The duration of yellow light change interval at Cary Town Blvd and Convention is less than the minimum required by law.

SL2001-286, Section 3

(b) Any traffic control photographic system or any device which is a part of that system, as described in subsection (a) of this section, installed on a street or highway which is a part of the State highway system shall meet requirements established by the North Carolina Department of Transportation. *Any traffic control system installed on a municipal street shall meet standards established by the municipality and shall be consistent with any standards set by the Department of Transportation*.

(e) The duration of the yellow light change interval at intersections where traffic control photographic systems are in use shall be no less than the yellow light change interval duration specified in the *Design Manual developed by the Signals and Geometrics Section of the North Carolina Department of Transportation*.

SL2004-141, Section 3

(e) The duration of the yellow light change interval at intersections where traffic control photographic systems are in use shall be no less than the yellow light change interval duration specified on the *traffic signal plan of record signed and sealed by a licensed North Carolina Professional Engineer* in accordance with Chapter 89C of the General Statutes, and shall be in full conformance with the requirements of the Manual on Uniform Traffic Control Devices.

Town of Cary Charter. Section 8.15. A repeat of SL2001-286

(b) Any traffic control photographic system or any device which is a part of that system, as described in subsection (a) of this section, installed on a street or highway which is a part of the state highway system shall meet requirements established by the North Carolina Department of Transportation. *Any traffic control system installed on a street within the Town of Cary shall meet standards established by the Town of Cary and shall be consistent with any standards set by the Department of Transportation*.

(e) The duration of the yellow light change interval at intersections where traffic control photographic systems are in use shall be no less than the yellow light change interval duration specified in the *Design Manual developed by the Signals and Geometrics Section of the North Carolina Department of Transportation*.

NCDOT Signal Guidelines

http://www.ncdot.gov/doh/preconstruct/altern/design_build/SignalGuidelines0509.pdf

Ensure the development of the Traffic Signal & Intelligent Transportation System plans are in compliance with the most current:

Manual on Uniform Traffic Control Devices for Streets and Highways
North Carolina Supplement to the Manual on Uniform Traffic Control Devices for Streets and Highways
NCDOT Traffic Signal Specifications and all addenda
NCDOT Intelligent Transportation and Signal Systems Unit Design Manual
National Electrical Safety Code
National Electric Code
NCDOT Roadway Standard Drawings
NCDOT Standard Specifications for Roads and Structures
.
.
.
All Traffic Signal Plans shall be sealed by the Engineer. The Engineer must be duly registered to practice engineering in North Carolina.

Determination of Yellow Change and Red Clearance Intervals

Yellow Change Interval

$$\text{Yellow interval} = t + \frac{v}{2a + 64.4g}$$

t = perception reaction time, typically 1.5 seconds
v = design speed*, in ft/sec
a = deceleration rate, typically 11.2 ft/sec^2
g = grade

Round up to nearest 0.1 second.

Minimum yellow change interval is 3.0 seconds.

Hold stakeholder discussion** when calculated yellow change interval is longer than 6.0 seconds.

Red Clearance Interval

$$\text{Red interval} = \frac{w}{v}$$

w = width of intersection, in feet
v = design speed*, in ft/sec

If the initial calculation results in an all red time longer than 3.0 seconds, recalculate the red time as follows:

$$\text{Recalculated red interval} = \frac{1}{2}\left(\frac{w}{v} - 3\right) + 3$$

Round up to nearest 0.1 second.

Minimum red clearance interval is 1.0 seconds.

Hold stakeholder discussion** when recalculated red clearance interval is longer than 4.0 seconds.

Notes

* Design speed is the speed limit unless a speed study determines that the 85th percentile speed is faster or intersection geometrics compel vehicles to traverse the intersection slower.

** The purpose of a stakeholder discussion is to provide advance notification and involvement to stakeholders and provide an opportunity to consider possible countermeasures.

For most left turn lanes, assume a speed of 20 mph (32 kph) to 30 mph (48 kph). For locations with unusual conditions a higher or lower speed may be appropriate.

For separate left turn phases, calculate yellow and red intervals.

For left turns without a separate phase, calculate yellow and red times for both the through movement and the left turn movement. Use the highest yellow and enough red to equal the highest total time.

Where existing times are higher than calculated times, use the calculated values unless there is a documented history of the need for higher times. If approach is high speed and existing times are significantly higher than the calculated times, use the calculated values but consider adding a note to the plan to direct field forces to reduce the time incrementally. Include in the note how much and how often to reduce time until the final value is reached. (Ex. Existing Yellow Change Interval for phase 2 may be decreased by 0.2 seconds per week until the required value is reached.)

Where revising a location or adding a new signal along a corridor, consider comparing clearance times at adjacent intersections to new calculations to meet driver expectations.

Sources:
Traffic Engineering Handbook, Fifth Edition, Institute of Transportation Engineers, 1999.

A Policy on Geometric Design of Highways and Streets, Fourth Edition, American Association of State Highway and Transportation Officials, 2001.

minimum yellow duration = t + v/(2a + 64.4g)

Where

t = perception reaction time, fixed at t = 1.5s according to STD 5.2.2
a = deceleration rate, fixed at 11.2 ft/s^2 according to STD 5.2.2
v = speed limit (in ft/s)
g = grade which is the rise over the run. Where 0 is level, and 1.0 is a 45 degree incline, -1.0 is a 45 degree downhill.

Calculate the minimum yellow light duration at the intersection of Cary Town Blvd and Convention (the Mall Entrance). The speed limit signs say 45 mph.

v = 45 miles/hour * 5280 ft/mile * 1 hour / 3600 seconds = 66 ft/s
g = 0.0 The road is level.
a = deceleration rate. From STD 5.2.2 fixed at 11.2 ft/s^2

minimum yellow light duration

= 1.5 s + 66/(2 * 11.2 + 64.4 * 0)
= 1.5s + 66/(22.4 + 0)
= 1.5s + 2.94s

= 4.5s (rounded up to nearest .1 s as directed by STD 5.2.2, Sheet 4 of 4)

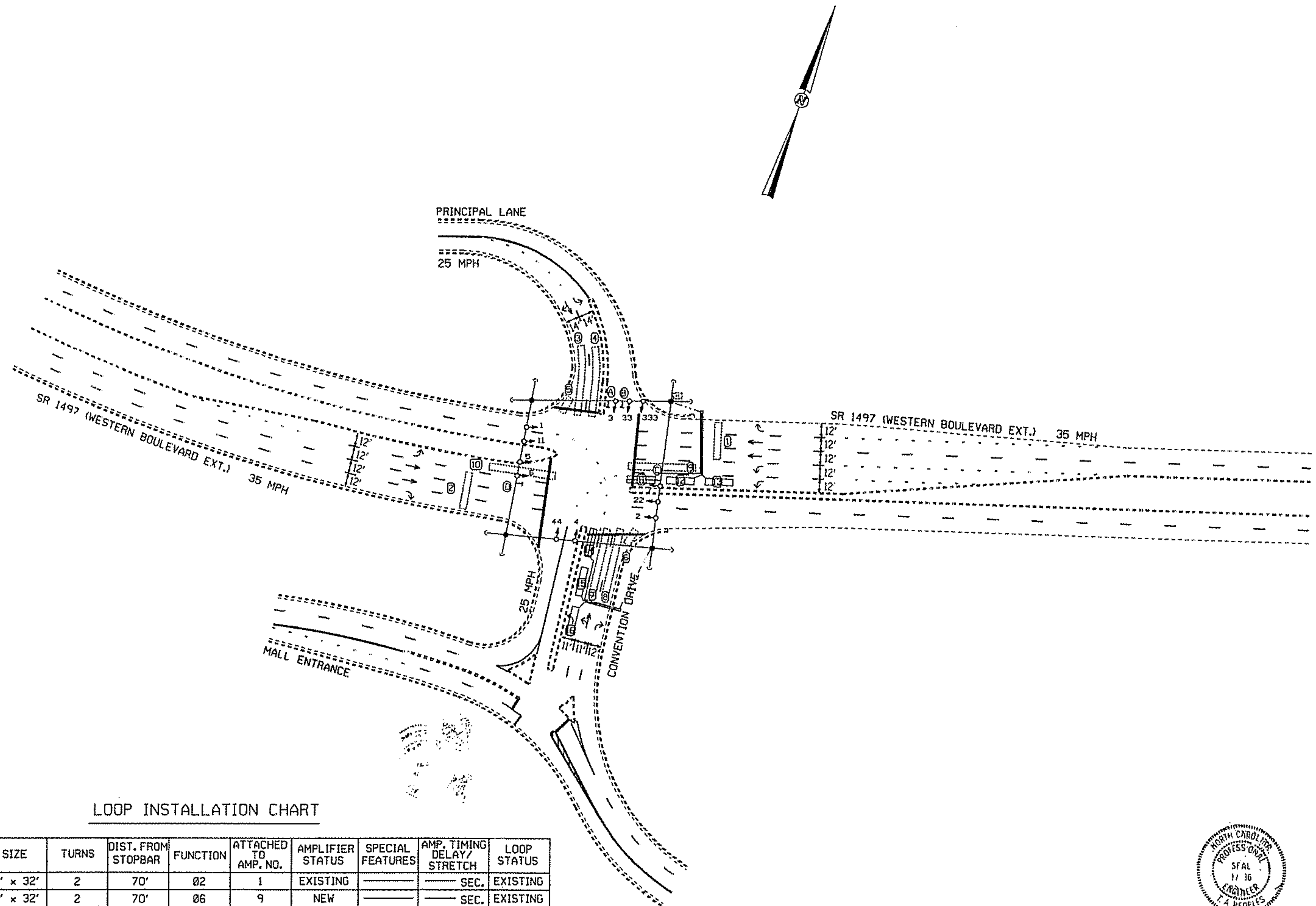
The current duration is 4.0s according to the signal plan.
According to stop watches, 3.9s is the duration of this yellow.

In all cases, the current duration is shorter than the NCDOT Design Manual requires.

Therefore, the red light camera operating at Cary Town Blvd and Convention fails the requirement of SL2004-141, SL2001-286 and the Cary Town Charter 8.15. Therefore, it is illegal for the Town of Cary to collect money from this traffic light.

It has been illegal to collect money since the inception of this camera in February 2004.
It is illegal today.
It will be illegal tomorrow.

STATE	PROJECT NO.	SHEET NO	TOTAL SHEETS
N.C.	4.6332069	1	4
F. A. PROJ. NO.	N/A		
PROJECT ID. NO.	N/A		



NOTES

1. SIGNAL UPGRADE.
2. REUSE EXISTING EQUIPMENT AS SHOWN.
3. WHEN IN FLASH MODE, ALL SIGNAL FACES FOR SAME APPROACH SHALL FLASH CONCURRENTLY.
4. CONTROLLER SHOULD BE PROGRAMMED TO START UP IN PHASE 2+6 GREEN.
5. SIGNAL TO FLASH FROM 11:00 PM UNTIL 6:00 AM UNLESS OTHERWISE DIRECTED BY AREA TRAFFIC ENGINEER.
6. PAVEMENT MARKING PLANS TO BE PREPARED BY OTHERS.
7. STOPBAR LOCATIONS ON ALL APPROACHES ARE EXISTING.
8. NO COUNTS AVAILABLE.

LEGEND

PROPOSED		EXISTING
	TRAFFIC SIGNAL FACE	
N/A	MODIFIED TRAFFIC SIGNAL FACE	
	PEDESTRIAN SIGNAL FACE WITH PUSH BUTTON & SIGN	
	SIGNAL POLE WITH GUY	
	SIGNAL POLE WITH SIDEWALK GUY	
	INDUCTIVE LOOP DETECTOR	
	CONTROLLER & CABINET	
	LOOP DETECTOR PULL BOX	
	2" UNDERGROUND PVC	
	INTERCONNECT CABLE (HARDWIRE)	
	RIGHT OF WAY WITH MARKER	
	DIRECTIONAL ARROW	
	PAVEMENT MARKING ARROW	

Ⓐ LEFT ARROW "ONLY" SIGN (30"X36") R3-5L
Ⓑ COMBINATION VERTICAL AND LEFT ARROW SIGN (30"X36") R3-6L
Ⓒ "LEFT TURN SIGNAL" SIGN (30"X36") R10-10L
Ⓓ U "TURN MUST YIELD" SYMBOL SIGN (24"X30") R3-27

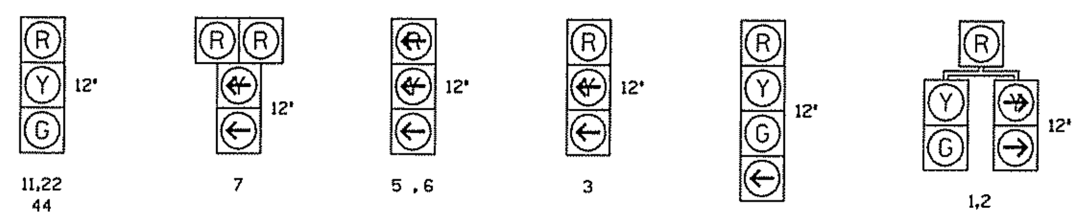
NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 11136 T.A. PEOPLES

TA Peoples 5-31-91

LOOP INSTALLATION CHART

LOOP NO.	SIZE	TURNS	DIST. FROM STOPBAR	FUNCTION	ATTACHED TO AMP. NO.	AMPLIFIER STATUS	SPECIAL FEATURES	AMP. TIMING DELAY/ STRETCH	LOOP STATUS
1	6' x 32'	2	70'	02	1	EXISTING	———	——— SEC.	EXISTING
2	6' x 32'	2	70'	06	9	NEW	———	——— SEC.	EXISTING
3 , 4	6' x 60'	1	5' BEYOND	04	2	EXISTING	———	——— SEC.	EXISTING
5	6' x 15'	2	5' BEYOND	04	3	EXISTING	CALL DELAY	15 SEC.	EXISTING
6	6' x 15'	2	5' BEYOND	03	4	NEW	CALL DELAY	15 SEC.	EXISTING
7	6' x 60'	1	5' BEYOND	03	5	EXISTING	———	——— SEC.	EXISTING
8	6' x 60'	1	5' BEYOND	03	6	NEW	CALL DELAY	15 SEC.	EXISTING
9	6' x 60'	1	5' BEYOND	01	7	EXISTING	———	——— SEC.	EXISTING
10	6' x 60'	1	5' BEYOND	05	8	EXISTING	———	——— SEC.	EXISTING
11	6' x 25'	2-4-2	5' BEYOND	01	10	NEW/DIGITAL	QUADRUPOLE	——— SEC.	NEW
12	6' x 25'	2	30'	01	10	NEW/DIGITAL	———	——— SEC.	NEW
13	6' x 25'	2	65'	01	10	NEW/DIGITAL	———	——— SEC.	NEW
14	6' x 25'	2-4-2	5' BEYOND	03	11	NEW/DIGITAL	QUADRUPOLE	——— SEC.	NEW
15	6' x 25'	2	30'	03	11	NEW/DIGITAL	———	——— SEC.	NEW
16	6' x 25'	2	65'	03	11	NEW/DIGITAL	———	——— SEC.	NEW

SIGNAL FACE I.D.



SIGNAL UPGRADE

CORR. FILE NO. 05-90-71

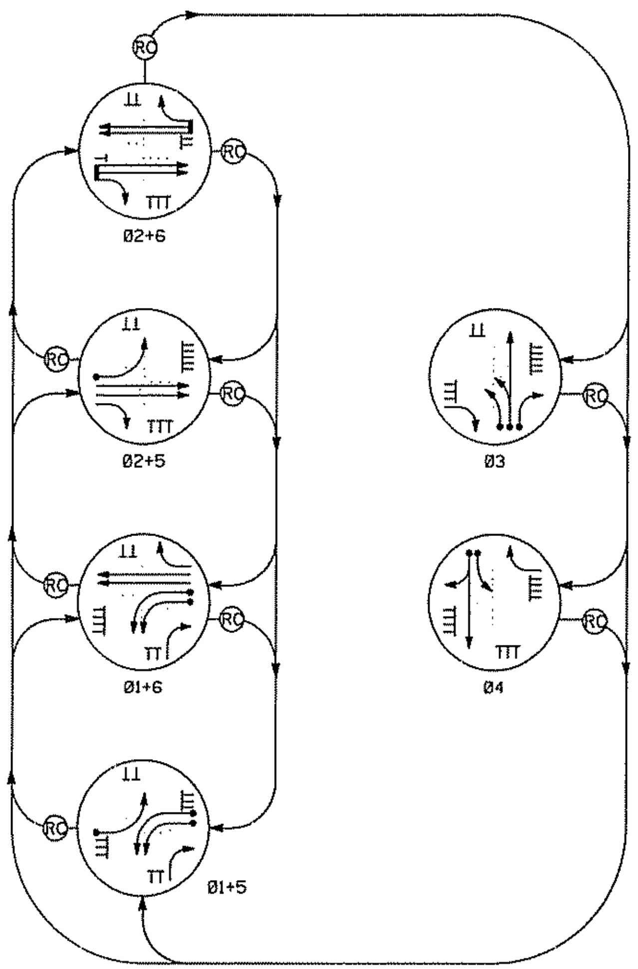
SR 1497 (WESTERN BOULEVARD EXT.)
AND
CONVENTION DRIVE - PRINCIPAL LANE

DIV. 05 WAKE COUNTY CARY

SCALE	1"=50'	N. C. DEPARTMENT OF TRANSPORTATION	REVISIONS
DATE	05-20-91	DIVISION OF HIGHWAYS	
DWG. BY	TGP		
DESIGN BY	TGP	TRAFFIC ENGINEERING BRANCH	
APPROVED	CAA		S/G INV. NO. 05-0873

STATE	PROJECT NO.	SHEET NO	TOTAL SHEETS
N.C.	4.6332069	2	4
F.A. PROJ. NO.	N/A		
PROJECT ID. NO.	N/A		

PHASING DIAGRAM



6Ø
FULLY ACTUATED
(ISOLATED)

COLOR SEQUENCE CHART

SIGNAL FACE	Ø2+6 R/W	Ø2+6 CLEAR Ø3 1	Ø3 2	Ø4 1	Ø4 2	Ø1+5 1	Ø1+5 2	Ø1+6 1	Ø1+6 2	Ø2+5 1	Ø2+5 2
11	G	Y	R	Y	R	Y	R	G	G	Y	R
22	G	Y	R	Y	R	Y	R	Y	R	G	G
3	R	—	—	—	—	—	—	—	—	—	R
33	R	—	—	—	—	—	—	—	—	—	R
333	R	—	—	—	—	—	—	—	—	—	R
4	R	—	—	—	—	—	—	—	—	—	R
44	R	—	—	—	—	—	—	—	—	—	R
5 ,6	←R	—	—	—	—	—	—	—	—	—	←R
7	R	—	—	—	—	—	—	—	—	—	R
1	G/→	Y/→	R	Y/→	R/→	Y/→	R	G/→	G/→	Y/→	R
2	G/→	Y/→	R/→	Y/→	R	Y/→	R	Y/→	R	G/→	G/→

SIGNAL FACE	Ø3 R/W	Ø3 CLEAR Ø2+6 1	Ø2+6 2	Ø4 1	Ø4 2	Ø1+5 1	Ø1+5 2	Ø1+6 1	Ø1+6 2	Ø2+5 1	Ø2+5 2
11	R	—	—	—	—	—	—	—	—	—	R
22	R	—	—	—	—	—	—	—	—	—	R
3	←	←Y	R	←Y	R	←Y	R	←Y	R	←Y	R
33	←G	Y	R	Y	R	Y	R	Y	R	Y	R
333	G/→	Y/→	R	Y/→	R	Y/→	R/→	Y/→	R/→	Y/→	R
4	R	—	—	—	—	—	—	—	—	—	R
44	R	—	—	—	—	—	—	—	—	—	R
5 ,6	←R	—	—	—	—	—	—	—	—	—	←R
7	R	—	—	—	—	—	—	—	—	—	R
1	R	—	—	—	—	—	—	—	—	—	R
2	R/→	R/→	R/→	R/→	R	R/→	R	R/→	R	R/→	R/→

SIGNAL FACE	Ø4 R/W	Ø4 CLEAR Ø2+6 1	Ø2+6 2	Ø1+5 1	Ø1+5 2	Ø1+6 1	Ø1+6 2	Ø2+5 1	Ø2+5 2
11	R	—	—	—	—	—	—	—	R
22	R	—	—	—	—	—	—	—	R
3	R	—	—	—	—	—	—	—	R
33	R	—	—	—	—	—	—	—	R
333	R	—	—	—	—	—	—	—	R
4	←G	Y	R	Y	R	Y	R	Y	R
44	G	Y	R	Y	R	Y	R	Y	R
5 ,6	←R	—	—	—	—	—	—	—	←R
7	R	—	—	—	—	—	—	—	R
1	R/→	R/→	R/→	R/→	R	R/→	R/→	R/→	R
2	R	—	—	—	—	—	—	—	R

SIGNAL FACE	Ø1+5 R/W	Ø1+5 CLEAR Ø2+6 1	Ø2+6 2	Ø1+6 1	Ø1+6 2	Ø2+5 1	Ø2+5 2
11	R	—	—	—	—	—	R
22	R	—	—	—	—	—	R
3	R	—	—	—	—	—	R
33	R	—	—	—	—	—	R
333	R/→	R/→	R	R/→	R/→	R/→	R
4	R	—	—	—	—	—	R
44	R	—	—	—	—	—	R
5 ,6	←	←Y	←R	←	←	←Y	←R
7	←	←Y	R	←Y	R	←	←
1	R	—	—	—	—	—	R
2	R	—	—	—	—	—	R

SIGNAL FACE	Ø1+6 R/W	Ø1+6 CLR Ø2+6 1	Ø2+6 2	Ø1+5 1	Ø1+5 2	Ø2+5 1	Ø2+5 2
11	G	G	G	Y	R	Y	R
22	R	—	—	—	—	—	R
3	R	—	—	—	—	—	R
33	R	—	—	—	—	—	R
333	R/→	R/→	R	R/→	R/→	R/→	R
4	R	—	—	—	—	—	R
44	R	—	—	—	—	—	R
5 ,6	←	←Y	←R	←	←	←Y	←R
7	R	—	—	—	—	—	R
1	G/→	G/→	G/→	Y/→	R	Y/→	R
2	R	—	—	—	—	—	R

SIGNAL FACE	Ø2+5 R/W	Ø2+5 CLR Ø2+6 1	Ø2+6 2	Ø1+5 1	Ø1+5 2	Ø1+6 1	Ø1+6 2	FLASH
11	R	—	—	—	—	—	R	Y
22	G	G	G	Y	R	Y	R	Y
3	R	—	—	—	—	—	R	R
33	R	—	—	—	—	—	R	R
333	R	—	—	—	—	—	R	R
4	R	—	—	—	—	—	R	R
44	R	—	—	—	—	—	R	R
5 ,6 *	←R						←R	←R
7 *	←	←Y	R	←	←	←Y	R	R
1	R	—	—	—	—	—	R	Y
2	G/→	G/→	G/→	Y/→	R	Y/→	R	Y

* REFER TO NOTE 3

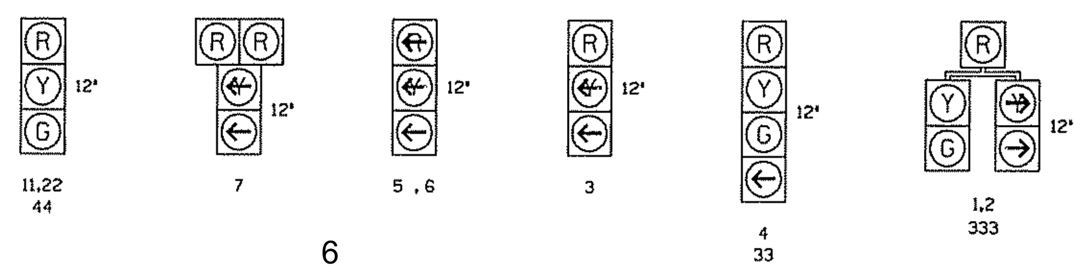
TIMING CHART

PHASE	Ø2	Ø6	Ø3	Ø4	Ø5	Ø1
MINIMUM GREEN	10 SEC.	10 SEC.	7 SEC.	7 SEC.	7 SEC.	7 SEC.
PASSAGE/GAP	3 SEC.	3 SEC.	1 SEC.	1 SEC.	1 SEC.	1 SEC.
YELLOW CLEARANCE	4.0 SEC.	4.0 SEC.	5.0 SEC.	4.5 SEC.	4.0 SEC.	4.5 SEC.
RED CLEARANCE	1.7 SEC.	1.3 SEC.	1.6 SEC.	1.6 SEC.	1.7 SEC.	1.6 SEC.
MAX. 1	40 SEC.	40 SEC.	30 SEC.	20 SEC.	20 SEC.	20 SEC.
MAX. 2	——— SEC.	——— SEC.	——— SEC.	——— SEC.	——— SEC.	——— SEC.
RECALL POSITION	MIN. RECALL	MIN. RECALL	NONE	NONE	NONE	NONE
VEHICLE CALL MEMORY	LOCK	LOCK	NONLOCK	NONLOCK	NONLOCK	NONLOCK

NORTH CAROLINA PROFESSIONAL SEAL ENGINEER T. A. PEOPLES

TAPeoples 5-31-91

SIGNAL FACE I.D.



SIGNAL UPGRADE

CORR. FILE NO. 05-90-71

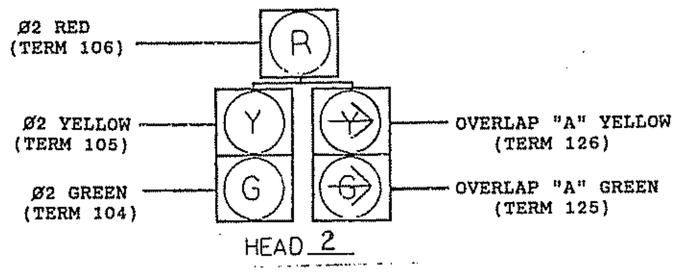
SR 1497 (WESTERN BOULEVARD EXT.)
AND
CONVENTION DRIVE - PRINCIPAL LANE

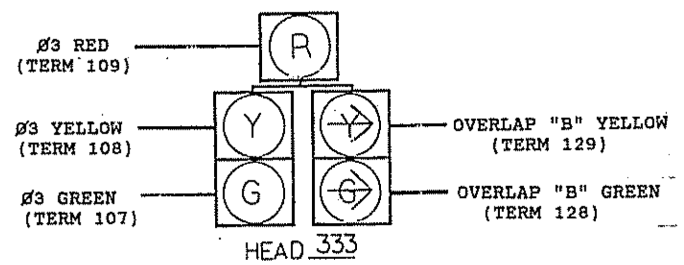
DIV. 05 WAKE COUNTY CARY

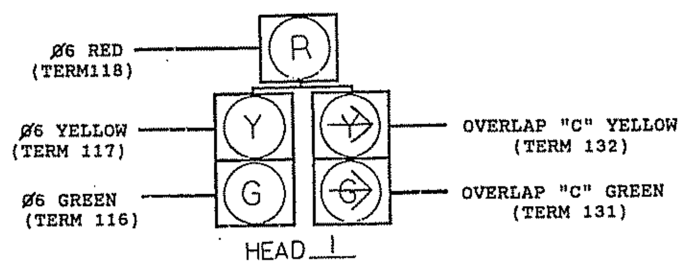
SCALE	N/A	N. C. DEPARTMENT OF TRANSPORTATION	REVISIONS
DATE	05-20-91	DIVISION OF HIGHWAYS	
DWG. BY	TGP	TRAFFIC ENGINEERING BRANCH	CADD NO.
DESIGN BY	TGP		PLAN NO. 05-0873
APPROVED	CPK		

5 SECTION RIGHT TURN SIGNAL WIRING DETAIL

(WIRE AS SHOWN)







CABINET WIRING NOTES

1. ADD A LOADSWTICH TO THE FOLLOWING LOADSWTICH POSITIONS: LS3, LS9, LS10, AND LS11.

   THE FOLLOWING LOADSWTICH POSITIONS SHOULD BE EMPTY: LS7, LS8, LS12, LS13, LS14, LS15, LS16.

2. PHASES 1, 5, 3, 4 AND OVERLAPS "A," "B," & "C" SHALL BE WIRED TO FLASH RED. PHASES 2 AND 6 SHALL BE WIRED TO FLASH YELLOW.

3. TO PREVENT RED FAILURE ON UNUSED MONITOR CHANNELS TIE UNUSED LOADSWITCH RED OUTPUTS TO LOADSWITCH AC+ BY MAKING THE FOLLOWING JUMPER CONNECTIONS IN A "DAISY-CHAIN" TYPE ARRANGEMENT.

   IMPORTANT: THIS JUMPER ARRANGEMENT WAS DESIGNED ASSUMING ALL UNUSED PHASES AND OVERLAPS HAVE BEEN CHANGED TO FLASH RED. IF THEY ARE NOT MADE TO FLASH RED, THIS JUMPER ARRANGEMENT WILL NOT BE VALID.

   INSTALL A JUMPER:
   FROM TERM F-21 (LS7 RED OUT) TO TERM F-22 (LS 8 RED OUT)
   FROM TERM F-22 (LS8 RED OUT) TO TERM F-36 (LS12 RED OUT)
   FROM TERM F-36 (LS12 RED OUT) TO TERM F-27 (LOADSWITCH AC+)

   NOTE: ALL FLASH TRANSFER RELAYS MUST BE IN PLACE.

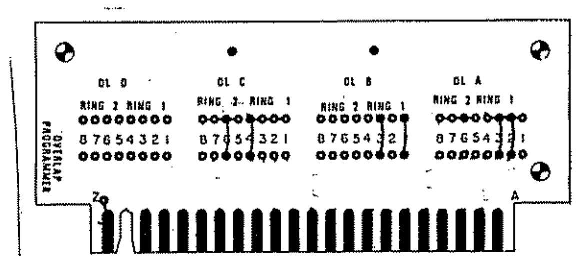
4. THE CONTROLLER SHALL BE PROGRAMMED TO "START-UP" IN PHASES 2+6 GREEN.

5. A POWER UP FLASH TIME OF 10 SECONDS SHALL BE SET AND IMPLEMENTED ON THE CONFLICT MONITOR.

FIELD CONNECTION HOOK-UP CHART

CONTR. PHASE	1	2	3	4	5	6	7	8	OLA	OLB	OLC	OLD	P2	P4	P6	P8	
SIGNAL HEAD NO.	5,6	2,22	3,33 333	4,44	7	1,11	NU	NU	2	333	1	NU	NU	NU	NU	NU	
GREEN		104	33,333 only 107	110		116											
YELLOW		105	33,333 only 108	111		117											
RED		106	109	112	115	118											
GREEN ARROW	101		3,33 only 107	HD 4 only 110	113				125	128	131						
YELLOW ARROW	102		HD 3 only 108		114				126	129	132						
RED ARROW	103																

NU = NOT USED

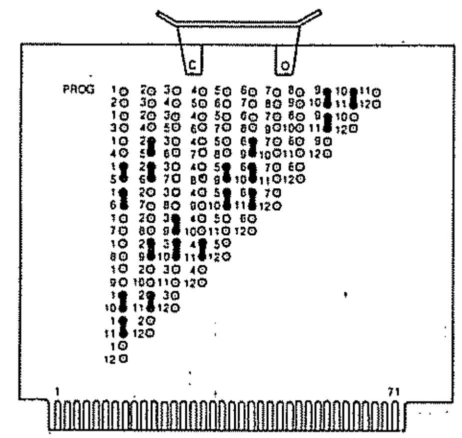


NEMA OVERLAP PROGRAMMING CARD

(INSTALL JUMPERS AS SHOWN)

NEMA CONFLICT MONITOR PROGRAMMING CARD

(INSTALL JUMPERS SHOWN)



CABINET MANUF: CONTROL TECH.
CABINET MOUNT: BASE
LOADBAY POSITIONS: 16
PHASES USED: 1, 2, 3, 4, 5, 6,
OL/A=Ø2+3
OL/B=Ø1+3
OL/C=Ø4+6
OL/D=NU

NU = NOT USED

ALL CABINET TERMINAL DESIGNATIONS ARE FOR CONTROL TECHNOLOGIES 8 PHASE, 16 POSITION BASE MOUNTED CABINETS

ELECTRICAL AND PROGRAMMING DETAIL FOR:
SR 1497 (WESTERN BOULEVARD EXT.)
AND
CONVENTION DR. – PRINCIPAL LANE

DIV. 05 WAKE CO. CARY

SCALE N/A	N. C. DEPARTMENT OF TRANSPORTATION	REVISIONS
DATE 6-6-91		
DWG. BY TDP	DIVISION OF HIGHWAYS	
DESIGN BY MWH-TDP	TRAFFIC ENGINEERING BRANCH	
APPROVED		S/G INV. NO. 05-0873

The Real Issue

The real issue is safety.

I would like to think that Cary installed the cameras to promote safety. But what my research has revealed is that the presence of the red light cameras only increases accidents. Specifically rear end collisions. That is what the statistics of five separate studies showed:

http://blog.motorists.org/red-light-cameras-increase-accidents-5-studies-that-prove-it/

So safety is not a motivation to install cameras.

There is a redeeming quality about the cameras. A very important one. Because these cameras are independent precision monitoring devices, they generate data which flush out problems with the signals themselves. In my case, an improperly set yellow light interval. According to Cary's own citation statistics, a 0.5 second short fall in the duration of a yellow light increases the likelihood that drivers will run the red light by a factor of 2. A 1.0 second short fall, and drivers running reds increases by a factor of 4. A 1.5 second short fall, a factor of 8. The number of accidents, the number of people being killed, increases by that same factor.

If the Town of Cary is really interested in preventing accidents, the Town of Cary should demand that the NCDOT set the yellow durations properly. It is properly set yellow durations that prevents drivers from running over people.