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**STRATEGIC HIGHWAY RESEARCH PROGRAM
LONG-TERM PAVEMENT PERFORMANCE STUDIES**

**MATERIAL SAMPLING AND FIELD TESTING
OF GPS TEST SECTIONS, SOUTHERN REGION**

May 1989



**SOUTHERN REGION COORDINATION OFFICE
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**COORDINATION FOR SHRP-LTPP
MATERIAL SAMPLING AND FIELD TESTING AT GPS SITES**

1. Introduction

The Long Term Pavement Performance (LTPP) project of the Strategic Highway Research Program (SHRP) will help reshape future pavement designs and public expenditures by determining the effects of variables such as loading, environment, material properties, and construction and design features, etc. on pavement performance.

The General Pavement Studies (GPS) will utilize existing pavement sections selected to represent a wide range of pavement designs, materials, and service conditions, located in widely different environmental areas across North America, including Hawaii and Puerto Rico. Each of these pavement sections will be thoroughly documented with respect to design, materials, and construction records, and will be monitored over a period of time with respect to traffic, pavement condition, and other performance measures to develop a National Pavement Data Base.

The Materials Sampling and Field Testing (MS&FT) for a GPS site is critically important as it will provide data on layer thicknesses and in situ properties, as well as samples for material testing in the laboratories. The purpose for this document is to communicate plans for accomplishing this work in the Southern Region.

2. Participants and Roles

The most important participants in the General Pavement Studies are the State Highway Agencies (Highway Agencies for Canadian Provinces and Puerto Rico are also referred to as "State Highway Agencies"). As owners of the highways on which the GPS test sections are located, the State Highway Agencies (SHA's) must approve of all sampling, field testing, and measurement activities which are to be carried out. As participants, the states have agreed to undertake inventory and traffic data collection and skid measurements, as well as effecting lane closures and providing traffic control necessary to carry out the field work associated with the program.

For the materials sampling and field testing, the SHA's have also agreed to patch test pits and holes in the pavements, and will decide on which test sections pits may be made and whether they are willing to excavate the test pits as well. Although SHRP contractor personnel have avoided underground

utilities during the location of the test sections to the extent that they were aware of their presence, each SHA will be responsible for checking their records and advising the SHRP representatives of any underground utilities within the test section (including the outside lane only and the shoulder).

In the Southern Region, SHRP has contracted with a joint venture of Law Engineering, Inc. of Atlanta, Georgia and Southwestern Laboratories of Houston, Texas to do both the material sampling and field testing at each test section and the laboratory testing of the materials. Law Engineering, Inc. will sample east of the Mississippi River and Southwestern Laboratories will sample west of it. Unbound and portland cement concrete samples will be shipped to Law Engineering for testing and "bound samples" (asphalt concrete, treated base, etc.) to Southwestern Laboratories.

The Southern Region Coordination Office (SRCO), Austin, Texas (Brent Rauhut Engineering, Inc.) will supply a Drilling Supervisor to be the SHRP representative on the site, and to coordinate the activities of the participants. The SRCO will also operate a Falling Weight Deflectometer (FWD) to obtain deflection data on the pavements concurrently with the MS&FT.

The plan is that Law Engineering (the lead contractor for MS&FT) will develop a tentative three month schedule, which will be approved by the SRCO after consulting with the states involved. The schedule will be updated continuously, as necessary to make adjustments for unforeseen delays due to equipment malfunction and inclement weather.

Approved schedules are to be presented to a state at least one month prior to the MS&FT contractor entering that state. At that time, the SRCO will hold discussions with the state concerning their readiness to participate with traffic control, test pit excavations, and with back filling and pavement restoration activities. Safety issues and procedures to be followed when dates/sites have to be adjusted will also be discussed.

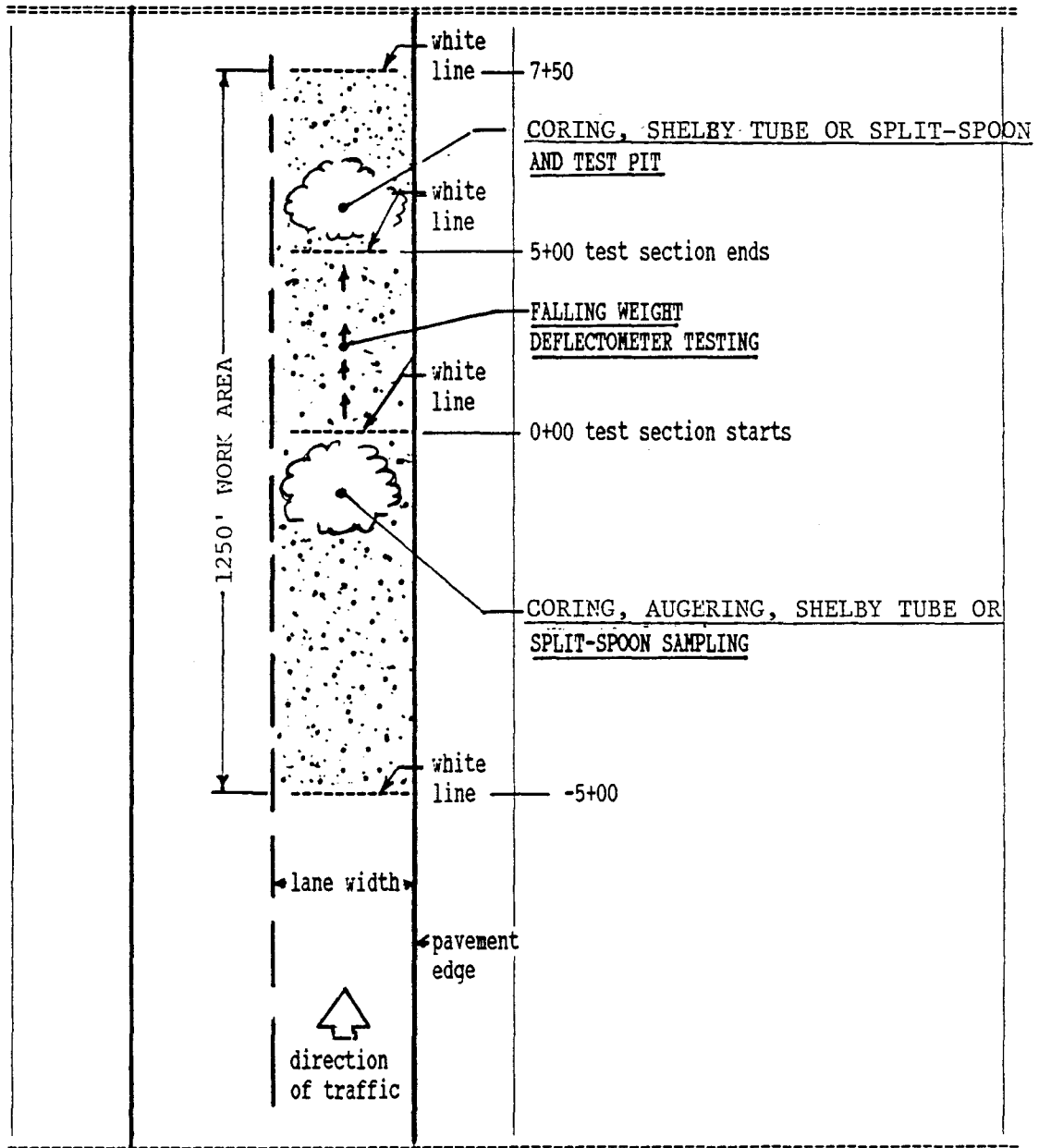
3. Traffic Control Requirements

The material sampling and field testing operations will take place in the lane adjacent to the outer shoulder of the pavement in a 100-foot long area at each end, but outside of the 500-foot test section. The FWD will test within the 500-foot test section. The working area to be closed to traffic will be one lane wide by 1250 feet in length, as shown in Figure 3-1. Traffic control will be required to exclude traffic on this entire section.

FIGURE 3-1

DIAGRAM SHOWING WORK AREA
FOR DRILLING, SAMPLING AND TESTING
OF GPS SECTIONS

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Lane closure will generally be needed for about 8 hours (bar-ring equipment breakdowns or other problems), beginning as early in the morning as possible, e.g., 8:00 a.m. Traffic control signs and channelizing devices usually take about 1/2 hour for set up.

SHRP has established safety as their first priority, and has clearly communicated that publicly and to its contractors. Although the state personnel conducting the traffic control will be primarily responsible, the SHRP representative on the site will observe the traffic control and may object if it does not appear to be generally consistent with the standards of the FHWA "Manual on Uniform Traffic Control Devices" (MUTCD).

Many of the test sections are located on 4-lane divided highways. The typical traffic control scheme from the MUTCD appears in Figure 3-2. Some of the test sections are on 2-lane highways, usually with wide paved shoulders (see Figure 3-3 for typical traffic control scheme). A typical traffic control scheme for a 4-lane undivided highway appears in Figure 3-4. This latter scheme may also work for highways with three or more lanes of traffic in the same direction.

Where concrete pavements are patched with portland cement concrete, it is likely that traffic control will be required until concrete strength has been sufficiently developed. This could vary from a few hours to a few days, depending on the mixes used.

With respect to coordination, it will be necessary for the SHRP representative to know which SHA district (or other organizational unit) is providing traffic control, and the name and phone number of the supervisor or other designated contact.

As traffic control requirements may sometimes span more than 8 hours, prior authorization of overtime may be necessary. In event of bad weather or equipment failure, additional days of lane closure for unfinished work, or for strength gain of concrete patches, may be required.

If there are time limitations (i.e., restrictions to operations during certain time periods or during nighttime) for particular sites, such as in heavily trafficked urban areas, the SHRP representative needs to be advised well in advance, and work adjustments planned. For nighttime operations, adequate lighting and appropriate flashing lights must be a part of traffic control operations to insure safety.

NOTES:

1. Taper Formula:

$L = SXW$ for speeds of 45 or more.

$L = \frac{WS^2}{60}$ for speeds of 40 or less.

Where:

L=Minimum length of taper.

S=Numerical value of posted speed limit prior to work or 85 percentile speed.

W=Width of offset.

2. The maximum spacing between channelizing devices in a taper should be approximately equal in feet to the speed limit.

KEY:

■ ■ Channelizing devices

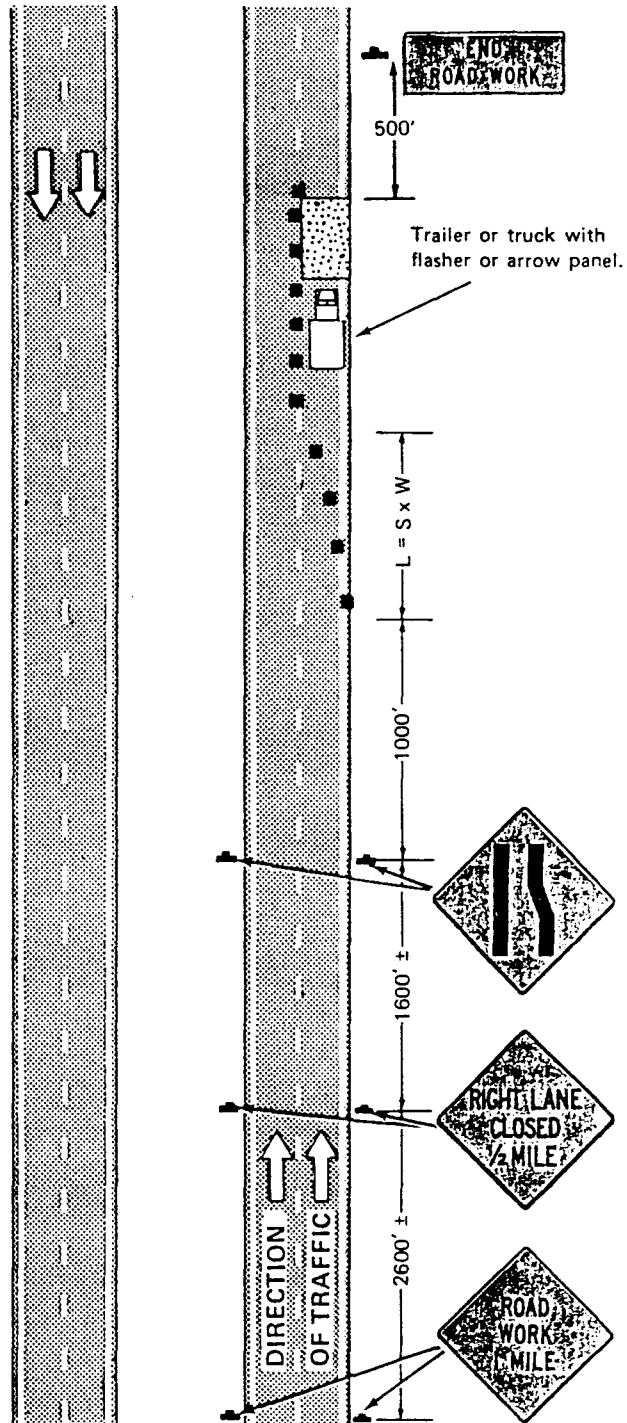


Figure 3.2 Typical Application—Daytime Maintenance Operations of Short Duration on a Four-lane Divided Roadway Where One Lane is Closed (MUTCD, Figure 6-9)

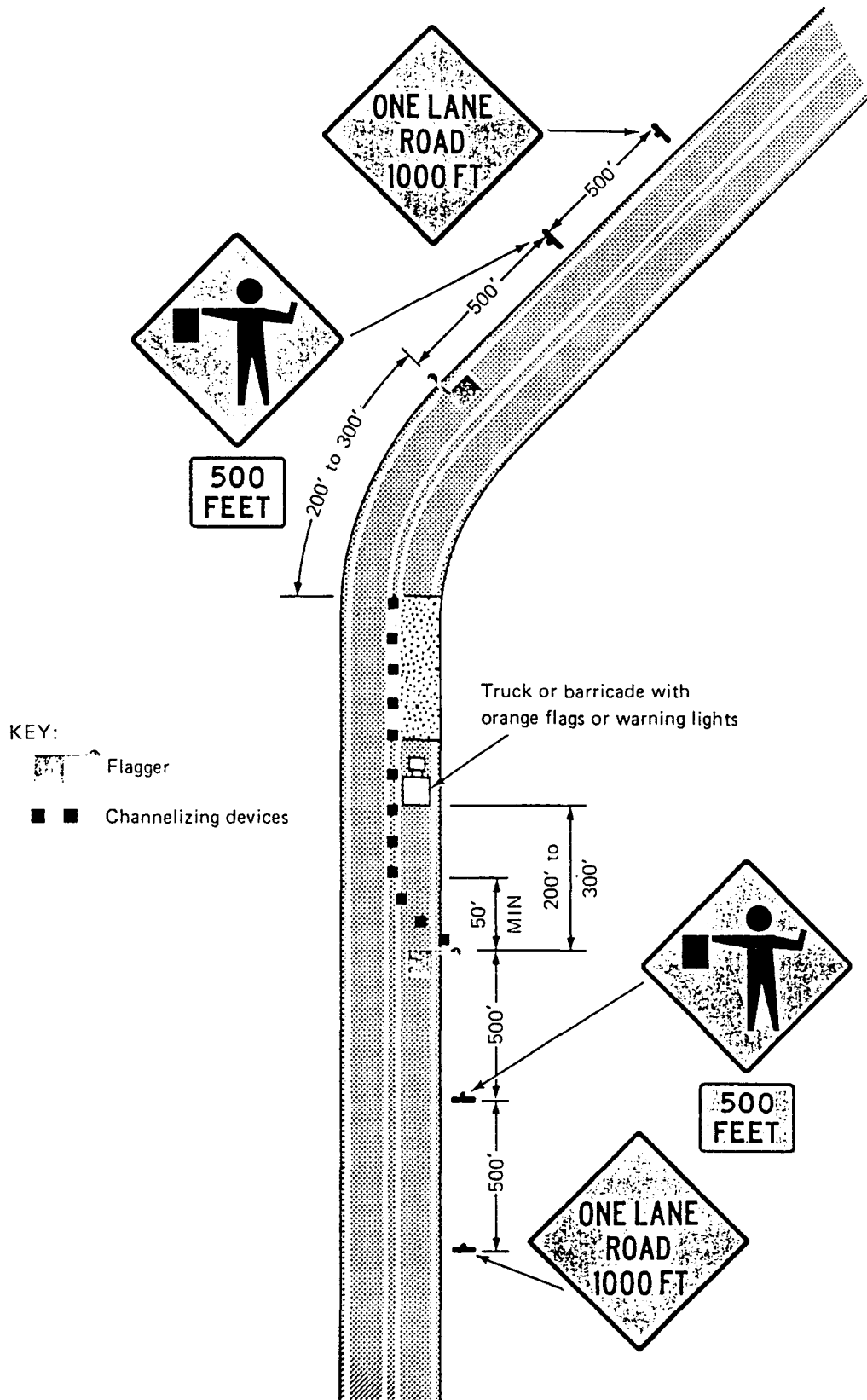
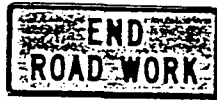


Figure 3.3 Typical Application—Daytime Maintenance Operations of Short Duration on a Two-lane Roadway and Flagging is provided (MUTCD, Figure 6-6)



NOTES:

1. Flashing warning lights and/or flags may be used to call attention to the advance warning signs and/or equipment.
2. All distances and spacings shown are approximate.
3. The word UTILITY may be substituted for ROAD in all signs where applicable.
4. Taper Formula:
 $L = S \times W$ for speeds of 45 or more.
 $L = WS^2 / 60$ for speeds of 40 or less.
5. The maximum spacing between channelizing devices in a taper should be approximately equal in feet to the speed limit.
6. One or more flaggers to be used where traffic, road conditions, or terrain warrant their use.



KEY:

- Channelizing devices
- ⚡ Flagger

Posted Speed or 85% Speed (MPH)	X Min. Distance (feet)
30 or less	80
35	120
40	160
45	240
50	320
55	500

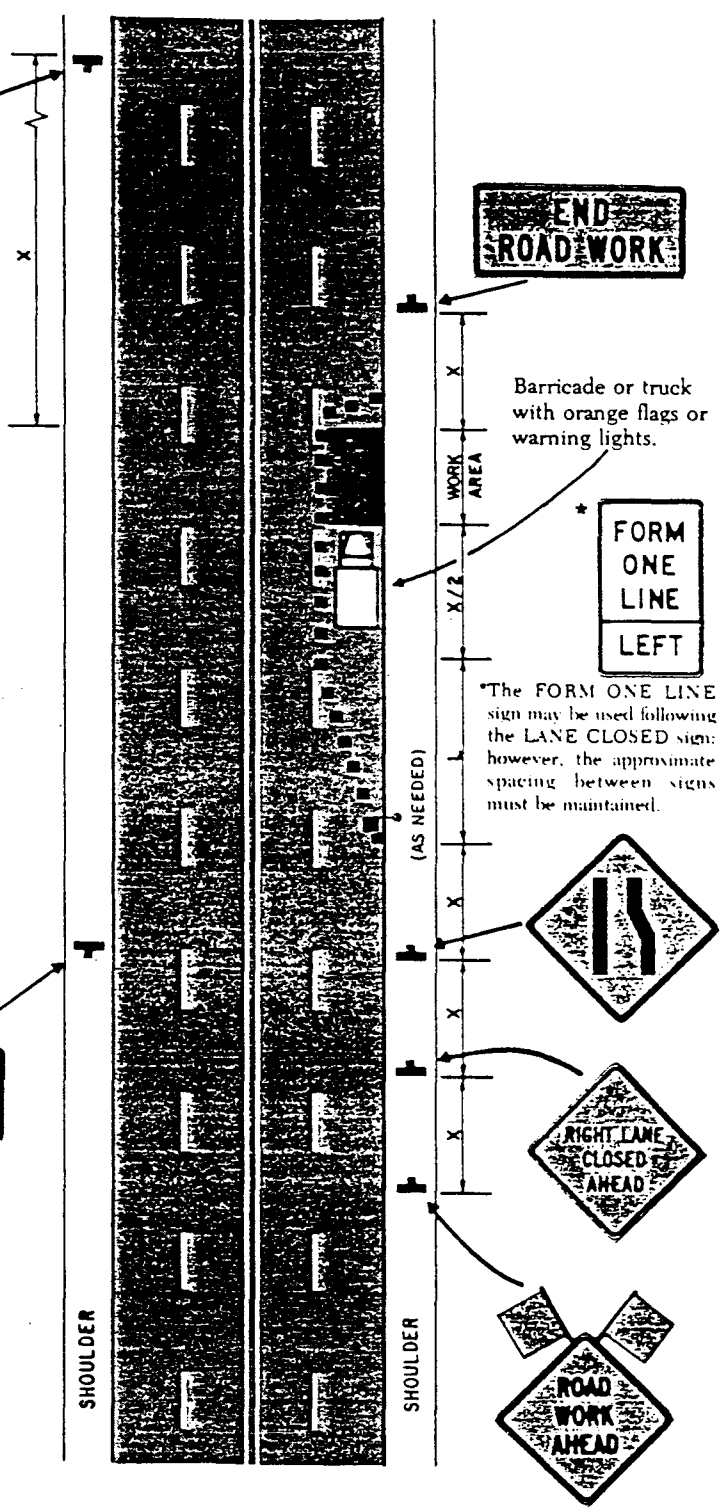


Figure 3.4 Typical Application—Minor Operation on Undivided 4-Lane Roadway Where One Lane Is Closed.

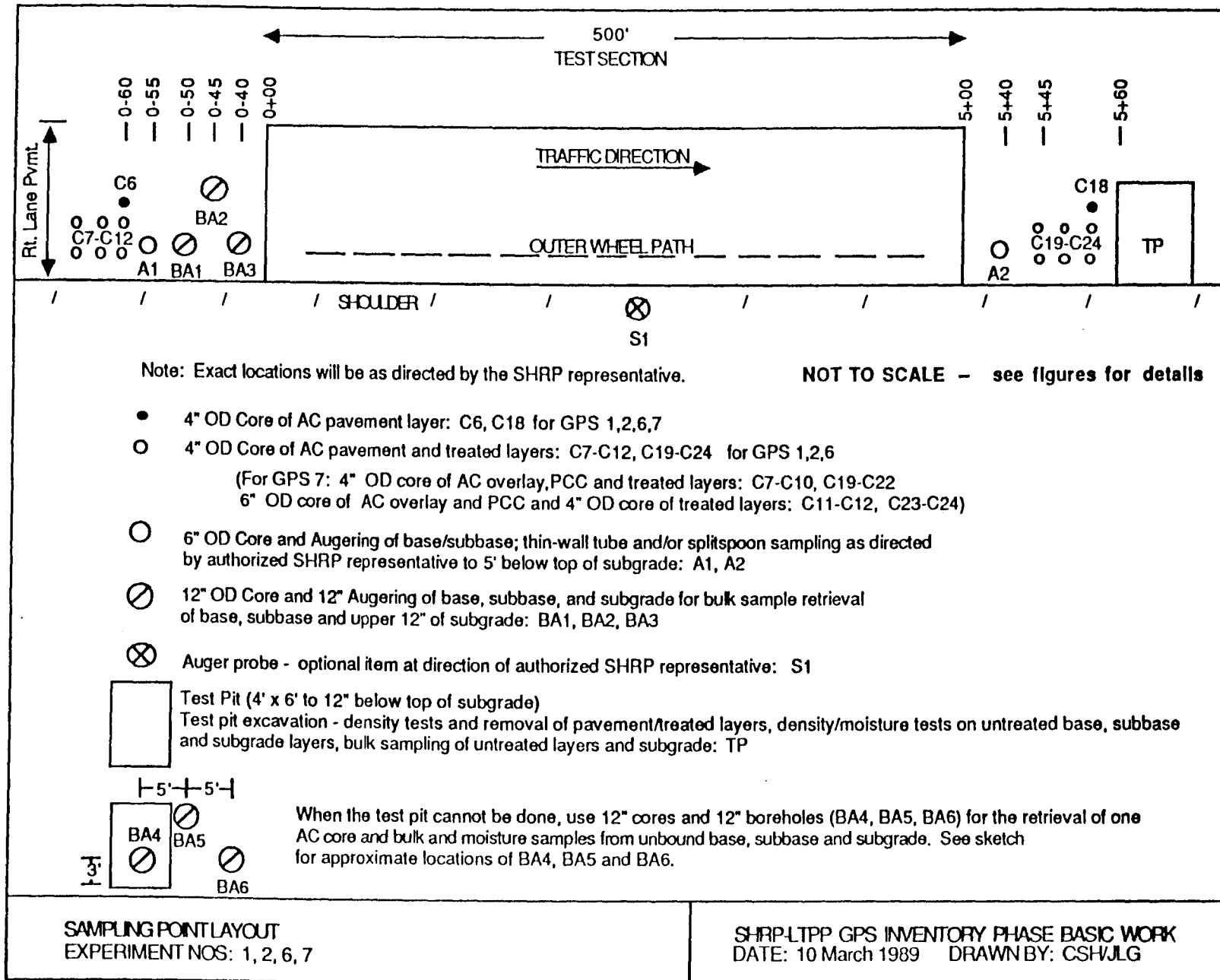
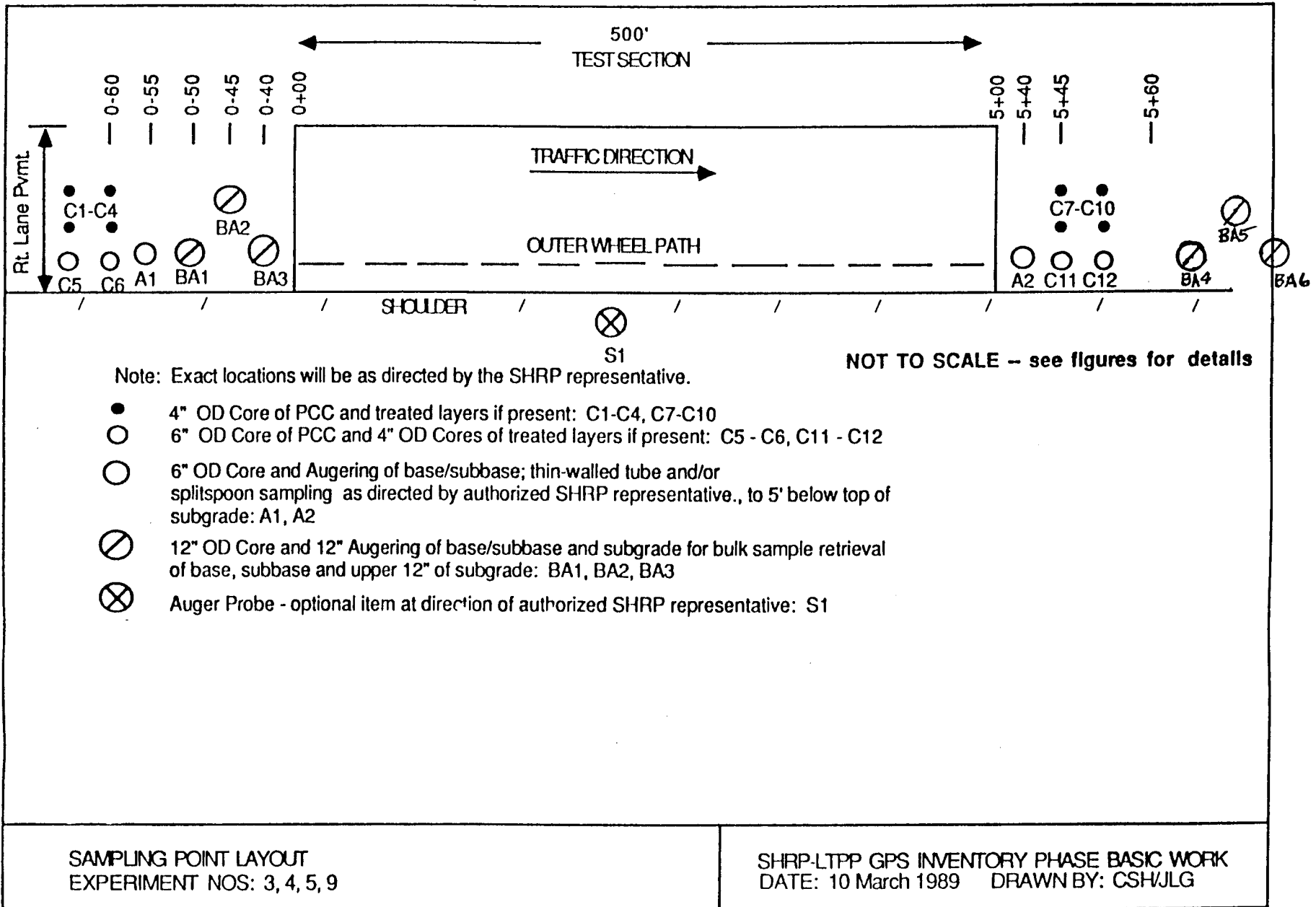


Figure 4.j. Typical Sampling Point Layout for GPS Designs 1, 2, 6, 7.



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Figure 4.2 Typical Sampling Layout for GPS Designs 3, 4, 5, 9

4. Sampling Requirements

The sampling requirements for asphalt surfaced pavements are shown in Figure 4-1 and for concrete surfaced pavements in Figure 4-2.

Four-inch diameter asphalt cores, and 6-inch diameter concrete cores are needed for laboratory materials tests. Shelby tube samples (or split-spoon samples if "undisturbed" samples cannot be obtained) of the subgrade are obtained through two of the 6-inch core holes. Bulk samples of the base, subbase, and subgrade are obtained by auger from the 12-inch diameter core holes on one end and the test pit on the other end (AC pavements only). A bulk sample of asphalt concrete for extractions is also obtained from the test pit. The test pit for AC pavements is very important because it offers the only opportunity for in situ density testing.

For PCC pavements, no test pit is excavated. Instead, three 12-inch diameter core holes are used for bulk sampling on both ends.

5. Test Pit Requirements

The 4-ft.x6-ft. test pit for AC pavements is located about 60 feet beyond the "leave" end of the test section. The 6-foot dimension is one half of the lane width and the 4-foot dimension is in the direction of traffic. The equipment needed for this task includes a "concrete saw" with a 24-inch diameter diamond blade (minimum), a compressor and jack hammer, a tractor-mounted backhoe with front end loader, a dump truck, plus hand tools (spade, pick-axe, etc.).

Deflection testing is carried out in the test pit area before sawing begins. Sawing operations in asphalt includes cutting one 12-in.x12-in. block for the laboratory. The pavement slab is carefully removed to expose an undisturbed base layer which is tested for nuclear density and moisture. Bulk samples are then taken. Underlying subbase and subgrade layers are similarly tested and sampled.

6. Example of a Typical Day of Material Sampling and Field Testing

A diagram of time required for various tasks appears in Figure 6-1. Beginning as soon as traffic control is in place, the deflection testing is first conducted at the locations of the 12-inch cores and the test pit.

Sawing for the test pit and coring operations begin as soon as the FWD clears a location. The truck drill rig takes out a 12-inch core of the pavement, then uses a 12-inch auger to obtain bulk samples of the base, subbase and subgrade. This

procedure is repeated twice for a total of three 12-inch holes outside the "approach end" of the test section (and also the "leave end" for PCC pavements). The core rig takes out a 6-inch core, (A1) then 4-inch and 6-inch cores at the "approach end" sampling area (see Figure 3-1) before moving down to the "leave end" sampling area to take out one 6-inch core (A2) and whatever other 4-inch and 6-inch cores are required. The drill rig takes Shelby tube samples (or split-spoon if "undisturbed" samples are not possible) of the subgrade through core holes A1 and A2.

The drill rig will, on instructions from the SHRP representative, extend a 4-inch auger probe down to 20 feet to explore for depth of bed rock (needed to correct FWD calculations). See Figures 4.1 and 4.2 for location of "S1" on the shoulder. The coring, and sampling operations take about 4 to 4½ hours, and are completed by 1:00 p.m. The sawing of the test pit area may take about 1 hour.

Surface preparation of the exposed base course is needed for the nuclear density test, and this may or may not require a thin "skim" of fine Ottawa sand to fill small depressions. Clean up of the site using the front-end loader takes about 1/2 hour.

The test pit operations may take as little as 3 hours, but are shown in this example as taking 6 hours. Experience to date, indicates that total time for all operations ranges from around 5 to 7 hours, depending on type of pavement.

7. Falling Weight Deflectometer (FWD)

The FWD simulates a loaded wheel moving over the pavement by employing a cushioned impact on the pavement due to a falling weight. The magnitude of the load (falling weight) will be varied to represent a range of wheel loads from approximately 6,000 to 16,000 pounds. The deflection responses of the pavement to these loads are measured at the center of the load and at six other locations to record the deflection basin. Analysis of the pavement response measurements results in a set of layer moduli.

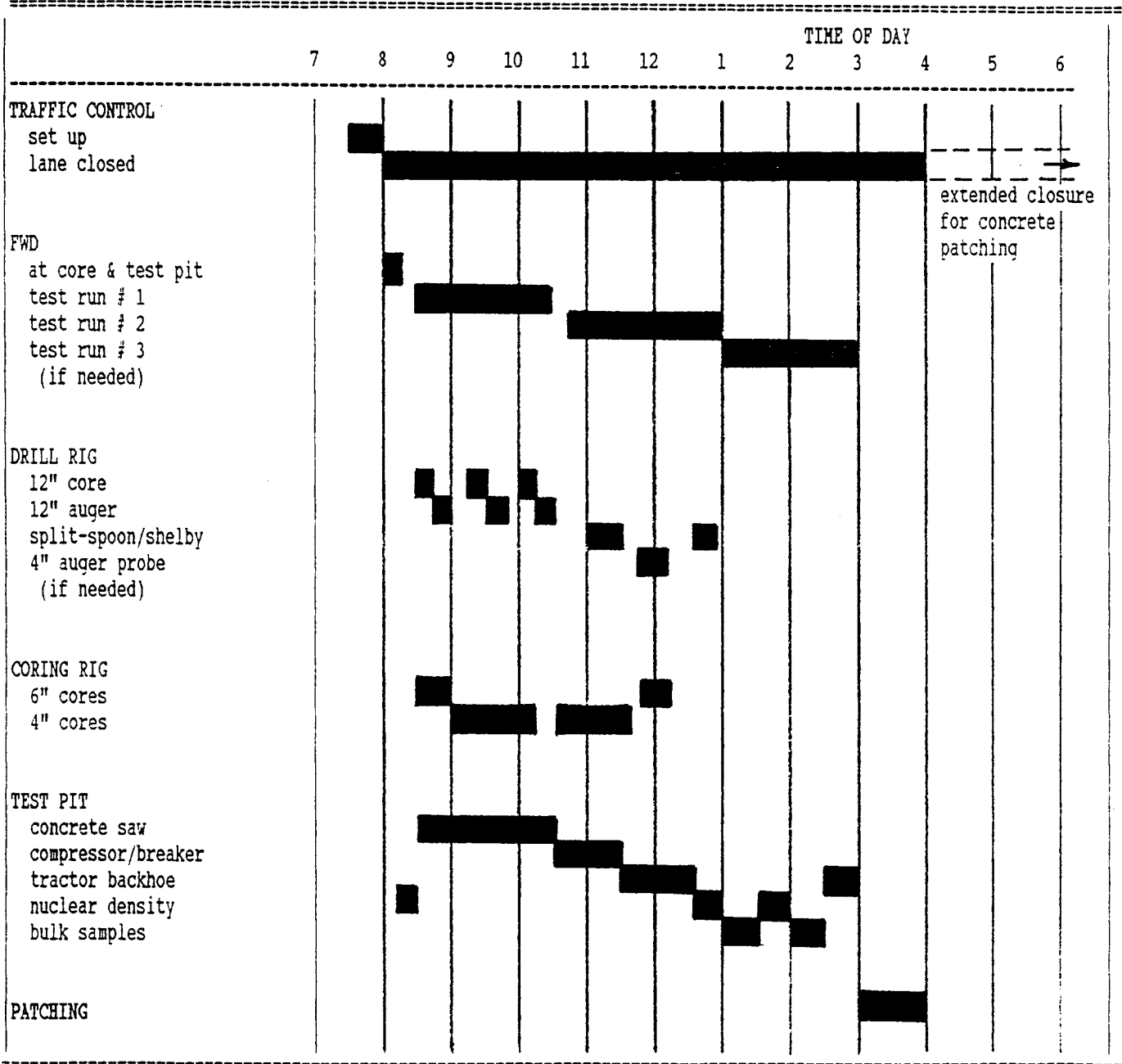
The pavement response is measured at many different locations on the pavement, mid-lane, pavement edge, at and across cracks and joints, etc. A sequence of four loads is used at each test point, and testing time at any test point varies from about 3 to 6 minutes, depending on the repeat testing needed to acquire acceptable results. The number of test points for a test section varies with type of pavement.

As illustrated in Figure 6-1, the FWD first tests the locations where the 12-inch auger samples and the test pit sample are to be taken, then proceeds into the test section to test the 500-foot test section itself.

FIGURE 6-1

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 JANUARY 1989

EXAMPLE OF TYPICAL DAY OF CORING,
 SAMPLING AND FIELD TESTING FOR GPS



8. Patching

Patching is required for the 4, 6 and 12-inch core holes, and the test pit. The 4 and 6-inch holes are generally just the thickness of the pavement surface, except where subgrade samples are taken. The 12-inch holes extend into the subgrade. The test pit tapers down from 4-ft.x6-ft. at the surface to about 4-ft.x4-ft. at the subgrade level.

Samples taken from the base, subbase, and subgrade may total about 1,000 pounds. Material from cores may total about 750 pounds. The 4-ft.x6-ft. test pit slab could weigh 2,600 pounds. Material requirements for patching is of the order of two tons.

The patching strategy in terms of materials to be used, when it is to be accomplished, and when the lane is to be opened to traffic is entirely up to the SHA staff involved.

9. Coordination Activities

Coordination begins with telephone contacts between the SRCO and the SHA's involved. This is followed by a meeting at the SHA offices, generally a minimum of 30 days prior to initiation of MS&FT. This meeting will generally be attended by representatives of the Southern Region Coordination Office and the State Highway Agency. Subjects to be discussed include safety planning, scheduling, traffic control requirements, test pit excavations, patching, and other such topics concerning the MS&FT operations. SHA personnel representing these interests are encouraged to attend.

SHRP believes that bulk and in situ density testing and sampling of base, subbase, and subgrade materials for testing is important to the success of the LTPP studies, especially for flexible pavements. However, the pavements belong to the SHA's and they may permit test pits or deny them on specific types of pavements. SHRP also has asked that the SHA's consider undertaking the excavation of the test pits as the anticipated cost for material sampling and testing exceeds the funds budgeted. Some SHA's have stated a preference for doing it themselves and others may or may not wish to. If they do not, it will be accomplished by contract. These decisions on test pits need to be made as soon as possible for planning purposes.

It is planned that the state traffic control forces, the state crew for test pit excavation and their equipment (when the SHA elects to excavate the test pits), the Law or SWL field crew and their equipment, and the FWD with operator will all meet with the SRCO drilling supervisor at a particular site at a

prearranged time, ready to start work. During early to mid-afternoon, a state maintenance crew will generally arrive with materials to patch core holes and the test pit.

The coordination of these 5 sets of field crews and their equipment should not present problems for the first few sites. However, as equipment malfunctions and weather delays accumulate, as they will inevitably, coordination is sure to become more complex. Close communication between all concerned will be critical to the achievement of a smooth efficient operation.

10. Contacts and Phone Numbers

Southern Regional Engineer

Homer Wheeler	Austin, TX	(512) 346-7477
		FAX (512) 346-8750

Southern Region Coordination Office (SRCO) - SHRP Site Representative

Brent Rauhut	Austin, TX	(512) 346-0870
Program Manager		FAX (512) 346-8750

Steve Davis	Austin, TX	(512) 346-0870
Drilling Supervisor		FAX (512) 346-8750

Law Engineering, Inc. (East of Mississippi River)

W.C. Greer	Atlanta, GA	(404) 873-4761
Principal Investigator		FAX (404) 881-0508

Mike Wilson	Atlanta, GA	(404) 873-4761
Crew Chief		FAX (404) 881-0508

Southwestern Laboratories (West of Mississippi River)

Fred Martinez	Houston, TX	(713) 696-6288
Co-Principal Investigator		FAX (713) 692-5128

L.B. Wurtenbach	Houston, TX	(713) 692-9151
Crew Chief		FAX (713) 692-5128

State Contacts

Figure 10-1 shows an example of a form which will be used to secure the names and telephone numbers of traffic control crew representatives together with location descriptions of the yards they operate from. These lists are to be developed by states within the next few months.

FIGURE 10-1 EXAMPLE
TRAFFIC CONTROL CONTACTS

SHRP-LTPP COORDINATION FOR
MATERIALS SAMPLING AND FIELD TESTING

STATE: Florida
LTPP STATE CONTACT: Mr. W.G. Miley
TEL: (904) 372-5304

<u>TYPE</u>	<u>SHRP I.D.</u>	<u>HWY. #</u>	<u>LOCATION OF TEST SECTION</u>	<u>NAME, DIST. # AND TEL. #</u>	<u>YARD LOCATION</u>	<u>PLANNED DATES</u>
JPCP	123997	US17SB	4.25 Mi. S. of Doctors Lake, 3 Mile N. of Black Creek, Between Orange Park and Green Cove Springs	John Doe District 2 (xxx)xxx-xxxx	Jacksonville, FL	10-2-89
AC/GB	121370	SR407NB	3 Mi. N. of Interchange with Beeline Exprwy. and 1.1 Mi. S. of Interchange with IH 95	Joe Smith District 5 (xxx)xxx-xxxx	Orlando, FL	10-4-89
AC/GB	121030	US1SB	3.8 Mi. S. of Junction with AIA and 1.75 Mi. North of Palm Beach/Martin County Line, Adjacent to Jonathan Dickenson State Park	Dave Who District 4 (xxx)xxx-xxxx	Fort Pierce, FL	10-5-89
JPCP	123995	IH95NB	600' N. of 1st Overhead Sign for Woolbright Rd. and 400' N. of a Canal Bridge	Who Can District 4 (xxx)xxx-xxxx	Delray, FL	10-6-89
AC/GB	121060	SH878WB	1.4 Mi. E. of S. Dade Exprwy. (SR 874) and 0.4 Mi. W. of Palmetto Exprwy. (SR 826)	A. Person District 6 (xxx)xxx-xxxx	Miami, FL	10-9-89