# ORANGE COUNTY

## Resources & Development Management Department

# TRAFFIC MANUAL

2007

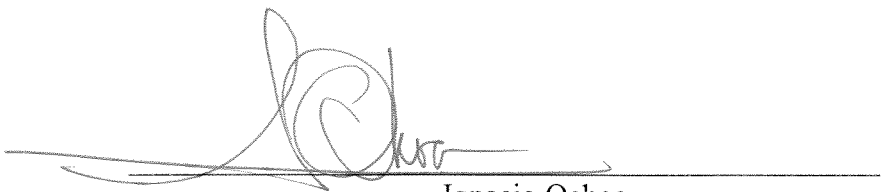
It is the intent of the Orange County Board of Supervisors and the Resources & Development Management Department (RDMD) to provide the benefits of safe, efficient and economical transportation of persons and goods by the application of modern traffic engineering principles.

To assist the Board of Supervisors in this endeavor, the Board established the Orange County Traffic Committee as the technical advisory body charged with the responsibility for investigating matters pertaining to traffic regulations and safety. To assist the Traffic Committee and RDMD Traffic Engineering (staff support for the Traffic Committee) the Board of Supervisors adopted Title 6, Division 4, Traffic Ordinance, of the Orange County Codified Ordinances (see Appendix B) and this manual.

The Orange County Traffic Manual (OCTM or Manual) has been developed to document traffic engineering practices and procedures in unincorporated Orange County. The Manual contains policies and interpretations which address the use of most of the traffic controls placed on the County arterial highway system. It is based largely on standards and guidelines developed by the State and Federal governments for uniform use throughout the nation. As such, it closely follows or expands on policies adopted in both the California Department of Transportation "California Manual on Uniform Traffic Control Devices" (CA MUTCD), formerly known as the "Traffic Manual") and the Federal Highway Administration "Manual on Uniform Traffic Control Devices".

Though adopted as policy, the OCTM is intended primarily to define, describe, and guide the use of standards and methodologies that apply to traffic controls and traffic control strategies. It is not intended to be a substitute for engineering judgment. In all cases, the application of the principles presented in this manual should be reviewed by RDMD Traffic Engineering to ensure that recommended actions arising from the use of this manual conform to applicable state laws and good traffic engineering practice.

The traffic policies in this manual are subject to revision as needed. In general, revision will only be made as new approaches become accepted or the laws of the State change. Under any circumstances, deviation from these policies should only be undertaken following careful consideration of the reasons which make strict adherence to them impractical.



4/12/07

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## INTRODUCTION

### A. Uniform Traffic Control Devices

To ensure the uniformity of all traffic control devices, Sections 21400 and 21401 of the California Vehicle Code specify that only those official traffic control devices conforming to the standards and specifications adopted by the California State Department of Transportation and set forth in the State Traffic Manual shall be placed upon a street or highway. The State of California "Manual on Uniform Traffic Control Devices" (CA MUTCD) has been adopted as the State Traffic manual and is, in turn, in basic conformance with the "Manual on Uniform Traffic Control Devices for Streets and Highways" (MUTCD), published by the U.S. Department of Transportation, Federal Highway Administration. This State manual is hereby adopted in principle and shall constitute the basic policy for the installation of all traffic control devices by the County of Orange.

The installation of traffic control devices in unincorporated Orange County, in accordance with the guidelines outlined in this manual, is under the authority of the Board of Supervisors through the adoption of Orange County Codified Ordinances Title 6 – Division 4 – Traffic Ordinances (Appendix B).

### B. Orange County Traffic Committee

The Board of Supervisors originally established the Orange County Traffic Committee by Minute Order on September 17, 1940. Its stated purpose in the minute order is "to make investigations of requests for traffic safety devices and controls and report its findings to the Board of Supervisors". The current seven member Committee is represented by the California Highway Patrol, Orange County Sheriff-Coroner, Capistrano Unified School District, Southern California Auto Club, California Department of Transportation and RDMD staff. Members serve without compensation. Individual representation is appointed by the respective agencies.

The Committee has historically provided the Orange County Board of Supervisors with consistent guidance on complex traffic safety issues. These include recommendations for adult crossing guard placement, residential traffic management and all manner of traffic control devices. The concept is used by most local jurisdictions. They recognize that public participation in traffic issues, at a grass roots level, can often satisfactorily resolve these issues without further escalation. In the few instances where this has not been the case, the Board has been provided factual foundations from which to make health and safety decisions.

In addition, the Board has delegated to the Traffic Committee full authority for street name change and private street name approvals. This was specifically done to streamline procedures by eliminating the public hearing requirement at the Board level. The Traffic Committee fulfills its purpose by ensuring consistent application of traffic laws and engineering standards. Its commitment to public safety promotes respect for traffic laws and limits County liability exposure. This has provided the County with a solid defense to unwarranted claim/liability actions.

# I. INTERSECTION CONTROLS

Intersection controls are designed to assign right-of-way to conflicting traffic movements. When properly installed, they are effective in "organizing" traffic at intersections. In this way, they also help reduce confusion, accidents, and delay. The most common intersection controls are traffic signals, stop signs, and yield signs. Each one is intended for specific purposes which are described in detail in the following paragraphs. Intersection controls typically require Board of Supervisors approval prior to installation.

## A. Traffic Signals

Traffic signals are electrically or electronically operated traffic control (CVC Sections 21450-21457) devices which alternately regulate traffic, both vehicular and pedestrian, by directing them to stop or go at street and highway intersections. Their purpose is the orderly and efficient assignment of right-of-way to the various traffic movements.

Depending on the conditions of the installation, a traffic signal can operate to the advantage or disadvantage of the vehicles and persons using the intersection. Consequently, the selection of this control device for traffic control must be preceded by a thorough engineering study of roadway and traffic conditions.

### 1. Benefits of Proper Signalization

When justified and properly designed, traffic signal installations can:

a. Reduce the frequency of certain types of accidents;
b. Effect orderly traffic movement;
c. By proper coordination, ensure the continuous or nearly continuous flow of traffic along a given route;
d. Allow other vehicles and pedestrians to cross an otherwise continuous traffic stream; and
e. Control traffic more economically than by manual methods.

### 2. Disadvantages of Improper Signalization

Unjustified or improperly designed traffic control signals may cause:

a. Increased frequency of certain types of accidents;
b. Excessive delay;
c. Excessive fuel consumption;
d. Excessive vehicle emissions;
e. Disregard of signal indications; or
f. Circuitous travel.

Contrary to common belief, traffic signals do not always increase safety or reduce delay. Experience shows that the number of right-angle collisions may decrease after the

installation of signals; however, the number of rear end collisions may increase in some instances. The installation of signals may also increase overall delay and reduce intersection capacity.

3. Traffic Signal Warrants

Nationally recognized warrants establishing minimum criteria for traffic signal controls as outlined in Part 4 of the California State Department of Transportation (Caltrans) CA MUTCD shall be used to evaluate proposed locations for traffic signals. The satisfaction of the prescribed warrant alone does not constitute absolute justification for traffic signals. Delay, congestion, confusion or other evidence of the need for right-of-way assignment must be shown.

Locations satisfying warrants and special needs will be recommended for consideration of installation as priorities are met and funds become available. Priority is determined by comparison of traffic volumes, accident history, special considerations, etc. among the warranted locations. In general, because funding is limited, only the highest priority intersections can be built each year.

The installation of a traffic signal system is considered if one or more of the following warrants are met (see Appendix A – Traffic Signal Warrants for application):

a. Minimum vehicular volume warrant (Warrant 1, Condition A)
b. Interruption of continuous traffic warrant (Warrant 1, Condition B)
c. Four hour volume warrant (Warrant 2)
d. Peak hour delay warrant (Warrant 3)
e. Pedestrian volume warrant (Warrant 4)
f. School crossing warrant (Warrant 5)
g. Coordinated signal system warrant (Warrant 6)
h. Crash experience warrant (Warrant 7)
i. Roadway network warrant (Warrant 8)
j. New intersection traffic estimate warrant (Figure 4c-103 (CA))

4. Protected/Permissive Left Turn Phasing

Protected/Permissive Left Turn Phasing (PPLTP) includes signal displays and associated regulatory signs that allow a left turning motorist to turn left both during the left turn arrow display (protected) and during the following through movement green ball display (permissive), provided it is safe to do so. The regulatory sign would state that left turning traffic must yield to on coming traffic when a green ball is displayed.

The Orange County Traffic Engineering Council (OCTEC), in 2001, updated a previous report which developed guidelines and standards for the uniform implementation of the PPLTP operation. These most recent guidelines were reviewed and adopted by the Traffic Committee and the Board in 2005. The guidelines identify a number of factors (volumes, number of lanes, sight distance, approach speed, accidents and gaps) which should be

reviewed in order to determine whether PPLTP should be installed and are attached in Appendix C.

While the use of protected/permissive left-turn traffic signal phasing (PPLTP) can significantly reduce overall intersection vehicle delays, fuel consumption, and emissions, the technique is not a panacea in traffic signal phasing and may result in the following:

a. A reduction in "green band width" for system operation;

b. Initial misunderstanding by a portion of the area's drivers; and

c. Potential increase in left-turn collisions.

The following considerations should be included in an evaluation of the use of PPLTP:

a. Use the "cluster" five-section signal head mounted on the mast arm;

b. An R73-7 (Left Turn Yield on Green Ball) sign should be mounted on the mast arm adjacent to the cluster head;

c. Sufficient sight distance should be provided for drivers turning left on the green ball;

d. Evaluate the number of safe gaps in oncoming traffic as the number of approach lanes and the volume and speed of opposing through vehicles increase;

e. The use of queue detection to minimize the display of the green arrow when the left-turn volume (during a particular cycle) can be adequately served with the green ball only;

f. The number of left-turn collisions (that cannot be corrected by sight distance or other operational improvements) warranting use of only full-time left-turn phasing;

g. The use of PPLTP should be limited to streets with a critical speed of less than 50 mph;

h. The use of PPLTP should be limited to less than three opposing through lanes;

i. PPLTP is not recommended for greater than one left turning lane; and

j. Implementation of PPLTP must include a guaranteed red interval for through traffic prior to the showing of the protected portion of the left turn phase, under all conditions, in order to eliminate the possibility of a "trap" situation.

B. Stop Signs

Stop signs (CVC Sections 21354 & 21355) are intended for use on roadways where traffic is required to stop for proper assignment of right-of-way. Because stop signs cause a substantial inconvenience to motorists, they should be used only where fully justified. Stop signs are not a "cure-all" or a substitute for other devices. Stop signs are not a speed control device and should not be used for that purpose.

1. Conditions for Installation

In general, conditions which justify installation of a stop are (from the CA MUTCD):

a. On the less important road at its intersection with a main road where application of the normal right-of-way rule is unduly hazardous as evidenced by accidents susceptible to correction by stop signs;

b. On a County road or City street at its intersection with a state highway;

c. At the intersection of two main highways. The highway traffic to be stopped depends on approach speeds, volumes, and turning movements;

d. On a street entering a legally established through highway or street (see Section VII); and

e. On a minor street where the safe approach speed to the intersection is less than 10 miles per hour. (Safe approach speed depends on visibility near the intersection.)

2. Four-Way & Three-Way (i.e. All-Way) Stops

Four-way and three-way stop sign installations are a useful traffic control measure where other less restrictive methods of control have proven ineffective. They should ordinarily be used only where the volume of traffic on the intersecting roads is nearly evenly divided among the approaches. However, all-way stops are generally undesirable at locations with low traffic volumes because it causes unnecessary delays and encourages violations.

Four-way and three-way stop controls may be justified by any of the following circumstances:

a. As an urgently needed interim control pending construction of a traffic signal system at an intersection fulfilling traffic signal warrants. Need is determined by a review of the intersection history. Four-way stops are not a substitute for traffic signals;

b. At an intersection having a demonstrated accident problem, evidenced by five or more recorded accidents in a twelve-month period of a type susceptible to correction by an all-way stop, such as right-angle, pedestrian, and left-turn accidents, together with evidence of the failure of lesser restrictions to control the problem. The intersection should be reviewed periodically for signal warrants; or

c. As a control at an intersection where the traffic volumes meet or exceed the volume or delay conditions of the four-way stop warrant (see Appendix A – All-Way Stop Warrant).

3. Two-Way and One-Way Stops

Two-way stop intersection controls may be established at locations where conflicting traffic volumes, restricted visibility, physical conditions, or past accident history are such that stop signs can reasonably be expected to reduce the accident potential.

Stop signs are not a substitute for effective enforcement of speed limits or other traffic control devices. The unjustified, indiscriminate use of stop signs at arbitrary locations encourages intentional violations and weakens compliance with properly posted regulatory devices where stop controls are essential to the orderly assignment of right-of-way.

Two-way and one-way stop controls may be justified by any of the following circumstances:

a. At an intersection with a designated through highway;

b. At an intersection where there is a demonstrated accident problem. This would be manifested by an accident history during the past 12 months disclosed by two (2) or more accidents of a type considered correctable by positive assignment of right-of-way (e.g., right-angle accidents);

c. At an intersection where the critical approach speed on the minor street is less than 10 miles per hour and

1) Average hourly (16 hours) traffic volume on the major street is at least 50 vehicles per hour; or

2) Approach volumes on the two intersecting streets are nearly equal and at least 25 vehicles per hour enter the intersection from each of the two intersecting roadways during any 16 hours in a 24 hour period; and

d. At an intersection where the critical approach speed on the minor street is between 10 and 15 miles per hour and average hourly (16 hours) traffic volume on the major street is at least 100 vehicles per hour.

C. Yield Signs

Yield intersection controls (CVC Section 21356) may be established under one or more of the following conditions:

a. On a minor street or road at the entrance to an intersection where it is necessary to assign right-of-way to the major road, but where stop controls would be overly restrictive;

b. Where there is a separate or channelized right-turn lane without an adequate acceleration lane;

c. At an intersection where a special problem may exist such as poor roadway geometry or limited visibility and an engineering study indicates the problem to be susceptible to correction by the use of yield signs; and

d. At an intersection satisfying all of the following requirements:

1. An average hourly volume of 125 vehicles for any eight hours of a 24 hour period where the volume on the major street is at least 50% greater than the minor street;

2. Two or more right-of-way conflict type accidents in any 12 consecutive month period; and

3. The safe approach speed on the minor street exceeds 10 miles per hour.

## II. SPEED LIMITS AND SPEED CONTROL MEASURES

Speed limits are intended to advise motorists of the speed that most drivers consider to be safe for normal roadway conditions. Once approved by the Board of Supervisors and posted they are enforceable under the California Vehicle Code. For this reason, they require very specific procedures to be followed before they can be established. If the proper studies are done and reasonable recommendations followed, speed limits can help improve the safety of the roadway by encouraging drivers to behave more predictably than they might without the controls.

The attempt to reduce speeds using arbitrary traffic controls, particularly speed zoning, has not generally been successful. The most effective application of speed zoning is to encourage reasonable and safe driving behavior based on a survey of roadway users. This approach helps establish enforceable limits which do not unnecessarily restrict the driver under safe conditions. Once reasonable speed limits are set, speed control is best left to the assigned enforcement agencies (California Highway Patrol).

A. General Speed Laws

1. Basic Speed

   The basic speed law is defined in Section 22350 of the California Vehicle Code. It states that: "No person shall drive a vehicle upon a highway at a speed greater than is reasonable or prudent having due regard for weather, visibility, the traffic on, and the surface and width of, the highway, and in no event at a speed which endangers the safety of persons or property."

2. Maximum Speed

   The maximum speed limit specified under Section 22349(a) of the CVC is 65 miles per hour upon any highway. Per Section 22349(b) the maximum speed for a two-lane, undivided highway is 55 mph unless a higher speed has been posted based on an Engineering and Traffic Survey.

B. Business and Residential Districts

Section 22352 of the California Vehicle Code authorizes the Orange County Board of Supervisors to post prima facie 25 mile per hour speed limits in valid Business and Residential Districts on identification of speed-related problems. As a general rule, an exception to this practice shall be observed on designated "through highways" carrying more than 2000 vehicles per day. On such through highways, speed limits must be established as described below in Intermediate Speed Zones.

C. Intermediate Speed Zones

Intermediate speed limit zones of 30, 35, 40, 45, 50, 55 or 60 mph must be established by action of the County Board of Supervisors on the basis of an Engineering and Traffic Survey as provided for in Section 22357 of the California Vehicle Code.

The Engineering and Traffic Survey shall follow the method established by the California Department of Transportation and shall be subject to the provisions of the California Vehicle Code.

D. Speed Limit Pavement Markings

Speed limit numerals may be stenciled on the pavement at the beginning of each speed zone established by County Ordinance, such pavement markings are intended only to supplement regular speed limit signs which are required by Sections 22357 and 22358 of the California Vehicle Code.

E. Advisory Speed Limits

At locations where conditions not visible to a driver exercising due care could cause a loss of control or an unusual hazard to motorists, a speed advisory is sometimes used. The advisory speed is used to supplement a warning sign such as that found at a sharp curve, a

dip in the roadway, etc. which requires a greater than normal reduction in speed. It generally applies to short roadway segments and is posted in advance of the roadway limitation.

F. Speed Bumps

Speed bumps have been officially rejected by the State as a standard traffic control device on public streets and alleys. Actual tests of various experimental designs have demonstrated that rather than control speed, speed, or road, bumps may actually encourage soft sprung vehicles to increase speed for a better ride. California courts have held public agencies liable for personal injuries resulting from the use of road bumps. Because of the increased hazard to the unwary, disruption of the movement of service and emergency vehicles, and the undesirable increase in noise, road bumps shall not be allowed within a public roadway.

G. Radar Enforcement of Speed Limits

When appropriate, areas of the unincorporated County may seek improved enforcement of speed laws by requesting authorization from the County and the California Highway Patrol to permit CHP officers to check speeds by use of a radar device. In such cases, RDMD Traffic Engineering, in cooperation with the CHP, must ensure that all streets and roadways to which radar is to be applied comply strictly with the requirements of the CVC regarding speed zoning. Furthermore, any speed surveys taken to establish the necessary speed limits must be updated at least once every 5 (five) years for the radar enforcement to remain valid.

## III. PARKING CONTROLS

Since most streets are designed and constructed in a manner that allows parking, parking should not be arbitrarily eliminated. Restricted parking may require additional Board of Supervisors approval and should be considered only when it is found, based on an engineering study, that a safety problem will be corrected. Prohibition of parking for aesthetic, nuisance elimination or security reasons is not a traffic engineering function under this Manual.

A. Prohibition of Stopping, Standing or Parking

Stopping, Standing, and Parking Regulations on the basis of a Traffic and Engineering Survey, are authorized in the Codified Ordinances and in Sections 22500 and 22507 of the California Vehicle Code. The regulations are for the purpose of facilitating the movement of traffic, increasing visibility at intersections and driveways, and correcting situations of potential conflict.

B. Time Limit Parking

Time limit parking zones may be established in accordance with Section 22507 of the California Vehicle Code when any of the following conditions exist:

a. Emergency vehicles cannot gain access to an area because of parking on narrow streets;

b. Safety problems occur due to parking of wide vehicles;

c. Overflow parking from commercial, industrial, public & quasi-public facilities reduces parking for local residents in a residential area; or

d. Commercial or business zone parking is inappropriately used by long duration parkers.

C. Curb Markings

Curb markings (i.e., painted curbs) may be used in cases where a problem cannot be corrected by signing. The high maintenance costs of painted curb discourages its indiscriminate use. When used, curb markings shall be in accordance with CVC Section 21458.

## IV. SUGGESTED ROUTE TO SCHOOL PROGRAM

The use of maps to indicate recommended routes to and from school was first used in June of 1973. The Board of Supervisors, by Resolution 75-329, dated March 11, 1975, established the Suggested Route to School Program for Orange County.

A. Participation

School districts in the unincorporated County are urged to actively participate in the program. Each school district should appoint a District Safety Officer who, as liaison, coordinates individual school requests for school safety devices with the OC Traffic Committee. Each school should have a safety committee which works through the District Safety Officer. RDMD Traffic Engineering reviews and processes the requests through the Traffic Committee as necessary.

B. Guidelines

1. The District Safety Officer will obtain the following information from each school in the district:

   a. School attendance boundary;
   b. List of days school will not be in session;
   c. The school's recommended "suggested route to school";
   d. Anticipated pedestrian volumes on each route; and

e. Indication of traffic control devices desired.

This information should be placed on maps and submitted to RDMD Traffic engineering for review.

2. RDMD Traffic Engineering will:

   a. Furnish appropriate maps for each school in the District;
   b. Review the final submittal and process either through the Traffic Committee or take necessary action to implement requested signing and striping; and
   c. Return an approved copy of the "suggested route to school" map to the School District.

3. Additional guidelines, as contained in Part 7 of the CA MUTCD and this Manual shall be used to promote and implement the Suggested Route to School Program.

## V. PEDESTRIAN SAFETY DEVICES

These devices are designed to channel pedestrians into specified corridors where conflicts with vehicular traffic can be minimized; and to advise motorists of the proximity of pedestrian activity. The primary intent is to encourage pedestrians to use designated street crossings or sidewalks where conditions afford both the driver and the pedestrian the best opportunity to negotiate hazards associated with pedestrian movements. Many of these control devices have been developed with school children in mind, but they apply to all pedestrians in concept.

A. School Safety Controls

1. School Area Speed Limit

   Section 22352 of the California Vehicle Code specifies that the prima facie speed, when passing a school contiguous to the highway and posted with a standard "SCHOOL" warning sign, shall be 25 miles per hour when children are present.

2. School Traffic Signals

   School area traffic signals shall be installed where necessary when all of the conditions are satisfied for a school crossing signal warrant (Warrant 5). School age children are defined as elementary school children, grades K – 6.

3. School Crosswalks

   a. School crosswalks should be installed only at locations on the "Suggested Route to School", provided the location is not hazardous, and may be installed at locations designated under any of the following conditions:

1) Measured average time of at least 30 gaps (time between successive vehicles passing a given point on the roadway) in traffic is 30 seconds or less and curb to curb distance is not greater than 64 feet and a minimum of 25 pedestrians cross the street in one hour;

2) Measured average time between gaps is 60 seconds or less and a minimum of 25 pedestrians cross the street in one hour; or

3) The product of vehicles (in thousands) on the street during the time of pedestrian activity multiplied by the number of pedestrians crossing the street exceeds 2.0 based on the 60 minute period in which the highest number of pedestrians cross the street.

b. Subject to the limitations contained above and in Section 21368 of the CVC, school crosswalks shall be marked in yellow if adjacent to school property or within a school zone.

The pavement marking legend "SLOW SCHOOL XING" is required in advance of all yellow school crosswalks, except in advance of a crosswalk at a stop sign, yield sign, or traffic signal. The legend shall be placed in each approach lane, and the work "XING" shall be at least 100 feet from the crosswalk.

Crosswalks installed along the "Suggested Route to School" further than 2800 feet (or further than 600 feet as detailed in Section 21368 of the CVC) from the school grounds shall be painted white.

4. School Crosswalk Illumination

In selected areas where school children regularly use a school crosswalk after dark for school-sponsored purposes, safety lighting should be considered. RDMD Traffic Engineering shall be responsible for determining the need for safety lighting.

5. Adult Crossing Guard

Assignment of adult crossing guards as herein specified applies only to school crossings serving elementary school (grades K through 6) children. Crossing guards are a supplemental protection and not a traffic control device as defined in the California Vehicle Code.

Requests for crossing guards shall be initiated by the District Safety Officer from the appropriate School District. RDMD Traffic Engineering and the Orange County Traffic Committee shall investigate and review the request prior to making a recommendation to the Board of Supervisors. If approved, the Board will direct the Orange County Sheriff to establish a crossing guard.

An adult crossing guard may be considered at a "Suggested Route to School" crossing under any of the following conditions:

a. The requirements of the adult crossing guard warrant are met (see Appendix A – Adult Crossing Guard Warrant);

b. The Orange County Traffic Committee determines a special problem exists and it is necessary to assist children across a street; or

c. A change in the school crossing is imminent; but supervision is needed for a limited time and it is not feasible to install other forms of control for the temporary period.

6. Flashing Yellow School Signals

Yellow flashing signals may be used for advance warning of school crossings or school zones but shall not be used to control traffic at school crossings. They should be installed only at locations where school signing and markings are justified.

Requests for flashing signals shall be initiated by the School District in accordance with Section 21373 of the California Vehicle Code.

Non-activated, continuously operating, flashing yellow school signals will operate only during the hours when children are going to and from school. Flashers may be installed where all the following conditions are met (see Appendix A – Flashing Yellow School Warrant):

a. The crossing is on the "Suggested Route To School";

b. The crossing is not controlled by stop signs or traffic signals;

c. Vehicle volume exceeds 200 vehicles per hour under urban conditions, or 140 vehicles per hour in rural settings, and pedestrian volume is 40 or more during each of the same two hours;

d. Critical approach speed exceeds 35 mph; and

e. The nearest controlled crossing is more than 600 feet away.

B. Pedestrian Controls

1. Intersection Crosswalks

Reliable engineering studies have demonstrated that pedestrians are more susceptible to being struck by a vehicle within a marked crosswalk than within an unmarked crosswalk. (The CVC states that a crosswalk exists at all right-angled or nearly right-

angled intersections whether it is marked or not.) The indiscriminate installation of marked crosswalks must therefore be avoided. Crosswalks should be marked only where there is evidence that the advantages clearly offset any potential increase in hazard to unwary pedestrians.

Installation Guidelines:

Pedestrian crosswalks installed at intersections in 25 mph zones will consist of two white parallel lines across the roadway. When a crosswalk is installed at an uncontrolled location and the speed limit exceeds 25 mph the white ladder style crosswalk may be utilized.

Appropriate signs, markings, and controls conforming to the CA MUTCD shall be used to inform motorists approaching the crosswalk.

2. Midblock Crosswalks

Marked crosswalks, including mid-block crosswalks, tend to create a false sense of security on the part of the pedestrian, encouraging careless crossing by those who take their right-of-way rights too literally. A painted line does not provide a positive traffic barrier and cannot be expected to provide any special degree of pedestrian safety. In general, these installations are discouraged.

3. In-Pavement Flashing Lights

Traditional pavement markings used to designate crosswalks are obvious to crossing pedestrians; however, these markings, and the pedestrians using them, can be difficult to detect by an approaching motorist, particularly in low-visibility conditions such as darkness or fog. An alternative is to increase the motorist's awareness of the crosswalk and pedestrians in the vicinity preparing to cross the street. One approach to making motorists aware of crosswalks is through the use of signs; however, static signs may often not be observed by motorists, particularly if they are placed in a visually cluttered environment. In addition these signs do not have the ability to provide real-time information, i.e., not just indicate that a crosswalk is present, but that a pedestrian is also present. An alternative approach, which uses real-time information, is the installation of in-roadway lighting, on both sides of the crosswalk.

The concept of in-roadway lighting to provide additional visibility of features or markings in the roadway is a fairly new concept in the United States. Several companies now manufacture various in-roadway warning light systems. Recently, California approved the application of in-roadway warning lights, or in-pavement flashing lights, at marked crosswalks at intersections that are not controlled by traffic signals. The new guidance is available in the CA MUTCD, in Chapter 4L, In-Roadway Lights.

A review of research indicates that the installation of in-roadway warning lights has immediate positive effects on driver behavior. In-roadway warning lights can improve drivers' awareness of crosswalks and pedestrians who are present in them. After the installation of the lights, motorist yield behavior increases; that is, more drivers stop or slow down when pedestrians attempt to cross the road than before the warning lights were present. Researchers have expressed concern that the meaning of the lights may be unclear to motorists and pedestrians alike, that it was difficult for pedestrians to know whether the lights were on or not, and that drivers did not know what to do when the lights were flashing. Little research has been done to determine if the positive improvements to driver behavior continues in the long term.

The following should be considered when evaluating the need for In-Pavement Flashing Lights:

a. The vehicular volume through the crosswalk exceeds 200 vehicles per hour;

b. The crosswalk is signed and marked with standard markings;

c. The critical approach speed is less than 45 mph;

d. The lights are compatible with the safe operation of nearby intersections;

e. The crossing is uncontrolled;

f. The crossing experiences pedestrian accidents of a type correctable through increased visibility; and

g. The in-pavement lights are visible to drivers at the minimum stopping sight distance for the critical speed.

4. “Children at Play” Signs

“Children at Play” signs are not enforceable and are not recognized by Federal or State policies. For these reasons, “Children at Play” signs are not used on or along County streets and highways.

Motorists must always watch for children or adult pedestrians while driving in a residential area. Children should not be encouraged or permitted to play in any street and when playing near one, they must be careful and cautious of motorists at all times.

There are many specific warnings available for schools, playgrounds, parks and other recreational facilities which will be used where clearly justified.

C. Temporary Asphalt Concrete Walkways

Pedestrian safety problems are not limited to crossing locations. Potential hazards also exist where physical conditions require pedestrians, particularly school children, to walk in or adjacent to the roadway in rural or suburban areas where the speed, volume of traffic, sight distance, and roadway width leave inadequate space for safe pedestrian travel.

Temporary asphalt concrete sidewalks will be considered for installation when the construction of permanent concrete sidewalks is not imminent and all of the following conditions are fulfilled:

1. The roadway lies on the "Suggested Route To School", as determined by the school;

2. The shoulders along the roadway outside of the pavement are less than five feet wide;

3. More than twenty school children use the route each day while walking to and from school, and more than 100 vehicles per hour use the roadway during these periods of the day; and

4. The school district has officially requested pedestrian walkway improvements.

## VI. SIGNING, STRIPING & CHANNELIZATION

This section discusses markings and devices placed on or along a street or highway to guide traffic. Depending on their use, these devices may inform, direct, or warn the driver. All these items, taken as a consistent package, constitute a "driver information system" which is designed to simplify the driving task.

Signs are posted along the highway to inform drivers of conditions ahead, while pavement markings are intended to guide drivers through a segment of roadway without diverting their attention from the roadway. The system minimizes the potential for conflicts with other vehicles and with existing on- and off-roadway facilities.

A. Signing

Signs give information about roadway conditions, special regulations, highway routes, directions, street names, etc. Ordinarily, signs are not needed to confirm the rules of the road or the provisions of the CVC, but they are placed where those rules or provisions might not be clearly or consistently interpreted by all drivers. Excessive use of signs should always be avoided.

There are four types of signs: Regulatory, Warning, Guide and Construction signs. Regulatory signs inform drivers of regulations that apply at definite locations. Warning

signs are intended to inform of conditions on or adjacent to the highway that would not be anticipated by a driver exercising due care. Guide signs provide directional, route, recreational and roadside service information. Construction signs are designed to call special attention to work sites within the roadway.

Information on signage is presented here for general information. Specific applications of the many signs sanctioned by the California Department of Transportation are discussed in the CA MUTCD.

B. Striping

1. Centerline Striping

Under all circumstances dedicated County highways shall be marked in accordance with the California Vehicle Code and the CA MUTCD. In general, any one of the following conditions justifies the installation of centerline striping:

a. All paved arterial highway routes;

b. All local public residential, industrial or commercial collector streets where the average daily traffic exceeds 1,200 vehicles;

c. All paved two-way local roads, other than arterial highway routes, with average daily traffic in excess of 1,200 vehicles and all of the following conditions are met:

1) The alignment of the roadway is curvilinear;

2) There is little or no roadway shoulder area; and

3) The area which the road traverses can generally be classified as hilly or mountainous;

d. Locations subject to occasionally severe visibility reductions from climatic conditions, such as fog, which also have an average daily traffic in excess of 1,200 vehicles per day;

e. Specific spot locations such as approaches to intersections, extreme vertical and horizontal curvature, or crosswalks where it is necessary to alert motorists to unusual conditions which are not readily apparent; or

f. Other locations where the reported accident records indicate a problem which can be corrected or alleviated by centerline striping.

New or replacement striping of dedicated non-arterial roadways requires prior approval by the Director, RDMD. Centerline striping on local streets is generally discouraged. In

many instances it may cause an increase in traffic volumes on residential streets by identifying a through route to drivers.

2. Edgeline Striping

Edgelines delineate the edge of traveled way and provide a visual reference during adverse weather and visibility conditions. They are also used to reduce driving on paved shoulders or other areas of lesser structural strength than adjacent pavement.

Edgelines, consisting of solid 4-inch-wide white lines, should be placed on uncurbed arterial highways. Edgelines may be placed on local or collector streets, as directed by RDMD Traffic Engineering, subject to following provisions:

a. Edgelines shall not be used on urban type streets with curbs, parking provisions, etc., except in special cases (e.g. bike lanes);

b. If there is a paved shoulder and no curb/gutter, the edgeline will typically be 12 feet from the lane line or centerline;

c. If there is no paved shoulder, the edgeline is to be placed near the edge of pavement;

d. Edgelines should be dropped at the beginning of intersection flares;

e. Edgelines shall be solid 6-inch wide white lines if they are also used to designate a Class II Bike Trail;

f. Edgelines should only be placed on local streets which are curvilinear or narrow combined with no paved shoulders;

g. Edgelines should be placed on two-lane roads in hilly and mountainous areas with:

1) Unpaved shoulders less than eight feet wide; or

2) Paved shoulders less than four feet wide where there is no contrasting color and texture;

h. Edgelines shall be placed on the left-hand side of the traveled way on one-lane, one-way roads (centerline striping not applicable); and

i. At other locations where the reported accident records indicate a problem that may be corrected or alleviated by edge line striping.

3. Raised Pavement Markers (RPMs)

a. Reflective RPMs

Reflective raised pavement markers are intended to improve night and rainy weather visibility of traffic lines, channelization lines and other pavement delineations.

Criteria for use of reflective RPMs:

1) On all arterial highways constructed and striped to their ultimate configuration;

2) On an interim arterial highway having an estimated pavement life of three years or greater, when in the opinion of the Chief Engineer, RDMD, the traveled way would not otherwise be adequately delineated;

3) On curvilinear alignments having a demonstrated safety problem that may be alleviated by reflective RPMs; or

4) On all bridges and their approaches (except very short bridges on arterials which do not fit the previous cases).

b. Non-reflective RPMs

Non-reflective raised pavement markers are intended to direct traffic along a limited travel way and to serve as rumble strips for inattentive drivers in demonstrated problem areas.

Use of non-reflective pavement markers may include:

1) Dual left-turn or right-turn lanes requiring delineation of the desired travel path;

2) Highways having a demonstrated collision problem which may be alleviated through the use of raised markers as rumble strips; or

3) Multilane arterial highway requiring delineation of lane lines.

Reflective and non-reflective raised pavement markers should be placed so as to conform to ultimate lane lines whenever possible.

C. Channelization

1. Medians

a. Striped medians should be installed on all Principal, Major and Primary Arterial Highways unless curbed medians exist. In some cases Secondary and Commuter Arterial Highways may have striped medians.

b. Curbed medians may be installed on Principal, Major and Primary Arterial Highways per the RDMD Standard Plans and in conformance with RDMD Polices and Procedures.

c. Raised or curbed medians may be installed on other than Principal, Major or Primary Arterial Highways, with the approval of the Chief Engineer, when it fills a gap on a stretch of road already built with raised median; when necessary to control traffic movements; or when required by the Board of Supervisors.

2. Median Openings – Left Turn Ingress and Egress

The following guidelines for median openings are established to facilitate traffic movement and promote traffic safety:

a. Median openings will normally be permitted at all street intersections with public streets except:

1) Where such movements will impair the movement of traffic; or

2) Where an unsafe condition would be created.

b. Mid-block median openings with turns permitted to or from adjacent driveways or alleys may be permitted where all the following conditions exist:

1) The property to be served is a major traffic generator and has a continuous frontage of 600 feet or more along the divided street;

2) The median opening is not less than 400 feet from any intersecting local street or not less than 600 feet from an intersection with an arterial highway or collector road;

3) The median opening is not less than 600 feet from any other existing or proposed mid-block median opening; and

4) The geometric design of the proposed median opening is approved by the Chief Engineer, RDMD.

c. Two-way lane left turn lanes may be permitted as “traversable medians” where individual parcels desiring left-turn access have less than the 600 feet required under subparagraph b.1. of this policy, and where there are heavy turn demands to multiple, closely spaced driveways on both sides of the street, and moderate traffic volumes demonstrate that this device would facilitate traffic flow and safety as determined by the Chief Engineer of RDMD.

3. Driveway Access

Driveway access should be extremely limited on arterial highways. If access must be provided, it should be right-turn-in, right-turn-out only. Where major traffic generators are located across the street from each other, with extensive frontage on both sides of the street, it is best to place primary driveway access where installation of a traffic signal will serve both properties through a median break. Location of driveways of this type must follow the criteria listed under Median Openings.

Whenever possible, driveway openings on arterial highways should be consolidated by creating common access locations for many small developments or businesses including, when necessary, internal reciprocal access agreement. This practice improves traffic flow on the arterial highway and greatly reduces friction that can become a safety hazard.

## VII. THROUGH HIGHWAY ROUTES

A "through highway" is defined by Section 600 of the California Vehicle Code as: "a highway or portion thereof at the entrance to which vehicular traffic from intersecting highways is regulated by stop signs or traffic control signals or is controlled when entering on a separated right-turn roadway by a yield-right-of-way sign".

A. Criteria for Designation

All Principal, Major, Primary, Secondary and Commuter highways as shown on the Master Plan of Arterial Highways are declared to be through highway routes.

A through highway may be established by the Board of Supervisors on other County roads carrying predominately through traffic, as evidenced by any of the following conditions:

1. Volume exceeds 2,000 vehicles per day on the proposed through street;

2. Volume exceeds 1,000 vehicles per day and:

   a. Is a regularly scheduled bus route;

   b. Is a "natural" route which is an extension of a through street; or

   c. Serves as a residential collector route;

3. Volume exceeds 500 vehicles per day on a rural highway; or

4. 50% or more of the intersections between the limits of the proposed route are controlled with traffic signals, stop signs or yield signs or meet the warrants for such controls.

## VIII. EQUESTRIAN CROSSINGS

Pursuant to Section 21805 of the California Vehicle Code, an equestrian crossing may be established at a location where an equestrian trail designated on the Master Plan of Riding and Hiking Trails of Orange County intersects a County road.

Equestrian crossings will be reserved for locations with heavy equestrian concentration where an engineering study indicated that the installation of equestrian crossings would markedly reduce the area of vehicular/equestrian conflict and approach visibilities are compatible with vehicular operating speeds.

When signs are erected establishing an equestrian crossing, the right-of-way is transferred to the equestrian. This may give equestrians a false sense of security, with an accompanying reduction in caution, increasing the accident potential. For this reason, the establishment of such crossings should be done on a highly selective basis.

Studies have shown that painted crossings further reinforce this false sense of security. A painted line does not prove a traffic barrier and cannot reasonably be expected to provide any special degree of equestrian safety. Therefore, painted crosswalks will not normally be used to supplement the advance signing system. If painted crosswalks are deemed necessary they shall be the ladder type.

## IX. HIGHWAY SAFETY LIGHTING

Safety lighting improves the drivers' ability to read and interpret traffic controls and respond to unusual or unexpected conditions at the intersection. Intersection safety lighting is installed at all signalized intersections and at intersections which may benefit from additional illumination based on adopted criteria for installation as described as follows:

A. Criteria for Installation

Highway intersection safety lighting may be installed by the County, subject to the availability of funds, in accordance with the RDMD Standard Plans, and in accordance with any of the following conditions:

1. Fulfillment of the minimum warrant criteria justifying installation of a traffic signal system at any intersection based on any single-hour count taken after dark;

2. Persistent intersection accident history, with three or more reported accidents during a 12-month period, occurring at night and of a type reasonably correctable by illumination;

3. Where a combination of sight distance, roadway alignment, grade, channelization or other factors create a confusing or unsatisfactory condition that may be improved with lighting;

4. As a desirable feature in conjunction with all intersection channelization installations, where the installation can be justified by the benefits resulting from significant nighttime use of the intersection;

5. At new intersections if there are indications that lighting criteria will be fulfilled within five (5) years after the opening of the project to traffic;

6. At school crosswalks (see Pedestrian Safety Devices, A-4); or

7. Pedestrian crosswalks at uncontrolled locations and with substantial night-time pedestrian activity.

B. Safety Lighting

Safety lighting may be installed by the County, subject to the availability of funds, at non-intersection locations in accordance with any of the following conditions:

1. At non-intersection locations of special hazard due to adverse or restricted roadway alignment, clearance or sight distance, such as at tunnels, narrow bridges, etc., where experience has indicated other warning devices have been ineffective; or

2. To illuminate ends of raised center island channelization projects on arterial highways and collector roads carrying an average daily traffic volume of 5,000 vehicles or more, including interim installations where construction is programmed in progressive stages; or

3. Where a flashing beacon is installed.

## X. HIGHWAY GUARDRAIL

Guardrail is installed at highway embankments and adjacent to fixed objects to reduce the combined effect of severity and frequency of “ran-off-road” type accidents. Guardrail is itself a fixed object and should not be used indiscriminately. Guardrail should not normally be used as a barricade or to prevent uncontrolled use of otherwise clear portions of the right-of-way. Guardrail will reduce accident severity only for those conditions where the severity of striking

the guardrail is less than the severity of leaving the roadway, going down the embankment or striking the fixed object.

Guardrail may be installed at County expense on existing streets in accordance with the following standards:

A. On Arterial Highways

1. Where a sudden narrowing of the roadway occurs adjacent to an obstruction;

2. On the outside of embankment curves when it is determined in accordance with the procedures outlined in Chapter 7 of the California Department of Transportation Traffic Manual that the installation of the guardrail will not increase the potential accident severity at a particular location; and

3. At individual locations of demonstrated hazard, as evidenced by a minimum of three reported accidents of a type susceptible to correction or alleviation by installation of guardrail.

B. On Local Streets

At locations on streets other than arterial highway where there exist hazardous conditions susceptible to correction or alleviation by installation of guardrail and lesser safety measures have proven to be ineffective.

C. Private Property Protection

A guardrail may also be installed within County property to protect private property (at the expense of the property owner) where the installation will not constitute a hazard to traffic. Such installations will be subject to the issuance of a County permit.

## XI. COMMERCIAL VEHICLE RESTRICTION

Pursuant to Section 35712 of the California Vehicle Code, commercial vehicles exceeding a gross weight of 14,000 pounds may be prohibited on a highway located in an unincorporated residential or subdivision area.

Commercial vehicle restrictions may be justified when an acceptable alternate route is available, and:

1. Removal of trucks can be reasonably expected to substantially reduce conflicts with pedestrians, bicycles, or parked vehicles;

2. Increased roadway capacity is needed to improve traffic operation and traffic safety;

3. Truck traffic would have a detrimental effect on the physical condition of the roadbed; or

4. Roadway geometrics (grade, alignment, width, etc.) are substandard for truck traffic.

The alternate route will be considered acceptable only when all of the following conditions are satisfied:

1. The use of the alternate route will not result in excessive out of direction travel;

2. The alternate route is a through highway or an arterial or collector street;

3. The alternate route has sufficient capacity to handle the added traffic without substantial reduction in level of service; and

4. The alternate route roadbed conditions and roadway geometrics are suitable for truck traffic.

The Caltrans CA LEGAL – 65 truck design vehicle should be used for all arterial highway intersections when evaluating truck route suitability.

## XII. TEMPORARY ROAD CLOSURES

At times, it is necessary to close a public road to accommodate a temporary activity. This can be a bicycle race, roadway improvement project, or some other special need or event. The decision to close a roadway must carefully weigh the need for the closure against the decrease in safety and convenience imposed on the driving public. Most reasonable requests for roadway closures can be approved contingent on proper detouring and safety provisions.

A. Closures for Public Events

1. A written request shall be submitted by the applicant to the RDMD County Property Permits Division for review.

2. RDMD Permits may approve those closures which do not seriously disrupt through traffic. The duration of the closure must be within a reasonable time limit (generally not to exceed 8 hours and generally not during peak hour traffic conditions). No such closing shall be for more than 24 hours without the approval of the Board of Supervisors.

3. All signing shall be in conformance with Part 6 of the CA MUTCD and shall be reviewed by RDMD Traffic Engineering.

4. All required signing shall be furnished by the applicant at his/her own expense.

B. Closures for Convenience of a Contractor

1. A written request shall be submitted to the RDMD Public Works/Construction Division by the Contractor doing or proposing to do work within a roadway, stating reasons why it would be impossible or impractical to proceed without closing the road, the length of time of such proposed closure and an agreement to place and adequately maintain all necessary barricades and warning signs and lights for the designated detour.

2. RDMD Traffic Engineering will review such requests and recommend approval, disapproval or modification to maximize public interest, convenience and safety.

3. After approval, all required signing shall be furnished, replaced, repaired, maintained or removed by the applicant at his/her own expense.

## XIII. BICYCLE LANES

Bicycles are becoming a significant mode of transportation in Orange County. Though many bicycle facilities are built away from the highway system on dedicated pathways, the greatest portion of the bikeway system in Orange County is on arterial highways extending along the shoulder of the roadway. This requires that roadway signing and striping be coordinated with bikeway planning as well as the usual traffic engineering driver/pedestrian considerations. The following are some of the guidelines used in establishing bicycle facilities on the highway network:

A. Bikeway Classifications

Bikeways refer to all facilities that provide service primarily for bicycle travel. Section 2373 of the California Streets and Highways Code classifies bikeways as follows:

1. Class I Bikeway

Provides a completely separated travel-way designated for the exclusive use of bicycles and pedestrians and where crossflows by motorists are minimized. This facility is also called a bike path or bike trail or off-road bike trail. Refer to the Orange County Highway Design Manual for design criteria.

2. Class II Bikeway

Provides a specific travel-way designated for the exclusive or semi-exclusive use of bicycles within which through travel by motor vehicles or pedestrians is prohibited, but where vehicle parking and crossflows by pedestrians and motorists may be permitted. This facility is also referred to as a bike lane or an on-road bike lane.

3. Class III Bikeway

   Provides a travel-way designated simply by guide signs and which is shared by bicycles with pedestrians or motorists. It is also called a bike route.

B. Class II Bikeways

As defined above and subject to the provisions outlined in Part 9 of the CA MUTCD and the Orange County Highway Design Manual (OC HDM), bike lanes may be established on a County road if all of the following conditions exist to the satisfaction of the Chief Engineer, RDMD:

1. Continuity

   The road intersects or is an integral part of the adopted OCTA Commuter Bikeways Strategic Plan (Bikeways Plan) or has a logical and readily apparent origin and destination.

2. Traffic Volume

   Existing average daily automobile traffic volume on the road is greater than 1,000 vehicles per day.

3. Minimum Width

   a) If the prevailing vehicle speed is 40 MPH or less and parking is to be prohibited, the minimum pavement width necessary for the installation of a bikeway lane is as stated in the OC HDM. If parking is not restricted, the minimum bikelane width shall be 11 feet.

   b) For prevailing speeds over 40 MPH, additional bike lane width should be provided in each direction of travel.

4. Road Grade

   Grades should not exceed 1.5 percent. Grades up to a maximum of 5 percent may be permitted for short distances (i.e., from 1700 feet at 2 percent to 700 feet at 5 percent).

Satisfaction of the above conditions alone does not necessarily indicate that establishment of a bicycle lane will improve the safety and efficiency of operation for motorists and cyclists. Additional factors which must be considered and evaluated include accident history, the effect of a bicycle lane on the capacity of the road, the predominate age of the cyclists who will use the bicycle lane, roadway alignment,

intersection sight distances, roadway surface conditions, type of drainage grates, and parking demand.

C. Class III Bikeways

A Class III Bikeway or bike route is a street identified as a bicycle facility by "Bike Route" guide signing only. There are typically no special lane markings, and bicycle traffic shares the roadway with motor vehicles.

The chief advantages of a shared route are:

1. The "Bike Route" signs alert motorists to watch for cyclists, and thus to some degree make the route safer for cycling;

2. The "Bike Route" signs can guide cyclists to another nearby bike facility, a specific destination or through an unfamiliar area; and

3. The "Bike Route" signs may attract cyclists, and thus further establish the road as a bicycle facility.

A shared route may be established by placing "Bike Route" signs along a road that is to be shared by bicycle and motor vehicle traffic if all of the following conditions are met to the satisfaction of the Director, RDMD:

1. The route intersects or is an integral part of the adopted OCTA Bikeways Plan; or the route has a logical and readily apparent origin and destination;

2. Vehicle traffic volumes do not exceed 2000 vehicles per day on two-lane roadway, or 1500 vehicles per lane per day on multi-lane roadways;

3. The minimum width of each outside traffic lane (excluding parking lanes) is 12 feet. Slightly narrower widths are tolerable with very light traffic. An additional three feet of lateral clearance may be required at obstructions along the roadway;

4. The prevailing vehicle speed does not exceed 30 MPH on 30 foot wide two-lane roadways. For each additional 5 MPH increment in speed over 30 MPH, one additional foot of pavement width should be required in each direction of travel; and

5. Grades should not exceed 1.5 percent, except grades up to a maximum of 5 percent will be permitted for short distances (i.e., from 1700 feet at 2 percent to 700 feet at 5 percent).

   Satisfaction of the above conditions alone does not justify establishment of shared routes. Additional factors which must be considered and evaluated

include accident history, roadway alignment, road surface condition, type of drainage grates, percentage of truck traffic, and the parking demand.

# APPENDIX

**TRAFFIC SIGNAL WARRANTS**

**COUNT DATE** _____ **CALC** _____ **DATE** _____
**CHK** _____ **DATE** _____

**Major St.** _____ **Critical Approach Speed** _____ **mph**
**Minor St.** _____ **Critical Approach Speed** _____ **mph**

**Speed limit or critical speed on major street traffic > 40 mph----------** ☐
**or**
**In built up area of isolated community of < 10,000 pop. ----------** ☐
} **RURAL (R)**
☐ **URBAN (U)**

**WARRANT 1 – Eight Hour Vehicular Volume** **SATISFIED** **YES** ☐ **NO** ☐
**(Condition A or Condition B or combination of A and B must be satisfied)**

**Condition A – Minimum Vehicle Volume** **100% SATISFIED** **YES** ☐ **NO** ☐
**80% SATISFIED** **YES** ☐ **NO** ☐

| | MINIMUM REQUIREMENTS (80% SHOWN IN BRACKETS) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | U | R | U | R | | | | | | | | | |
| APPROACH LANES | 1 | | 2 or more | | | | | | | | | | Hour |
| Both Approaches. Major Street | 500 (400) | 350 (280) | 600 (480) | 420 (336) | | | | | | | | | |
| Highest Approach Minor Street | 150 (120) | 105 (84) | 200 (160) | 140 (112) | | | | | | | | | |

**Condition B – Interruption of Continuous Traffic** **100% SATISFIED** **YES** ☐ **NO** ☐
**80% SATISFIED** **YES** ☐ **NO** ☐

| | MINIMUM REQUIREMENTS (80% SHOWN IN BRACKETS) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | U | R | U | R | | | | | | | | | |
| APPROACH LANES | 1 | | 2 or more | | | | | | | | | | Hour |
| Both Apprchs. Major Street | 750 (600) | 525 (420) | 900 (720) | 630 (504) | | | | | | | | | |
| Highest Apprch. Minor Street | 75 (60) | 53 (42) | 100 (80) | 70 (56) | | | | | | | | | |

**Combination of Condition A & B** **SATISFIED** **YES** ☐ **NO** ☐

| REQUIREMENT | CONDITION | X | FULFILLED |
|---|---|---|---|
| TWO CONDITIONS SATISFIED 80% | A. MINIMUM VEHICULAR VOLUME | | Yes ☐ No ☐ |
| | AND, B. INTERRUPTION OF CONTINUOUSTRAFFIC | | |
| AND, AN ADEQUATE TRAIL OF OTHER ALTERNATIVES THAT COULD CAUSE LESS DELAY AND INCONVENIENCE TO TRAFFIC HAS FAILED TO SOLVE THE TRAFFIC PROBLEMS | | | Yes ☐ No ☐ |

The satisfaction of a traffic signal warrant or warrants shall not in itself require the installation of a traffic control signal.

**TRAFFIC SIGNAL WARRANTS**

**WARRANT 2 – Four Hour Vehicular Volume** **SATISFIED* YES ☐ NO ☐**

Record hourly vehicular volumes for any four hours of an average day.

| Approach Lanes | One | 2 or more | | | | | Hour |
|---|---|---|---|---|---|---|---|
| Both Approaches -Major Street | ☐ | ☐ | | | | | |
| Highest Approach-Minor Street | ☐ | ☐ | | | | | |

| | |
|---|---|
| *All plotted points fall above the curves in MUTCD Figure 4C-1. (URBAN AREAS) | Yes ☐ NO ☐ |
| OR, All plotted points fall above the curves in Figure 4C-2. (RURAL AREAS) | Yes ☐ NO ☐ |

**WARRANT 3 – Peak Hour** **SATSIFIED YES ☐ NO ☐**
**(Part A or Part B must be satisfied)**

**PART A** **SATISFIED YES ☐ NO ☐**
**(All parts 1, 2, and 3 below must be satisfied for the same one hour, for any four consecutive 15-minute periods)**

| | |
|---|---|
| 1. The total delay experienced for traffic on one minor street approach (one directional only) controlled by a STOP sign equals or exceeds four vehicle-hours for a one-lane approach or five vehicle-hours for a two-lane approach; AND | YES ☐ NO ☐ |
| 2. The volume on the same minor street approach (one direction only) equals or exceeds 100 vph for one moving lane of traffic or 150 vph for two moving lanes; AND | YES ☐ NO ☐ |
| 3. The total entering volume serviced during the hour equals or exceeds 800 vph for intersections with four or more approaches or 650 vph for intersections with three approaches. | YES ☐ NO ☐ |

**PART B** **SATSIFIED YES ☐ NO ☐**

| Approach Lanes | | | One | 2 or more | | Hour |
|---|---|---|---|---|---|---|
| Both Approaches | - | Major Street | ☐ | ☐ | | |
| Highest Approaches | - | Minor Street | ☐ | ☐ | | |

| | |
|---|---|
| The plotted point falls above the curve in Figure 4C-3. | YES ☐ NO ☐ |
| OR, The plotted point falls above the curve in Figure 4C-4. | YES ☐ NO ☐ |

The satisfaction of a traffic signal warrant or warrants shall not in itself require the installation of a traffic control signal.

## TRAFFIC SIGNAL WARRANTS

**WARRANT 4 – Pedestrian Volume** **SATISFIED YES ☐ NO ☐**
**(All Parts Must Be Satisfied)**

**PART A (Parts 1 or 2 must be satisfied)** **SATISFIED YES ☐ NO ☐**

| | | Hours--------> | | | | | |
|---|---|---|---|---|---|---|---|
| 1. | Pedestrian Volume | | | | | Any hour ≥ 190 | Yes ☐ No ☐ |
| | | | | | | OR any 4 hours ≥ 100 | Yes ☐ No ☐ |
| | Adequate Crossing Gaps | | | | | AND <60 gap/hr | Yes ☐ No ☐ |

| | | | |
|---|---|---|---|
| 2. | Pedestrian Volume | Any hour ≥ 95 | Yes ☐ No ☐ |
| | | OR Any 4 hours ≥ 50 | Yes ☐ No ☐ |
| | | AND ped crossing < 4ft/sec | Yes ☐ No ☐ |

**PART B** **SATISFIED YES ☐ NO ☐**

| | |
|---|---|
| AND, The distance to the nearest traffic signal along the major street is greater than 300ft | Yes ☐ No ☐ |
| OR, The proposed traffic signal will not restrict progressive traffic flow along the major street | Yes ☐ No ☐ |

---

**WARRANT 5 – School Crossing** **SATISFIED YES ☐ NO ☐**

**PART A** (All Parts 1 and 2 below must be satisfied) **SATISFIED YES ☐ NO ☐**

| | | U | Ry* | | | |
|---|---|---|---|---|---|---|
| 1. | Vehicles/hr | 500 | 350 | | | YES ☐ NO ☐ |
| | AND, School Age Pedestrians Crossing Street / hr | 100 | 70 | | | YES ☐ NO ☐ |
| | OR, School Age Pedestrians Crossing Street / day | 500 | 350 | | | YES ☐ NO ☐ |

* When the critical (85th percentile) approach speed exceeds 35 mph or the sight distance to the intersection is less than the required stopping sight distance, rural criteria should be used.

| | | |
|---|---|---|
| 2. | The distance to the nearest controlled crossing is greater than 600 ft. | YES ☐ NO ☐ |

---

**WARRANT 6 – Coordinated Signal System** **SATISFIED YES ☐ NO ☐**
**(All Parts Must Be Satisfied)**

| MINIMUM REQUIREMENTS | DISTANCE TO NEAREST SIGNAL | |
|---|---|---|
| ≥1000 FT | N_____ft, S_____ft, E_____ft, W_____ft | YES ☐ NO☐ |
| On a one-way street or a street that has traffic predominantly in one direction, the adjacent traffic control signals are so far apart that they do not provide the necessary degree of vehicular platooning. | | |
| OR, On a two-way street, adjacent traffic control signals do not provide the necessary degree of platooning and the proposed and adjacent traffic control signals will collectively provide a progressive operation. | | YES ☐ NO☐ |

The satisfaction of a traffic signal warrant or warrants shall not in itself require the installation of a traffic control signal.

## TRAFFIC SIGNAL WARRANTS

### WARRANT 7 – Crash Experience Warrant
**(All Parts Must Be Satisfied)**

**SATISFIED YES ☐ NO ☐**

| | | | |
|---|---|---|---|
| Adequate trial of alternatives with satisfactory observance and enforcement has failed to reduce the crash frequency. | | | YES ☐ NO☐ |
| REQUIREMENTS | Number of crashes within a 12 month period susceptible to correction by a traffic signal, and involving injury or damage exceeding the requirements for a reportable crash | | YES ☐ NO☐ |
| 5 OR MORE | | | |
| REQUIREMENTS | CONDITIONS | X | |
| ONE CONDITION SATISFIED 80% | Warrant 1, Condition A- Minimum Vehicular Volume | | YES ☐ NO ☐ |
| | OR, Warrant 1, Condition B- Interruption of continuous traffic | | |
| | OR, Warrant 4, Pedestrian Volume Condition Ped Vol ≥ 152 for any hour OR, Ped Vol ≥ 80 for any 4 hours | | |

### WARRANT 8 – Roadway Network
**(All Parts Must Be Satisfied)**

**SATISFIED YES ☐ NO ☐**

| MINIMUM VOLUME REQUIREMENTS | ENTERING VOLUMES – ALL APPROACHES | X | FULFILLED |
|---|---|---|---|
| 1000 Veh/Hr | During Typical Weekday Peak Hour _____ Veh/Hr and has 5-year projected traffic volumes that meet one or more of Warrants 1,2 and 3 during an average weekday. | | YES ☐ NO ☐ |
| | OR During Each of Any 5 Hrs. of a Sat. and/or Sun _____Veh/Hr | | |

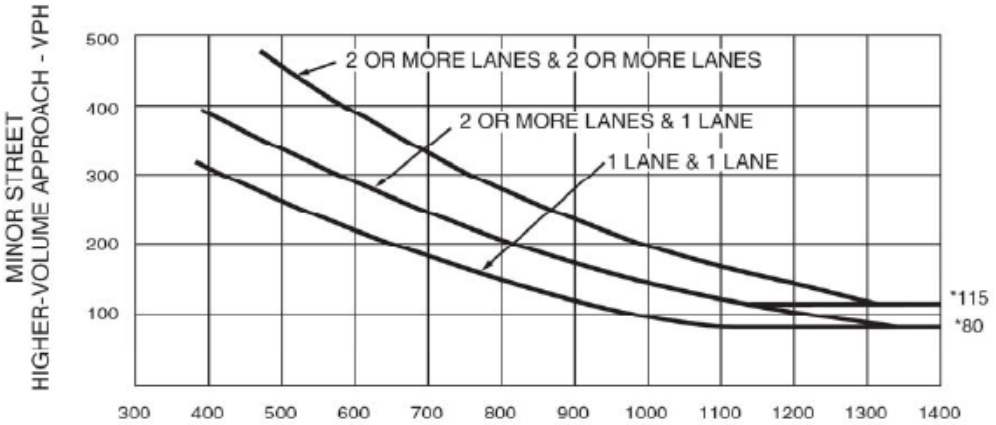
| CHARACTERISTICS OF MAJOR ROUTES | MAJOR ROUTE A | MINOR ROUTE B | |
|---|---|---|---|
| Hwy. System Serving as Principal Network for Through Traffic | | | |
| Rural or Suburban Highway Outside Of, Entering, or Traversing a City | | | |
| Appears as Major Route on an Official Plan | | | |
| Any Major Route Characteristics Met, Both Streets | | | YES ☐ NO ☐ |

The satisfaction of a traffic signal warrant or warrants shall not in itself require the installation of a traffic control signal.

## TRAFFIC SIGNAL WARRANTS

The following figures are reproduced from the CA MUCTD Chapter 4:

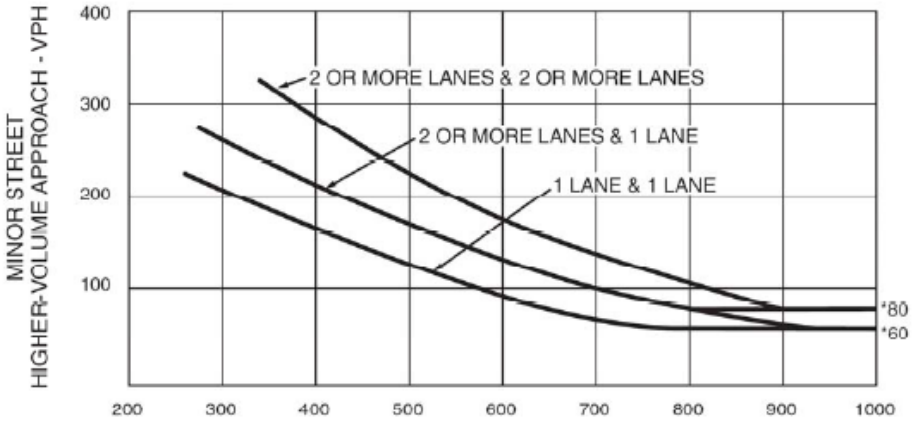
***Figure 4C-1. Warrant 2, Four-Hour Vehicular Volume***




*Note: 115 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 80 vph applies as the lower threshold volume for a minor-street approach with one lane.

***Figure 4C-2. Warrant 2, Four-Hour Vehicular Volume (70% Factor)***

**(COMMUNITY LESS THAN 10,000 POPULATION OR ABOVE ~~70~~ 64 km/h OR ABOVE 40 mph ON MAJOR STREET)**

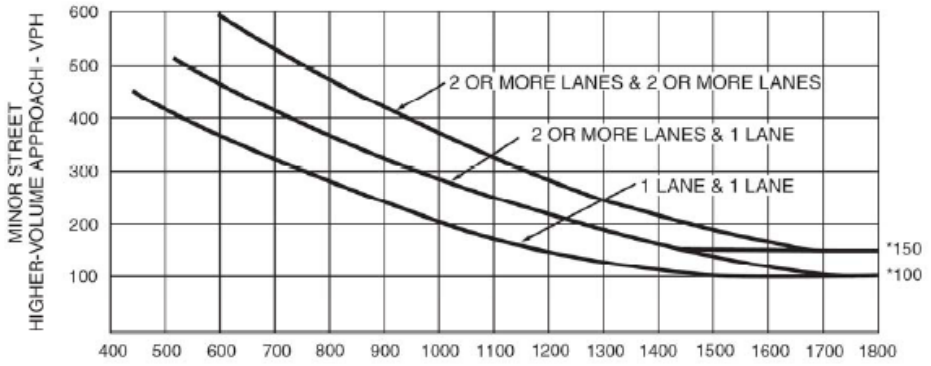



*Note: 80 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 60 vph applies as the lower threshold volume for a minor-street approach with one lane.

The satisfaction of a traffic signal warrant or warrants shall not in itself require the installation of a traffic control signal.

**TRAFFIC SIGNAL WARRANTS**

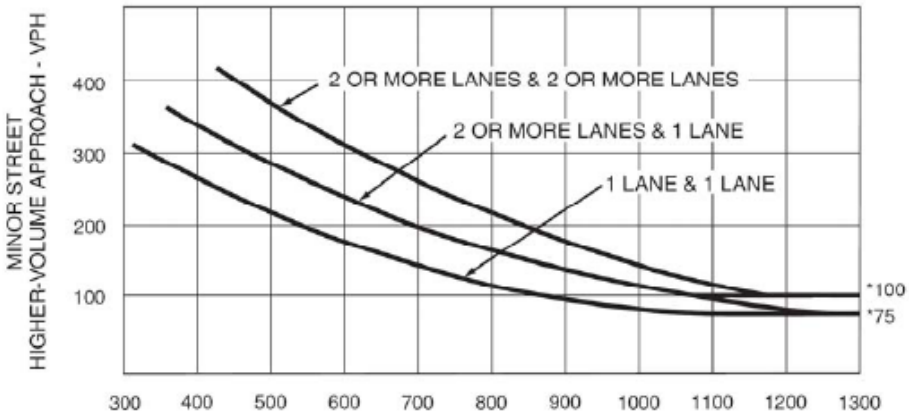
***Figure 4C-3. Warrant 3, Peak Hour***




*Note: 150 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 100 vph applies as the lower threshold volume for a minor-street approach with one lane.

***Figure 4C-4. Warrant 3, Peak Hour (70% Factor)***

**(COMMUNITY LESS THAN 10,000 POPULATION OR ABOVE ~~70~~ 64 km/h OR ABOVE 40 mph ON MAJOR STREET)**




*Note: 100 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 75 vph applies as the lower threshold volume for a minor-street approach with one lane.

The satisfaction of a traffic signal warrant or warrants shall not in itself require the installation of a traffic control signal.

**TRAFFIC SIGNAL WARRANTS**
**Figure 4C-103 (CA).**
**(Average Traffic Estimate Form)**

COUNT DATE _____ CALC _____ DATE _____
CHK _____ DATE _____

Major St. _____ Critical Approach Speed _____ mph
Minor St. _____ Critical Approach Speed _____ mph

Speed limit or critical speed on major street traffic > 40 mph ---------- ☐
or
In built up area of isolated community of < 10,000 population---------- ☐ RURAL (R)
☐ URBAN (U)

(Based on Estimated Average Daily Traffic – See Note)

| URBAN…… RURAL…… **CONDITION A – Minimum Vehicular Volume** Satisfied _____ Not Satisfied _____ | Minimum Requirements EADT | | | |
|---|---|---|---|---|
| Number of lanes for moving traffic on each approach | Vehicles Per Day on Major Street (Total of Both Approaches) | | Vehicles Per Day on Higher-Volume Minor Street Approach (One Direction Only) | |
| Major Street / Minor Street | Urban | Rural | Urban | Rural |
| 1…… / 1…… | 8,000 | 5,600 | 2,400 | 1,680 |
| 2 or More…… / 1…….. | 9,600 | 6,720 | 2,400 | 1,680 |
| 2 or More…… / 2 or More…… | 9,600 | 6,720 | 3,200 | 2,240 |
| 1…….. / 2 or More……... | 8,000 | 5,600 | 3,200 | 2,240 |
| **CONDITION B – Interruption of Continuous Traffic** Satisfied _____ Not Satisfied _____ | Vehicles Per Day on Major Street (Total of Both Approaches) | | Vehicles Per Day on Higher-Volume Minor Street Approach (One Direction Only) | |
| Number of lanes for moving traffic on each approach | Urban | Rural | Urban | Rural |
| Major Street / Minor Street | | | | |
| 1…… / 1…… | 12,000 | 8,400 | 1,200 | 850 |
| 2 or More…… / 1…….. | 14,400 | 10,080 | 1,200 | 850 |
| 2 or More…… / 2 or More…… | 14,400 | 10,080 | 1,600 | 1,120 |
| 1…….. / 2 or More……... | 12,000 | 8,400 | 1,600 | 1,120 |
| **Combination of CONDITIONS A + B** Satisfied _____ Not Satisfied _____ No one condition satisfied, but following conditions fulfilled 80% or more……..____ ____ A B | 2 CONDITIONS 80% | | 2 CONDITIONS 80% | |

**Note: To be used only for NEW INTERSECTIONS or other locations where it is not reasonable to count actual traffic volumes.**

The satisfaction of a traffic signal warrant or warrants shall not in itself require the installation of a traffic control signal.

## ALL-WAY STOP WARRANT

24-Hour Volumes
Entering Intersections

Major Street: _____ _____

Minor Street: _____ _____

**Warranted*** **Yes** ☐ **No** ☐ Date of Count: _____

* Satisfaction of Part 1, Part 2 OR Part 3 is acceptable for four-way stop controls.

**1. MINIMUM VOLUME** **SATISFIED YES** ☐ **NO** ☐

Part A, Part B AND Part C must be satisfied

A. The total vehicular volume entering the intersection from all approaches must average at least 500 vehicles per hour for any eight hours of an average day, and

Yes ☐ No ☐

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Hr. |
| | | | | | | | | Tot Vol. |

Average Volume _____

B. The average delay (calculated as indicated in the Highway Capacity Manual) to minor street vehicular traffic must be at least 30 seconds per vehicle during the highest hour , and

Yes ☐ No ☐

Delay _____

C. The combined vehicular and pedestrian volume of the entering traffic on the minor street must be at least 40 percent of the total entering from all directions.

Yes ☐ No ☐

% _____

D. When the critical (85th %) approach speeds on the major street traffic exceeds 40 miles per hour, the minimum vehicular volume warrant is 70 percent of the above requirements.

CRITICAL APPROACH SPEED OF MAJOR STREET _____

**2. TRAFFIC SIGNAL WARRANTED** **SATISFIED YES** ☐ **NO** ☐

Where traffic signal controls are warranted, urgent need for a four-way stop as an interim measure. Yes ☐ No ☐

**3. ACCIDENTS** **SATISFIED YES** ☐ **NO** ☐

# of accidents _____

5 or more accidents susceptible to correction by a multi-way stop installation in a 12 month period.

## ADULT CROSSING GUARD WARRANT – K THRU 6 GRADE

| | |
|---|---|
| Location: Crossing (1) _____ | School : _____ |
| At (2) _____ | By: _____ Date: _____ |

Intersection Control : _____

| | |
|---|---|
| Street Width (1) : _____ | |
| Critical (85th %) Speed (1) _____ | **WARRANTED*** **YES** ☐ **NO** ☐ |

BASIC REQUIREMENTS (Must meet Parts 1, 2 & 3 (A, B or C)).

**1) Is guard on "Suggested Route to School"?** **YES** ☐ **NO** ☐

**2) Pedestrian Volume** **YES** ☐ **NO** ☐

Pedestrian count must be at least 25 children per hour for any two hours of the day. For individual counts exceeding 1 hour but less than 2 hours the average pedestrian volume per hour shall be used.

| Hour | Date | Time | Count | (Average Count) | |
|---|---|---|---|---|---|
| 1 | _____ | _____ | _____ | (_____/hour) | Yes ☐ No ☐ |
| 2 | _____ | _____ | _____ | (_____/hour) | Yes ☐ No ☐ |

**3) Crossing Controls** **YES** ☐ **NO** ☐

Must meet A, B OR C.

**A. Uncontrolled Crossing** **YES** ☐ **NO** ☐

i) More than 600 feet to an intersection controlled by stop signs on the street to be crossed, a traffic signal or a grade separation, AND — Yes ☐ No ☐

ii) Minimum Requirements (must meet one) — Yes ☐ No ☐
Vehicle volume through the crosswalk during the same two hours of the day as indicated by date and time in II above. For individual vehicle counts exceeding 1 hour but less than 2 hour the average volume per hour shall be used.

| | |
|---|---|
| Time _____ | Time _____ |
| Straight on (1) _____ | Straight on (1) _____ |
| Turns from (1) L _____ R _____ | Turns from (1) L _____ R _____ |
| Turns from (2) L _____ R _____ | Turns from (2) L _____ R _____ |
| Total _____ | Total _____ |
| Veh/Hour _____ | Veh/Hour _____ |

iii) Streets less than 64' wide; total conflicting vehicle count must exceed 300 vehicles per hour for each of any two hours daily (not necessarily consecutive) when children normally cross the street, OR — Yes ☐ No ☐

iv) Streets 64' wide or more, with posted speed limits from 35 mph to 45 mph; conflicting vehicle count must exceed 275 vehicles per for each of any two hours daily (not necessarily consecutive) when children normally cross the street, OR — Yes ☐ No ☐

v) Streets 64' wide or more, with posted speed limits 50 mph or greater; conflicting vehicle count must exceed 250 vehicles per hour daily (not necessarily consecutive) when children normally cross the street, OR — Yes ☐ No ☐

vi) Sight distance impaired beyond reasonable stopping distance due to physical terrain.
Available Sight Distance _____ — Yes ☐ No ☐

**B. Stop Sign Controlled Crossing** — **YES** ☐ **NO** ☐

1. Highway (1) is four lanes or more and conflicting vehicles through the crosswalk exceed 500 per hour during any one hour period when children are going to or from school.

**C. Traffic Signal Controlled Crossing (must meet one)** — **YES** ☐ **NO** ☐

1. Conflicting vehicle counts through the crosswalk exceed 300 per hour during any one hour period when children are going to or from school, OR — Yes ☐ No ☐

2. Where there are circumstances not normally present at a signalized intersection, such as crosswalks more than 80 feet long no intermediate refuge or an abnormally high proportion of large commercial vehicles. — Yes ☐ No ☐

## FLASHING YELLOW SCHOOL SIGNAL WARRANT

CALC _____ DATE _____

CHK _____ DATE _____

Major St. _____ Critical Approach Speed _____ mph

Minor St. _____ Critical Approach Speed _____ mph

Critical speed of approach traffic >= 40 mph ------- ☐

or **RURAL (R)**

In built up area of isolated community of < 10,000 pop. ------ ☐

☐ **URBAN (U)**

**All parts must be satisfied** **WARRANTED YES ☐ NO ☐**

**PART A** **SATISFIED YES ☐ NO ☐**

| | Minimum Requirements | | | | | |
|---|---|---|---|---|---|---|
| | | | U | R | | |
| Vehicle Volume | Each of 2 hours | | 200 | 140 | | |
| School Age Pedestrian Crossing Street | Each of 2 hours | | 40 | 40 | | |

AND

**PART B** **SATISFIED YES ☐ NO ☐**

Critical Approach Speed Exceeds 35mph

AND

**PART C** **SATISFIED YES ☐ NO ☐**

Is the nearest controlled crossing more than 600 feet away?

# ORANGE COUNTY TRAFFIC COMMITTEE ESTABLISHMENT

## Orange County Codified Ordinances

## Division 4 TRAFFIC ORDINANCES*

***Editor's note:** Section 1 of Ord. No. 3885, adopted May 6, 1985, repealed former div. 4, §§ 6-4-1--6-4-701, entitled "Vehicle Regulations." Section 2 added a new div. 4, §§ 6-4-100--6-4-814. This was, in turn, repealed and renumbered by §§ 1, 2 of Ord. No. 3768, adopted Nov. 7, 1989. Although the section numbering is slightly at variance with the remainder of the Code, the style of the ordinance has been retained. Formerly, div. 4, was derived from Code 1961, §§ 64.011--64.016, 64.021--64.029, 64.031--64.033, 64.041--64.046, and 64.051--64.054, and the following ordinances:
TABLE INSET:

| Ord. No. | Date | Section | Ord. No. | Date | Section |
|---|---|---|---|---|---|
| 2629 | 10-17-72 | 1 | 3011 | 10-11-77 | 1 |
| 2661 | 3-13-72 | 1 | 3031 | 1-17-78 | 1 |
| 2720 | 12-4-73 | 1 | 3077 | 8-1-78 | 1, 2 |
| 2789 | 10-8-74 | 1 | 3091 | 10-17-78 | 1 |
| 2798 | 12-10-74 | 1 | 3104 | 12-5-78 | 1 |
| 2898 | 3-30-76 | 1 | 3117 | 2-20-79 | 2 |
| 2917 | 6-8-76 | 1 | 3271 | 7-21-81 | 1 |
| 2940 | 10-26-76 | 1 | 3291 | 11-10-81 | 1 |
| 2972 | 3-22-77 | 1 | 3375 | 3-29-83 | 1 |
| 2989 | 7-19-77 | 1 | 3448 | 4-10-84 | 1 |



## ARTICLE 1. GENERAL PROVISIONS

### Sec. 6-4-100. Purpose.

Title 6, division 4 of the Orange County Codified Ordinances shall serve as the Traffic Ordinance for the Unincorporated County of Orange. Adoption by the State Legislature of the

California Vehicle Code provides for uniform traffic regulations throughout the State. Within these regulations the California Vehicle Code also delegates to local government specific authority to adopt supplemental regulations by ordinance or resolution. It is the intent of this division to establish specific County legal and organizational authority for traffic management and regulatory enforcement of use within the public right-of-way.
(Ord. No. 3768, § 2, 11-7-89)

**Sec. 6-4-101. Traffic manual.**
To guide the application of the laws contained in this Traffic Ordinance not in the California Vehicle Code, the Board of Supervisors has adopted the Orange County Traffic Manual, which defines engineering policies, procedures, and interpretations of traffic engineering practice. Any amendments to the Traffic Manual shall be approved by resolution of the Board of Supervisors.
(Ord. No. 3768, § 2, 11-7-89)

**Sec. 6-4-102. Definitions.**
(a) *Definitions of Words and Phrases:* The following words and phrases when used in this division shall, for the purpose of this division, have the meanings respectively ascribed to them in this article.
(b) *California Vehicle Code Definitions To Be Used:* Whenever any words or phrases used herein are defined in the Vehicle Code of the State of California, and amendments thereto, such definitions shall apply if not elsewhere defined in this division.
(c) *Board:* The Board of Supervisors of the County of Orange.
(d) *Bus Stop Zone:* The space adjacent to the curb or edge of a roadway reserved for the exclusive use of buses during the loading or unloading of passengers.
(e) *Curb:* The lateral boundary of the roadway whether such curb be marked by curbing construction or not so marked; it does not include the line dividing the roadway of a street from parking strips in the center of a street, nor from tracks or rights-of-way of public utility companies.
(f) *EMA:* Environmental Management Agency.
(g) *Holidays:* Within the meaning of this division, holidays are the holidays defined in the Orange County Personnel and Salary Resolution.
(h) *Loading Zone:* The space adjacent to a curb reserved for the exclusive use of vehicles during the loading or unloading of passengers or materials.
(i) *Official Time Standard:* Whenever certain hours are named herein, they shall mean standard time or daylight saving time as may be in current use in the County.
(j) *Passenger Loading Zone:* The space adjacent to a curb reserved for the exclusive use of vehicles during the loading or unloading of passengers.
(k) *Director:* The Director of the Orange County Environmental Management Agency, or his authorized representative.
(l) *School days:* Days on which regularly scheduled public school classes are in session.
(m) *Vehicle Code:* The Vehicle Code of the State of California.
(n) *Bicycle Lane:* A marked lane within the roadway designated by appropriate signs and markings for the one-way use of bicycles.
(o) *Bicycle Path/Bicycle Trail:* A specifically designated area for bicycle use physically separated from the roadway.

(p) *Bicycle Route:* Any roadway designated as a bikeway pursuant to California Streets and Highways Code section 2371 with official signs giving notice of such a bikeway.
(q) *Skateboard:* A conveyance consisting of a short, oblong board with small wheels, propelled with or without mechanical power, which can be ridden by one (1) or more persons at a time.
(Ord. No. 3768, § 2, 11-7-89)

## ARTICLE 2. TRAFFIC ADMINISTRATION

### Sec. 6-4-200. Reserved.

**Editor's note:** Ord. No. 06-002, § 1, adopted January 24, 2006, amended the Code by repealing former § 6-4-200 in its entirety. Former § 6-4-200 pertained to traffic enforcement; and derived from Ord. No. 3768, adopted November 7, 1989.

### Sec. 6-4-201. County Traffic Engineering.

The Traffic Engineering Section of the EMA through the authority of the Director is hereby charged with the responsibility, under the powers and duties specified in this division, to carry out and review all traffic engineering functions affecting the County of Orange.
(Ord. No. 3768, § 2, 11-7-89)

### Sec. 6-4-202. Duties of Traffic Engineering.

It shall be the general duty of EMA Traffic Engineering to determine the installation, design, operation, and maintenance of traffic-control devices, design and/or review traffic flow systems and appurtenances, conduct engineering analyses of traffic accidents; devise remedial measures; conduct engineering and traffic investigations of traffic conditions. Traffic engineering shall also cooperate with the California Highway Patrol, the Orange County Sheriff's Department, the Orange County Fire Department, and other agencies as appropriate in the development of ways and means to improve traffic conditions and carry out the additional duties imposed by the ordinances of the County.
(Ord. No. 3768, § 2, 11-7-89)

### Sec. 6-4-203. Orange County Traffic Committee.

The Orange County Traffic Committee, as described herein, is hereby established in accordance with the original Minute Order of September 17, 1940, as modified in 1978 and 1985, and is hereinafter referred to as the Traffic Committee. The Traffic Committee shall serve without compensation and at the discretion of the Board of Supervisors.
(Ord. No. 3768, § 2, 11-7-89)

### Sec. 6-4-204. Membership.

The Traffic Committee shall consist of one (1) representative from each of the following organizations as indicated in the original 1940 Minute order as modified in 1978 and 1985:
(1) Automobile Club of Southern California;
(2) California Highway Patrol;
(3) California Department of Transportation;
(4) County of Orange EMA Traffic Engineering;
(5) County of EMA Public Works/Operations;
(6) School District representative designated by the Board of Supervisors and representing the unincorporated area of Orange County;
(7) Orange County Sheriff's Department.
(Ord. No. 3768, § 2, 11-7-89)

### Sec. 6-4-205. Authority.

The Traffic Committee is authorized to initiate investigations and develop recommendations for:
(1) Traffic-control regulations which must be enacted by the Board of Supervisors;
(2) Actions taken by the Director in line with his official duties to provide traffic-control devices;
(3) Traffic operations and traffic safety programs for recommendation to the Director and Board of Supervisors;
(4) Street name changes;
(5) Application of the California Vehicle Code, section 21107, "Private Roads," and its subsections as related to public usage of private streets.
(Ord. No. 3768, § 2, 11-7-89)

### Sec. 6-4-206. Meetings, staff, agendas, minutes.

(a) The Traffic Committee shall meet once each month on a regular basis. The meetings shall be open to the public.
(b) EMA/Traffic Engineering shall serve as staff to the Traffic Committee and shall prepare the agenda on items for each monthly meeting.
(c) EMA/Traffic Engineering shall be responsible for preparing the Traffic Committee minutes and submitting the minutes to the Board of Supervisors.
(Ord. No. 3768, § 2, 11-7-89)

## ARTICLE 3. TURNING MOVEMENTS

### Sec. 6-4-300. Authority to designate multiple turning lanes at intersections.

The Director is authorized to place official traffic-control devices within or adjacent to intersections indicating the course to be traveled by vehicles turning at such intersections, and the director is authorized to locate and indicate more than one (1) lane of traffic from which drivers of vehicles may make right or left turns.
(Ord. No. 3768, § 2, 11-7-89)

### Sec. 6-4-301. Two-way left turn lanes.

The Director is hereby authorized to establish and designate two-way left turn lanes on highways.
(Ord. No. 3768, § 2, 11-7-89)

### Sec. 6-4-302. Intersection turning movements.

The Director is hereby authorized to place and maintain signs or markings to prohibit or to restrict left turns, right turns or U-turns at intersections or driveways.
(Ord. No. 3768, § 2, 11-7-89)

## ARTICLE 4. STOP OR YIELD INTERSECTIONS AND RAILROAD CROSSINGS

### Sec. 6-4-400. Through highways defined.

All major, primary, secondary and commuter arterial highways of the County of Orange as shown on the Master Plan of Arterial Highways, as amended from time to time, originally adopted by resolution of the Board of Supervisors on May 31, 1956, as it may have been subsequently amended, and on file in the office of the Clerk of the Board of Supervisors, are hereby declared to be through highways, unless specifically designated otherwise, together with

such other highways, together with such other highways as the Board may, by resolution, declare to be through highways.
(Ord. No. 3768, § 2, 11-7-89)

### Sec. 6-4-401. Stop intersections designated.

The Director:
(a) Is authorized to erect and maintain stop signs at entrances to any or all of said throughways highways as defined in Section 6-4-400 from other public or private streets.
(b) Is authorized to install stop signs at intersections where, in his opinion, there is an imminent danger without such control. The Director shall follow said installation with request for Board approval at the earliest opportunity.
(Ord. No. 3768, § 2, 11-7-89)

## ARTICLE 5. PEDESTRIAN, BICYCLE, SKATEBOARD, AND EQUESTRIAN REGULATIONS

### Sec. 6-4-500. Bicycle operation.

(a) *Direction of Travel:* Persons riding or operating a bicycle on a bicycle trail or path may proceed in either direction except on those trails or paths designated for one-way traffic by appropriate markings or signs defined by the direction of adjacent vehicular traffic.
(b) *Walking bicycles:* Bicycles may be walked subject to all provisions of law applicable to pedestrians.
(Ord. No. 3768, § 2, 11-7-89; Ord. No. 98-15, § 64, 12-8-98)

### Sec. 6-4-501. Bicycles on sidewalks.

(a) *Riding on Sidewalks:* Bicycles may be ridden on all sidewalks in the unincorporated area of Orange County at a speed not to exceed five (5) miles per hour except upon sidewalks within a business district, upon sidewalks adjacent to any public school building when school is in session, recreation center when in use, church during services, over any pedestrian overcrossing or other sidewalk where prohibited by posted signs.
(b) *Director To Designate Prohibitions:* The Director may designate and declare certain portions of sidewalk to be prohibited to bicycle use.
(c) *Director To Post Prohibitions:* The Director is authorized to erect and maintain signs adjacent to sidewalks designating limits of bicycle prohibitions.
(d) *Yielding Right-of-Way:* Whenever any person is riding a bicycle upon a sidewalk, such person shall yield right-of-way to any and all pedestrians. A person riding a bicycle upon entering a roadway or driveway from a sidewalk shall yield to all traffic.
(Ord. No. 3768, § 2, 11-7-89)

### Sec. 6-4-502. Skateboards, roller skates and similar pedestrian traffic.

(a) No person shall ride a skateboard, roller skates or other conveyance propelled by human power other than a bicycle or cause or permit same to roll or coast on the roadway of any highway in the County of Orange.
(b) The provisions of subsection (a) shall not apply to cul-de-sacs where the length of the cul-de-sac is five hundred (500) feet or less.
(Ord. No. 3768, § 2, 11-7-89)

### Sec. 6-4-503. Pedestrian movements.

(a) *Intersections:* The Director is hereby authorized to place and maintain signs or markings to prohibit or to restrict pedestrian crossings at certain legs of intersection.

(Ord. No. 3768, § 2, 11-7-89)

## ARTICLE 6. STOPPING, STANDING AND PARKING OF VEHICLES

### Sec. 6-4-600. Regulations adopted by Board of Supervisors.

Except as hereinafter provided, regulations pertaining to the stopping, standing or parking of vehicles shall be established by ordinance or resolution of the Board of Supervisors.
(Ord. No. 3768, § 2, 11-7-89)

### Sec. 6-4-601. Director to establish and maintain prohibited or restricted no-stopping, no-standing or no-parking zones.

The Director is hereby authorized to place appropriate signs or markings prohibiting or restricting stopping, standing or parking of vehicles on County highways for purposes and conditions as set forth herein:
(a) *Bus stop zones:* For a distance not to exceed one hundred seventy (170) feet for loading and unloading passengers at a bus stop or for a distance not to exceed one hundred fifty (150) feet for loading and unloading children at a school bus stop.
(b) *Loading zones:* For a distance not to exceed fifty (50) feet in length for the purpose of loading and unloading passengers or materials.
(c) *Passenger loading zone:* For a distance not to exceed one hundred (100) feet for the purpose of loading and unloading passengers.
(d) *School zones:*
(1) For a distance not to exceed four hundred (400) feet from either side of any marked school pedestrian crosswalk.
(2) Prohibiting parking or restricting parking during specific hours of the day on that side of any street adjacent to any school property when such parking, in the opinion of the Director, interferes with pedestrian, bicycle or vehicle traffic, or creates a hazardous situation.
(e) *Crosswalks:* For a distance not to exceed four hundred (400) feet from either side of any marked pedestrian crosswalk.
(f) *Highway intersections:* For a distance not to exceed four hundred (400) feet on either side of any highway from its intersection with any other highway for purpose of turn lanes or sight distance and visibility.
(g) *Driveway:* For a distance not to exceed four hundred (400) feet adjacent to either side of a driveway entrance to any highway for purpose of sight distance and visibility.
(h) *Temporary "no-parking" zones:* Temporary "No Parking" on any county highway where the use of such highway or a portion thereof is necessary for the cleaning, repair or construction of the highway or the installation of underground utilities; or where the use of the highway or any portion thereof is authorized for a purpose other than the normal flow of traffic; or where the use of the highway or any portion thereof is necessary for the movement of equipment, articles or structures of unusual size and the parking of such vehicles would prohibit or interfere with such use of movement; provided that signs giving notice that such vehicles may be removed are erected or placed at least twenty-four (24) hours prior to the effective time of such no parking.
(i) *Railroad crossing:* Prohibit stopping for a distance not to exceed fifty (50) feet from the center line of a railroad track crossing on any highway.
(j) *Narrow streets:* Prohibit stopping on only one (1) side of a street which is thirty (30) feet or less in width.
(Ord. No. 3768, § 2, 11-7-89)

### Sec. 6-4-602. Inventory of parking restrictions.

The Director shall index and maintain an inventory of all parking restrictions established by the director under the authority of this article and furnish a copy thereof to the Clerk of the Board for retention by that office.
(Ord. No. 3768, § 2, 11-7-89)

### Sec. 6-4-603. Violations.

(a) *Loading Zones:*
(1) It shall be unlawful for the operator of the any motor vehicle to park or stop the same in any loading zone for any purpose other than unloading or loading of passengers or materials, provided that no stop for the loading or unloading of passengers shall be made for more than five (5) minutes, or provided that no stop for the loading or unloading of materials shall be made for more than twenty (20) minutes.
(2) It shall be unlawful for the operator of any motor vehicle other than a bus or school bus to stop or park said vehicle in a "bus stop" zone.
(b) *Maximum Parking Time Limit:* It shall be unlawful to park or stop a vehicle for a period of time longer than seventy-two (72) consecutive hours upon any county highway.
(c) *Recreation Vehicle; Camping Overnight:* It shall be unlawful for any person to camp overnight in a recreation vehicle upon any county highway, including any part of the right-of-way thereof. "Recreation vehicle" means a motor home, travel trailer, truck camper, or camping trailer, with or without motive power, designed for human habitation for recreational or emergency occupancy.
(d) *No-Parking Zones:* It shall be unlawful for any person to park in a designated "No-Parking," "No-Stopping," or any time-specific no-parking or no-stopping zone when signs or markings are placed giving notice of such prohibition.
(e) *Vehicle Not in Condition To Be Lawfully Operated:* Notwithstanding (b) above, it shall be unlawful to park, stop or leave sitting for a period of time longer than twelve (12) consecutive hours upon any public street or highway in the unincorporated area of the County of Orange any vehicle not in a condition to be lawfully operated on the public highways.
(f) *Vehicle Repair:* It shall be unlawful to repair, dismantle, overhaul or perform any mechanical work upon a vehicle, trailer, camp car, trailer coach or recreational vehicle on any part of any public street or highway in the unincorporated area, except to replace or otherwise repair a tire or to make emergency repairs to enable such vehicle to be removed to a proper place.
(g) *Trailers and Nonmotorized Vehicles:* No person shall at any time park or leave standing a nonmotorized vehicle or camper, regardless of width or length, when it has been detached from its motor vehicle on any public street or highway in the Unincorporated County except for purposes of loading or unloading and for a period not to exceed two (2) hours.
(h) *Bicycle Lanes:* No person shall park or leave standing a vehicle on a designated on-road bicycle lane anywhere on the County arterial highway system, providing signs identifying such a lane and prohibiting parking are posted.
(Ord. No. 3768, § 2, 11-7-89)

### Sec. 6-4-604. Removal of vehicles from county highways.

The removal of vehicles from a County highway, pursuant to the provisions of the Vehicle Code, section 22650 et seq., is authorized under the following circumstances:
(a) When a vehicle is parked or left standing for seventy-two (72) or more consecutive hours.

Whenever any vehicle is parked or left standing on a highway or portion thereof where such parking has been prohibited by this Code. No vehicle may be removed unless signs are posted giving notice of such removal.
(Ord. No. 3768, § 2, 11-7-89; Ord. No. 98-15, § 65, 12-8-98)

### Sec. 6-4-605. Tow-away zone.

Whenever a "No-Parking Area" has been established in accordance with the provisions of this Code, the Board may by resolution determine that any one (1) or more of the circumstances described in section 22651 of the Vehicle Code exist in such area, and may designate such area as a "Tow-Away Zone." Whenever the Board of Supervisors has designated a "Tow-Away Zone" it shall be the duty of the Director to cause signs to be posted, giving notice that any vehicle parked in such "Tow-Away Zone" may be removed.
(Ord. No. 3768, § 2, 11-7-89)

### Sec. 6-4-606. Oversized vehicle parking regulations.

(a) No person shall park and leave standing upon any public street or highway in a "residence district" any motor vehicle of a length in excess of twenty-five (25) feet or a weight in excess of ten thousand (10,000) pounds; also prohibited from being parked on public streets or highways in a "residence district" is any vehicle used or maintained for the transportation of persons for hire, compensation, or profit, and designed, and used, or maintained for the transportation of property, including buses, motor trucks, trailers, semi-trailers, trailer coaches or truck tractors as defined in the Vehicle Code and similar vehicles of a width in excess of ninety (90) inches as measured at the widest portion of the body, not including mirrors or other extensions; or any item of farm machinery or special-purpose machine. Prohibited vehicles may be parked on public "residence district" streets and highways while loading or unloading persons and/or property; or when such vehicle is parked in connection with or in aid of theperformance of a service to or on a property in the block in which such vehicle is parked; or to perform repairs of an emergency nature on the motor vehicle itself, for a maximum of seventy-two (72) consecutive hours.
(b) "Residence district," for purposes of this section, shall include those areas as defined in Vehicle Code section 515.
(Ord. No. 3768, § 2, 11-7-89)

### Sec. 6-4-607. Permit parking.

The Board may designate certain areas where a special permit program is determined to be necessary to the community as permit parking areas. Residents within such areas may apply to the County for permits to park vehicles in front of their garages or driveways, but not in road or street traveled way.
(Ord. No. 3768, § 2, 11-7-89)

## ARTICLE 7. SIZE, WEIGHT AND LOAD

### Sec. 6-4-700. Weight restrictions.

The Board may set varying weight limits on certain bridges or roadways when such a restriction is in the interest of the safety of the motoring public.
(Ord. No. 3768, § 2, 11-7-89)

### Sec. 6-4-701. Permits.

(a) *Director Authorized To Issue:* The Director is authorized to issue permits for variations from the size, weight and load limitations set forth in division 15 (commencing with section 35000) of the Vehicle Code. Such authorization shall be exercised in accordance with the guidelines and restrictions set forth in article 6 of chapter 5 of division 15 (commencing at section 35780).

(b) *Permit Fee:* An administration fee for permits issued for a vehicle or combination of vehicles under the provisions of this section shall be established by resolution of the Board.
(c) *Security May Be Required:* The Director may require such undertaking or security as he deems necessary to protect the highways and bridges from injury, or to provide indemnity for any injury resulting from the operation of the vehicle.
(Ord. No. 3768, § 2, 11-7-89)

### Sec. 6-4-702. Regulations for moving buildings or structures.

(a) *Manpower Minimum:* It shall be unlawful for any building or structure twenty (20) feet or more in width to be moved over, upon, along or across any highway, street, alley or way unless the contractor so moving the same shall have not less than five (5) persons engaged in said moving operations comprised as follows:
(1) A foreman;
(2) A truck driver;
(3) A person on the building to handle wire clearances;
(4), (5) Two (2) flagmen, one to be at least three hundred (300) feet ahead of the building or structure, the other flagman to follow said building or structure at a distance sufficient to give adequate warning to approaching traffic. Said flagman shall carry the signals required by law.
(b) *Relocation Permit Required:* When any building is to be moved, the permit shall not be issued unless a relocation permit, issued pursuant to division 1 of title 7 of this Code, has been obtained for the relocation of said building or structure.
(Ord. No. 3768, § 2, 11-7-89)

## ARTICLE 8. ABANDONED, WRECKED, DISMANTLED OR INOPERATIVE VEHICLES

### Sec. 6-4-800. Purpose.

In addition to other statutory authority for the removal of vehicles from public or private property and in accordance with the authority granted by the State of California under section 22669 of the Vehicle Code to remove abandoned, wrecked, dismantled or inoperative vehicles or parts thereof as public nuisances, the Board of Supervisors hereby makes the following findings and declarations.

The accumulation and storage of abandoned, wrecked, dismantled or inoperative vehicles or parts thereof on private or public property, not including highways, is hereby found to create a condition tending to reduce the value of private property, to promote blight and deterioration, to invite plundering, to create fire hazards, to constitute an attractive nuisance creating a hazard to the health and safety for minors, to create a harborage for rodents and insects and to be injurious to health, safety and general welfare. Therefore, the presence of an abandoned, wrecked, dismantled or inoperative vehicle or parts thereof, on private or public property not including highways, except as expressly hereinafter permitted, is hereby declared to constitute a public nuisance which may be abated as such in accordance with the provisions of this article.
(Ord. No. 3768, § 2, 11-7-89)

### Sec. 6-4-801. Definitions.

As used in this article:
(a) The term "owner of the land" means the owner of the land on which the vehicle, or parts thereof, is located as shown on the last equalized assessment roll.
(b) The term "owner of the vehicle" means the last registered owner and legal owner of record.
(Ord. No. 3768, § 2, 11-7-89)

### Sec. 6-4-802. Exemptions.

This article is not applicable to:

(a) A vehicle, or parts thereof, which is completely enclosed within a building in a lawful manner where it is not visible from the street or other public or private property; or

(b) A vehicle, or parts thereof, which is stored or parked in lawful manner on private property in connection with the business of a licensed dismantler, licensed vehicle dealer, a junk dealer, or when such storage or parking is necessary to the operation of a lawfully conducted business or commercial enterprise.

Nothing in this section shall authorize the maintenance of a public or private nuisance as defined under provisions of law other than this article.

(Ord. No. 3768, § 2, 11-7-89)

### Sec. 6-4-803. Other remedies.

This article is not the exclusive regulation of abandoned, wrecked, dismantled or inoperative vehicles within the unincorporated area of this County. It shall supplement and be in addition to the other regulatory codes, statutes and ordinances heretofore or hereafter enacted by the County, the State, or any other legal entity or agency having jurisdiction.

(Ord. No. 3768, § 2, 11-7-89)

**Cross references:** Storage of inoperative, etc., vehicles declared a nuisance, § 3-14-101(d)(2).

### Sec. 6-4-804. Administration and enforcement.

Except as otherwise provided herein, the provisions of this article shall be administered and enforced by the Sheriff. In the enforcement of this article such officer and his regularly salaried full-time deputies may enter upon private or public property to examine a vehicle or parts thereof, or obtain information as to the identity of the owner of the vehicle and to remove or cause the removal of a vehicle or parts thereof declared to be a nuisance pursuant to this article.

(Ord. No. 3768, § 2, 11-7-89)

### Sec. 6-4-805. Authority to remove.

When the Board of Supervisors has contracted with or granted a franchise to any person or persons to do so, such person or persons shall be authorized to enter upon private property or public property to remove or cause the removal of a vehicle or parts thereof declared to be a nuisance pursuant to this article.

(Ord. No. 3768, § 2, 11-7-89)

### Sec. 6-4-806. Costs of administration.

The Board of Supervisors shall, by resolution, determine and fix an amount to be assessed as costs of administration and removal of any vehicle or parts thereof, under this article.

(Ord. No. 3768, § 2, 11-7-89)

### Sec. 6-4-807. Authority to abate and cause removal.

Upon discovering the existence of an abandoned, wrecked, dismantled or inoperative vehicle, or parts thereof, on private property or public property within the unincorporated area of the County, the Sheriff shall have the authority to cause the abatement and removal thereof in accordance with the procedure prescribed herein.

(Ord. No. 3768, § 2, 11-7-89)

**Sec. 6-4-808. Notice of intention to abate and remove; form and mailing of notices.**

A ten-day notice of intention to abate and remove the vehicle or parts thereof as a public nuisance shall be given unless the owner of the land and the owner of the vehicle have signed releases authorizing removal and waiving further interest in the vehicles or parts thereof. Said notice shall be mailed by registered or certified mail to the owner of the land, and to the owner of the vehicle(s) unless the vehicle(s) is in such condition that identification numbers are not available to determine ownership. The notice of intention shall be in substantially the following forms:

LAND OWNER

NOTICE OF INTENTION TO ABATE AND REMOVE AN ABANDONED, WRECKED, DISMANTLED OR INOPERATIVE VEHICLE OR PARTS THEREOF AS A PUBLIC NUISANCE

"(Name and address of owner of the land)

"As owner shown on the last equalized assessment roll of the land located at (address), you are hereby notified that the undersigned, pursuant to section 6-4-804 of the Codified Ordinances of the County of Orange, California, has determined that there exists upon said land an abandoned, wrecked, dismantled or inoperative vehicle, or parts thereof (hereinafter "vehicle"), registered to _____, license number _____, which constitutes a public nuisance pursuant to the provisions of section 6-4-800 of said Codified Ordinances.

"You are hereby notified to abate said nuisance by the removal of said vehicle or parts thereof, within ten (10) days of the date of mailing of this notice, and upon your failure to do so the same will be abated and removed by the County, with administrative costs, assessed to you as owner of the land on which said vehicle is located. Upon removal, said vehicle(s) shall not be reconstructed or made operable unless it qualifies for either horseless carriage license plates or historical vehicle license platespursuant to section 5004 of the Vehicle Code.

"As owner of the land on which said vehicle is located, you are hereby notified that you may, within ten (10) days after the mailing of this notice of intention, request a public hearing; and if such a request is not received by the Sheriff within such ten-day period, the Sheriff shall have the authority to abate and remove said vehicle as a public nuisance and assess the cost as aforesaid without a public hearing. You may submit a sworn written statement within such ten-day period denying responsibility for the presence of said vehicle on said land, with your reasons for denial, and such statement shall be construed as a request for hearing at which your presence is not required. You may appear in person at any hearing requested by you or the owner of the vehicle or, in lieu thereof, may present a sworn written statement as aforesaid in time for consideration at such hearing.

Notice mailed _____.
(date)

/s/ _____

Sheriff"

VEHICLE OWNER

NOTICE OF INTENTION TO ABATE AND REMOVE AN ABANDONED, WRECKED, DISMANTLED OR INOPERATIVE VEHICLE OR PARTS THEREOF AS A PUBLIC NUISANCE

"(Name and address of last registered and/or legal owner of record of vehicle. Notice should be given to both if different.)

"As the last registered (and/or legal) owner of record of (description of vehicle-make, model, license, etc.), you are hereby notified that the undersigned, pursuant to section 6-4-804 of the Codified Ordinances of the County of Orange, California, has determined that said

vehicle, or parts thereof (hereinafter "vehicle"), exists as an abandoned, wrecked, dismantled or inoperative vehicle at (describe location on public or private property) and constitutes a public nuisance pursuant to the provisions of section 6-4-800 of said Codified Ordinances.

"You are hereby notified to abate said nuisance by the removal of said vehicle within ten (10) days after the mailing of this notice. You are further notified that you may, within ten (10) days after the mailing of this notice of intention, request a public hearing; and if such a request is not received by the Sheriff within such ten-day period, the Sheriff shall have the authority to abate and remove said vehicle without a hearing. Upon removal said vehicle(s) shall not be reconstructed or made operable unless it qualifies for either horseless carriage license plates or historical vehicle license plates pursuant to section 5004 of the Vehicle Code.
Notice mailed _____.

(date)
/s/ _____

Sheriff"
(Ord. No. 3768, § 2, 11-7-89; Ord. No. 05-021, § 1, 11-22-05)

### Sec. 6-4-809. Public hearing.

Upon request by the owner of the vehicle or owner of the land received by the Sheriff within ten (10) days after the mailing of the notices of the intention to abate and remove, a public hearing shall be held by the Sheriff or his designee on the question of abatement and removal of the vehicle or parts thereof as an abandoned, wrecked, dismantled or inoperative vehicle, and the assessment of the administration cost and the costs of removal of the vehicle or parts thereof against the property on which it islocated.

If the owner of the land submits a sworn written statement denying responsibility for the presence of the vehicle on his land within such ten-day period, said statement shall be construed as a request for a hearing which does not require his presence. Notice of the hearing shall be mailed, by registered or certified mail, at least ten (10) days before the hearing to the owner of the land, and to the owner of the vehicle, if known. If such a request for hearing is not received within said ten (10) days aftermailing of the notice of intention to abate and remove, the Sheriff shall have the authority to abate and remove the vehicle as a public nuisance without holding a public hearing.
(Ord. No. 3768, § 2, 11-7-89)

### Sec. 6-4-810. Procedure for hearings and orders.

All hearings under this article shall be held before the Sheriff or his designee, who shall hear all facts and testimony he deems pertinent. Said facts and testimony may include testimony on the condition of the vehicle or parts thereof and the circumstances concerning its location on said private or public property. The Sheriff or his designee shall not be limited by the technical rules of evidence. The owner of the land may appear in person at the hearing or present a sworn written statement in time for consideration at the hearing, and deny responsibility for the presence of the vehicle on the land, with his reasons for such denial.

The Sheriff or his designee may impose such conditions and take such other action as he deems appropriate under the circumstances to carry out the purpose of this article. He may delay the time for removal of the vehicle or parts thereof if, in his opinion, the circumstances justify it. At the conclusion of the public hearing, he may find that a vehicle or parts thereof has been abandoned, wrecked, dismantled or is inoperative on private or public property and order the same removed from the property as a public nuisance and disposed of as hereinafter provided and determine the administrative costs and the cost of removal to be charged against

the owner of the land. The order requiring removal shall include a description of the vehicle or parts thereof and the correct identification number and license number of the vehicle, if available. Such order shall be in writing.

If it is determined at the hearing that the vehicle was placed on the land without the consent of the owner of the land and that he has not subsequently acquiesced in its presence, the Sheriff or his designee shall not assess the cost of administration or removal of the vehicle against the property upon which the vehicle is located or otherwise attempt to collect such costs from such owner of the land.

If the owner of the land submits a sworn written statement denying responsibility for the presence of the vehicle on his land but does not appear, he shall be notified by registered or certified mail of the decision. If the owner of the vehicle requested the hearing, but does not appear, he shall be notified by registered or certified mail of the decision.
(Ord. No. 3768, § 2, 11-7-89)

### Sec. 6-4-811. Appeal.

(a) The owner of the land or the owner of the vehicle who requested a public hearing by the Sheriff may appeal the decision of the Sheriff by filing a written notice of appeal with the Clerk of the Board of Supervisors within five (5) days after the Sheriff's decision.
(b) The Clerk of the Board of Supervisors shall give written notice, by registered or certified mail, of the time and place of the hearing to the Sheriff, the appellant, and if different from the appellant, the owner of the land or the owner of the vehicle, if known. Such appeal shall be heard by a Hearing Officer, who may affirm, amend or reverse the Sheriff's decision or take other action he or she deems appropriate.
(c) In conducting the hearing, the Hearing Officer shall not be limited by the technical rules of evidence. The decision of the Hearing Officer shall be in writing and shall be final. The Sheriff, the appellant, and if different from the appellant, the owner of the land or the owner of the vehicle, if known, shall be notified of the Hearing Officer's decision by registered or certified mail.
(Ord. No. 3768, § 2, 11-7-89; Ord. No. 05-021, § 2, 11-22-05)

### Sec. 6-4-812. Disposition of vehicle after order or appeal.

Ten (10) days after adoption of the order declaring the vehicle or parts thereof to be a public nuisance, or ten (10) days from the date of mailing the notice of the decision if such notice is required by this article, or fifteen (15) days after the decision of the Hearing Officer authorizing removal following appeal, the vehicle or parts thereof may be disposed of by removal to a scrap yard or automobile dismantler's yard. After a vehicle has been removed, it shall not thereafter be reconstructed or made operable, unless it is a vehicle that qualifies for either horseless carriage license plates or historical vehicle license plates, pursuant to Vehicle Code § 5004, in which case the vehicle may be reconstructed or made operable.
(Ord. No. 3768, § 2, 11-7-89; Ord. No. 05-021, § 3, 11-22-05)

### Sec. 6-4-813. Notice to state.

Within five (5) days after the date of removal of the vehicle or parts thereof, notice shall be given to the Department of Motor Vehicles identifying the vehicle or parts thereof removed. At the same time there shall be transmitted to the Department of Motor Vehicles any evidence or registration available, including but not limited to registration card, certificates of ownership or license plates.
(Ord. No. 3768, § 2, 11-7-89)

### Sec. 6-4-814. Assessment of costs against the land.

If the administrative costs and the cost of removal which are charged against the owner of the parcel of land pursuant to section 6-4-806 are not paid within thirty (30) days of the date of the order, or the final disposition of an appeal there from, such costs shall be assessed against the parcel of land and collected pursuant to section 25845 of the Government Code.
(Ord. No. 3768, § 2, 11-7-89)

Informational Report:

# Protected/Permissive Left-turn Phasing
## Design and Operational Guidelines (Updated)

Prepared by:

**Orange County Traffic Engineering Council**
**Protected/Permissive Left-Turn Phasing Update Committee**

Draft Report, May 2001

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*Appendices:*

## REPORT CONTEXT

This Protected/Permissive Left-Turn (P/PLT) Guidelines Report has been prepared for use as a tool for traffic engineers. Recommendations contained herein are based on national and local (Orange County) agency experience regarding design and installation of P/PLT traffic signals.

This report is based on the work of a prior committee that in 1995 published OCTEC's original PPLT guidelines. The focus of the prior committee was to establish guidelines for P/PLT signal design in order to promote uniformity, which is believed to be a key to successful operation; and public outreach/education, in order to promote better understanding among drivers. The focus of this Update Committee was to:

- Update the Guidelines to conform to best current practices.
- Provide sight distance criteria in keeping with new national standards.
- Provide guidance for selecting left-turn phasing type.

This updated report is intended to stand alone; all relevant information from the prior report has been carried over.

The recommendations and guidelines contained in this report represent the majority judgments of the Update Committee as of May 2001. The Committee recognizes that as new research findings and experience are gathered, the opinions expressed in this report may be modified.

The opinions expressed are not intended to establish usage standards, but to provide the best current, collective opinions and experiences that the Committee majority can formulate. The Guidelines are not intended as a substitute for engineering knowledge, experience or judgment; each user must use his/her own judgment and experience in applying the information contained in this report. The guidelines do not necessarily represent the opinions of all OCTEC members, OCTEC officers, Committee members, and/or their employers. The information in these Guidelines shall be considered in addition to, rather than in lieu of other pertinent and generally accepted manuals. Additionally, such information is intended to serve as an aid in the solution of various traffic situations but it is not intended that any standard of conduct or duty toward the public shall be created or imposed by these Guidelines.



*NOTE: Complete OCTEC Protected/Permissive Left Turn Phasing Report is available separately.*

Informational Report:

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# I. SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

This is an overview of the Report's "bottom lines." This brief summary only highlights the various issues that the Committee considered and, therefore, the entire document must be considered to fully understand the various detailed conclusions and recommendations.

## A. Conclusions

- While the use of protected/permissive left-turn (P/PLT) traffic signal phasing can significantly reduce overall intersection vehicle delays, fuel consumption, and emissions, the technique is not a panacea in traffic signal phasing and may result in the following:
  - ♦ A reduction in "green band width" for system operation.
  - ♦ Initial misunderstanding by a portion of the area's drivers.
  - ♦ Potential increase in left-turn collisions.
- Improved driver education on "turning left on a green ball" is a challenge that is believed to be the most important step toward effective utilization of the more sophisticated P/PLT traffic signal phasing. This phasing has been used in Orange County since the 1960's, but recently has been gaining more widespread use.
- Uniformity of the traffic signal displays by local agencies is expected to help the driver comprehend and understand the P/PLT phasing and better facilitate the education process.
- Conversely, differentiation of traffic signal displays by type is important to helping drivers understand their differences. A major goal of this report is to help new P/PLT installations to look less like protected-only and more like permissive-only, thereby reducing the chance that a driver may mistakenly interpret the green ball as a protected left-turn indication.
- The traffic engineering profession should be actively involved in the public education process, not just the technical aspects, of P/PLT. To this end, OCTEC has previously:
  - ♦ Communicated to the California DMV our recommendations for changes in the "California Driver Handbook" concerning traffic signals (and pedestrian signals).
  - ♦ Designed color public information "handouts" on traffic and pedestrian signal operations that can be used as a model by local agencies.

- Developed a draft script for a public service video that will feature a celebrity. If produced, this video could be furnished to local agencies as a part of their educational efforts.

- Traffic engineers and their support staff need to be aware of the various aspects of P/PLT, in order to safely and effectively apply this tool.

## B. Recommendations

- Signal displays throughout Orange County should be uniform so that there will be no confusion as to the intended operation. Protected-permissive installations should look similar to each other and should look different from protected-only. The latter goal is accomplished by positioning the five-section "cluster" or "doghouse" head to the right of the barrier line.

- Continue to use the "cluster" five-section signal head mounted on the mast arm and the stacked five-section signal head at the far-left corner as the standard signal displays for P/PLT operations. To accentuate the permissive element of the operation, it is recommended that the cluster head be mounted eight feet (±3') to the right of the barrier line separating the left-turn lane from the adjacent through lane. No additional three-section mast-arm indications are required, but one may be provided on very wide approaches.

- If desired, an R73-7 (Left Turn Yield on green ball) sign may be mounted on the mast arm adjacent to the cluster head.

- Additional considerations:

  - Sufficient sight distance should be provided for drivers turning left on the green ball.
  - Avoid the "trap" situation (see Appendix B).
  - In some system situations, lead/lag full-time left-turn phasing may be more efficient than using lead/lead P/PLT.
  - As the number of approach lanes and the volume and speed of opposing through vehicles increase, the task of selecting a safe gap in oncoming traffic while turning left on a green ball is made more difficult. This factor should be evaluated when considering the suitability of P/PLT.
  - The use of queue detection may be appropriate to minimize the display of the green arrow when the left-turn volume (during a particular cycle) can be adequately served with the green ball only.

- The number of left-turn collisions (that cannot be corrected by sight distance or other operational improvements) warranting use of only full-time left-turn phasing should be determined by each local agency. This determination will require engineering evaluation and will consider the agency's desired balance between minimizing overall traffic delay and collisions.

Overall, the Committee has recognized that the successful technical aspects of traffic signal operations are closely related to the driving public's knowledge of our methods to increase the degree of mobility.

## II. INTRODUCTION

The use of protected/permissive left-turn (P/PLT) traffic signal operation has, over recent years, proliferated throughout California and the United States. The P/PLT traffic signal operation provides a dual function where an exclusive left-turn movement, under the arrow display, is followed by a permissive left-turn movement on a green ball (under the leading protected left turn scenario). The green ball indication allows drivers to continue making left turns, as a permissive movement, depending on suitable gaps in approaching traffic. The benefit of this P/PLT type of signal operation is a reduction in stops and delays, which reduces driver frustration, fuel consumption, and pollution.

In 1995, OCTEC published its original P/PLT Guidelines. New research and practitioner's experience since 1995 have indicated a need to update the Guidelines. The program for the January 27, 2000, OCTEC meeting, presented by Mr. Hank Mohle, and Mr. Dave Royer was "Protected/Permissive Signals: Lessons Learned." This presentation summarized the current state of the art in P/PLT implementation, especially with regard to sight distance and signal head positioning. Following the meeting, the OCTEC officers and membership chose to initiate a volunteer effort to update the OCTEC P/PLT Guidelines to reflect current best practices. A Committee was formed consisting of representatives from various Orange County municipalities and consulting firms with a wide variety of professional experience.

The membership of the update committee was as follows:

| | | |
|---|---|---|
| John Kerenyi, | Kimley-Horn and Associates, | Chair |
| Mark Esposito, | Hartzog & Crabill | |
| Jose Alire, | City of Fountain Valley | |
| Mike Evans, | City of Mission Viejo | |
| Mark Lewis, | City of Fountain Valley | |
| Hank Mohle, | Rick Engineering | |
| Carlos Ortiz, | Robert Bein, William Frost & Associates | |
| Jim Otterson, | Otterson & Associates | |
| David Royer, | U.C. Berkeley Institute of Transportation Studies | |
| Bob Stachelski, | City of Huntington Beach | |
| Monica Suter, | City of Santa Ana | |

The members of this committee would like to continue to recognize the efforts of the previous committee that originally authored this document. Much of this document is the result of their efforts and remains an integral part of the these guidelines. The members of the original committee, along with contact information for the Update Committee members, are listed in Appendix "A."

## A. Orange County Protected/Permissive Usage

For years, various P/PLT configurations have been used in Orange County. The City of Santa Ana had an installation on 17th Street and Main Street in the early 1960's that displayed a leading left-turn arrow followed by a green ball for eastbound left turns. This operation allowed the heavier eastbound left-turn movement to start early as a protected phase, followed by permissive movements. Caltrans had a similar operation for the southbound on-ramp signal at Red Hill Avenue and the I-5 Freeway. These displays used four-section heads and a blank amber (i.e. "dark yellow") operation. In the 1970's, the City of Tustin installed P/PLT signals at various locations on Irvine Avenue, Newport Avenue, and McFadden Avenue. The installations used four-section, mast-arm-mounted signal heads with the lower section being a dual-color (yellow, green) arrow display that was switched electronically. This allowed for a yellow arrow clearance interval. The dual-color signal indication was phased out of production, which led to using stacked and cluster five-section heads for mast-arm mountings. Five-section heads are generally considered to be a requirement for P/PLT operation. In the 1980's, the County of Orange installed several P/PLT signals in the Mission Viejo and North Tustin areas; however, most of the installations were designed for ease of conversion to full protected by placing the P/PLT mast-arm head where a future full protected head would be located. The conversion to fully protected operation was ultimately made at most locations. Cities such as Anaheim, Fountain Valley, and Tustin presently have progressive programs for the installation of P/PLT signals. All three agencies, along with installing new P/PLT signals, have converted existing signals (including protected left-turn locations) to P/PLT.

Besides the various signal head display configurations used in Orange County, we also have various placement of the signal heads. As with a fully protected operation, mast-arm and far-left display locations are used; however, both are five-section heads. The existing mast-arm-mounted locations vary from a position in the center of the left lane to somewhere in the number one lane. Actual placement of the P/PLT mast-arm head has typically been determined by the local agency.

## B. Previous Study Review

The study of P/PLT has been occurring for decades throughout the United States. Various studies have reviewed signal head displays, lane orientation, operation, warrants, and collision information. Public surveys have been taken to evaluate drivers' perception of P/PLT signal displays and operation. The vast amount of information has become somewhat redundant. Therefore, for the purpose of this

Report, information was selected that either involves the Southern California area or applies to the focus of the OCTEC Committee.

The following is a list of recent articles pertaining to P/PLT that were used by the Committee as references and as general background information. A brief overview of each document is provided. The information is for research only and does not imply endorsement by the OCTEC Committee in general.

1. Fisher, John (LADOT), "Toward Uniform Left-Turn Guidelines," ITE Journal, December 1998. This article proposes a warrant system for selecting left-turn phasing type. Criteria include collisions (including time of day criteria), geometry, gaps, capacity, delay, lane blockage, transit reliability, progression, and livable neighborhoods. The article recommends an incremental approach to providing left-turn phasing; that is, generally providing permissive left-turn phasing by default, then protected-permissive if necessary, then protected left turn phasing only if PPLT is not satisfactory.

2. Signals Technical Committee of the NCUTCD, "MUTCD Requirements for Signal Displays to Left-Turning Drivers," ITE Journal, September 1992. This article summarized the requirements of the 1988 version of the MUTCD with respect to various forms of left-turn phasing, including PPLT. The traffic signal indications are clearly specified, but lateral position of the mast arm-mounted five-section head is not specified. (The recommendations of the OCTEC committee were also double-checked against the new Millennium Edition of the MUTCD.)

3. Shebeeb, Ousama (U.T. Austin + City of Hurst, TX), "Safety and Efficiency for Exclusive Left-Turn Lanes at Signalized Intersections," ITE Journal, July 1995. This article quantitatively examined collision history at 54 intersections with different forms of left-turn phasing located in Texas and Louisiana. The analysts found a correlation between safety and efficiency. Permissive left-turn phasing was most efficient (in terms of left-turn stopped delay) but had the highest left-turn collision rate. Conversely, protected left-turn phasing had the highest left-turn stopped delay but the lowest left-turn collision rate. PPLT phasing was generally intermediate in both categories.

4. Poston, Jim (Reno Transportation Commission), "Flashing Yellow Arrow: Novelty or Nascency?" 1999 ITE International Meeting Compendium of Technical Papers. This paper presented a unique four-section display that allows selection of protected-only or PPLT by time of day, and allows for lead-lag PPLT operation without causing the yellow trap. The paper is an example of novel left-turn phasing techniques that Orange County agencies may wish to consider.

5. Agent, Kenneth (University of Kentucky), "Guidelines for the Use of Protected/Permissive Left-Turn Phasing," ITE Journal, July 1987. The study results reviewed previous recommendations and collision history of P/PLT installations in Kentucky. It was recommended that P/PLT be used as a time-

saving operation, rather than protected-only. However, P/PLT is not recommended for installation when any of the following conditions exist:

- Speed limit exceeds 45 MPH.
- Current signal operation is protected-only and speed limit is more than 35 MPH.
- Left-turn movement crosses three or more lanes of opposing traffic.
- Intersection geometrics require that the left-turn lane have a separate signal head.
- Double (or more) left-turn-only lanes on the approach.
- A left-turn collision problem exists (four or more left-turn collisions in one year or six or more in two years on an approach).
- A potential left-turn collision problem exists as documented by a traffic conflicts study.
- Sight distance limitations.

When P/PLT is used, the following recommendations are made for installation purposes:

- The signal head for P/PLT should be located so that the left-turning traffic does not have a separate signal head (this article recommended positioning the indication over the barrier line; that is, the line separating the left-turn lane from the through lane).
- The five-section cluster head should be used.
- No regulatory sign is necessary.

# III. GUIDELINES

## A. Use Guidelines

Caltrans Traffic Manual and other studies and reports indicate in their guidelines for left-turn phasing that when left-turn phasing is justified, P/PLT operation should be considered when implementing protected left-turn operation. These guidelines should be used to determine the need for left-turn phasing including the use of P/PLT.

Several additional factors should be considered in order to determine whether P/PLT should or should not be implemented if left-turn phasing is justified. Figure 1 presents a flow chart for reviewing basic traffic signal phasing alternatives including P/PLT. The following is a list of factors that should be reviewed when considering P/PLT:

1. Sight distance restrictions for drivers desiring to turn left should be analyzed in all locations where P/PLT is being considered. Sight restrictions for the left-turning driver are potential collision generators for non-protected left-turn operation, and if no modification of the intersection is possible to provide sufficient sight distance, fully protected left-turn operation is recommended. (See Design section.) Information contained in the NCHRP 383 provides standards for minimum sight distance for left-turning vehicles.

2. The designer should consider the number of acceptable gaps in the opposing traffic stream that are available for permissive left-turns during both the peak and off-peak conditions. Without acceptable gaps in traffic, the successful use of the permissive portion of the protected/permissive operation may be limited and may require different implementation strategies. Without sufficient gaps in traffic, significant delays to left turns are likely to occur and motorists may be more inclined to risk turning during gaps of insufficient size. System modifications may help to improve the availability of gaps by improving vehicle platoons. However, it is important that the gaps occur during periods when a permissive left-turn is allowed. Modification of "termination by gap" programming may be needed to allow vehicles the opportunity to use available gaps. The NCHRP Report 383 identifies appropriate gap size for various roadway conditions.

3. A high-speed approach (45 MPH or greater) of opposing through movement traffic makes it more difficult to identify an adequate gap for the driver attempting to turn left during the permissive portion of the green phase. Experience indicates that, as the approach speed of the opposing through traffic increases, the ability to determine an adequate gap for making a permissive left turn is reduced. The speed of opposing approach traffic should be considered along with the availability of gaps in determining the suitability of P/PLT application and the type of operation that should be implemented.

4. The number of opposing through lanes affects the ability of motorists to identify suitable gaps in traffic. The more opposing through lanes that are present, the more difficult it is to identify a suitable gap and the larger the gap must be. The number of opposing through lanes should be considered in combination with the availability of appropriate gaps and vehicle speeds in determining the suitability of P/PLT application and the type of operation that should be implemented. In general, motorists generally start to have more difficulty identifying gaps when more than two opposing through lanes exist. However, P/PLT operations have been successful with more than two opposing through lanes. Vehicle platooning and lower traffic volumes can make P/PLT an acceptable alternative with three opposing through lanes.

5. Left-turn collisions in one direction may indicate conditions that P/PLT cannot address. If it is determined that the collisions are the result of visibility restrictions or other factors that cannot be corrected by changing the configuration of the approaches, then exclusive protected left-turn operation is recommended. (See Design section.)

6. Two or more left-turn lanes in one direction introduces potential confusion and may affect the judgment of drivers attempting to complete a permissive left turn. Permissive dual left-turns may also impact pedestrian safety. Multiple turn lanes across a permitted pedestrian movement can restrict motorist views of pedestrians in crosswalks. Use of P/PLT is not recommended to serve two or more left-turn lanes in one direction unless pedestrians are simultaneously restricted.

7. The location of advance vehicle detection loops may affect the success of the operation of P/PLT at an intersection. One significant assumption of P/PLT is that two to three motorists will complete a left turn during the change interval (amber indication). The placement of advance detection can affect the number of motorists that me be "trapped" in the "dilemma zone." The actions of these motorists may be difficult to predict or discern by motorists making a permissive left turn during the amber indication. Advance loop detection locations and timing adjustments should be carefully evaluated and incorporated into the design of the P/PLT operation.

8. Geometric conditions or traffic signal coordination may restrict left-turn operations to lead/lag phasing. When this is a requirement at an intersection and it appears that protected/permissive left-turn phasing would be beneficial, the use of the "Dallas" style of designing and implementing P/PLT should be considered. This operation allows for the use of lead/lag operations while eliminating the potential for the "left-turn trap" situation.

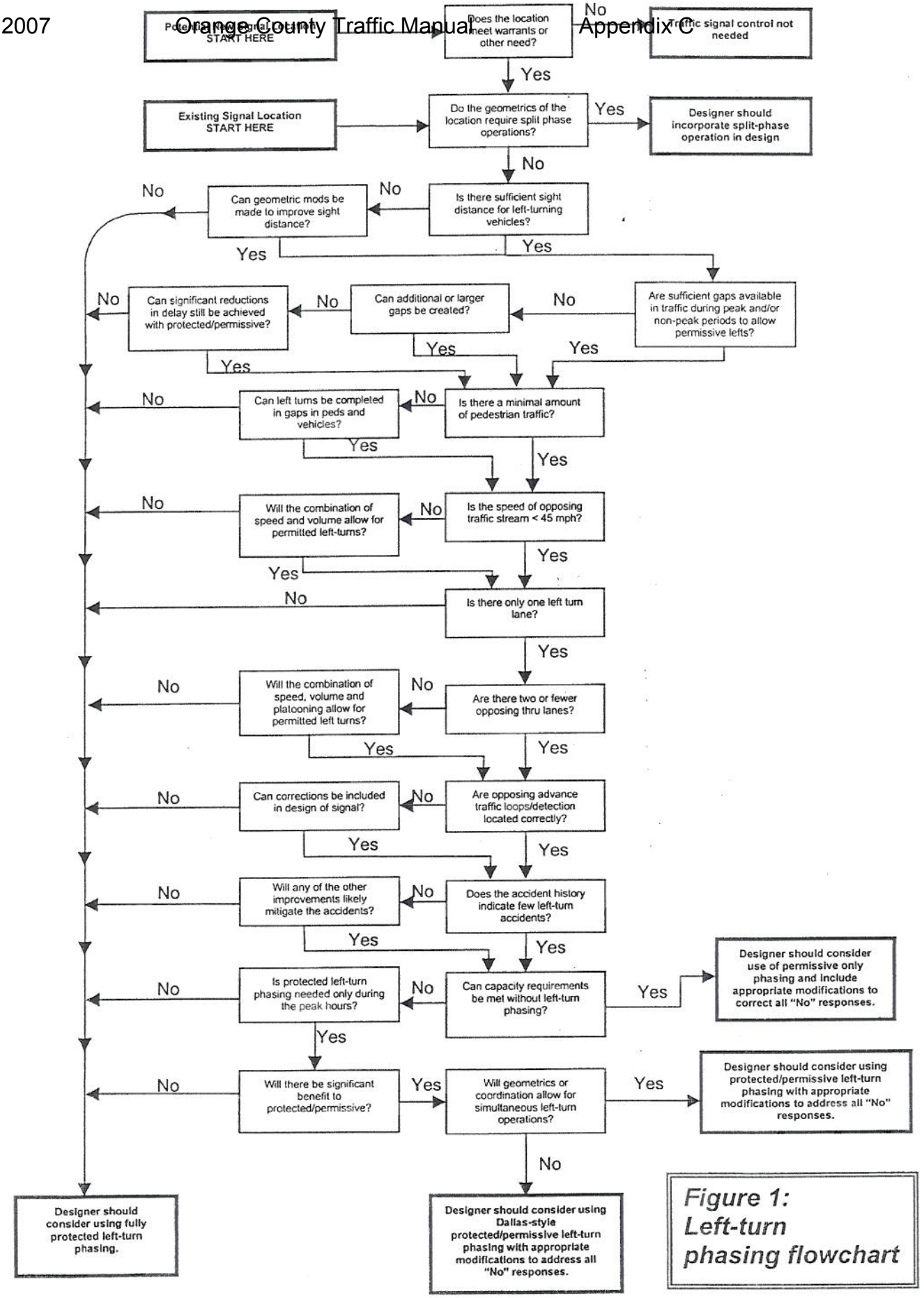



*Figure 1: Left-turn phasing flowchart*

## B. Additional Factors to Consider

1. If there are few or no gaps in the peak hour for the safe movement of a permissive left turn, is there significant gain in reducing overall delay to justify using P/PLT?

2. Is there any way to provide protected left turns in the peak and P/PLT in the off-peaks, and will it be economically feasible? Would this operation introduce a liability factor into the operation?

3. If a signal is operating free and fully actuated and fully flexible in its ability to terminate greens and respond to left-turn demand, is P/PLT effective in reducing delays?

4. Is there a need for P/PLT operation at some level below fully protected left-turn warrant satisfaction?

5. **Implementation of P/PLT must include a guaranteed red interval for through traffic prior to the showing of the protected portion of the left-turn phase, under all conditions, in order to eliminate the possibility of a "trap" situation.** This can either be a secondary phase green or an all-red interval if there is no demand on any secondary phase. A more complete description the "trap" situation is provided in Appendix B.

# IV. OPERATIONS

## A. Why Use Protected/Permissive Left-Turn Phasing?

From an operational standpoint, the purpose of using P/PLT phasing operation is generally to **reduce delay**. It is an especially effective remedy for reducing left-turn vehicle delay when operating a coordinated fixed-cycle-length timing plan at an intersection. By providing the ability for left-turn vehicles to turn left during permissive gaps in the through phase, required left-turn green phase time can be reduced, therefore reducing minimum required cycle length for the intersection, and hence reducing delay for all vehicles in all non-sync phase movements.

Along with travel time savings, other associated benefits of reduced delay include reduction in fuel consumption and vehicle pollution, thus improving air quality. The Committee also recognizes that motorists sometimes become frustrated at fully protected locations during off-peak hours and illegally turn in spite of the red arrow. This is one safety consideration related to fully protected operations, and motorists can develop an indirect disrespect for traffic control devices in general, as their frustration level increases.

Other factors may cause agencies to consider P/PLT. Intersections operating with protected left-turn phasing under unwarranted conditions may realize improved operations with P/PLT. Another use of P/PLT may be as a solution for left-turn capacity constraints when right of way is not available for a second left-turn lane. However, caution should be taken when operating P/PLT under high capacity levels as discussed later.

## B. The "Trap" and Real World Considerations

When operating P/PLT, the protected portion of the left-turn movement may be either simultaneous **leading** or **lagging**. Leading left turns are the most common, as they are generally more operationally efficient. Combination lead/lag operation may be a desirable use at an intersection to promote arterial progression, since through greens are not constrained to start simultaneously. **However, lead/lag operations can incur "trap" situations** (see Appendix B for the "trap" explanation). Lagging left turns may be an effective way to clear left-turn queues at intersections, although for P/PLT they should begin simultaneously.

An important operational factor to consider with P/PLT is the impact on arterial progression. Many agencies take advantage of lead/lag left turns to maximize green bandwidth. But under P/PLT operation, agencies may not want to design around the "trap" scenario. With the standard P/PLT indications **no lead/lag operation is possible without the "trap" scenario unless it is a "T" intersection**. However, the "Dallas style" P/PLT operation enables a lead-lag operation while effectively addressing the "trap" situation, as may other custom solutions.

## C. Queue Detection

With continual advancements in controllers and signal systems, possibilities exist to operate P/PLT under certain times of day. An operation commonly used that is similar to a "combined" phasing is to fully take advantage of P/PLT operation during off-peak hours by not bringing up the protected left-turn arrow unless there is a predetermined threshold of vehicles in the left-turn lane. This operation requires special left-turn queue detection.

The utilization of a queue detector system, usually located 50 to 80 feet from the limit line in the left-turn lane, provides a logic mechanism to display the green arrow only when there is a queue so long that the left-turning volume cannot be served by the "green ball" only on that particular phase. With only the "green ball" under many situations of opposing Through traffic, the left turners will find an adequate gap in the opposing Through traffic and/or they will be able to make their left turn during the "yellow ball" clearance period. The exact distance back of the limit line to set the queue detector depends on the designer's judgment on the number of vehicles in the queue that warrants "bringing up" the green arrow at the predetermined time in the particular signal cycle. Some agencies, such as Los Angeles, consider bus activity in placing queue detectors.

In many installations, if the queue detector is occupied at the time in the cycle for the left arrow phase to begin, the left-turn lane will be displayed a green arrow. After the start of the left-turn arrow, the timing of the arrow is transferred to the "up close" loops in the left-turn lane for green arrow gap timing with a predetermined maximum time.

It is recognized that there is much to be learned in operating the most efficient queue detection system, including the prediction of the number of adequate gaps that will be available in the opposing through traffic so that the number of vehicles that could turn left in the gaps can be estimated. In most situations, two cars can make a left turn during the clearance interval (amber display). This means that if the intersection is operating on an 80-second cycle length, there would be 45 cycles per hour or 90 cars per hour turning left **without** the need to take time away from the opposing through traffic phase to serve the left turners. In addition to these "yellow clearance" left turners, under many conditions during the day, the left-turn demand can be satisfied by the gaps in the opposing through traffic, thereby increasing the capacity of the left-turn lane without the need for the green arrow.

## D. All-Red Considerations

Intersections near major event generators can be good candidates for P/PLT operation. This would occur at an intersection with nominal cross-street traffic volumes most of the time, but with heavy directional flow on the cross street during events. An agency can operate the cross street under P/PLT and change the phase sequencing to run opposed (or "split") phasing on the cross street during event periods.

Agencies operating P/PLT may consider increasing "all red" time following through greens and yellows for permissive left-turn vehicle movements during the clearance interval (i.e., sneakers). However, experience indicates that once motorists become aware of the "all red," they begin to utilize it similar to a yellow clearance interval.

## E. Switching between PPLT and Other Modes

It may be desirable to turn off P/PLT during unfavorable gap acceptance periods (i.e., peak). This operation, however, would require a custom application such as:

- A six-section head with a red arrow display for exclusive protected left-turn control.
- The system recommended by Jim Poston (see the "Previous Study Review" section for a reference).

To our knowledge, no Orange County agency has implemented a system that switches between PPLT and another form of left-turn phasing by time of day.

## F. Survey of Orange County Agencies

The prior committee's survey of Orange County agencies revealed a desire for regional uniformity. Region-wide consistency on head design (cluster vs. vertical), head placement on the mast arm, and possible use of supplemental signing are most desirable. Agencies that have implemented many P/PLT signals have found that the operation works best when implemented on a corridor- or area-wide basis.

# V. DESIGN

## A. Introduction

The design element of this report is not intended to be used as a standard of practice for the design of P/PLT phasing. It is, however, intended to add uniformity and consistency in the design of traffic signals utilizing P/PLT phasing. Its use as a reference guideline could be extremely beneficial for traffic design professionals to facilitate design of different scenarios facing today's designer, ranging from a "T" intersection to a fully actuated eight-phase major arterial intersection.

The Update Committee has endeavored to incorporate the most recent hardware and software advances, as well as leading-edge operational practices and philosophies.

These design guidelines attempt to dispel long-standing myths associated with P/PLT phasing and address technical questions concerning operation, design, timing, peak-hour use, and indication placement. Its advantages and disadvantages, geometric constraints, and design characteristics are discussed in detail to allow the designer to be more informed and to make intelligent design decisions.

Being consistent in the design of P/PLT signal phasing is a two-fold proposition: first of all, it will help driver initiation, recognition, and acceptance of this particular form of phasing; and second, it will assist the governing agency to operate, program, and maintain this phasing system.

## B. Description of Operation

The particular types of left-turn signal phasing possibilities are as follows: lead/lead, lag/lag, lead/lag, and lag/lead. It seems that for as many different intersection configurations that exist today, there are an equal number of available operating possibilities and phase sequences. The four conditions mentioned previously are the four sequences specifically analyzed for these guidelines.

## C. Design Characteristics

This section has been compiled to point out many of the pros and cons the P/PLT designer might encounter (see Appendix C for summary). Review of the pros and cons will assist the designer in determining whether or not it is appropriate to implement this particular type of left-turn phasing at any given location. Also, for determining mounting and signing locations at new, modified, or retrofitted intersections, please review the technical diagrams in Appendix D for desired head placement, sign placement, and indication type considerations.

## D. Recommended Design Characteristics and Equipment

This section provides the engineer/designer a brief overview of the recommended equipment and design characteristics for P/PLT phasing.

For further explanation or clarification on any of the recommendations outlined below, please refer to Appendix D at the end of this report.

The recommendations are as follows:

1. Use a five-section cluster head for mast arm mounting only.

2. The five-section cluster head should be placed as follows:

    a. For intersections with one approach lane and a separate left-turn lane, a cluster head should be mounted over the center of the through lane, along with a pole-mounted three-section head for through traffic.

    b. For intersections with two or more approach lanes and a separate left-turn lane, a cluster head should be mounted eight feet (±3') to the right of the barrier line, along with a pole-mounted three-section head.

3. Far-left indications should be a five-section stack head type. All configurations shall have a far-left indication.

4. Use left-turn pocket detector switching or back-up protection to avoid the "trap" situation.

5. Use queue detectors to call protected periods (see Operations section).

6. No sign is required; however, if one is desired by a particular agency, then an R73-7 "Left Turn Yield on 'green ball'" may be used.

7. A four-section stack head type is recommended for use at "T" intersections or one-way streets with lagging left turns. Clearance time is during the yellow ball.

8. A supplemental three-section head on the mast arm is not required but may be provided on very wide approaches.

9. Queue detection should be considered as a part of any P/PLT installation. Many methods exist to implement this design feature, which allows greater signal efficiency. See the Operations section for discussion on the operational parameters.

In order to modify a traditional left-turn phasing intersection into a P/PLT phasing intersection and to reuse existing equipment or hardware, the designer should consider all relevant modifications.

## E. Geometric Constraints

The provisions listed in this geometric constraints section is a partial check-list of unfavorable geometric conditions that may exist at certain locations and to help determine if the proposed location is adaptable to P/PLT phasing.

- Horizontal curves creating sight distance problems (see discussion on sight distance problems in the Guidelines section and in Appendix E).
- Vertical curves creating sight distance problems (see discussion on sight distance problems in the Guidelines section and in Appendix E).
- Wide medians could obstruct sight distance (see sight distance considerations in Appendix E).

## F. Sight Distance

The terms "gap" and "sight distance" are used to explain and clarify two important aspects in relation to protected/permissive left-turn phasing signal operation. Both of these terms have a direct relationship and importance for the left-turning motorist making a left turn on a "green ball" signal (permissive period).

When a motorist makes a "protected" left turn on a "green arrow," the left turner has the right-of-way and is given an unrestricted pathway for making the left turn. This left-turning motorist will logically assume that all conflicting pedestrian and vehicular movements are not allowed to conflict with the left turner's left-turn movement. Under normal circumstances, the left turner's attention is primarily focused on the "green arrow" signal, and secondarily on possible obstructions in the left-turner's pathway.

When the left turner is making a left turn on a "green ball" (permissive left turn), the situation is significantly different.

The typical "permissive" left-turn operation (left turn on green ball) in full execution involves the following generalized incremental steps by the motorist making the left turn:

1. Left-turning motorist observes oncoming (opposing) vehicles as he/she drives the vehicle into the street intersection area.

2. Left-turning motorist evaluates the available openings, or "gaps," in the opposing traffic stream and conflicting pedestrian movements. The "gaps" are the clear distances between approaching vehicles.

3. Left-turning motorist makes the left turn if the motorist's evaluation of the "gap" in the opposing traffic results in the conclusion that an adequate "gap" is available so that the left turn can be safely completed.

4. If the left-turning motorist's evaluation of the available "gaps" (spaces) in the oncoming (opposing) traffic stream results in the conclusion that there is not an adequate "gap," the left-turning motorist will normally (and should) wait in the intersection until he/she sees the yellow ball signal *and* observes that the

opposing vehicles are slowing and will be stopping for the red signal; after which the left turn is completed on the yellow signal, at the end of the yellow signal, or during the red clearance interval.

In cases when there are not enough adequate "gaps" in the opposing traffic stream, and there is a heavy demand for left turns, the particular signal control for the left-turn movement may incorporate a "queue detector" which changes the operation from "permissive" to "protected." That is, when the number of cars waiting at the signal in the left-turn lane equals or exceeds approximately three or more, the signal has the capability of detecting this queue length and provides that the left-turning vehicles will be given a green arrow.

Protected left-turn operations can also be triggered using "first car detection." With this operation, the protected left turn is triggered whenever any car is present in the left-turn pocket at the point in the cycle when a left-turn arrow can be provided.

For the left-turning motorist making a left turn on a green ball, the availability and determination of an adequate "gap" is important to the safe operation of this type of left turn. It is important to recognize that the "gap" in the opposing approaching traffic stream can be created in the following two ways:

- Density of the opposing traffic stream determines the number of seconds or distance between the opposing vehicles.
- Platooning of approaching vehicles due to an upstream traffic signal operation.

Sometimes roadway alignment conditions may limit the left-turning motorists' ability to observe the "gaps" in the approaching traffic stream in adequate time to make the permitted left turn. Standards for sight distance of approaching vehicles are discussed below.

*"Gap" Standards*

Prior to the publication of NCHRP Report 383 titled "Intersection Sight Distance," by the Transportation Research Board of the National Research Council in 1996, the standard for sight-distance evaluation was based on stopping sight distance. This means that the opposing through-movement vehicle was expected to have adequate distance to stop for the left-turning vehicle assuming that the left-turning vehicle stopped or was in the direct line of the opposing through-movement vehicle. The new standard now relates to having adequate "gaps" in the flow of traffic along the major road opposing the left-turn movement so that it is now the left turner who has adequate "gaps" in the opposing stream. While the new standard is given in "seconds," the "gap" distance can be determined as the product of "gap" in seconds and the vehicle speed in feet per second. Table 1 titled "Recommended Travel Times for Determining Sight Distance for Left Turns from the Major Road Across Opposing Traffic Lanes," as shown on page 81 of NCHRP Report 383, provides the current acceptance standard for "gap" spacing or sight distance wherever left turns are made from the major road across opposing traffic lanes.

Table 1 (Table 37 from page 81 of NCHRP Report 383) and its accompanying note are shown below.

**TABLE 1:**
**Recommended Travel Times for Determining Sight Distance for Left Turns from the Major Road Across Opposing Traffic Lanes (Gap Acceptance)**

| Vehicle type | Travel time (sec) at design speed of major road |
|---|---|
| Passenger car | 5.5 |
| Single-unit truck | 6.5 |
| Combination truck | 7.5 |

*Note: For left turns that must cross more than one opposing lane, add 0.5 sec per additional lane for passenger cars, and 0.7 sec per additional lane for trucks.*

As noted in the above table, the travel times or "gaps" shown in the table (for instance, 5.5 seconds for passenger cars) are for left turners crossing just one opposing lane of traffic. If there are two opposing lanes of traffic to be crossed by the left-turning motorist, the table indicates that an additional one-half second should be added to the 5.5 seconds, thereby providing a total required "gap" of 6 seconds for left turners crossing two opposing through lanes of traffic.

While Table 1 shows the "gaps" in terms of seconds, the distance requirement between vehicles, or from the intersection to the nearest sight obstruction, can be converted to distance in feet by multiplying the travel time in seconds required for the particular speed in feet per second. The required minimum "gap" establishes the sight-distance requirement. The previously used standard using "stopping sight distance" (in feet) did not relate to the left turner but referred to the vehicle opposing the left turner.

*Determining the "Design Speed"*

It is recommended that in those instances where the particular agency does not have a "design speed" designated for the particular street segment, one of the following two alternative procedures be used to determine the "design speed" for the approaches to the particular intersection.

The alternatives are as follows:

*AASHTO Procedure*

Using Figure II-22, *Relation of Average Running Speed and Volume Conditions* (p. 70 of "A Policy on Geometric Design of Highways and Streets," 1994), and the average speed recorded for the particular street approach to the intersection, the "design speed" can be estimated using the appropriate traffic volume curve. A copy of Figure II-22 is included in Appendix F for reference.

*Procedure Based on 85th Percentile Speed*

To determine the design speed from the 85th percentile speed, the following procedure is recommended:

- If the 85th percentile speed is at a 5 MPH increment, the design speed would be assumed to be 5 MPH higher (e.g. 45 MPH 85th percentile, 50 MPH design speed).
- If the 85th percentile speed is not at a 5 MPH increment, the design speed would be assumed to be 5 MPH higher than the next highest 5 MPH increment (e.g. 46 MPH 85th percentile, 55 MPH design speed).

Other examples include:

| 85th Percentile | 5 MPH Increment | Design Speed |
|---|---|---|
| 40 MPH | 40 MPH | 45 MPH |
| 43 MPH | 45 MPH | 50 MPH |
| 52 MPH | 55 MPH | 60 MPH |
| 39 MPH | 40 MPH | 45 MPH |

Based on this procedure, the design speed will range from 5 to 9 MPH above the 85th percentile speed.

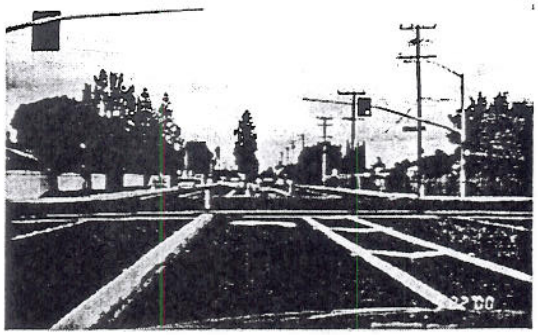
*Positive Offset Left-Turn Lanes*

In some cases, the policy in implementing protected/permissive left-turn phasing involves the offsetting of the left-turn lanes so that left-turning vehicles have a clear sight line of opposing through traffic which is not restricted by vehicles in the opposing left-turn lane.

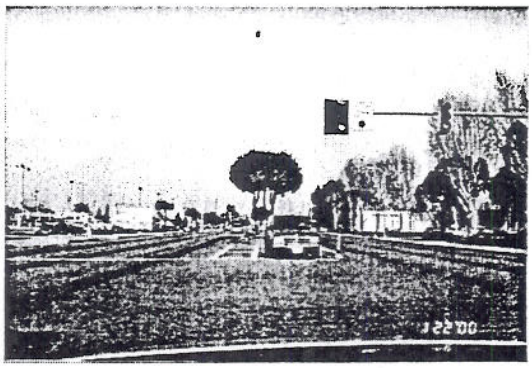
Figure 2, titled *Examples of "Positive Offset" Left-Turn Lanes at Signalized Intersections*, shows some examples of left-turn lane geometrics designed so that the driver in the left-turn lane can see approaching through traffic (i.e., past the vehicles in the opposing left-turn lane).

Appendix E illustrates examples of positive and negative offset.

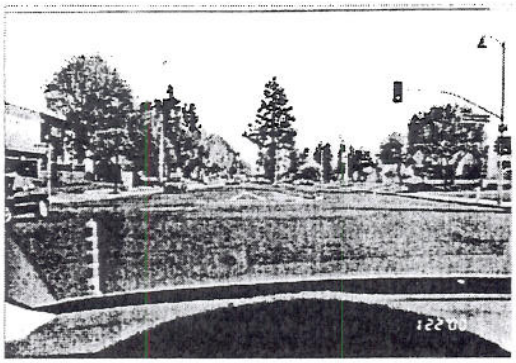
# Left turn "positive offset"



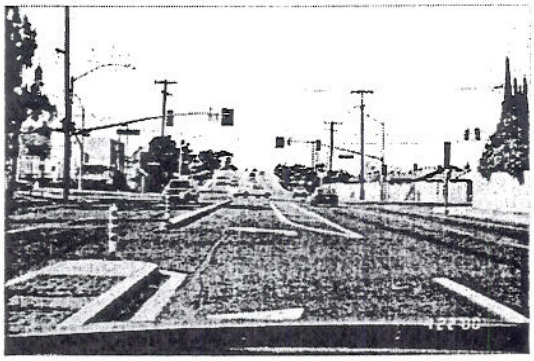
Example of left turn lane to create "positive offset" for visibility of opposing thru vehicles



Shows how "positive offset" allows good view of on-coming thru vehicles for permitted left turn driver



Example of a "positive offset" at a two phase signal



Shows narrowing of median nose to create "positive offset"

Photos taken in Fountain Valley

| | | |
|---|---|---|
| HMA | Examples of "positive offset" left turn lanes at signalized intersections | FIGURE 2 |

## G. Signal Indications

As the variety of signal displays for similar movements by agencies increases, so does driver confusion. There is a need for the driver to be able to associate (identify) specific indications for specific movements. These design guidelines will help resolve some of the problems with conflicting displays.

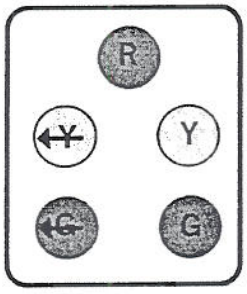
To aid drivers in movement identification, the following recommendations for protected/permissive signalized intersections are made:

1. The cluster head be used exclusively for left-turn displays on mast arm mount.
2. Three-section vertical heads only (on the mast arms) for Through movements (for two or more approach lanes and a separate left-turn lane).
3. Five-section stack heads should be used for far-left indication.

A graphic display of the signal heads, their uses, and their functions are discussed as follows:

Common Name:

Cluster Head ( aka "Doghouse")



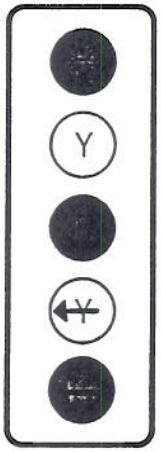
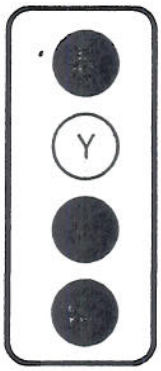

**Uses:** Mast-arm mounting. PPLT phasing.

**Sign:** (if used) R73-7 "Left-Turn Yield on 'green ball' (others possible)

**Advantages:** Distinctive indication arrangement, which alerts drivers to the P/PLT operation. Consistent with heads already in use.

**Disadvantages:** May be confusing to first-time users.

Note: Due to the distinctive shape of the cluster head and the Committee's desire to distinguish P/PLT operations, it was determined that this head should be used only for P/PLT operation (for the mast arm indications).

| Common Name: | Five-Section Stack | Common Name: | Four-Section Stack |
|---|---|---|---|
| |  | |  |
| **Uses:** | Far-left mounting. P/PLT phasing. | **Uses:** | Far-left and mast-arm mounting. P/PLT phasing at "T" intersections and where lagging left turns are used. |
| **Sign:** (if used) | R73-7 "Left-Turn Yield on 'green ball'." | **Signs:** (if used) | R73-7 "Left-Turn Yield on 'green ball'." |
| **Advantages:** | More consistent with traditional displays. Consistent with existing installations. (TV-1-T mounting recommended.) | **Advantages:** | Compact size and ease to recognize. (TV-1-T mounting recommended.) |
| **Disadvantages:** | Not as compact as the cluster head. May not be identified by drivers as a P/PLT operation. | **Disadvantages:** | No yellow arrow display. |

Note: Numerous other signal head configurations are in use today that cannot be listed separately here. Only commonly used configurations are illustrated in this section.

## H. Summary

Use of the P/PLT phasing sequence is a viable operational parameter during non-saturated traffic flow condition. Through the use of accepted updated traffic signal equipment, the installation, operation, and maintenance of these systems is an acceptable alternative to conventional left-turn design. Most people would prefer not to remain at a signalized intersection any longer than possible. At the same time, P/PLT saves the commuter time and increases the efficiency of the signal systems, which translates into fuel efficiency and less driver frustration.

It is always a good idea to remember that many locations are not well suited for this form of operation, such as arterials with high approach speed, multiple left-turn lanes, vertical and horizontal alignment problems, and high left-turn collision history. Therefore, extra care should be taken when designing a new P/PLT phasing intersection or in the modification of an existing conventional left-turn phasing intersection.

The benefit of using the protected/permissive operation is clearly in time savings and pollution reduction. This is a trend that has far-reaching impacts. Most public agencies using this system have reduced stop delay, fuel consumption, and citizen complaints.

The Committee acknowledges this operation is not ideal for every situation, but recommends considering this type of left-turn phasing at locations that could benefit from P/PLT phasing.

# VI. PUBLIC AWARENESS AND EDUCATION

## A. Summary of Prior Efforts

The previous PPLT Committee organized a major public education campaign with the following features:L

- Revisions to the State of California Department of Motor Vehicles (DMV) Driver Handbook to educate drivers about PPLT.
- Preparation of public information bulletins and hand-outs, also to educate drivers about PPLT.
- Preparation of a script for a Public Service Announcement video.

The current committee's efforts were focused on updating the guidelines to conform to best current practices, in part to reduce the need for public education. Therefore, no additional public education campaign was undertaken.

# Appendix A:

# Members of the Update Committee

and the

# Original PPLT Committee

## The PPLT Update Committee Membership

| | | |
|---|---|---|
| John A. Kerenyi, P.E. (Chair) | Kimley-Horn & Associates | (714) 939-1030 |
| Mark Esposito | Hartzog & Crabill | (714) 731-9455 |
| Jose Alire, P.E. | City of Fountain Valley | (714) 593-4517 |
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| Mark Lewis, P.E. | City of Fountain Valley | (714) 593-4435 |
| Hank Mohle, P.E. | Rick Engineering | (714) 939-1440 |
| Carlos Ortiz, P.E. | Robert Bein, William Frost & Associates | (949) 472-3505 |
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## The Original PPLT Committee Membership

Cory A. Bersch, P.E.

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R. Paul Grimm, P.E.

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R. Henry Mohle, P.E.

Ignacio G. Ochoa, P.E.

James D. Otterson, P.E.

James M. Paral, P.E.

Steven S. Sasaki, P.E.

Dennis Schmitz

James J. Sommers

Bernard J. Vokoun, P.E.

# Appendix B:

# The "Trap" situation explained

## Appendix B: The "Trap" Explanation

This appendix contains diagrams to explain the "trap" situation which shall not be permitted when protected/permissive left-turn phasing is used.

The "trap" occurs when a person turning left on a "yellow ball" crosses in front of opposing thru traffic that continues to be controlled by a "green ball."

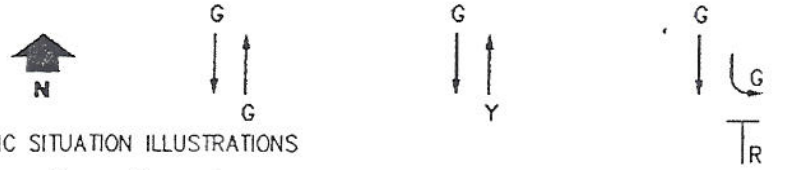
A basic driving assumption is that when a driver is turning left on a "yellow ball," the opposing thru traffic is also observing a "yellow ball" and, therefore, the opposing thru traffic will be stopping on the "red ball" following the "yellow ball." The driver turning left on the "yellow ball" must be assured that this basic assumption is true.

The diagrams were furnished by Brian Gallagher, P.E., Transportation Engineer, Signal Systems and Research Section, Department of Transportation, City of Los Angeles. Brian's valuable contribution to the original PPLT Committee's work is hereby acknowledged with sincere appreciation.

## THE "TRAP" ILLUSTRATED

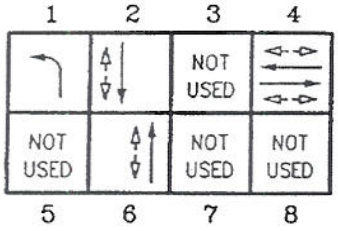
1) QUESTION – What is a "left turn trap" ?

2) ANSWER – This is a "trap" for Northbound & Westbound left turns. The left turns are permissive.



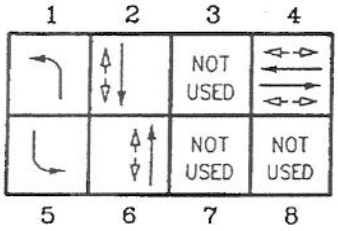

3) SPECIFIC SITUATION ILLUSTRATIONS

A)



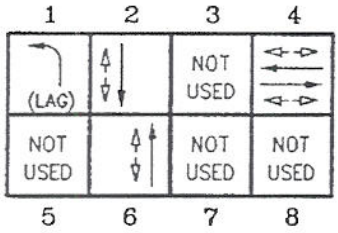

Trap for S/B Left–Turn if ø4 not on recall or ø1 does not place a call to ø4.
ø1 can be either Protected–Only or Protected/Permissive.

B)



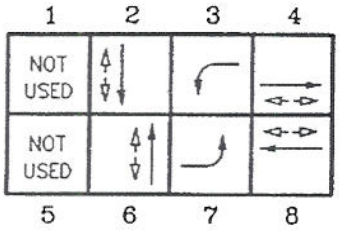

Trap for either N/B Left–Turn or S/B Left–Turn if there is no ø4 call and both Left–Turn Phases do not come up simultaneously.
Only applies if ø1 and ø5 are Protected/Permissive Left–Turn.

C)




You can Not have a Lagging Permissive/Protected Left–Turn when the cross street is 2–way.
This would be acceptable (and preferred) if the East–West street shown was One Way Westbound.

D)




As long as ø2 and ø6 are on recall, this is O.K. for Protected only or Protected/Permissive Left–Turn in either ø3, ø7 or both.
See note "C" regarding Lagging Permissive/Protected.

RULES:
1. If Left–turn phase for only 1 of 2 directions, use call to phase or min. recall for side street.
2. Don't use Lagging Permissive/Protected left–turn phases when a one–way street or T–intersections is Not Involved.
3. Even a 2–phase intersections a left–turn trap can occur during preemptions – BE CAREFUL.

Page 1 of 1
JULY 22, 1994

# Appendix C:

# Pros and Cons of PPLT

# Appendix C:

## Pros and Cons of Protected/Permissive Left-Turn Phasing

*Pros:*

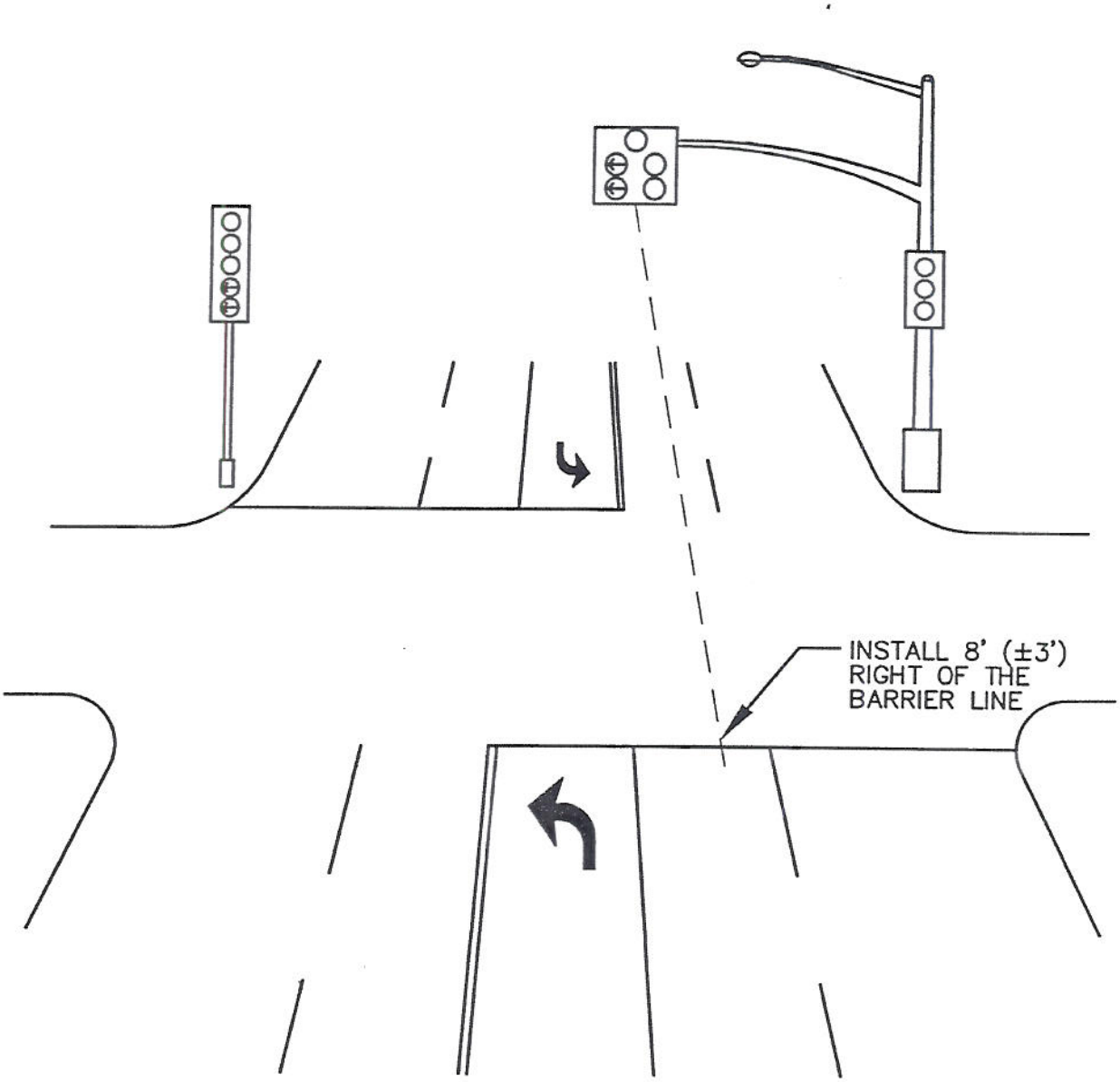
- Reduces delays and stopped time on coordinated systems.
- Allows for selective use of shorter cycle lengths at each intersection.
- Reduces fuel consumption.
- Reduces pollution.
- Provides high signal system efficiency (slightly less than only permissive in the worst case and as good in the best case) because it allows for all left-turn phasing combinations (with special equipment), thus producing the best fit into the green band, while still providing protected left turns. This benefit is high both during peak travel periods, when protected lef-turn phasing has the greatest effect; and off-peak, when the larger number of acceptable gaps in through traffic allow left turners to proceed without waiting for the green arrow.
- Fewer right-angle accidents may occur than under permissive-only operation, due to the presence of the protected lef-turn phase.

*Cons:*

- Lost time due to various measures required to prevent left-turn trap phasing situations.
- Driver confusion and resistance to acceptance.
- More right-angle accidents may occur when compared to protected-only.
- Signal head configuration and placement not uniform throughout the area.
- Arterial system timing is difficult to use with protected/permissive operation.

# Appendix D:

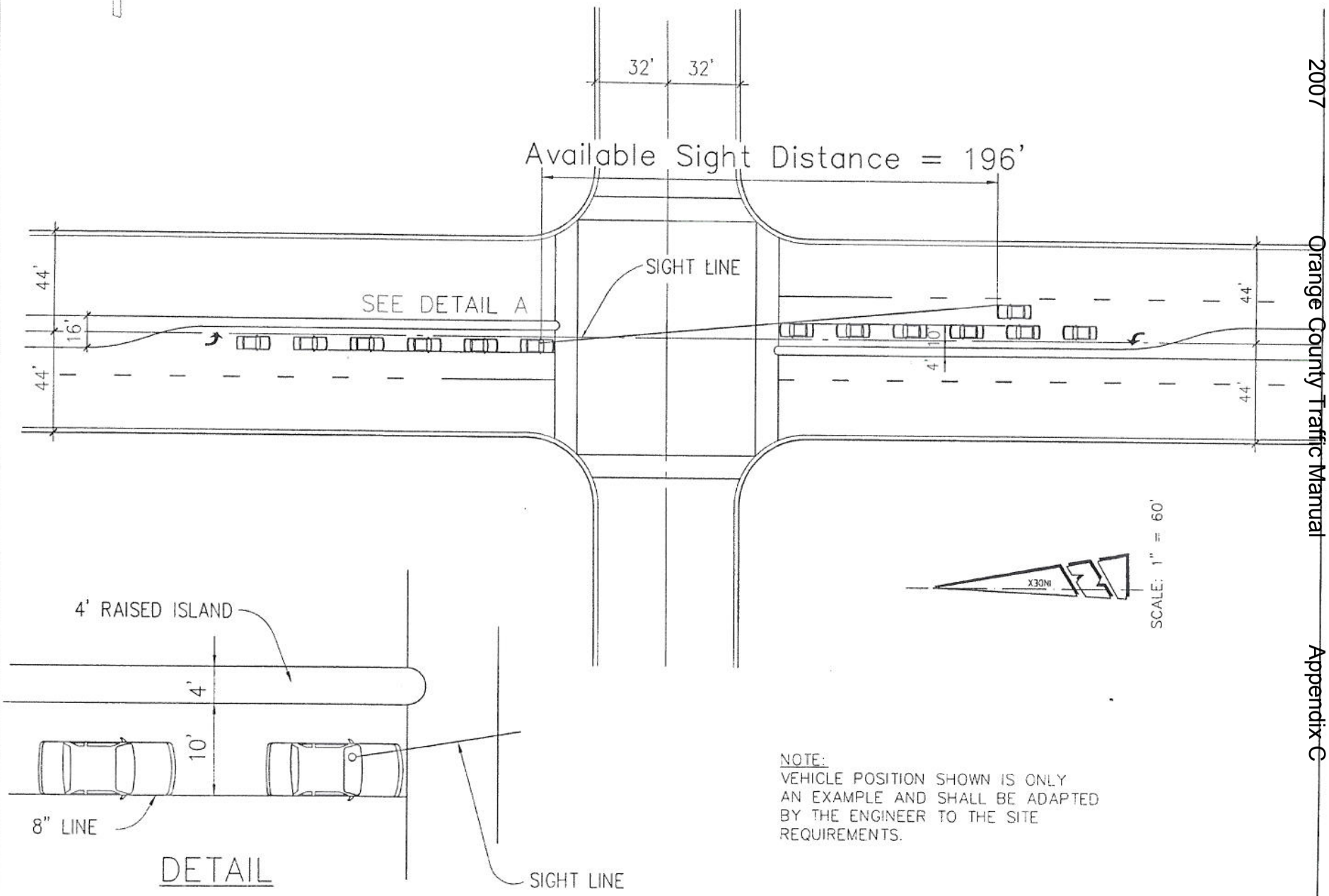
# Recommended Signal Head Locations



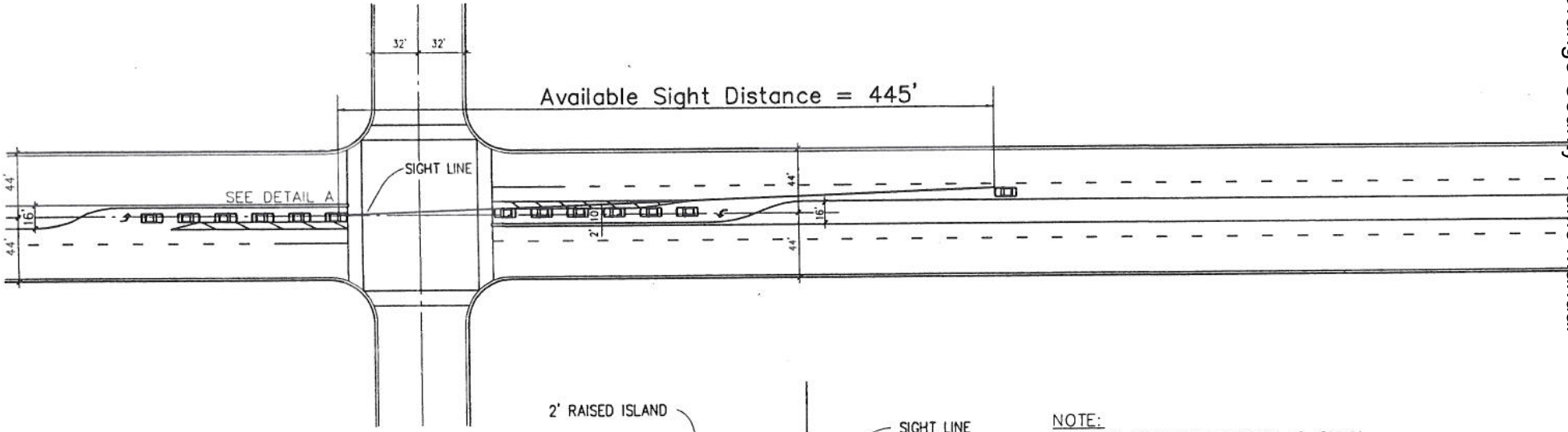

# Appendix D:
# Recommended Signal Head Locations

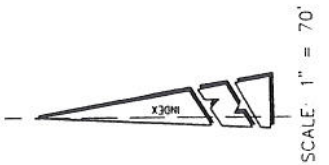
# Appendix E:

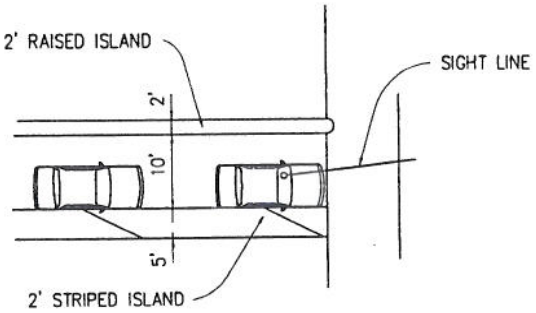
# Visibility Considerations




| OCTEC | Visibility Consideration for Left Turning Vehicles– Straight Roadway with Standard Islands | FIGURE E–1 |
|---|---|---|



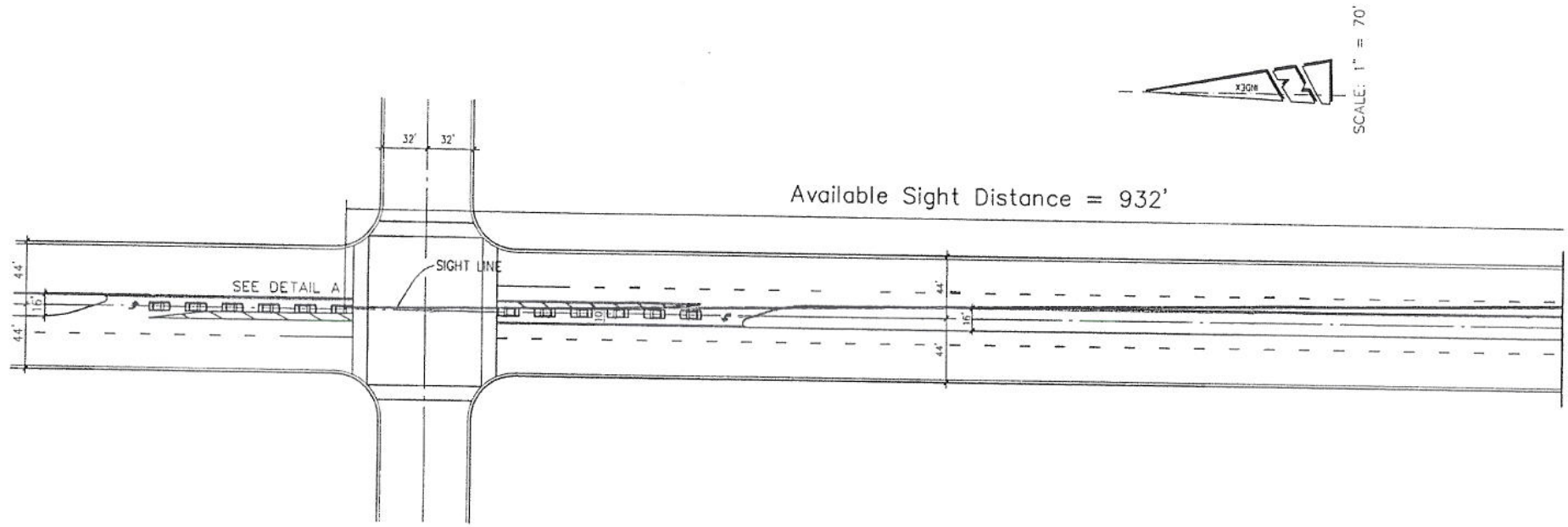



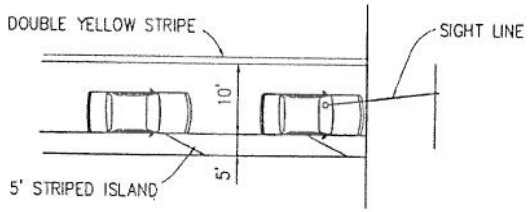




DETAIL

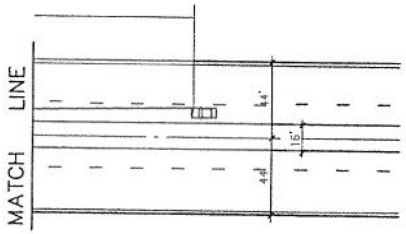
NOTE:
VEHICLE POSITION SHOWN IS ONLY AN EXAMPLE AND SHALL BE ADAPTED BY THE ENGINEER TO THE SITE REQUIREMENTS.

| | | |
|---|---|---|
| OCTEC | Visibility Consideration for Left Turning Vehicles– Straight Roadway with 2–Foot Noses | FIGURE E–2 |



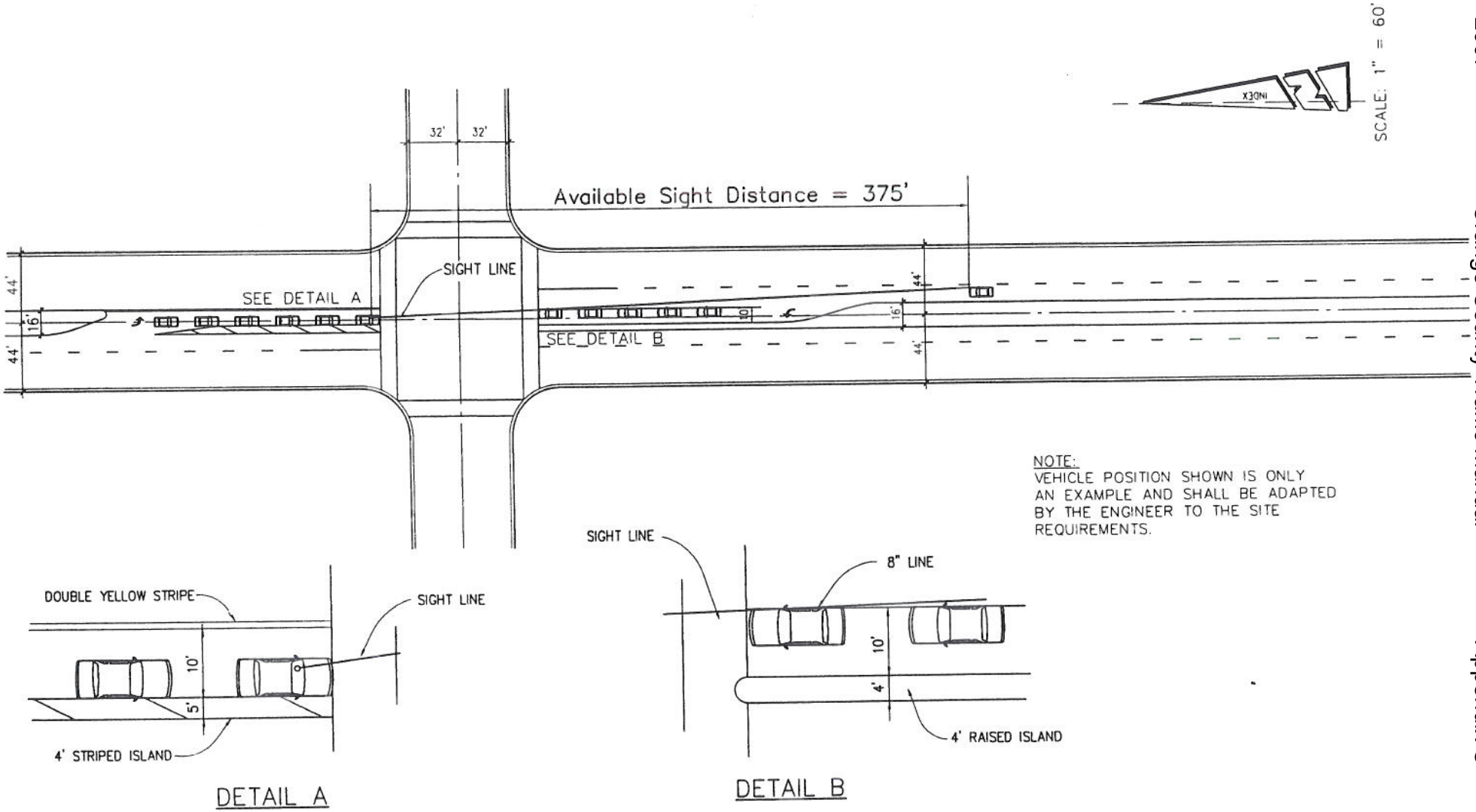




DETAIL




NOTE:
VEHICLE POSITION SHOWN IS ONLY AN EXAMPLE AND SHALL BE ADAPTED BY THE ENGINEER TO THE SITE REQUIREMENTS.

| OCTEC | Visibility Consideration for Left Turning Vehicles– Straight Roadway with Double–Yellow Lines | FIGURE E–3 |
|---|---|---|




| | | |
|---|---|---|
| OCTEC | Visibility Consideration for Left Turning Vehicles–<br>Straight Roadway with Double–Yellow Line and Opposing Standard Island | FIGURE E–4 |

# Appendix F:

# AASHTO Figure II-22:

# Relation of Average Running Speed and Volume Conditions

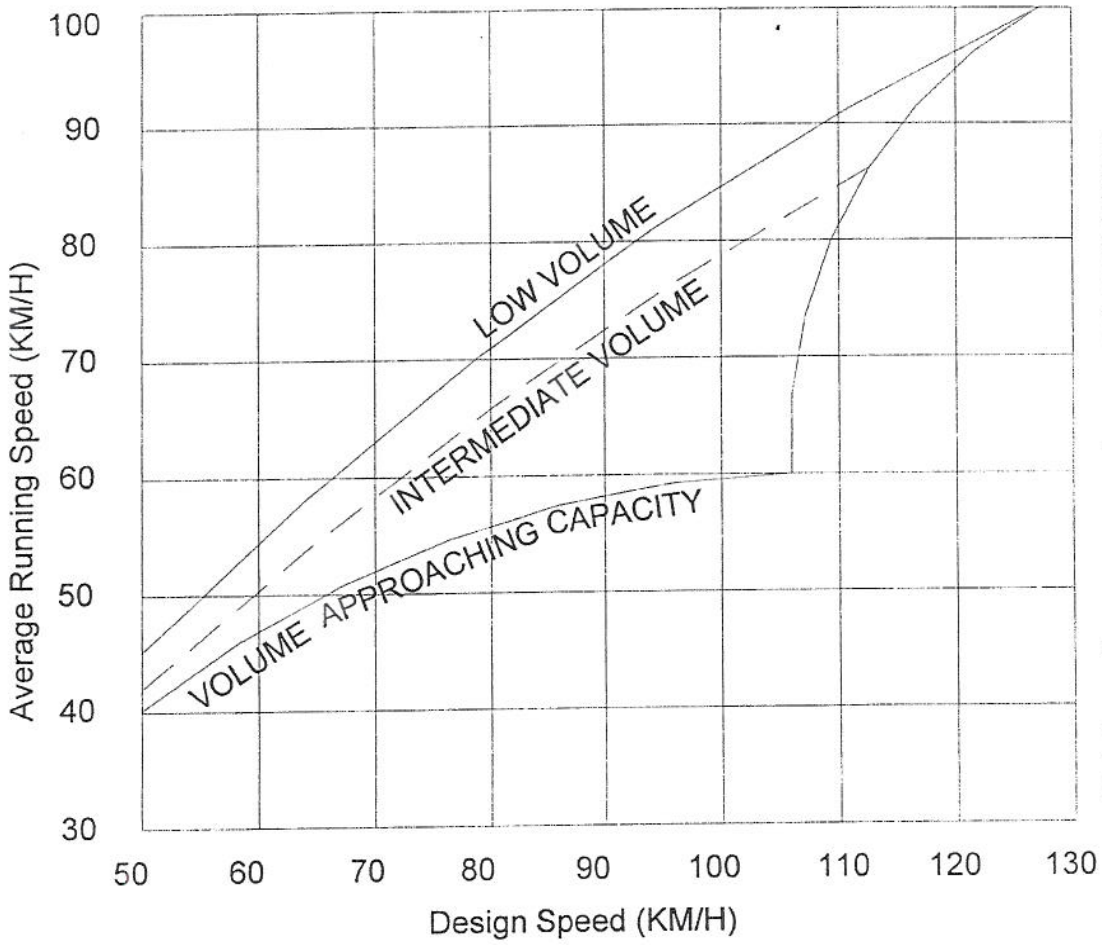



Figure 11.22 Relation of average running speed and Volume conditions.

Note: Diagram taken from page 70 of 1994 " A Policy in Geometric Design of Highway & Streets", by American Association of State Highway and Transportation officials (AASHTO)

| | | |
|---|---|---|
| Appendix A | Relation of Average Speed to Design Speed | Appendix A |