August 7, 2001

MODIFICATION OF SIGNAL TIMINGS DURING CONSTRUCTION

Just recently the four lane arterial near our office was widened to six lanes. This 2-mile section of road has 10 traffic signals that operate as a coordinated system. In order to effectuate the widening it was necessary to move the travel lanes on the arterial from one side of the road to the other as construction progressed and to adjust the span wire signal heads accordingly. Watching this project unfold brought to mind some ideas concerning traffic signal operations during roadway construction.

It takes quite a bit of forethought, planning, and competent design work to develop a set of staged roadway construction plans. Unfortunately, it is often the case that not much forethought, planning, or design goes into the various traffic signal timing, phasing and detection changes that will be required to keep traffic flowing in a optimal manner during construction. Here are some issues that should be address as part of any competent traffic operations plan associated with construction staging:

1. **Modification of Change Intervals** - As the arterial is widened, the distance that side street traffic must traverse is increased and there often becomes a need for a longer all-red interval (see Figure 1). This need for a longer side street all-red time is increased by the fact that the condition of the pavement often deteriorates during construction. In fact, part of the side street approach might be reduced to the subgrade or base during construction, which slows considerably the vehicular travel. If a longer all-red interval is not provided then the probability of a right angle collision between a slow-moving side street vehicle and a fast-moving main street vehicle is increased.

   A longer all-red change interval may also be needed for main street left turn movements. This is especially important during the stage of construction where main street traffic is moved to the outside of the travel way while work is performed in the median area (see Figure 2). During this construction stage, left turns from the main street must travel quite a distance to reach the cross street.

2. **Modification of Pedestrian Intervals** - As the arterial is widened, the distance that pedestrians must traverse is also increased and there often becomes a need for a longer flashing DON'T WALK interval (see Figure 3). In addition, certain crosswalks might be temporarily closed during construction and the associated pedestrian heads will need to be bagged.

3. **Modification of Passage Intervals** - You may need to increase minor movement passage intervals to compensate for poor pavement surfaces and narrow lanes that sometimes occur during construction. Poor pavement surfaces and narrow lanes can produce increased headways and, if passage intervals are not modified accordingly, you could experience problems with queues of vehicles prematurely gapping-out.

4. **Preservation of Detection** - It doesn't take long before the activities of a road construction project start tearing-up the inductance loops (or their lead-in cables) and detection is lost. Unless, of course, the corridor has some form of overhead detection. Loss of detection forces all of the phases to time fully (either to their maximum, if running free, or to their force-off, if in coordination). But maximum intervals and force-offs are usually set relative high to accommodate peaks in traffic flow, consequently, having each phase time to its full extent results in a considerable amount of wasted green time. Since this wasted green time occurs for the minor movements, it is the arterial thru movement that suffers the most from the lost detection. Combine this negative effect with the fact that the construction activities themselves tend to disrupt arterial traffic flow, and the combined negative effect on arterial traffic operations can be quite substantial.

   The best way to deal with this problem is to include provisions in the contract which require the contractor to maintain detection during construction. This can be done either through some form of overhead detection (video, infra-red, presence microwave, etc.) or by promptly replacing the damaged inductance loops (or damaged lead-in cables). The provision of temporary detection needs to be considered during the design of the work zone traffic control plans for the project so that a detection scheme (or set of schemes) is developed that works with each construction phase. And if you want to avoid an ongoing battle with the contractor, then I would highly recommend that you also devise some method to pay the contractor for this extra detection, or some monetary penalty if he or she does not maintain detection. Even the most altruistic of contractors will be very lethargic in replacing damaged detection if there is no monetary consequence.

   If maintaining detection turns out to be an impossible battle, then you will at least want to modify the maximum and force-off settings downward so that the wasted green time is kept to a reasonable level. I cannot tell you how many construction zones I have driven through where absolutely no thought was given to this. The amount of wasted green time that results is usually quite incredible, especially during off-peak periods.

5. **Modification of Main Street Left Turn Phasing** - If the main street had permissive or protected/permissive left turn phasing prior to construction, protected-only phasing may be needed during construction. As was shown in Figure 2, the turning path for vehicles making a main street left turn can become quite long during certain stages of construction. When this occurs, it may become difficult or dangerous to accommodate permissive left turns. Although one does not want to over-use restrictive protected-only left turn phasing, this is one instance where it may become necessary.

6. **Modify Coordinated Timings** - Many factors which effect coordinated timing plans change significantly during major road construction: arterial speeds decrease (either because of lower construction zone speed limits or "side friction" associated with construction activities), the number of intersection lanes changes (due to temporary lane closures), saturation flow rates are reduced (due to narrow lanes and poor pavement condition), and signal phasing may even change. It is naive to think that a set of coordinated timing plans developed for typical conditions will suffice under construction-related conditions. New timing plans will probably need to be developed. The development and field implementation

of such plans will be especially beneficial if the arterial is a busy one and if the construction period is anticipated to last for a few years.

All too often there is little thought given to the need for timing changes during construction. Many agencies simply cross their fingers and hope that "things won't get too bad out there" while the road is being improved. However, considerable benefit can be achieved by a forward-thinking approach that makes planning for traffic signal modifications as important as planning for lane shifts or utility relocations. This is especially true for major arterial reconstruction projects.

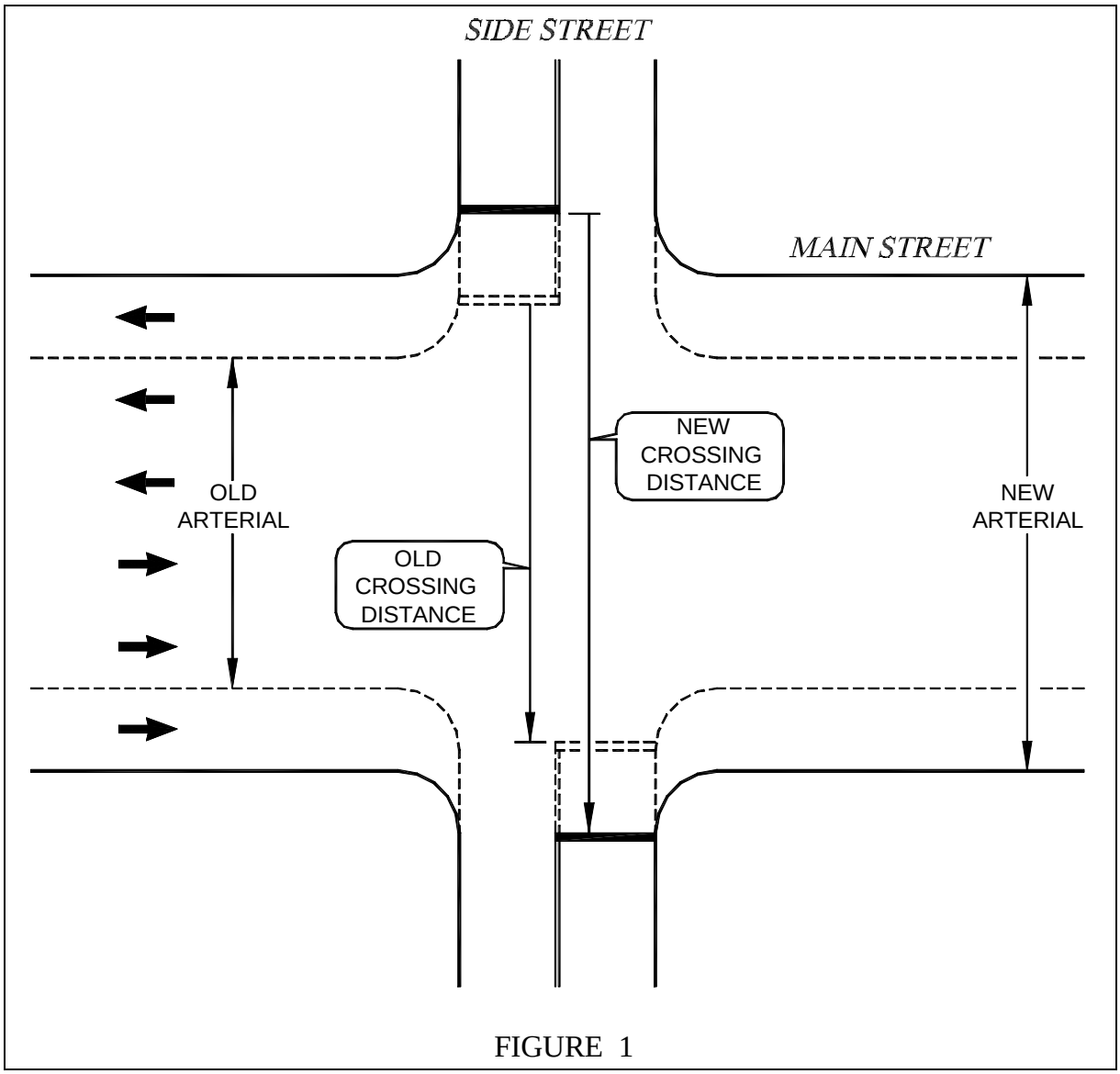
SIDE STREET
MAIN STREET
OLD
ARTERIAL
NEW
CROSSING
DISTANCE
NEW
ARTERIAL
OLD
CROSSING
DISTANCE

FIGURE 1

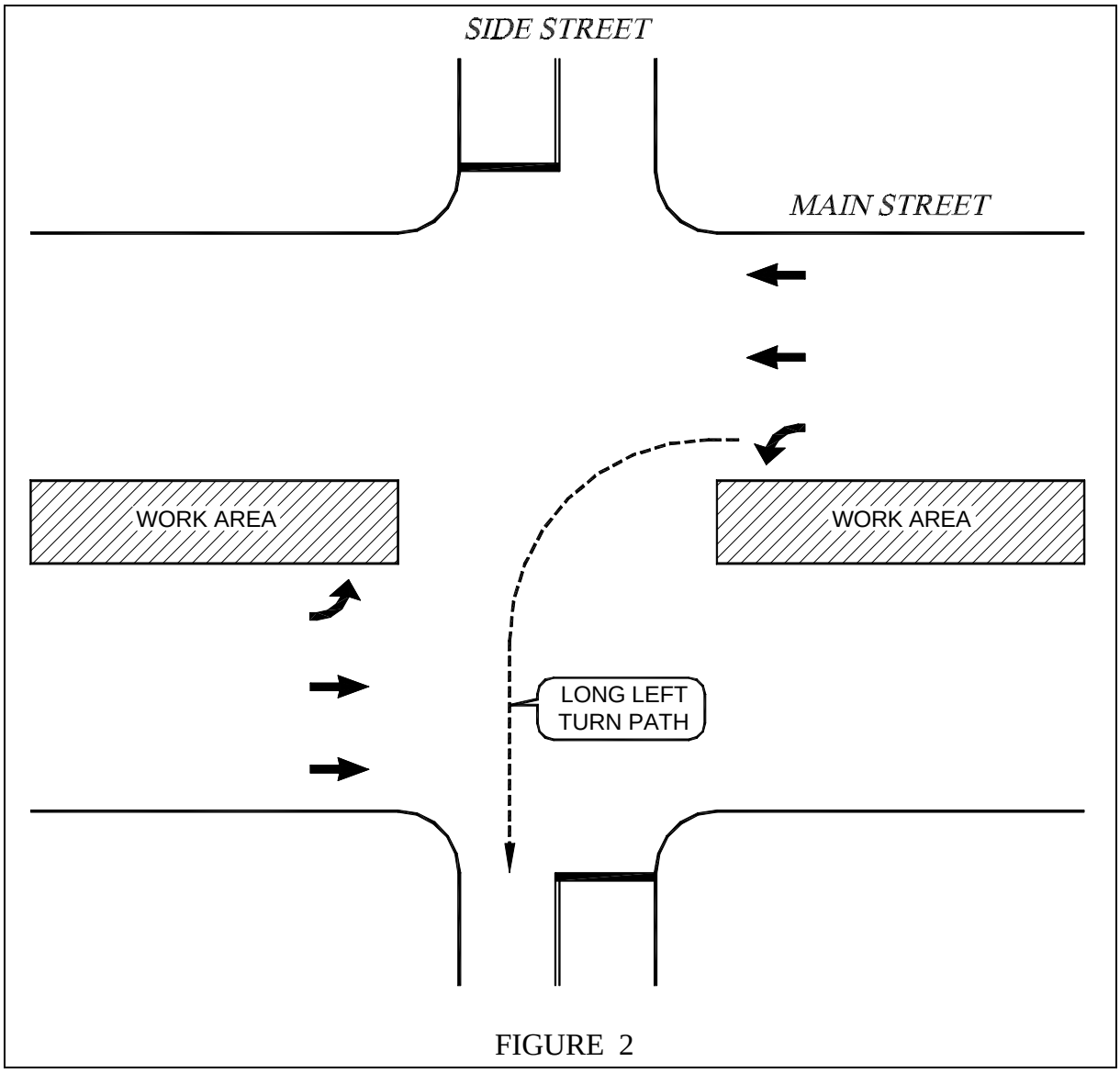
SIDE STREET
MAIN STREET
WORK AREA
WORK AREA
LONG LEFT
TURN PATH

FIGURE 2

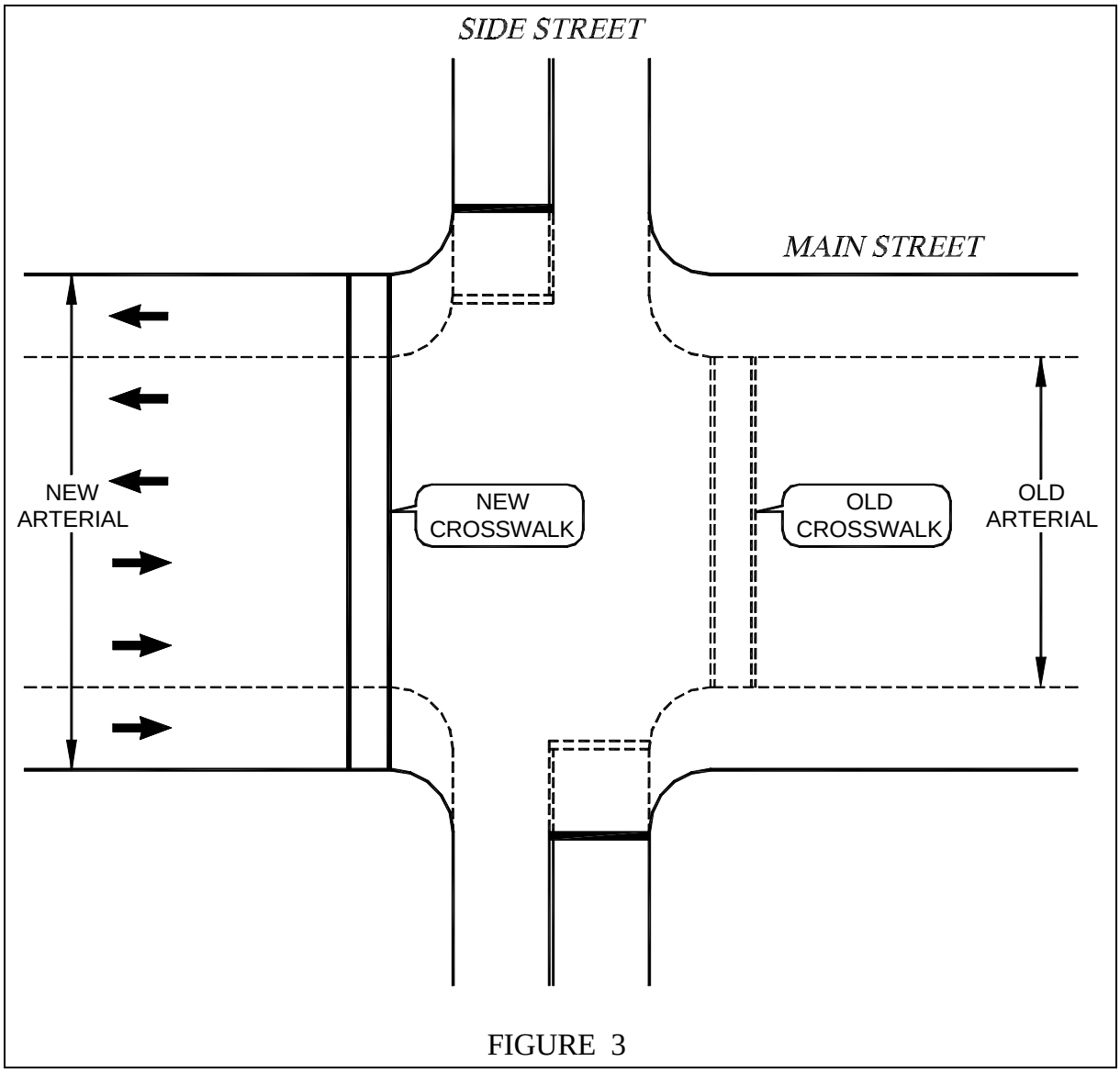
SIDE STREET
MAIN STREET
NEW
ARTERIAL
NEW
CROSSWALK
OLD
CROSSWALK
OLD
ARTERIAL

FIGURE 3