday PM and Saturday peak hours. The prohibiting of the left turn movement into the East Casino Access Road and the prohibiting of the left turn movement out of the West Casino Access Road enables both of theses intersections to utilize a two-phase signal operation. Furthermore, the left turn movement into the casino site at the West Casino Access Road occurs simultaneously with the left turn movement out of the casino site at the East Casino Access Road to increase efficiency and aid in the coordination of the Daly Avenue westbound through movement. The Bethworks Retail Center Access Road intersection with Daly Avenue, utilizing a three phase signal operation to facilitate the Daly Avenue eastbound left turn movement into the retail site, will function at overall level-of-service "B" during the weekday PM peak hour and level-of-service "C" during the Saturday peak hour.

The proposed improvements to the intersection of Daly Avenue (SR 412) and Stefko Boulevard (Minsi Trail Bridge) will provide enough capacity at that intersection to accommodate the additional site generated traffic. As in the existing condition the intersection utilizes a three-phase signal operation. The intersection of Daly Avenue and Stefko Boulevard will function at level-of-service "C" overall during both the weekday PM and Saturday peak hours.

The close proximity of the intersections of Daly Avenue and Stefko Boulevard, Daly Avenue and West Casino Access Road and Daly Avenue and East Casino Access Road necessitates a coordinated signal system to insure the efficient flow of traffic on Daly Avenue. The intersection of Daly Avenue and West Casino Access Road will only be partially signalized, that is the eastbound through movement on Daly Avenue will not be signalized and will flow freely. The fact that eastbound Daly Avenue is not signalized at this intersection enables this signal to be coordinated exclusively for the westbound

through movement on Daly Avenue. This signal should not create any impedance to either the eastbound or westbound through movements on Daly Avenue and will allow the traffic signals at the intersections of Daly Avenue and Stefko Boulevard and Daly Avenue and East Casino Access Road, which are approximately 1000 feet apart, to be coordinated effectively.

The storage lengths available on Daly Avenue between Stefko Boulevard, West Casino Access Road and East Casino Access Road are adequate to accommodate queuing vehicles during the peak hours at a confidence interval of 95%. The signal preemption devices proposed for the Daly Avenue westbound approaches to Stefko Boulevard and West Casino Access Road and the Daly Avenue eastbound left turn lane approach at West Casino Access Road will insure that no blockage of the intersections will occur.

Overall the proposed access scheme will provide for the safe and efficient flow of traffic throughout the site area.

HCS2000: Signalized Intersections Release 4.1e

Analyst: Walter Lublanecki
Agency: Lublanecki Engineering, Inc.
Date: 11/20/05
Period: PM Peak Hour
Project ID: Bethworks Now Traffic Impact Study
E/W St: Daly Avenue (SR 412)
Inter.: Daly Ave. (SR 412)/Stefko Blvd
Area Type: CBD or Similar
Jurisd: State
Year : Existing
N/S St: Stefko Boulevard

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	2	1	0	0	1	1	0	0	0	1	0	1
LGConfig	L	T			T	R				L		R
Volume	502	251			195	409				485		435
Lane Width	12.0	12.0			12.0	13.0				13.0		12.0
RTOR Vol						0						0

Duration 0.25 Area Type: CBD or Similar

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	A				NB Left			
Thru	P	P			Thru			
Right					Right			
Peds					Peds			
WB Left					SB Left	A		
Thru		P			Thru			
Right		P			Right	A		
Peds					Peds			
NB Right					EB Right			
SB Right	A				WB Right	P		
Green	16.0	14.0				25.0		
Yellow	3.0	3.0				3.0		
All Red	2.0	2.0				2.0		

Cycle Length: 70.0 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	714	3124	0.78	0.23	31.0	C		
T	838	1676	0.33	0.50	11.6	B	24.5	C
Westbound								
T	335	1676	0.61	0.20	33.6	C	17.0	B
R	858	1365	0.53	0.63	9.6	A		
Northbound								
Southbound								
L	605	1695	0.84	0.36	31.3	C		
							19.3	B
R	955	1453	0.51	0.66	6.6	A		

Intersection Delay = 20.5 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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E-Mail: lei@eclipse.net

OPERATIONAL ANALYSIS

Analyst: Walter Lublanecki
Agency/Co.: Lublanecki Engineering, Inc.
Date Performed: 11/20/05
Analysis Time Period: PM Peak Hour
Intersection: Daly Ave. (SR 412)/Stefko Blvd
Area Type: CBD or Similar
Jurisdiction: State
Analysis Year: Existing
Project ID: Bethworks Now Traffic Impact Study

East/West Street	North/South Street
Daly Avenue (SR 412)	Stefko Boulevard

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	502	251			195	409				485		435
% Heavy Veh	1	2			2	10				1		2
PHF	0.90	0.90			0.95	0.90				0.95		0.90
PK 15 Vol	139	70			51	114				128		121
Hi Ln Vol												
% Grade		0			0						-4	
Ideal Sat	1900	1900			1900	1900				1900		1900
ParkExist												
NumPark												
No. Lanes	2	1	0	0	1	1	0	0	0	1	0	1
LGConfig	L	T			T	R				L		R
Lane Width	12.0	12.0			12.0	13.0				13.0		12.0
RTOR Vol						0						0
Adj Flow	558	279			205	454				511		483
%InSharedLn												
Prop LTs		0.000			0.000							
Prop RTs		0.000			0.000	1.000						1.000
Peds Bikes					0			0			0	
Buses	0	0			0	0				0		0
%InProtPhase												
Duration	0.25			Area Type: CBD or Similar								

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		A			NB Left			
Thru		P	P		Thru			
Right					Right			
Peds					Peds			
WB Left					SB Left	A		
Thru			P		Thru			
Right			P		Right	A		
Peds					Peds			
NB Right					EB Right			
SB Right		A			WB Right	P		
Green		16.0	14.0			25.0		
Yellow		3.0	3.0			3.0		
All Red		2.0	2.0			2.0		

Cycle Length: 70.0 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	502	251			195	409				485		435
PHF	0.90	0.90			0.95	0.90				0.95		0.90
Adj flow	558	279			205	454				511		483
No. Lanes	2	1	0	0	1	1	0	0	0	1	0	1
Lane group	L	T			T	R				L		R
Adj flow	558	279			205	454				511		483
Prop LTs		0.000			0.000							
Prop RTs		0.000			0.000	1.000						1.000

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

	Eastbound				Westbound				Northbound				Southbound			
LG	L	T			T	R							L		R	
So	1900	1900			1900	1900							1900		1900	
Lanes	2	1	0	0	1	1	0	0	0	0	0	0	1	0	1	0
fW	1.000	1.000			1.000	1.033							1.033		1.000	
fHV	0.990	0.980			0.980	0.909							0.990		0.980	

fG	1.000	1.000		1.000	1.000				1.020		1.020	
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	0.900	0.900		0.900	0.900				0.900		0.900	
fLU	0.971	1.000		1.000	1.000				1.000		1.000	
fRT		1.000		1.000	0.850						0.850	
fLT	0.950	1.000		1.000					0.950			
Sec.												
fLpb	1.000	1.000		1.000					1.000			
fRpb		1.000		1.000	1.000						1.000	
S	3124	1676		1676	1365				1695		1453	
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	558	3124	#	0.18	0.23	714	0.78
Prot								
Perm								
Thru	T	279	1676		0.17	0.50	838	0.33
Right								
Westbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru	T	205	1676	#	0.12	0.20	335	0.61
Right	R	454	1365		0.33	0.63	858	0.53
Northbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru								
Right								
Southbound								
Prot								
Perm								
Left	L	511	1695	#	0.30	0.36	605	0.84
Prot								
Perm								
Thru								
Right	R	483	1453		0.33	0.66	955	0.51

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.60
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.77

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	0.78	0.23	25.4	1.000	714	0.33	5.6	0.0	31.0	C		
T	0.33	0.50	10.5	1.000	838	0.50	1.1	0.0	11.6	B	24.5	C
Westbound												
T	0.61	0.20	25.5	1.000	335	0.50	8.1	0.0	33.6	C	17.0	B
R	0.53	0.63	7.2	1.000	858	0.50	2.3	0.0	9.6	A		
Northbound												
Southbound												
L	0.84	0.36	20.7	1.000	605	0.38	10.6	0.0	31.3	C		
											19.3	B
R	0.51	0.66	6.2	1.000	955	0.11	0.4	0.0	6.6	A		

Intersection delay = 20.5 (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                          70.0    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                          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 PERMITTED LT WORKSHEET for shared lefts

```
Input
                                                  EB    WB    NB    SB
Opposed by Single(S) or Multiple(M) lane approach
Cycle length, C                          70.0    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                          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 70.0 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 20.5 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	T			T	R				L		R
Init Queue	0.0	0.0			0.0	0.0				0.0		0.0
Flow Rate	287	279			205	454				511		483
So	1900	1900			1900	1900				1900		1900
No.Lanes	2	1	0	0	1	1	0	0	0	1	0	1
SL	1609	1676			1676	1365				1695		1453
LnCapacity	367	838			335	858				605		955
Flow Ratio	0.18	0.17			0.12	0.33				0.30		0.33
v/c Ratio	0.78	0.33			0.61	0.53				0.84		0.51
Grn Ratio	0.23	0.50			0.20	0.63				0.36		0.66
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	5.2	3.3			3.6	4.9				9.1		4.8
kB	0.3	0.8			0.4	0.9				0.4		0.6
Q2	1.1	0.4			0.7	0.9				2.0		0.6
Q Average	6.3	3.7			4.3	5.9				11.2		5.4
Q Spacing	24.9	24.9			24.9	24.9				24.9		24.9
Q Storage	200	500			500	250				400		400
Q S Ratio	0.8	0.2			0.2	0.6				0.7		0.3
70th Percentile Output:												
fB%	1.2	1.2			1.2	1.2				1.2		1.2
BOQ	7.5	4.6			5.4	7.2				13.1		6.4
QSRatio	0.9	0.2			0.3	0.7				0.8		0.4
85th Percentile Output:												
fB%	1.5	1.5			1.5	1.5				1.5		1.6
BOQ	9.7	5.7			6.6	8.8				16.8		8.4
QSRatio	1.2	0.3			0.3	0.9				1.0		0.5
90th Percentile Output:												
fB%	1.7	1.7			1.7	1.7				1.6		1.7
BOQ	10.7	6.4			7.4	9.7				18.2		9.2
QSRatio	1.3	0.3			0.4	1.0				1.1		0.6
95th Percentile Output:												
fB%	1.9	2.1			2.0	1.9				1.8		1.9
BOQ	12.1	7.6			8.7	11.2				20.4		10.5
QSRatio	1.5	0.4			0.4	1.1				1.3		0.7
98th Percentile Output:												
fB%	2.3	2.4			2.3	2.2				2.1		2.4
BOQ	14.6	8.9			10.1	12.7				23.7		12.8
QSRatio	1.8	0.4			0.5	1.3				1.5		0.8

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: Walter Lublanecki
Agency: Lublanecki Engineering, Inc.
Date: 11/20/05
Period: PM Peak Hour
Project ID: Bethworks Now Traffic Impact Study
E/W St: Daly Avenue (SR 412)
Inter.: Daly Ave. (SR 412)/Stefko Blvd
Area Type: CBD or Similar
Jurisd: State
Year : No-Build
N/S St: Stefko Boulevard

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	2	1	0	0	1	1	0	0	0	1	0	1
LGConfig	L	T			T	R				L		R
Volume	530	265			206	431				512		459
Lane Width	12.0	12.0			12.0	13.0				13.0		12.0
RTOR Vol						0						0

Duration 0.25 Area Type: CBD or Similar

Signal Operations

Phase Combination		1	2	3	4		5	6	7	8
EB	Left		A			NB	Left			
	Thru		P	P			Thru			
	Right						Right			
	Peds						Peds			
WB	Left					SB	Left	A		
	Thru			P			Thru			
	Right			P			Right	A		
	Peds						Peds			
NB	Right					EB	Right			
SB	Right		A			WB	Right	P		
Green			16.0	14.0				25.0		
Yellow			3.0	3.0				3.0		
All Red			2.0	2.0				2.0		

Cycle Length: 70.0 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	714	3124	0.82	0.23	33.5	C		
T	838	1676	0.35	0.50	11.8	B	26.3	C
Westbound								
T	335	1676	0.65	0.20	35.1	D	17.9	B
R	858	1365	0.56	0.63	10.1	B		
Northbound								
Southbound								
L	605	1695	0.89	0.36	36.6	D		
							22.2	C
R	955	1453	0.53	0.66	6.9	A		

Intersection Delay = 22.4 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: Walter Lublanecki
Agency/Co.: Lublanecki Engineering, Inc.
Date Performed: 11/20/05
Analysis Time Period: PM Peak Hour
Intersection: Daly Ave. (SR 412)/Stefko Blvd
Area Type: CBD or Similar
Jurisdiction: State
Analysis Year: No-Build
Project ID: Bethworks Now Traffic Impact Study

East/West Street	North/South Street
Daly Avenue (SR 412)	Stefko Boulevard

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	530	265			206	431				512		459
% Heavy Veh	1	2			2	10				1		2
PHF	0.90	0.90			0.95	0.90				0.95		0.90
PK 15 Vol	147	74			54	120				135		128
Hi Ln Vol												
% Grade		0			0						-4	
Ideal Sat	1900	1900			1900	1900				1900		1900
ParkExist												
NumPark												
No. Lanes	2	1	0	0	1	1	0	0	0	1	0	1
LGConfig	L	T			T	R				L		R
Lane Width	12.0	12.0			12.0	13.0				13.0		12.0
RTOR Vol						0						0
Adj Flow	589	294			217	479				539		510
%InSharedLn												
Prop LTs		0.000			0.000							
Prop RTs		0.000			0.000	1.000						1.000
Peds Bikes					0			0			0	
Buses	0	0			0	0				0		0
%InProtPhase												
Duration	0.25			Area Type: CBD or Similar								

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		A			NB Left			
Thru		P	P		Thru			
Right					Right			
Peds					Peds			
WB Left					SB Left	A		
Thru			P		Thru			
Right			P		Right	A		
Peds					Peds			
NB Right					EB Right			
SB Right		A			WB Right	P		
Green		16.0	14.0			25.0		
Yellow		3.0	3.0			3.0		
All Red		2.0	2.0			2.0		

Cycle Length: 70.0 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	530	265			206	431				512		459
PHF	0.90	0.90			0.95	0.90				0.95		0.90
Adj flow	589	294			217	479				539		510
No. Lanes	2	1	0	0	1	1	0	0	0	1	0	1
Lane group	L	T			T	R				L		R
Adj flow	589	294			217	479				539		510
Prop LTs		0.000			0.000							
Prop RTs		0.000			0.000	1.000						1.000

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

	Eastbound				Westbound				Northbound				Southbound			
LG	L	T			T	R							L		R	
So	1900	1900			1900	1900							1900		1900	
Lanes	2	1	0	0	1	1	0	0	0	0	0	0	1	0	1	0
fW	1.000	1.000			1.000	1.033							1.033		1.000	
fHV	0.990	0.980			0.980	0.909							0.990		0.980	

fG	1.000	1.000		1.000	1.000				1.020		1.020	
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	0.900	0.900		0.900	0.900				0.900		0.900	
fLU	0.971	1.000		1.000	1.000				1.000		1.000	
fRT		1.000		1.000	0.850						0.850	
fLT	0.950	1.000		1.000					0.950			
Sec.												
fLpb	1.000	1.000		1.000					1.000			
fRpb		1.000		1.000	1.000						1.000	
S	3124	1676		1676	1365				1695		1453	
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	589	3124	#	0.19	0.23	714	0.82
Prot								
Perm								
Thru	T	294	1676		0.18	0.50	838	0.35
Right								
Westbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru	T	217	1676	#	0.13	0.20	335	0.65
Right	R	479	1365		0.35	0.63	858	0.56
Northbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru								
Right								
Southbound								
Prot								
Perm								
Left	L	539	1695	#	0.32	0.36	605	0.89
Prot								
Perm								
Thru								
Right	R	510	1453		0.35	0.66	955	0.53

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.64
Total lost time per cycle, L = 15.00 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	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor Del k	d2	Res Del d3	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound												
L	0.82	0.23	25.7	1.000	714	0.36	7.9	0.0	33.5	C		
T	0.35	0.50	10.6	1.000	838	0.50	1.2	0.0	11.8	B	26.3	C
Westbound												
T	0.65	0.20	25.7	1.000	335	0.50	9.3	0.0	35.1	D	17.9	B
R	0.56	0.63	7.4	1.000	858	0.50	2.6	0.0	10.1	B		
Northbound												
Southbound												
L	0.89	0.36	21.2	1.000	605	0.41	15.4	0.0	36.6	D		
											22.2	C
R	0.53	0.66	6.3	1.000	955	0.14	0.6	0.0	6.9	A		

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                          70.0    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                          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 PERMITTED LT WORKSHEET_____________________
                              for shared lefts
Input
                                                      EB    WB    NB    SB
Opposed by Single(S) or Multiple(M) lane approach
Cycle length, C                          70.0    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                          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 70.0 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 22.4 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	T			T	R				L		R
Init Queue	0.0	0.0			0.0	0.0				0.0		0.0
Flow Rate	303	294			217	479				539		510
So	1900	1900			1900	1900				1900		1900
No.Lanes	2	1	0	0	1	1	0	0	0	1	0	1
SL	1609	1676			1676	1365				1695		1453
LnCapacity	367	838			335	858				605		955
Flow Ratio	0.19	0.18			0.13	0.35				0.32		0.35
v/c Ratio	0.83	0.35			0.65	0.56				0.89		0.53
Grn Ratio	0.23	0.50			0.20	0.63				0.36		0.66
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	5.6	3.5			3.9	5.3				9.9		5.2
kB	0.3	0.8			0.4	0.9				0.4		0.6
Q2	1.3	0.5			0.8	1.1				2.7		0.7
Q Average	6.9	3.9			4.7	6.4				12.6		5.9
Q Spacing	24.9	24.9			24.9	24.9				24.9		24.9
Q Storage	200	500			500	250				400		400
Q S Ratio	0.9	0.2			0.2	0.6				0.8		0.4
70th Percentile Output:												
fB%	1.2	1.2			1.2	1.2				1.2		1.2
BOQ	8.2	4.9			5.8	7.9				14.8		7.0
QSRatio	1.0	0.2			0.3	0.8				0.9		0.4
85th Percentile Output:												
fB%	1.5	1.5			1.5	1.5				1.5		1.5
BOQ	10.7	6.0			7.1	9.5				18.8		9.1
QSRatio	1.3	0.3			0.4	0.9				1.2		0.6
90th Percentile Output:												
fB%	1.7	1.7			1.7	1.6				1.6		1.7
BOQ	11.7	6.8			7.9	10.5				20.3		10.0
QSRatio	1.5	0.3			0.4	1.0				1.3		0.6
95th Percentile Output:												
fB%	1.9	2.1			2.0	1.9				1.8		1.9
BOQ	13.2	8.1			9.3	12.0				22.6		11.4
QSRatio	1.6	0.4			0.5	1.2				1.4		0.7
98th Percentile Output:												
fB%	2.3	2.4			2.3	2.1				2.1		2.3
BOQ	15.8	9.4			10.7	13.5				26.2		13.8
QSRatio	2.0	0.5			0.5	1.3				1.6		0.9

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: Walter Lublanecki
Agency: Lublanecki Engineering, Inc.
Date: 11/20/05
Period: PM Peak Hour
Project ID: Bethworks Now Traffic Impact Study
E/W St: Daly Avenue (SR 412)
Inter.: Daly Ave. (SR 412)/Stefko Blvd
Area Type: CBD or Similar
Jurisd: State
Year : Build
N/S St: Stefko Boulevard

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	2	2	0	0	2	1	0	0	0	1	0	1
LGConfig	L	T			T	R				L		R
Volume	546	552			532	466				550		479
Lane Width	15.0	12.0			12.0	13.0				13.0		12.0
RTOR Vol						0						0

Duration 0.25 Area Type: CBD or Similar

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	A				NB Left			
Thru	P	P			Thru			
Right					Right			
Peds					Peds			
WB Left					SB Left	A		
Thru		P			Thru			
Right		P			Right	A		
Peds					Peds			
NB Right					EB Right			
SB Right	A				WB Right	P		
Green	18.0	22.0				33.0		
Yellow	4.0	4.0				3.0		
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 Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	687	3436	0.88	0.20	48.0	D		
T	1631	3192	0.38	0.51	14.0	B	30.9	C
Westbound								
T	780	3192	0.72	0.24	36.8	D	23.9	C
R	925	1365	0.56	0.68	10.0-	A		
Northbound								
Southbound								
L	622	1695	0.93	0.37	48.2	D		
							30.5	C
R	904	1453	0.59	0.62	11.1	B		

Intersection Delay = 28.6 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: Walter Lublanecki
Agency/Co.: Lublanecki Engineering, Inc.
Date Performed: 11/20/05
Analysis Time Period: PM Peak Hour
Intersection: Daly Ave. (SR 412)/Stefko Blvd
Area Type: CBD or Similar
Jurisdiction: State
Analysis Year: Build
Project ID: Bethworks Now Traffic Impact Study

East/West Street	North/South Street
Daly Avenue (SR 412)	Stefko Boulevard

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	546	552			532	466				550		479
% Heavy Veh	1	2			2	10				1		2
PHF	0.90	0.90			0.95	0.90				0.95		0.90
PK 15 Vol	152	153			140	129				145		133
Hi Ln Vol												
% Grade		0			0						-4	
Ideal Sat	1900	1900			1900	1900				1900		1900
ParkExist												
NumPark												
No. Lanes	2	2	0	0	2	1	0	0	0	1	0	1
LGConfig	L	T			T	R				L		R
Lane Width	15.0	12.0			12.0	13.0				13.0		12.0
RTOR Vol						0						0
Adj Flow	607	613			560	518				579		532
%InSharedLn												
Prop LTs		0.000			0.000							
Prop RTs		0.000			0.000	1.000						1.000
Peds Bikes					0			0			0	
Buses	0	0			0	0				0		0
%InProtPhase												
Duration	0.25			Area Type: CBD or Similar								

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		A			NB Left			
Thru		P	P		Thru			
Right					Right			
Peds					Peds			
WB Left					SB Left	A		
Thru			P		Thru			
Right			P		Right	A		
Peds					Peds			
NB Right					EB Right			
SB Right		A			WB Right	P		
Green		18.0	22.0			33.0		
Yellow		4.0	4.0			3.0		
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	546	552			532	466				550		479
PHF	0.90	0.90			0.95	0.90				0.95		0.90
Adj flow	607	613			560	518				579		532
No. Lanes	2	2	0	0	2	1	0	0	0	1	0	1
Lane group	L	T			T	R				L		R
Adj flow	607	613			560	518				579		532
Prop LTs		0.000			0.000							
Prop RTs		0.000			0.000	1.000						1.000

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

	Eastbound				Westbound			Northbound			Southbound			
LG	L	T			T	R					L		R	
So	1900	1900			1900	1900					1900		1900	
Lanes	2	2	0	0	2	1	0	0	0	0	1	0	1	
fW	1.100	1.000			1.000	1.033					1.033		1.000	
fHV	0.990	0.980			0.980	0.909					0.990		0.980	

fG	1.000	1.000			1.000	1.000					1.020			1.020	
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	0.900	0.900			0.900	0.900					0.900			0.900	
fLU	0.971	0.952			0.952	1.000					1.000			1.000	
fRT		1.000			1.000	0.850								0.850	
fLT	0.950	1.000			1.000						0.950				
Sec.															
fLpb	1.000	1.000			1.000						1.000				
fRpb		1.000			1.000	1.000								1.000	
S	3436	3192			3192	1365					1695			1453	
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	607	3436	#	0.18	0.20	687	0.88
Prot								
Perm								
Thru	T	613	3192		0.19	0.51	1631	0.38
Right								
Westbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru	T	560	3192	#	0.18	0.24	780	0.72
Right	R	518	1365		0.38	0.68	925	0.56
Northbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru								
Right								
Southbound								
Prot								
Perm								
Left	L	579	1695	#	0.34	0.37	622	0.93
Prot								
Perm								
Thru								
Right	R	532	1453		0.37	0.62	904	0.59

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.69
Total lost time per cycle, L = 17.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.86

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	0.88	0.20	35.0	1.000	687	0.41	13.0	0.0	48.0	D		
T	0.38	0.51	13.3	1.000	1631	0.50	0.7	0.0	14.0	B	30.9	C
Westbound												
T	0.72	0.24	31.2	1.000	780	0.50	5.6	0.0	36.8	D	23.9	C
R	0.56	0.68	7.5	1.000	925	0.50	2.4	0.0	10.0-	A		
Northbound												
Southbound												
L	0.93	0.37	27.4	1.000	622	0.45	20.8	0.0	48.2	D		
											30.5	C
R	0.59	0.62	10.1	1.000	904	0.18	1.0	0.0	11.1	B		

Intersection delay = 28.6 (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				

```
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
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
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
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 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 28.6 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	T			T	R				L		R
Init Queue	0.0	0.0			0.0	0.0				0.0		0.0
Flow Rate	312	321			294	518				579		532
So	1900	1900			1900	1900				1900		1900
No.Lanes	2	2	0	0	2	1	0	0	0	1	0	1
SL	1769	1676			1676	1365				1695		1453
LnCapacity	353	856			409	925				622		904
Flow Ratio	0.18	0.19			0.18	0.38				0.34		0.37
v/c Ratio	0.88	0.38			0.72	0.56				0.93		0.59
Grn Ratio	0.20	0.51			0.24	0.68				0.37		0.62
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	7.6	4.9			6.7	6.7				13.9		7.9
kB	0.4	1.0			0.6	1.1				0.5		0.6
Q2	2.0	0.6			1.4	1.3				4.0		0.9
Q Average	9.6	5.5			8.2	8.1				17.9		8.8
Q Spacing	24.9	24.9			24.9	24.9				24.9		24.9
Q Storage	500	500			400	300				400		400
Q S Ratio	0.5	0.3			0.5	0.7				1.1		0.6
70th Percentile Output:												
fB%	1.2	1.2			1.2	1.2				1.2		1.2
BOQ	11.3	6.7			10.0	9.8				20.9		10.4
QSRatio	0.6	0.3			0.6	0.8				1.3		0.6
85th Percentile Output:												
fB%	1.5	1.5			1.5	1.5				1.5		1.5
BOQ	14.6	8.2			11.9	11.8				26.3		13.5
QSRatio	0.7	0.4			0.7	1.0				1.6		0.8
90th Percentile Output:												
fB%	1.6	1.7			1.6	1.6				1.6		1.7
BOQ	15.8	9.1			13.0	12.9				28.0		14.6
QSRatio	0.8	0.5			0.8	1.1				1.7		0.9
95th Percentile Output:												
fB%	1.9	1.9			1.8	1.8				1.7		1.9
BOQ	17.8	10.6			14.7	14.5				30.9		16.5
QSRatio	0.9	0.5			0.9	1.2				1.9		1.0
98th Percentile Output:												
fB%	2.2	2.2			2.0	2.0				2.0		2.2
BOQ	20.9	12.0			16.3	16.1				35.0		19.5
QSRatio	1.0	0.6			1.0	1.3				2.2		1.2

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: Walter Lublanecki
Agency: Lublanecki Engineering, Inc.
Date: 11/20/05
Period: Saturday Peak Hour
Project ID: Bethworks Now Traffic Impact Study
E/W St: Daly Avenue (SR 412)

Inter.: Daly Ave. (SR 412)/Stefko Blvd
Area Type: CBD or Similar
Jurisd: State
Year : Existing
N/S St: Stefko Boulevard

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	2	1	0	0	1	1	0	0	0	1	0	1
LGConfig	L	T			T	R				L		R
Volume	410	203			175	292				291		413
Lane Width	12.0	12.0			12.0	13.0				13.0		12.0
RTOR Vol						0						0

Duration 0.25 Area Type: CBD or Similar

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	A				NB Left			
Thru	P	P			Thru			
Right					Right			
Peds					Peds			
WB Left					SB Left	A		
Thru		P			Thru			
Right		P			Right	A		
Peds					Peds			
NB Right					EB Right			
SB Right	A				WB Right	P		
Green	16.0	19.0				20.0		
Yellow	3.0	3.0				3.0		
All Red	2.0	2.0				2.0		

Cycle Length: 70.0 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	714	3124	0.61	0.23	25.6	C		
T	967	1693	0.23	0.57	8.0	A	19.6	B
Westbound								
T	460	1693	0.40	0.27	23.4	C	13.1	B
R	925	1472	0.35	0.63	7.2	A		
Northbound								
Southbound								
L	480	1679	0.64	0.29	24.7	C		
							15.5	B
R	860	1468	0.53	0.59	9.4	A		

Intersection Delay = 16.3 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: Walter Lublanecki
Agency/Co.: Lublanecki Engineering, Inc.
Date Performed: 11/20/05
Analysis Time Period: Saturday Peak Hour
Intersection: Daly Ave. (SR 412)/Stefko Blvd
Area Type: CBD or Similar
Jurisdiction: State
Analysis Year: Existing
Project ID: Bethworks Now Traffic Impact Study

East/West Street: Daly Avenue (SR 412)
North/South Street: Stefko Boulevard

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	410	203			175	292				291		413
% Heavy Veh	1	1			1	2				2		1
PHF	0.95	0.90			0.95	0.90				0.95		0.90
PK 15 Vol	108	56			46	81				77		115
Hi Ln Vol												
% Grade		0			0						-4	
Ideal Sat	1900	1900			1900	1900				1900		1900
ParkExist												
NumPark												
No. Lanes	2	1	0	0	1	1	0	0	0	1	0	1
LGConfig	L	T			T	R				L		R
Lane Width	12.0	12.0			12.0	13.0				13.0		12.0
RTOR Vol						0						0
Adj Flow	432	226			184	324				306		459
%InSharedLn												
Prop LTs		0.000			0.000							
Prop RTs		0.000			0.000	1.000						1.000
Peds Bikes					0			0			0	
Buses	0	0			0	0				0		0
%InProtPhase												
Duration	0.25			Area Type: CBD or Similar								

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		A			NB Left			
Thru		P	P		Thru			
Right					Right			
Peds					Peds			
WB Left					SB Left	A		
Thru			P		Thru			
Right			P		Right	A		
Peds					Peds			
NB Right					EB Right			
SB Right		A			WB Right	P		
Green		16.0	19.0			20.0		
Yellow		3.0	3.0			3.0		
All Red		2.0	2.0			2.0		

Cycle Length: 70.0 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	410	203			175	292				291		413
PHF	0.95	0.90			0.95	0.90				0.95		0.90
Adj flow	432	226			184	324				306		459
No. Lanes	2	1	0	0	1	1	0	0	0	1	0	1
Lane group	L	T			T	R				L		R
Adj flow	432	226			184	324				306		459
Prop LTs		0.000			0.000							
Prop RTs		0.000			0.000	1.000						1.000

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

	Eastbound				Westbound				Northbound				Southbound			
LG	L	T			T	R							L		R	
So	1900	1900			1900	1900							1900		1900	
Lanes	2	1	0	0	1	1	0	0	0	0	0	0	1	0	1	0
fW	1.000	1.000			1.000	1.033							1.033		1.000	
fHV	0.990	0.990			0.990	0.980							0.980		0.990	

fG	1.000	1.000		1.000	1.000				1.020		1.020	
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	0.900	0.900		0.900	0.900				0.900		0.900	
fLU	0.971	1.000		1.000	1.000				1.000		1.000	
fRT		1.000		1.000	0.850						0.850	
fLT	0.950	1.000		1.000					0.950			
Sec.												
fLpb	1.000	1.000		1.000					1.000			
fRpb		1.000		1.000	1.000						1.000	
S	3124	1693		1693	1472				1679		1468	
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	432	3124	#	0.14	0.23	714	0.61
Prot								
Perm								
Thru	T	226	1693		0.13	0.57	967	0.23
Right								
Westbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru	T	184	1693	#	0.11	0.27	460	0.40
Right	R	324	1472		0.22	0.63	925	0.35
Northbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru								
Right								
Southbound								
Prot								
Perm								
Left	L	306	1679	#	0.18	0.29	480	0.64
Prot								
Perm								
Thru								
Right	R	459	1468		0.31	0.59	860	0.53

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.43
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.55

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	0.61	0.23	24.2	1.000	714	0.19	1.5	0.0	25.6	C		
T	0.23	0.57	7.4	1.000	967	0.50	0.6	0.0	8.0	A	19.6	B
Westbound												
T	0.40	0.27	20.8	1.000	460	0.50	2.6	0.0	23.4	C	13.1	B
R	0.35	0.63	6.2	1.000	925	0.50	1.0	0.0	7.2	A		
Northbound												
Southbound												
L	0.64	0.29	21.8	1.000	480	0.22	2.8	0.0	24.7	C		
											15.5	B
R	0.53	0.59	8.7	1.000	860	0.14	0.7	0.0	9.4	A		

Intersection delay = 16.3 (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				

```
Cycle length, C                          70.0    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                          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 PERMITTED LT WORKSHEET_____________________
                              for shared lefts
Input
                                                      EB    WB    NB    SB
Opposed by Single(S) or Multiple(M) lane approach
Cycle length, C                          70.0    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                          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 70.0 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 16.3 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	T			T	R				L		R
Init Queue	0.0	0.0			0.0	0.0				0.0		0.0
Flow Rate	222	226			184	324				306		459
So	1900	1900			1900	1900				1900		1900
No.Lanes	2	1	0	0	1	1	0	0	0	1	0	1
SL	1609	1693			1693	1472				1679		1468
LnCapacity	367	967			460	925				480		860
Flow Ratio	0.14	0.13			0.11	0.22				0.18		0.31
v/c Ratio	0.60	0.23			0.40	0.35				0.64		0.53
Grn Ratio	0.23	0.57			0.27	0.63				0.29		0.59
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	3.9	2.2			2.9	3.0				5.2		5.4
kB	0.3	0.9			0.6	0.9				0.4		0.5
Q2	0.5	0.3			0.4	0.5				0.7		0.6
Q Average	4.3	2.5			3.3	3.5				5.8		6.0
Q Spacing	24.9	24.9			24.9	24.9				24.9		24.9
Q Storage	200	500			500	250				400		400
Q S Ratio	0.5	0.1			0.2	0.3				0.4		0.4
70th Percentile Output:												
fB%	1.2	1.3			1.3	1.2				1.2		1.2
BOQ	5.2	3.1			4.1	4.4				6.9		7.1
QSRatio	0.6	0.2			0.2	0.4				0.4		0.4
85th Percentile Output:												
fB%	1.6	1.6			1.6	1.5				1.5		1.5
BOQ	6.8	3.9			5.1	5.4				9.0		9.3
QSRatio	0.8	0.2			0.3	0.5				0.6		0.6
90th Percentile Output:												
fB%	1.7	1.8			1.8	1.7				1.7		1.7
BOQ	7.5	4.4			5.8	6.1				9.9		10.2
QSRatio	0.9	0.2			0.3	0.6				0.6		0.6
95th Percentile Output:												
fB%	2.0	2.2			2.1	2.1				1.9		1.9
BOQ	8.6	5.4			7.0	7.3				11.3		11.6
QSRatio	1.1	0.3			0.3	0.7				0.7		0.7
98th Percentile Output:												
fB%	2.4	2.6			2.5	2.4				2.3		2.3
BOQ	10.5	6.4			8.2	8.5				13.7		14.0
QSRatio	1.3	0.3			0.4	0.8				0.9		0.9

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: Walter Lublanecki
Agency: Lublanecki Engineering, Inc.
Date: 11/20/05
Period: Saturday Peak Hour
Project ID: Bethworks Now Traffic Impact Study
E/W St: Daly Avenue (SR 412)
Inter.: Daly Ave. (SR 412)/Stefko Blvd
Area Type: CBD or Similar
Jurisd: State
Year : No-Build
N/S St: Stefko Boulevard

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	2	1	0	0	1	1	0	0	0	1	0	1
LGConfig	L	T			T	R				L		R
Volume	433	214			185	308				307		436
Lane Width	12.0	12.0			12.0	13.0				13.0		12.0
RTOR Vol						0						0

Duration 0.25 Area Type: CBD or Similar

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A				NB Left				
Thru	P	P			Thru				
Right					Right				
Peds					Peds				
WB Left					SB Left	A			
Thru		P			Thru				
Right		P			Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right	A				WB Right	P			
Green	16.0	19.0				20.0			
Yellow	3.0	3.0				3.0			
All Red	2.0	2.0				2.0			

Cycle Length: 70.0 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	714	3124	0.64	0.23	26.3	C		
T	967	1693	0.25	0.57	8.1	A	20.1	C
Westbound								
T	460	1693	0.42	0.27	23.8	C	13.4	B
R	925	1472	0.37	0.63	7.4	A		
Northbound								
Southbound								
L	480	1679	0.67	0.29	25.8	C		
							16.2	B
R	860	1468	0.56	0.59	9.8	A		

Intersection Delay = 16.8 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: Walter Lublanecki
Agency/Co.: Lublanecki Engineering, Inc.
Date Performed: 11/20/05
Analysis Time Period: Saturday Peak Hour
Intersection: Daly Ave. (SR 412)/Stefko Blvd
Area Type: CBD or Similar
Jurisdiction: State
Analysis Year: No-Build
Project ID: Bethworks Now Traffic Impact Study

East/West Street	North/South Street
Daly Avenue (SR 412)	Stefko Boulevard

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	433	214			185	308				307		436
% Heavy Veh	1	1			1	2				2		1
PHF	0.95	0.90			0.95	0.90				0.95		0.90
PK 15 Vol	114	59			49	86				81		121
Hi Ln Vol												
% Grade		0			0						-4	
Ideal Sat	1900	1900			1900	1900				1900		1900
ParkExist												
NumPark												
No. Lanes	2	1	0	0	1	1	0	0	0	1	0	1
LGConfig	L	T			T	R				L		R
Lane Width	12.0	12.0			12.0	13.0				13.0		12.0
RTOR Vol						0						0
Adj Flow	456	238			195	342				323		484
%InSharedLn												
Prop LTs		0.000			0.000							
Prop RTs	0.000			0.000	1.000							1.000
Peds Bikes				0			0			0		
Buses	0	0			0	0				0		0
%InProtPhase												
Duration	0.25			Area Type: CBD or Similar								

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		A			NB Left			
Thru		P	P		Thru			
Right					Right			
Peds					Peds			
WB Left					SB Left	A		
Thru			P		Thru			
Right			P		Right	A		
Peds					Peds			
NB Right					EB Right			
SB Right		A			WB Right	P		
Green		16.0	19.0			20.0		
Yellow		3.0	3.0			3.0		
All Red		2.0	2.0			2.0		

Cycle Length: 70.0 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	433	214			185	308				307		436
PHF	0.95	0.90			0.95	0.90				0.95		0.90
Adj flow	456	238			195	342				323		484
No. Lanes	2	1	0	0	1	1	0	0	0	1	0	1
Lane group	L	T			T	R				L		R
Adj flow	456	238			195	342				323		484
Prop LTs		0.000			0.000							
Prop RTs	0.000			0.000	1.000							1.000

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

	Eastbound				Westbound			Northbound			Southbound			
LG	L	T			T	R					L		R	
So	1900	1900			1900	1900					1900		1900	
Lanes	2	1	0	0	1	1	0	0	0		1	0	1	
fW	1.000	1.000			1.000	1.033					1.033		1.000	
fHV	0.990	0.990			0.990	0.980					0.980		0.990	

fG	1.000	1.000		1.000	1.000				1.020		1.020	
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	0.900	0.900		0.900	0.900				0.900		0.900	
fLU	0.971	1.000		1.000	1.000				1.000		1.000	
fRT		1.000		1.000	0.850						0.850	
fLT	0.950	1.000		1.000					0.950			
Sec.												
fLpb	1.000	1.000		1.000					1.000			
fRpb		1.000		1.000	1.000						1.000	
S	3124	1693		1693	1472				1679		1468	
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	456	3124	#	0.15	0.23	714	0.64
Prot								
Perm								
Thru	T	238	1693		0.14	0.57	967	0.25
Right								
Westbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru	T	195	1693	#	0.12	0.27	460	0.42
Right	R	342	1472		0.23	0.63	925	0.37
Northbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru								
Right								
Southbound								
Prot								
Perm								
Left	L	323	1679	#	0.19	0.29	480	0.67
Prot								
Perm								
Thru								
Right	R	484	1468		0.33	0.59	860	0.56

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.45
Total lost time per cycle, L = 15.00 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	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	0.64	0.23	24.4	1.000	714	0.22	1.9	0.0	26.3	C		
T	0.25	0.57	7.5	1.000	967	0.50	0.6	0.0	8.1	A	20.1	C
Westbound												
T	0.42	0.27	21.0	1.000	460	0.50	2.8	0.0	23.8	C	13.4	B
R	0.37	0.63	6.3	1.000	925	0.50	1.1	0.0	7.4	A		
Northbound												
Southbound												
L	0.67	0.29	22.1	1.000	480	0.24	3.7	0.0	25.8	C		
											16.2	B
R	0.56	0.59	9.0	1.000	860	0.16	0.9	0.0	9.8	A		

Intersection delay = 16.8 (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				

```
Cycle length, C                          70.0    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                          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 PERMITTED LT WORKSHEET for shared lefts

```
Input
                                                    EB    WB    NB    SB
Opposed by Single(S) or Multiple(M) lane approach
Cycle length, C                          70.0    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                          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	70.0 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 16.8 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	T			T	R				L		R
Init Queue	0.0	0.0			0.0	0.0				0.0		0.0
Flow Rate	234	238			195	342				323		484
So	1900	1900			1900	1900				1900		1900
No.Lanes	2	1	0	0	1	1	0	0	0	1	0	1
SL	1609	1693			1693	1472				1679		1468
LnCapacity	367	967			460	925				480		860
Flow Ratio	0.15	0.14			0.12	0.23				0.19		0.33
v/c Ratio	0.64	0.25			0.42	0.37				0.67		0.56
Grn Ratio	0.23	0.57			0.27	0.63				0.29		0.59
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	4.1	2.3			3.1	3.2				5.6		5.8
kB	0.3	0.9			0.6	0.9				0.4		0.5
Q2	0.6	0.3			0.4	0.5				0.8		0.7
Q Average	4.7	2.6			3.5	3.7				6.3		6.5
Q Spacing	24.9	24.9			24.9	24.9				24.9		24.9
Q Storage	200	500			500	250				400		400
Q S Ratio	0.6	0.1			0.2	0.4				0.4		0.4
70th Percentile Output:												
fB%	1.2	1.3			1.2	1.2				1.2		1.2
BOQ	5.5	3.3			4.4	4.7				7.5		7.7
QSRatio	0.7	0.2			0.2	0.5				0.5		0.5
85th Percentile Output:												
fB%	1.6	1.6			1.5	1.5				1.5		1.5
BOQ	7.3	4.1			5.5	5.8				9.7		10.0
QSRatio	0.9	0.2			0.3	0.6				0.6		0.6
90th Percentile Output:												
fB%	1.7	1.8			1.7	1.7				1.7		1.7
BOQ	8.0	4.7			6.2	6.5				10.7		11.0
QSRatio	1.0	0.2			0.3	0.6				0.7		0.7
95th Percentile Output:												
fB%	2.0	2.2			2.1	2.1				1.9		1.9
BOQ	9.2	5.7			7.4	7.8				12.1		12.5
QSRatio	1.1	0.3			0.4	0.8				0.8		0.8
98th Percentile Output:												
fB%	2.4	2.6			2.4	2.4				2.3		2.3
BOQ	11.2	6.8			8.6	9.0				14.6		15.0
QSRatio	1.4	0.3			0.4	0.9				0.9		0.9

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: Walter Lublanecki
Agency: Lublanecki Engineering, Inc.
Date: 11/20/05
Period: Saturday Peak Hour
Project ID: Bethworks Now Traffic Impact Study
E/W St: Daly Avenue (SR 412)

Inter.: Daly Ave. (SR 412)/Stefko Blvd
Area Type: CBD or Similar
Jurisd: State
Year : Build
N/S St: Stefko Boulevard

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	2	2	0	0	2	1	0	0	0	1	0	1
LGConfig	L	T			T	R				L		R
Volume	466	803			820	385				384		473
Lane Width	15.0	12.0			12.0	13.0				13.0		12.0
RTOR Vol						0						0

Duration 0.25 Area Type: CBD or Similar

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left		A			NB Left			
Thru		P		P	Thru			
Right					Right			
Peds					Peds			
WB Left					SB Left	A		
Thru			P		Thru			
Right			P		Right	A		
Peds					Peds			
NB Right					EB Right			
SB Right		A			WB Right	P		
Green		15.0	34.0			24.0		
Yellow		4.0	4.0			3.0		
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 Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	573	3436	0.86	0.17	48.7	D		
T	1970	3224	0.45	0.61	10.2	B	23.9	C
Westbound								
T	1218	3224	0.71	0.38	27.3	C	20.4	C
R	1047	1472	0.41	0.71	6.5	A		
Northbound								
Southbound								
L	448	1679	0.90	0.27	53.0	D		
							35.6	D
R	718	1468	0.73	0.49	22.2	C		

Intersection Delay = 25.6 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: Walter Lublanecki
Agency/Co.: Lublanecki Engineering, Inc.
Date Performed: 11/20/05
Analysis Time Period: Saturday Peak Hour
Intersection: Daly Ave. (SR 412)/Stefko Blvd
Area Type: CBD or Similar
Jurisdiction: State
Analysis Year: Build
Project ID: Bethworks Now Traffic Impact Study

East/West Street	North/South Street
Daly Avenue (SR 412)	Stefko Boulevard

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	466	803			820	385				384		473
% Heavy Veh	1	1			1	2				2		1
PHF	0.95	0.90			0.95	0.90				0.95		0.90
PK 15 Vol	123	223			216	107				101		131
Hi Ln Vol												
% Grade		0			0						-4	
Ideal Sat	1900	1900			1900	1900				1900		1900
ParkExist												
NumPark												
No. Lanes	2	2	0	0	2	1	0	0	0	1	0	1
LGConfig	L	T			T	R				L		R
Lane Width	15.0	12.0			12.0	13.0				13.0		12.0
RTOR Vol						0						0
Adj Flow	491	892			863	428				404		526
%InSharedLn												
Prop LTs		0.000			0.000							
Prop RTs		0.000			0.000	1.000						1.000
Peds Bikes					0			0			0	
Buses	0	0			0	0				0		0
%InProtPhase												
Duration	0.25			Area Type: CBD or Similar								

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		A			NB Left			
Thru		P	P		Thru			
Right					Right			
Peds					Peds			
WB Left					SB Left	A		
Thru			P		Thru			
Right			P		Right	A		
Peds					Peds			
NB Right					EB Right			
SB Right		A			WB Right	P		
Green		15.0	34.0			24.0		
Yellow		4.0	4.0			3.0		
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	466	803			820	385				384		473
PHF	0.95	0.90			0.95	0.90				0.95		0.90
Adj flow	491	892			863	428				404		526
No. Lanes	2	2	0	0	2	1	0	0	0	1	0	1
Lane group	L	T			T	R				L		R
Adj flow	491	892			863	428				404		526
Prop LTs		0.000			0.000							
Prop RTs		0.000			0.000	1.000						1.000

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

	Eastbound				Westbound			Northbound			Southbound			
LG	L	T			T	R					L		R	
So	1900	1900			1900	1900					1900		1900	
Lanes	2	2	0	0	2	1	0	0	0	0	1	0	1	
fW	1.100	1.000			1.000	1.033					1.033		1.000	
fHV	0.990	0.990			0.990	0.980					0.980		0.990	

fG	1.000	1.000		1.000	1.000			1.020		1.020
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	0.900	0.900		0.900	0.900			0.900		0.900
fLU	0.971	0.952		0.952	1.000			1.000		1.000
fRT		1.000		1.000	0.850					0.850
fLT	0.950	1.000		1.000				0.950		
Sec.										
fLpb	1.000	1.000		1.000				1.000		
fRpb		1.000		1.000	1.000					1.000
S	3436	3224		3224	1472			1679		1468
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	491	3436	#	0.14	0.17	573	0.86
Prot								
Perm								
Thru	T	892	3224		0.28	0.61	1970	0.45
Right								
Westbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru	T	863	3224	#	0.27	0.38	1218	0.71
Right	R	428	1472		0.29	0.71	1047	0.41
Northbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru								
Right								
Southbound								
Prot								
Perm								
Left	L	404	1679	#	0.24	0.27	448	0.90
Prot								
Perm								
Thru								
Right	R	526	1468		0.36	0.49	718	0.73

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.65
Total lost time per cycle, L = 17.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.80

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor Del k	d2	Res Del d3	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound												
L	0.86	0.17	36.5	1.000	573	0.39	12.3	0.0	48.7	D		
T	0.45	0.61	9.4	1.000	1970	0.50	0.8	0.0	10.2	B	23.9	C
Westbound												
T	0.71	0.38	23.8	1.000	1218	0.50	3.5	0.0	27.3	C	20.4	C
R	0.41	0.71	5.3	1.000	1047	0.50	1.2	0.0	6.5	A		
Northbound												
Southbound												
L	0.90	0.27	31.9	1.000	448	0.42	21.1	0.0	53.0	D		
											35.6	D
R	0.73	0.49	18.3	1.000	718	0.29	3.9	0.0	22.2	C		

Intersection delay = 25.6 (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				

```
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
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
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
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	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 25.6 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	T		T	R					L		R
Init Queue	0.0	0.0		0.0	0.0					0.0		0.0
Flow Rate	252	468		453	428					404		526
So	1900	1900		1900	1900					1900		1900
No.Lanes	2	2	0	2	1	0	0	0		1	0	1
SL	1769	1693		1693	1472					1679		1468
LnCapacity	295	1034		639	1047					448		718
Flow Ratio	0.14	0.28		0.27	0.29					0.24		0.36
v/c Ratio	0.85	0.45		0.71	0.41					0.90		0.73
Grn Ratio	0.17	0.61		0.38	0.71					0.27		0.49
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	6.1	6.3		9.6	4.4					9.8		10.5
kB	0.3	1.2		0.8	1.2					0.4		0.6
Q2	1.5	1.0		1.9	0.8					2.6		1.5
Q Average	7.6	7.2		11.5	5.2					12.4		11.9
Q Spacing	24.9	24.9		24.9	24.9					24.9		24.9
Q Storage	500	500		400	300					400		400
Q S Ratio	0.4	0.4		0.7	0.4					0.8		0.7
70th Percentile Output:												
fB%	1.2	1.2		1.2	1.2					1.2		1.2
BOQ	9.0	8.9		13.9	6.4					14.5		14.0
QSRatio	0.4	0.4		0.9	0.5					0.9		0.9
85th Percentile Output:												
fB%	1.5	1.5		1.4	1.5					1.5		1.5
BOQ	11.7	10.7		16.5	7.8					18.6		17.9
QSRatio	0.6	0.5		1.0	0.6					1.2		1.1
90th Percentile Output:												
fB%	1.7	1.6		1.6	1.7					1.6		1.6
BOQ	12.8	11.7		17.8	8.7					20.0		19.3
QSRatio	0.6	0.6		1.1	0.7					1.2		1.2
95th Percentile Output:												
fB%	1.9	1.8		1.7	2.0					1.8		1.8
BOQ	14.5	13.3		19.6	10.1					22.3		21.6
QSRatio	0.7	0.7		1.2	0.8					1.4		1.3
98th Percentile Output:												
fB%	2.3	2.1		1.9	2.2					2.1		2.1
BOQ	17.2	14.9		21.3	11.5					25.8		25.0
QSRatio	0.9	0.7		1.3	1.0					1.6		1.6

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: Walter Lublanecki
Agency: Lublanecki Engineering, Inc.
Date: 11/20/05
Period: PM Peak Hour
Project ID: Bethworks Now Traffic Impact Study
E/W St: Daly Avenue (SR 412)

Inter.: Daly Ave. (SR 412)/East 4th St
Area Type: CBD or Similar
Jurisd: State
Year : Existing
N/S St: East 4th Street

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	1	1	0	0	0	1	0	0	0
LGConfig		T		L	T				R			
Volume		780		121	610				146			
Lane Width		13.0		13.0	13.0				15.0			
RTOR Vol									0			

Duration 0.25 Area Type: CBD or Similar

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru		P			Thru			
Right					Right			
Peds					Peds			
WB Left			A		SB Left			
Thru		P	A		Thru			
Right					Right			
Peds					Peds			
NB Right			A		EB Right			
SB Right					WB Right			
Green		30.0	18.0					
Yellow		4.0	4.0					
All Red		2.0	2.0					

Cycle Length: 60.0 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								
T	1649	3298	0.53	0.50	11.4	B	11.4	B
Westbound								
L	499	1662	0.28	0.30	16.4	B		
T	1750	1750	0.37	1.00	0.6	A	3.5	A
Northbound								
							16.9	B
R	483	1611	0.36	0.30	16.9	B		
Southbound								

Intersection Delay = 8.5 (sec/veh) Intersection LOS = A

HCS2000: Signalized Intersections Release 4.1e

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E-Mail: lei@eclipse.net

OPERATIONAL ANALYSIS

Analyst: Walter Lublanecki
Agency/Co.: Lublanecki Engineering, Inc.
Date Performed: 11/20/05
Analysis Time Period: PM Peak Hour
Intersection: Daly Ave. (SR 412)/East 4th St
Area Type: CBD or Similar
Jurisdiction: State
Analysis Year: Existing
Project ID: Bethworks Now Traffic Impact Study

East/West Street	North/South Street
Daly Avenue (SR 412)	East 4th Street

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		780		121	610				146			
% Heavy Veh		1		1	1				1			
PHF		0.90		0.85	0.95				0.85			
PK 15 Vol		217		36	161				43			
Hi Ln Vol												
% Grade		2			0			0				
Ideal Sat		1900		1900	1900				1900			
ParkExist												
NumPark												
No. Lanes	0	2	0		1	1	0	0	0	1	0	0	0
LGConfig		T		L		T				R		
Lane Width		13.0		13.0	13.0				15.0			
RTOR Vol									0			
Adj Flow		867		142	642				172			
%InSharedLn												
Prop LTs		0.000			0.000							
Prop RTs	0.000				0.000				1.000			
Peds Bikes	0							0				
Buses		0		0	0				0			
%InProtPhase												
Duration	0.25			Area Type: CBD or Similar								

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				

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru		P			Thru			
Right					Right			
Peds					Peds			
WB Left			A		SB Left			
Thru		P	P		Thru			
Right					Right			
Peds					Peds			
NB Right			A		EB Right			
SB Right					WB Right			
Green		30.0	18.0					
Yellow		4.0	4.0					
All Red		2.0	2.0					

Cycle Length: 60.0 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		780		121	610				146			
PHF		0.90		0.85	0.95				0.85			
Adj flow		867		142	642				172			
No. Lanes	0	2	0		1	1	0	0	0	1	0	0	0
Lane group		T		L		T				R		
Adj flow		867		142	642				172			
Prop LTs		0.000			0.000							
Prop RTs		0.000			0.000				1.000			

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

	Eastbound			Westbound			Northbound			Southbound		
LG		T			L	T			R			
So		1900			1900	1900			1900			
Lanes	0	2	0		1	1	0	0	1	0	0	0
fW		1.033			1.033	1.033			1.100			
fHV		0.990			0.990	0.990			0.990			

fG	0.990	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	0.900	0.900	0.900		0.900	
fLU	0.952	1.000	1.000		1.000	
fRT	1.000		1.000		0.865	
fLT	1.000	0.950	1.000			
Sec.						
fLpb	1.000	1.000	1.000			
fRpb	1.000		1.000		1.000	
S	3298	1662	1750		1611	
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	T	867	3298	# 0.26	0.50	1649	0.53
Right							
Westbound							
Prot							
Perm							
Left	L	142	1662	0.09	0.30	499	0.28
Prot							
Perm							
Thru	T	642	1750	0.37	1.00	1750	0.37
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right	R	172	1611	# 0.11	0.30	483	0.36
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
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) = 0.46

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor Del k	d2	Res Del d3	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound												
T	0.53	0.50	10.2	1.000	1649	0.50	1.2	0.0	11.4	B	11.4	B
Westbound												
L	0.28	0.30	16.1	1.000	499	0.11	0.3	0.0	16.4	B		
T	0.37	1.00	0.0	0.950	1750	0.50	0.6	0.0	0.6	A	3.5	A
Northbound												
											16.9	B
R	0.36	0.30	16.5	1.000	483	0.11	0.5	0.0	16.9	B		
Southbound												

Intersection delay = 8.5 (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				

```
Cycle length, C                          60.0    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                          1.000 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
Cycle length, C                          60.0    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                          1.000 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 60.0 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 8.5 sec/veh Intersection LOS A

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		T		L	T			R				
Init Queue		0.0		0.0	0.0			0.0				
Flow Rate		455		142	642			172				
So		1900		1900	1900			1900				
No.Lanes	0	2	0	1	1	0	0	0	1	0	0	0
SL		1732		1662	1750				1611			
LnCapacity		866		499	1750				483			
Flow Ratio		0.26		0.09	0.37				0.11			
v/c Ratio		0.53		0.28	0.37				0.36			
Grn Ratio		0.50		0.30	1.00				0.30			
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			
Q1		5.1		1.8					2.2			
kB		0.8		0.4	1.3				0.3			
Q2		0.8		0.1	0.7				0.2			
Q Average		6.0		2.0					2.4			
Q Spacing		24.9		24.9	24.9				24.9			
Q Storage		500		200	500				500			
Q S Ratio		0.3		0.2					0.1			
70th Percentile Output:												
fB%		1.2		1.2					1.2			
BOQ		7.4		2.3					2.9			
QSRatio		0.4		0.3					0.1			
85th Percentile Output:												
fB%		1.5		1.6					1.6			
BOQ		8.9		3.1					3.8			
QSRatio		0.4		0.4					0.2			
90th Percentile Output:												
fB%		1.7		1.8					1.8			
BOQ		9.9		3.4					4.3			
QSRatio		0.5		0.4					0.2			
95th Percentile Output:												
fB%		1.9		2.0					2.0			
BOQ		11.4		4.0					4.9			
QSRatio		0.6		0.5					0.2			
98th Percentile Output:												
fB%		2.2		2.6					2.5			
BOQ		12.9		5.0					6.2			
QSRatio		0.6		0.6					0.3			

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: Walter Lublanecki
Agency: Lublanecki Engineering, Inc.
Date: 11/20/05
Period: PM Peak Hour
Project ID: Bethworks Now Traffic Impact Study
E/W St: Daly Avenue (SR 412)
Inter.: Daly Ave. (SR 412)/East 4th St
Area Type: CBD or Similar
Jurisd: State
Year : No-Build
N/S St: East 4th Street

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	1	1	0	0	0	1	0	0	0
LGConfig		T		L	T				R			
Volume		823		128	644				154			
Lane Width		13.0		13.0	13.0				15.0			
RTOR Vol									0			

Duration 0.25 Area Type: CBD or Similar

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru		P			Thru			
Right					Right			
Peds					Peds			
WB Left			A		SB Left			
Thru		P	P		Thru			
Right					Right			
Peds					Peds			
NB Right			A		EB Right			
SB Right					WB Right			
Green		30.0	18.0					
Yellow		4.0	4.0					
All Red		2.0	2.0					

Cycle Length: 60.0 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								
T	1649	3298	0.55	0.50	11.7	B	11.7	B
Westbound								
L	499	1662	0.30	0.30	16.5	B		
T	1750	1750	0.39	1.00	0.6	A	3.5	A
Northbound								
							17.1	B
R	483	1611	0.37	0.30	17.1	B		
Southbound								

Intersection Delay = 8.7 (sec/veh) Intersection LOS = A

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: Walter Lublanecki
Agency/Co.: Lublanecki Engineering, Inc.
Date Performed: 11/20/05
Analysis Time Period: PM Peak Hour
Intersection: Daly Ave. (SR 412)/East 4th St
Area Type: CBD or Similar
Jurisdiction: State
Analysis Year: No-Build
Project ID: Bethworks Now Traffic Impact Study

East/West Street	North/South Street
Daly Avenue (SR 412)	East 4th Street

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		823		128	644				154			
% Heavy Veh		1		1	1				1			
PHF		0.90		0.85	0.95				0.85			
PK 15 Vol		229		38	169				45			
Hi Ln Vol												
% Grade		2			0			0				
Ideal Sat		1900		1900	1900				1900			
ParkExist												
NumPark												
No. Lanes	0	2	0		1	1	0	0	0	1	0	0	0
LGConfig		T		L		T				R		
Lane Width		13.0		13.0	13.0				15.0			
RTOR Vol									0			
Adj Flow		914		151	678				181			
%InSharedLn												
Prop LTs		0.000			0.000							
Prop RTs	0.000				0.000				1.000			
Peds Bikes	0							0				
Buses		0		0	0				0			
%InProtPhase												
Duration	0.25			Area Type: CBD or Similar								

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				

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru		P			Thru			
Right					Right			
Peds					Peds			
WB Left			A		SB Left			
Thru		P	P		Thru			
Right					Right			
Peds					Peds			
NB Right			A		EB Right			
SB Right					WB Right			
Green		30.0	18.0					
Yellow		4.0	4.0					
All Red		2.0	2.0					

Cycle Length: 60.0 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		823		128	644				154			
PHF		0.90		0.85	0.95				0.85			
Adj flow		914		151	678				181			
No. Lanes	0	2	0		1	1	0	0	0	1	0	0	0
Lane group		T		L		T				R		
Adj flow		914		151	678				181			
Prop LTs		0.000			0.000							
Prop RTs		0.000			0.000				1.000			

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

	Eastbound			Westbound			Northbound			Southbound		
LG		T		L	T				R			
So		1900		1900	1900				1900			
Lanes	0	2	0	1	1	0	0	0	1	0	0	0
fW		1.033		1.033	1.033				1.100			
fHV		0.990		0.990	0.990				0.990			

fG	0.990	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	0.900	0.900	0.900		0.900	
fLU	0.952	1.000	1.000		1.000	
fRT	1.000		1.000		0.865	
fLT	1.000	0.950	1.000			
Sec.						
fLpb	1.000	1.000	1.000			
fRpb	1.000		1.000		1.000	
S	3298	1662	1750		1611	
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	T	914	3298	#	0.28	0.50	1649	0.55
Right								
Westbound								
Prot								
Perm								
Left	L	151	1662		0.09	0.30	499	0.30
Prot								
Perm								
Thru	T	678	1750		0.39	1.00	1750	0.39
Right								
Northbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru								
Right	R	181	1611	#	0.11	0.30	483	0.37
Southbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru								
Right								

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.39
Total lost time per cycle, L = 12.00 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	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor Del k	d2	Res Del d3	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound												
T	0.55	0.50	10.4	1.000	1649	0.50	1.3	0.0	11.7	B	11.7	B
Westbound												
L	0.30	0.30	16.2	1.000	499	0.11	0.3	0.0	16.5	B		
T	0.39	1.00	0.0	0.950	1750	0.50	0.6	0.0	0.6	A	3.5	A
Northbound												
											17.1	B
R	0.37	0.30	16.6	1.000	483	0.11	0.5	0.0	17.1	B		
Southbound												

Intersection delay = 8.7 (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				

```
Cycle length, C                          60.0    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                          1.000 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
Cycle length, C                          60.0    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                          1.000 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	60.0 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 8.7 sec/veh Intersection LOS A

BACK OF QUEUE WORKSHEET

	Eastbound	Westbound	Northbound	Southbound
LaneGroup	T	L T	R	
Init Queue	0.0	0.0 0.0	0.0	
Flow Rate	480	151 678	181	
So	1900	1900 1900	1900	
No.Lanes	0 2 0	1 1 0	0 0 1	0 0 0
SL	1732	1662 1750	1611	
LnCapacity	866	499 1750	483	
Flow Ratio	0.28	0.09 0.39	0.11	
v/c Ratio	0.55	0.30 0.39	0.37	
Grn Ratio	0.50	0.30 1.00	0.30	
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	
Q1	5.5	1.9	2.4	
kB	0.8	0.4 1.3	0.3	
Q2	0.9	0.2 0.8	0.2	
Q Average	6.5	2.1	2.6	
Q Spacing	24.9	24.9 24.9	24.9	
Q Storage	500	200 500	500	
Q S Ratio	0.3	0.3	0.1	
70th Percentile Output:				
fB%	1.2	1.2	1.2	
BOQ	8.0	2.5	3.1	
QSRatio	0.4	0.3	0.2	
85th Percentile Output:				
fB%	1.5	1.6	1.6	
BOQ	9.6	3.3	4.1	
QSRatio	0.5	0.4	0.2	
90th Percentile Output:				
fB%	1.6	1.8	1.8	
BOQ	10.6	3.7	4.5	
QSRatio	0.5	0.5	0.2	
95th Percentile Output:				
fB%	1.9	2.0	2.0	
BOQ	12.1	4.3	5.2	
QSRatio	0.6	0.5	0.3	
98th Percentile Output:				
fB%	2.1	2.6	2.5	
BOQ	13.7	5.3	6.5	
QSRatio	0.7	0.7	0.3	

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: Walter Lublanecki
Agency: Lublanecki Engineering, Inc.
Date: 11/20/05
Period: PM Peak Hour
Project ID: Bethworks Now Traffic Impact Study
E/W St: Daly Avenue (SR 412)

Inter.: Daly Ave. (SR 412)/East 4th St
Area Type: CBD or Similar
Jurisd: State
Year : Build
N/S St: East 4th Street

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	1	1	0	0	0	1	0	0	0
LGConfig		T		L	T				R			
Volume		1244		128	1130				154			
Lane Width		13.0		13.0	13.0				15.0			
RTOR Vol									0			

Duration 0.25 Area Type: CBD or Similar

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left				
Thru		P			Thru				
Right					Right				
Peds					Peds				
WB Left			A		SB Left				
Thru		P	P		Thru				
Right					Right				
Peds					Peds				
NB Right			A		EB Right				
SB Right					WB Right				
Green		32.0	16.0						
Yellow		4.0	4.0						
All Red		2.0	2.0						

Cycle Length: 60.0 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								
T	1759	3298	0.79	0.53	14.9	B	14.9	B
Westbound								
L	443	1662	0.34	0.27	18.2	B		
T	1750	1750	0.68	1.00	2.1	A	4.0	A
Northbound								
							18.8	B
R	430	1611	0.42	0.27	18.8	B		
Southbound								

Intersection Delay = 10.1 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: Walter Lublanecki
Agency/Co.: Lublanecki Engineering, Inc.
Date Performed: 11/20/05
Analysis Time Period: PM Peak Hour
Intersection: Daly Ave. (SR 412)/East 4th St
Area Type: CBD or Similar
Jurisdiction: State
Analysis Year: Build
Project ID: Bethworks Now Traffic Impact Study

East/West Street	North/South Street
Daly Avenue (SR 412)	East 4th Street

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		1244		128	1130				154			
% Heavy Veh		1		1	1				1			
PHF		0.90		0.85	0.95				0.85			
PK 15 Vol		346		38	297				45			
Hi Ln Vol												
% Grade		2			0			0				
Ideal Sat		1900		1900	1900				1900			
ParkExist												
NumPark												
No. Lanes	0	2	0		1	1	0	0	0	1	0	0	0
LGConfig		T		L		T				R		
Lane Width		13.0		13.0	13.0				15.0			
RTOR Vol									0			
Adj Flow		1382		151	1189				181			
%InSharedLn												
Prop LTs		0.000			0.000							
Prop RTs	0.000				0.000				1.000			
Peds Bikes	0							0				
Buses		0		0	0				0			
%InProtPhase												

Duration 0.25 Area Type: CBD or Similar

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				

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru		P			Thru			
Right					Right			
Peds					Peds			
WB Left			A		SB Left			
Thru		P	P		Thru			
Right					Right			
Peds					Peds			
NB Right			A		EB Right			
SB Right					WB Right			
Green		32.0	16.0					
Yellow		4.0	4.0					
All Red		2.0	2.0					

Cycle Length: 60.0 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		1244		128	1130				154			
PHF		0.90		0.85	0.95				0.85			
Adj flow		1382		151	1189				181			
No. Lanes	0	2	0		1	1	0	0	0	1	0	0	0
Lane group		T		L		T				R		
Adj flow		1382		151	1189				181			
Prop LTs		0.000			0.000							
Prop RTs		0.000			0.000				1.000			

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

	Eastbound			Westbound			Northbound			Southbound		
LG		T		L	T				R			
So		1900		1900	1900				1900			
Lanes	0	2	0	1	1	0	0	0	1	0	0	0
fW		1.033		1.033	1.033				1.100			
fHV		0.990		0.990	0.990				0.990			

fG	0.990	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	0.900	0.900	0.900		0.900	
fLU	0.952	1.000	1.000		1.000	
fRT	1.000		1.000		0.865	
fLT	1.000	0.950	1.000			
Sec.						
fLpb	1.000	1.000	1.000			
fRpb	1.000		1.000		1.000	
S	3298	1662	1750		1611	
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	T	1382	3298		0.42	0.53	1759	0.79
Right								
Westbound								
Prot								
Perm								
Left	L	151	1662		0.09	0.27	443	0.34
Prot								
Perm								
Thru	T	1189	1750	#	0.68	1.00	1750	0.68
Right								
Northbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru								
Right	R	181	1611		0.11	0.27	430	0.42
Southbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru								
Right								

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.68
Total lost time per cycle, L = 0.00 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	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor Del k	d2	Res Del d3	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound												
T	0.79	0.53	11.2	1.000	1759	0.50	3.6	0.0	14.9	B	14.9	B
Westbound												
L	0.34	0.27	17.7	1.000	443	0.11	0.5	0.0	18.2	B		
T	0.68	1.00	0.0	0.950	1750	0.50	2.1	0.0	2.1	A	4.0	A
Northbound												
											18.8	B
R	0.42	0.27	18.2	1.000	430	0.11	0.7	0.0	18.8	B		
Southbound												

Intersection delay = 10.1 (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				

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Cycle length, C                          60.0    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                          1.000 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
Cycle length, C                          60.0    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                          1.000 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_________________
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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	60.0 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 10.1 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

	Eastbound	Westbound	Northbound	Southbound
LaneGroup	T	L T	R	
Init Queue	0.0	0.0 0.0	0.0	
Flow Rate	725	151 1189	181	
So	1900	1900 1900	1900	
No.Lanes	0 2 0	1 1 0	0 0 1	0 0 0
SL	1732	1662 1750	1611	
LnCapacity	923	443 1750	430	
Flow Ratio	0.42	0.09 0.68	0.11	
v/c Ratio	0.79	0.34 0.68	0.42	
Grn Ratio	0.53	0.27 1.00	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	
PF2	1.00	1.00	1.00	
Q1	9.7	2.0	2.5	
kB	0.8	0.3 1.3	0.3	
Q2	2.7	0.2 2.6	0.2	
Q Average	12.4	2.2	2.7	
Q Spacing	24.9	24.9 24.9	24.9	
Q Storage	500	200 500	500	
Q S Ratio	0.6	0.3	0.1	
70th Percentile Output:				
fB%	1.2	1.2	1.2	
BOQ	15.0	2.6	3.3	
QSRatio	0.7	0.3	0.2	
85th Percentile Output:				
fB%	1.4	1.6	1.6	
BOQ	17.7	3.5	4.3	
QSRatio	0.9	0.4	0.2	
90th Percentile Output:				
fB%	1.5	1.8	1.7	
BOQ	19.1	3.9	4.8	
QSRatio	1.0	0.5	0.2	
95th Percentile Output:				
fB%	1.7	2.0	2.0	
BOQ	20.9	4.5	5.5	
QSRatio	1.0	0.6	0.3	
98th Percentile Output:				
fB%	1.8	2.5	2.5	
BOQ	22.6	5.6	6.8	
QSRatio	1.1	0.7	0.3	

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: Walter Lublanecki
Agency: Lublanecki Engineering, Inc.
Date: 11/20/05
Period: Saturday Peak Hour
Project ID: Bethworks Now Traffic Impact Study
E/W St: Daly Avenue (SR 412)
Inter.: Daly Ave. (SR 412)/East 4th St
Area Type: CBD or Similar
Jurisd: State
Year : Existing
N/S St: East 4th Street

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	1	1	0	0	0	1	0	0	0
LGConfig		T		L	T				R			
Volume		481		134	485				109			
Lane Width		13.0		13.0	13.0				15.0			
RTOR Vol									0			

Duration 0.25 Area Type: CBD or Similar

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru		P			Thru			
Right					Right			
Peds					Peds			
WB Left			A		SB Left			
Thru		P	A		Thru			
Right					Right			
Peds					Peds			
NB Right			A		EB Right			
SB Right					WB Right			
Green		30.0	18.0					
Yellow		4.0	4.0					
All Red		2.0	2.0					

Cycle Length: 60.0 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								
T	1633	3265	0.31	0.50	9.4	A	9.4	A
Westbound								
L	494	1646	0.32	0.30	16.6	B		
T	1732	1732	0.31	1.00	0.5	A	4.1	A
Northbound								
							16.2	B
R	479	1595	0.25	0.30	16.2	B		
Southbound								

Intersection Delay = 7.2 (sec/veh) Intersection LOS = A

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: Walter Lublanecki
Agency/Co.: Lublanecki Engineering, Inc.
Date Performed: 11/20/05
Analysis Time Period: Saturday Peak Hour
Intersection: Daly Ave. (SR 412)/East 4th St
Area Type: CBD or Similar
Jurisdiction: State
Analysis Year: Existing
Project ID: Bethworks Now Traffic Impact Study

East/West Street	North/South Street
Daly Avenue (SR 412)	East 4th Street

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		481		134	485				109			
% Heavy Veh		2		2	2				2			
PHF		0.95		0.85	0.90				0.90			
PK 15 Vol		127		39	135				30			
Hi Ln Vol												
% Grade		2			0			0				
Ideal Sat		1900		1900	1900				1900			
ParkExist												
NumPark												
No. Lanes	0	2	0		1	1	0	0	0	1	0	0	0
LGConfig		T		L		T				R		
Lane Width		13.0		13.0	13.0				15.0			
RTOR Vol									0			
Adj Flow		506		158	539				121			
%InSharedLn												
Prop LTs		0.000			0.000							
Prop RTs	0.000				0.000				1.000			
Peds Bikes	0							0				
Buses		0		0	0				0			
%InProtPhase												

Duration 0.25 Area Type: CBD or Similar

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				

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru		P			Thru			
Right					Right			
Peds					Peds			
WB Left			A		SB Left			
Thru		P	P		Thru			
Right					Right			
Peds					Peds			
NB Right			A		EB Right			
SB Right					WB Right			
Green		30.0	18.0					
Yellow		4.0	4.0					
All Red		2.0	2.0					

Cycle Length: 60.0 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		481		134	485				109			
PHF		0.95		0.85	0.90				0.90			
Adj flow		506		158	539				121			
No. Lanes	0	2	0		1	1	0	0	0	1	0	0	0
Lane group		T		L		T				R		
Adj flow		506		158	539				121			
Prop LTs		0.000			0.000							
Prop RTs		0.000			0.000				1.000			

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

	Eastbound			Westbound			Northbound			Southbound		
LG		T		L	T				R			
So		1900		1900	1900				1900			
Lanes	0	2	0	1	1	0	0	0	1	0	0	0
fW		1.033		1.033	1.033				1.100			
fHV		0.980		0.980	0.980				0.980			

fG	0.990	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	0.900	0.900	0.900		0.900
fLU	0.952	1.000	1.000		1.000
fRT	1.000		1.000		0.865
fLT	1.000	0.950	1.000		
Sec.					
fLpb	1.000	1.000	1.000		
fRpb	1.000		1.000		1.000
S	3265	1646	1732		1595
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	T	506	3265		0.15	0.50	1633	0.31
Right								
Westbound								
Prot								
Perm								
Left	L	158	1646		0.10	0.30	494	0.32
Prot								
Perm								
Thru	T	539	1732	#	0.31	1.00	1732	0.31
Right								
Northbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru								
Right	R	121	1595		0.08	0.30	479	0.25
Southbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru								
Right								

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.31
Total lost time per cycle, L = 0.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.31

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor Del k	d2	Res Del d3	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound												
T	0.31	0.50	8.9	1.000	1633	0.50	0.5	0.0	9.4	A	9.4	A
Westbound												
L	0.32	0.30	16.3	1.000	494	0.11	0.4	0.0	16.6	B		
T	0.31	1.00	0.0	0.950	1732	0.50	0.5	0.0	0.5	A	4.1	A
Northbound												
											16.2	B
R	0.25	0.30	15.9	1.000	479	0.11	0.3	0.0	16.2	B		
Southbound												

Intersection delay = 7.2 (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				

```
Cycle length, C                          60.0    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                          1.000 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
Cycle length, C                          60.0    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                          1.000 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	60.0 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 7.2 sec/veh Intersection LOS A

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		T		L	T			R				
Init Queue		0.0		0.0	0.0			0.0				
Flow Rate		265		158	539			121				
So		1900		1900	1900			1900				
No.Lanes	0	2	0	1	1	0	0	0	1	0	0	0
SL		1714		1646	1732				1595			
LnCapacity		857		494	1732				479			
Flow Ratio		0.15		0.10	0.31				0.08			
v/c Ratio		0.31		0.32	0.31				0.25			
Grn Ratio		0.50		0.30	1.00				0.30			
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			
Q1		2.6		2.0					1.5			
kB		0.8		0.4	1.3				0.3			
Q2		0.3		0.2	0.6				0.1			
Q Average		3.0		2.2					1.6			
Q Spacing		24.9		24.9	24.9				24.9			
Q Storage		500		200	500				500			
Q S Ratio		0.1		0.3					0.1			
70th Percentile Output:												
fB%		1.3		1.2					1.2			
BOQ		3.7		2.6					2.0			
QSRatio		0.2		0.3					0.1			
85th Percentile Output:												
fB%		1.6		1.6					1.6			
BOQ		4.6		3.5					2.6			
QSRatio		0.2		0.4					0.1			
90th Percentile Output:												
fB%		1.8		1.8					1.8			
BOQ		5.3		3.9					2.9			
QSRatio		0.3		0.5					0.1			
95th Percentile Output:												
fB%		2.2		2.0					2.0			
BOQ		6.4		4.5					3.4			
QSRatio		0.3		0.6					0.2			
98th Percentile Output:												
fB%		2.5		2.5					2.6			
BOQ		7.5		5.6					4.2			
QSRatio		0.4		0.7					0.2			

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: Walter Lublanecki
Agency: Lublanecki Engineering, Inc.
Date: 11/20/05
Period: Saturday Peak Hour
Project ID: Bethworks Now Traffic Impact Study
E/W St: Daly Avenue (SR 412)
Inter.: Daly Ave. (SR 412)/East 4th St
Area Type: CBD or Similar
Jurisd: State
Year : No-Build
N/S St: East 4th Street

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	1	1	0	0	0	1	0	0	0
LGConfig		T		L	T				R			
Volume		507		141	512				115			
Lane Width		13.0		13.0	13.0				15.0			
RTOR Vol									0			

Duration 0.25 Area Type: CBD or Similar

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru		P			Thru			
Right					Right			
Peds					Peds			
WB Left			A		SB Left			
Thru		P	A		Thru			
Right					Right			
Peds					Peds			
NB Right			A		EB Right			
SB Right					WB Right			
Green		30.0	18.0					
Yellow		4.0	4.0					
All Red		2.0	2.0					

Cycle Length: 60.0 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								
T	1633	3265	0.33	0.50	9.5	A	9.5	A
Westbound								
L	494	1646	0.34	0.30	16.8	B		
T	1732	1732	0.33	1.00	0.5	A	4.2	A
Northbound								
							16.3	B
R	479	1595	0.27	0.30	16.3	B		
Southbound								

Intersection Delay = 7.3 (sec/veh) Intersection LOS = A

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: Walter Lublanecki
Agency/Co.: Lublanecki Engineering, Inc.
Date Performed: 11/20/05
Analysis Time Period: Saturday Peak Hour
Intersection: Daly Ave. (SR 412)/East 4th St
Area Type: CBD or Similar
Jurisdiction: State
Analysis Year: No-Build
Project ID: Bethworks Now Traffic Impact Study

East/West Street	North/South Street
Daly Avenue (SR 412)	East 4th Street

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		507		141	512				115			
% Heavy Veh		2		2	2				2			
PHF		0.95		0.85	0.90				0.90			
PK 15 Vol		133		41	142				32			
Hi Ln Vol												
% Grade		2			0			0				
Ideal Sat		1900		1900	1900				1900			
ParkExist												
NumPark												
No. Lanes	0	2	0		1	1	0	0	0	1	0	0	0
LGConfig		T		L		T				R		
Lane Width		13.0		13.0	13.0				15.0			
RTOR Vol									0			
Adj Flow		534		166	569				128			
%InSharedLn												
Prop LTs		0.000			0.000							
Prop RTs	0.000				0.000				1.000			
Peds Bikes	0							0				
Buses		0		0	0				0			
%InProtPhase												
Duration	0.25			Area Type: CBD or Similar								

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				

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru		P			Thru			
Right					Right			
Peds					Peds			
WB Left			A		SB Left			
Thru		P	P		Thru			
Right					Right			
Peds					Peds			
NB Right			A		EB Right			
SB Right					WB Right			
Green		30.0	18.0					
Yellow		4.0	4.0					
All Red		2.0	2.0					

Cycle Length: 60.0 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		507		141	512				115			
PHF		0.95		0.85	0.90				0.90			
Adj flow		534		166	569				128			
No. Lanes	0	2	0		1	1	0	0	0	1	0	0	0
Lane group		T		L		T				R		
Adj flow		534		166	569				128			
Prop LTs		0.000			0.000							
Prop RTs		0.000			0.000				1.000			

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

	Eastbound			Westbound			Northbound			Southbound		
LG		T		L	T				R			
So		1900		1900	1900				1900			
Lanes	0	2	0	1	1	0	0	0	1	0	0	0
fW		1.033		1.033	1.033				1.100			
fHV		0.980		0.980	0.980				0.980			

fG	0.990	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	0.900	0.900	0.900		0.900	
fLU	0.952	1.000	1.000		1.000	
fRT	1.000		1.000		0.865	
fLT	1.000	0.950	1.000			
Sec.						
fLpb	1.000	1.000	1.000			
fRpb	1.000		1.000		1.000	
S	3265	1646	1732		1595	
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	T	534	3265		0.16	0.50	1633	0.33
Right								
Westbound								
Prot								
Perm								
Left	L	166	1646		0.10	0.30	494	0.34
Prot								
Perm								
Thru	T	569	1732	#	0.33	1.00	1732	0.33
Right								
Northbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru								
Right	R	128	1595		0.08	0.30	479	0.27
Southbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru								
Right								

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.33
Total lost time per cycle, L = 0.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.33

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor Del k	d2	Res Del d3	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound												
T	0.33	0.50	9.0	1.000	1633	0.50	0.5	0.0	9.5	A	9.5	A
Westbound												
L	0.34	0.30	16.3	1.000	494	0.11	0.4	0.0	16.8	B		
T	0.33	1.00	0.0	0.950	1732	0.50	0.5	0.0	0.5	A	4.2	A
Northbound												
											16.3	B
R	0.27	0.30	16.0	1.000	479	0.11	0.3	0.0	16.3	B		
Southbound												

Intersection delay = 7.3 (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				

```
Cycle length, C                          60.0    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                          1.000 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
Cycle length, C                          60.0    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                          1.000 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	60.0 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 7.3 sec/veh Intersection LOS A

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		T		L	T			R				
Init Queue		0.0		0.0	0.0			0.0				
Flow Rate		280		166	569			128				
So		1900		1900	1900			1900				
No.Lanes	0	2	0	1	1	0	0	0	1	0	0	0
SL		1714		1646	1732				1595			
LnCapacity		857		494	1732				479			
Flow Ratio		0.16		0.10	0.33				0.08			
v/c Ratio		0.33		0.34	0.33				0.27			
Grn Ratio		0.50		0.30	1.00				0.30			
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			
Q1		2.8		2.2					1.6			
kB		0.8		0.4	1.3				0.3			
Q2		0.4		0.2	0.6				0.1			
Q Average		3.2		2.3					1.7			
Q Spacing		24.9		24.9	24.9				24.9			
Q Storage		500		200	500				500			
Q S Ratio		0.2		0.3					0.1			
70th Percentile Output:												
fB%		1.3		1.2					1.2			
BOQ		4.0		2.8					2.1			
QSRatio		0.2		0.3					0.1			
85th Percentile Output:												
fB%		1.6		1.6					1.6			
BOQ		4.9		3.7					2.8			
QSRatio		0.2		0.5					0.1			
90th Percentile Output:												
fB%		1.8		1.8					1.8			
BOQ		5.6		4.1					3.1			
QSRatio		0.3		0.5					0.2			
95th Percentile Output:												
fB%		2.1		2.0					2.0			
BOQ		6.7		4.7					3.6			
QSRatio		0.3		0.6					0.2			
98th Percentile Output:												
fB%		2.5		2.5					2.6			
BOQ		7.9		5.9					4.5			
QSRatio		0.4		0.7					0.2			

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: Walter Lublanecki
Agency: Lublanecki Engineering, Inc.
Date: 11/20/05
Period: Saturday Peak Hour
Project ID: Bethworks Now Traffic Impact Study
E/W St: Daly Avenue (SR 412)

Inter.: Daly Ave. (SR 412)/East 4th St
Area Type: CBD or Similar
Jurisd: State
Year : Build
N/S St: East 4th Street

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	1	1	0	0	0	1	0	0	0
LGConfig		T		L	T				R			
Volume		1403		141	1454				115			
Lane Width		13.0		13.0	13.0				15.0			
RTOR Vol									0			

Duration 0.25 Area Type: CBD or Similar

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru		P			Thru			
Right					Right			
Peds					Peds			
WB Left			A		SB Left			
Thru		P	A		Thru			
Right					Right			
Peds					Peds			
NB Right			A		EB Right			
SB Right					WB Right			
Green		32.0	16.0					
Yellow		4.0	4.0					
All Red		2.0	2.0					

Cycle Length: 60.0 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								
T	1741	3265	0.85	0.53	17.3	B	17.3	B
Westbound								
L	439	1646	0.38	0.27	18.5	B		
T	1732	1732	0.93	1.00	10.7	B	11.4	B
Northbound								
							17.9	B
R	425	1595	0.30	0.27	17.9	B		
Southbound								

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

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: Walter Lublanecki
Agency/Co.: Lublanecki Engineering, Inc.
Date Performed: 11/20/05
Analysis Time Period: Saturday Peak Hour
Intersection: Daly Ave. (SR 412)/East 4th St
Area Type: CBD or Similar
Jurisdiction: State
Analysis Year: Build
Project ID: Bethworks Now Traffic Impact Study

East/West Street: Daly Avenue (SR 412)
North/South Street: East 4th Street

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		1403		141	1454				115			
% Heavy Veh		2		2	2				2			
PHF		0.95		0.85	0.90				0.90			
PK 15 Vol		369		41	404				32			
Hi Ln Vol												
% Grade		2			0			0				
Ideal Sat		1900		1900	1900				1900			
ParkExist												
NumPark												
No. Lanes	0	2	0		1	1	0	0	0	1	0	0	0
LGConfig		T		L		T				R		
Lane Width		13.0		13.0	13.0				15.0			
RTOR Vol									0			
Adj Flow		1477		166	1616				128			
%InSharedLn												
Prop LTs		0.000			0.000							
Prop RTs	0.000				0.000				1.000			
Peds Bikes	0							0				
Buses		0		0	0				0			
%InProtPhase												

Duration 0.25 Area Type: CBD or Similar

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				

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru		P			Thru			
Right					Right			
Peds					Peds			
WB Left			A		SB Left			
Thru		P	P		Thru			
Right					Right			
Peds					Peds			
NB Right			A		EB Right			
SB Right					WB Right			
Green		32.0	16.0					
Yellow		4.0	4.0					
All Red		2.0	2.0					

Cycle Length: 60.0 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		1403		141	1454				115			
PHF		0.95		0.85	0.90				0.90			
Adj flow		1477		166	1616				128			
No. Lanes	0	2	0		1	1	0	0	0	1	0	0	0
Lane group		T		L		T				R		
Adj flow		1477		166	1616				128			
Prop LTs		0.000			0.000							
Prop RTs		0.000			0.000				1.000			

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

	Eastbound			Westbound			Northbound			Southbound		
LG		T		L	T				R			
So		1900		1900	1900				1900			
Lanes	0	2	0	1	1	0	0	0	1	0	0	0
fW		1.033		1.033	1.033				1.100			
fHV		0.980		0.980	0.980				0.980			

fG	0.990	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	0.900	0.900	0.900		0.900	
fLU	0.952	1.000	1.000		1.000	
fRT	1.000		1.000		0.865	
fLT	1.000	0.950	1.000			
Sec.						
fLpb	1.000	1.000	1.000			
fRpb	1.000		1.000		1.000	
S	3265	1646	1732		1595	
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	T	1477	3265		0.45	0.53	1741	0.85
Right								
Westbound								
Prot								
Perm								
Left	L	166	1646		0.10	0.27	439	0.38
Prot								
Perm								
Thru	T	1616	1732	#	0.93	1.00	1732	0.93
Right								
Northbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru								
Right	R	128	1595		0.08	0.27	425	0.30
Southbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru								
Right								

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.93
Total lost time per cycle, L = 0.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.93

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor Del k	d2	Res Del d3	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound												
T	0.85	0.53	11.9	1.000	1741	0.50	5.4	0.0	17.3	B	17.3	B
Westbound												
L	0.38	0.27	17.9	1.000	439	0.11	0.5	0.0	18.5	B		
T	0.93	1.00	0.0	0.950	1732	0.50	10.7	0.0	10.7	B	11.4	B
Northbound												
											17.9	B
R	0.30	0.27	17.5	1.000	425	0.11	0.4	0.0	17.9	B		
Southbound												

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				

```
Cycle length, C                          60.0    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                          1.000 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
Cycle length, C                          60.0    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                          1.000 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	60.0 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 14.2 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		T		L	T			R				
Init Queue		0.0		0.0	0.0			0.0				
Flow Rate		775		166	1616			128				
So		1900		1900	1900			1900				
No.Lanes	0	2	0	1	1	0	0	0	1	0	0	0
SL		1714		1646	1732				1595			
LnCapacity		914		439	1732				425			
Flow Ratio		0.45		0.10	0.93				0.08			
v/c Ratio		0.85		0.38	0.93				0.30			
Grn Ratio		0.53		0.27	1.00				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			
PF2		1.00		1.00					1.00			
Q1		11.0		2.3					1.7			
kB		0.8		0.3	1.3				0.3			
Q2		3.7		0.2	10.3				0.1			
Q Average		14.7		2.5					1.8			
Q Spacing		24.9		24.9	24.9				24.9			
Q Storage		500		200	500				500			
Q S Ratio		0.7		0.3					0.1			
70th Percentile Output:												
fB%		1.2		1.2					1.2			
BOQ		17.7		2.9					2.2			
QSRatio		0.9		0.4					0.1			
85th Percentile Output:												
fB%		1.4		1.6					1.6			
BOQ		20.8		3.9					2.9			
QSRatio		1.0		0.5					0.1			
90th Percentile Output:												
fB%		1.5		1.8					1.8			
BOQ		22.5		4.3					3.2			
QSRatio		1.1		0.5					0.2			
95th Percentile Output:												
fB%		1.7		2.0					2.0			
BOQ		24.3		5.0					3.8			
QSRatio		1.2		0.6					0.2			
98th Percentile Output:												
fB%		1.8		2.5					2.6			
BOQ		26.2		6.2					4.7			
QSRatio		1.3		0.8					0.2			

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: Walter Lublanecki
Agency: Lublanecki Engineering, Inc.
Date: 11/20/05
Period: PM Peak Hour
Project ID: Bethworks Now Traffic Impact Study
E/W St: East 3rd Street (SR 412)
Inter.: E. 3rd St. (SR 412)/Hayes Ave.
Area Type: CBD or Similar
Jurisd: City
Year : Existing
N/S St: Hayes Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	1	1	1	0	1	0	1	0	0	0
LGConfig		T	R	L	T		L		R			
Volume		485	106	317	310		151		273			
Lane Width		12.0	13.0	12.0	12.0		11.0		12.0			
RTOR Vol			0						100			

Duration 0.25 Area Type: CBD or Similar

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	A	P			SB Left			
Thru	P	P			Thru			
Right					Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	10.0	30.0			15.0			
Yellow	3.0	3.0			3.0			
All Red	2.0	2.0			2.0			

Cycle Length: 70.0 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								
T	726	1693	0.74	0.43	23.5	C	21.6	C
R	637	1487	0.20	0.43	13.2	B		
Westbound								
L	431	1608	0.87	0.64	26.4	C		
T	1088	1693	0.32	0.64	6.4	A	16.8	B
Northbound								
L	333	1555	0.53	0.21	26.1	C		
							28.4	C
R	308	1439	0.66	0.21	30.4	C		
Southbound								

Intersection Delay = 21.1 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: Walter Lublanecki
Agency/Co.: Lublanecki Engineering, Inc.
Date Performed: 11/20/05
Analysis Time Period: PM Peak Hour
Intersection: E. 3rd St. (SR 412)/Hayes Ave.
Area Type: CBD or Similar
Jurisdiction: City
Analysis Year: Existing
Project ID: Bethworks Now Traffic Impact Study

East/West Street	North/South Street
East 3rd Street (SR 412)	Hayes Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		485	106	317	310		151		273			
% Heavy Veh		1	1	1	1		1		1			
PHF		0.90	0.85	0.85	0.90		0.85		0.85			
PK 15 Vol		135	31	93	86		44		80			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900	1900	1900	1900		1900		1900			
ParkExist												
NumPark												
No. Lanes	0	1	1		1	1	0	1	0	1	0	0	0
LGConfig		T	R	L		T		L		R		
Lane Width		12.0	13.0	12.0	12.0		11.0		12.0			
RTOR Vol			0						100			
Adj Flow		539	125	373	344		178		204			
%InSharedLn												
Prop LTs		0.000		1.000	0.000							
Prop RTs		0.000	1.000		0.000				1.000			
Peds Bikes	0						0			0		
Buses		0	0	0	0		0		0			
%InProtPhase				0.0								

Duration 0.25 Area Type: CBD or Similar

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	A		
Thru		P			Thru			
Right		P			Right	A		
Peds					Peds			
WB Left		A	P		SB Left			
Thru		P	P		Thru			
Right					Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green		10.0	30.0			15.0		
Yellow		3.0	3.0			3.0		
All Red		2.0	2.0			2.0		

Cycle Length: 70.0 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		485	106	317	310		151		273			
PHF		0.90	0.85	0.85	0.90		0.85		0.85			
Adj flow		539	125	373	344		178		204			
No. Lanes	0	1	1		1	1	0	1	0	1	0	0	0
Lane group		T	R	L	T		L		R			
Adj flow		539	125	373	344		178		204			
Prop LTs		0.000		1.000	0.000							
Prop RTs		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	T	R		L	T		L		R			
So	1900	1900		1900	1900		1900		1900			
Lanes	0 1	1		1	1	0	1	0	1	0	0	0
fW	1.000	1.033		1.000	1.000		0.967		1.000			
fHV	0.990	0.990		0.990	0.990		0.990		0.990			

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	0.900	0.900	0.900	0.900	0.900	0.900
fLU	1.000	1.000	1.000	1.000	1.000	1.000
fRT	1.000	0.850		1.000		0.850
fLT	1.000		0.950	1.000	0.950	
Sec.			0.237			
fLpb	1.000		1.000	1.000	1.000	
fRpb	1.000	1.000		1.000		1.000
S	1693	1487	1608	1693	1555	1439
Sec.			401			

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	T	539	1693		0.32	0.43	726	0.74
Right	R	125	1487		0.08	0.43	637	0.20
Westbound								
Prot		230	1608	#	0.14	0.143	230	1.00
Perm		143	401	#	0.36	0.500	201	0.71
Left	L	373				0.64	431	0.87
Prot								
Perm								
Thru	T	344	1693		0.20	0.64	1088	0.32
Right								
Northbound								
Prot								
Perm								
Left	L	178	1555		0.11	0.21	333	0.53
Prot								
Perm								
Thru								
Right	R	204	1439	#	0.14	0.21	308	0.66
Southbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru								
Right								

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.64
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.75

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor Del k	d2	Res Del d3	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound												
T	0.74	0.43	16.8	1.000	726	0.50	6.8	0.0	23.5	C	21.6	C
R	0.20	0.43	12.5	1.000	637	0.50	0.7	0.0	13.2	B		
Westbound												
L	0.87	0.64	9.8	1.000	431	0.40	16.6	0.0	26.4	C		
T	0.32	0.64	5.6	1.000	1088	0.50	0.8	0.0	6.4	A	16.8	B
Northbound												
L	0.53	0.21	24.4	1.000	333	0.14	1.7	0.0	26.1	C		
											28.4	C
R	0.66	0.21	25.2	1.000	308	0.24	5.2	0.0	30.4	C		
Southbound												

Intersection delay = 21.1 (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                          70.0    sec
Total actual green time for LT lane group, G (s)              45.0
Effective permitted green time for LT lane group, g(s)        35.0
Opposing effective green time, go (s)                         30.0
Number of lanes in LT lane group, N                           1
Number of lanes in opposing approach, No                      1
Adjusted LT flow rate, VLT (veh/h)                            373
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)                       539
Lost time for LT lane group, tL                               5.00
Computation
LT volume per cycle, LTC=VLTC/3600                            7.25
Opposing lane util. factor, fLUo                     1.000 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)           10.48
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)                               17.10
gu=g-gq if gq>=gf, or = g-gf if gq<gf                         17.90
n=Max(gq-gf)/2,0)                                             8.55
PTHo=1-PLTo                                                   1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]                            1.00
EL1 (refer to Exhibit C16-3)                                  2.16
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)           0.24
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                                     0.237

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                          70.0    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                     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	70.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v			373		
v/c ratio from Capacity Worksheet, X			0.87		
Protected phase effective green interval, g (s)			10.0		
Opposing queue effective green interval, gq			17.10		
Unopposed green interval, gu			17.90		
Red time r=(C-g-gq-gu)			25.0		
Arrival rate, qa=v/(3600(max[X,1.0]))			0.10		
Protected ph. departure rate, Sp=s/3600			0.447		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)			0.22		
XPerm			0.93		
XProt			0.81		
Case			1		
Queue at beginning of green arrow, Qa			2.59		
Queue at beginning of unsaturated green, Qu			1.77		
Residual queue, Qr			0.00		
Uniform Delay, d1			9.8		

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 21.1 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound			Northbound			Southbound		
LaneGroup		T	R	L	T		L	R			
Init Queue		0.0	0.0	0.0	0.0		0.0	0.0			
Flow Rate		539	125	373	344		178	204			
So		1900	1900	1900	1900		1900	1900			
No.Lanes	0	1	1	1	1	0	1	0 1	0	0	0
SL		1693	1487	669	1693		1555	1439			
LnCapacity		726	637	431	1088		333	308			
Flow Ratio		0.32	0.08	0.56	0.20		0.11	0.14			
v/c Ratio		0.74	0.20	0.87	0.32		0.53	0.66			
Grn Ratio		0.43	0.43	0.64	0.64		0.21	0.21			
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		8.8	1.5	3.0	3.0		3.1	3.6			
kB		0.8	0.7	0.4	1.0		0.3	0.3			
Q2		2.0	0.2	1.8	0.5		0.3	0.6			
Q Average		10.8	1.7	4.8	3.5		3.4	4.2			
Q Spacing		24.9	24.9	24.9	24.9		24.9	24.9			
Q Storage		500	200	200	500		150	150			
Q S Ratio		0.5	0.2	0.6	0.2		0.6	0.7			
70th Percentile Output:											
fB%		1.2	1.3	1.2	1.2		1.2	1.2			
BOQ		13.1	2.1	5.7	4.3		4.1	5.0			
QSRatio		0.7	0.3	0.7	0.2		0.7	0.8			
85th Percentile Output:											
fB%		1.4	1.6	1.6	1.5		1.6	1.6			
BOQ		15.5	2.7	7.5	5.4		5.4	6.5			
QSRatio		0.8	0.3	0.9	0.3		0.9	1.1			
90th Percentile Output:											
fB%		1.6	1.9	1.7	1.7		1.7	1.7			
BOQ		16.8	3.1	8.2	6.1		5.9	7.2			
QSRatio		0.8	0.4	1.0	0.3		1.0	1.2			
95th Percentile Output:											
fB%		1.7	2.3	2.0	2.1		2.0	2.0			
BOQ		18.5	3.9	9.4	7.3		6.8	8.3			
QSRatio		0.9	0.5	1.2	0.4		1.1	1.4			
98th Percentile Output:											
fB%		1.9	2.8	2.4	2.4		2.5	2.4			
BOQ		20.2	4.7	11.5	8.5		8.4	10.1			
QSRatio		1.0	0.6	1.4	0.4		1.4	1.7			

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: Walter Lublanecki
Agency: Lublanecki Engineering, Inc.
Date: 11/20/05
Period: PM Peak Hour
Project ID: Bethworks Now Traffic Impact Study
E/W St: East 3rd Street (SR 412)

Inter.: E. 3rd St. (SR 412)/Hayes Ave.
Area Type: CBD or Similar
Jurisd: City
Year : No-Build
N/S St: Hayes Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	1	1	1	0	1	0	1	0	0	0
LGConfig		T	R	L	T		L		R			
Volume		512	112	334	327		159		288			
Lane Width		12.0	13.0	12.0	12.0		11.0		12.0			
RTOR Vol			0						120			

Duration 0.25 Area Type: CBD or Similar

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	A	P			SB Left				
Thru	P	P			Thru				
Right					Right				
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	12.0	29.0				14.0			
Yellow	3.0	3.0				3.0			
All Red	2.0	2.0				2.0			

Cycle Length: 70.0 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								
T	701	1693	0.81	0.41	28.0	C	25.4	C
R	616	1487	0.21	0.41	14.0	B		
Westbound								
L	440	1608	0.89	0.66	32.9	C		
T	1113	1693	0.33	0.66	6.0	A	20.0-	B
Northbound								
L	311	1555	0.60	0.20	28.7	C		
							30.8	C
R	288	1439	0.69	0.20	32.7	C		
Southbound								

Intersection Delay = 24.3 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: Walter Lublanecki
Agency/Co.: Lublanecki Engineering, Inc.
Date Performed: 11/20/05
Analysis Time Period: PM Peak Hour
Intersection: E. 3rd St. (SR 412)/Hayes Ave.
Area Type: CBD or Similar
Jurisdiction: City
Analysis Year: No-Build
Project ID: Bethworks Now Traffic Impact Study

East/West Street: East 3rd Street (SR 412)
North/South Street: Hayes Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		512	112	334	327		159		288			
% Heavy Veh		1	1	1	1		1		1			
PHF		0.90	0.85	0.85	0.90		0.85		0.85			
PK 15 Vol		142	33	98	91		47		85			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900	1900	1900	1900		1900		1900			
ParkExist												
NumPark												
No. Lanes	0	1	1		1	1	0	1	0	1	0	0	0
LGConfig		T	R	L		T		L		R		
Lane Width		12.0	13.0	12.0	12.0			11.0		12.0		
RTOR Vol			0							120		
Adj Flow		569	132	393	363			187		198		
%InSharedLn												
Prop LTs		0.000		1.000	0.000							
Prop RTs		0.000	1.000		0.000				1.000			
Peds Bikes	0							0			0	
Buses		0	0	0	0			0		0		
%InProtPhase				0.0								

Duration 0.25 Area Type: CBD or Similar

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	A		
Thru		P			Thru			
Right		P			Right	A		
Peds					Peds			
WB Left	A	P			SB Left			
Thru	P	P			Thru			
Right					Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	12.0	29.0			14.0			
Yellow	3.0	3.0			3.0			
All Red	2.0	2.0			2.0			

Cycle Length: 70.0 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		512	112	334	327		159		288			
PHF		0.90	0.85	0.85	0.90		0.85		0.85			
Adj flow		569	132	393	363		187		198			
No. Lanes	0	1	1		1	1	0	1	0	1	0	0	0
Lane group		T	R	L	T			L		R		
Adj flow		569	132	393	363			187		198		
Prop LTs		0.000		1.000	0.000							
Prop RTs		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	T		R	L	T		L		R			
So	1900		1900	1900	1900		1900		1900			
Lanes	0	1	1	1	1	0	1	0	1	0	0	0
fW	1.000		1.033	1.000	1.000		0.967		1.000			
fHV	0.990		0.990	0.990	0.990		0.990		0.990			

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	0.900	0.900	0.900	0.900	0.900	0.900
fLU	1.000	1.000	1.000	1.000	1.000	1.000
fRT	1.000	0.850		1.000		0.850
fLT	1.000		0.950	1.000	0.950	
Sec.			0.199			
fLpb	1.000		1.000	1.000	1.000	
fRpb	1.000	1.000		1.000		1.000
S	1693	1487	1608	1693	1555	1439
Sec.			338			

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	T	569	1693		0.34	0.41	701	0.81
Right	R	132	1487		0.09	0.41	616	0.21
Westbound								
Prot		276	1608	#	0.17	0.171	276	1.00
Perm		117	338	#	0.35	0.486	164	0.71
Left	L	393				0.66	440	0.89
Prot								
Perm								
Thru	T	363	1693		0.21	0.66	1113	0.33
Right								
Northbound								
Prot								
Perm								
Left	L	187	1555		0.12	0.20	311	0.60
Prot								
Perm								
Thru								
Right	R	198	1439	#	0.14	0.20	288	0.69
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 = 10.00 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	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor Del k	d2	Res Del d3	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound												
T	0.81	0.41	18.1	1.000	701	0.50	9.9	0.0	28.0	C	25.4	C
R	0.21	0.41	13.2	1.000	616	0.50	0.8	0.0	14.0	B		
Westbound												
L	0.89	0.66	12.8	1.000	440	0.42	20.1	0.0	32.9	C		
T	0.33	0.66	5.2	1.000	1113	0.50	0.8	0.0	6.0	A	20.0-	B
Northbound												
L	0.60	0.20	25.5	1.000	311	0.19	3.2	0.0	28.7	C		
											30.8	C
R	0.69	0.20	26.0	1.000	288	0.26	6.7	0.0	32.7	C		
Southbound												

Intersection delay = 24.3 (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                          70.0    sec
Total actual green time for LT lane group, G (s)              46.0
Effective permitted green time for LT lane group, g(s)        34.0
Opposing effective green time, go (s)                         29.0
Number of lanes in LT lane group, N                           1
Number of lanes in opposing approach, No                      1
Adjusted LT flow rate, VLT (veh/h)                            393
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)                       569
Lost time for LT lane group, tL                               5.00
Computation
LT volume per cycle, LTC=VLTC/3600                            7.64
Opposing lane util. factor, fLUo                     1.000 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)           11.06
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]                  0.59
gq, (see Exhibit C16-4,5,6,7,8)                               18.95
gu=g-gq if gq>=gf, or = g-gf if gq<gf                         15.05
n=Max(gq-gf)/2,0)                                             9.48
PTHo=1-PLTo                                                   1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]                            1.00
EL1 (refer to Exhibit C16-3)                                  2.22
EL2=Max((1-Ptho**n)/Plto, 1.0)
fmin=2(1+PL)/g  or  fmin=2(1+Pl)/g                            0.12
gdiff=max(gq-gf,0)                                            0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)           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                                     0.199

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                          70.0    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                     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	70.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v			393		
v/c ratio from Capacity Worksheet, X			0.89		
Protected phase effective green interval, g (s)			12.0		
Opposing queue effective green interval, gq			18.95		
Unopposed green interval, gu			15.05		
Red time r=(C-g-gq-gu)			24.0		
Arrival rate, qa=v/(3600(max[X,1.0]))			0.11		
Protected ph. departure rate, Sp=s/3600			0.447		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)			0.21		
XPerm			1.16		
XProt			0.73		
Case			3		
Queue at beginning of green arrow, Qa			3.14		
Queue at beginning of unsaturated green, Qu			2.07		
Residual queue, Qr			0.52		
Uniform Delay, d1			12.8		

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 24.3 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound			Northbound			Southbound		
LaneGroup		T	R	L	T		L	R			
Init Queue		0.0	0.0	0.0	0.0		0.0	0.0			
Flow Rate		569	132	393	363		187	198			
So		1900	1900	1900	1900		1900	1900			
No.Lanes	0	1	1	1	1	0	1	0 1	0	0	0
SL		1693	1487	669	1693		1555	1439			
LnCapacity		701	616	440	1113		311	288			
Flow Ratio		0.34	0.09	0.59	0.21		0.12	0.14			
v/c Ratio		0.81	0.21	0.89	0.33		0.60	0.69			
Grn Ratio		0.41	0.41	0.66	0.66		0.20	0.20			
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		9.8	1.6	3.1	3.1		3.3	3.6			
kB		0.7	0.7	0.4	1.0		0.3	0.3			
Q2		2.8	0.2	2.2	0.5		0.4	0.6			
Q Average		12.5	1.8	5.3	3.6		3.7	4.2			
Q Spacing		24.9	24.9	24.9	24.9		24.9	24.9			
Q Storage		500	200	200	500		150	150			
Q S Ratio		0.6	0.2	0.7	0.2		0.6	0.7			
70th Percentile Output:											
fB%		1.2	1.3	1.2	1.2		1.2	1.2			
BOQ		15.1	2.3	6.3	4.5		4.5	4.9			
QSRatio		0.8	0.3	0.8	0.2		0.7	0.8			
85th Percentile Output:											
fB%		1.4	1.6	1.6	1.5		1.6	1.6			
BOQ		17.8	3.0	8.2	5.5		5.9	6.5			
QSRatio		0.9	0.4	1.0	0.3		1.0	1.1			
90th Percentile Output:											
fB%		1.5	1.8	1.7	1.7		1.7	1.7			
BOQ		19.3	3.4	9.0	6.2		6.5	7.2			
QSRatio		1.0	0.4	1.1	0.3		1.1	1.2			
95th Percentile Output:											
fB%		1.7	2.3	1.9	2.1		2.0	2.0			
BOQ		21.1	4.2	10.3	7.5		7.4	8.2			
QSRatio		1.0	0.5	1.3	0.4		1.2	1.4			
98th Percentile Output:											
fB%		1.8	2.7	2.4	2.4		2.5	2.4			
BOQ		22.8	5.0	12.5	8.7		9.2	10.1			
QSRatio		1.1	0.6	1.6	0.4		1.5	1.7			

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: Walter Lublanecki
Agency: Lublanecki Engineering, Inc.
Date: 11/20/05
Period: PM Peak Hour
Project ID: Bethworks Now Traffic Impact Study
E/W St: East 3rd Street(SR 412)
Inter.: E. 3rd St. (SR 412)/Hayes Ave.
Area Type: CBD or Similar
Jurisd: City
Year : Build
N/S St: Hayes Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	1	1	1	0	1	0	1	0	0	0
LGConfig		T	R	L	T		L		R			
Volume		661	112	434	427		159		374			
Lane Width		12.0	13.0	12.0	12.0		11.0		12.0			
RTOR Vol			0						120			

Duration 0.25 Area Type: CBD or Similar

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	A	P			SB Left				
Thru	P	P			Thru				
Right					Right				
Peds					Peds				
NB Right	A				EB Right				
SB Right					WB Right				
Green	22.0	40.0				12.0			
Yellow	3.0	4.0				3.0			
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 Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
T	752	1693	0.98	0.44	52.0	D	46.5	D
R	661	1487	0.20	0.44	15.9	B		
Westbound								
L	473	1608	1.02	0.74	73.9	E		
T	1260	1693	0.38	0.74	4.9	A	39.7	D
Northbound								
L	207	1555	0.90	0.13	75.6	E		
							40.7	D
R	624	1439	0.48	0.43	18.8	B		
Southbound								

Intersection Delay = 42.5 (sec/veh) Intersection LOS = D

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: Walter Lublanecki
Agency/Co.: Lublanecki Engineering, Inc.
Date Performed: 11/20/05
Analysis Time Period: PM Peak Hour
Intersection: E. 3rd St. (SR 412)/Hayes Ave.
Area Type: CBD or Similar
Jurisdiction: City
Analysis Year: Build
Project ID: Bethworks Now Traffic Impact Study

East/West Street	North/South Street
East 3rd Street(SR 412)	Hayes Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		661	112	434	427		159		374			
% Heavy Veh		1	1	1	1		1		1			
PHF		0.90	0.85	0.90	0.90		0.85		0.85			
PK 15 Vol		184	33	121	119		47		110			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900	1900	1900	1900		1900		1900			
ParkExist												
NumPark												
No. Lanes	0	1	1		1	1	0	1	0	1	0	0	0
LGConfig		T	R	L		T		L		R		
Lane Width		12.0	13.0	12.0	12.0		11.0		12.0			
RTOR Vol			0						120			
Adj Flow		734	132	482	474		187		299			
%InSharedLn												
Prop LTs		0.000		1.000	0.000							
Prop RTs		0.000	1.000		0.000				1.000			
Peds Bikes	0						0			0		
Buses		0	0	0	0		0		0			
%InProtPhase				0.0								

Duration 0.25 Area Type: CBD or Similar

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	A		
Thru		P			Thru			
Right		P			Right	A		
Peds					Peds			
WB Left	A	P			SB Left			
Thru	P	P			Thru			
Right					Right			
Peds					Peds			
NB Right	A				EB Right			
SB Right					WB Right			
Green	22.0	40.0			12.0			
Yellow	3.0	4.0			3.0			
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		661	112	434	427		159		374			
PHF		0.90	0.85	0.90	0.90		0.85		0.85			
Adj flow		734	132	482	474		187		299			
No. Lanes	0	1	1		1	1	0	1	0	1	0	0	0
Lane group		T	R	L		T		L		R		
Adj flow		734	132	482	474		187		299			
Prop LTs		0.000		1.000	0.000							
Prop RTs		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	T		R	L	T		L		R			
So	1900		1900	1900	1900		1900		1900			
Lanes 0	1		1	1	1	0	1	0	1	0	0	0
fW	1.000		1.033	1.000	1.000		0.967		1.000			
fHV	0.990		0.990	0.990	0.990		0.990		0.990			

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	0.900	0.900	0.900	0.900	0.900	0.900
fLU	1.000	1.000	1.000	1.000	1.000	1.000
fRT	1.000	0.850		1.000		0.850
fLT	1.000		0.950	1.000	0.950	
Sec.			0.091			
fLpb	1.000		1.000	1.000	1.000	
fRpb	1.000	1.000		1.000		1.000
S	1693	1487	1608	1693	1555	1439
Sec.			154			

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	T	734	1693		0.43	0.44	752	0.98
Right	R	132	1487		0.09	0.44	661	0.20
Westbound								
Prot		393	1608	#	0.24	0.244	393	1.00
Perm		89	154	#	0.58	0.500	80	1.11
Left	L	482				0.74	473	1.02
Prot								
Perm								
Thru	T	474	1693		0.28	0.74	1260	0.38
Right								
Northbound								
Prot								
Perm								
Left	L	187	1555	#	0.12	0.13	207	0.90
Prot								
Perm								
Thru								
Right	R	299	1439		0.21	0.43	624	0.48
Southbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru								
Right								

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.94
Total lost time per cycle, L = 11.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.07

Control Delay and LOS Determination

Appr/ Lane	Ratios		Unf Del	Prog Adj	Lane Grp	Incremental Factor	Del	Res Del	Lane Group		Approach	
Grp	v/c	g/C	d1	Fact	Cap	k	d2	d3	Delay	LOS	Delay	LOS
Eastbound												
T	0.98	0.44	24.5	1.000	752	0.50	27.5	0.0	52.0	D	46.5	D
R	0.20	0.44	15.2	1.000	661	0.50	0.7	0.0	15.9	B		
Westbound												
L	1.02	0.74	27.7	1.000	473	0.50	46.3	0.0	73.9	E		
T	0.38	0.74	4.1	1.000	1260	0.50	0.9	0.0	4.9	A	39.7	D
Northbound												
L	0.90	0.13	38.4	1.000	207	0.42	37.2	0.0	75.6	E		
											40.7	D
R	0.48	0.43	18.2	1.000	624	0.11	0.6	0.0	18.8	B		
Southbound												

Intersection delay = 42.5 (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		

```
Cycle length, C                          90.0    sec
Total actual green time for LT lane group, G (s)              67.0
Effective permitted green time for LT lane group, g(s)        45.0
Opposing effective green time, go (s)                         40.0
Number of lanes in LT lane group, N                           1
Number of lanes in opposing approach, No                      1
Adjusted LT flow rate, VLT (veh/h)                            482
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)                       734
Lost time for LT lane group, tL                               6.00
Computation
LT volume per cycle, LTC=VLTC/3600                            12.05
Opposing lane util. factor, fLUo                     1.000 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)           18.35
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]                  0.56
gq, (see Exhibit C16-4,5,6,7,8)                               34.43
gu=g-gq if gq>=gf, or = g-gf if gq<gf                         10.57
n=Max(gq-gf)/2,0)                                             17.21
PTHo=1-PLTo                                                   1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]                            1.00
EL1 (refer to Exhibit C16-3)                                  2.59
EL2=Max((1-Ptho**n)/Plto, 1.0)
fmin=2(1+PL)/g  or  fmin=2(1+Pl)/g                            0.09
gdiff=max(gq-gf,0)                                            0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)           0.09
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                                     0.091

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
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
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			482		
v/c ratio from Capacity Worksheet, X			1.02		
Protected phase effective green interval, g (s)			22.0		
Opposing queue effective green interval, gq			34.43		
Unopposed green interval, gu			10.57		
Red time r=(C-g-gq-gu)			23.0		
Arrival rate, qa=v/(3600(max[X,1.0]))			0.13		
Protected ph. departure rate, Sp=s/3600			0.447		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)			0.18		
XPerm			3.07		
XProt			0.60		
Case			3		
Queue at beginning of green arrow, Qa			7.01		
Queue at beginning of unsaturated green, Qu			4.52		
Residual queue, Qr			3.99		
Uniform Delay, d1			27.7		

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 42.5 sec/veh Intersection LOS D

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound			Northbound			Southbound		
LaneGroup		T	R	L	T		L	R			
Init Queue		0.0	0.0	0.0	0.0		0.0	0.0			
Flow Rate		734	132	482	474		187	299			
So		1900	1900	1900	1900		1900	1900			
No.Lanes	0	1	1	1	1	0	1	0 1	0	0	0
SL		1693	1487	631	1693		1555	1439			
LnCapacity		752	661	473	1260		207	624			
Flow Ratio		0.43	0.09	0.76	0.28		0.12	0.21			
v/c Ratio		0.98	0.20	1.02	0.38		0.90	0.48			
Grn Ratio		0.44	0.44	0.74	0.74		0.13	0.43			
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		18.0	2.0	4.1	4.2		4.6	5.3			
kB		0.9	0.9	0.4	1.3		0.3	0.5			
Q2		8.2	0.2	5.7	0.8		1.5	0.5			
Q Average		26.2	2.2	9.8	5.0		6.2	5.8			
Q Spacing		24.9	24.9	24.9	24.9		24.9	24.9			
Q Storage		500	200	500	500		150	150			
Q S Ratio		1.3	0.3	0.5	0.2		1.0	1.0			
70th Percentile Output:											
fB%		1.2	1.3	1.2	1.2		1.2	1.2			
BOQ		31.5	2.8	11.6	6.2		7.3	6.9			
QSRatio		1.6	0.4	0.6	0.3		1.2	1.1			
85th Percentile Output:											
fB%		1.4	1.6	1.5	1.5		1.5	1.5			
BOQ		36.7	3.5	14.9	7.6		9.5	9.0			
QSRatio		1.8	0.4	0.7	0.4		1.6	1.5			
90th Percentile Output:											
fB%		1.5	1.8	1.6	1.7		1.7	1.7			
BOQ		39.4	4.0	16.1	8.4		10.4	9.9			
QSRatio		2.0	0.5	0.8	0.4		1.7	1.6			
95th Percentile Output:											
fB%		1.6	2.2	1.8	2.0		1.9	1.9			
BOQ		42.1	5.0	18.1	9.9		11.9	11.3			
QSRatio		2.1	0.6	0.9	0.5		2.0	1.9			
98th Percentile Output:											
fB%		1.7	2.7	2.2	2.3		2.3	2.3			
BOQ		44.8	5.9	21.3	11.3		14.3	13.6			
QSRatio		2.2	0.7	1.1	0.6		2.4	2.3			

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: Walter Lublanecki
Agency: Lublanecki Engineering, Inc.
Date: 11/20/05
Period: Saturday Peak Hour
Project ID: Bethworks Now Traffic Impact Study
E/W St: East 3rd. Street (SR 412)

Inter.: E. 3rd St. (SR 412)/Hayes Ave.
Area Type: CBD or Similar
Jurisd: City
Year : Existing
N/S St: Hayes Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	1	1	1	0	1	0	1	0	0	0
LGConfig		T	R	L	T		L		R			
Volume		408	54	220	370		160		250			
Lane Width		12.0	13.0	12.0	12.0		11.0		12.0			
RTOR Vol			0						100			

Duration 0.25 Area Type: CBD or Similar

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	A	P			SB Left				
Thru	P	P			Thru				
Right					Right				
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	8.0	28.0				19.0			
Yellow	3.0	3.0				3.0			
All Red	2.0	2.0				2.0			

Cycle Length: 70.0 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								
T	677	1693	0.67	0.40	22.4	C	21.4	C
R	595	1487	0.10	0.40	13.5	B		
Westbound								
L	413	1608	0.63	0.59	12.2	B		
T	992	1693	0.41	0.59	9.2	A	10.4	B
Northbound								
L	422	1555	0.45	0.27	21.9	C		
							21.8	C
R	391	1439	0.43	0.27	21.8	C		
Southbound								

Intersection Delay = 16.7 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: Walter Lublanecki
Agency/Co.: Lublanecki Engineering, Inc.
Date Performed: 11/20/05
Analysis Time Period: Saturday Peak Hour
Intersection: E. 3rd St. (SR 412)/Hayes Ave.
Area Type: CBD or Similar
Jurisdiction: City
Analysis Year: Existing
Project ID: Bethworks Now Traffic Impact Study

East/West Street	North/South Street
East 3rd. Street (SR 412)	Hayes Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		408	54	220	370		160		250			
% Heavy Veh		1	1	1	1		1		1			
PHF		0.90	0.90	0.85	0.90		0.85		0.90			
PK 15 Vol		113	15	65	103		47		69			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900	1900	1900	1900		1900		1900			
ParkExist												
NumPark												
No. Lanes	0	1	1		1	1	0	1	0	1	0	0	0
LGConfig		T	R	L		T		L		R		
Lane Width		12.0	13.0	12.0	12.0		11.0		12.0			
RTOR Vol			0						100			
Adj Flow		453	60	259	411		188		167			
%InSharedLn												
Prop LTs		0.000		1.000	0.000							
Prop RTs		0.000	1.000		0.000				1.000			
Peds Bikes	0						0			0		
Buses		0	0	0	0		0		0			
%InProtPhase				0.0								

Duration 0.25 Area Type: CBD or Similar

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	A		
Thru		P			Thru			
Right		P			Right	A		
Peds					Peds			
WB Left		A	P		SB Left			
Thru		P	P		Thru			
Right					Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green		8.0	28.0			19.0		
Yellow		3.0	3.0			3.0		
All Red		2.0	2.0			2.0		

Cycle Length: 70.0 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		408	54	220	370		160		250			
PHF		0.90	0.90	0.85	0.90		0.85		0.90			
Adj flow		453	60	259	411		188		167			
No. Lanes	0	1	1		1	1	0	1	0	1	0	0	0
Lane group		T	R	L	T		L		R			
Adj flow		453	60	259	411		188		167			
Prop LTs		0.000		1.000	0.000							
Prop RTs		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	T	R		L	T		L		R			
So	1900	1900		1900	1900		1900		1900			
Lanes	0 1	1		1	1	0	1	0	1	0	0	0
fW	1.000	1.033		1.000	1.000		0.967		1.000			
fHV	0.990	0.990		0.990	0.990		0.990		0.990			

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	0.900	0.900	0.900	0.900	0.900	0.900
fLU	1.000	1.000	1.000	1.000	1.000	1.000
fRT	1.000	0.850		1.000		0.850
fLT	1.000		0.950	1.000	0.950	
Sec.			0.287			
fLpb	1.000		1.000	1.000	1.000	
fRpb	1.000	1.000		1.000		1.000
S	1693	1487	1608	1693	1555	1439
Sec.			486			

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	T	453	1693	#	0.27	0.40	677	0.67
Right	R	60	1487		0.04	0.40	595	0.10
Westbound								
Prot		184	1608	#	0.11	0.114	184	1.00
Perm		75	486		0.15	0.471	229	0.33
Left	L	259				0.59	413	0.63
Prot								
Perm								
Thru	T	411	1693		0.24	0.59	992	0.41
Right								
Northbound								
Prot								
Perm								
Left	L	188	1555	#	0.12	0.27	422	0.45
Prot								
Perm								
Thru								
Right	R	167	1439		0.12	0.27	391	0.43
Southbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru								
Right								

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.50
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.64

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor Del k	d2	Res Del d3	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound												
T	0.67	0.40	17.2	1.000	677	0.50	5.2	0.0	22.4	C	21.4	C
R	0.10	0.40	13.1	1.000	595	0.50	0.3	0.0	13.5	B		
Westbound												
L	0.63	0.59	9.2	1.000	413	0.21	3.0	0.0	12.2	B		
T	0.41	0.59	7.9	1.000	992	0.50	1.3	0.0	9.2	A	10.4	B
Northbound												
L	0.45	0.27	21.1	1.000	422	0.11	0.8	0.0	21.9	C		
											21.8	C
R	0.43	0.27	21.0	1.000	391	0.11	0.8	0.0	21.8	C		
Southbound												

Intersection delay = 16.7 (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                          70.0    sec
Total actual green time for LT lane group, G (s)              41.0
Effective permitted green time for LT lane group, g(s)        33.0
Opposing effective green time, go (s)                         28.0
Number of lanes in LT lane group, N                           1
Number of lanes in opposing approach, No                      1
Adjusted LT flow rate, VLT (veh/h)                            259
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)                       453
Lost time for LT lane group, tL                               5.00
Computation
LT volume per cycle, LTC=VLTC/3600                            5.04
Opposing lane util. factor, fLUo                     1.000 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)           8.81
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]                  0.60
gq, (see Exhibit C16-4,5,6,7,8)                               14.12
gu=g-gq if gq>=gf, or = g-gf if gq<gf                         18.88
n=Max(gq-gf)/2,0)                                             7.06
PTHo=1-PLTo                                                   1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]                            1.00
EL1 (refer to Exhibit C16-3)                                  1.99
EL2=Max((1-Ptho**n)/Plto, 1.0)
fmin=2(1+PL)/g  or  fmin=2(1+Pl)/g                            0.12
gdiff=max(gq-gf,0)                                            0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)           0.29
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                                     0.287

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                          70.0    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                     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	70.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v			259		
v/c ratio from Capacity Worksheet, X			0.63		
Protected phase effective green interval, g (s)			8.0		
Opposing queue effective green interval, gq			14.12		
Unopposed green interval, gu			18.88		
Red time r=(C-g-gq-gu)			29.0		
Arrival rate, qa=v/(3600(max[X,1.0]))			0.07		
Protected ph. departure rate, Sp=s/3600			0.447		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)			0.24		
XPerm			0.53		
XProt			0.74		
Case			1		
Queue at beginning of green arrow, Qa			2.09		
Queue at beginning of unsaturated green, Qu			1.02		
Residual queue, Qr			0.00		
Uniform Delay, d1			9.2		

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 16.7 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound			Northbound			Southbound		
LaneGroup		T	R	L	T		L	R			
Init Queue		0.0	0.0	0.0	0.0		0.0	0.0			
Flow Rate		453	60	259	411		188	167			
So		1900	1900	1900	1900		1900	1900			
No.Lanes	0	1	1	1	1	0	1	0 1	0	0	0
SL		1693	1487	705	1693		1555	1439			
LnCapacity		677	595	413	992		422	391			
Flow Ratio		0.27	0.04	0.37	0.24		0.12	0.12			
v/c Ratio		0.67	0.10	0.63	0.41		0.45	0.43			
Grn Ratio		0.40	0.40	0.59	0.59		0.27	0.27			
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		7.2	0.7	2.2	4.4		3.0	2.7			
kB		0.7	0.7	0.3	1.0		0.4	0.3			
Q2		1.4	0.1	0.6	0.7		0.3	0.2			
Q Average		8.6	0.8	2.8	5.0		3.3	2.9			
Q Spacing		24.9	24.9	24.9	24.9		24.9	24.9			
Q Storage		500	200	200	500		150	150			
Q S Ratio		0.4	0.1	0.4	0.3		0.5	0.5			
70th Percentile Output:											
fB%		1.2	1.3	1.2	1.2		1.2	1.2			
BOQ		10.5	1.0	3.4	6.2		3.9	3.5			
QSRatio		0.5	0.1	0.4	0.3		0.7	0.6			
85th Percentile Output:											
fB%		1.5	1.7	1.6	1.5		1.6	1.6			
BOQ		12.5	1.3	4.4	7.6		5.2	4.6			
QSRatio		0.6	0.2	0.6	0.4		0.9	0.8			
90th Percentile Output:											
fB%		1.6	1.9	1.7	1.7		1.7	1.7			
BOQ		13.7	1.5	4.9	8.5		5.8	5.1			
QSRatio		0.7	0.2	0.6	0.4		1.0	0.8			
95th Percentile Output:											
fB%		1.8	2.5	2.0	2.0		2.0	2.0			
BOQ		15.3	2.0	5.7	9.9		6.6	5.9			
QSRatio		0.8	0.2	0.7	0.5		1.1	1.0			
98th Percentile Output:											
fB%		2.0	3.0	2.5	2.2		2.5	2.5			
BOQ		17.0	2.4	7.1	11.3		8.2	7.3			
QSRatio		0.8	0.3	0.9	0.6		1.4	1.2			

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: Walter Lublanecki
Agency: Lublanecki Engineering, Inc.
Date: 11/20/05
Period: Saturday Peak Hour
Project ID: Bethworks Now Traffic Impact Study
E/W St: East 3rd Street (SR 412)
Inter.: E. 3rd St. (SR 412)/Hayes Ave.
Area Type: CBD or Similar
Jurisd: City
Year : No-Build
N/S St: Hayes Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	1	1	1	0	1	0	1	0	0	0
LGConfig		T	R	L	T		L		R			
Volume		430	57	232	390		169		264			
Lane Width		12.0	13.0	12.0	12.0		11.0		12.0			
RTOR Vol			0						100			

Duration 0.25 Area Type: CBD or Similar

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	A	P			SB Left				
Thru	P	P			Thru				
Right					Right				
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	8.0	28.0				19.0			
Yellow	3.0	3.0				3.0			
All Red	2.0	2.0				2.0			

Cycle Length: 70.0 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								
T	677	1693	0.71	0.40	23.7	C	22.5	C
R	595	1487	0.11	0.40	13.5	B		
Westbound								
L	395	1608	0.69	0.59	14.8	B		
T	992	1693	0.44	0.59	9.5	A	11.5	B
Northbound								
L	422	1555	0.47	0.27	22.1	C		
							22.1	C
R	391	1439	0.47	0.27	22.1	C		
Southbound								

Intersection Delay = 17.7 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: Walter Lublanecki
Agency/Co.: Lublanecki Engineering, Inc.
Date Performed: 11/20/05
Analysis Time Period: Saturday Peak Hour
Intersection: E. 3rd St. (SR 412)/Hayes Ave.
Area Type: CBD or Similar
Jurisdiction: City
Analysis Year: No-Build
Project ID: Bethworks Now Traffic Impact Study

East/West Street	North/South Street
East 3rd Street (SR 412)	Hayes Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		430	57	232	390		169		264			
% Heavy Veh		1	1	1	1		1		1			
PHF		0.90	0.90	0.85	0.90		0.85		0.90			
PK 15 Vol		119	16	68	108		50		73			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900	1900	1900	1900		1900		1900			
ParkExist												
NumPark												
No. Lanes	0	1	1		1	1	0		1	0	1	0		0	0	0
LGConfig		T	R	L		T		L			R					
Lane Width		12.0	13.0	12.0	12.0		11.0		12.0			
RTOR Vol			0						100			
Adj Flow		478	63	273	433		199		182			
%InSharedLn												
Prop LTs		0.000		1.000	0.000							
Prop RTs		0.000	1.000		0.000				1.000			
Peds Bikes	0							0			0					
Buses		0	0	0	0		0		0			
%InProtPhase					0.0							

Duration 0.25 Area Type: CBD or Similar

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	A		
Thru		P			Thru			
Right		P			Right	A		
Peds					Peds			
WB Left		A	P		SB Left			
Thru		P	P		Thru			
Right					Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green		8.0	28.0			19.0		
Yellow		3.0	3.0			3.0		
All Red		2.0	2.0			2.0		

Cycle Length: 70.0 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		430	57	232	390		169		264			
PHF		0.90	0.90	0.85	0.90		0.85		0.90			
Adj flow		478	63	273	433		199		182			
No. Lanes	0	1	1		1	1	0		1	0	1	0		0	0	0
Lane group		T	R	L		T		L			R					
Adj flow		478	63	273	433		199		182			
Prop LTs		0.000		1.000	0.000							
Prop RTs		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	T	R		L	T		L		R			
So	1900	1900		1900	1900		1900		1900			
Lanes 0	1	1		1	1	0	1	0	1	0	0	0
fW	1.000	1.033		1.000	1.000		0.967		1.000			
fHV	0.990	0.990		0.990	0.990		0.990		0.990			

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	0.900	0.900	0.900	0.900	0.900	0.900
fLU	1.000	1.000	1.000	1.000	1.000	1.000
fRT	1.000	0.850		1.000		0.850
fLT	1.000		0.950	1.000	0.950	
Sec.			0.265			
fLpb	1.000		1.000	1.000	1.000	
fRpb	1.000	1.000		1.000		1.000
S	1693	1487	1608	1693	1555	1439
Sec.			448			

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	T	478	1693	#	0.28	0.40	677	0.71
Right	R	63	1487		0.04	0.40	595	0.11
Westbound								
Prot		184	1608	#	0.11	0.114	184	1.00
Perm		89	448		0.20	0.471	211	0.42
Left	L	273				0.59	395	0.69
Prot								
Perm								
Thru	T	433	1693		0.26	0.59	992	0.44
Right								
Northbound								
Prot								
Perm								
Left	L	199	1555	#	0.13	0.27	422	0.47
Prot								
Perm								
Thru								
Right	R	182	1439		0.13	0.27	391	0.47
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 = 15.00 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 Del k	d2	Res Del d3	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound												
T	0.71	0.40	17.6	1.000	677	0.50	6.1	0.0	23.7	C	22.5	C
R	0.11	0.40	13.2	1.000	595	0.50	0.4	0.0	13.5	B		
Westbound												
L	0.69	0.59	9.7	1.000	395	0.26	5.1	0.0	14.8	B		
T	0.44	0.59	8.1	1.000	992	0.50	1.4	0.0	9.5	A	11.5	B
Northbound												
L	0.47	0.27	21.3	1.000	422	0.11	0.8	0.0	22.1	C		
											22.1	C
R	0.47	0.27	21.3	1.000	391	0.11	0.9	0.0	22.1	C		
Southbound												

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		

```
Cycle length, C                          70.0    sec
Total actual green time for LT lane group, G (s)              41.0
Effective permitted green time for LT lane group, g(s)        33.0
Opposing effective green time, go (s)                         28.0
Number of lanes in LT lane group, N                           1
Number of lanes in opposing approach, No                      1
Adjusted LT flow rate, VLT (veh/h)                            273
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)                       478
Lost time for LT lane group, tL                               5.00
Computation
LT volume per cycle, LTC=VLTC/3600                            5.31
Opposing lane util. factor, fLUo                     1.000 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)           9.29
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]                  0.60
gq, (see Exhibit C16-4,5,6,7,8)                               15.19
gu=g-gq if gq>=gf, or = g-gf if gq<gf                         17.81
n=Max(gq-gf)/2,0)                                             7.59
PTHo=1-PLTo                                                   1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]                            1.00
EL1 (refer to Exhibit C16-3)                                  2.04
EL2=Max((1-Ptho**n)/Plto, 1.0)
fmin=2(1+PL)/g  or  fmin=2(1+Pl)/g                            0.12
gdiff=max(gq-gf,0)                                            0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)           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                                     0.265

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                          70.0    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                     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	70.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v			273		
v/c ratio from Capacity Worksheet, X			0.69		
Protected phase effective green interval, g (s)			8.0		
Opposing queue effective green interval, gq			15.19		
Unopposed green interval, gu			17.81		
Red time r=(C-g-gq-gu)			29.0		
Arrival rate, qa=v/(3600(max[X,1.0]))			0.08		
Protected ph. departure rate, Sp=s/3600			0.447		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)			0.23		
XPerm			0.61		
XProt			0.79		
Case			1		
Queue at beginning of green arrow, Qa			2.20		
Queue at beginning of unsaturated green, Qu			1.15		
Residual queue, Qr			0.00		
Uniform Delay, d1			9.7		

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 17.7 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound			Northbound			Southbound		
LaneGroup		T	R	L	T		L		R			
Init Queue		0.0	0.0	0.0	0.0		0.0		0.0			
Flow Rate		478	63	273	433		199		182			
So		1900	1900	1900	1900		1900		1900			
No.Lanes	0	1	1	1	1	0	1	0	1	0	0	0
SL		1693	1487	674	1693		1555		1439			
LnCapacity		677	595	395	992		422		391			
Flow Ratio		0.28	0.04	0.41	0.26		0.13		0.13			
v/c Ratio		0.71	0.11	0.69	0.44		0.47		0.47			
Grn Ratio		0.40	0.40	0.59	0.59		0.27		0.27			
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		7.8	0.8	2.4	4.7		3.2		3.0			
kB		0.7	0.7	0.3	1.0		0.4		0.3			
Q2		1.6	0.1	0.7	0.7		0.3		0.3			
Q Average		9.4	0.8	3.1	5.4		3.5		3.2			
Q Spacing		24.9	24.9	24.9	24.9		24.9		24.9			
Q Storage		500	200	200	500		150		150			
Q S Ratio		0.5	0.1	0.4	0.3		0.6		0.5			
70th Percentile Output:												
fB%		1.2	1.3	1.2	1.2		1.2		1.2			
BOQ		11.4	1.1	3.7	6.7		4.2		3.9			
QSRatio		0.6	0.1	0.5	0.3		0.7		0.6			
85th Percentile Output:												
fB%		1.4	1.7	1.6	1.5		1.6		1.6			
BOQ		13.6	1.4	4.9	8.1		5.6		5.1			
QSRatio		0.7	0.2	0.6	0.4		0.9		0.8			
90th Percentile Output:												
fB%		1.6	1.9	1.7	1.7		1.7		1.7			
BOQ		14.8	1.6	5.4	9.0		6.2		5.6			
QSRatio		0.7	0.2	0.7	0.5		1.0		0.9			
95th Percentile Output:												
fB%		1.8	2.4	2.0	1.9		2.0		2.0			
BOQ		16.5	2.1	6.2	10.5		7.1		6.5			
QSRatio		0.8	0.3	0.8	0.5		1.2		1.1			
98th Percentile Output:												
fB%		1.9	3.0	2.5	2.2		2.5		2.5			
BOQ		18.2	2.5	7.7	12.0		8.7		8.0			
QSRatio		0.9	0.3	1.0	0.6		1.4		1.3			

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: Walter Lublanecki
Agency: Lublanecki Engineering, Inc.
Date: 11/20/05
Period: Saturday Peak Hour
Project ID: Bethworks Now Traffic Impact Study
E/W St: East 3rd Street (SR 412)

Inter.: E. 3rd St. (SR 412)/Hayes Ave.
Area Type: CBD or Similar
Jurisd: City
Year : Build
N/S St: Hayes Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	1	1	1	0	1	0	1	0	0	0
LGConfig		T	R	L	T		L		R			
Volume		710	57	392	653		169		435			
Lane Width		12.0	13.0	12.0	12.0		11.0		12.0			
RTOR Vol			0						100			

Duration 0.25 Area Type: CBD or Similar

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	A	P			SB Left				
Thru	P	P			Thru				
Right					Right				
Peds					Peds				
NB Right	A				EB Right				
SB Right					WB Right				
Green	20.0	40.0				14.0			
Yellow	3.0	4.0				3.0			
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 Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
T	752	1693	0.99	0.44	56.1	E	52.9	D
R	661	1487	0.10	0.44	14.8	B		
Westbound								
L	437	1608	1.00	0.72	70.7	E		
T	1223	1693	0.56	0.72	7.7	A	32.2	C
Northbound								
L	242	1555	0.82	0.16	56.7	E		
							33.5	C
R	624	1439	0.60	0.43	21.0	C		
Southbound								

Intersection Delay = 39.2 (sec/veh) Intersection LOS = D

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: Walter Lublanecki
Agency/Co.: Lublanecki Engineering, Inc.
Date Performed: 11/20/05
Analysis Time Period: Saturday Peak Hour
Intersection: E. 3rd St. (SR 412)/Hayes Ave.
Area Type: CBD or Similar
Jurisdiction: City
Analysis Year: Build
Project ID: Bethworks Now Traffic Impact Study

East/West Street: East 3rd Street (SR 412)
North/South Street: Hayes Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		710	57	392	653		169		435			
% Heavy Veh		1	1	1	1		1		1			
PHF		0.95	0.90	0.90	0.95		0.85		0.90			
PK 15 Vol		187	16	109	172		50		121			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900	1900	1900	1900		1900		1900			
ParkExist												
NumPark												
No. Lanes	0	1	1		1	1	0	1	0	1	0	0	0
LGConfig		T	R	L		T		L		R		
Lane Width		12.0	13.0	12.0	12.0			11.0		12.0		
RTOR Vol			0							100		
Adj Flow		747	63	436	687			199		372		
%InSharedLn												
Prop LTs		0.000		1.000	0.000							
Prop RTs		0.000	1.000		0.000				1.000			
Peds Bikes	0							0			0	
Buses		0	0	0	0			0		0		
%InProtPhase					0.0							

Duration 0.25 Area Type: CBD or Similar

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	A		
Thru		P			Thru			
Right		P			Right	A		
Peds					Peds			
WB Left		A	P		SB Left			
Thru		P	P		Thru			
Right					Right			
Peds					Peds			
NB Right		A			EB Right			
SB Right					WB Right			
Green		20.0	40.0			14.0		
Yellow		3.0	4.0			3.0		
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		710	57	392	653		169		435			
PHF		0.95	0.90	0.90	0.95		0.85		0.90			
Adj flow		747	63	436	687		199		372			
No. Lanes	0	1	1		1	1	0	1	0	1	0	0	0
Lane group		T	R	L	T			L		R		
Adj flow		747	63	436	687			199		372		
Prop LTs		0.000		1.000	0.000							
Prop RTs		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	T		R	L	T		L		R			
So	1900		1900	1900	1900		1900		1900			
Lanes 0	1		1	1	1	0	1	0	1	0	0	0
fW	1.000		1.033	1.000	1.000		0.967		1.000			
fHV	0.990		0.990	0.990	0.990		0.990		0.990			

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	0.900	0.900	0.900	0.900	0.900	0.900
fLU	1.000	1.000	1.000	1.000	1.000	1.000
fRT	1.000	0.850		1.000		0.850
fLT	1.000		0.950	1.000	0.950	
Sec.			0.089			
fLpb	1.000		1.000	1.000	1.000	
fRpb	1.000	1.000		1.000		1.000
S	1693	1487	1608	1693	1555	1439
Sec.			150			

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	T	747	1693		0.44	0.44	752	0.99
Right	R	63	1487		0.04	0.44	661	0.10
Westbound								
Prot		357	1608	#	0.22	0.222	357	1.00
Perm		79	150	#	0.53	0.500	80	0.99
Left	L	436				0.72	437	1.00
Prot								
Perm								
Thru	T	687	1693		0.41	0.72	1223	0.56
Right								
Northbound								
Prot								
Perm								
Left	L	199	1555	#	0.13	0.16	242	0.82
Prot								
Perm								
Thru								
Right	R	372	1439		0.26	0.43	624	0.60
Southbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru								
Right								

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.88
Total lost time per cycle, L = 11.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.00

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor Del k	d2	Res Del d3	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound												
T	0.99	0.44	24.9	1.000	752	0.50	31.2	0.0	56.1	E	52.9	D
R	0.10	0.44	14.5	1.000	661	0.50	0.3	0.0	14.8	B		
Westbound												
L	1.00	0.72	28.2	1.000	437	0.50	42.4	0.0	70.7	E		
T	0.56	0.72	5.8	1.000	1223	0.50	1.9	0.0	7.7	A	32.2	C
Northbound												
L	0.82	0.16	36.8	1.000	242	0.36	19.9	0.0	56.7	E		
											33.5	C
R	0.60	0.43	19.5	1.000	624	0.19	1.6	0.0	21.0	C		
Southbound												

Intersection delay = 39.2 (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		

```
Cycle length, C                          90.0    sec
Total actual green time for LT lane group, G (s)              65.0
Effective permitted green time for LT lane group, g(s)        45.0
Opposing effective green time, go (s)                         40.0
Number of lanes in LT lane group, N                           1
Number of lanes in opposing approach, No                      1
Adjusted LT flow rate, VLT (veh/h)                            436
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)                       747
Lost time for LT lane group, tL                               6.00
Computation
LT volume per cycle, LTC=VLTC/3600                            10.90
Opposing lane util. factor, fLUo                     1.000 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)           18.67
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]                  0.56
gq, (see Exhibit C16-4,5,6,7,8)                               35.47
gu=g-gq if gq>=gf, or = g-gf if gq<gf                         9.53
n=Max(gq-gf)/2,0)                                             17.74
PTHo=1-PLTo                                                   1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]                            1.00
EL1 (refer to Exhibit C16-3)                                  2.62
EL2=Max((1-Ptho**n)/Plto, 1.0)
fmin=2(1+PL)/g  or  fmin=2(1+Pl)/g                            0.09
gdiff=max(gq-gf,0)                                            0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)           0.09
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

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
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
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			436		
v/c ratio from Capacity Worksheet, X			1.00		
Protected phase effective green interval, g (s)			20.0		
Opposing queue effective green interval, gq			35.47		
Unopposed green interval, gu			9.53		
Red time r=(C-g-gq-gu)			25.0		
Arrival rate, qa=v/(3600(max[X,1.0]))			0.12		
Protected ph. departure rate, Sp=s/3600			0.447		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)			0.20		
XPerm			2.91		
XProt			0.61		
Case			3		
Queue at beginning of green arrow, Qa			6.60		
Queue at beginning of unsaturated green, Qu			4.30		
Residual queue, Qr			3.58		
Uniform Delay, d1			28.2		

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 39.2 sec/veh Intersection LOS D

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound			Northbound			Southbound		
LaneGroup		T	R	L	T		L	R			
Init Queue		0.0	0.0	0.0	0.0		0.0	0.0			
Flow Rate		747	63	436	687		199	372			
So		1900	1900	1900	1900		1900	1900			
No.Lanes	0	1	1	1	1	0	1	0 1	0	0	0
SL		1693	1487	599	1693		1555	1439			
LnCapacity		752	661	437	1223		242	624			
Flow Ratio		0.44	0.04	0.73	0.41		0.13	0.26			
v/c Ratio		0.99	0.10	1.00	0.56		0.82	0.60			
Grn Ratio		0.44	0.44	0.72	0.72		0.16	0.43			
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		18.6	0.9	3.9	8.0		4.8	7.1			
kB		0.9	0.9	0.4	1.3		0.3	0.5			
Q2		9.0	0.1	4.7	1.6		1.1	0.7			
Q Average		27.6	1.0	8.6	9.7		5.9	7.9			
Q Spacing		24.9	24.9	24.9	24.9		24.9	24.9			
Q Storage		500	200	500	500		150	150			
Q S Ratio		1.4	0.1	0.4	0.5		1.0	1.3			
70th Percentile Output:											
fB%		1.2	1.3	1.2	1.2		1.2	1.2			
BOQ		33.2	1.3	10.2	11.7		7.1	9.3			
QSRatio		1.7	0.2	0.5	0.6		1.2	1.5			
85th Percentile Output:											
fB%		1.4	1.6	1.5	1.4		1.5	1.5			
BOQ		38.7	1.7	13.1	14.0		9.2	12.0			
QSRatio		1.9	0.2	0.7	0.7		1.5	2.0			
90th Percentile Output:											
fB%		1.5	1.9	1.7	1.6		1.7	1.7			
BOQ		41.5	1.9	14.3	15.2		10.1	13.1			
QSRatio		2.1	0.2	0.7	0.8		1.7	2.2			
95th Percentile Output:											
fB%		1.6	2.4	1.9	1.7		1.9	1.9			
BOQ		44.3	2.4	16.1	16.9		11.5	14.8			
QSRatio		2.2	0.3	0.8	0.8		1.9	2.5			
98th Percentile Output:											
fB%		1.7	2.9	2.2	1.9		2.3	2.2			
BOQ		47.1	2.9	19.1	18.5		13.9	17.6			
QSRatio		2.3	0.4	0.9	0.9		2.3	2.9			

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: Walter Lublanecki
Agency: Lublanecki Engineering, Inc.
Date: 11/20/05
Period: PM Peak Hour
Project ID: Bethworks Now Traffic Impact Study
E/W St: Broad Street

Inter.: Broad Street/Stefko Blvd
Area Type: CBD or Similar
Jurisd: City
Year : Existing
N/S St: Stefko Boulevard

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	1	0	1	0	1	2	0	1	2	0
LGConfig		LT	R		LTR		L	TR		L	TR	
Volume	186	1	343	1	2	1	148	653	1	1	592	158
Lane Width		12.0	13.0		15.0		12.0	12.0		12.0	12.0	
RTOR Vol			100			0			0			0

Duration 0.25 Area Type: CBD or Similar

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A				NB Left	A			
Thru	A				Thru	P	P		
Right	A				Right	P	P		
Peds	X				Peds				
WB Left	A				SB Left		P		
Thru	A				Thru		P		
Right	A				Right		P		
Peds	X				Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	18.0					12.0	25.0		
Yellow	4.0					3.0	4.0		
All Red	2.0						2.0		

Cycle Length: 70.0 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	316	1228	0.62	0.26	26.8	C	28.4	C
R	382	1487	0.71	0.26	29.5	C		
Westbound								
LTR	436	1697	0.01	0.26	19.4	B	19.4	B
Northbound								
L	273	1593	0.64	0.17	31.9	C		
TR	1842	3223	0.39	0.57	8.9	A	13.4	B
Southbound								
L	228	637	0.00	0.36	14.5	B		
TR	1113	3116	0.85	0.36	29.2	C	29.2	C

Intersection Delay = 22.9 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

Walter Lublanecki
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OPERATIONAL ANALYSIS

Analyst: Walter Lublanecki
Agency/Co.: Lublanecki Engineering, Inc.
Date Performed: 11/20/05
Analysis Time Period: PM Peak Hour
Intersection: Broad Street/Stefko Blvd
Area Type: CBD or Similar
Jurisdiction: City
Analysis Year: Existing
Project ID: Bethworks Now Traffic Impact Study

East/West Street	North/South Street
Broad Street	Stefko Boulevard

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	186	1	343	1	2	1	148	653	1	1	592	158
% Heavy Veh	1	1	1	1	1	1	2	1	1	1	1	1
PHF	0.95	0.85	0.90	0.85	0.85	0.85	0.85	0.90	0.85	0.85	0.80	0.75
PK 15 Vol	49	1	95	1	1	1	44	181	1	1	185	53
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900	1900		1900		1900	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	0	1	1	0	1	0	1	2	0	1	2	0
LGConfig		LT	R		LTR		L	TR		L	TR	
Lane Width		12.0	13.0		15.0		12.0	12.0		12.0	12.0	
RTOR Vol			100			0			0			0
Adj Flow		197	270		4		174	727		1	951	
%InSharedLn												
Prop LTs		0.995			0.250			0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.250			0.001			0.222	
Peds Bikes	0		0	0		0	0			0		
Buses		0	0		0		0	0		0	0	
%InProtPhase												
Duration	0.25			Area Type: CBD or Similar								

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	
Arriv. Type		3	3		3		3	3		3	3	
Unit Ext.		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	
Ext of g		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	P	P	
Right	A				Right	P	P	
Peds	X				Peds			
WB Left	A				SB Left	P		
Thru	A				Thru	P		
Right	A				Right	P		
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	18.0				12.0	25.0		
Yellow	4.0				3.0	4.0		
All Red	2.0					2.0		

Cycle Length: 70.0 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	186	1	343	1	2	1	148	653	1	1	592	158
PHF	0.95	0.85	0.90	0.85	0.85	0.85	0.85	0.90	0.85	0.85	0.80	0.75
Adj flow	196	1	270	1	2	1	174	726	1	1	740	211
No. Lanes	0	1	1	0	1	0	1	2	0	1	2	0
Lane group		LT	R		LTR		L	TR		L	TR	
Adj flow		197	270		4		174	727		1	951	
Prop LTs		0.995			0.250			0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.250			0.001			0.222	

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

	Eastbound			Westbound			Northbound			Southbound		
LG		LT	R		LTR		L	TR		L	TR	
So		1900	1900		1900		1900	1900		1900	1900	
Lanes 0	1		1	0	1	0	1		2	0	1	2	0
fW		1.000	1.033		1.100			1.000	1.000		1.000	1.000
fHV		0.990	0.990		0.990			0.980	0.990		0.990	0.990

fG	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
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fA	0.900	0.900	0.900	0.900	0.900	0.900	0.900
fLU	1.000	1.000	1.000	1.000	0.952	1.000	0.952
fRT	1.000	0.850	0.966		1.000		0.967
fLT	0.725		0.943	0.950	1.000	0.376	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	1228	1487	1697	1593	3223	637	3116
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	197	1228		0.16	0.26	316	0.62
Right	R	270	1487	#	0.18	0.26	382	0.71
Westbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru	LTR	4	1697		0.00	0.26	436	0.01
Right								
Northbound								
Prot								
Perm								
Left	L	174	1593	#	0.11	0.17	273	0.64
Prot								
Perm								
Thru	TR	727	3223		0.23	0.57	1842	0.39
Right								
Southbound								
Prot								
Perm								
Left	L	1	637		0.00	0.36	228	0.00
Prot								
Perm								
Thru	TR	951	3116	#	0.31	0.36	1113	0.85
Right								

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.60
Total lost time per cycle, L = 15.00 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	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor Del k	d2	Res Del d3	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound												
LT	0.62	0.26	23.0	1.000	316	0.21	3.8	0.0	26.8	C	28.4	C
R	0.71	0.26	23.6	1.000	382	0.27	5.9	0.0	29.5	C		
Westbound												
LTR	0.01	0.26	19.4	1.000	436	0.11	0.0	0.0	19.4	B	19.4	B
Northbound												
L	0.64	0.17	27.0	1.000	273	0.22	4.9	0.0	31.9	C		
TR	0.39	0.57	8.3	1.000	1842	0.50	0.6	0.0	8.9	A	13.4	B
Southbound												
L	0.00	0.36	14.5	1.000	228	0.50	0.0	0.0	14.5	B		
TR	0.85	0.36	20.8	1.000	1113	0.50	8.4	0.0	29.2	C	29.2	C

Intersection delay = 22.9 (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

Cycle length, C	70.0 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)					40.0
Number of lanes in LT lane group, N					1
Number of lanes in opposing approach, No					2
Adjusted LT flow rate, VLT (veh/h)					1
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)					727
Lost time for LT lane group, tL					6.00
Computation					
LT volume per cycle, LTC=VLTC/3600					0.02
Opposing lane util. factor, fLUo		1.000	1.000	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)					7.42
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]					0.43
gq, (see Exhibit C16-4,5,6,7,8)					0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf					25.00
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)					2.66
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)					0.38
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					0.376

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		S	M		
Cycle length, C	70.0 sec				
Total actual green time for LT lane group, G (s)		18.0	18.0		
Effective permitted green time for LT lane group, g(s)		18.0	18.0		
Opposing effective green time, go (s)		18.0	18.0		
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)		196	1		
Proportion of LT in LT lane group, PLT		0.995	0.250	0.000	0.000
Proportion of LT in opposing flow, PLTo		0.25	0.99		
Adjusted opposing flow rate, Vo (veh/h)		4	197		
Lost time for LT lane group, tL		6.00	6.00		
Computation					
LT volume per cycle, LTC=VLTC/3600		3.81	0.02		
Opposing lane util. factor, fLUo		1.000	1.000	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		0.08	3.83		
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g		0.0	11.1		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.74	0.74		
gq, (see Exhibit C16-4,5,6,7,8)		0.00	4.03		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		18.00	6.92		
n=Max(gq-gf)/2,0)		0.00	0.00		
PTHo=1-PLTo		0.75	0.01		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.99	0.25		
EL1 (refer to Exhibit C16-3)		1.38	1.69		
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00	1.00		
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.22	0.14		
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	0.94		
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	0.943		

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)	18.0	18.0		
Conflicting pedestrian volume, Vped (p/h)	0	0		
Pedestrian flow rate, Vpedg (p/h)	0	0		
OCCpedg	0.000	0.000		
Opposing queue clearing green, gq (s)	0.00	4.03		
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.224		
OCCpedu	0.000	0.000		
Opposing flow rate, Vo (veh/h)	4	197		
OCCr	0.000	0.000		
Number of cross-street receiving lanes, Nrec	2	2		
Number of turning lanes, Nturn	1	1		
ApbT	1.000	1.000		
Proportion of left turns, PLT	0.995	0.250		
Proportion of left turns using protected phase, PLTA	0.000	0.000		
Left-turn adjustment, fLpb	1.000	1.000		

Permitted Right Turns

Effective pedestrian green time, gp (s)	18.0	18.0		
Conflicting pedestrian volume, Vped (p/h)	0	0		
Conflicting bicycle volume, Vbic (bicycles/h)	0	0		
Vpedg	0	0		
OCCpedg	0.000	0.000		
Effective green, g (s)	18.0	18.0		
Vbicg	0	0		
OCCbicg	0.020	0.020		
OCCr	0.000	0.000		
Number of cross-street receiving lanes, Nrec	2	2		
Number of turning lanes, Nturn	1	1		
ApbT	1.000	1.000		
Proportion right-turns, PRT	1.000	0.250		
Proportion right-turns using protected phase, PRTA	0.000	0.000		
Right turn adjustment, fRpb		1.000		

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C 70.0 sec

	EBLT	WBLT	NBLT	SBLT
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 22.9 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LT	R	LTR		L	TR	L	TR
Init Queue	0.0	0.0	0.0		0.0	0.0	0.0	0.0
Flow Rate	197	270	4		174	381	1	499
So	1900	1900	1900		1900	1900	1900	1900
No.Lanes	0 1	1	0 1	0	1	2 0	1	2 0
SL	1228	1487	1697		1593	1692	637	1636
LnCapacity	316	382	436		273	967	228	584
Flow Ratio	0.16	0.18	0.00		0.11	0.23	0.00	0.31
v/c Ratio	0.62	0.71	0.01		0.64	0.39	0.00	0.85
Grn Ratio	0.26	0.26	0.26		0.17	0.57	0.36	0.36
I Factor	1.000		1.000			1.000		1.000
AT or PVG	3	3	3		3	3	3	3
Pltn Ratio	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
Q1	3.4	4.8	0.1		3.1	4.1	0.0	9.0
kB	0.3	0.3	0.4		0.3	0.9	0.3	0.7
Q2	0.5	0.8	0.0		0.5	0.6	0.0	3.0
Q Average	3.9	5.5	0.1		3.6	4.7	0.0	12.0
Q Spacing	24.9	24.9	24.9		24.9	24.9	24.9	24.9
Q Storage	500	200	100		150	500	150	500
Q S Ratio	0.2	0.7	0.0		0.6	0.2	0.0	0.6
70th Percentile Output:								
fB%	1.2	1.2	1.2		1.2	1.2	1.3	1.2
BOQ	4.6	6.6	0.1		4.3	5.8	0.0	14.5
QSRatio	0.2	0.8	0.0		0.7	0.3	0.0	0.7
85th Percentile Output:								
fB%	1.6	1.5	1.6		1.6	1.5	1.7	1.4
BOQ	6.0	8.6	0.1		5.7	7.1	0.0	17.1
QSRatio	0.3	1.1	0.0		0.9	0.4	0.0	0.9
90th Percentile Output:								
fB%	1.7	1.7	1.8		1.7	1.7	2.0	1.5
BOQ	6.7	9.4	0.1		6.3	8.0	0.0	18.5
QSRatio	0.3	1.2	0.0		1.0	0.4	0.0	0.9
95th Percentile Output:								
fB%	2.0	1.9	2.1		2.0	2.0	2.6	1.7
BOQ	7.7	10.7	0.1		7.2	9.4	0.0	20.3
QSRatio	0.4	1.3	0.0		1.2	0.5	0.0	1.0
98th Percentile Output:								
fB%	2.4	2.4	2.7		2.5	2.3	3.2	1.8
BOQ	9.4	13.0	0.2		8.9	10.7	0.0	22.0
QSRatio	0.5	1.6	0.0		1.5	0.5	0.0	1.1

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: Walter Lublanecki
Agency: Lublanecki Engineering, Inc.
Date: 11/20/05
Period: PM Peak Hour
Project ID: Bethworks Now Traffic Impact Study
E/W St: Broad Street

Inter.: Broad Street/Stefko Blvd
Area Type: CBD or Similar
Jurisd: City
Year : No-Build
N/S St: Stefko Boulevard

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	1	0	1	0	1	2	0	1	2	0
LGConfig		LT	R		LTR		L	TR		L	TR	
Volume	196	1	362	1	2	1	156	689	1	1	625	167
Lane Width		12.0	13.0		15.0		12.0	12.0		12.0	12.0	
RTOR Vol			100			0			0			0

Duration 0.25 Area Type: CBD or Similar

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A				NB Left	A			
Thru	A				Thru	P	P		
Right	A				Right	P	P		
Peds	X				Peds				
WB Left	A				SB Left		P		
Thru	A				Thru		P		
Right	A				Right		P		
Peds	X				Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	18.0					12.0	25.0		
Yellow	4.0					3.0	4.0		
All Red	2.0						2.0		

Cycle Length: 70.0 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	316	1228	0.66	0.26	28.1	C	30.8	C
R	382	1487	0.76	0.26	32.8	C		
Westbound								
LTR	436	1695	0.01	0.26	19.4	B	19.4	B
Northbound								
L	273	1593	0.67	0.17	33.6	C		
TR	1842	3223	0.42	0.57	9.1	A	13.9	B
Southbound								
L	219	612	0.00	0.36	14.5	B		
TR	1113	3116	0.90	0.36	33.1	C	33.1	C

Intersection Delay = 25.2 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: Walter Lublanecki
Agency/Co.: Lublanecki Engineering, Inc.
Date Performed: 11/20/05
Analysis Time Period: PM Peak Hour
Intersection: Broad Street/Stefko Blvd
Area Type: CBD or Similar
Jurisdiction: City
Analysis Year: No-Build
Project ID: Bethworks Now Traffic Impact Study

East/West Street: Broad Street
North/South Street: Stefko Boulevard

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	196	1	362	1	2	1	156	689	1	1	625	167
% Heavy Veh	1	1	1	1	1	1	2	1	1	1	1	1
PHF	0.95	0.85	0.90	0.85	0.85	0.85	0.85	0.90	0.85	0.85	0.80	0.75
PK 15 Vol	52	1	101	1	1	1	46	191	1	1	195	56
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900	1900		1900		1900	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	0	1	1	0	1	0	1	2	0	1	2	0
LGConfig		LT	R		LTR		L	TR		L	TR	
Lane Width		12.0	13.0		15.0		12.0	12.0		12.0	12.0	
RTOR Vol			100			0			0			0
Adj Flow		207	291		4		184	767		1	1004	
%InSharedLn												
Prop LTs		0.995			0.250			0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.250			0.001			0.222	
Peds Bikes	0		0	0		0	0			0		
Buses		0	0		0		0	0		0	0	
%InProtPhase												
Duration	0.25			Area Type: CBD or Similar								

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	
Arriv. Type		3	3		3		3	3		3	3	
Unit Ext.		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	
Ext of g		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	P	P	
Right	A				Right	P	P	
Peds	X				Peds			
WB Left	A				SB Left	P		
Thru	A				Thru	P		
Right	A				Right	P		
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	18.0				12.0	25.0		
Yellow	4.0				3.0	4.0		
All Red	2.0					2.0		

Cycle Length: 70.0 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	196	1	362	1	2	1	156	689	1	1	625	167
PHF	0.95	0.85	0.90	0.85	0.85	0.85	0.85	0.90	0.85	0.85	0.80	0.75
Adj flow	206	1	291	1	2	1	184	766	1	1	781	223
No. Lanes	0	1	1	0	1	0	1	2	0	1	2	0
Lane group		LT	R		LTR		L	TR		L	TR	
Adj flow		207	291		4		184	767		1	1004	
Prop LTs		0.995			0.250			0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.250			0.001			0.222	

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

	Eastbound			Westbound			Northbound			Southbound		
LG		LT	R		LTR		L	TR		L	TR	
So		1900	1900		1900		1900	1900		1900	1900	
Lanes 0	1	1	0	1	0		1	2	0	1	2	0
fW		1.000	1.033		1.100			1.000	1.000		1.000	1.000
fHV		0.990	0.990		0.990			0.980	0.990		0.990	0.990

fG	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
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fA	0.900	0.900	0.900	0.900	0.900	0.900	0.900
fLU	1.000	1.000	1.000	1.000	0.952	1.000	0.952
fRT	1.000	0.850	0.966		1.000		0.967
fLT	0.725		0.942	0.950	1.000	0.361	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	1228	1487	1695	1593	3223	612	3116
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	207	1228		0.17	0.26	316	0.66
Right	R	291	1487	#	0.20	0.26	382	0.76
Westbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru	LTR	4	1695		0.00	0.26	436	0.01
Right								
Northbound								
Prot								
Perm								
Left	L	184	1593	#	0.12	0.17	273	0.67
Prot								
Perm								
Thru	TR	767	3223		0.24	0.57	1842	0.42
Right								
Southbound								
Prot								
Perm								
Left	L	1	612		0.00	0.36	219	0.00
Prot								
Perm								
Thru	TR	1004	3116	#	0.32	0.36	1113	0.90
Right								

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.63
Total lost time per cycle, L = 15.00 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	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor Del k	d2	Res Del d3	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound												
LT	0.66	0.26	23.2	1.000	316	0.23	4.8	0.0	28.1	C	30.8	C
R	0.76	0.26	24.0	1.000	382	0.31	8.8	0.0	32.8	C		
Westbound												
LTR	0.01	0.26	19.4	1.000	436	0.11	0.0	0.0	19.4	B	19.4	B
Northbound												
L	0.67	0.17	27.2	1.000	273	0.25	6.4	0.0	33.6	C		
TR	0.42	0.57	8.4	1.000	1842	0.50	0.7	0.0	9.1	A	13.9	B
Southbound												
L	0.00	0.36	14.5	1.000	219	0.50	0.0	0.0	14.5	B		
TR	0.90	0.36	21.3	1.000	1113	0.50	11.8	0.0	33.1	C	33.1	C

Intersection delay = 25.2 (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

Cycle length, C	70.0 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)					40.0
Number of lanes in LT lane group, N					1
Number of lanes in opposing approach, No					2
Adjusted LT flow rate, VLT (veh/h)					1
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)					767
Lost time for LT lane group, tL					6.00
Computation					
LT volume per cycle, LTC=VLTC/3600					0.02
Opposing lane util. factor, fLUo		1.000	1.000	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)					7.83
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]					0.43
gq, (see Exhibit C16-4,5,6,7,8)					0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf					25.00
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)					2.77
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)					0.36
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					0.361

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		S	M		
Cycle length, C	70.0 sec				
Total actual green time for LT lane group, G (s)		18.0	18.0		
Effective permitted green time for LT lane group, g(s)		18.0	18.0		
Opposing effective green time, go (s)		18.0	18.0		
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)		206	1		
Proportion of LT in LT lane group, PLT		0.995	0.250	0.000	0.000
Proportion of LT in opposing flow, PLTo		0.25	1.00		
Adjusted opposing flow rate, Vo (veh/h)		4	207		
Lost time for LT lane group, tL		6.00	6.00		
Computation					
LT volume per cycle, LTC=VLTC/3600		4.01	0.02		
Opposing lane util. factor, fLUo		1.000	1.000	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		0.08	4.03		
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g		0.0	11.1		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.74	0.74		
gq, (see Exhibit C16-4,5,6,7,8)		0.00	4.42		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		18.00	6.92		
n=Max(gq-gf)/2,0)		0.00	0.00		
PTHo=1-PLTo		0.75	0.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00-	0.25		
EL1 (refer to Exhibit C16-3)		1.38	1.71		
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00	1.00		
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.22	0.14		
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	0.94		
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	0.942		

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)	18.0	18.0		
Conflicting pedestrian volume, Vped (p/h)	0	0		
Pedestrian flow rate, Vpedg (p/h)	0	0		
OCCpedg	0.000	0.000		
Opposing queue clearing green, gq (s)	0.00	4.42		
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.246		
OCCpedu	0.000	0.000		
Opposing flow rate, Vo (veh/h)	4	207		
OCCr	0.000	0.000		
Number of cross-street receiving lanes, Nrec	2	2		
Number of turning lanes, Nturn	1	1		
ApbT	1.000	1.000		
Proportion of left turns, PLT	0.995	0.250		
Proportion of left turns using protected phase, PLTA	0.000	0.000		
Left-turn adjustment, fLpb	1.000	1.000		

Permitted Right Turns

Effective pedestrian green time, gp (s)	18.0	18.0		
Conflicting pedestrian volume, Vped (p/h)	0	0		
Conflicting bicycle volume, Vbic (bicycles/h)	0	0		
Vpedg	0	0		
OCCpedg	0.000	0.000		
Effective green, g (s)	18.0	18.0		
Vbicg	0	0		
OCCbicg	0.020	0.020		
OCCr	0.000	0.000		
Number of cross-street receiving lanes, Nrec	2	2		
Number of turning lanes, Nturn	1	1		
ApbT	1.000	1.000		
Proportion right-turns, PRT	1.000	0.250		
Proportion right-turns using protected phase, PRTA	0.000	0.000		
Right turn adjustment, fRpb		1.000		

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 70.0 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 25.2 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound	Northbound		Southbound	
LaneGroup	LT	R	LTR	L	TR	L	TR
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	207	291	4	184	402	1	527
So	1900	1900	1900	1900	1900	1900	1900
No.Lanes	0 1	1	0 1 0	1	2 0	1	2 0
SL	1228	1487	1695	1593	1692	612	1636
LnCapacity	316	382	436	273	967	219	584
Flow Ratio	0.17	0.20	0.00	0.12	0.24	0.00	0.32
v/c Ratio	0.66	0.76	0.01	0.67	0.42	0.00	0.90
Grn Ratio	0.26	0.26	0.26	0.17	0.57	0.36	0.36
I Factor	1.000		1.000		1.000		1.000
AT or PVG	3	3	3	3	3	3	3
Pltn Ratio	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
Q1	3.6	5.2	0.1	3.4	4.4	0.0	9.7
kB	0.3	0.3	0.4	0.3	0.9	0.3	0.7
Q2	0.5	1.0	0.0	0.5	0.7	0.0	3.9
Q Average	4.1	6.2	0.1	3.9	5.1	0.0	13.6
Q Spacing	24.9	24.9	24.9	24.9	24.9	24.9	24.9
Q Storage	500	200	100	150	500	150	500
Q S Ratio	0.2	0.8	0.0	0.6	0.3	0.0	0.7
70th Percentile Output:							
fB%	1.2	1.2	1.2	1.2	1.2	1.3	1.2
BOQ	4.9	7.4	0.1	4.6	6.2	0.0	16.5
QSRatio	0.2	0.9	0.0	0.8	0.3	0.0	0.8
85th Percentile Output:							
fB%	1.6	1.5	1.6	1.6	1.5	1.7	1.4
BOQ	6.5	9.6	0.1	6.1	7.6	0.0	19.4
QSRatio	0.3	1.2	0.0	1.0	0.4	0.0	1.0
90th Percentile Output:							
fB%	1.7	1.7	1.8	1.7	1.7	2.0	1.5
BOQ	7.1	10.5	0.1	6.7	8.5	0.0	20.9
QSRatio	0.4	1.3	0.0	1.1	0.4	0.0	1.0
95th Percentile Output:							
fB%	2.0	1.9	2.1	2.0	2.0	2.6	1.7
BOQ	8.2	12.0	0.1	7.7	9.9	0.0	22.7
QSRatio	0.4	1.5	0.0	1.3	0.5	0.0	1.1
98th Percentile Output:							
fB%	2.4	2.3	2.7	2.4	2.2	3.2	1.8
BOQ	10.0	14.4	0.2	9.5	11.3	0.0	24.5
QSRatio	0.5	1.8	0.0	1.6	0.6	0.0	1.2

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: Walter Lublanecki
Agency: Lublanecki Engineering, Inc.
Date: 11/20/05
Period: PM Peak Hour
Project ID: Bethworks Now Traffic Impact Study
E/W St: Broad Street

Inter.: Broad Street/Stefko Blvd
Area Type: CBD or Similar
Jurisd: City
Year : Build
N/S St: Stefko Boulevard

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	1	0	1	0	1	2	0	1	2	0
LGConfig		LT	R		LTR		L	TR		L	TR	
Volume	196	1	383	1	2	1	165	731	1	1	662	167
Lane Width		12.0	13.0		15.0		12.0	12.0		12.0	12.0	
RTOR Vol			100			0			0			0

Duration 0.25 Area Type: CBD or Similar

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A				NB Left	A			
Thru	A				Thru	P	P		
Right	A				Right	P	P		
Peds	X				Peds				
WB Left	A				SB Left		P		
Thru	A				Thru		P		
Right	A				Right		P		
Peds	X				Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	18.0					12.0	25.0		
Yellow	4.0					3.0	4.0		
All Red	2.0						2.0		

Cycle Length: 70.0 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	316	1228	0.66	0.26	28.1	C	34.0	C
R	382	1487	0.82	0.26	37.9	D		
Westbound								
LTR	436	1695	0.01	0.26	19.4	B	19.4	B
Northbound								
L	273	1593	0.71	0.17	35.7	D		
TR	1842	3223	0.44	0.57	9.4	A	14.4	B
Southbound								
L	209	585	0.00	0.36	14.5	B		
TR	1115	3121	0.94	0.36	37.9	D	37.9	D

Intersection Delay = 28.0 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: Walter Lublanecki
Agency/Co.: Lublanecki Engineering, Inc.
Date Performed: 11/20/05
Analysis Time Period: PM Peak Hour
Intersection: Broad Street/Stefko Blvd
Area Type: CBD or Similar
Jurisdiction: City
Analysis Year: Build
Project ID: Bethworks Now Traffic Impact Study

East/West Street: Broad Street
North/South Street: Stefko Boulevard

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	196	1	383	1	2	1	165	731	1	1	662	167
% Heavy Veh	1	1	1	1	1	1	2	1	1	1	1	1
PHF	0.95	0.85	0.90	0.85	0.85	0.85	0.85	0.90	0.85	0.85	0.80	0.75
PK 15 Vol	52	1	106	1	1	1	49	203	1	1	207	56
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900	1900		1900		1900	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	0	1	1	0	1	0	1	2	0	1	2	0
LGConfig		LT	R		LTR		L	TR		L	TR	
Lane Width		12.0	13.0		15.0		12.0	12.0		12.0	12.0	
RTOR Vol			100			0			0			0
Adj Flow		207	314		4		194	813		1	1050	
%InSharedLn												
Prop LTs		0.995			0.250			0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.250			0.001			0.212	
Peds Bikes	0		0	0		0	0			0		
Buses		0	0		0		0	0		0	0	
%InProtPhase												
Duration	0.25			Area Type: CBD or Similar								

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	
Arriv. Type		3	3		3		3	3		3	3	
Unit Ext.		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	
Ext of g		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	P	P	
Right	A				Right	P	P	
Peds	X				Peds			
WB Left	A				SB Left	P		
Thru	A				Thru	P		
Right	A				Right	P		
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	18.0				12.0	25.0		
Yellow	4.0				3.0	4.0		
All Red	2.0					2.0		

Cycle Length: 70.0 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	196	1	383	1	2	1	165	731	1	1	662	167
PHF	0.95	0.85	0.90	0.85	0.85	0.85	0.85	0.90	0.85	0.85	0.80	0.75
Adj flow	206	1	314	1	2	1	194	812	1	1	827	223
No. Lanes	0	1	1	0	1	0	1	2	0	1	2	0
Lane group		LT	R		LTR		L	TR		L	TR	
Adj flow		207	314		4		194	813		1	1050	
Prop LTs		0.995			0.250			0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.250			0.001			0.212	

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

	Eastbound			Westbound			Northbound			Southbound		
LG		LT	R		LTR		L	TR		L	TR	
So		1900	1900		1900		1900	1900		1900	1900	
Lanes 0	1	1	0	1	0		1	2	0	1	2	0
fW		1.000	1.033		1.100			1.000	1.000		1.000	1.000
fHV		0.990	0.990		0.990			0.980	0.990		0.990	0.990

fG	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
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fA	0.900	0.900	0.900	0.900	0.900	0.900	0.900
fLU	1.000	1.000	1.000	1.000	0.952	1.000	0.952
fRT	1.000	0.850	0.966		1.000		0.968
fLT	0.725		0.942	0.950	1.000	0.345	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	1228	1487	1695	1593	3223	585	3121
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	207	1228		0.17	0.26	316	0.66
Right	R	314	1487	#	0.21	0.26	382	0.82
Westbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru	LTR	4	1695		0.00	0.26	436	0.01
Right								
Northbound								
Prot								
Perm								
Left	L	194	1593	#	0.12	0.17	273	0.71
Prot								
Perm								
Thru	TR	813	3223		0.25	0.57	1842	0.44
Right								
Southbound								
Prot								
Perm								
Left	L	1	585		0.00	0.36	209	0.00
Prot								
Perm								
Thru	TR	1050	3121	#	0.34	0.36	1115	0.94
Right								

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.67
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.85

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor Del k	d2	Res Del d3	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound												
LT	0.66	0.26	23.2	1.000	316	0.23	4.8	0.0	28.1	C	34.0	C
R	0.82	0.26	24.5	1.000	382	0.36	13.5	0.0	37.9	D		
Westbound												
LTR	0.01	0.26	19.4	1.000	436	0.11	0.0	0.0	19.4	B	19.4	B
Northbound												
L	0.71	0.17	27.4	1.000	273	0.27	8.3	0.0	35.7	D		
TR	0.44	0.57	8.6	1.000	1842	0.50	0.8	0.0	9.4	A	14.4	B
Southbound												
L	0.00	0.36	14.5	1.000	209	0.50	0.0	0.0	14.5	B		
TR	0.94	0.36	21.8	1.000	1115	0.50	16.1	0.0	37.9	D	37.9	D

Intersection delay = 28.0 (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	70.0 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)					40.0
Number of lanes in LT lane group, N					1
Number of lanes in opposing approach, No					2
Adjusted LT flow rate, VLT (veh/h)					1
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)					813
Lost time for LT lane group, tL					6.00
Computation					
LT volume per cycle, LTC=VLTC/3600					0.02
Opposing lane util. factor, fLUo		1.000	1.000	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)					8.30
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]					0.43
gq, (see Exhibit C16-4,5,6,7,8)					0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf					25.00
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)					2.89
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)					0.35
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					0.345

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		S	M		
Cycle length, C	70.0 sec				
Total actual green time for LT lane group, G (s)		18.0	18.0		
Effective permitted green time for LT lane group, g(s)		18.0	18.0		
Opposing effective green time, go (s)		18.0	18.0		
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)		206	1		
Proportion of LT in LT lane group, PLT		0.995	0.250	0.000	0.000
Proportion of LT in opposing flow, PLTo		0.25	1.00		
Adjusted opposing flow rate, Vo (veh/h)		4	207		
Lost time for LT lane group, tL		6.00	6.00		
Computation					
LT volume per cycle, LTC=VLTC/3600		4.01	0.02		
Opposing lane util. factor, fLUo		1.000	1.000	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		0.08	4.03		
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g		0.0	11.1		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.74	0.74		
gq, (see Exhibit C16-4,5,6,7,8)		0.00	4.42		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		18.00	6.92		
n=Max(gq-gf)/2,0)		0.00	0.00		
PTHo=1-PLTo		0.75	0.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00-	0.25		
EL1 (refer to Exhibit C16-3)		1.38	1.71		
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00	1.00		
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.22	0.14		
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	0.94		
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	0.942		

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)	18.0	18.0		
Conflicting pedestrian volume, Vped (p/h)	0	0		
Pedestrian flow rate, Vpedg (p/h)	0	0		
OCCpedg	0.000	0.000		
Opposing queue clearing green, gq (s)	0.00	4.42		
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.246		
OCCpedu	0.000	0.000		
Opposing flow rate, Vo (veh/h)	4	207		
OCCr	0.000	0.000		
Number of cross-street receiving lanes, Nrec	2	2		
Number of turning lanes, Nturn	1	1		
ApbT	1.000	1.000		
Proportion of left turns, PLT	0.995	0.250		
Proportion of left turns using protected phase, PLTA	0.000	0.000		
Left-turn adjustment, fLpb	1.000	1.000		

Permitted Right Turns

Effective pedestrian green time, gp (s)	18.0	18.0		
Conflicting pedestrian volume, Vped (p/h)	0	0		
Conflicting bicycle volume, Vbic (bicycles/h)	0	0		
Vpedg	0	0		
OCCpedg	0.000	0.000		
Effective green, g (s)	18.0	18.0		
Vbicg	0	0		
OCCbicg	0.020	0.020		
OCCr	0.000	0.000		
Number of cross-street receiving lanes, Nrec	2	2		
Number of turning lanes, Nturn	1	1		
ApbT	1.000	1.000		
Proportion right-turns, PRT	1.000	0.250		
Proportion right-turns using protected phase, PRTA	0.000	0.000		
Right turn adjustment, fRpb		1.000		

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

		EBLT	WBLT	NBLT	SBLT
Cycle length, C	70.0 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 28.0 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LT	R	LTR		L	TR	L	TR
Init Queue	0.0	0.0	0.0		0.0	0.0	0.0	0.0
Flow Rate	207	314	4		194	426	1	551
So	1900	1900	1900		1900	1900	1900	1900
No.Lanes	0 1	1	0 1	0	1	2 0	1	2 0
SL	1228	1487	1695		1593	1692	585	1639
LnCapacity	316	382	436		273	967	209	585
Flow Ratio	0.17	0.21	0.00		0.12	0.25	0.00	0.34
v/c Ratio	0.66	0.82	0.01		0.71	0.44	0.00	0.94
Grn Ratio	0.26	0.26	0.26		0.17	0.57	0.36	0.36
I Factor	1.000		1.000			1.000		1.000
AT or PVG	3	3	3		3	3	3	3
Pltn Ratio	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
Q1	3.6	5.8	0.1		3.6	4.7	0.0	10.4
kB	0.3	0.3	0.4		0.3	0.9	0.3	0.7
Q2	0.5	1.3	0.0		0.6	0.7	0.0	4.9
Q Average	4.1	7.1	0.1		4.2	5.5	0.0	15.3
Q Spacing	24.9	24.9	24.9		24.9	24.9	24.9	24.9
Q Storage	500	200	100		200	500	200	500
Q S Ratio	0.2	0.9	0.0		0.5	0.3	0.0	0.8
70th Percentile Output:								
fB%	1.2	1.2	1.2		1.2	1.2	1.3	1.2
BOQ	4.9	8.4	0.1		5.0	6.8	0.0	18.5
QSRatio	0.2	1.0	0.0		0.6	0.3	0.0	0.9
85th Percentile Output:								
fB%	1.6	1.5	1.6		1.6	1.5	1.7	1.4
BOQ	6.5	10.9	0.1		6.5	8.2	0.0	21.7
QSRatio	0.3	1.4	0.0		0.8	0.4	0.0	1.1
90th Percentile Output:								
fB%	1.7	1.7	1.8		1.7	1.7	2.0	1.5
BOQ	7.1	11.9	0.1		7.2	9.1	0.0	23.3
QSRatio	0.4	1.5	0.0		0.9	0.5	0.0	1.2
95th Percentile Output:								
fB%	2.0	1.9	2.1		2.0	1.9	2.6	1.6
BOQ	8.2	13.5	0.1		8.3	10.6	0.0	25.2
QSRatio	0.4	1.7	0.0		1.0	0.5	0.0	1.3
98th Percentile Output:								
fB%	2.4	2.3	2.7		2.4	2.2	3.2	1.8
BOQ	10.0	16.1	0.2		10.2	12.1	0.0	27.1
QSRatio	0.5	2.0	0.0		1.3	0.6	0.0	1.4

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: Walter Lublanecki
Agency: Lublanecki Engineering, Inc.
Date: 11/20/05
Period: Saturday Peak Hour
Project ID: Bethworks Now Traffic Impact Study
E/W St: Broad Street

Inter.: Broad Street/Stefko Blvd
Area Type: CBD or Similar
Jurisd: City
Year : Existing
N/S St: Stefko Boulevard

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	1	0	1	0	1	2	0	1	2	0
LGConfig		LT	R		LTR		L	TR		L	TR	
Volume	194	1	123	1	4	1	104	560	1	1	531	151
Lane Width		12.0	13.0		15.0		12.0	12.0		12.0	12.0	
RTOR Vol			40			0			0			50

Duration 0.25 Area Type: CBD or Similar

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	A				NB Left	A		
Thru	A				Thru	P	P	
Right	A				Right	P	P	
Peds	X				Peds			
WB Left	A				SB Left	P		
Thru	A				Thru	P		
Right	A				Right	P		
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	19.0				12.0	24.0		
Yellow	4.0				3.0	4.0		
All Red	2.0					2.0		

Cycle Length: 70.0 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	332	1224	0.65	0.27	27.2	C	25.1	C
R	404	1487	0.23	0.27	20.1	C		
Westbound								
LTR	479	1763	0.01	0.27	18.7	B	18.7	B
Northbound								
L	276	1608	0.44	0.17	27.1	C		
TR	1796	3223	0.33	0.56	8.9	A	12.0	B
Southbound								
L	250	728	0.00	0.34	15.2	B		
TR	1041	3037	0.68	0.34	23.3	C	23.3	C

Intersection Delay = 19.0 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: Walter Lublanecki
Agency/Co.: Lublanecki Engineering, Inc.
Date Performed: 11/20/05
Analysis Time Period: Saturday Peak Hour
Intersection: Broad Street/Stefko Blvd
Area Type: CBD or Similar
Jurisdiction: City
Analysis Year: Existing
Project ID: Bethworks Now Traffic Impact Study

East/West Street	North/South Street
Broad Street	Stefko Boulevard

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	194	1	123	1	4	1	104	560	1	1	531	151
% Heavy Veh	1	1	1	1	1	1	1	1	1	1	5	2
PHF	0.90	0.85	0.90	0.85	0.85	0.85	0.85	0.95	0.85	0.85	0.90	0.85
PK 15 Vol	54	1	34	1	1	1	31	147	1	1	148	44
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900	1900		1900		1900	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	0	1	1	0	1	0	1	2	0	1	2	0
LGConfig		LT	R		LTR		L	TR		L	TR	
Lane Width		12.0	13.0		15.0		12.0	12.0		12.0	12.0	
RTOR Vol			40			0			0			50
Adj Flow		217	92		7		122	590		1	709	
%InSharedLn												
Prop LTs		0.995			0.143			0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.143			0.002			0.168	
Peds Bikes	0		0	0		0	0			0		
Buses		0	0		0		0	0		0	0	
%InProtPhase												
Duration	0.25			Area Type: CBD or Similar								

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	
Arriv. Type		3	3		3		3	3		3	3	
Unit Ext.		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	
Ext of g		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	P	P	
Right	A				Right	P	P	
Peds	X				Peds			
WB Left	A				SB Left	P		
Thru	A				Thru	P		
Right	A				Right	P		
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	19.0				12.0	24.0		
Yellow	4.0				3.0	4.0		
All Red	2.0					2.0		

Cycle Length: 70.0 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	194	1	123	1	4	1	104	560	1	1	531	151
PHF	0.90	0.85	0.90	0.85	0.85	0.85	0.85	0.95	0.85	0.85	0.90	0.85
Adj flow	216	1	92	1	5	1	122	589	1	1	590	119
No. Lanes	0	1	1	0	1	0	1	2	0	1	2	0
Lane group		LT	R		LTR		L	TR		L	TR	
Adj flow		217	92		7		122	590		1	709	
Prop LTs		0.995			0.143			0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.143			0.002			0.168	

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

	Eastbound			Westbound			Northbound			Southbound		
LG		LT	R		LTR		L	TR		L	TR	
So		1900	1900		1900		1900	1900		1900	1900	
Lanes	0	1	1	0	1	0	1	2	0	1	2	0
fW		1.000	1.033		1.100		1.000	1.000		1.000	1.000	
fHV		0.990	0.990		0.990		0.990	0.990		0.990	0.957	

fG	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
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fA	0.900	0.900	0.900	0.900	0.900	0.900	0.900
fLU	1.000	1.000	1.000	1.000	0.952	1.000	0.952
fRT	1.000	0.850	0.981		1.000		0.975
fLT	0.723		0.965	0.950	1.000	0.430	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	1224	1487	1763	1608	3223	728	3037
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	217	1224	# 0.18	0.27	332	0.65
Right	R	92	1487	0.06	0.27	404	0.23
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	7	1763	0.00	0.27	479	0.01
Right							
Northbound							
Prot							
Perm							
Left	L	122	1608	# 0.08	0.17	276	0.44
Prot							
Perm							
Thru	TR	590	3223	0.18	0.56	1796	0.33
Right							
Southbound							
Prot							
Perm							
Left	L	1	728	0.00	0.34	250	0.00
Prot							
Perm							
Thru	TR	709	3037	# 0.23	0.34	1041	0.68
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.49
Total lost time per cycle, L = 15.00 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	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												
LT	0.65	0.27	22.6	1.000	332	0.23	4.6	0.0	27.2	C	25.1	C
R	0.23	0.27	19.8	1.000	404	0.11	0.3	0.0	20.1	C		
Westbound												
LTR	0.01	0.27	18.7	1.000	479	0.11	0.0	0.0	18.7	B	18.7	B
Northbound												
L	0.44	0.17	26.0	1.000	276	0.11	1.1	0.0	27.1	C		
TR	0.33	0.56	8.4	1.000	1796	0.50	0.5	0.0	8.9	A	12.0	B
Southbound												
L	0.00	0.34	15.1	1.000	250	0.50	0.0	0.0	15.2	B		
TR	0.68	0.34	19.7	1.000	1041	0.50	3.6	0.0	23.3	C	23.3	C

Intersection delay = 19.0 (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	70.0 sec				
Total actual green time for LT lane group, G (s)					24.0
Effective permitted green time for LT lane group, g(s)					24.0
Opposing effective green time, go (s)					39.0
Number of lanes in LT lane group, N					1
Number of lanes in opposing approach, No					2
Adjusted LT flow rate, VLT (veh/h)					1
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)					590
Lost time for LT lane group, tL					6.00
Computation					
LT volume per cycle, LTC=VLTC/3600					0.02
Opposing lane util. factor, fLUo		1.000	1.000	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)					6.03
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]					0.44
gq, (see Exhibit C16-4,5,6,7,8)					0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf					24.00
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)					2.33
EL2=Max((1-Ptho**n)/Plto, 1.0)					
fmin=2(1+PL)/g or fmin=2(1+Pl)/g					0.17
gdiff=max(gq-gf,0)					0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)					0.43
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					0.430

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		S	M		
Cycle length, C	70.0 sec				
Total actual green time for LT lane group, G (s)		19.0	19.0		
Effective permitted green time for LT lane group, g(s)		19.0	19.0		
Opposing effective green time, go (s)		19.0	19.0		
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)		216	1		
Proportion of LT in LT lane group, PLT		0.995	0.143	0.000	0.000
Proportion of LT in opposing flow, PLTo		0.14	1.00		
Adjusted opposing flow rate, Vo (veh/h)		7	217		
Lost time for LT lane group, tL		6.00	6.00		
Computation					
LT volume per cycle, LTC=VLTC/3600		4.20	0.02		
Opposing lane util. factor, fLUo		1.000	1.000	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		0.14	4.22		
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g		0.0	12.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.73	0.73		
gq, (see Exhibit C16-4,5,6,7,8)		0.00	4.58		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		19.00	6.97		
n=Max(gq-gf)/2,0)		0.00	0.00		
PTHo=1-PLTo		0.86	0.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00-	0.14		
EL1 (refer to Exhibit C16-3)		1.39	1.73		
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00	1.00		
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.21	0.12		
gdiff=max(gq-gf,0)		0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.72	0.97		
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		0.723	0.965		

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)	19.0	19.0		
Conflicting pedestrian volume, Vped (p/h)	0	0		
Pedestrian flow rate, Vpedg (p/h)	0	0		
OCCpedg	0.000	0.000		
Opposing queue clearing green, gq (s)	0.00	4.58		
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.241		
OCCpedu	0.000	0.000		
Opposing flow rate, Vo (veh/h)	7	217		
OCCr	0.000	0.000		
Number of cross-street receiving lanes, Nrec	2	2		
Number of turning lanes, Nturn	1	1		
ApbT	1.000	1.000		
Proportion of left turns, PLT	0.995	0.143		
Proportion of left turns using protected phase, PLTA	0.000	0.000		
Left-turn adjustment, fLpb	1.000	1.000		

Permitted Right Turns

Effective pedestrian green time, gp (s)	19.0	19.0		
Conflicting pedestrian volume, Vped (p/h)	0	0		
Conflicting bicycle volume, Vbic (bicycles/h)	0	0		
Vpedg	0	0		
OCCpedg	0.000	0.000		
Effective green, g (s)	19.0	19.0		
Vbicg	0	0		
OCCbicg	0.020	0.020		
OCCr	0.000	0.000		
Number of cross-street receiving lanes, Nrec	2	2		
Number of turning lanes, Nturn	1	1		
ApbT	1.000	1.000		
Proportion right-turns, PRT	1.000	0.143		
Proportion right-turns using protected phase, PRTA	0.000	0.000		
Right turn adjustment, fRpb		1.000		

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

		EBLT	WBLT	NBLT	SBLT
Cycle length, C	70.0 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 19.0 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LT	R	LTR		L	TR	L	TR
Init Queue	0.0	0.0	0.0		0.0	0.0	0.0	0.0
Flow Rate	217	92	7		122	309	1	372
So	1900	1900	1900		1900	1900	1900	1900
No.Lanes	0 1	1	0 1	0	1	2 0	1	2 0
SL	1224	1487	1763		1608	1692	728	1595
LnCapacity	332	404	479		276	943	250	546
Flow Ratio	0.18	0.06	0.00		0.08	0.18	0.00	0.23
v/c Ratio	0.65	0.23	0.01		0.44	0.33	0.00	0.68
Grn Ratio	0.27	0.27	0.27		0.17	0.56	0.34	0.34
I Factor	1.000		1.000			1.000		1.000
AT or PVG	3	3	3		3	3	3	3
Pltn Ratio	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
Q1	3.7	1.4	0.1		2.1	3.3	0.0	6.2
kB	0.3	0.3	0.4		0.3	0.9	0.4	0.6
Q2	0.6	0.1	0.0		0.2	0.4	0.0	1.3
Q Average	4.3	1.5	0.1		2.3	3.7	0.0	7.5
Q Spacing	24.9	24.9	24.9		24.9	24.9	24.9	24.9
Q Storage	500	200	100		150	500	150	150
Q S Ratio	0.2	0.2	0.0		0.4	0.2	0.0	1.2
70th Percentile Output:								
fB%	1.2	1.2	1.2		1.2	1.2	1.3	1.2
BOQ	5.1	1.8	0.1		2.8	4.6	0.0	9.1
QSRatio	0.3	0.2	0.0		0.5	0.2	0.0	1.5
85th Percentile Output:								
fB%	1.6	1.6	1.6		1.6	1.5	1.7	1.5
BOQ	6.7	2.4	0.2		3.7	5.7	0.0	11.0
QSRatio	0.3	0.3	0.0		0.6	0.3	0.0	1.8
90th Percentile Output:								
fB%	1.7	1.8	1.8		1.8	1.7	2.0	1.6
BOQ	7.4	2.6	0.2		4.1	6.4	0.0	12.0
QSRatio	0.4	0.3	0.0		0.7	0.3	0.0	2.0
95th Percentile Output:								
fB%	2.0	2.1	2.1		2.0	2.1	2.6	1.8
BOQ	8.5	3.1	0.2		4.7	7.7	0.0	13.6
QSRatio	0.4	0.4	0.1		0.8	0.4	0.0	2.3
98th Percentile Output:								
fB%	2.4	2.6	2.7		2.5	2.4	3.2	2.0
BOQ	10.4	3.9	0.3		5.9	8.9	0.0	15.2
QSRatio	0.5	0.5	0.1		1.0	0.4	0.0	2.5

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: Walter Lublanecki
Agency: Lublanecki Engineering, Inc.
Date: 11/20/05
Period: Saturday Peak Hour
Project ID: Bethworks Now Traffic Impact Study
E/W St: Broad Street

Inter.: Broad Street/Stefko Blvd
Area Type: CBD or Similar
Jurisd: City
Year : No-Build
N/S St: Stefko Boulevard

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	1	0	1	0	1	2	0	1	2	0
LGConfig		LT	R		LTR		L	TR		L	TR	
Volume	205	1	130	1	4	1	110	591	1	1	560	159
Lane Width		12.0	13.0		15.0		12.0	12.0		12.0	12.0	
RTOR Vol			40			0			0			50

Duration 0.25 Area Type: CBD or Similar

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A				NB Left	A			
Thru	A				Thru	P	P		
Right	A				Right	P	P		
Peds	X				Peds				
WB Left	A				SB Left		P		
Thru	A				Thru		P		
Right	A				Right		P		
Peds	X				Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	19.0					12.0	24.0		
Yellow	4.0					3.0	4.0		
All Red	2.0						2.0		

Cycle Length: 70.0 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	332	1224	0.69	0.27	28.8	C	26.2	C
R	404	1487	0.25	0.27	20.2	C		
Westbound								
LTR	478	1762	0.01	0.27	18.7	B	18.7	B
Northbound								
L	276	1608	0.47	0.17	27.4	C		
TR	1796	3223	0.35	0.56	9.0	A	12.2	B
Southbound								
L	242	705	0.00	0.34	15.2	B		
TR	1041	3036	0.72	0.34	24.4	C	24.4	C

Intersection Delay = 19.7 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: Walter Lublanecki
Agency/Co.: Lublanecki Engineering, Inc.
Date Performed: 11/20/05
Analysis Time Period: Saturday Peak Hour
Intersection: Broad Street/Stefko Blvd
Area Type: CBD or Similar
Jurisdiction: City
Analysis Year: No-Build
Project ID: Bethworks Now Traffic Impact Study

East/West Street	North/South Street
Broad Street	Stefko Boulevard

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	205	1	130	1	4	1	110	591	1	1	560	159
% Heavy Veh	1	1	1	1	1	1	1	1	1	1	5	2
PHF	0.90	0.85	0.90	0.85	0.85	0.85	0.85	0.95	0.85	0.85	0.90	0.85
PK 15 Vol	57	1	36	1	1	1	32	156	1	1	156	47
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900	1900		1900		1900	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	0	1	1	0	1	0	1	2	0	1	2	0
LGConfig		LT	R		LTR		L	TR		L	TR	
Lane Width		12.0	13.0		15.0		12.0	12.0		12.0	12.0	
RTOR Vol			40			0			0			50
Adj Flow		229	100		7		129	623		1	750	
%InSharedLn												
Prop LTs		0.996			0.143			0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.143			0.002			0.171	
Peds Bikes	0		0	0		0	0			0		
Buses		0	0		0		0	0		0	0	
%InProtPhase												
Duration	0.25			Area Type: CBD or Similar								

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	
Arriv. Type		3	3		3		3	3		3	3	
Unit Ext.		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	
Ext of g		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	P	P	
Right	A				Right	P	P	
Peds	X				Peds			
WB Left	A				SB Left	P		
Thru	A				Thru	P		
Right	A				Right	P		
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	19.0				12.0	24.0		
Yellow	4.0				3.0	4.0		
All Red	2.0					2.0		

Cycle Length: 70.0 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	205	1	130	1	4	1	110	591	1	1	560	159
PHF	0.90	0.85	0.90	0.85	0.85	0.85	0.85	0.95	0.85	0.85	0.90	0.85
Adj flow	228	1	100	1	5	1	129	622	1	1	622	128
No. Lanes	0	1	1	0	1	0	1	2	0	1	2	0
Lane group		LT	R		LTR		L	TR		L	TR	
Adj flow		229	100		7		129	623		1	750	
Prop LTs		0.996			0.143			0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.143			0.002			0.171	

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

	Eastbound			Westbound			Northbound			Southbound		
LG		LT	R		LTR		L	TR		L	TR	
So		1900	1900		1900		1900	1900		1900	1900	
Lanes 0	1	1	0	1	0	1	2	0	1	2	0	
fW		1.000	1.033		1.100		1.000	1.000		1.000	1.000	
fHV		0.990	0.990		0.990		0.990	0.990		0.990	0.957	

fG	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
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fA	0.900	0.900	0.900	0.900	0.900	0.900	0.900
fLU	1.000	1.000	1.000	1.000	0.952	1.000	0.952
fRT	1.000	0.850	0.981		1.000		0.974
fLT	0.723		0.965	0.950	1.000	0.416	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	1224	1487	1762	1608	3223	705	3036
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	229	1224	#	0.19	0.27	332	0.69
Right	R	100	1487		0.07	0.27	404	0.25
Westbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru	LTR	7	1762		0.00	0.27	478	0.01
Right								
Northbound								
Prot								
Perm								
Left	L	129	1608	#	0.08	0.17	276	0.47
Prot								
Perm								
Thru	TR	623	3223		0.19	0.56	1796	0.35
Right								
Southbound								
Prot								
Perm								
Left	L	1	705		0.00	0.34	242	0.00
Prot								
Perm								
Thru	TR	750	3036	#	0.25	0.34	1041	0.72
Right								

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.51
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.65

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor Del k	d2	Res Del d3	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound												
LT	0.69	0.27	22.9	1.000	332	0.26	6.0	0.0	28.8	C	26.2	C
R	0.25	0.27	19.9	1.000	404	0.11	0.3	0.0	20.2	C		
Westbound												
LTR	0.01	0.27	18.7	1.000	478	0.11	0.0	0.0	18.7	B	18.7	B
Northbound												
L	0.47	0.17	26.1	1.000	276	0.11	1.3	0.0	27.4	C		
TR	0.35	0.56	8.5	1.000	1796	0.50	0.5	0.0	9.0	A	12.2	B
Southbound												
L	0.00	0.34	15.1	1.000	242	0.50	0.0	0.0	15.2	B		
TR	0.72	0.34	20.1	1.000	1041	0.50	4.3	0.0	24.4	C	24.4	C

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	70.0 sec				
Total actual green time for LT lane group, G (s)					24.0
Effective permitted green time for LT lane group, g(s)					24.0
Opposing effective green time, go (s)					39.0
Number of lanes in LT lane group, N					1
Number of lanes in opposing approach, No					2
Adjusted LT flow rate, VLT (veh/h)					1
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)					623
Lost time for LT lane group, tL					6.00
Computation					
LT volume per cycle, LTC=VLTC/3600					0.02
Opposing lane util. factor, fLUo		1.000	1.000	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)					6.36
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]					0.44
gq, (see Exhibit C16-4,5,6,7,8)					0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf					24.00
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)					2.40
EL2=Max((1-Ptho**n)/Plto, 1.0)					
fmin=2(1+PL)/g or fmin=2(1+Pl)/g					0.17
gdiff=max(gq-gf,0)					0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)					0.42
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					0.416

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		S	M		
Cycle length, C	70.0 sec				
Total actual green time for LT lane group, G (s)		19.0	19.0		
Effective permitted green time for LT lane group, g(s)		19.0	19.0		
Opposing effective green time, go (s)		19.0	19.0		
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)		228	1		
Proportion of LT in LT lane group, PLT		0.996	0.143	0.000	0.000
Proportion of LT in opposing flow, PLTo		0.14	1.00		
Adjusted opposing flow rate, Vo (veh/h)		7	229		
Lost time for LT lane group, tL		6.00	6.00		
Computation					
LT volume per cycle, LTC=VLTC/3600		4.43	0.02		
Opposing lane util. factor, fLUo		1.000	1.000	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		0.14	4.45		
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g		0.0	12.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.73	0.73		
gq, (see Exhibit C16-4,5,6,7,8)		0.00	5.02		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		19.00	6.97		
n=Max(gq-gf)/2,0)		0.00	0.00		
PTHo=1-PLTo		0.86	0.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00-	0.14		
EL1 (refer to Exhibit C16-3)		1.39	1.75		
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00	1.00		
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.21	0.12		
gdiff=max(gq-gf,0)		0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.72	0.96		
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		0.723	0.965		

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)	19.0	19.0		
Conflicting pedestrian volume, Vped (p/h)	0	0		
Pedestrian flow rate, Vpedg (p/h)	0	0		
OCCpedg	0.000	0.000		
Opposing queue clearing green, gq (s)	0.00	5.02		
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.264		
OCCpedu	0.000	0.000		
Opposing flow rate, Vo (veh/h)	7	229		
OCCr	0.000	0.000		
Number of cross-street receiving lanes, Nrec	2	2		
Number of turning lanes, Nturn	1	1		
ApbT	1.000	1.000		
Proportion of left turns, PLT	0.996	0.143		
Proportion of left turns using protected phase, PLTA	0.000	0.000		
Left-turn adjustment, fLpb	1.000	1.000		

Permitted Right Turns

Effective pedestrian green time, gp (s)	19.0	19.0		
Conflicting pedestrian volume, Vped (p/h)	0	0		
Conflicting bicycle volume, Vbic (bicycles/h)	0	0		
Vpedg	0	0		
OCCpedg	0.000	0.000		
Effective green, g (s)	19.0	19.0		
Vbicg	0	0		
OCCbicg	0.020	0.020		
OCCr	0.000	0.000		
Number of cross-street receiving lanes, Nrec	2	2		
Number of turning lanes, Nturn	1	1		
ApbT	1.000	1.000		
Proportion right-turns, PRT	1.000	0.143		
Proportion right-turns using protected phase, PRTA	0.000	0.000		
Right turn adjustment, fRpb		1.000		

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

		EBLT	WBLT	NBLT	SBLT
Cycle length, C	70.0 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 19.7 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LT	R	LTR		L	TR	L	TR
Init Queue	0.0	0.0	0.0		0.0	0.0	0.0	0.0
Flow Rate	229	100	7		129	327	1	393
So	1900	1900	1900		1900	1900	1900	1900
No.Lanes	0 1	1	0 1	0	1	2 0	1	2 0
SL	1224	1487	1762		1608	1692	705	1594
LnCapacity	332	404	478		276	943	242	546
Flow Ratio	0.19	0.07	0.00		0.08	0.19	0.00	0.25
v/c Ratio	0.69	0.25	0.01		0.47	0.35	0.00	0.72
Grn Ratio	0.27	0.27	0.27		0.17	0.56	0.34	0.34
I Factor	1.000		1.000			1.000		1.000
AT or PVG	3	3	3		3	3	3	3
Pltn Ratio	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
Q1	4.0	1.5	0.1		2.3	3.5	0.0	6.7
kB	0.3	0.3	0.4		0.3	0.9	0.4	0.6
Q2	0.6	0.1	0.0		0.2	0.5	0.0	1.5
Q Average	4.6	1.6	0.1		2.5	4.0	0.0	8.2
Q Spacing	24.9	24.9	24.9		24.9	24.9	24.9	24.9
Q Storage	500	200	100		150	500	150	500
Q S Ratio	0.2	0.2	0.0		0.4	0.2	0.0	0.4
70th Percentile Output:								
fB%	1.2	1.2	1.2		1.2	1.2	1.3	1.2
BOQ	5.5	2.0	0.1		3.0	4.9	0.0	10.0
QSRatio	0.3	0.2	0.0		0.5	0.2	0.0	0.5
85th Percentile Output:								
fB%	1.6	1.6	1.6		1.6	1.5	1.7	1.5
BOQ	7.2	2.6	0.2		3.9	6.1	0.0	11.9
QSRatio	0.4	0.3	0.0		0.7	0.3	0.0	0.6
90th Percentile Output:								
fB%	1.7	1.8	1.8		1.8	1.7	2.0	1.6
BOQ	8.0	2.9	0.2		4.4	6.9	0.0	13.0
QSRatio	0.4	0.4	0.0		0.7	0.3	0.0	0.6
95th Percentile Output:								
fB%	2.0	2.0	2.1		2.0	2.1	2.6	1.8
BOQ	9.1	3.3	0.2		5.0	8.2	0.0	14.7
QSRatio	0.5	0.4	0.1		0.8	0.4	0.0	0.7
98th Percentile Output:								
fB%	2.4	2.6	2.7		2.5	2.4	3.2	2.0
BOQ	11.1	4.2	0.3		6.3	9.5	0.0	16.3
QSRatio	0.6	0.5	0.1		1.0	0.5	0.0	0.8

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: Walter Lublanecki
Agency: Lublanecki Engineering, Inc.
Date: 11/20/05
Period: Saturday Peak Hour
Project ID: Bethworks Now Traffic Impact Study
E/W St: Broad Street

Inter.: Broad Street/Stefko Blvd
Area Type: CBD or Similar
Jurisd: City
Year : Build
N/S St: Stefko Boulevard

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	1	0	1	0	1	2	0	1	2	0
LGConfig		LT	R		LTR		L	TR		L	TR	
Volume	205	1	152	1	4	1	128	683	1	1	652	159
Lane Width		12.0	13.0		15.0		12.0	12.0		12.0	12.0	
RTOR Vol			40			0			0			50

Duration 0.25 Area Type: CBD or Similar

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	A				NB Left	A		
Thru	A				Thru	P	P	
Right	A				Right	P	P	
Peds	X				Peds			
WB Left	A				SB Left	P		
Thru	A				Thru	P		
Right	A				Right	P		
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	19.0					12.0	24.0	
Yellow	4.0					3.0	4.0	
All Red	2.0						2.0	

Cycle Length: 70.0 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	332	1224	0.69	0.27	28.8	C	26.0	C
R	404	1487	0.31	0.27	20.7	C		
Westbound								
LTR	478	1762	0.01	0.27	18.7	B	18.7	B
Northbound								
L	276	1608	0.55	0.17	28.8	C		
TR	1796	3223	0.40	0.56	9.5	A	12.9	B
Southbound								
L	220	641	0.00	0.34	15.2	B		
TR	1044	3044	0.82	0.34	28.0	C	28.0	C

Intersection Delay = 21.3 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: Walter Lublanecki
Agency/Co.: Lublanecki Engineering, Inc.
Date Performed: 11/20/05
Analysis Time Period: Saturday Peak Hour
Intersection: Broad Street/Stefko Blvd
Area Type: CBD or Similar
Jurisdiction: City
Analysis Year: Build
Project ID: Bethworks Now Traffic Impact Study

East/West Street	North/South Street
Broad Street	Stefko Boulevard

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	205	1	152	1	4	1	128	683	1	1	652	159
% Heavy Veh	1	1	1	1	1	1	1	1	1	1	5	2
PHF	0.90	0.85	0.90	0.85	0.85	0.85	0.85	0.95	0.85	0.85	0.90	0.85
PK 15 Vol	57	1	42	1	1	1	38	180	1	1	181	47
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900	1900		1900		1900	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	0	1	1	0	1	0	1	2	0	1	2	0
LGConfig		LT	R		LTR		L	TR		L	TR	
Lane Width		12.0	13.0		15.0		12.0	12.0		12.0	12.0	
RTOR Vol			40			0			0			50
Adj Flow		229	124		7		151	720		1	852	
%InSharedLn												
Prop LTs		0.996			0.143			0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.143			0.001			0.150	
Peds Bikes	0		0	0		0	0			0		
Buses		0	0		0		0	0		0	0	
%InProtPhase												
Duration	0.25			Area Type: CBD or Similar								

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	
Arriv. Type		3	3		3		3	3		3	3	
Unit Ext.		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	
Ext of g		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	P	P	
Right	A				Right	P	P	
Peds	X				Peds			
WB Left	A				SB Left	P		
Thru	A				Thru	P		
Right	A				Right	P		
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	19.0				12.0	24.0		
Yellow	4.0				3.0	4.0		
All Red	2.0					2.0		

Cycle Length: 70.0 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	205	1	152	1	4	1	128	683	1	1	652	159
PHF	0.90	0.85	0.90	0.85	0.85	0.85	0.85	0.95	0.85	0.85	0.90	0.85
Adj flow	228	1	124	1	5	1	151	719	1	1	724	128
No. Lanes	0	1	1	0	1	0	1	2	0	1	2	0
Lane group		LT	R		LTR		L	TR		L	TR	
Adj flow		229	124		7		151	720		1	852	
Prop LTs		0.996			0.143			0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.143			0.001			0.150	

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

	Eastbound			Westbound			Northbound			Southbound		
LG		LT	R		LTR		L	TR		L	TR	
So		1900	1900		1900		1900	1900		1900	1900	
Lanes 0	1	1	0	1	0	1	2	0	1	2	0	
fW		1.000	1.033		1.100		1.000	1.000		1.000	1.000	
fHV		0.990	0.990		0.990		0.990	0.990		0.990	0.956	

fG	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
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fA	0.900	0.900	0.900	0.900	0.900	0.900	0.900
fLU	1.000	1.000	1.000	1.000	0.952	1.000	0.952
fRT	1.000	0.850	0.981		1.000		0.977
fLT	0.723		0.965	0.950	1.000	0.379	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	1224	1487	1762	1608	3223	641	3044
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	229	1224	# 0.19	0.27	332	0.69
Right	R	124	1487	0.08	0.27	404	0.31
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	7	1762	0.00	0.27	478	0.01
Right							
Northbound							
Prot							
Perm							
Left	L	151	1608	# 0.09	0.17	276	0.55
Prot							
Perm							
Thru	TR	720	3223	0.22	0.56	1796	0.40
Right							
Southbound							
Prot							
Perm							
Left	L	1	641	0.00	0.34	220	0.00
Prot							
Perm							
Thru	TR	852	3044	# 0.28	0.34	1044	0.82
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.56
Total lost time per cycle, L = 15.00 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	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
LT	0.69	0.27	22.9	1.000	332	0.26	6.0	0.0	28.8	C	26.0	C
R	0.31	0.27	20.3	1.000	404	0.11	0.4	0.0	20.7	C		
Westbound												
LTR	0.01	0.27	18.7	1.000	478	0.11	0.0	0.0	18.7	B	18.7	B
Northbound												
L	0.55	0.17	26.5	1.000	276	0.15	2.3	0.0	28.8	C		
TR	0.40	0.56	8.8	1.000	1796	0.50	0.7	0.0	9.5	A	12.9	B
Southbound												
L	0.00	0.34	15.1	1.000	220	0.50	0.0	0.0	15.2	B		
TR	0.82	0.34	21.0	1.000	1044	0.50	7.1	0.0	28.0	C	28.0	C

Intersection delay = 21.3 (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	70.0 sec				
Total actual green time for LT lane group, G (s)					24.0
Effective permitted green time for LT lane group, g(s)					24.0
Opposing effective green time, go (s)					39.0
Number of lanes in LT lane group, N					1
Number of lanes in opposing approach, No					2
Adjusted LT flow rate, VLT (veh/h)					1
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)					720
Lost time for LT lane group, tL					6.00
Computation					
LT volume per cycle, LTC=VLTC/3600					0.02
Opposing lane util. factor, fLUo		1.000	1.000	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)					7.35
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]					0.44
gq, (see Exhibit C16-4,5,6,7,8)					0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf					24.00
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)					2.64
EL2=Max((1-Ptho**n)/Plto, 1.0)					
fmin=2(1+PL)/g or fmin=2(1+Pl)/g					0.17
gdiff=max(gq-gf,0)					0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)					0.38
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					0.379

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		S	M		
Cycle length, C	70.0 sec				
Total actual green time for LT lane group, G (s)		19.0	19.0		
Effective permitted green time for LT lane group, g(s)		19.0	19.0		
Opposing effective green time, go (s)		19.0	19.0		
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)		228	1		
Proportion of LT in LT lane group, PLT		0.996	0.143	0.000	0.000
Proportion of LT in opposing flow, PLTo		0.14	1.00		
Adjusted opposing flow rate, Vo (veh/h)		7	229		
Lost time for LT lane group, tL		6.00	6.00		
Computation					
LT volume per cycle, LTC=VLTC/3600		4.43	0.02		
Opposing lane util. factor, fLUo		1.000	1.000	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		0.14	4.45		
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g		0.0	12.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.73	0.73		
gq, (see Exhibit C16-4,5,6,7,8)		0.00	5.02		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		19.00	6.97		
n=Max(gq-gf)/2,0)		0.00	0.00		
PTHo=1-PLTo		0.86	0.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00-	0.14		
EL1 (refer to Exhibit C16-3)		1.39	1.75		
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00	1.00		
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.21	0.12		
gdiff=max(gq-gf,0)		0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.72	0.96		
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		0.723	0.965		

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)	19.0	19.0		
Conflicting pedestrian volume, Vped (p/h)	0	0		
Pedestrian flow rate, Vpedg (p/h)	0	0		
OCCpedg	0.000	0.000		
Opposing queue clearing green, gq (s)	0.00	5.02		
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.264		
OCCpedu	0.000	0.000		
Opposing flow rate, Vo (veh/h)	7	229		
OCCr	0.000	0.000		
Number of cross-street receiving lanes, Nrec	2	2		
Number of turning lanes, Nturn	1	1		
ApbT	1.000	1.000		
Proportion of left turns, PLT	0.996	0.143		
Proportion of left turns using protected phase, PLTA	0.000	0.000		
Left-turn adjustment, fLpb	1.000	1.000		

Permitted Right Turns

Effective pedestrian green time, gp (s)	19.0	19.0		
Conflicting pedestrian volume, Vped (p/h)	0	0		
Conflicting bicycle volume, Vbic (bicycles/h)	0	0		
Vpedg	0	0		
OCCpedg	0.000	0.000		
Effective green, g (s)	19.0	19.0		
Vbicg	0	0		
OCCbicg	0.020	0.020		
OCCr	0.000	0.000		
Number of cross-street receiving lanes, Nrec	2	2		
Number of turning lanes, Nturn	1	1		
ApbT	1.000	1.000		
Proportion right-turns, PRT	1.000	0.143		
Proportion right-turns using protected phase, PRTA	0.000	0.000		
Right turn adjustment, fRpb		1.000		

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 70.0 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 21.3 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LT	R	LTR		L	TR	L	TR
Init Queue	0.0	0.0	0.0		0.0	0.0	0.0	0.0
Flow Rate	229	124	7		151	378	1	447
So	1900	1900	1900		1900	1900	1900	1900
No.Lanes	0 1	1	0 1	0	1	2 0	1	2 0
SL	1224	1487	1762		1608	1692	641	1598
LnCapacity	332	404	478		276	943	220	548
Flow Ratio	0.19	0.08	0.00		0.09	0.22	0.00	0.28
v/c Ratio	0.69	0.31	0.01		0.55	0.40	0.00	0.82
Grn Ratio	0.27	0.27	0.27		0.17	0.56	0.34	0.34
I Factor	1.000		1.000			1.000		1.000
AT or PVG	3	3	3		3	3	3	3
Pltn Ratio	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
Q1	4.0	1.9	0.1		2.7	4.2	0.0	7.9
kB	0.3	0.3	0.4		0.3	0.9	0.3	0.6
Q2	0.6	0.2	0.0		0.3	0.6	0.0	2.3
Q Average	4.6	2.1	0.1		3.0	4.8	0.0	10.3
Q Spacing	24.9	24.9	24.9		24.9	24.9	24.9	24.9
Q Storage	500	200	100		200	500	200	500
Q S Ratio	0.2	0.3	0.0		0.4	0.2	0.0	0.5
70th Percentile Output:								
fB%	1.2	1.2	1.2		1.2	1.2	1.3	1.2
BOQ	5.5	2.5	0.1		3.6	5.9	0.0	12.5
QSRatio	0.3	0.3	0.0		0.4	0.3	0.0	0.6
85th Percentile Output:								
fB%	1.6	1.6	1.6		1.6	1.5	1.7	1.4
BOQ	7.2	3.3	0.2		4.7	7.3	0.0	14.8
QSRatio	0.4	0.4	0.0		0.6	0.4	0.0	0.7
90th Percentile Output:								
fB%	1.7	1.8	1.8		1.7	1.7	2.0	1.6
BOQ	8.0	3.6	0.2		5.2	8.1	0.0	16.1
QSRatio	0.4	0.5	0.0		0.7	0.4	0.0	0.8
95th Percentile Output:								
fB%	2.0	2.0	2.1		2.0	2.0	2.6	1.7
BOQ	9.1	4.2	0.2		6.0	9.5	0.0	17.8
QSRatio	0.5	0.5	0.1		0.8	0.5	0.0	0.9
98th Percentile Output:								
fB%	2.4	2.6	2.7		2.5	2.3	3.2	1.9
BOQ	11.1	5.3	0.3		7.5	10.9	0.0	19.4
QSRatio	0.6	0.7	0.1		0.9	0.5	0.0	1.0

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: Walter Lublanecki
Agency: Lublanecki Engineering, Inc.
Date: 11/20/05
Period: PM Peak Hour
Project ID: Bethworks Now Traffic Impact Study
E/W St: Daly Avenue (SR 412)
Inter.: Daly Ave. (SR 412)/East Casino
Area Type: CBD or Similar
Jurisd: State
Year : Build
N/S St: East Casino Access Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	1	0	0	0	2	0	1
LGConfig		T			T	R				L		R
Volume		968			923	200				230		80
Lane Width		12.0			12.0	13.0				12.0		13.0
RTOR Vol						0						0

Duration 0.25 Area Type: CBD or Similar

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru		P			Thru			
Right					Right			
Peds					Peds			
WB Left					SB Left	A		
Thru		P			Thru			
Right		P			Right	A		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right	P		
Green		45.0				34.0		
Yellow		4.0				3.0		
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								
T	1596	3192	0.67	0.50	19.3	B	19.3	B
Westbound								
T	1596	3192	0.61	0.50	17.9	B	14.6	B
R	1472	1472	0.15	1.00	0.2	A		
Northbound								
Southbound								
L	1168	3093	0.22	0.38	19.1	B		
							19.0	B
R	556	1472	0.16	0.38	18.7	B		

Intersection Delay = 17.1 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

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E-Mail: lei@eclipse.net

OPERATIONAL ANALYSIS

Analyst: Walter Lublanecki
Agency/Co.: Lublanecki Engineering, Inc.
Date Performed: 11/20/05
Analysis Time Period: PM Peak Hour
Intersection: Daly Ave. (SR 412)/East Casino
Area Type: CBD or Similar
Jurisdiction: State
Analysis Year: Build
Project ID: Bethworks Now Traffic Impact Study

East/West Street	North/South Street
Daly Avenue (SR 412)	East Casino Access Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		968			923	200				230		80
% Heavy Veh		2			2	2				2		2
PHF		0.90			0.95	0.90				0.90		0.90
PK 15 Vol		269			243	56				64		22
Hi Ln Vol												
% Grade		0			0						0	
Ideal Sat		1900			1900	1900				1900		1900
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	1	0	0	0		2	0 1
LGConfig		T			T	R				L		R
Lane Width		12.0			12.0	13.0				12.0		13.0
RTOR Vol						0						0
Adj Flow		1076			972	222				256		89
%InSharedLn												
Prop LTs		0.000			0.000							
Prop RTs		0.000			0.000	1.000						1.000
Peds Bikes					0			0			0	
Buses		0			0	0				0		0
%InProtPhase												
Duration	0.25											

Area Type: CBD or Similar

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			
Thru		P			Thru			
Right					Right			
Peds					Peds			
WB Left					SB Left	A		
Thru		P			Thru			
Right		P			Right	A		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right	P		
Green		45.0				34.0		
Yellow		4.0				3.0		
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		968			923	200				230		80
PHF		0.90			0.95	0.90				0.90		0.90
Adj flow		1076			972	222				256		89
No. Lanes	0	2	0	0	2	1	0	0	0		2	0 1
Lane group		T			T	R				L		R
Adj flow		1076			972	222				256		89
Prop LTs		0.000			0.000							
Prop RTs		0.000			0.000	1.000						1.000

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

	Eastbound			Westbound			Northbound			Southbound		
LG		T			T	R					L	R
So		1900			1900	1900					1900	1900
Lanes	0	2	0	0	2	1	0	0	0	2	0	1
fW		1.000			1.000	1.033					1.000	1.033
fHV		0.980			0.980	0.980					0.980	0.980

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	0.900	0.900	0.900	0.900	0.900	
fLU	0.952	0.952	1.000	0.971	1.000	
fRT	1.000	1.000	0.850		0.850	
fLT	1.000	1.000		0.950		
Sec.						
fLpb	1.000	1.000		1.000		
fRpb	1.000	1.000	1.000		1.000	
S	3192	3192	1472	3093	1472	
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	T	1076	3192	#	0.34	0.50	1596	0.67
Right								
Westbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru	T	972	3192		0.30	0.50	1596	0.61
Right	R	222	1472		0.15	1.00	1472	0.15
Northbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru								
Right								
Southbound								
Prot								
Perm								
Left	L	256	3093	#	0.08	0.38	1168	0.22
Prot								
Perm								
Thru								
Right	R	89	1472		0.06	0.38	556	0.16

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.42
Total lost time per cycle, L = 11.00 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	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor Del k	d2	Res Del d3	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound												
T	0.67	0.50	17.0	1.000	1596	0.50	2.3	0.0	19.3	B	19.3	B
Westbound												
T	0.61	0.50	16.2	1.000	1596	0.50	1.7	0.0	17.9	B	14.6	B
R	0.15	1.00	0.0	0.950	1472	0.50	0.2	0.0	0.2	A		
Northbound												
Southbound												
L	0.22	0.38	19.0	1.000	1168	0.11	0.1	0.0	19.1	B	19.0	B
R	0.16	0.38	18.5	1.000	556	0.11	0.1	0.0	18.7	B		

Intersection delay = 17.1 (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				

```
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
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
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
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 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 17.1 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

	Eastbound	Westbound	Northbound	Southbound
LaneGroup	T	T R		L R
Init Queue	0.0	0.0 0.0		0.0 0.0
Flow Rate	565	510 222		131 89
So	1900	1900 1900		1900 1900
No.Lanes	0 2 0	0 2 1	0 0 0	2 0 1
SL	1676	1676 1472		1593 1472
LnCapacity	838	838 1472		601 556
Flow Ratio	0.34	0.30 0.15		0.08 0.06
v/c Ratio	0.67	0.61 0.15		0.22 0.16
Grn Ratio	0.50	0.50 1.00		0.38 0.38
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
Q1	10.7	9.2		2.2 1.5
kB	1.0	1.0 1.5		0.5 0.5
Q2	2.0	1.5 0.3		0.1 0.1
Q Average	12.6	10.7		2.4 1.6
Q Spacing	24.9	24.9 24.9		24.9 24.9
Q Storage	500	500 400		400 400
Q S Ratio	0.6	0.5		0.1 0.1
70th Percentile Output:				
fB%	1.2	1.2		1.2 1.2
BOQ	15.3	12.9		2.8 1.9
QSRatio	0.8	0.6		0.2 0.1
85th Percentile Output:				
fB%	1.4	1.4		1.6 1.6
BOQ	18.0	15.3		3.7 2.5
QSRatio	0.9	0.8		0.2 0.2
90th Percentile Output:				
fB%	1.5	1.6		1.8 1.8
BOQ	19.4	16.6		4.1 2.8
QSRatio	1.0	0.8		0.3 0.2
95th Percentile Output:				
fB%	1.7	1.7		2.0 2.1
BOQ	21.2	18.3		4.8 3.2
QSRatio	1.1	0.9		0.3 0.2
98th Percentile Output:				
fB%	1.8	1.9		2.5 2.6
BOQ	23.0	20.0		6.0 4.1
QSRatio	1.1	1.0		0.4 0.3

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: Walter Lublanecki
Agency: Lublanecki Engineering, Inc.
Date: 11/20/05
Period: Saturday Peak Hour
Project ID: Bethworks Now Traffic Impact Study
E/W St: Daly Avenue (SR 412)

Inter.: Daly Ave. (SR 412)/East Casino
Area Type: CBD or Similar
Jurisd: State
Year : Build
N/S St: East Casino Access Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	1	0	0	0	2	0	1
LGConfig		T			T	R				L		R
Volume		918			1025	400				499		180
Lane Width		12.0			12.0	13.0				12.0		13.0
RTOR Vol						0						0

Duration 0.25 Area Type: CBD or Similar

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru		P			Thru			
Right					Right			
Peds					Peds			
WB Left					SB Left	A		
Thru		P			Thru			
Right		P			Right	A		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right	P		
Green		45.0				34.0		
Yellow		4.0				3.0		
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								
T	1612	3224	0.63	0.50	18.4	B	18.4	B
Westbound								
T	1612	3224	0.67	0.50	19.1	B	13.7	B
R	1472	1472	0.30	1.00	0.5	A		
Northbound								
Southbound								
L	1168	3093	0.47	0.38	21.5	C		
							21.3	C
R	556	1472	0.36	0.38	20.6	C		

Intersection Delay = 16.9 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

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E-Mail: lei@eclipse.net

OPERATIONAL ANALYSIS

Analyst: Walter Lublanecki
Agency/Co.: Lublanecki Engineering, Inc.
Date Performed: 11/20/05
Analysis Time Period: Saturday Peak Hour
Intersection: Daly Ave. (SR 412)/East Casino
Area Type: CBD or Similar
Jurisdiction: State
Analysis Year: Build
Project ID: Bethworks Now Traffic Impact Study

East/West Street	North/South Street
Daly Avenue (SR 412)	East Casino Access Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		918			1025	400				499		180
% Heavy Veh		1			1	2				2		2
PHF		0.90			0.95	0.90				0.90		0.90
PK 15 Vol		255			270	111				139		50
Hi Ln Vol												
% Grade		0			0						0	
Ideal Sat		1900			1900	1900				1900		1900
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	1	0	0	0		2	0 1
LGConfig		T			T	R				L		R
Lane Width		12.0			12.0	13.0				12.0		13.0
RTOR Vol						0						0
Adj Flow		1020			1079	444				554		200
%InSharedLn												
Prop LTs		0.000			0.000							
Prop RTs		0.000			0.000	1.000						1.000
Peds Bikes					0			0			0	
Buses		0			0	0				0		0
%InProtPhase												
Duration	0.25											

Area Type: CBD or Similar

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			
Thru		P			Thru			
Right					Right			
Peds					Peds			
WB Left					SB Left	A		
Thru		P			Thru			
Right		P			Right	A		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right	P		
Green		45.0				34.0		
Yellow		4.0				3.0		
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		918			1025	400				499		180
PHF		0.90			0.95	0.90				0.90		0.90
Adj flow		1020			1079	444				554		200
No. Lanes	0	2	0	0	2	1	0	0	0		2	0 1
Lane group		T			T	R				L		R
Adj flow		1020			1079	444				554		200
Prop LTs		0.000			0.000							
Prop RTs		0.000			0.000	1.000						1.000

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

	Eastbound			Westbound			Northbound			Southbound		
LG		T			T	R				L		R
So		1900			1900	1900				1900		1900
Lanes	0	2	0	0	2	1	0	0	0	2	0	1
fW		1.000			1.000	1.033				1.000		1.033
fHV		0.990			0.990	0.980				0.980		0.980

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	0.900	0.900	0.900		0.900	0.900
fLU	0.952	0.952	1.000		0.971	1.000
fRT	1.000	1.000	0.850			0.850
fLT	1.000	1.000			0.950	
Sec.						
fLpb	1.000	1.000			1.000	
fRpb	1.000	1.000	1.000			1.000
S	3224	3224	1472		3093	1472
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	T	1020	3224		0.32	0.50	1612	0.63
Right								
Westbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru	T	1079	3224	#	0.33	0.50	1612	0.67
Right	R	444	1472		0.30	1.00	1472	0.30
Northbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru								
Right								
Southbound								
Prot								
Perm								
Left	L	554	3093	#	0.18	0.38	1168	0.47
Prot								
Perm								
Thru								
Right	R	200	1472		0.14	0.38	556	0.36

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.51
Total lost time per cycle, L = 11.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.59

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												
T	0.63	0.50	16.5	1.000	1612	0.50	1.9	0.0	18.4	B	18.4	B
Westbound												
T	0.67	0.50	16.9	1.000	1612	0.50	2.2	0.0	19.1	B	13.7	B
R	0.30	1.00	0.0	0.950	1472	0.50	0.5	0.0	0.5	A		
Northbound												
Southbound												
L	0.47	0.38	21.2	1.000	1168	0.11	0.3	0.0	21.5	C	21.3	C
R	0.36	0.38	20.2	1.000	556	0.11	0.4	0.0	20.6	C		

Intersection delay = 16.9 (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				

```
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
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
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
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	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 16.9 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

	Eastbound	Westbound	Northbound	Southbound
LaneGroup	T	T R		L R
Init Queue	0.0	0.0 0.0		0.0 0.0
Flow Rate	535	566 444		285 200
So	1900	1900 1900		1900 1900
No.Lanes	0 2 0	0 2 1	0 0 0	2 0 1
SL	1693	1693 1472		1593 1472
LnCapacity	846	846 1472		601 556
Flow Ratio	0.32	0.33 0.30		0.18 0.14
v/c Ratio	0.63	0.67 0.30		0.47 0.36
Grn Ratio	0.50	0.50 1.00		0.38 0.38
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
Q1	9.8	10.6		5.4 3.6
kB	1.0	1.0 1.5		0.5 0.5
Q2	1.7	1.9 0.6		0.5 0.3
Q Average	11.5	12.6		5.9 3.9
Q Spacing	24.9	24.9 24.9		24.9 24.9
Q Storage	500	500 400		400 400
Q S Ratio	0.6	0.6		0.4 0.2
70th Percentile Output:				
fB%	1.2	1.2		1.2 1.2
BOQ	13.9	15.2		6.9 4.6
QSRatio	0.7	0.8		0.4 0.3
85th Percentile Output:				
fB%	1.4	1.4		1.5 1.6
BOQ	16.4	17.9		9.1 6.1
QSRatio	0.8	0.9		0.6 0.4
90th Percentile Output:				
fB%	1.6	1.5		1.7 1.7
BOQ	17.8	19.4		9.9 6.7
QSRatio	0.9	1.0		0.6 0.4
95th Percentile Output:				
fB%	1.7	1.7		1.9 2.0
BOQ	19.5	21.1		11.3 7.7
QSRatio	1.0	1.1		0.7 0.5
98th Percentile Output:				
fB%	1.9	1.8		2.3 2.4
BOQ	21.2	22.9		13.7 9.5
QSRatio	1.1	1.1		0.9 0.6

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: Walter Lublanecki
Agency: Lublanecki Engineering, Inc.
Date: 11/20/05
Period: PM Peak Hour
Project ID: Bethworks Now Traffic Impact Study
E/W St: Daly Avenue (SR 412)
Inter.: Daly Ave.(SR 412)/West Casino
Area Type: CBD or Similar
Jurisd: State
Year : Build
N/S St: West Casino Access 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	0	2	1	0	0	0	0	0	2
LGConfig	L	T			T	R						R
Volume	134	968			955	48						43
Lane Width	12.0	12.0			12.0	13.0						13.0
RTOR Vol						0						0

Duration 0.25 Area Type: CBD or Similar

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	A				NB Left			
Thru	P	P			Thru			
Right					Right			
Peds					Peds			
WB Left					SB Left			
Thru		P			Thru			
Right		P			Right			
Peds					Peds			
NB Right					EB Right			
SB Right	A				WB Right			
Green	28.0	50.0						
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	496	1593	0.30	0.31	23.9	C		
T	3192	3192	0.34	1.00	0.3	A	3.2	A
Westbound								
T	1773	3192	0.57	0.56	14.3	B	14.0	B
R	818	1472	0.06	0.56	9.4	A		
Northbound								
Southbound								
							21.8	C
R	811	2606	0.06	0.31	21.8	C		

Intersection Delay = 8.5 (sec/veh) Intersection LOS = A

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: Walter Lublanecki
Agency/Co.: Lublanecki Engineering, Inc.
Date Performed: 11/20/05
Analysis Time Period: PM Peak Hour
Intersection: Daly Ave.(SR 412)/West Casino
Area Type: CBD or Similar
Jurisdiction: State
Analysis Year: Build
Project ID: Bethworks Now Traffic Impact Study

East/West Street	North/South Street
Daly Avenue (SR 412)	West Casino Access Rd.

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	134	968			955	48						43
% Heavy Veh	2	2			2	2						2
PHF	0.90	0.90			0.95	0.90						0.90
PK 15 Vol	37	269			251	13						12
Hi Ln Vol												
% Grade		0			0						0	
Ideal Sat	1900	1900			1900	1900						1900
ParkExist												
NumPark												
No. Lanes	1	2	0	0	2	1	0	0	0	0	0	2
LGConfig	L	T			T	R						R
Lane Width	12.0	12.0			12.0	13.0						13.0
RTOR Vol						0						0
Adj Flow	149	1076			1005	53						48
%InSharedLn												
Prop LTs		0.000			0.000							
Prop RTs		0.000			0.000	1.000						1.000
Peds Bikes					0						0	
Buses	0	0			0	0						0
%InProtPhase												
Duration	0.25			Area Type: CBD or Similar								

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	

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left		A			NB Left			
Thru		P	P		Thru			
Right					Right			
Peds					Peds			
WB Left					SB Left			
Thru			P		Thru			
Right			P		Right			
Peds					Peds			
NB Right					EB Right			
SB Right		A			WB Right			
Green		28.0	50.0					
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	134	968			955	48						43
PHF	0.90	0.90			0.95	0.90						0.90
Adj flow	149	1076			1005	53						48
No. Lanes	1	2	0	0	2	1	0	0	0	0	0	2
Lane group	L	T			T	R						R
Adj flow	149	1076			1005	53						48
Prop LTs		0.000			0.000							
Prop RTs		0.000			0.000	1.000						1.000

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

	Eastbound				Westbound			Northbound			Southbound			
LG	L	T			T	R								R
So	1900	1900			1900	1900								1900
Lanes	1	2	0	0	2	1	0	0	0	0	0	0	0	2
fW	1.000	1.000			1.000	1.033								1.033
fHV	0.980	0.980			0.980	0.980								0.980

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	0.900	0.900		0.900	0.900							0.900
fLU	1.000	0.952		0.952	1.000							0.885
fRT		1.000		1.000	0.850							0.850
fLT	0.950	1.000		1.000								
Sec.												
fLpb	1.000	1.000		1.000								
fRpb		1.000		1.000	1.000							1.000
S	1593	3192		3192	1472							2606
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	1593	#	0.09	0.31	496	0.30
Prot								
Perm								
Thru	T	1076	3192		0.34	1.00	3192	0.34
Right								
Westbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru	T	1005	3192	#	0.31	0.56	1773	0.57
Right	R	53	1472		0.04	0.56	818	0.06
Northbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru								
Right								
Southbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru								
Right	R	48	2606		0.02	0.31	811	0.06

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.41
Total lost time per cycle, L = 12.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.47

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor Del k	d2	Res Del d3	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound												
L	0.30	0.31	23.6	1.000	496	0.11	0.3	0.0	23.9	C		
T	0.34	1.00	0.0	0.950	3192	0.50	0.3	0.0	0.3	A	3.2	A
Westbound												
T	0.57	0.56	13.0	1.000	1773	0.50	1.3	0.0	14.3	B	14.0	B
R	0.06	0.56	9.2	1.000	818	0.50	0.2	0.0	9.4	A		
Northbound												
Southbound												
											21.8	C
R	0.06	0.31	21.8	1.000	811	0.11	0.0	0.0	21.8	C		

Intersection delay = 8.5 (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				

```
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
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
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
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	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 8.5 sec/veh Intersection LOS A

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	T			T	R						R
Init Queue	0.0	0.0			0.0	0.0						0.0
Flow Rate	149	565			527	53						27
So	1900	1900			1900	1900						1900
No.Lanes	1	2	0	0	2	1	0	0	0	0	0	2
SL	1593	1676			1676	1472						1472
LnCapacity	496	1676			931	818						458
Flow Ratio	0.09	0.34			0.31	0.04						0.02
v/c Ratio	0.30	0.34			0.57	0.06						0.06
Grn Ratio	0.31	1.00			0.56	0.56						0.31
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
Q1	2.8				8.5	0.6						0.5
kB	0.5	1.6			1.1	1.0						0.4
Q2	0.2	0.8			1.4	0.1						0.0
Q Average	3.0				9.9	0.7						0.5
Q Spacing	24.9	24.9			24.9	24.9						24.9
Q Storage	380	500			400	300						300
Q S Ratio	0.2				0.6	0.1						0.0
70th Percentile Output:												
fB%	1.2				1.2	1.3						1.2
BOQ	3.6				12.0	0.9						0.6
QSRatio	0.2				0.7	0.1						0.0
85th Percentile Output:												
fB%	1.6				1.4	1.7						1.6
BOQ	4.8				14.3	1.1						0.8
QSRatio	0.3				0.9	0.1						0.1
90th Percentile Output:												
fB%	1.7				1.6	1.9						1.8
BOQ	5.3				15.6	1.3						0.9
QSRatio	0.3				1.0	0.1						0.1
95th Percentile Output:												
fB%	2.0				1.7	2.5						2.1
BOQ	6.1				17.2	1.7						1.0
QSRatio	0.4				1.1	0.1						0.1
98th Percentile Output:												
fB%	2.5				1.9	3.0						2.7
BOQ	7.5				18.9	2.0						1.3
QSRatio	0.5				1.2	0.2						0.1

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: Walter Lublanecki
Agency: Lublanecki Engineering, Inc.
Date: 11/20/05
Period: Saturday Peak Hour
Project ID: Bethworks Now Traffic Impact Study
E/W St: Daly Avenue (SR 412)

Inter.: Daly Ave. (SR 412)/West Casino
Area Type: CBD or Similar
Jurisd: State
Year : Build
N/S St: West Casino Access 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	0	2	1	0	0	0	0	0	2
LGConfig	L	T			T	R						R
Volume	269	918			1116	99						89
Lane Width	12.0	12.0			12.0	13.0						13.0
RTOR Vol						0						0

Duration 0.25 Area Type: CBD or Similar

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	A				NB Left			
Thru	P	P			Thru			
Right					Right			
Peds					Peds			
WB Left					SB Left			
Thru		P			Thru			
Right		P			Right			
Peds					Peds			
NB Right					EB Right			
SB Right	A				WB Right			
Green	25.0	53.0						
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	443	1593	0.67	0.28	32.9	C		
T	3224	3224	0.32	1.00	0.3	A	7.7	A
Westbound								
T	1899	3224	0.62	0.59	13.5	B	13.1	B
R	867	1472	0.13	0.59	8.5	A		
Northbound								
Southbound								
							24.5	C
R	724	2606	0.14	0.28	24.5	C		

Intersection Delay = 10.8 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: Walter Lublanecki
Agency/Co.: Lublanecki Engineering, Inc.
Date Performed: 11/20/05
Analysis Time Period: Saturday Peak Hour
Intersection: Daly Ave. (SR 412)/West Casino
Area Type: CBD or Similar
Jurisdiction: State
Analysis Year: Build
Project ID: Bethworks Now Traffic Impact Study

East/West Street	North/South Street
Daly Avenue (SR 412)	West Casino Access Rd.

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	269	918			1116	99						89
% Heavy Veh	2	1			1	2						2
PHF	0.90	0.90			0.95	0.90						0.90
PK 15 Vol	75	255			294	28						25
Hi Ln Vol												
% Grade		0			0						0	
Ideal Sat	1900	1900			1900	1900						1900
ParkExist												
NumPark												
No. Lanes	1	2	0	0	2	1	0	0	0	0	0	2
LGConfig	L	T			T	R						R
Lane Width	12.0	12.0			12.0	13.0						13.0
RTOR Vol						0						0
Adj Flow	299	1020			1175	110						99
%InSharedLn												
Prop LTs		0.000			0.000							
Prop RTs		0.000			0.000	1.000						1.000
Peds Bikes					0						0	
Buses	0	0			0	0						0
%InProtPhase												
Duration	0.25			Area Type: CBD or Similar								

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	

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left		A			NB Left			
Thru		P	P		Thru			
Right					Right			
Peds					Peds			
WB Left					SB Left			
Thru			P		Thru			
Right			P		Right			
Peds					Peds			
NB Right					EB Right			
SB Right		A			WB Right			
Green		25.0	53.0					
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	269	918			1116	99						89
PHF	0.90	0.90			0.95	0.90						0.90
Adj flow	299	1020			1175	110						99
No. Lanes	1	2	0	0	2	1	0	0	0	0	0	2
Lane group	L	T			T	R						R
Adj flow	299	1020			1175	110						99
Prop LTs		0.000			0.000							
Prop RTs		0.000			0.000	1.000						1.000

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

	Eastbound				Westbound			Northbound			Southbound			
LG	L	T			T	R								R
So	1900	1900			1900	1900								1900
Lanes	1	2	0	0	2	1	0	0	0	0	0	0	0	2
fW	1.000	1.000			1.000	1.033								1.033
fHV	0.980	0.990			0.990	0.980								0.980

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	0.900	0.900		0.900	0.900								0.900
fLU	1.000	0.952		0.952	1.000								0.885
fRT		1.000		1.000	0.850								0.850
fLT	0.950	1.000		1.000									
Sec.													
fLpb	1.000	1.000		1.000									
fRpb		1.000		1.000	1.000								1.000
S	1593	3224		3224	1472								2606
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	299	1593	#	0.19	0.28	443	0.67
Prot								
Perm								
Thru	T	1020	3224		0.32	1.00	3224	0.32
Right								
Westbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru	T	1175	3224	#	0.36	0.59	1899	0.62
Right	R	110	1472		0.07	0.59	867	0.13
Northbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru								
Right								
Southbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru								
Right	R	99	2606		0.04	0.28	724	0.14

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.55
Total lost time per cycle, L = 12.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.64

Control Delay and LOS Determination

Appr/ Lane	Ratios		Unf Del	Prog Adj	Lane Grp	Incremental Factor Del		Res Del	Lane Group		Approach	
Grp	v/c	g/C	d1	Fact	Cap	k	d2	d3	Delay	LOS	Delay	LOS
Eastbound												
L	0.67	0.28	28.9	1.000	443	0.25	4.0	0.0	32.9	C		
T	0.32	1.00	0.0	0.950	3224	0.50	0.3	0.0	0.3	A	7.7	A
Westbound												
T	0.62	0.59	12.0	1.000	1899	0.50	1.5	0.0	13.5	B	13.1	B
R	0.13	0.59	8.2	1.000	867	0.50	0.3	0.0	8.5	A		
Northbound												
Southbound												
											24.5	C
R	0.14	0.28	24.4	1.000	724	0.11	0.1	0.0	24.5	C		

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				

```
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
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
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
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	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 10.8 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	T			T	R						R
Init Queue	0.0	0.0			0.0	0.0						0.0
Flow Rate	299	535			617	110						55
So	1900	1900			1900	1900						1900
No.Lanes	1	2	0	0	2	1	0	0	0	0	0	2
SL	1593	1693			1693	1472						1472
LnCapacity	443	1693			997	867						409
Flow Ratio	0.19	0.32			0.36	0.07						0.04
v/c Ratio	0.67	0.32			0.62	0.13						0.13
Grn Ratio	0.28	1.00			0.59	0.59						0.28
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
Q1	6.6				10.0	1.2						1.0
kB	0.4	1.7			1.1	1.0						0.4
Q2	0.8	0.8			1.8	0.1						0.1
Q Average	7.5				11.8	1.4						1.1
Q Spacing	24.9	24.9			24.9	24.9						24.9
Q Storage	380	500			400	300						300
Q S Ratio	0.5				0.7	0.1						0.1
70th Percentile Output:												
fB%	1.2				1.2	1.3						1.2
BOQ	8.9				14.2	1.8						1.3
QSRatio	0.6				0.9	0.1						0.1
85th Percentile Output:												
fB%	1.5				1.4	1.6						1.6
BOQ	11.5				16.8	2.2						1.7
QSRatio	0.8				1.0	0.2						0.1
90th Percentile Output:												
fB%	1.7				1.5	1.9						1.8
BOQ	12.5				18.2	2.6						1.9
QSRatio	0.8				1.1	0.2						0.2
95th Percentile Output:												
fB%	1.9				1.7	2.4						2.1
BOQ	14.2				19.9	3.2						2.3
QSRatio	0.9				1.2	0.3						0.2
98th Percentile Output:												
fB%	2.3				1.8	2.8						2.6
BOQ	16.9				21.7	3.9						2.9
QSRatio	1.1				1.3	0.3						0.2

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: Walter Lublanecki
Agency: Lublanecki Engineering, Inc.
Date: 11/20/05
Period: PM Peak Hour
Project ID: Bethworks Now Traffic Impact Study
E/W St: Daly Avenue
Inter.: Daly Ave./Beth Retail Access R
Area Type: CBD or Similar
Jurisd: State
Year : Build
N/S St: Bethworks Retail Ctr Access 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	0	2	1	0	0	0	2	0	1
LGConfig	L	T			T	R				L		R
Volume	139	891			753	258				207		112
Lane Width	12.0	12.0			12.0	13.0				13.0		13.0
RTOR Vol						0						0

Duration 0.25 Area Type: CBD or Similar

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A				NB Left				
Thru	P	P			Thru				
Right					Right				
Peds					Peds				
WB Left					SB Left	A			
Thru		P			Thru				
Right		P			Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right	A				WB Right	P			
Green	20.0	33.0				20.0			
Yellow	4.0	4.0				3.0			
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 Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	357	1608	0.43	0.22	30.9	C		
T	2093	3192	0.47	0.66	8.5	A	11.5	B
Westbound								
T	1170	3192	0.68	0.37	27.2	C	21.9	C
R	975	1487	0.29	0.66	7.4	A		
Northbound								
Southbound								
L	703	3163	0.33	0.22	29.6	C		
							23.6	C
R	729	1457	0.17	0.50	12.4	B		

Intersection Delay = 17.5 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

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E-Mail: lei@eclipse.net

OPERATIONAL ANALYSIS

Analyst: Walter Lublanecki
Agency/Co.: Lublanecki Engineering, Inc.
Date Performed: 11/20/05
Analysis Time Period: PM Peak Hour
Intersection: Daly Ave./Beth Retail Access R
Area Type: CBD or Similar
Jurisdiction: State
Analysis Year: Build
Project ID: Bethworks Now Traffic Impact Study

East/West Street	North/South Street
Daly Avenue	Bethworks Retail Ctr Access Rd

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	139	891			753	258				207		112
% Heavy Veh	1	2			2	1				1		1
PHF	0.90	0.90			0.95	0.90				0.90		0.90
PK 15 Vol	39	248			198	72				58		31
Hi Ln Vol												
% Grade		0			0						4	
Ideal Sat	1900	1900			1900	1900				1900		1900
ParkExist												
NumPark												
No. Lanes	1	2	0	0	2	1	0	0	0	2	0	1
LGConfig	L	T			T	R				L		R
Lane Width	12.0	12.0			12.0	13.0				13.0		13.0
RTOR Vol						0						0
Adj Flow	154	990			793	287				230		124
%InSharedLn												
Prop LTs		0.000			0.000							
Prop RTs		0.000			0.000	1.000						1.000
Peds Bikes					0			0			0	
Buses	0	0			0	0				0		0
%InProtPhase												
Duration	0.25			Area Type: CBD or Similar								

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		A			NB Left			
Thru		P	P		Thru			
Right					Right			
Peds					Peds			
WB Left					SB Left	A		
Thru			P		Thru			
Right			P		Right	A		
Peds					Peds			
NB Right					EB Right			
SB Right		A			WB Right	P		
Green		20.0	33.0			20.0		
Yellow		4.0	4.0			3.0		
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	139	891			753	258				207		112
PHF	0.90	0.90			0.95	0.90				0.90		0.90
Adj flow	154	990			793	287				230		124
No. Lanes	1	2	0	0	2	1	0	0	0	2	0	1
Lane group	L	T			T	R				L		R
Adj flow	154	990			793	287				230		124
Prop LTs		0.000			0.000							
Prop RTs		0.000			0.000	1.000						1.000

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

	Eastbound				Westbound			Northbound			Southbound			
LG	L	T			T	R					L		R	
So	1900	1900			1900	1900					1900		1900	
Lanes	1	2	0	0	2	1	0	0	0	0	2	0	1	
fW	1.000	1.000			1.000	1.033					1.033		1.033	
fHV	0.990	0.980			0.980	0.990					0.990		0.990	

fG	1.000	1.000		1.000	1.000			0.980		0.980		
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	0.900	0.900		0.900	0.900			0.900		0.900		
fLU	1.000	0.952		0.952	1.000			0.971		1.000		
fRT		1.000		1.000	0.850					0.850		
fLT	0.950	1.000		1.000				0.950				
Sec.												
fLpb	1.000	1.000		1.000				1.000				
fRpb		1.000		1.000	1.000					1.000		
S	1608	3192		3192	1487			3163		1457		
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	154	1608	#	0.10	0.22	357	0.43
Prot								
Perm								
Thru	T	990	3192		0.31	0.66	2093	0.47
Right								
Westbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru	T	793	3192	#	0.25	0.37	1170	0.68
Right	R	287	1487		0.19	0.66	975	0.29
Northbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru								
Right								
Southbound								
Prot								
Perm								
Left	L	230	3163	#	0.07	0.22	703	0.33
Prot								
Perm								
Thru								
Right	R	124	1457		0.09	0.50	729	0.17

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.42
Total lost time per cycle, L = 17.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.51

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor Del k	d2	Res Del d3	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound												
L	0.43	0.22	30.1	1.000	357	0.11	0.8	0.0	30.9	C		
T	0.47	0.66	7.7	1.000	2093	0.50	0.8	0.0	8.5	A	11.5	B
Westbound												
T	0.68	0.37	24.0	1.000	1170	0.50	3.2	0.0	27.2	C	21.9	C
R	0.29	0.66	6.6	1.000	975	0.50	0.8	0.0	7.4	A		
Northbound												
Southbound												
L	0.33	0.22	29.4	1.000	703	0.11	0.3	0.0	29.6	C		
											23.6	C
R	0.17	0.50	12.3	1.000	729	0.11	0.1	0.0	12.4	B		

Intersection delay = 17.5 (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				

```
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
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
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
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 (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 17.5 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	T			T	R				L		R
Init Queue	0.0	0.0			0.0	0.0				0.0		0.0
Flow Rate	154	519			416	287				118		124
So	1900	1900			1900	1900				1900		1900
No.Lanes	1	2	0	0	2	1	0	0	0	2	0	1
SL	1608	1676			1676	1487				1629		1457
LnCapacity	357	1099			614	975				361		729
Flow Ratio	0.10	0.31			0.25	0.19				0.07		0.09
v/c Ratio	0.43	0.47			0.68	0.29				0.33		0.17
Grn Ratio	0.22	0.66			0.37	0.66				0.22		0.50
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	3.3	6.5			8.8	3.1				2.5		1.7
kB	0.4	1.2			0.8	1.1				0.4		0.6
Q2	0.3	1.1			1.6	0.5				0.2		0.1
Q Average	3.6	7.5			10.4	3.5				2.7		1.8
Q Spacing	24.9	24.9			24.9	24.9				24.9		24.9
Q Storage	400	500			500	450				400		400
Q S Ratio	0.2	0.4			0.5	0.2				0.2		0.1
70th Percentile Output:												
fB%	1.2	1.2			1.2	1.2				1.2		1.2
BOQ	4.3	9.2			12.6	4.4				3.2		2.2
QSRatio	0.3	0.5			0.6	0.2				0.2		0.1
85th Percentile Output:												
fB%	1.6	1.5			1.4	1.5				1.6		1.6
BOQ	5.6	11.1			14.9	5.5				4.2		2.9
QSRatio	0.4	0.6			0.7	0.3				0.3		0.2
90th Percentile Output:												
fB%	1.7	1.6			1.6	1.7				1.8		1.8
BOQ	6.2	12.2			16.2	6.2				4.6		3.2
QSRatio	0.4	0.6			0.8	0.3				0.3		0.2
95th Percentile Output:												
fB%	2.0	1.8			1.7	2.1				2.0		2.0
BOQ	7.2	13.7			17.9	7.4				5.4		3.7
QSRatio	0.4	0.7			0.9	0.4				0.3		0.2
98th Percentile Output:												
fB%	2.5	2.0			1.9	2.4				2.5		2.6
BOQ	8.8	15.3			19.6	8.6				6.7		4.7
QSRatio	0.5	0.8			1.0	0.5				0.4		0.3

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: Walter Lublanecki
Agency: Lublanecki Engineering, Inc.
Date: 11/20/05
Period: Saturday Peak Hour
Project ID: Bethworks Now Traffic Impact Study
E/W St: Daly Avenue
Inter.: Daly Ave./Beth Retail Access R
Area Type: CBD or Similar
Jurisd: State
Year : Build
N/S St: Bethworks Retail Ctr. Access R

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	0	0	2	1	0	0	0	2	0	1
LGConfig	L	T			T	R				L		R
Volume	259	839			813	480				430		231
Lane Width	12.0	12.0			12.0	13.0				13.0		13.0
RTOR Vol						0						0

Duration 0.25 Area Type: CBD or Similar

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A				NB Left				
Thru	P	P			Thru				
Right					Right				
Peds					Peds				
WB Left					SB Left	A			
Thru		P			Thru				
Right		P			Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right	A				WB Right	P			
Green	23.0	31.0				19.0			
Yellow	4.0	4.0				3.0			
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 Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	411	1608	0.70	0.26	35.6	D		
T	2149	3224	0.43	0.67	7.7	A	14.3	B
Westbound								
T	1110	3224	0.77	0.34	31.5	C	24.3	C
R	925	1487	0.58	0.62	12.6	B		
Northbound								
Southbound								
L	668	3163	0.72	0.21	36.7	D		
							28.3	C
R	761	1457	0.34	0.52	12.7	B		

Intersection Delay = 21.5 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: Walter Lublanecki
Agency/Co.: Lublanecki Engineering, Inc.
Date Performed: 11/20/05
Analysis Time Period: Saturday Peak Hour
Intersection: Daly Ave./Beth Retail Access R
Area Type: CBD or Similar
Jurisdiction: State
Analysis Year: Build
Project ID: Bethworks Now Traffic Impact Study

East/West Street	North/South Street
Daly Avenue	Bethworks Retail Ctr. Access R

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	259	839			813	480				430		231
% Heavy Veh	1	1			1	1				1		1
PHF	0.90	0.90			0.95	0.90				0.90		0.90
PK 15 Vol	72	233			214	133				119		64
Hi Ln Vol												
% Grade		0			0						4	
Ideal Sat	1900	1900			1900	1900				1900		1900
ParkExist												
NumPark												
No. Lanes	1	2	0	0	2	1	0	0	0	2	0	1
LGConfig	L	T			T	R				L		R
Lane Width	12.0	12.0			12.0	13.0				13.0		13.0
RTOR Vol						0						0
Adj Flow	288	932			856	533				478		257
%InSharedLn												
Prop LTs		0.000			0.000							
Prop RTs		0.000			0.000	1.000						1.000
Peds Bikes					0			0			0	
Buses	0	0			0	0				0		0
%InProtPhase												
Duration	0.25			Area Type: CBD or Similar								

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		A			NB Left			
Thru		P	P		Thru			
Right					Right			
Peds					Peds			
WB Left					SB Left	A		
Thru			P		Thru			
Right			P		Right	A		
Peds					Peds			
NB Right					EB Right			
SB Right		A			WB Right	P		
Green		23.0	31.0			19.0		
Yellow		4.0	4.0			3.0		
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	259	839			813	480				430		231
PHF	0.90	0.90			0.95	0.90				0.90		0.90
Adj flow	288	932			856	533				478		257
No. Lanes	1	2	0	0	2	1	0	0	0	2	0	1
Lane group	L	T			T	R				L		R
Adj flow	288	932			856	533				478		257
Prop LTs		0.000			0.000							
Prop RTs		0.000			0.000	1.000						1.000

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

	Eastbound				Westbound			Northbound			Southbound			
LG	L	T			T	R					L		R	
So	1900	1900			1900	1900					1900		1900	
Lanes	1	2	0	0	2	1	0	0	0	0	2	0	1	
fW	1.000	1.000			1.000	1.033					1.033		1.033	
fHV	0.990	0.990			0.990	0.990					0.990		0.990	

fG	1.000	1.000			1.000	1.000				0.980			0.980
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	0.900	0.900			0.900	0.900				0.900			0.900
fLU	1.000	0.952			0.952	1.000				0.971			1.000
fRT		1.000			1.000	0.850							0.850
fLT	0.950	1.000			1.000					0.950			
Sec.													
fLpb	1.000	1.000			1.000					1.000			
fRpb		1.000			1.000	1.000							1.000
S	1608	3224			3224	1487				3163			1457
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		288	1608	#	0.18	0.26	411	0.70
Prot									
Perm									
Thru	T		932	3224		0.29	0.67	2149	0.43
Right									
Westbound									
Prot									
Perm									
Left									
Prot									
Perm									
Thru	T		856	3224	#	0.27	0.34	1110	0.77
Right	R		533	1487		0.36	0.62	925	0.58
Northbound									
Prot									
Perm									
Left									
Prot									
Perm									
Thru									
Right									
Southbound									
Prot									
Perm									
Left	L		478	3163	#	0.15	0.21	668	0.72
Prot									
Perm									
Thru									
Right	R		257	1457		0.18	0.52	761	0.34

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.60
Total lost time per cycle, L = 17.00 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	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound												
L	0.70	0.26	30.4	1.000	411	0.27	5.3	0.0	35.6	D		
T	0.43	0.67	7.0	1.000	2149	0.50	0.6	0.0	7.7	A	14.3	B
Westbound												
T	0.77	0.34	26.3	1.000	1110	0.50	5.2	0.0	31.5	C	24.3	C
R	0.58	0.62	10.0	1.000	925	0.50	2.6	0.0	12.6	B		
Northbound												
Southbound												
L	0.72	0.21	33.0	1.000	668	0.28	3.7	0.0	36.7	D		
											28.3	C
R	0.34	0.52	12.5	1.000	761	0.11	0.3	0.0	12.7	B		

Intersection delay = 21.5 (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                          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
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
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
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	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 21.5 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	T			T	R				L		R
Init Queue	0.0	0.0			0.0	0.0				0.0		0.0
Flow Rate	288	489			449	533				246		257
So	1900	1900			1900	1900				1900		1900
No.Lanes	1	2	0	0	2	1	0	0	0	2	0	1
SL	1608	1693			1693	1487				1629		1457
LnCapacity	411	1128			582	925				343		761
Flow Ratio	0.18	0.29			0.27	0.36				0.15		0.18
v/c Ratio	0.70	0.43			0.77	0.58				0.72		0.34
Grn Ratio	0.26	0.67			0.34	0.62				0.21		0.52
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	6.5	5.7			10.0	7.8				5.7		3.7
kB	0.4	1.2			0.8	1.1				0.4		0.6
Q2	0.9	0.9			2.3	1.4				0.9		0.3
Q Average	7.4	6.7			12.3	9.3				6.6		4.0
Q Spacing	24.9	24.9			24.9	24.9				24.9		24.9
Q Storage	400	500			500	450				400		400
Q S Ratio	0.5	0.3			0.6	0.5				0.4		0.3
70th Percentile Output:												
fB%	1.2	1.2			1.2	1.2				1.2		1.2
BOQ	8.8	8.2			14.9	11.3				7.8		4.8
QSRatio	0.5	0.4			0.7	0.6				0.5		0.3
85th Percentile Output:												
fB%	1.5	1.5			1.4	1.4				1.5		1.6
BOQ	11.4	9.9			17.6	13.4				10.1		6.3
QSRatio	0.7	0.5			0.9	0.7				0.6		0.4
90th Percentile Output:												
fB%	1.7	1.6			1.5	1.6				1.7		1.7
BOQ	12.4	10.9			19.0	14.6				11.1		7.0
QSRatio	0.8	0.5			0.9	0.8				0.7		0.4
95th Percentile Output:												
fB%	1.9	1.9			1.7	1.8				1.9		2.0
BOQ	14.1	12.4			20.8	16.3				12.6		8.0
QSRatio	0.9	0.6			1.0	0.9				0.8		0.5
98th Percentile Output:												
fB%	2.3	2.1			1.8	1.9				2.3		2.4
BOQ	16.8	14.0			22.5	17.9				15.1		9.8
QSRatio	1.0	0.7			1.1	1.0				0.9		0.6

ERROR MESSAGES

No errors to report.