January 5, 2016

Ms. Ruth Smith
City of Los Alamitos
3191 Katella Avenue
Los Alamitos, CA 90720

17-J16-1753

SUBJECT: Yellow and All-Red Traffic Signal Timing at (2) Intersections in the City of Los Alamitos

Dear Ruth:

Iteris, Inc. is pleased to submit our check of the yellow and all-red timing at the two signalized intersections of Katella Avenue at Los Alamitos Boulevard and Bloomfield Avenue, in the City of Los Alamitos. This letter shall serve as confirmation that the yellow and all-red times operating in the traffic signal controllers have been verified as what is approved per the attached calculation sheets, and are in conformance with the latest 2014 California MUTCD guidelines.

Please feel free to contact me at (949) 270-9633 or bkl@iteris.com should you have any questions.

Sincerely,
Iteris, Inc.

Bernard K. Li, EE, TE, PTOE
Associate Vice President
Transportation Systems

Attachment: Yellow and All-Red Time Calculation Tables (2 intersections)

VEHICLE CLEARANCE INTERVAL CALCULATIONS

KATELLA AVENUE AT LOS ALAMITOS BOULEVARD

Agency:	City of Los Alamitos, CA	North-South Street:	Los Alamitos Boulevard
Date:	January 5, 2016	East-West Street:	Katella Avenue

Standard:
The minimum yellow change interval shall be in accordance with Table 4D-102(CA) of the latest 2014 State of California Manual on Uniform Traffic Control Devices (CA-MUTCD). The 85th Percentile speed of free-flow traffic rounded up to the next 5 miles per hour, if available, shall be used for determination of the minimum yellow change interval for the through traffic movement. Where the posted speed limit, or the prima facie speed limit established by the California Vehicle Code (CVC), is higher than the 85th Percentile speed rounded value, the posted speed limit, or the prima facie speed limit, shall be used. The minimum yellow change interval for a protected left-turn or protected right-turn phase shall be 3.0 seconds; however, to be conservative, the city standard is to use 3.2 seconds for a protected left turn phase. The duration of a red clearance interval shall be predetermined. The following formula is for yellow clearance as prescribed in CA-MUTCD Section 4D.26, "Yellow Change and Red Clearance Intervals", and Table 4D-102(CA).

$$T = t_R + \frac{V}{2d}$$

Where:
T = Minimum Yellow Change Interval (sec); t_R = Reaction time (1.0 sec); V = 85th Percentile Speed, rounded-up (ft/sec); and d = Deceleration rate (10 ft/sec^2)

Support: When used, red clearance intervals normally range from 0.1 to 2.0 seconds, with guidance provided to not exceed 6.0 seconds.

EASTBOUND INTERSECTION APPROACH						EASTBOUND APPROACH CONTROLLER TIMING VALUES (sec)	
t_R (sec)	85th percentile speed (mph)	Rounded-up V (mph)	V (ft/sec)	d (ft/sec^2)	T (sec) *		
1	39.9	40	58.67	10	3.9	Yellow Change†:	4.0
						All-Red Clearance:	1.0
WESTBOUND INTERSECTION APPROACH						**WESTBOUND APPROACH CONTROLLER TIMING VALUES (sec)**	
t_R (sec)	85th percentile speed (mph)	Rounded-up V (mph)	V (ft/sec)	d (ft/sec^2)	T (sec) *		
1	35.7	40	58.67	10	3.9	Yellow Change†:	4.0
						All-Red Clearance:	1.0
NORTHBOUND INTERSECTION APPROACH						**NORTHBOUND APPROACH CONTROLLER TIMING VALUES (sec)**	
t_R (sec)	85th percentile speed (mph)	Rounded-up V (mph)	V (ft/sec)	d (ft/sec^2)	T (sec) *		
1	36.8	40	58.67	10	3.9	Yellow Change†:	4.0
						All-Red Clearance:	1.0
SOUTHBOUND INTERSECTION APPROACH						**SOUTHBOUND APPROACH CONTROLLER TIMING VALUES (sec)**	
t_R (sec)	85th percentile speed (mph)	Rounded-up V (mph)	V (ft/sec)	d (ft/sec^2)	T (sec) *		
1	38.5	40	58.67	10	3.9	Yellow Change†:	4.0
						All-Red Clearance:	1.0

Notes: * If opposing approaches are different, use the higher value for both directions.
† City standard practice for Yellow intervals to be rounded up to the nearest 0.5 seconds.

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VEHICLE CLEARANCE INTERVAL CALCULATIONS

KATELLA AVENUE AT BLOOMFIELD AVENUE

Agency:	City of Los Alamitos, CA	North-South Street:	Bloomfield Avenue
Date:	January 5, 2016	East-West Street:	Katella Avenue

Standard:
The minimum yellow change interval shall be in accordance with Table 4D-102(CA) of the latest 2014 State of California Manual on Uniform Traffic Control Devices (CA-MUTCD). The 85th Percentile speed of free-flow traffic rounded up to the next 5 miles per hour, if available, shall be used for determination of the minimum yellow change interval for the through traffic movement. Where the posted speed limit, or the prima facie speed limit established by the California Vehicle Code (CVC), is higher than the 85th Percentile speed rounded value, the posted speed limit, or the prima facie speed limit, shall be used. The minimum yellow change interval for a protected left-turn or protected right-turn phase shall be 3.0 seconds; however, to be conservative, the city standard is to use 3.2 seconds for a protected left turn phase. The duration of a red clearance interval shall be predetermined. The following formula is for yellow clearance as prescribed in CA-MUTCD Section 4D.26, "Yellow Change and Red Clearance Intervals", and Table 4D-102(CA).

$$T = t_R + \frac{V}{2d}$$

Where:
T = Minimum Yellow Change Interval (sec); t_R = Reaction time (1.0 sec); V = 85th Percentile Speed, rounded-up (ft/sec); and d = Deceleration rate (10 ft/sec^2)

Support: When used, red clearance intervals normally range from 0.1 to 2.0 seconds, with guidance provided to not exceed 6.0 seconds.

EASTBOUND INTERSECTION APPROACH						EASTBOUND APPROACH CONTROLLER TIMING VALUES (sec)	
t_R (sec)	85th percentile speed (mph)	Rounded-up V (mph)	V (ft/sec)	d (ft/sec^2)	T (sec) *		
1	35.7	40	58.67	10	3.9	Yellow Change†:	4.0
						All-Red Clearance:	1.0
WESTBOUND INTERSECTION APPROACH						**WESTBOUND APPROACH CONTROLLER TIMING VALUES (sec)**	
t_R (sec)	85th percentile speed (mph)	Rounded-up V (mph)	V (ft/sec)	d (ft/sec^2)	T (sec) *		
1	39.9	40	58.67	10	3.9	Yellow Change†:	4.0
						All-Red Clearance:	1.0
NORTHBOUND INTERSECTION APPROACH						**NORTHBOUND APPROACH CONTROLLER TIMING VALUES (sec)**	
t_R (sec)	85th percentile speed (mph)	Rounded-up V (mph)	V (ft/sec)	d (ft/sec^2)	T (sec) *		
1	25.2	30	44.00	10	3.2	Yellow Change†:	4.5 *
						All-Red Clearance:	1.0
SOUTHBOUND INTERSECTION APPROACH						**SOUTHBOUND APPROACH CONTROLLER TIMING VALUES (sec)**	
t_R (sec)	85th percentile speed (mph)	Rounded-up V (mph)	V (ft/sec)	d (ft/sec^2)	T (sec) *		
1	41.0	45	66.00	10	4.3	Yellow Change†:	4.5
						All-Red Clearance:	1.0

Notes: * If opposing approaches are different, use the higher value for both directions.
† City standard practice for Yellow intervals to be rounded up to the nearest 0.5 seconds.

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