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April 27, 1990

MEMO TO: Mr. ~~Greg~~ Craig Gilbertson
Soils Engineer District 2A
Mn/DOT
Box 490
Bemidji, MN 56601

FROM: Ron Urbach RRU

RE: Sampling Information from the SHRP-LTPP Guide for Drilling and Sampling Version 1

This is some of the information from the Drilling and Sampling Guide that we discussed on April 26. This is not a copy of the complete Guide but it covers the areas that we were discussing. The information is to be used for all sampling and drilling on the SHRP projects. It covers the GPS and SPS sections. This information you can keep for your records and if you have any further questions, give me a call or talk to Gene Skok.

I will be in Canada the week of April 30-May 5. I will have Gene or Dick Ingberg give you a call concerning the SPS 5 information that we also discussed. I will be in Bemidji working on the SPS 3 sections mid-week of April 30.

It was nice to talk with you in Phoenix last week.

cc: Gene Skok

TRDF

MEMORANDUM

TECH MEMO NO: TM-EC-55 (GH) DATE: May 31, 1990

AUTHORS: J.L. Groeger and G.E. Elkins (G.E.) FILE: P1-TM-EC-55

DISTRIBUTION: R. Urbach, E. Lukanen, G. Skok, D. Ingberg, A. Hanna, A. Pelzner, B. Hadley

SUBJECT: Comments on Proposed Sampling Plan for SPS-5 Westbound Trunk Highway 2 West of Bemidji, MN.

We have slightly revised the SPS-5 materials sampling plans you have submitted for the above referenced project. The changes we have proposed are as follows:

- Renumber the section 12 designation from 270510 to 270512. As it is presently specified, the data from the two sections currently designated 270510 will not be able to be entered into the RIMS (Regional Information Management System) because each test section must be uniquely identified (see Figure 1).

- Addition of four C-type cores. Two cores should be added before section 9 and two cores should be added after section 12. Because there is a transition of approximately a mile and a half between sections 8 and 9, there should be a way to quantify the bound layer (AC, treated base/subbase) thicknesses. Therefore cores C~~25~~ 24 and C~~26~~ 25 were added. Cores C~~36~~ 35 and C~~37~~ 36 were added to determine bound layer thicknesses at the end of the project.

- Relocation of the sampling area between section 9 and section 10. We propose to move the sampling area from near the end of section 9, to near the beginning of section 10. This will provide for more precise layer thickness information for section 10.

- One other concern are core locations C-8, C-17, C-23 and C-28 on your proposed sampling plan. We assume the Minnesota DOT would like to have six-inch cores instead of four-inch cores for their own testing purposes. If this is the case then it is fine, otherwise, we do not see the need to take a six-inch core when a four-inch core will suffice.

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MAY 31 '90 16:24 FROM TRDF-MD TO BRAUN-MINN PAGE.002

Overall, your sampling plans for this project were very good. The minor changes we propose are based on the methodology we are developing for material sampling and testing plans for the SPS-5 experiments. Of course, you may have to revise this further depending on actual site conditions. If possible, in the future, please submit a copy of site plans and profile sheets showing the location of the test sections. This will give us a better idea of the variability in the cross-section of the entire project and be more useful when reviewing materials sampling plans for the SPS experiments.

Please call us if you have any questions about this sampling plan.

/jg

Attachments: Letter of 5/24/90 from Ron Urbach to Gary Elkins.

MAY 31 '90 16:24 FROM TRDF-MD TO BRAUN-MINN PAGE.003

SPS-5 PROJECT - 14 MILES WEST OF BEMIDJI, MN WESTBOUND TH 2

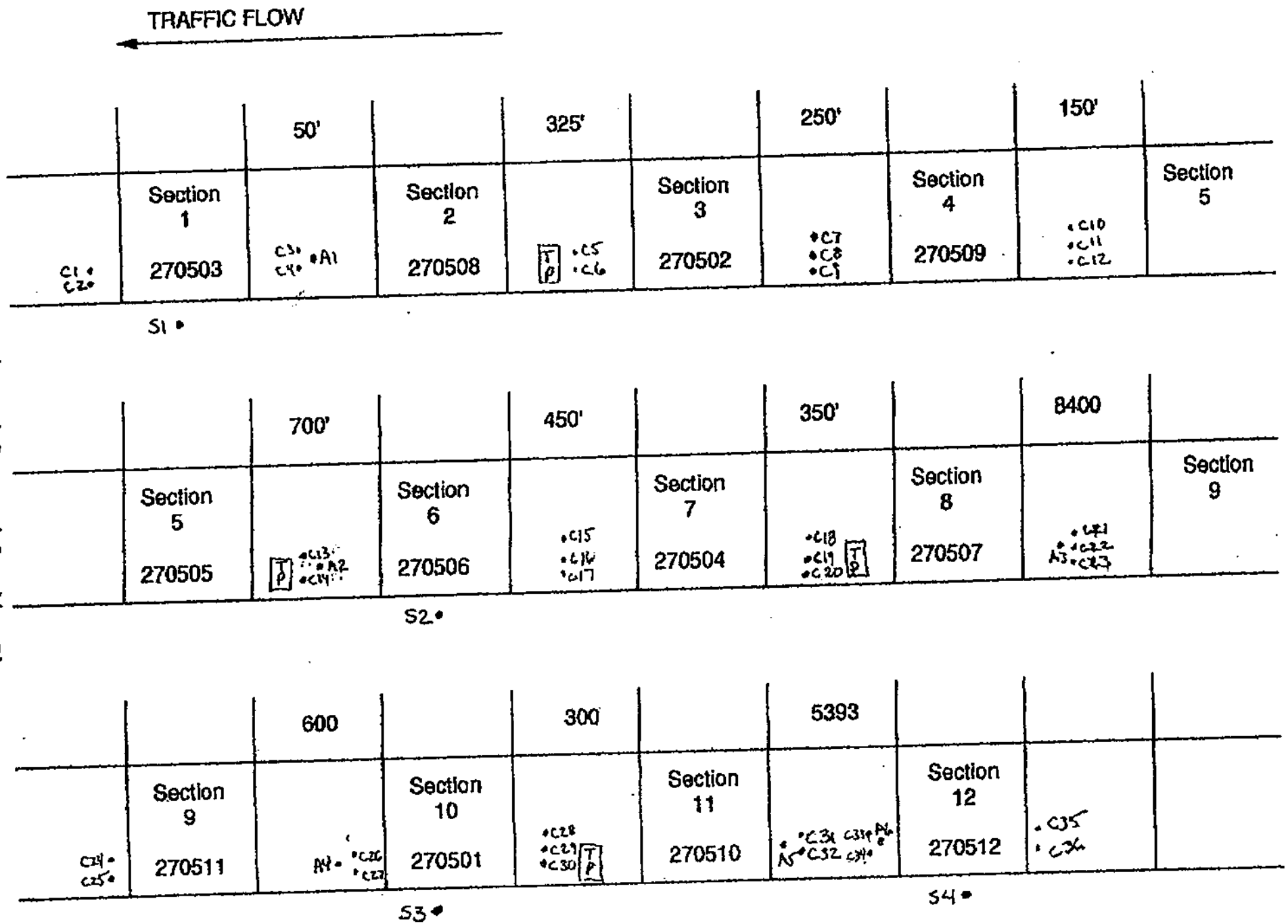
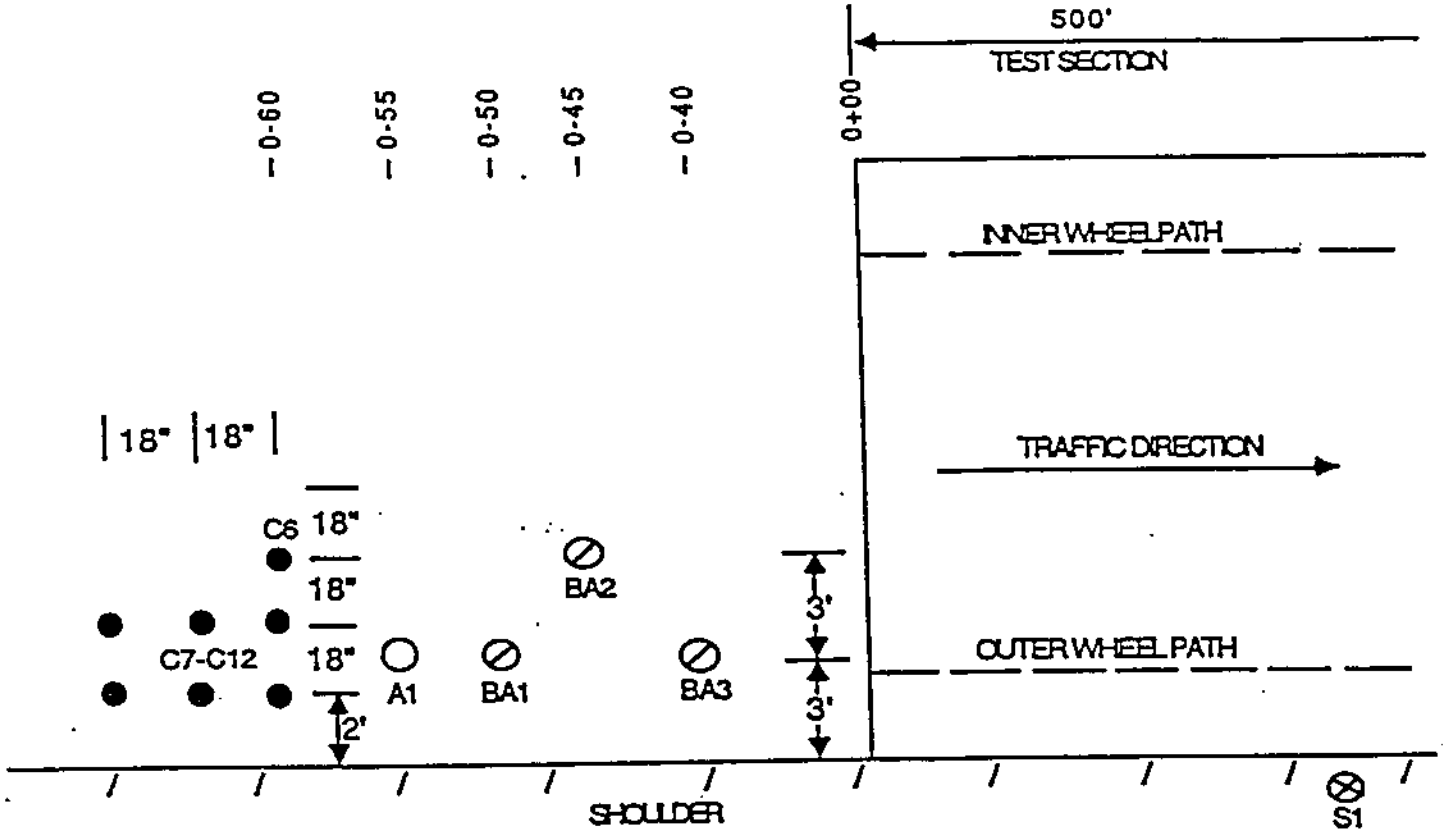
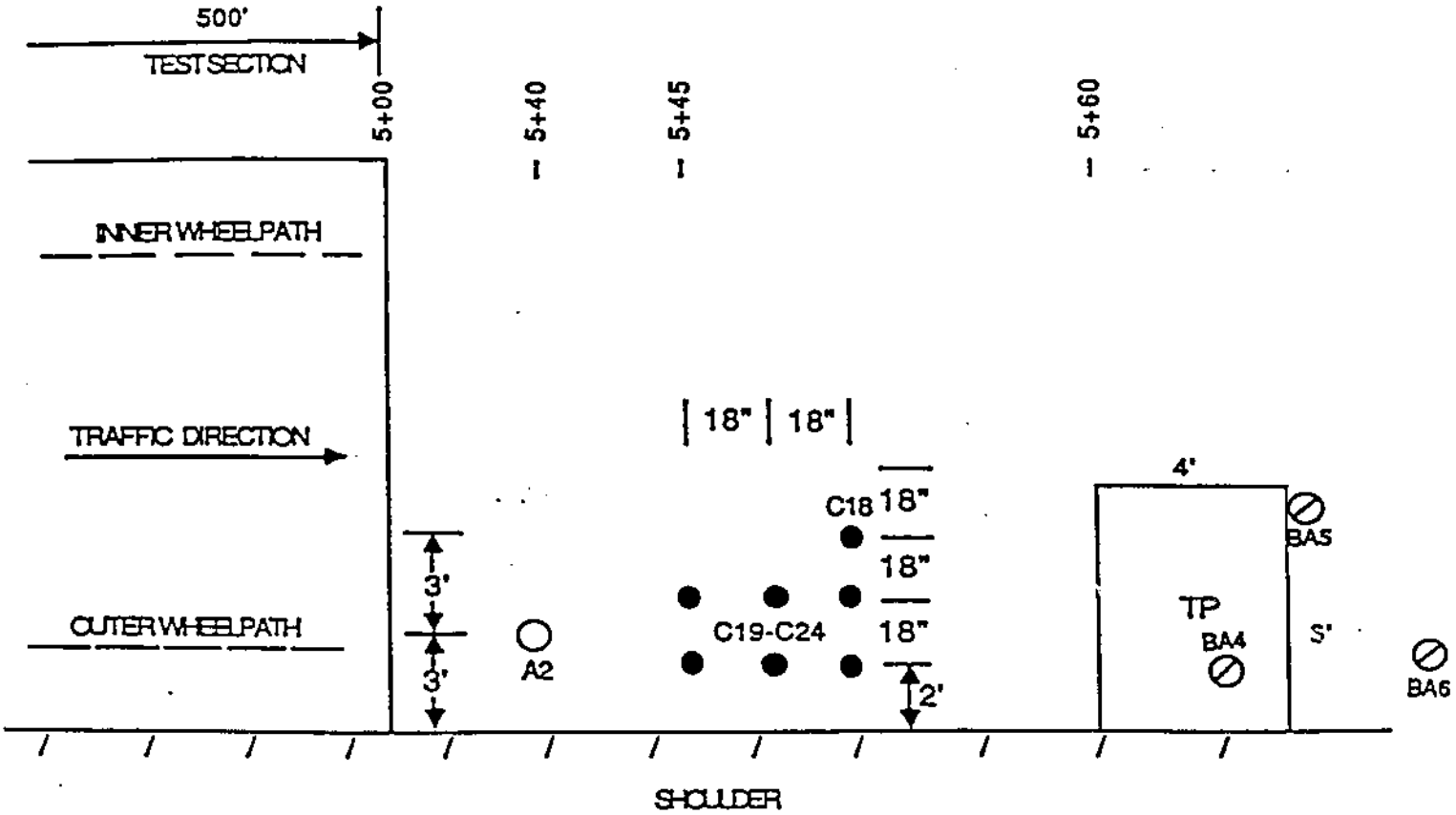


Figure 1 Proposed Sampling Plan





Sampling Point Locations After Test Section - Experiment 1
Asphalt Concrete over Granular Base

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MEMORANDUM

TO:	See Distribution	DATE:	March 13, 1990
FROM:	William A. Phang	FILE:	13.2.5
SUBJECT:	Materials and Testing Plans for SPS 5 and SPS 6		

In reviewing the Field Sampling and Laboratory Testing Memos for SPS 5 and SPS 6 dated January 30 and January 29/90 respectively, and the Tech Memos TM-PCS-1 and TM-PCS-2 dated February 23/90, "Rationale for Materials Testing Proposed for SPS-5 and SPS-6" respectively, the impression is very strong that these proposals are 'loaded' towards more testing than say a GPS because of the extent of the project and perhaps because of direct state funding.

So we may have a more austere perspective to consider at our March 23rd meeting. I have made some suggestions attached, which considerably reduce the size of the testing plan, without it is hoped compromising the quality of the data.

A point of note in both SPS 5 and SPS 6 layouts is the suggestion that the 500' test sections are spaced 300' apart. Is this a confirmed change from the 100' minimum transition?

Should we be considering FWD testing at this meeting? It has been put forward that this will be similar to FWD testing of GPS sections. It is my understanding that statistically speaking FWD tests from ten (10) test points should be capable of representing the characteristics of what is constructed as a uniform 500' test section. The ten points should conceptually be randomly selected. However because it is intended to follow the changes over time, measurement each time needs to be at the same points. This is more easily accomplished when the points are equally spaced, say at 100' intervals at lane center and in wheel track, for an SPS 5. Capturing the characteristics of an existing concrete pavement for an SPS 6 is more complex, but can be done by testing a small number of consecutive slabs, say five (5) to ten (10). Because of the overlays, it would be useful to test more of the joints than slab center and edges. A suggested pattern would be to test five points at slab center, five at pavement edge slab center, and 10 joints in the wheel track. This would allow testing of about 3 test sections per day, or completion of FWD testing at about the same time as drilling and sampling.

Distribution:

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Sampling and Testing of SPS-5 Projects

Q. For the SPS-5 experiment, what needs to be known about the existing pavement for carrying out the analysis?

A 1. As a minimum, the asphalt pavement thickness, and the stiffness modulus of the asphalt concrete.

Based on the minimum, the following tests of the asphalt concrete are recommended:

- Measurement of pavement thickness from cores taken at each end of a test section

- Measurement of resilient modulus at each end of the project. Because at this time M_R testing is still mainly a research tool, stiffness values are often obtained by using the correlations developed by Van der Poel and Heukelom from common tests of mix air voids, asphalt content, volume concentration of the aggregate, and the penetration (at 77° F and 39.2° F) and softening point of the recovered asphalt cement.

The sampling requirements are:

1. 2-4" OD cores from each end of the test section. From these one can obtain thickness air voids, asphalt content and volume concentration of the aggregate.

2. 4-4" OD cores from each end of the project or near each end of the project (e.g., between sections 3 and 4, and 7 and 8). From these one obtain thicknesses and can do M_R testing as per the current SHRP protocol P07.

3. 1-12" core or block from say the middle of the project. The asphalt from Abson Recovery can be tested for penetration at 77° F and 39.2° F, and for softening point.

A 2. As a minimum, the layer thicknesses of the base and subbase, the physical make up of the materials, the relative condition/state, and the stiffness modulus. These properties are also needed for the subgrade.

The following tests and sampling requirements are:

- 3 or more 12" diameter access holes to the base, subbase, and subgrade, for natural moisture and auger samples of these materials. These are all taken in the same area as the 4" cores for M_R testing, say between sections 3 and 4. Split spoon or Shelby tube samples to 5' below top of subgrade would be taken through one of these access holes.

The auger samples of unbound material are combined in the laboratory and samples split off for testing. Tests are for particle size gradation and Atterberg Limits so that the materials may be classified, natural moisture contents, moisture density relationships, and resilient modulus.

A 6'x4' test pit from which a 12"x12" block of pavement is recovered, would permit in-place density determinations of base, subbase, and subgrade, would permit measurement of layer thickness, and would allow recovery of natural moisture samples and large samples of base, subbase, and subgrade. The test pit should be located near the second set of 4" M_R cores, i.e., between sections 7 and 8.

A 3. For the overlays after construction, pavement thicknesses and stiffness modulus of the overlays are needed. Similar sampling as for the existing pavement i.e., 2-4" OD cores at each end of a section plus two sets each of eight 4" OD cores from two areas representing the virgin mix and the recycled mix.

A 4. Other Desirable Tests

1. Moisture susceptibility determinations of the overlay mixes, carried out during mix design of virgin and recycled mixes, could be helpful in future interpretation of pavement distress and durability performance. Moisture susceptibility determination of the existing pavement is of questionable value because it would have to be done on re-heated material, a process which does not yield similar results as for fresh mixes. Procedures for moisture susceptibility testing of cores have not yet been developed. Mix design will be done by the participating state, and any moisture susceptibility testing should be carried out at the same time. The state should be notified of any required testing, and given a SHRP protocol.

2. Creep compliance of the overlay mixes, both virgin and recycled, and of the existing pavement may be determined from cores. The results may be useful in future interpretation of rutting. C.P. Valkering, et el indicated that static creep testing results underestimates rut formation, so that a dynamic correction factor must be investigated ("Rutting Resistance of Asphalt Mixes Containing Non-Conventional and Polymer-Modified Binders", C.P. Valkering, D.J.L. Lancon, E. de Hilster, and D.A. Stoker, AAPT 1990). The SHRP project on bituminous mixes would be recommending meaningful tests on asphalt mixes. Because the current creep compliance test appears to be not inclusive, it is suggested that testing of this nature be postponed.

3. Permeability of unbound granular bases may be of some value in future performance interpretation. A SHRP protocol is needed. As permeability criteria are still being sought, it would be useful to have at least two permeability measurements in an SPS-5.

SAMPLING & TESTING SPS-5

SAMPLING PLAN

NARCO MAR 9/90

CONTROL.

(1)

(2) 2" Recycled		(3) 5" R.		(4) 5" R		(5) 2" Virgin		(6) 2" V		(7) 5" V		(8) 5" R		(9) 2" R

PRE-CONSTRUCTION SAMPLING.

C1 (BSG, AC) C3 (AC BSG) C5 BA1 (Abson + C11 C13 (BSG, AC) C15 (AC, BSG) C17 TP1 (Abson + C23 C25 (BSG, AC
C2 (MSG,) C4 (MSG) C6 BA2 C12 C14 (MSG.) C16 (MSG) C18 C24 C26 (MSG)

(MR) C7, C8, C9, C10 — BA3 (Split Spoon or Shelby)

(MR) C19, C20, C21, C22

C - 4" OD core
BA - 12" OD "
TP - 4'x6' TEST PIT.

POST-CONSTRUCTION SAMPLING.

C1 (BSG, AC) DESIRABLE C3 C5 (AC, BSG) C7 C13 C15 C17
C2 (MSG) C4 C6 (MSG) C8 C14 C16 C18

(MR Recy) C9, C10, C11, C12

DESIRABLE C19 C21 AC (BSG) C23 C25
C20 C22 (MSG) C24 C26

(MR Virg.) C27, C28, C29, C30

ABSON VIRGIN
C31 C33
C32 C34

C35 C37
C36 C38
Abson + Recycled.

C39 (BSG, A
C40 (MSG.

TABLE 1

SPS-5 LABORATORY TESTING PLANS (PRE-CONSTRUCTION)

Material Type and Properties	SHRP Designation	SHRP Protocol	Test Method	Tests/Samples per Layer (Testable)	Material Source/ Test Locations
PRE-CONSTRUCTION					
1. ASPHALT CONCRETE					
A. Asphaltic Concrete:					
Core Examination/Thickness	AC01	P01	SHRP-LTPP Method	~~K~~30	ALL CORES (ALL LAYERS)
Bulk Specific Gravity	AC02	P02	AASHTO T166-88I	K5	C1 C5 C13 C17 C25
Maximum Specific Gravity	AC03	P03	AASHTO T209-82	K5	C2 C6 C14 C18 C26
Asphalt Content (Extraction)	AC04	P04	AASHTO T164-86	K5	C1 C5 C13 C17 C25
Moisture Susceptibility	AC05		AASHTO T283-87I	1	
Creep Compliance	AC06		SHRP-LTPP Method	1	
Resilient Modulus	AC07	P07	ASTM D4123-82	K2	C7 C8 C9 / C19 C20 C21
Tensile Strength	AC07	P07	ASTM D4123-82	K2	C10 / C22
B. Extracted Aggregate:					
Bulk Specific Gravity:					
Coarse Aggregate	AG01		AASHTO T85-88I	4	
Fine Aggregate	AG02		AASHTO T84-88I	4	
Type and Classification:					
Coarse Aggregate	AG03		ASTM D2488-84	4	
Fine Aggregate	AG03		ASTM D2488-84	4	
Gradation of Aggregate	AG04	P14	AASHTO T30-87I	K5	C1 C5 C13 C17 C25
C. Asphalt Cement:					
Abson Recovery	AE01		AASHTO T170-84	K2	BA1 TP1
Penetration at 77F & 39.2°F	AE02		AASHTO T49-87I	K2	BA1 TP1
Ductility at 77F	AE03		AASHTO T51-87I	4	
Specific Gravity (60F)	AE04		AASHTO T228-87I	4	
Ring and Ball Softening Pt.	AE05		AASHTO T53-87I	K2	BA1 TP1
Viscosity at 77F	AE06		AASHTO T202-84	4	
Viscosity at 140F	AE06		AASHTO T202-84	4	

TABLE 1 cont'd

SPS-5 LABORATORY TESTING PLANS (PRE-CONSTRUCTION)

Material Type and Properties	SHRP Designation	SHRP Printed	Test Method	Tests/Samples ~~per Layer~~	Material Source/ Test Locations
II. BOUND (TREATED) BASE AND SUBBASE					
Type and Classification of Material and Treatment	TB01	P31	ASTM D2488-84	4	
Compressive Strength	TB02	P32	ASTM D2166-66(79)/ ASTM C39-83	4	
Dynamic Modulus (77F)	TB03	P33	ASTM D3497-78(85)	4	
III. UNBOUND GRANULAR BASE AND SUBBASE					
Particle Size Analysis	UG01	P41	AASHTO T27-881	~~4~~ 2	BA1 BA2 BA3 TP1
Sieve Analysis (washed)	UG02	P41	AASHTO T11-85	~~4~~ 2	BA1 BA2 BA3 TP1
? Hydrometer to 0.001mm	UG03		AASHTO T88-86	4	
Atterberg Limits	UG04	P43	AASHTO T89-871 AASHTO T90-871	4	
Moisture-Density Relations	UG05	P44	AASHTO T180-86	~~4~~ 1	BA1 BA2 BA3 TP1
? Laboratory CBR	UG06		AASHTO T193-81	4	
Resilient Modulus	UG07	P46	AASHTO T274-82	~~4~~ 1	BA1 BA2 BA3 TP1
Classification	UG08	P47	ASTM D2488-84	~~4~~ 2	
? Permeability	UG09	?	ASTM D2434-68(79)	~~4~~ 2	BA1 BA2 BA3 TP1
Natural Moisture Content	UG10	P49	AASHTO T265-86	~~4~~ 4	BA1 BA2 BA3 TP1
IV. SUBGRADE					
Sieve Analysis	SS01	P51	AASHTO T27-881	~~4~~ 2	BA1 BA2 BA3 TP1
Hydrometer to 0.001mm	SS02	P42	AASHTO T88-86	~~4~~ 2	BA1 BA2 BA3 TP1
Atterberg Limits	SS03	P43	AASHTO T89-871/ AASHTO T90-871	~~4~~ 2	BA1 BA2 BA3 TP1
Classification	SS04	P52	AASHTO M145-82 ASTM D2488-84	~~4~~ 2	BA1 BA2 BA3 TP1
Moisture-Density Relations	SS05	P55	AASHTO T99-86/ AASHTO T180-86	~~4~~ 1	BA1 BA2 BA3 TP1
? Laboratory CBR	SS06		AASHTO T193-81	4	
Resilient Modulus	SS07	P46	AASHTO T274-82	4	
? Unit Weight	SS08		SHRP-LTPP Method	4	
Natural Moisture Content	SS09	P49	AASHTO T265-86	4	BA1 BA2 BA3 TP1
? Unconfined Compressive Strength	SS10		AASHTO T208-70(84)	~~4~~ 1	BA3

TABLE 2

SPS-5 LABORATORY TESTING PLANS (POST-CONSTRUCTION)

Material Type and Properties	SHRP Designation	Test Method	Tests/Samples per Layer (Testable)	Material Source/ Test Locations
POST-CONSTRUCTION				
I. ASPHALT CONCRETE				
A. Asphaltic Concrete:				
Core Examination/Thickness	AC01	SHRP-LTPP Method	~~18~~ 40	ALL CORES
Bulk Specific Gravity	AC02	AASHTO T166-88I	~~18~~ 4	C1 C7 C23 C39
Maximum Specific Gravity	AC03	AASHTO T209-82	4	C2 C8 C24 C40
Asphalt Content (Extraction)	AC04	AASHTO T164-86	4	C1 C7 C23 C39
Moisture Susceptibility	AC05	AASHTO T283-87I	1	
Creep Compliance	AC06	SHRP-LTPP Method	1	
Resilient Modulus	AC07	ASTM D4123-82	4	C9 C10 C11 / DESIRABLE C4 C5 C6 / C27 C28 C29 / DESIRABLE C20 C21 C22
Tensile Strength	AC07	ASTM D4123-82	4	C12 / C3 / C30 / C19
B. Extracted Aggregate:			?	
Bulk Specific Gravity:				
Coarse Aggregate	AG01	AASHTO T85-88I	4	STOCKPILE SAMPLES.
Fine Aggregate	AG02	AASHTO T84-88I	4	STOCKPILE SAMPLES.
Type and Classification:				STOCKPILE SAMPLES.
Coarse Aggregate	AG03	ASTM D2488-84	4	STOCKPILE SAMPLES.
Fine Aggregate	AG03	ASTM D2488-84	4	STOCKPILE SAMPLES.
Gradation of Aggregate	AG04	AASHTO T30-87I	4	C1 C7 C23 C39
C. Asphalt Cement:				VIRGIN / RECYCLED / STORAGE TANK SAMPLE
Abson Recovery	AE01	AASHTO T170-84	4	C31 C32 / C35 C36
Penetration at 77F & 39.2°F	AE02	AASHTO T49-87I	~~4~~ 2	C31 C32 / C35 C36
Ductility at 77F	AE03	AASHTO T51-87I	4	
Specific Gravity (60F)	AE04	AASHTO T228-87I	4	
Ring and Ball Softening Pt.	AE05	AASHTO T53-87I	~~4~~ 2	C31 C32 / C35 C36
Viscosity at 77F	AE06	AASHTO T202-84	4	
Viscosity at 140F	AE06	AASHTO T202-84	4	

Sampling and Testing of SPS-6 Projects

Q. For the SPS-6 experiment, what needs to be known about the existing pavement for carrying out the analysis?

A 1. Asphalt Overlays on concrete pavement develop problems at joints and cracks in the underlying concrete. It is important to know where these cracks and joints are located. Pavement thicknesses are important,as are stiffnesses measured from cores or deduced from deflection measurements. The presence of voids under a joint is useful information. A knowledge of the coefficient of expansion of the concrete is useful.

A minimum number of results to characterize material properties of the concrete cores is perhaps five. SHRP protocol P61 (Compressive Strength) and P64 (Static Modulus of Electricity) require testing of 4" OD cores, while P62 (Splitting Tensile Strength) require testing of 6" OD cores. It is proposed that five sets 4" and 6" cores for these tests be taken (at every other transitions), with two additional 4" cores at the ends of the project. These additional cores will be used if M_R testing of asphalt treated subbase is needed.

To obtain bulk samples of subbase and subgrade, access is proposed through 3-12" core holes at each end of the project. Tests for coefficient of expansion may be carried out on blocks sawn from the 12" OD core, or on the additional 4" cores. Voids under the pavement may be inferred from FWD tests at joints or from evidence of pumping or faulting.

A 2. As in concrete GPS test sections, a test pit will not be required, although there will be then no opportunity to measure layer thickness or the in-place density of unbound subbase or the subgrade. However if full depth patches are part of the intensive CPR, with cooperation of the contractor, it may still be possible to carry out such in-situ measurement.

There seems to be no need for CBR testing, as resilient modulus tests are to be performed on the subgrade materials Permeability measurement of unbound granular subbase may prove valuable.

A 3. (It is proposed in post-construction, sampling to take 10-4" OD cores and 20-6" OD cores, and to use the 6" OD cores for tests for Bulk S.G., Max. S.G., and asphalt content. Since all previous tests by these procedures use 4" OD cores, the reason for changing to 6" OD cores is unclear).

SAMPLING & TESTING SPS-6.

SAMPLING PLAN

SECT. NO. →	1		2		5		6		3		4		7		8	
	CONTROL		min. restoration		intensive CPR		4" AC intensive CPR		4" AC min. restoration		4" AC Saw & Seal min. restoration		4" AC break & seat		8" AC. break & seat	
SAMPLING AREA →	1	2 3	4	9	10	11	API	12 5		6 7		8 13	AP 2	14 15		16

PRE-CONSTRUCTION.

SM - C1 BA1 - Comp. } MR
Comp - C2 BA2
ST - C3 BA3
C4

SM - C5
Comp. C6
ST C7

SM - C8
Comp - C9
ST - C10

SM - C11
Comp. C12
ST - C13

SM - C14 Comp BA4
Comp - C15 BA5
ST - C16 BA6
C17
MR

C - 4" OD CORE
⊖ - 6" OD CORE.
BA - 12" OD CORE

POST-CONSTRUCTION

AC BSG C1
MSG C2

MR C3 C5 BSG AC
MR C4 C6 MSG

MR C7 C9 BSG AC
MR C8 C10 MSG

MR C11 C13 BSG AC
MR C12 C14 MSG

MR C15 C17 BSG AC
MR C16 C18 MSG

C19 BSG
C20 MSG

TABLE 1. SPS-6 LABORATORY TESTING PLANS (PRE-CONSTRUCTION)

SHRP Protocol

Material Type and Properties	SHRP Test Designation	Test Method	Tests/Layer	Material Source/ Test Location
I. PORTLAND CEMENT CONCRETE				
4" dia. cores → Compressive Strength	PC01 PC1	AASHTO T22-88I	~~18~~ 5	C2 C6 C9 C12 C15
6" → Splitting Tensile Strength	PC02 PC2	AASHTO T198-88I	~~18~~ 5	C3 C7 C10 C13 C16
PCC Coefficient of Thermal Expansion	PC03	ASTM E228-85	6	
→ Static Modulus of Elasticity	PC04 PC4	ASTM C468-87	~~8~~ 5	C1 C5 C8 C11 C14
PCC Unit Weight	PC05	SHRP-LTPP Method	26	
Core Examination / Thickness	PC06	SHRP-LTPP Method	~~15~~ 17	ALL CORES
		Extra 4" Cores: ~~Extra 6" Cores:~~		C4, C17
II. BOUND (TREATED) BASE AND SUBBASE				
Type and Classification of Material and Type of Treatment	TB01	ASTM D2488-84	9	
4" or 3" cores Compressive Strength	TB02	ASTM D2166-66(79) AND ASTM C39-83	3	C2 C6 C9
Dynamic Modulus (3 cores/ test)	TB03	ASTM D3497-78(85)	~~8~~ 2	C1 C4 C5 C8 C11 C14
III. UNBOUND GRANULAR BASE AND SUBBASE				
Particle Size Analysis	UG01	AASHTO T27-88I	~~6~~ 2	BA1 BA2 BA3 BA4 BA5 BA6
Sieve Analysis (washed)	UG02	AASHTO T11-85	~~6~~ 2	" "
Atterberg Limits	UG04	AASHTO T89-87I	~~6~~ 2	" "
Moisture-Density Relations	UG05	AASHTO T180-86	~~6~~ 2	" "
Lab. CBR (at in-situ density and moisture; soaked and unsoaked)	UG06	AASHTO T193-81	4	
Resilient Modulus (at in-situ density and moisture)	UG07	AASHTO T274-82	~~6~~ 2	BA1 BA2 BA3 BA4 BA5 BA6
Classification	UG08	ASTM D2488-84	~~6~~ 2	" "
Permeability	UG09	ASTM D2434-68(79)	~~6~~ 2	" "
Natural Moisture Content	UG10	AASHTO T265-86	~~6~~ 6	BA1 BA2 BA3 BA4 BA5 BA6

TABLE 1 (Cont'd) SPS-6 LABORATORY TESTING PLANS (PRE-CONSTRUCTION)

Material Type and Properties	SHRP Test Designation	Test Method	Tests/Layer	Material Source/ Test Location	
III. SUBGRADE					
Sieve Analysis	SS01	AASHTO T27-88I	X2	BA1 BA2 BA3 BA4 BA5 BA6	
Hydrometer to 0.001mm	SS02	AASHTO T88-86	X2	" "	
Atterberg Limits	SS03	AASHTO T89-87I/ AASHTO T90-87I	X2	" "	
Classification and Type of Subgrade	SS04	AASHTO M145-82/ ASTM D2488-84	X2	" "	
Moisture-Density Relations	SS05	AASHTO T99-86/ AASHTO T180-86	X2	" "	
Lab. CBR (at in-situ density and moisture; soaked and unsoaked)	SS06	AASHTO T193-81	4		
Resilient Modulus (at in-situ density and moisture)	SS07	AASHTO T274-82	X2	BA1 BA2 BA3 BA4 BA5 BA6	
Unit Weight	SS08	SHRP-LTPP Method	4		
Natural Moisture Content	SS09	AASHTO T265-86	X6	BA1 BA2 BA3 BA4 BA5 BA6	SHELBY TUBES
Unconfined Comp. Strength	SS10	AASHTO T208-70(84	X6	"	

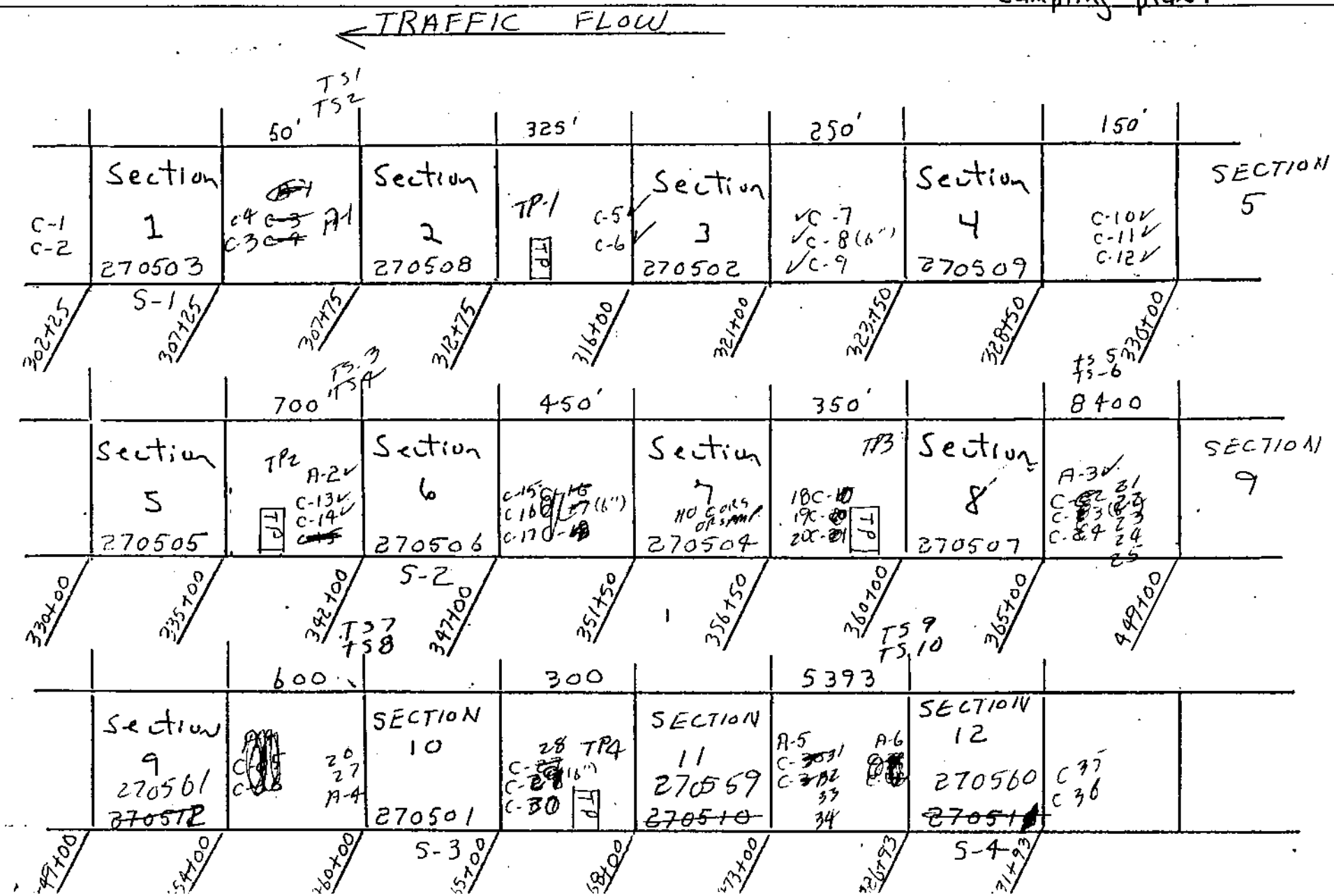
TABLE 2. SPS-4 LABORATORY TESTING PLANS (POST-CONSTRUCTION)

Material Type and Properties	SHRP Test Designation	Test Method	Tests/Layer	Material Source/ Test Location
I. ASPHALT CONCRETE				
Core Examination/Thickness	P01	SHRP-LTPP Method	~~20~~ 20	ALL CORES
Bulk Specific Gravity	P02	AASHTO T166-88I	~~6~~ 6+2	C1 C5 C9 C13 C14 C19
Maximum Specific Gravity	P03	AASHTO T209-82	~~6~~ 6+2	C2 C6 C10 C14 C15 C20
Asphalt Content	P04	AASHTO T164-86	~~6~~ 6+2	C1 C5 C9 C13 C14 C19
Moisture Susceptibility	P05	AASHTO T283-87I	1	
Creep Compliance	P06	SHRP-LTPP Method	1	
Resilient Modulus	P07	ASTM D4123-82	~~2~~ 2	C3 C4 C7 C8 C11 C12
Tensile Strength	P07	ASTM D4123-82	~~2~~ 2	C15 C16

~~Extra 4" Cores~~
Extra 6" Cores

SPS 5
14 MILES WEST OF BEMIDJI MN
WESTBOUND TH 2

According To March 29, 1990
sampling plan.



SPS-5 PROJECT - 14 MILES WEST OF BEMIDJI, MN WESTBOUND TH 2

Final

TRAFFIC FLOW ←

		50'		325'		250'		150'	
	Section 1		Section 2		Section 3		Section 4		Section 5
C1 • C2 •	270503	C3 • C4 • A1	270508	TP • C5 • C6	270502	• C7 • C8 • C9	270509	• C10 • C11 • C12	
S1 •									
		700'		450'		350'		8400	
	Section 5		Section 6		Section 7		Section 8		Section 9
	270505	TP • C13 • A2 • C14	270506	• C15 • C16 • C17	270504	• C18 • C19 • C20 TP	270507	• C21 • C22 A3 • C23	
			S2 •						
		600		300		5393			
	Section 9		Section 10		Section 11		Section 12		
C24 • C25 •	270511	A4 • C26 • C27	270501	• C28 • C29 • C30 TP	270510	• C31 C33 • A6 • A5 • C32 C34 •	270512	• C35 • C36	
S3 •						S4 •			

According To Ma h 29, 1990
sampling plan.

	50'		325'		250'		150'	
Section 1 270503		Section 2 270508		Section 3 270502		Section 4 270507		SECTION 5

	700'		450'		350'		8400	
Section 5 270505		Section 6 270506		Section 7 270504		Section 8 270507		SECTION 9

	600		300		5393			
Section 9 270511		SECTION 10 270501		SECTION 11 270510		SECTION 12 270510		

TABLE 1

SPS-5 LABORATORY TESTING PLANS (PRE-CONSTRUCTION)

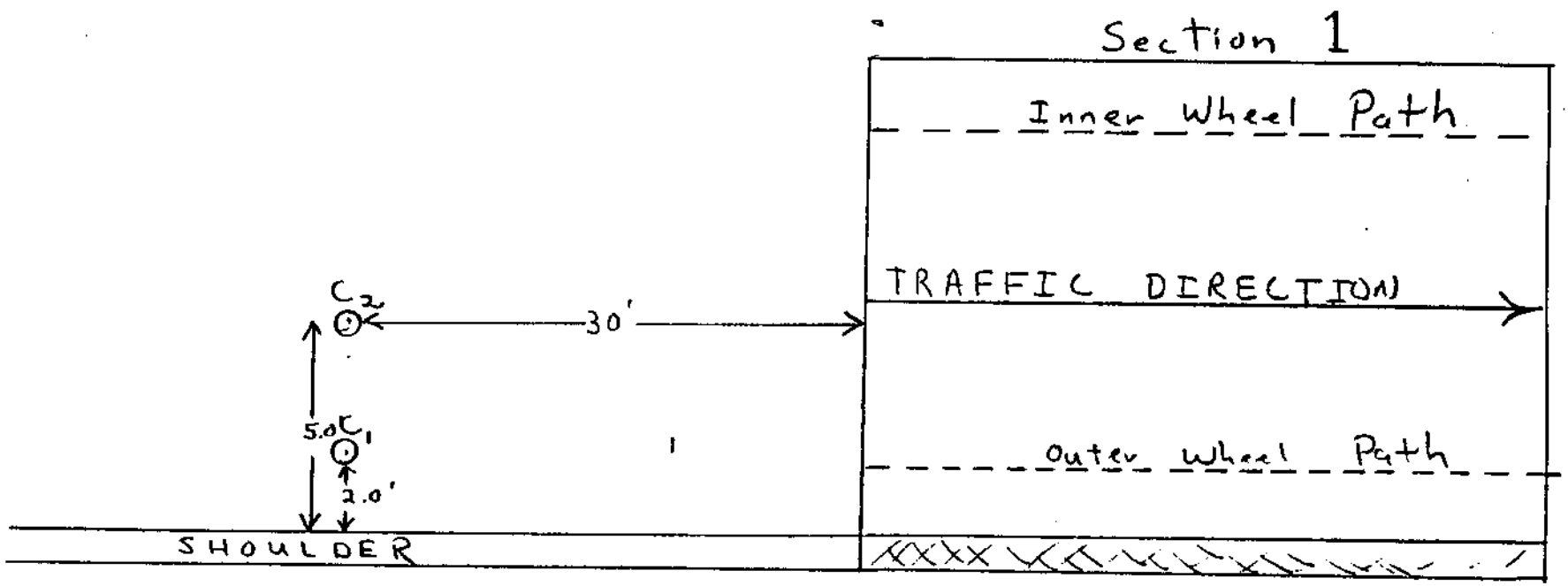
Material Type and Properties	SHRP Designation	SHRP GPS Protocol	Tests/Samples per Layer	Material Source/ Test Locations
PRE-CONSTRUCTION				
I. ASPHALT CONCRETE				
A. ASPHALTIC CONCRETE:				
Core Examination/Thickness	AC01	P01	26	ALL CORES
Bulk Specific Gravity	AC02	P02	9	C2 [C3,C4] C13 [C14,C15] C22 [C23,C24][4]
Maximum Specific Gravity	AC03	P03	3	[BA1-3] [TP] [BA4-6]
Asphalt Content (Extraction)	AC04	P04	3	[BA1-3] [TP] [BA4-6]
Moisture Susceptibility	------	NOTE 1	3	A1 A2 A3
Creep Compliance	------	NOTE 2	3	C5 C9 C20
Resilient Modulus	AC07	P07	3	[C3,C4] [C14,C15] [C23,C24]
Tensile Strength	AC07	P07	3	C2 C13 C22
B. EXTRACTED AGGREGATE:				
Type and Classification:				
Coarse Aggregate	AG03		3	[BA1-3] [TP] [BA4-6]
Roundness Index of Coarse Aggregate	------	NOTE 3	3	[BA1-3] [TP] [BA4-6]
Fine Aggregate	AG03		3	[BA1-3] [TP] [BA4-6]
NAA Test for Fine Aggregate Particle Shape	AG05	P14A NOTE 3	3	[BA1-3] [TP] [BA4-6]
Gradation of Aggregate	AG04	P14	3	[BA1-3] [TP] [BA4-6]
C. ASPHALT CEMENT:				
Abson Recovery	AE01		3	[BA1-3] [TP] [BA4-6]
Penetration at 50F,77F,90F	AE02		3	[BA1-3] [TP] [BA4-6]
Specific Gravity (60F)	AE04		3	[BA1-3] [TP] [BA4-6]
Viscosity at 77F	------	ASTM D3205-86	3	[BA1-3] [TP] [BA4-6]
Viscosity at 140F,275F	AE06		3	[BA1-3] [TP] [BA4-6]

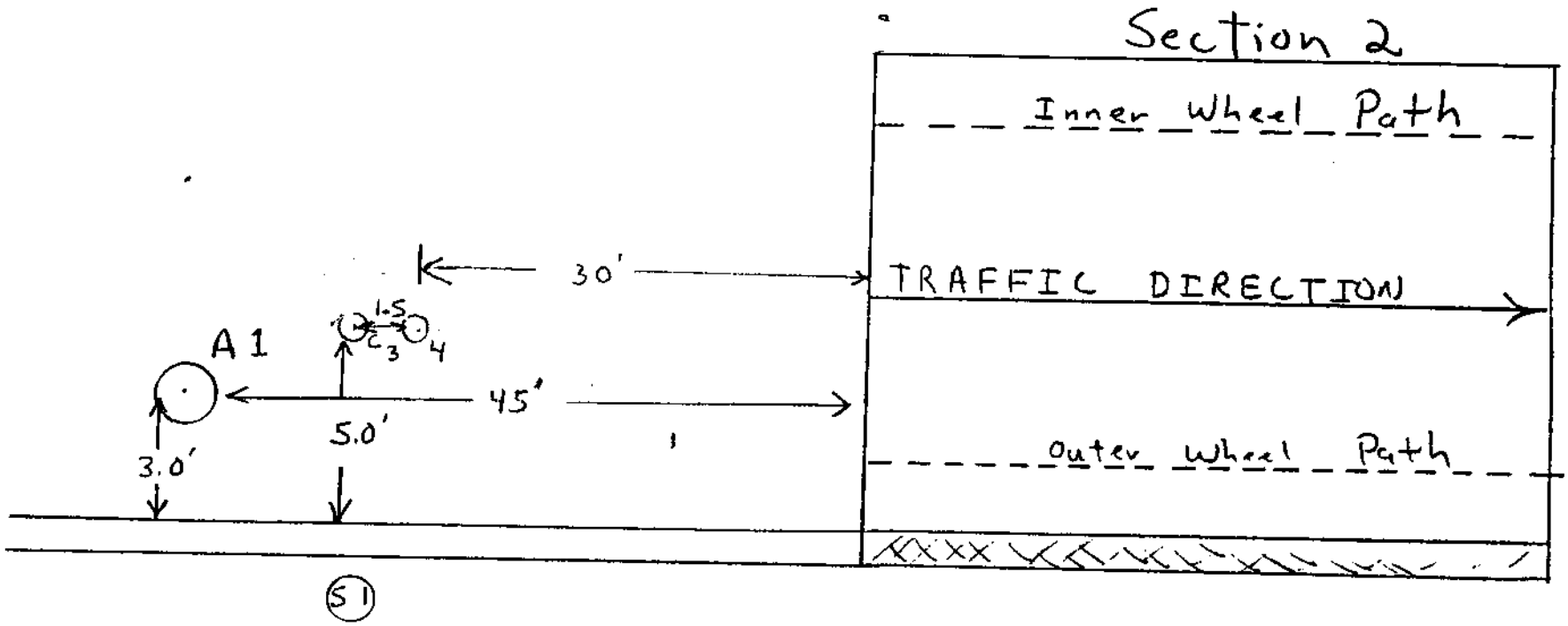
NOTES:
1. Moisture susceptibility will be assessed by visual means on cores split in the field.— size if raveled around edges is there a difference in integrity
2. Creep compliance will be performed when suitable procedures are developed -- cores will be stored.
3. National Aggregate Association will perform tests at no cost to the State.
4. Cores within brackets are from the same sampling location.

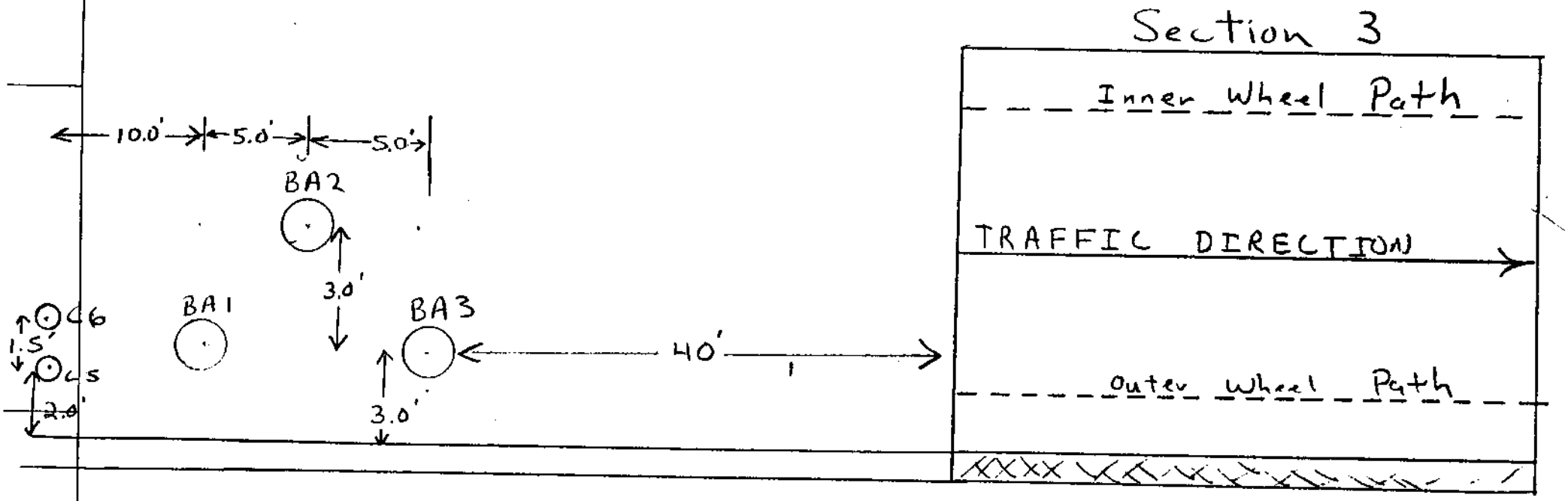
TABLE 1 cont'd

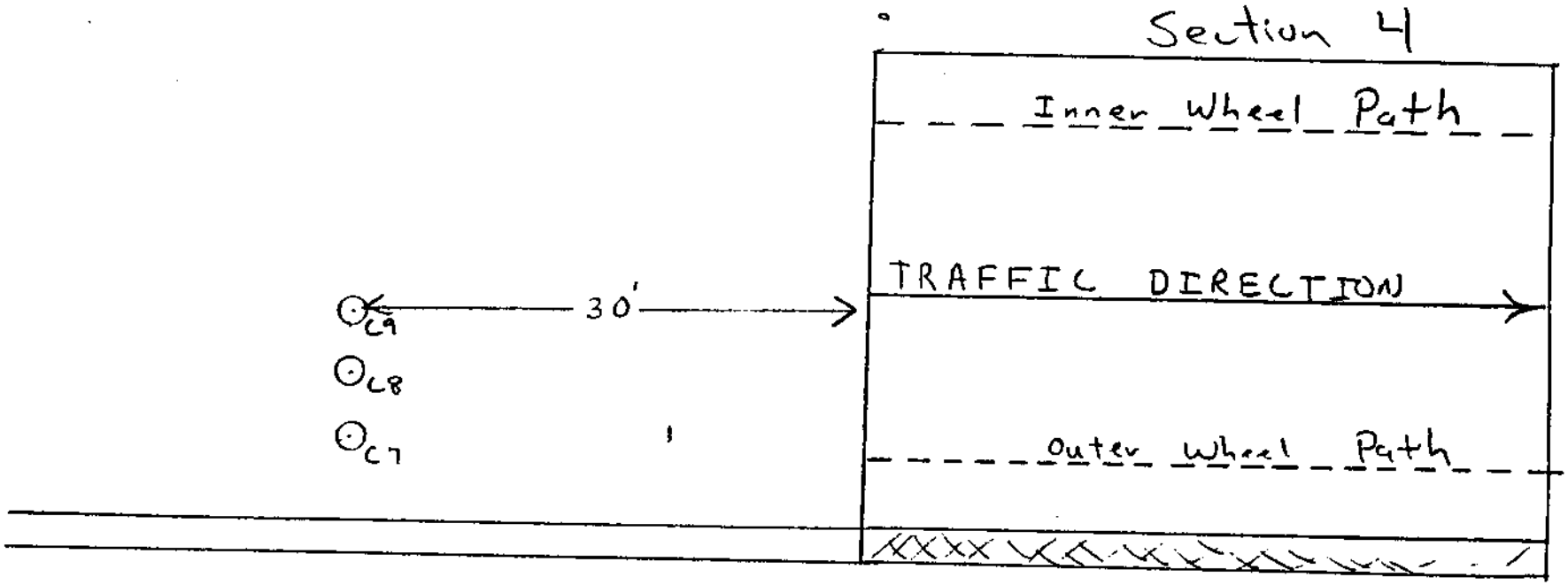
SPS-5 LABORATORY TESTING PLANS (PRE-CONSTRUCTION)

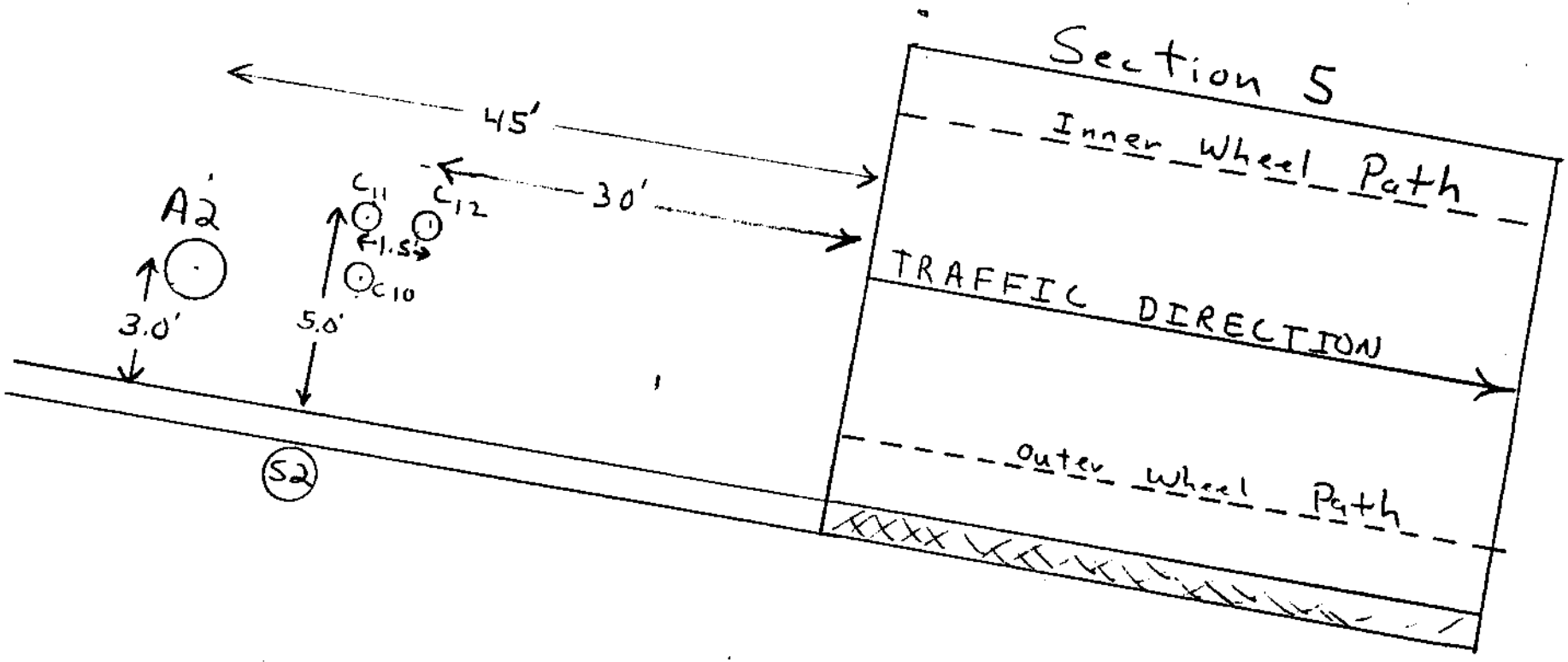
Material Type and Properties	SHRP Designation	SHRP GPS Protocol	Tests/Samples per Layer	Material Source/ Test Locations
II. BOUND (TREATED) BASE AND SUBBASE				
Type and Classification of Material and Treatment	TB01	P31	3	C3,C4 C14,C15 C23,C24
Pozzolanic/Cementitious: Compressive Strength	TB02	P32	3	C3,C4 C14,C15 C23,C24
Asphalt treated: Dynamic Modulus (77F)	TB03	P33	3	C3,C4 C14,C15 C23,C24
HMAC: Resilient Modulus	AC07	P07	3	C3,C4 C14,C15 C23,C24
III. UNBOUND GRANULAR BASE AND SUBBASE				
Particle Size Analysis	UG01	P41	3	[BA1-3] [TP] [BA4-6]
Sieve Analysis (washed)	UG02	P41	3	[BA1-3] [TP] [BA4-6]
Atterberg Limits	UG04	P43	3	[BA1-3] [TP] [BA4-6]
Moisture-Density Relations	UG05	P44	3	[BA1-3] [TP] [BA4-6]
Resilient Modulus	UG07	P46	3	[BA1-3] [TP] [BA4-6]
Classification	UG08	P47	3	[BA1-3] [TP] [BA4-6]
Permeability	UG09		3	[BA1-3] [TP] [BA4-6]
Natural Moisture Content	UG10	P49	3	[BA1-3] [TP] [BA4-6]
IV. SUBGRADE				
Sieve Analysis	SS01	P51	3	[BA1-3] [TP] [BA4-6]
Hydrometer to 0.001mm	SS02	P42	3	[BA1-3] [TP] [BA4-6]
Atterberg Limits	SS03	P43	3	[BA1-3] [TP] [BA4-6]
Classification	SS04	P52	3	[BA1-3] [TP] [BA4-6] A1 A2 A3
Moisture-Density Relations	SS05	P55	3	[BA1-3] [TP] [BA4-6]
Resilient Modulus	SS07	P46	3	[BA1-3] [TP] [BA4-6]
Unit Weight	SS08		3	[BA1-3] [TP] [BA4-6] A1 A2 A3
Natural Moisture Content	SS09	P49	3	[BA1-3] [TP] [BA4-6]
Depth to Rigid Layer			3	S1 S2 S3

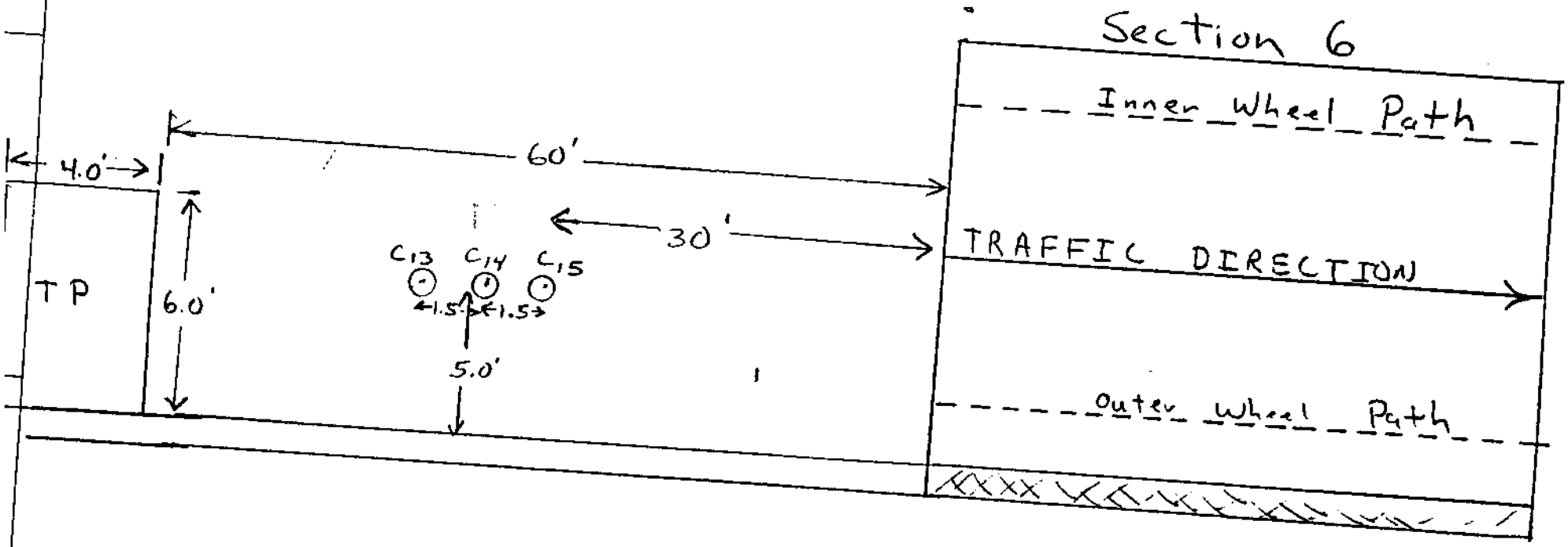

Section 1
Inner Wheel Path
TRAFFIC DIRECTION
Outer Wheel Path
C2
30'
5.0
C1
2.0'
SHOULDER

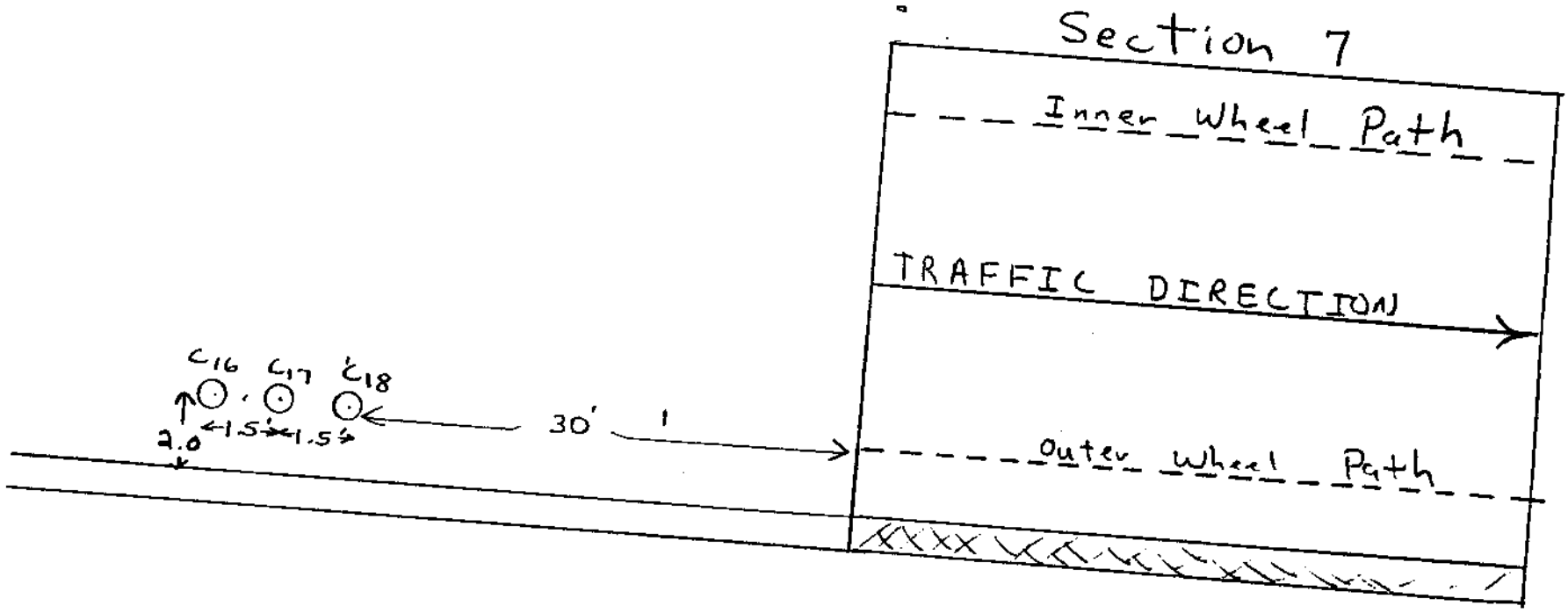

Section 2
Inner Wheel Path
30'
TRAFFIC DIRECTION
1.5
A 1
3
4
45'
5.0'
3.0'
Outer Wheel Path
S 1

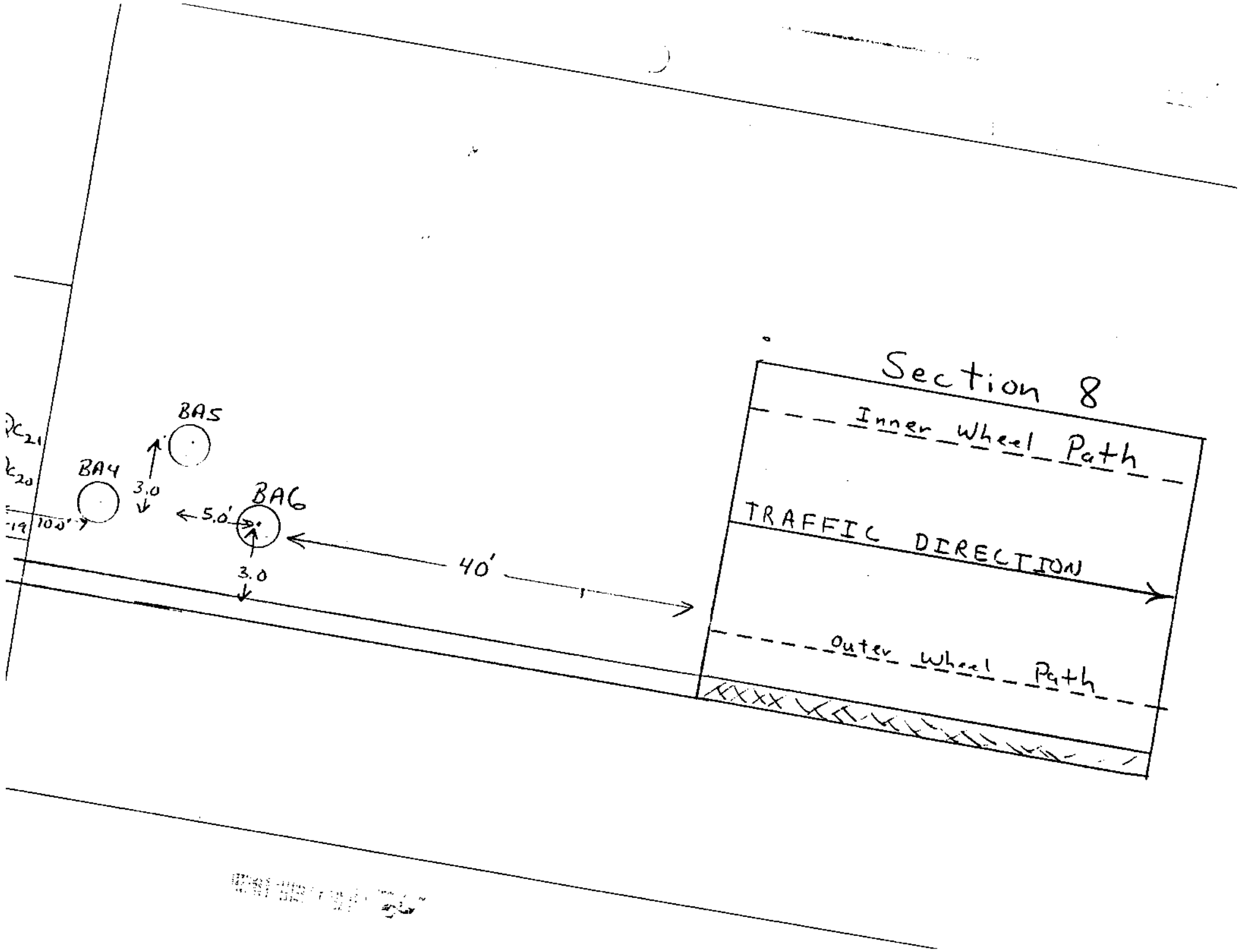

Section 3
Inner Wheel Path
TRAFFIC DIRECTION
Outer Wheel Path
10.0'
5.0'
5.0'
BA2
BA1
BA3
3.0'
3.0'
40'
1.5'
2.0'
6
5

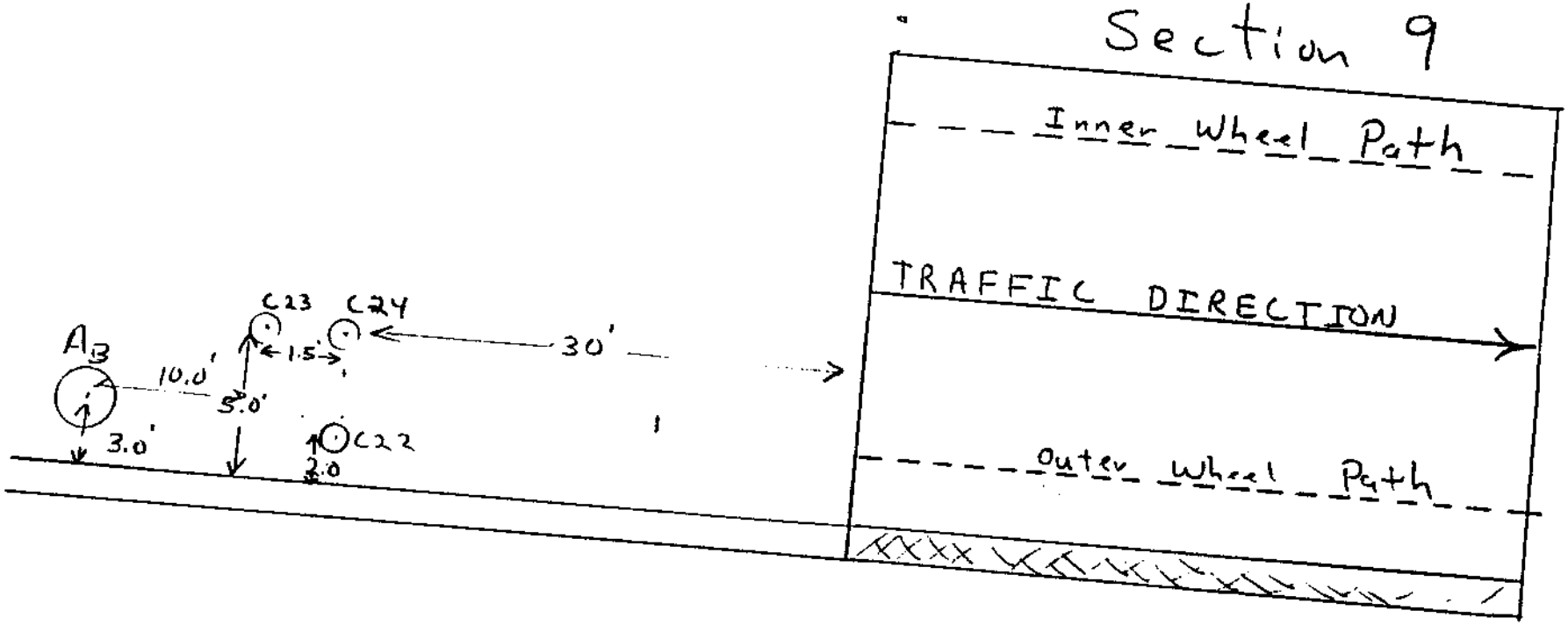

Section 4
Inner Wheel Path
TRAFFIC DIRECTION
30'
C9
C8
C7
Outer Wheel Path

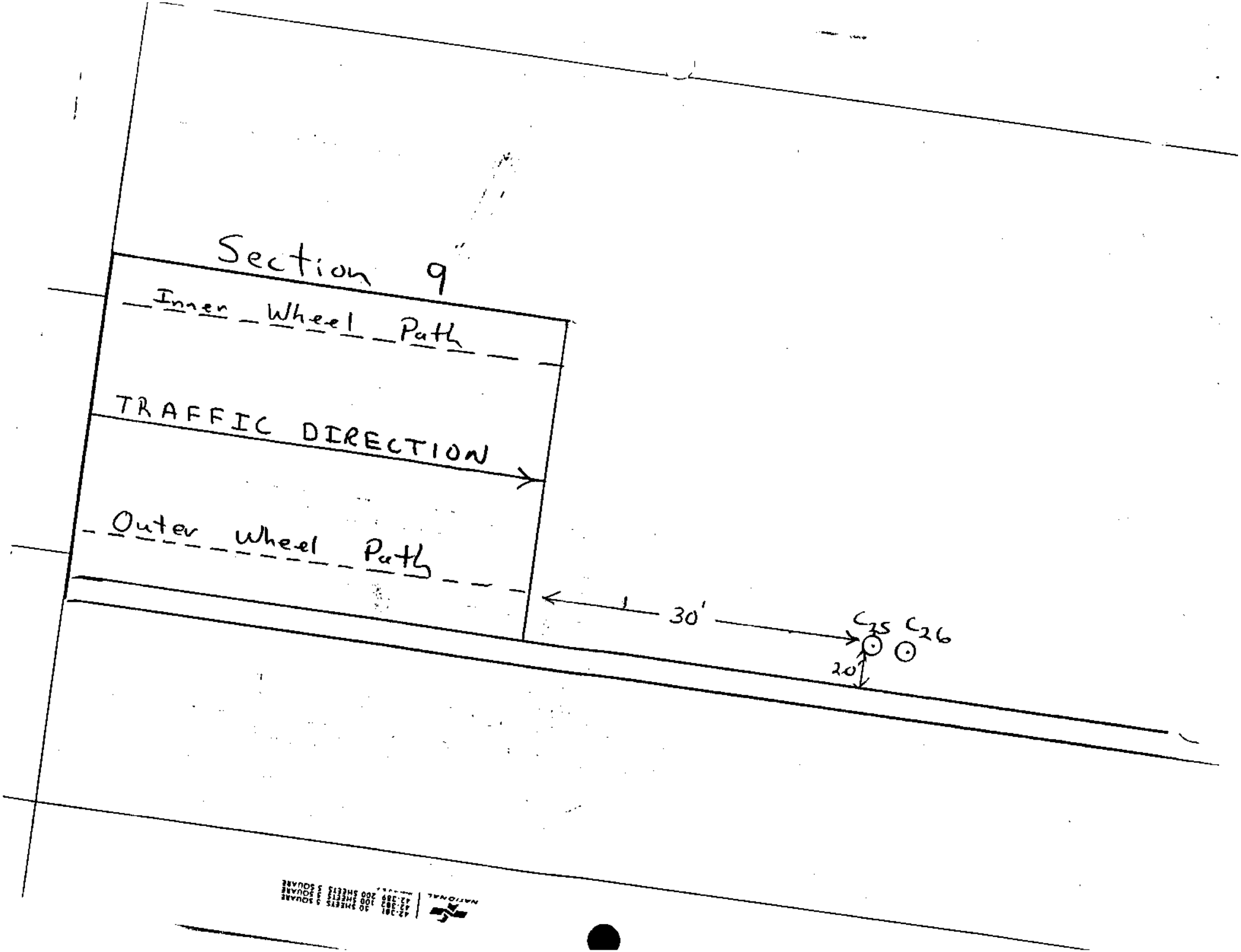

Section 5
Inner Wheel Path
TRAFFIC DIRECTION
Outer Wheel Path
45'
30'
A2
C11
C12
C10
1.5
3.0'
5.0'
S2


Section 6
Inner Wheel Path
TRAFFIC DIRECTION
Outer Wheel Path
60'
30'
4.0'
6.0'
TP
C13
C14
C15
1.5
1.5
5.0'


Section 7
Inner Wheel Path
TRAFFIC DIRECTION
Outer Wheel Path
C16
C17
C18
2.0
1.5
1.5
30'


Section 8
Inner Wheel Path
TRAFFIC DIRECTION
Outer Wheel Path
BA5
BA4
BA6
3.0
5.0'
3.0
40'
10.0'


Section 9
Inner Wheel Path
TRAFFIC DIRECTION
Outer Wheel Path
A3
10.0'
3.0'
5.0'
C23
C24
1.5'
30'
C22
2.0


Section 9
Inner Wheel Path
TRAFFIC DIRECTION
Outer Wheel Path
30'
20'
C25
C26

T.P. Removal of Pavement layers
Collection of Slabs; Nuclear Density and
Moisture Measurements on Unstabilized layers
and Subgrade.

Test #0	OLD	# Tests per layer	New	# Tests per layer
TP1	Extracted Ag		Extracted Ag	
	Specific G. Coarse, fine	4,4	Type And Class Coarse, Fine	3,3
	Type Agg and Class for Coarse and fine	4,4	Roundness index of Coarse	3,
			Aggregate particle shape	3,
	Gradation	4	Gradation	3
	AC		AC	
	Abson recovery, Pen. 77	4,4	Max Spec G., AC content	3,3
	Ductility 77, Spec. G.	4,4	Abson recovery, (pen 50,77 90)	3,3
	Ring and Boll Soft pt., Vis 77, 140	4,4,4	Spec G. (60°F), Vis cos 77, 140, 275	3,3,3,3
	BASE AND SUBBase		Base and Subbase	
	Particle size, Sieve Anal, Hydro,	4,4,4	Particle size, sieve	3,3
	Atterberg, Moisture-Density,	4,4	Atterberg, Moisture Density,	3,3
	? Lab CBR, Resi Mod	4,4	Resilient Mod, Class,	3,3
	Classif, Permeability, Nat M.C.	4,4,4	Permeability, Nat. M.C.	3,3
	Subgrade		Subgrade	
	Sieve Hydrometer, Atterberg	4,4,4	Sieve, Hydrom, Atterberg	3,3,3
	Classification, Moisture Density	4,4	Classification, Moisture Density	3,3
	Lab CBR, Resilient Mod, Unit wt	4,4,4	Resil, Mod, Unit wt	3,3
	Nat. M.C., Unconfined Comp St.	4,4	Natural mc Depth to rigid layer	3,3
TP2	"			

TEST PITS

Material Tested	SHRP DESIG	SHRP Prot. L.I.	Method	Test Samples per layer	Other
Asphalt Concrete					
Max. Spec G.	AC03	P03	AASHTO T209-82	4	
A.C. Content (Extraction)	AC04	P04	AASHTO T164-86	4	
Extracted Aggregate Type and Class.					
Coarse Ag. Roundness Index of Coarse	AG03		ASTM 2488-84	4	
Fine Aggregate	AG03		ASTM 2488-84	4	Nat'l Aggregate Assoc. performs at no cost to st.
NAA test for fine				4	
Agg. Part. Shape	AG05	P14A	NAA Test	4	No Information
Gradation	AG04	P14	AASHTO T30-87I	4	Nat'l Assoc. Assoc. perform at no cost to state
Asphalt Cement					
Absan Recovery	AE01		AASHTO T170-84	4	C.O. Lab
Pen. 50, 77°, 90 F	AE02		AASHTO T 49-87 I	4	" can't do pen @ 50
Spec. Grav 60°F	AE04		AASHTO T 228-87I	4	"
Viscosity @ 77°F			ASTM D3205-86	4	"
Viscosity @ 140, 275	AE06		AASHTO T202-84	4	"

TEST IT. (4)

Material Tested	SHRP Desig	SHRP Prot	Method	Test sample per layer.	Other
Sample for each					
(1) Unbound Base & SubBase (1)					
Particle size	UG01	P41	AASHTO T27-88I		
Sieve Analysis (washed)	UG02	P41	AASHTO T11-85		
Atterberg Limits	UG04	P43	AASHTO T89-87I		
Classification	SS04	P52	AASHTO M 145-82/ ASTM D2488-84		
Moisture Density	SS05	P44	AASHTO T99-86/ AASHTO T180-86		
Resilient Mod'	UG07	P46	AASHTO T274-82		30lbs x 2 = 60; 1 for base and 1 for Subba
Classification	UG08	P47	ASTM D2488-84		
Permeability	UG09		ASTM D2434-68(79)		5lbs x 2 = 10 1 for base " " " "
Nat. Mois. Content	UG10	P49	AASHTO T265-86		
Subgrade					
Sieve Analysis	SS01	P51	AASHTO T27-88I		
Hydrom. 0.001mm	SS02	P42	AASHTO T88-86		
Atter. Limits	SS03	P43	AASHTO T89-87I/ T90		
Classification	SS04	P52	AASHTO M145-82/ ASTM D2488-84		
Moisture Density Relations	SS05	P55	AASHTO T99-86/ AASHTO T180-86		
Resilient Modulus	SS07	P46	AASHTO T274-82		5lbs
Unit Wt.	SS08		SHRP-LTPP Method		Nuclear; according to Gene Skok 6-6-90
Natural Mois. Cont.	SS09	P49	AASHTO T265-86		
					S

○ 6" OD Core of A.C. Pavement

Augering of unstabilized Base and Subbase; Splitspoon Sampling and or shelby to 5.0' below subgrade.

TEST	OLD	# per lot	NEW	# per layer
A_1	thickness, Creep, Classification moisture Content.	6, 1, 6	6 moisture suscept., classification unit wt, thickness	3, 3, 3
A_2	thickness, Classification moisture Content.	6, 6 6	moisture suscept, classification unit wt. thickness	3, 3, 3
A_3	" " "		" moisture suscept, classification unit wt. thickness	3, 3, 3
A_4	" " "			
A_5	" " "		moisture susceptability – see if raveled around edges or there is a difference in integrity.	
A_6	" " "			
			classification; - UG08	
			Unit wt; - SS08	

UNDISTURBED | A HOLES

6 holes.

Material Tested	SHRP Desig.	SHRP GPS Protocol	Test Samples/layer	Method
ASPHALT CONCRETE			4	
moisture susceptibility				see if raveling around edges, visual
Thickness				
SUBGRADE				
classification	SS04	P52	4	AASHTO M145-82 - need hyd.
				ASTM D2488-84
unit weight	SS08			SHRP-LTPP Method -
moisture content				
Resilient Modu.				