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FINAL REPORT

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SMALL CAR EXPOSURE DATA PROJECT: PHASE I METHODOLOGY

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October 1985

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16. Abstract

The Small Car Exposure Data Project represents the first phase of an effort to build a data base of exposure variables for crash-avoidance studies. Among these are: (1) vehicle make, model, year, body style, wheel base, weight, and horsepower; (2) driver sex and age; (3) vehicle headway, speed and turning maneuver; (4) permanent site characteristics; and (5) temporary site characteristics. Phase I data collection took place from March 15 to November 21, 1984 in 12 towns in the western suburbs of Boston. This report is concerned with data collection methodology and recommendations for its improvement in Phase II.

The most significant methodological change in this study from previous roadside exposure data collection efforts was the introduction of portable computers. With appropriate software, these lap computers permitted a single observer to record estimates of vehicle type, driver sex and age decile, and turning maneuver. The computer also automatically triggered a camera to photograph the license plate and recorded speed from a radar gun.

In the data editing process, license plates from the film were appended to each record. From these plate numbers, the Registry of Motor Vehicles supplied the corresponding vehicle identification numbers. These were run through the VINDICATOR program to generate a file of output records with all of the vehicle characteristics above.

Traffic counts and Police Accident Report data were also collected for the same area and time period as the exposure data. All of these data are being analyzed and intepreted in a report prepared by Mid-America Research Institute.

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Among the project field staff hired by Calspan, the following individuals were the major contributors to its success: Michael McFadden supervised all field work from May, 1984 to the conclusion, bringing about a dramatic improvement in productivity through his efforts. Mary and David Alexander collected more than half of all the data and developed many ideas to simplify procedures and speed training for future data collection. Kevin Sutherland proved unusually adept in all phases of field work and almost single-handedly edited both exposure and accident report files.

The author is also grateful to the Massachusetts Turnpike Authority, Massachusetts State Police (Troop E), and the police departments of all of the towns in the survey area for their cooperation in carrying out this project.

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1.0 EXECUTIVE SUMMARY

Analysis of motor vehicle accident data shows significant differences in involvement rates for different categories of vehicles expressed in relation to the numbers of such vehicles in use. These findings have often been challenged on the grounds that the different size classes (or other categorizations) of vehicles may have substantially different patterns of use and distributions of driver age and sex. Because these exposure variables are known to influence accident rates profoundly, crash-avoidance studies have long been hampered by the lack of a sufficiently large and comprehensive data base of exposure factors.

The Small Car Exposure Data Project represents the first phase of what evolved into a multi-year, multiple-site program designed to build a data base containing as many of the variables useful in crash-avoidance studies as can be obtained by remote observations.

Among these are:

1. vehicle make, model, year, body style, wheel base, weight, and horsepower;
2. driver sex and age;
3. vehicle headway, speed and turning maneuver;
4. permanent characteristics of the observation site (geography and road design); and
5. temporary characteristics of the site (weather, lighting, traffic density, speed distribution, etc.).

Phase I data collection took place from March 15 to November 21, 1984, in 12 towns in the western suburbs of Boston. Calspan Field Services Inc. (CFSI) provided liaison with local police, office space, vehicles, and (through Superior Design, a subcontractor supplying temporary workers) field staff. The experimental design, scheduling, analysis and interpretation were performed by personnel of the Center for Environment and Man (CEM), now transferred to Mid-America Research Institute (MARI). The Transportation Systems Center (TSC) designed and procured hardware, trained personnel, supervised operations, and processed data. A report describing the experimental design and results from the data analysis is being prepared by MARI. This report is concerned with data collection methodology and recommendations for its improvement in Phase II.

The most significant methodological change in this study from previous roadside exposure data collection efforts was substitution of portable computers for pencil and paper or audio recorders. With appropriate software, these lap computers permitted a single observer to record estimates of vehicle type, driver sex and age decile, and turning maneuver with only three keystrokes. These keystrokes automatically added the exact time (down to the second) to each record and triggered a camera to photograph the license plate. The exact time was imprinted in each photograph so that they could be readily matched with the corresponding records in the subsequent data editing process. A fourth keystroke (optional) added a reading from a radar speed gun to the record. With this equipment, a skilled observer could record exposure data on every vehicle, even when they were spaced as little as two seconds apart. When platoons of vehicles passed by on very close headways, some were counted only as "missed vehicles," which preserved the accuracy of headway and density data, but dropped the other data. By this technique, the productivity of an observer was greatly increased over that of one using pencil and paper and sampling only every fourth vehicle, as had been done previously.

In the data editing process, license plates from the film were appended to each record. From these plate numbers, the Registry of Motor Vehicles (RMV) supplied the corresponding vehicle identification numbers (VIN's). These were run through the VINDICATOR program at the National Institutes of Health (NIH) Computer Facility generating a file of output records with all of the items listed in Line 1 above.

While driver and vehicle characteristics data were being gathered on vehicles in one approach to an intersection, a second observer, also using a lap computer linked to a radar gun, counted the vehicles entering from each of the other approaches and recorded the speed distribution of those on the directly opposite appraoch. Data files containing all of the permanent characteristics of each intersection (geography and road design data) were also created.

About four successful observation sessions were conducted at each of nearly 200 sites. More than 20,000 passenger cars were photographed, of which 15,821 had readable Massachusetts plates. 13,721 of these were matched by the RMV. The VINDICATOR program generated vehicle characteristics data for 12,661 of them.

Because the road carrying the largest volume of traffic in the survey area is the Massachusetts Turnpike and because automatic equipment set up was neither possible nor efficient at the toll booths, manual observations were conducted there. 6,872 Massachusetts plate numbers were collected, from which 5,203 complete vehicle characteristic records were obtained.

Analysis of exposure variables also requires extensive traffic density information and accident data. Both of these were gathered and encoded by project staff. The former came from hourly traffic counters placed for intervals of about one week at 70 of the sites. Each site was counted two or three times. The accident data were entered into machine-readable form from 2,805 Police Accident Reports, representing a 100 percent sample of the accidents investigated by police in the 12 towns in which at least one of the vehicles was a Massachusetts-registered passenger car.

During the eight-month pilot study, dozens of hardware, software, and personnel problems were encountered. The most important deficiency in the hardware was its inability to cope with poorly lighted intersections. Experiments with auxilliary lighting and automatic camera triggers are now being conducted to remedy this situation for Phase II. New software to schedule site visits, control the data editing process, and evaluate employee performance is also being prepared. Numerous recommendations for employee selection and training were also developed.

2.0 INTRODUCTION

This report describes activities undertaken or supervised by TSC personnel in support of the "Small Car Exposure Data Study." The original objective of this study was to determine whether accident risk is greater for small cars than for larger ones. To make such comparisons, one must relate crash data to suitable exposure measures and control for non-vehicle factors, such as driver age and sex, traffic density, environmental variables, etc. As the study evolved, it became clear that the methodology and data being developed could be applied to many other questions besides the relative accident risk of small cars. Hence, the work described here is regarded as only the pilot stage (Phase I) of a multi-year effort intended to generate exposure data for a variety of crash-avoidance studies from multiple sampling locations across the country.

2.1 ORGANIZATION

This project was initiated by the Mathematical Analysis Division of the National Center for Statistics and Analysis. That office awarded contracts to Calspan Field Services (CFSI) and to the Center for Environment and Man (CEM), whose personnel were subsequently transferred to Mid-America Research Institute (MARI). The Transportation Systems Center (TSC) joined in the effort under the terms of Project Plan Agreement HS-470 (Highway Accident Statistics Analysis).

The roles of the organizations may be summarized as follows:

1. MARI - designed the experiment, specified types of data to be collected, scheduled observations, analyzed and interpreted the results.

2. CFSI - provided office space, vehicles, and (through Superior Design, a temporary workers specialist) field staff. CFSI personnel also established working relationships with police departments in the study area.

3. TSC - developed data collection procedures and data entry software, specified, designed, and procured necessary hardware, maintained equipment, trained personnel, processed data, and supervised field operations.

Figure 2.1-1 shows the overall organizational structure.

2.2 OBJECTIVES

Overall study objectives are described in detail in the report being prepared by MARI (Ref. 1). The present report is concerned with data collection and processing methodologies, and field experiences only. Its purpose is to record what was done in Phase I for the benefit of persons participating in Phase II studies and for traffic safety researchers elsewhere who may wish to employ similar techniques.

The bulk of the effort in this project was directed toward collecting a sample of observations of the exposure variables which are known to affect the risk of accident involvement significantly. These include:

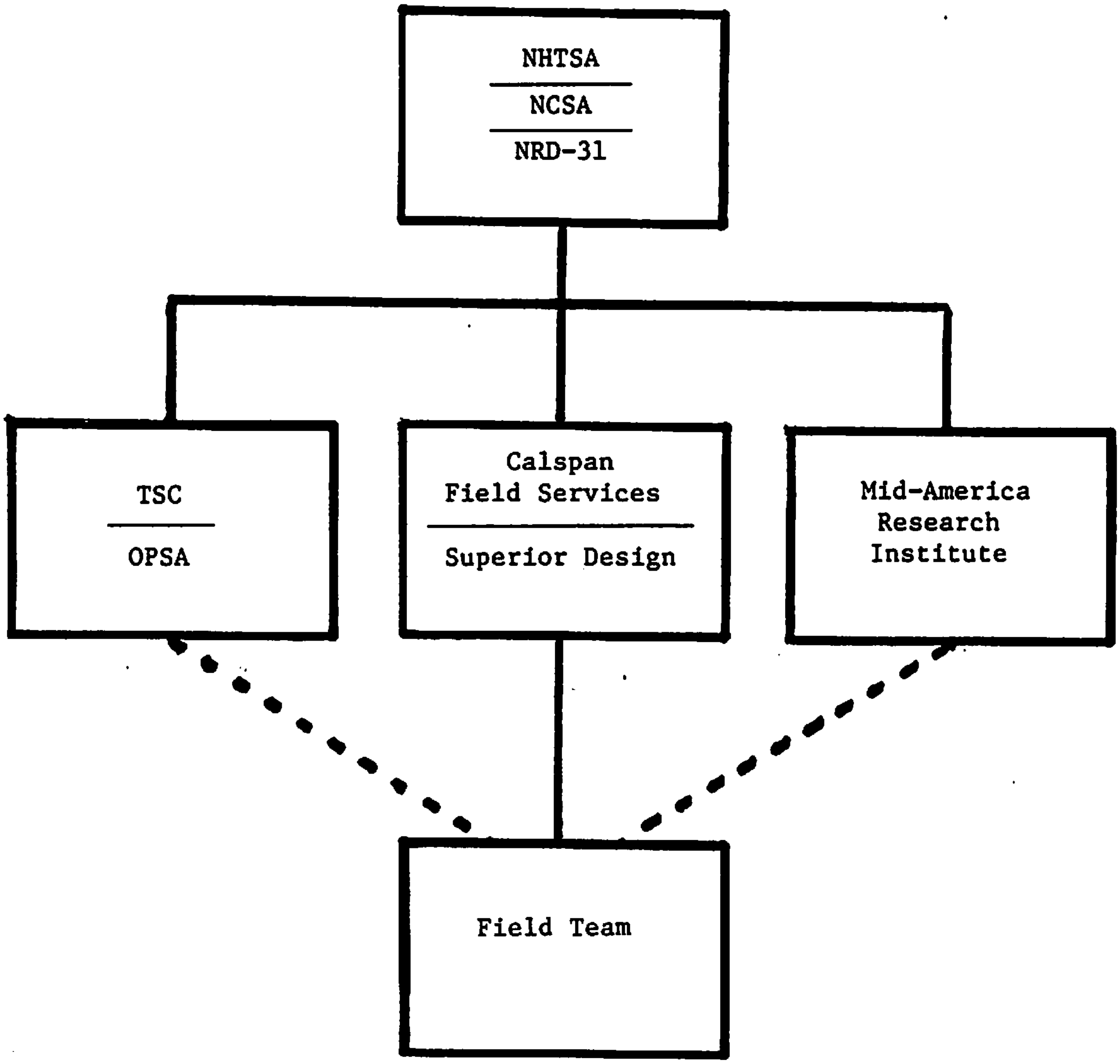
1. specific vehicle (make, model, type, year, weight, wheelbase, horsepower, etc.)
2. driver age and sex
3. speed, headway, and maneuver
4. time of day, day of week
5. traffic volume density
6. weather, road conditions, lighting, etc.
7. type of road, number of lanes, number of accesses, alignment, etc.

These data were to be collected at such times and places as to satisfy the requirements of the experimental design developed by MARI and described in their report.

Ultimately, a very large exposure data base will be required for the analysis of many crash-avoidance issues. For the pilot study, however, a goal was set by MARI of 20,000 observations of specific passenger cars matched with all of the types of information listed above. In order that a much larger data base eventually be created, it is clearly necessary that the cost per observation be reduced as much as possible. Accordingly, the design of a methodology with the lowest marginal cost became a major secondary goal.

For analytical purposes, MARI also required vehicle-specific accident data. It was found to be convenient and relatively inexpensive to have this information gathered and

FIGURE 2.1-1: ORGANIZATION CHART



processed, in the form of Police Accident Reports, by the same personnel who were also collecting exposure data.

2.3 APPROACH

Most of the types of information listed above have been gathered in previous exposure studies. Some of these have been based upon trip diaries kept by a sample of drivers who agreed to participate in the study. Because of the possible bias caused by willingness to participate and selective recall of trip details and lack of information about other traffic, other methods have been sought. The dominant method has been to simply post observers (usually two or three) by the roadsides with clip boards to note drivers' ages and sexes and record vehicle descriptions and/or license numbers. From license numbers, vehicle identification numbers (VIN's) can be supplied by motor vehicle registries and from VIN's make, model, weight, etc. can be decoded through a look-up program like VINDICATOR or VINA. State and local highway departments have been the principal sponsors of such studies. However, for their own purposes it was unnecessary to gather all of the data items required for vehicle-specific crash-avoidance studies. Hence, none of the extant data bases are sufficient.

The pencil and paper appraoch can be augmented with radar guns (for speed data) and photography (to make sure license numbers of fast-moving cars are accurately recorded). This technique was employed in a pre-pilot study conducted in upstate New York in 1982-1983 under the supervision of MARI personnel (Ref. 2). However, the cost per observation of manual techniques has remained so high as to severely limit the amount of data that has been collected.

For this study, the first approach to cost minimization that was considered entailed the use of video cameras and recorders to capture both license numbers and drivers' faces by a single camera operator. In an experimental session with rented commercial-grade video gear, it was found that this technique was workable only in good light and only at traffic speeds below 30 mph. Because of these limitations it was judged unsuitable for the range of conditions that a properly balanced statistical sample requires. Although advanced video technologies are thought to have been developed for military applications which would be workable, their cost is presumed to be prohibitive and no further effort was devoted to that approach.

Since no cost-effective substitutes for direct observation of driver age and sex and film photography of license plates could be found, methodology development has concentrated upon raising productivity as high as possible. By far, the most important innovation in this project was the replacement of pencil and paper with a small portable computers. With appropriate software, these computers allowed their human operators to record vehicle type, driver sex and age decile, and manuever with only three keystrokes.

These strokes simultaneously invoked automatic processes to record the exact time of vehicle passage and to accuate the camera. An optional fourth keystroke generated a fresh speed reading from a radar gun. A skilled observer could record every vehicle, even when headways were as short as two seconds. Thus, the number of observations per unit of time could be much higher than with manual methods in which only about one vehicle out of five could be recorded. Productivity was further enhanced by the elimination of additional clerical labor for data entry. The details of this approach are described in Chapter 3 and in Appendix 1. A second observer, also equipped with a computer and a radar gun recorded data concerning other traffic passing through the intersection.

The other data gathering tasks required for this study included: (1) exposure data from a toll road (Chapter 4); (2) traffic counting (Chapter 5); and (3) collection and processing of Police Accident Reports (Chapter 6).

In the course of carrying out these tasks, scores of problems were encountered and solved. These are grouped and described as follows:

software (Chapter 7),
hardware (Chapter 8),
personnel (Chapter 9),
training (Chapter 10), and
miscellaneous management problems (Chapter 11)

3.0 PRINCIPAL DATA COLLECTION PROCEDURES

This chapter describes the principal data collection and editing procedures--the activities which were the chief objectives of this pilot study and which accounted for more than 80 percent of the time and monies spent.

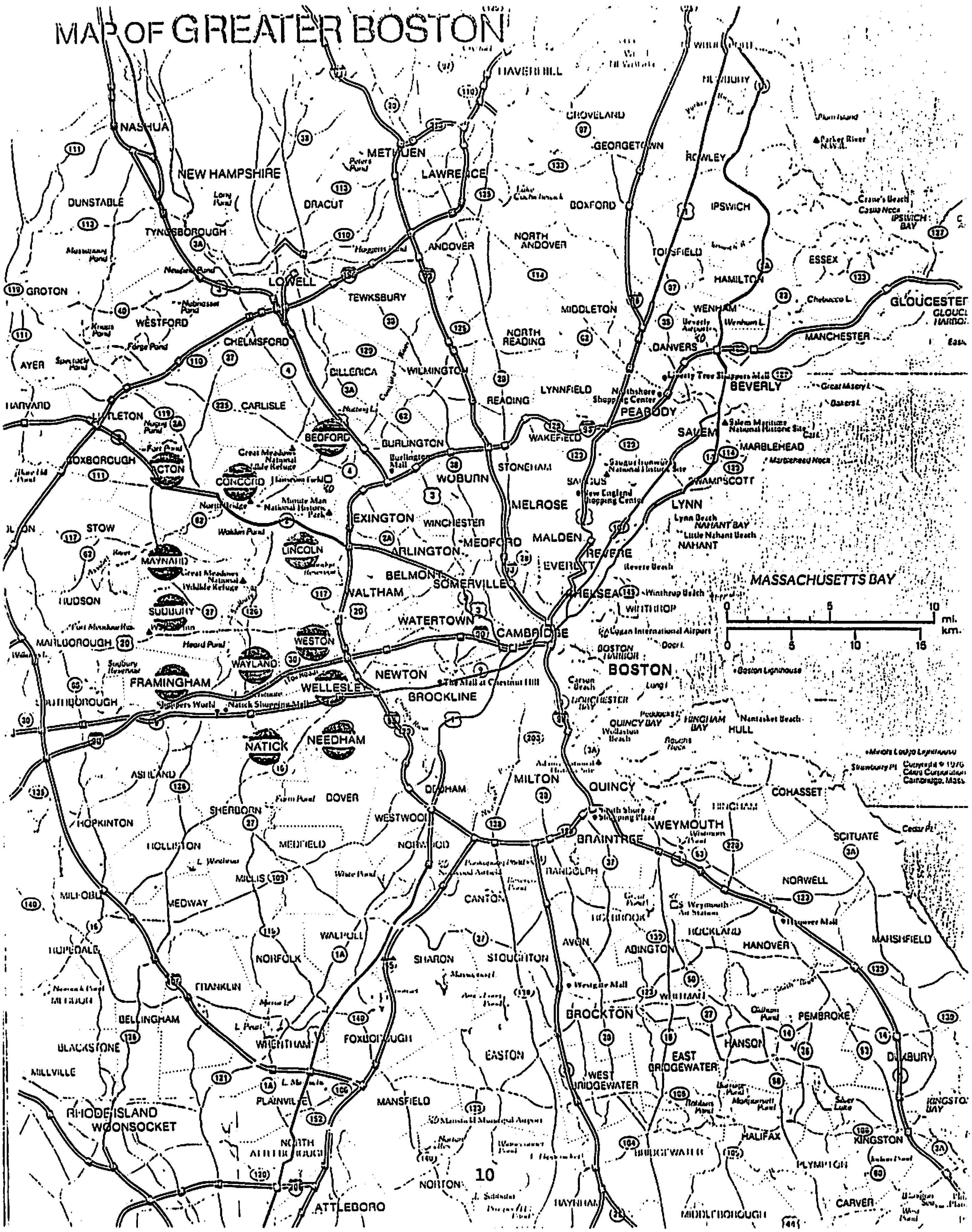
As described in the preceeding chapter, these activities were directed toward the development of an exposure data base suitable for multi-variant analysis of every factor involved in accident causation which can be quickly recorded without interfering with traffic flow.

Data collection was conducted in 12 towns among the western suburbs of Boston spreading over an area of about 225 square miles. Those towns were chosen primarily because their police departments generally prepare accident reports for every accident brought to their attention. This avoids the errors often present in "operator reports" commonly filed in more urbanized areas. Figure 3.0-1 shows a map of the study area. One hundred ninety-two sites were selected in the survey area according to criteria developed by MARI and described in Reference 3.

Exposure data were gathered in several different categories. These included:

1. Permanent site characteristics - geographic and road design measures.
2. Temporary site characterics - weather, lighting, road surface conditions, numbers of parked cars, etc.
3. Individual vehicle observations on passenger cars - sex, age decile, speed, turning maneuver, headway and license plate number. From the latter item vehicle identification number (VIN) could be obtained through the state Registry of Motor Vehicles. A computer program called VINDICATOR allows VIN's to be decoded into make, model, year, series, body style, wheelbase, weight, and horsepower.
4. Other traffic - Non-passenger car vehicles travelling in the same direction as the passenger cars being observed were also included in the data files so that headways could be established. All vehicles entering the intersection being observed were counted and speed distributions were gathered for those entering from the approach directly opposite to that where the individual observations were made.

FIGURE 3.0-1: MAP OF STUDY AREA



5. Upstream speed distribution - At certain intersections controlled by stop signs or signal lights, a sample of speed data in both directions was collected a few blocks upstream from the designated site.

3.1 FIELD PROCEDURES

Data collection was conducted by two-person teams using the following equipment:

2 Radio Shack Model 100 lap computers
2 police radar speed guns (modified)
1 Minolta X-700 SLR camera fitted with motor drive, data back, and 200mm telephoto lens or 70-210mm zoom lens
1 or 2 Plymouth Voyager Van(s)

A large assortment of photographic accessory items, spares, power packs, cables, and interfaces was also required to conduct the basic operation. Many tools, safety items, carrying cases, etc. were also necessary. A total value of these items was about $500. An inventory of back up computer and photo equipment amounting to about $1,500 was also required to protect against equipment failure. Step-by-step instructions for data collection and complete equipment lists are contained in Appendix 1, which is excerpted from the script of the video training tape prepared to support Phase II of this project. All of these items were carried to the sites in a mini-van. At only one of the 192 sites was it necessary to unload the equipment and set up tripods. All the rest of the sites allowed observations to be conducted from inside the van.

Upon arrival at a site, the observers generally parked off the road on a dirt shoulder. Where necessary, they parked on sidewalks or medians, in no parking zones, etc. The primary objectives in parking were to avoid interference with traffic flow and to avoid being rear-ended. Because of the excellent cooperation of the local police in the survey area, no parking tickets were received. Figure 3.1-1 shows a typical site location.

The MAIN approach data (MAIN, referring to the data containing the individual vehicle observations as well as the temporary site characteristics and the upstream speed data in the MAIN direction, if required) was collected by the van driver. To do this, the MAIN observer placed one radar gun on its case in the back seat of the van facing rearward. This was connected to the computer through its bar-code-reader port. The camera was mounted on a special clamp and connected to the computer through a custom-built interface through the RS-232 port. It was aimed and focused on a point about 50 feet ahead of the van.

Upon initiation of the program (called MAIN.BA and listed in Appendix 2), the computer prompted the data collector to enter the site and visit numbers, and to answer various questions regarding weather, light, number of lanes in use, etc. (see Appendices 1 and 2 for greater detail). Date and day of week were recorded automatically. Next, site number, date, observer number were recorded on the film using the built-in functions of the Minolta data back.

With the preliminaries completed, this MAIN observer began his principal task. As a vehicle approached, he first polled the radar gun by pressing the "Enter" key. As the vehicle passed, he observed the sex and age of its driver. As it reached the zone where the camera was focussed, he pressed one of the computer function keys according to the following:

F1 - passenger car, male driver
F2 - passenger car, female driver
F3 - passenger car, driver sex unknown
F4 - light truck
F5 - other vehicle
F6 - missed vehicle

Pressing F1, F2, or F3 triggered the camera to photograph the license plate; F1 and F2 also prompted for age (a single key stroke of a digit from 1 to 9 representing teens, 20s, 30s, . . .). This was followed by a prompt for maneuver:

1 = straight
2 = stop, then straight
3 = right
4 = stop, then right
5 = left
6 = stop, then left
7 = U turn or other
8 = stop, then U turn or other

Keys F4 and F6 required no further action while F5 promted for type of other vehicle where:

3 = heavy single unit truck
4 = combination truck
5 = bus
6 = other (bicycle, motor cycle, etc.)

When groups of vehicles passed on close headways, separate speed readings for each were eliminated since processing a radar reading required about two seconds. Instead, the speed reading from the lead vehicle was assigned to every vehicle in the platoon. With this technique, a skilled observer could record every vehicle even when headways were under two seconds.

Figure 3.1-2 shows a MAIN operator at work. Figure 3.1-3 is a sample of the output from the MAIN program prior to editing. Each record contains the site and visit number, the exact time, vehicle type code, sex code, age, maneuver code, and speed. Times are used both to calculate headways and to match the photographs (which had the exact time imprinted by the data back) with their corresponding records in the computer.

Because the experimental design did not require large samples at each site, observations were completed when one roll of film per lane had been shot or 45 minutes elapsed, which ever occurred first.

While the driver conducted the MAIN observations, the other data collector gathered the other traffic (OTRAF) data. For these, a second radar gun was placed on the dashboard facing forward and connected to the OTRAF computer. After responding to prompts regarding site number, number of lanes, number of approaches to the intersection, etc. the OTRAF operator started his data collection at the same time as the MAIN operator. The OTRAF program is listed in Appendix 3.

Approaches to the intersections being observed were numbered clockwise beginning with the one immediately to the left of the MAIN approach. As vehicles entered the intersection from various approaches, they were counted by touching the corresponding function keys on the OTRAF computer. For vehicles entering from directly opposite

FIGURE 3.1-1: TYPICAL SITE

FIGURE 3.1-2: "MAIN" DATA COLLECTOR AT WORK

FIGURE 3.1-3: EXAMPLE OF "MAIN" DATA FILE BEFORE EDITING

```
*SITE/VISIT NUMBER=0583
*MAIN APPROACH, TEMPORARY HEADER
*DAY/DATE=Fri                07/06/84
*SURFACE CONDITION= 1
*ROAD CONDITION= 1
*LIGHT CONDITION= 1
*WEATHER CONDITION= 1
*PARKED CARS= 0
*LANES IN USE= 1
*LANE 1 RESTRICTIONS= 0
*LANE 2 RESTRICTIONS= 0
*LANE 3 RESTRICTIONS= 0
*LANE 4 RESTRICTIONS= 0

*LANE NUMBER= 1
*MAX EXPECTED MAIN SPEED= 50
*OBSERVER NUMBER= 16
*STARTING TIME=07:38:56
        0583 07:40:25 1 1 3 1 35
??????  0583 07:40:31
        0583 07:40:40 1 2 2 1 43
        0583 07:40:57 3
        0583 07:41:00 3
        0583 07:41:43 1 2 3 5 37
        0583 07:42:09 1 2 4 1 40
        0583 07:42:12 1 1 4 1 40
        0583 07:42:23 1     1 39
        0583 07:42:25 1 1 4 1 39
        0583 07:42:30 1 1 5 1 39
        0583 07:42:45 1 2 5 1 38
        0583 07:43:37 1 1 4 1 38
        0583 07:44:35 1 2 3 1 38
        0583 07:44:41 3
        0583 07:44:44 1 1 4 1 38
        0583 07:45:52 1 1 2 1 40
        0583 07:45:59 1 2 3 1 46
        0583 07:46:01 1 1 2 1 46
        0583 07:46:13 1 1 4 1 40
        0583 07:46:22 1 1 3 1 38
        0583 07:46:24 1 1 4 1 38
        0583 07:46:27 1 1 4 1 38
        0583 07:47:29 1 2 2 1 42
        0583 07:47:43 1 2 5 1 44
*OBSERVATIONS COMPLETE AT 07:48:26
```

the MAIN approach, radar speed readings were also recorded These observations were concluded when the MAIN program was stopped. Figure 3.1-4 shows an OTRAF operator while Figure 3.1-5 contains a sample of output data.

For some night observations, the OTRAF observer drove a separate vehicle, linked to the other van by CB radio. The two vehicles were parked as shown in Figure 3.1-6. Both vans kept their engines running and their headlights on. As vehicles passed through the OTRAF observer's headlights on the main approach, estimates of driver sex and age were radioed to the MAIN observer, who photographed their license plates as they passed through the beam of his own headlights and recorded the other information in the same manner as during daylight operations. Figure 3.1-7 shows night operations using this procedure.

At the conclusion of each site visit, the data collectors noted any problems encountered on the log sheet, an example of which appears in Figure 3.1-8.

3.2 SCHEDULING

Initial scheduling of site visits was done by MARI personnel according to the dictates of their sample design (see Reference 3). Figure 3.2-1 shows an example of the schedule for one week provided by MARI.

Each day was divided into five kinds of time periods:

1.	Morning Rush Hour	7:00 a.m. - 9:00 a.m.
2.	Late Morning	9:00 a.m. - 11:00 a.m.
3.	Mid-Day	11:00 a.m. - 3:00 p.m.
4.	Afternoon Rush Hour	3:00 p.m. - 6:00 p.m.
5.	Evening	6:00 p.m. - 10:00 p.m.

In alternate weeks, all visits were scheduled either before 2 pm or after 2 pm. Fridays, Saturdays, and Sundays were always data-collection days. Because traffic patterns are quite similar on the remaining days of the week, only two of them were sampled in any given week. Thus, the data collectors had two days off each week, randomly distributed in the Monday through Thursday period and not necessarily consecutive. This schedule

FIGURE 3.1-4: "OTRAF" DATA COLLECTOR AT WORK

FIGURE 3.1-5: EXAMPLE OF "OTRAF" OUTPUT FILE

```
*SITE/VISIT NUMBER= 0583
*OPPOSITE APPROACHES, TEMPORARY HEADER, SPEED PROGRAM
*LANES IN USE= 1
*OBSERVER NUMBER= 1
*START TIME= 07:37:12
*SPEEDS BY LANE:
*LANE1  LANE2  LANE3  LANE4
* 29
* 36
* 35
* 41
* 35
* 33
* 34
*  0
* 41
* 38
* 39
* 36
* 30
* 32
* 29
* 22
* 43
* 39
* 38
* 36
* 39
*  0
* 37
* 46
* 45
* 39
* 38
* 29
* 28
* 44
* 49
* 39
* 50
*OBSERVATIONS COMPLETED AT:07:45:06
*TOTAL VEHICLES:
* 38

*SITE/VISIT NUMBER=0583
*OTHER APPROACHS,TEMPORARY HEADER, COUNTING PROGRAM
*DAY/DATE=Fri              07/06/84
*APPROACHS IN USE= 2
*OBSERVER NUMBER= 1
*STARTING TIME=07:37:14
*OBSERVATIONS COMPLETED AT:07:49:40
*TOTAL VEHICLES BY APPROACH:
*APPROACH1  APPROACH2  APPROACH3  APPROACH4
*   88          2          0          0
```

FIGURE 3.1-6: PARKING DIAGRAM FOR NIGHT OPERATIONS

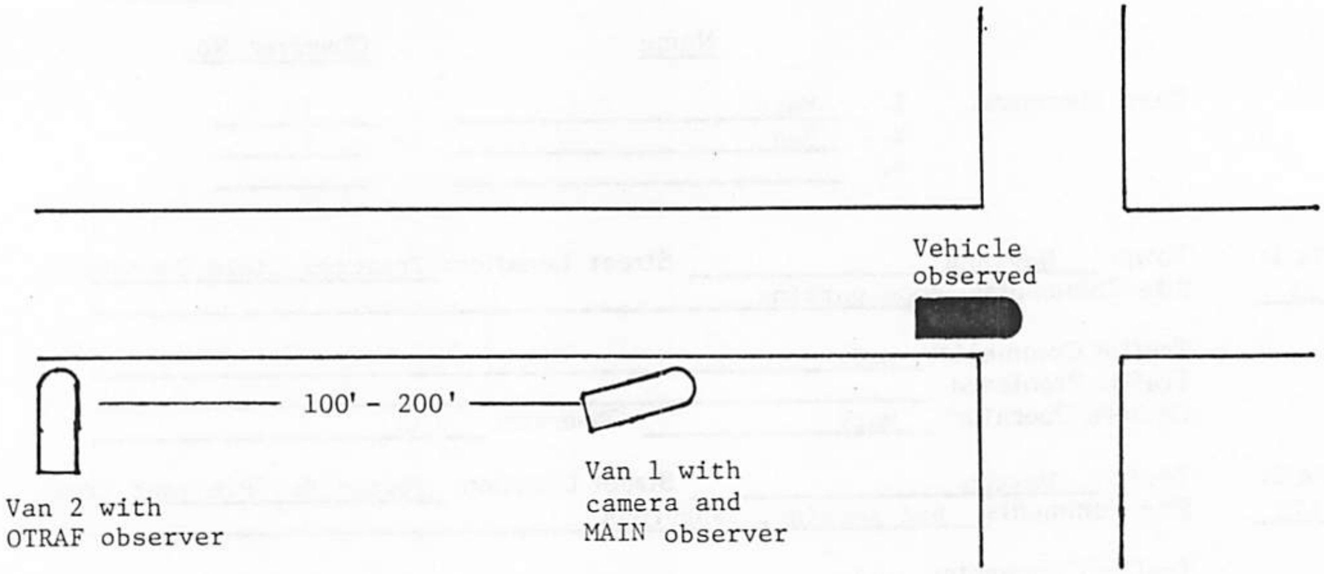


FIGURE 3.1-7: NIGHT OPERATIONS BEING CONDUCTED FROM THE PARKING LOT OF A CLOSED FAST-FOOD ESTABLISHMENT

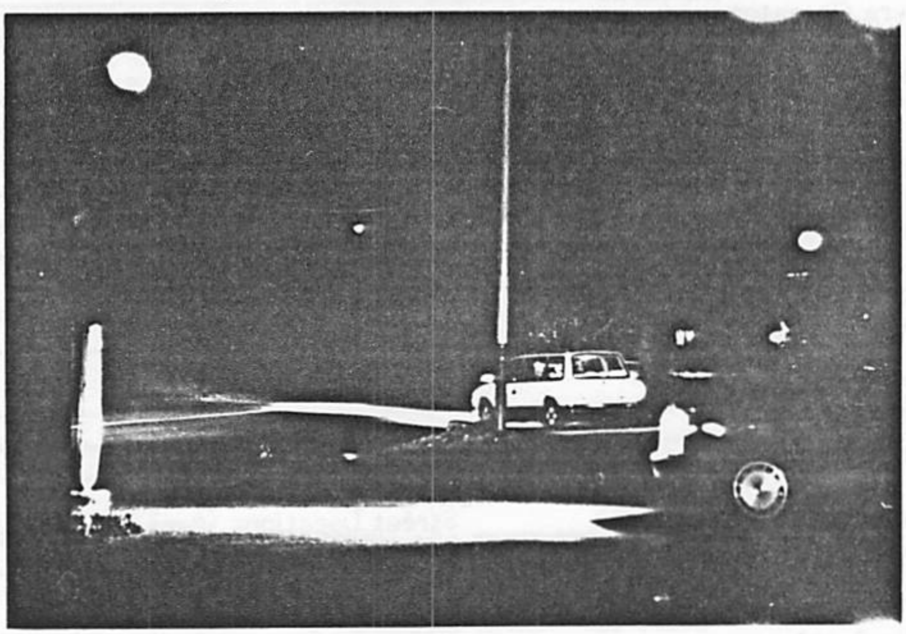


FIGURE 3.1-8: EXAMPLE OF LOG SHEET

LOG

Date: 7/6/84

		Name	Observer No.
Team Members:	1.	Mary	16
	2.	Dan	1
	3.		

Site 1: # 58
Town: Wayland Street Location: Training field/Concord
Site Comments: good parking

Traffic Comments: med.
Traffic Problems:
Camera Operator: Mary Observer: Dan

Site 2: # 173
Town: Weston Street Location: Newton St./Pleasant Trail
Site Comments: bad parking, dangerous

Traffic Comments: med.
Traffic Problems: none
Camera Operator: Mary Observer: Dan

Site 3: # 175
Town: Natick Street Location: N. Main St./West Lake Road
Site Comments: did not arrive before 9:00 a.m.

Traffic Comments: C A N C E L L E D
Traffic Problems:
Camera Operator: Observer:

Site 4: # 96
Town: Natick Street Location: Oak St./Eirie Dr.
Site Comments:

Traffic Comments:
Traffic Problems:
Camera Operator: Dan Observer: Mary

Site 5: # 109
Town: Natick Street Location: Worcester Rd./Overbrook Ter.
Site Comments:

Traffic Comments:
Traffic Problems:
Camera Operator: Dan Observer: Mary

Site 6: # 159
Town: Needham Street Location: Central Ave, E./Webster Rd.
Site Comments:

Traffic Comments:
Traffic Problems:
Camera Operator: Dan Observer: Mary

Equipment or vehicle problems: No problems with oppspd today. However, upstream note is on wrong computer case. Turns program crashed twice at first site. Put us behind schedule so third site was scrapped.

was entirely acceptable to project personnel, although a large fraction of persons who inquired about employment declined once they learned of the odd working hours.

While the scheduling could be prepared according to a set of simple rules, adherence to it was another matter entirely. Personnel absences, mechanical breakdowns, operator errors, communications problems, bad weather, etc. resulted in a substantial number of failures to collect data at the time and place intended. Especially during the first season when personnel turnover was very high, so many site visits were missed that it was impossible to schedule enough make-up visits to compensate.

Scheduling of make-ups was done by the field supervisor on a largely ad hoc basis. Because most of the causes of missed data collection tended to manifest themselves at the beginning of the work shift, a disproportionate number of missed visits were in early time slots. These could never be properly rescheduled during an eight-hour shift of make-up visits.

3.3 DATA EDITING

At the conclusion of observations at each site, the data file was recorded on a cassette tape. This tape and all of the film shot during a given work shift were placed in an appropriately labeled file jacket back at the office for subsequent editing.

Once each week, all of the exposed film rolls were pulled from the jackets, sorted as to film type and processing required, and taken to a photo lab. The (uncut) negatives were collected the following week and resorted back to their original file jackets according to the date imprinted in the first frame of each roll.

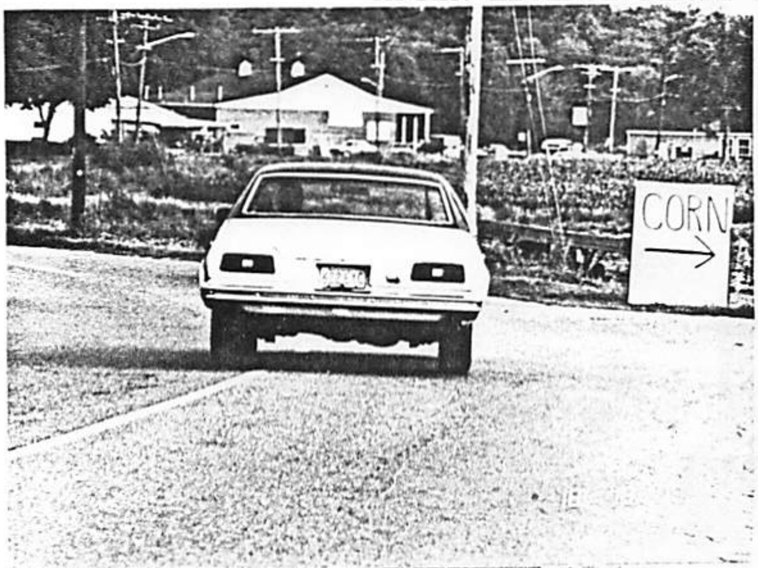
In the data editing process, the files from the cassette tape were reloaded into RAM of one of the lap computers set up in the office with a dual disk drive and video monitor (Figure 3.3-1). One by one, they were then moved into the computer's text editor. Each file was read by the human editor, checked for obvious errors, and corrected as necessary. The corresponding film strip was loaded into a projector and license numbers appended to the record of each passenger car photographed. Figure 3.3-2 shows an example of three lines of the data file with the corresponding photos. (For clarity and reproductibility in this report, these photos were enlarged and printed,

FIGURE 3.2-1: EXAMPLE OF SCHEDULE

	Week	9 season2						
	date		8/3	4	5	6	7	
	day	Th	Fr	Sa	Su	Mo	Tue	We
7-(9)			c 28	C 63	C 100	c 25	C 86	
			C 15	a 90	c 130	a 179	a 161	
					a 177	C 11		
(9)-11			C 21	a 142	C 155	a 45	C 169	
			a 3	C 129	A 108	C 79	c 43	
							c 30	
-15			a 4	A 108	a 151	C 163	C 117	
			C 8					
15-18								
18-22								

FIGURE 3.3-1: DATA EDITING EQUIPMENT SETUP

FIGURE 3.3-2: PHOTOS OF THREE CARS TAKEN DURING THE THIRD VISIT TO SITE #076 WITH CORRESPONDING RECORDS AFTER LICENSE PLATE ENTRY.



622EYC 0763 18:18:02 1 1 2 1 34

396GIB 0763 18:18:05 1 1 3 1 23

YBROWN 0763 18:18:52 1 1 2 1 34

but in normal practice, only negatives were used). Figure 3.3-3 shows the same file which appeared in Figure 3.1-3 after completion of editing.

After editing, the files were saved on diskettes with all of the data collected in one shift combined in a single file. Hard copy of all files was printed for subsequent use by the supervisor in evaluating the performance of each employee.

The data editor also kept a log book summarizing the quantity of data collected at each site. Figure 3.3-4 shows one page from the log. The log information was required both in determining the need for make-up visits to specific sites and to evaluate the performance of individual observers.

3.4 DATA PROCESSING

After all data had been collected and edited, the files were first transferred from Radio Shack diskettes to IBM PC diskettes. Minor additional editing was performed during the transfer using the "Telecommuter" software package. 15,821 Massachusetts passenger car plate numbers were contained in the files.

From the PC, files were uploaded to TSC's DEC-10 mainframe through a 1200 baud modem. A FORTRAN program called "STRFIL.FOR" was written to strip out license numbers and reformat them according to the specifications of the Massachusetts Registry of Motor Vehicles (RMV). A copy of these specifications is contained in Appendix 4. "STRFIL.FOR" appears in Appendix 5.

Although the program STRFIL.FOR always produced properly formatted records, several attempts were required to produce a complete inquiry request tape which the Registry's programs would process. Most of the problems had to do with the layout of the header and trailer records. After the fifth unsuccessful try, the Registry supplied an example of correct header and trailer records, which eliminated further difficulties in these areas (see Figure 3.4-1). The tapes would still not run, however.

Eventually, after consultation with several Registry staff members, it was suggested that three dummy records (all zeros) be added to the file to make the total number of records an integer multiple of four. This suggestion solved the problem, although it is not documented in any of the Registry's literature.

FIGURE 3.3-3: EXAMPLE OF "MAIN" DATA FILE AFTER EDITING

```
*SITE/VISIT NUMBER=0583
*MAIN APPROACH, TEMPORARY HEADER
*DAY/DATE=Fri              07/06/84
*SURFACE CONDITION= 1
*ROAD CONDITION= 1
*LIGHT CONDITION= 1
*WEATHER CONDITION= 1
*PARKED CARS= 0
*LANES IN USE= 1
*LANE 1 RESTRICTIONS= 0
*LANE 2 RESTRICTIONS= 0
*LANE 3 RESTRICTIONS= 0
*LANE 4 RESTRICTIONS= 0

*LANE NUMBER= 1
*MAX EXPECTED MAIN SPEED= 50
*OBSERVER NUMBER= 16
*STARTING TIME=07:38:56
850140  0583 07:40:25 1 1 3 1 35
??????  0583 07:40:31
563329  0583 07:40:40 1 2 2 1 43
        0583 07:40:57 3
        0583 07:41:00 3
491105  0583 07:41:43 1 2 3 5 37
144BJH  0583 07:42:09 1 2 4 1 40
@       0583 07:42:12 1 1 4 1 40
351FOJ  0583 07:42:23 1     1 39
730JKG  0583 07:42:25 1 1 4 1 39
749KOH  0583 07:42:30 1 1 5 1 39
470NDL  0583 07:42:45 1 2 5 1 38
143DTV  0583 07:43:37 1 1 4 1 38
206135  0583 07:44:35 1 2 3 1 38
        0583 07:44:41 3
151432  0583 07:44:44 1 1 4 1 38
786AYX  0583 07:45:52 1 1 2 1 40
@       0583 07:45:59 1 2 3 1 46
228HZV  0583 07:46:01 1 1 2 1 46
597GZA  0583 07:46:13 1 1 4 1 40
271BMS  0583 07:46:22 1 1 3 1 38
425DBO  0583 07:46:24 1 1 4 1 38
550471  0583 07:46:27 1 1 4 1 38
738044  0583 07:47:29 1 2 2 1 42
X 668   0583 07:47:43 1 2 5 1 44
*OBSERVATIONS COMPLETE AT 07:48:26
```

NOTE:RECORDS WITH "??????" IN LICENSE PLATE FIELD ARE "MISSED VEHICLES."
"@" DENOTES PASSENGER CAR WITH OUT-OF-STATE PLATE.

FIGURE 3.3-4: EXAMPLE FROM DATA EDITOR'S LOG #058

Site Number: 058

Town: WAYLAND

Location: TRAINING-HILL ROAD W/CONCORD ROAD

Density Stratum: LOW

Problems with Site:

Visit Number:	1	2	3	4	5	6	7	8	TOTAL
Date:	5/4	3/24 (6/2)	7/6	8/12	9/30	11/10			
Total Photos at intersection	11	54	19	28	—	—			
Useable Records in "T" file:	5	20	19	5	—	—			
Explanation Code*:	1	3	0	5	10	11			
UPSTRM required? Y or N	N	N	N	N	—	N			
UPSTRM photos taken									
" good records	N	/	/	/		/			
" explanation code									
Speed data collected?	Y	Y	Y	Y		Y			
- main Y or N	N	N	Y	Y		Y			
- opposite Y or N	Y	Y	Y	Y		Y			
OTHAPP data collected? Y or N	Y	Y	Y	Y	-	Y			
TURNS or FASTER OB #		15	16	1		16			N/A
OPPSPD OB #		16	1	16		15			N/A
OTHAPP OB #		17	1	15		15			N/A
CAM OB #	5	15	16	1		16			N/A

*Explanation Codes:
- 0 = OK (20 or more good records)
- 1 = low volume, but otherwise OK
- 2 = poor photography, day time, fair weather
- 3 = poor photography, day time, foul weather
- 4 = poor photography, night time, fair weather
- 5 = poor photography, night time, foul weather
- 6 = poor photography, camera failure
- 7 = poor photography, bad film or processig
- 8 = computer failure
- 9 = computer operator error
- 10 = missed site
- 11 = missing Film

FIGURE 3.4-1: EXAMPLES OF CORRECT HEADER AND TRAILER RECORDS FOR MASSACHUSETTS RMV INQUIRIES

HEADER:

```
VOL1      U S  DOT-TSC
1
HDR1RMV-INQUIRY-INP        00010001000100 85038 85365 000000 MASS PIKE DATA
```

TRAILER:

```
EOF1RMV-INQUIRY-INP        00010001000100 85038 85365 000034 MASS PIKE DATA
```

NOTES:

1. DO NOT USE PERIODS OR SLASH MARKS IN ANY COLUMN.

2. "1" MUST APPEAR IN COLUMN 80 OF THE HEADER RECORD.

3. COLUMN POSITIONS 1-27 MUST BE EXACTLY AS SHOWN ABOVE. 28-41 ARE ARBITRARY. DATES IN 43-47 AND 49-54 ARE ARBITRARY. NUMBER APPEARING IN 55-61 OF THE TRAILER RECORD MUST REPRESENT THE NUMBER OF BLOCKS ON THE INQUIRY INPUT TAPE.

Once these problems were solved, the Registry was able to return an output tape containing a list of license plate numbers matched with the corresponding vehicle identification numbers (VIN's) along with numerous other items of information (see Appendix 4 for a complete listing). 13,724 (87 percent) of the license plate numbers submitted were matched.

Technology Research and Analysis Corporation (TRAAC) Inc. was retained under a Small Purchase Agreement to prepare programs to process the RMV output tape through VINDICATOR and merge these results back into the original field data file. Appendix 6 contains a brief letter report describing their work together with listings of several programs required.

VINDICATOR was able to process successfully 92 percent of the VIN's supplied by the RMV. For each record in which a match was obtained, data describing make, year, series, model, body, weight, wheelbase, and horsepower were appended. Model year data from the Registry file were also processed and used when VINDICATOR was unable to generate this information. Figure 3.4-2 shows an example of field data after the VINDICATOR outputs have been appended. The "R" in the "Flag" column of the 16th record indicates that the model year data is from the Registry rather than from VINDICATOR.

3.5 SITE SURVEYS

Because many of the characteristics of an observation site are relatively unchanging, such data need be collected only once. Thus, the data items listed below were gathered during site surveys which were conducted separately from the regular field observations.

Permanent Header Data:

- o Site number
- o Location (names of intersecting roads)
- o Starting point of approaching link (names of intersecting roads)
- o Direction from which main approach occurs
- o Traffic control
  - none
  - yield sign

FIGURE 3.4-2: EXAMPLE OF "MAIN" DATA FILE AFTER VINDICATOR OUTPUT HAS BEEN ADDED.

```
*SITE/VISIT NUMBER=0583
*MAIN APPROACH, TEMPORARY HEADER
*DAY/DATE=Fri              07/06/84
*SURFACE CONDITION= 1
*ROAD CONDITION= 1
*LIGHT CONDITION= 1
*WEATHER CONDITION= 1
*PARKED CARS= 0
*LANES IN USE= 1
*LANE 1 RESTRICTIONS= 0
*LANE 2 RESTRICTIONS= 0
*LANE 3 RESTRICTIONS= 0
*LANE 4 RESTRICTIONS= 0

*LANE NUMBER= 1
*MAX EXPECTED MAIN SPEED= 50
*OBSERVER NUMBER= 16
*STARTING TIME=07:38:56
850140   0583 07:40:25 1 1 3 1 35 23 81 81  9  0 20  2248  91  75  75   81
??????   0583 07:40:31
563329   0583 07:40:40 1 2 2 1 43  2 84 84 54 43 30  2402 100  84  84   84
         0583 07:40:57 3
         0583 07:41:00 3
491105   0583 07:41:43 1 2 3 5 37  8 78 78  6 10  0  3043  95  67  67   78
144BJH   0583 07:42:09 1 2 4 1 40 16 82 82 20  0 28  1900  98  45  45   82
@        0583 07:42:12 1 1 4 1 40
351FOJ   0583 07:42:23 1     1 39 20 81 81  7  7 30  3032 104 107 107   81
730JKG   0583 07:42:25 1 1 4 1 39 21 82 82  8  0 22  2146 100 100 100   82
749KOH   0583 07:42:30 1 1 5 1 39  8 84 84  9 20 70  1980  95  74  74   84
470NDL   0583 07:42:45 1 2 5 1 38  1 82 82 35 46 70  2095  97  70  70   82
143DTV   0583 07:43:37 1 1 4 1 38 23 79 79  9  0 20  2106  91  72  72   79
206135   0583 07:44:35 1 2 3 1 38 32 81 81 23  0  0  4234 128   0   0   81
         0583 07:44:41 3
151432   0583 07:44:44 1 1 4 1 38 16 76 76 12  0 64  2645  98  96  96 R 76
786AYX   0583 07:45:52 1 1 2 1 40 15 81 81 20  0 62  2195  95  92 100   81
@        0583 07:45:59 1 2 3 1 46
228HZV   0583 07:46:01 1 1 2 1 46  8 82 82 18  0 70     0 100  74  74   82
597GZA   0583 07:46:13 1 1 4 1 40
271BMS   0583 07:46:22 1 1 3 1 38  1 81 81 28 46 50  2051  94  70  70   81
425DBO   0583 07:46:24 1 1 4 1 38 16 78 78 10  0 22  2375  98  95  95 R 78
550471   0583 07:46:27 1 1 4 1 38 26 83 83 17  3 68  2130  97  73  73   83
738044   0583 07:47:29 1 2 2 1 42 26 83 83 19  3 64  2250  97  73  73   83
X 668    0583 07:47:43 1 2 5 1 44
*OBSERVATIONS COMPLETE AT 07:48:26
```

NOTE: AN "R" IN THE SECOND TO LAST COLUMN DENOTES THAT MODEL YEAR DATA COULD NOT BE OBTAINED FROM VINDICATOR AND CAME FROM THE RMV INSTEAD.

- stop sign
- flashing yellow light
- flashing red light
- green/yellow/red light
- green/yellow/red light with turning arrow
- other control

o Number of lanes

  o In direction of approach
    - number of lanes before additional turning lanes
    - number of additional turning lanes

  o In opposite direction
    - number of lanes

o Division
  - undivided
  - painted line(s)
  - curb, raised island, etc.
  - barrier, guardrail, fence
  - one-way street

o Length of approach link (#.# miles)

o Number of curves right

o Number of curves left

o Number of accesses right

o Number of minor intersecting streets

o Right roadside
  - shoulder
  - curb or gutter
  - guardrail, chain, etc., immediately at pavement

o Area character
  - built up (urban)
  - residential, detached
  - business, detached
  - school, park
  - rural (fields, woods)
  - other

o Alignment
  - straight

- curved left
- curved right
- S-curve

o Profile
- level
- uphill
- downhill
- crest
- sag

o Traffic regulation
- speed limit (as posted) - "99" if none posted
- no passing yes/no
- no parking yes/no

o Map of site

About 25 to 30 sites could be surveyed per day including preparation of a rough site map and entry of the above-mentioned items into memory of one of the Radio Shack's using the "SURVEY" program listed in Appendix 7. Two person teams were used, one person driving while the other entered data. These data were saved to diskette at the conclusion of each working day.

Although data entry seems quite straightforward, confusion arose on several points. The six different persons who entered data at various times failed to make consistent interpretations on the following questions:

1. Direction of approach (as specified in original directions from MARI or as changed by field observers for safety considerations).

2. Definition of turning lane (specifically marked v.s. increased pavement width, parking limitations, etc.)

3. Definition of controlled intersection (stop sign on main approach only vs stop sign on any approach).

4. Starting point of approaching link (especially when the nearest upstream intersection with a major road lay outside the defined survey area).

5. Meaning of the term "direction of flow" (from or toward).

Because of this confusion, it was necessary to resurvey more than 40 sites. Figure 3.5-1 shows an example of the permanent data file for one site and Figure 3.5-2 shows the corresponding site map.

3.6 RECOMMENDATIONS

In the course of field operations and data processing, scores of hardware, software and personnel problems arose. These are discussed at length in Chapters 7 through 11. The principal recommendations are summarized below:

Hardware:

1. Vans should be purchased with air conditioning because computers malfunction above 90°F.

2. Outside setups should be avoided because of problems with high or low temperature, rain or road spray, and equipment breakage.

3. Equipment should be powered from the vehicle electrical system rather than rechargeable battery packs.

4. All interconnecting cables should be made as rugged as possible.

5. Vans should be fitted with auxiliary interior lighting for night work.

6. Automatic shutter triggering is required for reliable night photography where traffic speeds exceed 30 miles per hour.

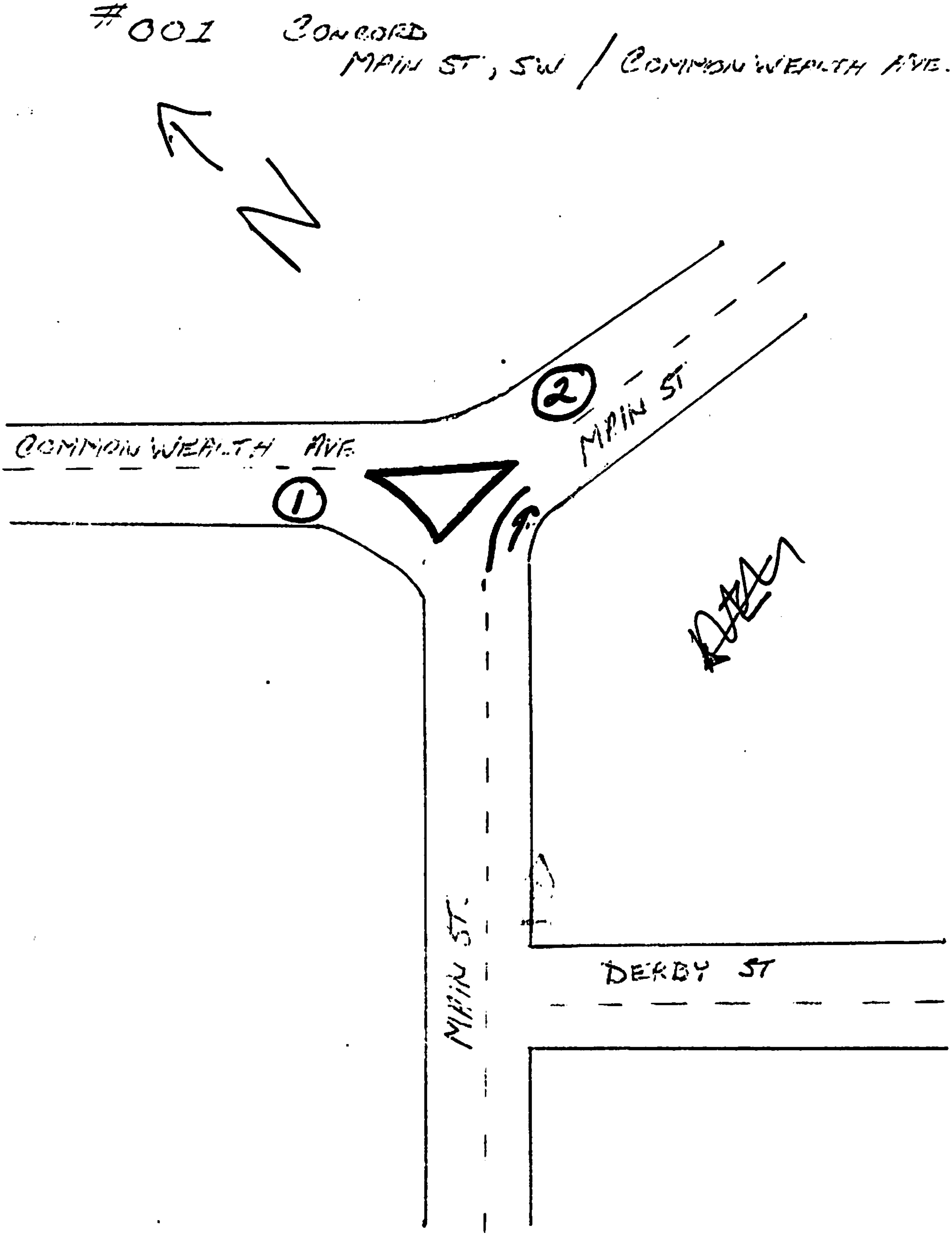
Software:

1. Data collection programs should be stored in read only memory (ROM) rather than ramdom access memory (RAM).

FIGURE 3.5-1: EXAMPLE OF SITE SURVEY DATA FILE

```
*SITE/VISIT NUMBER=001
*MAIN APPROACH,PERMANENT HEADER
*DAY/DATE=Tue              07/03/84
*NAME OF MAJOR INTERSECTION= HARRINGTON RD AT MAIN ST RT.62
*ACCESSES ON RIGHT= 46
*CURVES LEFT= 1
*CURVES RIGHT= 1
*MINOR INTERSECTIONS= 9
*NAME OF INTERSECTION= MAIN ST. (RT.62) /SW/ AT COMMONWEALTH AVE.
*DISTANCE FROM MAJOR INTERSECTION = 1.1  MILES
*TYPE OF TRAFFIC CONTROL= 4
*NUMBER OF LANES BEFORE TURNING LANES= 1
*NUMBER OF ADDITIONAL TURNING LANES = 1
*NUMBER OF LANES IN OPPOSITE DIRECTION = 1
*DIVISION OF ROAD= 1
*TYPE OF ROADSIDE= 2
*TYPE OF AREA= 1
*TYPE OF ALIGNMENT= 1
*PROFILE OF AREA= 3
*SPEED LIMIT= 35
*THERE *IS* PARKING
*THIS *IS NOT* A PASSING ZONE
*TRAFFIC COUNTERS **CAN NOT** BE USED AT THIS SITE
*THE SITE ** HAS BEEN** MARKED
```

FIGURE 3.5-2: EXAMPLE OF A SITE MAP



04

2. Data should be retained in RAM until the end of a shift, then transferred to PC diskettes. Cassette storage should be avoided.

3. A custom-designed data editing program should be used rather than a general-purpose word processing program.

4. Proper scheduling of sites is too complex to be done by hand. A dedicated scheduling program is required.

Personnel:

1. Full-time employees are far more satisfactory than part-timers.

2. Employees must be selected much more carefully with respect to reliability, honesty, and attitude. References should be checked prior to hiring.

Site Selection:

1. Site surveys should be completed prior to the start of regular data collection.

2. Many sites chosen in Phase I presented conditions which made observations difficult or unsafe, or both. In Phase II, such sites should be eliminated. This can usually be accomplished by moving the point of observation a block or so along the same road.

4.0 TOLL ROAD PROCEDURES

Within the geographic area encompassed by this study, the road carrying the highest traffic volume is the Massachusetts Turnpike. Four of its exits lie in the study area. Because the toll plazas range from 4 to 20 lanes wide, most vehicles and drivers cannot be seen or photographed from a vehicle parked at one edge. Hence, the techniques used at other locations were inappropriate for toll booths. Fortunately, vehicles remain stopped for 10 seconds or more at the booths, which allows the use of a simple manual data collection technique described below. This was the easiest and most straightforward portion of the project. Data collection and other operations described below proceeded smoothly from the first day with virtually no training required.

4.1 FIELD OPERATIONS

At accesses to the Massachusetts Turnpike, observations were made at the toll booths for both entering and exiting traffic. A schedule was produced by MARI and followed by selected field workers at specific toll booths in a specified order. A copy of the observation schedule is given in Figure 4.1-1.

Field workers collected data at each booth for either a five-minute period or 20 observations of passenger vehicles. Information was recorded on standard forms (Figure 4.1-2) and included:

- Header information.
- A count of all vehicles, classified by car and other (small trucks, large trucks, combination (semi) trucks, vans, buses, motorcycles, out-of-state and other) classifications.
- For each Massachusetts passenger car, the license number, driver age, and sex.

Figure 4.1-3 shows an observer at work.

A team of two was utilized to collect data and generally completed the scheduled work within three to four hours including travel from the office.

FIGURE 4.1-1: MASSACHUSETTS TURNPIKE SURVEY SCHEDULE

Date	Day	Exit Order	Time
7/6/84	Friday	15 — 12	14:00 - 18:00
7/14/84	Saturday	15 — 12	11:00 - 15:00
7/23/84	Monday	15 — 12	18:00 - 22:00
7/27/84	Friday	15 — 12	07:00 - 11:00
8/5/84	Sunday	15 — 12	14:00 - 18:00
8/12/84	Sunday	15 — 12	07:00 - 11:00
8/21/84	Tuesday	15 — 12	14:00 - 18:00
8/28/84	Tuesday	15 — 12	11:00 - 15:00
9/1/84	Saturday	15 — 12	18:00 - 22:00
9/19/84	Wednesday	12 — 15	14:00 - 18:00
9/23/84	Sunday	12 — 15	11:00 - 15:00
10/3/84	Wednesday	12 — 15	18:00 - 22:00
10/6/84	Saturday	12 — 15	07:00 - 11:00
10/13/84	Saturday	12 — 15	14:00 - 18:00
10/18/84	Thursday	12 — 15	11:00 - 18:00
10/26/84	Friday	12 — 15	18:00 - 22:00
11/2/84	Friday	15 — 12	11:00 - 15:00
11/11/84	Sunday	12 — 15	18:00 - 22:00
11/15/84	Thursday	12 — 15	07:00 - 11:00

FIGURE 4.1-2: COMPLETED MASS. PIKE SURVEY FORM

SMALL CAR STUDY - MASS. PIKE DATA

DATE: ______ Location: ______

Ob. #: ______ Booth #: ______ Enter or leave: ______

START TIME: ______ STOP TIME: ______

	MALE	Female	License #		MALE	FeMALE	License #
1.				11.			
2.				12.			
3.				13.			
4.				14.			
5.				15.			
6.				16.			
7.				17.			
8.				18.			
9.				19.			
10.				20.			

SMALL Truck	Large Truck	Combo Truck (semi)	VaN
Total	Total	Total	Total

Bus	Motor-cycle	Other	Out-of-State
Total	Total	Total	Total

FIGURE 4.1-3: DATA COLLECTOR AT A MASS. PIKE TOLL BOOTH

4.2 EQUIPMENT

The equipment involved was minimal and included:

- clipboards
- pencils
- forms
- safety vests and hard hats
- a vehicle (either a project van or the personal car of an employee)

4.3 DATA ENTRY AND PROCESSING

Twenty to forty data collection forms were completed during a session, depending upon the number of toll collection booths open at the time. These were returned to the office, coded using the BASIC program, "PIKE.BA" (Appendix 8), and stored on diskettes. Figure 4.3-1 shows the output for the same booth as Figure 4.1-2. This work took about one hour per session.

After editing, license plate numbers were extracted and sent to the Registry of Motor Vehicles for matching with corresponding VIN's. This was accomplished much more cheaply than with the field exposure observations because the stripping out and formatting was done on a desk top IBM-compatible personal computer rather than a mainframe. A BASIC program, "EXTRACT.BAS" (Appendix 9) performed this task. Only the actual plate numbers were uploaded to the mainframe, which was used only to write a nine-track tape, at a cost of about $25. The total number of useable license plates was 6,872.

The output tape from the Registry, containing 5,673 (83 percent) matched plates, was mailed to NIH and processed through PALTAPE, TAPERMV, and FORTNN13 as described in Appendix 6. Output files were recovered by modem from NIH. Figure 4.3-2 shows an excerpt from one of these files. 5,203 output records were generated.

The final step in processing involved using a data-base-management package called "Knowledgeman" (described in Appendix 6) to append the VINDICATOR data. Unfortunately, a number of extraneous characters had been inserted into the files as a result of telephone-line noise. These severely disturbed the operation of Knowledgeman, which requires explicit data delimiters (e.g, commas) at specific

FIGURE 4.3-1: EXAMPLE OF MASS PIKE DATA FILE BEFORE VINDICATOR

```
***************PIKE SITE NUMBER=1315
DATE=10/18
LOCATION=13
----------------------------------------

BOOTH NUMBER= 1
DIRECTION=LEAVING
OBSERVER NUMBER= 15
START TIME =11:55
STOP TIME =12:00
THE TOTAL NUMBER OF OBSERVATIONS AT BOOTH  1 IS  20
 1   1 3 0204JD2
 2   2 3 0805DFR
 3   2 4 0217IRI
 4   2 3 0535EGG
 5   1 2 0468FDG
 6   2 3 0612595
 7   2 4 0247IGX
 8   2 3 0889JAT
 9   2 4 0787579
 10  2 2 0808IKY
 11  1 4 0817ICJ
 12  2 4 0283IWS
 13  1 4 0557INE
 14  1 3 0568HRB
 15  1 3 0189JFN
 16  2 2 0186EYM
 17  2 2 0309HSB
 18  1 4 0649DLH
 19  1 3 0855529
 20  1 3 0753744
NUMBER OF SMALL TRUCKS= 3
NUMBER OF LARGE TRUCKS= 0
NUMBER OF COMBINATION TRUCKS = 1
NUMBER OF VANS= 1
NUMBER OF BUSSES = 0
NUMBER OF OUT OF STATE PLATES = 2
NUMBER OF OTHERS = 0
```

NOTE: THE PIKE SITE NUMBER, "1315," REFERS TO THE 15TH VISIT TO EXIT 13.

FIGURE 4.3-2: EXAMPLE OF MASS PIKE DATA FILE AFTER ADDITION OF VINDICATOR OUTPUT

```
***************PIKE SITE NUMBER=1315
DATE=10/18
LOCATION=13
----------------------------------------

BOOTH NUMBER= 1
DIRECTION=LEAVING
OBSERVER NUMBER= 15
START TIME =11:55
STOP TIME =12:00
THE TOTAL NUMBER OF OBSERVATIONS AT BOOTH  1 IS  20
 1   1 3 0204JD2
 2   2 3 0805DFR167878 3 0 82010 93 58 58R78
 3   2 4 0217IRI 27676 8 0342678 96  0  0 76
 4   2 3 0535EGG 284844142422081 94 70 80 84
 5   1 2 0468FDG
 6   2 3 0612595 2797925 0302706106 85 85 79
 7   2 4 0247IGX 4787815 0683730119155155 78
 8   2 3 0889JAT 177771438664139116165180 77
 9   2 4 0787579 68484 1 370324210811011O 84
 10  2 2 0808IKY238484 9 0202266 97100100 84
 11  1 4 0817ICJ107979 4 0283792114125125 79
 12  2 4 0283IWS36848410 0683740116120120 84
 13  1 4 0557INE138383 4 1704162117130130 83
 14  1 3 0568HRB 684841935702704105110110 84
 15  1 3 0189JFN 1808037 0622437105 90 90 80
 16  2 2 0186EYM
 17  2 2 0309HSB16808020 028   0 98 60 60 80
 18  1 4 0649DLH
 19  1 3 0855529
 20  1 3 0753744
NUMBER OF SMALL TRUCKS= 3
NUMBER OF LARGE TRUCKS= 0
NUMBER OF COMBINATION TRUCKS = 1
NUMBER OF VANS= 1
NUMBER OF BUSSES = 0
NUMBER OF OUT OF STATE PLATES = 2
NUMBER OF OTHERS = 0
```

locations to separate different data fields on the same line. Hence, an additional BASIC program, "UNSPACER" (Appendix 10), was written to detect and eliminate bad lines and also to remove unneeded spaces from the VINDICATOR output. Figure 4.3-3 shows the same records as 4.2-1, but after the addition of the VINDICATOR data.

4.4 PROBLEMS

The only significant problems involved in conducting the Turnpike data collection were those of securing the necessary approvals from the Turnpike Authority. Various officials including lawyers concerned with liability for accidents, supervisors of toll collectors and a representatiave of the toll collectors' union attended four separate meetings with project personnel extending over a period of several weeks. As a result of the protracted negotiations, the data collection did not begin until well into the second season.

To secure their approval, the following actions were required:

1. They were assured that the observations would be of brief duration, lasting no longer than five minutes at any one booth.

2. A rider to Superior Design's liability insurance was secured specifically naming the Turnpike Authority and the Commonwealth of Massachusetts as "Additional Insureds" as respects their liability arising out of the issuance of permits to conduct the observations (see Figure 4.4-1).

3. Superior Design and all of its employees participating in the study were required to sign an agreement to "indemnify, save harmless and reimburse" the Authority in case of accident (see Figure 4.4-2).

4. Personnel were required to wear safety vests and hard hats.

These concerns with safety and liability are in fact well founded. Many toll collectors have been injured while crossing lanes by careless drivers. Indeed, project personnel arrived at one toll plaza only minutes after a large truck went out of control during hard braking as its approached the booths. It overturned and slid into the concrete barrier, causing considerable damage.

FIGURE 4.4-1: INSURANCE RIDER REQUIRED BY THE MASSACHUSETTS TURNPIKE AUTHORITY

Certificate of Insurance

acord

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES LISTED BELOW.

NAME AND ADDRESS OF AGENCY	COMPANIES AFFORDING COVERAGES
Alexander & Alexander of New York Inc. P.O. Box 512 Buffalo, NY 14240	COMPANY LETTER **A** American Employers Insurance Co. COMPANY LETTER **B** Commercial Union Ins. Co.
NAME AND ADDRESS OF INSURED Superior Design Co., Inc. & Sudesco Systems, Inc., Sudesco Placement Agency, Inc. & Tempro Technical Services, Inc. 643 Walden Avenue Buffalo, NY 14211	COMPANY LETTER **C** Federal Insurance Co. COMPANY LETTER **D** COMPANY LETTER **E**

This is to certify that policies of insurance listed below have been issued to the insured named above and are in force at this time.

COMPANY LETTER	TYPE OF INSURANCE	POLICY NUMBER	POLICY EXPIRATION DATE	Limits of Liability in Thousands (000)	EACH OCCURRENCE	AGGREGATE
A	**GENERAL LIABILITY** (2) [X] COMPREHENSIVE FORM [X] PREMISES—OPERATIONS [X] EXPLOSION AND COLLAPSE HAZARD [X] UNDERGROUND HAZARD [X] PRODUCTS/COMPLETED OPERATIONS HAZARD * [X] CONTRACTUAL INSURANCE [X] BROAD FORM PROPERTY DAMAGE [X] INDEPENDENT CONTRACTORS [X] PERSONAL INJURY *Blanket	AJ9047-003	10/1/84	BODILY INJURY	$ 500,	$ 500,
				PROPERTY DAMAGE	$ 100,	$ 100,
				BODILY INJURY AND PROPERTY DAMAGE COMBINED	$	$
				PERSONAL INJURY		$ 500,
B	**AUTOMOBILE LIABILITY** [X] COMPREHENSIVE FORM [X] OWNED [X] HIRED [X] NON-OWNED	CJ9047-014	10/1/84	BODILY INJURY (EACH PERSON)	$	
				BODILY INJURY (EACH OCCURRENCE)	$	
				PROPERTY DAMAGE	$	
				BODILY INJURY AND PROPERTY DAMAGE COMBINED	$ 500,	
A	**EXCESS LIABILITY** (2) [X] UMBRELLA FORM [ ] OTHER THAN UMBRELLA FORM	AJ9047-015	10/1/84	BODILY INJURY AND PROPERTY DAMAGE COMBINED	$ 10,000,	$ 10,000,
A	**WORKERS' COMPENSATION** ** and **EMPLOYERS' LIABILITY**	AJ9047-013	10/1/84	STATUTORY	$ 100, (EACH ACCIDENT)	
C	**OTHER** Crime Insurance Policy	80586774-A	10/1/84	Insuring Clause I - Employee Theft Coverage - $250, Limit (1)		

DESCRIPTION OF OPERATIONS/LOCATIONS/VEHICLES

** All States except monopolistic states
(1) Including theft of customer's property
(2) Massachusetts Turnpike Authority and Commonwealth of Massachusetts are Additional Insureds as respec their liability arising out of the issuance of permits granted to facilitate a traffic survey.

Cancellation: Should any of the above described policies be cancelled before the expiration date thereof, the issuing company will ~~endeavor~~ XXXXXXXX to mail 30 days written notice to the below named certificate holder, ~~but failure to mail such notice shall impose no obligation or liability of any kind upon the company.~~ XXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

NAME AND ADDRESS OF CERTIFICATE HOLDER

Massachusetts Turnpike Authority
3000 Prudential Center
Boston, MA 02199

DATE ISSUED 5/30/84 RM/eh

AUTHORIZED REPRESENTATIVE

ACORD 25 (Ed 2/77)

FIGURE 4.4-2: EXAMPLE OF WAIVER REQUIRED BY THE MASSACHUSETTS TURNPIKE AUTHORITY

RELEASE OF CERTAIN CLAIMS AND DEMANDS
AND
COVENANT NOT TO SUE

In consideration of permission to me granted by the MASSACHUSETTS TURNPIKE AUTHORITY to enter upon its right of way for the purpose of Data Collection and for other valuable consideration, I Michael D. McFadden do hereby remise, release and discharge the said MASSACHUSETTS TURNPIKE AUTHORITY from any and all claims and demands which I now have or ever may have against the said AUTHORITY for personal injury or property damage resulting from my presence upon the said TURNPIKE right of way.

And for such consideration, I do further covenant and agree with the said AUTHORITY, for myself and for and in behalf of my heirs, administrators, executors and assigns, that neither I nor they will ever make any such claim against the said AUTHORITY for personal injury, including death, or property damage by me sustained or suffered while upon the TURNPIKE right of way under such permission to me granted by the said AUTHORITY.

IN WITNESS WHEREOF, I have hereunto set my hand and seal this 18 day of June 19

Michael D. McFadden

PERMISSION IS GIVEN UPON THE EXPRESS CONDITION THAT THERE WILL NOT BE ANY INTERFERENCE WITH TURNPIKE CAUSED BY THE TRAFFIC STUDY.

4.5 OBSERVATIONS AND RECOMMENDATIONS

The erratic behavior of drivers at toll booths while queing, searching for money and locating toll cards was both remarkable and unnerving. Several near misses were noted by field workers as they crossed between booths. Caution is required at all times and the potential for injury even at the relatively slow speeds is quite high. The skill levels required for this task are modest, but this is no place for the immature. Safety in this work cannot be stressed enough.

Because of the protracted negotiations and the need to secure special insurance documents, any future observations on toll roads must be planned and cleared with the appropriate authorities at least three months prior to the desired beginning of data collection.

5.0 TRAFFIC COUNTING

Traffic counting serves three purposes in this project: (1) determination of the distribution of traffic volume in time and space; (2) calculation of more precise weighting factors for the exposure observations; and (3) characterization of accident locations in terms of traffic flow. To fulfill these purposes, MARI personnel developed guidelines for traffic counting (Ref. 3, Page 33) and subsequently selected the actual sites.

5.1 SCHEDULING

The orginal plan for traffic counting developed by MARI was predicated upon the availability of ten recorders (Ref. 3). At the time the plan was conceived, it was expected that ten or more units would be available as surplus property from other DOT organizations and that these could be deployed concurrently with the start of exposure observations, March 15, 1984.

Due to unforeseen delays, transfer of the traffic counting equipment was not accomplished until March 9. When the surplus units arrived, there were found to be only six useable recorders and they were missing a number of expendable support items (described in detail in Section 5.4 below). Two units were deployed during the last week of March, but the passage of snowplows destroyed their road tubes on the second day. Because frequent minor snowstorms persisted in the Boston area through the first week of May and because of the shortage of road tubing, no further deployments were attempted until the ninth week of observations.

As a result of these delays in beginning traffic counting, insufficient numbers of recorders, and numerous operational problems (Section 5.4), the schedule of traffic counting had to be curtailed considerably. 360 counts were planned originally (10 recorders x 36 weeks). This would have allowed making three counts at each of 120 sites. Instead, the list of sites was reduced to 72 plus about a dozen alternates. Two or three counts were made at each of these.

The original traffic counting plan also called for overlapping counts in each traffic-volume-density stratum (Ref. 3). With five strata, this would have required ten recorders working continually. Since, there were only six available (often fewer because of breakdowns), the original plan was unworkable.

In practice, the scheduling of counts reduced to a very simply process. Sites were grouped so as to minimize the travel time to collect and set up equipment. This process continued until all sites had been visited once. It was then repeated. The data collection phase ended in November before the third round of visits could be completed.

5.2 EQUIPMENT

The inventory of surplus traffic counting equipment acquired at the start of data collection consisted of the following items:

2 Streeter-Amet Model 103 paper tape traffic recorders, each equipped with a single air switch (Figure 5.2-1)

4 Streeter-Amet Model 141 solid-state traffic recorders, each equipped with a pair of air switches (Figure 5.2-2)

2 Streeter-Amet Model 140 solid-state readers, which both program and collect data from the Model 141's (Figure 5.2-3)

200 feet of used road tube with a few clips and nails attached

Initial experience with this equipment showed that the probability of a road tube's surviving one week in place was less than .9. Hence, it was expected that three or four 50-foot lengths of road tubing would be consumed for each counter over the course of a season. Accordingly, 900 feet of tubing were ordered over the course of the project. Additional supplies included:

100 road tube clips
20 splices
30 tube clamps
100 PK nails
20 6" spikes

FIGURE 5.2-1: STREETER-AMET MODEL 103 PAPER-TAPE TRAFFIC COUNTER

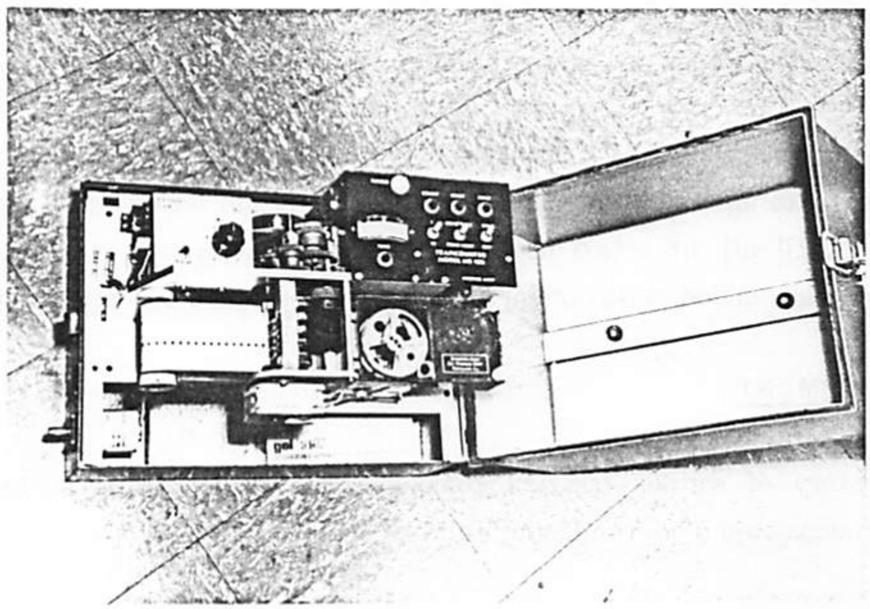


FIGURE 5.2-2: STREETER-AMET MODEL 141 SOLID-STATE TRAFFIC RECORDER

FIGURE 5.2-3: STREETER-AMET MODEL 140 READER

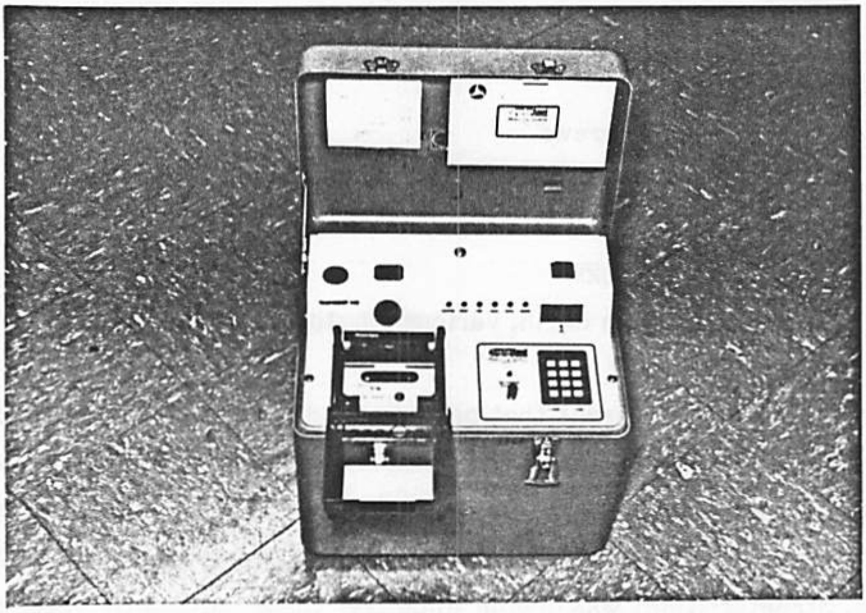
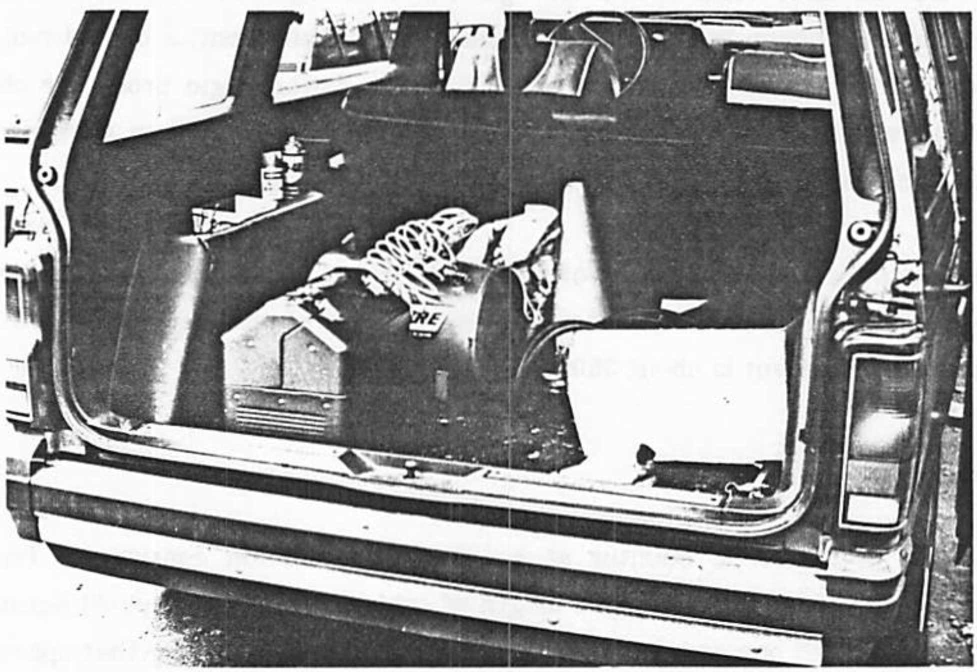


FIGURE 5.2-4: TRAFFIC COUNTER SUPPORT EQUIPMENT



12	stakes
100	10-32 x 1/2" ss screws
100	10-32 ss nuts
100	1/4 x 20 x 1" ss screws
20	1/4 x 20 x 3" ss screws
50	1/4 x 20 ss nuts
10	heavy duty padlocks
12	pieces of 1/4-inch chain, various lengths from 4 to 10 feet

By June it had become apparent that because of delays in beginning traffic counts and the numerous failures (described in Section 5.4), the number of successful counts would be much smaller than desired. To help offset this shortfall, two additional Model 141A recorders were ordered. However, because of the heavy demand for traffic counters during 1984, Streeter-Amet was unable to deliver these units until October.

In addition to the "on-the-road" equipment described above, traffic counting also requires a substantial collection of supporting tools and instruments. These include a compressed air tank fitted with a blow gun (for cleaning road tubes and testing them for cuts), about two dozen hand tools, personnel safety equipment, a digital multimeter for checking batteries and for fault diagnosis, and a digital logic probe for checking air-switch operation. Figure 5.2-4 shows most of these items as they were carried in the back of one of vans and Figure 5.2-5 is a close up of the tool box.

Back at the office, an assortment of battery chargers for the readers and recorders plus an inventory of spare batteries occupied several feet of shelf space. The total value of this support equipment is about $500.

5.3 PROCEDURES

Installation of a traffic counter at a temporary location consists of four essential activities: (1) securely attaching a length of rubber hose ("road tube") across the lanes to be counted with one end connected to the recorder; (2) insuring that appropriate data specifying site, time and date are entered at the beginning of the counting period; (3) testing the system for proper operation; and (4) protecting the recorder against theft and tampering with chains and locks. Figure 5.3-1 shows a typical installation. At the conclusion of the counting period, the ending time and date must be recorded, the data

FIGURE 5.2-5: CLOSE-UP OF TOOL BOX FOR TRAFFIC COUNTING

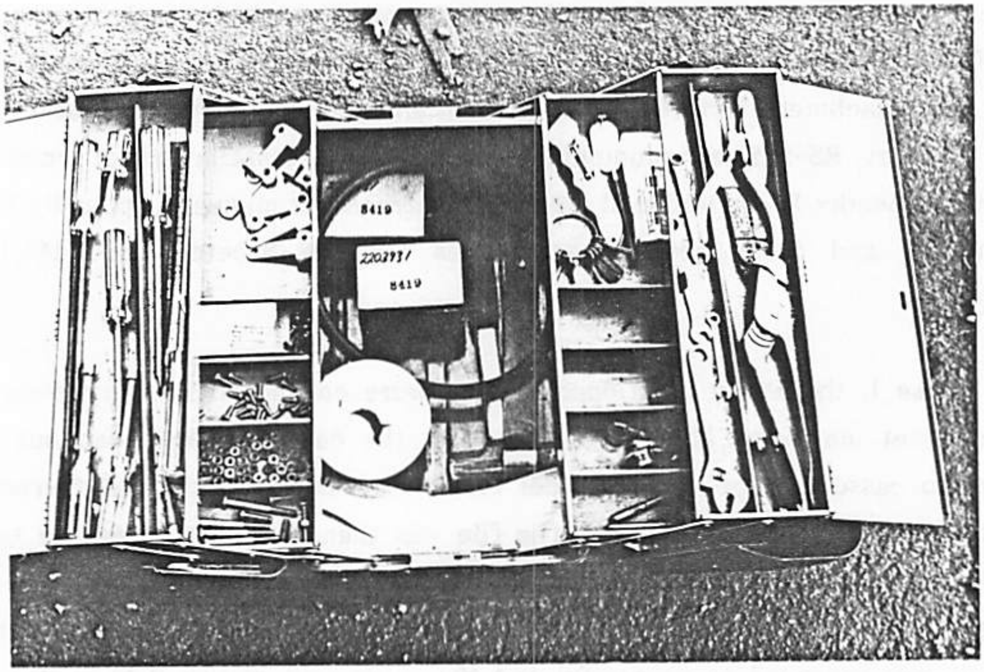
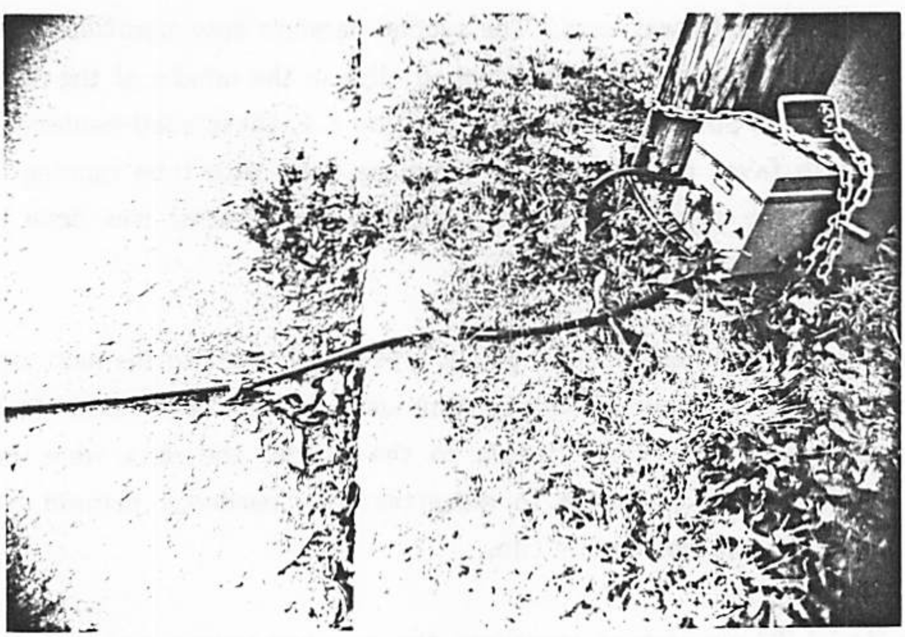


FIGURE 5.3-1: TYPICAL TRAFFIC COUNTER INSTALLATION



file recovered and stored, and the equipment removed and made ready for the next site. Each of these activities embraces dozens of details ranging from assembly of various clamps and attachment fixtures to recognition and diagnosis of various failure modes to setting correct RS-232 communication parameters. Installation of road tubes is described Appendix 11, reproduced from a Streeter-Amet manual. Appendix 12 outlines programming and data recovery procedures for the Steeter-Amet 140/141 series equipment.

During Phase I, the above mentioned actions were conducted in accordance with the Streeter-Amet manuals. However, as soon as the data file was read out from the recorder to cassette tape in the Model 140, it was immediately transferred to a lap computer through the RS-232 port. The file was then examined using the text editor for evidence of malfuctions and to determine the time of occurrence of road-tube breakage, if any. If at least five days of valid data appeared to have been collected, the count was regarded as successful and the equipment removed to another site. If only four or fewer days of valid data were obtained, the equipment was repaired, reprogrammed and left to count for another week.

Initially a two-person crew was used. The second person's only significant function was to serve as flagman while his partner attached clips in the middle of the road. Because of the problem of nail pullout described in Section 5.4, these road-center attachments were eliminated in favor of bidirectional counting (i.e., with tube running all the way across the road). The remainder of the counting (six months) was done by a single collector.

The average time required to collect a count, move equipment to the next site, reinstall it, and program it was one hour. Thus, as many as four counters could be collected and relocated in an afternoon. Upon return to the office, the data were immediately transferred from the lap computer to diskettes with hardcopy printed out as well. Figure 5.3-2 shows an excerpt from a file.

For the two Model 103 paper-tape recorders, the data had to be typed in by hand using a BASIC program "INP103.BA," listed Appendix 13. This program yielded an output file format exactly indentical to that of the Model 140's. It required about 20 minutes of tedious labor per week of tape.

FIGURE 5.3-2: EXCERPT FROM TRAFFIC COUNTER DATA FILE FOR AN UNDIVIDED ROAD

STATION: 151 IDENT: 1378 PROG: 1004 INTRVL: 60 MIN

SETUP DATE: 1015 SETUP TIME: 1528
RETRIEVAL DATE: 1022 RETRIEVAL TIME: 1500

HOUR:	CHANNEL: 1	2
17	1368	0
18	1861	0
19	1164	0
20	641	0
21	422	0
22	413	0
23	258	0
24	171	0

--24 HOUR TOTALS--

CHAN:	TOTALS:
1	6819
2	0

HOUR:	CHANNEL: 1	2
1	70	0
2	35	0
3	26	0
4	12	0
5	32	0
6	124	0
7	685	0
8	1367	0
9	1392	0
10	811	0
11	690	0
12	760	0
13	742	0
14	757	0
15	952	0
16	1169	0
17	1497	0
18	1720	0
19	1143	0
20	713	0
21	464	0
22	469	0
23	347	0
24	173	0

--24 HOUR TOTALS--

CHAN:	TOTALS:
1	16150
2	0

5.4 TECHNICAL PROBLEMS AND SOLUTIONS

Several categories of technical problems plagued the traffic counting operation. In approximate order of significance these were:

1. Lack of proper software - More than ten programs on casette tapes were received along with the surplus counters. Unfortnately, none of them were simple volume-counting programs appropriate for this project. Because of backlogs at Streeter-Amet, the desired programs were not obtained until eight weeks after data collection was supposed to have begun.

2. Frequent snow - Snow plow blades almost invariably destroy road tubes. The frequent small storms that persisted all through April of 1984 discouraged placement of the two available paper-tape counters.

3. PK nail pullout - The initial traffic counting plan called for single-direction counts, which meant that at most sites, one end of the tube had to be held by a "PK" nail driven into the center of the road. In that location, tire impacts were frequent and the single-nail clips being used loosened and failed in less than a week more often than not.

4. Road tube failures - The initial inventory of surplus road tubing was several years old and showed clear signs of embrittlement, which accounted for some of the instances of breakage observed. Because of backlogs at Streeter-Amet, a local hose vender was used as a stopgap. The tubing he supplied worked, but wore out in about three weeks on high-volume roads. When the new Streeter-Amet tubing was finally received, it wore very well. At the conclusion of the pilot phase, none had actually worn out. Wear life is probably in excess of one million axle counts. However, several non-wear failures, i.e., cuts, were experienced. Some were presumed to have been caused by truck drivers who deliberately lock up their brakes while passing over a tube, thus dragging it until it snaps. Others were caused by the passage of heavy vehicles within three inches of the curb which crushed the tube clamps, usually blocked the tube and sometimes cut it as well.

5. Mechanical failures in the paper-tape counters - Both of the Model 103 counters had been in service for many years when they were received. As a result of this

heavy use, many of their gears, print wheels, bearings, etc. were essentially worn out. During the May-July period the probability of one of the these units operating properly for an entire week was only about 0.5. During July, a shipment of parts arrived and several subassemblies were replaced. No further reliability problems were experienced.

6. Battery connector failures - Due to difficulty in procuring the Elpower gell-cell batteries specified by Streeter-Amet, an electrically equivalent Gates battery was used. Unfortunately, the connectors on the Gates battery were not designed for very low current applications (4ma) and occasionally opened (usually during very hot weather), causing loss of memory.

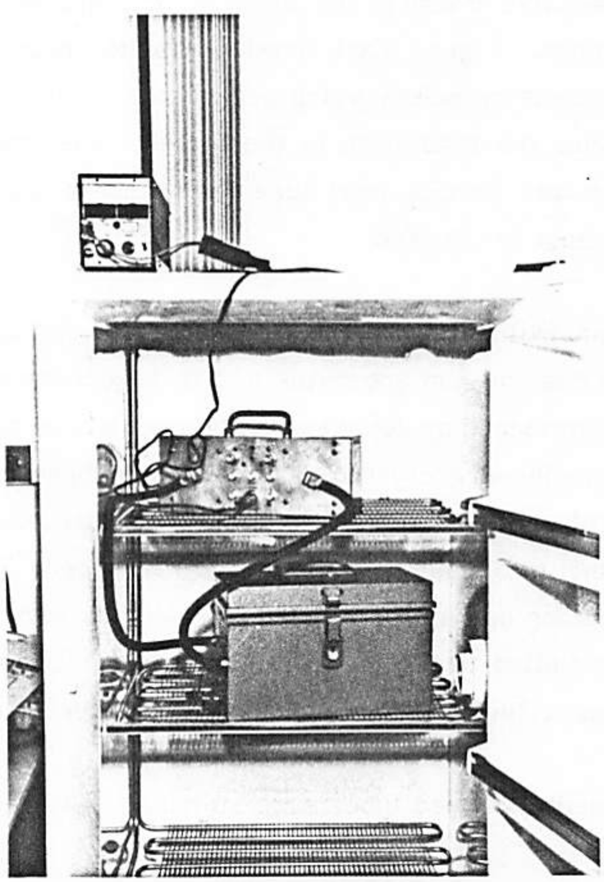
7. Air switch failures - Several data files showed peculiar counts (e.g. adjacent hours different by a factor of more than ten). When the counters which produced these suspicious files were operated side-by-side with good counters, they generally produced files which were essentially identical most of the time, but tended to show anomalies around sunrise. This malfunction was eventually traced to temperature-sensitive cracks in the piezo-electric diaphragms in the air-pressure-activated switches. Figure 5.4-1 shows a cracked diaphragm. This cracking is caused by high-pressure pulses which occur when a large truck travelling at high speed passes over the tube close to the switch. The problem can be avoided by leaving at least ten feet of road tube between the edge of the road and the counter, which acts as a buffer.

   Because the air switches were not designed to be inspected for cracks without destructive disassembly, an apparatus had to be constructed to simulate the air pressure pulses produced by vehicles passing over a road tube. The test equipment (Figure 5.4-2) included a crystal-controlled time base producing one pulse per second, a pair of power amplifiers, and a pair of loud speakers sealed to the back of the front panel into which hose barbs were threaded. The test generator and a Model 141 recorder containing suspect air switches were placed inside a freezer and repeatedly chilled to $0^{o}F$ and warmed to room temperature. Any variation from the nominal 1,800-vehicles-per-hour count indicated a defective air switch.

8. Theft and Vandalism - Road tubes were stolen at two sites and deliberately pulled up at another.

FIGURE 5.4-1: EXAMPLE OF CRACKED DIAPHRAGM IN AIR-SWITCH. HAIRLINE CRACK MAY BE IMPERCEPTABLE IN XEROGRAPHIC COPIES

FIGURE 5.4-2: TEST SETUP TO DETECT CRACKED DIAPHRAGMS



9. Street cleaning - One tube was caught up in a street cleaning machine and mangled.

10. Model 140 reader defects - Several design defects in the Model 140 reader complicated data collection: The most annoying of these was the default clock setting. Following battery replacement in a Model 141, its clock frequently (but not consistently) reset to 1 am. The Model 140 reader did not provide any convenient means of detecting this malfunction or avoiding it. As a result, dozens of files had wrong times of day, and had to be corrected subsequently with a word processor.

    Other design weaknesses included the use of cassette tape for data storage, which resulted in loss of one file due to a wrinkled tape and to the loss of another file when the cassette electronics failed in one of the two readers.

    Additionally, the programing process required a large number of keystrokes through a heavy protective membrane, which raised the probability to operator error.

5.5 RECOMMENDATIONS

Fortunately, many of the technical problems experienced in the pilot phase can be eliminated by the simple substitution of the Model 240 reader for the 140. In the new unit, storage of both programs and data is entirely solid state, and programming is greatly simplified.

Other means of increasing productivity in traffic counting include:

1. Counting all lanes on a expanse of pavement. This avoids both the risk of PK nail pullout and the necessity for a two-person crew.

2. Avoiding snow.

3. Using stakes driven into the soil rather than PK nails driven into the asphalt to anchor the road tube. This is especially important in very hot weather when asphalt softens appreciably.

4. Because of the long lead times associated with purchase of traffic counters in 1984, this equipment should be ordered four months in advance of need. Expendables (road tube, fittings, etc.) should be ordered at least two months ahead.

5. Open purchase orders with Streeter-Amet for supplies, repair service, and parts should be maintained continuously. Since such assemblies range in price from about $45 (for an air-switch) to about $300 (most circuit boards), these open purchase orders should be renewed whenever the available balance drops below $1,000.

6.0 ACCIDENT REPORTS

While the principal effort in this study was devoted to collection of exposure data, understanding of accident causation clearly requires data describing accidents as well. For this purpose, the only reliable source is the Police Accident Report (PAR). These documents, filled out by local or state police officers, record dozens of items regarding the vehicles, drivers, sites, environmental factors, etc. for every accident investigated. Virtually every accident involving personal injury and most involving significant vehicle damage are investigated in the survey area. Figure 6.0-1 shows an example of the blank two-page form used by all police departments in the study area.

6.1 COLLECTION OF PAR'S

Because PAR's often contain information which is embarrassing to the persons described and which may also be the grounds for a civil law suit or even a criminal prosecution, there is naturally great concern about protecting the confidentiality of these reports. Furthermore, the labor and other costs involved in reproducing many thousands of pages are not insignificant. For both these reasons, it was expected that there might be some resistance to requests for copies of PAR's.

To overcome this resistance, a careful plan was necessary. The CFSI Project Manager began by contacting the police chief in one of the survey towns who happened to be the current President of the Massachusetts Police Association, and who was thought to be sympathetic toward traffic studies. A letter and briefing package (reproduced as Appendix 14) were sent to him, followed by a phone call a week later. After gaining his approval, similar letters and packages were sent to the other eleven police chiefs and to the state police. These were followed by phone calls during which in-person meetings were scheduled between the police chiefs and the Project Manager for all but one of the towns. All of these chiefs agreed to cooperate. In the one town where no meeting could be scheduled because the chief was out of town, subordinate officers informed project staff that their chief had decided not to cooperate, but could probably be persuaded to change his mind. An additional letter was sent to him (Appendix 15) which ultimately secured his cooperation.

Once the approvals were in place, team members began visiting each department weekly or bi-weekly to gather copies of PARs. At most departments, clerks had

FIGURE 6.0-1: EXAMPLE OF PAR FORM, PERSONAL INFORMATION HAS BEEN BLANKED OUT

NOT TO BE USED BY OPERATOR

MUST TYPE OR PRINT

COMMONWEALTH OF MASSACHUSETTS
POLICE REPORT OF MOTOR VEHICLE ACCIDENT

SEND ONE COPY TO:
REGISTRAR OF MOTOR VEHICLES
100 NASHUA STREET
BOSTON, MASS. 02114

NAME OF POLICE DEPT. SUBMITTING REPORT: BEDFORD - #90

REGISTRY USE ONLY
2-7: 3
8-10: 111

11-15 Date of Accident: Mo. 03 Day 18 Yr. 84
16 Day of the Week: S M T W T F S — [X] S (1)
A.M. [ ] X / P.M. [X] Y
17 Hour: 5:45

18 Did you notice any indication that an operator had been taking any medication or drugs? Check one: YES 1 [ ] NO 2 [X]
To your knowledge has any operator had a history of epilepsy, heart disease, fainting spells? YES 3 [ ] NO 4 [X] (explain on reverse)

19 Was this Accident Investigated by an Officer? If Yes, Check One Box Below
1 [ ] Registry 2 [ ] MDC 3 [ ] Other 4 [ ] State Police 5 [X] Local Police 6 [ ] None

VEHICLE 1

Name of Operator: Phone:
20 Number of Vehicles Involved: 2
21-26 Date of Birth: MO. 10 DAY 02 YR. 22
27 Sex: 1 [X] M 2 [ ] F
Street Address / City/Town / State / Zip: , South Hamilton, MA 01936
28-29 Driver's License Number and State:
Owners Name and Address (if same, write "same") Zip:
Registration Number & State:
Name of Insurance Company only may be written here: Ins. Co. of North America
Year: 1981 Make: Olds Type: Wagon
Approximate Cost to Repair: $ unk.
Describe Damage to Vehicle: Front Passenger Side - totaled
Parked Car: YES [ ] NO [X]

VEHICLE 2

Name of Operator: Phone: Zip:
30-35 Date of Birth: MO. 03 DAY 01 YR. 62
36 Sex: 1 [ ] M 2 [X] F
Street Address / City/Town / State:
37-38 License Number and State:
Owners Name and Address (if same, write "same") Phone Zip: Same
Registration Number & State:
Name of Insurance Company only may be written here: Hanover Insurance Co.
Year: 1977 Make: Plymouth Type: Sedan
Approximate Cost to Repair: $ unk.
Describe Damage to Vehicle: Passenger side totaled
Parked Car: YES [ ] NO [XX]

OTHER

Describe Other Property Damage:
Approximate Cost to Repair: $
Name of Property Owner: Address:

WITNESSES

Other Witnesses or Persons Present	Address	Phone
Ernest Flammini	158 Concord Rd., Apt. K-7, Billerica	Bus. / Res. 1-663-7079
Pamela Flammini	Same	Same

39 Number injured: two
To what hospital was injured taken? Lahey Clinic, Burlington, MA

INJURED 1

Name of Injured: Street: City/Town: State:
40-1 Age: 60
42 Sex: 1 [ ] M. 2 [X] F.
43 Check if wearing Seat Belt 1 [ ]
44 Check if Wearing Helmet 1 [ ]
45 Severity — Mark First One That Applies: Killed 1 [ ]; Visible signs of injury, as bleeding wound, or distorted member; or had to be carried from scene 2 [ ]; Other visible injury, as bruises, abrasions, swelling, limping, etc. 3 [ ]; No visible injury but complaints of pain or momentary unconsciousness 4 [X]
46 Person Injured: 1 [ ] Operator / 2 [X] Passenger } In vehicle No. 1; 3 [ ] Passenger in train, bus, etc.; 4 [ ] Operator / 5 [ ] Passenger } On Motorcycle; 6 [ ] Pedestrian; 7 [ ] Bicyclist; 8 [ ] Other

INJURED 2

Name of Injured: Street: City/Town: State:
47-8 Age: 64
49 Sex: 1 [ ] M. 2 [X] F.
50 Check if wearing Seat Belt 1 [ ]
51 Check if Wearing Helmet 1 [ ]
52 Severity — Mark First One That Applies: Killed 1 [ ]; Visible signs of injury, as bleeding wound, or distorted member; or had to be carried from scene 2 [ ]; Other visible injury, as bruises, abrasions, swelling, limping, etc. 3 [ ]; No visible injury but complaints of pain or momentary unconsciousness 4 [X]
53 Person Injured: 1 [ ] Operator / 2 [X] Passenger } In vehicle No. 1; 3 [ ] Passenger in train, bus, etc.; 4 [ ] Operator / 5 [ ] Passenger } On Motorcycle; 6 [ ] Pedestrian; 7 [ ] Bicyclist; 8 [ ] Other

INJURED 3

Name of Injured: Street: City/Town: State:
40-1 Age:
42 Sex: 1 [ ] M. 2 [ ] F.
43 Check if wearing Seat Belt 1 [ ]
44 Check if Wearing Helmet
45 Severity — Mark First One That Applies: Killed 1 [ ]; Visible signs of injury, as bleeding wound, or distorted member; or had to be carried from scene 2 [ ]; Other visible injury, as bruises, abrasions, swelling, limping, etc. 3 [ ] 62; No visible injury but complaints of pain or momentary unconsciousness 4 [ ]
46 Person Injured: 1 [ ] Operator / 2 [ ] Passenger } In vehicle No.____; 3 [ ] Passenger in train, bus, etc.; 4 [ ] Operator } On Motorcycle; 6 [ ] Pedestrian; 7 [ ] Bicyclist; 8 [ ] Other

NOTE: Mark all items which apply. The diagram and description of what happened (below) need not be completed if separate 8½ x 11 size sheet with same detailed information is attached. Please sign report in space provided below.

LOCATION

City or Town Where Accident Occurred	Nearest Mile Marker	Reserved for Registry
Bedford		

Street Name and/or Route Number: Middlesex Turnpike at intersection with "The Center" driveway

or ______ feet N. S. E. W. Of nearest intersection, bridge, mile marker, railroad.

Other Landmarks:

Which direction was each vehicle traveling?

	N.	S.	E.	W.
Vehicle No. 1		X		
No. 2	X			

54: 1 [ ] On ramp from route ___ 2 [ ] Off ramp from route ___ 3 [ ] At rotary

55: 1 [X] Area built up 2 [ ] Area not built up

TYPE

56 Accident Involved Collision With:

1 [ ] Pedestrian	4 [ ] Railroad train	7 [ ] Overturned in road
2 [X] Motor Vehicle in Traffic	5 [ ] Ran off roadway hit fixed object ___ feet from road	8 [ ] Ran off roadway — non-collision
3 [ ] Motor Vehicle Parked	6 [ ] Bicycle	9 [ ] Fixed object on shoulder, sidewalk or island
		A [ ] Other

57 If collision involved two or more vehicles mark one of the following: 1 [ ] Rear end 2 [X] Angle 3 [ ] Head on

SITUATION

What were vehicles doing prior to accident? Mark appropriate box. 58-60

	Vehicle 1	Vehicle 2			Vehicle 1	Vehicle 2			Vehicle 1	Vehicle 2	
1			Making right turn	8			Skidding	F			Parked
2			Making left turn	9			Slowing or stopping	G			Stalled or disabled
3			Making U turn	A			Crossing median strip	H			Stalled or disabled with flasher on
4		X	Going straight ahead	B			Driverless moving vehicle	J			In process of parking
5			Passing on right	C			Backing	K	X		Entering or exiting from alley or driveway.
6			Passing on left	D			Starting in traffic	L			Other
7			Stop sign	E			Starting from parked position				

Where was pedestrian located at time of accident? Mark appropriate box. 61

	X			X	
1		At intersection	7		Getting on/off vehicle
2		Within 300 feet of intersection	8		Working on vehicle
3		More than 300 feet from intersection	9		Working in street
4		Walking in street with traffic	A		Playing in street
5		Walking in street against traffic	B		Not in street
6		Standing in street	C		Other

CONDITIONS

62 Light Conditions

	X	
1		Daylight
2		Dawn or dusk
3	X	Darkness — road lighted
4		Darkness — road unlighted

63 Traffic Controls

	X			X	
1		Stop sign	6		Railroad crossing gate
2		Yield sign	7		Railroad automatic signal
3		Warning sign	8		Control device not working
4		Signal light	9	X	No control present
5		Officer or flagman			

64 Weather Conditions

	X	
1		Clear
2		Foggy
3		Cloudy
4	X	Rain
5		Snow
6		Sleet

65 Road Surface

	X	
1		Dry
2		Wet
3		Snowy
4		Icy
5		Other

76 Road Conditions

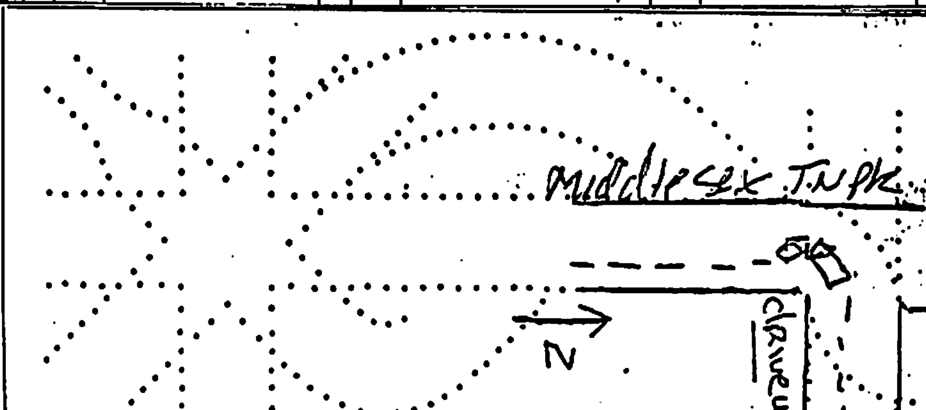
	X	
1	X	No Defects
2		Holes, ruts, bumps
3		Foreign matter on surface
4		Defective shoulder
5		Road under construction
6		Other

COLLISION CONDITIONS

66

	X			X			X			X			X	
1		Entered median	4		Hit guard rail	7		Hit signpost	A		Embankment	D		Stone wall
2		Crossed median	5		Hit curbing	8		Hit utility or light pole	B		Ditch	E		Other post
3		Hit median barrier	6		Hit abutment	9		Hit tree	C		Rock ledge	F		Bridge rail

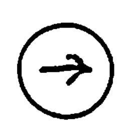
DIAGRAM



INDICATE ON THIS DIAGRAM WHAT HAPPENED

Use one of these outlines to sketch the scene of your accident, writing in street or highway names or numbers.

1. Number each vehicle and show direction of travel by arrow: 1 2
2. Use solid line to show path before accident 2 ; dotted line after accident. 2
3. Show pedestrian by:
4. Show railroad by:
5. Show distance and direction to landmarks; identify landmarks by name or number.
6. Indicate north by arrow, as:



INDICATE NORTH BY ARROW

VIOLATIONS

Operator (mark one or more) 67-72

	Operator 1	Operator 2			Operator 1	Operator 2			Operator 1	Operator 2			Operator 1	Operator 2	
1			Operating Under Influence of Liquor	6			Improper Passing	B			Disregarded Traffic Light	G			Leaving Scene of Accident
2			Operating Under Influence of Drugs	7			On Wrong Side of Road Not Overtaking	C			Disregarded Warning or Stop Signs	H			Other Moving Violations (explain below)
3			Exceeding Lawful Speed	8			Failed to Give Proper Signal	D			Disregarded Other Traffic Control	J			Operating to Endanger
4	X		Failed to Grant Right of Way to Other Vehicle	9			Improper Turning Movement	E			Improper Start from Parked Position	K			Failed to Stop for a School Bus
5			Failed to Grant Right of Way to Pedestrian	A			Operating Unregistered Uninsured Vehicle	F			Improper Parked Position	L		X	No Violation

Describe What Happened: (Refer to Vehicles by Number)

Citation Number if issued 048506X Operator 2 stated that as she approached the driveway of the Gift Center, a vehicle suddenly pulled out in front of her. She had no time to apply her brakes. Operator 1 stated that her vehicle was on the wrong side of the road "going like sixty" however, eyewitness' stated that this was not so, that vehicle 1 did in fact pull right out in front of vehicle 2.

Signature Ptlm. Richard Petrino Bedford Date 03/18/84

already prepared the copies, but at some project staff were required to do the copying, supplying the paper in one instance.

Collecting PARs required about eight hours labor per week. A substantial portion of this time was consumed simply in the driving, but waiting times were also significant. That is, the officer responsible for gathering the PAR's was often busy with other matters. Once that officer was free, the actual handing over of the documents usually required only a few seconds. There were instances, however, in which officers wished to chat, complain about the burden of the task, berate the government in general and NHTSA in particular, etc. In order that their complaints could be dealt with effectively and immediately, the task of visiting the police was performed by the team supervisor.

During the period of the study, nearly 3,000 reports were collected, almost all of which were two pages in length. These were filed in chronological order and filled two standard record storage cartons.

6.2 DATA ENTRY

Although the vast majority of questions on the PAR (see Figure 6-1) are objective, and thus lend themselves to easy coding for data entry, most of the understanding of the sequence of events leading to the accident must be interpreted from the diagram and narrative at the bottom of the second page. Location coding required use of a coding manual (Appendix 16) and maps. Familiarity with the area is highly desirable in this task.

The first version of the data entry program required up to 15 minutes of labor per PAR. Since this amounted to more than double the sum budgeted for this task, the program was modified several times over a period of several months in order to achieve the best compromise between richness of information and data entry cost. To further reduce costs, accidents which did not involve at least one Massachusetts passenger car were eliminated, as were pedestrian and bicycle accidents.

The final version of the data entry program is reproduced as Appendix 17. Figure 6.2-1 shows an example of the records produced by this program for one day during which nine accidents were reported.

FIGURE 6.2-1: EXCERPT FROM PAR DATA FILES PRIOR TO APPENDING THE VINDICATOR DATA. THESE ARE THE COMPLETE RECORDS FOR MARCH 22,1984, WHEN THERE WERE ONLY NINE ACCIDENTS.

```
0322  1111A221350295500  00020N31011030002000000000000O
0322  1211NY0220KLD73FORD SEDANY5 6 7 0000500 +
0322  1212000000000M000F00 00000000
0322  1221YY0352HMB79TOYOTSEDANN1 12
0322  12226L1      Y H  W411  20 111

0322  2111A184550463030  00000N22911031002000000000000O
0322  2211YY006912178WINNECAMPEN2 3 4 0000500 +
0322  22122110000OY0M00W135 01300220
0322  2221YY071607583VOLKSRABBIN1011000000500 +
0322  222248100000Y0M00W135 01300120

0322  3111A163050460000  00000N32021011002000000000000O
0322  3211NY0814411820LDSMCIERRY150000000500 +
0322  32120000000000000F00 00000000
0322  3221YY0323FID78MERCUWAGONN000000000500 +
0322  322200200000N00000E40 02000020

0322  4111A173051550090 00080N50011211001000000000000O
0322  4211YY0423HHD78DODGESEDANN1 2 101112500 +
0322  421238200000Y0L00E411314021101

0322  1111A084850290009  00000N21011011002000000000000l
0322  1211YYAE1571083FORD TRUCKN120000000500 +
0322  12125610000ON0000E411 01301110
0322  1221YY0162CZT830LDSMCOUPEN5 6 7
0322  1222562      Y    E411  14 161
0322  131112000

0322  2111A020150290009  00000N21423034002000000000000O
0322  2211YY0158DXZ77PONTICOUPEN6 7 8 0000500 +
0322  221264100000Y0000W711101301610
0322  2221YY0904DKW68FORD MUSTAN1 2 120000500 +
0322  222263100000Y0H000411 01301100

0322  3111A234051612012A 00030N22016011002000000000000O
0322  3211YY0988FRD79FORD BRONCN8 9 100000500 +
0322  321259200000N0000W200100000000
0322  3221YY015040174CHEVRSEDANN1 11120000500 +
0322  322210100000Y0000W400 00000000

0322  4111A12385161101000000200N22010011002000000000000O
0322  4211YN000000079PLYMOHORIZN6 7 8 0000500 +
0322  421249200000Y0000S200100000000
0322  4221YY0254GSM78SUBARSEDANN1 2 120000500 +
0322  422248100000Y0000E400 00000000

0322  5111A22135029000000000200310110300020000000000000O
0322  5211NY0220KLD73FORD SEDANY5 6 7 0000500 +
0322  5212000000000M000F00100000000
0322  5221YY0352HMB79TOYOTSEDANN1112000000500 +
0322  522261100000Y01H0W411 02309110
```

Due to lack of staff time and office space, data entry was performed under contract and was not completed until several months after the conclusion of the regular field data collection. The contractor was a former field observer who was both capable of interpreting the diagram narratives and location codes as well as actual data entry.

6.3 DATA PROCESSING

2,805 PARs were coded and returned to TSC on Radio Shack Model 100 diskettes, grouped by days. They were first converted to IBM diskettes and grouped by weeks. About five percent of the license plate numbers were found to have been improperly coded, that is, in violation of the rules detailed in Appendix 4. A BASIC program called LPFIXER (Appendix 18) was written to detect and correct them. This routine will be incorporated in future versions of the data entry program.

Once the miscodes were corrected, the subsequent processing of PAR data was handled exactly the same as the Turnpike data, except for minor alterations of the programs to account for differences in record layout. See Section 4 for details.

6.4 COSTS

PAR data costs were dominated by the expense of in-person collection by the team supervisor. At $15/hour salary plus 50 percent overhead, each day of his time cost $180. Sixty miles of driving at 20¢ per mile added $24. The average number of PARs collected per week was about 83, hence the collection cost averaged $2.43 per report.

Data entry was contracted at $1.25 per report coded with no charge for the small number (about five percent) which were not coded because they did not involve Massachusetts-registered passenger cars.

No additional hardware was required for PAR handling, but a vehicle was tied up for one day per week and a data-entry computer was engaged for about 300 hours (6 minutes per report).

6.5 RECOMMENDATIONS

By far, the greatest opportunity to improve efficiency in the PAR task is to replace in-person collection with mail. Each police department should be periodically supplied with a stock of postage-paid envelopes for this purpose. This will reduce collection costs to less than 10¢ per report.

In general, data entry clerks cannot be expected to have the ability to interpret the collision diagram, narrative and location coding. Hence, the PAR's should be marked with approprate code numbers for these difficult questions by field team members. They can then be mailed to a central facility for data entry.

The field supervisors should receive some feedback as to the number of reports being processed each week from each police department and how that compares with expected numbers. If any discrepancies arise, the supervisor should explore these with the police department by telephone first and make in-person visits only when really necessary.

7.0 HARDWARE PROBLEMS AND RECOMMENDATIONS

Over the 36 weeks of Phase I nearly three dozen specific hardware failures were experienced. Most were solved or avoided by means of minor changes in procedures or by straightforward repairs requiring less than an hour to complete. However, a few have required major changes in hardware, software or procedures. Some of these revisions are still in the experimental stage at this writing. For convenience, the discussion of hardware problems is broken down according to major equipment items. Sections 7.1 through 7.6 deal with problems which were solved. Section 7.7 treats the issue of night-time operations, for which much experimental work remains to be done at this writing.

7.1 CAMERAS

The Minolta X-700 was chosen for this project because it is the only modestly priced ($750 for complete system) unit offering a data back capable of recording time down to the second as well as arbitrary code numbers. Although the camera was generally well-liked by the data collectors, it does have certain deficiencies of which future users should be aware:

1. Film loading is more difficult than on most 35mm SLRs. Film can easily slip loose on the take-up spool if the operator is not careful to maintain tension. This problem is more severe with bulk-load film, the use of which is not recommended. Even with factory-rolled film, it is suggested that two frames be advanced with the back open. Loading is especially difficult in poor light and the incidence of loading errors rose accordingly. Auxiliary lights on goosenecks will be installed in the vans to alleviate this problem during Phase II.

2. There is no shutter priority mode on this camera. Hence, there is no means of insuring that shutter speeds will always remain fast enough for fast-moving vehicles under changing light. Programmed mode can be used only in fairly bright light, i.e, exposure values above 11.

In addition to these shortcomings, both of the X700 cameras and both of the motor drives used in Phase I experienced wear failures in their film-advance mechanisms at between 10,000 and 15,000 shots. All were repaired under warranty by Minolta. Repair times averaged four weeks, including shipping both ways. Thus, backup units are essential.

Bulk-load film was used throughout the pilot phase because it costs about 75¢ per 36-exposure roll as opposed to about $2.30 for factory-rolled film. Labor and cassettes add about 75¢ leaving a net savings of about 80¢ per roll or about $1,500 total. However, its use is not recommended in Phase II for the following reasons:

1. It is more difficult to load properly than factory-rolled film. On at least 20 occasions, data were lost because of this problem.

2. Light leaks which blurred some photos were noticed frequently.

3. Bulk-loaded cassettes have noticeably more friction than factory cassettes. This probably contributed to the wear out of parts in the motor drive mentioned above.

4. On several occasions, exposed film was ruined when bulk-load cassettes popped open in handling.

5. Loading cassettes is an exceedingly tedious task.

Battery failures in the cameras, motor drives, and data backs interrupted data collection on several occasions and ruined an entire day's work on at least one occasion. Future data collectors must be aware that as the silver-oxide cells used in the cameras and data backs approach the end of their useful life, they will still appear to be working normally in the office, i.e., at normal room temperature. If, however, they are taken out of doors into a 50°F environment, their output voltages will drop. The camera will simply stop working. Unfortunately, the data back may appear to operate normally, but in fact, its clock will run slow. Thus, it will quickly get out of synchronization with the computer clock.

Lithium batteries (used in the data back for a few months) exhibit an even more peculiar discharge curve. Their voltages vary significantly in a complex way as functions of time, current drain and temperature. They are not recommended for future use. The motor drive slows down as its alkaline cells weaken, but this is obvious and does not cause problems.

To avoid battery failure problems in the future, it is essential that batteries in the cameras and data backs be replaced on a schedule (three months recommended, but depends on rate of use) rather than only after failure is evident. Only silver-oxide cells should be in the cameras and data backs. Motor-drive batteries may continue to be replaced only when necessary.

Two other precautions must be stressed in relation to the cameras:

1. To protect the equipment from breakage, padded bags must always be used for equipment transport. Every lens should be fitted with a rubber hood, not because of glare, but simply to act as a bumper. 1A filters should also be fitted. These protect the main lens from scratches and on at least one occasion, saved a lens from being broken.

2. Operators must keep their hands clean. Any dirt or grease transferred to the interior of the camera will greatly accelerate wear. Paper towels and premoistened towelettes must be provided so that data collectors may clean their hands in the field whenever necessary.

7.2 COMPUTERS

The overall reliability of the Radio Shack Model 100 computers was excellent. Very little maintenance work was required—about one hour every three months per machine, principally for cleaning. The only faults observed were the following:

1. At temperatures above 90-95°F, the computers simply stop working. Old data and programs are not lost, but no data can be collected. Air conditioned vehicles are essential for hot-weather operations. If vehicles are left parked in the sun during hot weather for a lunch break, a cool down

period of 15 minutes or more may be needed before data collection can resume.

2. F1 and F2 key switches wore out after less than 50,000 operations on some machines. Replacement parts cost less than $2.00, but a skilled technician must perform the labor. Installing two new switches plus a thorough cleaning (using compressed air and appropriate solvents) takes about one hour.

3. At every cleaning, a substantial amount of sand (50 or more grains) was found in each machine. This accumulation, which contributes to key switch wear out, is caused by leaving machines on the floor of the van, from which static electricity draws up sand. Treating the machines with anti-static spray helps, but it is essential that observers be trained to return their machines to the bags and never left on the floor. The bags themselves should be blown out with compressed air about once per month. Vans should be vacuumed and washed at least once per month.

4. Beverages spilled into keyboards, even a few drops, can cause keys to stick intermittently. Freeing these keys requires complete disassembly of the machine—nearly one hour of labor. Data collectors should be discouraged from eating or drinking while conducting observations. Equipment should be returned to the bags and the bags zipped closed during snack and meal breaks.

7.3 CASSETTE RECORDER

Cassette recorders were used to store observations data in the field immediately after collection for three reasons: (1) the procedure is simpler than disk storage on the Model 100's, (2) the memories on the lap computers were not quite large enough to store all of the data that could be collected on a day with several high-volume sites, and (3) unexplained "crashes" were experienced which required "cold starting" the computers, a procedure which wipes out the directory. The cassette medium had been found to be reasonably reliable during pre-Phase I testing.

In practice, a significant amount, perhaps 10%, of the data collected during the first few weeeks of field operations was lost due to operator errors in using the cassette recorder. These errors included: (1) plugging connectors into wrong sockets; (2) recording on the leader; (3) recording one file on top of another; (4) failing to press and lock the record key; (5) saving the wrong file; and (6) failing to perform the cassette save at all. After the least competent employees were fired or removed from unsupervised data collection, the incidence of these errors fell to a very low level.

Throughout the summer of 1984, very few problem were encountered in recovering data from cassettes. However, in autumn, several faults began to occur in the cassette system. Unfortunately, because of staff shortage caused by an accident (discussed in Section 9.0) the data editor was detailed to data collection, site surveying and PAR-program development. Hence the unedited data cassettes were allowed to accumulate and the faults were unnoticed.

After Phase I data collection terminated in November, editing of fall season data began. It was then discovered that nearly half of the cassette files would not load properly on the first try. (The Model 100's built-in cassette handling software aborts the entire loading if even one character in a file is bad.) By making repeated attempts to load and readjusting playback level and head-amizuth alignment, many of these were ultimately recovered. Nonetheless about 15-20% of the fall data were given up as lost.

Five separate types of defects contributed to the unreliability of the cassettes, often acting in combination: (1) variation in head alignment (due to shock and vibration); (2) head wear; (3) dirt in the head gap; (4) oxide shedding from some of the tapes; and (5) off-speed readings caused by low battery voltage (recording speed dropped enough to cause problems before the low-battery warning light came on).

In Phase II, all of these problems can avoided by transferring data directly from the lap computers to PC diskettes. Software currently under development will make this process foolproof and nearly automatic. Storage of programs on PROM chips will eliminate the other reasons for field-storage on cassettes.

7.4 RADAR GUNS

No problems whatsoever were experienced with the radar guns. One of the chargers used with the radar gun batteries failed and was replaced.

7.5 CABLES, INTERFACES, AND BATTERY PACKS

By far, the most common hardware problem was cable failure, i.e, fatigue breaks in small wires near soldered connections. More than a dozen such faults were repaired during Phase I. Use of more expensive connectors and cables with better resistance to strain should reduce the frequency of these problems by about an order of magnitude in Phase II. Nonetheless, backups for every cable should be carried in the van at all times. Observers must be trained to recognize cable faults and diagnose them with the digital multi-meter.

During Phase I, the computer-camera interface circuit was installed inside a small plastic case along with a gell-cell battery which powered the computer and its night-lite. Because of the weight of the battery, this assembly was easily broken when dropped only a short distance. For Phase II, this box will be eliminated by installing the interface circuit within the shell of the RS-232 connector and drawing power from the vehicle electrical system.

7.6 VANS

During the 21,000 miles of travel accumulated on the two vans during Phase I, relatively few problems were experienced. No unscheduled maintenance was required on one of the vans. Electrical problems and tire failure resulted in some lost data collection time on the other van.

The electrical problems first manifested themselves as failure of the memory in the digital radio, which shorted and discharged the battery completely. The radio was replaced under warranty. Some months later, the battery in that van was found dead for no apparent reason. Twice more, this dead-battery condition has been observed, but the cause remains unknown. The original-equipment battery is being replaced at the time of this writing. To avoid lost time from future battery problems, it is strongly recommended that jumper cables be carried.

Tire failure occurred during an attempt to climb onto a high curb so that observations could be conducted without blocking traffic. There is no obvious way to avoid this risk, other than to use as much care as possible. Steering alignment should be checked regularly because of the extra stresses imposed by these frequent curb-climbing manuevers.

Since the emergency flashers are heavily used in these vehicles, they can be expected to wear out in six months or less. Spares should be carried at all times.

7.7 NIGHT OPERATIONS

In pre-Phase I testing, several sessions of night operations were conducted successfully on the streets of Cambridge near TSC. This area is highly unbanized and well-lit with high-pressure sodium-vapor lamps. These provide sufficient light to identify the driver's age and sex for most vehicles. Speeds above 35 mph are unusual. Traffic density is so high that most cars are being closely followed. So long as there is a following vehicle no more than 60 feet behind, adequate light for license plate photography will be provided by its headlights.

The Phase I survey area however, was predomimately suburban, bordering on rural. Only a handful of the 192 sites had bright streetlighting. Traffic densities were much lower and travel speeds much higher than in Cambridge. Most drivers could not be identified as to age or sex. There was seldom a following vehicle in the right position to illuminate the license plates. Hence, most of the records collected at night during Plase I were incomplete.

To cope with this problem, the most obvious approach would have been the use of flash photography, but this was rejected out of concern for possibly causing an accident by startling a driver. The next approach considered was infrared flash. This has been successfully used at fixed sites in the United Kingdom for both research and enforcement purposes.

Because of the very large (greater than 95 percent) light losses caused by infrared filters, a special reflector, and a high-powered strobe had to be ordered. These were received in early July. Static tests (in a parking lot) of infrared exposure parameters were conducted on July 15 (see Appendix 19 for details). These tests showed that readable plate images could be obtained over a reasonable distance.

When infrared photogrphy of moving vehicls was begun, the results were far less than satisfactory. At best, slightly more than 50% of the photographs made at a few sites were readable. Often, there was not a single readable image on an entire roll. Since the films and special processing cost more than $10 per roll, the experiment was ended when the first 10 rolls were shot.

The difficulty with infra-red photography at temporary locations is that the camera can not be aimed nor can the observers get visual feedback through the viewfinder once the infra-red filter is in place over the camera lens. Without the filter, most film is blurred by ambient visible light. The camera mount available in Phase I was not sufficently rigid to allow aiming with the IR filter off and then reinstalling it without disturbing the aim point. Finally, even with a 200-watt-second strobe and a special narrow beam reflector, there was only enough IR light available to permit a 1/125 second exposure through an F 3.0 lens. Under these conditions, blurred images were to be expected because of the very shallow depth of field and because of the movement of cars travelling at more than 30 mph.

Kodak No. 2475 high-speed surveillance film (ASA 1600) was also tried. Results were no better than with push-processed TRI-X and the cost was much higher.

The next approach to the problem of night operation required two vehicles, linked by CB radios. Figures 3.1-6 and 3.1-7 illustrate how the vans were parked at a typical site. When a vehicle approached the site, the observer in van 2 noted the driver's age and sex as he/she passed through the beam of the second van's headlights. This information was radioed to the observer in van 1. Van 1 was parked at angle of about 20° so that its headlights could illuminate the license plates of cars about 50 feet in front. Otherwise, operations were the same as during the daytime. The driver of van 2 also ran the OTRAF program.

This technique could be made to work well, with greater than 80 percent good photographs in 35-45 mph traffic. Because of the shallow-depth-of-field problem, it required much greater skill and concentration than usual, however.

It also required an opportunity to park van 2 at a perpendicular angle near the site. At most sites, the only place to park at a right angle was in someones driveway. Since this could be done only when it was obvious that the driveway would not be used (e.g. a business establishment after closing), the use of this approach was quite limited. In one instance in which this technique was applied at an intersection on a busy highway (with van 2 parked in the ditch), the state police were inundated with telephone calls reporting an accident.

In conclusion, Phase I tests showed that night-time data collection can be conducted successfully only it is possible to provide sufficient illumination from sources at the side of the road to light up both the license plates and the faces of the drivers of passing vehicles. Using two vehicles to do this is possible, but doubles vehicle costs and severely constrains site selection because of the special parking requirements for van 2.

The next experimental step is to fit the observation van with a set of spot lights capable of producing a beam about eight-feet wide at the level of a driver's face and readily adjustable to compensate for ground slope. An automatic shutter-release system is being designed to cope with the need for extreme precision in trigger timing so as to reduce the skill level required. By these means, it is hoped that a cheap, flexible technique for night-time data collection in non-urban areas can be developed for use in Phase II.

8.0 SOFTWARE AND DATA PROCESSING

Given error-free performance on the part of the human operators, all of the data collection and processing tasks of this project could be satisfied with a few rather simple BASIC programs plus the built-in text editing and communication software of the Model 100's. In reality, of course, dozens of different types of operator errors were observed, most of which can be minimized or eliminated through software enhancements. More than ten revisions were made in the MAIN approach data collection program during Phase I; almost as many were made in the OTRAF program. Numerous other shortcomings were discovered which could not be corrected without changing the output-file record layout. Changes are now being made in the software to be used in Phase II. The following sections describe the types of problems which occurred and the recommended remedial actions.

8.1 FIELD DATA COLLECTION PROGRAMS

By far, the most numerous of the required changes in the field data collection programs were those designed to prevent: (1) failure to respond to a prompt (i.e. pressing the "Enter" key without first answering a question); (2) invalid responses; (e.g. entering an "5" when only "1-4" are allowable); (3) failure to notice invalid machine-generated data (e.g. wrong settings of calendar/clock). In Phase II software, operator responses will be tested for validity to the maximum extent possible and the operators will be repeatedly prompted to verify the accuracy of computer and radar-generated data.

The most mysterious software problem in Phase I was occassional machine lockup from which the only escape was a "cold start". This necessitated reloading programs and resetting clock and calendar. Since this problem occurred infrequently, its cause was not determined until midway through the pilot study. It turned out to the result of connecting the radar gun to the computer with the power on. This action will sometimes introduce extraneous characters into the portion of RAM occupied by the data-collection program. These characters can cause lockup but do not necessarily result in the generation of error messages. To avoid this problem in the future, programs will be stored in programmable read-only memory (PROM) rather than RAM and operators will be strongly cautioned against connecting or disconnecting cables while their computers are on. The use of PROM chips will also free about 8K bytes of RAM for data storage, which is sufficient to allow the 32K byte lap computers to hold printer. Files were read in from the cassettes, appended and edited, then stored on diskettes. Although the very simple text editor built in to the lap computers provided all of the essential capabilities and was very easy to learn, it was not particularly efficient. Moreover, it did not insure that edited files were always consistent with the established format for record layouts. Nor was there any systematic way of insuring that the human operator would check every data field for validity and consistency.

The several changes of storage medium (lap computer RAM to cassette to RAM to lap computer diskette back to RAM to PC to PC diskette) provided numerous opportunities for data loss. Although software was written to automate the latter stages of the process and thus prevent errors of omission, there was no such protection in the first three transfers. Several files were lost because the data editor was distracted between completing work on a film and actually saving it to disk.

For Phase II, a dedicated editor program is being prepared to run on an PC which is expected to accomplish the following:

1. Cut editing time in half.
2. Insure that consistency of record format is maintained.
3. Insure that license numbers are entered in accordance with the special rules of each state registry of motor vehicles.
4. Insure that all required file saves are automatic.

an entire shift's data without cassette storage and all of the associated problems described in Section 7.3.

Several minor problems were evident the portion of the data-collection program which reads the radar speed data through the bar-code-reader port on the lap computers. The first of these is that the process requires about two seconds. In practice, this does not interfere with collecting data on closely spaced vehicles because the same speed can be assigned to all vehicles in a platoon simply by skipping the radar step for all but the first one. Nonetheless, this delay does complicate matters in some instances and it will be shortened if possible.

A non-linearity was also found in the original speed calculation. This has been compensated by a set of correction factors (see lines 2320-2370 of the program listed in Appendix 2). Eliminating the need for this compensation should also help shorten the delay caused be reading the radar gun.

The radar guns produce meaningless readings under several circumstances. When no vehicle is present, they display indicated speeds of about 17 miles per hour. Real vehicles traveling at less than 20 mph do not produce true speed readings. Occassionally, the radar beam experiences multiple reflections (i.e. is Doppler-shifted twice). This produces an indicated speed which is double the true speed of the vehicle. In Phase I, all of these conditions, (i.e., speeds below 21 mph or above the expected maximum) were converted to zero and printed that way in the output file. For Phase II, separate default values will be used to indicate low speed and multiple-reflection conditions, which will make possible more accurate estimates of the true speed distribution.

Finally, as discussed in the following section on data editing, a great many changes in the field data collection program are required to improve efficiency and accuracy in downstream processing. These will all be made and tested extensively before the PROMs are burned.

8.2 DATA EDITING

In Phase I, the appending of license plate numbers and all other file editing was done on a lap computer, equipped with a disk/video interface, monitor, cassette player, and

9.0 PERSONNEL

Selection and effective management of the group of field data collectors turned out to be the most critical task faced during Phase I. Most of the 15 persons hired presented one or more special problems for project management. Many of these problems resulted in lost or unuseable data, and collectively they consumed substantial amounts of management effort.

During discussions among NHTSA, TSC, MARI, and CFSI personnel, it was generally agreed that because of the abnormal working hours associated with this project, personnel recruitment might be difficult. In order to have sufficient personnel available to cover all the possible time slots, ten or more part-time workers, mostly college students, would be necessary. Recruitment was directed toward such individuals through help-wanted ads in the newspapers (see sample ad in Figure 9.0-1). The first running of the ad generated only 15 responses while the second week produced only 5 more.

FIGURE 9.0-1: Sample Recruitment Ad

Traffic Survey Observers

to work out of Lexington, Mass. on a basis of approximately 20 hours per week from March to November at a rate of $6.50 per hour. Will consider college students in the Engineering Field. Knowledge of photography helpful. Send reply to: Superior Design Co., Inc., 582 Main St., Williamsville, New York 14221.

Announcements were then posted at the placement offices of colleges in or near the survey area. Six more applicants were found through these efforts. Ten persons were selected. Of these, six were students, two recent graduates holding one or more part-time jobs, one a full-time fireman, and one unemployed and available full-time. One of the students resigned after one day of training when he realized fully the peculiarity of the working hours. The fireman also found that in practice, he could not schedule traffic observation shifts around his regular work shifts.

The remaining eight recruits completed four to eight days of training and practice as traffic observers and began data collection as scheduled on March 15, 1984.

During the first few weeks of data collection, snowfalls were frequent in the Boston area. While snow was falling, or blowing after a fall, data collection was pointless because most automobile windows and/or license plates were partially or totally obscured. More significantly, the shoulders of most roads in the survey area were covered by snowbanks, which remained well into April. These snowbanks made safe parking impossible at about half of the sites. Miscellaneous equipment problems were also frequent the first few weeks. In view of these difficulties, the relatively small amount of data being collected could be excused.

By the end of the first month of data collection, the work force had coalesced into three groups who preferred to work together. Certain patterns in work output began to emerge. The team consisting of recent graduates (who also worked together as part-time Customs Inspectors) proved reliable and conscientious. Another group (the full-timer plus two of the students) missed many of its assigned sites completely and displayed a much higher rate of operator error than the first group. Of the remaining employees (all students), one proved adept and conscientious in all phases of data collection. The others could not perform reliably without his presence as leader and MAIN observer.

Shortly after this performance disparity became apparent, it also came to light that the one full-time employee and two of the part-time employees were using project vans for personal business and annoying certain CFSI employees with whom the project shared office space. These three were summarily fired by TSC personnel.

At this point, April, 1984, there was an acute shortage of labor and many scheduled site visits were missed because of it. Recruitment of a new full-time supervisor of data collection was begun at once and accomplished on May 2. Late in May, the three part-time Customs Inspectors were promoted to full-time Inspectors and left the project. At the same time, one part-time and two additional full-timers were added through word-of-mouth. Because of their previous experience with photography, the full-timers were able to learn the procedures in two days and effectively ended the labor shortage.

From June onward, the bulk of the data collection was performed by the two full-time observers. The one student who had proved capable assumed responsibility for all data editing and processing, but continued to collect data occassionally when needed. The remaining students were permitted to work only under supervision and seldom more than 15 or 20 hours per week. All but one of them resigned by the end of the summer.

Unfortunately, on August 23, the van carrying the two full-time observers was struck in the rear by another vehicle. The accident occurred in motion, not at an observation site. Though damage to the vehicle was relatively minor and covered by the other driver's insurance, both observers suffered severe whiplash and were unable to return to work for four weeks. In their absence, the supervisor and data editor, assisted by two part-time students (one newly hired) attempted to cover the schedule as best as they could. Nevertheless, there was a substantial fall off in the quantity of useable data collected. Part of this was due to technical problems with the camera batteries (see Section 7.1) and the cassette recorder (see Section 7.3). Even after allowing for these, however, it was apparent that the substitutes never attained a high level of skill in keeping the camera properly aimed and in timing the shutter release so as to produce readable photographs of license plates consistently.

9.1 MANAGEMENT ISSUES

From the foregoing personnel history of the project, certain management issues are apparent. The first and most critical has to do with the selection process for employees. Of the first dozen hires, three had to be fired for malfeasance, five had schedule conflicts and/or other job interests, and three were only marginally competent. A much more careful selection process is clearly indicated for Phase II.

Second, evaluation of employee performance was not systematic in Phase I. Most of the supervisor's judgments were based upon direct observations of work performance in the field. While fairly effective, this process consumed a great deal of time. Determination of final performance (i.e, number of readable license plates photographed) could not be determined until editing was completed, at least two weeks later. Quantitative measures could be obtained only by hand counting because appropriate software was not available.

Third, compatibility between team mates was quite important. The cramped working conditions for eight hours at a stretch tended to bring out all possible opportunities for interpersonal conflict. The extent to which the numerous conflicts contributed to loss of data cannot be quantified, but was perceived to be quite important by supervisor and workers alike. The two observers who were by far the most productive had been lovers for years and were recently married.

Fourth, as the various shortcomings of the employees who were eventually fired came to light, there was a period of about three weeks of much discussion and uncertainty as to the proper course of action. On the one hand, it was argued that they should be given more time to shape up and more warning of dismissal and that if they were fired, there was no one immediately available to replace them. The counter argument was that they were causing so many problems and were such a demoralizing influence that the project would be better off without them even if some data collection had to be missed for a while. This decision could have come more quickly and easily had explicit guidelines been laid down in advance.

9.2 RECOMMENDATIONS

1. Much of the difficulty in personnel selection can be traced to the inadequate size of the applicant pool and the lack of explicit, objective selection criteria. In order to insure that the pool of applicants is large enough to provide several good candidates at each location for Phase II, it is desirable to allow at least six weeks (and preferably eight) between the date on which recruiting begins and the date employment begins. This will allow for several weeks of newspaper advertising and whatever additional means may be necessary.

2. A list of desired skills, academic preparation and personality traits can and should be provided to the interviewer(s). Because several of the Phase I employees exaggerated their understanding of photography, computer operations, and programming, it is desirable to administer a brief, multiple-choice test to measure understanding of computers and cameras. Personal habits, smoking, taste in music, etc. may all be important in determining whether certain individuals can work together effectively as data collectors.

3. Data collectors must possess better than average degrees of visual perception and hand-eye coordination in order to recognize two or more characteristics of a passing driver and to make three or four correct keyboard entries in the space of two seconds. An aptitude test using the Model 100 computer can and should be developed to screen applicants.

4. Quantitative measures of performance of individual employees should be incorporated into the data editing software (see Section 11 for further discussion of this issue).

10.0 TRAINING

10.1 PROCESS

The ten persons originally hired to serve as data collectors met as a group for the first time on March 5, 1984, at TSC. That was the only day on which they were ever all together. One of the original hires formally resigned that day when he fully understood the odd working hours and another said he doubted he would be able to schedule very much work. Since almost every employee was either a student or had another job, none could attend all of the eight days of planned training. Each employee had a different schedule of conflicts, so no two attended exactly the same sequence of training sessions beyond the first day. Most attended four or five days out of the schedule described below:

Day 1 -- In the first hour, new employees were introduced to TSC personnel, each other and the objective of the project. The remainder of the morning was spent on the Radio Shack 100—the uses of the function keys, loading and saving operations on cassette tapes, and clock/calendar setting. The Minolta cameras were introduced in the afternoon with most of the time spent on programming the data backs. The last two hours of the days were devoted to discussion of each employee's personal schedule and an attempt to define who could work in which time slots.

Day 2 -- The second session was also held at TSC with a morning of practice on computer usage. Cassette operations caused students the most difficulty, both because there are far more details to remember than in other computer procedures, and because the probability of successful completion is only about 0.9 even when every step is performed correctly. Students were often frustrated because of this.

In the afternoon, students were given their first experience in attempting to collect data using cameras and computers together. Since the vans had not been received, these sessions were held out of doors and were relatively brief due to sub-freezing temperatures.

Day 3 -- On the third day, training was moved to Calspan's office in Lexington. Space was no longer a problem since no more than four trainees were ever present at the same session. Students spent the day reading manuals and practicing routines on the camera and computer while TSC staff pursued adminstrative problems relating to vehicle, equipment and supply procurements.

Day 4 -- Training exercises were conducted morning and afternoon out of doors on the streets of Lexington. The use of radar was introduced.

Day 5 -- In the morning, one group of trainees practiced data collection, unsupervised. TSC staff were largely engaged with other matters. In the afternoon, a group of these trainees was introduced to the Radio Shack 100 text editor and the data editing process.

Day 6 -- By the sixth day, one of the vans was available for use. Groups of three students were sent out in it to practice data collection near Calspan's office with intermittent supervision. Trainees spent more than half their time running errands to acquire various supplies and services and moving equipment from TSC to Lexington. A set of instructions covering critical technical details was distributed to all employees. A copy appears as Appendix 20.

Day 7 -- Much like Day 6.

Day 8 -- Because of the snowbanks obstructing parking at many sites, trainees were sent to scout sites in Bedford to determine where parking was possible. In the afternoon, four students were driven to actual sites in Beford for practice.

No formal training was ever held for the six employees hired after the start of data collection. New hires rode with a team of experienced observers on their first day on the job. Since the OTRAF operator's job is so easy, new employees were assigned to that task on the second day. So long as the other observer (operating the MAIN program) was able and conscientious, this practice worked very well. In less than a week, new employees were ready to begin functioning as MAIN operators.

Tasks such as site surveying, installation of traffic counters, collection of Police Accident Reports, and data editing were learned by only one or two employees. In each case, this training occurred while TSC or CFSI personnel were performing actual data collection. Because of the severe technical problems encountered with the traffic counters, this operation was never turned over to the regular data collectors. Hence, it was never necessary to attempt to train them to diagnose and repair all of the faults encountered.

10.2 OBSERVATIONS AND RECOMMENDATIONS

From the experience gained in Phase I, the following guidelines are suggested for future training:

1. Training a large group simultaneously with one instructor is impractical. In groups of more than two, most members will not be able to see the fine details of hand movements around the camera, databack, or computer. A video training program, with appropriate close ups, will make this aspect of training much easier.

2. Lecture and demonstrations are useful only for introduction. Most of the learning takes place while actually doing the task.

3. The most efficient training seems to be one-on-one given after one or two days of introductory lecture and demonstration, coupled with observations of an experienced working team.

4. One week of total training is sufficient for field data collection procedures, given trainees of adequate intelligence and dexterity.

5. Certain individuals, even if possessing above-average intelligence, can never master the MAIN data collection procedure. Further training is wasted upon them.

6. Basic data editing procedures can be learned in two days. However, at least one employee at each Phase II location, and preferably both the data editor and the team leader, must be familiar with IBM PC DOS. If employees are not hired who already possess such knowledge, a few days of additional training time must be allowed for them.

7. Basic training in traffic counter installation and use can be done in two days. Only employees who have demonstrated aptitude for mechanical and electronic repairs should be considered for this task. One additional day for field maintenance procedures should be sufficient.

8. Team leaders will need to acquire a much larger body of knowledge than other employees. In addition to learning all of the details of the tasks performed by their subordinates, they must learn a host of other functions. These include such items as: coordination of activities with police departments; handling of time cards; hiring and firing procedures; site selection criteria; handling petty cash; establishment and payment of accounts with local vendors for vehicle fuel and service, photo processing, equipment repairs, etc. Software packages to assist supervisors in site scheduling, employee evaluation, film inventory management, etc. are being developed for Phase II. The use of these packages can be learned in a day, assuming one is already familiar with DOS.

9. Total training time for team leaders should be about three weeks, If at all possible, these individuals should already be familiar with DOS and word processing. If not, they may benefit greatly by working with tutorial packages (e.g., "Professor DOS") before arriving at TSC for training.

10. Employees selected to serve as data editors or traffic counter installers should receive a total of two weeks training at TSC—one in their specialties, and one as general data collectors.

11. A video training program (see Appendix 1 for script) coupled with on-the-job training should suffice for replacement employees. It is highly desirable, however, to arrange for an overlap period of one week so that departing workers may provide adequate one-on-one training.

12. Many site-specific problems can be expected to occur which will not be covered in training. TSC employees must remain available for in-person and telephone consultation for several months after the start of routine operations to deal with such problems.

11.0 OTHER MANAGEMENT PROBLEMS

This chapter deals with a variety of managerial and administrative problems which were confronted during Phase I. None of these consumed substantial amounts of staff time, but a brief discussion of each of them will nonetheless be useful in planning for Phase II. In rough order of importance according to the amount of time and cost associated with them in Phase I, they are: (1) scheduling of observations; (2) employee motivation and data quality control; (3) community relations; (4) budgeting; (5) vehicle logistics; (6) film processing; (7) office arrangements; and (8) communication facilities.

11.1 SCHEDULING

In Phase I, there were two major types of scheduling problems. The first was that sites had to be scheduled for specific time slots according to several criteria imposed by the sampling design. This task was performed by MARI personnel, who dispatched sheets like the one shown in Figure 3.2-1 to the field staff. These were carried in the log book and visited in the sequence specified. The system worked well with only a handful of errors due to misreading site code numbers.

However, because of the frequent missed site visits, equipment malfunctions and human errors, many sites needed extra visits for make-up data collection. This scheduling was done by the team supervisor on a manual, ad hoc basis. Sample balance may have been somewhat degraded in this process.

The most severe shortcoming of the Phase I site scheduling process is that it left too much slack time. Only five or six sites were selected for each shift because, under some conditions, no more could be handled in eight hours. However, it was not unusual for a crew to finish in less than six hours. To avoid this slack time, a more complex scheduling system which takes into consideration not only the requirements of sampling design, but also expected observation time (based on site-specific average hourly traffic density, time of day, and day of week) and driving time between sites. An appropriate scheduling program designed for use by the team leaders on an IBM PC-XT has been developed to do this.

The other sort of scheduling, matching part-time workers against workshifts, presented numerous problems early in Phase I, but disappeared latter. With about ten part-time workers, it was frequently the case that several wanted to work in certain time slots and none wanted to work at others. The supervisor(s) spent a good deal of time trying to resolve these conflicts at first. By June, nearly all data collection was being handled by two full-time observers, which largely eliminated the problem.

11.2 EMPLOYEE MOTIVIATION AND DATA QUALITY CONTROL

Although all of the persons hired during Phase I were probably intellectually capable of performing their assigned tasks, a few of them showed very little inclination to do so and another few were marginal. Achieving a satisfactory level of work from each employee is the supervisor's most important function. Among the critical elements in this function noted during Phase I are the following:

1. Willingness to acknowledge hiring mistakes and promptly fire incompetent or dishonest workers. Although firing a worker is emotionally trying and may result in lost data and/or overtime work for others, supervisors must recognize that is often the best course of action.

2. Employee understanding of project goals -- Employees, especially those who do not go through the formal training process, must understand that data collection is not a sterile exercise and that it will ultimately advance the study of accident causation and lead to a safer driving environment.

3. Performance Feedback -- Employees need to know how well they are performing, preferably in quantitative terms. In Phase I, this information could be provided only by inspection of the output data files and hand counting of the number of good photos taken, sites completed, etc., because no software had been developed for this task. The supervisor had to spend several hours per week going through files and was forced to suspend this activity during periods of labor shortage when he was serving as a data collector.

   The highest levels of productivity were attained during the summer when employee performance was being scored regularly and a competitive spirit developed to see which staff member could achieve the highest number and highest percentage of good photos or the highest percentage of assigned sites completed. Prizes, e.g, bottles of wine, were sometimes offerred to the weekly winner.

For Phase II, the data editing program has been designed to generate output files containing measures of the quantity and quality of data collected by each worker. Additional software is being developed to permit the supervisor to analyze these performance files and to summarize their contents graphically.

4. Independent checks on employee performance -- It became obvious to certain employees in Phase I that they could finish their assigned six sites in about four hours if all of the sites had high traffic density. This provided an incentive to collect data on busy streets, but identify it as being collected at the assigned low-volume sites. Clocks in the computer and camera were reset to make it appear that the data had been collected according to the schedule. Cheating of this sort can be discovered only if the supervisor makes occassional unannounced spot-checks on data collection in the field.

11.3 COMMUNITY RELATIONS

Field data collectors should expect to be interrupted by owners of property abutting the observation sites and/or local police fairly often. Once or twice a week was typical in Phase I. While most of these visitors were simply curious and most of the questioners expressed approval of the project, occassional hostility or irrationality was not unknown. Belligerent drunks demanded observers leave the scene three times. One of these men carried a gun. A woman, well known to local police as a paranoid, called them to report that five men had gotten out of the project van in front of her house and removed their pants. Early in Phase I, when three-person crews were still being used, a property owner at a very low-volume site wrote to the Director of TSC attacking the project as grossly inefficient and the crew (all Customs Inspectors) as impolite (see Appendix 20 for copy of this letter and its reply).

Although incidents of the sort mentioned above can never be eliminated, the following guidelines are suggested to minimize them:

1. Prior to the start of data collection, each police department in the survey area should be visited. The Chief, or some other senior officer, should be briefed on the purpose of the project, nature of the work, etc.

2. Press releases describing the project should be prepared for each location. These should be distributed to the local media with extra copies supplied to the police departments for internal circulation. Additional copies of the press releases should be carried by field data collectors and handed out to curious passers-by.

3. When questioned by abutting property owners, data collectors should place their computers in "pause" mode and give full and courteous answers. Requests to move off freshly planted grass, customer parking areas, etc. should be honored. When challenged by armed, drunken, or irrational individuals, observers should leave immediately and mark the log sheet for relocation of the site, if the problem situation seems likely to recur.

11.4 BUDGETING

This secton presents a breakdown of data collection and processing costs based on Phase I experiences for one survey location, but adjusted to a nominal 40 site visits per week, improved data editing software and four traffic counters.

1. Labor for Data Collection and Processing:

Item	Hours/Week	Hours/Year
field observations	80	4,160
data editing	12	624
film pickup, delivery, and sorting	4	208
traffic counting	5	260
supervision, administration, PAR's	40	2,080
equipment maintenance	5	260
miscellaneous errands	4	208
vacation and sick leave	10	520
TOTALS	160	8,320

2. Non-labor Operating Costs

	$/Year
film (2,400 rolls per year @ $2.50/roll)	$ 6,000
photo lab (2,400 rolls @ $3.00/roll)	7,200
vehicle fuel and maintenance (18,000 miles @ 11¢/mile)	1,980
office supplies and expendables	2,000
office rent (400 sq. feet @ $20/sq. foot)	8,000
equipment repairs	1,500
telephone	2,000
TOTAL	$28,680

3. Capital Items

	First Cost
Plymouth Voyager van with air conditioning	$12,000
IBM PC-XT with hard disk and peripherals	4,000
office furniture and equipment	3,000
traffic counter (4 recorders, reader, and supplies)	8,000
lap computer (3 with peripherals)	2,400
radar guns (2 with cables)	2,200
photo equipment (2 cameras, motor drives, etc.)	1,500
special equipment for night operations	500
TOTAL	$33,600

Insurance for motor vehicle accidents and equipment theft is not included above. Hence, a substantial contingency reserve, e.g., $20,000 for three locations should be allowed.

11.5 VEHICLE LOGISTICS

The two Voyager vans used in Phase I were purchased by CFSI but ownership was immediately turned over to NHTSA. This brought the vans and their drivers under DOT's blanket liability coverage policy with Aetna Insurance. Had the vehicles been registered to CFSI, a separate insurance policy would have been required. Because of the predominance of young males among the data collectors, such a policy would have carried a much higher premium than the blanket Aetna coverage. Continuance of DOT ownership is recommended for Phase II.

Vehicle fueling and maintenance were handled through a charge account set up at a local filling station. The project was fortunate in having a large and very well managed station directly across the street from its office. This made fueling and vehicle drop off for service very convenient. A special charge account, rather than a credit card, was used because this prevented unscrupulous employees from charging fuel for their personal cars to the project account.

11.6 FILM PROCESSING

The vast majority of the film shot during Phase I was either TRI-X with its standard processing or VR1000 with C41 processing. Virtually any photo finishing store will handle these. However, unsuccessful experiments were conducted with Kodak No. 2475 high-speed (ASA 1600) surveillance film and with both black-and-white and color infrared film. Best results for night observations were finally achieved using TRI-X pushed two stops in development, i.e., to ASA 1600. Unfortunately, relatively few photo finishers are willing or able to provide these special services. Most of the automatic developing machines for TRI-X cannot be slowed down sufficiently to provide speeds above ASA 1000.

Because of these special needs, project personnel found it necessary to drive eight miles to the nearest photo finisher who could provide the full range of required services. A charge account was established at this store. No significant problems in film handling or billing occurred, other than a few cassettes of bulk-loaded flim which popped open.

In Phase II, field supervisors may wish to consider using two photo finishers—one close by for standard services and a distant one for special services. Such an arrangement may be both cheaper in terms of out-of-pocket costs and may also save staff time in pickup and delivery.

11.7 OFFICE ARRANGEMENTS

CFSI provided only one room (about 200 square feet) plus partial use (about 50 square feet) of a data terminal room plus occasional use of a conference room. Two desks, a large supply cabinet, a set of book shelves, a file cabinent, and a small computer stand were crammed into the one room. Although average office occupancy was less than one person, during the periods when crews were loading or unloading, this room was decidedly crowded. The data editor was not able to get much work done during these periods. Numerous errors in data editing, map preparation, etc. were probably traceable to the distraction of conversations going on with and around the person performing these tasks. Supplies and data had to be shuffled back to TSC because there was no place to store them on site.

For Phase II operations, it is recommended that about 400 square feet of office space, preferably in two rooms, be provided at each survey location. If a larger single room must be used, acoustic partitions between work areas are suggested.

11.8 COMMUNICATIONS

Both desks used by project pesonnel were equipped with telephones wired through CFSI's call director. That call director was attended only during regular business hours. Since project personnel tend to make and receive most of their calls at the beginning or end of their shifts (approximately 6:00 a.m. or 10:00 p.m.), this arrangement was clearly unsatisfactory. Furthermore, the need for a telephone answering machine quickly became apparent. This could not be added on the call director lines because CFSI already had its own answering machine on these lines. Hence, a separate single-line service was installed exclusively for the Small Car Project. This line was fitted with a Radio Shack TAD-220 answering machine with remote control. This machine was heavily used, especially early in the project for communications among data collectors and supervisors. Purchase of such machines for Phase II teams is highly recommended.

APPENDIX 1: EXCERPT FROM THE SCRIPT OF THE VIDEO TRAING PROGRAM, "DATA COLLECTION METODOLOGY FOR CRASH-AVOIDANCE STUDIES"

This tape will describe the job of the field data collector, illustrating the set-up and operation of the "EXPOSURE DATA" methodology.

When you arrive at the office, locate the site schedule,
and assemble the data collection field equipment.

Start with a blank log sheet.

Fill in the date, names and observer # of both crew members.

One drives the van and operates the MAIN program;
the other navigates and operates the OTRAFF program.

From the site schedule, determine the sites to be observed for the day.

Note their assigned time slots.

The average day will include 5 or more sites to be observed during an eight-hour work period.

Continue to fill in the log with the street location and city of each site.

Take a databag from the storage locker
and write the date on it.

Also, gather an adequate supply of the proper type or types of film noting your withdrawals on the film inventory sheet.

Place the film and log in the databag, and put it aside until you are ready to load the van.

Assemble the field data collection equipment, starting with the MAIN equipment.

This bag should include

1 portable computer

1 6-volt battery, if outside work is scheduled

1 cable connecting computer to power supply

1 35mm camera and accessories

1 trigger cable connecting camera to computer

1 spot meter

8 AA replacement batteries for the camera motor drive

1 camera lens cleaning set

1 audiocassette with a pre-recorded back-up copy of the MAIN program.

The OTRAFF bag should include the following equipment:

1 portable computer

1 6 volt battery, if outside work is . scheduled

1 cable connecting computer to power supply

1 audiocassette with a prerecorded back-up copy of the OTRAFF program

1 portable tape recorder

1 cable connecting cassette recorder to computer.

The RADAR bag should include the following equipment:

2 radar guns

2 12 volt batteries, if outside work is scheduled

1 extension cable connecting radar gun to power supply

2 cables connecting radar guns to computers.

1 tuning fork for radar gun calibration

This equipment, along with your film and log sheet, is the bulk of your field data collection material.

 All other equipment is stored inside

the van. This includes:

tripods

safety vests

hardhats

safety reflector cones

map with site locations

area map of all cities being observed

site list & site schedule

2 flashlights

a roll of white "PUSH" stickers

battery jumper cables

CB radio

full set of back-up cables

all manuals

DOT authorization letter

van registration and insurance card

pencils

3-ring notebook containing "hard" or written copies of both programs.

spare flasher relay

nylon cord with 40' & 50' markers

fuses

If the weather is very hot or cold, start up the van at least 5-10 minutes before you are ready to leave the office. Turn on either the heater or air-conditioner. Fewer problems will be ex-perienced with the computers and camera, if the vehicle temperature is kept no lower than 50@ F., and no higher than 85@ F.

When the interior of the van has reached the desired temperature range, you may load up your primary equipment.

Before leaving the office check the answering machine or bulletin board for any new information pertaining to the equipment and/or computer programs.

Reexamine the log sheet, noting which towns you will be working in that day.

If experience has shown it necessary, notify the police departments of these communities, telling them where you will be parking, and at what time of day you will be there.

Now, gather all your field data collection equipment.

Finally, when you leave the office building,
make sure that all equipment lockers and doors have been secured.

This is particularly important for the night shift.

When loading the van,
make sure everything is stowed securely and safely.

The less bouncing and
bumping suffered by the equipment, the longer it will perform for you.

With the van loaded, you are now ready to hit the road.

Make sure all windows, especially the rear and driver's side, are clean.

The operator of the MAIN computer drives.
The operator of the OTRAFF computer navigates.

Before moving,
fasten your seat belts,
adjust both rear and side view mirrors,
lock all doors,
and make sure all equipment is stored securely, with absolutely nothing lying on the dashboard.

Check the gas gauge.
If there is less than 1/2 tank, fill it up.

Once each week have the oil, water, and transmission fluid levels checked, as well as the air pressure in the tires.

Once under way, always obey the rules

of the road, especially speed limit and use of directional signals.

It is the responsibility of the navigator to plan the specific routing by consulting the local street map stored in the van.

When you get to within half a block of the site intersection, pull over to the side of the road.

Check your manual for specific instructions regarding parking location at that site.
Once you are sure you have identified the correct parking spot, pull the van up and park as close to this location as possible.

Whenever you can, park the van completely off the road.

However, if this means parking on private property, and you are asked to move, do so.

If you must park partially or completely in the road, be sure and set-up 2-3 orange safety cones, placed about 100 feet behind the van.

Any time you leave the van and walk into the road, put on an orange safety vest.

Whether parked on or off the road, always engage your emergency flashers and keep them on for the duration of the site study.

If a particular site does not allow for parking ,
unload your equipment near the intersection,
park the van where possible,
and proceed with your data collection from outside the van.

Keep in mind that your first priority is to collect accurate data at the exact location called for.

Whether you do this from inside or outside the van is secondary, although under adverse weather conditions, certain compromises will be allowed.

Finally, double check your site list
 and the map to make absolutely sure

you are at the proper location.

If so, you are now ready to begin setting up your equipment.

The MAIN program operator sets up as follows:

Start by removing the MAIN radar gun from its travel bag.

Position the gun in the rear seat facing out the window of the rear door.

Rest the gun on its case,
or attach it to its bracket.

Aim the gun out the rear window, with an unobstructed view toward traffic moving in the same direction the van is facing; that is, the MAIN direction.

With the power switch "OFF",
plug the male end of the cable from the radar gun into its extension cable and plug that into the female receptacle on the power supply panel.

The other cable from the radar gun, which will later be plugged into the computer, should run along the left side of the driver's seat, awaiting connection to the MAIN computer.

Now, unpack the MAIN computer, resting it on your lap.

Connect the power supply cable to the computer by inserting the 25-pin plug into its socket on the back of the computer.

Then insert the power plug into the right side of the computer.
Connect the other end of this cable to the power supply panel by inserting the XLR plug into the socket nearer the driver.

With the radar gun still in the power off position, and the computer power in the off position,
connect the radar gun cable resting on the floor to the computer,
by inserting the 9-pin connector into its socket on the left side of the

computer.

At this point you have the radar gun connected to its power supply and the computer; and the computer connected to its power supply.

The final piece of MAIN equipment you will set-up is the camera.

Start by removing it from its bag.

Do this carefully, keeping the lens free from dirt and scratches.

Insert the stud of the "Magic Arm" into its mount on the A pillar of the van,
and tighten the thumb screw.

Lock the arm in the approximately correct position.

Then mount the camera on the arm.

Now reposition the arm so that the camera is aimed properly,
and the viewfinder is comfortable for you.

With the camera firmly in place, screw the shutter release cable into
its outlet
to the left of the lens.

Plug the BNC end of this cable into the BNC jack on the interface connector and secure it by twisting it clockwise.

At this point, all MAIN equipment is in place.

Now, to set up the OTRAFF equipment.

Begin by removing the OTRAFF radar gun from its travel bag.

Place the gun on the dashboard in front of you.

The gun should be aimed directly toward oncoming traffic, with an unobstructed view.

With the radar gun "OFF"
plug the already attached power cable into the power supply panel.

Next, unpack the OTRAFF computer,
resting it on your lap.

The final connection is from the base of the radar gun,
to the computer.

Fit the BNC end of the cable to the gun.

The 9-pin end plugs into the side of the computer. Do not connect this plug unless the computer power is in the off position. If left on, the computer may crash.

At this point, all OTRAFF equipment is in place.

Now both operators must synchronize the clocks on their computers with the clock on the databack on the camera. The MAIN operator sets the databack to the time mode by depressing the MODE key until the time is displayed.
First check that the databack clock is no more than one minute off from the correct time. If it is, it must be reset according to the instructions in its manual.

Next, turn on both computers.
The MENU display will show the time.
If it does not agree with the databack clock to the exact second, it must be reset. This requires entering BASIC mode on the computer.

Do this by moving the shaded rectangle with the cursor keys until it covers the heading "BASIC." Then hit ENTER.

Using the computer, type the following:

TIME$= "hh:mm:ss"

Using military time configuration, set the computers about 20 seconds ahead of real time.

Now watch the clock on the databack.

About one second before it changes to the time you have punched in, hit the ENTER key.

The times should be synchronized to within one second.

 If not, repeat this procedure until

they are.

THIS IS AN EXTREMELY IMPORTANT PROCEDURE. IF THE CLOCKS ARE NOT IN SYNCH, ALL THE DATA YOU COLLECT WILL BE UNUSABLE.

Set the databack switch to "AUTO".

Advance the mode key on the databack until the "number" mode is displayed.

Press the diamond key until all six diamonds appear.

The databack will display and transfer to film six digits.

Program these digits as follows:
- use the first two digits to denote your observer number
- use the next three digits to denote the site number
- use the last digit to denote the visit number

Now press the "diamond" key again.

The first diamond will begin to flash.

This means you can now program the first digit.

Do this by depressing the "0-9" key until you arrive at the desired number.

Once again depress the "diamond" key.

Now the second diamond will flash.

Program this digit using again, the "0-9" key.

Repeat this process until all six digits are properly numbered.

Next, adjust the exposure setting of the databack. Depress the "mode" key until the window displays diamonds. Using the "diamond" key, set one diamond for VR-1000 or push-processed TRI-X. Use two diamonds for regular TRI-X.
Now, set the ASA, or speed rating, on the camera.

During daylight hours, shoot
 B&W TRI-X film; set the ASA at 400.

At dawn or dusk, shoot VR-1000 Color film; set the ASA at 1000.

In darkness (before dawn or after sunset), shoot B&W TRI-X film, at ASA 1600. This is referred to as "pushing" the film.

All film that is pushed, should be marked by applying a white stick-on label to the outside of the film cartridge so that it can be processed correctly.
Set the shutter speed mode selector at "P" if you are shooting during fairly bright daylight.

Turn on the motor drive by moving the selector to the "S" setting.

To load film, start by opening the camera back.

Pull up on the winding arm and insert the film cartridge with the feed slot pointing to the right.

Thread the end of the film onto the film sprockets.

Now trigger the camera two times to advance the film.

Close the camera back.

Finally, advance the film two more frames by triggering the camera.

Next, you will focus your lens.

If you are using a zoom lens, zoom all the way in on your subject, and then focus.

Focus on an object in the road such as a painted line or shadow;
or focus on an object off the road such as a tree or sign.

Whatever you use to focus on, your focal subject should be 40-50 feet away.

If you have trouble estimating distance, use the nylon cord with 40 and 50 foot markers, that is stored in the van.

Double check the distance to your focal point by using the lens distance scale found on the lens itself.

You will know that you are properly focused when the top half of the circle in the viewfinder lines up with the bottom half of the circle.

To start the MAIN program:
Move the shaded rectangle with the cursor keys until it covers the heading "MAIN.BA"

Hit the "ENTER" key and you have entered the program.

The first window is to verify the time and date settings on the computer and camera. If these are correct, enter the site/visit number using the numerical keys on the computer.

Hit the "ENTER" key
to prompt the next question.

If you mistakenly hit the wrong key, you can remove your entry with the "DELETE BACKSPACE" key, as long as you do so before hitting the "ENTER" key.

If you have already hit the "ENTER" key, make a note of your improper entry on the log sheet.

"UPSTREAM" is a part of the program we use when the site being studied is a "controlled intersection."

By "controlled" we mean an intersec-= tion where traffic flow is affected by a stoplight,
stopsign,
or any other type of control factor.

The programs provide for doing UPSTREAM either before or after the main data collection, whichever is more convienent for you.

If the site being studied is a controlled intersection,
and you choose to record your UPSTREAM observations first,
hit the "Y" key,
and then "ENTER."

At this site, we will record our UPSTREAM observations after we have completed our MAIN observations.

The next five questions relate to temporary conditions at the site. Consult your manual for the code numbers that correspond to the conditions you observe.

This is asking for the number of travel lanes in the MAIN direction.

When counting make sure and include "LEFT TURN ONLY' & "RIGHT TURN ONLY" lanes.

Answer this question with your own judgement - what is the fastest expected speed for a vehicle travelling in the MAIN direction.

Enter your own observer number.

The closest lane to the curb in the MAIN direction is always LANE 1.

Moving away from the curb, the lane numbers increase. Enter the proper code numbers for lane restrictions each time this question appears.

Now, with the MODE on the databack set to the current date,
hit the "ENTER" key.

This will trigger the camera.

Change the MODE on the databack to the observer, site, and visit numbers.

Hit the "ENTER" key.

You have now recorded the date and site numbers on the film.

Finally, set the databack to the time.

Hit the "ENTER" key.

You are now starting the observation period.

Watch the traffic behind you in the rear
or side view mirror.

As soon as you see an approaching
vehicle,
hit the "ENTER" key.

This will display the vehicle speed
as taken from the radar gun.

As this vehicle passes the van,
take note of the drivers' age and
sex.

Now, lean forward and look through
the camera viewfinder.

As soon as the vehicle license plate
enters the viewfinder,
hit the appropriate "F-key"
to trigger the camera.

If the vehicle driver is male, use the
"F-1" key;
if the driver is female, use the
"F-2" key;
if the driver's sex is not discernable,
use the "F-3" key.

If the vehicle is a van or pick-up
truck, hit the
"F-4" key.
If the vehicle is a large truck,
bus,
or any other non-auto type of vehicle
hit the
"F-5" key.

Both the "F-4" and "F-5" keys will record information; however, neither
will trigger the camera.

If traffic is too dense or moving too
quickly to photograph every vehicle
that passes you,
hit the "F-6" key for every vehicle
that goes by, but isn't photographed.

Next, enter your estimate of the age
of the driver.

Use a single numerical key denoting
twenties,
thirties,
forties, etc.

What type of maneuveur did the vehicle
make at the intersection ?

Did it

proceed forward,
turn,

stop and turn,
etc.

After you enter the maneuveur,
the window will look like this,
ready for the next
vehicle observation.

When bunches of vehicles come
down the road together, it is not
necessary to hit the ENTER key
for radar readings on each one
since they are travelling at
about the same speed anyway.
Simply begin the observation with
an f-key.

Continue this process, record-
ing every vehicle that passes the van
and enters the intersection.

On busy, multi-lane roads, shoot one
roll of film for each lane.

When you complete your observations in
the first lane,
hit the "F-8_" key.

Reload the camera,
and repeat for the next lane number,
making sure to record the date, ob-
server/site/visit number on the new
roll of film.

Stay at each site for 45 minutes, or
until you have collected at least 30
observations, whichever comes first.

When you have completed all your obser-
vations at this site,
hit the "F-8" key.

Once again the UPSTREAM option will
be displayed.

Since this is a controlled intersec-
tion,
hit the "Y" key and then "ENTER."

UPSTREAM observations should be re-
corded about 1/4 mile before the ac-
tual site,
with the van facing in the same di-
rection as it was at the site.

Once parked at the UPSTREAM location,
type the word "GO" on the computer,
and hit "ENTER."

 Enter the expected maximum speed.

For each vehicle that passes the van in the MAIN direction, hit the "F1" key.

Do this until you have recorded 10 observations,'
or for a period of 20 minutes, whichever comes first. The program will stop automatically after 10 counts.
If ever necessary,
the "F-7" will put the program into "PAUSE".
To restart, simply hit the "F-7" key again.

While the MAIN program is being run by the driver, the other observer starts OTRAF by moving the shaded rectangle with the
cursor keys
until it covers the heading "OTRAF.BA"

Hit the "ENTER" key and you are in the program.

Just like the MAIN program,
the first question will ask for verification of the time and date settings on the computer and camera.

If these are correct, enter the site/visit number.

Hit the "ENTER" key,
and the window will look like this.

If UPSTREAM is required, so indicate .

The next question is asking how many travel lanes there are coming toward you from the opposite direction.

The next question is asking how many different approaches, not including the MAIN direction,
feed the intersection.

Assign each approach a number,
starting from the left and moving in a clockwise direction.

When using the OTRAF program,
these approach numbers will correspond to your F-Keys.

This intersection has ___ approaches.

This one has ___ approaches.

And this one has ___ approaches.

The opposite approach is the one directly opposed to the MAIN approach.

In this intersection, this is the opposite approach.

In this intersection, this is the opposite approach.

Answer this as you did in the MAIN program.

Enter your observer number.

Press the "ENTER" key to start the observation period.

Record each vehicle entering the intersection by hitting the F-key
that corresponds to each approach.

The F-key that denotes the opposite approach
will also record the vehicle speed.

Continue this process for the length of your stay at this site.

When you have completed your observations at this site,
hit the "F-8" key to end the program.

DIM LIGHT PROCEDURE

When shooting at a site under dim light conditions,
(EV between ___ and ___),
load the camera with color print film.

Set the ASA to 1000
and the shutter speed selector to "A"

The "A" mode will allow you to manually select the aperture setting
while the camera automatically sets the correct shutter speed.

An LED light, seen through the viewfinder, will indicate which shutter speed is in use.

Adjust the aperture by moving the aperture ring
until a shutter speed of no less than 1/250 of a second is indicated.

Shoot at a shutter speed of 1/250
whenever traffic speeds are 30 MPH or

less.

For traffic speeds greater than 30 MPH adjust the aperture until a shutter speed of 1/500 of a second is indicated.

Because the light level will be consistently changing at this time of day, you must constantly be aware of any shutter speed slowing which may occur.

Whenever the shutter speed slows down, compensate by opening up the aperture one to one-half F-STOP.

All other data collection procedure, including OTRAFF, is the same as during daylight hours.

NIGHT (total darkness) PROCEDURE

Load the camera with B&W Tri-X print film.

Normally this film has an ASA setting at 400.

When used at night, we "push" the film two stops, making the new ASA 1600.

The shutter speed should be set at 1/250 when traffic speeds are less than 30 MPH; 1/500 when traffic speeds are greater than 30 MPH.

Set the aperture to its fastest setting, usually F3.

These setting should remain constant.

Because of the lack of depth of focus created by the selected F-STOP, the camera must be triggered precisely at the exact point of focus.

Since this is such a difficult, and also important function, experimental techniques to automate shutter actuation are now under development; these will be explained to you later, in further training sessions.

The rest of the operating procedure for total darkness is the same as during daylight hours, except for the following:

'PARKING'
At night, park the van at an angle to the street so that the headlights can be used to illuminate the license plate of passing vehicles being photographed.

'DISTANCE TO SUBJECT'
In order for the van headlights to supply enough illumination for a proper film exposure, the distance from the van to the subject must be about 40 feet.

'SEX OF DRIVER'
If the MAIN program operator is having difficulty identifying the age and sex of observed drivers, use a spotter.

The spotter should be parked UPSTREAM about 100-300 feet in a second vehicle..

The spotter vehicle should be parked perpendicular to the street, using his vehicle headlights to illuminate the drivers of observed vehicles.

The spotter will report each approaching vehicle to the primary van with the CB Radio.

If this method is not used and no other source of good light is present, simply record each observation with the F-3 key, as instructed earlier.

Since night shooting means using the van headlights constantly, leave the engine running at idle to prevent battery failure.

Since film shot at night will generally record more poor images than film shot in daylight, shoot an extra roll whenever time allows.

Identify each roll of film shot at ASA 1600 with the white "push" stickers stored in the van.

When the MAIN operator has finished, the following tasks must be done:

Remove the film from the camera and store it in your databag.

Turn off the camera and motor drive.

Return the camera to its travel bag.

Each data collector should check the data files just created for accuracy and indications of malfunction. Do this by moving the menu cursor over the name of the file and pressing "enter." Then scroll down the file with the down arrow key. Check that proper codes have been entered, that speed readings are reasonable, and that no "garbage characters" are present. If any problems are evident, note them on the log and take corrective action immediately.

Turn off both computers, and radar guns.

Store your equipment in bags on the floor of the van. Most of the cables may be left connected.

Never leave anything on the dashboard.

Never leave a computer or camera directly on the floor; sand and dirt from the carpet will damage the equipment.

Before moving, make sure your film from this site has been stored in the databag.

Complete the log information for this site.

Note any unusual traffic or road conditions which may have affected your data, such as road work, or a lane closing.

Also note any equipment or vehicle problems you have encountered.

Proceed to the next site, and repeat this entire process.

When you have finished observing the last site for the day,
start breaking down the equipment by turning everything "OFF."

This includes the computers,
camera and motor drive,
the radar guns,
and any accessories you may have used.

Next, unplug the "power supply" end of each cable.

Return each piece of equipment ot its original bag or case.

During the ride back to the office, the OTRAFF operator should double check the film, making sure it is all in the databag;
as well as make sure the log has been fully completed.

Back at the office,
unload all the field data collection equipment.

Transfer your data from the portable computers,
to the office PC.

Next, return all the equipment to its storage locker.

Lock it.

Put the databag with your film and log sheet in a dated manila folder,
and file it in the file cabinet.

Indicate on the folder the date and whether from an AM or PM session.

Check the battery charging schedules and connect portable batteries to their chargers as required.

Before you leave the office, lock all doors and turn off all lights.

Return to the van and park it in its proper parking space.

Lock it before you leave.

APPENDIX 2: "MAIN.BA," DATA COLLECTION PROGRAM FOR THE MAIN APPROACH TO AN INTERSECTION WRITTEN FOR THE RADIO SHACK MODEL 100 LAP COMPUTER

```
1 REM "MAIN.BA" REVISED 8/23/84
2 CLEAR: CLEAR 100,61180
3 MAXFILES = 3
5 K=61184
6 READ M
7 IF M<0 THEN 20
8 POKE K,M
9 K=K+1
10 GOTO 6
11 DATA 243,245,197,213,229,  1,50,  0, 17, 68
12 DATA 239,197,205, 31,239,193,125, 18, 19,124
13  DATA  18, 19, 11,120,177,194, 11,239,195, 60
14  DATA 239,219,179,230,  8,202, 31,239,  1,  0
15  DATA   0,  3,219,179,230,  8,194, 41,239,  3
16  DATA 219,179,230,  8,202, 49,239,197,225,201
17  DATA 225,209,193,241,251,201
18 DATA -1
20 INPUT "WAS RADAR GUN CONNECTED WITH POWER OFF?  IF SO, ENTER SITE/VISIT
NUMBER";SN$
21 FN$="RAM:T"+SN$+".DO"
22 OPEN FN$ FOR APPEND AS 1
23 PRINT#1,"*SITE/VISIT NUMBER="SN$:PRINT#1,"*MAIN APPROACH, TEMPORARY
HEADER, TURNS PROGRAM"
24 PRINT#1,"*DAY/DATE=";DAY$,DATE$
25 INPUT"SURFACE CONDITION";SC:PRINT#1,"*SURFACE CONDITION=";SC
26 INPUT"ROAD CONDITION";RC:PRINT#1,"*ROAD CONDITION=";RC
27 INPUT"LIGHT CONDITION";LC:PRINT#1,"*LIGHT CONDITION=";LC
28 INPUT"WEATHER CONDITION";WC:PRINT#1,"*WEATHER CONDITION=";WC
29 INPUT"UPSTREAM NOW(Y/N)";U$:IF U$="Y"OR U$="y" THEN 3000
30 INPUT"PARKED CARS";PC:PRINT#1,"*PARKED CARS=";PC
31 INPUT"LANES IN USE";LU:PRINT#1,"*LANES IN USE=";LU
32 INPUT"LANE 1 RESTRICTIONS";L1:PRINT#1,"*LANE 1 RESTRICTIONS=";L1
33 INPUT"LANE 2 RESTRICTIONS";L2:PRINT#1,"*LANE 2 RESTRICTIONS=";L2
34 INPUT"LANE 3 RESTRICTIONS";L3:PRINT#1,"*LANE 3 RESTRICTIONS=";L3
35 INPUT"LANE 4 RESTRICTIONS";L4:PRINT#1,"*LANE 4 RESTRICTIONS=";L4
36 PRINT#1,
41 INPUT "LANE NUMBER";LN:PRINT#1,"*LANE NUMBER=";LN:P=0
45 INPUT"MAXIMUM EXPECTED SPEED";MS
46 PRINT#1,"*MAX EXPECTED MAIN SPEED=";MS
50 INPUT "OBSERVER NUMBER";OB:PRINT#1,"*OBSERVER NUMBER=";OB
51 INPUT"SET CAMERA MODE TO DATE.                PRESS enter TO TRIGGER
SHUTTER";X:GOSUB 600
53 INPUT"SET CAMERA OB/SITE/VISIT NUMBER.        PRESS enter TO TRIGGER
SHUTTER.";X:GOSUB 600
54 INPUT"SET CAMERA MODE BACK TO TIME.           PRESS enter TO START";Y
55 PRINT #1,"*STARTING TIME=";TIME$
56 ST$=TIME$
70 CLS:KEY ON:IF P>30 THEN GOTO 900
71 PRINT"CARS PHOTOGRAPHED = "; P
72 PRINT"CURRENT TIME IS   ";TIME$
73 PRINT"STARTING TIME WAS ";ST$
74 PRINT"PRESS enter FOR RADAR OR f-key FOR TYPE"
75 Y$=INKEY$:IF Y$="" THEN 75
```

```
76 IF Y$=CHR$(13) THEN GOSUB 1000
80 PRINT"VEHICLE TYPE?"
90 ON KEY GOSUB 100,200,300,400,500,610,700,800
91 GOTO 90
97 PRINT "VEHICLE TYPE?"
100 BEEP:X$=INKEY$:X$=INKEY$:X$=INKEY$
109 GOSUB 600
110 V$(I)="1":T$(I)=TIME$:S(I)=1
123 PRINT "AGE?"
124 A$(I)=INKEY$
125 IF A$(I)="" THEN 124
126 BEEP
127 PRINT"MANEUVER?":PRINT"1=,2=S+,3=,4=S+,5=,6=S+,7=,8=S+
130 TC$(I)=INKEY$:IF TC$(I)="" THEN 130
131 BEEP
135 PRINT #1,USING "          \  \ \       \ \\#
\\\\##";SN$,T$(I),V$(I),S(I),A$(I),TC$(I),SP(I)
140 P=P+1:GOTO 70
200 BEEP:X$=INKEY$:X$=INKEY$:X$=INKEY$
209 GOSUB 600:V$(I)="1":T$(I)=TIME$:S(I)=2
223 PRINT "AGE?"
224 A$(I)=INKEY$
225 IF A$(I)="" THEN 224
226 BEEP
227 PRINT"MANEUVER?":PRINT"1=,2=S+,3=,4=S+,5=,6=S+,7=,8=S+
230 TC$(I)=INKEY$:IF TC$(I)="" THEN 230
231 BEEP
235 PRINT #1,USING "          \  \ \       \ \\#
\\\\##";SN$,T$(I),V$(I),S(I),A$(I),TC$(I),SP(I)
240 P=P+1:GOTO 70
300 BEEP:X$=INKEY$:X$=INKEY$:X$=INKEY$
309 GOSUB 600:V$(I)="1":T$(I)=TIME$
327 PRINT"MANEUVER?":PRINT"1=,2=S+,3=,4=S+,5=,6=S+,7=,8=S+
330 TC$(I)=INKEY$:IF TC$(I)="" THEN 330
331 BEEP
335 PRINT #1,USING "          \  \ \       \ \\
\\##";SN$,T$(I),V$(I),TC$(I),SP(I)
340 P=P+1:GOTO 70
400 BEEP:X$=INKEY$:X$=INKEY$:X$=INKEY$
410 V$(I)="2":T$(I)=TIME$
430 PRINT #1,USING "          \  \ \       \ \\";SN$,T$(I),V$(I)
450 GOTO 70
500 BEEP:X$=INKEY$:X$=INKEY$:X$=INKEY$
504 PRINT"OTHER TYPE?"
505 PRINT"      3=HEAVY SINGLE TRUCK"
506 PRINT"      4=COMBINATION TRUCK"
507 PRINT"      5=BUS"
508 PRINT"      6=ALL OTHERS"
515 V$(I)=INKEY$:IF V$(I)=""THEN 515
516 BEEP:T$(I)=TIME$
530 PRINT #1,USING "          \  \ \       \ \\";SN$,T$(I),V$(I)
550 GOTO 70
599 REM SUB TO RAISE PIN 4 OF RS-232        HIGH FOR 100 MSEC
600 KEY OFF: OPEN"COM:37I1E" FOR OUTPUT AS 2
601 FOR J=1 TO 50:NEXT J:CLOSE2
604 KEY ON:RETURN
610 PRINT #1,"??????  ";SN$;" ";TIME$
611 GOTO 70
700 IF TC=7 THEN 770
760 PRINT#1,"*PAUSE AT:";TIME$
```

```
762 TC=7:CLS:PRINT"PAUSE MODE, PRESS F7 TO RESTART":KEYON:GOTO 90
770 PRINT#1,"*RESTART AT:";TIME$
771 TC=6:GOTO 70
800 PRINT#1,"*OBSERVATIONS COMPLETED AT:";TIME$:PRINT"OBSERVATIONS
COMPLETED IN LANE";LN;"        AT SITE/VISIT # ";SN$
810 LU=LU-1:IF LU>0 THEN GOTO 860
820 M$="Y":IF U$<>"Y"THEN 840
830 END
840 INPUT"IS UPSTREAM REQUIRED(Y/N)";Q$
841 IF Q$="Y" OR Q$="y"THEN 850
842 IF Q$="N" OR Q$="n"THEN END
843 IF Q$="" THEN 840
850 PRINT"PROCEED TO UPSTREAM LOCATION. LEAVE     COMPUTER ON.  TYPE "
CHR$(34)"GO"CHR$(34)" WHEN READY"
855 INPUT"READY";R$:IF R$="GO" OR R$="go" THEN 3000
856 GOTO 840
860 PRINT#1,:GOTO 41
900 PRINT"END OF ROLL":P=0:GOTO 90
1000 CALL 61184 : GOTO 2000
1009 FOR X = 61184 TO 61250
1100 L=PEEK(X)
1200 X1=INT(L/16) : X2=L-16*X1
1300 PRINT
MID$("0123456789ABCDEF",X1+1,1);MID$("0123456789ABCDEF",X2+1,1);"  ";
1400 NEXT X
1500 STOP
2000 U=0:Z=0:FOR X = 61272 TO 61292 STEP 2
2100 Z=Z+PEEK(X)+256*PEEK(X+1)
2200 U=U+1
2300 GS(I)=11140/(14*Z/U)
2310 IF GS(I)<16 THEN RS(I)=0
2320 IF GS(I)>=16 AND GS(I)<30 THEN RS(I)=GS(I)+3.23
2330 IF GS(I)>=30 AND GS(I)<40 THEN RS(I)=.91*GS(I)+5.6
2340 IF GS(I)>=40 AND GS(I)<50 THEN RS(I)=.81*GS(I)+9.34
2350 IF GS(I)>=50 AND GS(I)<60 THEN RS(I)=.72*GS(I)+13.97
2360 IF GS(I)>=60 AND GS(I)<70 THEN RS(I)=.64*GS(I)+19.25
2370 IF GS(I)>=70 AND GS(I)<80 THEN RS(I)=.57*GS(I)+24.99
2380 IF GS(I)>=90 THEN RS(I)=0
2400 NEXT
2450 PRINT"SPEED=";:PRINT USING"##";RS(I):BEEP
2460 IF 22<RS(I) AND RS(I)<MS THEN SP(I)=RS(I) ELSE SP(I)=0
2700 RETURN
3000 PRINT#1,"*UPSTREAM SPEED DATA:"
3010 INPUT"WAS RADAR GUN CONNECTED WITH POWER OFF? IF SO,  PRESS enter TO
START";Z
3015 C=0:I=0
3016 INPUT "MAXIMUM EXPECTED SPEED";MS
3017 PRINT#1,"*MAX EXPECTED UPSTREAM SPEED";MS
3020 PRINT#1,"*STARTING TIME=";TIME$
3030 BT$=TIME$
3100 CLS:KEY ON
3110 IF C>10 THEN 3300
3120 PRINT"STARTING TIME WAS:";BT$
3130 PRINT"CURRENT TIME IS:  ";TIME$
3160 PRINT"PRESS f1 TO RECORD A SPEED IN THE MAIN  DIRECTION"
3170 ON KEY GOSUB 3200,,,,,,,3300
3180 GOTO 3170
3200 BEEP: GOSUB 1000
3210 PRINT#1,USING"!  ##";"*",SP(I)
3220 PRINT"SPEED=",SP(I)
```

```
3230 C=C+1:I=I=1
3250 GOTO 3100
3300 KEY OFF:PRINT"UPSTREAM DATA COLLECTION ENDED AT SITE ";SN$
3310 PRINT#1,"*UPSTREAM DATA COLLECTION ENDED:";TIME$
3320 PRINT#1,:IF M$="Y"THEN END
3330 PRINT"PROCEED TO MAIN SITE. LEAVE COMPUTER ON.  TYPE
"CHR$(34)"GO"CHR$(34)" WHEN READY"
3335 ON KEY GOSUB
3340 INPUT"READY";G$:IF G$="GO" OR G$="go" THEN 3350
3345 GOTO 3330
3350 GOTO 30
```

APPENDIX 3: "OTRAF.BA," DATA COLLECTION PROGRAM FOR THE OTHER APPROACHES TO AN INTERSECTION WRITTEN FOR THE RADIO SHACK MODEL 100 LAP COMPUTER

```
1 REM "OTRAF.BA, OPPOSITE SPEED & OTHER APPROACHES PROGRAM,
REVISED 8/11/84"
2 CLEAR 100,61180
3 MAXFILES=3
4 DIM SP(55),S1(55)
5 K=61184
6 READ M
7 IF M<0 THEN 20
8 POKE K,M
9 K=K+1
10 GOTO 6
11 DATA 243,245,197,213,229,  1,50,  0, 17, 68
12 DATA 239,197,205, 31,239,193,125, 18, 19,124
13  DATA  18, 19, 11,120,177,194, 11,239,195, 60
14  DATA 239,219,179,230,  8,202, 31,239,  1,  0
15  DATA   0,  3,219,179,230,  8,194, 41,239,  3
16  DATA 219,179,230,  8,202, 49,239,197,225,201
17  DATA 225,209,193,241,251,201
18 DATA -1
20 INPUT"ENTER SITE/VISIT NUMBER";SN$
21 FN$="RAM:O"+SN$+".DO":FA$="RAM:A"+SN$+".DO"
22 OPEN FN$ FOR APPEND AS 1:OPEN FA$ FOR APPEND AS 2
23 PRINT#1,"*SITE/VISIT NUMBER=";SN$:PRINT#2,"*SITE /VISIT NUMBER=";SN$
24 PRINT#1,"*OPPOSITE APPROACH,TEMPORARY HEADER, SPEED
PROGRAM":PRINT#2,"*OTHER APPROACHES,TEMPORARY HEADER, COUNTING PROGRAM"
25 PRINT#1,"*DAY/DATE=";DAY$,DATE$:PRINT#2,"*DAY/DATE=";DAY$,DATE$
29 INPUT"UPSTREAM NOW(Y/N)";U$:IF U$="Y" THEN 3000
30 INPUT "LANES IN USE";LU:PRINT#1,"*LANES IN USE=";LU
35 INPUT"APPROACHES IN USE";AU:PRINT#2,"*APPROACHES IN USE=";AU
45 INPUT"MAXIMUM EXPECTED SPEED";MS:PRINT#1,"*MAX EXPECTED SPEED=";MS
50 INPUT"OBSERVER NUMBER";OB:PRINT#1,"*OBSERVER
NUMBER=";OB:PRINT#2,"*OBSERVER NUMBER";OB
55 INPUT"press ENTER to start";X$
60 PRINT#1,"*STARTING TIME=";TIME$:PRINT#2,"*STARTING TIME=";TIME$
62 PRINT#1,"*OPPOSITE SPEEDS:"
65 I=1
70 CLS:KEY ON
71 IF I=51 OR I>51 THEN KEY (5) OFF:PRINT"OPPOSITE SPEED COMPLETE"
74 PRINT"OTHER APPROACHES  f1 f2 f3 f4"
75 PRINT"VEHICLES COUNTED:";C1;C2;C3;C4
80 PRINT"ENTER COUNT":PRINT
81 PRINT"OPPOSITE SPEED f5"
82 PRINT"VEHICLES COUNTED:";C5
83 PRINT"ENTER COUNT"
84 IF I=51 OR I>51 THEN PRINT"OPPOSITE SPEED COMPLETE"
90 ON KEY GOSUB 100,200,300,400,500,600,700,800
91 GOTO 90
92 PRINT"ENTER COUNT"
100 BEEP:X$=INKEY$:X$=INKEY$:X$=INKEY$
130 C1=C1+1
140 GOTO 70
200 BEEP:X$=INKEY$:X$=INKEY$:X$=INKEY$
230 C2=C2+1
240 GOTO 70
```

```
300 BEEP:X$=INKEY$:X$=INKEY$:X$=INKEY$
330 C3=C3+1
340 GOTO 70
400 BEEP:X$=INKEY$:X$=INKEY$:X$=INKEY$
430 C4=C4+1
440 GOTO 70
500 BEEP:X$=INKEY$:X$=INKEY$:X$=INKEY$
516 GOSUB 1000
520 PRINT#1,USING"! ##";"*",S1(I)
530 C5=C5+1
535 I=I+1
540 GOTO 70
600 PRINT#1,"*PAUSE AT:";TIME$
610 PRINT"PAUSE MODE, PRESS F7 TO RESTART"
620 GOTO 90
700 PRINT#1,"*RESTART AT:";TIME$
710 GOTO 70
800 PRINT#1,"*OPPOSITE SPEED OBSERVATIONS COMPLETED AT:";TIME$
805 PRINT" observations complete"
807 PRINT#1,"*TOTAL VEHICLES:"
810 PRINT#1,USING"! ##";"*",C5
823 PRINT#2,"*OBSERVATION COMPLETE AT:";TIME$
824 PRINT#2,"*TOTAL VEHICLES BY APPROACH:"
825 PRINT#2,"*APPROACH1   APPROACH2   APPROACH3   APPROACH4"
826 PRINT#2,USING"!   ##          ##          ##          ##";"*",C1,C2,C3,C4
828 M$="Y":IF U$<>"Y"THEN 840
830 END
840 INPUT"IS UPSTREAM REQUIRED(Y/N)";Q$
841 IF Q$="LIST" THEN 840
842 IF Q$="Y" THEN 850
843 IF Q$="N" THEN END
844 IF Q$="" THEN 840
850 PRINT"PROCEED TO UPSTREAM LOCATION. LEAVE     COMPUTER ON.  TYPE "
CHR$(34)"GO"CHR$(34)" WHEN READY"
855 INPUT"READY";R$:IF R$="GO"THEN 3000
860 IF R$="LIST"THEN 840
1000 CALL 61184 : GOTO 2000
1009 FOR X = 61184 TO 61250
1100 L=PEEK(X)
1200 X1=INT(L/16) : X2=L-16*X1
1300 PRINT
MID$("0123456789ABCDEF",X1+1,1);MID$("0123456789ABCDEF",X2+1,1);"  ";
1400 NEXT X
1500 STOP
2000 U=0:Z=0:FOR X = 61272 TO 61292 STEP 2
2100 Z=Z+PEEK(X)+256*PEEK(X+1)
2200 U=U+1
2300 SP(I)=2.3+25800/(12.8*Z/U)
2400 NEXT
2450 PRINT"SPEED=";:PRINT USING"##";SP(I):BEEP
2460 IF 22<SP(I) AND SP(I)<MS THEN S1(I)=SP(I) ELSE S1(I)=0
2700 RETURN
3000 BEEP:PRINT#1,"*UPSTREAM SPEED DATA:"
3010 INPUT"CONNECT RADAR & PRESS enter TO START";Z
3015 C=0:I=0
3016 INPUT "MAXIMUM EXPECTED SPEED";MS
3017 PRINT#1,"*MAX EXPECTED UPSTREAM SPEED";MS
3020 PRINT#1,"*STARTING TIME=";TIME$
3030 BT$=TIME$
3100 CLS:KEY ON
```

```
3101 IF C=10 THEN 3310
3102 PRINT"VEHICLES COUNTED:";C
3110 PRINT"STARTING TIME WAS:"BT$
3130 PRINT"CIRRENT TIME IS:  ";TIME$
3140 PRINT"ENTER COUNT"
3170 ON KEY GOSUB 3200,,,,3300,3301,3310
3180 GOTO 3170
3200 BEEP: GOSUB 1000
3210 PRINT#1,USING"!  ##";"*",SP(I)
3220 PRINT"SPEED=",SP(I)
3230 C=C+1:I=I+1
3250 GOTO 3100
3300 PRINT#1,"*PAUSE AT:";TIME$
3301 PRINT#1,"*RESTART AT:";TIME$
3310 PRINT#1,"*UPSTREAM DATA COLLECTION ENDED:";TIME$
3320 PRINT#1,"*TOTAL VEHICLES:"
3325 PRINT#1,USING"! ##";"*",C
3326 IF M$="Y" THEN END
3327 PRINT#1,
3330 PRINT"PROCEED TO MAIN SITE. LEAVE COMPUTER ON.  TYPE
"CHR$(34)"G"CHR$(34)"WHEN READY"
3340 INPUT"READY";G$:IF G$="G" THEN 3350
3345 GOTO 3330
3350 GOTO 30
5000 END
```

APPENDIX 4

RMV INQUIRY

TECHNICAL SPECIFICATIONS

I. General Information

A. The Registry of Motor Vehicles will process queries or lookups of registration records in machine readable form or based on specific information contained within its registration records.

B. Current State regulations require the RMV to charge a fee for any computerized output.
   1. A fee will be charged for each transaction according to the following schedule:
      a. $200 for the first one thousand records or fraction thereof and $30 for each additional thousand or fraction thereof.
         1. Currently, there are over four million records on the Registration Data Base.
      b. Transaction is defined as a single, separate computer run.
   2. Payment of fee is by check only. Checks are to be made out to, "Registry of Motor Vehicles" and, the notation "RMV INQUIRY PROGRAM" is to appear on the face of the check.
   3. All transactions are C.O.D.. Payment must be received before completed work will be released.
      a. If work is to be mailed out, postage must be received in advance and can not be included in the same check.

C. Each transaction is to be submitted to the Registry of Motor Vehicles; 3rd Floor Computer Room; 100 Nashua Street; Boston, MA 02114, and should include:
   1. A formal written request containing:
      a. A detailed explanation of what you are requesting.
         1. Match specific registration or VIN numbers from input tape.
         2. Selection of specific data contained within the registration data base itself; for example:
            a. All records whose town code is 001, 012, 321, 351,...etc., (see Attachment "B" for list of Town Codes)
            b. All 1981 Chevrolets
            c. All records with a registration number whose last numeric digit is "5".

            ...etc., and/or anything else that can be determined from the information contained within the registration file.

b. The name and the telephone number of the person to be contacted when the job is completed or if there are any questions.

2. Input tape(s) (properly marked with stick-on labels as noted in instructions) <u>if</u> required.
3. Output tape(s) (properly marked with stick-on labels as noted in instructions).

II. Query or Lookup Types:

A. Specific registration numbers or specific vehicle identification numbers.
  1. <u>Input tape(s) required</u>. These lookups will be processed in machine readable form only.
    a. Machine readable form means magnetic tape only.
      1. Input tapes must be clean 1200 or 2400 foot reels
      2. 9 track
      3. 1600 BPI
      4. ASCII
      5. ANSI standard tape labels
        a. File-id "RMV-INQUIRY-INP"
        b. File sequence 0001
      6. 25 character records
      7. 204 records per block
      8. Stick-on label should clearly mark the outside of the tape(s) for easy identification by RMV personnel (i.e.; "Name of Purchaser", "RMV-INQUIRY-INPUT", "1 of __")
  2. Input record format:

Character Positions	Field Name	Description
1	Blank	Registry Use
2-8	Registration Number	Registration number assigned to vehicle (see attachment "A")
9-25	Vehicle Identification Number	Left Justified

    a. If registration number search, the VID information in character positions 9-25 will be blank.
    b. If vehicle identification search, the registration number information in character positions 2-8 will be blank.
    c. Both Fields are character mode.

B. General registration information, the output is determined from information contained within the data base itself.
  1. <u>No input tape (s) required</u>. Request is based on specific requirements stated in your formal written request.

III. Query Output Types:

A. Continuous standard 1-part computer paper.
   1. Up to 1 case only.

B. Magnetic Tape.
   1. Tape-General Description;
      a. Output tapes must be clean 1200 or 2400 foot reels
      b. 9 track
      c. 1600 BPI
      d. ASCII
      e. ANSI standard tape labels
         1. File-id "RMV-INQUIRY-OUT"
         2. File-sequence 0001
      f. 228 character record
      g. 22 records per block
      h. Stick-on label should clearly mark the outside of the tape(s) for easy identification by RMV personnel (i.e.; "Name of Purchaser", "RMV-INQUIRY-OUTPUT", "1 of __")
   2. Tape record layout:
      a. All fields that are not completely filled are left justified.
      b. All fields are character mode.

Character Positions	Field Name	Description
1	Blank	Registry Use
2-8	Registration Number	Registration number assigned to vehicle. See attachment "A"
9-40	Name	Last Name, first name, middle initial
41-57	Residential Street Address	
58-72	Residential City or Town	
73-75	Town Code	See attachment "B"
76-80	Registration Date	Date of registration shown as MDDYY. Month is coded A thru L A=Jan.. B=Feb. etc.

Character Positions	Field Name	Description
81-89	Residential Zip	Owner Residential Zip Code-(When Available)
90-121	Joint Owner Name	Name of second owner where applicable. Format same as owner's name.
122-138	Mail Street Address	
139-153	Mail City of Town	
154-162	Mail Zip	(When Available)
163-164	Model Year	
165-169	Make of Vehicle	First five letters of name. EXAMPLE: Chevrolet-CHEVR Pontiac-PONTI
170-175	Model Name	
176-181	Model Number	
182	Type Vehicle Code	1. Coupe 2. Sedan 3. Station Wag. 4. Convertible 5. Hardtop 6. Limousine 7. Other (including Buses & Ambul) 8. Truck O. Motorcycle T. Trailer
183	Number of Cylinders	
184	Number of Passengers	
185	Number of Doors	
186-202	Vehicle Identification Number	
203	Fuel Type	D=Diesel E=Electric G=Gas O=Other
204	Transmission	1=Automatic 2=Other
205	Registration Status Code	
206-210	Date of Status Update	

Character Positions	Field Name	Description
211-213	Expiration Date	Year and Month of plate expiration shown as YYM. Month is coded A thru L. A=Jan. B=Feb. etc.
214	Vehicle Color-Major	1. Black 5. Yellow 9. Purpl 2. Blue 6. Green 3. Brown 7. White 4. Red 8. Grey
215	Vehicle Color-Minor	
216-218	Insurance Code	Code to indicate insurance company. See Attachment "C"
219-225	Title Number	
226-228	Weight	Weight of Vehicle in hundreds of pounds. (Primarily for Trucks & Trailers)

NUMBER PLATE CODES

- REGISTRATION NUMBER DATA ENTRY INSTRUCTIONS -

1. The registration number field now contains 7 characters.

2. All special characters have been dropped (Except Vanity and Ham Plates)

3. All 7 positions in the field must be filled. (Zero Fill)

4. Key enter as follows:

   (a) Regular 1 to 6 digit plates - Right adjusted, zero filled in to left.
   EXAMPLES: ØØØØØØ1, ØØØØ123, ØØØ1234, Ø123456

   (b) Lettered Series - Preface with Letter, digits right adjusted, zeros filled to Letter.
   EXAMPLES: H000003, K000123, K012345

   (c) Series with letter at end of number - Right adjusted, zeros left.
   EXAMPLES: ØØØØØ1H, ØØØ123H, ØØØØ12K

   (d) Double Prefix - Left zero filled -
   EXAMPLES: ØØØØ3F2, ØØØØ1A1, ØØØØ2A2

   (e) Three numeric and three alpha series -
   EXAMPLES: Ø123ABC, Ø678BAC, Ø126CBA

   (f) Special Series Codes:

AMBULANCE	AMB----
ANIMAL AMBULANCE	ANI----
ANTIQUES	ANT----
ANTIQUE MOTOR CYCLES	ANMC---
BUS	BU-----
CAMPER	CA-----
CONSULAR CORPS	CONS---
DISABLED VETERAN'S	V------
DOCTOR	MD-----
EX PRISONERS OF WAR	XPØW----

EMERGENCY VEHICLES	EMR----
FIREMEN	FIR----
GOVERNOR'S COUNCIL	GC-----
HANDICAPPED PERSON (HP OR WHEELCHAIR LOGO)	HP-----
HAM RADIO OPERATOR	ØØW1/AB (LEFT ZERO FILLED) WA1/ABC (SLASH MUST BE KEYED FOR LIGHTNING BOLT)
HEARSE	HR-----
HOUSE MEMBER	HOUS---
MASS BAY TRANSIT AUTHORITY (T ON PLATE)	MBT----
MET DISTRICT COM	MDC----
MET DISTRICT COM CYCLES	MDCM---
MOTORCYCLES	AX----- BX----- CX-----BK----- etc
MUNICIPAL	M------
MUNICIPAL POLICE CYCLES	MMC----
NEWS PHOTOGRAPHER	NP-----
POLICE	MP-----
REGISTRY	REG----
REGISTRY MOTORCYCLES	RMC----
SCHOOL BUS	SB-----
SENATE MEMBER	SENAT--
STATE	ST-----
STATE POLICE	SP-----
TAXI	TA-----
TRAILERS	T------ TL----- TN----- TT----- TR----- TY-----
TRUCKS (COMMERCIAL VEHICLES)	A------ B------ C------ AA----- AB----- AC----- AD----- BB----- AE----- AH Ø AI
TRUCK (ON PLATE)	TK-----

UNITED STATES CONGRESS	USC----	
UNITED STATES SENATE	USS----	
VANITY PLATES:		
MIKE	ØØØMIKE	(LEFT ZERO FILLED)
MIKE·12	MIKE-12	(PERIOD OR DOT MUST BE INCLUDED BUT KEYED AS DASH)
AB·CD	ØØAB-CD	
ABCD	ØØØABCD	
VETERAN OF FOREIGN WARS	VFW----	
SINGLE LETTER PLATES	ØØØØØØA	ØØØØØØB etc. (LEFT ZERO FILLED)
CAPITOL POLICE	CAPT----	
NATIONAL GUARD	NG-----	
** SPECIAL SERIES (O ALPHA)	O------	EXAMPLE: OØØØØ27
** SPECIAL SERIES (OO ALPHA)	OO-----	EXAMPLE: OOØØØ28

SPECIAL BUS SERIES

PIONEER VALLEY TRANSIT AUTHORITY	PVT----
BROCKTON TRANSIT AUTHORITY	BAT----
SOUTHEAST REGIONAL TRANSIT AUTHORITY	SRT----
BERKSHIRE REGIONAL TRANSIT AUTHORITY	BRT----
WORCESTER REGIONAL TRANSIT AUTHORITY	WRT----
FRANKLIN REGIONAL TRANSIT AUTHORITY	FRT----
ATTLEBORO REGIONAL TRANSIT AUTHORITY	ATT----

APPENDIX 5: STRFIL.FOR, A FORTRAN PROGRAM TO FORMAT LICENSE PLATE NUMBERS TO MASSACHUSETTS RMV SPECIFICATIONS

```
C         THIS PROGRAM IS WRITTEN FOR THE SMALL CAR EXPOSURE
C         PROJECT.  ITS FUNCTION IS TO READ INPUT DATA FROM
C         DISK, FILL LICENCE PLATE NUMBERS WITH ZEROS WHERE
C         NEEDED AND WRITE OUT TO 2 DISK FILES;
C          1) FILE REGNUM.RMV WILL CONTAIN LICENCE PLATE
C                 NUMBERS TO BE DUMPED ON TO TAPE AND SENT TO
C                 THE REGISTRY OF MOTOR VEHICLES.
C          2) FILE CAREX.SAV WILL CONTAIN ALL INPUT FIELDS
C                 INCLUDING THE UPDATED LICENCE PLATE FIELD.
C         IMPORTANT VARIABLES USED....
C         REC() - HOLDS INPUT RECORD
C         CNUM() - CHARACTERS 1,2,3,4,5,6,7,8,9,0
C         RECBUF() & RECEND() - INPUT RECORD MINUS PLATE NO.
C         OUT(), OUTFIL(), OUTAL(), OUTTMP() - STORAGE NEEDED
C                 FOR PLATE ZERO FILL PROCESS.
C         IFILL - NUMBER OF 0'S TO BE FILLED IN TO STRING
C         ICOUNT - NUMBER OF CHARS IN PLATE FIELD
C         WRITTEN BY JEFF ZANK/SDC FOR TSC 2/20/84
          DIMENSION REC(40), CNUM(10), RECBUF(33), RECEND(33)
          LOGICAL FLAG, INDEX      ! T/F FLAGS USED
          DIMENSION OUT(7), OUTFIL(7), OUTAL(7), OUTTMP(7)
          DOUBLE PRECISION INFILE           !STORAGE FOR INPUT FILE
          DATA CNUM /'1','2','3','4','5','6','7','8','9','0'/
C         PROMPT FOR NAME OF INPUT FILE
          TYPE 99
99        FORMAT(' ENTER NAME OF INPUT FILE: ',$)
          ACCEPT 98,INFILE
98        FORMAT(A10)
C         OPEN ALL NEEDED FILES
          OPEN (FILE=INFILE,UNIT=21,ACCESS='SEQIN')
          OPEN (UNIT=22,ACCESS='APPEND',FILE='CAREX.SAV')
          OPEN (UNIT=23,ACCESS='SEQOUT',FILE='REGNUM.RMV')
1         CONTINUE
          READ(21,100,END=900) (REC(I),I=1,40)  ! GET INPUT RECORD
100       FORMAT(40A1)
          IF (REC(1).EQ.'*') GOTO 1       ! SPECIAL LANE $ OBS. NAME
          IF (REC(1).EQ.'#'.OR.REC(1).EQ.'@') GOTO 250  ! SPECIAL
          IF (REC(23).NE.'1') GOTO 250  ! FIELDS
          DO 2 ICK=1,7
          IF (REC(ICK).EQ.'?') GOTO 250
```

```
2       CONTINUE

        ENCODE(7,200,OUT) (REC(J),J=1,7)          ! GET PLATE NO.
200     FORMAT(7A1)
        DECODE(7,200,OUT) OUTTMP          ! PLATE CODE OUT TO USE

        ENCODE(33,201,RECBUF) (REC(JJJ),JJJ=8,40)
201     FORMAT(33A1)     ! SAVE REST OF RECORD TO WRITE OUT
        DECODE(33,201,RECBUF) RECEND

C       BLANK OUT STORAGE VARS

        DO 5 NN=1,7
        OUTFIL(NN) = ' '
        OUTAL(NN) = ' '
5       CONTINUE

C       COUNT THE NUMBER OF CHARS IN FIELD

        DO 10 ICOUNT=1,8
        IF(OUTTMP(ICOUNT).EQ.' ') GOTO 11
10      CONTINUE

11      CONTINUE
        ICOUNT=ICOUNT-1
        IF (ICOUNT.EQ.7) GOTO 50          ! FIELD HAS 7 CHAR
        IFILL=7-ICOUNT      ! FIND THE NUMBER OF 0'S TO FILL

C       CHECK IF 1ST CHAR IS ALPHA

        FLAG=.FALSE.     ! SET FLAG INITALLY
        DO 40 N=1,10
        IF (OUTTMP(1).EQ.CNUM(N)) FLAG=.TRUE.  ! SET FLAG IF NOT
40      CONTINUE
        IF(.NOT.FLAG) GOTO 70    ! BRANCH IF ALPHA

C       FILL FIELD WITH NUMBER OF ZEROS NEEDED

60      CONTINUE
        DO 80 KK=1,IFILL
        OUTFIL(KK) = '0'
80      CONTINUE

C       FILL IN REST OF PLAGE NUMBER

        DO 90 LL=1,ICOUNT
        OUTFIL(LL+IFILL) = OUTTMP(LL)
90      CONTINUE

C       WRITE OUT PLATE NUMBER AND REST OF RECORD

        WRITE(22,300) OUTFIL, RECEND   ! TO CAREX.SAV
300     FORMAT(7A1,33A1)
        WRITE(23,500) OUTFIL              ! TO REGNUM.RMV
500     FORMAT(1X,7A1,'                 ')
        GOTO 1             ! GET NEXT RECORD

C       PROCESS HERE IF 1ST CHAR IS ALPHA
C       FIND THE NUMBER OF ALPHA CHARS FIRST

```

```
70      CONTINUE

        INUM=0
        DO 30 II=1,ICOUNT
        INDEX=.FALSE.
        DO 31 I=1,10
        IF(OUTTMP(II).EQ.CNUM(I)) INDEX=.TRUE.  ! SET FLAG
31      CONTINUE
        IF(.NOT.INDEX) INUM=INUM+1   ! COUNT NUMBER OF FLAGS SET
30      CONTINUE

C       FILL IN ALL ALPHA CHARS

        DO 15 L=1,INUM
        OUTAL(L) = OUTTMP(L)
15      CONTINUE

C       FILL IN ZEROS AFTER ALL ALPHA

        DO 25 K=INUM+1,INUM+IFILL
        OUTAL(K) = '0'
25      CONTINUE

C       IF NO NUMBERS TO FILL IN AFTER ZEROS AND ALPHA CONTINUE

        IF (INUM+IFILL.EQ.7) GOTO 35

C       FILL IN THE REST OF THE PLATE FIELD AFTER ALPHAS & ZEROS

        ITMP=INUM+IFILL
        ITMP1=1
        DO 35 M=ITMP+1,7
        OUTAL(M) = OUTTMP(INUM+ITMP1)
        ITMP1=ITMP1+1
35      CONTINUE

C       WRITE OUT PLATE NUMBER AND REST OF RECORD

        WRITE(22,300) OUTAL, RECEND      ! TO CAREX.SAV
        WRITE(23,500) OUTAL              ! TO REGNUM.RMV
        GOTO 1

C       WRITE OUT PLATE NUMBER AND REST OF RECORD

50      CONTINUE
        WRITE(22,300) OUTTMP, RECEND     ! TO CAREX.SAV
        WRITE(23,500) OUTTMP             ! TO REVNUM.RMV
        GOTO 1

C       WRITE OUT REC() AS IS DUE TO SPECIAL CHARS IN PLATE FIELD

250     CONTINUE
        WRITE(22,400) REC                ! TO CAREX.SAV
400     FORMAT(40A1)
        GOTO 1

900     CONTINUE         ! DONE CLOSE FILES AND EXIT
        CLOSE(UNIT=21)
        CLOSE(UNIT=22)
        CLOSE(UNIT=23)
```

```
17500          STOP
17600          END
```

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March 14, 1985

Mr. John K. Pollard
DTS-45
U.S. Department of Transportation
Transportation Systems Center
Kendall Square
Cambridge, MA 02142

Subject: Transmission of Deliverables

Dear Mr. Pollard:

This letter is to transmit all deliverables for TSC Purchase Orders DTRS57-85-P-80781 and DTRS57-85-P-81119. Other related material provided to us by TSC is being returned under separate cover.

The following items are enclosed:

1) A listing showing the compilation, link editing and execution of a Fortran program used to process Mass. Registry of Motor Vehicle data for input to the Vindicator subroutine. This program also calls the Vindicator subroutine and formats its output so as to facilitate later processing.

2) A listing of a program (PREPLATE) written in Turbo Pascal which prepares the output of the Fortran program mentioned above for further processing. This program runs on an IBM Personal Computer.

3) A listing of a program written in the Knowledgeman language for use on an IBM PC. This program appends the data output by the above Turbo Pascal program to experimental field data. The data is placed in the following columns:

34-35	MAKE
37-38	YEARF
40-41	YEARL
43-44	SERIES
46-47	MODEL
49-50	BODY
52-56	WEIGHT
58-60	WHBLS
62-64	MINHP
66-68	MAXHP
70	FLAG
72-73	Model Year From RMV File

All data is right justified in the columns indicated. Leading zeros are not included, and missing values are indicated by zeros. The flag character in column 70 can have 3 values as follows:

blank - The model year from the RMV file was not needed to obtain Vindicator data.

"R" - This means a) When the Vindicator subroutine was first called without the RMV model year as input, the output model year was ambiguous (YEARF < YEARL). In this case the data to be placed in columns 43 through 68 is not available; and b) The RMV year was within the range output by Vindicator (YEARF <= RMV Year <= YEARL); and c) Vindicator was called again with the RMV year as input. This resulted in new values of output such that all data was available and YEARF = YEARL = RMV Year.

"?" - Same as "R" except that when Vindicator was first called and there was ambiguity, the RMV model year was one year outside the YEARF to YEARL range (i.e., RMV Year = YEARF - 1 or RMV Year = YEARL + 1). In this case the RMV year was assumed to be one year in error, and Vindicator was called again with YEARF or YEARL as input.

4) Eight diskettes containing: a) thirty two files (S1W2.APP through S3W12.APP) of experimental field data with Vindicator data appended to certain records, and b) source code for the Pascal and Knowledgeman programs mentioned in (2) and (3) above.

In addition to the above deliverables, a number of disk files are on the NIH computer in Bethesda, Maryland under account WQR1 (initials CTE). These are stored on the disk with VOL-SER FILE09 and are:

PALTAPE	JCL used to process the Mass. RMV tape. This tape is considered a "problem" tape by NIH since its blocksize exceeds the ANSI standard. Therefore it can be processed only by the PALTAPE utility program which copies it to a standard-label tape.
TAPERMV	JCL used to copy Mass. RMV data from standard-label tape to disk file.
RMVOUT.DATA	Mass. RMV data.
VINGENER	JCL used to copy Vindicator files from tape to disk.
SUBSYS.V85BASE	Data base from Vindicator tape.
PLI	JCL used to compile and link edit Vindicator subroutine.
SUBSYS.LOAD	Compiled and partially linked Vindicator subroutine. This is a partitioned data set, and its one member is named VNDCTR85.
FORTNN13	JCL and Fortan source code used to create listing (1) above.
V01...V13	Output files from execution of Fortran program.

If you need any further assistance, including instruction in the operation of the above programs, please feel free to call. Enclosed, for your information, is a copy of the final invoice. It is our understanding that this letter and the enclosed printouts and diskettes fulfill all requirements of the Purchase Orders. We hope we can be of service to TSC in the future.

Sincerely,

Robert E. Johnson
Associate

Enclosures:

Printouts
Diskettes
Final Invoice

cc: Paul Hoxie, TSC

APPENDIX 6 (CONT.): LISTING OF THE PASCAL PROGRAM "PREPLATE.PAS" WHICH REFORMATS FIELD DATA FILES TO ELIMINATE THE PROBLEM OF BLANK LINES.

```
program preplate;
   (* This program reads in a file from disk 'C:' and writes it out *)
   (* with the character "X" tacked on the front to disk 'C:KMAN\'. The*)
   (* output filename is the input filename + '.in'                  *)

  var
     temp    : string[80];
     filename: string[8];
     dest,
     source  : text;

  begin
     write('Enter filename (ex. slw7) :');          readln(filename);
     assign(source, 'C:' + filename + '.');          reset(source);
     assign(dest,   'C:' + filename + '.in');        rewrite(dest);
     while not eof(source) do
        begin
          readln(source,temp);
          writeln(dest,'X',temp);
        end;
     writeln;
     writeln('Transfer complete.');
     close(source);
     close(dest);
  end.
```

APPENDIX 6 (CONT.): LISTING OF THE KNOWLEDGEMAN PROCEDURE, "PLATES.IPF," WHICH MERGES VINDICATOR OUTPUT WITH THE FIELD DATA FILES.

```
/*                    FILE:plates.ipf                                  */
/*      This program appends xtrainfo from vinsort.itb                 */
/*  & vinsort.ind to the record in the input table temp.ITB            */
/*  The input file is XXXXXX.in and the output file is XXXXXX.app      */
/*  use the following Knowledgeman commands to create vinsort.ind:     */
/*  use vin                                                            */
/*  sort vin to "vinsort.itb"  by platenum                             */
/*  index "vinsort.ind" for vinsort by az platenum                     */
/*                                                                     */
/*      Before this program is run, a record format called "expform" */
/*  must be created according to the instructions specified in the     */
/*  Knowledgeman manual.                                               */
e.lstr=100
e.ms="~"   /* set wildcard to tilda */
e.supd=true
e.serr=true
finish all
use expform
run "erase temp.itb"
if #a="" then
    input fname using "rrrrrr" with "Enter filename to append to (ex. slw7) :"
else
   fname=#a
endif
e.serr=false
tempout=fname + ".app"
fname=fname + ".in"
cmd="erase " + tempout
run cmd
impress expform to temp
?"Attaching..."
attach from ^fname to temp
blanks="                                                                "
zeroes="0000000"
finish all
use temp
use vinsort with "vinsort.ind"
?"Appending fields..."
obtain first record from temp
while not pastend(temp) do
   temp.aline=substr(temp.aline,2,len(temp.aline)-1)  /* remove 'X' */
   platenum=substr(temp.aline,12,7)
       pluck platenum from vinsort
       if #found then
            temp.aline=temp.aline + vinsort.xtrainfo
       endif

    obtain next record from temp
endwhile
```

```
/* write out to disk for DOS */
?"Writing out to disk..."
e.cf=3
convert aline from temp to ^tempout
e.supd=false
```

APPENDIX 6 (CONT.): "PALTAPE" JCL TO CALL PALTAPE ROUTINE TO REWRITE A NON-STANDARD TAPE TO THE FORMAT REQUIRED FOR SUBSEQUENT PROCESSING AT NIH. NOTE: INPUT TAPE IS NAMED "PAR" IN THIS EXAMPLE; SERIAL NUMBER FOR OUTPUT TAPE, "046168," MUST BE OBTAINED FROM NIH STAFF AT THE TIME TAPE IS ISSUED.

```
//CTEPAL  JOB (WQR1,884,B),POLLARD
/*MESSAGE PAR,RS
/*MESSAGE 046168,W
/*ROUTE XEQ 9T1600
/*ROUTE XEQ 9T6250
//S1   EXEC  PALTAPE,INUNIT=9T1600,INTAPE=PAR,
//       OUTTAPE=046168,OPTIONS=Q
//SYSIN    DD *
FILEIN  LABEL=NO,DSNUM=2,LRECL=228,BLKSIZE=5016,RECFM=FB
FILEOUT DSN=WQR1CTE.COPY.OF.PAR
COPY
```

APPENDIX 6 (CONT.): "TAPERMV" JCL TO CONVERT STANDARDIZED RMV OUTPUT DATA TAPE TO ONLINE DISK STORAGE. INPUT DATA IS FOUND ON TAPE "RMVOUT," WITH VOL=SER 012368 IN THIS EXAMPLE. OUTPUT IS STORED ON FILE09.

```
 1.    //CTERMVT  JOB (WQR1,884,B),JOHNSON
 2.1   /*MESSAGE 012368,R
 4.    /*ROUTE XEQ 9T6250
 5.    //S1   EXEC  PGM=IEBGENER
 6.    //SYSPRINT DD SYSOUT=A
 7.    //SYSUT1    DD DSN=WQR1CTE.COPY.OF.RMVOUT,UNIT=9T6250,
 8.    //     VOL=SER=012368,LABEL=1,DISP=(OLD,KEEP)
 9.    //SYSUT2    DD DSN=WQR1CTE.RMVOUT.DATA,UNIT=FILE,VOL=SER=FILE09,
10.    //     DCB=(RECFM=FB,LRECL=228,BLKSIZE=5016),
11.    //     SPACE=(TRK,(68,10),RLSE),DISP=(,KEEP,DELETE)
12.    //SYSIN     DD DUMMY
```

APPENDIX 6 (CONT.): "FORTNN13" PROGRAM TO READ IN RMV DATA FROM A DISK FILE, CALL THE "VINDICATOR" PROGRAM AND DATABASE, AND WRITE OUTPUT FILES

```
//CTEVIN  JOB  (WQR1,884,B),JOHNSON
//S1  EXEC  FORVCOMP,OPTIONS='LANGLVL(66)'
//COMP.SYSIN DD *
C  WRITTEN BY:  ROBERT E. JOHNSON
C               TRAAC
C               703/522-2000
C
C  DATE:  MARCH 1985
C
C  DESCRIPTION:
C
C       This program reads a Mass Registry of Motor Vechicles (RMV)
C  output file, calls the VNDCTR subroutine, and creates  number
C  of output files consisng of plate # and descriptive data (the
C  descriptive data is to be later appended to field data, keying
C  on plate #).  Up to 1000 records are put into each output file,
C  after which a new file is started.  These small files are
C  easy to download to a microcomputer and manipulate there.
C
C       VNDCTR is first called without giving it a model year as
C  input.  If it retunns a single model year (i.e. R(5)=R(6)) and no
C  errors, the data returned is written to the output file and
C  the next record is processed.  If it returns an ambiguous
C  model year (i.e. R(5) < R(6)), then R(7) thru R(16) are not
C  returned.  In this case, if the model year from the RMV file
C  is within -- or one year outside -- the range returned by
C  VNDCTR, then VNDCTR is called again (if not, the abbreviated
C  dta returned by VNDCTR is output, and the next record is
C  processed).
C
C       If VNDCTR is called again, INARG(1) is set equal to that
C  year in the range first returned that is closest to the
C  RMV year.  If the RMV year is used to eliminate
C  ambiguity and it is within the range R(5) to R(6), then
C  a flag of 'R' is set within the next-to-last output field.
C  If the RMV year is one year less than R(5) o one year
C  greater than R(6) and it is used to eliminate ambiguity
C  (by setting INARG(1) to R(5) or R(6) respectively), then
C  a flag of '?' is set.  This indicates that we are
C  assuming that the RMV year is one year off.
C
C       If errors are encountered during any call to VNDCTR
C  (R(1) NE 0), then a record corresponding to that plate #
C  is not output.
C
C      *** Values retrrned by VNDCTR used by this program ***
C
C                                Name in
C          Variable            Vindicator85
C         in program           Users Guide         Meaning
C
C            R(1)                IERR            zero if no errors
C            R(2)                AMBSW           zero if YEARL=YEARF
```

```
C           R(4)                   MAKE          make #
C           R(5)                   YEARF         firs  possible model yr
C           R(6)                   YEARL         last possible model yr
C           R(7)                   SERIES        series #
C           R(8)                   MODEL         model #
C           R(9)                   BODY          body code
C           R(13)                  WEIGHT        curb weight in lbs
C           R(14)                  WHLBS         wheelbase in inches
C           R(15)                  MINHP         min possibl horsepower
C           R(16)                  MAXHP         max possible horsepower
C
      INTEGER*4 FLAG,BLANK/'    '/,RRRR/'RRRR'/,QMARK/'????'/
      INTEGER*4 CODE/3/,CHECK/1/,UN,RMVYR,R1900
      INTEGER*4 PLATE(2),NAME(2),NOMAT(2)/'NOMA','TCH '/,INARG(6),
     A  R(72)
C
      KREC = 0
      KNOMAT = 0
      KERROR = 0
      KOUT = 0
      KRRRR = 0
     KQMARK = 0
  100 READ(3,101,END=200) PLATE,NAME,RMVYR,(INARG(J),J=2,6)
  101 FORMAT(1X,A4,A3,2A4,146X,I2,21X,4A4,A1)
      KREC = KREC + 1
      IF((NAME(1).NE.NOMAT(1)).OR.(NAME(2).NE.NOMAT(2))) GO TO 110
C
C      'NOMATCH'
      KNOMAT = KNOMAT + 1
      GO TO 100
C
  110 FLAG = BLANK
      INARG(1) = 0
      CALL VNDCTR(CODE,CHECK,INARG(1),R(1))
      IF(R(1).NE.0) GO TO 120
      IF(R(2).EQ.0) GO TO 130
C
C         AMBIGUOUS YEAR -- R(5) < R(6)
C         FIRST -- IF RMVYR TOO FAR OFF TO USE, THEN OUTPUT
C         WHAT WE HAVE
      R1900 = RMVYR + 1900
      IF((R1900.LT.R(5)-1).OR.(R1900.GT.R(6)+1)) GO TO 130
C
C         WE CAN USE RMVYR -- 'R' FLAG IF IN RANGE, '?' FLAG IF
C         ONE YEAR OUT OF RANGE
      FLAG = RRRR
      INARG(1) = R1900
      IF(R1900.LT.R(5)) FLAG = QMARK
      IF(R1900.LT.R(5)) INARG(1) = R(5)
      IF(R1900.GT.R(6)) FLAG = QMARK
      IF(R1900.GT.R(6)) INARG(1) = R(6)
      CALL VNDCTR(CODE,CHECK,INARG(1),R(1))
      IF(R(1).EQ.0) GO TO 130
C
C         ERROR FROM VNDCTR
  120 WRITE(6,121),KREC,PLATE,RMVYR,(INARG(J),J=2,6),R(1)
  121 FORMAT(1X,'VNDCTR ERROR:  REC=',I6,' PLATE= ',A4,A3,
     1  '  RMVYR=',I5,'  VIN= ',5A4,' IERR=',I4)
      KERROR = KERROR + 1
      GO TO 100
```

113. C

```
C          READY TO OUTPUT
  130 IF(R(5).GT.0) R(5) = R(5) - 1900
      IF(R(6).GT.0) R(6) = R(6) - 1900
  135 UN = 21 + KOUT/1000
      WRITE(UN,136) PLATE,R(4),R(5),R(6),R(7),R(8),R(9),
     A  R(13),R(14),R(15),R(16),FLAG,RMVYR
  136 FORMAT(A4,A3,',',I2,5I3,I6,3I4,1X,A1I3)
      KOUT = KOUT + 1
      IF(FLAG.EQ.RRRR) KRRRR = KRRRR + 1
      IF(FLAG.EQ.QMARK) KQMARK = KQMARK + 1
      GO TO 100
C
  200 WRITE(6,201) KREC
  201 FORMAT(///,1X,I5,' RECORDS PROCESSED')
      WRITE(6,205) KNOMAT
  205 FORMAT(/,1X,I5,' RECORDS WERE NOMATCH')
      WRITE(6,211) KERROR
  211 FORMAT(/,1X,I5,' RECORDS HAD VNDCTR ERRORS')
      WRITE(6,216) KOT
  216 FORMAT(/,1X,I5,' RECORDS OUTPUT')
      WRITE(6,218) KRRRR,KQMARK
  218 FORMAT(/,1X,I5,' RECORDS HAD R-FLAG, ',I5,' HAD ?-FLAG')
      STOP
      END
//S2  EXEC  FORVLKGO,LIBNAME='WQR1CTE.SUBSYS.LOAD',
//    LIBDISK=FILE09
//LOAD.SYSLIN DD
//    DD *
  INCLUDE SYSLIB(VNDCTR85)
  ENTRY MAIN
//GO.FT03F001 DD DSN=WQR1CTE.PIKE.DATA,UNIT=FILE,
//    VLL=SER=FILE29,DISP=SHR
//GO.VBASE DD DSN=WQR1CTE.SUBSYS.V85BASE,UNIT=FILE,
//    VOL=SER=FILE09,DCB=BUFNO=1,DISP=SHR
//GO.FT21F001 DD DSN=WQR1CTE.PIKE01,
//    VOL=SER=FILE29,SPACE=(TRK,(5,5),RLSE),UNIT=FILE,
//    DCB=(RECFM=FB,LRECL=80,BLKSIZE=4000),DISP=(,KEEP,DELETE)
//GO.FT22F001 DD DSN=WQR1CTE.PIKE02,
//    VOL=SER=FILE29,SPACE=(TRK,(5,5),RLSE),UNIT=FILE,
//    DCB=(RECFM=FB,LRECL=80,BLKSIZE=4000),DISP=(,KEP,DELETE)
//GO.FT23F001 DD DSN=WQR1CTE.PIKE03,
//    VOL=SER=FILE29,SPACE=(TRK,(5,5),RLSE),UNIT=FILE,
//    DCB=(RECFM=FB,LRECL=80,BLKSIZE=4000),DISP=(,KEEP,DELETE)
//GO.FT24F001 DD DSN=WQR1CTE.PIKE04,
//    VOL=SER=FILE29,SPACE=(TRK,(5,5),RLSE),UNIT=FILE,
//    DCB=(RECFM=FB,LRECL=80,BLKSIZE=4000),DISP=(,KEEP,DELETE)
//GO.FT25F001 DD DSN=WQR1CTE.PIKE05,
//    VOL=SER=FILE29,SPACE=(TRK,(5,5),RLSE),UNIT=FILE,
//    DCB=(RECFM=FB,LRECL=80,BLKSIZE=4000),DISP=(,KEEP,DELETE)
//GO.FT26F001 DD DSN=WQR1CTE.PIKE06,
//    VOL=SER=FILE29,SPACE=(TRK,(5,5),RLSE),UNIT=FILE,
//    DCB=(RECFM=FB,LRECL=80,BLKSIZE=4000),DISP=(,KEEP,DELETE)
//GO.FT27F001 DD DSN=WQR1CTE.PIKE07,
//    VOL=SER=FILE29,SPACE=(TRK,(5,5),RLSE),UNIT=FILE,
//    DCB=(RECFM=FB,LRECL=80,BLKSIZE=4000),DISP=(,KEEP,DELETE)
//GO.FT28F001 DD DSN=WQR1CTE.PIKE08,
//    VOL=SER=FILE29,SPACE=(TRK,(5,5),RLSE),UNIT=FILE,
//    DCB=(RECFM=FB,LRECL=80,BLKSIZE=4000),DISP=(,KEEP,DELETE)
//GO.FT29F001 DD DSN=WQR1CTE.PIKE09,
//    VOL=SER=FILE29,SPACE=(TRK,(5,5),RLSE),UNIT=FILE,
```

```
//     DCB=(RECFM=FB,LRECL=80,BLKSIZE=4000),DISP=(,KEEP,DELETE)
//GO.FT30F001 DD DSN=WQR1CTE.V10,
//     VOL=SER=FILE29,SPACE=(TRK,(5,5),RLSE),UNIT=FILE,
//     DCB=(RECFM=FB,LRECL=80,BLKSIZE=4000),DISP=(,KEEP,DELETE)
//GO.FT31F001 DD DSN=WQR1CTE.V11,
//     VOL=SER=FILE29,SPACE=(TRK,(5,5),RLSE),UNIT=FILE,
//     DCB=(RECFM=FB,LRECL=80,BLKSIZE=4000),DISP=(,KEEP,DELETE)
//GO.FT32F001 DD DSN=WQR1CTE.V12,
//     VOL=SER=FILE29,SPACE=(TRK,(5,5),RLSE),UNIT=FILE,
//     DCB=(RECFM=FB,LRECL=80,BLKSIZE=4000),DISP=(,KEEP,DELETE)
//GO.FT33F001 DD DSN=WQR1CTE.V13,
//     VOL=SER=FILE29,SPACE=(TRK,(5,5),RLSE),UNIT=FILE,
//     DCB=(RECF==FB,LRECL=80,BLKSIZE=4000),DISP=(,KEEP,DELETE)
```

APPENDIX 7: "SURVEY.BA," DATA COLLECTION PROGRAM FOR PERMANENT SITE CHARACTERISTICS

```
1  REM "SURVEY.BA, SITE CHARACTERISTICS PROGRAM
2  REM "REVISED 4/16/85
3  CLS:PRINT"DAY/DATE SETTINGS CORRECT(Y/N)?"
4  PRINT @130,DAY$;"  ";DATE$
5  DV$=INKEY$:IF DV$="" THEN 5
6  IF DV$="Y" THEN 15
7  IF DV$="N" THEN MENU ELSE LINE INPUT"LOCK CAPS AND PRESS ENTER";Z$:GOTO 3
10 MAXFILES = 5
15 INPUT "ENTER SITE NUMBER (3 DIGITS)";SN$:IF SN$="" THEN 15
18 IF LEN(SN$)<>3 THEN 15
19 SN$=RIGHT$(SN$,3)
20 FN$="RAM:M"+SN$+".DO":OPEN FN$ FOR OUTPUT AS 1:CLOSE 1
25 OPEN FN$ FOR APPEND AS 1
30 PRINT#1,"*SITE/VISIT NUMBER="SN$:PRINT#1,"*MAIN APPROACH,PERMANENT HEADER"
35 PRINT#1,"*DAY/DATE=";DAY$,DATE$
40 PRINT"NAME OF MAJOR INTERSECTION                (STARTING POINT)"
45 INPUT MI$:IF MI$=""THEN 45 ELSE PRINT#1,"*NAME OF MAJOR INTERSECTION= ";MI$
60 CLS:INPUT"ENTER LAST THREE NUMBERS OF THE         ODOMETER (EG.:21.2)";S$
61 IF LEN(S$)<>4 THEN 60
62 S=VAL(S$)
65 CLS:PRINT"BEGIN DRIVING TO DESIGNATED SITE.                LEAVE COMPUTER ON"
70 FOR N=1 TO 1000:NEXT N
80 CLS:PRINT"  KEY:" TAB(10)"F1"TAB(17)"F2"TAB(26)"F3"TAB(34)"F4"
82 PRINT TAB(9)"LEFT"TAB(15)"INTER-"TAB(24)"RIGHT"TAB(32)"RIGHT"
84 PRINT TAB(8)"CURVES"TAB(15)"SECTIONS"TAB(24)"CURVES"TAB(32)"ACCESS"
86 PRINT TAB(9)C1 TAB(16)C2 TAB(25)C3  TAB(33)C4
88 PRINT @200,"PRESS F-KEY FOR COUNT"
89 PRINT @240,"PRESS F8 WHEN YOU REACH SITE"
90 KEY ON:ON KEY GOSUB 100,200,300,400,,,,700
91 GOTO 90
100 SOUND9394,30:X$=INKEY$:X$=INKEY$:X$=INKEY$
130 C1=C1+1
140 GOTO 80
200 SOUND4697,30:X$=INKEY$:X$=INKEY$:X$=INKEY$
230 C2=C2+1
240 GOTO 80
300 SOUND2484,30:X$=INKEY$:X$=INKEY$:X$=INKEY$
330 C3=C3+1
340 GOTO 80
400 SOUND1174,30:X$=INKEY$:X$=INKEY$:X$=INKEY$
430 C4=C4+1
440 GOTO 80
700 CLS:KEY OFF
712 PRINT#1,"*ACCESSES ON RIGHT=";C4
713 PRINT#1,"*CURVES LEFT=";C1
714 PRINT#1,"*CURVES RIGHT=";C3
715 PRINT#1,"*MINOR INTERSECTIONS=";C2
720 PRINT"NAMES OF STREETS AT SITE INTERSECTION   AND DIRECTION FROM WHICH
APPROACH OCCURS (EX:FIRST ST. /W/ AT WILSON AV.)"
730 INPUT A$:IF A$="" THEN 730 ELSE PRINT#1,"*NAME OF INTERSECTION= ";A$
800 CLS:INPUT"ENTER LAST THREE ODOMETER DIGITS(EG:34.5)";F$
801 IF LEN(F$)<>4 THEN 800
802 F=VAL(F$)
810 LET T=F-S:IF T<0 THEN T=T+100
```

```
815 IF T=0 THEN T=.05
820 PRINT#1,"*DISTANCE FROM MAJOR INTERSECTION =";T" MILES"
1000 CLS:PRINT "TRAFFIC CONTROL"
1010 PRINT "   1=NONE 2=YEILD SIGN 3=STOP SIGN"
1020 PRINT "   4=FLASHING YELLOW LIGHT"
1030 PRINT "   5=FLASHING RED LIGHT"
1040 PRINT"   6=GREEN/YELLOW/RED LIGHT"
1050 PRINT"   7=GREEN/YELLOW/RED W/ ARROW"
1060 PRINT"   8=OTHER CONTROL"
1070 INPUT"TYPE OF TRAFFIC CONTROL";TC:IF TC=0 OR TC>8 THEN 1000 ELSE
PRINT#1,"*TYPE OF TRAFFIC CONTROL=";TC:CLS
2000 CLS:INPUT"NUMBER OF LANES BEFORE ADDITIONAL        TURNING LANES";AL:IF
AL=0 OR AL>4 THEN 2000 ELSE PRINT#1,"*NUMBER OF LANES BEFORE TURNING LANES=";AL
2010 CLS:INPUT"NUMBER OF ADDITIONAL TURNING LANES";TL:IF TL>2 THEN 2010 ELSE
PRINT#1,"*NUMBER OF ADDITIONAL TURNING LANES =";TL
2030 CLS:INPUT"NUMBER OF LANES IN OPPOSITE DIRECTION";OL:IF OL>5 THEN 2030 ELSE
PRINT#1,"*NUMBER OF LANES IN OPPOSITE DIRECTION =";OL
2040 CLS:PRINT"*DIVISION OF ROAD*"
2050 PRINT"    1=UNDIVIDED"
2060 PRINT"    2=PAINTED LINE(S)"
2070 PRINT"    3=CURB,RAISED ISLAND,ECT."
2080 PRINT"    4=BARRIER,GUARDRAIL"
2090 PRINT"    5=ONE-WAY STREET"
3000 INPUT"DIVISION OF ROAD";D:IF D=0 OR D>5 THEN 2040 ELSE PRINT#1,"*DIVISION
OF ROAD=";D:CLS
3090 CLS:PRINT"*RIGHT ROADSIDE*"
4000 PRINT"    1=SHOULDER"
4010 PRINT"    2=CURB OR GUTTER"
4020 PRINT"    3=GUARDRAIL,CHAIN,ECT                      IMMEDIATELY AT
PAVEMENT"
4030 INPUT"TYPE OF ROADSIDE";RR:IF RR=0 OR RR>3 THEN 3090 ELSE PRINT#1,"*TYPE
OF ROADSIDE=";RR
4040 CLS:PRINT"*AREA CHARACTER*"
4050 PRINT"    1=BUILT UP(URBAN)"
4060 PRINT"    2=RESIDENTIAL(DETACHED)"
4070 PRINT"    3=BUSINESS(DETACHED)"
4080 PRINT"    4=SCHOOL,PARK"
4090 PRINT"    5=RURAL(FIELDS,WOODS)"
5000 INPUT"TYPE OF AREA";AC:IF AC=0 OR AC>5 THEN 4040 ELSE PRINT#1,"*TYPE OF
AREA=";AC:CLS
5010 CLS:PRINT"*ALIGNMENT OF ROAD*"
5020 PRINT"    1=STRAIGHT"
5030 PRINT"    2=CURVED LEFT"
5040 PRINT"    3=CURVED RIGHT"
5050 PRINT"    4=S-CURVE"
5060 INPUT"TYPE OF ALIGNMENT";AR:IF AR=0OR AR>4 THEN 5010 ELSE PRINT#1,"*TYPE
OF ALIGNMENT=";AR
5070 CLS:PRINT"*PROFILE OF AREA*"
5080 PRINT"    1=LEVEL"
5090 PRINT"    2=UPHILL"
6000 PRINT"    3=DOWNHILL"
6010 PRINT"    4=CREST"
6020 PRINT"    5=SAG"
6030 INPUT"PROFILE OF AREA";PA:IF PA=0 OR PA>5 THEN 5070 ELSE PRINT#1,"*PROFILE
OF AREA=";PA
6040 CLS:PRINT"*TRAFFIC REGULATION*"
6050 PRINT
6060 INPUT"SPEED LIMIT(AS POSTED)              -99- IF NONE POSTED";SL:IF
SL=0 OR SL>99 THEN 6040 ELSE PRINT#1,"*SPEED LIMIT=";SL
6080 CLS:INPUT"IS THERE PARKING(Y/N)"A-B$
```

```
6090 IF P$="Y" THEN 7000
6095 IF P$="N" THEN 7010 ELSE 6080
7000 PRINT#1,"*THERE *IS* PARKING":GOTO 7030
7010 PRINT#1,"*THERE IS *NO* PARKING"
7030 CLS:INPUT"IS THIS A NO PASSING ZONE(Y/N)";PZ$
7040 IF PZ$="Y" THEN 7060
7045 IF PZ$="N" THEN 7050 ELSE 7030
7050 PRINT#1,"*THIS *IS* A PASSING ZONE":GOTO 7070
7060 PRINT#1,"*THIS *IS NOT* A PASSING ZONE"
7070 CLS: INPUT"CAN TRAFFIC COUNTERS BE USED            AT THIS SITE(Y/N)";S$
7071 IF S$="Y" THEN 7073
7072 IF S$="N" THEN 7074 ELSE 7070
7073 PRINT#1,"*TRAFFIC COUNTERS **CAN BE USED** AT THIS SITE":GOTO 7075
7074 PRINT#1,"*TRAFFIC COUNTERS **CAN NOT** BE USED AT THIS SITE"
7075 CLS: INPUT"HAS THIS SITE BEEN MARKED(Y/N)";M$
7076 IF M$="Y" THEN 7078
7077 IF M$="N" THEN 7079 ELSE 7075
7078 PRINT#1,"*THE SITE ** HAS BEEN** MARKED":GOTO 7080
7079 PRINT#1,"*THE SITE **HAS NOT** BEEN MARKED"
7080 PRINT"MAIN APPROACH PROGRAM COMPLETE          AT SITE NUMBER ";SN$
8000 MENU:END
```

APPENDIX 8: "PIKE.BA," DATA ENTRY PROGRAM FOR OBSERVATIONS AT MASSACHUSETTS TURNPIKE TOLL BOOTHS (WRITTEN FOR RADIO SHACK MODEL 100)

```
1 REM "PIKE.BA, MASS PIKE DATA"
5 REM 8/22/84 VERSION 2 BY KEVIN SUTHERLAND
10 INPUT "ENTER PIKE SITE NUMBER(3 DIGITS)";TN$
20 FN$="RAM:P"+TN$+".DO"
30 OPEN FN$ FOR APPEND AS 1
40 PRINT#1,"PIKE SITE NUMBER="TN$
50 INPUT "PLEASE ENTER THE DATE OF DATA COLLECTION(MN/DA/YR)";DA$
60 PRINT #1, "DATE="DA$
70 INPUT "ENTER LOCATION(2 DIGITS)";LO$
80 PRINT#1, "LOCATION="LO$
85 PRINT#1, "----------------------------------------"
86 PRINT#1,
90 INPUT "ENTER BOOTH NUMBER";BN:PRINT#1,"BOOTH NUMBER="BN
95 PRINT "ENTERING OR LEAVING?"
96 INPUT EL$
97 PRINT#1, "DIRECTION="EL$
100 INPUT "ENTER OBSERVER NUMBER";OO:PRINT#1,"OBSERVER NUMBER="OO
110 INPUT "ENTER START TIME";ST$:PRINT#1,"START TIME ="ST$
120 INPUT "ENTER STOP TIME";TT$:PRINT#1,"STOP TIME ="TT$
130 INPUT "ENTER THE NUMBER OF OBSERVATIONS";NO
140 PRINT#1,"THE TOTAL NUMBER OF OBSERVATIONS AT BOOTH ";BN;"IS ";NO
142 IF NO<10 THEN 144 ELSE 200
144 FOR Z=1 TO NO
160 INPUT"ENTER AGE,SEX,AND PLATE NUMBER        ";AG$,SE$,PN$
170 IF LEN(PN$)<>7 THEN PRINT"ERROR":PRINT"PLEASE REPEAT":GOTO160
180 PRINT #1, Z;" ";SE$;" ";AG$;" ";PN$
190 NEXT Z
195 GOTO 1000
200 FOR Z=1 TO 9
202 INPUT"ENTER AGE,SEX,AND PLATE NUMBER        ";AG$,SE$,PN$
203 IF LEN(PN$)<>7 THEN PRINT"ERROR":PRINT"PLEASE REPEAT":GOTO 202
204 PRINT#1,Z;"  ";SE$;" ";AG$;" ";PN$
205 NEXT Z
210 FOR Z=10 TO NO
212 INPUT"ENTER AGE,SEX,AND PLATE NUMBER        ";AG$,SE$,PN$
213 IF LEN(PN$)>7 THEN PRINT"ERROR":PRINT"PLEASE REPEAT":GOTO 212
214 PRINT#1,Z;" ";SE$;" ";AG$;" ";PN$
215 NEXT Z
1000 REM SUBROUTINE FOR TRUCKS,VANS,ETC.
1005 INPUT "ENTER THE NUMBER OF SMALL TRUCKS";GG
1010 PRINT#1,"NUMBER OF SMALL TRUCKS="GG
1020 INPUT "ENTER THE NUMBER OF LARGE TRUCKS";LT
1030 PRINT#1,"NUMBER OF LARGE TRUCKS="LT
1040 INPUT "ENTER THE NUMBER OFCOMBINATION TRUCKS";CT
1050 PRINT#1,"NUMBER OF COMBINATION TRUCKS ="CT
1060 INPUT "ENTER THE NUMBER OF VANS";NV
1070 PRINT#1,"NUMBER OF VANS="NV
1080 INPUT "ENTER THE NUMBER OF BUSSES";NB
1090 PRINT#1, "NUMBER OF BUSSES ="NB
1100 INPUT "ENTER THE NUMBER OF OUT OF STATE PLATES";SP
1110 PRINT#1,"NUMBER OF OUT OF STATE PLATES ="SP
1120 INPUT "ENTER THE NUMBER OF OTHERS";OT
1130 PRINT#1,"NUMBER OF OTHERS ="OT
```

```
1140 PRINT"IS THERE ANOTHER BOOTH ?"
1150 INPUT AB$
1160 IF AB$="Y" THEN 85
2000 END
```

APPENDIX 9: "EXTRACT.BAS," BASIC PROGRAM FOR IBM PC TO EXTRACT LICENSE PLATE NUMBERS FROM MASS PIKE FILES AND FORMAT THEM FOR SUBMISSION TO THE RMV

```
10 'EXTRACT.BAS, EXTRACTS LICENSE PLATE NUMBERS FROM MASS PIKE FILES
12 'REVISED 4/25/85 BY J.K. POLLARD
15 OPEN "B:RMV.DAT" FOR OUTPUT AS 2
20 FOR N=1 TO 20:IF N=9 THEN N=10
25 N$=STR$(N):N$=MID$(N$,2,2)
30 F$="A:MP"+N$
40 OPEN F$ FOR INPUT AS 1
46 GOSUB 50
48 NEXT N: PRINT"TOTAL PLATES=";I:END
50 LINE INPUT#1,L$
60 IF EOF(1) THEN CLOSE 1: RETURN
70 PRINT L$
80 D$=MID$(L$,10,7): IF D$="       " THEN 50
85 SP$=SPACE$(17)
90 D$=" "+D$+SP$
100 T$=MID$(L$,2,2)
110 TN=VAL(T$)
120 IF TN>0 AND TN<21 THEN PRINT#2,D$:LPRINT D$:I=I+1:GOTO 50
130 GOTO 50
```

APPENDIX 10: "UNSPACER.BAS," BASIC PROGRAM FOR IBM PC TO REMOVE LINE NUMBERS, UNNEEDED SPACES AND GARBAGE LINES

```
10 'UNSPACER.BAS, ELIMINATES LINE NUMBERS, UNNEEEDED SPACES & GARBAGE
15 'revised 7/16/85 by J.K. POLLARD
20 OPEN "c:com\PIKEVIN." FOR INPUT AS 1
30 OPEN "c:kman\PIKEVIN.txt" FOR OUTPUT AS 2
100 LINE INPUT #1,L$
105 IF EOF(1) THEN CLOSE: BEEP:BEEP:BEEP:END
108 IF LEN(L$)<55 THEN LPRINT L$: GOTO 100:'GARBAGE LINES ARE ALWAYS TOO
SHORT
109 L$=RIGHT$(L$,48)
110 F1$=LEFT$(L$,10)
111 F2$=MID$(L$,12,2):F3$=MID$(L$,15,2)
112 F4$=MID$(L$,18,2):F5$=MID$(L$,21,2)
113 F6$=MID$(L$,24,2)
114 F7$=MID$(L$,28,4):F8$=MID$(L$,33,3)
115 F9$=MID$(L$,37,3)
116 G1$=MID$(L$,41,3):G2$=MID$(L$,45,1)
117 G3$=RIGHT$(L$,2)
118 DD$=F1$+F2$+F3$+F4$+F5$+F6$+F7$+F8$+F9$+G1$+G2$+G3$
120 PRINT DD$
130 PRINT#2,DD$
150 GOTO 100
```

Traficounter

ROADTUBE INSTALLATION INSTRUCTIONS

1. GENERAL

Before installing the Traficounter, check the following:

A. Roadtube for dirt and holes.
B. Batteries for proper strength.

NO MATTER WHERE YOU SET UP THE TRAFICOUNTER OR HOW MANY TIMES YOU SET IT UP, ALWAYS CHECK THE ROADTUBE FOR CUTS, HOLES AND DIRT. BLOW THE INSIDE CLEAN WITH AN AIR HOSE.

1. The Traficounter will not work if the roadtube leaks.
2. The Traficounter will not work if the roadtube is clogged.

IMPORTANT

2. WHERE TO SET UP THE TRAFICOUNTER

A. Chain the Traficounter to a tree, sign post or street lamp at the side of the road (see figure 1). Select a spot where the road is straight and at least 100 feet away from TRAFFIC LIGHTS, STOP SIGNS OR INTERSECTIONS.
B. When installing on a highway with a center median, place the Traficounter on the median. Since most heavy trucks travel on the outside lanes, this procedure will make it easier for the Traficounter to detect them.
C. Follow directions when you set up the Traficounter. The side of the road across from the Traficounter is called the FAR SIDE. The side of the road that the Traficounter is on is called the NEAR SIDE.

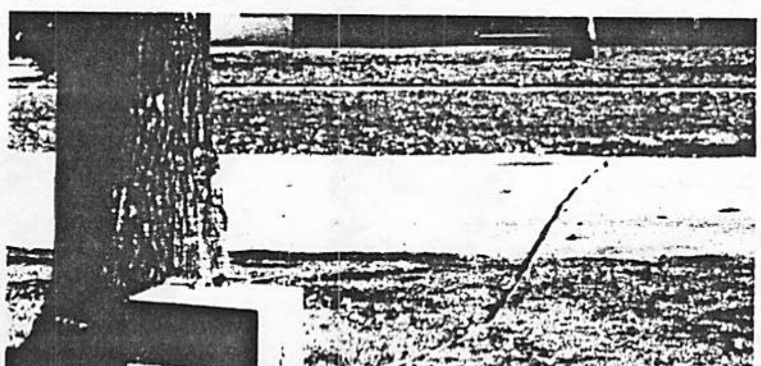

Figure 1. Traficounter Installation

StreeterAmet

Measurement Systems Division

The Mangood Group

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3. INSTALLATION ON ROAD WITHOUT CURBS

A. Place the Traficounter next to a tree, sign post or lamp post. This is the NEAR SIDE.
B. Lay tube (9117202) across highway.
C. On the FAR SIDE of the road, plug the end of the roadtube with a 1/4" x 20 x 1" Round Head Screw (see figure 2).
D. Slide a clamp (9118600) over the end of the roadtube. BE SURE the long metal end of the clamp points AWAY from the road.
E. Tighten the clamp around the roadtube and plug-screw by turning the small screw (9121201) on the side of the clamp.
F. If ground is hard, drive spike (9120701) through the hole in the metal end of the clamp, into the ground. If the ground is too soft to hold the spike firmly, drive in the stake (9120306) instead. Fasten clamp to stake with a 1/4" screw.
G. COME BACK TO THE NEAR SIDE. Slide second clamp (9118600) over this end of the roadtube. BE SURE the long metal end of the clamp points AWAY from the road (see figure 3).
H. The roadtube should be across the road, Perpendicular to the flow of traffic (see figure 6).
J. Attach clamp to the ground no less than one foot away from the road (see figure 3). Fasten down with stake or spike in the same manner as on the far side. (see paragraph F).

NOTE

MAKE CERTAIN THAT THE ROADTUBE SLIDES THROUGH THE CLAMP FREELY.

K. Pull the roadtube through the clamp until it has stretched 10%. This means stretch it 1 foot if the road is 10 feet wide, 2 feet if the road is 20 feet wide or 3 feet if the road is 30 feet wide and so on.

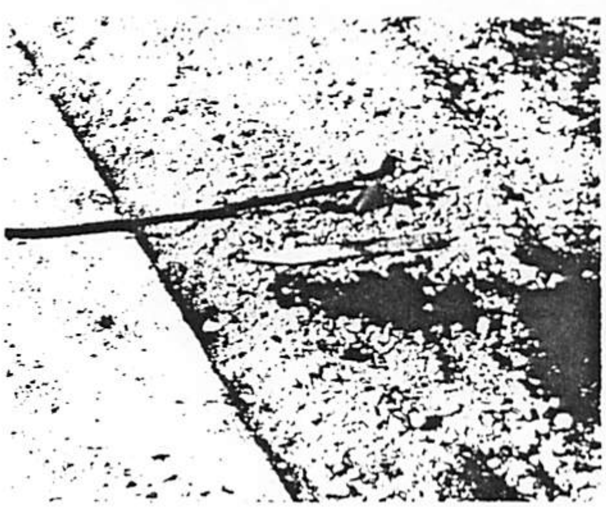


Figure 2. Roadtube Installation, Far Side Without Curbs

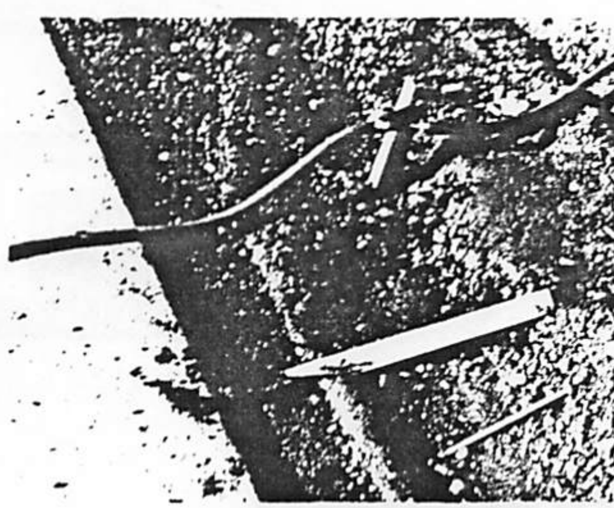


Figure 3. Roadtube Installation, Near Side Without Curbs

L. After stretching the roadtube the right amount, wrap enough TAPE around the roadtube next to the clamp, so that the roadtube cannot slide back through the clamp. When the road width is greater than the length of the roadtube, it will be necessary to extend it by using a roadtube extension sleeve (9116902). On narrow roads, keep any additional roadtube length coiled on the near side of the road by the Traficounter.

CAUTION

THE EXTENSION SLEEVE SHOULD NOT BE USED ON THE TRAFFIC BEARING AREA.

M. Slide the free end of the roadtube over the end of the pipe on the side of the Traficounter.

4. INSTALLATION ON A ROAD WITH CURBS

A. The roadtube must be held flat against the road at every point. For this reason the roadtube must be attached to the road itself and not to the ground beside the road.

B. Follow the instructions in paragraph 2 through 3 except as follows: DO NOT drive spike (9120701) or stake (9120306) into the ground. Instead, find a crack, expansion joint or mortar joint in the pavement NEXT TO THE CURB. Drive a masonry spike (9120801) through the hole in the metal end of the clamp into crack, expansion joint or mortar joint (see figures 5 and 6).

C. Bring the free end of the roadtube up and over the curb and attach it to the pipe on the side of the Traficounter.

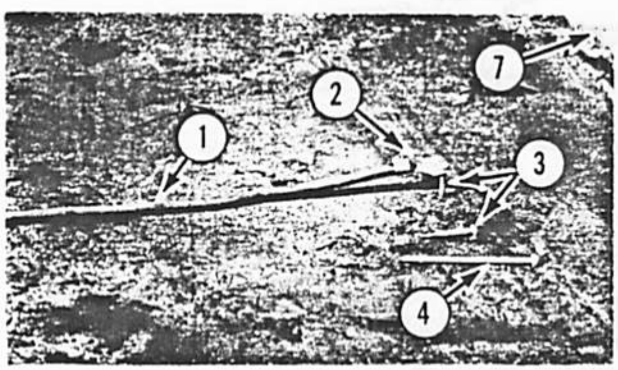


Figure 4. Roadtube Installation, Far Side With Curbs

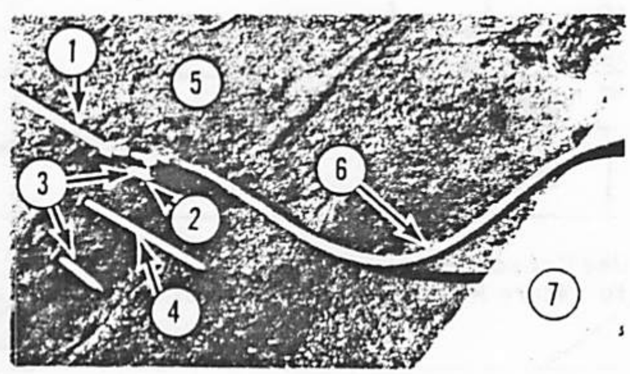


Figure 5. Roadtube Installation, Near Side With Curbs

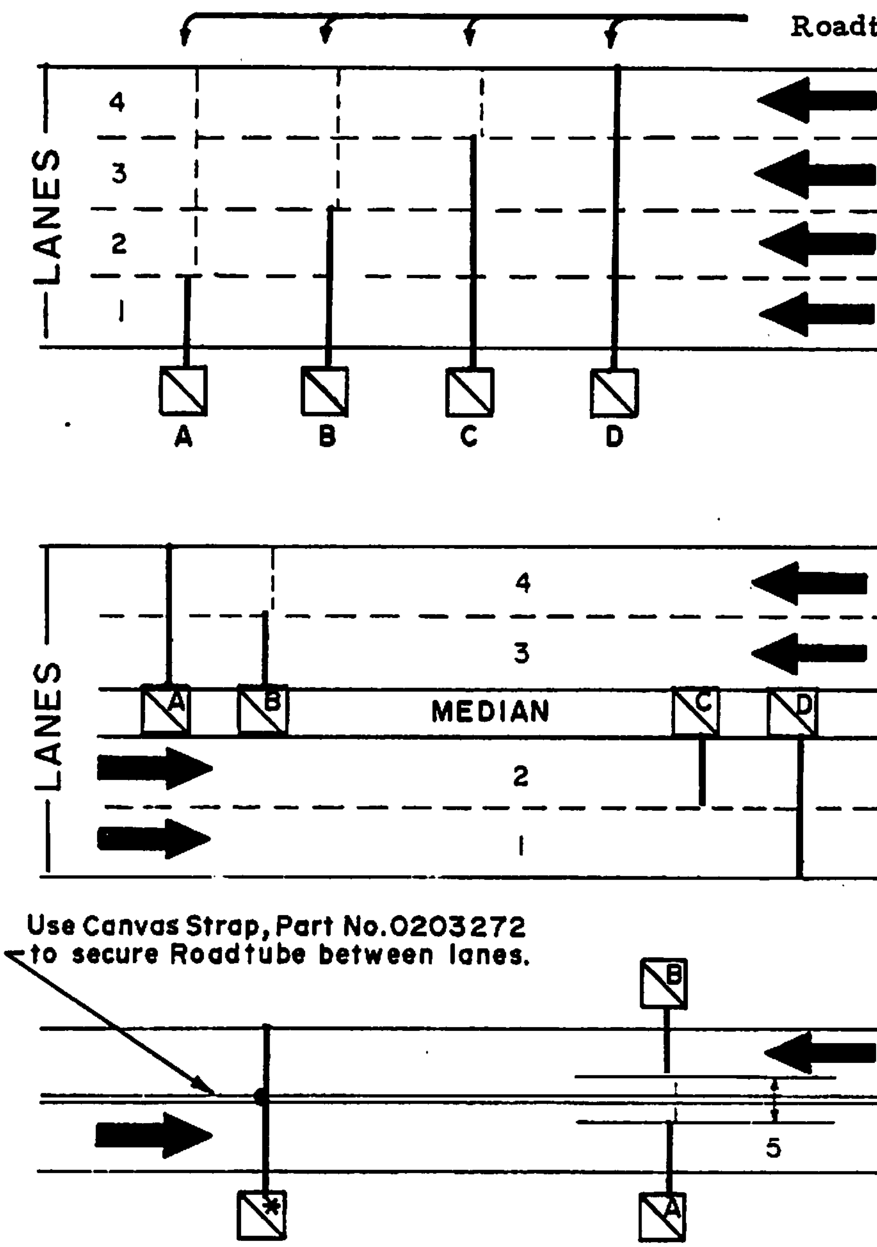
1 ROADTUBE
2 ROADTUBE CLAMP
3 MASONRY NAIL
4 SPIKE

5 EXTENSION SLEEVE
6 ROADTUBE TO COUNTER
7 CURB

IDEAL ROADTUBE INSTALLATION

For proper roadtube installation, the methods illustrated below (Figure 6) should be followed. The roadtubes should be placed in a perpendicular plane, directly against traffic flow. This will allow both wheels of a vehicle to strike the roadtube at the same time.

Variations in methods of installation are illustrated below.



Roadtubes in Perpendicular plane

Individual lane traffic counting - one way traffic flow

LANES		Traficounters
1	=	A
2	=	B minus A
3	=	C minus B
4	=	D minus C

Individual lane traffic counting - two way traffic flow

LANES		Traficounters
1	=	D minus C
2	=	C
3	=	B
4	=	A minus B

Two applications: Two lanes, two way traffic counting (*); individual lane traffic counting (A & B)

Figure 6. Proper Road Tube Placement

section two

2.0 INSTALLATION and OPERATING INSTRUCTIONS

CAUTION

Before attempting to use the equipment, carefully read this Instruction.

2.1 UNPACKING and INSPECTION

This TraficCOMP™ System Instrument and Accessories were carefully inspected both mechanically and electrically before shipment. They should be physically free of mars or scratches and in perfect electrical order upon receipt. To confirm this, the instrument should be inspected for physical damage that occurred in transit.

Unpack and Inspect as follows:

One or more of the following items should be present:

A. Model 140 TrafiCOMP™ Reader.

B. Model 141 TrafiCOMP™ Recorder equipped with air switches and/or 750P Dual Channel Vehicle Detectors.

C. Vehicle Detector Cable Assembly, if -3 or -4 models ordered.

D. Extra 6V Dry Cell Batteries for 141 Recorder.

E. Tape cassettes for Program and Data.

F. Printer cable.

G. Manuals:

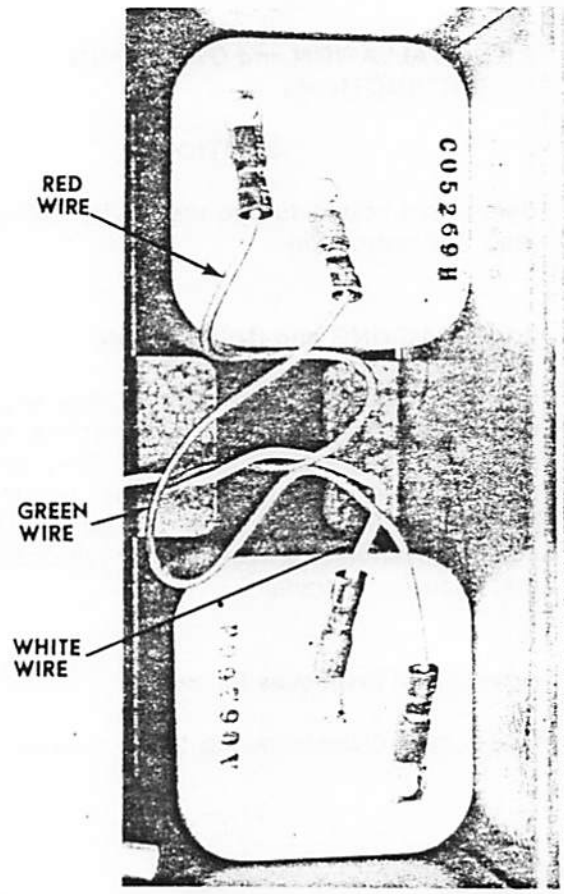
140/141 TrafiCOMP™ System Printer Manual, if ordered.
750 Vehicle Detector, if ordered.

Unpack and visually inspect all equipment for shipping damage.

2.2 140 READER INITIAL CHECKOUT

WARNING

Make sure that the equipment supplied has been designed to operate with your supply voltage. Connecting 115V equipment to a 230V supply will cause serious damage. Supply voltage must be indicated on all equipment including Recorder Adapter, Reader, Printer, etc. The following instructions apply to all equipment, except for power, which is assumed to be 115 VAC.



2.2 140 READER INITIAL CHECKOUT

A. Connect the Reader to the correct AC power.

B. Turn power switch to ON (blue alternate action switch) to the "out" position.

C. Verify that the numeric display reads 0000 for approximately 1 second and then goes blank. This indicates that the microprocessor is running normally.

D. Press the 8 button then the 9 button on the keyboard. After each is pressed, the corresponding number will appear on the display and then disappear. This indicates that the memory and logic are functioning properly. If either are not correct, an error code will appear.

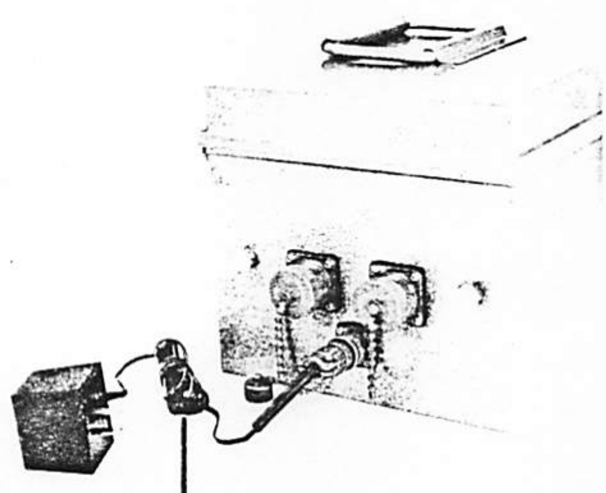
E. Refer to section 3 (3.2.3.1), if further testing of the Reader is desired.

2.3 RECORDER SETUP and PROGRAM ENTRY

A. Open Recorder lid and remove inner cover.

B. Connect battery power by connecting battery jumper lead (green) to vacant battery terminals, as shown.

C. Connect AC Adapter Assembly, as shown when the optional power pack is used.



AC ADAPTER ASSY

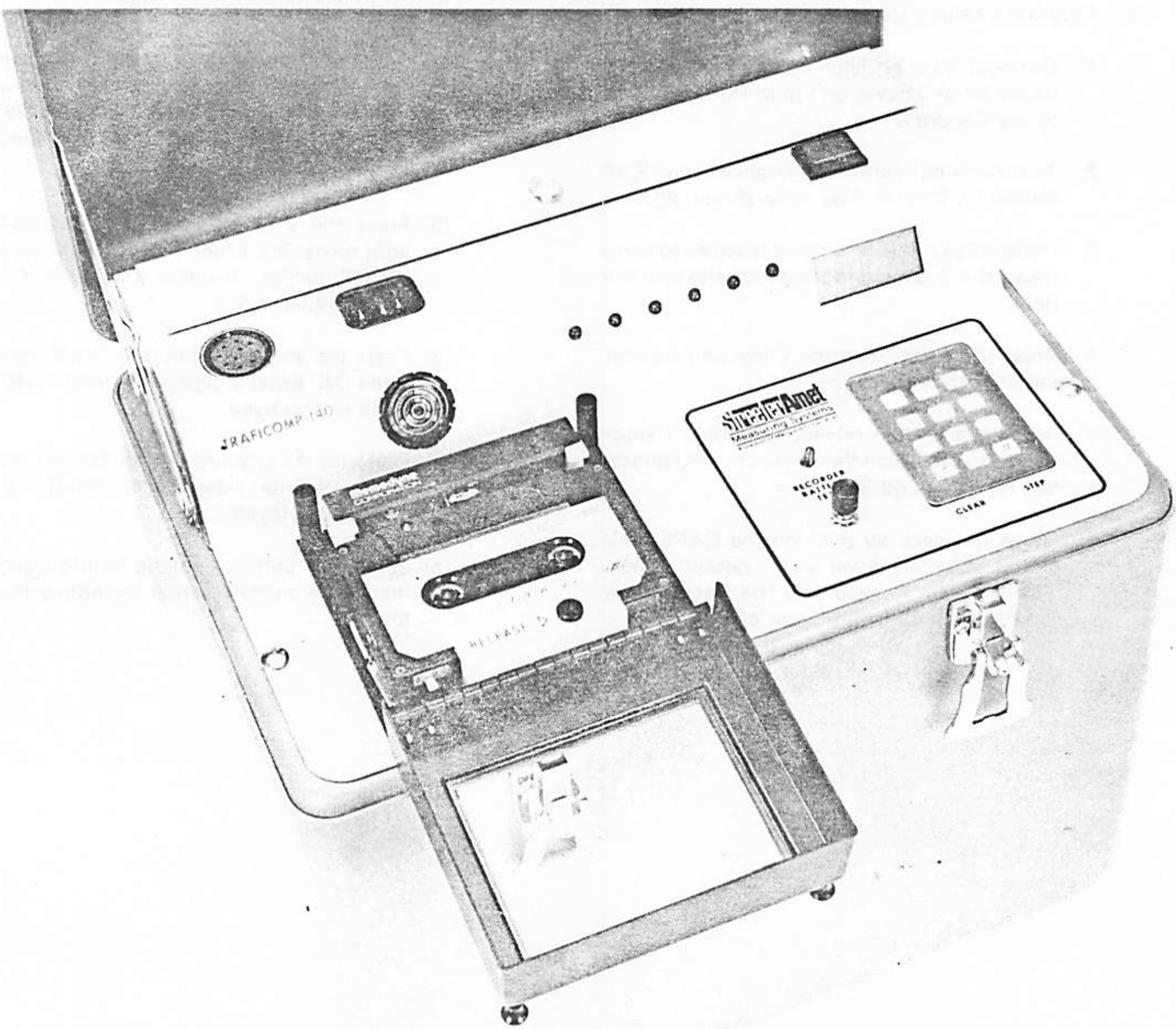


Figure 10. TrafiCOMP™ Model 140 Reader Controls and Displays, Cassette Deck Cover Open

2.3 141 RECORDER SETUP and PROGRAM ENTRY (cont'd.)

B. Program Loading (refer to Table IV)

1. Connect Reader field cable (coiled cable under hinged cover on top of Reader panel) to the Recorder.

2. Test Recorder batteries by depressing TEST button on Reader. The lamp should light.

3. Press RELEASE button on cassette deck and insert the desired program cassette into the deck.

4. Press the 0 key, then the 1 key, and wait for cassette to rewind.

5. Actuate and then release the RESET (momentary) switch on the Recorder CPU board, see Fig. 11, page 2-6.

6. Close the deck by pushing the CAPSTAN/HEAD assembly down on the cassette deck. The program is read into the Recorder. A tone signals the completion of this.

7. Setup the Recorder STATION, ID, TIME, and DATE, by the following procedure:

   (1) Press the # keyboard button. Station light turn ON. Enter 4 digits of the new station number, i.e. enter 0123 for 123. Station number entered is displayed (4095 max.)

   (2) Press the # keyboard button. INDENT light turns ON. Enter 4 digits of the new IDENT number. Number entered is displayed (4095 max.)

   (3) Press the # keyboard button. TIME light turns ON. Enter 4 digits of correct TIME. Time is displayed.

   (4) Press the # keyboard button. DATE light turns ON. Enter 4 digits of correct DATE. Date is displayed.

   (5) Press the * button, then the 1 button, and then the # button to enter the above into memory.

	Function	Response
A.	Connect the batteries in the Recorder. Refer to page 2-2	Power is applied to Recorder.
B.	Turn ON Reader.	
C.	Connect the Reader's field cable to the Recorder. Press the battery test on the Reader control panel. The Reader's batteries can be fast charged by pressing the battery test button while the Reader is on a service bench with AC power connected.	0 is displayed after a momentary delay. The test lamp will light.
D.	Place the desired program cartridge in the cassette deck.	
E.	Press the 0 keyboard button and then the 1 button. Wait for rewind.	The tape is rewound and the DATA light turns on.
F.	Actuate and then release the RESET switch located on the Recorder CPU module. See Fig. 11, page 2-6.	
G.	Close the DECK.	The program is transferred from the cassette to the Recorder.
H.		Self Diagnostics are performed to insure proper program transfer.
I.	See Step 7, page 2-4 for setup for Station ID, Time and Date.	
J.	Disconnect the Reader field cable from the Recorder and remove the program cassette.	
K.	Turn the Reader power OFF.	
L.	Replace inner cover on Recorder.	The system is ready for field installation.

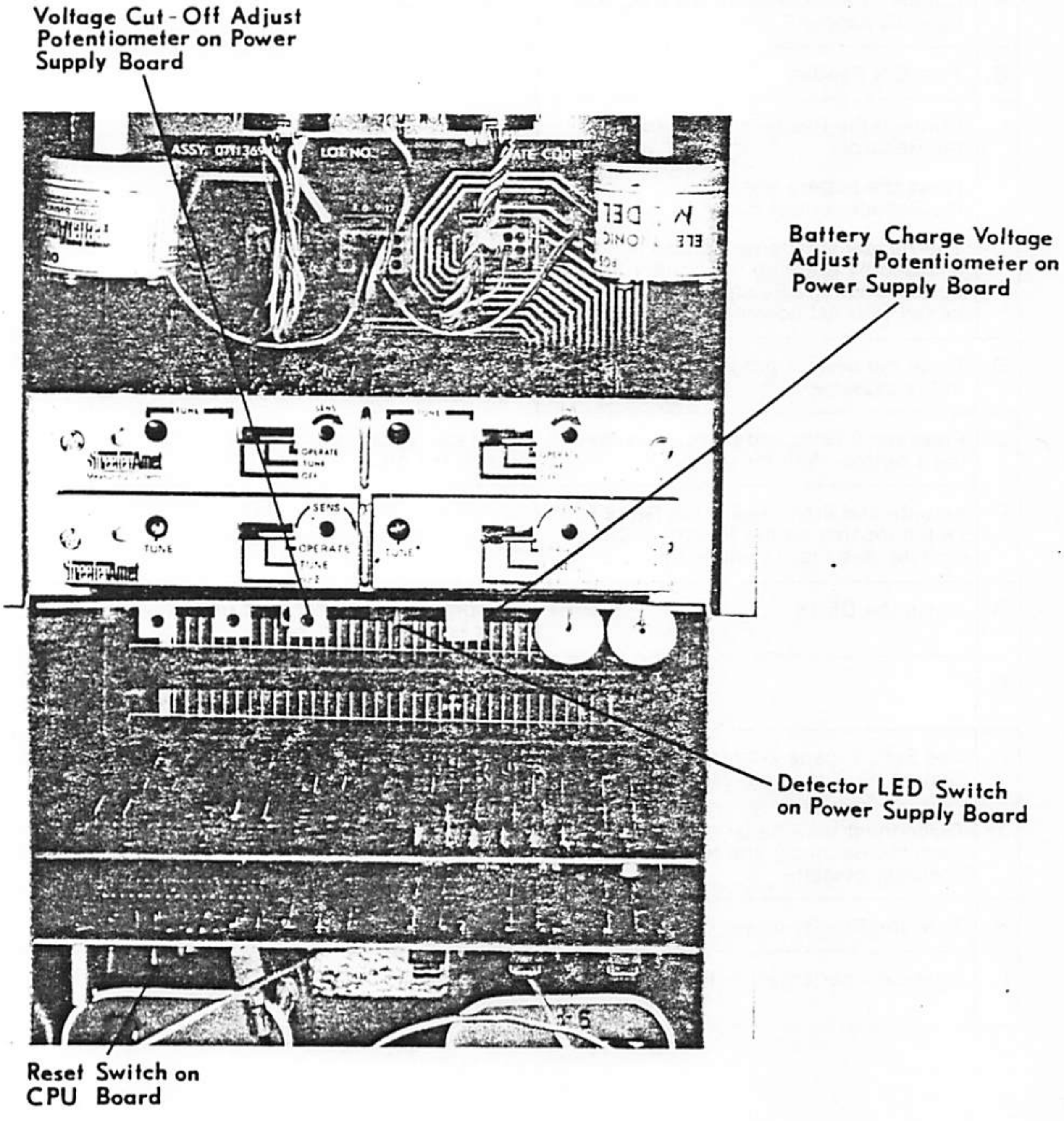
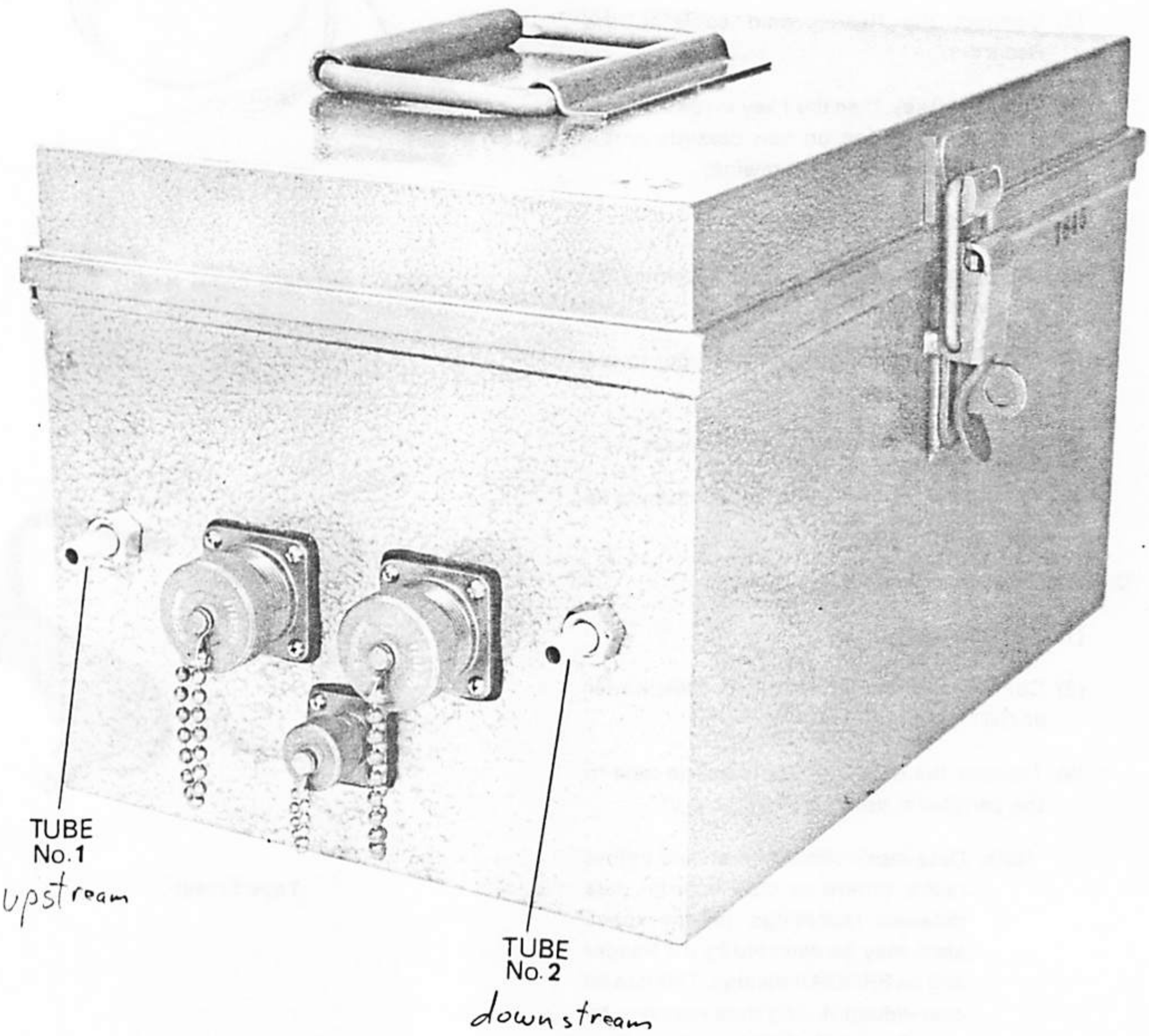


Figure 11. 141 Recorder Electronics with Inner Cover Removed.

ROADTUBE HOOKUP ON RECORDER



See Appendix B for Roadtube Installation Instructions

C. Data Collection

(1) Press the RELEASE button on the cassette deck.

(2) Insert a DATA cassette into the cassette deck on the Reader.

(3) Connect the Reader field cable to the Recorder.

(4) Press the 0 key, then the 1 key to rewind tape.
*Note: First station on new cassette only -
- thereafter don't rewind!

(5) Press the * (CLEAR) key.

(6) Engage the CAPSTAN/HEAD assembly on the cassette deck.

(7) Transfer the data from the Recorder to the Reader using Table V.

(8) Remove the field cable from Recorder.

(9) For subsequent stations, until cassette is filled, skip Steps (1) through (6).

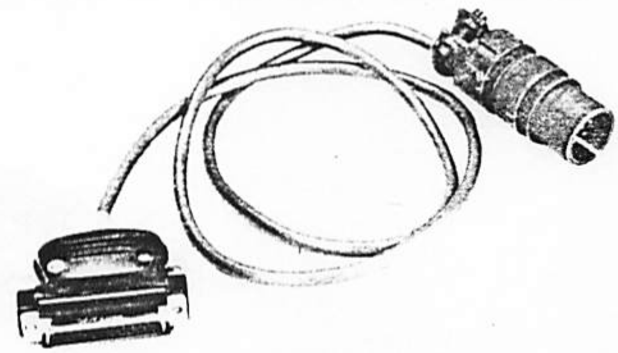
D. Cassette Data Readout

(1) Turn the Reader ON.

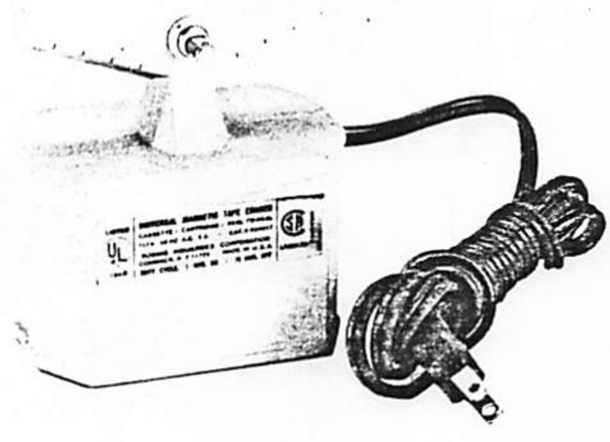
(2) Connect the interface cable to a teleprinter or CRT terminal.

(3) Transfer the data from the cassette tape to the peripheral device using Table VI.

*Note: Data tapes should be erased before reuse, otherwise old Recorder data between recordings (in the space area) may be detected by the Reader and an ERROR indicated. This can be over-ridden during data recovery by pressing the CLEAR button and then the STEP button - but this becomes unduly time consuming.



Interface Cable Assy



Tape Eraser

TABLE V FIELD STATION SETUP & DATA COLLECTION

	Function	Response
A.	Turn the Reader ON.	Power is applied to the Reader.
B.	Connect the Reader field cable to the Recorder.	0 or traffic data is displayed after a short delay.
C.	Press the # keyboard button.	Station light turns ON.
D.	Observe Station No. If a change is desired, enter 4 digits or new Sta. No., i.e., enter 0123 for 123.	Station No. is displayed (4095 max.)
E.	Press the # keyboard button.	Ident — light turns ON.
F.	Observe Ident NO. If a change is desired, enter 4 digits of new Ident No.	Ident — is displayed (4095 max.)
G.	Press the #keyboard button.	Time light turns ON.
H.	Observe the time. If incorrect, enter 4 digits of correct time.	Time is displayed.
		Date light turns ON.
J.	Observe the date. Enter 4 digits of correct date.	Date is displayed.
	Note: For Station Setup "Only" go to Step M.	
K.	Press the # keyboard button.	Data light turns ON.
L.	Press the 0 keyboard button. Note: display can be slowed down by holding the # button.	Data is transferred from the Recorder to the cassette tape.
M.	Press the * keyboard button.	Data light is OFF. Data from vehicles passing over the system may now be observed on the Display.
N.	Disconnect the Reader field cable from the Recorder.	
O.	Turn the Reader power OFF.	
	Note: If an error is made during Steps D, F, H, or J, complete the 4 digit entry and then enter the correct 4 digits. At any time in this sequence prior to Step J, the * keyboard button may be pressed and the sequence may be restarted at Step C.	

Table VI **CASSETTE DATA TRANSLATION**

	Function	Response
A.	Turn the Reader ON.	
B.	*Connect the proper cable to the Reader.*	
C.	Place the desired data tape in the cassette deck. Do not close the deck.	
D.	Press the # keyboard button. Wait for rewind.	Tape is rewound.
E.	Close the cassette deck.	Data light is turned ON. The data is transferred from the cassette tape to the peripheral device.
F.	Open the cassette deck.	
G.	To rewind the tape, press the 3 keyboard button.	The tape is rewound.
H.	Disconnect the peripheral cable from the Reader.	
I.	Turn the Reader OFF.	

2.5 PROGRAM ADJUSTMENT PROCEDURE

Several "adjustments" may be made to the standard TrafiCOMP™ Recorder to alter its operation. These are done by changing the contents of one or more programs locations after the program is loaded from the cassette tape.

The contents of a program location may be changed using the following general procedure.

A. Load the appropriate program from the cassette using step B, section 2.3.

B. Refer to Appendix A, C & D for adjustments to the VOLUME & VELOCITY programs.

C. Press the * (CLEAR) key.

D. Press the 5 key. The display will acknowledge with 005.

E. Enter the 4 digit address of the location to be changed. The display will then show the contents of the location selected.

F. To change the contents of the location, press the 6 key. The display will acknowledge with 006.

G. Enter the 4 digit number to be deposited in the selected memory location. This new content is then displayed.

H. Press the * (CLEAR) key.

Note: If after step D above, the contents of the location has the correct value, skip steps F & G.

The following is an example of changing location 0061 to contain 2345.

Action	Result	Comment
1. Depress 5 key.	005 displayed	Acknowledge
2. Enter 0061 on keyboard.	1693 displayed	Current contents of location 0061 is 1693.
3. Depress 6 key.	006 displayed	Acknowledge.
4. Enter 2345 on keyboard.	2345 displayed	New contents of location 0061 is 2345.

Program Change Procedures for Vehicle Type and other Classification Programs acquired under special options, will be included in the Appendix of the manual provided.

TABLE VII ***ERROR CODES**

Code	Error Description	Possible Cause or Corrective Action
0003	Data Cassette not in place	Insert correctly
0002	Cassette file protected	Wrong cassette
0001	Cassette not ready	Not closed or possibly wrong cassette
0004	Parity Error	Check Recorder
0005	Frame Error	Check Recorder
0006	Data not returned from Recorder	Check Reader to Recorder *Coupling/Reset
0007	End of cassette tape	Use another tape & repeat last portion of data
0008	Data not on cassette tape	Use another tape
0009	Data format error	Try reading with 2 key
0010	Program Format error	Check cassette
0011	Recorder not reset	Reset
1000	RAM memory fault	Replace RAM board
2000	PROM memory fault	Replace PROM board
3000	Program fault	Check Recorder
4000	Data not received by Recorder	Check Recorder & Reader

0012 Printer not "On" — Plug in cable + turn on printer (or enable "Down loading")

*Appear on the Reader Display

Key	RECORDER Supervisory Mode (1)		RECORDER Data Collection Mode	RECORDER Not Connected	READER Output Mode	Key
•	Clear		Clear	Clear	Clear	*
#	-----		1st # Ident #1			*
0	*Load Program	1	2nd # Ident #2		Rewind & Output tape to Peripheral	#
1	Reset Memory	S (STEP)	3rd # Time			
2	Readout	S	4th # Date		Output 1 dump only	0
3	Store Data	S	5th # Data LED			
4	Display Time	S	0 Data Transfer		Output without Heading	1
5	Select Parameter	S			Ignore Protocol	2
6	Alter Parameter	S			Rewind tape	3
7	Input Diagnostic	S	Active Counting Display while idle	7 Input/Output Diagnostic		
8	RAM Diagnostic	S		8 RAM Disgnostic		
9	Program Diagnostic	S		9 Program Diagnostic		

Extreme care must be exercised when making these adjustments as carelessness will cause erratic operation.

*Recorder Reset prior to Function

(1) See page 2-18 for further description of these functions

☐ Denotes Common Use

READER CONTROLS
TABLE VIII

SUPERVISORY MODE FUNCTIONS

(Other than Common Use)

Key	Function	Remarks
1	Reset Memory	Used when it is desired to Reset Recorders
2	Readout	Provides operator a readout of data in Recorder
3	Store Data	A forced storage of data, normally automatic
4	Display Time	Time is displayed, normally automatic
5	Select Parameter	For program alteration, see Sec. 2-5 and Appendix
6	Alter Parameter	As above
7	Input Diagnostic	Normally self-diagnostic of input. Recommend this Diagnostic only for Service Personnel.
8	RAM Diagnostic	Test of Random Access Memory
9	Program Diagnostic	Test of Stored Program

APPENDIX 13: "INP103.BA," DATA ENTRY PROGRAM FOR MODEL 103 TRAFFIC COUNTERS WRITTEN FOR RADIO SHACK 100

```
10 REM "INP103.BA" DATA ENTRY PROGRAM FOR MODEL 103 TRAFFIC COUNTERS
15 REM REVISED 12/13/84 BY J.K. POLLARD
20 CLEAR:CLS
25 DIM C(25)
30 INPUT"ENTER WEEK/SITE CODE";WS$
40 FN$="RAM:C"+WS$+".DO"
50 OPEN FN$ FOR APPEND AS 1
100 ST$=RIGHT$(WS$,3)
105 ST=VAL(ST$)
110 INPUT"COUNTER ID(4 DIGITS)";ID
120 INPUT"SETUP DATE(4 DIGITS)";SD
130 INPUT"SETUP TIME(4 DIGITS)";SU
140 INPUT"RETRIEVAL DATE(4 DIGITS)";RD
150 INPUT"RETRIEVAL TIME(4 DIGITS)";RT
190 PRINT#1,
191 PRINT#1,
192 PRINT#1,
193 PRINT#1,
200 PRINT#1,USING"\       \####\       \####\         \\
\";"STATION:",ST,"    IDENT: ",ID,"    PROG: 1004","    INTRVL:  60  MIN"
210 PRINT#1,
220 PRINT#1,USING"\                   \ #### \                 \ ####";"
SETUP  DATE: ",SD,"          SETUP TIME:",SU
230 PRINT#1,USING"\                    \####\                   \####";"
RETRIEVAL  DATE: ",RD,"    RETRIEVAL  TIME:",RT
240 GOSUB 600
290 PRINT#1,
300 INPUT"SECOND HOUR ON TAPE";T
310 PRINT"FOR HOUR=";T:INPUT"ENTER COUNT";C(J)
315 IF C(J)=999 THEN 325
320 PRINT#1,USING"#####  ### ####";T,C(J),0:GOTO 330
325 PRINT#1,USING"#####    ! ####";T,"U",0
326 C(J)=0
330 CT=CT+C(J)
340 T=T+1:J=J+1
350 IF T=25 THEN 400
360 GOTO 310
400 PRINT#1,:PRINT#1,"--24 HOUR TOTALS__":PRINT#1,
410 PRINT#1,"CHAN:   TOTALS:"
420 PRINT#1,USING"\     \####";"    1    ",CT
430 PRINT#1,"    2      0"
440 T=1:CT=0:J=1
450 GOSUB 600:GOTO 310
600 PRINT#1,:PRINT#1,
650 PRINT#1,"HOUR:   CHANNEL:"
660 PRINT#1,"        1    2"
670 PRINT#1,:RETURN
```

ARVIN/CALSPAN
FIELD SERVICES, INCORPORATED

January 31, 1984

Mr. John Arena
Chief of Police
Natick Police Department
2 Park Street
Natick, MA 01760

Dear Chief Arena:

The Town of Natick is one of 12 townships selected to be included in the study area for the "Small Car Safety Study" (SCSS) which is to be conducted for the National Highway Traffic Safety Administration.

Briefly stated, the objective of this study is to make available reliable, quantitative information on the effect that a changing proportion of small cars among the population of passenger cars has on highway safety.

The prime contractor is the Center for Environment and Man, Inc. (CEM) in Hartford, CT. That organization is responsible for developing the Work Plan, the Exposure and Data Collection Plans and the Analyses. Cooperating closely with CEM is the Transportation Systems Center (TSC) in Cambridge, MA.

We (CFSI) have been asked to participate in the data collection phase of the study, in part, because of our operation of the National Accident Sampling System (NASS) team in Boston, MA. Enclosed, for your information, is a brochure that briefly describes the NASS program. Our team of investigators operate out of an office in Dorchester, MA.

The SCSS study is to be conducted in a 200 square mile area west of Boston. According to the recently received Work Plan, the jurisdictions in the study area are those townships shown on the attached map.

Data collection is scheduled to start March 15 and is to continue for eight months through November, 1984.

We have the cooperation of the Boston Police Department, the Metropolitan District Commission and the Massachusetts State Police in the conduct of the NASS program in Boston. Similarly, for the SCSS study we will need your cooperation as well as the cooperation of the 11 other police departments in the study area during the eight-month data collection phase.

ARVIN
CALSPAN FIELD SERVICES, INC. PO BOX 400, BUFFALO, NEW YORK 14225 TEL. (716) 632-7512
APPLIED TECHNOLOGY GROUP OF ARVIN INDUSTRIES INC.

I plan to be in Boston the latter part of February or early March at which time I would like to visit the 12 townships. I would like to phone ahead for an appointment. Perhaps we could schedule a brief meeting at your convenience. I would appreciate the opportunity to meet you and to answer any questions you might have.

In the meantime, I enclose some background material of possible interest to you.

Sincerely,

Dick Braisted

Richard C. Braisted
Operations Manager
Accident Research Division

RCB:jes
Attachment
Enclosure

January 27, 1984

SMALL CAR SAFETY STUDY

Objective

To make available reliable, quantitative information on the effect that a changing proportion of small cars among the population of passenger cars has on highway safety. To determine, for instance, whether the accident risk is greater for smaller cars than for larger cars?

Implementation

Some questions and answers:

- Where is the study to be conducted?

  In an area roughly 200 square miles in size located west of Boston, comprising the townships of Acton, Bedford, Concord, Framingham, Lincoln, Maynard, Natick, Needham, Sudbury, Wayland, Wellesley and Weston.

- When is data collection scheduled to start?

  March 15, 1984

- Will the Exposure Data Collection involve public contact?

  NO - absolutely not. The observers recording exposure data will be as inconspicuous as possible.

- Will traffic be hampered in any way?

  No. Surveillance will be low key--in order to record normal traffic patterns. The study team vehicle will be legally parked.

- How many observers at an observation site?

  Probably three. At most a team will comprise four observers but they are likely to be separated by some distance--i.e., between intersections.

- Duration of observation periods?

  Probably no more than 1/2 hour shall be spent for the main observation at one location?

- <u>Periods of exposure data observations? When made?</u>

  The Work Plan schedule requires 5 working days per week. Friday, Saturday and Sunday for each week--and only 2 working days on Monday through Thursday.

- <u>How many sites?</u>

  1,050 observations at <u>185</u> sites--i.e., an average of 5.7 sessions per site

- <u>Duration of data collection?</u>

  36 weeks--through November, 1984

- <u>How many accidents expected during the study period?</u>

  Approximately 7,000 accidents involving passenger cars in the 12 jurisdictions in the study area.

- <u>What cooperation is required of the 12 police departments and the Massachusetts State Police?</u>

  The extent of cooperation would be limited to enabling the team to obtain hard copies of the accident reports during the study period. Although the distribution is uneven, the volume averages out to 16 accidents per town per week. Any costs incurred would, of course, be reimbursed.

- <u>How often would police departments be visited?</u>

  Because Framingham accounts for 1/3 of the accidents, a weekly visit will be scheduled to that police department; biweekly to all other police departments.

POLICE CHIEFS IN SCSS STUDY AREA

Acton
George W. Robinson
Box 212
365 Main Street
Acton, MA 01720

Concord
William J. Costello
P. O. Box 519
Concord, MA 01742

Bedford
Donald Eunson
3 Elm Street
Bedford, MA 01730

Maynard
Arner Tibbetts
1 Summer Street
Maynard, MA 01754

Lincoln
Dominick J. Arena
169 Lincoln Road
Lincoln, MA 01773

Sudbury
Peter B. Lembo
415 Boston Post Road
Sudbury, MA 01776

Framingham
Arthur F. Martins
81 Union Street
Framingham, MA 01701

Wayland
John W. Phylis
38 Cochituat Road
Wayland, MA 01778

Weston
Frank O. Shaw
180 Boston Post Road By Pass
Weston, MA 02193

Wellesley
Leroy L. Weaver
485 Washington Street
Wellesley, MA 02181

Natick
John Arena*
2 Park Street
Natick, MA 01760

Needham
Louis Roman
99 School Street
Needham, MA 02192

*Current President, Massachusetts Police Chiefs Association

APPENDIX 15

ARVIN/CALSPAN
FIELD SERVICES, INCORPORATED

April 10, 1984

Mr. Leroy L. Weaver
Chief of Police
Town of Wellesley
485 Washington Street
Wellesley, MA 02181

Dear Chief Weaver:

I regret that I did not get to meet you during my limited time in your area last month. However, as you know, I did discuss the Small Car Safety Study (SCSS) with Lt. Jack Broyles. And I was able to visit all of the police departments (12) in the study area.

As I indicated to Lt. Broyles, I had been trying to determine the most efficient procedure for obtaining the hard copies of the police accident reports which are needed by the study group.

The Framingham Police Department was one of my first visits. In discussing the matter of the hard copies, I suggested as a viable solution the procedure outlined in the attached draft of a proposed memo to come from the Registry. I was informed, however, that if we only needed copies of the reports normally sent to the Registry this would not create a budgetary problem and they would be glad to run the copies to be picked up by our courier. The feeling expressed was that, since their department would receive the final report of the study findings, their contribution to the effort would be justified. This same offer was volunteered by all the other departments. One police chief did ask me if we would supply the paper. But, of course. Glad to. We all have our budgetary limits and that goes for our contract funds but at the same time we are prepared and more than willing to offset any costs incurred.

I very much appreciate the courtesies extended to me and Karol Sullivan by Lt. Broyles.

Your assistance with respect to the SCSS study will be very much appreciated.

Sincerely,

Dick Braisted

Richard C. Braisted
Operations Manager
Accident Research Division

RCB:jes
Attachments
cc: Lt. Broyles

APPENDIX 16

MARI

MID-AMERICA RESEARCH INSTITUTE, INC.

Hartford Office

WORKING MATERIAL -- DRAFT

2005
1/10/85
J. Kaminski

DICTIONARIES FOR ACCIDENT DATA CODING

Attached are dictionaries for coding towns and streets on the accident report form.

1. Town codes. They are the same as in the Massachusetts motor vehicle registration file.

2. Streets alphabetically, by town with codes. Revised to include codes for route numbers and streets with more than one classification when the exact location cannot be determined.

3. Streets by stratum by town.

4. Multiple strata streets. Check this list before assigning any 700 code.

SMALL CAR STUDY TOWN CODE LIST

from the Mass. RMV registration file data base

1.	ACTON	161
2.	BEDFORD	103
3.	CONCORD	060
4.	FRAMINGHAM	029
5.	LINCOLN	168
6.	MAYNARD	138
7.	NATICK	033
8.	NEEDHAM	046
9.	SUDBURY	176
10.	WAYLAND	118
11.	WELLESLEY	047
12.	WESTON	155

REVISED 1/10/85 TO INCLUDE "CATCH-ALL" * CODES (700)

* when exact location cannot be determined.

REVISED 10/17/84 TO INCLUDE ROUTE CODES.

SMALL CAR STUDY

STREET CODE LIST

for the following Massachusetts towns:

1.	ACTON	7.	NATICK
2.	BEDFORD	8.	NEEDHAM
3.	CONCORD	9.	SUDBURY
4.	FRAMINGHAM	10.	WAYLAND
5.	LINCOLN	11.	WELLESLEY
6.	MAYNARD	12.	WESTON

(Route numbers in parentheses)

STREET CODES

100 = divided arteries

200 = undivided arteries

300 = major collectors

400 = minor collectors

500, 600 = unclassified streets

ACTON

ROUTES
27 - 250
62 - 251
111 - 252

Agawam Rd.	501
Arlington St. (701)	
(n. of Mass. Ave.)	301
(Mass. Ave. s. to Summer St.)	401
(s. of Summer St.)	502
Birch Ridge Rd.	503
Brook St.	402
Carlisle St.	403
Cedar Ter.	504
Central St. (702)	
(n. of Mass. Ave.)	302
(s. of Mass. Ave.)	404
Charter Rd.	405
Conant St.	406
Concord Rd.	303
Coughlin St.	407
Deacon Hunt	505
Elm St.	408
Esterbrook Rd.	506
Forest Rd.	409
Foster St.	507
Freedom Farm Rd.	508
Great Rd. (111)	201
Hammond St.	410
Hapgood Ln..	509
Harris St.	411
Haynes Ct.	510
Hayward St.	412
High St.	413
Hillside Ter.	511
Homestead	512
Hosmer St. (703)	
(n. of Mass. Ave.)	304
(s. of Mass. Ave.)	414
Houghton Ln.	513
Juniper Ridge	514
Kingman Dr.	515
Kinsley Rd.	516

Laws Brook Rd.	305
Liberty St.	415
Longfellow Pk.	517
Main St. (27)	202
Maple St.	416
Martin St. (704)	
(n. of Stow Rd.)	417
(s. of Stow Rd.)	518
Mass. Ave. (705)	
(2)	101
(111)	203
Mead Ter.	519
Minot Ave.	418
Musket Dr.	419
Nagog Hill Rd.	306
Newtown Rd.	307
Parker St.	420
Piper Rd.	421
Pope Rd.	308
Powder Mill Rd. (62)	204
Prospect St.	422
River St.	423
Robbins St.	424
Robinwood Rd.	520
Russell Rd.	521
School St.	309
S. Main St. (27)	205
Spruce St.	522
Squirrel Rd.	523
Stow St.	310
Strawberry Hill Rd. (706)	
(e. of Pope Rd.)	311
(w. of Pope Rd.)	425
Sudbury Rd.	426
Summer St.	427
Taylor Rd.	428
West Rd.	524
Wetherbee St.	525
Whittier Dr.	526
Willow St.	429
Windsor Ave.	527
Wright Ter.	528

BEDFORD

Apple Tree Ln.	501
Bandera Dr.	502
Beverly Rd.	503
Brooksby Rd. (62)	201
Buehler St.	504
Burlington Rd. (62)	202
Carlisle Rd. (225)	203
Chelmsford Rd. (4)	204
Concord Rd. (62)	205
Cot Hill Rd.	505
Crosby Dr.	401
Dudley Rd.	402
Dunster Dr.	506
Elm Brook Dr.	507
Fox Run Rd.	403
Frances Kelly Rd.	507
Great Rd. (225)	206
Green St.	508
Hartwell Rd.	404
Harvard Dr.	509
Hemlock Ln.	405
Kingsley Ter.	510
Minuteman Dr.	511
Noreen Dr.	512
North Rd. (4) (701)	
(to Chelmsford Rd.)	207
(n. of Chelmsford)	301
Old Billerica Rd. (702)	
(fr. Page Rd. to Burlington Rd.-62)	208
(n. of Burlington Rd.)	302
Old Middlesex Tpke.	303
Page Rd. (703)	
(fr. Brooksby Rd. to O. Billerica Rd. (62))	209
(w. of Brooksby Rd. & fr. Old Billerica Rd. to Wilson Rd.)	304
(e. of Wilson Rd.)	406
Pine Hill Rd.	305
Pond Cir.	513
Reeves Rd.	514
Ridewood Ln.	515
Russett Rd.	516
Shawsheen Rd.	306
Singletary Ln.	517
South Rd.	307
Spring Rd.	308
Summer St.	309
Sweetwater Ave.	518
Temple Ter.	519
Wagon Wheel Dr.	520
Wildwood Dr.	521
Wilson Rd.	310

ROUTES

4	250
62	251
225	252

CONCORD

Assabet Ave.	501
Baker Ave.	401
Barnes Hill Rd.	402
Barrett's Mill Rd.	301
Bedford St. (62)	201
Brister's Hill Rd.	502
Butternut Cir.	503
Cambridge Tpke.	302
Commonwealth Ave.	303
Concord Tpke. (2)	202
Court Ln.	403
Dalton Rd.	504
Elm Pl.	505
Elm St. (2A)	203
Everett St.	506
Fitchburg Tpke. (117)	204
Garfield Rd.	304
Harrington Ave.	305
Heywood St.	507
Hillside Ave.	404
Hubbard St.	508
Laurel St.	509
Laws Brook Rd.	306
Lexington Rd. (2A)	205
Liberty St.	405
Lincoln Tpke. (2)	101
Lowell Rd.	307
Magnolia St.	510
Main St. (62)	206
Merriam St.	511
Minot Rd.	512
Monument St.	308
Nine Acre Cor. Rd.	309
Old Bedford Rd. (701)	
(e. of Bedford St. (62)	207
(s. of Bedford St.)	310
Old Marlboro Rd.	311
Old Pickard Rd.	312
Old Stow Rd. (702)	
(e. of Hillside Av.)	406
(w. of Hillside Av.)	513
Sandy Pond Rd.	407
Spencer Brook Rd.	408
Strawberry Hill Rd.	313
Sudbury Rd.	314
Thoreau St.	315
Virginia Rd.	409
Walden St. (703)	
(s. of Concord. Tpke (126)	208
(fr. Thoreau St. to Concord Tpke.)	316
(n. of Thoreau St.)	410
Westford Rd.	317
Williams Rd.	318

ROUTES	
2	250
2A	251
62	252
117	253
126	254

ROUTES

9	101
30	250
126	251
135	207

FRAMINGHAM

A St.	501
Aberdeen Rd.	502
Adams Rd.	503
Anzio Red.	504
Arthur St.	505
Audubon Rd.	506
B St.	507
Beacon St.	401
Beaver St.	402
Belknap Rd.	301
Belvidere Ave.	508
Bishop St.	403
Blackberry Ln.	509
Blanding Ave.	404
Bonvin Dr.	510
Boston-Worcester Tpke. (9)	101
Brainerd Rd.	511
Brewer Rd.	302
Brook St.	303
Brownlea Rd.	512
Burdette Ave.	513
Campello Rd.	514
Capri Dr.	515
Central St.	304
Chappellwood Dr.	516
Chatham St.	517
Checkerberry Ln.	518
Cherry St.	519
Church St.	520
Clark St.	521
Clinton St.	522
Club Ln.	305
Cochituate Rd. (30)	201
Concord St. (701)	
(s. of School (126))	202
(n..of School)	306
Concord Ter.	523
Corregidor Rd.	524
Curve St.	525
Danforth St.	307
Debra Ln.	526
Denison Ave.	527
Desperes Ave.	528
Dietz Cir.	529
Donlon Ave.	530
Duffett Rd.	531
Dunham Rd.	532
Edgell Rd.	308
Edmands Rd.	309
Elizabeth Ave.	533
Elm St.	310
Essex St.	534
Everett Ave.	535
Fairbanks St.	536
Fay Rd.	311
Fenton St.	537
Fenwood St.	538
Flagg Rd.	405
Foster Dr.	539
Fountain St.	406
Franklin St.	407
Frederickson St.	540
Frost St.	408
Fuller St.	541
Gates St. (702)	
(e. of Club Ln.)	312
(w. of Club Ln.)	542
Gerald St. Ext.	543
Gibbs St.	544
Goodnow Ln.	545
Gorman Rd.	546
Granite St.	547
Greenleaf Cir.	548
Grove St. (703)	
(w. of Maynard Rd.)	313
(e. of Maynard Rd.)	409
Guadalcanal Rd.	546
Hamilton St.	547
Hardy St.	548
Harrington St.	314
Harrison St.	549
Hartford St.	550
Hemenway Rd.	410
Hollis St. (126)	203
Howard St.	411
Indian Head Rd.	412
Irving St.	315
Jodie Rd. (704)	
(e. of Singletary Ln.)	413
(w. of Singletary Ln.)	551

FRAMINGHAM (continued)

Kendall St.	552
King St.	553
Kittredge Rd.	554
Landseer Ave.	555
Lavelle Ln.	556
Lawrence St.	557
Leland St.	414
Leslie Rd.	558
Lincoln St.	415
Lindbergh Rd.	559
Loring Drive	316
Lovering Ave.	560
Main St. (705)	
(w. of Union Ave.)	317
(e. of Union Ave.)	416
Mansfield St.	561
Maple St.	417
Maynard Rd. (706)	
(n. of of B-W Tpke.)	318
(s. of B-W Tpke.)	418
McPhee Rd.	563
Mechanics St.	562
Mellon St.	564
Merchant Rd.	319
Millwood St.	419
Moulton Park Rd.	565
Mt. Wayte Ave.	420
Newbury Sr.	566
Nixon Rd.	421
Normandy Rd.	567
North Rd.	422
Oaks Rd. (707)	
(n. of Flagg Rd.)	423
(s. of Flagg Rd.)	568
Old Ct. Path (708)	
(n. of School (126))	204
(s. of School)	320
Oliver St.	569
Olympic St.	570
Oran Rd.	571
Oregon St.	572
Palmer Rd.	573
Park St.	574
Parker Rd. (709)	
(e. of Gates St.)	321
(w. of Gates St.)	424

Parker St.	575
Parmenter Rd.	425
Paula Pl.	426
Phelps Rd.	576
Pinecrest Rd.	577
Pine Hill Rd.	426
Pleasant St. (30)	205
Pond St.	578
Potter Rd.	322
Prindiville Ave.	579
Prospect St.	427
Raleigh Rd.	580
Ricky Ln.	581
Rockridge Rd.	582
Royce Rd.	583
Salem End Rd.	323
Sanger St.	584
School St. (126)	206
Sealtest Dr.	585
Sewell St.	586
Singletary Ln.	428
Speen St.	324
State St.	429
Sturgis Rd.	587
Summer St.	430
Temple St.	325
Thelma Rd.	588
Union Ave.	326
Valentine AVe.	589
Vernon St.	590
Walnut St.	431
Warren Rd.	432
Water St.	327
Waveney Rd.	433
Waverly St. (135)	207
Wayside Ave.	591
Wayside Inn Rd.	328
Webster St.	592
West Rd.	434
Western Ave. * (710)	329
*betw. Merch. & Loring	435
Willow Brook Rd.	593
Winch Park Rd.	594
Winch St.	436
Winter St.	330
Winthrop St.	437
Woodward Rd.	595
Worcester Rd.	596

LINCOLN

Airport Rd.	301	Mill St.	408
Baker Bridge Rd.	401	Old Bedford Rd.	304
Bedford Rd.	302	Old Country Rd.	409
Brooks Rd.	402	Page Rd.	305
Cambridge Tpke. Cut-Off Rd.	~~201~~ 350	Sandy Pond Rd.	306
Codman Rd.	403	Silver Hill Rd.	410
Conant Rd.	404	South Great Rd. (117)	204 ✓
Concord Tpke. (202)	202 ✓	Tower Rd.	412
Great Rd. (2A)	203 ✓	Trapelo Rd.	307
Hanscom Dr.	405	Virginia Rd.	411
Lexington Rd.	406	Weston Rd.	308
Lincoln St.	407	Winter St.	309

MAYNARD

Acton St.	401
Brown St. (27)	201
Concord St.	402
Great Rd. (117)	202 ✓
Hillside St.	403
Main St. (62)	203
Marlboro St.	404
Old Marlboro Rd.	405
Old Mill Rd.	406
Park St.	407
Parker St. (27)	204
Powder Mill Rd. (62)	205
Rockland Ave.	408
Sudbury St.	409
Summer Hill Rd.	410
Summer St.	301
Thompson St.	411
Waltham St.	302

ROUTES

27 250
62 251
117 202

NATICK

Allen Ct.	501
Bacon St. (701)	
(e. of Oak St.)	301
(w. of Oak St.)	401
Bay State Rd.	502
Beacon St.	503
Beaconsfield St.	504
Bigelow Ave.	505
Boden St.	402
Charles St. (702)	
(s. of N. Main (27))	201
(n. of N. Main)	506
Coleman Ct.	507
Commonwealth Ave. (30)	202
Cottage St.	403
Dover Rd.	302
E. Central St. (135)	203
Eliot St. (16)	204
Everett St.	404
Franconia Ave.	508
Grove St.	405
Hartford St.	303
Loker St.	509
Marion St.	510
Meadow St.	511
Mechanic St.	512
Middlesex Ave.	513
Mill St.	406
North Ave.	514
N. Main St. (27)	205
Oak Ridge Ave.	515
Oak St.	304
Payson Rd.	516
Pine St.	407
Pleasant St.	305
Pond St.	408
Rolling Ln.	517
S. Main St. (27)	206
South St.	306
Speen St.	307
Tower Ct.	518
Tyler St.	519
Union St.	308
Walnut St.	409
W. Central St. (135)	207
West St.	410
Willow St.	521
Winter St.	411
Woodland St.	412
Worcester St. (9)	101
Yuba Pl.	522

ROUTES

9	101
16	204
27	250
30	251
135	252

NEEDHAM

Abbott St.	501
Alfreton Rd.	502
Arden Ave.	503
Avalon Rd.	504
Avon Cir.	505
Babson Pk.	506
Barrett St.	507
Berkshire Rd.	508
Bird St.	509
Birds Hill Ave.	510
Bobsled Dr.	511
Bradford St.	512
Briarwood Ct.	513
Broad Meadow Rd.	401
Brookline St.	402
Brookside Rd.	403
Carey Rd.	514
Carol Rd.	515
Cedar St.	404
Central Ave.	301
Chapel St.	516
Charles River St.	302
Cheney St.	517
Chestnut St.	303
Cimino Rd.	518
Cleveland Rd.	519
Colgate Rd.	520
Coolidge Ave.	521
Curtis Rd.	522
Curve St.	523
Davenport Rd.	524
Dedham Ave. (135)	201
Douglas Rd.	525
Easton St.	526
Eaton Rd.	527
Elder Rd.	528
Elliott St.	529
Elmwood Rd.	530
Enslin Rd.	531
Evelyn Rd.	532
Fairfield St..	533
Fair Oaks Pk.	534
Fairview Rd.	535
Forest St.	304
Fox Hill Rd.	536
Frank St.	537
Fuller Ave.	538
Gage St.	539
Garden St.	540
George St.	541
Gilbert Rd.	542
Glendon Rd.	543
Gordon Rd.	544
Grasmere Rd.	545
Great Plain Ave. (701)	
(w. of Ded. Av. (135)	202
(e. of Dedham Av.)	305
Great Plain Ter.	546
Green St.	547
Greendale Ave. (702)	
(s.e. of High St.)	306
(n.w. of High St.)	548
Greendale Ter.	549
Greenwood Ave.	550
Grosvenor Rd.	551
Grove St.	307
Guild Rd.	552
Hamlin Ln.	553
Hardy St.	554
Harris Ave.	555
Harvard Cir.	556
High St.	308
Highgate St.	557
Highland Ave.	309
High Rock St.	310
Hill St.	558
Hillcrest Ave.	559
Hillside Ave.	560
Holland St.	561
Homestead Pk.	562
Hoover Rd.	563
Howland St.	564
Hunnewell St. (703)	
(w. of Highland)	311
(e. of Highland)	565
Hunnewell Ter.	566
Hunting Rd.	312
Intervale Rd.	567
Ivy Rd.	568
Kendrick St.	313
Kenney St.	569
Kingsbury St.	570

ROUTES

135 250

NEEDHAM (continued)

LaSalle Rd.	571
Lester St.	572
Lexington Rd.	573
Lindbergh Ave.	574
Linden St.	575
Longfellow Rd.	576
Mann Ave.	577
Manning St.	405
Maple St.	578
Mark Lee Rd.	579
Marked Tree Rd. (704)	
(w. of High Rock)	314
(e. of High Rock)	406
Marshall St.	580
Mason Rd.	581
Mayflower Rd.	582
Mayo St.	583
Mellen St.	584
Melrose St.	585
Melvern St.	586
Mercer St.	587
Morton St.	588
Mt. Vernon Ave.	589
Nehoiden St.	407
Nevada Ave.	590
Newell St.	591
Norfolk St.	592
North Hill	593
Noyes St.	594
Oak Crest Rd.	595
Oak Hill Rd.	596
Oakland St.	408
Old Farms Rd.	597
Old Greendale Rd.	598
Otis St.	599
Park Ave.	600
Parker Rd.	601
Parkinson St.	602
Paul Revere Rd.	603
Peacedale Rd.	604
Perry Dr.	605
Pickering St.	606
Pilgrim Rd.	607
Pine St.	315

Pinehurst Ter.	608
Pinewood Ave.	609
Pleasant St.	610
Plymouth St.	611
Powder House Rd.	612
Powers St.	613
Prince St.	614
Putnam St.	615
Ridgeway Ave.	616
Rivard St.	617
Rosalie Rd.	618
Roscoe St.	619
Rosemary St.	409
Rybury Hillway	620
St. Cloud Ave.	621
South St..	316
Spring St.	622
Standish Rd.	623
Sterling Rd.	624
Stevens Rd.	625
Stewart Rd.	626
Stockdale Rd.	627
Sutton St.	628
Thorpe Rd.	629
Tower Rd.	630
Trout Pond Ln.	631
Valley Rd.	632
Walnut St.	633
Warren St.	634
Washington Ave.	635
Webster Pk.	636
Webster St. (705)	
(fr. Highland Ave. to Dedham Ave.)	317
(n. of Highland)	410
(s. of Dedham Ave.)	637
Wellesley Ave.	318
West St.	319
Whiting Way	638
Whittier Rd.	639
Wilshire Pk.	640
Winding River Rd.	411
Winfield Rd.	641
Woodlawn Ave.	642

SUDBURY

Boston Post Rd. (20)	201 ✓
Bowditch Rd.	301
Candy Hill Rd.	401
Church St.	501
Codjer Ln.	402
Concord Rd. (701)	
(n. of Union Ave.)	302
(s. of Union ave.)	403
Dakin Rd.	303
Dudley Rd.	404
Dutton Rd.	304
Fairbanks Rd.	305
Fox Hill Rd.	502
French Rd.	405
Goodman's Hill Rd.	406
Great Rd. (117)	202
Green Hill Rd.	407
Haynes Rd.	306
Hudson Rd.	307
Landham Rd.	308
Marlboro Rd.	309
Maynard Rd. (27)	203
Moore Rd.	408
Morse Rd.	409
Mossman Rd.	410
New Bridge Rd.	411
Nobscot Rd.	310
North Rd. (702)	
(e. of Great Rd. (117))	204
(n.w. of Great Rd.)	311
Old Framingham Rd.	312
Old Garrison Rd.	412
Old Lancaster Rd.	413
Old Sudbury Rd. (27)	205
Pantry Rd.	313
Peakham Rd.	314
Pelham Island Rd.	414
Pennymeadow Rd.	503
Plympton Rd.	415
Pond Rd.	315
Powder Mill Rd.	416
Puffer Ln.	504
Raymond Rd.	417
Thompson Dr.	505
Union Ave.	316
Walk-Up Rd.	506
Water Row Rd.	418
Wayside Inn Rd.	317
Willard Grant Rd.	419
Willis Rd.	420
Windmill Rd.	507

ROUTES

20	201
27	250
117	251

WAYLAND

Autumn Ln.	501
Bigelow Rd.	502
Boston Post Rd. (20)	201 ✓
Claypit Hill Rd.	401
Cochituate Rd. (27, 126)	202
Commonwealth Rd. (30)	203 ✓
Concord Rd. (126)	204
Coolidge Rd.	503
Draper Rd.	301
E. Plain St.	302
Folsom Pond Rd.	504
Glen Rd.	505
Glezen Ln. (701)	
(e. of Concord Rd.)	303
(w. of Training Field Rd.)	402
(betw. Concord Rd. & Training Field Rd.)	506
Hazelbrook Ln.	507
Millbrook Rd.	403
Moore Rd.	508
Oak St.	304
Old Conn. Path East	305
Old Conn. Path West (126)	205
Old Sudbury Rd. (27)	206
Parmenter Rd.	509
Pear Tree Ln.	510
Pelham Island Rd.	404
Pine Brook Rd.	405
Plain Rd. (702)	
(e. of Draper Rd.)	306
(w. of Draper Rd.)	406
Rice Rd.	307
School St.	407
Sherman Bridge Rd.	308
Stone Bridge Rd.	309
Training Field Rd.	408
W. Plain St.	310

ROUTES

20	201
30	203
27	250
126	251

WELLESLEY

Abbott Rd.	401
Barton Rd.	501
Benvenue St.	402
Bethel St.	502
Bobolink	503
Brooks St.	403
Brookside Red.	404
Cedar St. (701)	
(n. of Hunnewell St.)	301
(s. of Hunnewell St.)	405
Cedar Ter.	504
Central St. (135)	201
Charles St.	505
Cliff Rd.	302
Crest Rd. (702)	
(s. of Linden St.)	406
(n. of Linden St.)	506
Curve St.	507
Dover Rd.	407
Dunedin Rd.	508
Fife Rd.	509
Forest St.	303
Glen Rd.	304
Great Plains Ave. (135)	202
Grove St.	305
Hastings St.	510
Hunnewell St.	306
Linden St.	408
Livingston Rd.	409
McLean St.	511
Oakencroft	512
Oakland St.	410
Pond Rd.	411
Redwing Rd.	513
River Ridge	514
Summit	515
Walnut St.	307
Washington St. (16)	203
Wellesley Ave.	308
Weston Ave.	309
Winding River Rd.	412
Worcester St. (9)	101

ROUTES

9	101
16	203
135	250

WESTON

Apple Crest Rd.	501
Ash St.	301
Ashbury Ln.	502
Birch Ln.	503
Boston Post Rd. (701)	
(Route 20)	201
(from Highland to Ash)	302
(Bypass)	202
Bogle St.	402
Buckskin Rd.	504
Center St.	505
Chestnut St.	403
Church St.	404
Cliff Rd.	303
Colpitts Rd.	506
Conant Rd.	405
Concord Rd. (702)	
(e. of Sudbury Rd.)	304
(n. of Sudbury Rd.)	406
Crescent St.	507
Derby Ln.	508
Fiske Ln.	509
Glen Rd.	305
Golden Ball Rd.	510
Hemlock Rd.	511
Highland St.	306
Jericho Rd.	512
Jones Rd.	513
Kidney Pond Rd.	514

Laxfield Rd.	515
Lexington St.	307
Linwood Ave.	516
Loring Rd.	308
Love Lane	407
Maple Rd.	408
Meadowbrook Rd.	309
Merriam St.	310
Newton St.	311
North Ave. (117)	203
Oak St.	312
Park Rd.	313
Pine St.	314
Plain Rd.	517
Ridgeway Rd.	409
River Rd.	315
Rolling Ln.	518
School St.	410
Sibley Rd.	519
Skating Pond Rd.	520
South Ave. (30)	204
Sudbury Rd.	316
Summer St.	317
Tower Rd.	411
Town House Rd.	521
Warren Ave.	522
Wellesley St.	318
Winter St.	412

ROUTES

20	250
30	251
117	252

SMALL CAR STUDY

STREET LIST

BY STRATUM

STRATA CLASSIFICATION

(A) = divided arteries (a) = undivided arteries

(C) = major collectors (c) = minor collectors

(x) = unclassified streets

(route numbers in parentheses)

ACTON

Divided arteries (A)

1. Mass. Ave., FCA (2)

Undivided arteries (a)

1. Great Rd. (111)
2. Main St. (27)
3. Mass. Ave. (111) (w. of FCA)
4. Powder Mill Rd. (62)
5. South Main St. (27)

Major collectors (C)

1. Arlington St. (n. of Mass Ave.)
2. Central St. (n. of Mass. Ave.)
3. Concord Rd.
4. Hosmer St. (n. of Mass. Ave.)
5. Laws Brook Rd.
6. Nagog Hill Rd.
7. Newtown Rd.
8. Pope Rd.
9. School St.
10. Stow St.
11. Strawberry Hill Rd. (e. of Pope Rd.)

Minor collectors (c)

1. Arlington St. (from Summer St. to Mass. Ave.)
2. Brook St.
3. Carlisle St.
4. Central St. (s. of Mass. Ave.)
5. Charter Rd.
6. Conant St.
7. Coughlin St.
8. Elm St.
9. Forest Rd.
10. Hammond St.
11. Harris St.
12. Hayward St.
13. High St.
14. Hosmer St. (s. of Mass. Ave.)
15. Liberty St.
16. Maple St.
17. Martin St. (n. of Stow Rd.)
18. Minot Ave.
19. Musket Dr.
20. Parker St.
21. Piper Rd.
22. Prospect St.
23. River St.
24. Robbins St.
25. Strawberry Hill Rd. (w. of Pope Rd.)
26. Sudbury Rd.
27. Summer St.
28. Taylor Rd.
29. Willow St.

BEDFORD

Divided arteries (A)

1. FCA (3)

Undivided arteries (a)

1. Brooksby Rd. (62)
2. Burlington Rd. (62)
3. Carlisle Rd. (225)
4. Chelmsford Rd. (4)
5. Concord Rd. (62)
6. Great Rd. (225)
7. North Rd. (4)
   (to Chelmsford Rd.)
8. Old Billerica Rd. (62)
   (from Page Rd.
   to Burlington Rd.)
9. Page Rd. (62)
   (from Brooksby Rd.
   to Old Billerica Rd.

Major collectors (C)

1. North Rd.
   (n. of Chelmsford Rd.
2. Old Billerica Rd.
   (n. of Burlington Rd.
3. Old Middlesex Tpke.
4. Page Rd.
   (w. of Brooksby Rd. &
   from Old Billerica Rd.
   to Wilson Rd.)
5. Pine Hill Rd.
6. Shawsheen Rd.
7. South Rd.
8. Spring Rd.
9. Summer St.
10. Wilson Rd.

Minor collectors (c)

1. Crosby Drive
2. Dudley Rd.
3. Fox Run Rd.
4. Hartwell Rd.
5. Hemlock Lane
6. Page Rd.
   (e. of Wilson Rd.)

CONCORD

Divided arteries (A)

1. Lincoln Tpke., FCA to cor. Elm & Concord (2)

Undivided arteries (a)

1. Bedford St. (62)
2. Concord Tpke. (2)
3. Elm St. (2A)
4. Fitchburg Tpke. (117)
5. Lexington Rd. (2A)
6. Main St. (62)
7. Old Bedford Rd. (62) (e. of Bedford St.
8. Walden St. (126) (s. of Concord Tpke.)

Major collectors (C)

1. Barrett's Mill Rd.
2. Cambridge Tpke.
3. Commonwealth Ave.
4. Garfield Rd.
5. Harrington Ave.
6. Laws Brook Rd.
7. Lowell Rd.
8. Monument St.
9. Nine Acre Corner Rd.
10. Old Bedford Rd. (s. of Bedford St.)
11. Old Marlboro Rd.
12. Old Pickard Rd.
13. Strawberry Hill Rd.
14. Sudbury Rd.
15. Thoreau St.
16. Walden St. (from cor. Thoreau St. to Concord Tpke.)
17. Westford Rd.
18. Williams Rd.

Minor collectors (c)

1. Baker Ave.
2. Barnes Hill Rd.
3. Court Lane
4. Hillside Ave.
5. Liberty St.
6. Old Stow Rd. (e. of Hillside Ave.)
7. Sandy Pond Rd.
8. Spencer Brook Rd.
9. Virginia Rd.
10. Walden St. (n. of Thoreau Rd.)

FRAMINGHAM

Divided arteries (A)

1. Boston-Worcester Tpke. (9)
2. Mass. Tpke. (I-90)

Undivided arteries (a)

1. Cochituate Rd. (30)
2. Concord St. (126) (s. of School St.)
3. Hollis St. (126)
4. Old Connecticut Path (126) (n. of School St.)
5. Pleasant St. (30)
6. School St. (126)
7. Waverly St. (135)

Major collectors (C)

1. Belknap Rd.
2. Brewer Rd.
3. Brook St.
4. Central St.
5. Club Lane
6. Concord St. (n. of School St.)
7. Danforth St.
8. Edgell Rd.
9. Edmands Rd.
10. Elm St.
11. Fay Rd.
12. Gates St. (e. of Club Lane)
13. Grove St. (w. of Maynard Rd.)
14. Harrington Rd.
15. Irving St.
16. Loring Drive
17. Main St. (w. of Union Ave.)
18. Maynard Rd. (n. of Boston-Worcester Tpke.)
19. Merchant Rd.
20. Old Connecticut Path (s. of School St.)
21. Parker Rd. (e. of Gates St.)

Major collectors (C) continued

22. Potter Rd.
23. Salem End Rd.
24. Speen St.
25. Temple St.
26. Union Ave.
27. Water St.
28. Wayside Inn Rd.
29. Western Ave. * (* exc. betw. Merchant & Loring)
30. Winter St.

Minor collectors (c)

1. Beacon St.
2. Beaver St.
3. Bishop St.
4. Blanding Ave.
5. Flagg Rd.
6. Fountain St.
7. Franklin St.
8. Frost St.
9. Grove St. (e. of Maynard Rd.)
10. Hemenway Rd.
11. Howard St.
12. Indian Head Rd.
13. Jodie Rd. (s. of Singletary Lane)
14. Leland St.
15. Lincoln St.
16. Main St. (e. of Union Ave.)
17. Maple St.
18. Maynard Rd. (s. of B-W Tpke.)
19. Millwood St.
20. Mt. Wayte Ave.
21. Nixon Rd.
22. North Rd.
23. Oaks Rd. (n. of Flagg Rd.)
24. Parker Rd. (w. of Gates St.)
25. Parmenter Rd.
26. Pine Hill Rd.
27. Prospect St.
28. Singletary Lane
29. State St.
30. Summer St.
31. Walnut St.
32. Warren Rd.
33. Waveney Rd.
34. West Rd.
35. Western Ave. * (*from Loring to Merchant)
36. Winch St.
37. Winthrop St.

LINCOLN

Divided arteries (A)

None

Undivided arteries (a)

1. Cambridge Tpke. Cut-off (2A)
2. Concord Tpke. (2)
3. Great Rd. (2A)
4. South Great Rd. (117)

Major collectors (C)

1. Airport Rd.
2. Bedford Rd.
3. Lincoln Rd.
4. Old Bedford Rd.
5. Page Rd.
6. Sandy Pond Rd.
7. Trapelo Rd.
8. Weston Rd.
9. Winter St.

Minor collectors (c)

1. Baker Bridge Rd.
2. Brooks Rd.
3. Codman Rd.
4. Conant Rd.
5. Hanscom Drive
6. Lexington Rd.
7. Lincoln St.
8. Mill St.
9. Old County Rd.
10. Silver Hill Rd.
11. Virginia Rd.
12. Tower Rd.

MAYNARD

Divided arteries (A)

None

Undivided arteries (a)

1. Brown St. (27)
2. Great Rd. (117)
3. Main St. (62)
4. Parker St. (27)
5. Powder Mill Rd. (62)

Major collectors (C)

1. Summer St.
2. Waltham St.

Minor collectors (c)

1. Acton St.
2. Concord St.
3. Hillside St.
4. Marlboro St.
5. Old Marlboro Rd.
6. Old Mill Rd.
7. Park St.
8. Rockland Ave..
9. Sudbury St.
10. Summer Hill Rd.
11. Thompson St.

NATICK

Divided arteries (A)

1. Mass. Tpke. (I-90)
2. Worcester St. (9)

Undivided arteries (a)

1. Charles St. (27)
   (s. of N. Main St.)
2. Commonwealth Ave. (30)
3. East Central St. (135)
4. Eliot St. (16)
5. North Main St. (27)
6. South Main St. (27)
7. West Central St. (135)

Major collectors (C)

1. Bacon St.
   (e. of Oak St.)
2. Dover Rd.
3. Hartford St.
4. Oak St.
5. Pleasant St.
6. South St.
7. Speen St.
8. Union St.

Minor collectors (c)

1. Bacon St.
   (w. of Oak St.)
2. Boden St.
3. Cottage St.
4. Everett St.
5. Grove St.
6. Mill St.
7. Pine St.
8. Pond St.
9. Walnut St.
10. West St.
11. Winter St.
12. Woodland St.

NEEDHAM

Undivided arteries (A)

1. Route 128 (I-95)

Divided arteries (a)

1. Dedham Ave. (135)
2. Great Plain Ave. (135)
(w. of Dedham Ave.)

Major collectors (C)

1. Central Ave.
2. Charles River St.
3. Chestnut St.
4. Forest St.
5. Great Plain Ave.
(n.e. of Dedham Ave.)
6. Greendale Ave.
(s.e. of High St.)
7. Grove St.
8. High St.
9. Highland Ave.
10. High Rock St.
11. Hunnewell St.
(w. of Highland Ave.)
12. Hunting Rd.
13. Kendrick St.
14. Marked Tree Rd.
(w. of High Rock St.)±
15. Pine St.
16. South St.
17. Webster St.
(from Highland Ave.
to Dedham Ave.)
18. Wellesley Ave.
19. West St.

Minor collectors (c)

1. Broad Meadow Rd.
2. Brookline St.
3. Brookside Rd.
4. Cedar St.
5. Manning St.
6. Marked Tree Rd.
(e. of High Rock St.)
7. Nehoiden St.
8. Oakland St.
9. Rosemary St.
10. Webster St.
(n. of Highland Ave.)
11. Winding River Rd.

SUDBURY

Divided arteries (A)

None

Undivided arteries (a)

1. Boston Post Rd. (20)
2. Great Rd. (117)
3. Maynard Rd. (27)
4. North Rd. (117)
   (e. of Great Rd.)
5. Old Sudbury Rd. (27)

Major collectors (C)

1. Bowditch Rd.
2. Concord Rd.
   (n. of Union Ave.)
3. Dakin Rd.
4. Dutton Rd.
5. Fairbanks Rd.
6. Haynes Rd.
7. Hudson Rd.
8. Landham Rd.
9. Marlboro Rd.
10. Nobscot Rd.
11. North Rd.
    (nw. of Great Rd.)
12. Old Framingham Rd.
13. Pantry Rd.
14. Peakham Rd.
15. Pond Rd.
16. Union Ave.
17. Wayside Inn Rd.

Minor collectors (c)

1. Candy Hill Rd.
2. Codjer Lane
3. Concord Rd.
   (s. of Union Ave.)
4. Dudley Rd.
5. French Rd.
6. Goodman's Hill Rd.
7. Green Hill Rd.
8. Moore Rd.
9. Morse Rd.
10. Mossman Rd.
11. New Bridge Rd.
12. Old Garrison Rd.
13. Old Lancaster Rd.
14. Pelham Island Rd.
15. Plympton Rd.
16. Powder Mill Rd.
17. Raymond Rd.
18. Water Row Rd.
19. Willard Grant Rd.
20. Willis Rd.

WAYLAND

Divided arteries (A)

1. Mass. Tpke. (I-90)

Undivided arteries (a)

1. Boston Post Rd. (20)
2. Cochituate Rd. (27, 126)
3. Commonwealth Rd. (30)
4. Concord Rd. (126)
5. Old Connecticut Path West (126)
6. Old Sudbury Rd. (27)

Major collectors (C)

1. Draper Rd.
2. East Plain St.
3. Glezen Lane
   (e. of Concord Rd.)
4. Oak St.
5. Old Connecticut Path East
6. Plain Rd.
   (e. of Draper Rd.)
7. Rice Rd.
8. Sherman Bridge Rd.
9. Stone Bridge Rd.
10. West Plain St.

Minor collectors (c)

1. Claypit Hill Rd.
2. Glezen Lane
   (w. of Training Field Rd.)
3. Millbrook Rd.
4. Pelham Island Rd.
5. Pine Brook Rd.
6. Plain Rd.
   (w. of Draper Rd.)
7. School St.
8. Training Field Rd.

WELLESLEY

Divided arteries (A)

1. Worcester St. (9)

Undivided arteries (a)

1. Central St. (135)
2. Great Plains Ave. (135)
3. Washington St. (16)

Major collectors (C)

1. Cedar St. (n. of Hunnewell St.)
2. Cliff Rd.
3. Forest St.
4. Glen Rd.
5. Grove St.
6. Hunnewell St.
7. Walnut St.
8. Wellesley Ave.
9. Weston Rd.

Minor collectors (c)

1. Abbott Rd.
2. Benvenue St.
3. Brooks St.
4. Brookside Rd.
5. Cedar St. (s. of Hunnewell St.)
6. Crest Rd. (betw. Linden & Central)
7. Dover Rd.
8. Linden St.
9. Livingston Rd.
10. Oakland St.
11. Pond Rd.
12. Winding River Rd.

WESTON

Divided arteries (A)

1. Mass Tpke. (I-90)

Undivided arteries (a)

1. Boston Post Rd. (20)*
2. Boston Post Rd. Bypass (20)*
3. North Ave. (117)
4. South Ave. (30)

Major collectors (C)

1. Ash St.
2. Boston Post Rd. *
   (from Highland to Ash -- length of bypass)
3. Cliff Rd.
4. Concord Rd.
   (e. of Sudbury Rd.)
5. Glen Rd.
6. Highland St.
7. Lexington St.
8. Loring Rd.
9. Meadowbrook Rd.
10. Merriam St.
11. Newton St.
12. Oak St.
13. Park Rd.
14. Pine St.
15. River Rd.
16. Sudbury Rd.
17. Summer St.
18. Wellesley St.

Minor collectors (c)

2. Bogle St.
3. Chestnut St.
4. Church St.
5. Conant Rd.
6. Concord Rd.
   (n. of Sudbury Rd.)
7. Love Lane
8. Maple Rd.
9. Ridgeway Rd.
10. School St.
11. Tower Rd.
12. Winter St.

SMALL CAR STUDY

Streets with more than one classification

Streets with more than one classification

ACTON

Mass. Ave. (A)
- Hosmer St.
- Piper Rd.
- School St.
- Taylor Rd.
- Wetherbee St.

Mass. Ave. (a)
- Arlington St.
- Birch Ridge Rd.
- Cedar Ter.
- Central St.
- Charter Rd.
- Deacon Hunt
- Hillside Ter.
- Juniper Ridge
- Kinsley Rd.
- Main St.
- Mead Ter.
- Prospect St.
- Spruce St.
- Windsor Ave.
- Wright Ter.

Arlington St. (C)
- Agawam Rd.
- Elm St.
- Freedom Farm Rd.
- Hayward Rd.
- Houghton Ln.
- Spruce St.
- West Rd.

Arlington St. (c)
- Birch Ridge Rd.
- Haynes Ct.
- Homestead
- Summer St.

Arlington St. (x)
- Kingman Dr.
- Squirrel Rd.

Strawberry Hill Rd. (C)
- Hapgood Ln.

Strawberry Hill Rd. (c)
- Esterbrook Rd.

Hosmer St. (E)
- Foster St.
- Robinwood Rd.
- Russell Rd.

Hosmer St. (κ)
- Concord Rd.
- Forest Dr.
- Longfellow Pk.
- Whittier Dr.

Martin St. (c)
- Maple St.

Martin St. (x)
- None

Streets with more than one classification

BEDFORD

North Rd. (a)
- Apple Tree Lane
- Beverly Rd.
- Buehler St.
- Dudley Rd.
- Harvard Dr.
- Minute Man Dr.
- Pine Hill Dr.
- Russett Rd.
- Sweetwater Ave.
- Wildwood Dr.

North Rd. (c)
- Green St.

Old Billerica Rd. (a)
- None

Old Billerica Rd. (C)
- Bandera Dr.
- Cot Hill Rd.
- Noreen Dr.
- Pond Cir.
- Ridewood Ln.
- Singletary Ln.
- Temple Ter.
- Wagon Wheel Dr.

Page Rd. (a)
- Elm Brook Dr.

Page Rd. (C)
- Dunster Dr.
- Frances Kelly Rd.
- Kingsley Ter.

Page Rd. (c)
- Reeves Rd.

CONCORD

Route 2 (A)
- Assabet Ave.
- Elm Pl.

Old Bedford Rd. (2) (a)
- Butternut Cir.
- Minot Rd.

Old Bedford Rd. (C)
- Dalton Rd.
- Merriam Rd.
- Virginia St.

Walden St. (a)
- None

Walden St. (C)
- Brister's Hill Rd.

Walden St. (c)
- Everett St.
- Heywood St.
- Hubbard St.
- Laurel St.
- Magnolia St.

Old Stow Rd. (c, x)
- Hillside divides.

Streets with more than one classification

FRAMINGHAM

Concord St. (a)
- A St.
- Aberdeen Rd.
- Anzio Rd.
- Arthur St.
- Audubon Rd.
- B St.
- Beacon St.
- Belvidere Ave.
- Burdette Ave.
- Campello Rd.
- Chatham St.
- Cherry St.
- Clark St.
- Clinton St.
- Cochituate Rd.
- Concord Ter.
- Corregidor Rd.
- Debra Ln.
- Denison Ave.
- Donlon Ave.
- Duffett Rd.
- Dunham Rd.
- Elizabeth Ave.
- Essex St.
- Everett Ave.
- Fairbanks St.
- Foster Dr.
- Frederickson St.
- Gibbs St.
- Gorman Rd.
- Guadalcanal Rd.
- Hardy St.
- Harrison St.
- Hartford St.
- Howard St.
- Kendall St.
- King St.
- Landseer Ave.
- Lawrence St.
- Lincoln St.
- Lindbergh Rd.
- Mansfield St.
- McPhee Rd.
- Mellon St.
- Normandy Rd.
- Old Conn. Path
- Oliver St.
- Olympic St.
- Oram Rd.
- Palmer Rd.
- Park St.
- Parker St.
- Phelps Rd.
- Pond St.
- Prindiville Ave.
- Sanger St.
- Sewell St.
- Sturgis Rd.
- Summer St.
- Thelma Rd.
- Union Ave.
- Valentine Ave.
- Waverley St.
- Wayside Ave.
- Webster St.
- Winch Park Rd.
- Worcester Rd.

Concord St. (C)
- A St.
- Danforth St.
- Fuller St.
- Mechanics St.
- Watson Pl.

Old Conn. Path (C)
- Brownlea Rd.
- Capri Dr.
- Chappellwood Dr.
- Desperes Ave.
- Concord St.
- Fenton St.
- Fenwood St.
- Greenleaf Cir.
- Hamilton St.
- Hardy St.
- Lovering Ave.
- Newbury St.
- Pinecrest Rd.
- Sealtest Dr.
- Speen St.

Old Conn. Path (x)
- Beacon St.
- Foster Dr.
- Gerald St. Ext.
- Royce Rd.
- Woodward Rd.

Gates St. (C)
- None

Gates St. (x)
- Goodnow Ln.
- Rockridge Rd.

Grove St. (C)
- Belknap Rd.
- Blackberry Ln.
- Bonvin Dr.
- Dietz Cir.
- Lavelle Ln.
- Raleigh Rd.
- Winch St.

Grove St. (c)
- Vernon St.

Main St. (C)
- Curve St.
- Franklin St.
- Granite St.
- Maple St.
- Moulton Park Rd.
- Wheeler Ave.

Main St. (c)
- Union Ave.
- Walnut St.

Maynard Rd. (C)
- Grove St.
- Pleasant St.

Maynard Rd. (c)
- Adams Rd.
- Church St.
- Salem End Rd.
- State St.

Streets with more than one classification

FRAMINGHAM (continued)

Parker Rd. (C)
None

Parker Rd. (c)
Oregon St.
Willow Brook Rd.

Western Ave. (C) & (c)
All intersectors --
Leland, Loring, Merchants --
are classed.

Jodie Rd. (c)
Paula Pl.

Jodie Rd. (x)
Checkerberry Ln.
Ricky Ln.

Oaks Rd. (c)
Brainerd Rd.
Leslie Rd.

Oaks Rd. (x)
Kittredge Rd.
Warren Rd.

NATICK

Charles St. (a)
- Allen Ct.
- Bigelow Ave.
- Mechanic St.
- Middlesex Ave.
- North Ave.
- N. Main St.
- Willow St.
- Yuba Pl.

Charles St. (x)
- Bacon St.
- Beaconsfield St.
- Grove St.
- Payson Rd.

Bacon St. (C)
- Oak Ridge Ave.
- Rolling Lane

Bacon St. (c)
- Bay State Rd.
- Beacon St.
- Belvidere St.
- Charles St.
- Coleman Ct.
- Franconia Ave.
- Loker St.
- Marion St.
- Meadow St.
- N. Main St.
- Tower Ct.
- Tyler St.
- Walnut St.

NEEDHAM

Great Plain Ave. (a)
- Abbott St.
- Babson Park
- Carol Rd.
- Central Ave.
- Chapel St.
- Chestnut St.
- Curtis Rd.
- Curve St.
- Easton St.
- Fuller Ave.
- Gage St.
- Garden St.
- George St.
- Glendon Rd.
- Highland Ave.
- Linden St.
- Maple St.
- Marked Tree Rd.
- Marshall St.
- Mason Rd.
- Mayflower Rd.
- Nehoiden St.
- Newell St.
- North Hill
- Noyes St.
- Pilgrim Rd.
- Powder House Rd.
- Rivard St.
- Standish Rd.
- Stewart Rd.
- Stockdale Rd.
- Trout Pond Ln.
- Whiting Way
- Winfield Rd.

Great Plain Ave. (C)
- Arden Ave.
- Berskshire Rd.
- Birds Hill Ave.
- Bradford St.
- Broadmeadow Rd.
- Coolidge Ave.
- Douglas Rd.
- Eaton Rd.
- Elliott St.
- Elmwood Rd.
- Fairfield St.
- Fair Oaks Park
- Great Plan Ter.
- Green St.
- Greenwood Ave.
- Greendale Ave.
- Harris Ave.
- Hillcrest Ave.
- Ivy Rd.
- Manning St.
- Mayo St.
- Melrose Ave.
- Mt. Vernon Ave.
- Old Farms Rd.
- Peacedale Rd.
- Pickering St.
- Pinehurst Ter.
- Pinewood Ave.
- Pleasant St.
- Plymouth St.
- Prince St.
- Ridgeway Ave.
- Sterling Rd.
- Stevens Rd.
- South St.
- Valley Rd.
- Warren St.
- Washington Ave.
- Webster St.
- Wilshire Pk.
- Whittier Rd.
- Woodlawn Ave.

Hunnewell St. (C)
- Bobsled Dr.
- Briarwood Ct.
- Central Ave.
- Grasmere Rd.
- Hill St.
- Hillside Ave.
- Hunnewell Ter.
- Lester St.
- Wellesley Ave.

Hunnewell St. (x)
- Mark Lee Rd.
- West St.

Marked Tree Rd. (C)
- Avalon Rd.
- Barrett St.
- Gilbert Rd.

Marked Tree Rd. (c)
- Curve St.
- Fairview Rd.
- Oakcrest Rd.
- Perry Dr.
- Walnut St.

NEEDHAM (continued)

Webster St. (C)
- Alfreton Rd.
- Brookline St.
- Carey Rd.
- Cleveland Rd.
- Great Plain Ave.
- Gordon Rd.
- Greendale Ave.
- Harris Ave.
- High St.
- Holland St.
- Homestead Pk.
- Hoover Rd.
- Hunnewell St.
- Kingsbury St.
- LaSalle Rd.
- Lexington Rd.
- Lindbergh Ave.
- Longfellow Rd.
- Mark Lee Rd.
- Mellen St.
- Mercer St.
- Morton St.
- Otis St.
- Park Ave.
- Parkinson St.
- Powers St.
- Rosemary St.
- Spring Rd.
- Thorpe Rd.
- Webster Pk.
- West St.

Webster St. (c)
- Central Ave.
- Elder Rd.
- Evelyn Rd.
- Frank St.
- Guild Rd.
- Harvard Cir.
- Hillside Ave.
- Putnam St.
- Roscoe

Webster St. (x)
- Fox Hill Rd.
- High Rock St.
- Howland St.
- Melvern St.
- Norfolk St.
- Sutton St.

Greendale Ave.
- Avon Cir.
- Bird St.
- Broadmeadow Rd.
- Brookline St.
- Cheney
- Cimino Rd.
- Colgate Rd.
- Enslin Rd.
- Great Plain Ave.
- Greendale Ter.
- Grosvenor Rd.
- Hamlin Ln.
- Hardy
- Highgate St.
- Intervale Rd.
- Kendrick St.
- Kenney St.
- Mann Ave.
- Nevada Ave.
- Oak Hill Rd.
- Old Greendale Rd.
- Parker Rd.
- Paul Revere Rd.
- Rosalie Rd.
- Rybury Hillway
- St. Cloud Ave.
- Tower Ave.

Greendale Ave. (x)
- Davenport Rd.
- Park Ave.
- Spring Rd.

SUDBURY

North Rd. (a)
- Dakin Rd.
- Great Rd.
- Haynes Rd.
- Pantry Rd.
- Powder Mill Rd.
- Puffer Ln.
- Willard Grant Rd.
- Windmill Rd.

North Rd. (C)
- Fox Hill Rd.

Concord Rd. (C)
- Candy Hill Rd.
- Goodman's Hill Rd.
- Maynard Rd.
- New Bridge Rd.
- Old Lancaster Rd. (w.)
- Old Sudbury Rd.
- Pennymeadow Rd.
- Plympton Rd.
- Thompson Dr.

Concord Rd. (c)
- Church St.
- Codjer Ln.
- Old Lancaster Rd. (e.)
- Walk-Up Rd.

WAYLAND

Glezen Ln. (C)
- Autumn Ln.
- Draper Rd.
- Folsom Pond Rd.
- Hazelbrook Ln.

Glezen Ln. (c)
- Pear Tree Ln.
- Training Field Rd.

Glezen Ln. (x)
- Moore Rd.

Plain Rd. (C)
- Bigelow Rd.
- Boston Post Rd.
- Coolidge Rd.

Plain Rd. (c)
- Claypit Hill Rd.
- Concord Rd.
- Glen Rd.
- Millbrook Rd.
- Parmenter Rd.

WELLESLEY

Cedar St. (C)
- Barton Rd.
- Bethel St.
- Bobolink
- Cedar Ter.
- Charles
- Hastings St.
- McLean St.
- Redwing Rd.
- River Ridge
- Walnut St.
- Worcester St.

Cedar St. (c)
- Dunedin Rd.
- Fife Rd.

Crest Rd. (C)
- None

Crest Rd. (c)
- Curve St.
- Oakencroft
- Summit

WESTON

Boston Post Rd. (a)
- (w. of bypass)
- Apple Crest Rd.
- Buckskin Rd.
- Love Ln.
- Plain Rd.
- (e. of bypass)
- Ashbury Ln.
- Birch Ln.
- Crescent St.
- Derby Ln.
- Rolling Ln.
- Sibley Rd.
- Skating Pond Rd.
- Summer St.

Boston Post Rd. (c)
- Center St.
- Church St.
- Colpitts Rd.
- Concord Rd.
- Fiske Ln.
- Golden Ball Rd.
- Hemlock Rd.
- Highland St.
- Jones Rd.
- Linwood Ave.
- Maple St.
- Town House Rd.
- Warren Ave.

Concord Rd. (C)
- Fiske Ln.
- Jericho Rd.
- Laxfield Rd.
- Merriam St.

Concord Rd. (c)
- Kidney Pond Rd.

APPENDIX 17: "ACCREP5.BAS," IBM PC VERSION OF DATA ENTRY PROGRAM FOR POLICE ACCIDENT REPORTS

```
100 REM "ACCIDENT REPORTS--02/14/85"
120 CLS:MAXFILES=7:PRINT"ACCIDENT REPORTS"
140 PRINT:PRINT:PRINT"INSERT ACCIDENT REPORT DISKETTE INTO    DRIVE
A":PRINT:PRINT
160 INPUT"Press ENTER when ready";X
180 INPUT"IS THIS A CONTINUATION(Y OR N)";CN$:IF CN$="Y" THEN 220
200 INPUT"ACCIDENT DATE(MMDD)";DD$:GOTO 240
220 OPEN"LSTSEQ" FOR INPUT AS 3:INPUT #3,DD$,NN:CLOSE 3:PRINT"CONTINUATION
OF INPUT FOR ";DD$;".          LAST CASE COMPLETED WAS";NN:GOTO 260
240 AF$="A:A"+DD$:OPEN AF$ FOR OUTPUT AS 1:CLOSE 1
260 AF$="A:A"+DD$:OPEN AF$ FOR APPEND AS 1: CLOSE 1
280 NN=NN+1
300 RT$="0":DY$="0":TM$="0000"
320 FOR N=1 TO
5:DP$(N)="0":YB$(N)="00":SX$(N)="0":ZP$(N)="00000":OO$(N)="0":SL$(N)="0":SR$
(N)="0":MR$(N)="0000000":MY$(N)="00":MK$(N)="00000":VT$(N)="00000":VP$(N)="0
"
340 D1$(N)="00":D2$(N)="00":D3$(N)="00":D4$(N)="00":D5$(N)="00":
VR$(N)="500":RR$(N)="+"
360 IP$(N)="0":IV$(N)="0":IA$(N)="00":IS$(N)="0":IE$(N)="0":SU$(N)="0"
370
DT$(N)="0":PA$(N)="0":BM$(N)="0":SM$(N)="0":IM$(N)="0":PH$(N)="0":FE$(N)="0"
:PC$(N)="0":DR$(N)="0":LP$(N)="0":IC$(N)="0":CO$(N)="0":RA$(N)="0":V1$(N)="0
":V2$(N)="0":V3$(N)="0":NEXT N
380
TN$="00":SN$="000":RN$="000":IN$="000":NL$="0":RO$="0":AR$="0":CW$="0":CT$="
0":TC$="0":RS$="0":RC$="0":CC$="0":LC$="0":WC$="0":CH$="0":AI$="0":NA$="0"
400
NI$="0":CS$(1)="00":CS$(2)="00":CS$(3)="00":CS$(4)="00":CS$(5)="00":CS$(6)="
00":NP$="0":NV$="0"
440 INPUT"REPORT TYPE(A,B OR O)";RT$
460 INPUT"DAY OF WEEK";DY$:INPUT"TIME OF DAY(24 HR)";TM$
470 T$=TIME$:GOSUB 4000:T1=T
480 INPUT"# VEH INVOLVED";NV$:NV=VAL(NV$)
500 FOR N=1 TO NV:CLS:PRINT"DATA FOR VEHICLE ";N:PRINT
520 INPUT"DRIVER PRESENT(Y/N)";DP$(N):IF DP$(N)="N" THEN 580
540 INPUT"YR OF BIRTH";YB$(N):INPUT"SEX (M OR F)";SX$(N)
560 INPUT"OWN=OP(Y/N)";OO$(N)
580 INPUT"MASSREG(Y/N)";SR$(N):IF SR$(N)="Y" THEN 600 ELSE 620
600 INPUT"MASS REG #(7 CHR)";MR$(N)
620 INPUT"MODEL YR";MY$(N):INPUT"MAKE(5 CHR)";MK$(N)
640 INPUT"VEH TYPE(5 CHR)";VT$(N):INPUT"VEH PARKED(Y/N)";VP$(N)
660 INPUT"DAMAGE 1";D1$(N):INPUT"DAMAGE 2";D2$(N):INPUT"DAMAGE
3";D3$(N):INPUT"DAMAGE 4";D4$(N):INPUT"DAMAGE 5";D5$(N)
680 NEXT N
690 T$=TIME$:GOSUB 4000:T2=T
700 CLS:PRINT"***PERSONAL INJURY DATA***
720 INPUT"NUMBER INJURED";NP$:P=VAL(NP$):IF NP$="0" THEN 810
740 FOR N=1 TO P:CLS:PRINT"DATA FOR PERSON";N
760 INPUT"TYPE PERSON INJURED";IP$(N):INPUT"IN VEHICLE NUMBER";IV$(N)
780 INPUT"INJURY SEVERITY";IE$(N)
800 NEXT N
810 T$=TIME$:GOSUB 4000:T3=T
820 CLS:PRINT"***LOCATION INFORMATION***
840 INPUT"CODE # OF TOWN";TN$:INPUT"CODE # OF STREET";SN$
860 INPUT"CODE # OF INTERSECT ST.";IN$:INPUT"ROUTE # (0=MISSING,1=NO)";RN$:
```

```
880 FOR N=1 TO NV:PRINT:PRINT"FOR VEHICLE";N:INPUT"DIRECTION OF TRAVEL
(N.S.E.W)";DT$(N):NEXT N
900 PRINT:INPUT"# OF LANES";NL$:INPUT"ON RAMP (Y/N)";AR$
910 T$=TIME$:GOSUB 4000:T4=T
920 CLS:PRINT"***COLLISION TYPE & CONDITIONS":PRINT
940 INPUT"COLLISION WITH";CW$
943 PRINT "COLLISION TYPE":PRINT "1,2,3 AS CHECKED"
945 PRINT "4=1 @ 2 CHECKED":PRINT "5=1 @ 3 CHECKED"
948 PRINT "6=2 @ 3 CHECKED":PRINT "7=1 @ 2 @ 3 CHECKED"
951 INPUT "COLLISION TYPE";CT$
960 FOR N=1 TO NV
980 PRINT:PRINT"FOR VEHICLE";N
1000 INPUT"PRIOR ACTION 1";PA$(N):INPUT"PRIOR ACTION 2";PA$(N):INPUT"PRIOR
ACTION 3";PA$(N):INPUT"PRIOR ACTION 4";PA$(N):NEXT N
1020 PRINT:INPUT"TRAFFIC CONTROL";TC$:INPUT"ROAD SURFACE";RS$:INPUT"ROAD
CONDITION";RC$
1040 IF CW$="5" OR CW$="9" THEN INPUT"COLLISION CONDITIONS";CC$
1060 INPUT"LIGHT CONDITIONS";LC$:INPUT"WEATHER CONDTIONS";WC$
1063 FOR N=1 TO NV
1065 CLS:PRINT"**VIOLATION DATA**":PRINT:PRINT"       **VEHICLE";N;"ONLY
**"
1070 INPUT"VIOLATION 1";V1$(N):INPUT"VIOLATION 2";V2$(N):INPUT"VIOLATION
3";V3$(N):NEXT N
1075 T$=TIME$:GOSUB 4000:T5=T
1080 CLS:PRINT"*PRE-ACCIDENT FACTORS INTERPRETED FROM*         *DIAGRAM AND
NARRATIVE*":PRINT
1090 INPUT "USABLE DIAGR OR NARRATIVE?(Y/N)";GN$
1095 IF GN$="N" GOTO 2800
1100 INPUT"AT INTERSECTION (Y/N)";AI$
1120 IF AI$="Y" THEN PRINT"NUMBER OF APPROACHES:     1=THREE     3=MORE THAN
4                2=FOUR       0=UNABLE TO DETERMINE":INPUT"HOW MANY
APPROACHES";NA$
1130 IF NV$ >"2" THEN GOTO 1140 ELSE GOTO 1200
1140 INPUT"NUMBER OF IMPACTS";NI$:IM=VAL(NI$)
1160 FOR J=1 TO IM
1180 INPUT"COLLISION SEQ(STRIKING/STRUCK)";CS$(J):NEXT J
1200 FOR N=1 TO NV
1205 IF VP$(N)="Y" GOTO 2790
1210 CLS:PRINT "DATA FOR VRHICLE";N
1220 PRINT"BASIC MANEUVER":PRINT
1240 PRINT"  1=FOLLOWING ROAD":PRINT
1260 PRINT"  2=TURNING":PRINT
1280 PRINT"  3=ENTER OR CROSSING TRAFFIC-WAY FROM      OFF-ROAD POSITION"
1300 PRINT"    (DRIVEWAY PARKING LOT;                  INCLUDING
BACKING)":PRINT
1320 PRINT"  4=BACKING ON ROAD (INCLUDES BACKING       INTO PARKING
POSITION)":PRINT
1340 PRINT"  5=PARKING (EXCEPT BACKING INTO PARKING    POSITION)":PRINT
1360 PRINT"  6=DISABLED IN TRAFFIC":PRINT
1380 PRINT"  7=OTHER      0=UNKNOWN":PRINT
1400 INPUT"WHAT WAS THE BASIC MANEUVER";BM$(N):CLS
1420 IF BM$(N)="2" THEN 1500
1440 IF BM$(N)="3" THEN 1580
1460 IF BM$(N)="1" THEN 1700
1480 IF BM$(N)="4" OR BM$(N)="5" OR BM$(N)="6" OR BM$(N)="0" OR BM$(N)="9"
THEN 1820
1500 PRINT"VEHICLE";N:PRINT"DIRECTION"
1520 PRINT"  1=RIGHT TURN     3=U-TURN":PRINT
1540 PRINT"  2=LEFT TURN      0=UNKNON":PRINT
1560 INPUT"SPECIFIC TURNING MANEUVER";SM$(N):CLS:GOTO 1820
```

```
1580 PRINT"VEHICLE";N:PRINT"TURNING/CROSSING MANEUVER":PRINT
1600 PRINT"  5=ENTERING FROM DRIVEWAY TOWARD NEAR      SIDE OF
STREET":PRINT
1620 PRINT"  6=ENTERING FROM DRIVEWAY TOWARD FAR       SIDE OF
STREET":PRINT
1640 PRINT"  7=ENTERING FROM PARKED POSITION":PRINT
1660 PRINT"  0=UNKNOW":PRINT
1680 INPUT"SPECIFIC ENTERING/CROSSING MANEUVER";SM$(N):CLS:GOTO 1820
1700 PRINT"VEHICLE";N:PRINT"SPECIFIC PASSING MANEUVER"
1720 PRINT"  0=UNKNOWN":PRINT
1740 PRINT" 10=PASSING ANOTHER VEHICLE ONRIGHT":PRINT
1760 PRINT" 11=PASSING ANOTHER VEHICLE ONLEFT         OR DIRECTION NOT
INDICATED":PRINT
1780 PRINT" 12=NOT PASSING":PRINT
1800 INPUT"SPECIFIC PASSING MANEUVER";SM$(N):CLS
1820 PRINT"VEHICLE";N:PRINT"INTERRUPTED MANEUVER":PRINT
1840 PRINT"  1=STOPPED IN TRAFFIC(WAITING FOR SIGNAL,OTHER VEHICLE TO
PASS)":PRINT
1860 PRINT"  2=LOSS OF CONTROL(SKIDDING,SPINNING)":PRINT
1880 PRINT"  3=EVASIVE MANEUVER":PRINT
1900 PRINT"  8=NONE    9=OTHER":PRINT
1920 INPUT"INTERRUPTIONS OF BASIC MANEUVER";IM$(N):PRINT
1940 IF IM$(N)="2" OR IM$(N)="3" THEN PRINT"VEHICLE";N:PRINT"PHANTOM
VEHICLE" ELSE 2040
1960 PRINT"  1=YES"
1980 PRINT"  2=NO"
2000 PRINT"  0=UNKNOWN"
2020 INPUT"WAS PHANTOM VEHICLE INVOLVED";PH$(N):CLS
2040 CLS:PRINT"VEHICLE";N:PRINT"FIRST EVENT":PRINT
2060 PRINT"  1=COLLISION WITH OTHER MOTOR VEHICLE":PRINT
2080 PRINT"  2=COLLISION WITH PARKED MOTOR VEHICLE":PRINT
2100 PRINT"  3=COLLISION WITH OBJECT ON ROAD           (INCLUDES DISABLED
VEHICLE)":PRINT
2120 PRINT"  4=RUN-OFF-ROAD OR STRUCK ROADSIDE         OBJECT":PRINT
2140 PRINT"  5=OTHER   0=UNKNOW":PRINT
2160 INPUT"WHAT WAS THE FIRST EVENT";FE$(N):CLS
2180 IF FE$(N)<>"4" AND NV>1 THEN 2220
2200 IF FE$(N)="4" AND NV>=2 THEN 2220
2205 IF FE$(N)="4" AND NV=1 GOTO 2340 ELSE 2700
2220 PRINT"VEHICLE";N:PRINT"PRE-CRASH CONFIGURATION":PRINT
2240 PRINT"  1=RIGHT      4=OPPOSITE DIRECTION":PRINT
2260 PRINT"  2=LEFT       5=OTHER:PRINT
2280 PRINT"  3=SAME       0=UNKNOWN
2300 PRINT"    DIRECTION":PRINT
2320 INPUT"VEHICLE 'X' APPROACHING VEHICLE IN      QUESTION
FROM";PC$(N):CLS
2325 IF FE$(N)<>"4" THEN 2440
2340 PRINT"VEHICLE";N:PRINT"DIRECTION OF RUN-OFF":PRINT
2360 PRINT"  1=RIGHT SIDE OF ROAD":PRINT
2380 PRINT"  2=LEFT  SIDE OF ROAD":PRINT
2400 PRINT"  3=OTHER    0=UNKNOWN":PRINT
2420 INPUT"WHAT WAS THE DIRECTION";DR$(N):CLS
2440 IF BM$(N)="1" OR BM$(N)="6" THEN PRINT"VEHICLE";N:PRINT"LANE POSITION"
ELSE 2580
2460 PRINT"  1=VEHICLE IN LANE OF TRAVEL DIRECTION":PRINT
2480 PRINT"  2=VEHICLE IN LANE OF OPPOSITE TRAVEL      DIRECTION":PRINT
2500 PRINT"  3=STRADDLING CENTERLINE"
2520 PRINT"    (CENTER OF ROAD)":PRINT
2540 PRINT"  4=OTHER     0=UNKNOWN":PRINT
2560 INPUT"WHAT WAS THE LANE POSITION";LP$(N):CLS
```

```
2580 PRINT"VEHICLE";N:INPUT"INITIAL CONTACT  CODE ONLY ONE          REFER
TO DIAGRAM";IC$(N):IF NV=1 THEN 2700
2600 PRINT:PRINT"VEHICLE";N:PRINT"COLLISION TYPE"
2620 PRINT"  0=MISSING     3=HEAD-ON":PRINT
2640 PRINT"  1=REAR-END    4=SIDESWIPE":PRINT
2660 PRINT"  2=ANGLE       5=OTHER":PRINT
2680 INPUT"TYPE OF COLLISION";CO$(N)
2700 CLS:PRINT"VEHICLE";N:PRINT"ROAD ALIGNMENT"
2720 PRINT"  0=UNKNOWN     2=TURNING RIGHT":PRINT
2740 PRINT"  1=STRAIGHT    3=TURNING LEFT":PRINT
2760 PRINT"          4=OTHER
2780 INPUT"ALIGNMENT OF ROAD-WAY";RA$(N)
2790 NEXT N
2800 T$=TIME$:GOSUB 4000:T6=T
2840 CLS:'**OUTPUT STATEMENTS**
2860 PRINT"AN ACCIDENT RECORD, ";NV;" VEHICLE RECORDS AND ";P;" INJURY
RECORDS WILL BE GENERATED."
2880 INPUT"OK TO WRITE OUTPUT FILE(Y OR N)";CL$:IF CL$="Y" THEN 3500 ELSE
STOP
2900 OPEN AF$ FOR APPEND AS 1
2920 PRINT#1,USING"\  \###\ \!\  \!\ \\ \\ \\
\!!!!!!!!!!!!!!!\\\\\\\\\\\\!";DD$,NN,"111",RT$,TM$,DY$,TN$,SN$,RN$,IN$,NL$,
RO$,AR$,CW$,CT$,TC$,RS$,RC$,CC$,LC$,WC$,CH$,NA$,NV$,NI$,CS$(1),CS$(2),CS$(3)
,CS$(4),CS$(5),CS$(6),NP$
2940 FOR N=1 TO NV
2960 PRINT#1,USING"\  \###!#!!!\      \\\\    \\    \!\\\\\\\\\\\   \\
\";DD$,NN,"2",N,"1",DP$(N),SR$(N),MR$(N),MY$(N),MK$(N),VT$(N),VP$(N),D1$(N),
D2$(N),D3$(N),D4$(N),D5$(N),VR$(N),RR$(N)
2980 PRINT#1,USING"\  \###!#!\\!\
\!!!!!!!!!!!!!!!!!!!";DD$,NN,"2",N,"2",YB$(N),SX$(N),ZP$(N),OO$(N),SL$(N),V1
$(N),V2$(N),V3$(N),DT$(N),PA$(N),BM$(N),SM$(N),IM$(N),PH$(N),FE$(N),PC$(N),D
R$(N),LP$(N).,IC$(N),CO$(N),RA$(N)
3000 NEXT N
3020 P=VAL(NP$):IF P=0 THEN 3080
3040 FOR N=1 TO P
3060 PRINT#1,USING"\
\###!#!!!\\!!!";DD$,NN,"3",N,"1",IP$(N),IV$(N),IA$(N),IS$(N),IE$,SU$:NEXT N
3080 PRINT#1,:CLOSE 1:INPUT"QUIT NOW(Y OR N)";QN$:IF QN$="Y" THEN 3120
3100 CLS:PRINT"***NEXT REPORT***":GOTO 280
3120 OPEN "LSTSEQ" FOR OUTPUT AS 3
3140 PRINT#3,USING"\  \! ###";DD$,",",NN
3160 CLOSE:END
3500 TF$="A:T"+DD$
3560 U1=T2-T1: U2=T3-T2: U3=T4-T3: U4=T5-T4: U5=T6-T5
3580 ZD=0
3600 IF GN$="Y" THEN ZD=1
3620 OPEN TF$ FOR APPEND AS #2
3640 PRINT #2,U1,U2,U3,U4,U5,NN,NV,P,ZD: CLOSE
3660 GOTO 2900
4000 T=3600*VAL(LEFT$(T$,2))+60*VAL(MID$(T$,4,2))+VAL(RIGHT$(T$,2)):RETURN
```

APPENDIX 18: "LPFIXER.BAS," IBM PC PROGRAM TO DETECT MISCODED LICENSE PLATES IN PAR FILES GROUPED BY SEASON & WEEK. BAD NUMBERS ARE PRESENTED FOR MANUAL CORRECTION.

```
10 'LPFIXER.BAS, DETECTS BAD PLATE NUMBERS AND PRESENTS THEM FOR CORRECTION
12 'REVISED 6/12/85 BY J.K. POLLARD
15 INPUT "SEASON NUMBER";S:S$=STR$(S):S$=MID$(S$,2)
20 FOR N=1 TO 12
30 N$=STR$(N):N$=MID$(N$,2)
40 NM$="A:AS"+S$+"W"+N$
45 OP$="B:CAS"+S$+"W"+N$
47 OPEN OP$ FOR OUTPUT AS 2
50 OPEN NM$ FOR INPUT AS 1
55 PRINT NM$
60 LINE INPUT #1,L$
70 IF EOF(1) THEN 300
75 V$=MID$(L$,8,1):C$=MID$(L$,10,1)
76 IF V$="1" THEN A=A+1 :GOTO 250
80 IF V$<>"2" OR C$<>"1" THEN 250
100 LP$=MID$(L$,13,7)
110 IF LP$="0000000" THEN 250
120 P1$=LEFT$(LP$,1):P2$=MID$(LP$,2,1):V2=VAL(P2$)
125 P=P+1
140 IF P1$="0" AND V2=0 AND P2$<>"0" THEN 200
150 GOTO 250
200 BL$=LEFT$(L$,12):RL$=MID$(L$,20,28)
210 QL$=BL$+" "+LP$+" "+RL$
220 LPRINT QL$:I=I+1
230 PRINT QL$:INPUT"ENTER CORRECTED PLATE NUMBER";LP$:NC=LEN(LP$)
233 IF NC<>7 THEN 230
235 L$=BL$+LP$+RL$
240 LPRINT L$
250 PRINT#2;L$:GOTO 60
300 CLOSE :NEXT
310 LPRINT
315 LPRINT "PAR COUNT=";A
320 LPRINT"USEABLE PLATES=";I:END
```

APPENDIX 19

Mary Warsaskas
David Alexander
PO BOX 241
Auburndale, Mass 02166
November 15, 1984

Mr. Michael McFadden
Arvin/Calspan
3 Militia Drive
PO BOX 9X
Lexington, Mass 02173

re: INFRA-RED PHOTOGRAPHY

Dear Micheal,

Enclosed please find our report and findings regarding the use of infra-red film for the small car study.

We trust these will be of use to you in preparing your final report.

If you need assistance and technical write-ups on other aspects of the project we are available and interested. Our fee for future work is open to discussion; please do not hesitate to call upon us.

Cordially,

Mary Warsaskas
David Alexander

cc: J.K. Pollard
enc.
MW,DA/usa

Temperature: 65-70 degrees F.
Light condition: total darkness
Weather condition: Partly cloudy

Equipment used:
-Minolta X-700 35mm camera w/fixed 200mm lens
-Minolta multi function back
-Kodak Wratten gelatin filter #87 - 75 mm x 75 mm - CAT 149 6256
-Minolta Wireless Controller IR-1 Set
-Norman Strobe 200B w/light tight housing
-Hercules tripod

INPUT VARIABLES

F-Stop	Strobe Setting	Subject Speed	Distance to Subject	Shutter Speed	Motor Drive Speed	ASA	Filter
3	50	25	50	1/60	High	25	yes
3	100	35	50	1/60	High	25	yes
3	200	45	50	1/60	High	25	yes
5.6	50	25	50	1/60	High	25	yes
5.6	100	35	50	1/60	High	25	yes
5.6	200	45	50	1/60	High	25	yes
8	50	25	50	1/60	High	25	yes
8	100	35	50	1/60	High	25	yes
8	200	45	50	1/60	High	25	yes
11	50	25	50	1/60	High	25	yes
11	100	35	50	1/60	High	25	yes
11	200	45	50	1/60	High	25	yes
16	50	25	50	1/60	High	25	yes
16	100	35	50	1/60	High	25	yes
16	200	45	50	1/60	High	25	yes
22	50	25	50	1/60	High	25	yes
22	100	35	50	1/60	High	25	yes
22	200	45	50	1/60	High	25	yes
3	50	25	50	1/60	High	25	no
3	100	35	50	1/60	High	25	no
3	200	45	50	1/60	High	25	no
8	50	25	50	1/60	High	25	no
8	100	35	50	1/60	High	25	no
8	200	45	50	1/60	High	25	no
22	50	25	50	1/60	High	25	no
22	100	35	50	1/60	High	25	no
22	200	45	50	1/60	High	25	no

The next set of results include a new variable: these were all shot with illumination from the headlights of oncoming vehicles. These headlights were angled directly into the camera lens.

3	200	25	50	1/60	High	25	yes
8	200	25	50	1/60	High	25	yes
22	200	25	50	1/60	High	25	yes
3	200	25	50	1/60	High	25	no
8	200	25	50	1/60	High	25	no
22	200	25	50	1/60	High	25	no

Some variables (distance to subject, shutter speed, motor drive speed, ASA) were constant per test results acquired June 15, 1984.

Based on reviewing the developed infra-red film from this test, the following settings were deemed to be most workable under similar conditions:

F-Stop:	F3 if site is unlit F5.6 if site has street lights present
Strobe setting:	at a setting of 50, recycle time is 1/3 second; this is acceptable when traffic flow is heavy at a setting of 100, recycle time is 3/4 second; this is acceptable when traffic flow is moderate at a setting of 200, recycle time if 1.5 seconds; this is acceptable when traffic flow is slow
Subject speed:	best results were obtained at speeds of 35 and under; at higher speeds, subject blurred on developed film
Distance to subject:	per test of June 15, 1984, it was determined that a distance to subject greater than 50 feet produced ineffective results
Shutter speed:	per test of June 15, 1984, it was determined that a shutter speed of 1/60 second (camera synchronized speed) produced best results
Motor drive speed:	high speed is most acceptable for all type of traffic flow
ASA setting:	per test of June 15, 1984, it was determined that the ideal ASA setting for this type of situation is 25; this also is the recommended base film speed per the manufacturer, KODAK
Filter use:	filter use is recommended at all times; when not used, oncoming light source (headlights) will negate any image on film

CONCLUSIONS & RECOMMENDATIONS:

-For best results the infra-red equipment should be set up outside, not inside the data collector's vehicle

-When infra-red film was shot with equipment inside the vehicle, it was found to be 100% ineffective, probably due to refraction of light by the vehicle's windshield

-When infra-red film was shot with equipment outside the vehicle, climate conditions (specifically precipitation) affected outcome; i.e., infra-red film results are not valid when precipitation (rain, sleet, snow, etc.) is present

-Best results were obtained when subject speed was less than 35 MPH

-When using the Minolta Wireless Controller IR-1 Set, the sender unit should be no more than 15 feet from the receiver unit, with a clear, unobstructed line of fire

-The camera must be completely focused before the Kodak Wratten gelatin filter is applied

-The computer trigger should be engaged approximately 1-2 seconds before the subject is precisely framed, in order to allow for signal processing (Wireless system)

-Based on these results, we recommend use of a higher powered strobe unit for all infra-red shoots; this will enable use of faster shutter speeds, and provide a greater depth of field

SMALL CAR STUDY DATA COLLECTION GUIDE

1. 863-1703 - CALSPAN - leave message if you'll be missing or late

2. - Keys locked in Van — someone on team must have van key

3. Equipment needed for observations: 1 team

Observer 1 - Red Van
Blue Bag

1. OPPSPD computer
2. white interface cable
3. 1 walkie-talkie
4. blue battery pack
5. 2 night lights
6. audio cassette recorder
7. microphone
8. 2 blank cassettes

Observer 2 - Red Van
Tan Bag

1. TURNS computer
2. white interface cable
3. computer cassette recorder
4. cassette recorder cables
5. blue battery pack
6. infrared transmitter
7. BNC-BNC cables

Observer 3 - White Van
Grey Bag

1. OTHAPP computer
2. white interface cable
3. blue battery pack
4. 1 walkie-talkie
5. infrared receiver
6. camera with lens
7. BNC-shutter release cable
8. 2 plastic bags
9. 10 rolls of film
10. package of sticker labels

Check the bags before you leave the Office! Write down the site number and town for the day's observations and take them with you. Also carry radar gun.

If shooting in daylight and fair weather, take white van only.

4. While driving set computer clock to camera.

ENTER BASIC
TIME $ = "hh: mm: ss" — enter button starts clock
F8 (main menu) — (press it the second before desired time)

Times must agree within one second. If not repeat procedure.

5. Controlled Intersections: Any intersection where the traffic in the direction of interest is slowed or stopped by signs or signals is a controlled intersection.

A. Upstream Observations

Observer 1) Computer - (UPSTRM) age, sex, speed, (traffic in the direction of interest) (1 roll)

Observer 2) Camera for plates

Observer 3) Speed in opposite direction

(20 obs)

B. At Intersection

Observer 1) Computer (TURNS) (1 roll) - age, sex, turning maneuver (traffic in the direction of interest)

Observer 2) Camera

Observer 3) Computer (OTHAPP)

(20 obs)

6. Uncontrolled Intersections

Observer 1) Computer (TURSPD) (one roll)

Observer 2) Camera (OPPSPD) (20 obs)

Observer 3) Computer (OTHAPP)

(20 each direction)

7. Rewind the film

- Turn off the motor drive.
- Push up the button on the motor drive.
- Rewind with lever.
- Remove film. If shot at night, attach stick on label to roll.

8. SAVE DATA (See Saving Data). Make LOG entries.

9. After each shift:

- o Recharge - blue box (according to schedule on wall)
  - radar gun

- o Label an accordion file with the day's date.

- o Put the data tape(s), film and LOG page from the day's observations in the accordion file and into the file cabinet.

- o Place equipment bags in storage cabinet and lock cabinet.

- o Lock CALSPAN door (if late shift).

- o Return keys to storage box in van.

- o Lock van.

SETTING UP THE CAMERA

1. Load camera with film.

2. Set the ASA to 400.

3. Turn on camera and take 3 pictures to advance film to 1.

4. Set the rest of the camera.

   a. Set data back to "auto". Make sure data exposure is set to "two diamonds."

   b. Turn on motor driver to "S".

   c. Set shutter speed to "P" in daylight. Set to 1/125 before sundown for night shots.

   d. Set lens apperture to the highest number (16 or 22) for daylight sessions, set lens wide open for evening sessions.

   e. Check computer and camera times.

   f. If working with camera inside van with computer, connect shutter release cable from camera to battery box (BNC). Use BNC extension cable if needed.

      If working outside van or with camera in separate van, do the following:

      Turn on the infrared receiver to "S".

      Set the channel to match the computer - sender channel number.

      Check battery of the receiver.

      Attach the cable from camera to receiver.

5. Set the observer/site/visit number on the data back.

   a. Press mode until number appears.

   b. Press the diamond until six diamonds appear.

   c. The number should be:

      observer number (2 digits), site number (3 digits), visit number (1 digit)

d. Each digit is set up when the correct diamond is flashing. Press the 0-9 button until the correct number appears.

e. Press the diamond again until just one diamond appears.

6. Cover the lens and take a picture using TURNS or FASTER (see directions for those programs). This records the observer/site/visit number on the first frame.

7. Press mode button on the data back until time appears.

8. Focus the camera on the cone, a light post, a team member, etc. positioned at the point where the rear end of a car appears to take up about half of the width of a frame, i.e., approximately 75 feet with a 200 mm lens..

   a. Match the lines in the two halfs of the circle.

TURNS
(later called "MAIN")

1. See header information. After entering header data, connect to camera or IR transmitter and fire camera to record ob/site/visit number when prompt comes up. Reset camera to time mode on next prompt and begin data taking.

2. Vehicle Type.

   F1 - passenger car driven by male
   F2 - passenger car driven by female
   F3 - passenger car unknown sex
   F4 - van/pickup trucks
   F5 - other (code from prompt) bicycles and motor cycles are "other"

   (Note: on ly F1, F2, and F3 fire camera)

3. Age (1st digit of age. 32 = 3, 25 = 2, 59 = 5).

4. Maneuver (see prompt for codes).

5. Hit F6 to record missed vehicles (any type) in dense traffic.

6. Hit F7 to pause; press F7 again to RESTART.

7. Hit F8 after the lane's observations are complete.

8. If program does not work properly, see "Software Repairs".

FASTER

FASTER is used in place of TURNS when trafic is too dense to enter all of the information on the keyboard. Age estimates and tuning maneuvers (if other than straight) are recorded on an audio cassette.

1. Header information is identical to TURNS.

2. Vehicle Type is only response made on computer.

   F1 - passenger car driven by male
   F2 - passenger car driven by female
   F3 - passenger car driven by unknown sex
   F4 - light truck
   F5 - any other wheeled vehicle
   F6 - missed vehicle
   F7 - PAUSE/RESTART
   F8 - OBSERVATIONS COMPLETE

3. While observing traffic, announce sex, age, turning maneuver (if any) atthe same time you press the corresponding F key. At the end of each platoon of vehicles, read off the current time.

4. When observations are complete, label the cassette box with the name of the FASTER site.

5. At the end of the shift, put the cassette back in its box and place in the accordion folder with the film, log and data cassette.

HEADER FOR TURNS AND UPSTRM

Temporary Header for Main Approach

- Site/visit number   site (3 digits)   visit (1 digit)
- Surface condition

  1 - dry
  2 - wet
  3 - snowy
  4 - icy
  5 - other

- Road conditions

  1 - no defects
  2 - holes, ruts, bumps
  3 - foreign matter on surface
  4 - defective shoulder
  5 - road under construction
  6 - other

- Light condition

  1 - daylight
  2 - dawn or dusk
  3 - darkness, road lighted
  4 - darkness, road unlighted

- Weather condition

  1 - clear
  2 - foggy
  3 - cloudy
  4 - rain
  5 - snow
  6 - sleet

- Number of parked vehicles right (between previous intersection and the intersection observed.
- Number of actual travel lanes in observation direction.
- Characteristics Lane 1 (lanes numbered from curb)
- Characteristics Lane 2
- Characteristics Lane 3

  1 - no restrictions
  2 - designated straight only
  3 - designated straignt/left
  4 - designated straight/right
  5 - designated left
  6 - designated right

- o Characteristics Lane 4
  - 7 - additional left-turn lane
  - 8 - additional right-turn lane
  - 9 - parking
- o Code 11 -19 if the lane is blocked, i.e., put a "1" before the prior codes.
- o Lane number observed.
- o Observer number.

If you make an error, you can DELETE if you notice it before pressing ENTER. If you have already ENTERED an incorrect code, you must either kill the file and start over, or make a note to yourself to edit the file before you save it to cassette.

OPPSPD - Opposite Speed
(later incorporated in "OTRAF")

In this program, information about the speed of the vehicle in the direction opposite the main approach is collected. Data is collected by lane #. Lanes are numbered from the curb (right lane is 1 when facing the direction of traffic).

1. Site/visit number (3 digit) site #: (1 digit) visit #

2. Number of lanes used in the opposite direction.

3. Observer number.

4. Press enter when you are ready to start taking data.

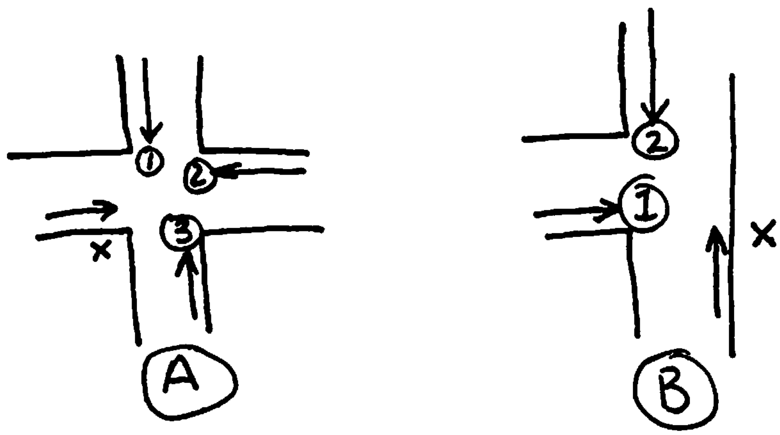
5. Press the function key (F1, F2 . . .) corresponding to the lane the vehicle is in and then enter the speed of the vehicle from the radar gun.

6. Get at least 20 observations.

7. Hit F8 to end observations.

OTHAPP - Other Approaches
(later incorporated in "OTRAF")

This program is used to collect information on the number of cars entering the intersection from other approaches. The numbering convention for these approaches (clock-wise from the observation approach (x).



1. Site/visit number (3 digit) site #: (1 digit) visit #

2. Approaches in use = all but the observation approach in A = 3 in B = 2.

3. Observer number.

4. Timing is important. Press enter when you are ready to start observations. Get every vehicle which enters the intersection from approaches other than the main observation approach.

5. Use the function keys (F1, F2 . . .) with the number corresponding to the approach number.

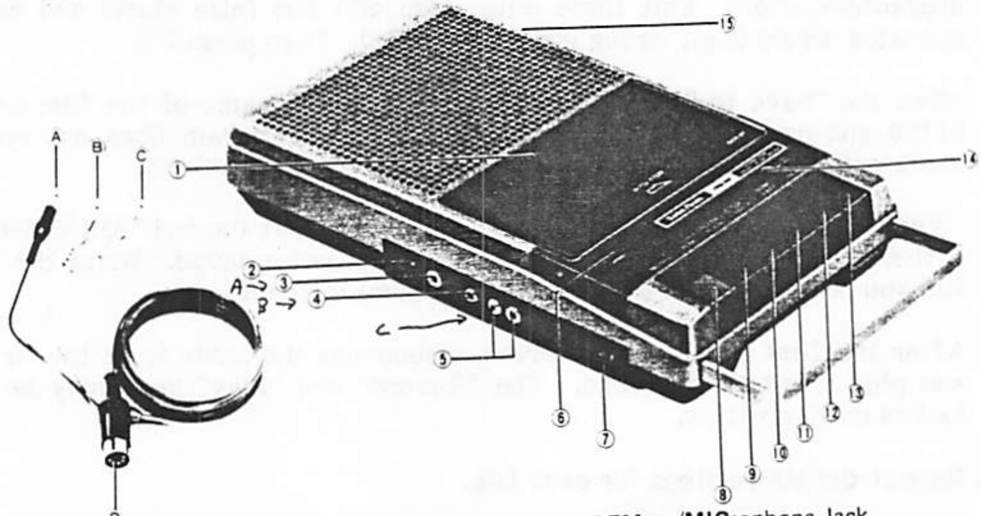
6. Continue counting all approaches until there are 20 cars in each direction or until the TURNS program is completed. Then press F8 to end observation.

SAVING DATA

1. In general, data should be saved to cassette tape as soon as possible. The most efficient procedure is to save it during the drive to the next site. In the event of a failure of the cassette recorder, broken tape, etc., it is possible to retain an entire day's data in RAM and save it to cassette after returning to the CALSPAN office using the backup machine kept in the storage cabinet.

2. To save data make sure that the cassette recorder cable is connected as shown in the illustration:

CONTROLS AND CONNECTIONS



A. Tape output plug (to EARphone Jack)
B. Tape input plug (to AUXiliary Input Jack)
C. Tape control plug (to REMote Jack)
D. Computer cassette plug (to TAPE output on computer)

1. Cassette Compartment
2. DC 6V Jack
3. EARphone Jack
4. AUXiliary Input Jack
5. REMote/MICrophone Jack
6. TAPE COUNTER
7. VOLUME Control
8. RECORD Key
9. PLAY Key
10. REWIND/REVIEW Key
11. FAST-Forward/CUE Key
12. STOP/EJECT Key
13. PAUSE Key
14. BATTERY/RECORD LED Indicator
15. AC Line Cord Receptacle

3. Insert a blank tape into the cassette recorder with Side A (or Side 1) up. Reset counter. Wind past the leader using fast forward (to "005"). Reset the counter to "000".

4. Lock the "Record" and "Play" keys down.

5. Move the cursor on the MENU to the name of the file you wish to save. Files should be saved in the following order at a TURNS or FASTER site:

   1. T
   2. O
   3. A

   At an UPSTRM site, save them as:

   1. U
   2. O

6. Enter the file, check that it is what you want and look for bad data (Ms, odd characters, etc.). Edit these out. Also edit out false starts and correct other operator errors (e.g., wrong condition codes). Then press F3.

7. When the "Save to:" prompt appears, type in the name of the file; e.g., T0912 or S1756 and press RETURN. The cassette save program does not recognize file name extensions (e.g., DO), so there is no need to type them.

8. Verify that the cassette reels are turning and that the red "RECORD" light is on. If these things have not occurred, data is not being saved. Write the name of the file you have saved on the cassette box label in pencil.

9. After the first file has been saved, disconnect the cable from the first computer and plug it into the second. The "Record" and "Play" keys may be left in the locked down position.

10. Repeat the above steps for each file.

11. While driving back to CALSPAN from the last site, rewind the data tape.

12. Also KILL all the data files in each computer unless there has been some malfunction with the cassette recorder.

13. Place the cassette tapes in the accordion folder with the film for that day.

SOFTWARE REPAIRS

The Radio Shack computers occassionally reprogram themselves so that they no longer function properly. The most common problem results in a return to the MENU immediately after entering a program. To correct this fault, do the following:

1. Enter BASIC.
2. Load "TURNS" (or whatever program isn't working).
3. EDIT 1-20 (it may be necessary to edit higher line numbers, but usually the problem is near the beginning).
4. Locate the line with the "MENU" statement in it and remove it with the DELETE key.
5. Press F8 to save the corrected version.
6. Press F4 to RUN.
7. If the above procedure fails, enter BASIC and KILL the defective program, e.g., KILL "TURNS.BA. Then reload the program from the BACKUP tape kept in the van at all times.

CML Group

524 Main Street
Acton Massachusetts 01720
Telephone: (617) 264-[illegible]

G Robert Tod
President

April 20, 1984

Dr. Robert J. Ravera
Acting Director
Transportation Systems Center
Department of Transportation
Kendall Square
Cambridge, MA 02142

Dear Dr. Ravera:

At approximately 8:00 AM on April 17, 1984, I had an unfortunate confrontation with three of your employees. A combination of their initial attitude, camera with telephoto lens, location, and the fact that three employees were doing a job which (it seemed) one could easily do, caused me to become quite upset. As a tax payer, especially on the day tax returns were due, I am very conscious of my obligation to support our government's activities, but in turn believe it is essential that government agencies constantly promote efficiency and productivity.

On the morning in question, upon leaving my home on Estabrook Road in Concord, I noticed three people parked at the side of the road at the edge of my land. I could see one taking (or preparing to take) pictures - the other two doing nothing. I asked them if I could help them and got back a curt no. Somehow the attitude, a defensive one, bothered me. I then asked him to move off my land. He moved ahead about 20 feet but was still at the edge of or partially on my land.

Shortly thereafter, seeing he had not moved further and was still on the bend in the road adjacent to my land, with camera in hand, I again approached him. I said I did not appreciate his attitude and he responded that he didn't care for mine. I then asked for their names. They refused to tell me or show identification but did say they were with the Department of Transportation. I could tell this by the vehicle plates (80506).

C[illegible] Group

Dr. Robert J. Ravera
April 20, 1984
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I am on a Board of Directors with Judith Conner who recently served as Assistant Secretary of Transportation. I am very much aware that Judith, as well as the present administration, is concerned with both employee attitude and cost reduction. I was, therefore, surprised to see three people doing a job [illegible] could apparently have done, as well as an [illegible] which could not be described as pleasant.

I am enthusiastically supportive of the job the DOT is doing but quite concerned with the attitude displayed by a government employee. I understand that the job being performed on Estabrook Road could be sensitive or confidential in nature. I do believe, however, that employees of any organization, be it public or private, should consider the customer. In our company, we use the common motto, "the customer is always right."

When one combines a poor attitude with "none of your business," a camera with telephoto lens, a lot of film in a quiet residential neighborhood, and a failure to produce identification, one certainly begins to wonder what's going on. It also happens that some of our neighbors noticed some people a week ago taking pictures in the same area (none of these people were taking pictures of anything which [illegible] to have any "photographic significance"). This [illegible] ld be legimate but again, it may not be. [illegible] case, the attitude combined with the [illegible] has raised many questions in our mind.

I would very much appreciate an explanation as to what was taking place on Estabrook Road this week. I also thought you would want to be aware of the attitude displayed by your employees. Thank you for your attention to this matter.

Sincerely,

G. Robert Tod

GRT:cw

U.S. Department
of Transportation

Research and
Special Programs
Administration

Mr. G. Robert Tod
President, CML Group
524 Main Street
Acton, MA 01720

Dear Mr. Tod:

This letter is in response to your letter of the 20th of April 1984. I am pleased to have the opportunity to explain the data collection activities which you observed in Concord on April 17, 1984, and to apologize for the behavior of the individuals carrying out the activities. The individuals you encountered are employees of a private firm which is under contract to the Department of Transportation and whose efforts are being monitored by the Transportation Systems Center. I have been assured by their supervisor that the inappropriateness of their behavior has been brought to their attention. I heartily agree that all individuals involved in Government-directed activities should recognize that they serve the citizens of the United States. As I am sure you appreciate, it is not always easy to instill this spirit in the staff of firms under contract to the government.

The purpose of the data collection activity is to establish the relative exposure of small and large cars to accident situations. This information, when combined with counts of accidents in similar situations, will permit an assessment of the relative risk of being involved in an accident for small and large cars. An assessment of this risk is the first step in the development of strategies for improving the crash avoidance capabilities of the growing small-car fleet.

The data collection techniques which you observed are experimental. They promise to save substantial sums of money when compared with the interview techniques which they are designed to replace, and they may produce data with less bias. Our efforts to further reduce the cost of obtaining this data have led to the use of low-cost labor hired by a subcontractor to the prime Government contractor.

The data collectors observe cars and drivers at locations selected at random in twelve communities in the Western suburbs of Boston. At some locations the traffic flow is very light (like at Estabrook Road in Concord). At others the traffic is very dense, requiring the intense concentration of all three observers to obtain the information. The data collection team visits six sites of varying traffic density at precise time slots