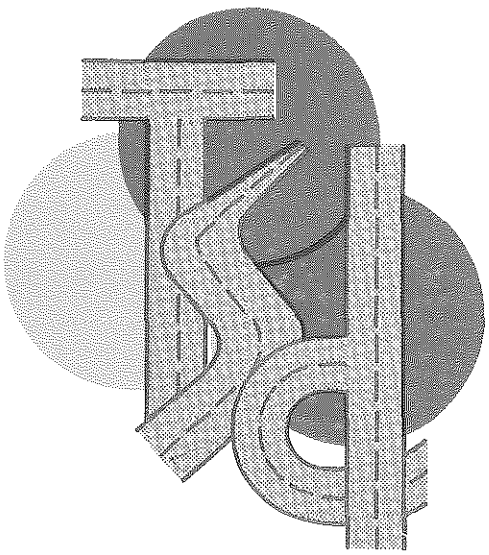
EVALUATION OF AN OPERATIONAL CHANGE AT 17 LOCATIONS

Addition of an All Red Clearance Interval to the Traffic Signal Timing Sequence

TSD-G-208-72



TRAFFIC and SAFETY DIVISION

DEPARTMENT OF STATE HIGHWAYS
STATE OF MICHIGAN

65-9232

MICHIGAN DEPARTMENT OF STATE HIGHWAYS

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by

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and

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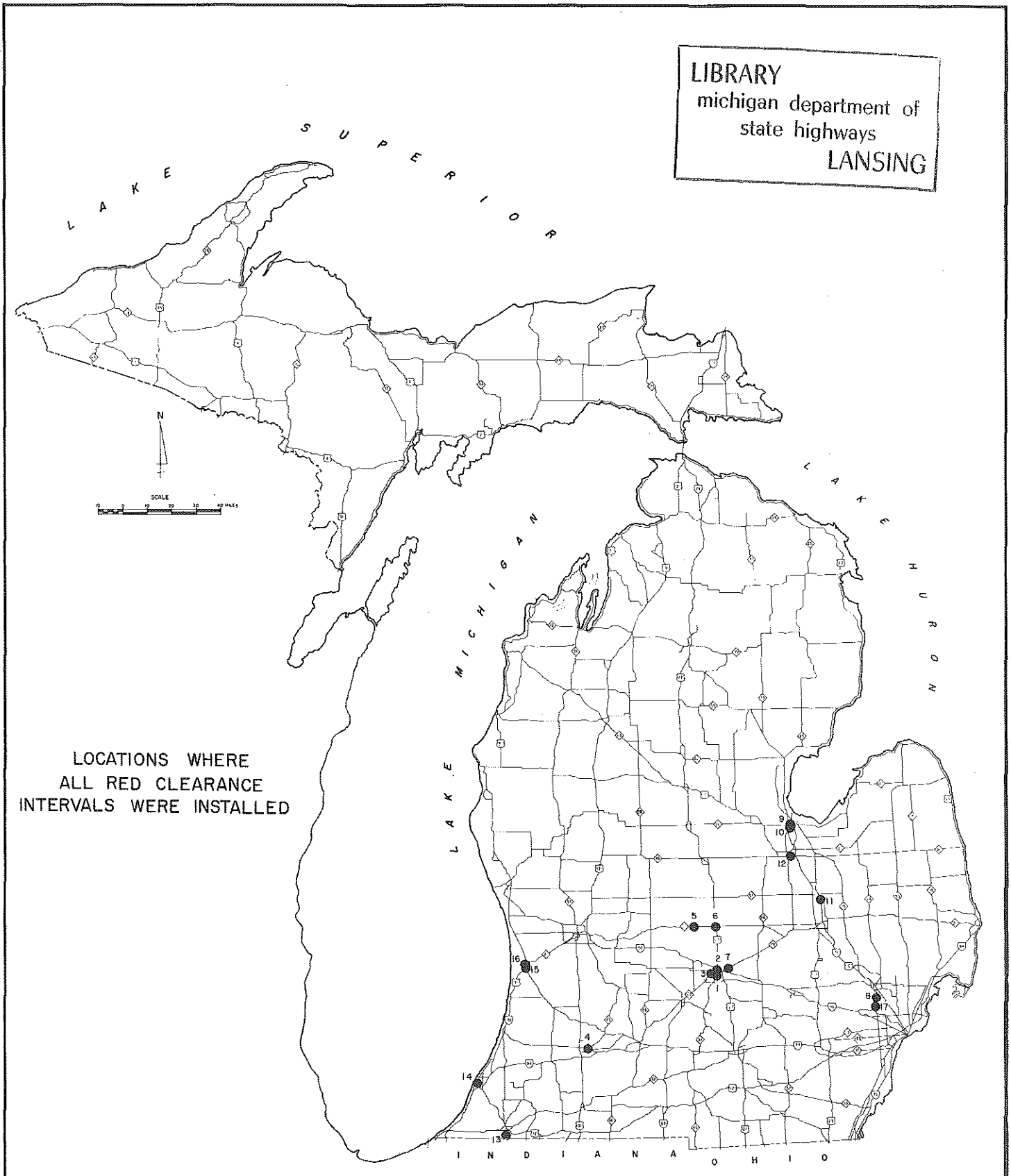


LOCATIONS WHERE
ALL RED CLEARANCE
INTERVALS WERE INSTALLED

Synopsis

This report was prepared in order to evaluate the addition of a timing sequence change made at seventeen signalized intersections. The change in traffic signal timing involved the addition of a brief all-red interval (less than 2 seconds), requiring a pause for traffic from all directions.

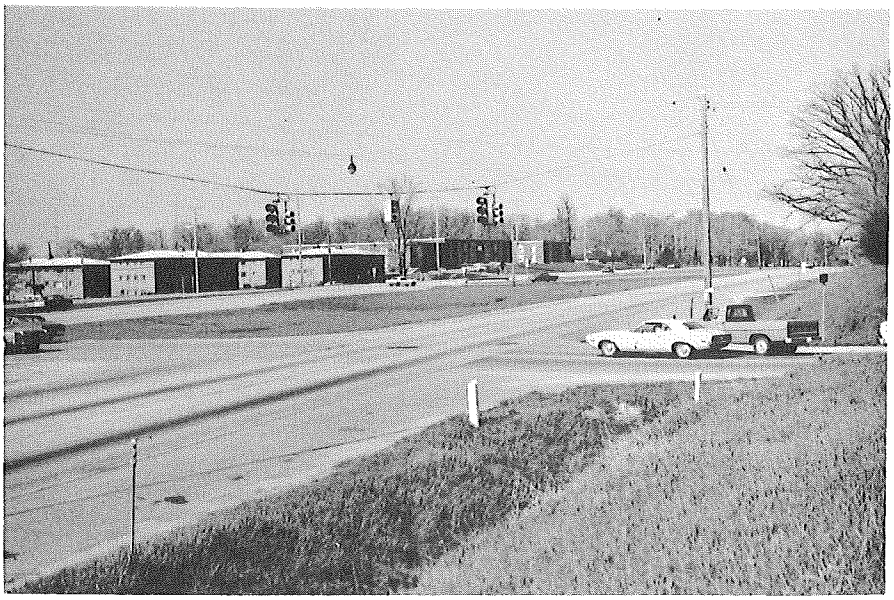
A comparison of accident experience for a twelve-month period before and after this operational change reveals that total accidents were reduced, with the primary benefit attributable to a decrease in right angle type collisions. Perhaps more importantly, it was found that overall casualties were even more significantly reduced.

The accident reductions were found to be statistically significant. The total cost of the timing change was less than $2,000 and the calculated benefit during the one-year period after the improvement was $219,400.

Background

Between 1965 and 1971 a number of locations were selected for a signal timing change, involving the addition of a brief all-red interval. Intersections selected for the signal timing change were generally locations where the speed of approaching traffic was high or where visibility was poor. Evidence of a right angle accident pattern prompted the majority of the changes.

In the absence of any other apparent contributing cause for this accident pattern, all red clearance intervals of two seconds or less in duration were installed. The intention was to provide an increased margin of safety between the opposing traffic movements in addition to that normally afforded by the yellow interval.



Typical rural high speed, divided roadway with narrow median. All red phase provides extra margin of safety between "near-side" and "far-side" signals.

Note truck passing through intersection on "red" while opposing movement is momentarily held back.

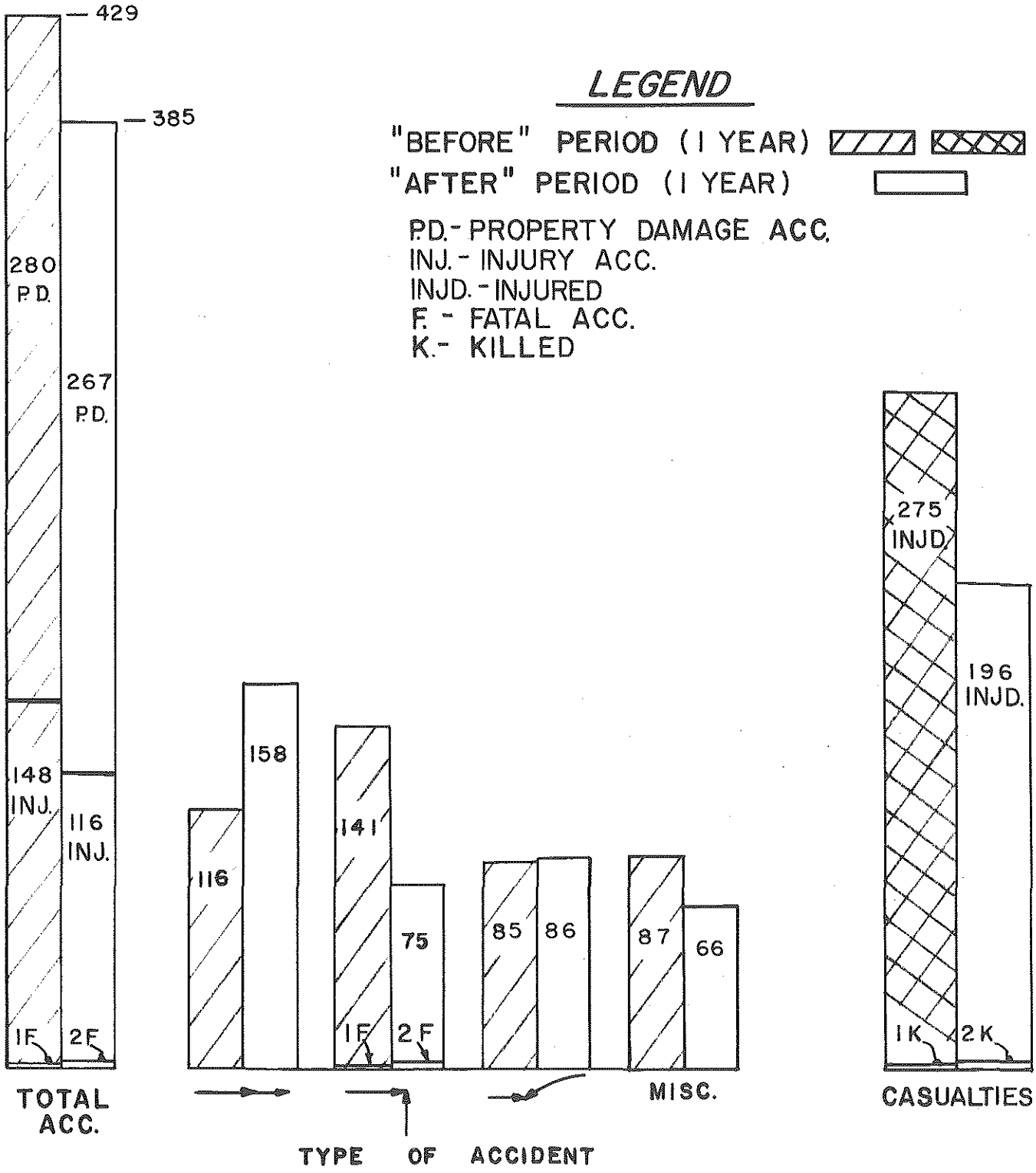
Conclusion

This study reviewed "before" and "after" accident experience at seventeen intersections with special attention given to both patterns and severity. A statistical analysis was then performed to confirm the significance of the findings. It was found that total accidents were reduced 10 per cent, from 429 to 385. More significantly, it was found that overall casualties were reduced 28 per cent, from 276 to 198.

As expected, reductions in right-angle type accidents contributed the primary benefit, decreasing from 141 to 75, a 46 per cent reduction. Rear-end type accidents did, in fact, increase in the "after" period going from 116 to 158, but this increase was not enough to counter the overall improvement trend. These improvements were accomplished at a nominal expense totaling less than $2,000 for all locations.

This study, while limited in scope to only seventeen intersections, proved to be statistically significant and supports continued and perhaps expanded selective use of the "all red" phase.

EVALUATION OF ALL RED CLEARANCE INTERVALS AT 17 LOCATIONS



TRUNKLINE ADT "BEFORE" - 388,900
TRUNKLINE ADT "AFTER" - 406,300

	Location	City/County	Date Installed
1.	BL-96 (Cedar) @ Jolly Rd.	Lansing	5-19-70
2.	US-27 (Larch) @ Saginaw	Lansing	6-7-65
3.	US-27 (Cedar) @ Saginaw	Lansing	6-9-65
4.	BL-94 @ Vande Giessen Rd.	Kalamazoo	11-23-70
5.	M-21 @ Main (Co. Rd. 543)	Fowler	11-6-68
6.	US-27 @ M-21	St. Johns	10-17-67
7.	M-78 @ Hagadorn	Ingham Co.	6-9-67
8.	US-24 @ West Long Lake Rd.	Oakland Co.	8-11-70
9.	M-13 (Euclid) @ Jenny St.	Bay City	10-27-67
10.	M-13 (Euclid) @ Thomas	Bay City	10-27-67
11.	M-54 (Saginaw) @ Mt. Morris Rd.	Genesee Co.	2-8-66
12.	M-46 (Sheridan) @ Holland	Saginaw	6-1-70
13.	US-31, US-33 @ Bertrand Rd.	Berrien Co.	8-8-67
14.	BL-94 (Main) @ BL-94 (Post)	St. Joseph	10-19-67
15.	US-31 @ 16th St.	Holland	2-5-68
16.	US-31 @ 8th St.	Holland	2-5-68
17.	US-24 @ 14 Mile Road	Oakland Co.	12-4-68

STATISTICAL ANALYSIS OF THE ALL RED CLEARANCE INTERVALS

PROJECT AT 17 TRUNKLINE LOCATIONS

I. Objective

The primary objective of this analysis is to determine if the ALL RED CLEARANCE INTERVALS project is effective in reducing accidents at 17 trunkline locations.

II. Traffic and Accident Data Used

The traffic and accident data used are as shown in Figure 1.

III. Testing Hypothesis

H_o (null hypothesis): The probability of accident occurrences at 17 trunkline locations for the "AFTER" period is higher than or equal to the probability of accident occurrences in the "BEFORE" period (i.e. the safety project is ineffective in reducing accidents).

H_A (Alternative hypothesis): The probability of accident occurrences at 17 trunkline locations for the "AFTER" period is less than the probability of accident occurrences in the "BEFORE" period (i.e. the safety project is effective in reducing accidents).

Using Normal approximation to Binomial distribution,* we make our decisions based on the following Z statistic:

$$Z = \frac{\hat{p}_b - \hat{p}_a}{\sqrt{\frac{\hat{p}_b\,(1 - \hat{p}_b)}{N_b} + \frac{\hat{p}_a\,(1 - \hat{p}_a)}{N_a}}}$$

*See Paul G. Hoel, Introduction to Mathematical Statistics, (Wiley) New York, 1971.

where $\hat{p}_b = \frac{T_b}{N_b}$, $\hat{p}_a = \frac{T_a}{N_a}$

T_b = Total accidents before the safety project

N_b = Total traffic volumes before the safety project

T_a = Total accidents after the safety project

N_a = Total traffic volumes after the safety project

Decision Rules:

Use $\alpha = 0.01$ (level of significance)

Rule 1: Reject H_o if $Z > 2.33$
Rule 2: Accept H_o if $Z \leq 2.33$

From Figure 1, we find

$$\hat{p}_b = \frac{T_b}{N_b} = \frac{429}{141,948,500} = 3.02 \times 10^{-6}$$

$$\hat{p}_a = \frac{T_a}{N_a} = \frac{385}{148,299,500} = 2.60 \times 10^{-6}$$

The Z statistic is

$$Z = \frac{3.02 \times 10^{-6} - 2.60 \times 10^{-6}}{\sqrt{\frac{3.02 \times 10^{-6}\ (1-0.00000302)}{141,948,500} + \frac{2.60 \times 10^{-6}\ (1-0.00000260)}{148,299,500}}}$$

$$= 10.82$$

We reject H_o since $Z = 10.82 > 2.33$. Hence, we conclude that the ALL RED CLEARANCE INTERVALS project did significantly reduce accidents at 17 trunkline locations.