5.0 SIGNAL OPERATION OPPORTUNITIES DURING OFF-PEAK HOURS

5.1 Introduction

There are a variety of alternatives in traffic signal operation. For example, during peak period conditions, due to heavier traffic volumes on the roadways, traffic signals are generally set to coordinated operation. The following is a list of modes of operation available in operating signalized intersections during various periods of the day.

1. Coordinated Operation: The predominant goal of coordination is to service the greatest number of vehicles through a series of intersections (system) with the fewest stops. Ideally, every vehicle entering the system could proceed through the system without stopping. However, this is not possible, even in well-spaced, well-designed systems. Coordinated timing can be used to provide for the minimum number of stops and/or delays through intersections that are fully actuated, semi-actuated or pre-timed.

2. Fully-Actuated / "Free" Operation: A fully actuated intersection is one that has vehicle detection on every approach. A fully actuated intersection with "free" operation refers to an intersection signal timing plan operating based on actual demand that is detected by vehicle detectors, either in the roadway or via cameras installed overhead.

3. Semi-Actuated Operation: A semi-actuated intersection generally has vehicle detection on the minor-street approaches. In semi-actuated operation, the major movement is continuously served until the minor movement requests to be served (via vehicle detectors). Once this request has been detected, the minor movement is served and then the signal resumes normal operation (serving the major movement).

4. Pre-Timed Operation: An intersection without vehicle detection is operated with pre-timed signal timing plans. The timing plans at these intersections are based on traffic counts collected on a typical day.

5. Flashing Operation: Two different flashing operations exist.

    a. *Yellow/red flashing operation*: The major street approach is provided with a flashing yellow indication and the minor street approach receives a flashing red indication. Some jurisdictions around the country utilize this operation during late-night hours to reduce vehicular delays and save on energy consumption.

    b. *Red/red flashing operation*: All approaches receive flashing red indications. This operation is also used during late night hours by some jurisdictions across the country. A red/red flashing operation is also sometimes utilized at intersections near fire stations (when a fire personnel vehicle is entering or exiting the fire station) or when the intersection is malfunctioning.

The City of Lincoln has been updating its signal timing plans during the peak periods (AM, Midday, and PM). In order to reduce vehicle delays and increase safety during the late-night, low-volume hours, the City has been investigating the implementation of an alternate late night timing plan. Currently, the City is utilizing free operation and reduced cycle lengths at some intersections. During low volume time periods (usually between 10:00 p.m. and 6:00 a.m.), there are a number of methodologies available to provide efficient movement of vehicles through intersections. This chapter summarizes the results of a study performed to identify a set of guidelines for alternative operation of signalized intersections during these late night hours and/or during low volume, off-peak time periods.

The remainder of this chapter is organized as follows:

Section 5.2 Literature Review: In order to develop a set of recommendations, various articles and previous research studies were analyzed. In addition, various jurisdictions across the country were contacted to better understand their late night, low volume signal timing methodologies.

Section 5.3 State of Practice for Late Night Operation: A review of existing standards in traffic signal operation during late night/low volume hours.

Section 5.4 Guidelines: Proposed guidelines for operation in the City of Lincoln.