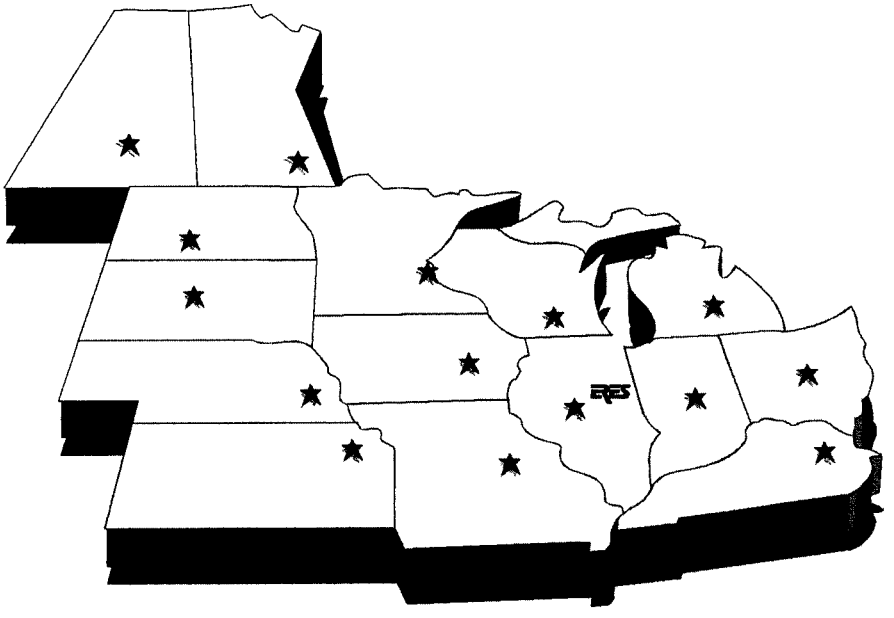
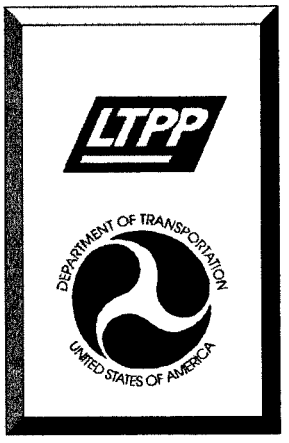
Construction Report for Wisconsin SPS-1

DTFH61-96-C-00013

March 7, 2000





Submitted by

ERES CONSULTANTS
A Division of Applied Research Associates Inc

SPS-1 Construction Report
STH 29, Westbound
Marathon County, Wisconsin
0.5 Miles East of Hatley, Wisconsin

Sections 550113 to 550124

Federal Highway Administration
LTPP Division
North Central Region

Report Prepared By
Brenda B. Mehnert

ERES Consultants
A Division of Applied Research Associates, Inc
505 West University Ave.
Champaign, Illinois 61820

March 2000

TABLE OF CONTENTS

1 Project Overview

The Strategic Highway Research Program (SHRP) SPS-1 project investigates the effect of the following structural factors on the long-term pavement performance of flexible pavements:

- Surface layer thickness
- Base course thickness
- Base type (material)
- Drainage (permeability)

The study objective includes a determination of the influence of environmental region and soil type on these factors. Accomplishing these objectives will provide substantially improved tools for use in the design and construction of new and reconstructed flexible pavements.

This report summarizes the "as-built" pavement layers of the Wisconsin SPS-1 site that includes 12 SHRP test sections Field tests were performed, and laboratory samples obtained and analyzed, at different stages of construction from each test section. All samples were taken from the outer lane.

1.1 Experiment Cell

This Wisconsin SPS-1 experiment is located in the wet-freeze environmental zone and was constructed on a coarse-grained subgrade. The pavement is being reconstructed, with only enough of the existing pavement removed to accommodate the new pavement structure while maintaining the existing grade. The existing pavement was 7 75 in of asphalt concrete (AC) placed on 9 in of crushed rock base over 10 in of subbase (soil-aggregate mixture, predominantly coarse-grained soil) placed on a silty sand subgrade

1.2 Project Location

The Wisconsin SPS-1 project is located on westbound Wisconsin State Highway 29 (STH-29) in Marathon County, Wisconsin. This site is roughly 0.5 miles east of Hatley, Wisconsin Attachment A is a project location map.

1.3 Project Layout

The Marathon County SPS-1 site incorporates 12 SHRP sections. Attachment B contains the test section layout that summarizes AC thickness and layer descriptions.

1.4 Traffic Characteristics

This four-lane section of STH-29 is classified as a rural arterial Table 1 shows traffic data at the time of construction·

Table 1 Traffic data for Wisconsin SPS-1.

Current average daily traffic (1995)	6150 vehicles
Design year average daily traffic (2015)	7900 vehicles
Design period	20 years
Design hourly volume (2015)	664 vehicles
Truck distribution	29.5%
Directional distribution	50%
Legal speed	70 miles per hour

The test site is located on a 0.4 percent downgrade. The first four test sections are located on a 1-degree horizontal curve The lanes are 12 ft wide with an outside shoulder of 10 ft and an inside shoulder of 6 ft

1.5 Limits of Test Sections

Table 2 shows the limits of the test sections at the SPS-1 site. Each test section includes a monitoring section of 500 ft and 50 ft at each end of the monitoring section to be used as sampling areas.

Table 2. Limits of Wisconsin SPS-1 test sections.

Test Section #	600-ft Test Section		500-ft Monitoring Section	
	Beginning Station	End Station	Beginning Section	End Station
550113	907+50	913+50	908+00	913+00
550116	914+50	920+50	915+00	920+00
550118	924+50	930+50	925+00	930+00
550122	931+50	937+50	932+00	937+00
550120	944+50	950+50	945+00	950+00
550121	951+50	957+50	952+00	957+00
550119	958+50	964+50	959+00	964+00
550124	968+50	974+50	969+00	974+00
550123	975+50	981+50	976+00	981+00
550115	984+50	990+50	985+00	990+00
550117	992+50	998+50	993+00	998+00
550114	999+00	1005+00	999+50	1004+50

1.6 Weather Monitoring

During construction, a site was prepared for a weather monitoring station. This AWS unit was installed in June 1997.

1.7 Traffic Monitoring

A weight-in-motion (WIM) system was installed August 29,1997, to classify all individual axles by wheel in all lanes of this section of State Highway 29 The WIM equipment used in this project was a DAW-100 unit manufactured by PAT, Equipment. Their address is.

1665 Orchard Dr
Chambersburg, Pennsylvania 17201
Phone: (717) 263-7655

The WIM scale (in each lane) consists of two bending plates mounted in the pavement that cover half of each lane. The bending plates in each lane are staggered with an inductance loop for vehicle classification between bending plates The WIM device is located at station 1073+81 in both directions near the intersection of State Highway 29 and County Highway D.

1.8 Personnel

North Central Regional Coordination Office

ERES Consultants, a Division of ARA, Inc.
Tom Wilson
Principal Investigator
505 West University Avenue
Champaign, Illinois 61820 (800) 344-7477

Material Testing

Construction-Geotechnical Consulting Engineering/Testing, Inc (CGC)
3011 Perry St
Madison, WI 53713 (608) 288-4100

University of Wisconsin-Madison, Structures Materials Lab
Peter J. Bosscher and Hussain U Bahia
2210 Engr. Bldg., 14515 Engr Dr.
UW-Madison, WI 53706 (608) 265-4481

Kapur & Associates, Inc
Joel Weber
7711 N. Port Washington Rd.
Milwaukee, WI 53217 (715) 253-3827

American Asphalt of Wisconsin
P O. Box 98
Mosinee, WI 5455-0098 (715) 693-5200

Field Sampling and Testing

Kapur & Associates, Inc
Joel Weber
7711 N. Port Washington Rd.
Milwaukee, WI 53217 (715) 253-3827

Construction Technology Laboratories, Inc
5420 Old Orchard Rd
Skokie, IL 60077-1030 (847) 965-7500

Design Team

Mr Van Walling, PE
CH2M Hill Incorporated
411 East Wisconsin Ave
Suite 1600
Milwaukee, WI 53202 (414) 272-4408

LTPP Design Review

John Miller
PCS/LAW
A Division of Law Engineering and Environmental Services, Inc.
12104 Indian Creek Court, Suite A
Beltsville, Maryland 20705 (301) 210-4105

State Department of Transportation

Scott Schwandt (Nomination form)
Steve Shober, PE (chief pavement & research engineer)
Wisconsin Department of Transportation
3502 Kinsman Blvd.
Madison, WI 53704-2507 (608) 246-5399

Contractors

Tom Pagel
Pagel Construction
1380 Division St.
Almond, WI 54909 (715) 366-2975

Ray Gausmann
Mathy Construction Co.
920 10TH Ave N.
Onalaska, Wisconsin 54650 (608) 783-6411

Mr. Dan Beaudoin
James Cape & Sons, Co., Inc
6422 North Hwy. 31
Racine, WI 53401-1315

1.9 Known Deviations from Guidelines

Attachment E contains project deviation reports filled out during and after construction.

1.10 Summary of Key Construction Equipment

Subgrade Preparation

- push cat
- scrapers
- bulldozers

Dense Graded Aggregate Base and Permeable Asphalt Treated Base Preparation

- Single drum vibrator (8 0-ton)
- Asphalt concrete drum mix plant
- Blaw-Knox (model PF-172) paver
- Base trimmer

Asphalt Concrete Pavement and Asphalt Treated Base Layer Placement

- Blaw-Knox (model PF-172) paver
- 10 0-ton steel wheel tandem roller
- 25.0-ton pneumatic rubber-tired roller at 90 psi
- 11.5-ton single drum vibrator (2600 vibr./min)
- Asphalt concrete drum mix plant

2 Project Details

Project meetings were held on site weekly from the initial meeting, May 1997, through the end of construction, November 1997. These meetings were attended by representatives from the contractor, sub-contractors, LTPP, and Wisconsin DOT and were an effective way of communicating changes or delays

2.1 Design Features

Table 3 summarizes the asphalt and base layer thickness for each section. Edge drains were located in half of the sections

Table 3. Summary of material thickness and edge drains for each section.

Test Section Number	AC Thickness (in) (Surface)	Material and Thickness (in) (Base 1)	Material and Thickness (in) (Base 2)	Edge Drains
550113	4	DGAB 8	-	No
550116	4	ATB 12	-	No
550118	4	ATB 8	DGAB 4	No
550122	4	ATB 4	PATB 4	Yes
550120	4	PATB 4	DGAB 8	Yes
550121	4	PATB 4	DGAB 12	Yes
550119	7	PATB 4	DGAB 4	Yes
550124	7	ATB 12	PATB 4	Yes
550123	7	ATB 8	PATB 4	Yes
550115	7	ATB 8	-	No
550117	7	ATB 4	DGAB 4	No
550114	7	DGAB 12	-	No

NOTE:
AC – Asphalt Concrete
DGAB – Dense Graded Aggregate Base
ATB – Asphalt Treated Base
PATB – Permeable Asphalt Treated Base

2.2 Material Sampling and Testing

Locations of material sampling and field testing for each layer are given in attachment C. LTPP sampling field testing procedures have been developed specifically for the SHRP program, and all activities were performed in accordance with these guidelines unless noted in attachment E Samples for laboratory testing were sent to C G.C., James Cape & Sons Co., Inc., the University of Wisconsin, Madison, and the Wisconsin Department of Transportation. Samples for long-term storage were obtained from the asphalt concrete base layers.

Samples for Long-Term Storage

- Samples of the different types of asphalt cement used for asphalt-based layers.
- Bulk samples of the graded course and fine aggregate used for all asphalt-based layers except the permeable asphalt treated base (ATB).
- Bulk samples of the uncompacted mix from all asphalt-based layers.

2.3 Construction Activities

Before removing the existing pavement, Falling Weight Deflectometer (FWD) tests were performed over the sections. This test provided proof of the relative strength of the subgrade. Removal of the existing pavement for this project began in early July 1997. Subgrade preparation followed shortly thereafter. Paving operations were completed by mid-October 1997. When sampling using shelby tubes, remnants of old PCC pavement were found in the subgrade. PCC slabs were removed and subgrade was reworked to bring it back to the required elevation. Figure 1 shows a backhoe removing the existing pavement.

Figure 1. Asphalt removal process using backhoe.

2.4 Subgrade Preparation

Scrapers, bulldozers, and push cats were used to compact the subgrade. For the sections requiring fill (550113, 550116 and 550114), the lift thickness was typically 8 in. All other sections required cutting.

2.5 Placement of Base Layers

Dense Graded Aggregate Base (DGAB) Placement

Preparation of the DGAB layer was performed in August 1997. An 8-ton single drum vibrator roller was used for compaction. Lift thickness ranged from 4 to 6 in, depending on the desired thickness of the layer. When a 12 in DGAB was desired, two lifts of 6 in were typically used. A base trimmer was used to maintain the desired elevation and to trim the excess off the top of the DGAB as shown in figure 2.

Figure 2. Dense graded aggregate base trimmed using base trimmer.

Permeable Asphalt Treated Base (PATB) and Asphalt Treated Base (ATB)

The asphalt for the PATB and the ATB was obtained from the Mosinee Drum Mix Plant located 22 miles (30 minutes) from the site. The PATB and ATB layers were paved using a Blaw-Knox model PF-172 paver, as shown in figure 3, with a single pass laydown width of 12.0 ft.

To allow for greater permeability, the PATB was typically 4 in thick. No information regarding compaction of the PATB layer was provided. The ATB layer was typically 4 to 8 in thick. Figure 4 shows the sequence and the difference between the PATB and the ATB. Compaction was obtained using a 10-ton steel wheel tandem and an 11.5-ton single-drum vibrator with a 2600 vibration/minute frequency.

Figure 3. PATB layed using Blaw Knox (PF-172) paver.

Figure 4. ATB over PATB.

2.6 Geotextile Fabric

In sections 550122, 550124, and 550123--where the PATB layer was located directly above the subgrade--a woven geotextile fabric was placed immediately below the PATB. This geotextile conformed to ASTM D4354 and was installed according to the manufacturer's specifications. Figure 5 shows the geotextile fabric and the overlap between the 2 lanes.

Figure 5. Layout of woven geotextile.

2.7 Asphalt Paving

Two asphalt concrete mixes are used in these test sections, the Type HV binder (intermediate) course and Type HV surface course. The Mosinee Drum Mix Plant produced the hot mix asphalt concrete (dense graded) for this site. Placement of the asphalt concrete was performed with a Blaw-Knox, model PF-172, paver. The mean laydown temperature of the asphalt was 274°F.

The AC binder course was placed before the final AC surface. A minimum compacted thickness of 2.3 in was maintained for the AC binder, and no intermediate compaction was performed on this layer.

Typically, for the AC surface layers, breakdown compaction was performed with three passes of an 11.5-ton single drum vibrator. Three passes with a pneumatic-tired roller at 90 psi were used for the intermediate compaction. Lastly, a 10.0-ton steel-wheel tandem roller made the final three passes.

Attachment A

Project Location

Wisconsin (55)

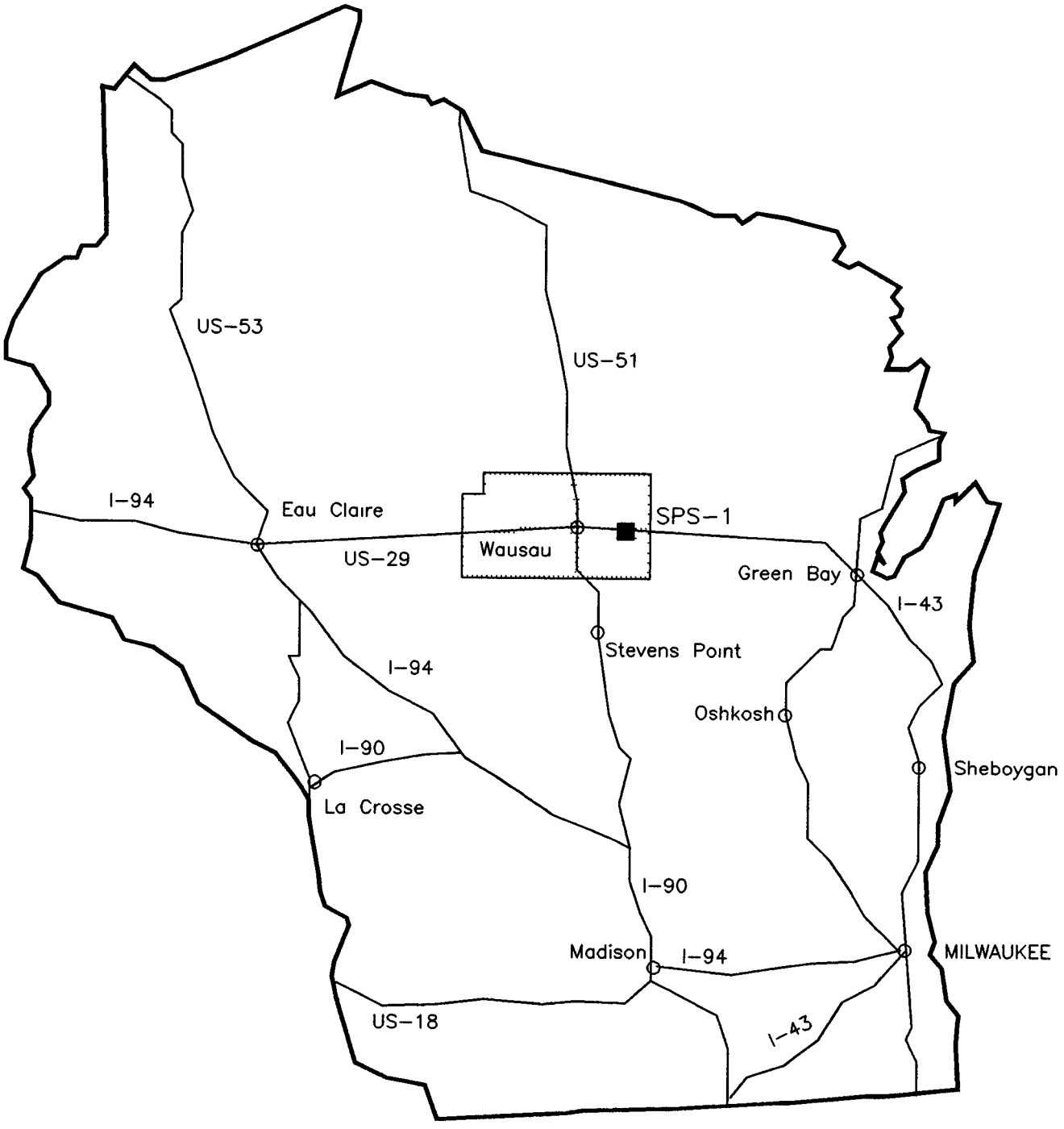


Figure A–1. General project location.

Attachment B

Site Layout

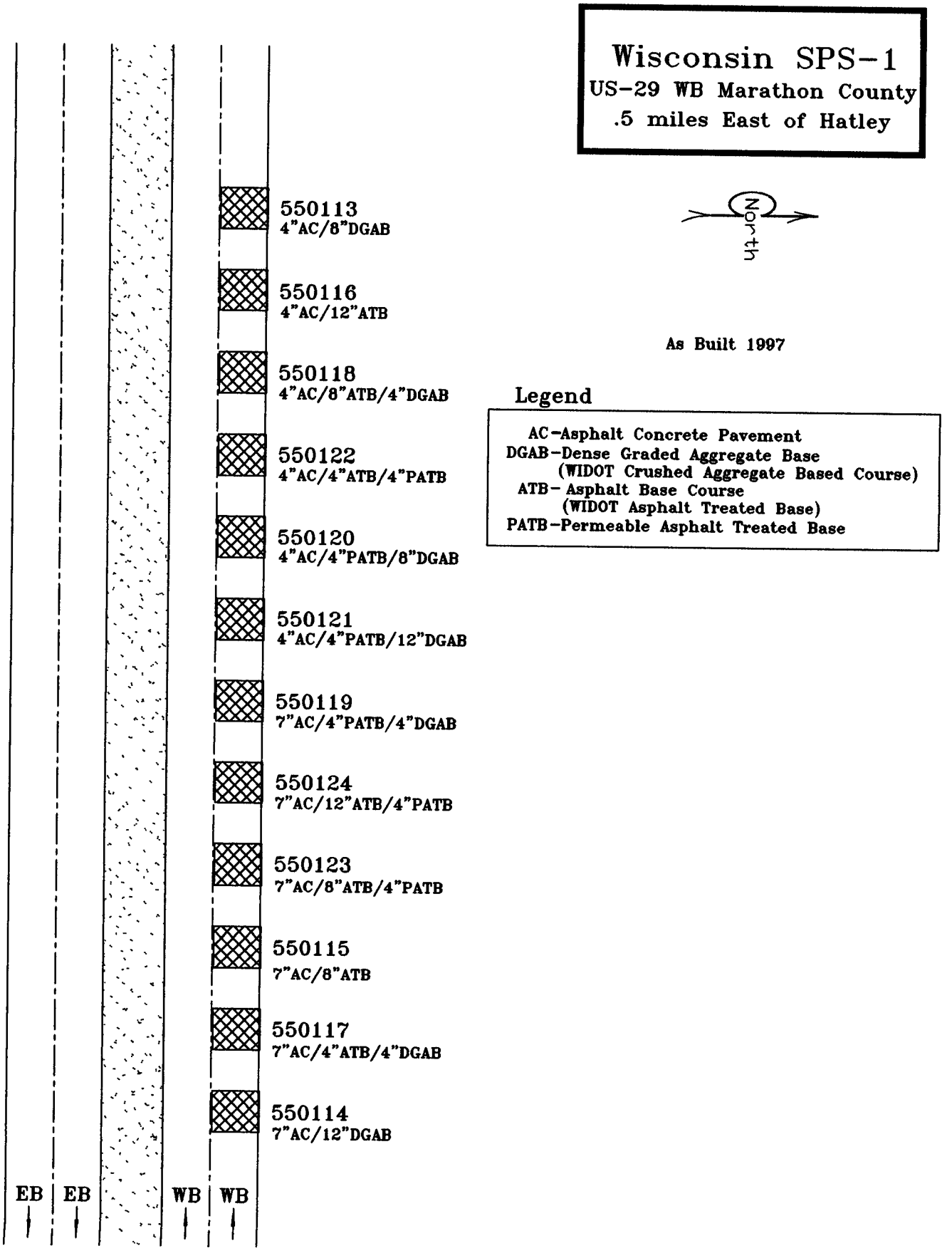


Figure B-1. Wisconsin SPS-1 site layout.

Attachment C

Material Sampling and Testing Plan

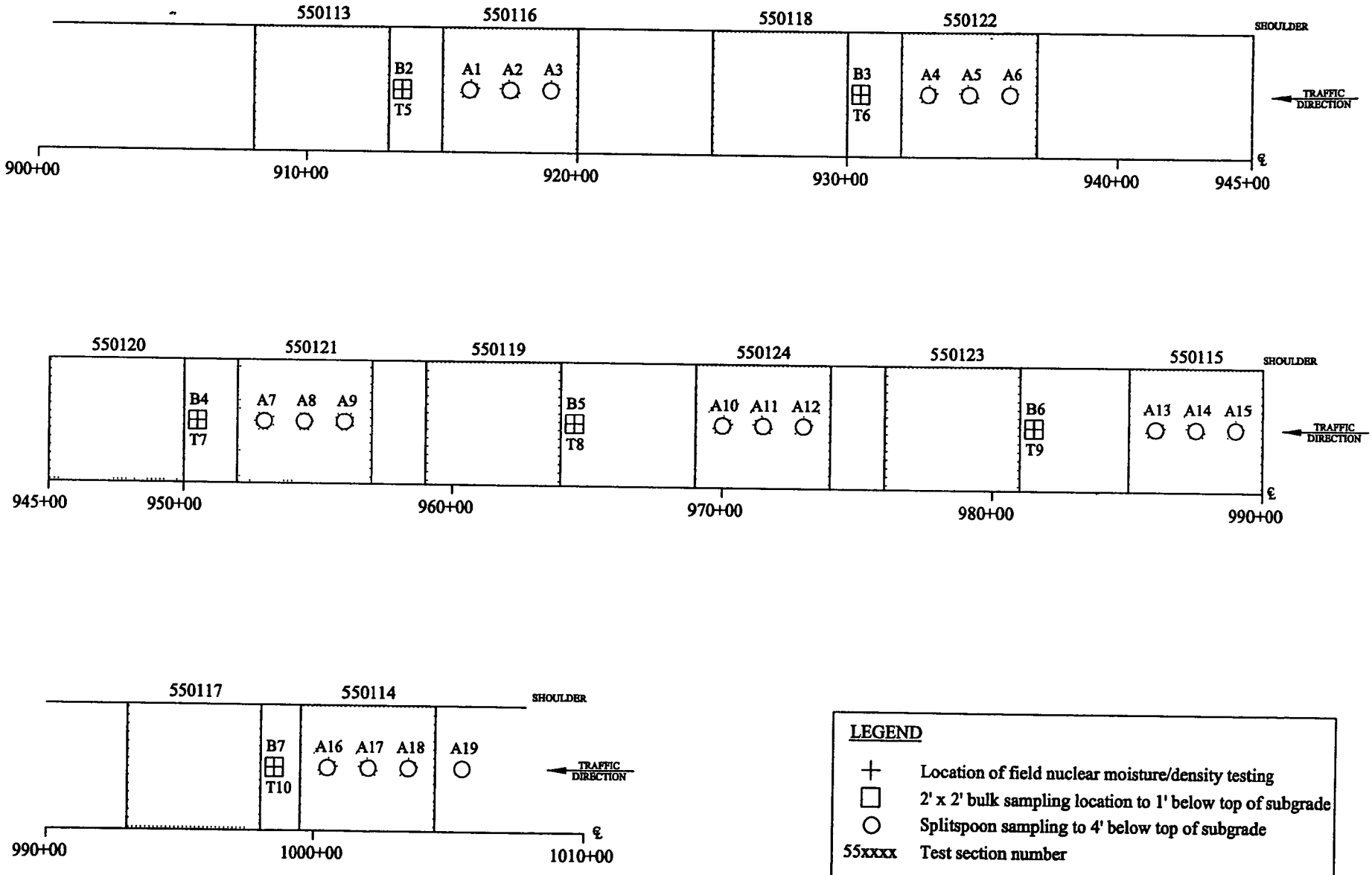


Figure C-1. Sampling and testing locations on the subgrade.

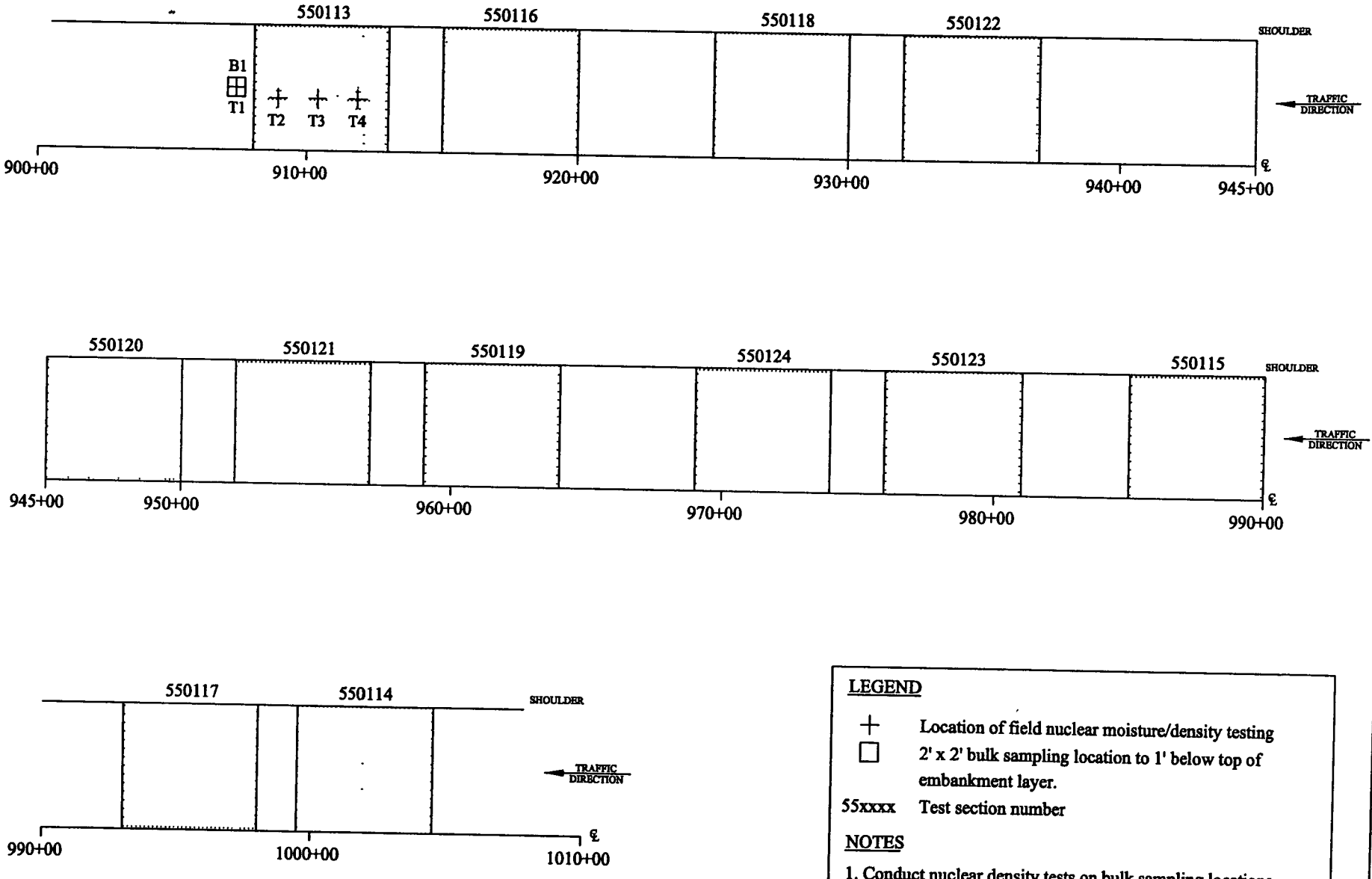


Figure C-2. Sampling and testing locations on the embankment (fill).

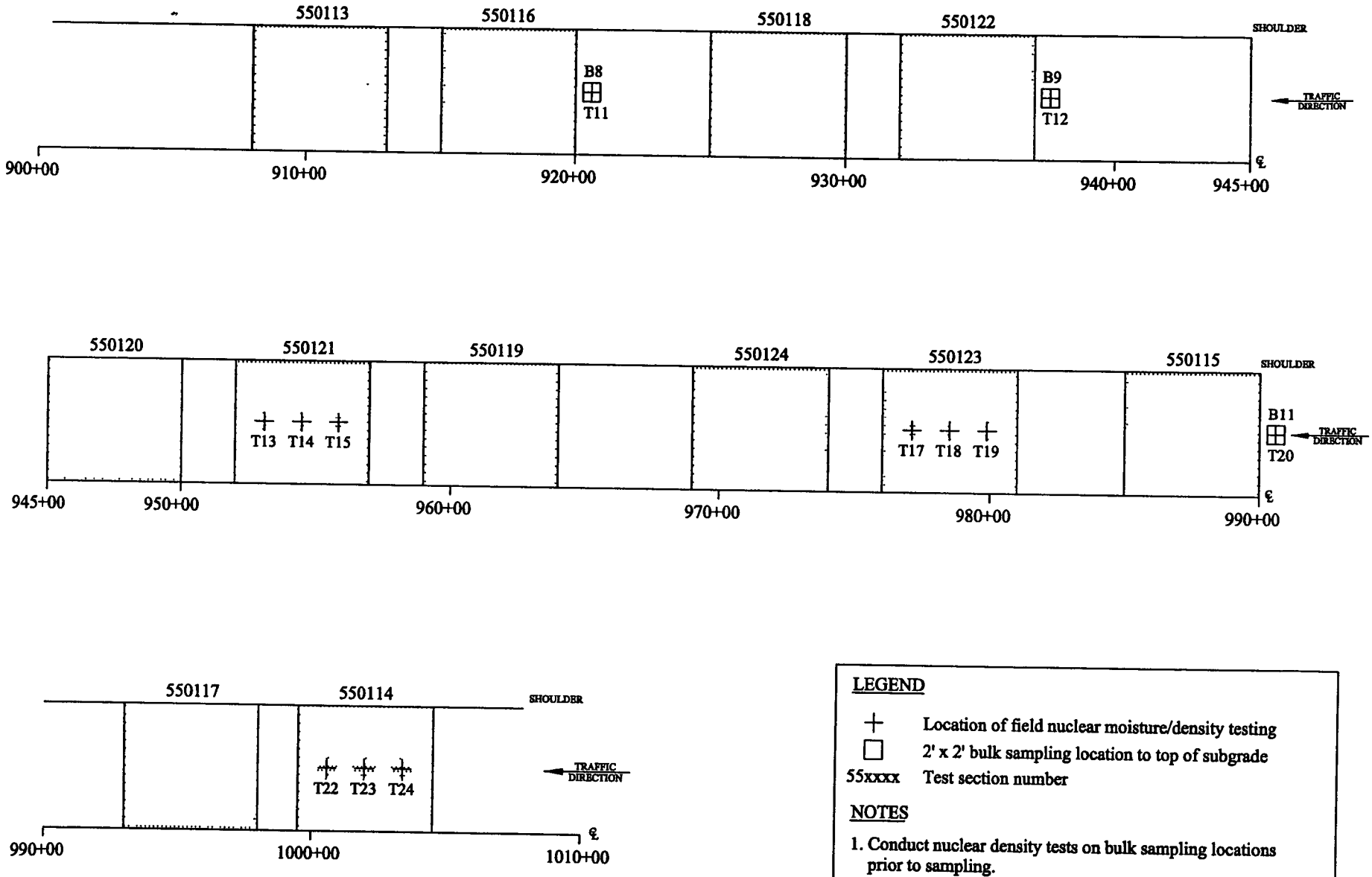


Figure C-3. Sampling and testing locations on the existing subbase.

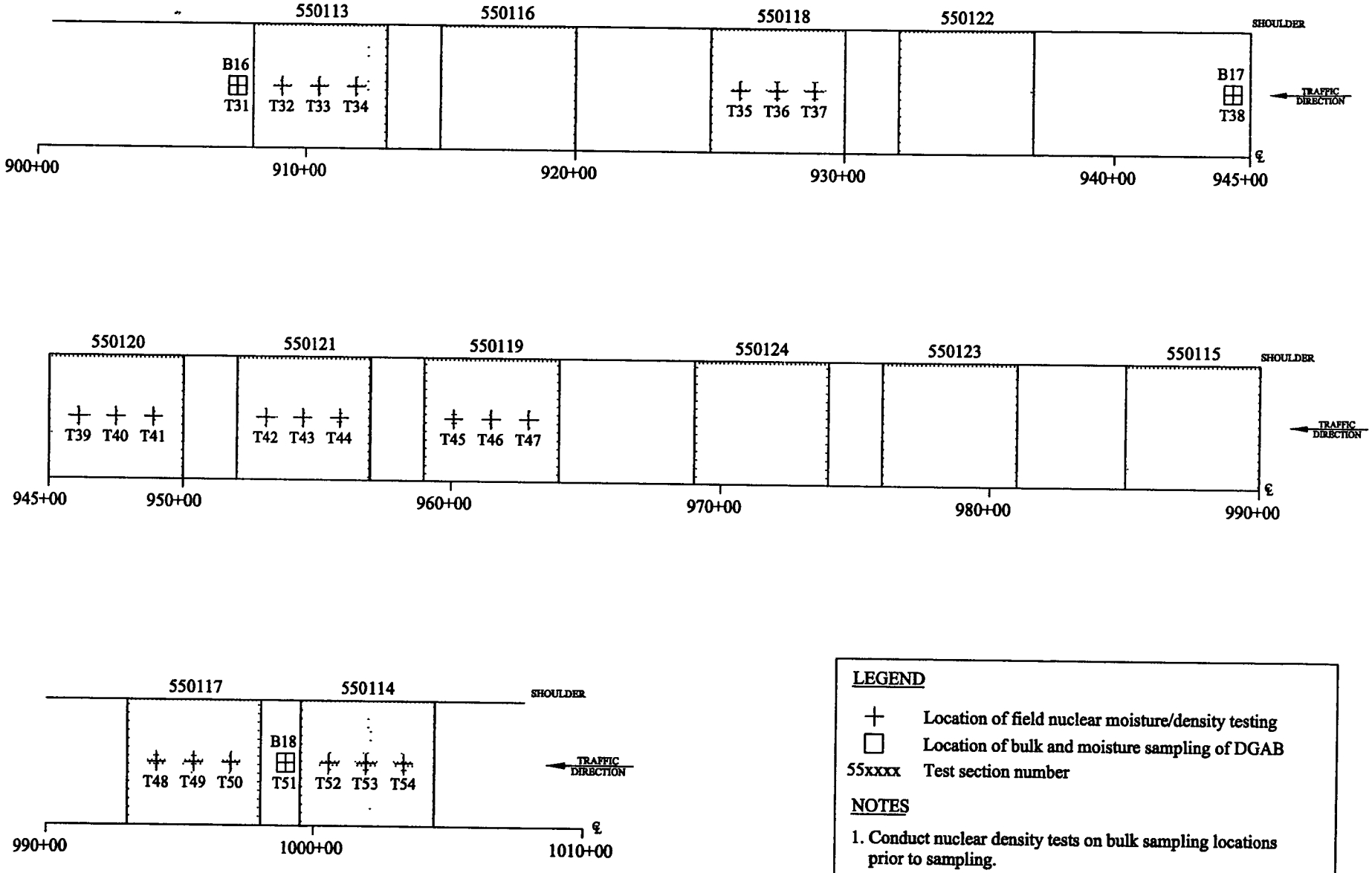


Figure C-4. Sampling and testing locations on the aggregate base.

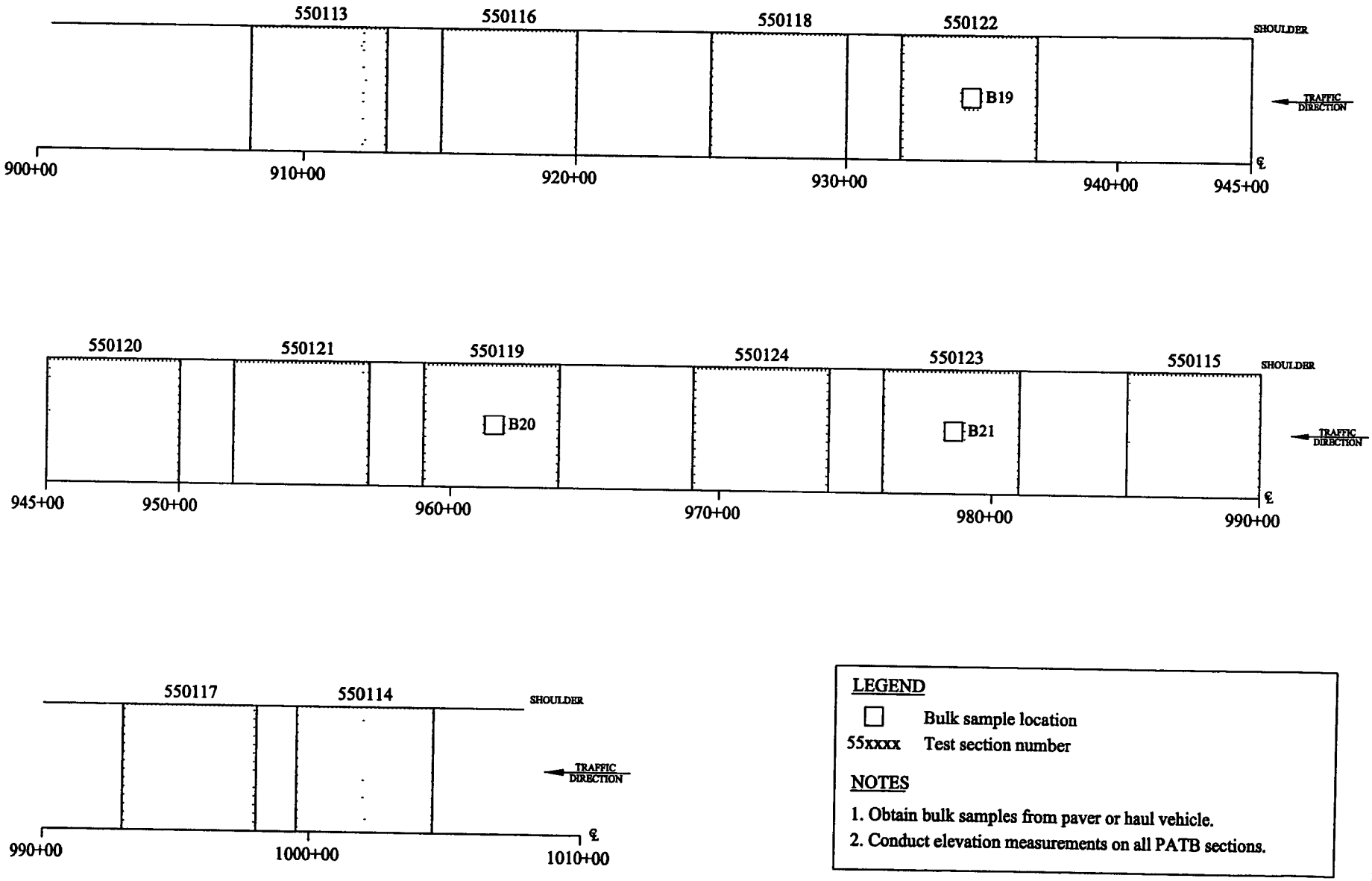


Figure C-5. Sampling and testing locations on the permeable asphalt treated base.

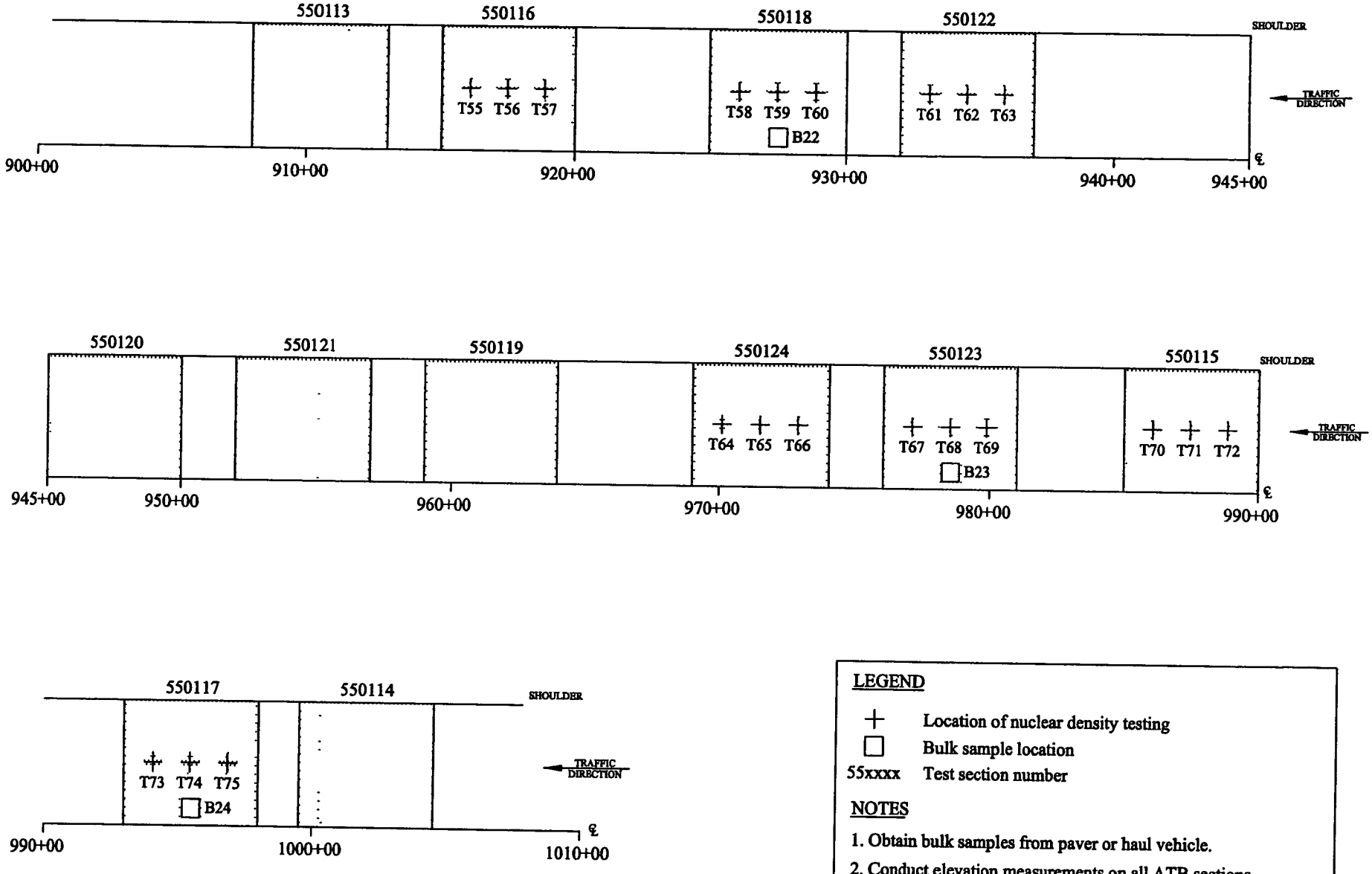


Figure C-6. Sampling and testing locations on the asphalt treated base.

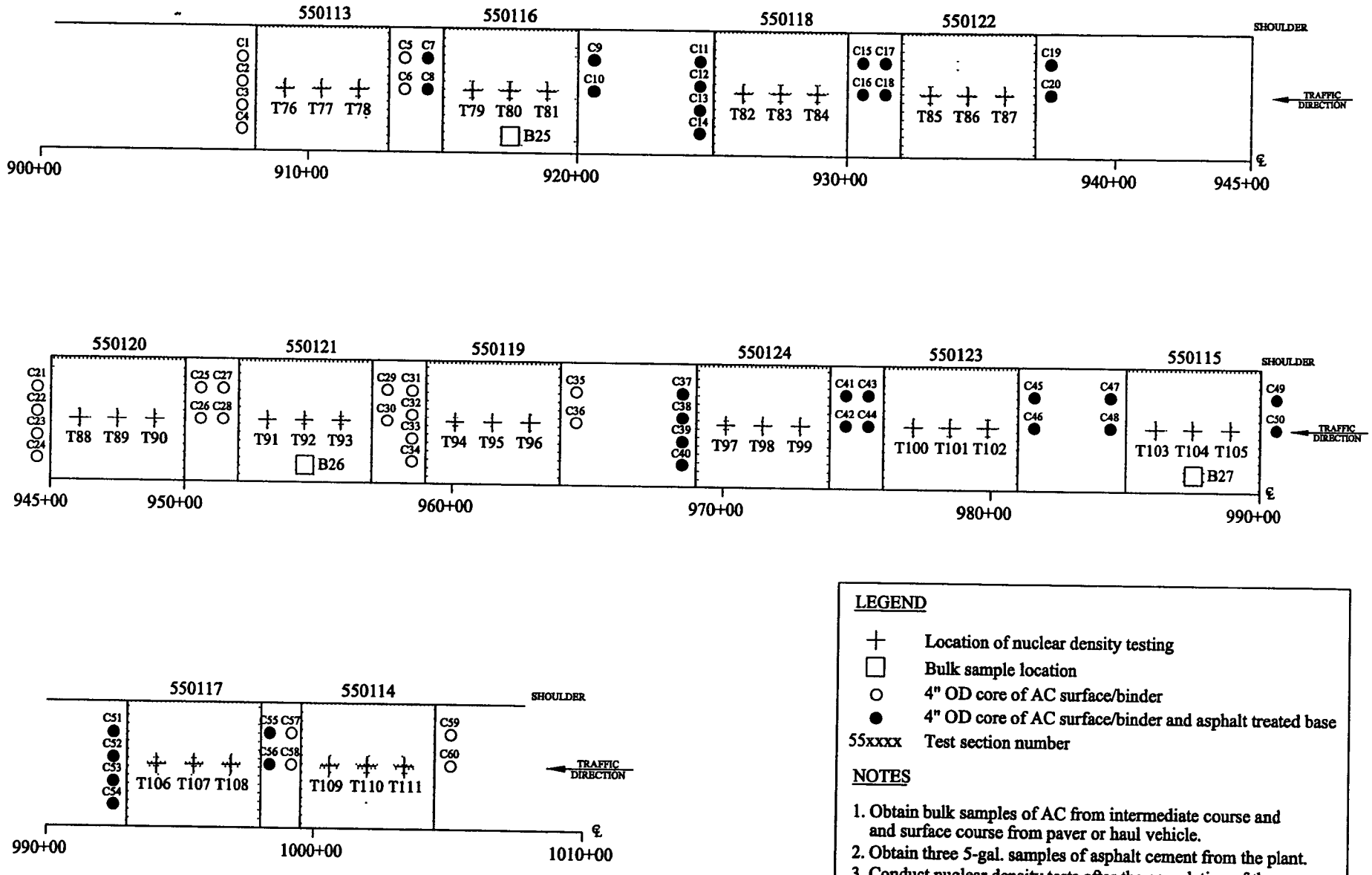


Figure C-7. Sampling and testing locations on the asphalt concrete surface.

Attachment D

Layer Description and Thickness for Each Section

Table D-1. Material Codes

Material Code	Material Description
74	Woven Geotextile
201	Coarse-Grained Soils Sand
210	Coarse-Grained Soils. Well-Graded Sand
214	Coarse-Grained Soils· Silty Sand
303	Crushed Stone
308	Soil-Aggregate Mixture (Predominantly Coarse Grained
700	Asphalt Concrete (AC)

Table D-2. Layer description and thickness for each section

Test Section	Layer Number	Project Layer	Material Code	Average Layer Thickness (inches)
550113 WB	1	Subgrade	214	N/A
	2	Embankment (Fill)	210	24
	3	Dense Graded Aggregate Base	303	8 0
	4	AC Binder	700	2.25
	5	AC Surface	700	1 75

Test Section	Layer Number	Project Layer	Material Code	Average Layer Thickness (inches)
550116 WB	1	Subgrade	201	N/A
	2	Existing Subbase	214	10.0
	3	Existing Crushed Rock Base	201	0.75
	4	ATB	700	12 0
	5	AC Binder	700	2 25
	6	AC Surface	700	1.75

Table D-2 Layer description and thickness for each section (continued).

Test Section	Layer Number	Project Layer	Material Code	Average Layer Thickness (inches)
550118 WB	1	Subgrade	201	N/A
	2	Existing Subbase	308	10 0
	3	Existing Crushed Rock Base	303	0 75
	4	DGAB	214	4 0
	5	ATB	700	8.0
	6	AC Binder	700	2 25
	7	AC Surface	700	1.75

Test Section	Layer Number	Project Layer	Material Code	Average Layer Thickness (inches)
550122 WB	1	Subgrade	201	N/A
	2	Existing Subbase	308	10.0
	3	Existing Crushed Rock Base	303	4 75
	4	Geotextile Fabric	74	N/A
	5	PATB	700	4 0
	6	ATB	700	4.0
		AC Binder	700	2.25
	7	AC Surface	700	1 75

Test Section	Layer Number	Project Layer	Material Code	Average Layer Thickness (inches)
550120 WB	1	Subgrade	214	N/A
	2	Existing Subbase	308	10 0
	3	Existing Crushed Rock Base	303	0 75
	4	DGAB	303	8 0
	5	PATB	700	4 0
	6	AC Binder	700	2.25
	7	AC Surface	700	1.75

Table D-2. Layer description and thickness for each section (continued).

Test Section	Layer Number	Project Layer	Material Code	Average Layer Thickness (inches)
550121 WB	1	Subgrade	214	N/A
	2	Existing Subbase	308	6 75
	3	DGAB	303	12.0
	4	PATB	700	4.0
	5	AC Binder	700	2.25
	6	AC Surface	700	1.75

Test Section	Layer Number	Project Layer	Material Code	Average Layer Thickness (inches)
550119 WB	1	Subgrade	214	N/A
	2	Existing Subbase	308	10 0
	3	Existing Crushed Rock Base	303	1 75
	4	DGAB	303	4.0
	5	PATB	700	4 0
	6	AC Binder	700	5.5
	7	AC Surface	700	1.5

Test Section	Layer Number	Project Layer	Material Code	Average Layer Thickness (inches)
550124 WB	1	Subgrade	214	N/A
	2	Existing Subbase	308	3 75
	3	Geotextile Fabric	74	N/A
	4	PATB	700	4 0
	5	ATB	700	12.0
	6	AC Binder	700	5 5
	7	AC Surface	700	1 5

Table D-2. Layer description and thickness for each section (continued).

Test Section	Layer Number	Project Layer	Material Code	Average Layer Thickness (inches)
550123 WB	1	Subgrade	214	N/A
	2	Existing Subbase	308	7 75
	3	Geotextile Fabric	74	N/A
	4	PATB	700	4.0
	5	ATB	700	8.0
	6	AC Binder	700	5.5
	7	AC Surface	700	1 5

Test Section	Layer Number	Project Layer	Material Code	Average Layer Thickness (inches)
550115 WB	1	Subgrade	214	N/A
	2	Existing Subbase	308	10 0
	3	Existing Crushed Rock Base	303	1 75
	4	ATB	700	8 0
	5	AC Binder	700	5 5
	6	AC Surface	700	1 5

Test Section	Layer Number	Project Layer	Material Code	Average Layer Thickness (inches)
550117 WB	1	Subgrade	214	N/A
	2	Existing Subbase	308	10
	3	Existing Crushed Rock Base	303	1.75
	4	DGAB	303	4 0
	5	ATB	700	4 0
	6	AC Binder	700	5.5
	7	AC Surface	AC Surface	1 5

Table D-2. Layer description and thickness for each section (continued).

Test Section	Layer Number	Project Layer	Material Code	Average Layer Thickness (inches)
550114 WB	1	Subgrade	Subgrade	N/A
	2	Existing Subbase	308	7.75
	3	DGAB	303	12 0
	4	AC Binder	700	5.5
	5	AC Surface	700	1 5

Attachment E

Project Deviation Reports

LTPP SPS Project Deviation Report **Project Summary Sheet**	State Code 5 5 Project Code 0 1 0 0

Project Classification Information	
SPS Experiment Number SPS-1	State or Province: Wisconsin
LTPP Region.	☐ North Atlantic ☒ North Central ☐ Southern ☐ Western
Climate Zone:	☐ Dry-Freeze ☐ Dry-No Freeze ☒ Wet-Freeze ☐ Wet-No Freeze
Subgrade Classification:	☐ Fine Grain ☒ Coarse Grain ☐ Active (SPS-8 Only)
Project Experiment Classification Designation (SPS 1, 2, & 8): SPS-1	
Construction Start Date June 1997	Construction End Date November 1997
FHWA Incentive Funds Provided to Agency for this Project:	☒ Yes ☐ No

Deviation Summary	
Site Location Deviations	☒ No Deviations ☐ Minor Deviations ☐ Significant Deviations
Construction Deviations	☐ No Deviations ☒ Minor Deviations ☐ Significant Deviations

Data Collection and Processing Status Summary	
Inventory Data (SPS 5,6,7, & 9).	☐ Complete Submission ☐ Incomplete ☐ Data Not Available
Materials Data	☒ All Scheduled Samples Obtained and Tested ☐ Incomplete
Construction Data	☒ All Required Data Obtained ☐ Incomplete / Missing Data Elements
Historical Traffic Data.	☐ All Required Historical Estimates Submitted (SPS 5, 6, 7, & 9) ☐ Required Estimates Not Submitted
Traffic Monitoring Equipment:	☒ WIM Installed On-Site ☐ AVC Installed On-Site ☐ ATR Installed On-Site ☐ No Equipment Installed
Traffic Monitoring:	☐ Preferred ☒ Continuous ☐ Minimum ☐ Below Minimum ☐ Site Related
Traffic Monitoring Data.	☒ Monitoring Data Submitted ☐ No Monitoring Data Submitted
FWD Measurements:	☒ Pre-construction Tests Performed ☐ Construction Tests Performed ☒ Post-construction Tests Performed
Profile Measurements:	☐ Pre-construction Tests Performed ☒ Post-construction Tests Performed
Distress Measurements	☐ Pre-construction Tests Performed ☒ Post-construction Tests Performed
Maintenance and Rehab Data:	☐ Complete Submission ☐ Incomplete ☐ Data Not Available
Friction Data:	☐ Complete Submission ☐ Incomplete ☒ Data Not Available

Report Status	
Materials Sampling and Test Plan:	☐ Document Prepared ☒ Final Submitted To FHWA
Construction Report:	☒ Document Prepared ☐ Final Submitted To FHWA
AWS: (SPS 1, 2, & 8)	☒ AWS Installed ☐ AWS Installation Report Submitted to FHWA

Page 1 of 5 Prepared by Brenda B Mehnert Date 2-10-2000

LTPP SPS Project Deviation Report **Construction Guidelines Deviation**	State Code 5 5 Project Code 0 1 0 0

☒ Comments Pertain to All Test Sections on Project

☐ Comments Pertain Only to Section(s): (Specify) _____

Construction Guidelines Deviation Comments

All sections dense graded aggregate base layers cut to grade using a base trimmer with an allowable tolerance of ¾ in

During the splitspoon testing, old concrete slabs were discovered beneath the old pavement structure These slabs were removed, and fill was placed in these areas (550113, 550116 and 550114).

Shoulders were constructed with a minimum width of 3 ft instead of the required 4 ft.

LTPP SPS Project Deviation Report Other Deviations	State Code 5 5 Project Code 0 1 0 0

☒ Comments Pertain to All Test Sections on Project

☐ Comments Pertain Only to Section(s). (Specify) _____

Other Deviation Comments

None known

Page 3 of 5 Prepared by Brenda B. Mehnert Date 2-10-2000

LTPP SPS Project Deviation Report **Site Location Guidelines Deviations**	State Code 5 5 Project Code 0 1 0 0

☒ Comments Pertain to All Test Sections on Project

☐ Comments Pertain Only to Section(s). (Specify) _____

Site Location Guideline Deviation Comments

None known

Page 4 of 5 Prepared by Brenda B. Mehnert Date 2-10-2000

LTPP SPS Project Deviation Report **Data Collection and Materials Sampling and Testing Deviations**	State Code 5 5 Project Code 0 1 0 0

☒ Comments Pertain to All Test Sections on Project

☐ Comments Pertain Only to Section(s): (Specify) _____

Data Collection & Material Sampling and Testing Deviation Comments

During the splitspoon testing, a number of existing concrete slabs were discovered beneath the old pavement structure These slabs were removed, and fill was placed in these areas.

Because of the process used to remove the existing pavement it was not possible to obtain undisturbed samples of the existing base or subbase material, thus, there are no samples of the existing crushed rock base Samples deleted from the original test plan include B10, B12, B13, B14, B15, T16, T21, and T25-T30.

Soil boring records were provided that made it unnecessary to perform shoulder probes. The depth to rigid layer exceeded 20 ft

FWD testing was performed on the old pavement in order to determine the modulus of elasticity of the subgrade. Data was not included in IMS, since the original pavement structure was not part of LTPP sections.

Page 5 of 5 Prepared by Brenda B. Mehnert Date 2-10-2000

Submitted by

ERES CONSULTANTS
A Division of Applied Research Associates Inc

505 West University Avenue
Champaign, IL 61820-3915
Phone (800) 344-7477 (DIG-SHRP)
Fax (217) 356-3088
www.eresnet.com

ERES Project No. 95-075-R1