Rehabilitation Performance Trends: Early Observations From Long-Term Pavement Performance (LTPP) Specific Pavement Studies (SPS)

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LTPP

FOREWORD

Among the more pressing questior pavement engineers are those related to the timing and effectiveness of different rehat strategies. Three of the Specific Pavement Studies (SPS) experiments within the Long Term Pavement Performance (LTPP) program (SPS-5, SPS-6, and SPS-7) were undertaken to address some of these questions. This report documents the findings of a first look at the performance of the SPS-5, -6, and -7 test sections after 3 to 4 years of service. While it is too early in the life of these test sections to draw definitive conclusions about their long-term performance, differences in the performance of the various strategies have been observed. In addition, problems that can lead to early failure of the rehabilitation treatments considered are identified.

This report will be of interest to all engineers involved in the rehabilitation of highway pavements. It will be of special interest to the States participating in the LTPP rehabilitation experiments.

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NOTICE

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16. Abstract

This report documents the early observations from the Long-Term Pavement Performance (LTPP) Specific Pavement Studies (SPS) conducted as part of the LTPP Program Data Insight conducted to identify initial findings from the test sections established for this program.

Comparisons of performance trends were made to evaluate both the distinctions between the various rehabilitation treatments and the performance of the individual treatments themselves based on their condition prior to the treatment.

Most of the rehabilitation strategies are still performing adequately after 3 to 4 years of service, as should be expected. Problems have been identified though that can definitely lead to early failures, such as mix design problems and reflective cracking problems. Even at this early point in the life of these rehabilitation strategies, differences in performance can be observed between treatments. With the continued monitoring of these sections, it is anticipated that the pavement community will continue to learn more and more about the performance of the various strategies and the effects of their design factors.

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yards	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
NOTE: Volumes greater than 1000 l shall be shown in m^3.				
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5(F-32)/9 or (F-32)/1.8	Celcius temperature	°C
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.71	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact)		
°C	Celcius temperature	1.8C + 32	Fahrenheit temperature	°F
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

* SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.

(Revised September 1993)

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CHAPTER 1. INTRODUCTION

As part of the Strategic Highway Research Program (SHRP) Long-Term Pavement Performance (LTPP) Studies, sections of highway are being selected to observe the performance of specific treatments in an effort to improve on the pavement design decisions of highway agencies. Several of these Specific Pavement Study (SPS) experiments target rehabilitation treatments specifically. Experiments for rehabilitation of asphalt concrete pavement (SPS-5), rehabilitation of jointed concrete pavements (SPS-6), and bonded portland cement concrete overlays (SPS-7) have each been designed as controlled experiments to evaluate a variety of "comparable" rehabilitation strategies. The experiments as they are currently designed will eventually contain 16 to 24 (for SPS-6) projects across the country for each of these experiments. All test sections for each SPS project are constructed by the same contractor. Fourteen of the sixteen asphalt rehabilitation projects (SPS-5) are already completed and have been in service for several years. The other two experiments (SPS-6 and SPS-7) do not have as many of the projects completed at this time; however, the design of these projects is such that each individual project provides a fairly substantial amount of information through comparisons of the performances for the various treatment applications applied within a given project.

Highway agencies are very eager to gain as much insight as they can from these various treatment applications. Several papers have been prepared in an attempt to address these needs (1,2). These very limited investigations using data available soon after construction of a few projects produced sufficient insight to heighten awareness of the potential that these projects hold over the long term.

This current study was initiated by the Federal Highway Administration (FHWA) to study any observable trends at this early point in the experiment that would be of value to the highway community. Specifically, this study was established to:

1. Obtain SPS-5, SPS-6, and SPS-7 data, as required, from the National Information Management System (NIMS) and the LTPP regional coordination offices.

2. Perform the necessary data processing to provide representative data for analysis purposes and to organize the data into a user-friendly "stand alone" data base.

3. Review the performance data for each of the projects to identify trends in performance. Comparisons of surface distress and profile (both longitudinal and transverse) have been made between treatments within a project and between projects to identify unique patterns of performance.

4. Conduct correlation studies to identify the significant factors that control the performance trends noted.

5. Identify analytical results for designers to consider in the selection of rehabilitation strategies and in their design. Provide recommendations for implementation of these results.

SPS-5 EXPERIMENT DESIGN

The specific products anticipated from the SPS-5 experiment are included in table 1 (3). In general, the experiment is intended to evaluate some of the more common asphalt rehabilitation techniques currently used by State Highway Agencies (SHA's). The experimental factors include the condition of the pavement before overlay (both structurally and functionally), the loading conditions the section is exposed to (including both environment and traffic), and the various treatment applications. The standard SPS-5 experiment design consists of nine test sections, as shown in table 2 (3). Each column represents a specific project and each cell represents a specific test section. The test sections include:

1. Four 152.5-m- (500-ft-) long asphalt concrete pavement rehabilitation sections with milling prior to overlay and four without milling, and one control section that is neither milled nor overlaid.

2. Two of the milled sections are overlaid with recycled asphalt concrete mix and two are overlaid with virgin asphalt concrete mix. Similarly, two of the unmilled sections are overlaid with recycled asphalt concrete mix and two are overlaid with virgin asphalt concrete mix.

3. For each set of two overlays (as described above), one is placed with a thickness of 51 mm (2 in) and the other is placed with a thickness of 127 mm (5 in).

Table 1. Key products expected from SPS-5 data analyses.

Product No.	**Description**
1	Comparisons and development of empirical prediction models for performance of asphalt concrete (AC) pavements with different intensities of surface preparation, with thin and thick AC overlays, and with virgin and recycled AC overlay mixtures.
2	Evaluation and field verification of the *American Association of State Highway and Transportation Officials (AASHTO) Guide* design procedures for rehabilitation of existing AC pavements with AC overlays, and other analytical overlay design procedures for AC pavements.
3	Determination of appropriate timing to rehabilitate AC pavements in relation to existing condition and type of rehabilitation procedures.
4	Development of procedures to verify and update the pavement management and life-cycle cost concepts in the *AASHTO Guide* using the performance prediction models developed for rehabilitated AC pavements.
5	Development of a comprehensive data base on the performance of rehabilitation AC pavements for use by State and provincial engineers and other researchers.

Table 2. Experimental design for SPS-5, Rehabilitation of Asphalt Concrete Pavements.

REHABILITATION PROCEDURES			FACTORS FOR MOISTURE, TEMPERATURE, AND PAVEMENT CONDITION															
LEVEL OF SURFACE PREPARATION	OVERLAY MATERIAL	OVERLAY THICKNESS	WET								DRY							
			FREEZE				NO FREEZE				FREEZE				NO FREEZE			
			FAIR		POOR		FAIR		POOR		FAIR		POOR		FAIR		POOR	
Routine Maint. (Control)		0"					X											
MINIMUM	Recycled AC	2"					X											
		5"					X											
	Virgin AC	2"					X											
		5"					X											
INTENSE	Recycled AC	2"					X											
		5"					X											
	Virgin AC	2"					X											
		5"					X											

1 in = 25.4 mm

Subgrade Soil: Fine

Traffic: > 85k Equivalent Single Axle Loads (KESAL)/year

X = One section of an SPS-5 project

As part of the experiment design, a control section to which no treatments were applied was also established to provide for comparisons with the other test sections. In table 2, "intensive surface preparation" denotes those sections where 51 mm (2 in) of the surface were milled off and patching was done where needed to rectify localized failures. "Minimum surface preparation" indicates that only patching was done. As part of the experiment, it was specified that the recycled mixture contain 30 percent of Recycled Asphalt Pavement (RAP) and that the RAP material was to be the material milled from the intensive surface preparation sections.

Each test section has an identifying number that is common for all projects, which indicates its characteristics as follows:

Number	Description
501	Control (no treatment)
502	51-mm (2-in) overlay, recycled mix
503	127-mm (5-in) overlay, recycled mix
504	127-mm (5-in) overlay, virgin mix
505	51-mm (2-in) overlay, virgin mix
506	51-mm (2-in) overlay, virgin mix, with milling
507	127-mm (5-in) overlay, virgin mix, with milling
508	127-mm (5-in) overlay, recycled mix, with milling
509	51-mm (2-in) overlay, recycled mix, with milling

SPS-6 EXPERIMENT DESIGN

The specific products anticipated from the SPS-6 experiment are included in table 3 (4). This experiment parallels the SPS-5 experiment by investigating some of the more common concrete rehabilitation techniques currently used by SHA's, including hot-mix asphalt concrete (HMAC) overlays, but not portland cement concrete (PCC) overlays. The factors for this experiment include the condition of the pavement before overlay, the loading conditions the section is exposed to (including both environment and traffic), and the various treatment applications. The standard SPS-6 experiment design consists of eight test sections, as shown in table 4 (4). Each column represents a specific project and each cell represents a specific test section. The test sections include:

1. Two 305-m- (1000-ft-) long concrete pavement restoration sections, one with retrofitted edge drains and one without.

2. Two test sections with the existing pavement broken and seated, one receiving a 102-mm (4-in) asphalt overlay and the other receiving a 203-mm (8-in) asphalt overlay.

3. Three sections with 102-mm (4-in) asphalt overlays placed on the existing Jointed Concrete Pavement (JCP), one with retrofitted edge drains, one for which joints were sawed in the asphalt overlay directly above the existing concrete joints and were then resealed with hot-poured rubber asphalt, and one conventional overlay.

The types of concrete restoration include minimum restoration, maximum restoration [Concrete Pavement Restoration (CPR)], and crack/break and seat. Minimum restoration consists of routine maintenance, including limited patching, crack repair and sealing, and stabilization of joints. Maximum restoration consists of activities performed depending on distress level and condition. The activities may include grinding, subsealing, subdrainage retrofit, joint repair and sealing, full-depth patching, restoration of load transfer, and shoulder rehabilitation. Surface grinding and joint and crack repair were not performed on sections receiving an AC overlay.

As part of the experiment design, a control section that had no treatments applied was also established to provide for comparisons with the other test sections.

Table 3. Key products expected from SPS-6 data analyses.

Product No.	Description
1	Comparisons and development of empirical prediction models for performance of rehabilitated jointed plain concrete (JPC) and jointed reinforced concrete (JRC) pavements with different methods of surface preparation, with and without AC overlays, with sawed and sealed joints, with crack/break-and-seat preparation and different AC overlay thicknesses, and with and without retrofitted drainage.
2	Evaluation and field verification of *AASHTO Guide* design procedures for rehabilitation of existing JPC and JRC pavements with and without AC overlay, and other analytical overlay design procedures for JPC and JRC pavements.
3	Determination of appropriate timing to rehabilitate JPC and JRC pavements in relation to existing conditions and type of rehabilitation procedures.
4	Development of procedures to verify and update the pavement management and life-cycle cost concepts in the *AASHTO Guide* using the performance prediction models developed for rehabilitated JPC and JRC pavements.
5	Development of a comprehensive data base on the performance of rehabilitated JCP for use by State and provincial engineers and other researchers.

Table 4. Experimental design for SPS-6, Rehabilitation of Jointed Portland Cement Concrete Pavements.

REHABILITATION PROCEDURES		FACTORS FOR MOISTURE, TEMPERATURE, PAVEMENT TYPE, AND PAVEMENT CONDITION													
		WET FREEZE				WET, NO FREEZE				DRY FREEZE				DRY, NO FREEZE	
		PCCP		JRCP		JPCP		JRCP		JPCP		JRCP		JPCP	
SURFACE PREPARATION	OVERLAY THICKNESS	FAIR	POOR	FAIR	POOR	FAIR	POOR	FAIR	POOR	FAIR	POOR	FAIR	POOR	FAIR	POOR
Routine Maintenance (Control)	0		X												
Minimum Restoration	0		X												
	4"		X												
	4" *		X												
Maximum Restoration (CPR)	0		X												
	4"		X												
Crack/Break and Seat	4"		X												
	8"		X												

1 in = 25.4 mm
* With sawed AC overlay joints above JCP joints and seal
Subgrade soil = fine
Traffic ≥ 200 KESAL/Year
X = One section of an SPS-6 project

Each test section has an identifying number that is common for all projects, which indicates its characteristics as follows:

Number	Description
601	Control (minimum maintenance)
602	Minimum Concrete Pavement Restoration (CPR) and no overlay
603	Minimum CPR and a 102-mm (4-in) AC overlay
604	Minimum CPR, 102-mm (4-in) AC overlay, sawed AC overlay joints above JCP joints, and joint sealing
605	Maximum CPR with edge drains and no overlay
606	Maximum CPR, a 102-mm (4-in) overlay, and edge drains
607	JCP cracked and seated, with a 102-mm (4-in) overlay
608	JCP cracked and seated, with a 203-mm (8-in) overlay

SPS-7 EXPERIMENT DESIGN

Like the SPS-6 experiment, this investigation concerns portland cement concrete pavement rehabilitation; however, this study focuses on the performance of bonded portland cement concrete overlays instead of asphalt concrete. The key products expected from this study include:

1. Evaluation of existing design methods.

2. Determination of the effects of specific design features on pavement performance.

3. Development of a comprehensive data base for use by State and provincial engineers and other researchers.

The factors for this experiment include the loadings that the section is exposed to (including both environment and traffic), surface preparation techniques and bonding materials, type of PCC pavement type being overlaid, and the various overlay thicknesses. The standard SPS-7 experiment design consists of nine test sections, as shown in table 5 (5). The test sections include:

1. Four 152.5-m- (500-ft-) long portland cement concrete pavement rehabilitation sections with milling prior to overlay and four sections with shot-blasting prior to overlay.

2. Two of the milled sections had a grout bonding agent applied before overlay and two did not. Similarly, two of the shot-blasted sections had a grout bonding agent applied and two did not.

3. For each set of two overlays (as described above), one is placed with a thickness of 76 mm (3 in), and one is placed with a thickness of 127 mm (5 in).

As part of the experiment design, a control section, to which no treatments were applied, was also established to provide for comparisons with the other test sections.

Each test section has an identifying number that is common for all projects, which indicates its characteristics as follows:

Number	Description
701	Control (routine maintenance and no overlay)
702	Milled surface grouted and a 76-mm (3-in) overlay
703	Milled surface not grouted and a 76-mm (3-in) overlay
704	Surface shot-blasted, not grouted, and a 76-mm (3-in) overlay
705	Surface shot-blasted and grouted, and a 76-mm (3-in) overlay
706	Surface shot-blasted and grouted, and a 127-mm (5-in) overlay
707	Surface shot-blasted, not grouted, and a 127-mm (5-in) overlay
708	Milled surface not grouted and a 127-mm (5-in) overlay
709	Milled surface grouted and a 127-mm (5-in) overlay

Table 5. Experimental design for SPS-7, Bonded Portland Cement Concrete Overlays.

Rehabilitation Procedures			Factors for Moisture, Temperature, and Type of PCC Pavement							
			Wet				Dry			
Surface Preparation	Grout	Overlay Thickness	Freeze		No Freeze		Freeze		No Freeze	
			Traffic Rate = 200 KESAL/year							
			JCP	CRCP*	JCP	CRCP	JCP	CRCP	JCP	CRCP
Cold Milling Plus Sand Blasting	No	3″								
		5″								
	Yes	3″								
		5″								
Shot-Blasting	No	3″								
		5″								
	Yes	3″								
		5″								

*CRCP: Continuously Reinforced Concrete Pavement
1 in = 25.4 mm

LIMITATIONS

In performing these investigations, two limitations have been identified that should be taken into consideration. The first restriction is the age of these rehabilitation projects. The oldest project is an SPS-6 project constructed in the fall of 1989. Table 6 shows the projects included in these investigations, their construction dates, and other pertinent features. Since many of these projects are only 3 or 4 years old, a full range of performance is not yet available, so the data available for analysis are limited to these early observations of the various projects.

The second restriction is that data for many of these projects are still in various stages of processing. As an example, data from materials testing and traffic and climatic data since 1991 are not yet available for these projects. Performance data are generally available, but the overall data shortcomings limit these analyses to the trend studies reported.

These limitations were anticipated, however, which allowed the studies to be tailored to glean as much as possible out of the data now available. Although performance data from future observations will allow much more thorough analyses, results from the study of these early observations should prove quite beneficial.

Table 6. Specific pavement study rehabilitation projects to date.

			REHAB DATE	Original Layer Thicknesses (mm)				Subgrade Type	Original Surface Type	Condition Prior to Overlay	Environmental Data Annual Averages								
				TS	GB	TB	SURF				Rain	32	90	Wet	High	FRZT	FIND	MAX	MIN
a. SPS-5																			
Alabama	(AL)	1	Dec-91	0	272	0	94	Clayey Sand	ACP	Poor	54	31	66	139	34	34	20	77	54
Arizona	(AZ)	4	May-90	0	361	0	127	Silty Gravel	ACP	Poor	7	6	182	42	3	10	0	88	59
California	(CA)	6	May-92	Not Available					ACP	Poor	13	18	58	32	7	22	12	26	6
Colorado	(CO)	8	Oct-91	0	0	91	170		ACP	Fair	16	168	29	92	7	156	660	65	33
Florida	(FL)	12	Apr-95	0	683	0	81	Sand	ACP	Poor	56	1	50	190	32	1	0	83	65
Georgia	(GA)	13	Jun-93	0	737	0	467	Clayey Silt	ACP	Fair	50	66	34	141	33	68	104	71	48
Maine	(ME)	23	Jun-95	Not Available					ACP	Poor	44	170	2	172	25	108	1534	53	32
Maryland	(MD)	24	Jun-92	152	147	107	112	Silt	ACP	Fair	38	89	31	122	23	86	217	67	45
Minnesota	(MN)	27	Oct-90	0	457	0	90	Silty Clay	ACP	Fair	26	184	4	113	15	91	2624	50	28
Mississippi	(MS)	28	Sep-90	150	0	0	320	Silty Clay	ACP	Poor	54	56	68	110	35	59	45	76	50
Montana	(MT)	30	Sep-91	0	457	0	130	Clayey Gravel	ACP	Fair	15	148	28	82	6	128	841	61	34
New Jersey	(NJ)	34	Aug-92	0	254	0	241	Clayey Sand	ACP	Fair	47	103	12	143	30	90	386	63	43
Texas	(TX)	48	Sep-91	203	0	376	234	Fat Clay	ACP	Fair	37	39	92	106	24	41	69	76	53
Alberta	(AB)	81	Oct-90	0	295	74	165	Clayey Gravel	ACP	Fair	19	200	0	130	7	112	2411	48	26
Manitoba	(MB)	83	Sep-89	0	257	0	137	Silty Clay	ACP	Poor	20	192	5	113	9	78	3350	47	25
b. SPS-6																			
Arizona	(AZ)	4	Oct-90	0	246	79	201	Sandstone	JPCP	Poor	14	149	40	77	6	157	97	71	36
California	(CA)	6	Nov-92	Not Available					JPCP	Poor	50	129	32	106	31	143	70	66	36
Illinois	(IL)	17	Jun-90	0	0	76	254	Sandy Clay	JRCP	Poor	38	122	16	148	22	90	792	62	41
Indiana	(IN)	18	Aug-90	0	0	76	254	Sandy Clay	JPCP	Poor	38	123	12	160	20	86	773	60	40
Iowa	(IA)	19	Sep-89	0	58	0	20	Sandy Clay	JRCP	Fair	33	148	12	117	20	91	1400	58	36
Michigan	(MI)	26	Aug-90	0	356	0	229	Clay	JRCP	Fair	33	161	5	154	17	106	1211	56	34
Missouri	(MO)	29	Aug-92	0	107	0	231	Sandy Clay	JRCP	Poor	36	129	25	119	22	99	874	63	40
Oklahoma	(OK)	40	Aug-92	0	419	0	224	Silt	JRCP	Fair	33	87	69	102	20	77	321	70	47
Pennsylvania	(PA)	42	Sep-92	Not Available					JRCP	Fair	42	149	1	198	19	108	930	57	36
South Dakota	(SD)	46	Sep-92	0	0	102	178	Silty Clay	JPCP	Fair	22	164	19	89	12	101	1736	56	34
c. SPS-7																			
Iowa	(IA)	19	Sep-92	0	711	0	203	Clay	CRCP		33	148	12	117	20	91	1400	58	36
Louisiana	(LA)	22	Apr-92	132	0	86	206	Lean Clay	CRCP		68	29	71	125	41	33	13	78	55
Minnesota	(MN)	27	Oct-90	0	559	0	203	Clay	CRCP		25	178	6	122	12	87	2517	52	29
Missouri	(MO)	29	Jul-90	0	102	0	203	Sandy Clay	JPCP		38	105	34	124	23	86	549	66	43

ACP: Asphalt Concrete Pavement
TS: Treated Subgrade
GB: Granular Base
TB: Treated Base
SURF: Surface

1 in = 25.4 mm
Rain: Annual Rainfall (in)
32: Number of Days Below 32°F
90: Number of Days Above 90°F
WET: Number of Days With Precip.
HIGH: Number of Days With Heavy Precip.

°C = (°F - 32)/1.8
FRZT: Number of Freeze/Thaw Cycles
FIND: Freeze Index
MAX: Avg. Monthly Max. Temp. (°F)
MIN: Avg. Monthly Min. Temp. (°F)

CHAPTER 2. DATA BASE DEVELOPMENT

COLLECTION OF DATA

The first step in this process was the determination of exactly which of the data elements should be included and how they can best be represented. The LTPP IMS (NIMS) currently houses five different kinds of data. These include traffic, climatic, materials and inventory (static with time), monitoring, and maintenance and rehabilitation data.

For the General Pavement Study (GPS) sites, traffic data currently available consist of historical estimates of traffic (by the SHA's) from the time of the last major rehabilitation to 1989, plus monitored traffic data through 1993. SPS projects should have monitored traffic data from the date the construction was completed. At this time, these data are not accessible for these SPS projects. However, comparison of performance trends between test sections in a specific project does not require traffic data, as each test section receives the same traffic, even though the 80-kN (18-kip) equivalent single axle loads (ESAL's) are not identified numerically.

Climatic data consist of annual rainfall, annual freeze/thaw cycles, annual freeze index, number of days with the minimum temperature less than 0°C (32°F) by month, number of days with the maximum temperature greater than 32°C (90°F) by month, monthly averages of minimum and maximum temperatures and monthly precipitation for all 12 months. Although these data have not yet been specifically quantified for SPS projects, climatic data have been collected and processed for each of the GPS test sections. With the assistance of each of the Regional Coordination Offices, representative GPS sections were identified and their climatic data were used to estimate the climatic data for use in these evaluations. Specifically, the climatic data have been summarized to include: average annual precipitation, average number of days with the minimum temperature below freezing, average number of days with the maximum temperature greater than 32°C (90°F), annual freeze index, average daily temperature range determined from the monthly average, monthly maximum and minimum temperatures, the average daily maximum temperature for the summer, and the average daily minimum temperature for the winter. As no additional environmental data have been collected since the contractor reduced it for the early GPS analyses in 1993, these same data were used for this study. This assumed that mean climatic history (representing the 30 years of data in the climatic data base) may approximate the environmental conditions for the years since the climatic data base was developed.

Performance data utilized for these studies included deflections measured by a Falling-Weight Deflectometer, roughness calculated from longitudinal profile measured with a profilometer, manual (visual) distress surveys, and automated distress surveys and transverse profiles (performed by using a PASCO Road Recon Unit). The data collected prior to construction were of major importance, as performance of the various rehabilitation treatments was found to be heavily correlated to the condition prior to treatment application.

ORGANIZATION OF DATA

It was originally proposed that the data be processed into separate tables to represent the four climatic regions, with an additional table containing all regions combined for those sections in either fair or poor condition prior to treatment. Anticipating the need to update the data base periodically, however, and recognizing the limited number of sections that will ultimately be associated with each experiment, the decision was made to use tables of data sorted by data type, similar to the format currently employed by the NIMS. By adopting this structure, the tables can be readily updated in the future without the need for considerable processing to accommodate the user-friendly interface. Tables have been established by experiment that contain the following data types: manual pavement surface distress data, pavement surface distress data reduced from PASCO photographs, longitudinal roughness calculated from profile measurements, transverse profile data, and project "construction" data.

The table of rehabilitation data is currently limited to the date of construction. As previously discussed, this should be sufficient for the performance trend analysis; however, additional data may ultimately be desired for incorporation in the User-Friendly Data Base.

Information such as mix designs; rolling patterns; in situ densities; placement temperatures; or details associated with miscellaneous operations such as milling, cracking and seating, and edge drain installation will ultimately be desirable.

For each of the sections, all "lifts" of an overlay have been combined into one layer, the "original" bound layers are represented by another layer, and all unbound base and subbase layers are treated as one layer. Stabilized bases and subbases were also combined into one layer if the stabilizing agent is the same; otherwise, it was necessary to leave them as separate layers. This reduces the pavement structure to fewer layers to allow reasonable consideration of the effects on performance of the various layers and their characteristics.

The NIMS currently contains numerous data elements in English units and numerous others in the International System of Units (SI), otherwise known as the metric system. The data base created here has been constructed to convert all data elements to SI units for display and analysis.

USER-FRIENDLY INTERFACE

In processing all of the data assembled for consideration in these investigations, a convenient mechanism to facilitate future access to a data base of these SPS projects was considered essential. As previously noted, each of the various data types is currently stored in a separate table. Combining all of these data into one or more files for analysis was at first considered a must, but this presented several problems that the research team considered significant, but avoidable. Considerable processing and manipulation of the data would be required to generate the various files originally proposed.

Recognizing that this effort would need to be repeated every time a researcher wanted to take advantage of updates in the NIMS, it was considered preferable to automate this data processing in such a way that when the user was interested in referencing the data, he or she could do so readily. Working from this concept, a Windows-based interface has been created that allows the user to select the site of interest from a map, click on the various data types of interest (currently, distress, profile, materials, construction, environment, and peak deflections), and then select the mode of display (or presentation). The interface can present the data graphically or in tabular form. The user can elect to output the data onto the screen, into a file, or using a printer.

Figure 1 shows the entry screen to the Rehab Trends interface. On entry into the system, a map is provided to select the project of interest (figure 2). With the selection of a project, the user is then offered a choice of data and viewing mediums. After the data type and viewing medium have been selected (figure 3), the user is given the opportunity to identify the sections within an SPS project for which data are desired (figure 4). From this screen, the system proceeds to the display of the data (figure 5).

Although the data base is currently designed to interface with tables created from data downloaded off the NIMS, it is believed that the software could be enhanced to interface directly with the various tables incorporated in the NIMS. Users with a "read only, direct line" could then request, review, and/or collect data from the complicated collection of NIMS tables.

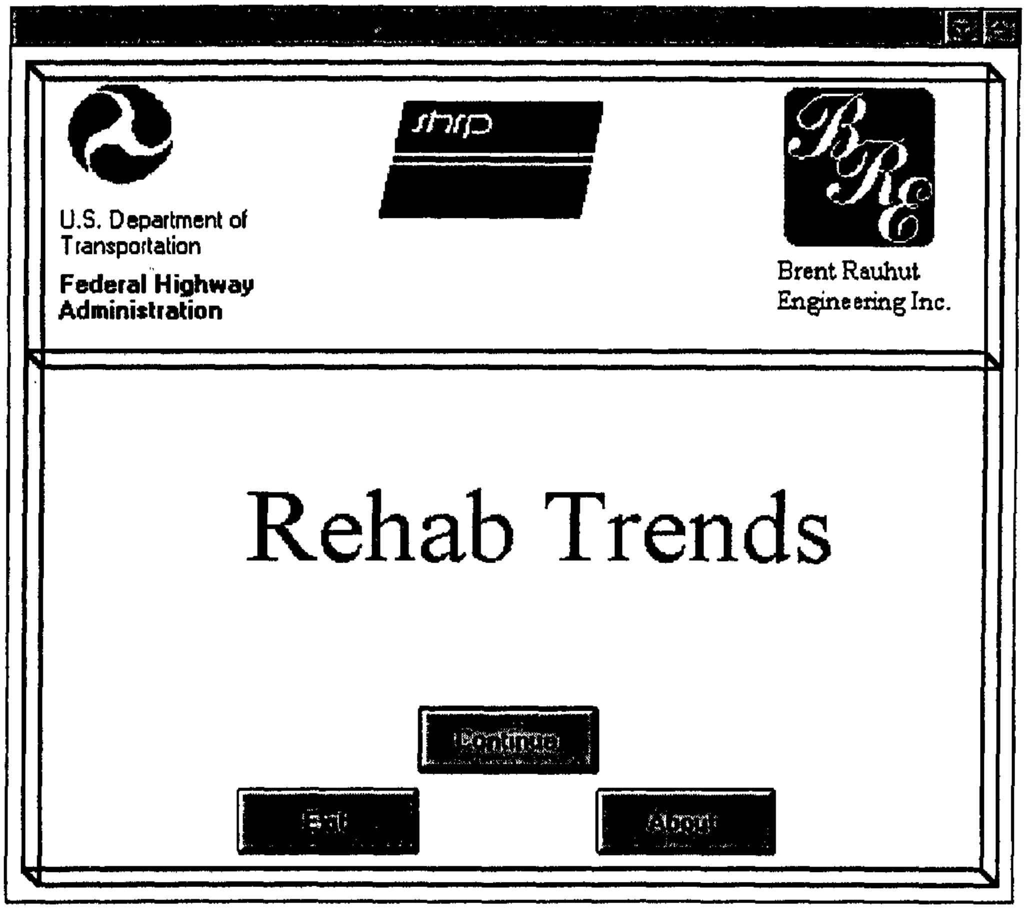


Figure 1. Entry screen to Rehab Trends interface.

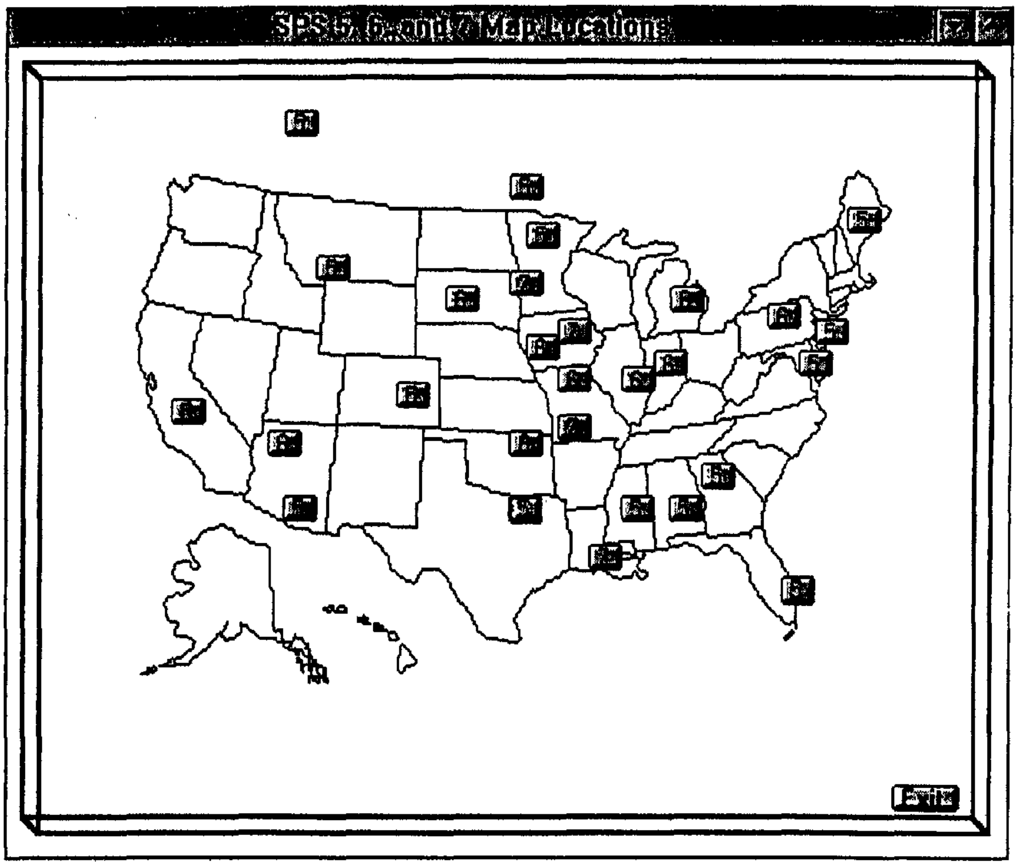


Figure 2. Map of SPS rehabilitation project locations for selection of project.

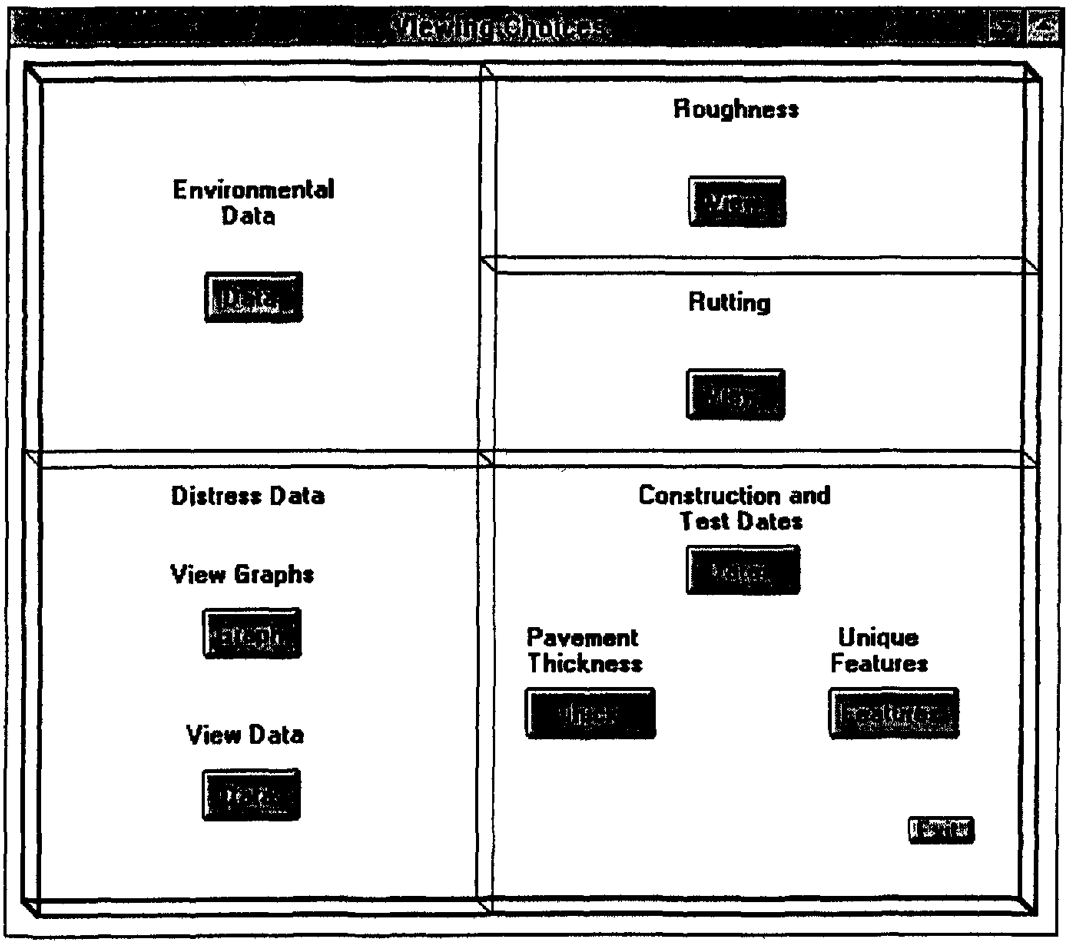


Figure 3. Viewing choices.

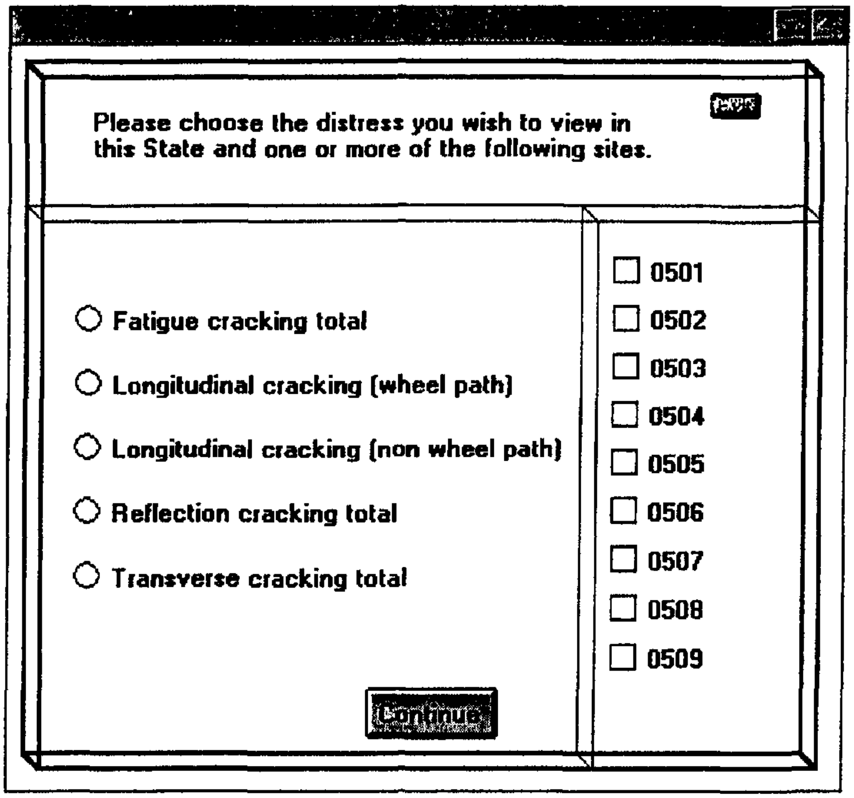


Figure 4. Section and distress type selection screen.

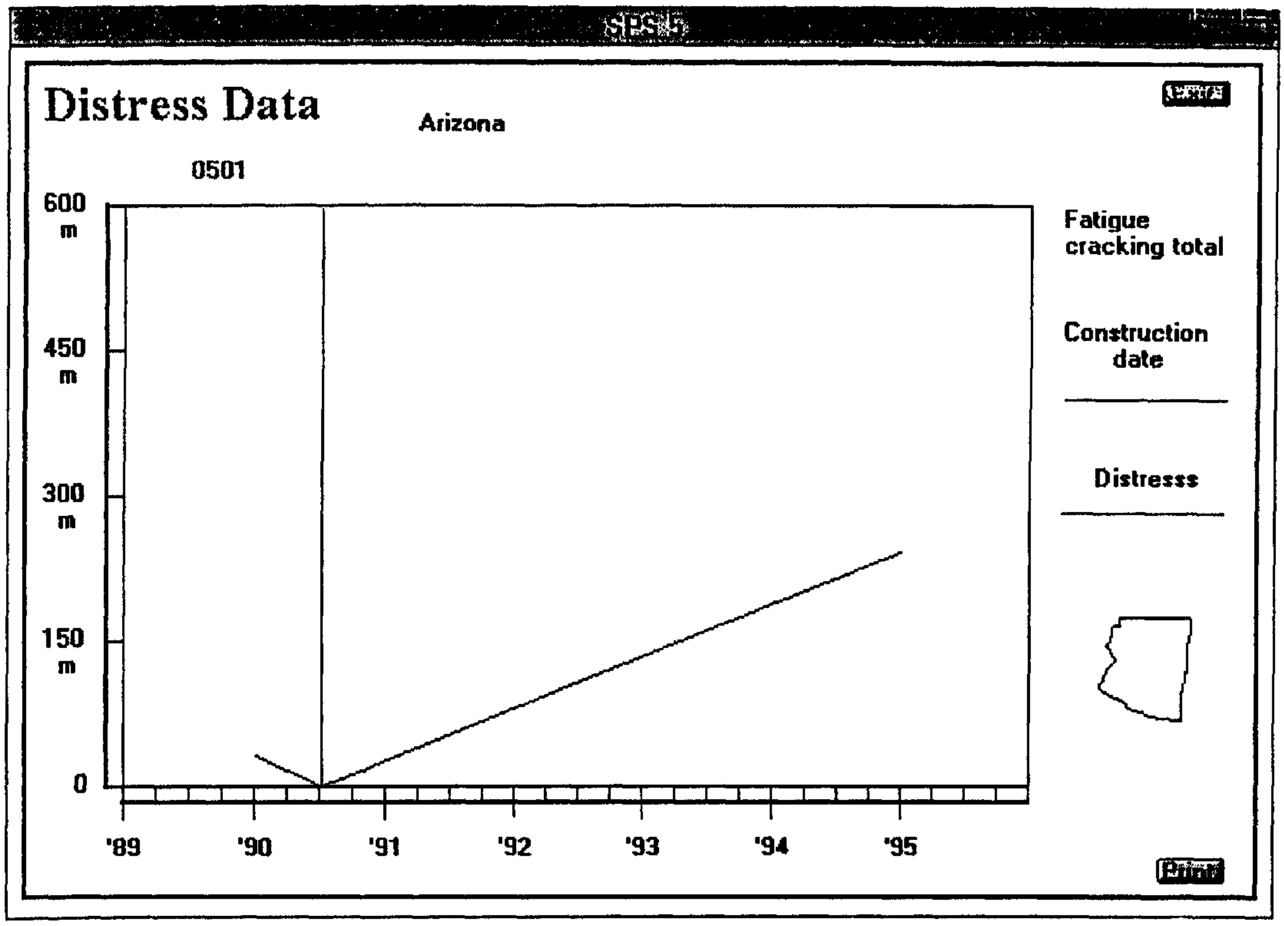


Figure 5. Graphical display of distress data.

CHAPTER 3. PERFORMANCE COMPARISONS

To evaluate the performance trends for the rehabilitation studies, plots were generated of the significant performance indicators versus time. As previously discussed, time was selected instead of traffic, due to limited traffic data. Through study of these plots of the performance data collected to date, one can begin to identify patterns in the performance for the different rehabilitation strategies. The primary performance indicators evaluated here include surface distress, roughness, permanent deformation (rutting) where applicable, and deflections. The results from studies of each of the SPS experiments are discussed separately.

Each plot includes the performance before and after rehabilitation (where available), along with some indication of the date of rehabilitation. For surface distress and mechanical deformation, this is indicated by the performance measure dropping to zero. For roughness and deflection, the rehabilitation date is depicted by a vertical line at that date. In those cases where some portions of the performance data were not available (for whatever reason), some insight as to the performance for specific rehabilitation techniques was obtained by comparing the performance of rehabilitated test sections to that of the control test section. All plots were produced using common scales and common groupings of test sections to facilitate comparisons (e.g., performance data test sections for SPS-5 overlaid with virgin AC were plotted together with those for the control section, and separate plots were produced for the test sections incorporating RAP in the overlay). Many different groupings or combinations could be conceived for the production of such plots; however, all will typically bear out the same general conclusions. The grouping selections were not intended to single out any anticipated anomalies, but rather just to provide for consistency and simplicity in the review of the performance trends.

PERFORMANCE TRENDS FOR SPS-5, REHABILITATION OF ASPHALT CONCRETE PAVEMENTS

Surface Distress

As one might expect, the 15 asphalt rehabilitation projects did not all exhibit the same distresses. However, it was decided to consider all distress types that had occurred in significant quantities on the projects prior to the overlays.

Table 10 (see Appendix A) contains a complete summary of the distresses noted on each test section prior to and subsequent to being overlaid. As can be seen, there are several projects (Florida, Georgia, and Alberta) for which no distress has been noted yet. There are also two projects (Montana and New Jersey) for which post-construction surface distress data are not available at this time.

For each of the distresses noted in table 7, plots were prepared for those projects (identified by their State) noted to have the particular distress in question (either before or after rehabilitation). All of the virgin AC test sections were plotted together with the control, and a separate plot was produced with all of the recycled sections with the control. These plots appear in Appendix A. A summary of the observations noted from these plots will be provided in the following paragraphs for each distress type, along with a general overall summary at the end of this section.

Fatigue Cracking

All five of the projects experiencing fatigue cracking prior to rehabilitation had fairly limited amounts of cracking (less than 100 m^2). All of the treatments appear to effectively control fatigue for at least 3 years. It is interesting to note that for two projects (Alabama and Arizona), fatigue was successfully arrested by the treatments, as witnessed by a significant increase in fatigue in the untreated control section. It appears that for two of the five projects

(Arizona and Colorado), sections with virgin mix are showing some fatigue, whereas the sections with overlays containing RAP are not. However, this is too limited a sample from which to conclude that recycled mixes perform better than virgin mixes. Currently, there does not appear to be any indication that subgrade type, environment, overlay thickness, or milling have significantly affected the occurrence of fatigue cracking.

Table 7. Summary of distress types observed prior to overlay, SPS-5 projects.

State	Fatigue Cracking	Longitudinal (in WP)	Longitudinal (not in WP)	Transverse Cracking	Bleeding
Alabama	Yes	No	No	No	No
Arizona	Yes	Yes	No	Yes	No
California	Yes	Yes	No	Yes	No
Colorado	Yes	Yes	Yes	Yes	Yes
Florida	No	No	No	No	No
Georgia	No	No	No	No	No
Maine	No	No	No	No	Yes
Maryland	Yes	Yes	Yes	Yes	Yes
Minnesota	No	No	Yes	Yes	No
Mississippi	No	Yes	No	Yes	No
Montana	No	No	No	No	No
New Jersey	No	No	No	No	No
Texas	No	No	Yes	Yes	No
Alberta	No	No	No	No	No
Manitoba	No	Yes	Yes	Yes	No

Longitudinal Cracking in the Wheelpaths

The six projects with longitudinal cracking in the wheelpaths prior to treatment had experienced from 10 m to 250 m of cracking since being overlaid. The amount of cracking prior to rehabilitation appears to have had little impact on the amount of cracking that occurs in the overlays. Some of this cracking is reoccurring after 3 years, particularly in the thinner sections.

There is no indication that either the mixes with RAP or those with virgin asphalt are performing better than the other for this distress.

The test sections in Arizona, California, and Maryland experienced less longitudinal cracking in the wheelpaths than those in Colorado, Mississippi, and Manitoba. The control sections appeared to have performed better than the overlays in four of the six projects, but it is known that the cracks in the control sections for California and Colorado were covered when the ruts were filled. (This is discussed later in the Permanent Deformation sections.) As the cracking in the Arizona control section had disappeared over time, the distress surveys were investigated and it was found that the subsequent surveyor called the cracking "block cracking" instead of longitudinal cracking. The control section in Manitoba received a thin overlay, which appears to be performing better than the other treatments for that project.

Projects in the wetter environments appear to experience more cracking in the wheelpaths (e.g., Mississippi and Manitoba). Milling does not appear to reduce the potential for the development of longitudinal cracking in the wheelpaths. In general, it does not appear that any of these treatments were particularly effective in arresting the development of longitudinal cracking in the wheelpaths, with the possible exception of the projects in Arizona and California (noting that some additional treatment of the wheelpaths was performed in advance of the California overlays). Subgrade type or choice of RAP or virgin materials does not appear to have affected the occurrence of longitudinal cracking in wheelpaths.

Longitudinal Cracking Not in the Wheelpaths

For the five projects with longitudinal cracking not in the wheelpaths, varying amounts of cracking were noted prior to treatment (from 10 m to 250 m). From a review of the amounts of cracking after rehabilitation, it appears that the amount of cracking prior to rehabilitation has had little impact on the amount of cracking after treatment. However, some longitudinal cracking not in the wheelpaths is reappearing after 3 years. Subgrade type, mix type, overlay thickness, or milling do not appear to have affected the occurrence of the cracks. Longitudinal cracking not in the wheelpaths is particularly pronounced in the wet freeze region (Maryland, Minnesota, and Manitoba). It appears that the treatments were marginally successful in controlling longitudinal cracking not in the wheelpaths, as most of the sections did exhibit less cracking than their untreated control sections.

Transverse Cracking

For the eight projects with transverse cracking, varying amounts of cracking were noted prior to treatment [from 5 or 10 m to 200 or 500 m (see Appendix A for plots of number of cracks and length of cracks)]. For transverse cracking, the amount of cracking prior to rehabilitation appears to have a significant impact on the amount of cracking after rehabilitation. Some transverse cracking is reoccurring after 3 years. Environment, subgrade type, mix type, overlay thickness, or milling do not appear to have affected the occurrence of the cracks. It appears that the treatments were marginally successful in controlling the transverse cracking, as most of the sections did exhibit less cracking than their untreated control sections.

Bleeding

For the three projects with bleeding, varying amounts of bleeding were noted prior to treatment [from 25 m^2 to 225 m^2 (see Appendix A)]. The amount of bleeding prior to rehabilitation appears to have no impact on the amount of bleeding after rehabilitation. Environmental region, subgrade type, HMAC mix (RAP or virgin), thickness, or milling do not appear to have significantly affected the occurrence of bleeding for this limited sample, although the mix design per se would certainly be expected to have a significant effect.

Roughness

Plots of the International Roughness Index (IRI) were prepared for each of the projects, except for Florida and Maine, which were just completed, and Arizona and California (profile data are not yet available). These plots are provided in Appendix A. Values of IRI prior to treatment ranged from 473 mm of roughness/km to 3157 mm of roughness/km (30 in/mi to 200 in/mi) (from "like new" to fairly rough). These treatments have typically improved ride quality (reduced roughness), but the improvement was less dramatic for those cases where quality of ride was fairly good prior to treatment. Environmental region, subgrade type, mix type, overlay thickness, or milling do not appear to have significantly affected the reductions in IRI accomplished by the overlays or the rate of IRI increase after overlay.

Permanent Deformation (Rutting)

Plots of the rut depths calculated from cross profiles on the basis of a 1.8-m (6-ft) straight edge were prepared for each of the projects, with the exception of Florida and Maine, which were just completed. These plots appear in Appendix A. Values prior to treatment ranged from 6 mm (0.25 in) to 20 mm (0.75 in). "Zero" rutting is shown on these plots to reflect the date of rehabilitation. Again, it should be pointed out that two States (California and Colorado) apparently filled the ruts on the control sections as well. These treatments have typically reduced the rut depths, except for those cases where the rutting was minimal prior to treatment. The only sections showing appreciable rutting (>5 mm) after several years of performance are the thicker (130-mm) overlays on the project in Mississippi. This is believed to be a mix-related problem (based on knowledge of the construction history), but materials test results are not complete at this time to verify this suspicion. Environmental region, subgrade type, mix (virgin versus recycled), or milling do not appear to have significantly affected the occurrence of rutting.

Deflections

Plots of the Falling-Weight Deflectometer (FWD) data were prepared for each of the projects, with the exception of Florida and Maine, which were just completed, and Maryland and New Jersey, for which deflection data are not yet available. These plots (see Appendix A) represent the deflections at Sensor 1 (under the loading plate) and Sensor 7 (1.5 m from the load) for a normalized load of 730 kPa (12,000 lb on a 12-in-diameter load plate). They are arranged in sets of three by State, with the first plot for Sensor 1 deflections, the second for Sensor 7, and the third for the ratio of Sensor 1 to those for Sensor 7. Values for Sensor 1 prior to treatment ranged from 150 μm to 900 μm. Values for Sensor 7 prior to treatment ranged from 20 μm to 80 μm.

The measured deflections for Sensor 7 are typically indicative of the subgrade stiffness at any given location. These treatments were not expected to alter or improve the subgrade stiffness and a quick review of the Sensor 7 plots generally confirms this belief.

Therefore, any decreases in Sensor 1 deflections after treatment can be considered to be due to the overlay's contribution to the pavement structure above the subgrade. This is especially noticeable where relatively flexible pavement structures were placed on a relatively stiff subgrade. In general, the overlays appeared to have contributed more to structural stiffening (reflected by reduced deflections for Sensor 1) when the subgrade was relatively stiff, and contributed less when the subgrade was relatively weak.

Regardless of the subgrade stiffness (or strength), the thick (130-mm) overlays (Sections 503, 504, 507, and 508) have typically increased structural stiffness, with the increase being less dramatic for structures that were already relatively stiff. Environmental region or mix (RAP or virgin) do not appear to have significantly affected rut depths, but subgrade type, thickness, or milling do affect structural capacity (as expected).

Summary of Observations for Rehabilitation of Asphalt Concrete Pavements

Table 8 provides a summary of the trends noted for the performance of these various asphalt rehabilitation strategies after observation for approximately 4 years (varies). It can generally be concluded that the treatments have all provided additional structural capacity and have effectively reduced or controlled the structural deterioration during these first few years of performance observation.

Review of table 8 is disquieting, as some of the results seem to be in conflict with prior knowledge. These are listed below:

1. Prior knowledge would indicate that thickness does affect the amount of cracking, since cracks must begin either at the top or bottom and propagate through the AC layer or layers.

2. The conclusion that the environment does not affect transverse cracking is contradictory to prior knowledge, as existing theory and previous observations of pavements indicate that temperature has a significant effect.

3. Past experience has indicated that the prior condition of a pavement significantly affects its performance after overlay.

4. Milling has become popular in recent years as removal of some thickness of the surface material appeared to delay reflection cracking and replaced the material that would be expected to have undergone the greatest oxidation. It is difficult to accept that it had no effect on the reappearance of distress at the surface of the overlay.

These trend studies were conceived to seek useful information that could be gleaned at this early stage of the studies. They have been successful in providing valuable general information on relative impacts of various parameters on performance under a variety of conditions, which has never been available on the basis of broad comparisons. The plots themselves are not only educational to study, but will be augmented in the future as additional performance data become available. Some of the concerns addressed above will be addressed as these overlays progress through their life cycles.

Table 8. Summary of apparent effects of various parameters on performance of SPS-5 projects.

	Fatigue Cracking	Longitudinal Cracking (in WP)	Longitudinal Cracking (not in WP)	Transverse Cracking	Bleeding	IRI	Rut Depth	Deflection
No. of Projects	5	6	5	8	3	11	13	11
Units	m^2	m^2	m^2	m^2	m^2	in/mi	mm	µm
Range Prior	10-150	10-250	10-250	10-500	10-250	50-180	6-20	150-900
Range After[1]	0-10	10-300	10-250	10-100	0-300	30-100	6-10	150-600
Prior Condition	N	N	N	Y	N	N	N	Y
Mix[2]	S	N	N	N	N	N	N	N
Thickness	N	Y	N	N	N	N	Y	Y
Milling	N	N	N	N	N	N	N	Y
Environment	N	Y(Wet)	Y(WF)	N	N	N	N	N
Subgrade Type[3]	N	N	N	N	N	N	N	Y

1 in/mi = 16 mm/km

Notes:

1 - Excluding Control
2 - Virgin versus Recycled
3 - No projects with extremely weak or active clays were included.

Legend:

WF - Wet freeze
N - No apparent effect
S - Some effect
Y - Apparent effect

PERFORMANCE TRENDS FOR SPS-6, REHABILITATION OF JOINTED CONCRETE PAVEMENTS

Surface Distress

Excluding the control section, all but two of the SPS-6 test sections (Sections 602 and 605) in a project received asphalt overlays as part of the rehabilitation strategy. This complicates the evaluation of distress, both before and after treatment, because the surface distress types vary between sections with and without overlays. At this early stage in the performance of these sections, however, the only surface distress of particular prominence is reflective cracking, particularly transverse cracking. With this is mind, the focus for this investigation has been on this distress.

Table 11 (Appendix B) provides the concrete surface distresses before overlay for all of the test sections, as well as after rehabilitation for those test sections not overlaid. Table 12 (Appendix B) provides the asphalt concrete surface distresses noted in the overlays.

For the crack-and-seat sections, reflective cracking was not expected, but there has been some cracking noted. To ensure that no cracking is overlooked, the reflective and transverse cracking, which is hard to differentiate between, were added together for plotting purposes. In preparing these plots, no pre-treatment information was plotted (to avoid confusion between the concrete surface distress types prior to treatment and the asphalt surface distress types after treatment). Such information is not really essential here, as will be seen. Similarly, only those sections that were overlaid (Sections 603, 604, 606, 607, and 608) are included in the plots. No significant surface distress was apparent on Sections 602 and 605 (the concrete pavement restoration projects) at the times of the surveys. These plots are shown in Appendix B.

For the 10 projects, transverse cracking and/or transverse reflection cracks varied in number from 0 to 50. Some of these larger values are associated with the saw-and-seal sections (Section 604), where the overlay was sawed above each joint in the original concrete pavement and then sealed. Excluding the crack-and-seat sections, most of the joints reflected through the 100-mm asphalt overlays within 1 to 2 years. Also, some of the crack-and-seat sections are showing some transverse cracking occurring after a few years (primarily in the 100-mm overlay of Section 607). Subgrade type, drainage, or amount of patching and preparation did not appear to have significantly affected the occurrence of cracking. The observations to date indicate that the crack-and-seat sections are typically performing considerably better than the other treatments.

Roughness

Plots of the International Roughness Index (IRI) were prepared for each of the projects, with the exception of California, for which profile data are not yet available. These plots are provided in Appendix B. Values of IRI prior to treatment ranged from 1578 mm/km to 3157 mm/km (100 in/mi to 200 in/mi) (from average to fairly rough). These asphalt overlay treatments have consistently reduced the IRI values to below 1263 mm/km (80 in/mi). Results for the diamond-ground sections are noticeably less consistent. For some of these diamond-ground sections, the IRI improved noticeably [down to values of 1263 mm/km (80 in/mi) or less in Oklahoma and South Dakota], but for the majority of the projects, the IRI values remained about the same. For two of the projects, it appears that the grinding made the sections rougher (Indiana and Michigan). Environmental region, subgrade type, or thickness do not appear to have noticeably affected the performance at the times of these surveys.

Transverse Profile

In order to study rutting in the overlays, it was necessary to apply the RUT Software to the digitized transverse profiles measured by PASCO, USA. The result for the PCC pavements was the calculation of the mean separation between a 1.8-m (6-ft) straight edge and the PCC pavement surfaces. Values prior to treatment ranged from 1 mm to 9 mm (0.04 in to 0.4 in), which would include normal differences in construction, measurement errors, and any real changes in cross-section shape. (Could some differences be due to studded tire wear in older pavements?) The mean measurement was 4 mm (0.18 in), with a standard deviation of 2 mm (0.08 in).

The measurement error can be as much as 2 mm from the actual separation between the surface and the straight edge, so it would be theoretically possible to have 4 mm of error between two measurements. However, it is probable that this error rarely exceeds around 2 mm between measurements. If it may be assumed that the shape of the concrete slab only changes nominally between measurements, this represents a rare opportunity to observe differences between measurements for the control section (Section 601). The plots appear in Appendix B. The differences between measurements were as follows:

State	Differences Between Measurements, mm
Arizona	-1.0
California	-0.5
Illinois	-1.2
	-0.4
	+1.2
Indiana	-3.4
	-2.0
	+1.0
Iowa	+0.8
	+2.4
	-2.9
	-1.0
Michigan	-1.1
	+1.4
Missouri	+0.2
Oklahoma	+0.3
Pennsylvania	-0.1
South Dakota	-0.2

As can be seen, the differences are quite nominal for all projects, except for those in Indiana and Iowa. It is interesting to note that all differences in measurements for Indiana (including overlaid pavements) were approximately the same for the 1991 and 1992 measurements, which tends to indicate that a common (or systematic) error occurred. Similarly, the 2.4-mm increase for Iowa between the 1990 and 1991 measurements and the 2.9-mm decrease for the next measurement later in 1991 were approximated by the measurements for the overlaid pavements, again indicating probable common errors. Except for Indiana, the initial and final values differed very little, perhaps indicating some compensation in errors. This also applied for Indiana if the initial measurement in 1989 was assumed to be in error. If PASCO has records of cross profiles on GPS rigid pavements, it should be possible to study potential measurement errors in detail by processing the digitized cross profiles using the RUT software.

Early Rutting of Overlays

Review of the plots (Appendix B) indicates that the early rut depths (first 3 years or less) were less than 6.3 mm (0.25 in) for all test sections, except for Sections 603, 604, and 606 in the Pennsylvania project, and these only experienced 7 mm to 8 mm (0.3 in to 0.314 in) of rutting. As the early rutting in the overlays was generally nominal, it appears that rutting will probably not present a problem for many years (if ever) for the overlays, because most of the rutting on an asphalt pavement can be expected in the first year that the pavement is open to traffic.

Deflections

Plots of the Falling-Weight Deflectometer (FWD) data were prepared for each of the projects, with the exception of Arizona and Pennsylvania, for which deflection data are not yet available. As previously noted, these plots represent the deflections at Sensor 1 (under the loading plate) and Sensor 7 (1.5 m from the load) for a normalized load of 730 kPa (12,000 lb on a 12-in-diameter loading plate) and are provided in Appendix B. Values for Sensor 1 prior to treatment ranged from 100 μm to 400 μm and values for Sensor 7 prior to treatment ranged from 50 μm to 120 μm. These treatments were not expected to alter or improve the subgrade stiffness and a quick review of the Sensor 7 plots confirms this belief. For these jointed concrete projects, Sensor 1 seldom exhibited considerable change after rehabilitation. The only notable exception was for the crack-and-seat sections with the 100-mm overlays (Section 607), where deflections increased for Missouri and Oklahoma. The observations from this study are as follows:

1. The rehabilitation treatments did not affect subgrade stiffness and offered little additional pavement stiffness. This latter observation is believed to be because the PCC pavement is so much stiffer than the overlay.

2. The crack-and-seat operations can reduce the stiffness of the slab and thus increase deflections.

Summary of Observations for Jointed Concrete Rehabilitation, SPS-6

Table 9 provides a summary of the trends noted for the performance of these various rehabilitation strategies (after approximately 4 years of performance). It may generally be concluded that the treatments can all improve the ride quality, but should not be expected to provide additional pavement stiffness. Reflective cracking over joints in the original PCC surface may be expected soon after application of thin overlays, but may take some time to occur on thicker overlays. Unacceptable rutting in the overlays appears to be avoidable.

SPS-7, BONDED PCC CONCRETE OVERLAYS OF PCC PAVEMENTS

Surface Distress

Three of the bonded concrete overlay projects are continuously reinforced concrete (CRC) overlays of CRC pavement (Iowa, Louisiana, and Minnesota). The fourth project (Missouri) is a jointed concrete overlay of a jointed concrete pavement. At this early stage in the performance of these sections, however, little distress has occurred. Table 13 (Appendix C) contains a complete summary of all the distresses noted on the CRC pavement surface by test section.

Table 9. Summary of apparent effects of various parameters on the performance of SPS-6 projects.

	Transverse Cracking	IRI	Rut Depth	Deflections
No. of Projects	10	9	10	10
Units	m	in/mi	mm	µm
Range Prior	5-50	100-200	2-9	100-400
Range After[1]	0-50	80-200	2-6	100-350
Thickness	Y	N	N	Y
Crack & Seat	Y	N	N	Y
Environment	N	N	Y	N
Subgrade Type	Y	N[2]	N[2]	N
CPR vs. O/L	Y	S	N	N

1 in/mi = 16 mm/km

Notes:
1 - Excluding Control
2 - No projects with extremely weak or active clays were included.

Legend:
N - No apparent effect
S - Some effect
Y - Apparent effect
O/L - Overlay

The only significant distress noted in the CRC overlays was transverse cracking. With this in mind, the focus was on transverse cracking for these investigations. Plots of transverse cracking are shown in Appendix C.

While transverse cracking is expected in CRC pavements, the number and spacing are expected to affect the number of reflection cracks that occur in an overlay. Some interesting data extracted from table 14 appear below:

State	Test Section No.	Prior to Overlay	Immediately After Overlay	After 8 Months	After 12 Months	After 26 Months	After 34 Months
		Number of Cracks					
Iowa	701				237		
	702		37		71		
	703		6		81		
	704	123	6		50		
	705	204	1		36		
	706	129	39		96		
	707	111	52		52		
	708		53		97		
	709		59		102		
	710		39		46		
Louisiana	702	126		78		87	
	703	141		60		85	
	704	140		67		104	
	705	146		59		86	
	706	88		84		89	
	707	94		78		86	
	708	87		91		95	
	709	95		126		128	
Minnesota	701						430
	702						110
	703						106
	704						112
	705						107
	706						76
	707						71
	708						77
	709						87

It should be noted that other photographic surveys have probably been conducted by PASCO, but results from those surveys were not available for these studies. Some results from the study of the data above are:

1. The control sections without overlays for the Iowa and Minnesota projects have many more transverse cracks than have appeared in the overlays. (Louisiana did not allow an untreated control section on their project).

2. The 76-mm (3-in) overlays in Iowa experienced very few cracks immediately (same month) after the overlays, whereas the 127-mm (5-in) overlays experienced much more. This was also true for Louisiana test sections after 8 months, but the differences between numbers were less dramatic. This is consistent with the observation in item 3 below.

3. After 12 months, the numbers of cracks in the 76-mm (3-in) overlays in Iowa were approaching the number of cracks in the 127-mm (5-in) overlays. Also, the number of cracks in the overlays was considerably less than in the original pavements for the four sections having data prior to overlays.

4. Although the cracking in the original slabs before overlays in the Louisiana project was much greater for the sections receiving 76-mm (3-in) overlays than for those receiving 127-mm (5-in) overlays (happenstance), the numbers of cracks in the overlays were quite similar after 26 months.

It may be concluded tentatively (based on only the two control sections available) that the bonded CRC overlays may generally be expected to have fewer transverse cracks than the original CRC pavements. Also, the transverse cracks seem to appear more readily in the thicker overlays, but the numbers of cracks may be expected to become similar for both thin and thick overlays after a year or so has passed.

It is not clear as yet what the numbers of cracks in the overlays portend. Their presence in the overlay probably does not represent a problem unless spalls or punchouts occur and their occurrence is found to depend on numbers of transverse cracks. If a transverse cracking pattern similar to that of the original surface does not occur in the overlay, it might indicate that bonding between the original pavement and the overlay has not been attained.

Table 14 (Appendix C) contains a summary of distresses for the jointed concrete project in Missouri. Plots of transverse and longitudinal cracking and spalling in longitudinal joints appear in Appendix C. There appears to be serious problems with the data. As an example, the distress surveyor found 282 transverse cracks in Section 705 in July 1991, but only 6 in June 1992 and 69 in September 1994. Similarly, 112 transverse cracks were noted in July 1991 for Section 704, 15 in June 1992, and 129 in September 1994. The data also failed to indicate the length of cracks in two cases, although numbers of cracks were indicated.

Surprisingly, considering the many cracks in the overlays, no transverse cracks were noted on the control section until September 1994, and then only two were noted with a length of only 1.8 m. As the joint spacing is roughly 6.1 m (20 ft), few transverse cracks (if any) would be expected in the original pavement, so the major cracking in the overlays appears to be a phenomenon related to them alone. In this regard, discussions with the regional office responsible for data collection at this project confirmed that it was extremely hot when this project was constructed and that delamination was definitely occurring. It appears likely that the numerous transverse cracks, which normally would not be expected, may have resulted from shrinkage, possibly before the joints were sawed to relieve much of the shrinkage stresses.

Substantial longitudinal cracking also occurred in the overlay sections where shot-blasting had been used on the original pavement surface. The two 76-mm (3-in) overlays where the original surface had been milled experienced no longitudinal cracking, while the 127-mm (5-in) overlay where the original surface had been milled and grout applied experienced essentially no longitudinal cracking. Section 708, for which the original surface had been milled but no grout was applied, experienced less longitudinal cracking than those for which the original surface had been shot-blasted. It should be noted that the control section also experienced nominal longitudinal cracking. As there apparently was no manual survey prior to the overlay (PASCO photographed the pavements, but the data are not available), it is not known whether this longitudinal cracking is reflected from prior cracks in the original JCP or not. Based on the very limited data, it appears that milling was a better treatment than shot-blasting for limiting longitudinal cracking in the overlay, and that grout was also helpful.

Spalling of longitudinal joints was also experienced in all overlays. Nominal spalling occurred on the control section, but much less than was experienced on the overlays. The data are again somewhat confusing as there appears to be less spalling later in several cases, but this could mean that repairs had occurred. There does not appear to be clear trends for the spalling of longitudinal joints.

Roughness

Plots of the International Roughness Index (IRI) were prepared for each of the projects, with the exception of Missouri, which only has one profile measurement to date (Appendix C). Values of IRI prior to treatment ranged from 1263 mm/km to 2525 mm/km (80 in/mi to 160 in/mi) (from average to fairly rough). The treatments have consistently reduced the IRI values to below 1263 mm/km (80 in/mi). Environmental region, subgrade type, treatment type, or overlay thickness do not appear to have affected the roughness observed for these test sections.

Deflections

Plots of the Falling-Weight Deflectometer (FWD) data were prepared for each of the projects (see Appendix C). These plots represent the deflections at Sensor 1 (under the loading plate) and Sensor 7 (1.5 m from the load) for a normalized load of 730 kPa (12,000 lb on a 12-in-diameter load plate). Values for Sensor 1 prior to treatment ranged from 120 μm to 200 μm. Values for Sensor 7 prior to treatment ranged from 60 μm to 120 μm. Although these treatments do not alter or improve the subgrade stiffness, review of the Sensor 7 plots indicates that a decrease of approximately 20 μm of deflection occurred in each case. These decreases apparently reflect the overall decrease in deflections in the "deflection basin." The overlays increased structural strength (as indicated by decreased deflections), and this did not appear to be affected by environmental region, subgrade type, or thickness of overlay. Based on the similarity in deflection magnitudes, the 127-mm (5-in) overlays did not provide substantially more decrease in deflections than the 76-mm (3-in) overlays.

Summary of Observations for Bonded Concrete Overlays

From this limited review of four bonded concrete overlay projects, it may generally be concluded that there are still some unanswered questions regarding the quality of the bonds between the original surface and the overlays. Study of observed distresses for these projects appears to reemphasize the importance of good construction quality control. All of these overlays improved ride quality, and appear to provide appreciable additional structural capacity (despite the concerns regarding bonding).

CHAPTER 4. CONDUCT CORRELATION STUDIES AND OTHER STATISTICAL STUDIES

Correlation matrices were obtained to identify variables that significantly affected the occurrence of distresses and other performance measures. In general, the results from these studies were disappointing, probably because of the limited occurrence of distresses this early in the pavements' lives.

CORRELATIONS FOR SPS-5

Many of the strong correlations that were observed would be expected, e.g., climatic variables to other climatic variables or reflective cracking in overlays to cracking prior to overlay. Others might not be quite so obvious, e.g., a positive correlation of 0.90 between transverse cracking and longitudinal cracking in the wheelpath before overlays. Still others appear to be due to the characteristics of the specific set of projects, e.g., a positive correlation of 0.70 between sand subgrade and total number of days with precipitation.

CORRELATIONS FOR SPS-6

Although this was not apparent from the study of the plots, average IRI after overlay had a negative correlation coefficient of -0.581 with overlay thickness. Both transverse and longitudinal cracking prior to overlay had a positive correlation coefficient of 0.50 with annual number of days with temperature below freezing. Spalling of transverse joints prior to overlay increases with annual number of freeze/thaw cycles. While these seem to be logical results, others are more difficult to accept as typical, e.g., spalling of transverse joints prior to overlay decreases with increasing freeze index.

SUMMARY OF CORRELATION RESULTS

While many of the correlations are quite logical and expected, others do not appear logical and are probably consequences of the limited sets of data available or biases in the inference spaces represented by the projects. Consequently, these results were not considered to be reliable enough for detailed reporting herein.

CHAPTER 5. DATA DEFICIENCIES

A number of shortcomings in the data for the rehabilitation projects used for these studies have been discussed in Chapter 3. The purpose of the discussion below is to focus on these shortcomings so that they may be corrected or guidelines may be developed to avoid such shortcomings for ongoing or future projects.

Manual distress surveys had not been conducted for seven projects prior to rehabilitation. These surveys were not conducted because PASCO had photographed the test sections after they had been marked and before rehabilitation. However, it will be important that these data be made available prior to future analyses, and that compatibility is obtained between the manual survey data and the data reduced from PASCO film. One example was the apparent switch from "longitudinal cracking in wheelpaths" to "block cracking" for one SPS-5 control section.

Review of the tables in the appendices that reflect the results from manual distress surveys shows many apparent discrepancies. When conducting distress surveys, the surveyor must be objective; but at the same time, it is useful to review the last survey to avoid major differences in distress identification that are difficult to deal with in analysis.

As an example, if there is substantial cracking noted in one survey but not in the next, some maintenance or repair activity should be noted. There are a number of such cases (some discussed in Chapter 3) that are apparent in the tables. Much of this could be avoided if new surveys were compared to previous surveys to see if the changes are logical before the data are entered into the Regional Information Management System (RIMS).

As this may be the first occasion where distress data have been tabulated in a format allowing easy comparisons of results from sequential manual distress surveys, the problems noted spawn concern that much of the manual distress survey data for GPS and other SPS projects may also have similar shortcomings. It should not be difficult to develop similar tables to allow easy observation for all test sections. As the primary objective would be to gain more consistency, it would be important to establish fully coordinated and specific guidelines for revising the data. This should probably be accomplished by a single agency, with strong coordination with the LTPP Regional Coordination Offices.

The necessity for having a control section needs to be emphasized in future recruitment. Two SPS-5 projects had control sections, but the ruts had been filled and all cracks were covered up; for another project, a thin overlay was placed on the control section. One SPS-7 project was built without a control section because the SHA would not agree to leave a section without an overlay. Agreement to allow a control section should be part of the recruitment process, with a clear understanding of what "routine maintenance" will be allowed and what will not.

CHAPTER 6. CONCLUSIONS AND RECOMMENDATIONS

The expected products from the proposed work effort were:

1. Identification of parameters (such as condition prior to overlay, thicknesses, climatic variables, subgrade characteristics) that significantly affect performance of rehabilitation treatments.

2. Greater understanding of the relative importance of significant parameters to the performance of the various rehabilitation alternatives.

3. Indications as to which treatments perform best under the various conditions and why.

The growing rehabilitation needs of the highway infrastructure necessitate the selection of the most cost-effective rehabilitation strategies for the prevailing conditions. Any early insights that can be gleaned from the SPS rehabilitation experiments will not only aid designers toward this objective, but should help to remind all agencies involved of the significant contribution these projects can make to our future design practices.

LIMITATIONS

In performing these investigations, two limitations have been identified that should be taken into consideration. The first restriction to bear in mind is the age of these rehabilitation projects. The oldest project is an SPS-6 project constructed in the fall of 1989. With many of these projects that are only 3 or 4 years of age, a full range of performance is not yet available, so the data available for analysis are limited to these early observations of the various projects.

Similarly, data for many of these projects are still in various stages of processing. As an example, data from materials testing and traffic and climatic data since 1991 are not yet available for these projects. Performance data are generally available, but the overall data shortcomings limit these analyses to the trend studies reported.

Most of these limitations were anticipated, however, which allowed the studies to be tailored to glean as much as possible out of the data that are currently available. Although performance data from future observations will allow much more thorough analyses, results from the study of these early observations should prove quite beneficial.

SUMMARY OF OBSERVATIONS FOR ASPHALT REHABILITATION

All of the asphalt rehabilitation treatments included in these studies provided additional pavement stiffness and have effectively reduced or controlled the structural deterioration during these first few years of performance observation. It is too early to establish how much additional life can be gained with the thicker overlays, but this should become apparent from future monitoring.

The overlays also improved ride quality for those projects where considerable roughness had already developed. After several years of monitoring, these projects show little loss of ride quality. Future monitoring of these projects should indicate how long these improvements in ride quality can be expected to last.

The distresses noted to date appear to be associated with environmental factors or construction-related problems. The cracking observed is either transverse cracking or longitudinal cracking outside of the wheelpaths. Such cracking is typically associated with thermal contraction. Similarly, bleeding and deformation (where it exists) are primarily associated with mix design issues.

As indicated in Chapter 3, some factors, such as thickness of the AC, the environment, prior condition, and milling, were not identified as significantly affecting performance at this time, although past experience indicates that they do. It is expected that future monitoring will either find them to be significant or explain why they are not.

SUMMARY OF OBSERVATIONS FOR JOINTED CONCRETE REHABILITATION

All of the overlays improved ride quality for those projects where considerable roughness had already developed. After several years of monitoring, these projects show little loss of ride quality. As previously noted for SPS-5, future monitoring of these projects should indicate how long these improvements in ride quality can be expected to last.

As expected, none of these treatments provided significant reduction in deflection under load. Review of the surface distress data indicates that standard overlay treatments, such as those placed on these projects, can generally be expected to rapidly develop reflection cracking over joints. Some reflection cracking was even noted on the sections where the overlay was sawed in anticipation of this crack development. Although the crack-and-seat treatment seems to be quite effective at controlling cracking, some increases in deflection (decreases in pavement stiffness) were noted.

SUMMARY OF OBSERVATIONS FOR BONDED CONCRETE OVERLAYS

Although there are only four bonded concrete overlays included in this study at this time, there does appear to be some useful results thus far. All of these overlays improved the ride quality and appear to provide appreciable additional pavement stiffness (reduced deflection under load).

From this limited review of four bonded concrete overlay projects, it may generally be concluded that there are still some unanswered questions regarding the quality of the bond. The surface distress data appear to reemphasize how critical construction quality control can be for projects of this nature. It is too early to determine whether and/or how much absence of grout affects overlay bond or performance, as the distress exhibited by most of the sections was not unexpected.

RECOMMENDATIONS

At this time, with only 3 years of performance data, any recommendations for improvements would be premature. In general, these sections are all still performing fairly well. Although these projects have only been monitored for a few years, thus far the observations discussed above indicate some of the potential that may be realized from continued monitoring of these projects. As additional projects and data come on line, these studies will contribute more and more to the insight needed by pavement designers. In order to reap the full potential of these sections, it is imperative that they not be altered in anticipation of deterioration. These sections should be monitored as long as safely possible to thoroughly document the performance characteristics.

APPENDIX A. TABLES AND PLOTS OF DISTRESSES OCCURRING ON SPS-5 PROJECTS

Table 10. Quantities of distresses by test section for individual distress surveys on SPS-5 projects.

					Quantities of Distress by Distress Code															
ST	SHRP	REHAB	*	SURVEY	1	2	3	4a	4as	4b	4bs	6n	6l	6ls	7n	7a	11	13	15n	15l
1	501	Dec-91	M	Sep-91	68	0	0	2.7	0	0	0	0	0	0	1	0.2	0	0	0	0
1	501	Dec-91	M	Apr-93	201	0	0	0	0	0	0	2	2.3	0	0	0	0	0	0	0
1	501	Dec-91	M	Jul-95	271	0	0	0	0	0	0	8	3	0	0	0	0	564	0	0
1	502	Dec-91	M	Sep-91	31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	502	Dec-91	M	Apr-93	4.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	502	Dec-91	M	Jul-95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	503	Dec-91	M	Sep-91	31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	503	Dec-91	M	Apr-93	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	503	Dec-91	M	Jul-95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	504	Dec-91	M	Sep-91	2.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	504	Dec-91	M	Apr-93	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	504	Dec-91	M	Jul-95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	505	Dec-91	M	Sep-91	31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	505	Dec-91	M	Apr-93	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	505	Dec-91	M	Jul-95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	506	Dec-91	M	Sep-91	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	506	Dec-91	M	Apr-93	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	506	Dec-91	M	Jul-95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	507	Dec-91	M	Sep-91	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	507	Dec-91	M	Apr-93	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	507	Dec-91	M	Jul-95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	508	Dec-91	M	Sep-91	31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	508	Dec-91	M	Apr-93	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	508	Dec-91	M	Jul-95	0	0	0	10	0	0	0	1	0.6	0	0	0	0	0	0	0
1	509	Dec-91	M	Sep-91	25	0	0	0	0	0	0	0	0	0	21	10	0	0	0	0
1	509	Dec-91	M	Apr-93	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	509	Dec-91	M	Jul-95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	501	May-90	P	Nov-89	31	0	0	252	0	0	0	196	415	0	0	0	0	0	0	0
4	502	May-90	P	Nov-89	36	0	0	281	0	0	0	202	486	0	0	0	0	0	0	0
4	503		P																	
4	504	May-90	P	Nov-89	31	0	0	172	0	0	0	81	202	0	0	0	0	0	0	0
4	505	May-90	P	Nov-89	56	0	0	80	0	0	0	71	164	0	0	0	0	0	0	0
4	506	May-90	P	Nov-89	162	0	0	63	0	0	0	88	160	0	0	0	0	0	0	0
4	507	May-90	P	Nov-89	170	0	0	103	0	0	0	137	267	0	0	0	0	0	0	0
4	508	May-90	P	Nov-89	87	0	0	47	0	0	0	125	234	0	0	0	0	0	0	0
4	509	May-90	P	Nov-89	22	0	0	141	0	0	0	141	291	0	0	0	0	0	0	0
4	501	May-90	M	Oct-94	243	510	0	0	0	0	0	0	0	0	0	0	0	0	1	243
4	502	May-90	M	Oct-94	0.4	0	0	42	0	3.6	0	41	71	0	0	0	0	0	0	0
4	503	May-90	M	Oct-94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	504	May-90	M	Oct-94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	505	May-90	M	Oct-94	17	0	0	0	0	0	0	2	1.4	0	0	0	0	0	0	0
4	506	May-90	M	Oct-94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	507	May-90	M	Oct-94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	508	May-90	M	Oct-94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	509	May-90	M	Oct-94	0	0	0	0	0	0	0	6	17	0	0	0	0	0	0	0

Table 10. Quantities of distresses by test section for individual distress surveys on SPS-5 projects (continued).

					Quantities of Distress by Distress Code															
ST	SHRP	REHAB	*	SURVEY	1	2	3	4a	4as	4b	4bs	6n	6l	6ls	7n	7a	11	13	15n	15l
6	501	May-92	P	Nov-89	34	0	0	109	0	0	0	162	312	0	0	0	0	0	0	0
6	502	May-92	P	Nov-89	15	0	0	43	0	0	0	42	61	0	0	0	0	0	0	0
6	504	May-92	P	Nov-89	37	0	0	23	0	0	0	32	49	0	0	0	0	0	0	0
6	505	May-92	P	Nov-89	38	0	0	35	0	0	0	27	47	0	0	0	0	0	0	0
6	506	May-92	P	Nov-89	39	0	0	94	0	0	0	56	107	0	0	0	0	0	0	0
6	507	May-92	P	Nov-89	43	0	0	139	0	0	0	94	143	0	0	0	0	0	0	0
6	508	May-92	P	Nov-89	22	0	0	197	0	0	0	98	148	0	0	0	0	0	0	0
6	509	May-92	P	Nov-89	59	0	0	133	0	0	0	88	137	0	0	0	0	0	0	0
6	501	May-92	M	Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	501	May-92	M	Oct-94	0	0	0	0	0	2.6	0	6	9.6	0	0	0	0	0	0	0
6	502	May-92	M	Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	502	May-92	M	Oct-94	0	0	0	2.5	0	0	0	0	0	0	0	0	0	0	0	0
6	503	May-92	M	Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	503	May-92	M	Oct-94	0	0	0	1.6	0	0	0	0	0	0	0	0	0	0	0	0
6	504	May-92	M	Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	504	May-92	M	Oct-94	0	0	0	0.9	0	0	0	0	0	0	0	0	0	0	0	0
6	505	May-92	M	Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	505	May-92	M	Oct-94	0	0	0	17	0	4.4	0	4	3.3	0	0	0	0	0	0	0
6	506	May-92	M	Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	506	May-92	M	Oct-94	0	0	0	4.4	0	6.4	0	0	0	0	0	0	0	0	0	0
6	507	May-92	M	Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	507	May-92	M	Oct-94	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0
6	508	May-92	M	Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	508	May-92	M	Oct-94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	509	May-92	M	Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	509	May-92	M	Oct-94	2.5	0	0	14	0	3	0	1	0.5	0	0	0	0	0	0	0
8	501	Oct-91	M	May-91	0.9	0	0	24	0	123	0	10	7.6	0	0	0	232	0	0	0
8	501	Oct-91	M	Oct-94	0	0	0	3.3	0	9.7	0	9	6.1	0	0	0	0	0	0	0
8	502	Sep-91	M	May-91	0	0	0	0	0	122	0	4	5.1	0	1	0.8	184	0	0	0
8	502	Oct-91	M	Oct-94	0	0	0	63	0	4.2	0	1	1.6	0	0	0	0	0	0	0
8	503	Sep-91	M	May-91	2.8	0	0	6	0	153	0	7	10	0	0	0	232	0	0	0
8	503	Oct-91	M	Oct-94	0	0	0	4.2	0	5.5	0	0	0	0	0	0	0	0	0	0
8	504	Sep-91	M	May-91	0.8	0	1.2	6.4	0	136	0	22	34	0	2	4.6	232	0	0	0
8	504	Oct-91	M	Oct-94	0	0	0	14	0	13	0	1	1	0	0	0	0	0	0	0
8	505	Sep-91	M	May-91	15	0	0	15	0	148	0	24	25	0	0	0	232	0	0	0
8	505	Oct-91	M	Oct-94	3.5	0	0	27	0	73	0	1	1.4	0	0	0	0	0	2	8.5
8	506	Sep-91	M	May-91	44	0	0	19	0	144	0	21	25	0	4	53	221	0	0	0
8	506	Oct-91	M	Oct-94	18	0	0	32	0	92	0	15	18	0	0	0	0	0	12	25
8	507	Sep-91	M	May-91	28	0	0	10	0	116	0	30	37	0	0	0	232	0	0	0
8	507	Oct-91	M	Oct-94	7.8	0	0	61	0	52	0	1	1	0	0	0	0	0	0	0
8	508	Sep-91	M	May-91	15	0	0	0	0	124	0	24	32	0	3	17	229	0	0	0
8	508	Oct-91	M	Oct-94	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
8	509	Oct-91	M	May-91	0	0	0	0	0	154	0	6	7.3	0	0	0	232	0	0	0
8	509	Oct-91	M	Oct-94	0	0	0	3	0	7	0	0	0	0	0	0	0	0	0	0

Table 10. Quantities of distresses by test section for individual distress surveys on SPS-5 projects (continued).

ST	SHRP	REHAB	*	SURVEY	1	2	3	4a	4as	4b	4bs	6n	6l	6ls	7n	7a	11	13	15n	15l
					Quantities of Distress by Distress Code															
12	502	Apr-95	M	Sep-94	0	436	3	47	0	24	0	24	14	0	0	0	0	0	0	0
12	503	Apr-95	M	Sep-94	0	6.3	0	271	0	259	0	232	124	0	0	0	0	0	0	0
12	504	Apr-95	M	Sep-94	387	69	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	505	Apr-95	M	Sep-94	0	523	0	0	0	0	0	5	2.5	0	0	0	0	0	0	0
12	506	Apr-95	M	Sep-94	488	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	507	Apr-95	M	Sep-94	354	55	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	508	Apr-95	M	Sep-94	0	0	0	304	0	199	0	267	135	0	0	0	0	0	0	0
12	509	Apr-95	M	Sep-94	236	161	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	501	Jun-93	M	Oct-94	0	0	0	0	0	0	0	0	0	0	1	24	0	0	0	0
13	502	Jun-93	M	Oct-94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	503	Jun-93	M	Oct-94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	504	Jun-93	M	Oct-94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	505	Jun-93	M	Oct-94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	506	Jun-93	M	Oct-94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	507	Jun-93	M	Oct-94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	508	Jun-93	M	Oct-94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	509	Jun-93	M	Oct-94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	501	Jun-95	M	Apr-95	0.2	0	0	0	0	266	0	23	9.4	0	0	0	34	0	0	0
23	501	Jun-95	M	Oct-95	0.2	0	0	0	0	266	0	23	9.4	0	0	0	34	0	0	0
23	502	Jun-95	M	Apr-95	0	0	0	0	0	296	0	35	3.9	0	0	0	17	0	0	0
23	502	Jun-95	M	Oct-95	0	0	0	0	0	0	0	0	0	0	0	0	282	0	0	0
23	503	Jun-95	M	Apr-95	0	0	0	0	0	245	0	62	14	0	0	0	31	0	0	0
23	503	Jun-95	M	Oct-95	0	0	0	0	0	0	0	0	0	0	0	0	282	0	0	0
23	504	Jun-95	M	Apr-95	0	0	0	0	0	280	0	42	14	0	0	0	46	0	0	0
23	504	Jun-95	M	Oct-95	0	0	0	0	0	0	0	0	0	0	0	0	282	0	0	0
23	505	Jun-95	M	Apr-95	0	0	0	0.4	0	283	0	1	0.5	0	0	0	34	0	0	0
23	505	Jun-95	M	Oct-95	0	0	0	0	0	0	0	0	0	0	0	0	282	0	0	0
23	506	Jun-95	M	Apr-95	0	0	0	0.8	0	198	0	14	8.4	0	0	0	34	0	0	0
23	506	Jun-95	M	Oct-95	0	0	0	0	0	0	0	0	0	0	0	0	282	0	0	0
23	507	Jun-95	M	Apr-95	0	0	0	0	0	305	0	0	0	0	0	0	92	0	0	0
23	507	Jun-95	M	Oct-95	0	0	0	0	0	0	0	0	0	0	0	0	282	0	0	0
23	508	Jun-95	M	Apr-95	0	0	0	0	0	305	0	0	0	0	0	0	76	0	0	0
23	508	Jun-95	M	Oct-95	0	0	0	0	0	0	0	0	0	0	0	0	282	0	0	0
23	509	Jun-95	M	Apr-95	0	0	0	0	0	295	0	2	2.9	0	0	0	26	105	0	0
23	509	Jun-95	M	Oct-95	0	0	0	0	0	0	0	0	0	0	0	0	282	0	0	0

Table 10. Quantities of distresses by test section for individual distress surveys on SPS-5 projects (continued).

					Quantities of Distress by Distress Code															
ST	SHRP	REHAB	*	SURVEY	1	2	3	4a	4as	4b	4bs	6n	6l	6ls	7n	7a	11	13	15n	15l
24	501	Jun-92	M	May-90	0	28	0	7	0	0	0	11	40	0	0	0	0	0	0	0
24	501	Jun-92	M	Feb-92	2.3	27	0	7.3	0	0	0	14	48	0	1	0.1	0.3	0	0	0
24	501	Jun-92	M	Oct-95	0	23	0	7.2	0	238	10	26	68	11	2	10	0	0	0	0
24	502	Jun-92	M	May-90	0	0	0	44	0	1.2	0	8	28	0	3	2.6	0	0	0	0
24	502	Jun-92	M	Feb-92	0	0	0	62	0	7	0	17	37	1.8	2	1.2	0	0	0	0
24	502	Jun-92	M	Oct-95	0	0	0	0	0	42	0	4	5.1	0	0	0	335	0	0	0
24	503	Jun-92	M	May-90	0	0	0	65	0	0	0	11	35	0	0	0	0	0	0	0
24	503	Jun-92	M	Feb-92	59	0	0	3	0	0	0	11	34	0	0	0	0	0	0	0
24	503	Jun-92	M	Oct-95	0	0	0	0	0	0	0	0	0	0	0	0	351	0	0	0
24	504	Jun-92	M	May-90	5.6	0	0	70	0	0	0	11	32	0	1	5.7	0	0	0	0
24	504	Jun-92	M	Feb-92	88	0	0	3	0	0	0	9	31	0	2	5.7	0	0	0	0
24	504	Jun-92	M	Oct-95	0	0	0	0	0	0	0	4	2.3	0	0	0	119	0	0	0
24	505	Jun-92	M	May-90	0	0	0	84	0	5.5	0	10	37	0	2	3.3	0	0	0	0
24	505	Jun-92	M	Feb-92	103	0	0	0	0	0	0	12	35	0	2	14	0	0	0	0
24	505	Jun-92	M	Oct-95	0	0	0	4.9	0	65	0	13	36	0	0	0	0	0	0	0
24	506	Jun-92	M	May-90	0	1.3	0	35	0	1.8	0	7	23	0	0	0	0	0	0	0
24	506	Jun-92	M	Feb-92	47	3	0	5.8	0	12	0	10	29	0	2	0.6	0	0	0	0
24	506	Jun-92	M	Oct-95	0	0	0	0	0	47	0	7	17	0	0	0	43	0	0	0
24	507	Jun-92	M	May-90	8	0	0	54	0	0	0	7	25	0	0	0	0	0	0	0
24	507	Jun-92	M	Feb-92	56	0	0	21	0	85	0	14	36	0	0	0	0	0	0	0
24	507	Jun-92	M	Oct-95	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0
24	508	Jun-92	M	May-90	0	0	0	46	0	3.7	0	7	26	0	0	0	0	0	0	0
24	508	Jun-92	M	Feb-92	67	0	0	0	0	17	0	9	28	0	0	0	0	0	0	0
24	508	Jun-92	M	Oct-95	0	0	0	0	0	28	0	0	0	0	0	0	275	0	0	0
24	509	Jun-92	M	May-90	9.3	0	0	89	0	0	0	6	22	0	0	0	0	0	0	0
24	509	Jun-92	M	Feb-92	140	0	0	0	0	13	0	6	20	0	0	0	0	0	0	0
24	509	Jun-92	M	Oct-95	0	0	0	0	0	0.2	0	0	0	0	0	0	305	0	0	0

Table 10. Quantities of distresses by test section for individual distress surveys on SPS-5 projects (continued).

ST	SHRP	REHAB	*	SURVEY	Quantities of Distress by Distress Code 1	2	3	4a	4as	4b	4bs	6n	6l	6ls	7n	7a	11	13	15n	15l
27	501	Oct-90	M	Nov-90	0	0	0	0	0	211	0	22	0	240	0	0	153	0	0	0
27	501	Oct-90	M	Jun-92	0	0	0	0	0	136	20	26	84	0	0	0	63	0	0	0
27	501	Oct-90	M	Sep-93	0	0	0	0	0	275	225	26	84	3.7	0	0	64	0	0	0
27	502	Oct-90	M	Nov-90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	502	Oct-90	M	Sep-93	0	0	0	0	0	169	97	23	84	0	0	0	0	0	0	0
27	502	Oct-90	M	Aug-95	0	0	0	0	0	92	0	21	100	0	0	0	0	0	0	0
27	503	Oct-90	M	Nov-90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	503	Oct-90	M	Jun-92	0	0	0	0	0	0	0	11	40	29	0	0	0	0	0	0
27	503	Oct-90	M	Sep-93	0	0	0	0	0	131	0	11	40	0	0	0	0	0	0	0
27	504	Oct-90	M	Nov-90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	504	Oct-90	M	Jun-92	0	0	0	0	0	63	63	9	31	29	0	0	0	0	0	0
27	504	Oct-90	M	Sep-93	0	0	0	0	0	84	45	9	33	3.7	0	0	0	0	0	0
27	504	Oct-90	M	Aug-95	0	0	0	0	0	137	0	16	55	0	0	0	0	0	0	0
27	505	Oct-90	M	Nov-90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	505	Oct-90	M	Jun-92	0	0	0	0	0	151	53	30	109	7.9	0	0	0	0	0	0
27	505	Oct-90	M	Sep-93	0	0	0	0	0	293	39	32	114	3.7	0	0	0	0	0	0
27	505	Oct-90	M	Aug-95	0	0	0	0	0	241	17	24	79	0	0	0	0	0	0	0
27	506	Oct-90	M	Nov-90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	506	Oct-90	M	Jun-92	0	0	0	0	0	14	14	14	51	15	0	0	0	0	0	0
27	506	Oct-90	M	Sep-93	0	0	0	0	0	92	17	15	55	0	0	0	0	0	0	0
27	506	Oct-90	M	Aug-95	0	0	0	0	0	230	0	25	83	0	0	0	0	0	0	0
27	507	Oct-90	M	Nov-90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	507	Oct-90	M	Jun-92	0	0	0	0	0	10	10	10	34	12	0	0	0	0	0	0
27	507	Oct-90	M	Sep-93	0	0	0	0	0	23	6.1	10	35	0	0	0	0	0	0	0
27	507	Oct-90	M	Aug-95	0	0	0	0	0	184	0	13	49	0	0	0	0	0	0	0
27	508	Oct-90	M	Nov-90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	508	Oct-90	M	Jun-92	0	0	0	0	0	0	0	7	23	17	0	0	0	0	0	0
27	508	Oct-90	M	Sep-93	0	0	0	0	0	0	0	7	25	0	0	0	0	0	0	0
27	509	Oct-90	M	Nov-90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	509	Oct-90	M	Jun-92	0.1	0	0	0	0	17	0	17	52	0.3	0	0	0	0	0	0
27	509	Oct-90	M	Sep-93	0	0	0	0	0	21	0	17	55	0	0	0	0	0	0	0
27	509	Oct-90	M	Aug-95	0	0	0	0	0	101	0	20	70	0	0	0	0	0	0	0

Table 10. Quantities of distresses by test section for individual distress surveys on SPS-5 projects (continued).

ST	SHRP	REHAB	*	SURVEY	Quantities of Distress by Distress Code 1	2	3	4a	4as	4b	4bs	6n	6l	6ls	7n	7a	11	13	15n	15l
28	501	Sep-90	P	Jun-89	0	0	0	27	0	0	0	14	21	0	0	0	0	0	0	0
28	502	Sep-90	P	Jun-89	5	191	0	93	0	0	0	46	81	0	2	1	0	0	0	0
28	503	Sep-90	P	Jun-89	6	0	0	120	0	0	0	74	107	0	0	0	0	0	0	0
28	504	Sep-90	P	Jun-89	0	0	0	96	0	0	0	24	36	0	0	0	0	0	0	0
28	505	Sep-90	P	Jun-89	0	0	0	37	0	0	0	9	10	0	0	0	0	0	0	0
28	506	Sep-90	P	Jun-89	0	0	0	33	0	0	0	9	11	0	0	0	0	0	0	0
28	507	Sep-90	P	Jun-89	0	0	0	50	0	0	0	26	33	0	0	0	0	0	0	0
28	508	Sep-90	P	Jun-89	0	0	0	114	0	0	0	57	76	0	0	0	0	0	0	0
28	509	Sep-90	P	Jun-89	7	0	0	134	0	0	0	111	164	0	2	2	0	0	0	0
28	501	Sep-90	M	Jul-93	0	0	0	67	0	0	0	28	36	0	0	0	0	0	0	0
28	502	Sep-90	M	Jul-93	0	0	0	175	0	0	0	0	0	0	0	0	0	0	0	0
28	503	Sep-90	M	Jul-93	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	504	Sep-90	M	Jul-93	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	505	Sep-90	M	Jul-93	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	506	Sep-90	M	Jul-93	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0
28	507	Sep-90	M	Jul-93	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	508	Sep-90	M	Jul-93	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	509	Sep-90	M	Jul-93	0	0	0	80	0	0	0	0	0	0	0	0	0	0	0	0
30	502	Sep-91	M	May-91	101	0	0	0	0	23	0	19	23	0	0	0	0	0	0	0
30	503	Sep-91	M	May-91	185	0	0	24	0	22	0	82	120	0	0	0	0	0	0	0
30	504	Sep-91	M	May-91	204	0	0	12	0	53	0	57	88	0	0	0	0	0	0	0
30	505	Sep-91	M	May-91	45	0	0	0.9	0	83	0	22	39	0	0	0	0	0	0	0
30	506	Sep-91	M	May-91	108	0	0	11	0	16	0	30	59	0	0	0	0	0	0	0
30	507	Sep-91	M	May-91	155	78	0	42	0	2.7	0	31	62	0	0	0	0	0	0	0
30	508	Sep-91	M	Jul-91	111	0	0	16	0	14	0	69	112	0	0	0	0	0	0	0
30	509	Sep-91	M	May-91	137	0	0	10	0	36	0	45	75	0	0	0	0	0	0	0
34	501	Aug-92	M	Apr-92	141	170	0	7.6	0	3	0	15	25	0	3	3.9	0	0	0	0
34	502	Aug-92	M	Apr-92	456	0	73	1.5	0	0	0	4	10	0	1	4	4.8	0	0	0
34	503	Aug-92	M	Apr-92	0	240	0	0	0	15	0	6	11	2.4	0	0	14	22	0	0
34	504	Aug-92	M	Apr-92	28	31	0	4	0	76	0	19	42	0	0	0	0	1.3	0	0
34	505	Aug-92	M	Apr-92	66	144	0	10	0	15	0	21	31	0	1	1.3	0	0	0	0
34	506	Aug-92	M	Apr-92	0	217	0	1.8	0	0	0	11	11	0	3	21	0	0	0	0
34	507	Aug-92	M	Apr-92	1.5	263	0	2.7	0	0	0	10	20	0	2	6.9	1.2	24	0	0
34	508	Aug-92	M	Apr-92	0	155	0	0	0	31	0	11	17	0	2	0.2	0	2	0	0
34	509	Aug-92	M	Apr-92	0	391	0	1.1	0	0	0	2	2.1	0	2	9	0	5	0	0

Table 10. Quantities of distresses by test section for individual distress surveys on SPS-5 projects (continued).

ST	SHRP	REHAB	*	SURVEY	Quantities of Distress by Distress Code 1	2	3	4a	4as	4b	4bs	6n	6l	6ls	7n	7a	11	13	15n	15l
48	501	Sep-91	M	Aug-93	0	0	0	5	0	261	79	92	150	22	0	0	0	0	0	0
48	501	Sep-91	M	Jun-95	0	0	0	10	0	366	61	161	182	16	0	0	0	0	0	0
48	502	Sep-91	M	Aug-93	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	502	Sep-91	M	Jun-95	0	0	0	0	0	0	0	1	2.3	0	0	0	0	0	0	0
48	503	Sep-91	M	Aug-93	0	0	0	0	0	0	0	0	0	0	3	0.2	0	0	0	0
48	503	Sep-91	M	Jun-95	0	0	0	0	0	0	0	0	0	0	3	0.2	0	0	0	0
48	504	Oct-91	M	Aug-93	0	0	0	0	0	0	0	0	0	0	5	0.3	0	0	0	0
48	504	Oct-91	M	Jun-95	0	0	0	0	0	0	0	0	0	0	5	0.3	0	0	0	0
48	505	Oct-91	M	Aug-93	0	0	0	0	0	0	0	0	0	0	2	0.1	0	0	0	0
48	505	Oct-91	M	Jun-95	0	0	0	0	0	149	0	25	27	0	2	0.1	0	0	0	0
48	506	Oct-91	M	Aug-93	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	506	Oct-91	M	Jun-95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	507	Oct-91	M	Aug-93	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	507	Oct-91	M	Jun-95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	508	Sep-91	M	Aug-93	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	508	Sep-91	M	Jun-95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	509	Sep-91	M	Aug-93	0	0	0	0	0	0	0	0	0	0	4	0.3	0	0	0	0
48	509	Sep-91	M	Jun-95	0	0	0	0	0	0	0	0	0	0	4	0.3	0	0	0	0
81	505	Oct-90	P	May-90	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
81	506	Oct-90	P	May-90	11	0	0	0	0	0	0	3	2	0	0	0	0	0	0	0
81	507	Oct-90	P	May-90	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
81	508	Oct-90	P	May-90	0	0	0	2	0	0	0	1	4	0	1	1	0	0	0	0
81	501	Oct-90	M	May-91	0.8	0	0	3	0	0	0	1	3.7	0	8	2.5	54	2.4	0	0
81	502	Oct-90	M	May-91	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
81	503	Oct-90	M	May-91	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
81	504	Oct-90	M	May-91	0	0	0	0	0	0	0	0	0	0	1	17	0	0	0	0
81	505	Oct-90	M	May-91	0	0	0	0	0	0	0	0	0	0	1	0.1	0	0	0	0
81	506	Oct-90	M	May-91	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
81	507	Oct-90	M	May-91	0	0	0	0	0	0	0	0	0	0	1	1.4	0	0	0	0
81	508	Oct-90	M	May-91	0	0	0	0	0	4.6	0	0	0	0	0	0	0	0	0	0
81	509	Oct-90	M	May-91	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 10. Quantities of distresses by test section for individual distress surveys on SPS-5 projects (continued).

					Quantities of Distress by Distress Code															
ST	SHRP	REHAB	*	SURVEY	1	2	3	4a	4as	4b	4bs	6n	6l	6ls	7n	7a	11	13	15n	15l
83	501	Sep-89	M	May-89	0	0	0	0	0	0	0	3	11	0	0	0	0	47	0	0
83	501	Sep-89	M	Jun-91	2	0	0	4.9	0	50	0	2	7.4	0	8	7.3	0	0	0	0
83	501	Sep-89	M	Jul-92	24	0	140	0	0	23	0	3	11	0	10	1.7	0	0.4	0	0
83	501	Sep-89	M	Jun-93	5.4	0	81	0	0	11	10	1	1	0	2	252	0	0	0	0
83	501	Sep-89	M	Sep-95	17	0	0	6	0	144	0	4	12	0	6	233	0	0	0	0
83	502	Sep-89	M	May-89	0	0	2.4	0	0	7.6	0	1	3.7	0	3	10	0	47	0	0
83	502	Sep-89	M	Jun-91	0	0	0	7.3	0	136	0	2	7.4	0	0	0	0	0	0	0
83	502	Sep-89	M	Jul-92	0	0	0	0	0	154	0	3	10	0	0	0	0	0	0	0
83	502	Sep-89	M	Jun-93	2	0	0	85	0	162	162	3	11	11	0	0	0	0	0	0
83	502	Sep-89	M	Sep-95	2	0	0	282	0	140	4.5	4	15	2.3	0	0	0	564	0	0
83	503	Sep-89	M	May-89	1	0	0	0	0	53	0	3	11	0	0	0	0	47	0	0
83	503	Sep-89	M	Jun-91	0	0	0	0	0	152	0	3	11	0	0	0	0	0	0	0
83	503	Sep-89	M	Jul-92	0	0	0	0	0	153	0	3	11	0	0	0	0	0	0	0
83	503	Sep-89	M	Jun-93	0	0	0	70	0	154	153	3	11	11	0	0	0	0	0	0
83	503	Sep-89	M	Sep-95	3.4	0	0	305	0	0	0	1	3.7	0	0	0	0	0	0	0
83	504	Sep-89	M	May-89	6.5	0	0	0	0	0	0	2	5	0	2	3.4	0	0	0	0
83	504	Sep-89	M	Jun-91	0	0	0	0	0	0	0	2	7.4	0	0	0	0	0	0	0
83	504	Sep-89	M	Jul-92	0	0	0	0	0	57	0	2	7.4	0	0	0	0	0	0	0
83	504	Sep-89	M	Jun-93	0	0	0	48	0	86	84	2	7	7	0	0	0	0	0	0
83	504	Sep-89	M	Sep-95	0	0	0	80	0	152	0	3	6.7	3.7	0	0	0	2.5	0	0
83	505	Sep-89	M	May-89	0	0	0	0	0	19	0	0	0	0	3	185	0	33	0	0
83	505	Sep-89	M	Jun-91	0	0	0	0	0	59	0	3	11	0	0	0	0	0	0	0
83	505	Sep-89	M	Jul-92	5	0	0	0	0	109	0	3	12	0	0	0	0	0	0	0
83	505	Sep-89	M	Jun-93	0	0	0	147	0	160	135	3	11	11	0	0	0	0	0	0
83	505	Sep-89	M	Sep-95	4	0	0	224	0	176	120	4	12	7.9	0	0	0	0	0	0
83	506	Sep-89	M	May-89	0	0	0	0	0	5.5	0	0	0	0	1	335	0	19	0	0
83	506	Sep-89	M	Aug-89	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
83	506	Sep-89	M	Jun-91	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0
83	506	Sep-89	M	Jul-92	8	0	0	0	0	67	0	0	0	0	0	0	0	0	0	0
83	506	Sep-89	M	Jun-93	6	0	0	120	0	122	106	0	0	0	0	0	0	0	0	0
83	506	Sep-89	M	Sep-95	0	0	0.7	294	0	16	10	0	0	0	0	0	0	0	0	0
83	507	Sep-89	M	May-89	9.3	0	0	0	0	14	0	1	3.7	0	3	5.9	0	56	0	0
83	507	Sep-89	M	Aug-89	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0
83	507	Sep-89	M	Jul-92	1	0	0	0	0	16	0	3	8.4	0	0	0	0	0	0	0
83	507	Sep-89	M	Sep-95	0	0	0	158	0	90	0	4	12	2	0	0	0	0	0	0
83	508	Sep-89	M	May-89	0	0	0	0	0	9.1	0	1	3.7	0	2	245	0	85	0	0
83	508	Sep-89	M	Aug-89	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
83	508	Sep-89	M	Jul-92	0	0	0	0	0	110	0	1	3.8	0	0	0	0	0	0	0
83	508	Sep-89	M	Jun-93	0	0	0	53	0	140	109	1	3.5	3.5	0	0	0	0	0	0
83	508	Sep-89	M	Sep-95	0	0	0	305	0	68	0	1	3.6	0	0	0	0	0	0	0
83	509	Sep-89	M	May-89	3	0	0	0	0	0	0	1	3.7	0	1	421	0	38	0	0
83	509	Sep-89	M	Aug-89	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
83	509	Sep-89	M	Jul-92	0	0	0	0	0	0	0	2	7.4	0	0	0	0	0	0	0
83	509	Sep-89	M	Jun-93	3	0	0	130	0	94	69	2	7	7	0	0	0	0	0	0
83	509	Sep-89	M	Sep-95	0	0	0	0	0	125	0	2	7.4	0	0	0	0	1	0	0

Table 10. Quantities of distresses by test section for individual distress surveys on SPS-5 projects (continued).

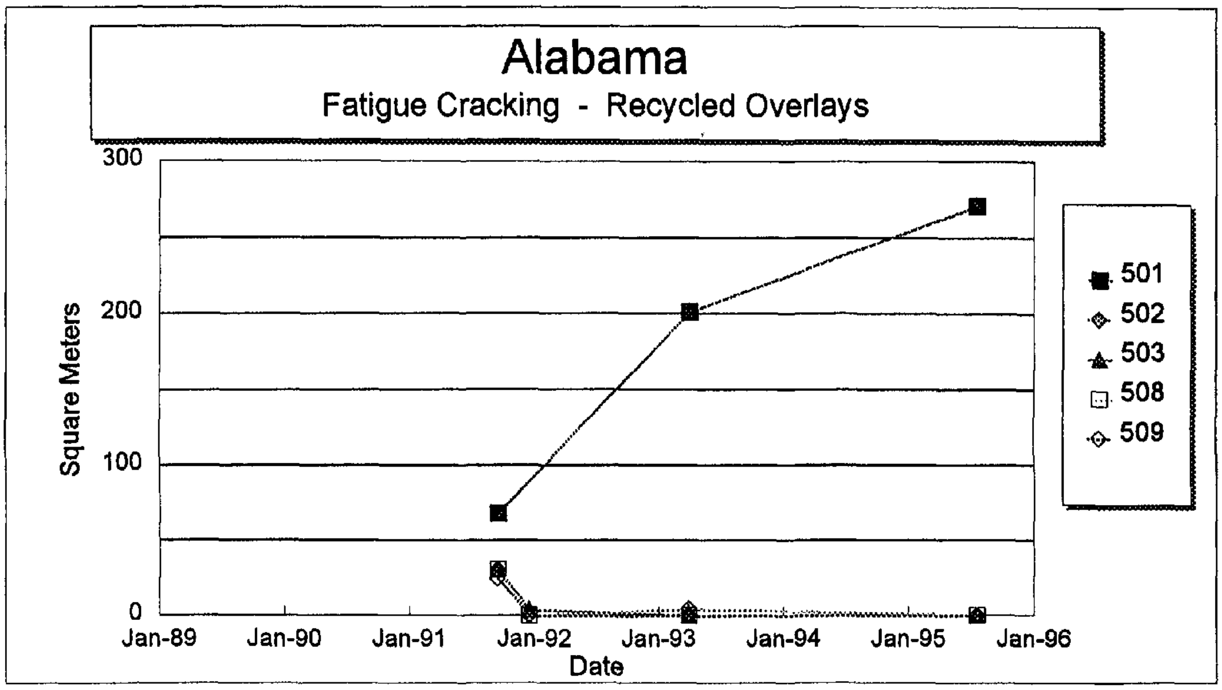
DISTRESS CODES:	1	Fatigue Cracking (m^2)
	2	Block Cracking (m^2)
	3	Edge Cracking (m)
	4a	Longitudinal Cracking in the wheelpath (m)
	4as	Longitudinal Cracking in the wheelpath, sealed (m)
	4b	Longitudinal Cracking not in the wheelpath (m)
	4bs	Longitudinal Cracking not in the wheelpath, sealed (m)
	6n	Transverse Cracks, number
	6l	Transverse Cracks, length (m)
	6ls	Transverse Cracks, length sealed (m)
	7n	Patching, number
	7a	Patching, area (m^2)
	11	Bleeding (m^2)
	13	Raveling (m^2)
	15n	Water Bleeding and Pumping, number
	15l	Water Bleeding and Pumping, length (m)

TEST SECTION CODES:	501	Control
	502	2-in (51-mm) Recycled AC Overlay
	503	5-in (127-mm) Recycled AC Overlay
	504	5-in (127-mm) Virgin AC Overlay
	505	2-in (51-mm) Virgin AC Overlay
	506	2-in (51-mm) Virgin AC Overlay, with milling
	507	5-in (127-mm) Virgin AC Overlay, with milling
	508	5-in (127-mm) Recycled AC Overlay, with milling
	509	2-in (51-mm) Recycled AC Overlay, with milling

SURVEY TYPES:	M	Manual Survey
	P	PASCO Film

Table 10. Quantities of distresses by test section for individual distress surveys on SPS-5 projects (continued).

STATE CODES:	1	Alabama
	4	Arizona
	6	California
	8	Colorado
	12	Florida
	13	Georgia
	23	Maine
	24	Maryland
	27	Minnesota
	28	Mississippi
	30	Montana
	34	New Jersey
	48	Texas
	81	Alberta
	83	Manitoba



Note: Section 501 is a non-overlayed control section.

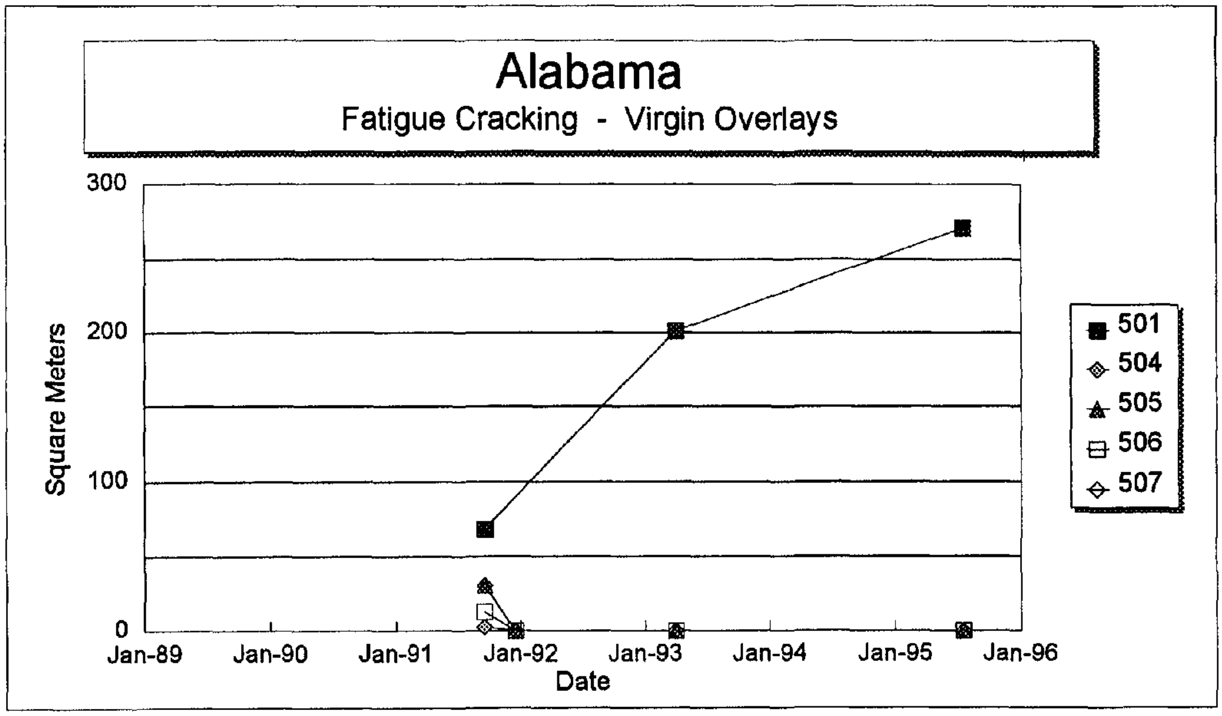
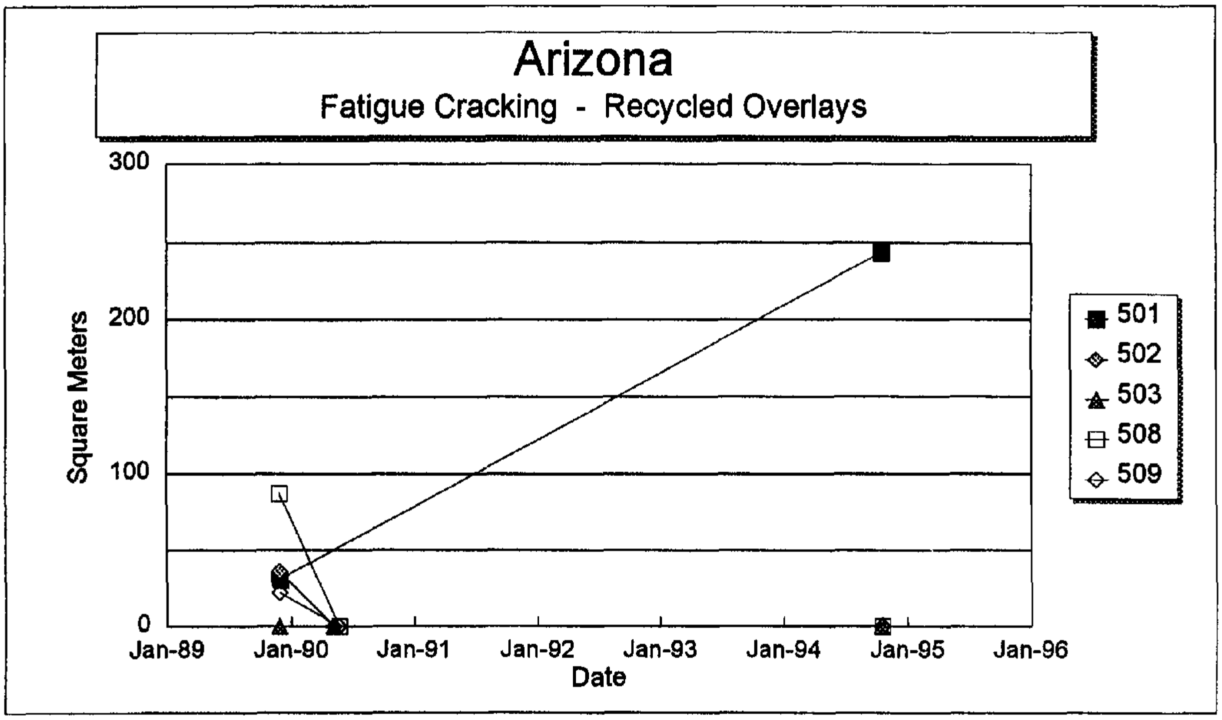


Figure 6. Total area of fatigue cracking versus time on each section of the Alabama SPS-5 project.



Note: Section 501 is a non-overlayed control section.

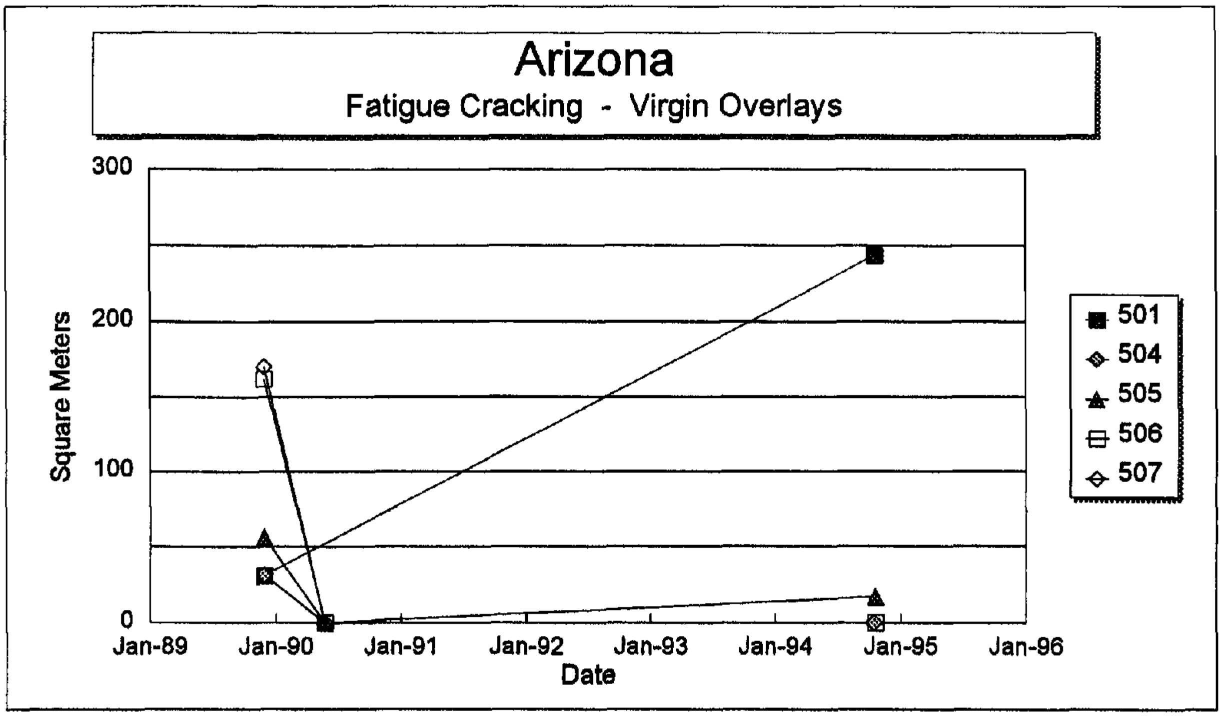
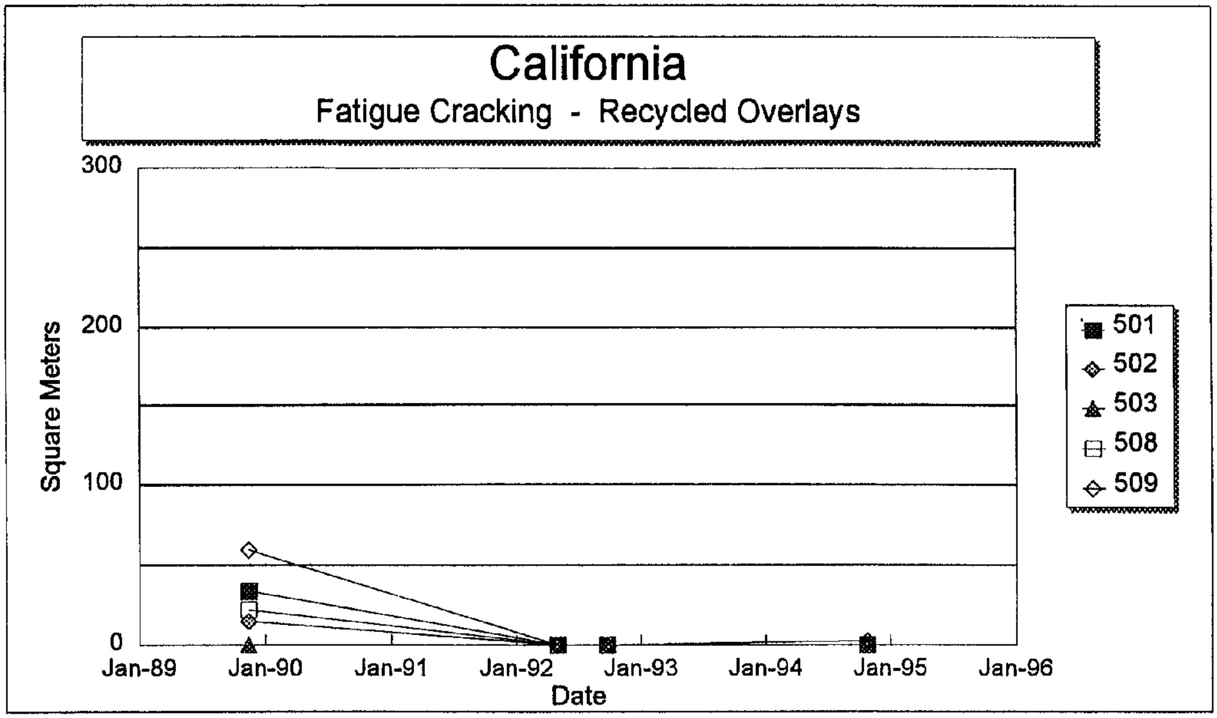


Figure 7. Total area of fatigue cracking versus time on each section of the Arizona SPS-5 project.



Note: Section 501 is a non-overlayed control section. (However, the control on this particular project did not remain untreated.)

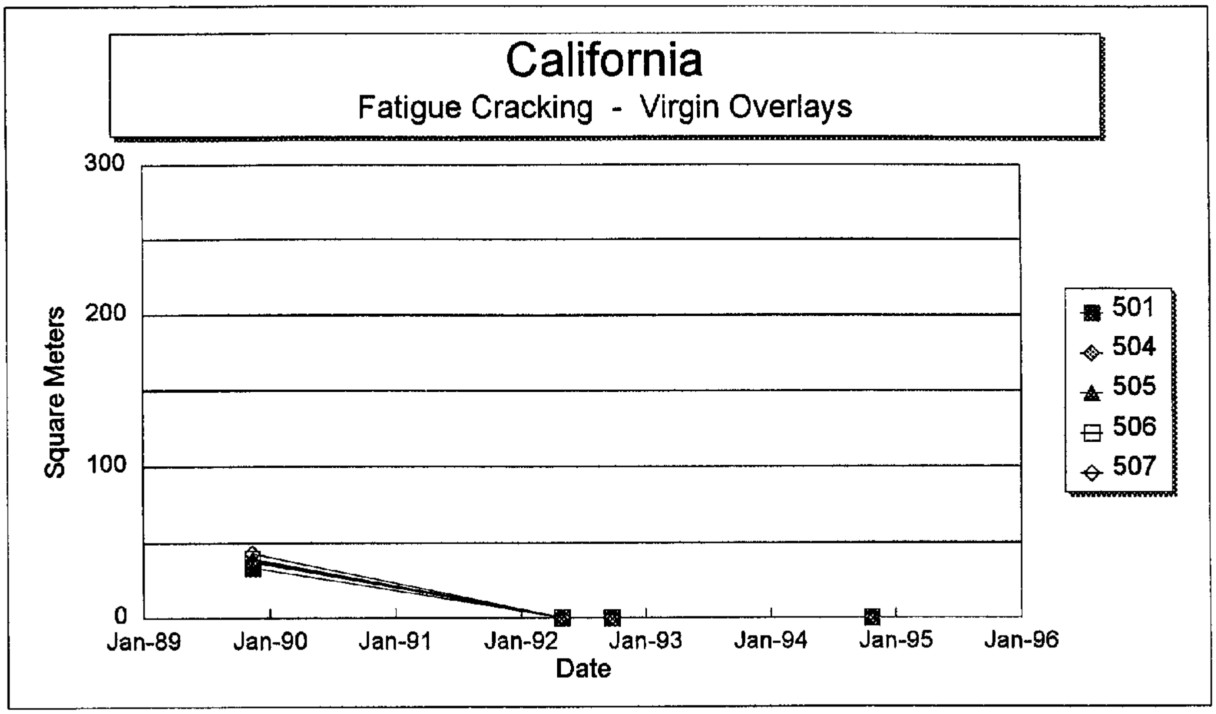
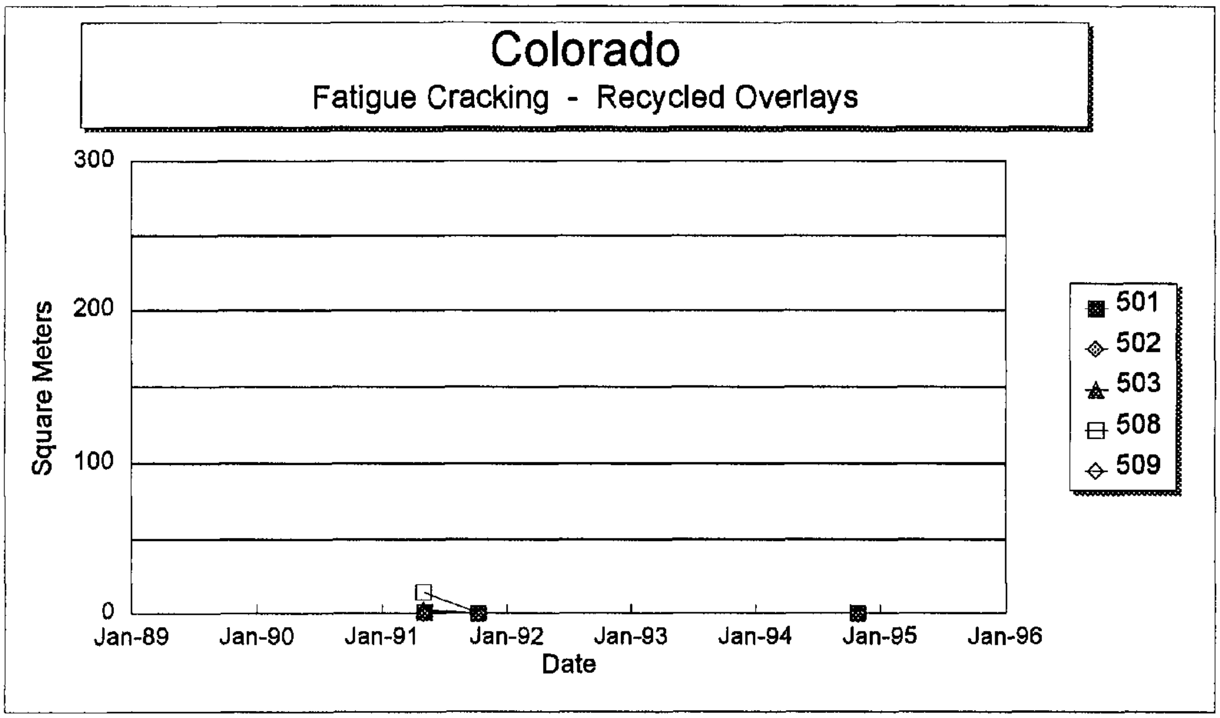


Figure 8. Total area of fatigue cracking versus time on each section of the California SPS-5 project.



Note: Section 501 is a non-overlayed control section. (However, the control on this particular project did not remain untreated.)

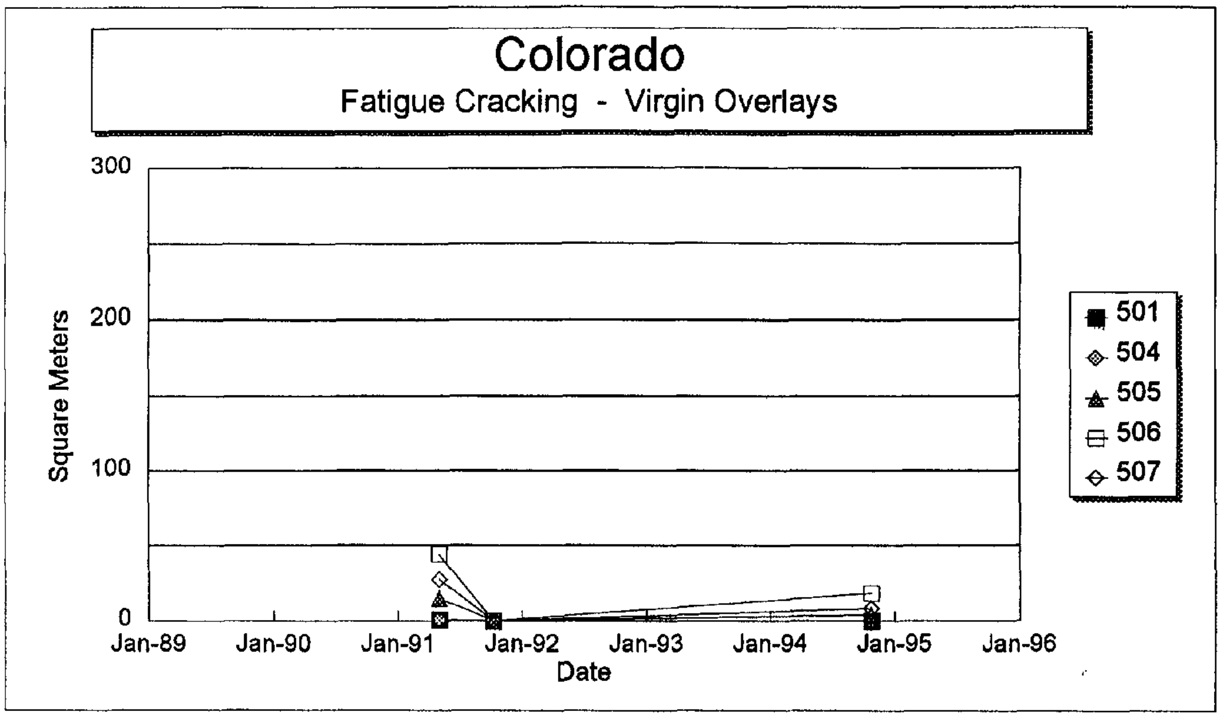
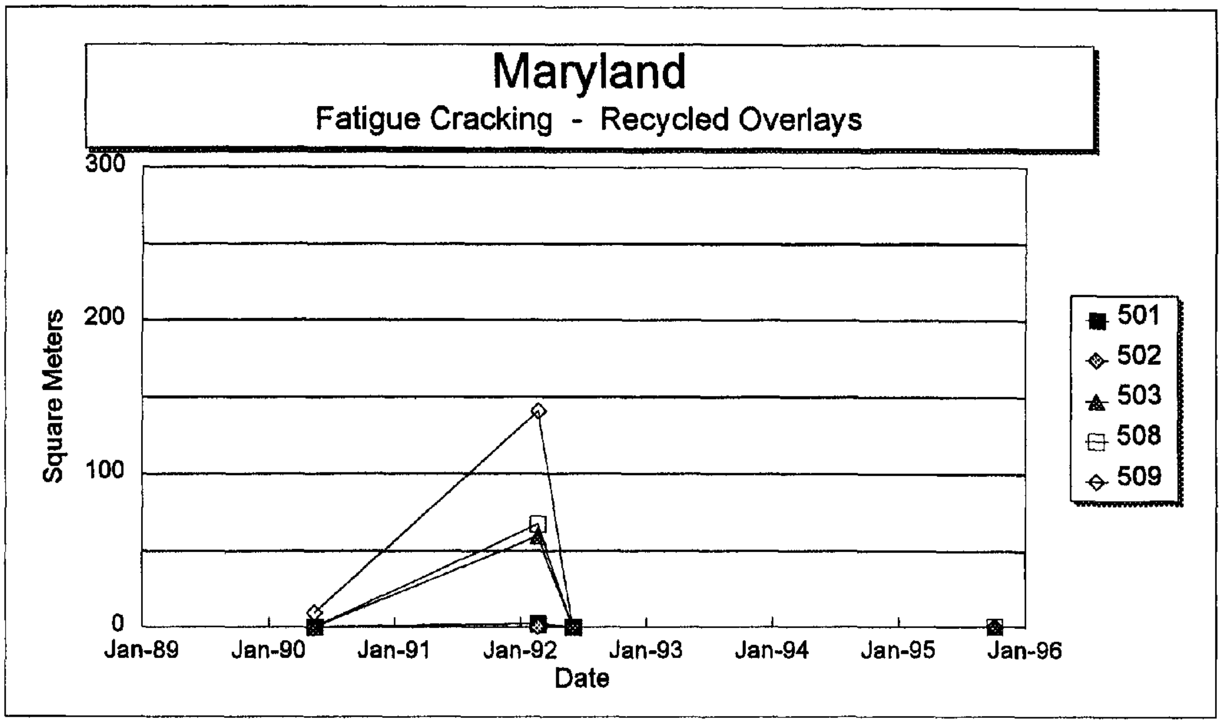


Figure 9. Total area of fatigue cracking versus time on each section of the Colorado SPS-5 project.



Note: Section 501 is a non-overlayed control section.

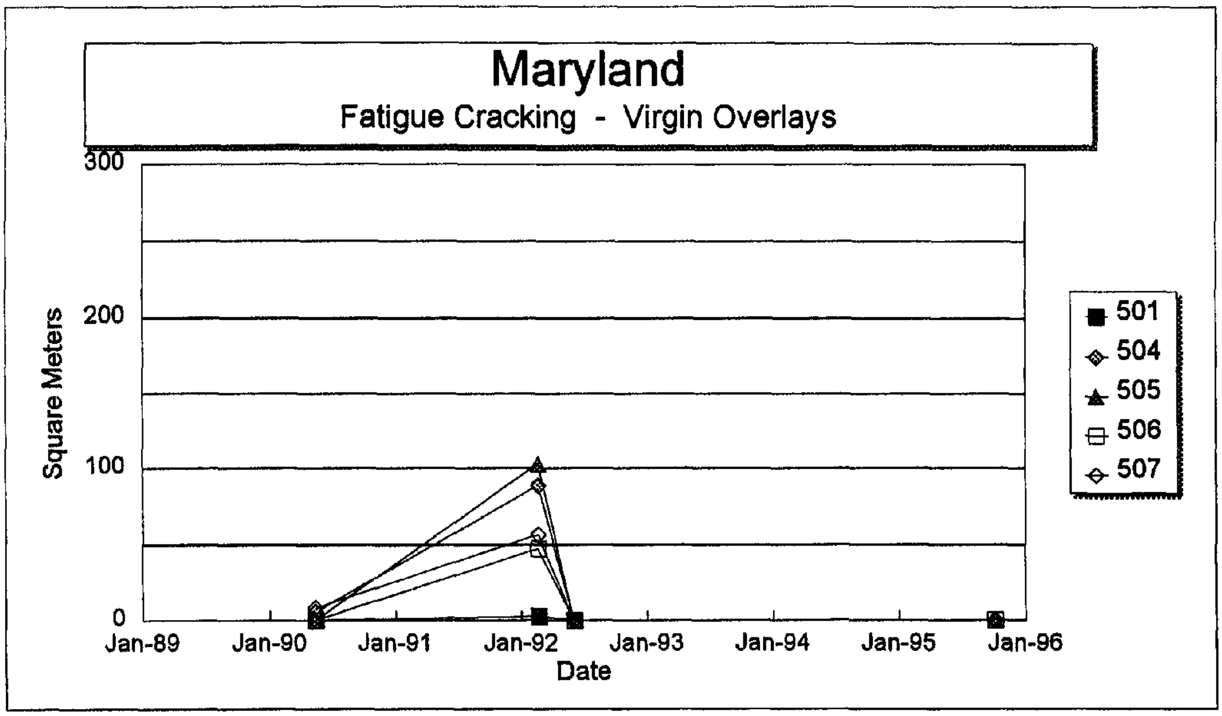
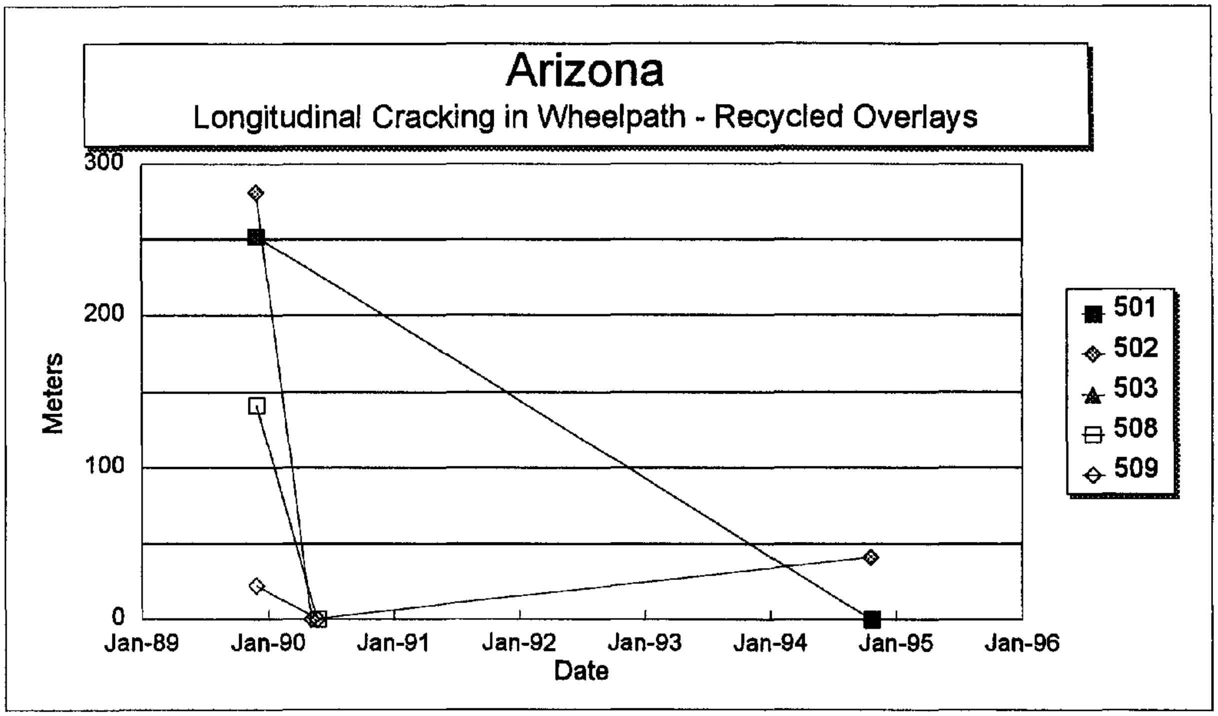


Figure 10. Total area of fatigue cracking versus time on each section of the Maryland SPS-5 project.



Note: Section 501 is a non-overlayed control section.

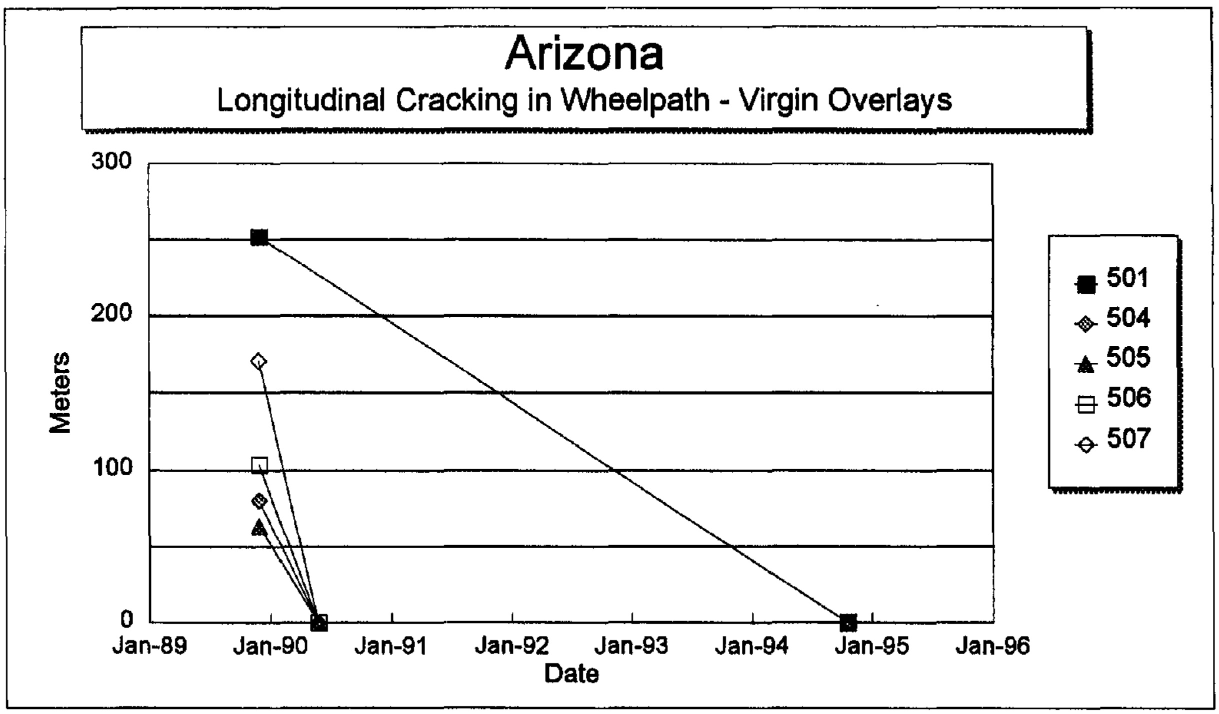
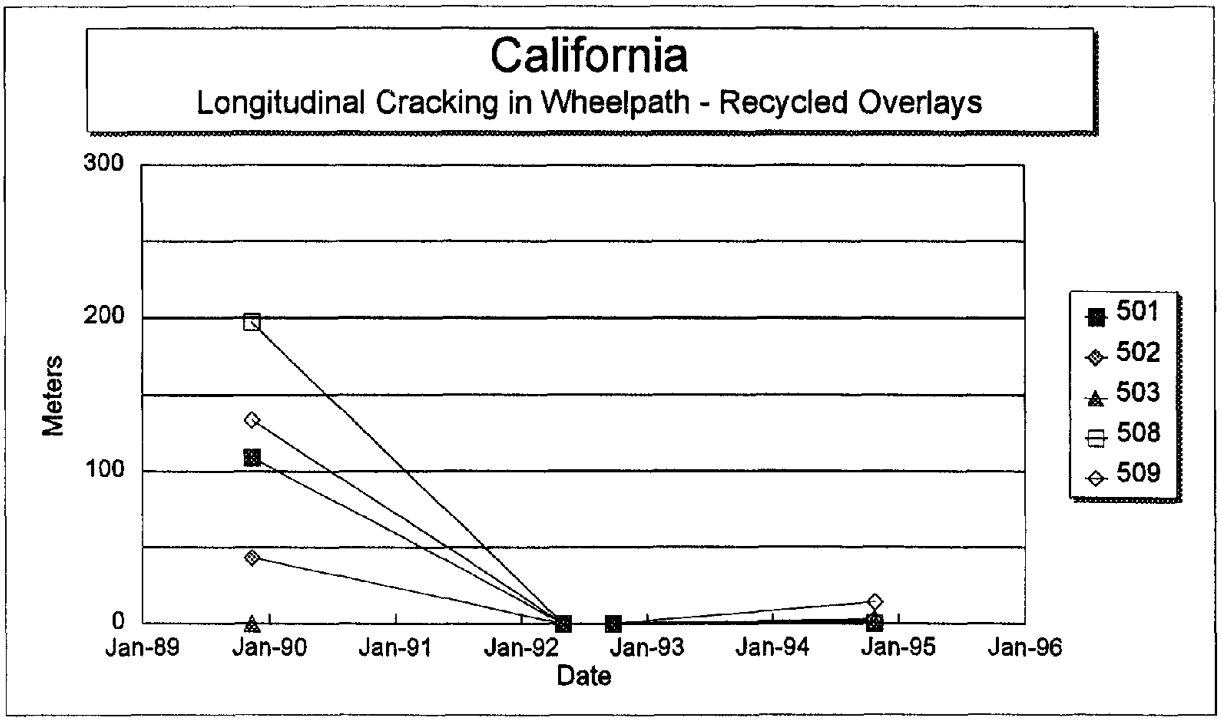


Figure 11. Total length of longitudinal cracking in the wheelpath versus time on each section of the Arizona SPS-5 project.



Note: Section 501 is a non-overlayed control section. (However, the control on this particular project did not remain untreated.)

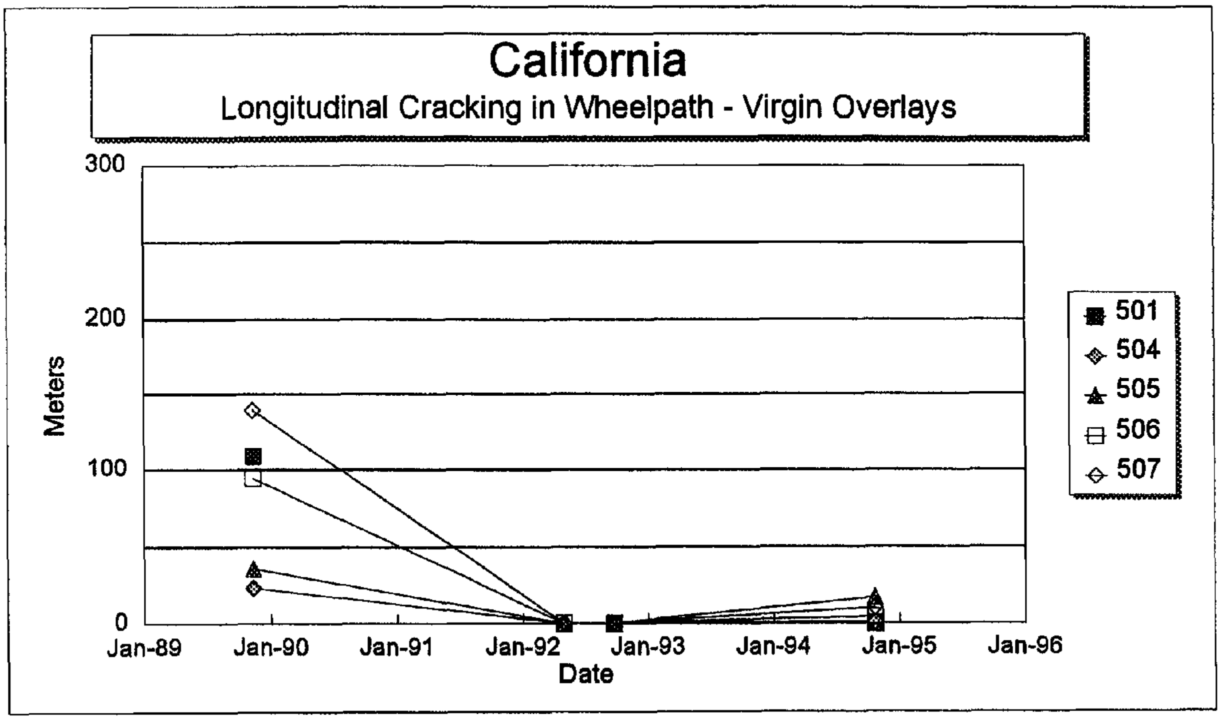
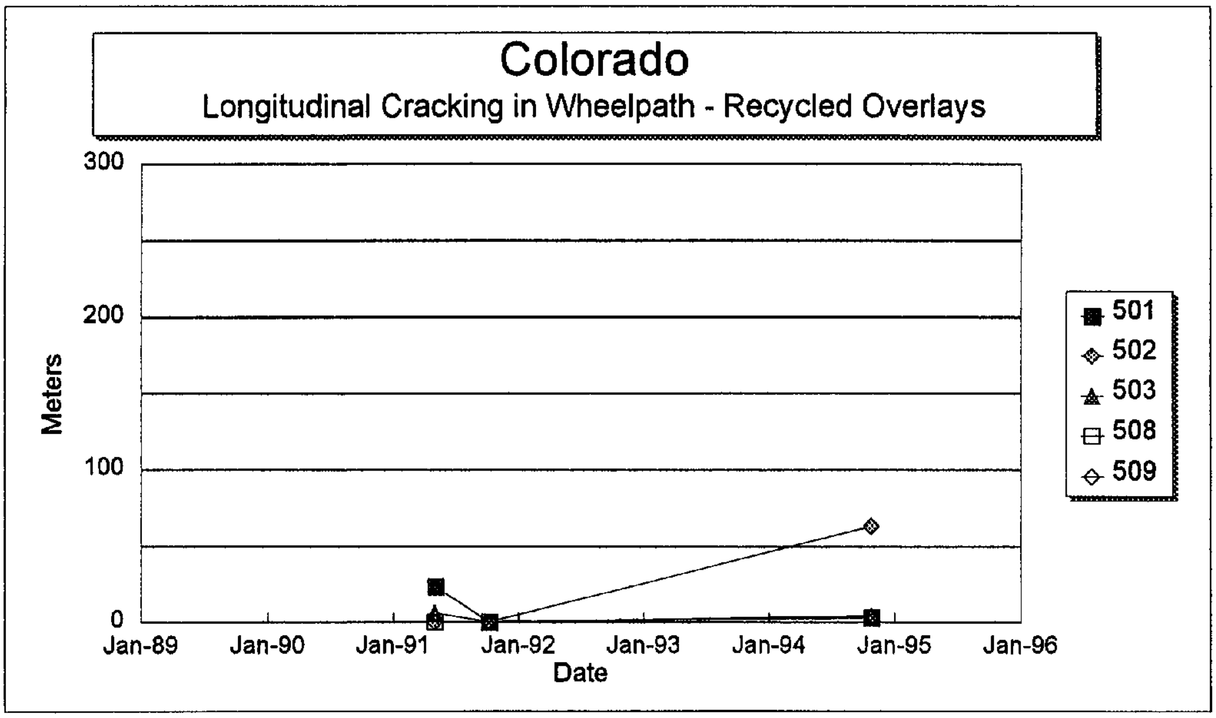


Figure 12. Total length of longitudinal cracking in the wheelpath versus time on each section of the California SPS-5 project.



Note: Section 501 is a non-overlayed control section. (However, the control on this particular project did not remain untreated.)

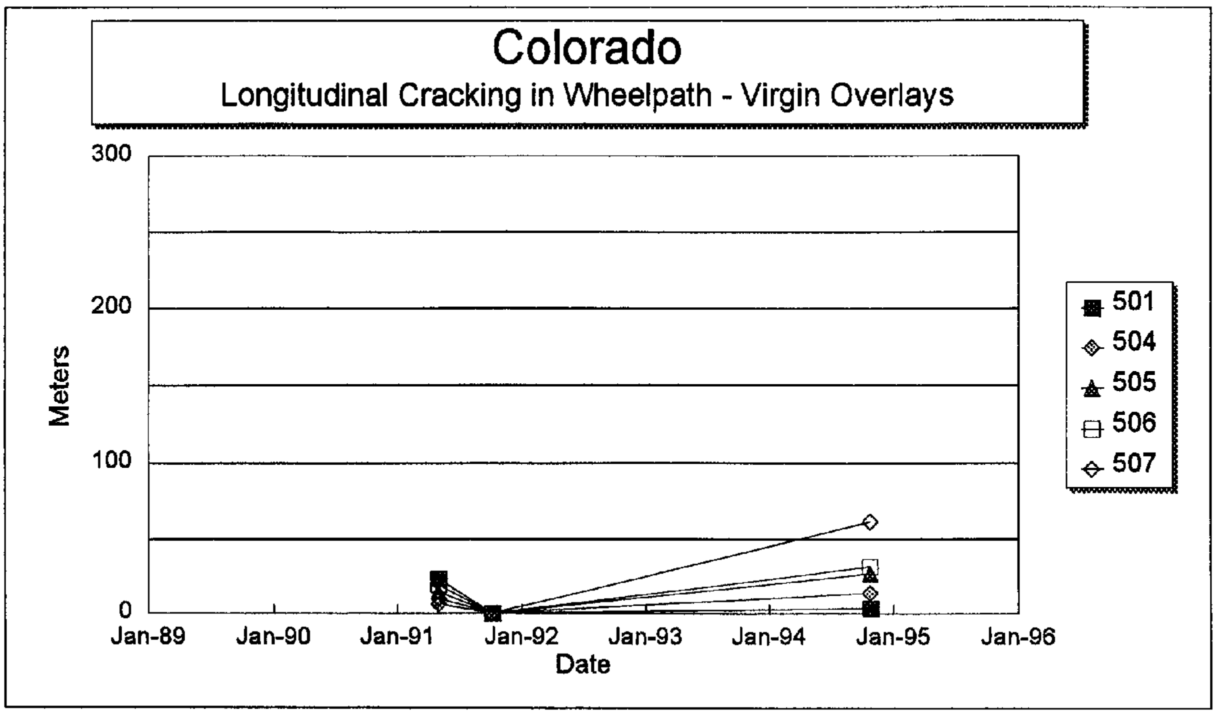
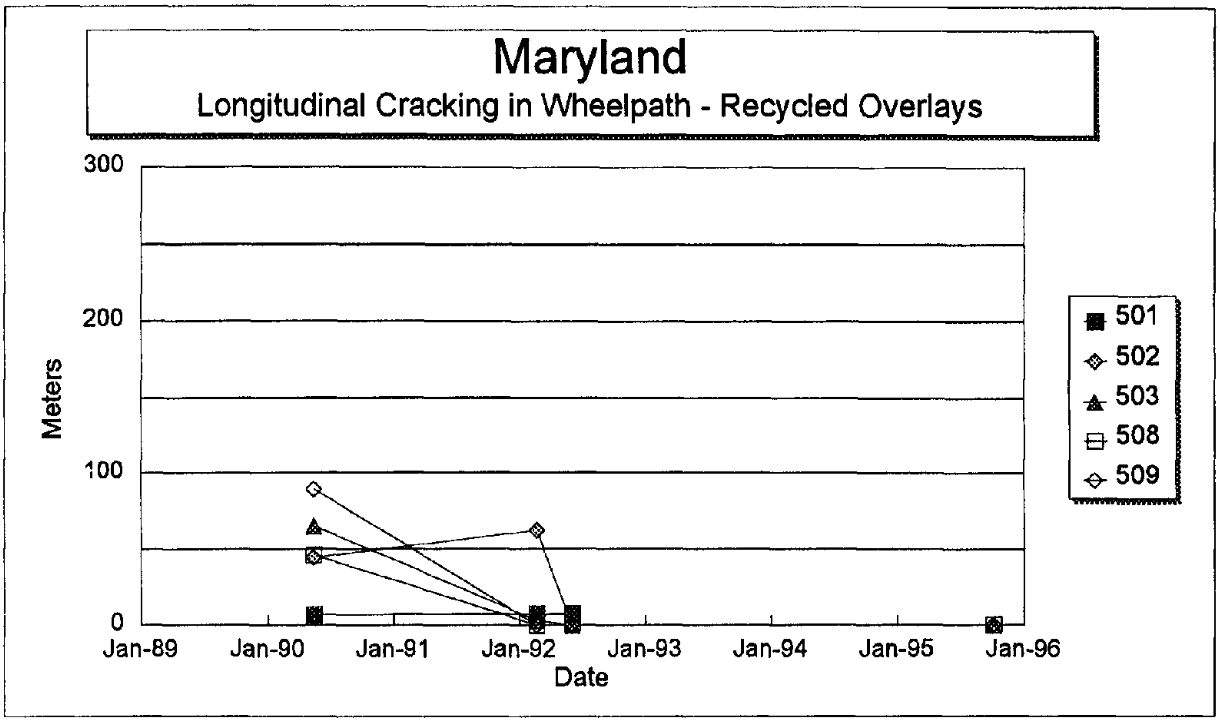


Figure 13. Total length of longitudinal cracking in the wheelpath versus time on each section of the Colorado SPS-5 project.



Note: Section 501 is a non-overlayed control section.

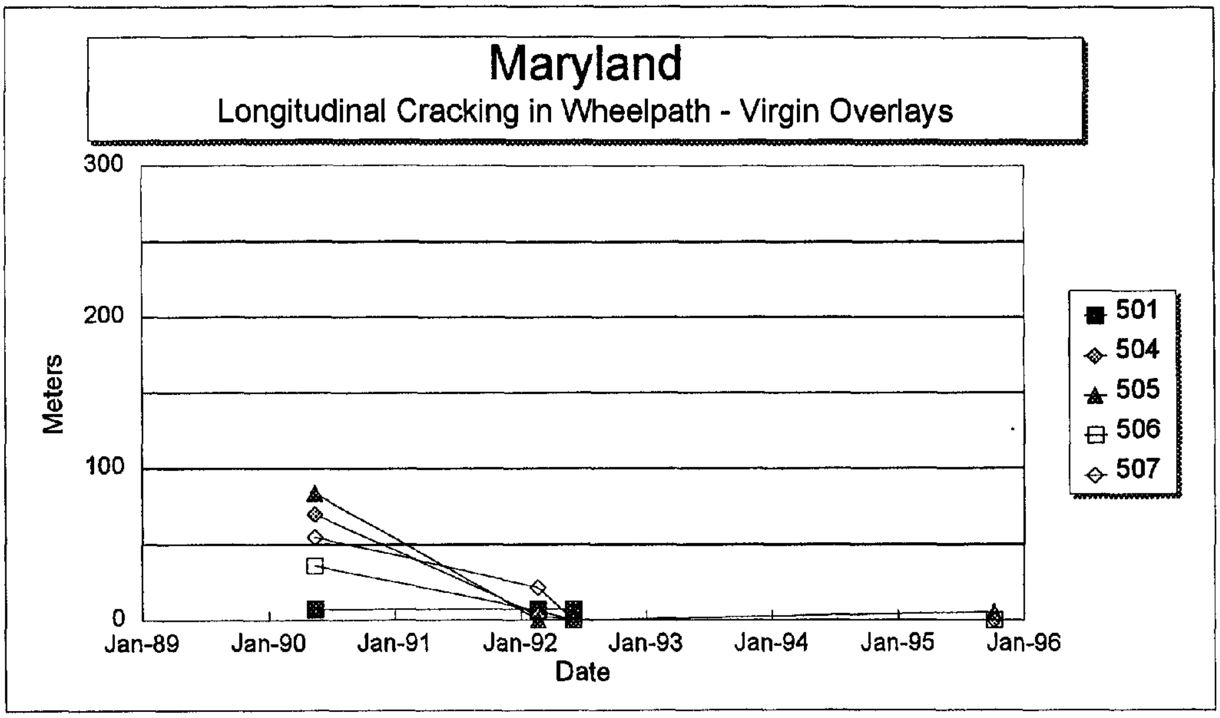
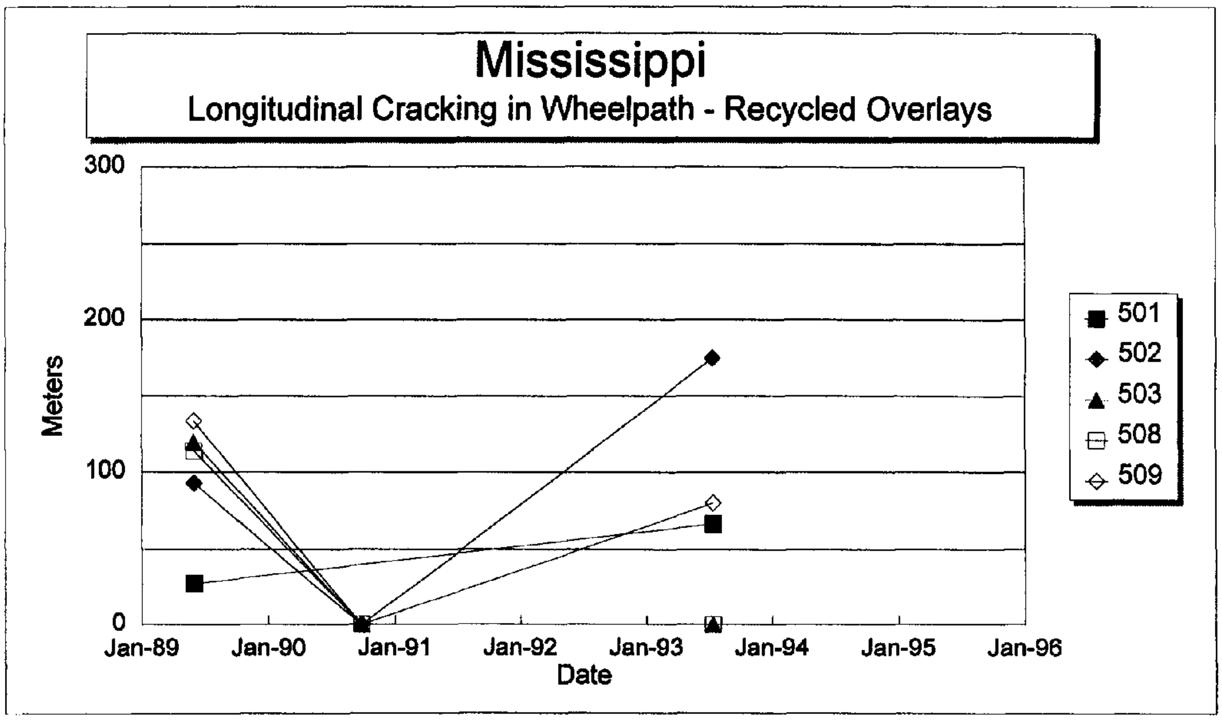


Figure 14. Total length of longitudinal cracking in the wheelpath versus time on each section of the Maryland SPS-5 project.



Note: Section 501 is a non-overlayed control section.

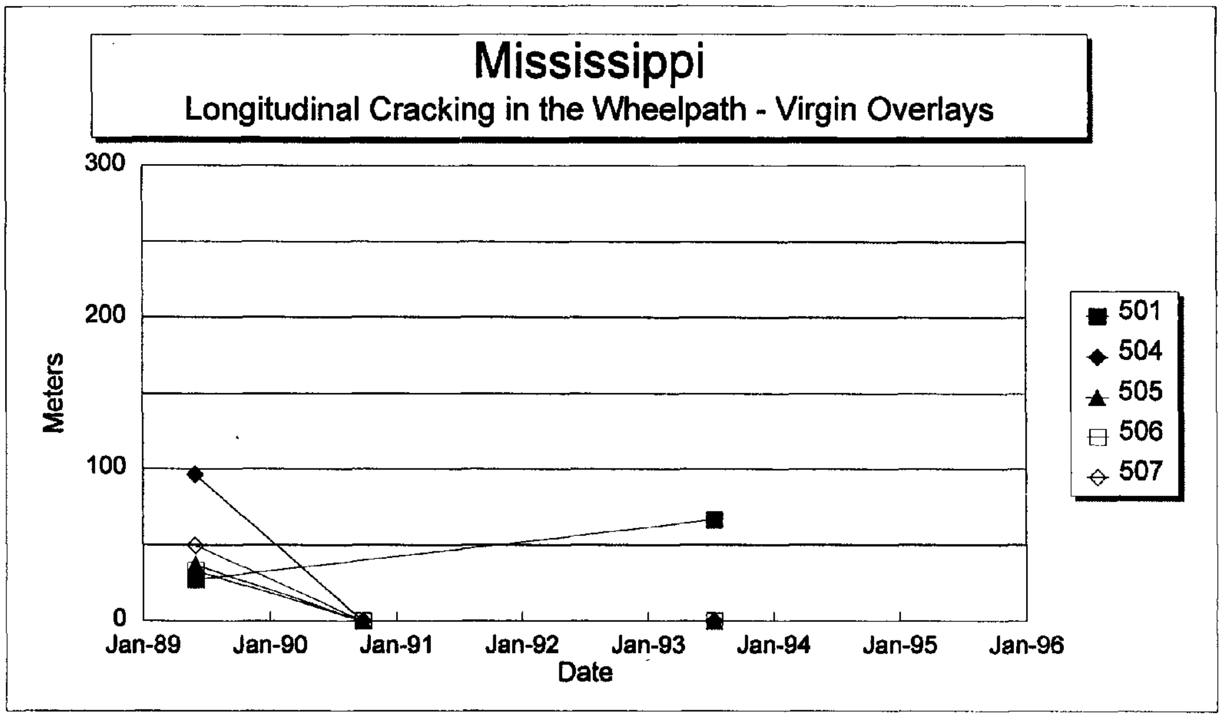
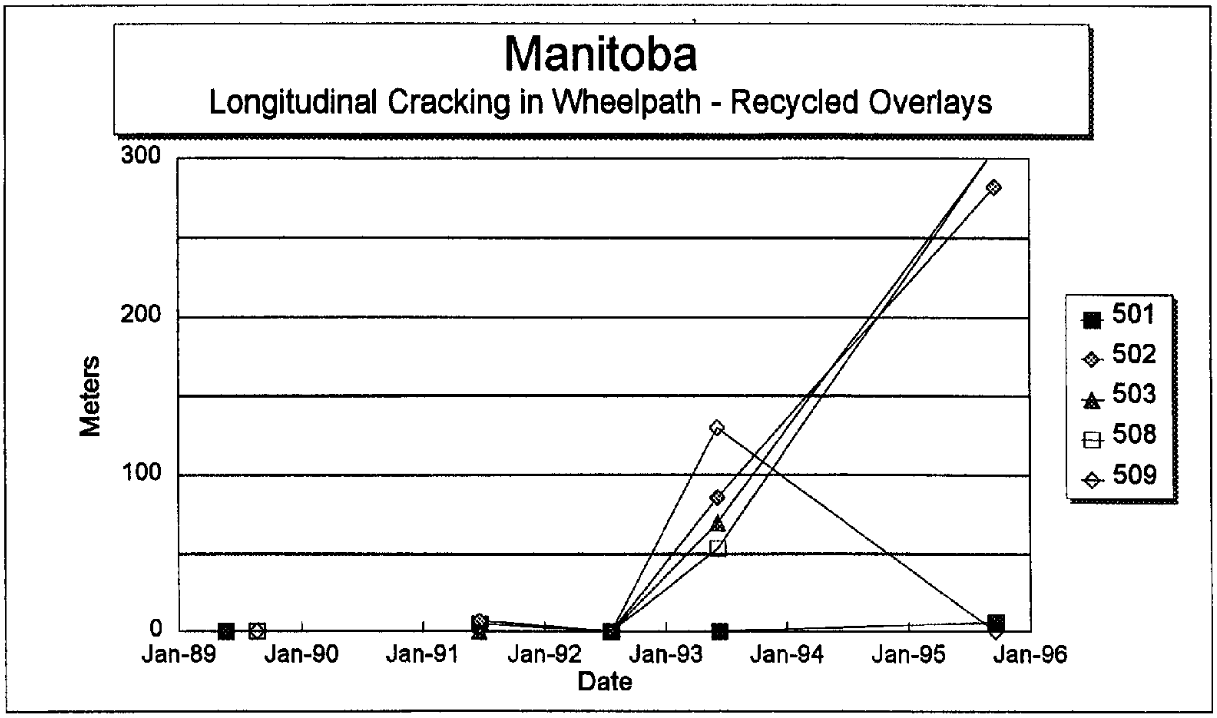


Figure 15. Total length of longitudinal cracking in the wheelpath versus time on each section of the Mississippi SPS-5 project.



Note: Section 501 is a non-overlayed control section.

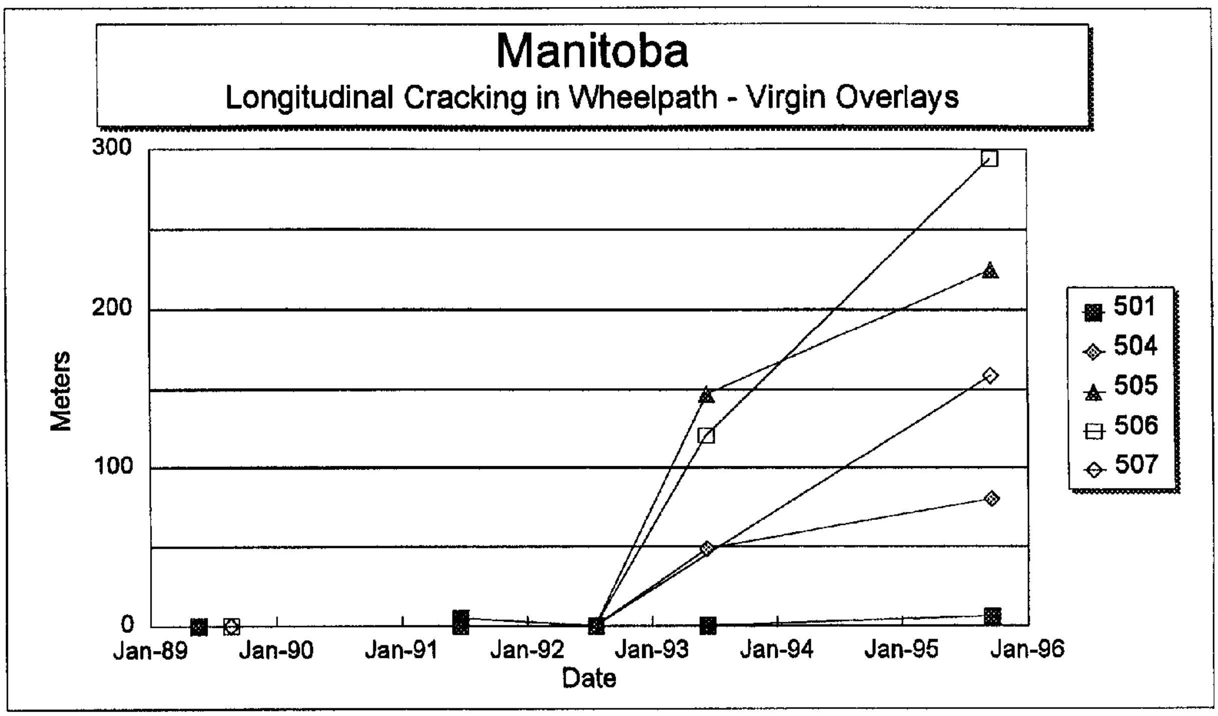
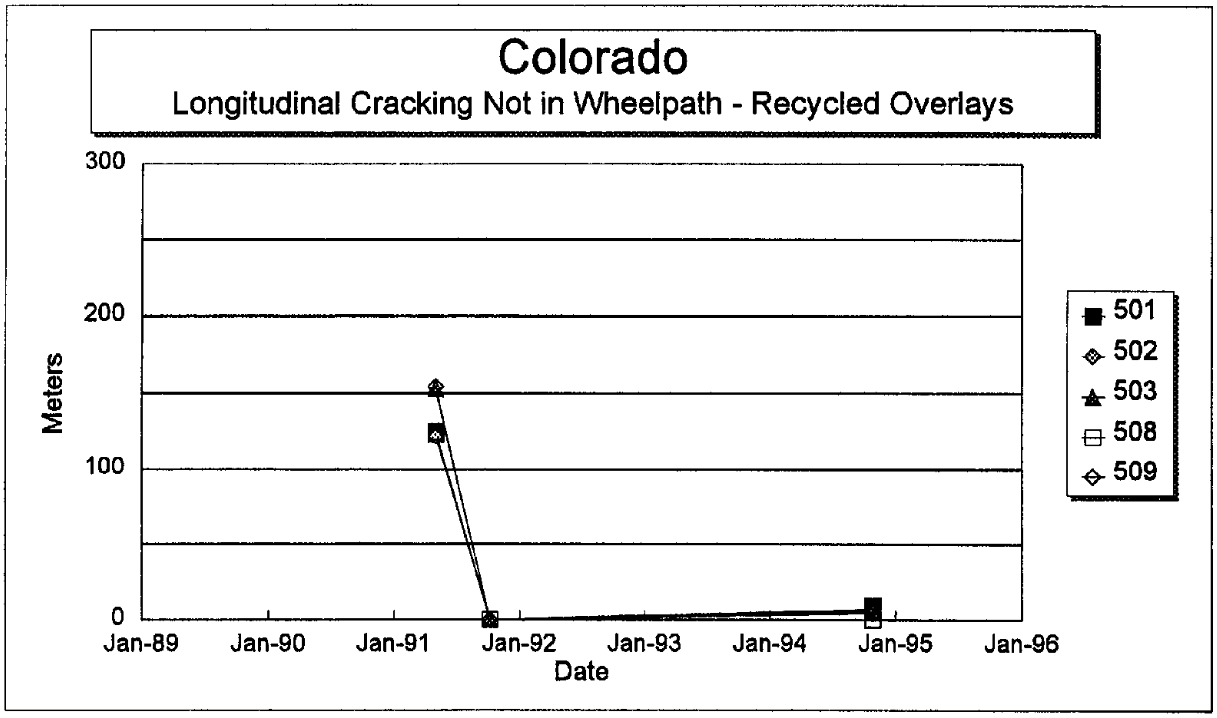


Figure 16. Total length of longitudinal cracking in the wheelpath versus time on each section of the Manitoba SPS-5 project.



Note: Section 501 is a non-overlayed control section. (However, the control on this particular project did not remain untreated.)

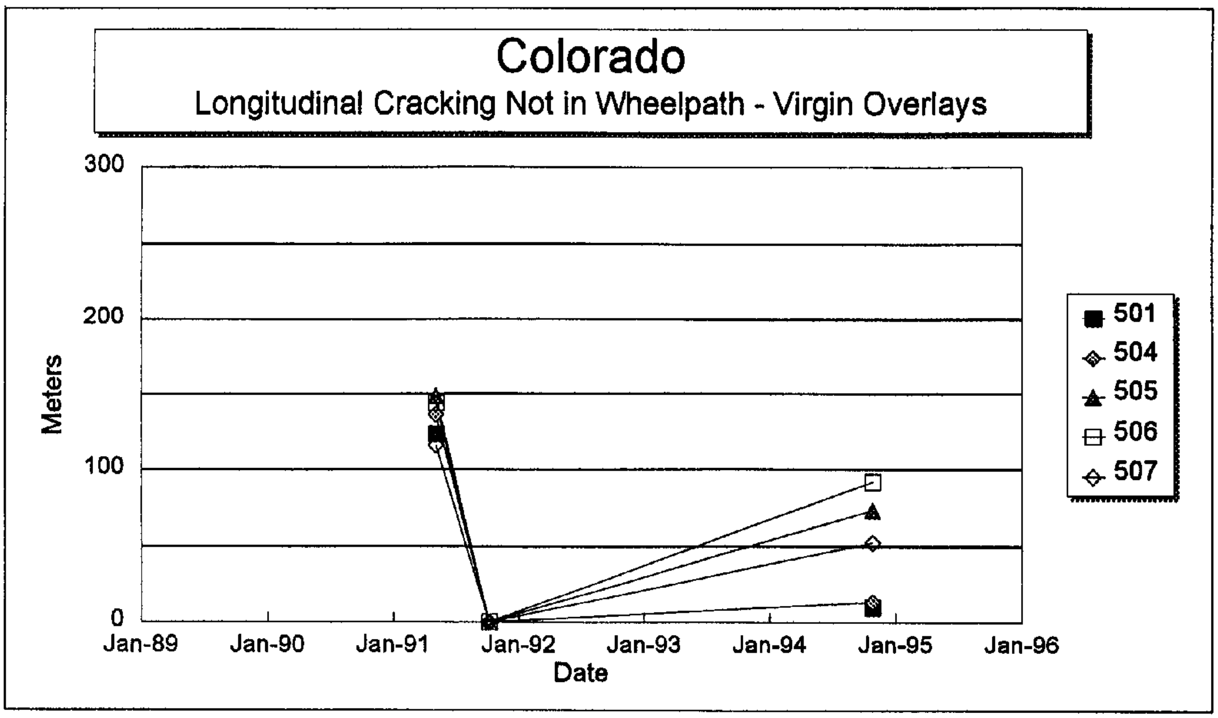
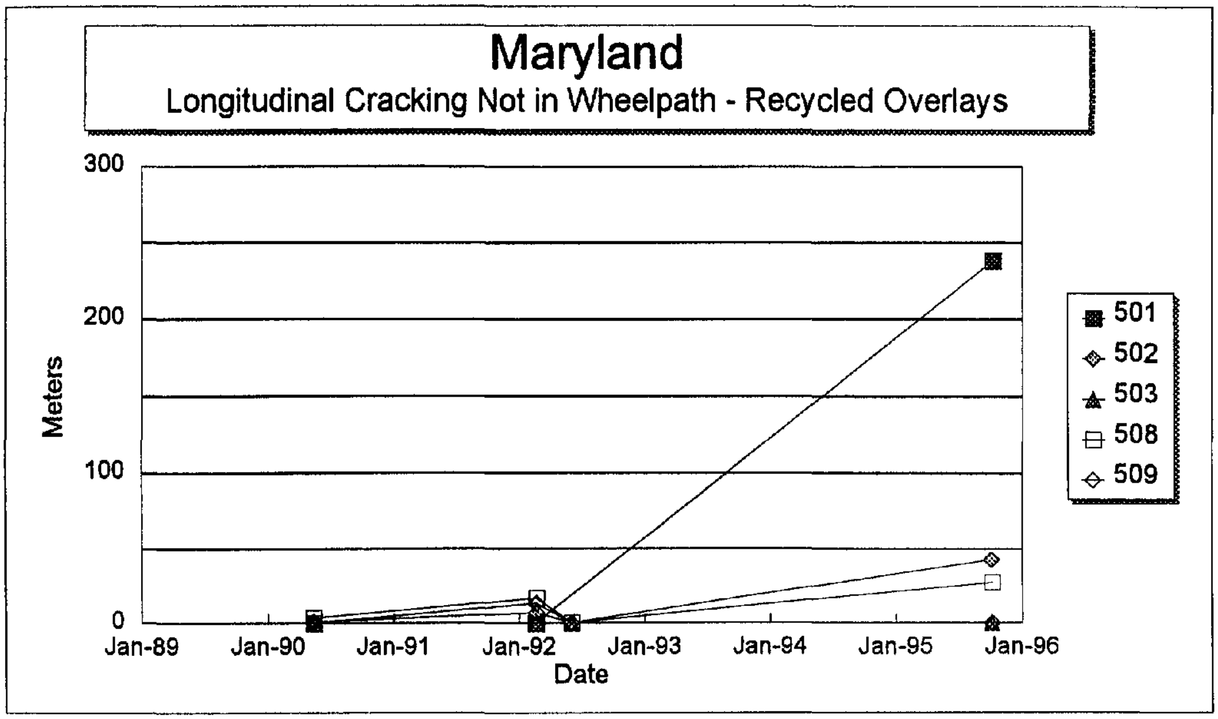


Figure 17. Total length of longitudinal cracking not in the wheelpath versus time on each section of the Colorado SPS-5 project.



Note: Section 501 is a non-overlayed control section.

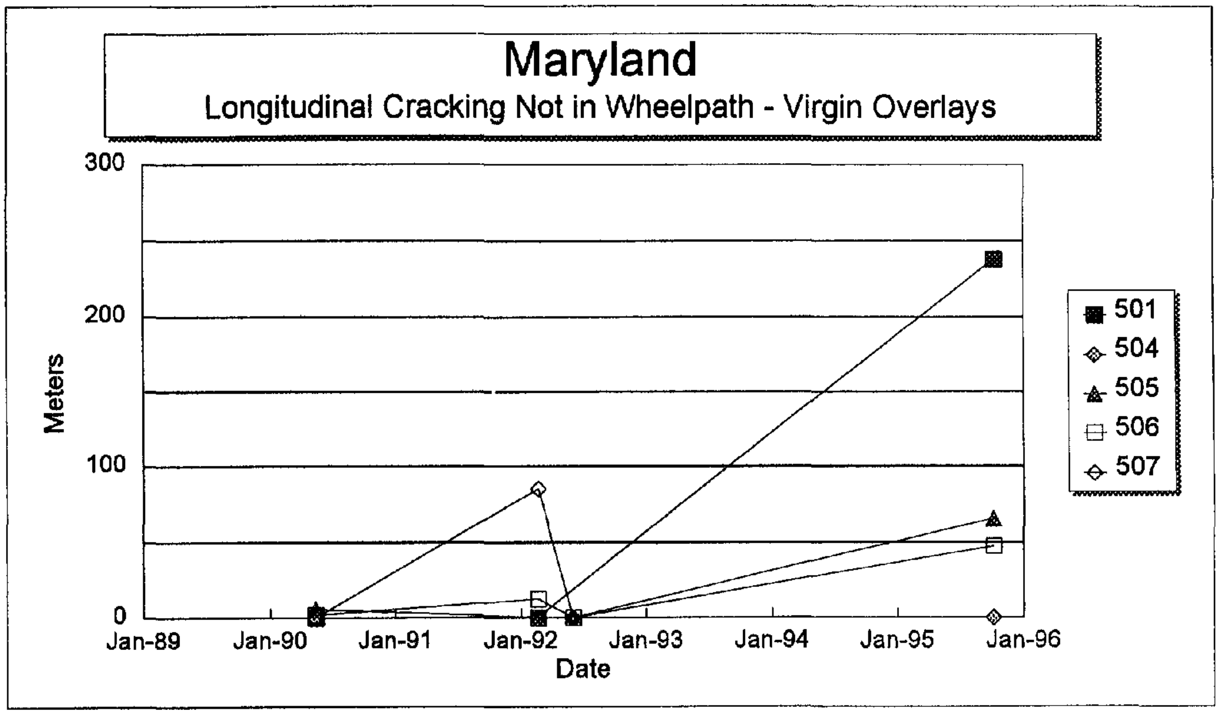
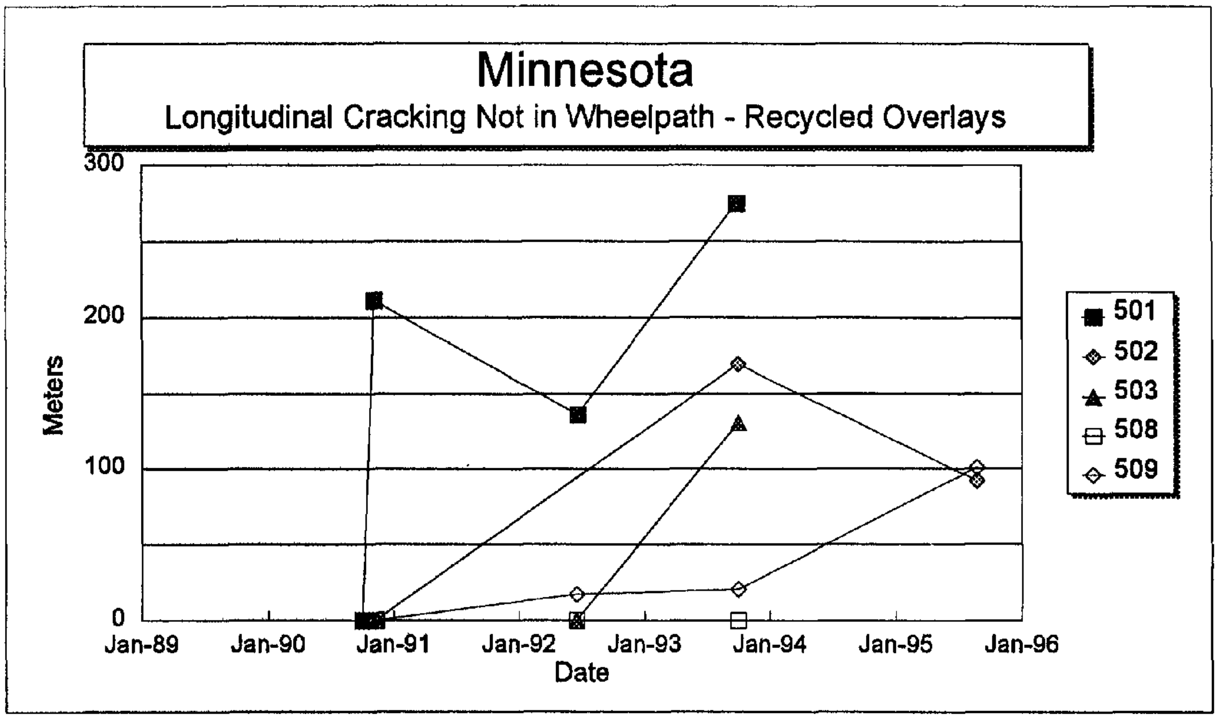


Figure 18. Total length of longitudinal cracking not in the wheelpath versus time on each section of the Maryland SPS-5 project.



Note: Section 501 is a non-overlayed control section.

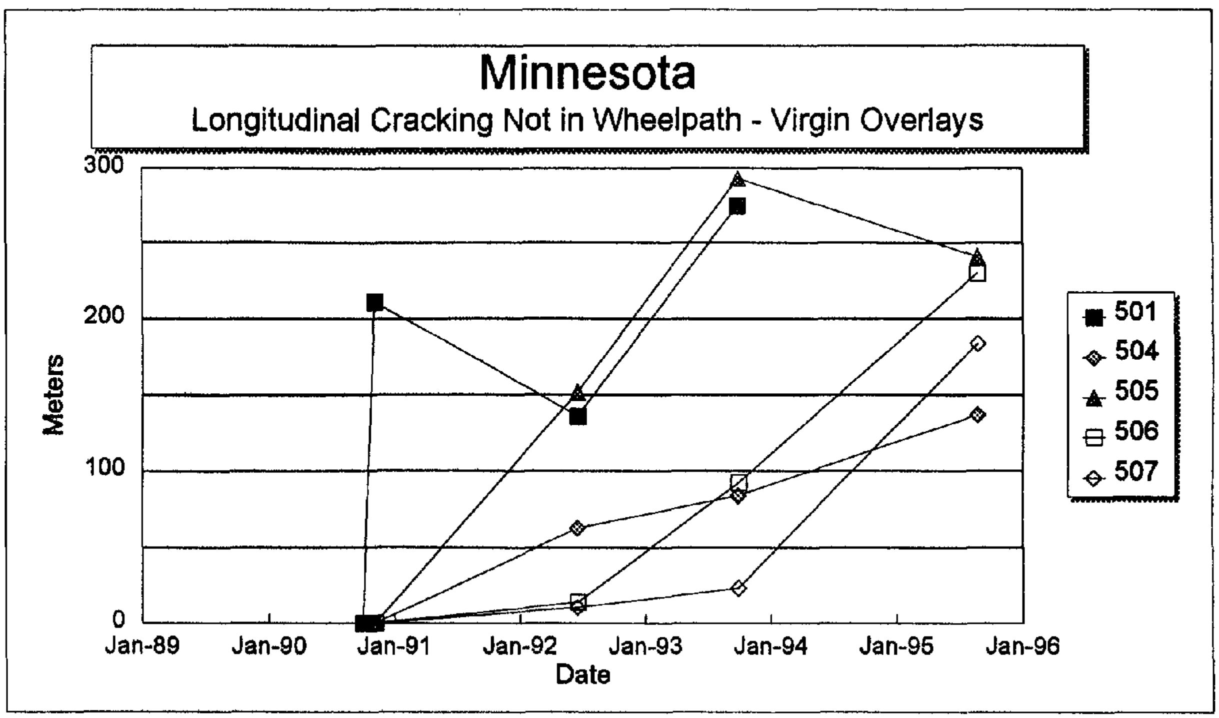
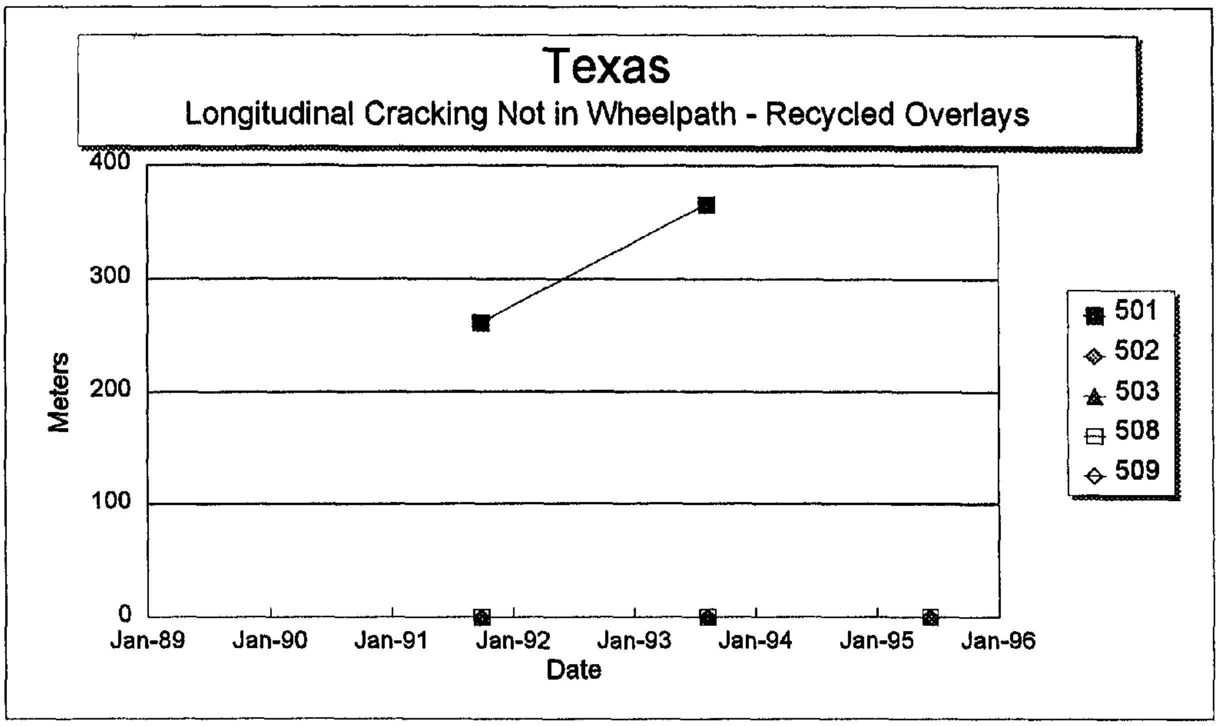


Figure 19. Total length of longitudinal cracking not in the wheelpath versus time on each section of the Minnesota SPS-5 project.



Note: Section 501 is a non-overlayed control section.

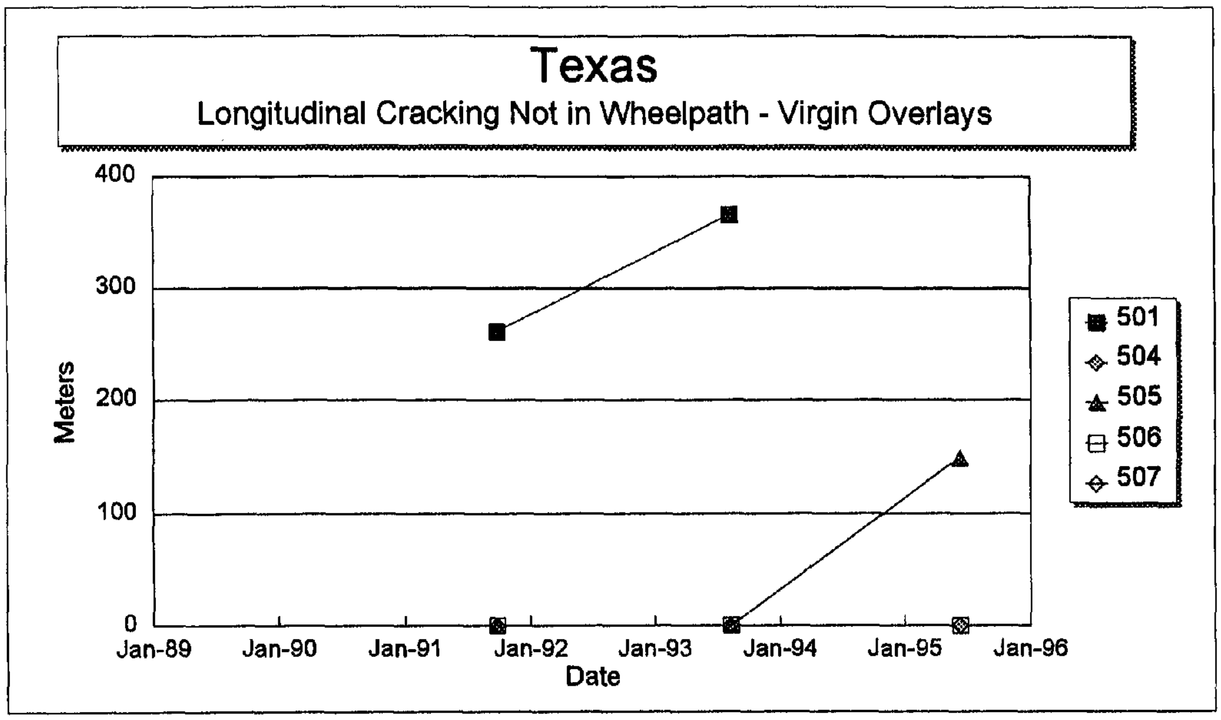
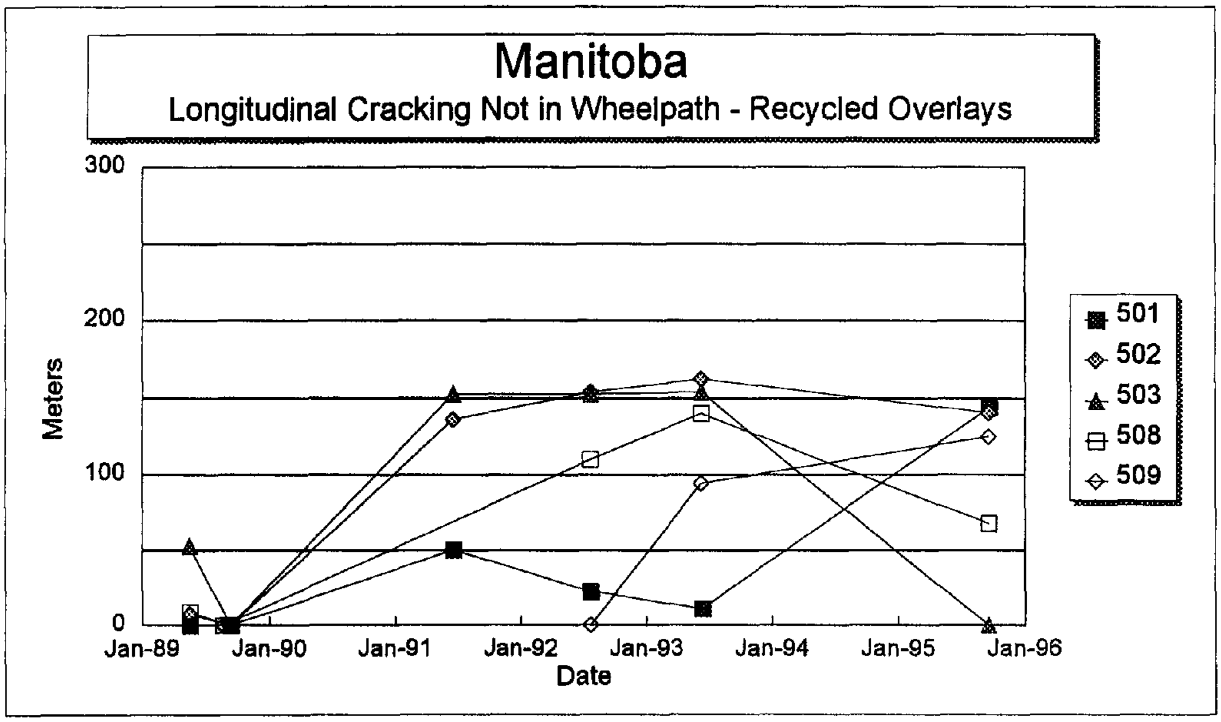


Figure 20. Total length of longitudinal cracking not in the wheelpath versus time on each section of the Texas SPS-5 project.



Note: Section 501 is a non-overlayed control section.

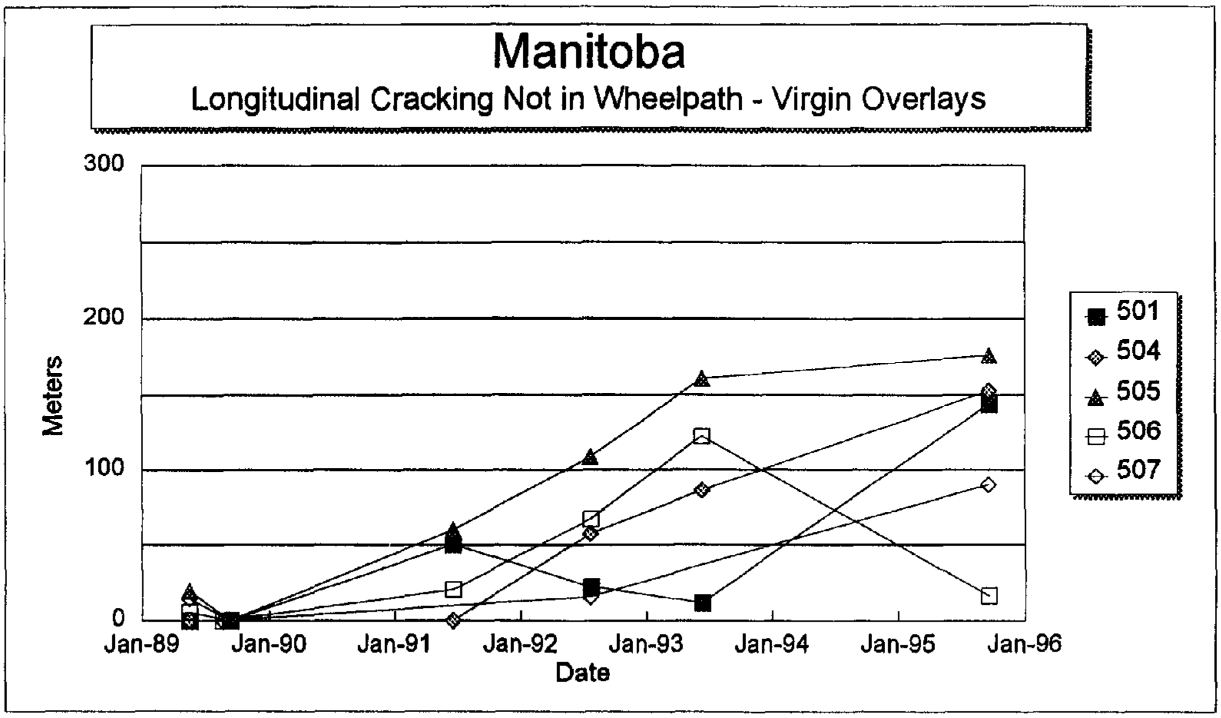
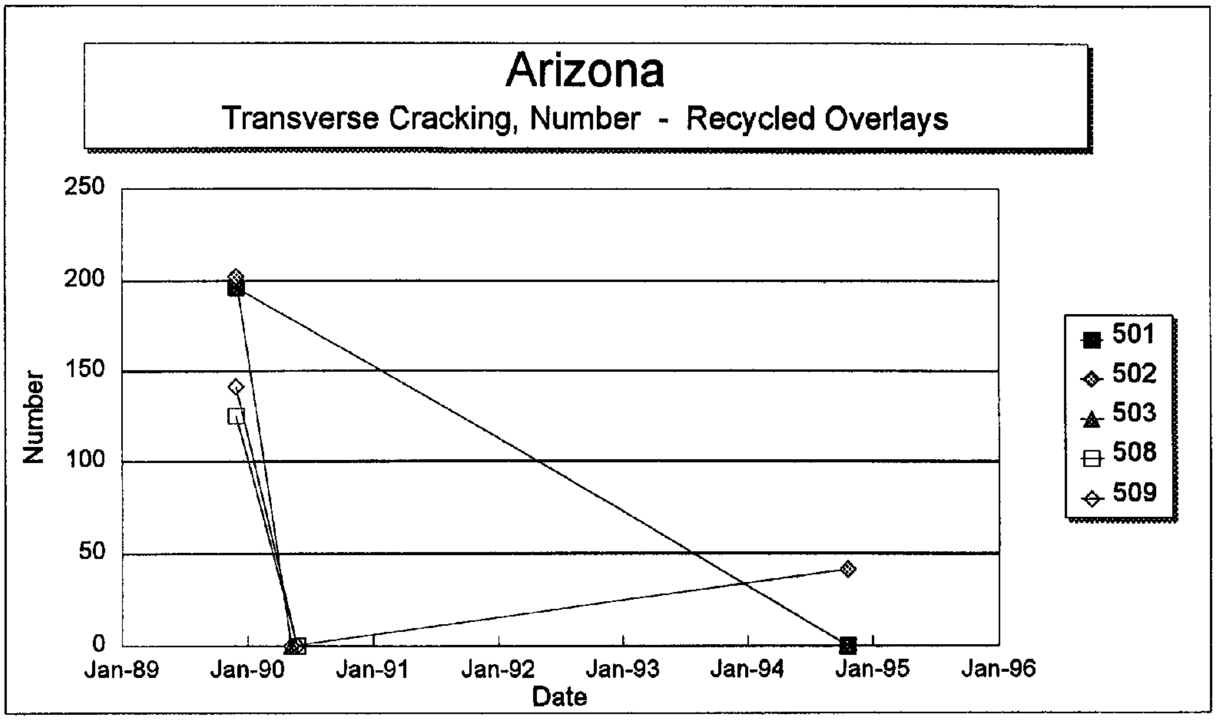


Figure 21. Total length of longitudinal cracking not in the wheelpath versus time on each section of the Manitoba SPS-5 project.



Note: Section 501 is a non-overlayed control section.

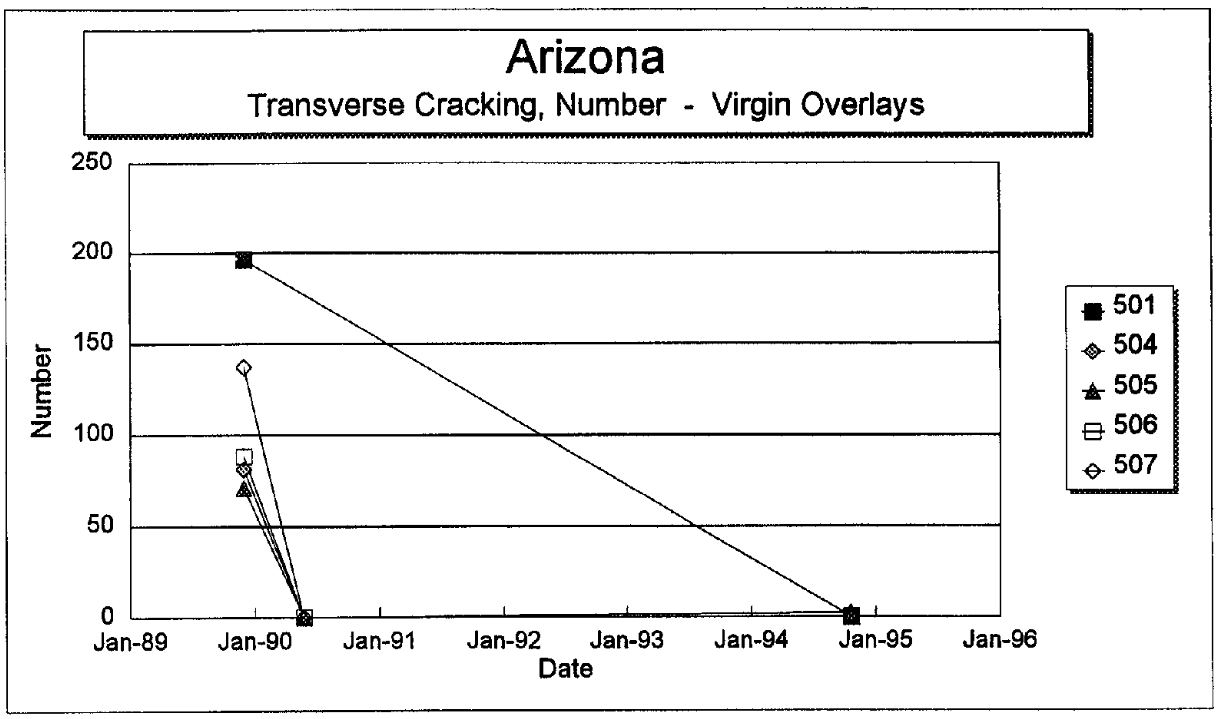
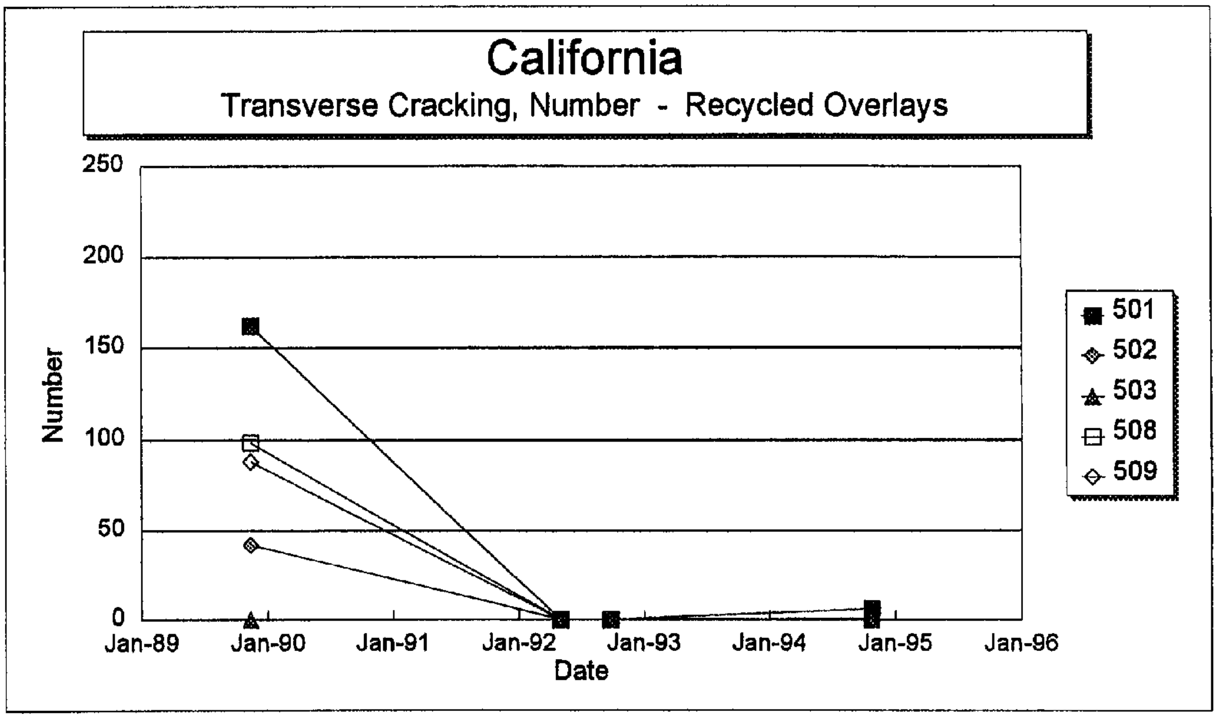


Figure 22. Total number of transverse cracks versus time on each section of the Arizona SPS-5 project.



Note: Section 501 is a non-overlayed control section. (However, the control on this particular project did not remain untreated.)

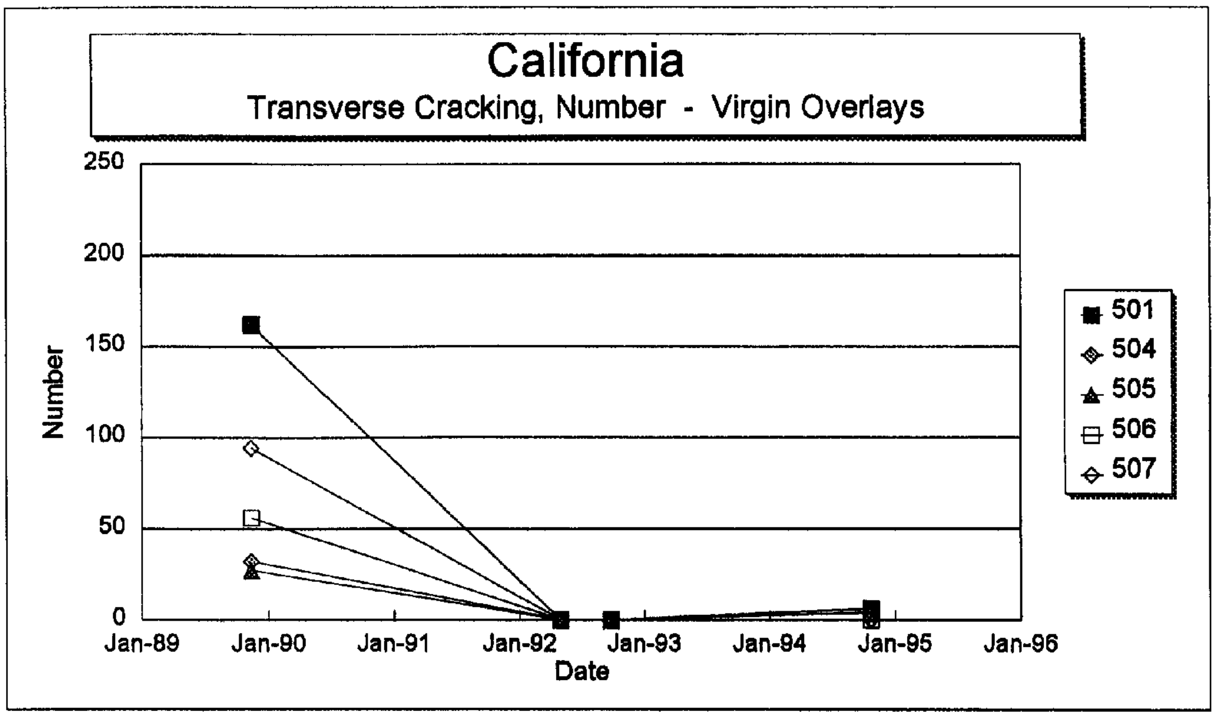
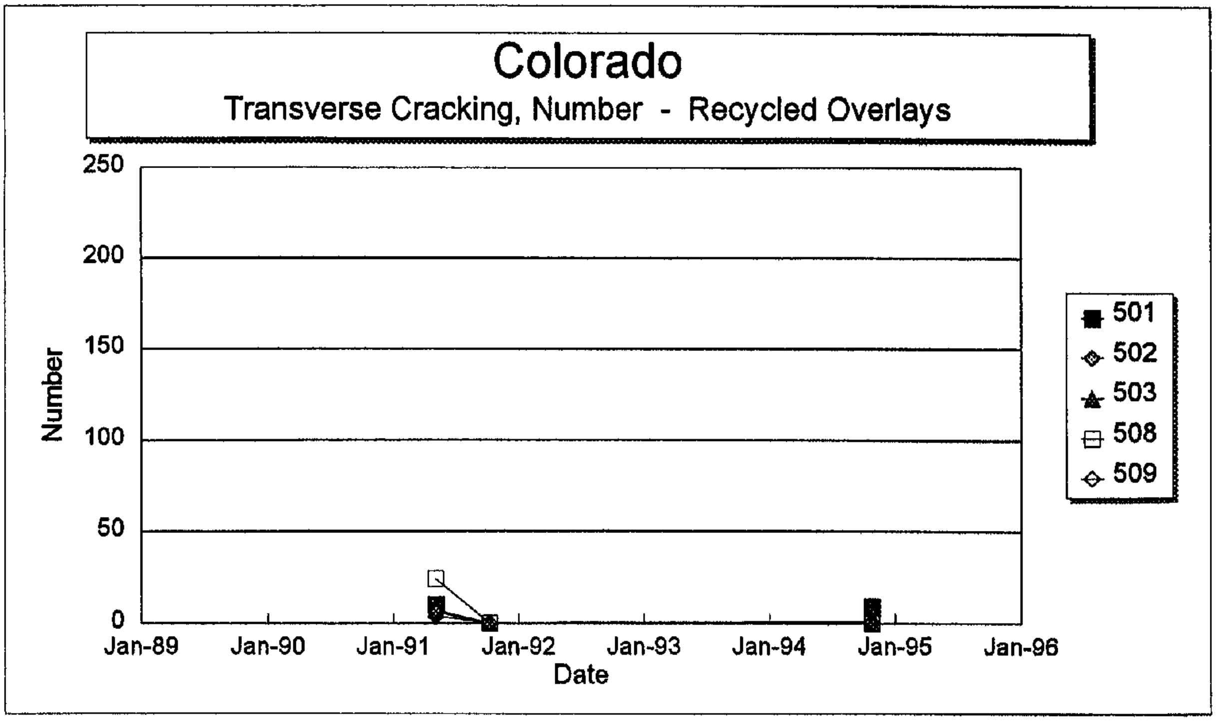


Figure 23. Total number of transverse cracks versus time on each section of the California SPS-5 project.



Note: Section 501 is a non-overlayed control section. (However, the control on this particular project did not remain untreated.)

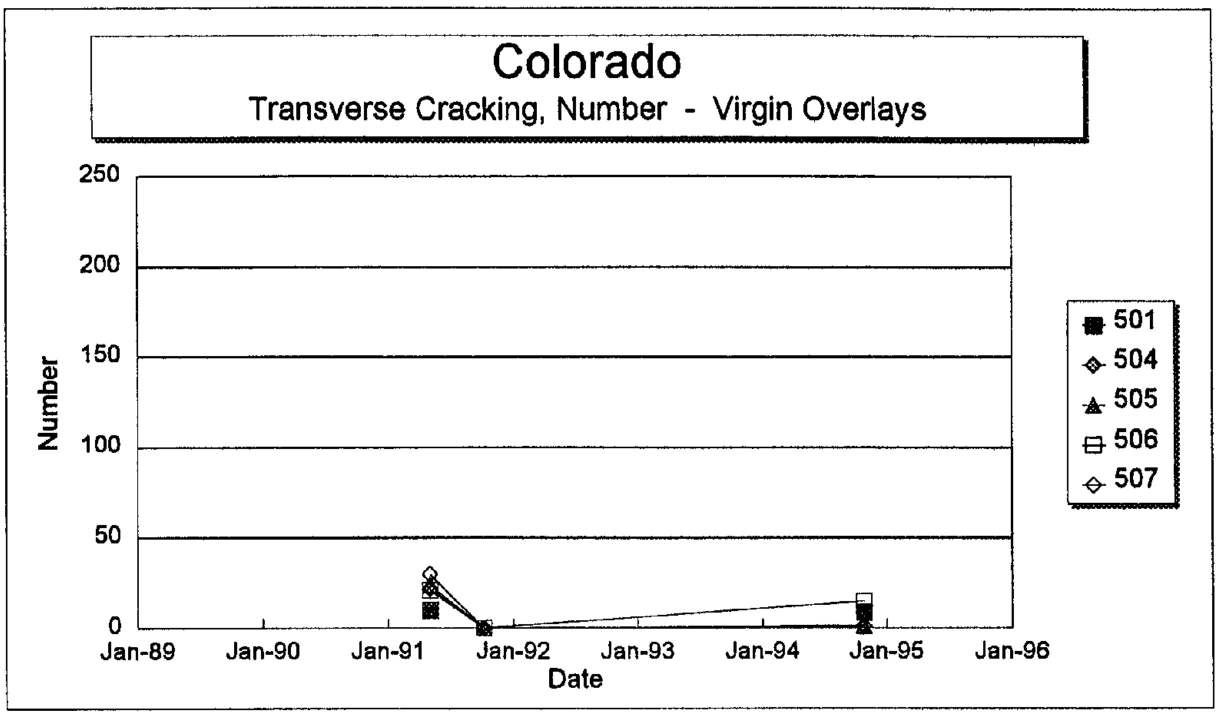
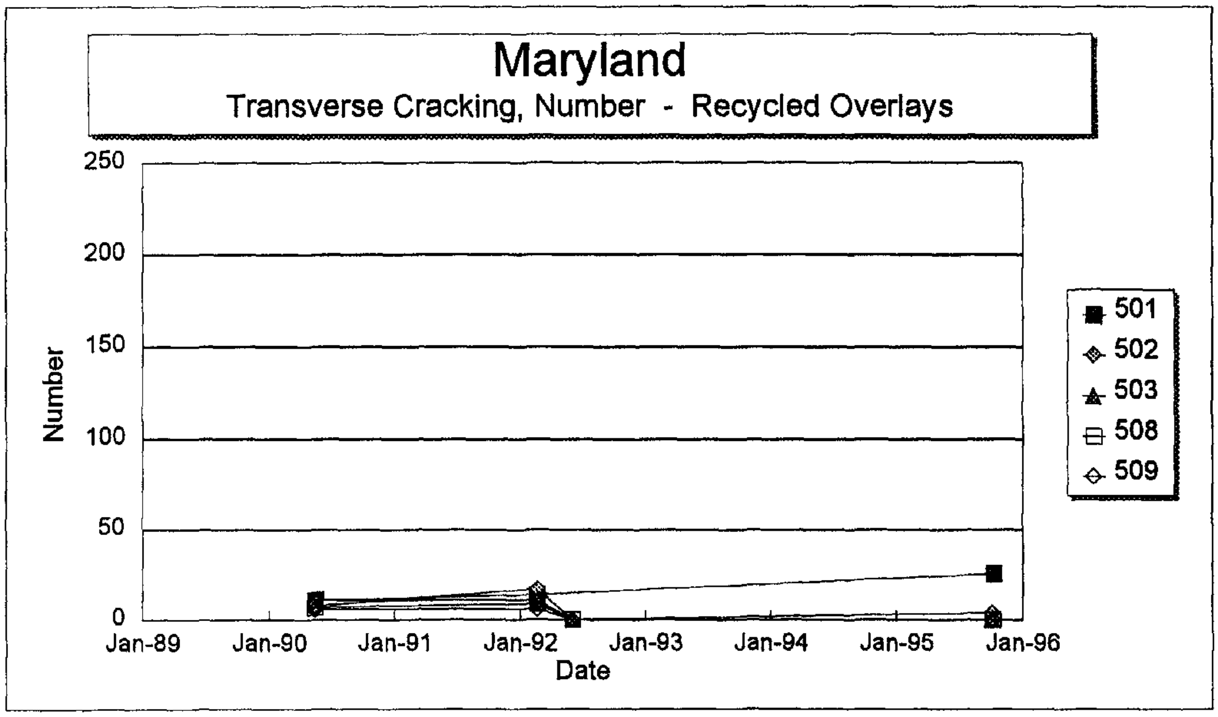


Figure 24. Total number of transverse cracks versus time on each section of the Colorado SPS-5 project.



Note: Section 501 is a non-overlayed control section.

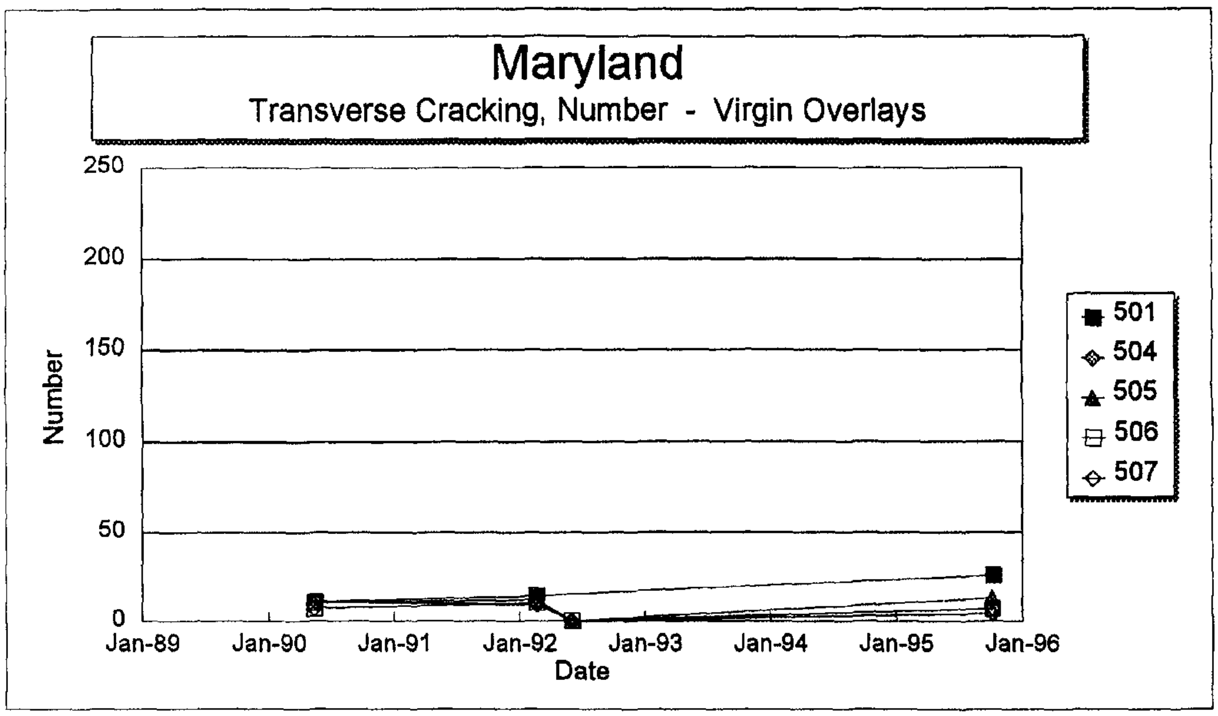
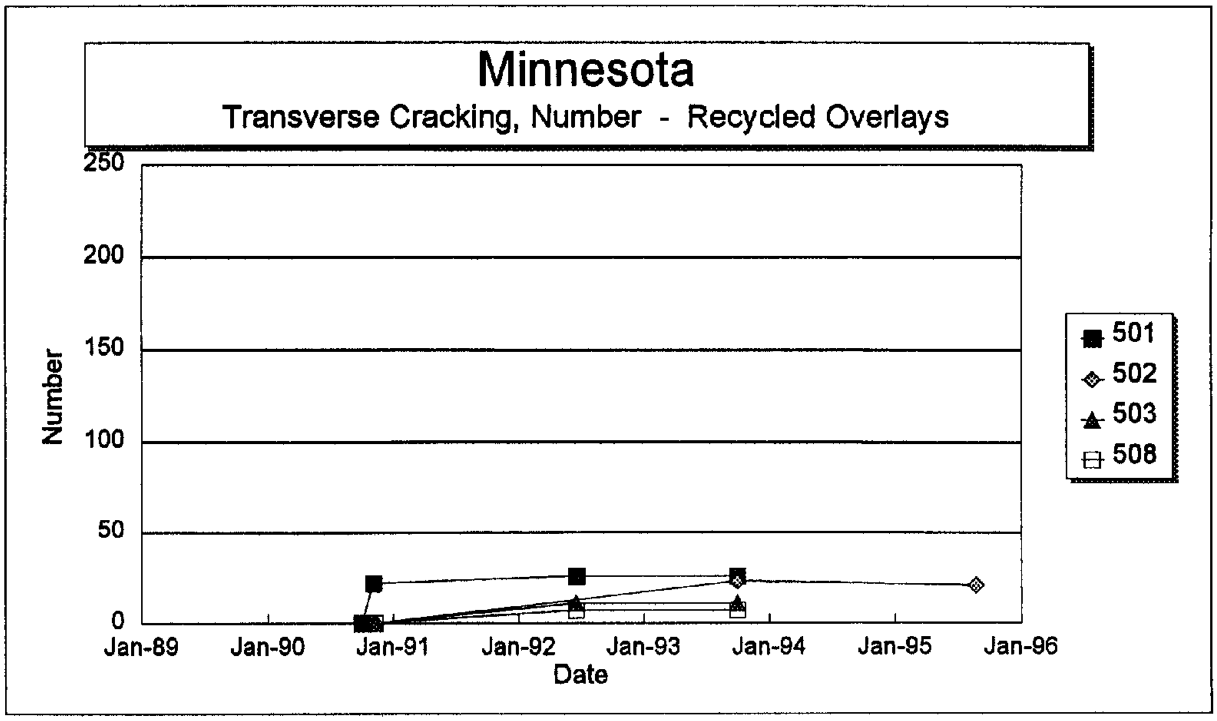


Figure 25. Total number of transverse cracks versus time on each section of the Maryland SPS-5 project.



Note: Section 501 is a non-overlayed control section.

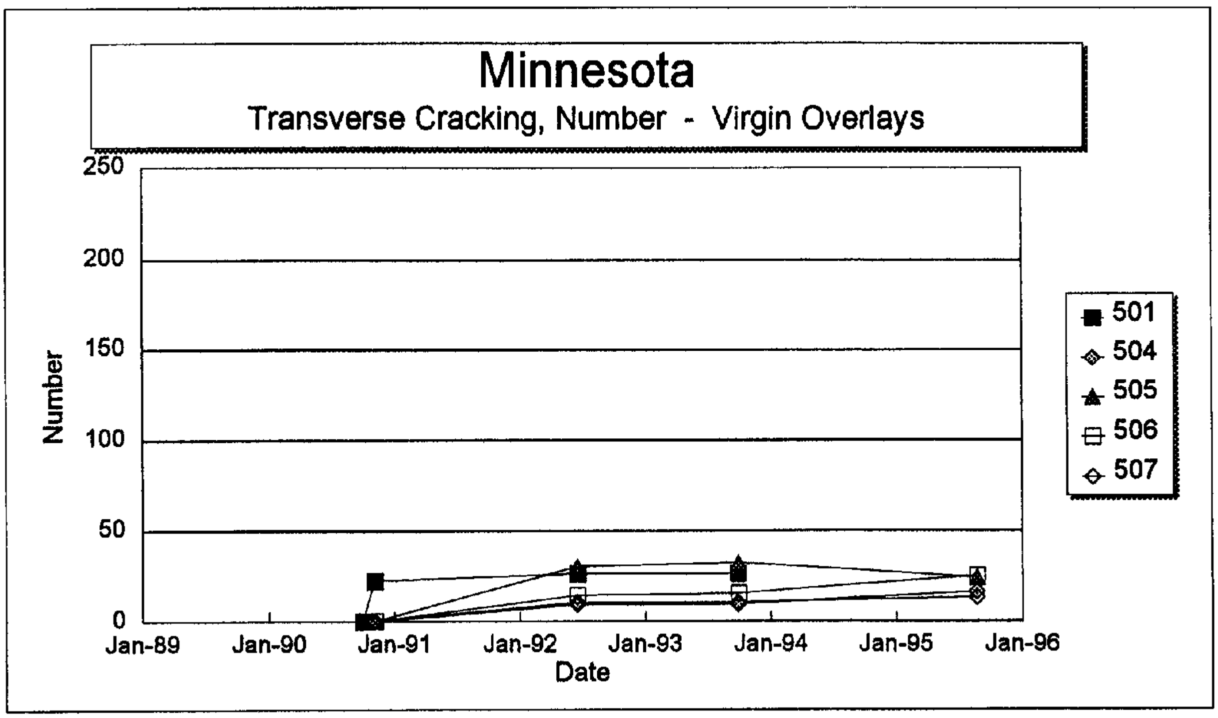
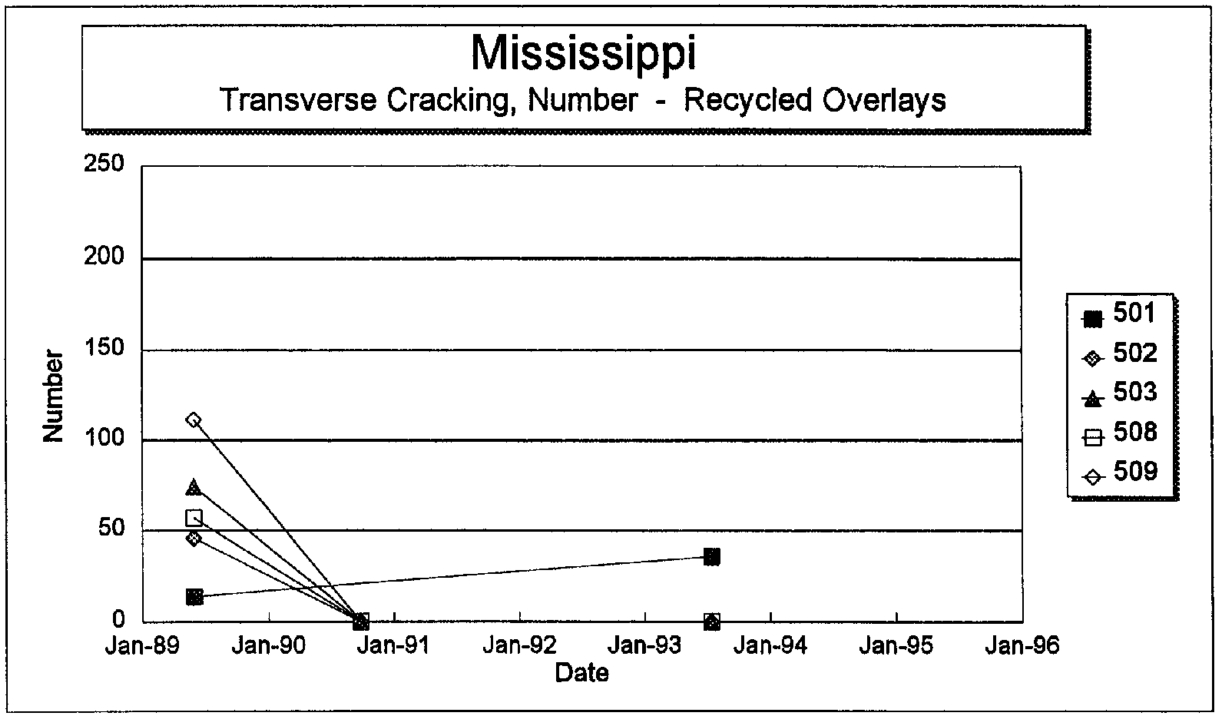


Figure 26. Total number of transverse cracks versus time on each section of the Minnesota SPS-5 project.



Note: Section 501 is a non-overlayed control section.

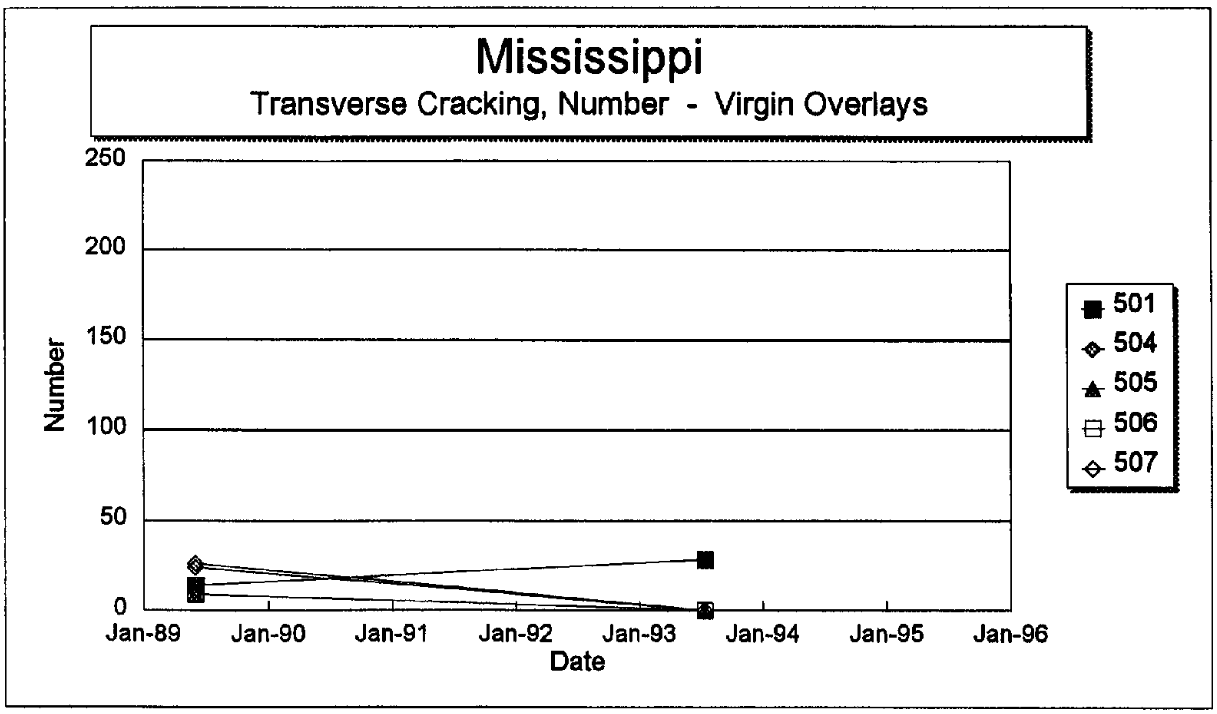
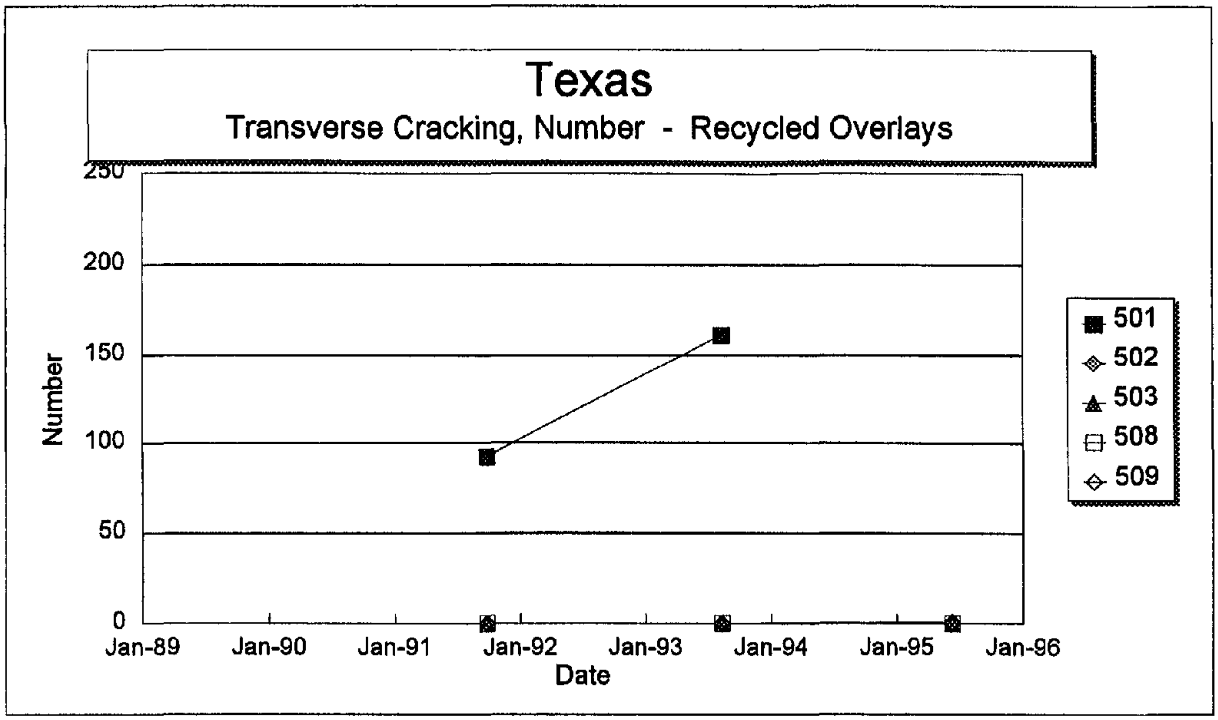


Figure 27. Total number of transverse cracks versus time on each section of the Mississippi SPS-5 project.



Note: Section 501 is a non-overlayed control section.

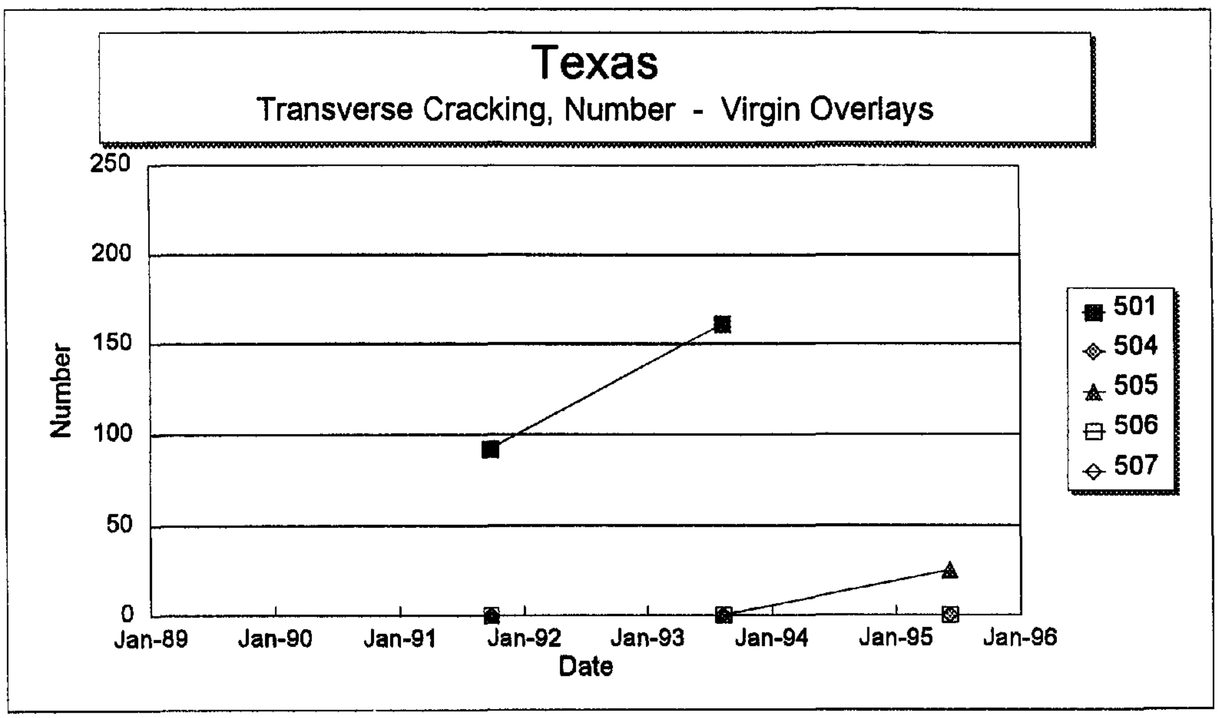
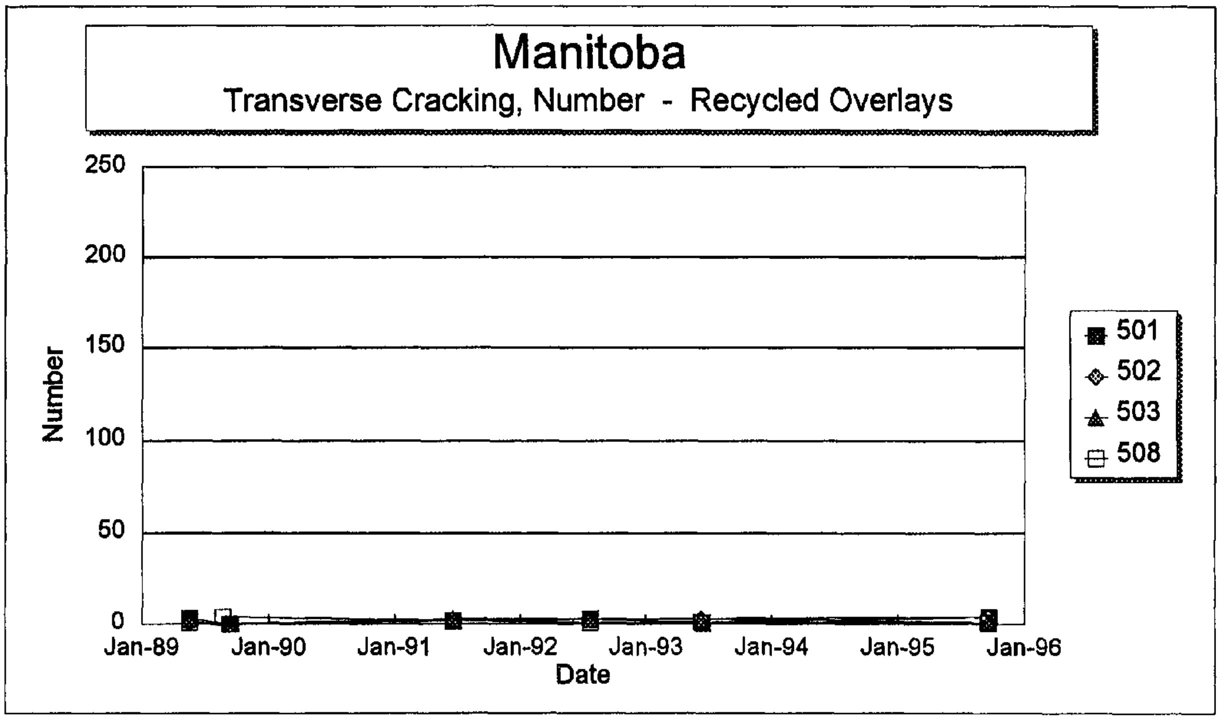


Figure 28. Total number of transverse cracks versus time on each section of the Texas SPS-5 project.



Note: Section 501 is a non-overlayed control section.

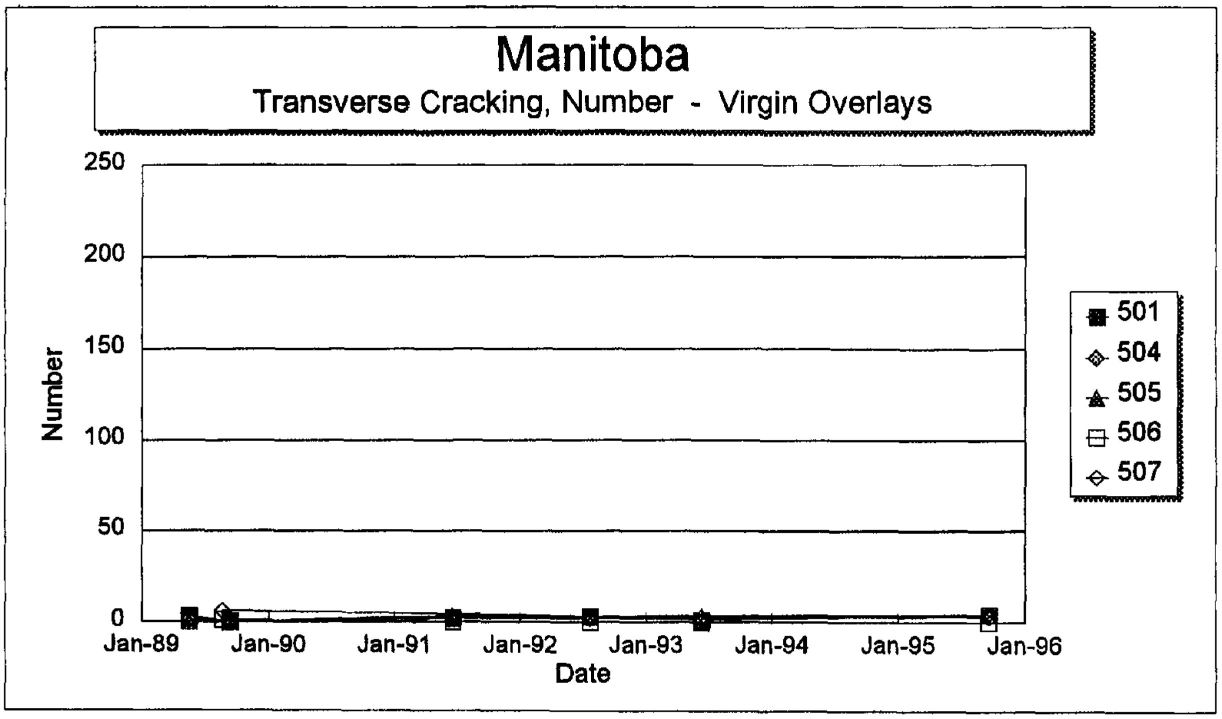
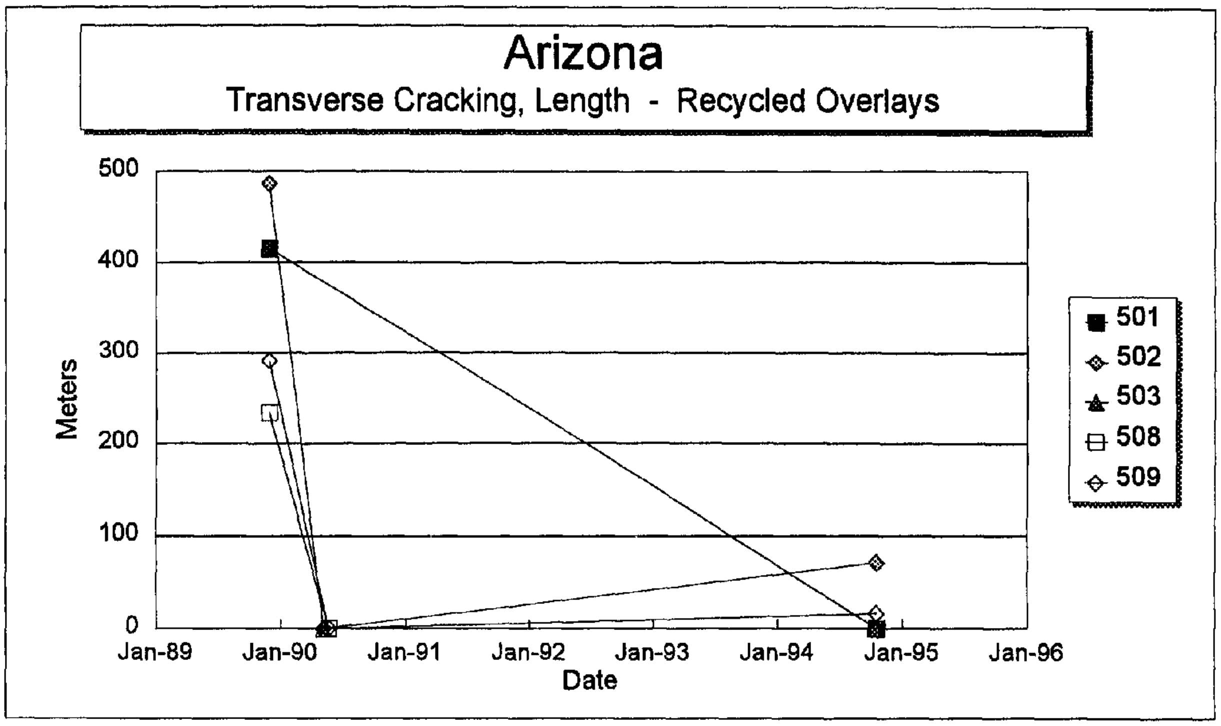


Figure 29. Total number of transverse cracks versus time on each section of the Manitoba SPS-5 project.



Note: Section 501 is a non-overlayed control section.

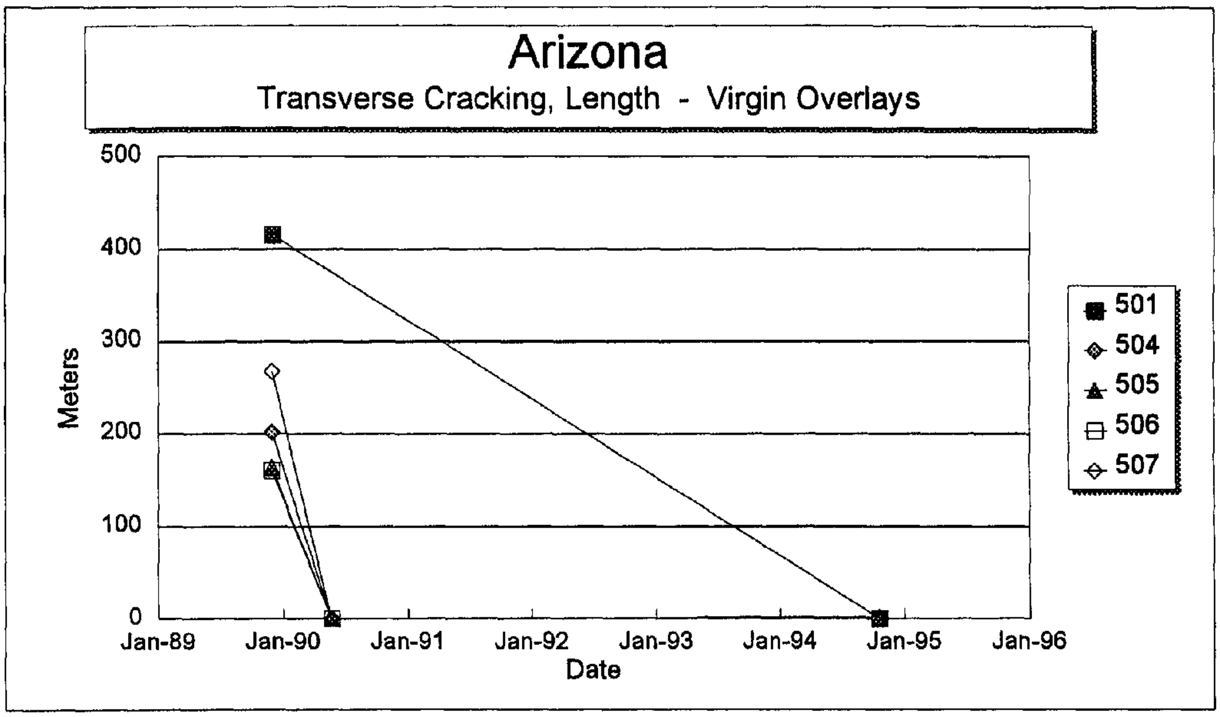
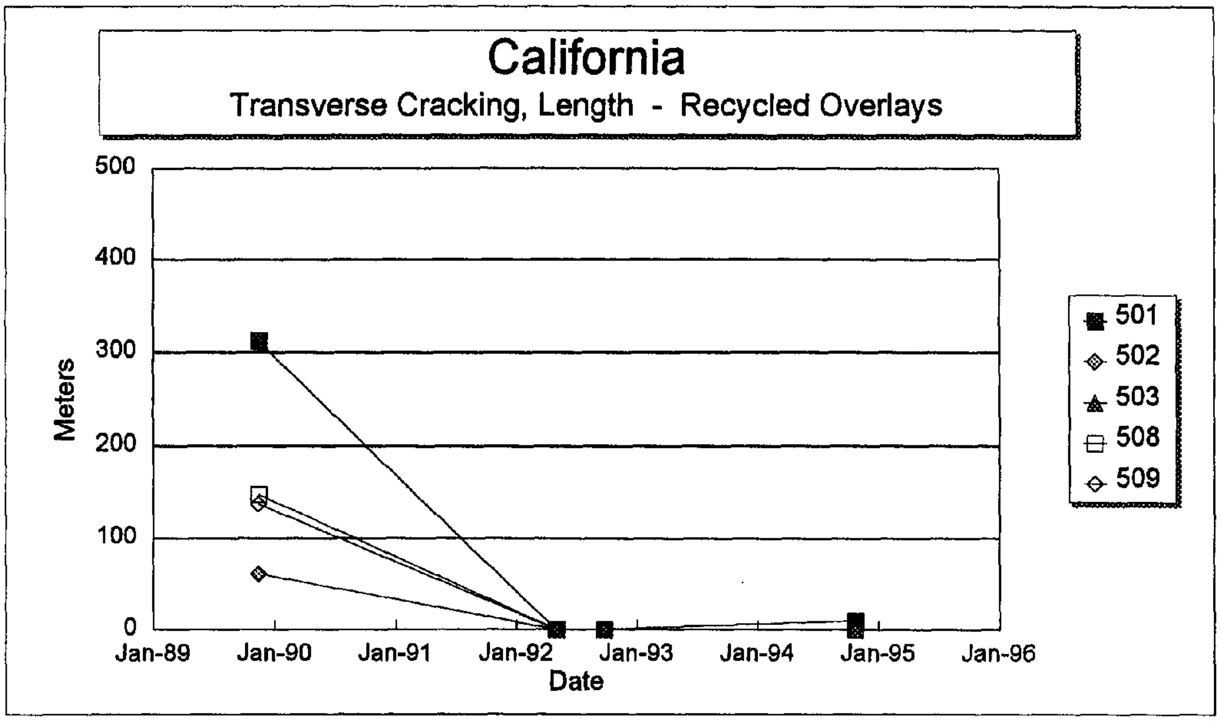


Figure 30. Total length of transverse cracks versus time on each section of the Arizona SPS-5 project.



Note: Section 501 is a non-overlayed control section. (However, the control on this particular project did not remain untreated.)

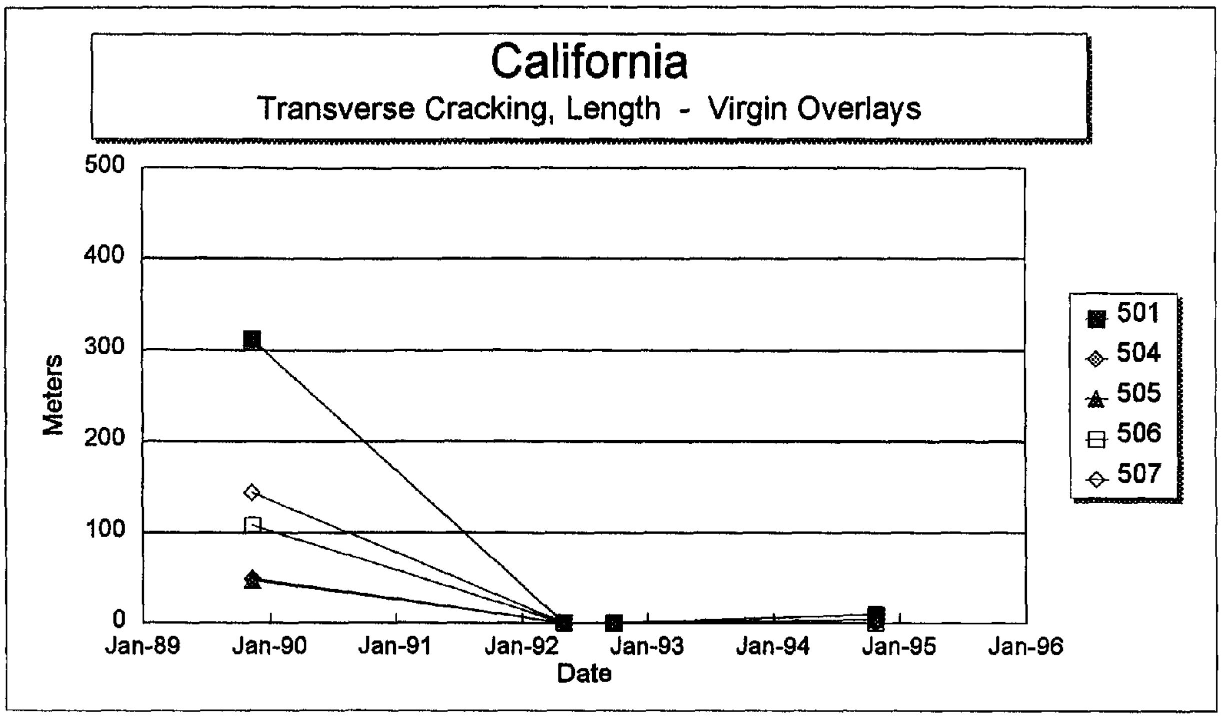
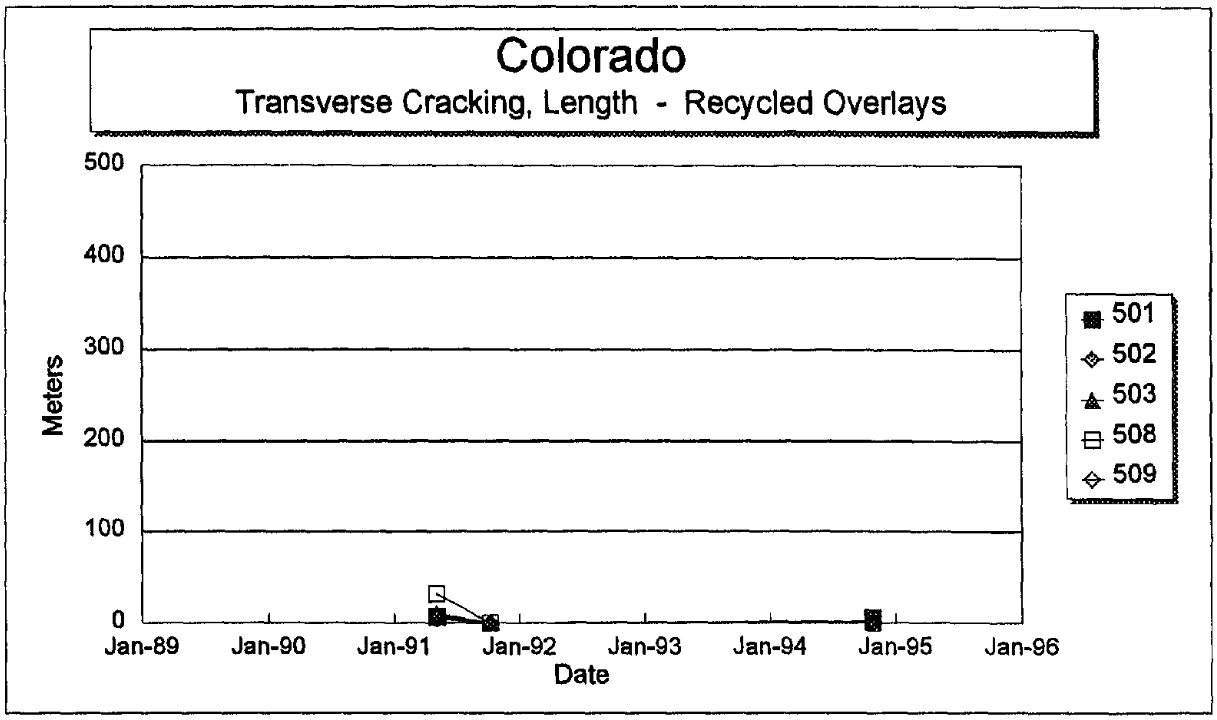


Figure 31. Total length of transverse cracks versus time on each section of the California SPS-5 project.



Note: Section 501 is a non-overlayed control section. (However, the control on this particular project did not remain untreated.)

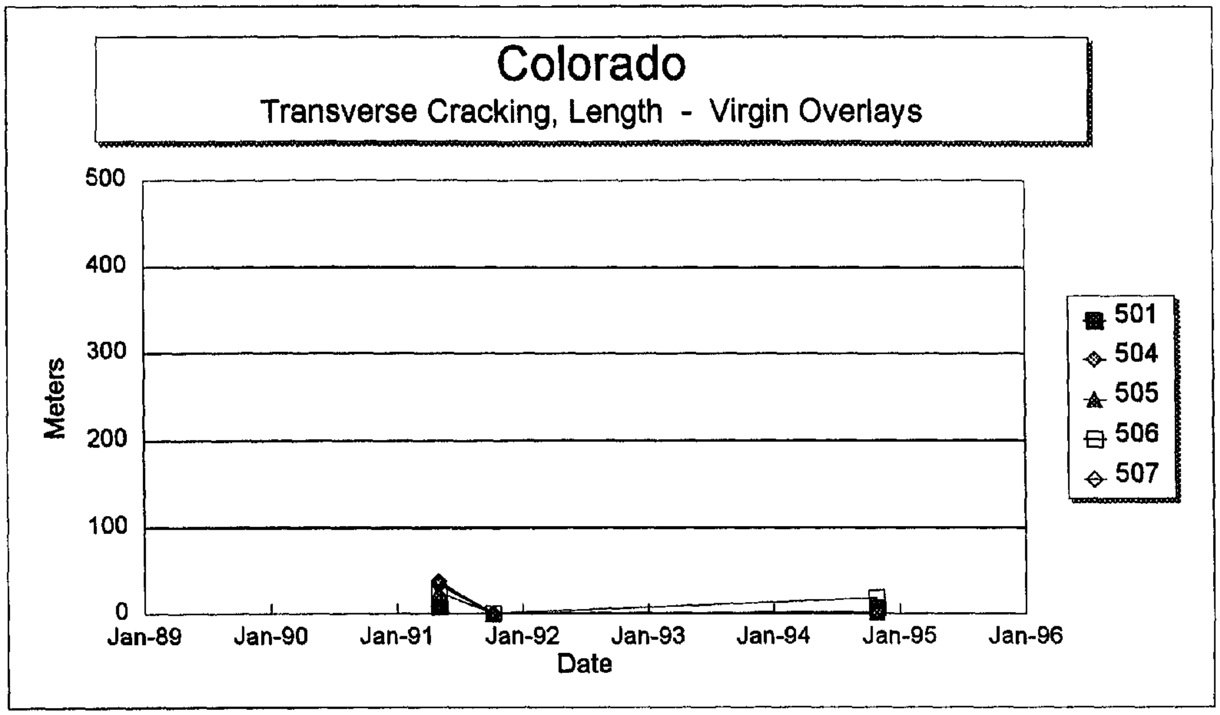
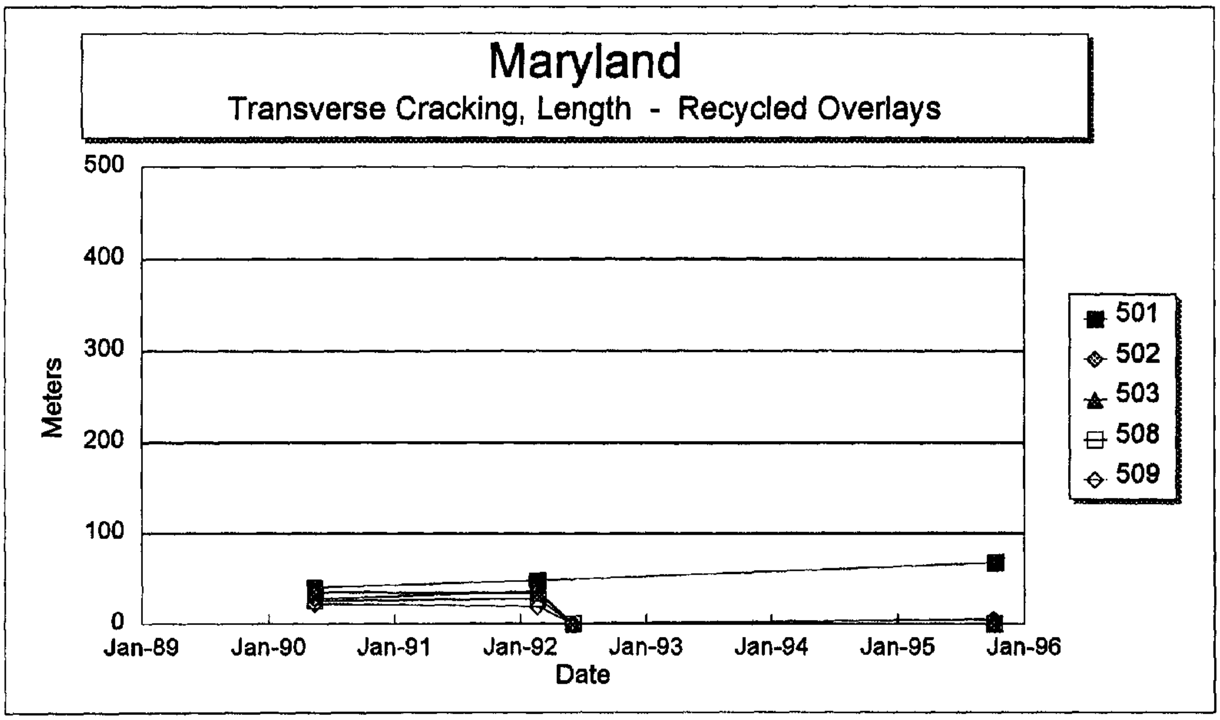


Figure 32. Total length of transverse cracks versus time on each section of the Colorado SPS-5 project.



Note: Section 501 is a non-overlayed control section.

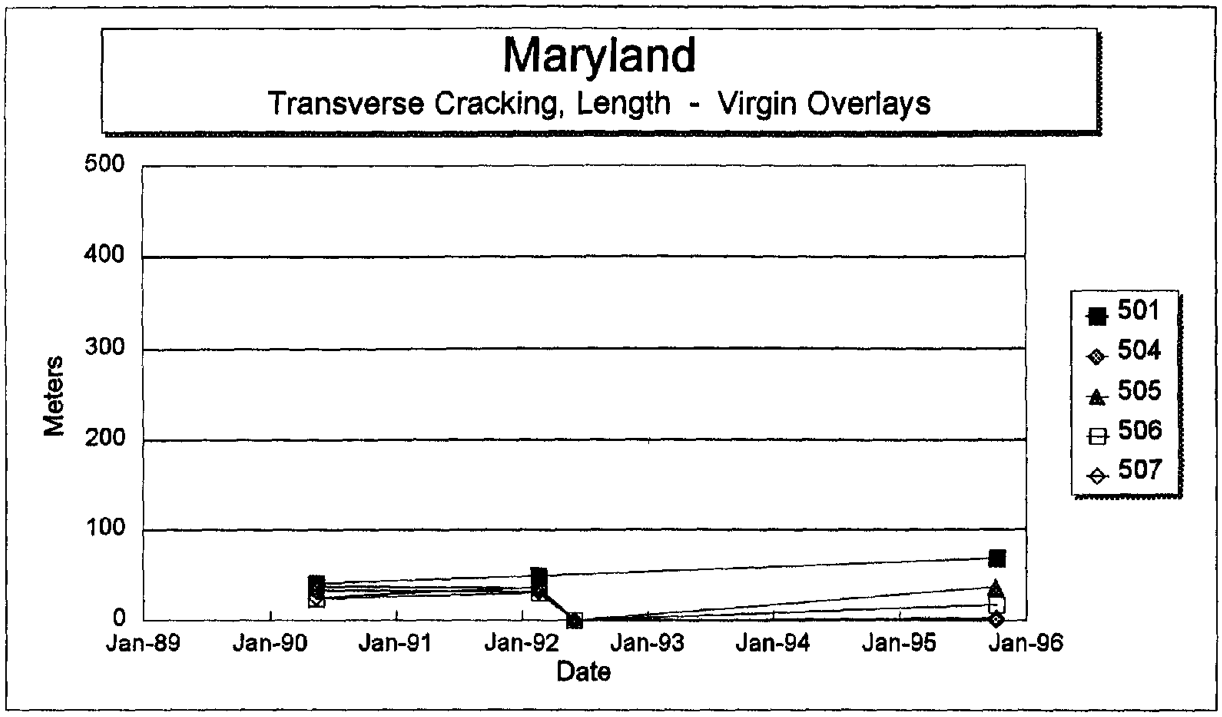
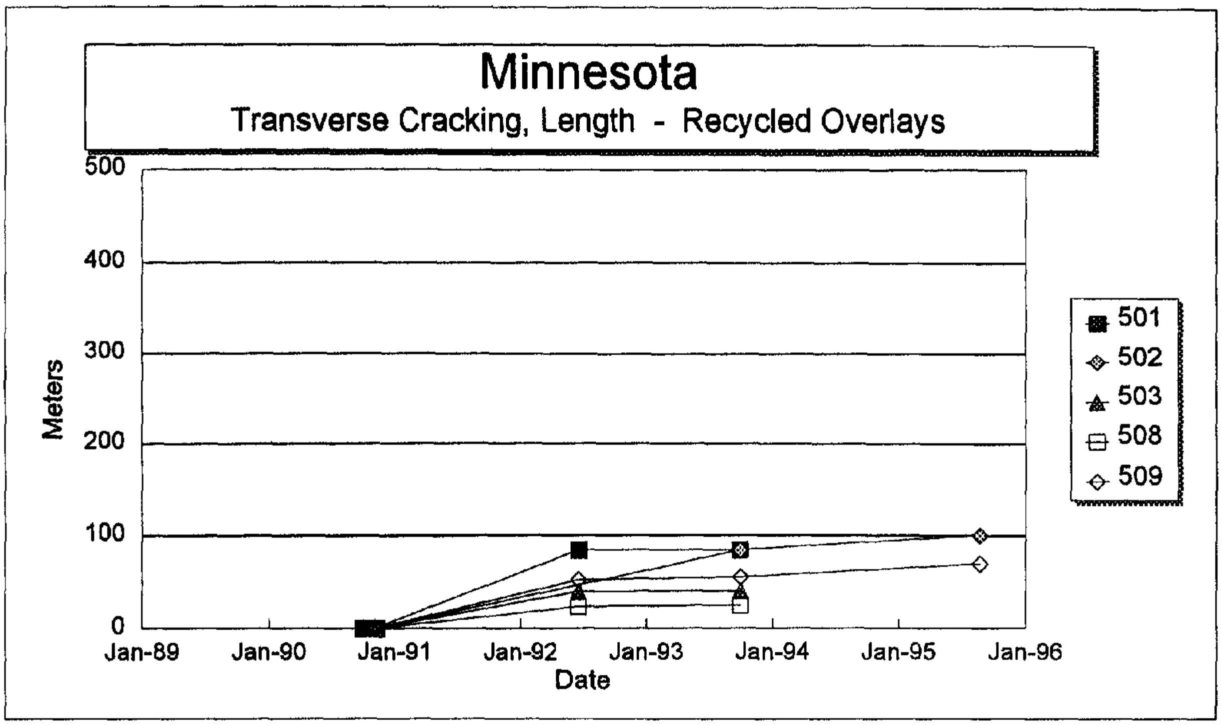


Figure 33. Total length of transverse cracks versus time on each section of the Maryland SPS-5 project.



Note: Section 501 is a non-overlayed control section.

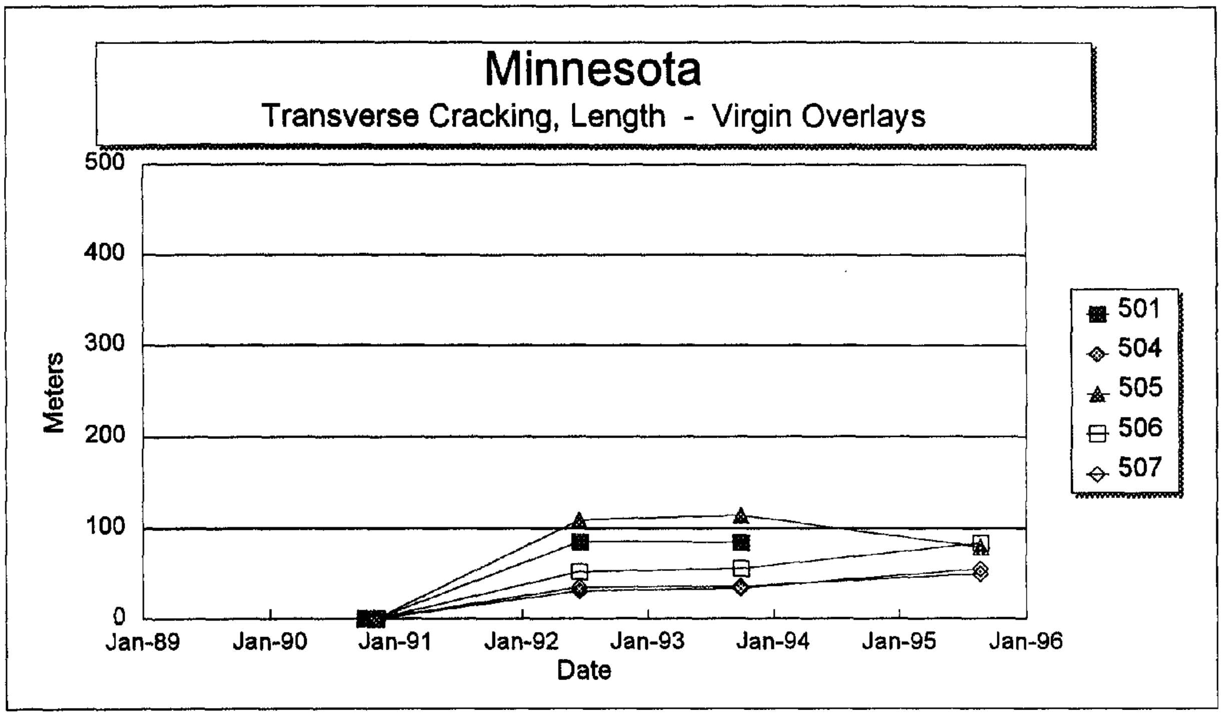
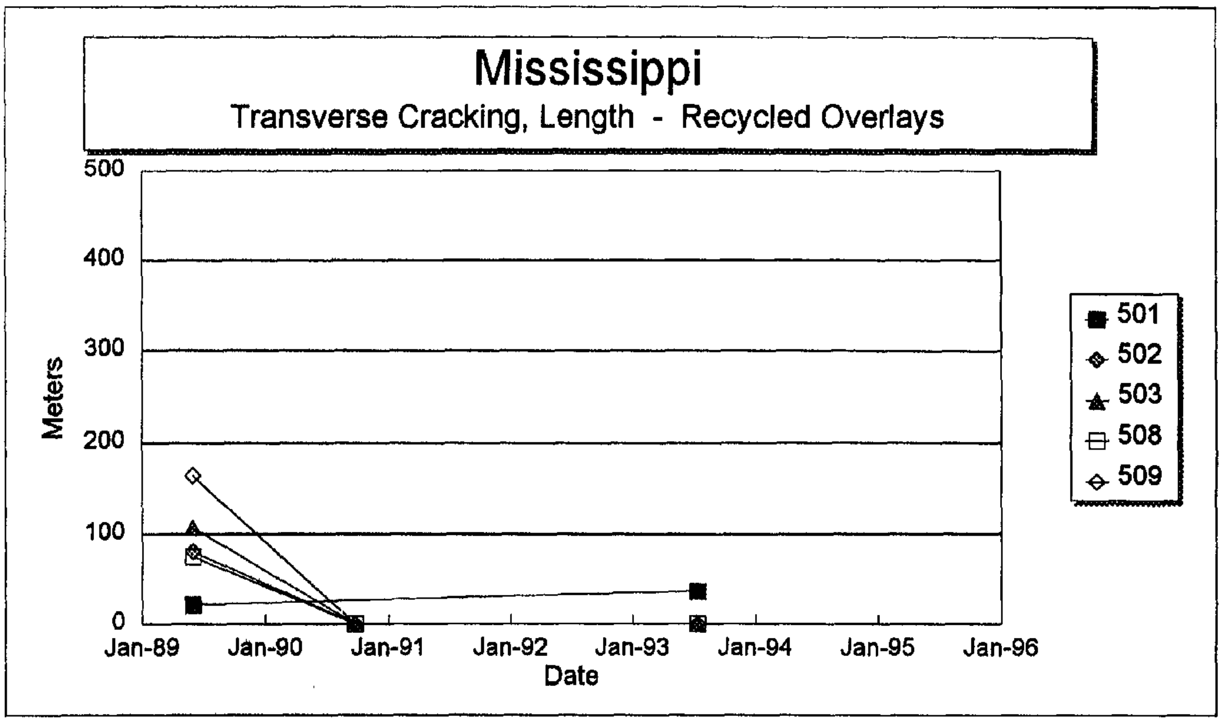


Figure 34. Total length of transverse cracks versus time on each section of the Minnesota SPS-5 project.



Note: Section 501 is a non-overlayed control section.

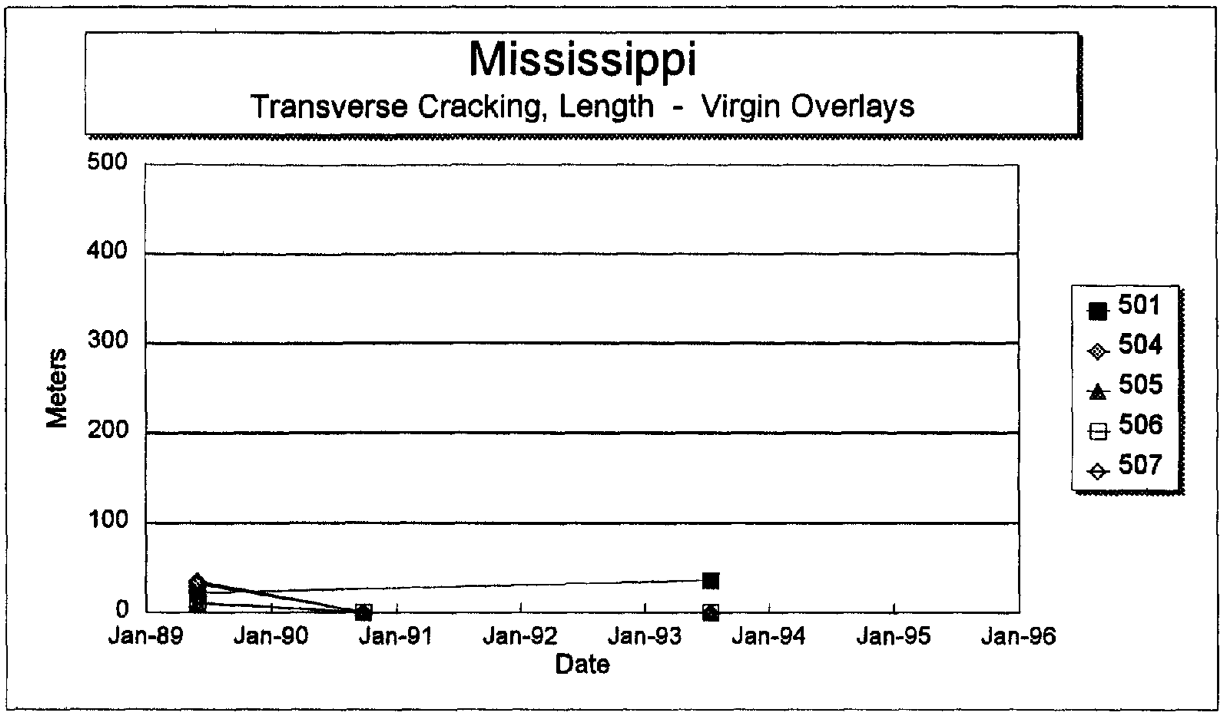
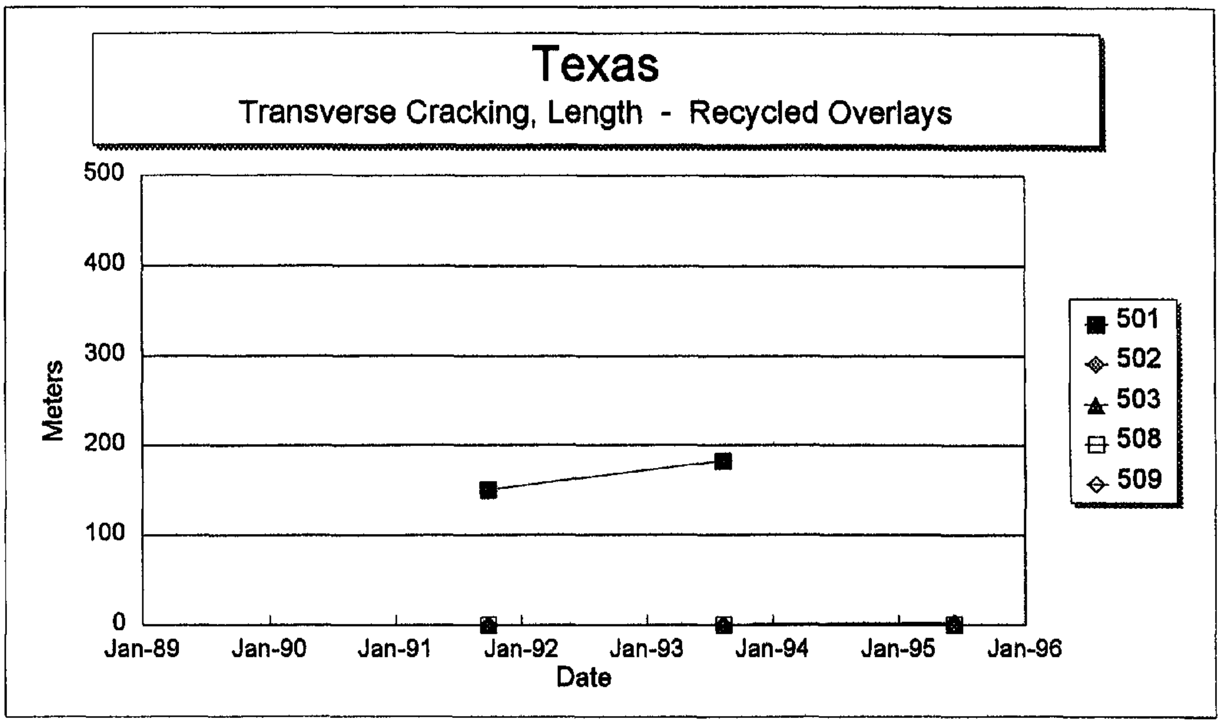


Figure 35. Total length of transverse cracks versus time on each section of the Mississippi SPS-5 project.



Note: Section 501 is a non-overlayed control section.

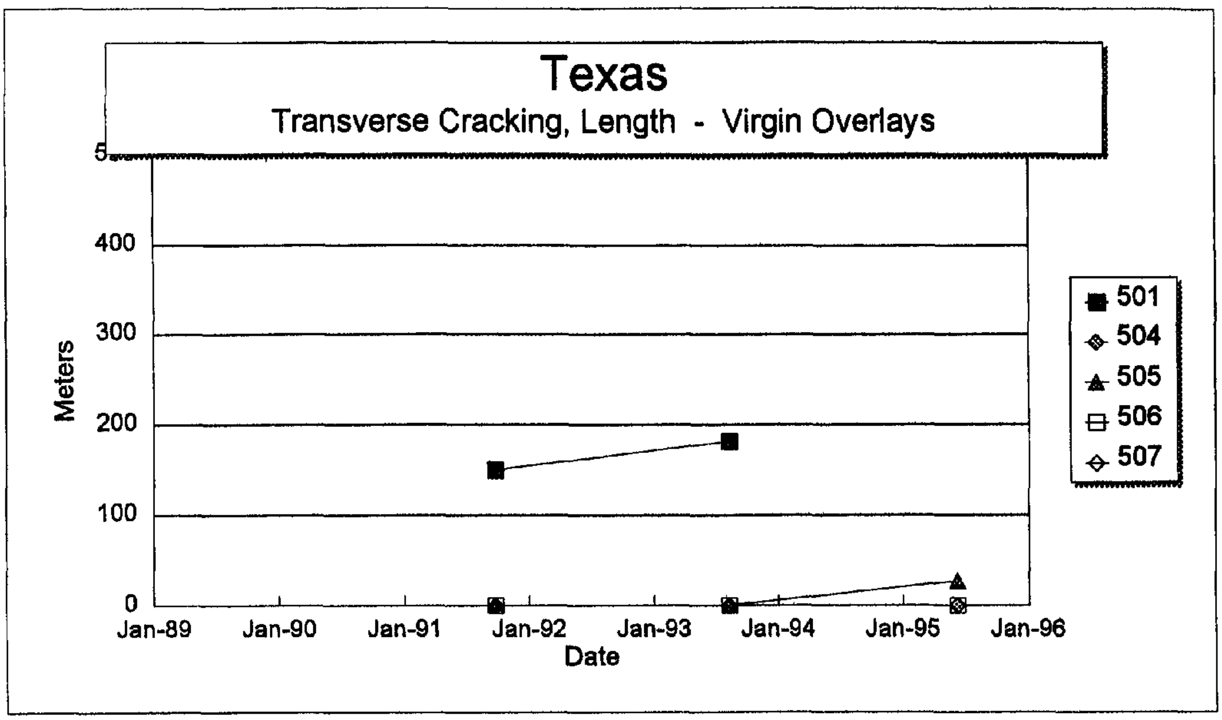
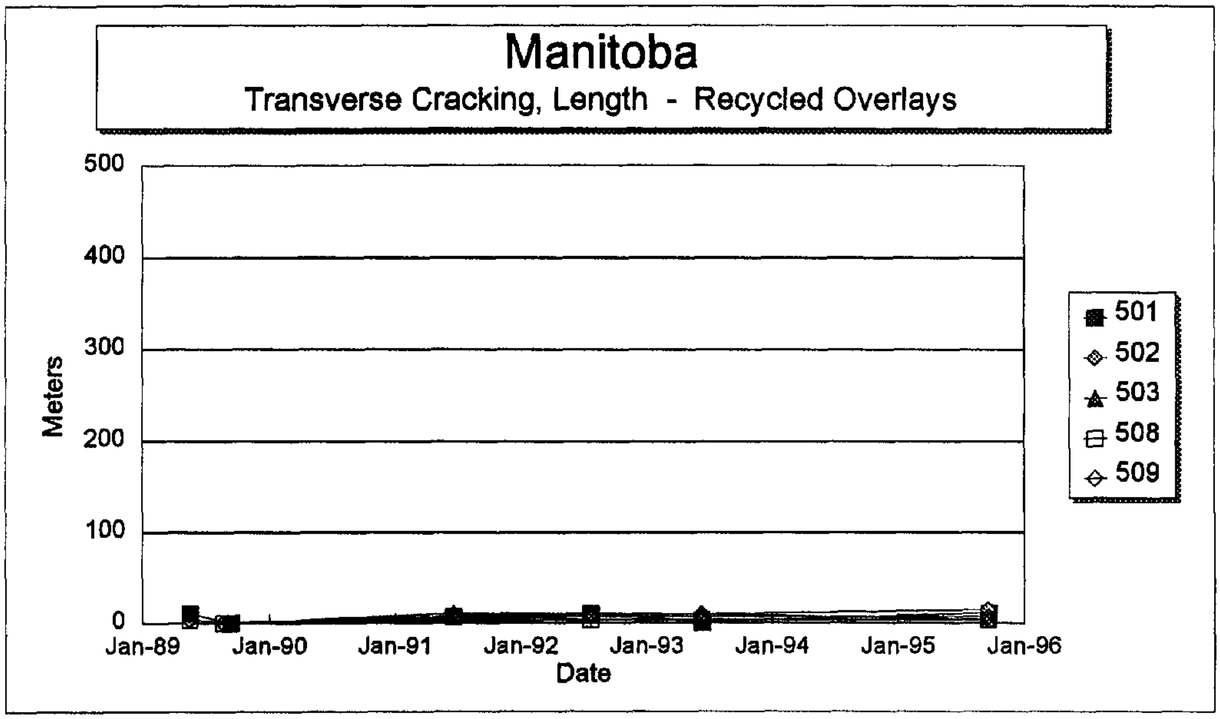


Figure 36. Total length of transverse cracks versus time on each section of the Texas SPS-5 project.



Note: Section 501 is a non-overlayed control section.

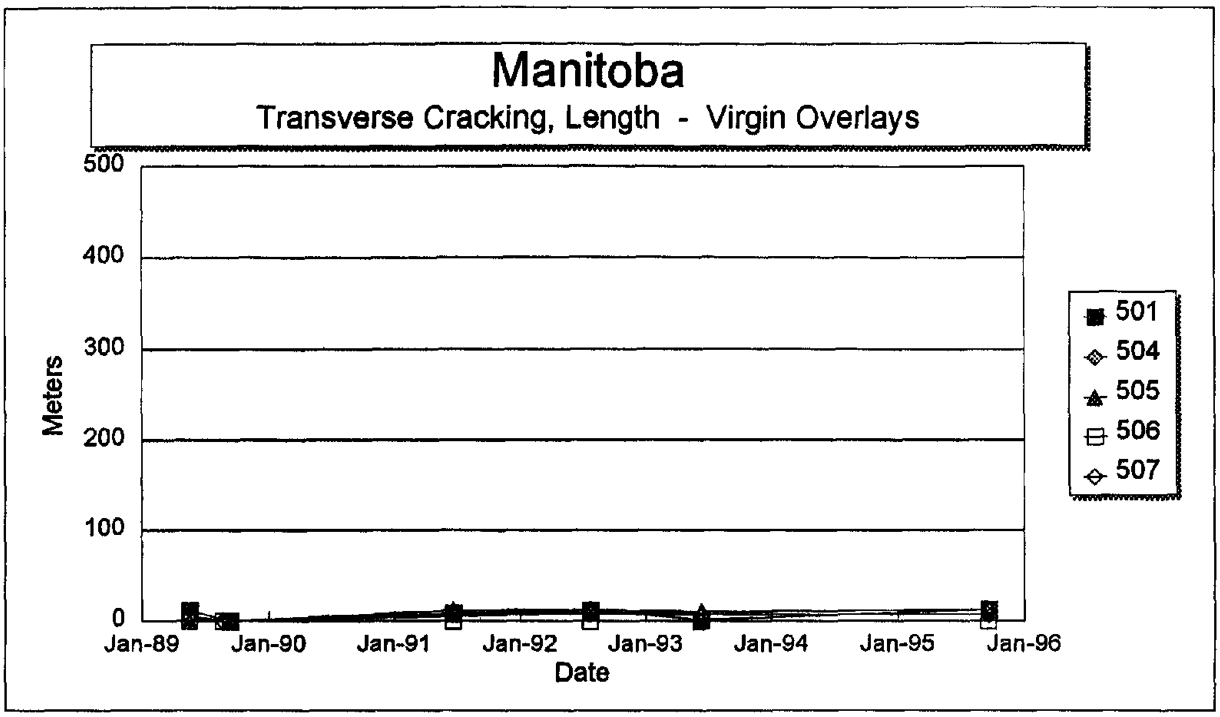
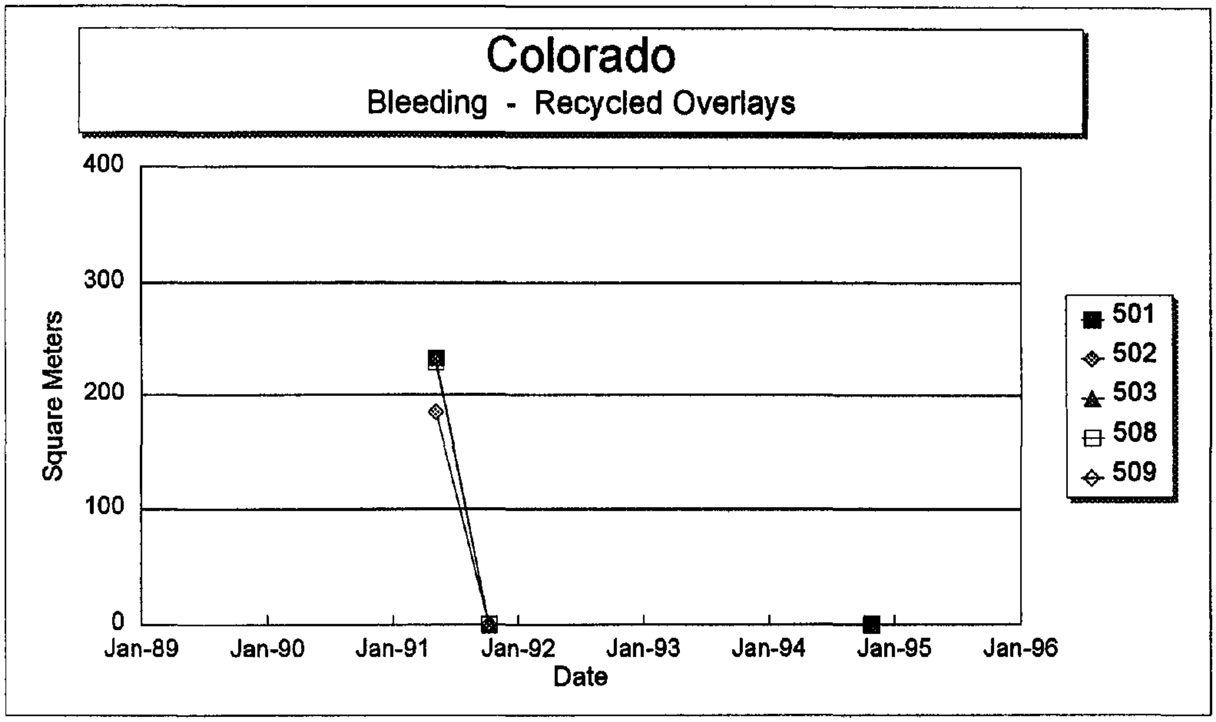


Figure 37. Total length of transverse cracks versus time on each section of the Manitoba SPS-5 project.



Note: Section 501 is a non-overlayed control section. (However, the control on this particular project did not remain untreated.)

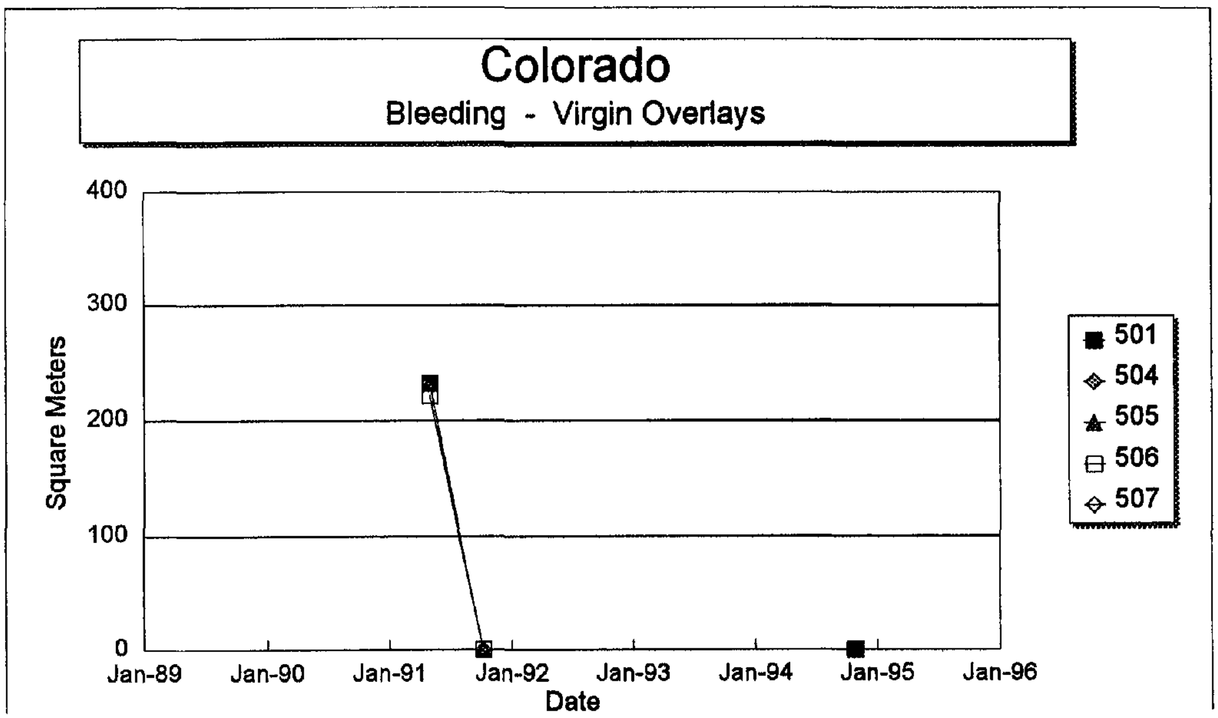
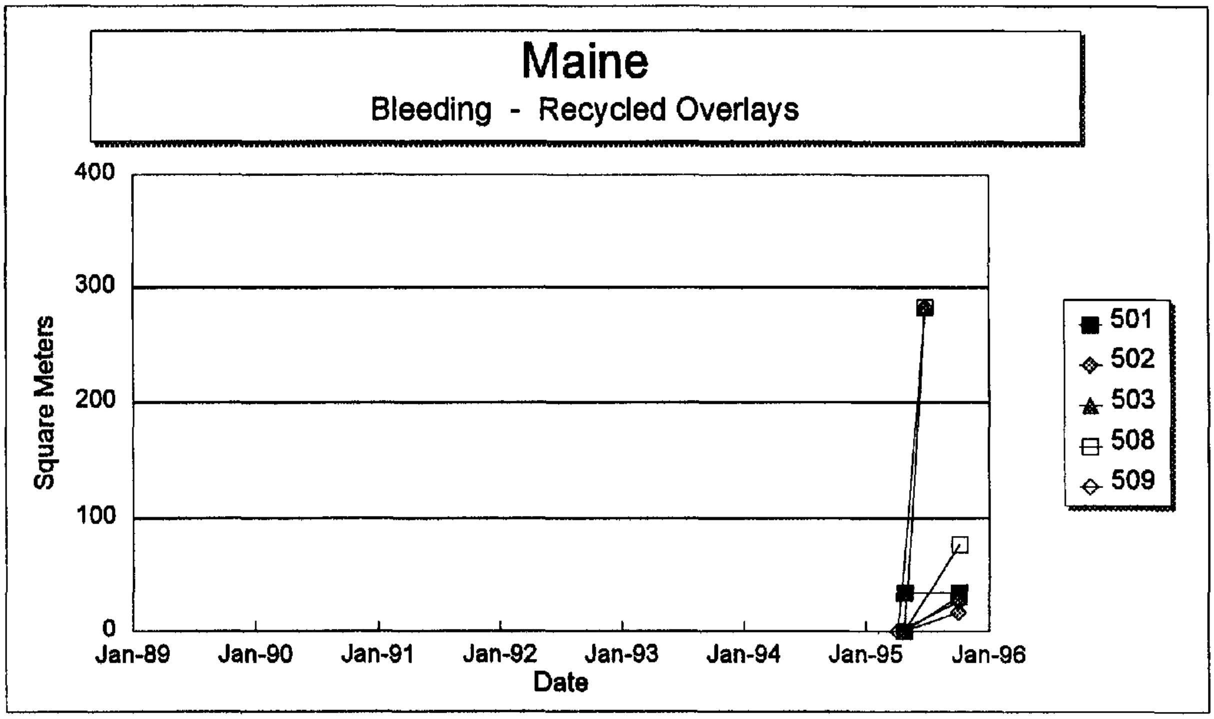


Figure 38. Total area of bleeding versus time on each section of the Colorado SPS-5 project.



Note: Section 501 is a non-overlayed control section.

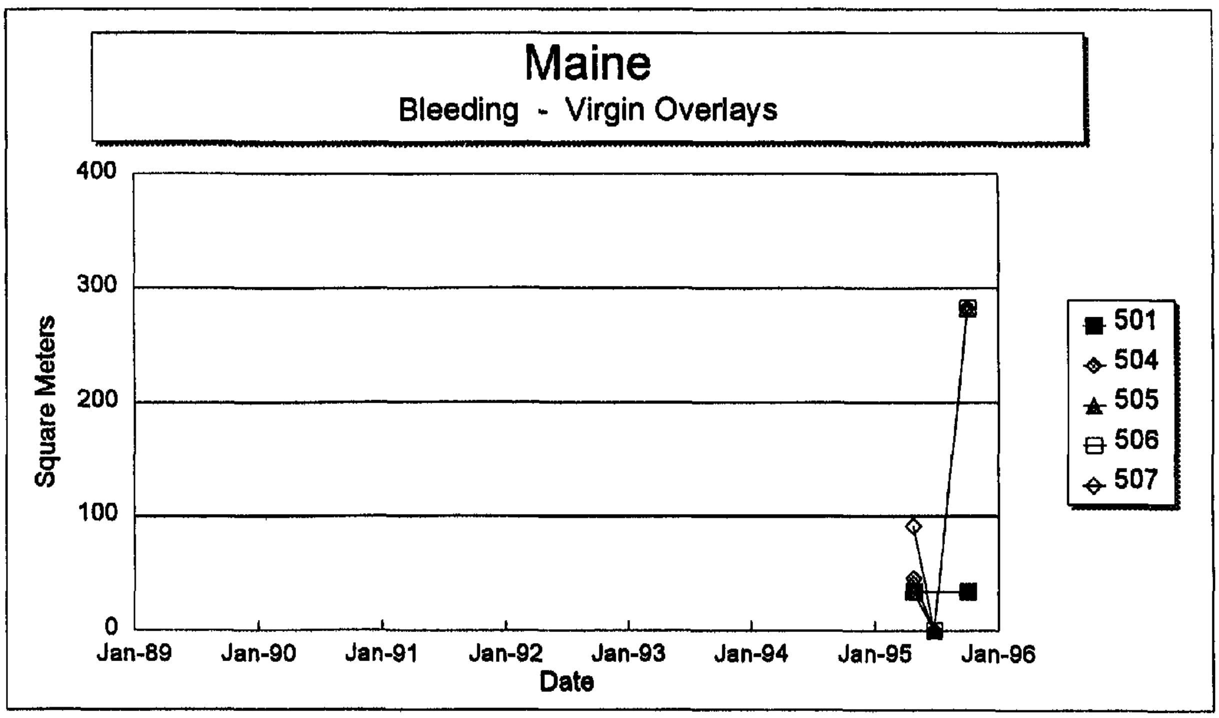
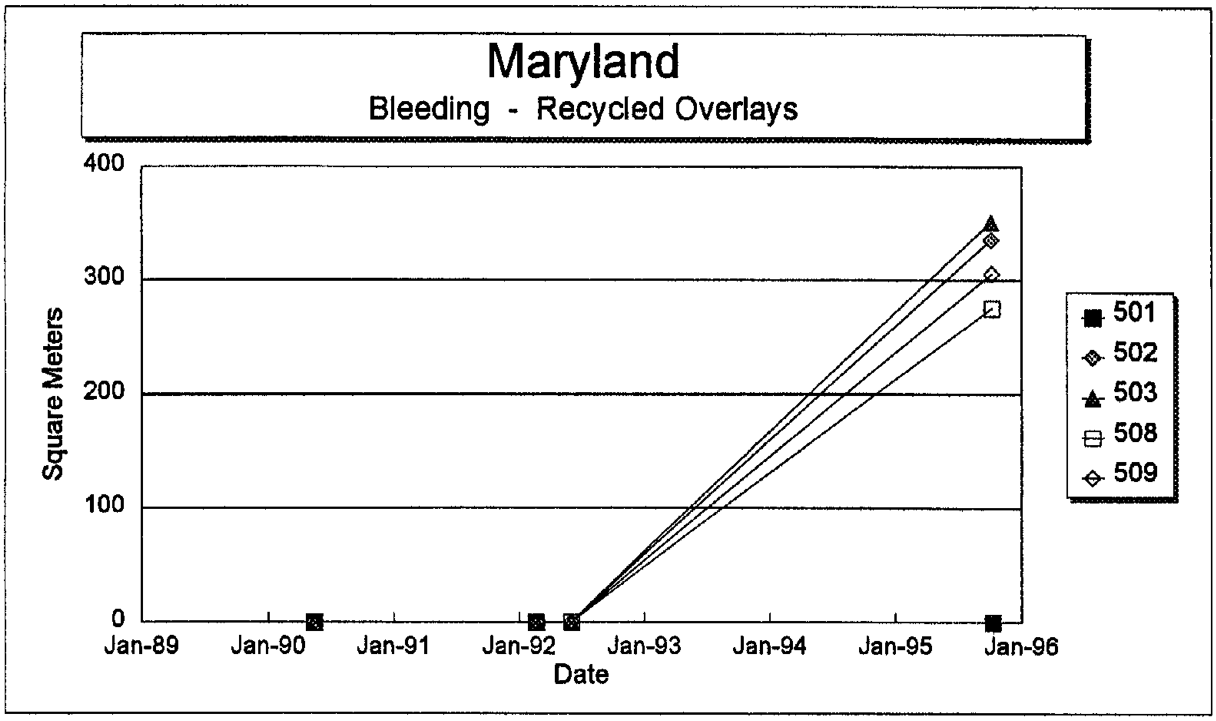


Figure 39. Total area of bleeding versus time on each section of the Maine SPS-5 project.



Note: Section 501 is a non-overlayed control section.

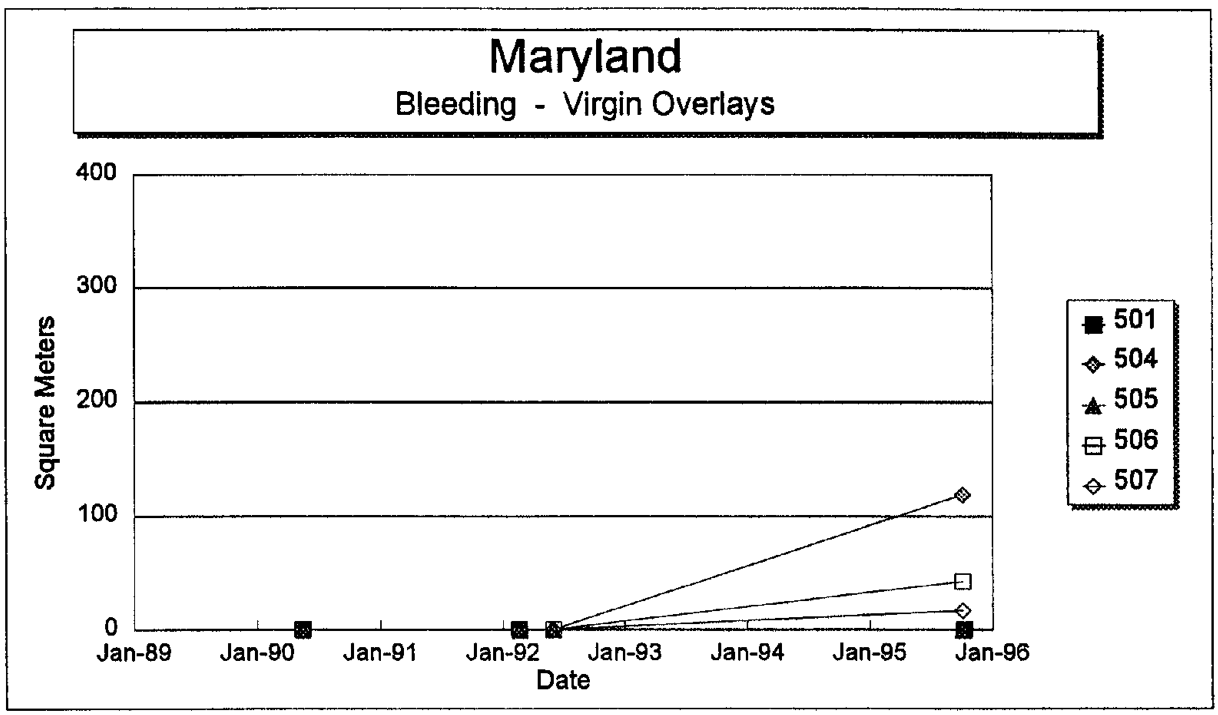
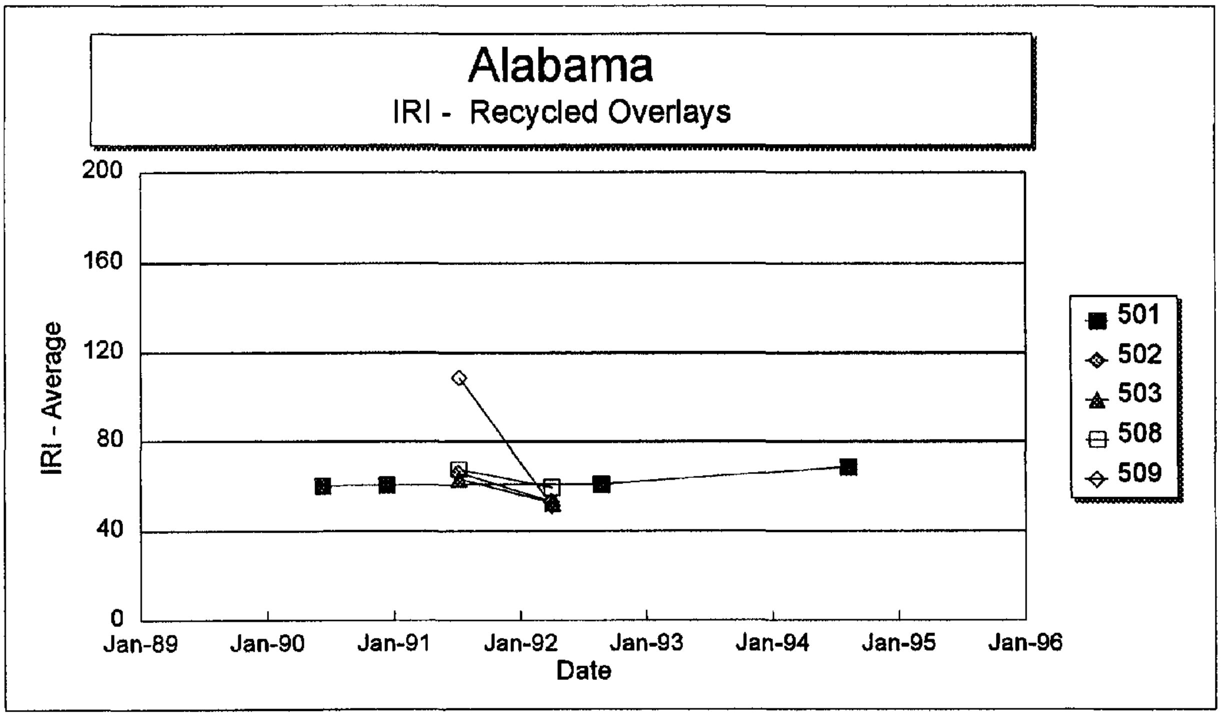


Figure 40. Total area of bleeding versus time on each section of the Maryland SPS-5 project.



Note: Section 501 is a non-overlayed control section.

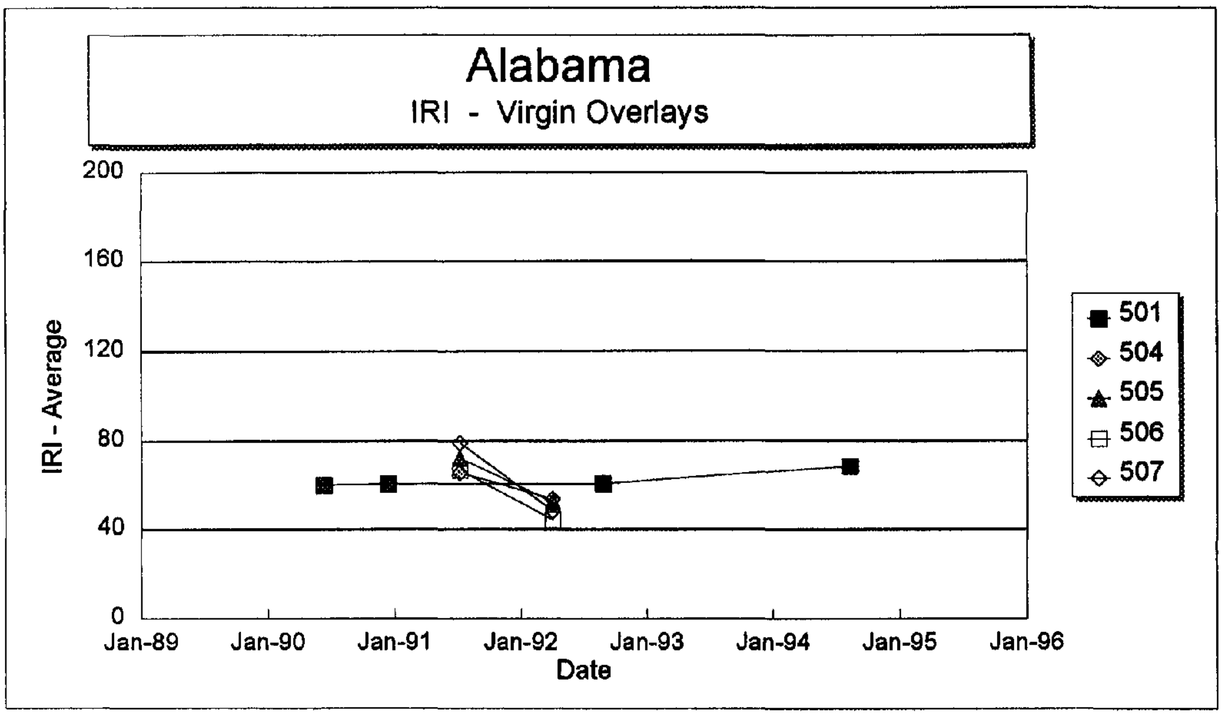
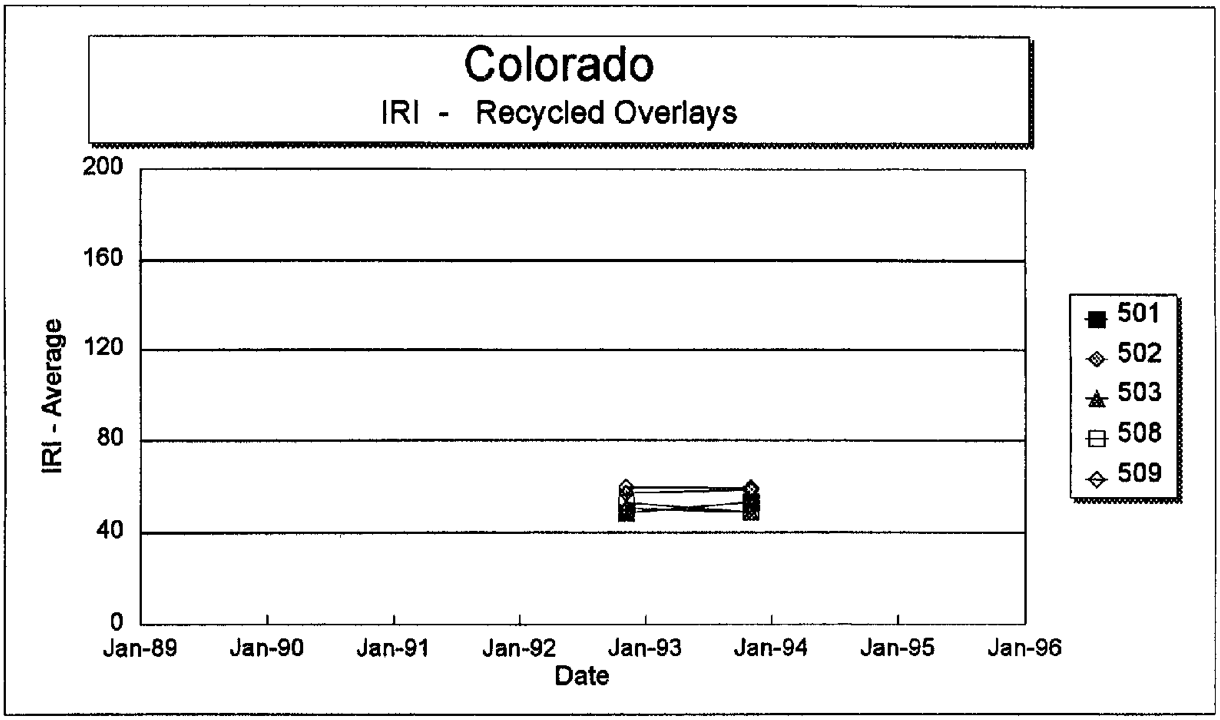


Figure 41. International Roughness Index versus time on each section of the Alabama SPS-5 project.



Note: Section 501 is a non-overlayed control section.

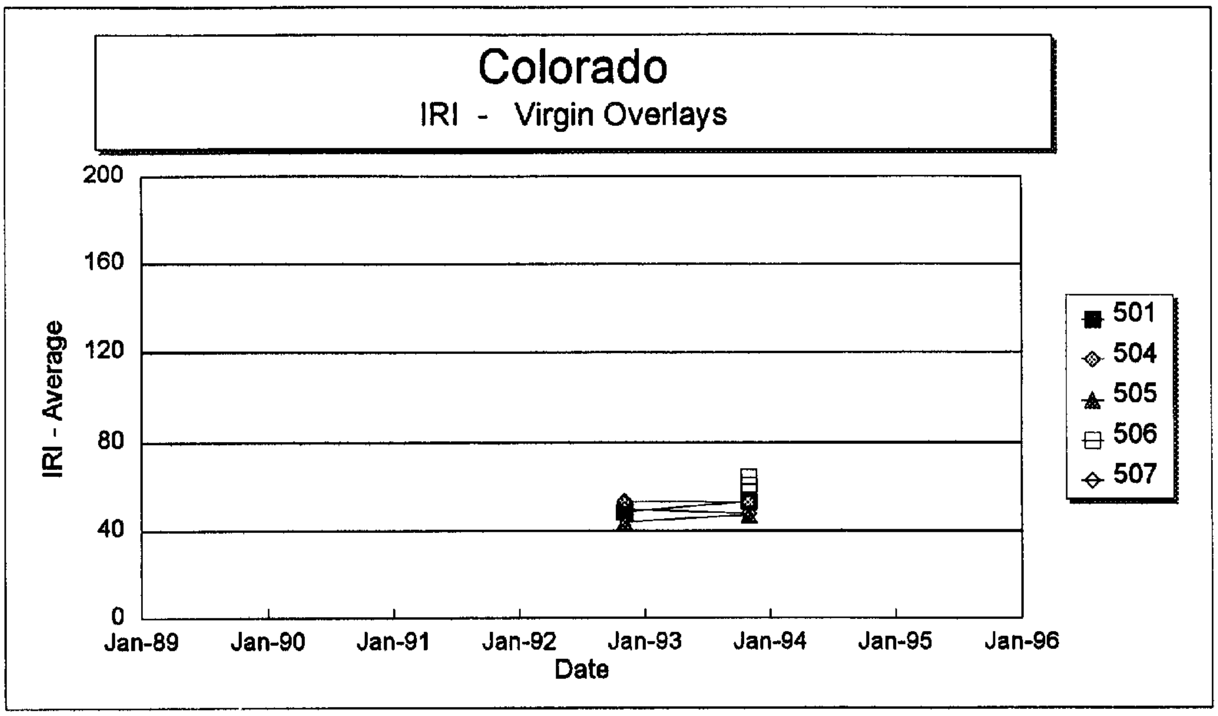
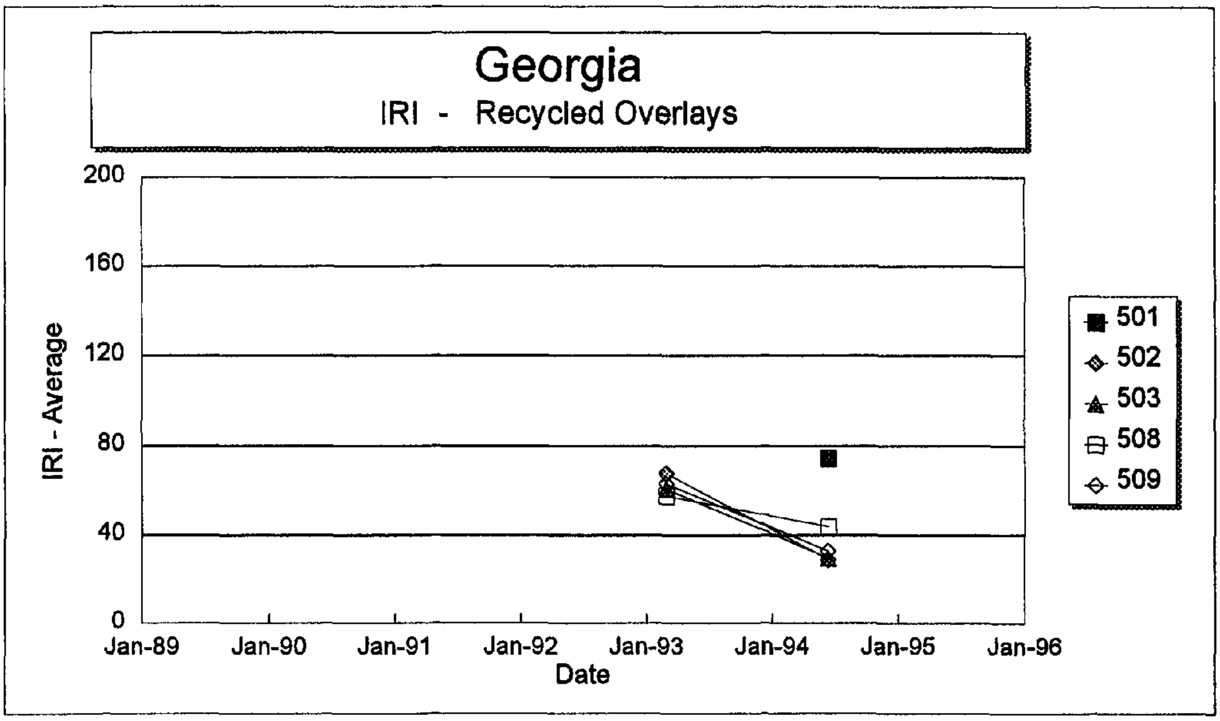


Figure 42. International Roughness Index versus time on each section of the Colorado SPS-5 project.



Note: Section 501 is a non-overlayed control section.

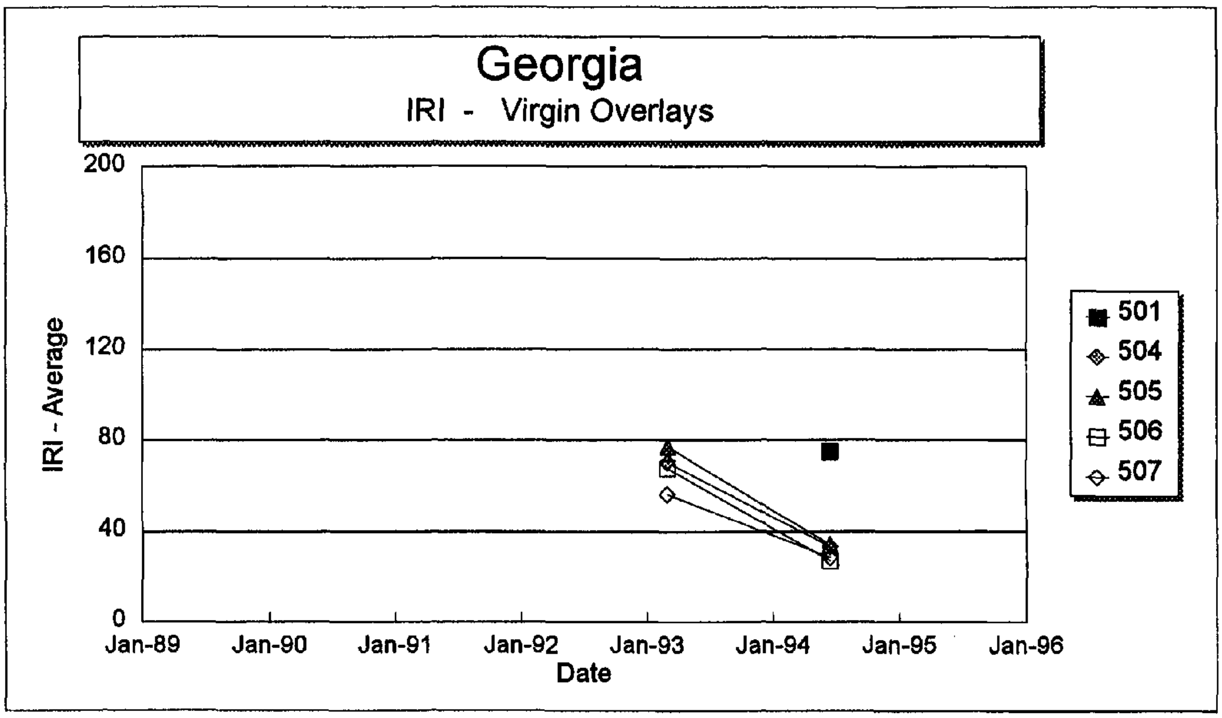
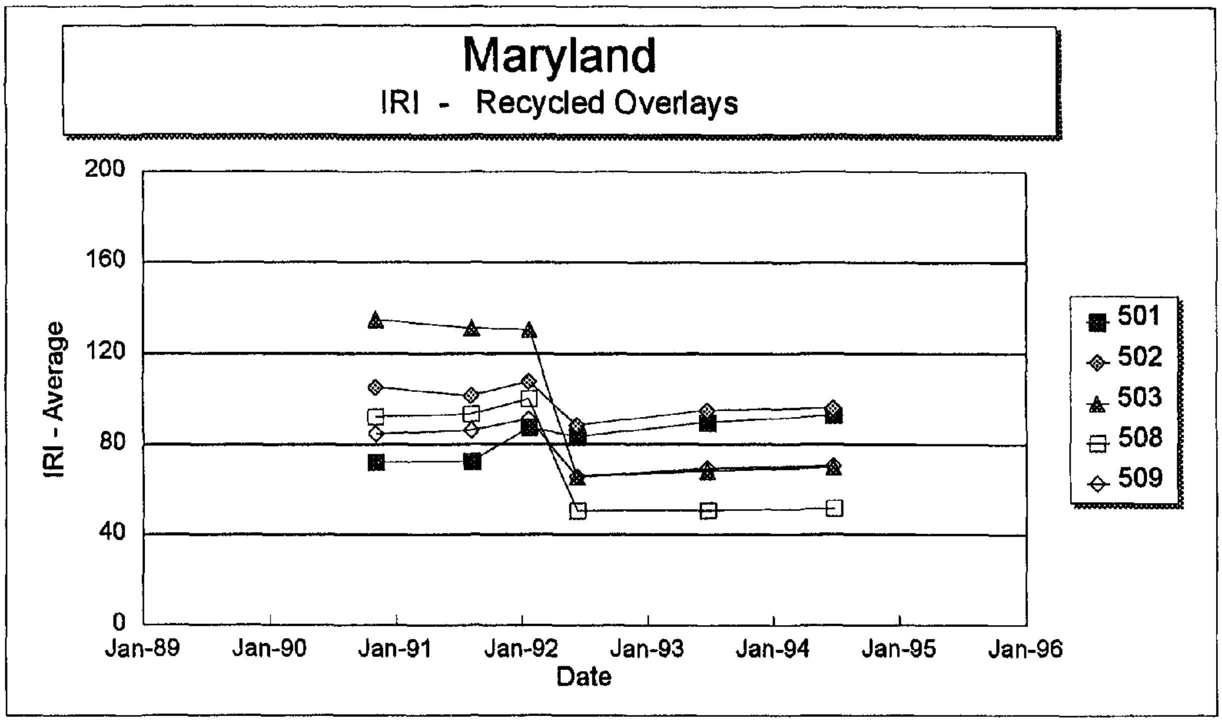


Figure 43. International Roughness Index versus time on each section of the Georgia SPS-5 project.



Note: Section 501 is a non-overlayed control section.

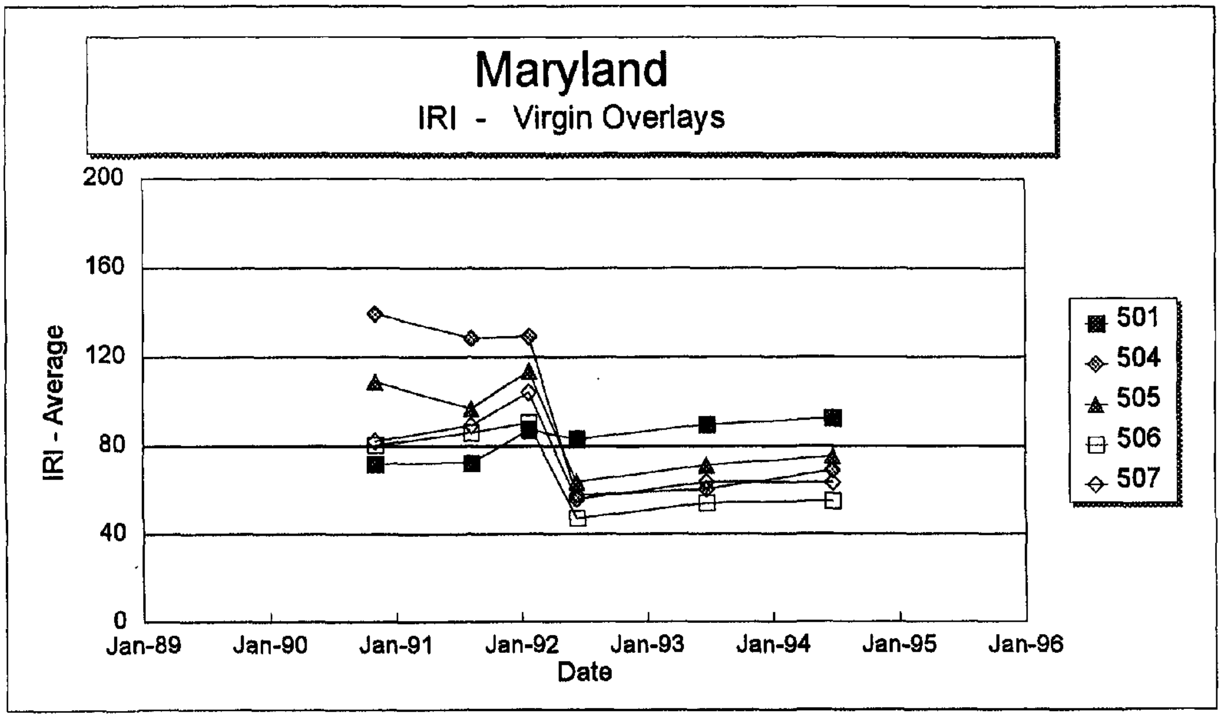
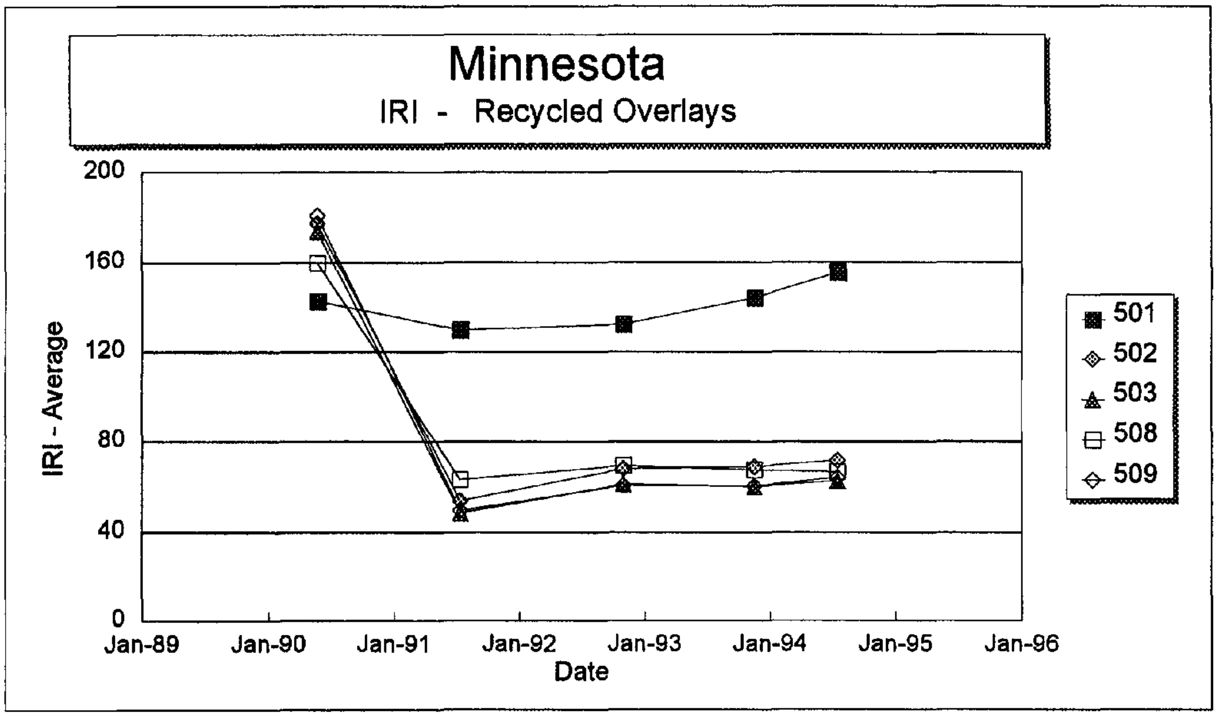


Figure 44. International Roughness Index versus time on each section of the Maryland SPS-5 project.



Note: Section 501 is a non-overlayed control section.

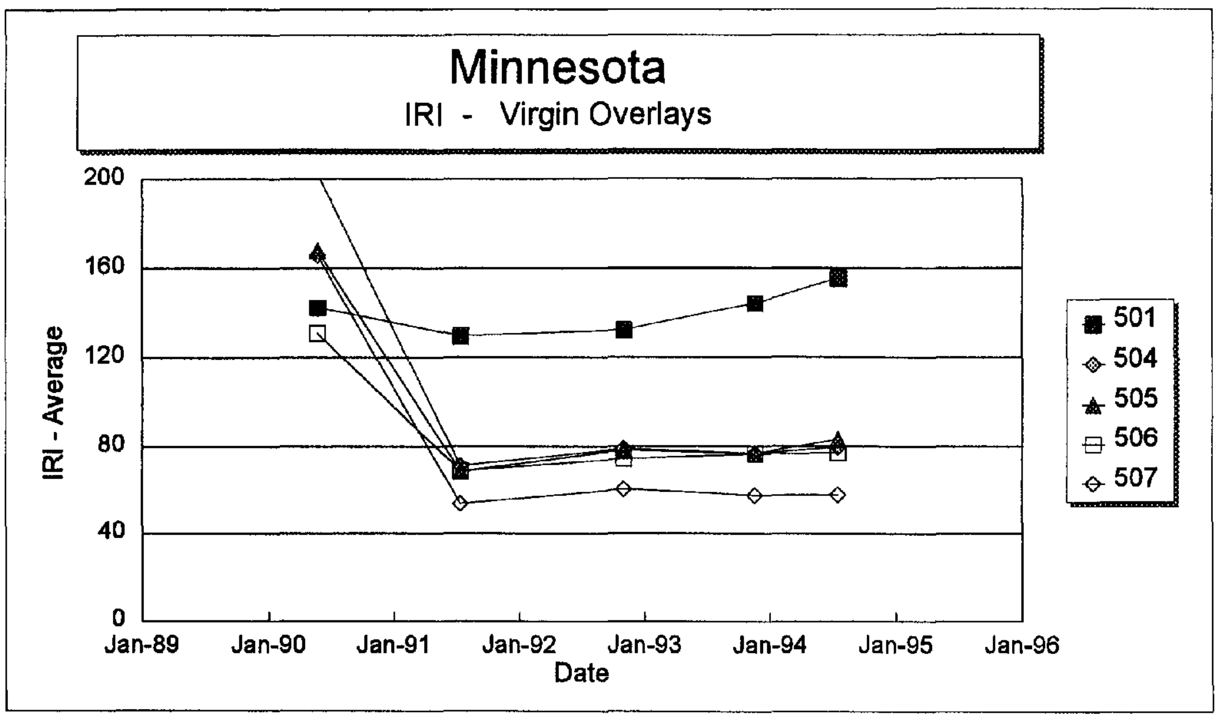
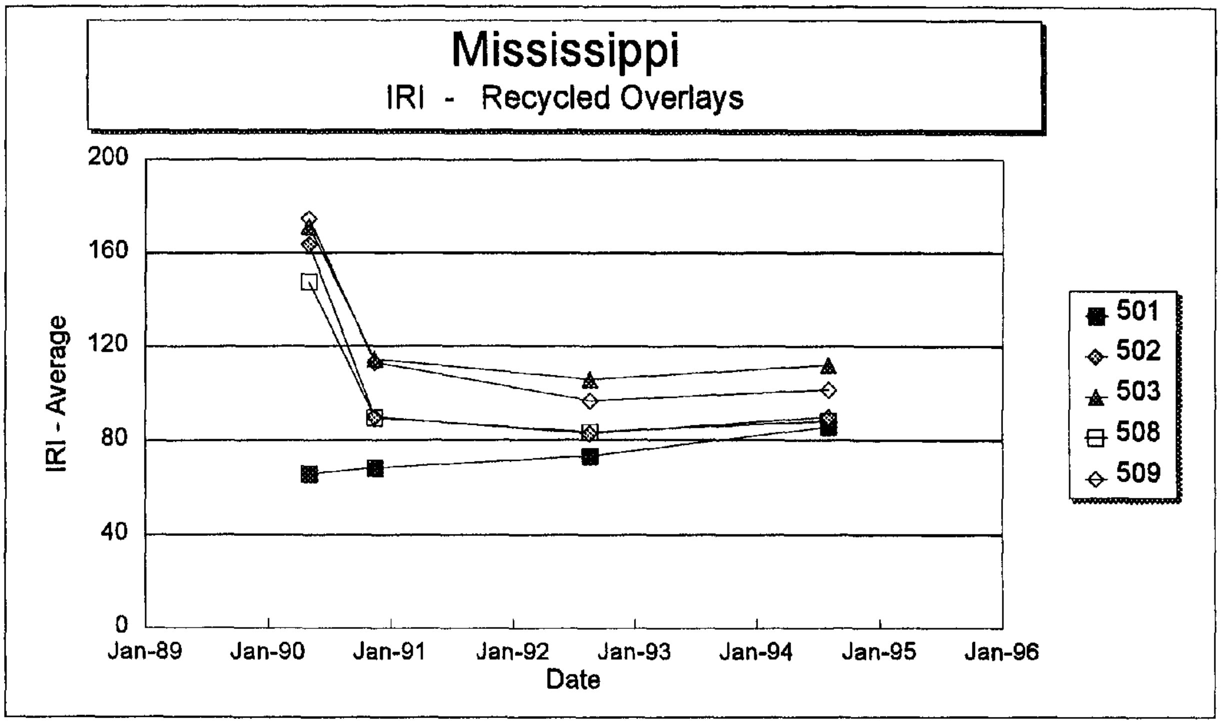


Figure 45. International Roughness Index versus time on each section of the Minnesota SPS-5 project.



Note: Section 501 is a non-overlayed control section.

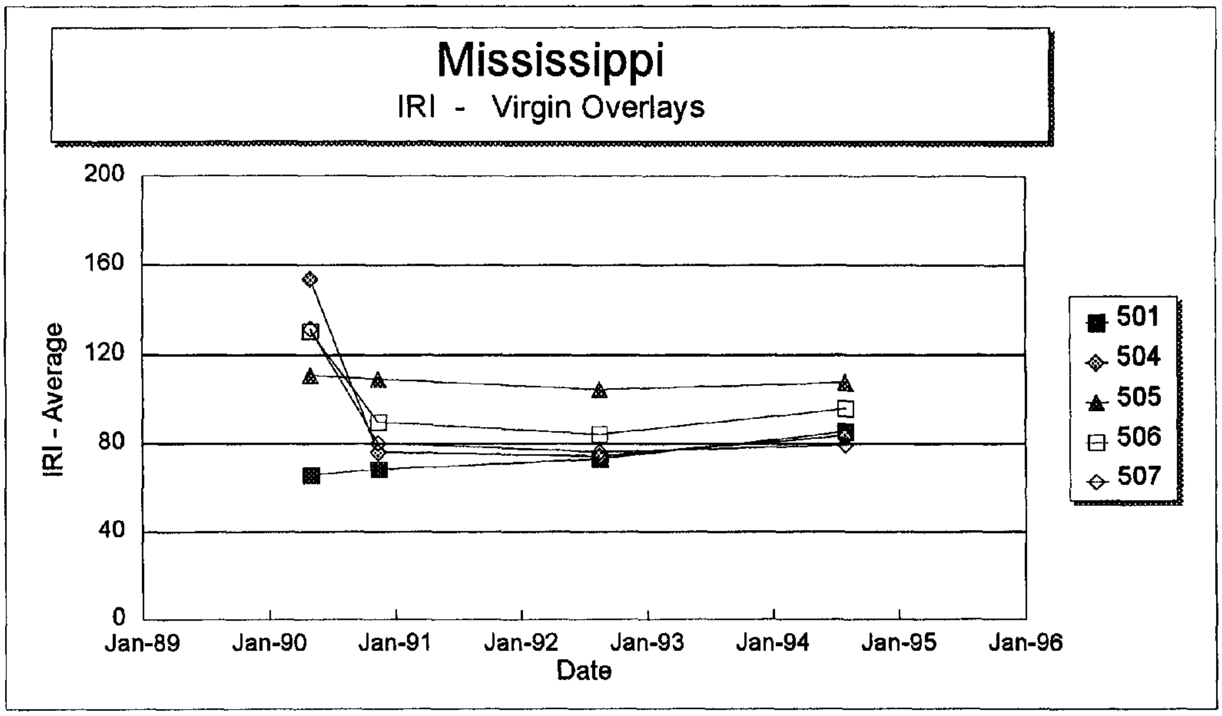
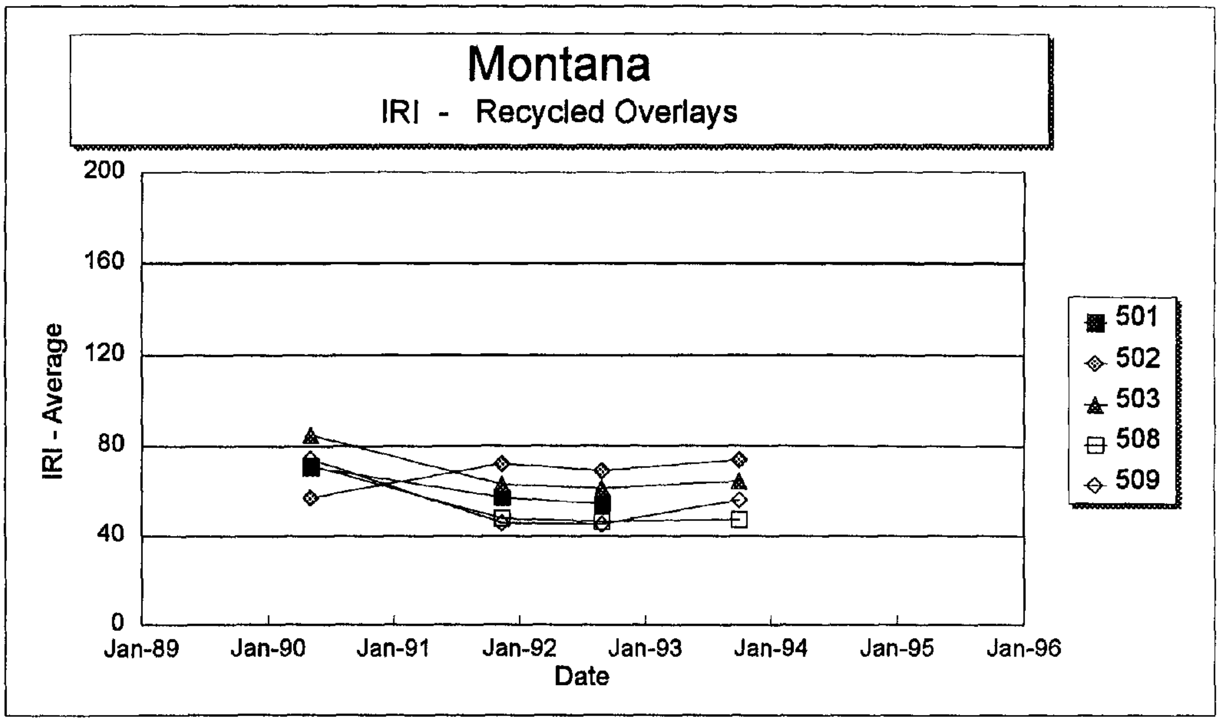


Figure 46. International Roughness Index versus time on each section of the Mississippi SPS-5 project.



Note: Section 501 is a non-overlayed control section.

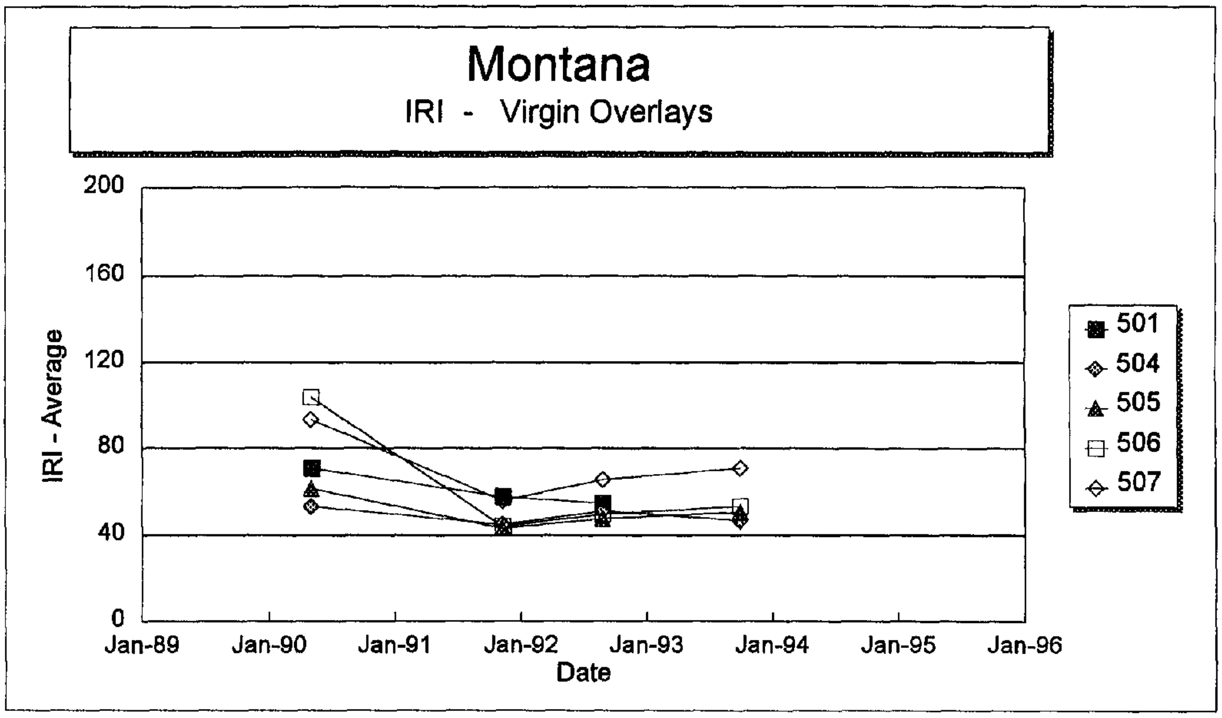
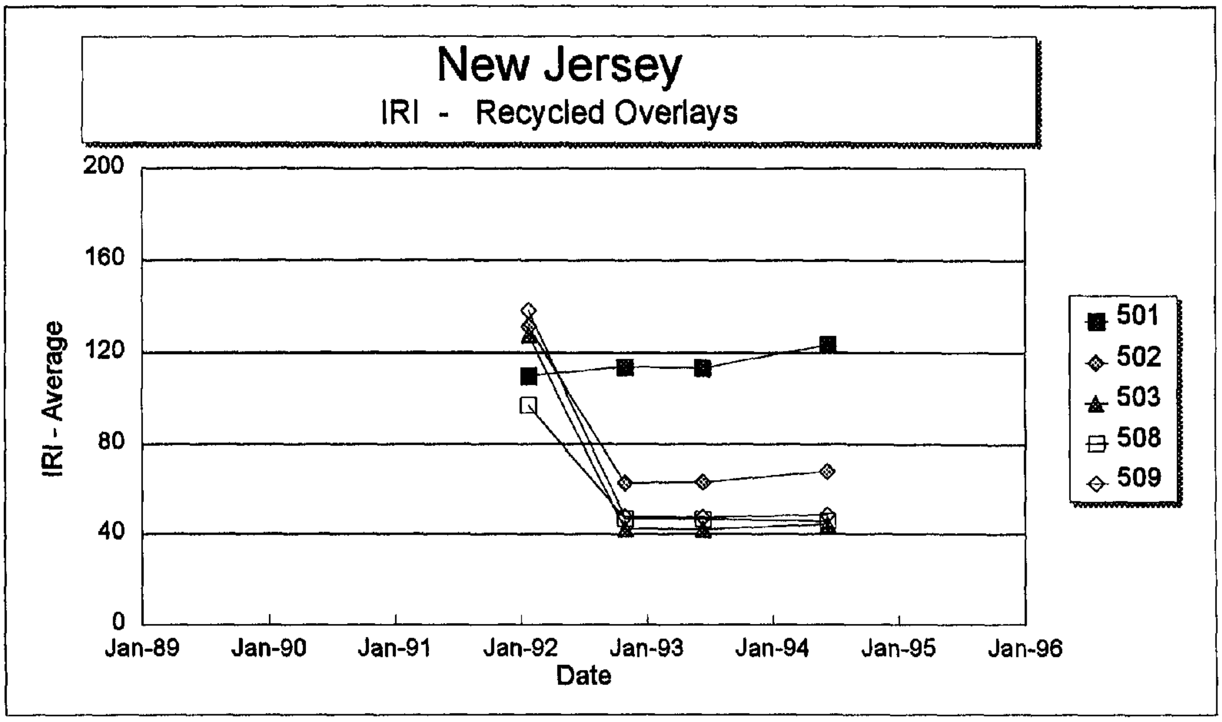


Figure 47. International Roughness Index versus time on each section of the Montana SPS-5 project.



Note: Section 501 is a non-overlayed control section.

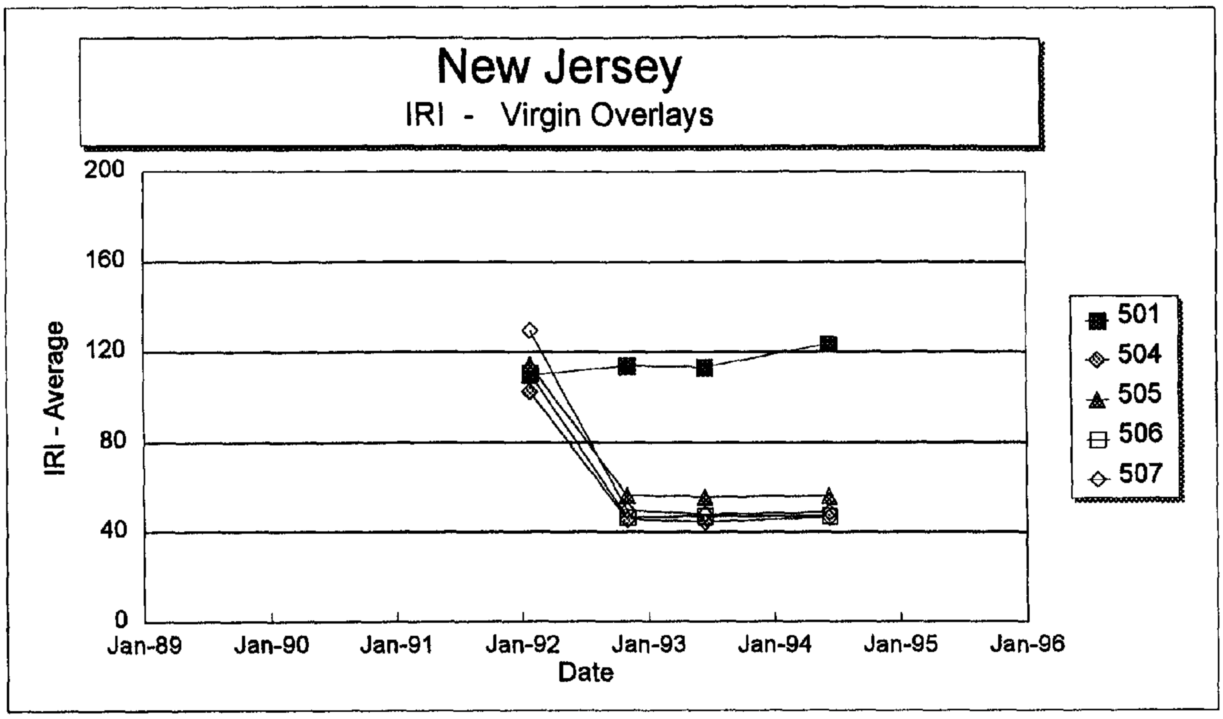
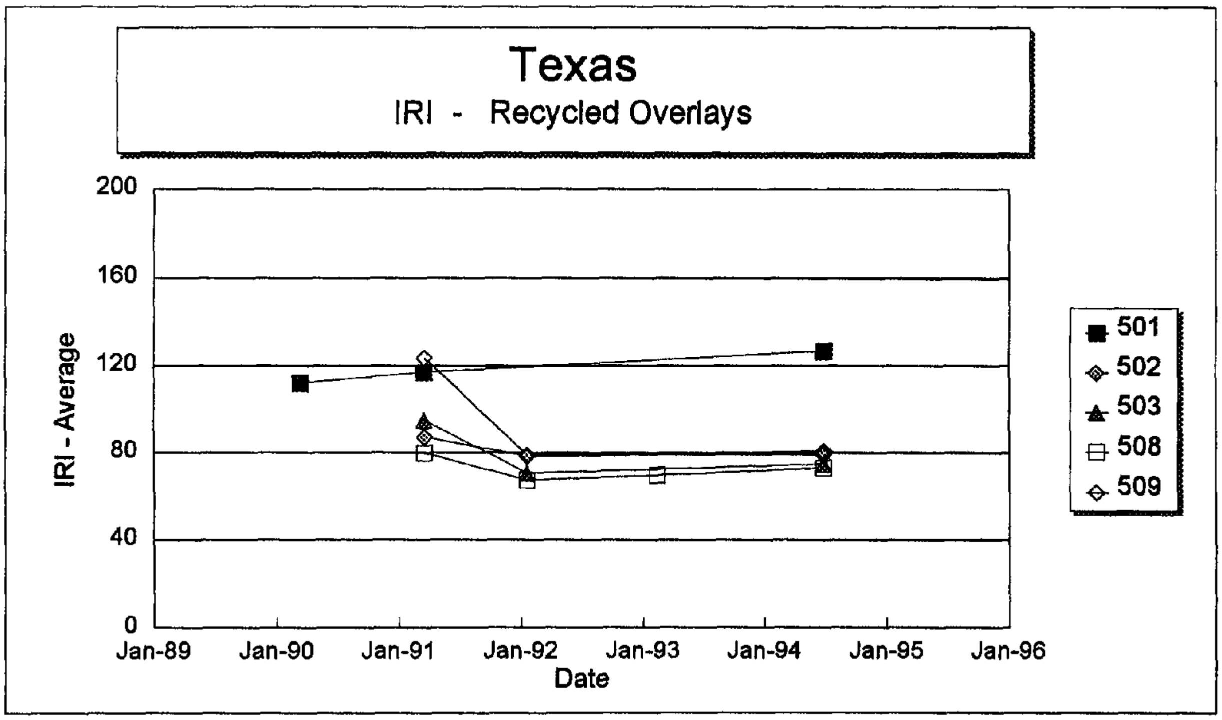


Figure 48. International Roughness Index versus time on each section of the New Jersey SPS-5 project.



Note: Section 501 is a non-overlayed control section.

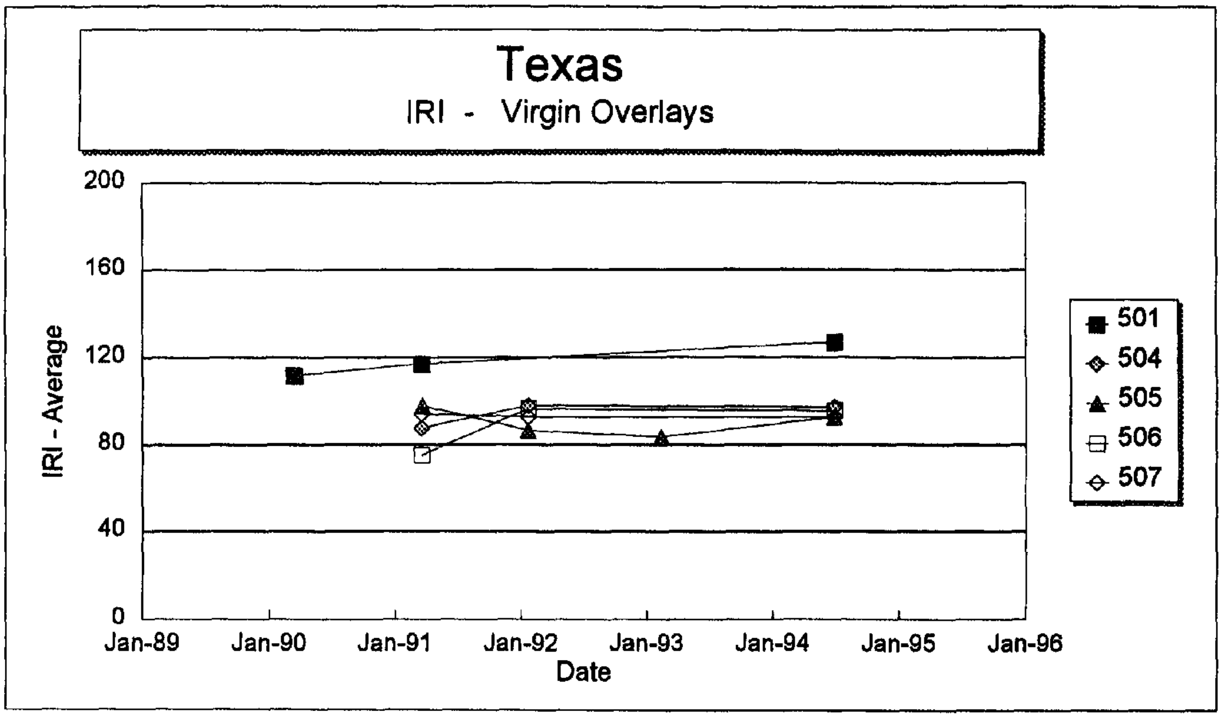
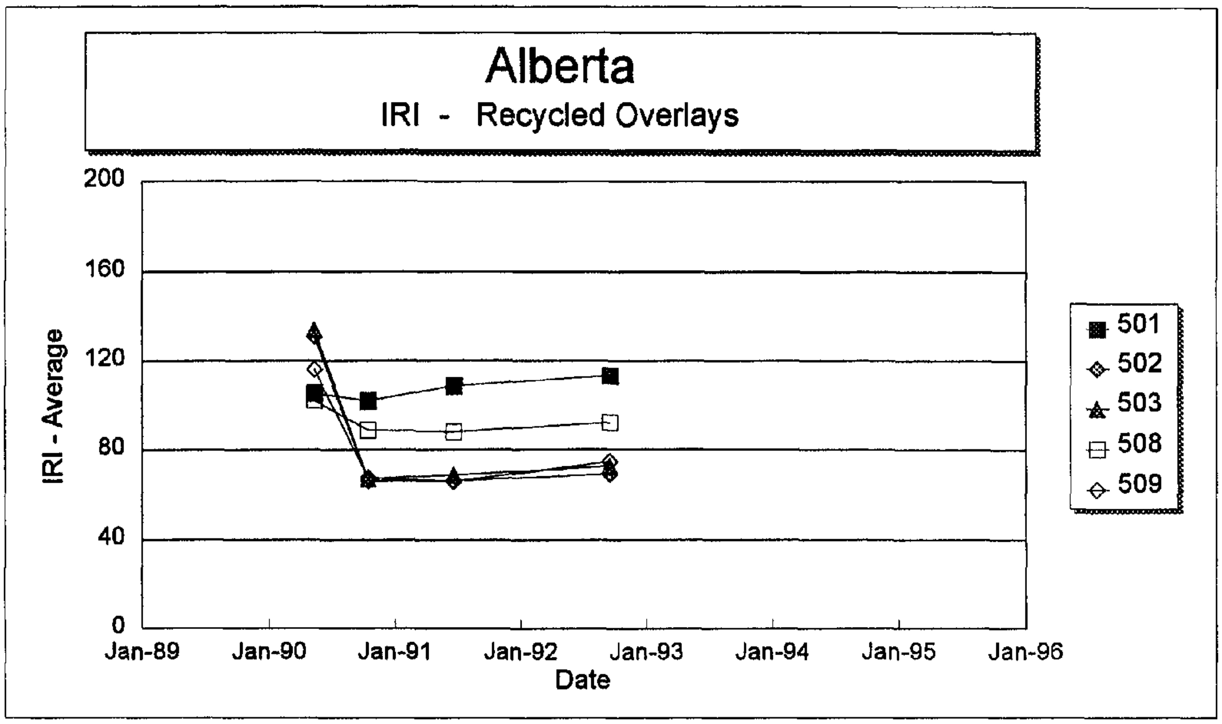


Figure 49. International Roughness Index versus time on each section of the Texas SPS-5 project.



Note: Section 501 is a non-overlayed control section.

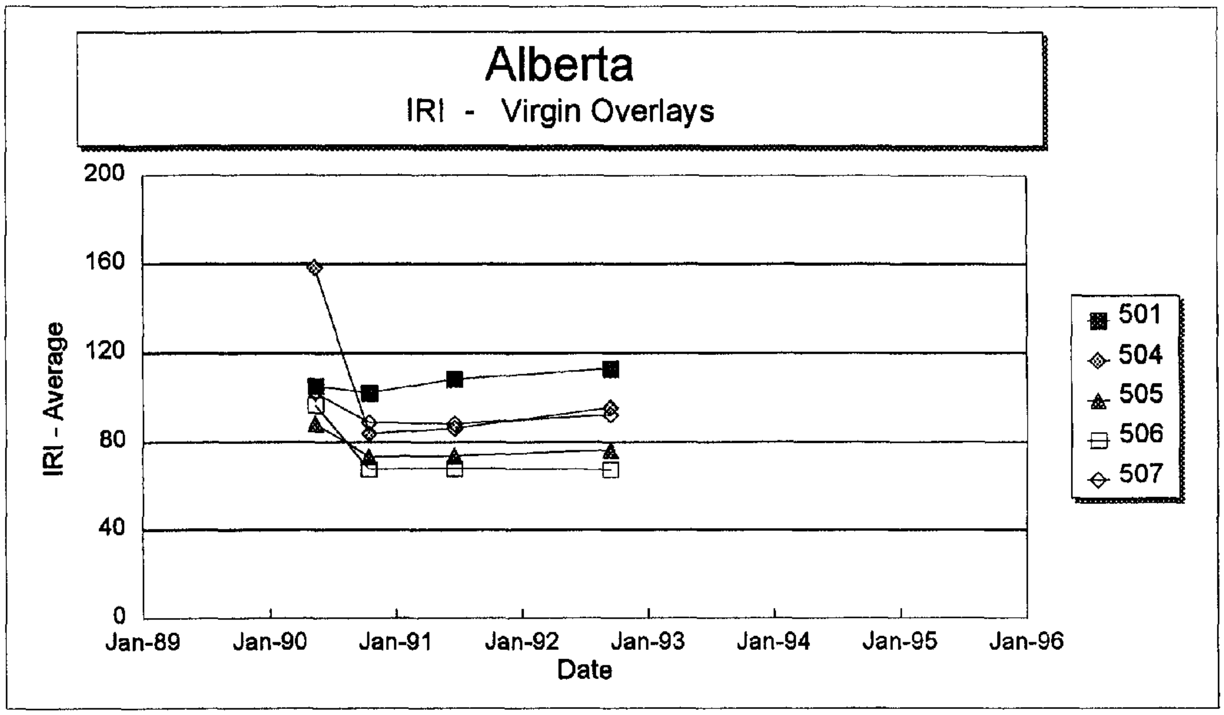
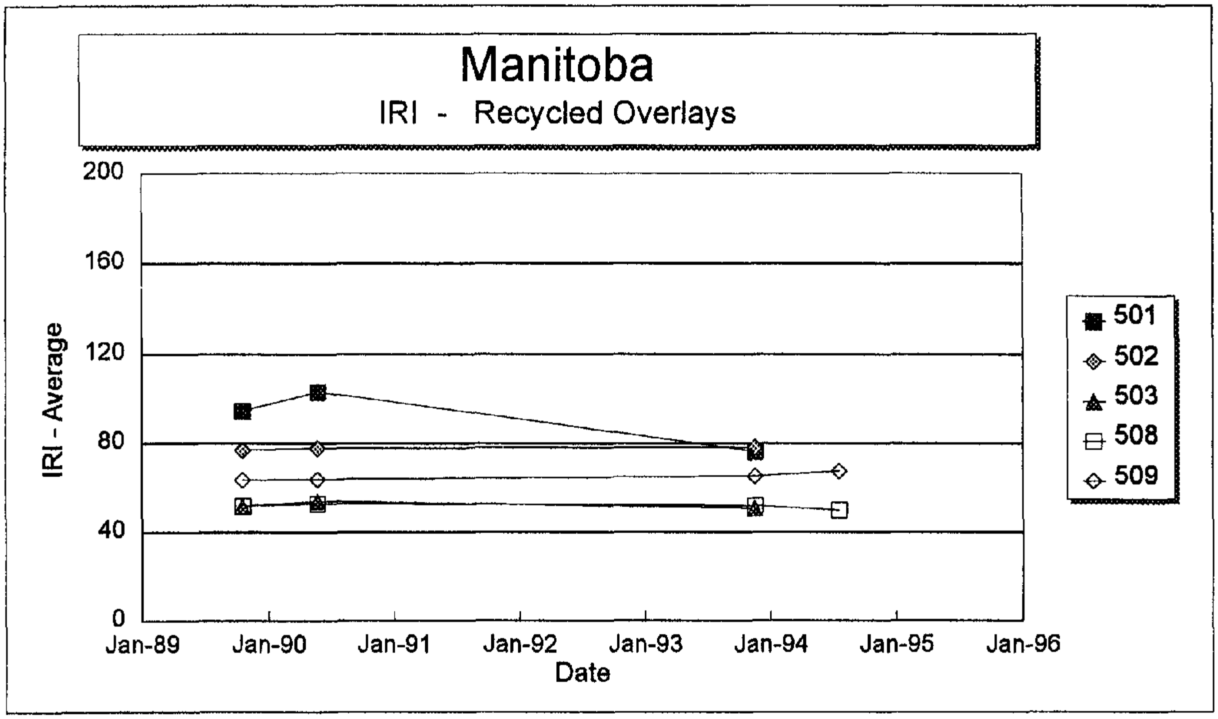


Figure 50. International Roughness Index versus time on each section of the Alberta SPS-5 project.



Note: Section 501 is a non-overlayed control section.

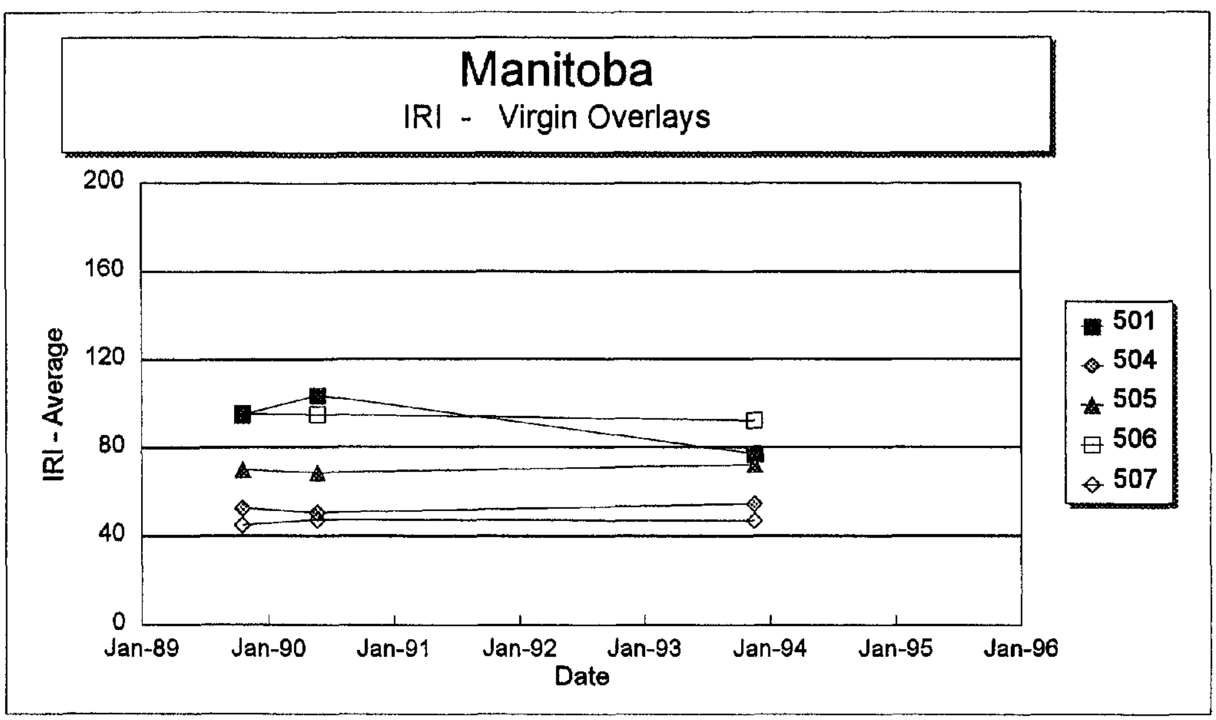
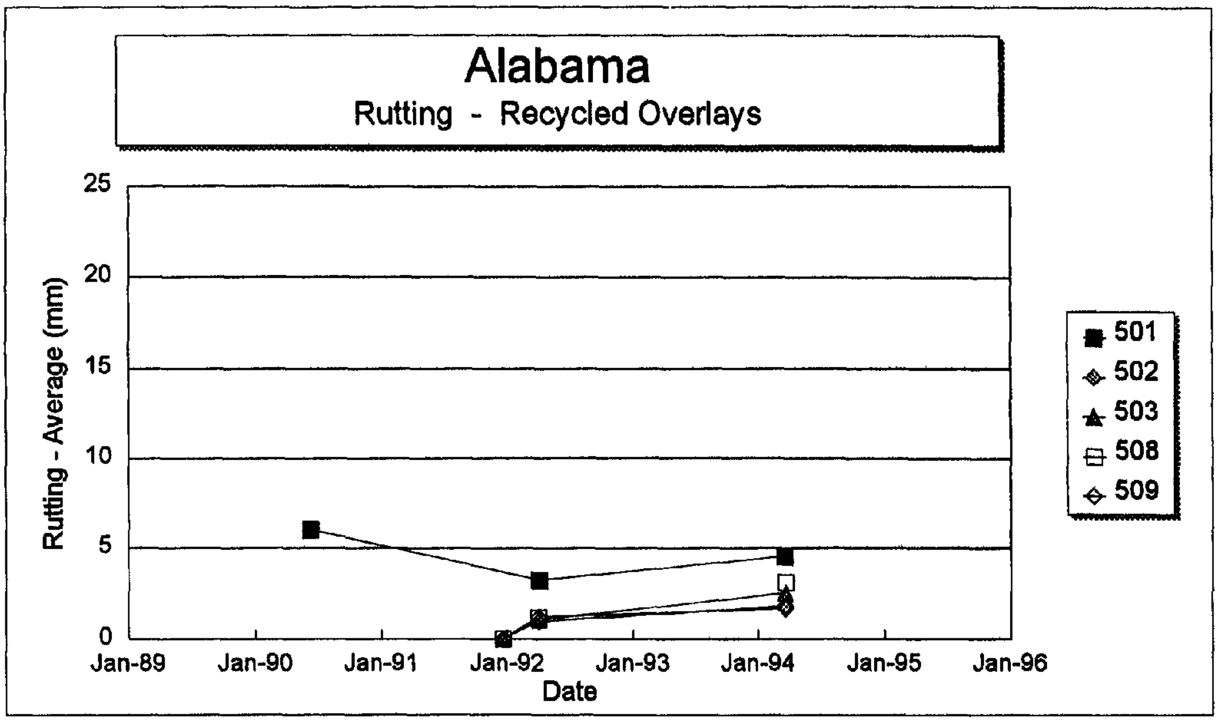


Figure 51. International Roughness Index versus time on each section of the Manitoba SPS-5 project.



Note: Section 501 is a non-overlayed control section.

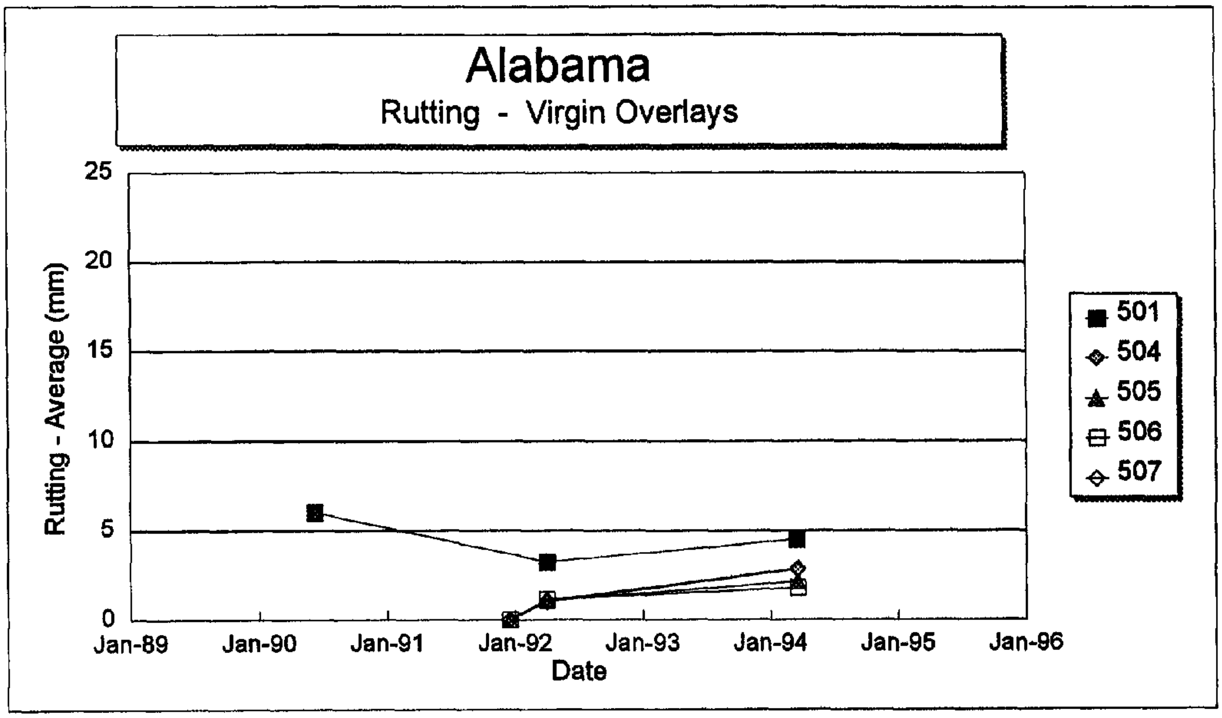
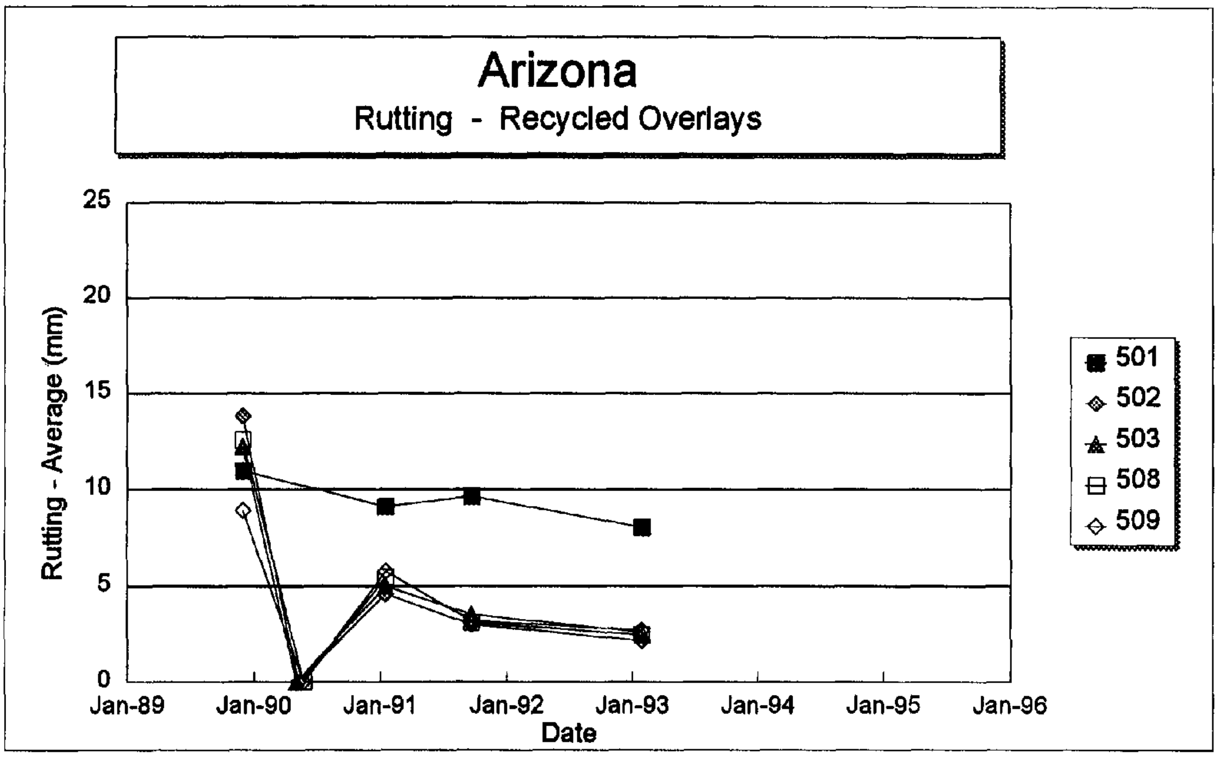


Figure 52. Rut depth versus time on each section of the Alabama SPS-5 project.



Note: Section 501 is a non-overlayed control section.

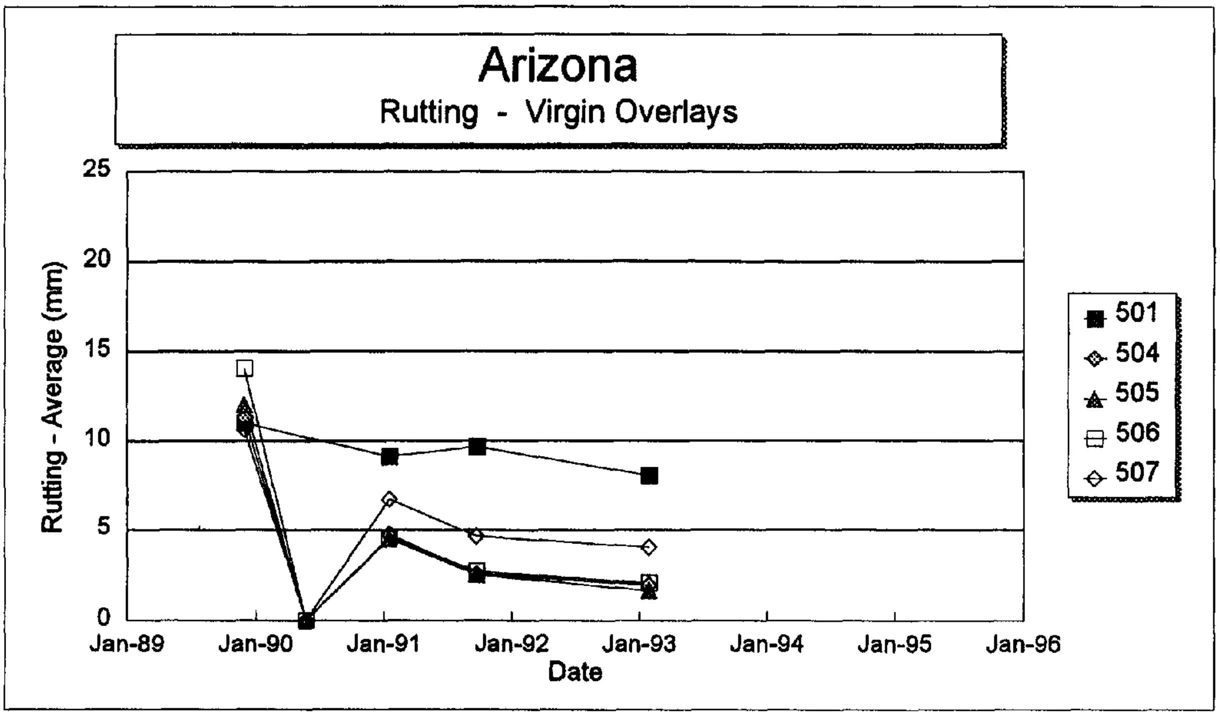
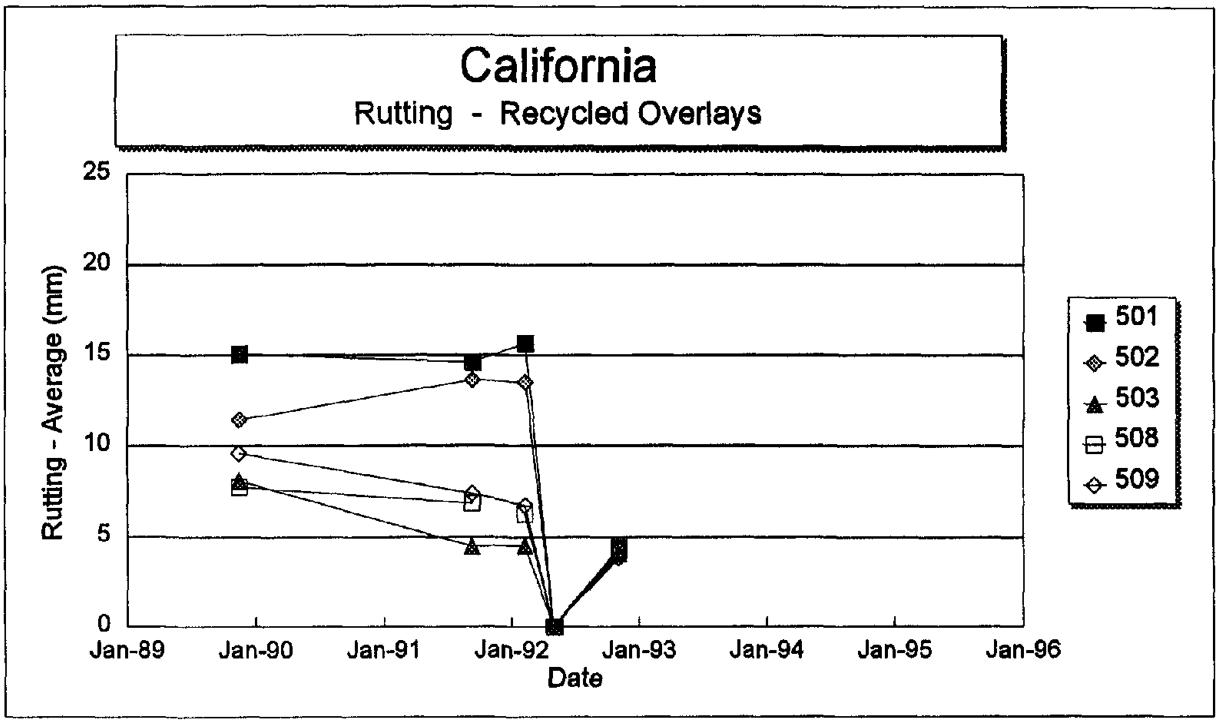


Figure 53. Rut depth versus time on each section of the Arizona SPS-5 project.



Note: Section 501 is a non-overlayed control section.

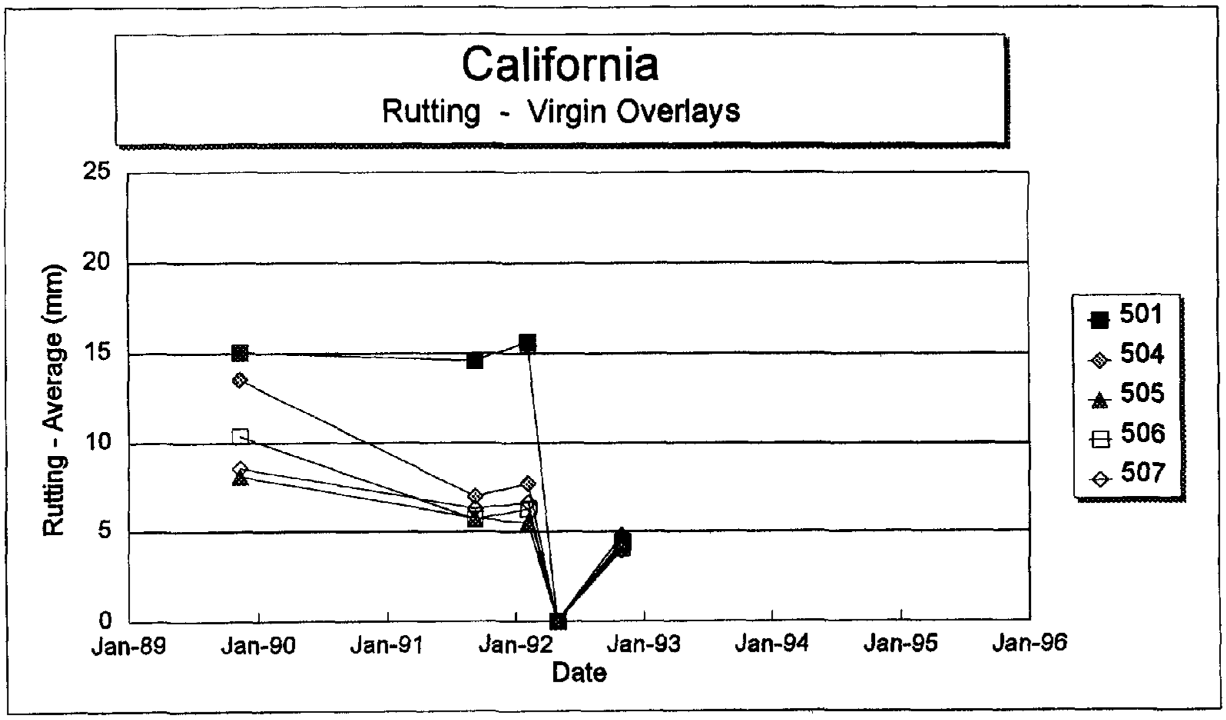
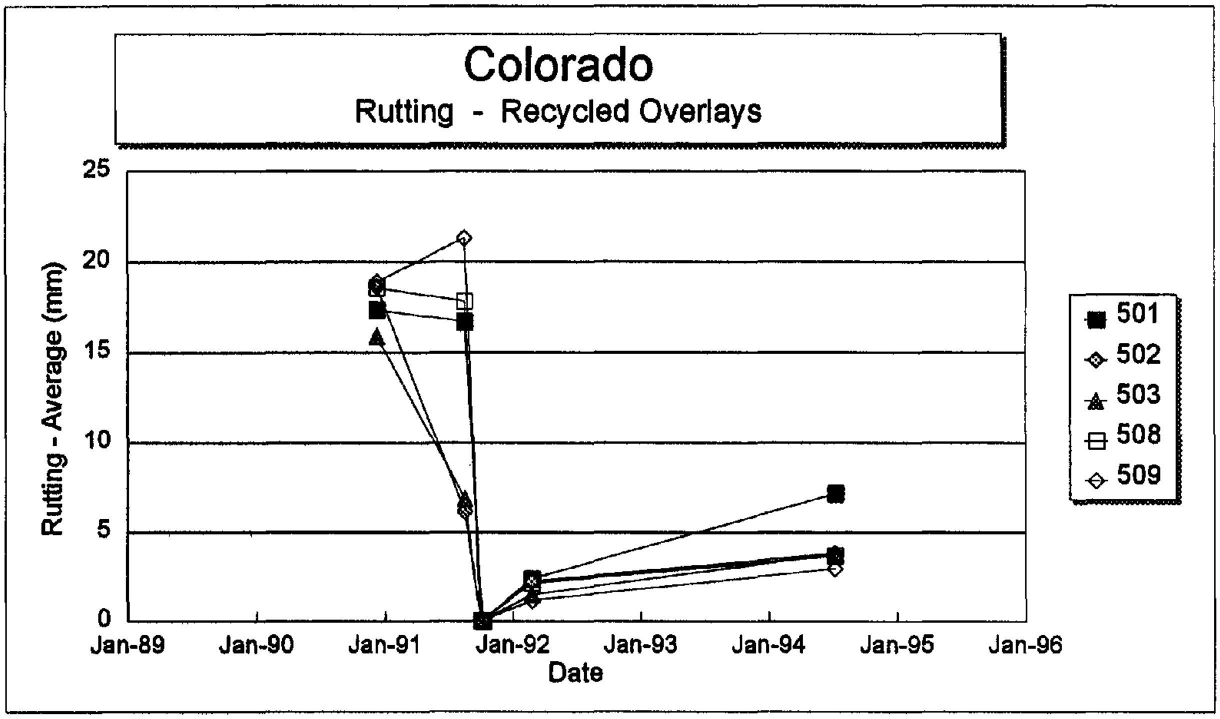


Figure 54. Rut depth versus time on each section of the California SPS-5 project.



Note: Section 501 is a non-overlayed control section.

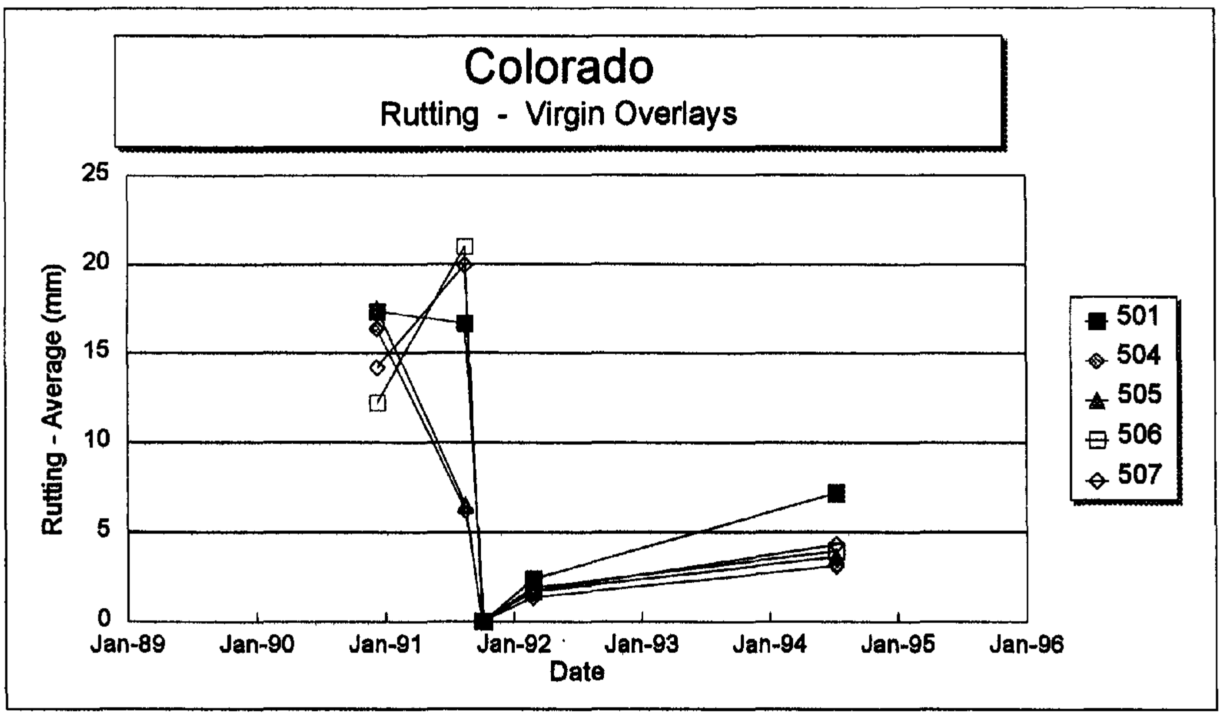
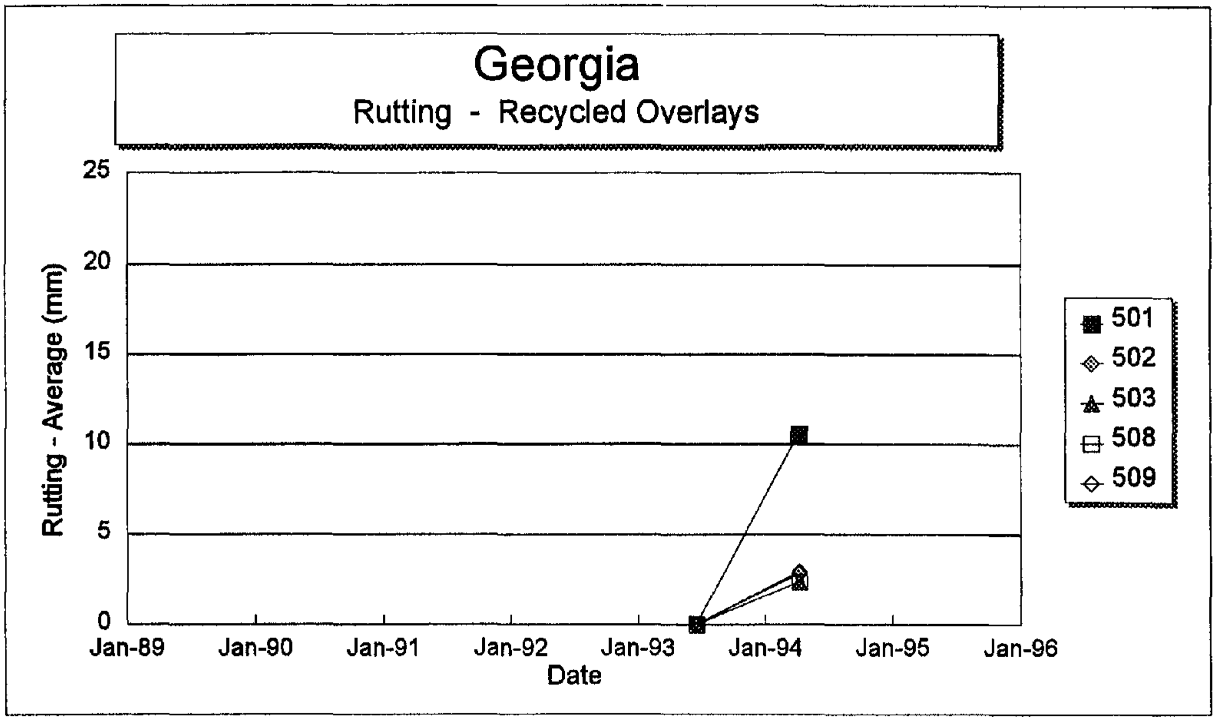


Figure 55. Rut depth versus time on each section of the Colorado SPS-5 project.



Note: Section 501 is a non-overlayed control section.

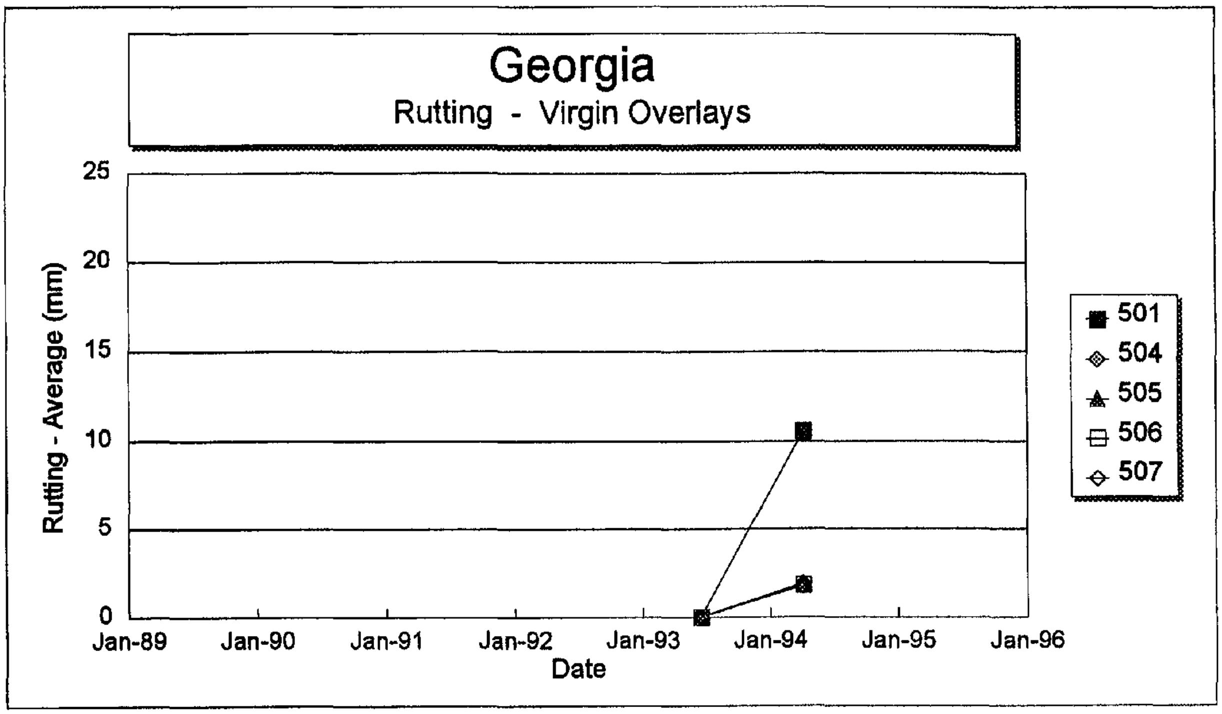
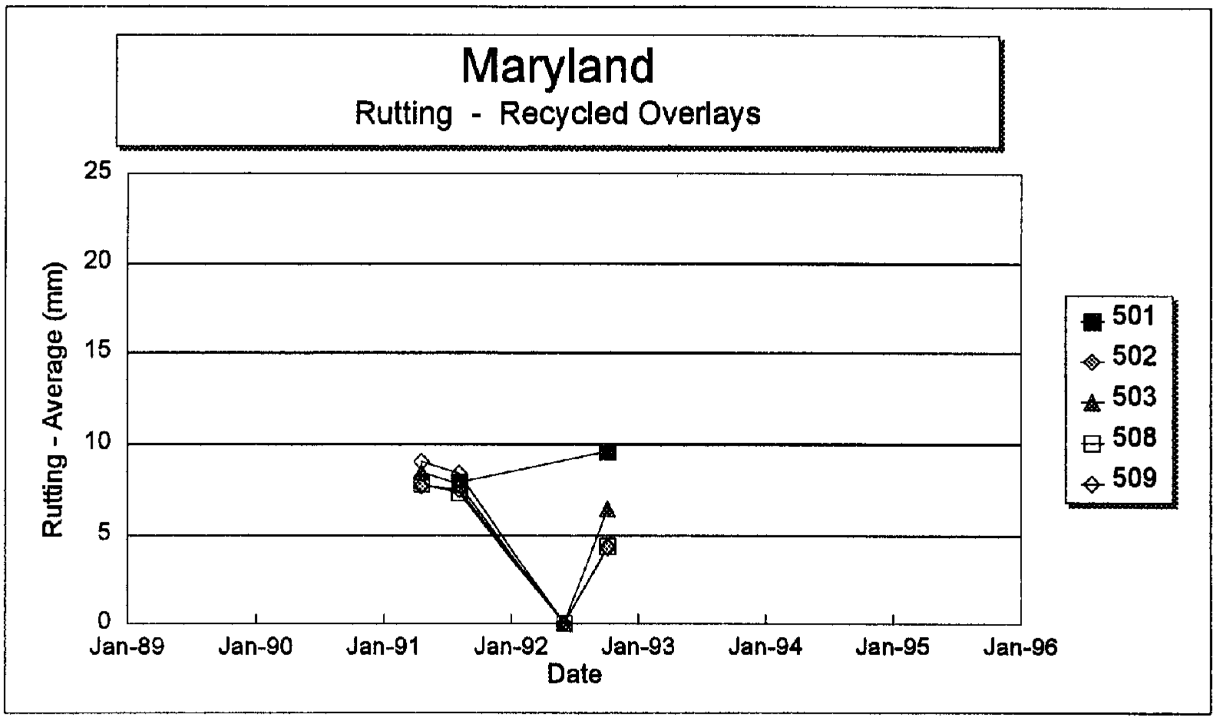


Figure 56. Rut depth versus time on each section of the Georgia SPS-5 project.



Note: Section 501 is a non-overlayed control section.

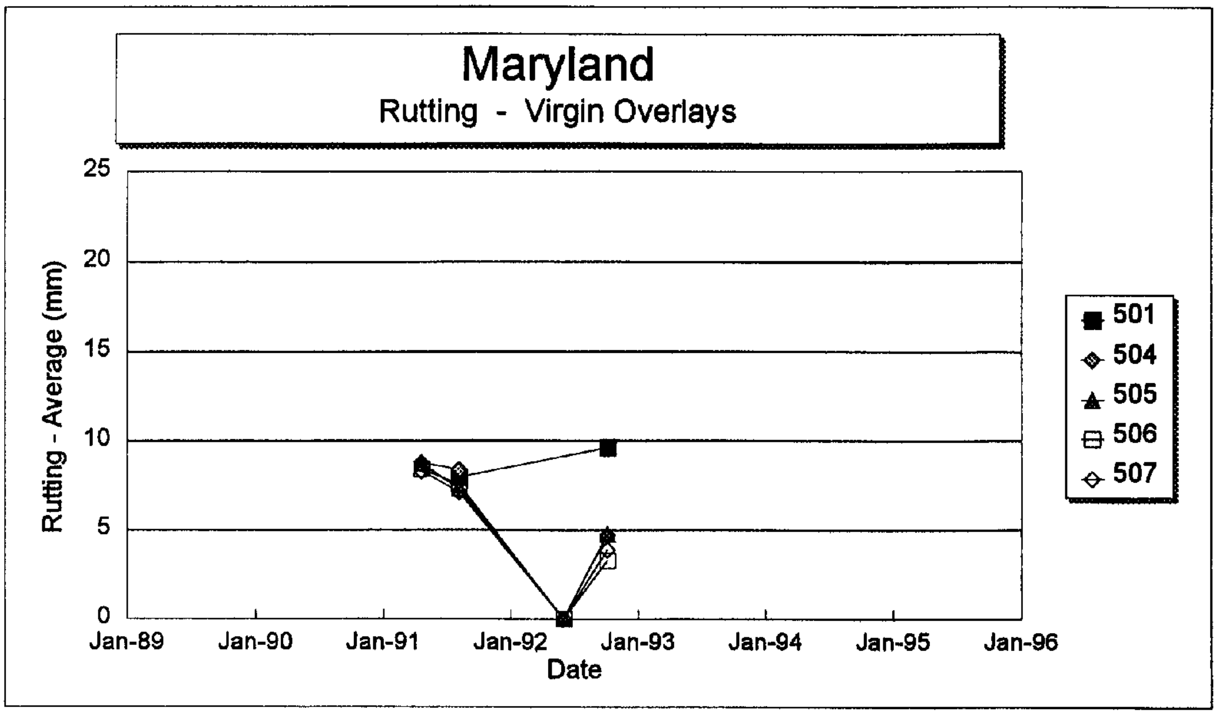
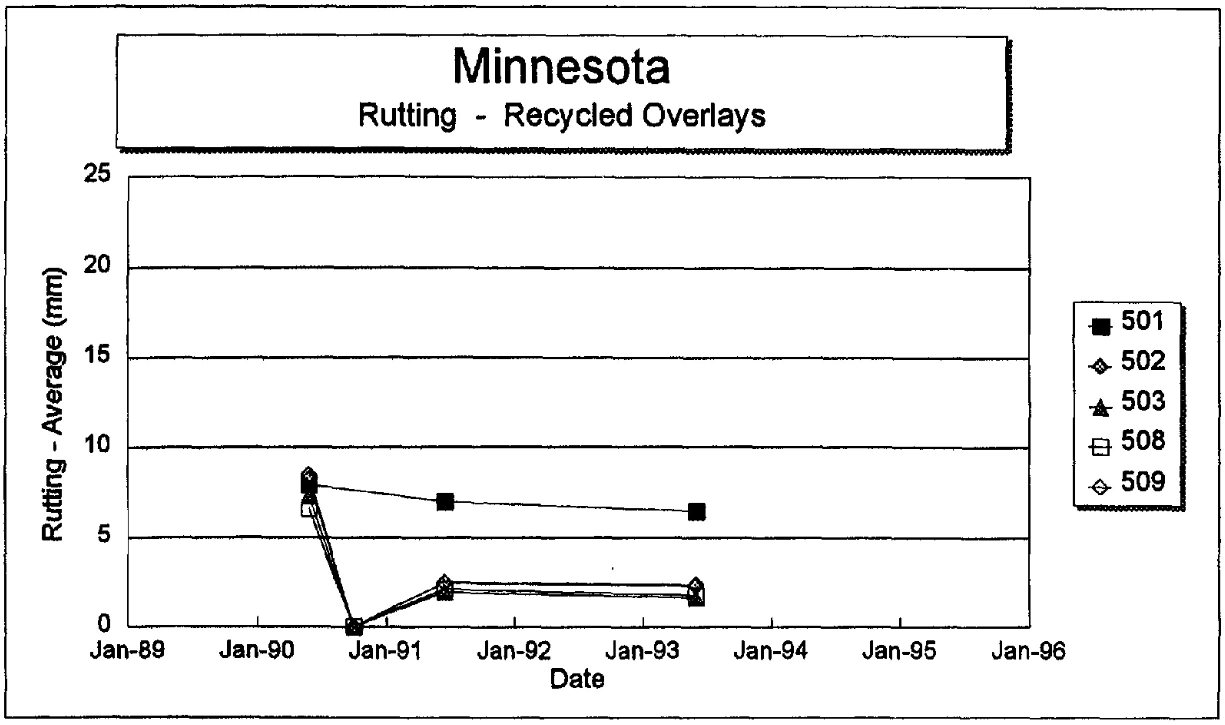


Figure 57. Rut depth versus time on each section of the Maryland SPS-5 project.



Note: Section 501 is a non-overlayed control section.

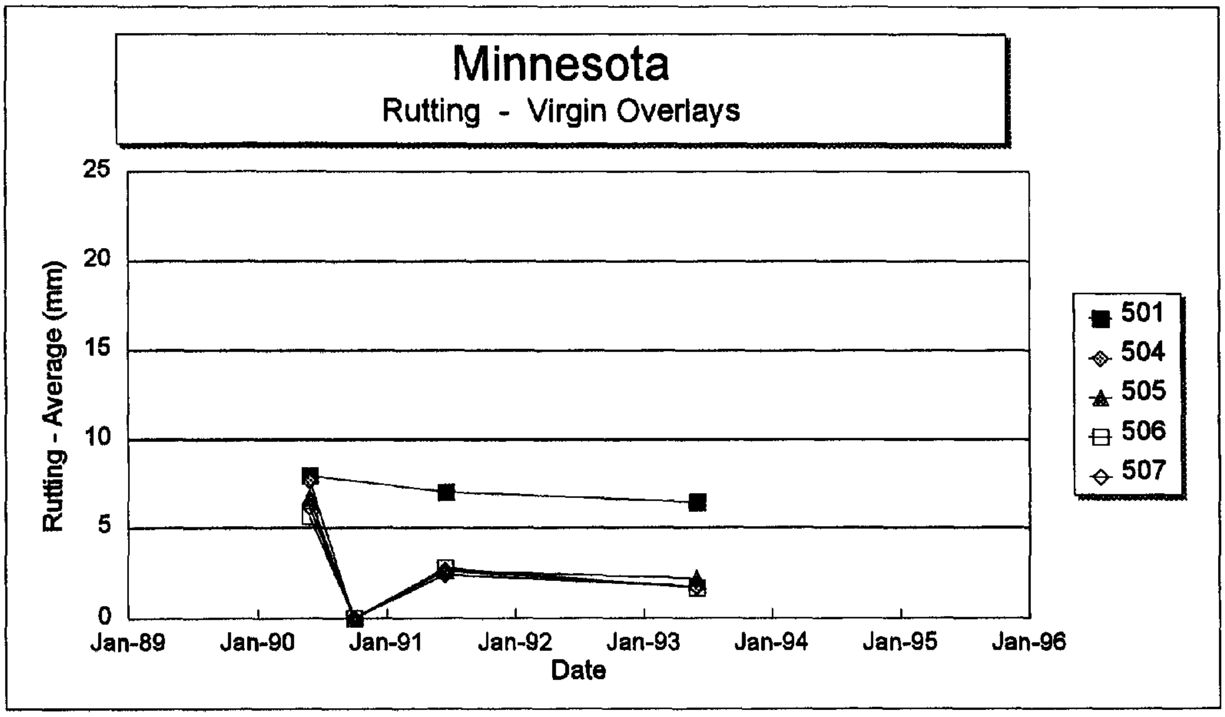
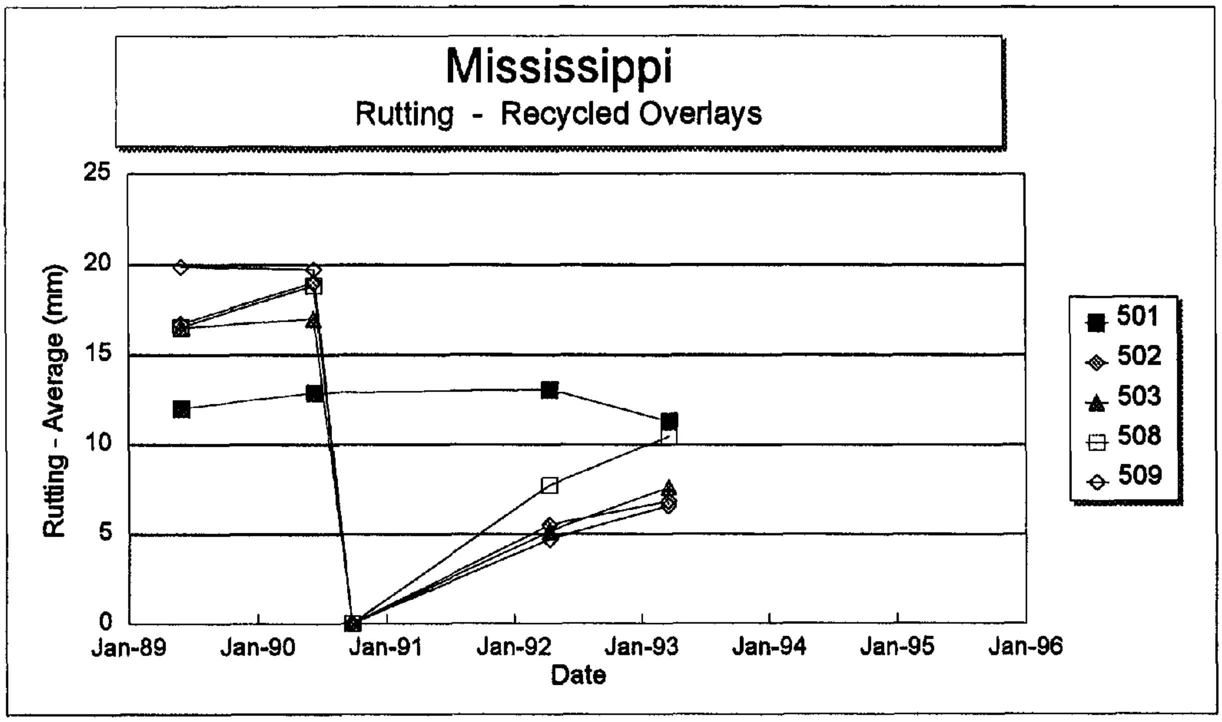


Figure 58. Rut depth versus time on each section of the Minnesota SPS-5 project.



Note: Section 501 is a non-overlayed control section.

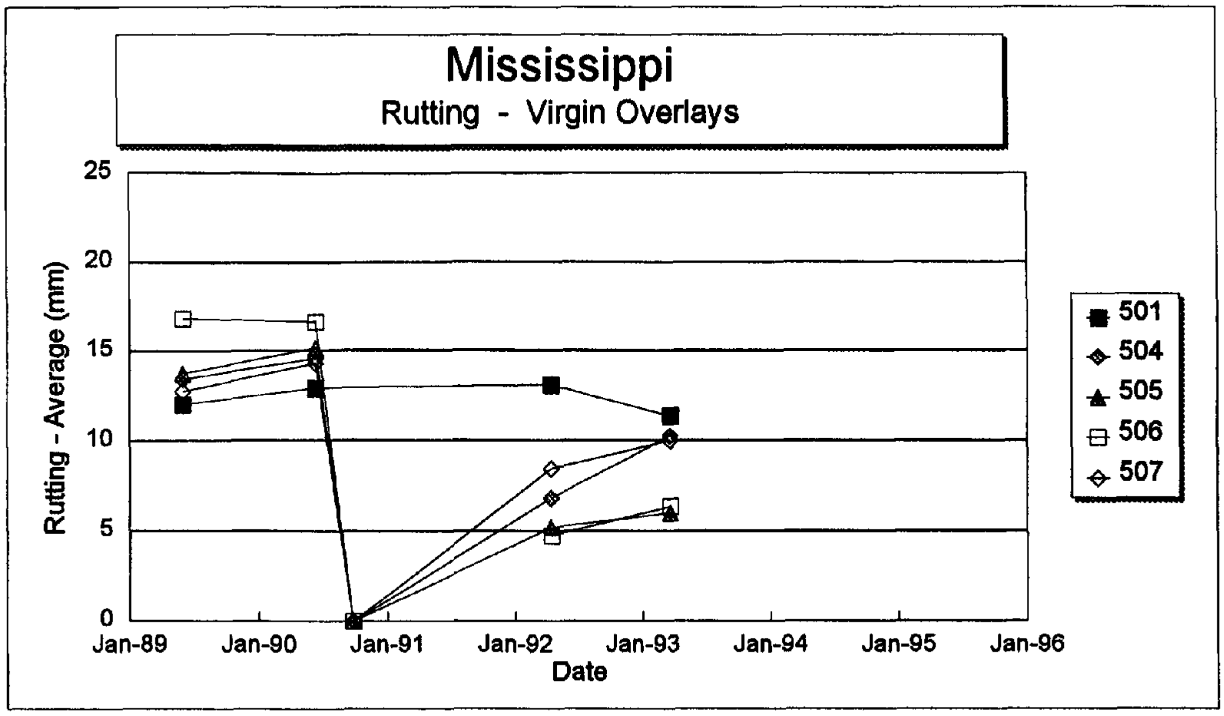
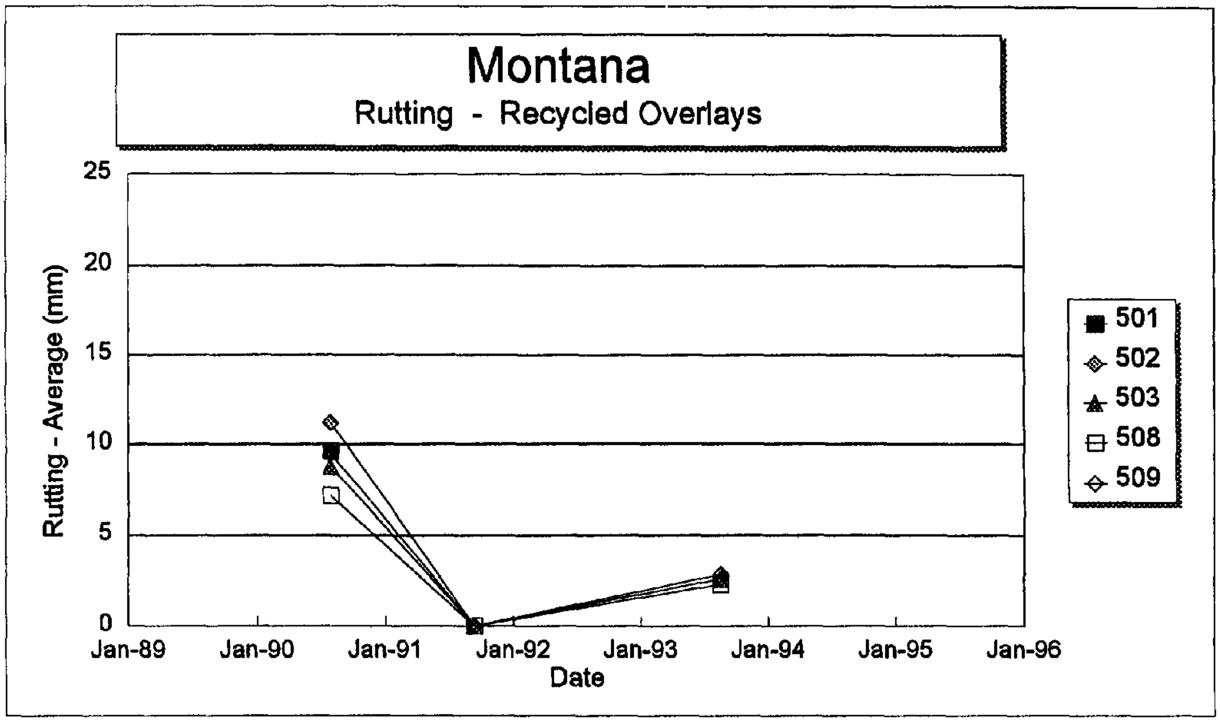


Figure 59. Rut depth versus time on each section of the Mississippi SPS-5 project.



Note: Section 501 is a non-overlayed control section.

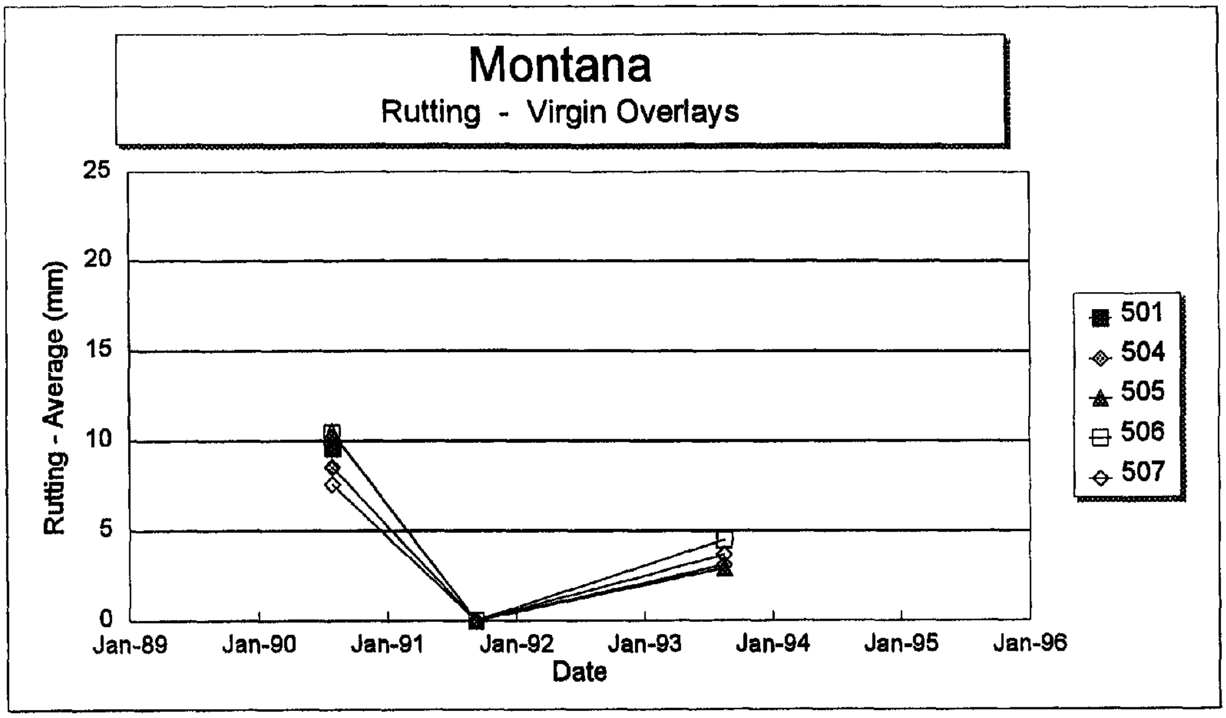
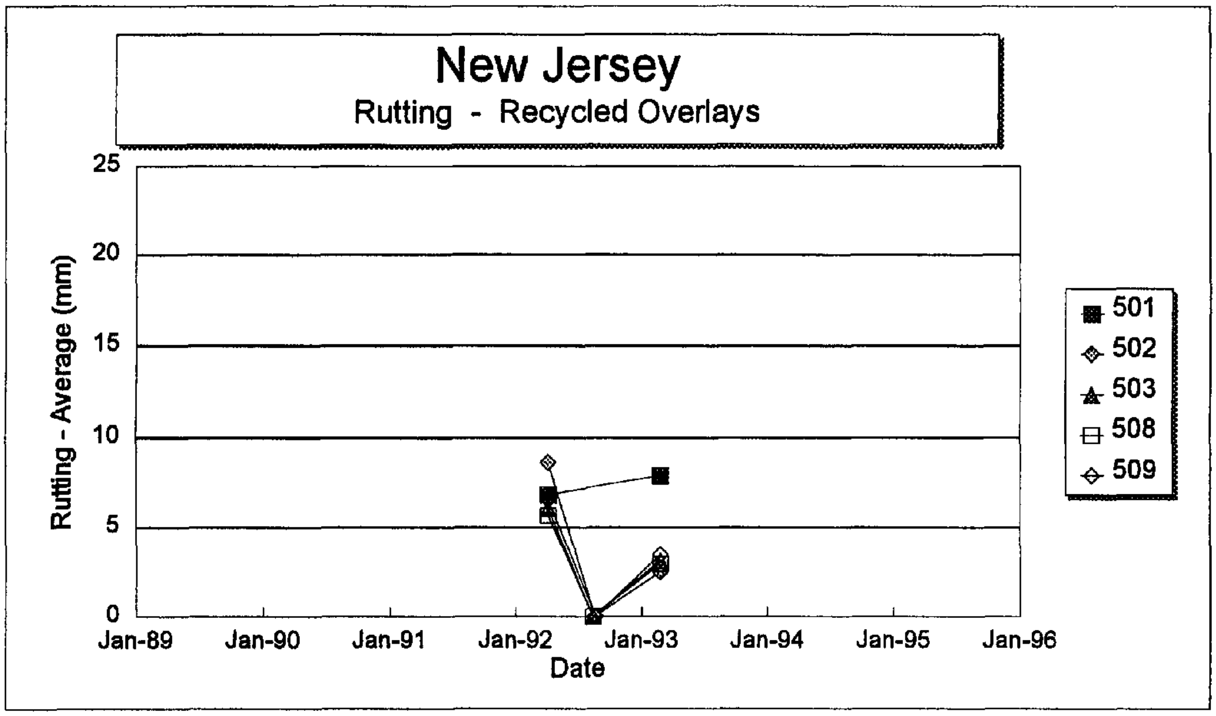


Figure 60. Rut depth versus time on each section of the Montana SPS-5 project.



Note: Section 501 is a non-overlayed control section.

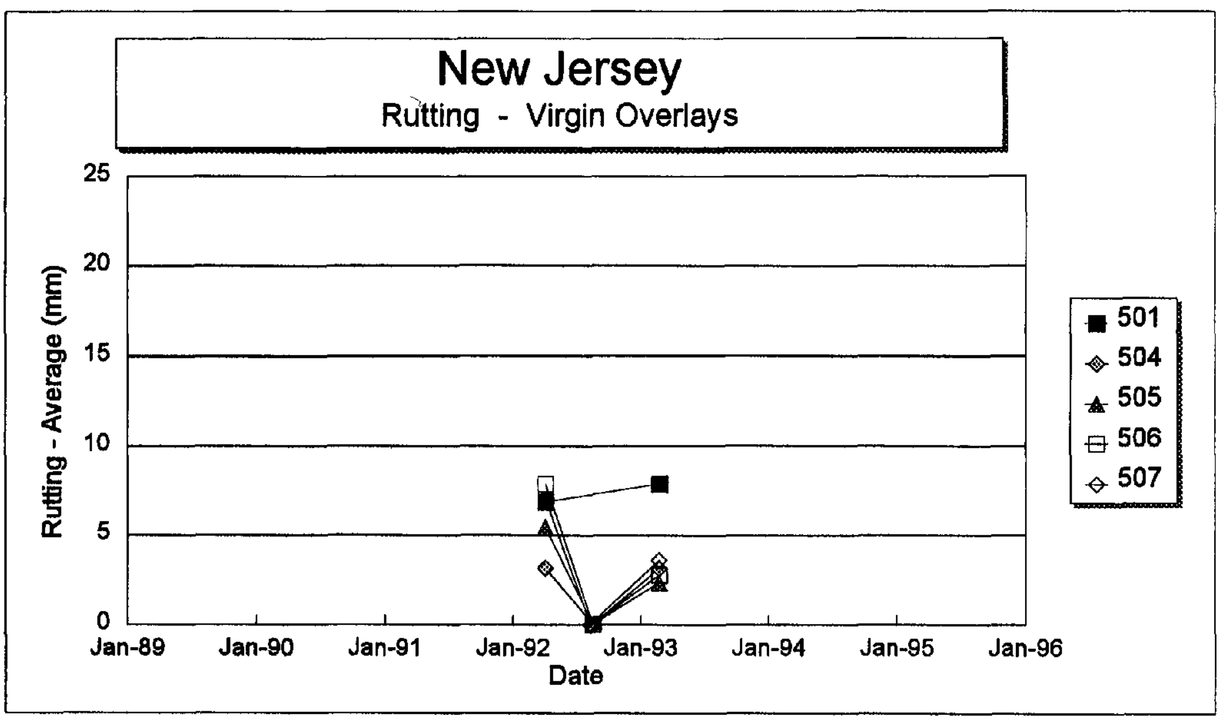
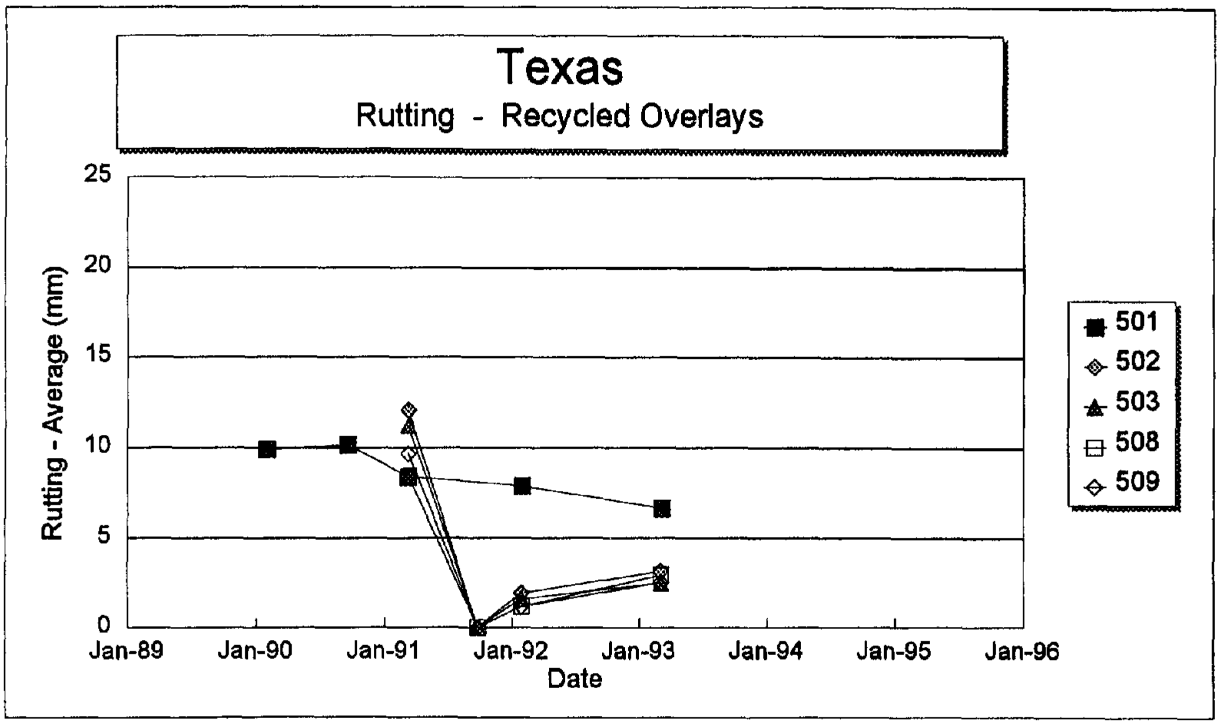


Figure 61. Rut depth versus time on each section of the New Jersey SPS-5 project.



Note: Section 501 is a non-overlayed control section.

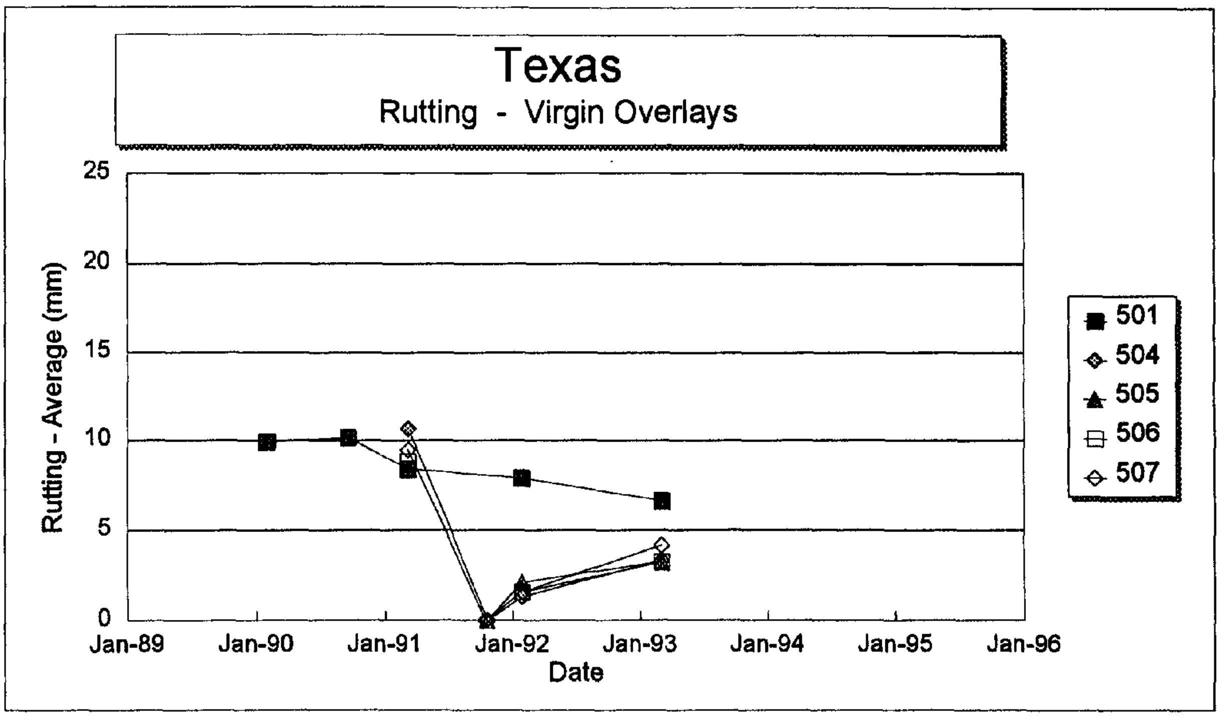
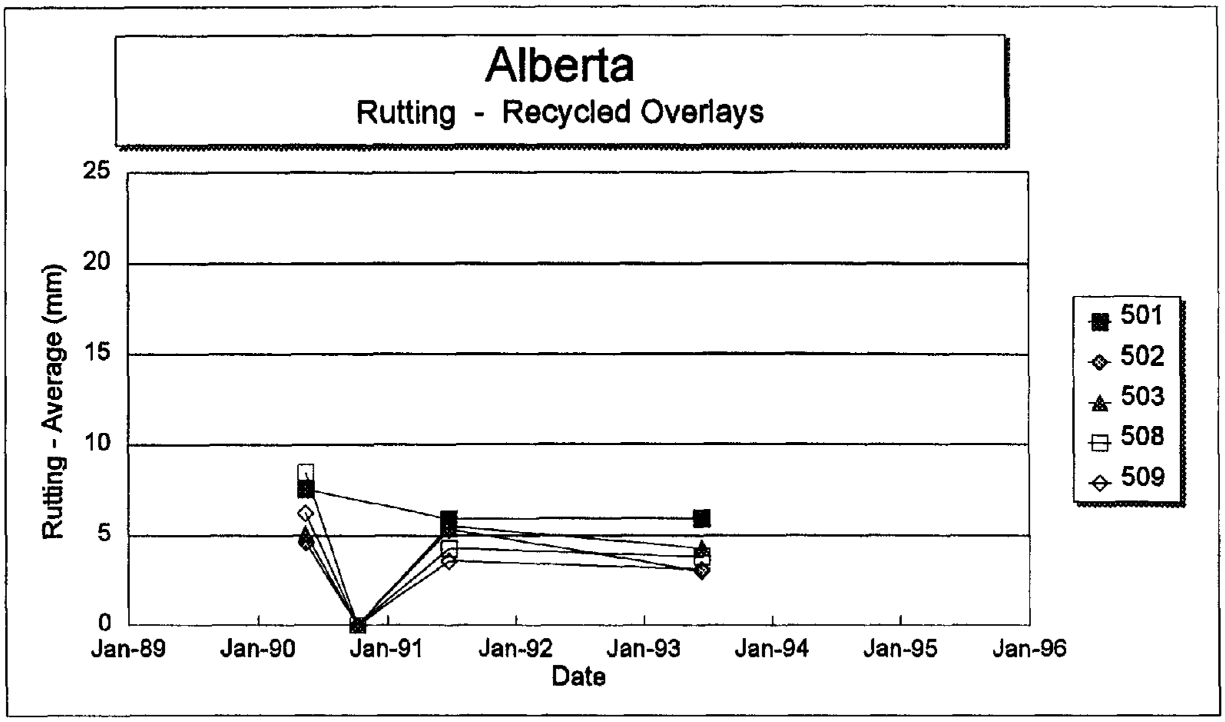


Figure 62. Rut depth versus time on each section of the Texas SPS-5 project.



Note: Section 501 is a non-overlayed control section.

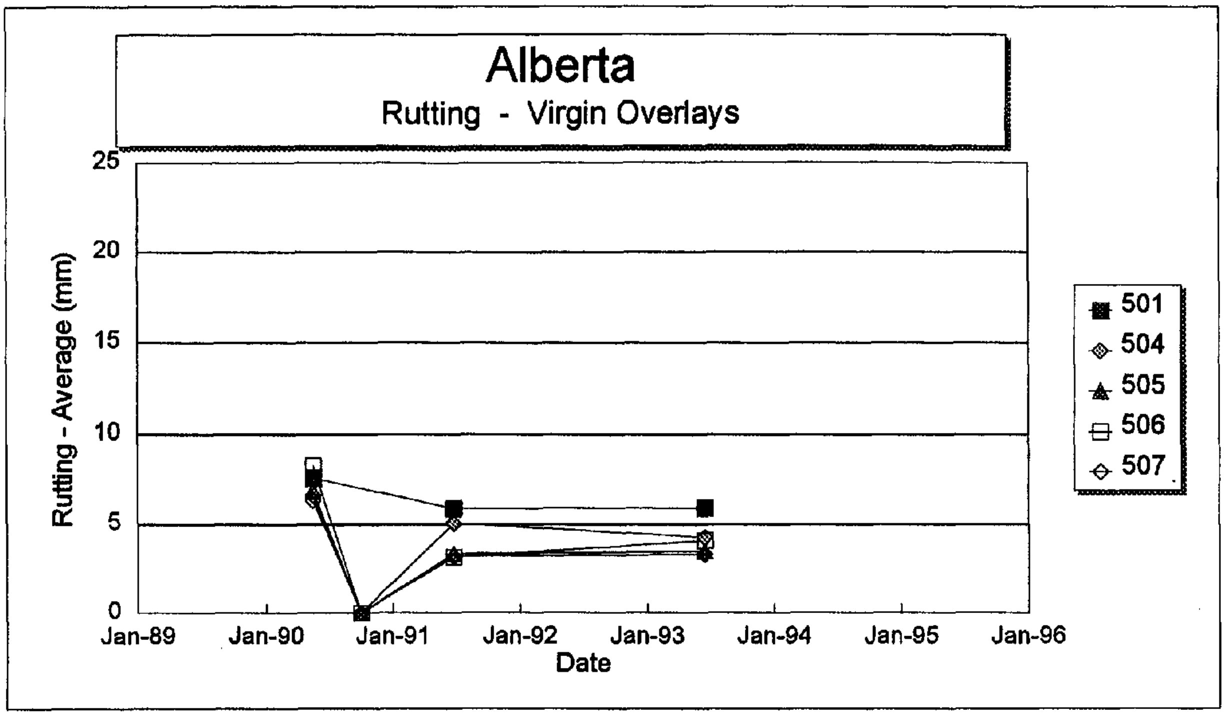
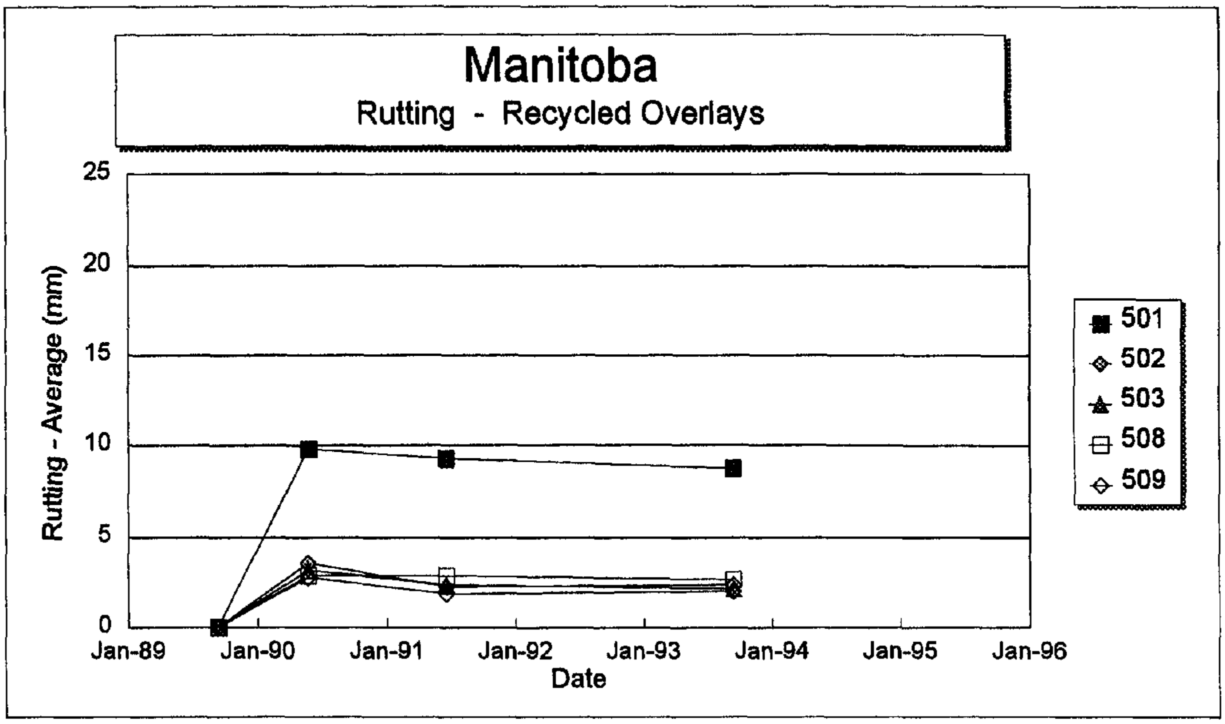


Figure 63. Rut depth versus time on each section of the Alberta SPS-5 project.



Note: Section 501 is a non-overlayed control section.

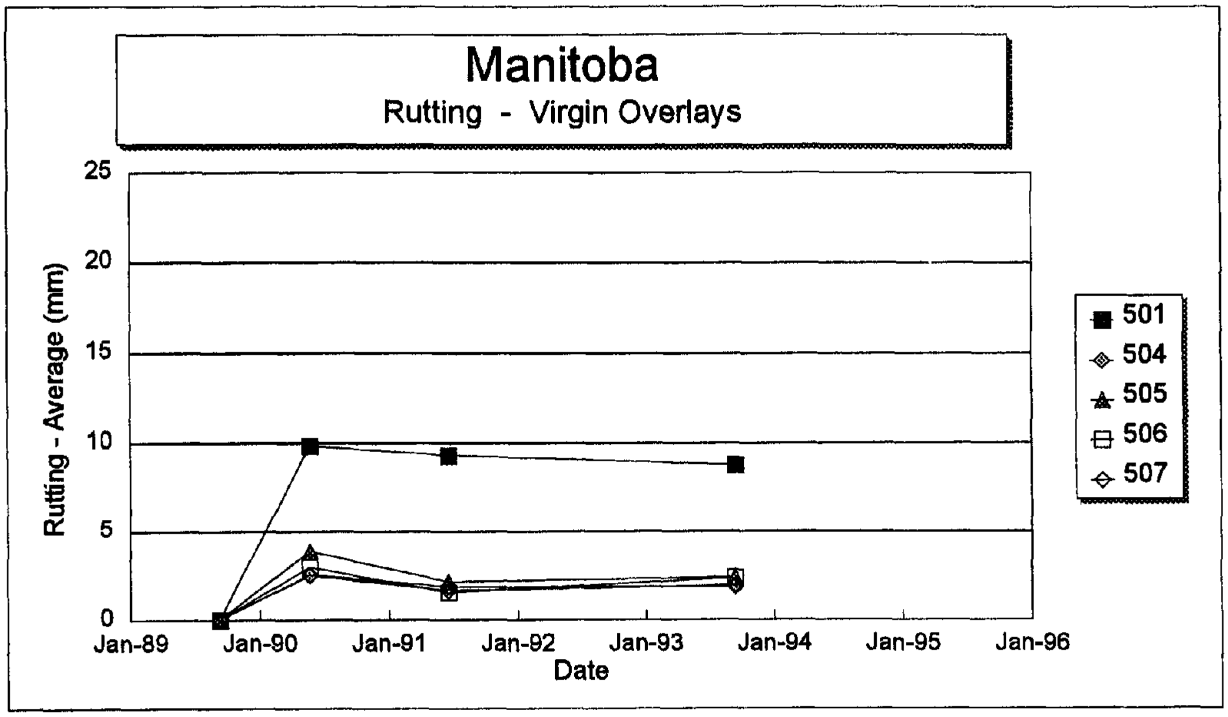
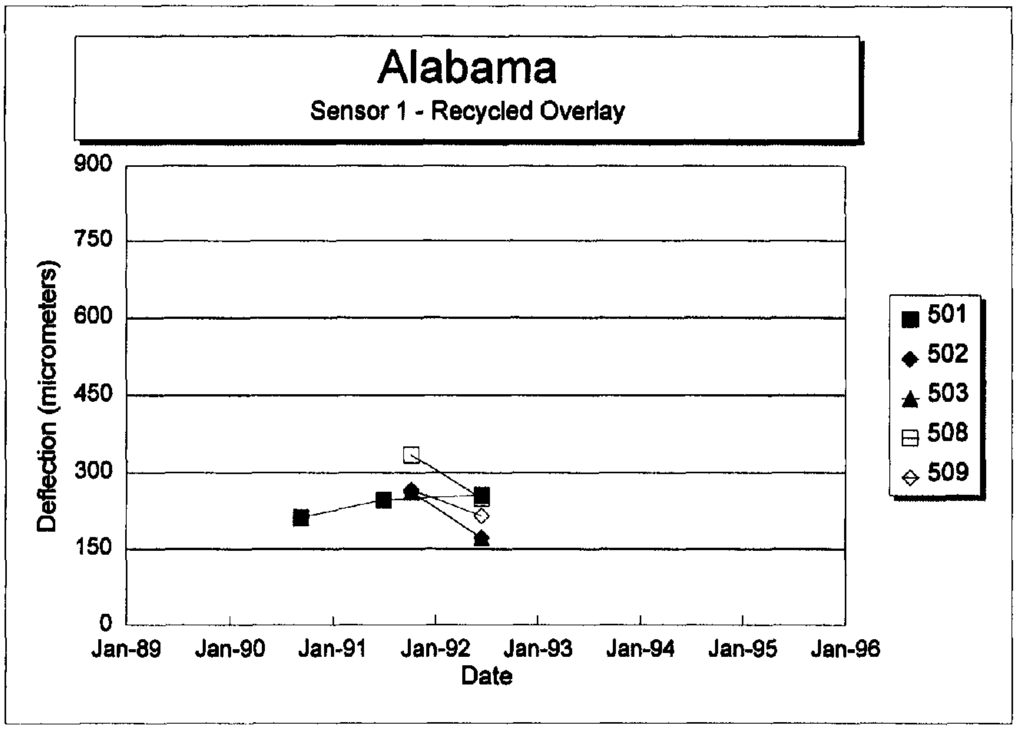


Figure 64. Rut depth versus time on each section of the Manitoba SPS-5 project.



Note: Section 501 is a non-overlayed control section.

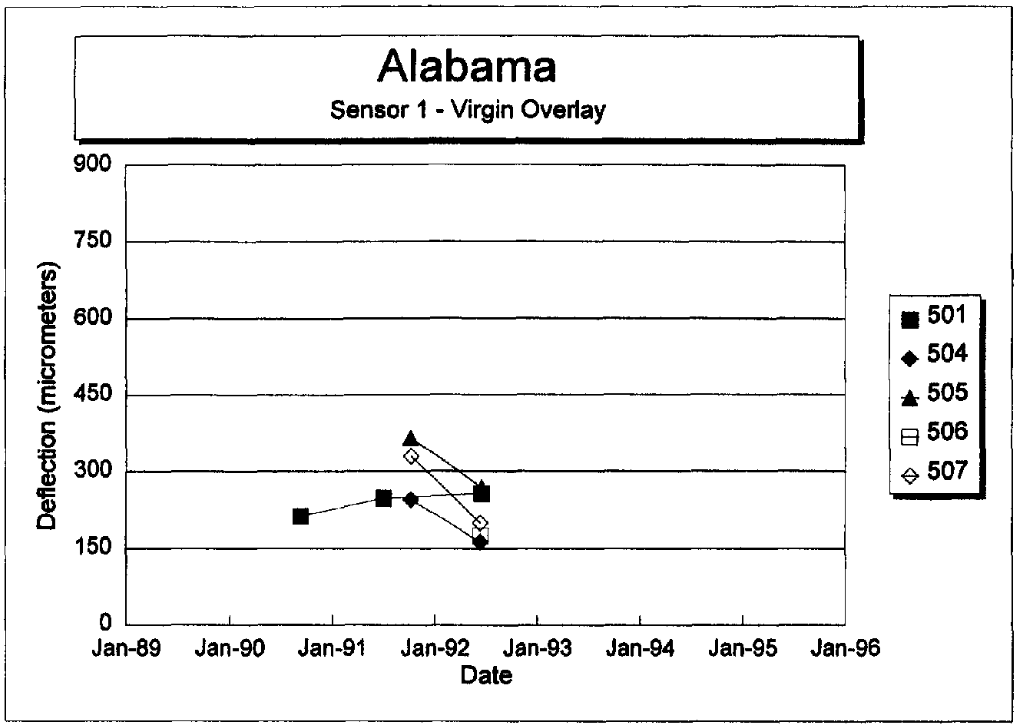
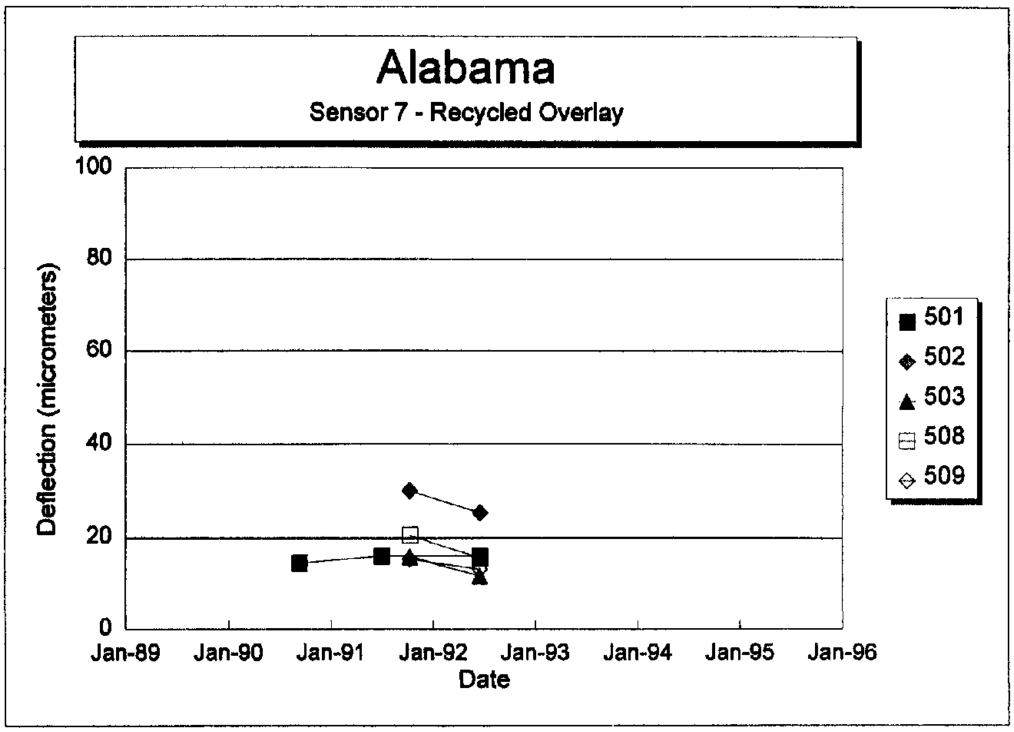


Figure 65. Sensor 1 deflection versus time for each section of the Alabama SPS-5 project.



Note: Section 501 is a non-overlayed control section.

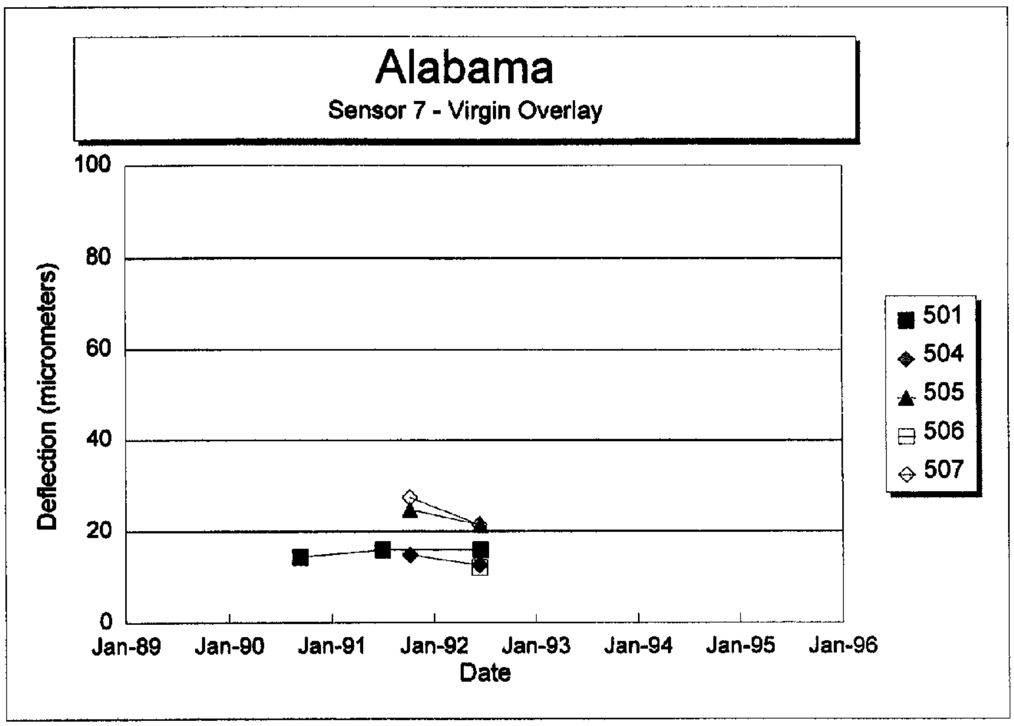
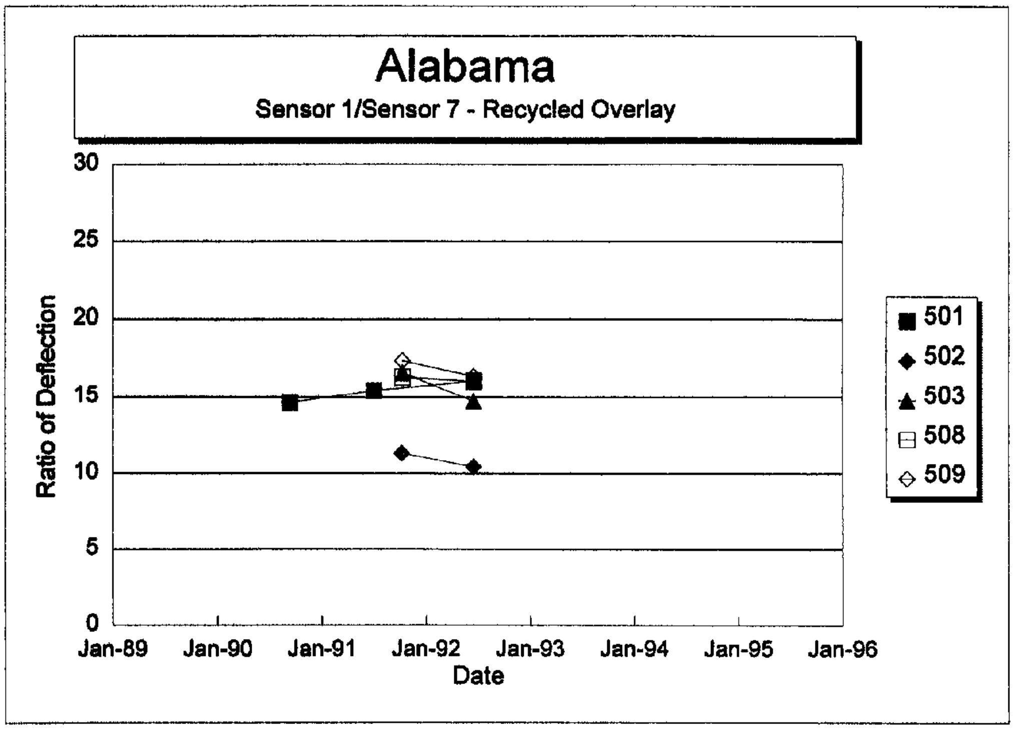


Figure 66. Sensor 7 deflection versus time for each section of the Alabama SPS-5 project.



Note: Section 501 is a non-overlayed control section.

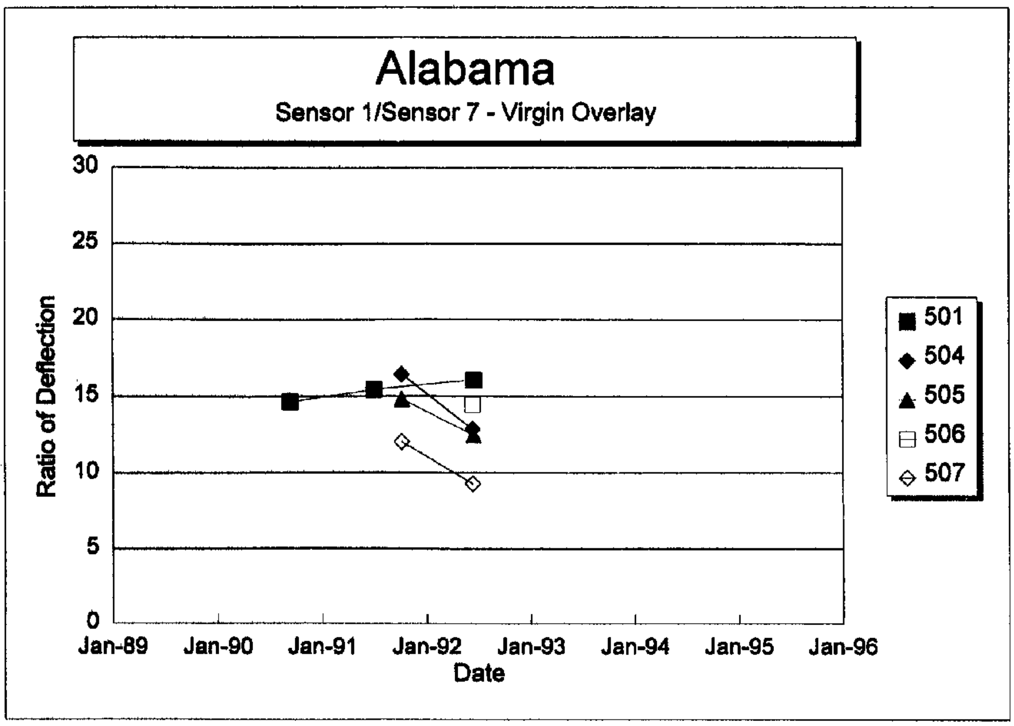
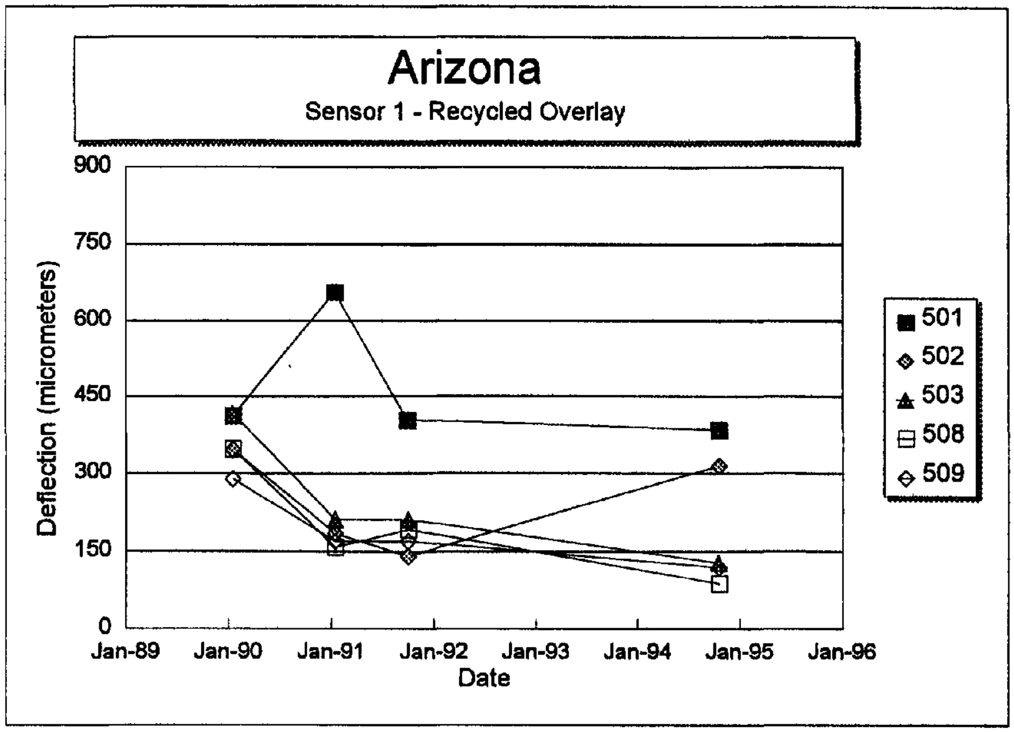


Figure 67. Sensor 1 deflection divided by Sensor 7 deflection versus time for each section of the Alabama SPS-5 project.



Note: Section 501 is a non-overlayed control section.

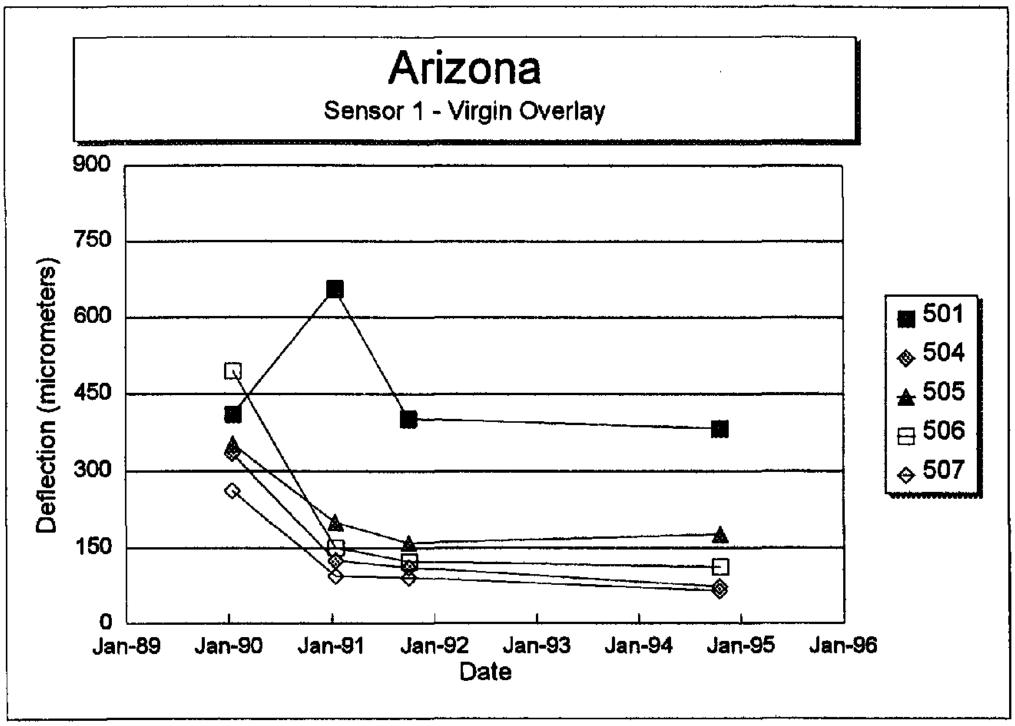
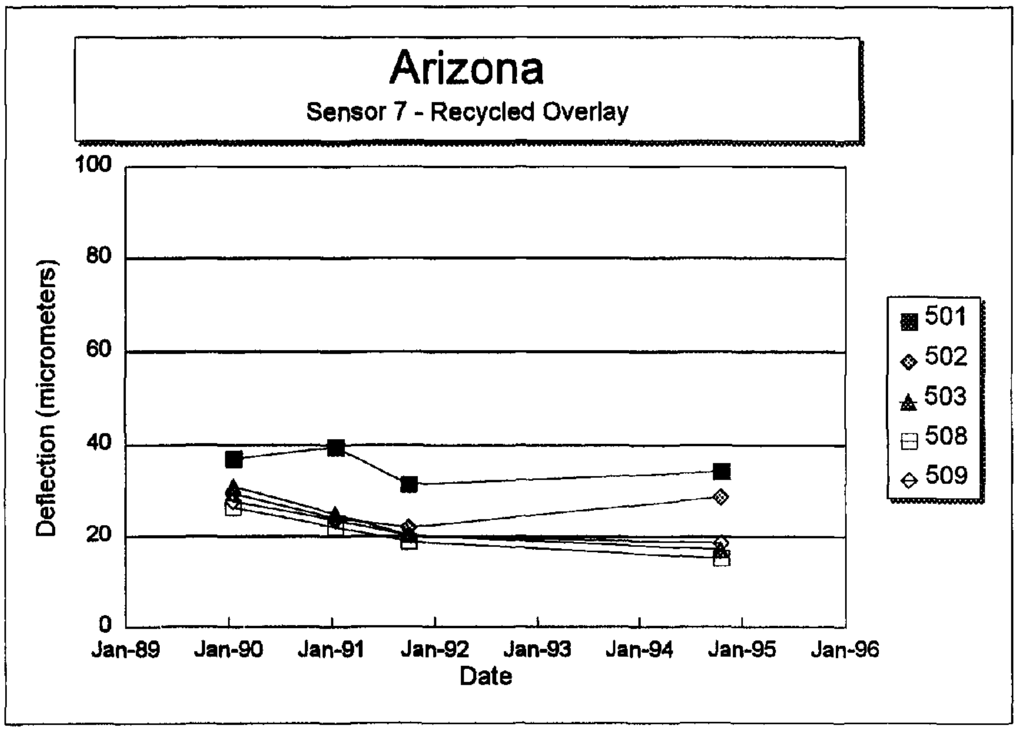


Figure 68. Sensor 1 deflection versus time for each section of the Arizona SPS-5 project.



Note: Section 501 is a non-overlayed control section.

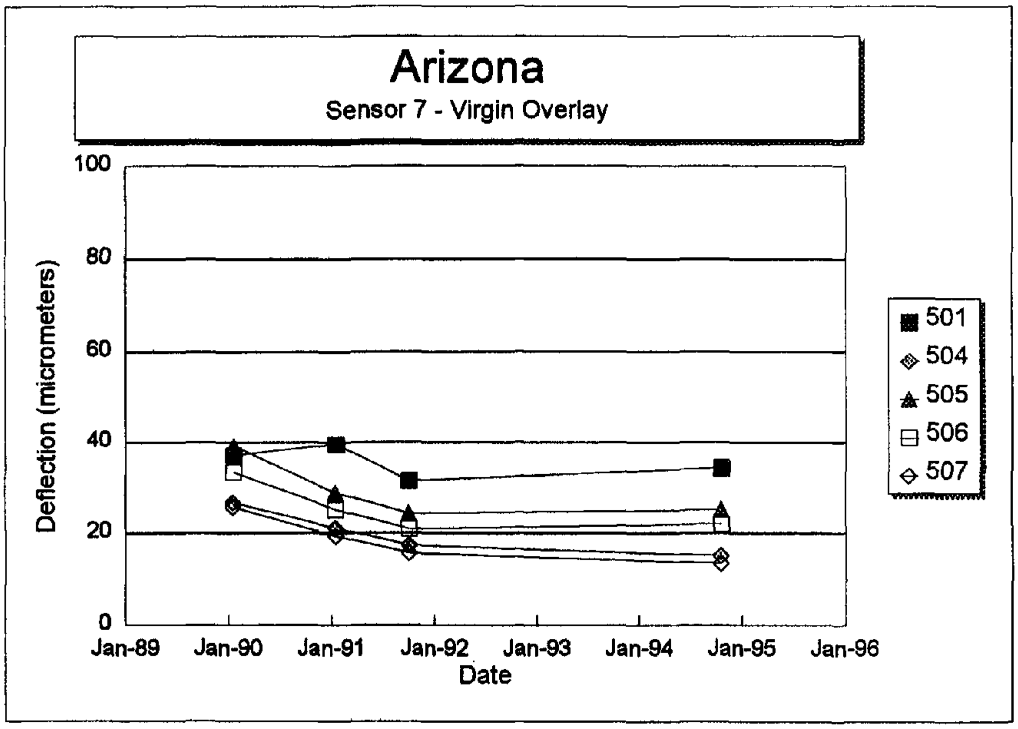
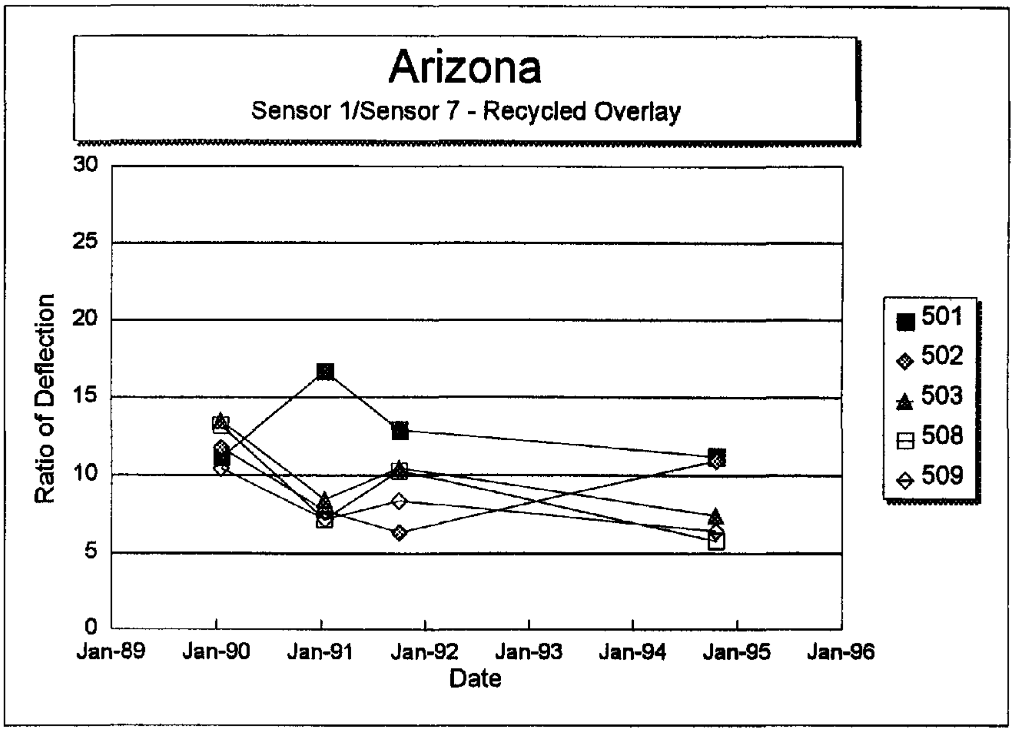


Figure 69. Sensor 7 deflection versus time for each section of the Arizona SPS-5 project.



Note: Section 501 is a non-overlayed control section.

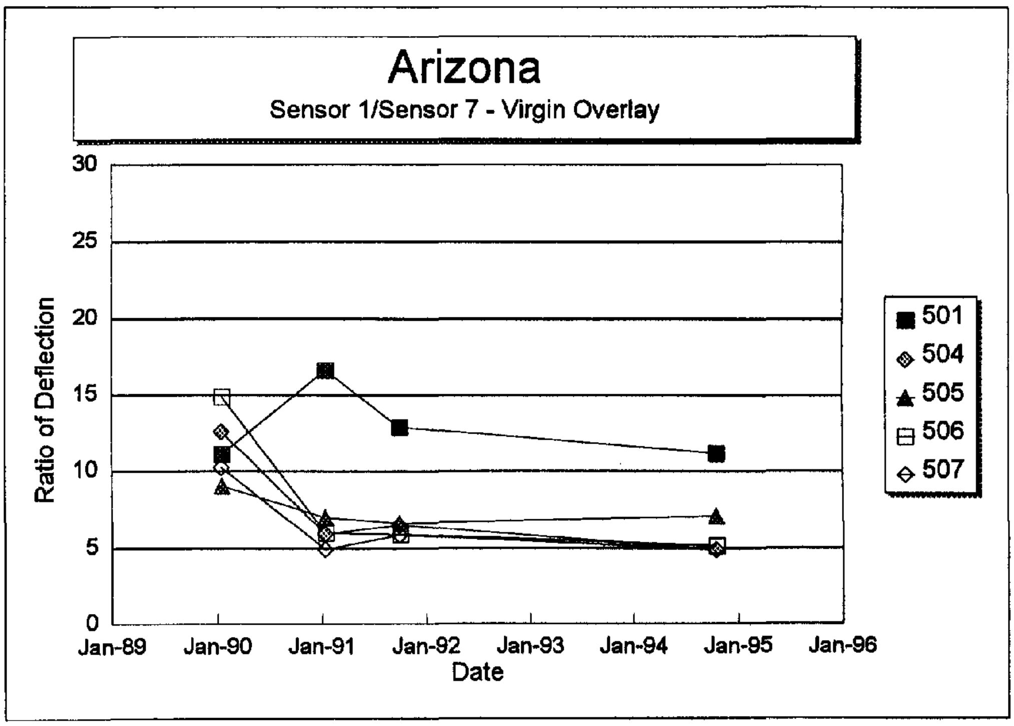
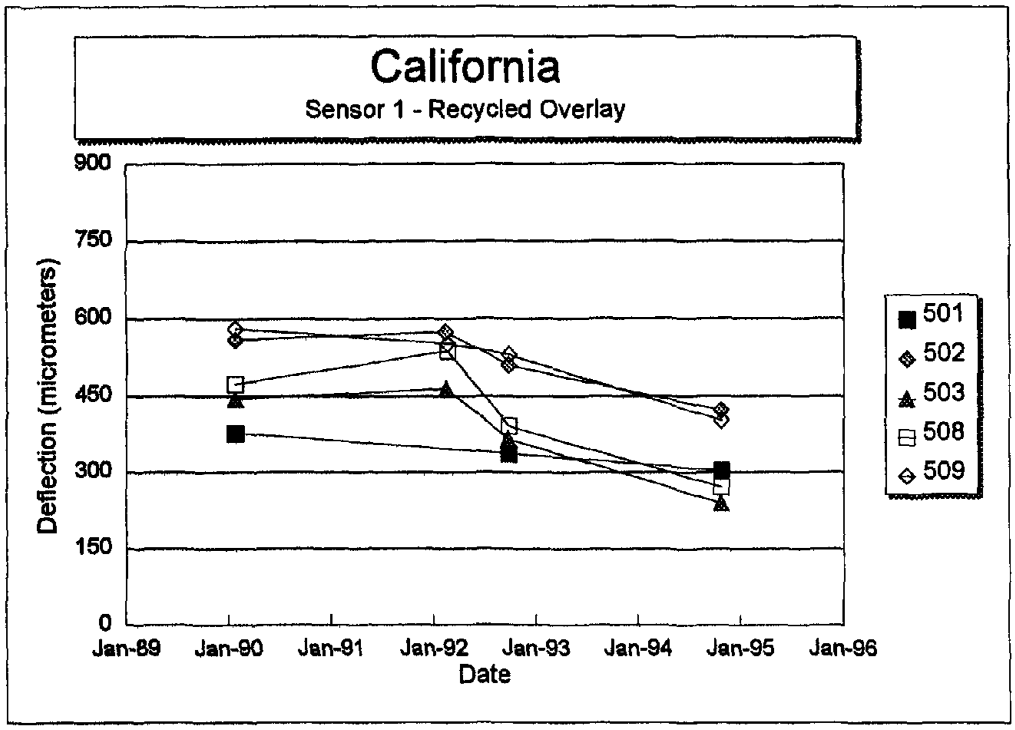


Figure 70. Sensor 1 deflection divided by Sensor 7 deflection versus time for each section of the Arizona SPS-5 project.



Note: Section 501 is a non-overlayed control section.

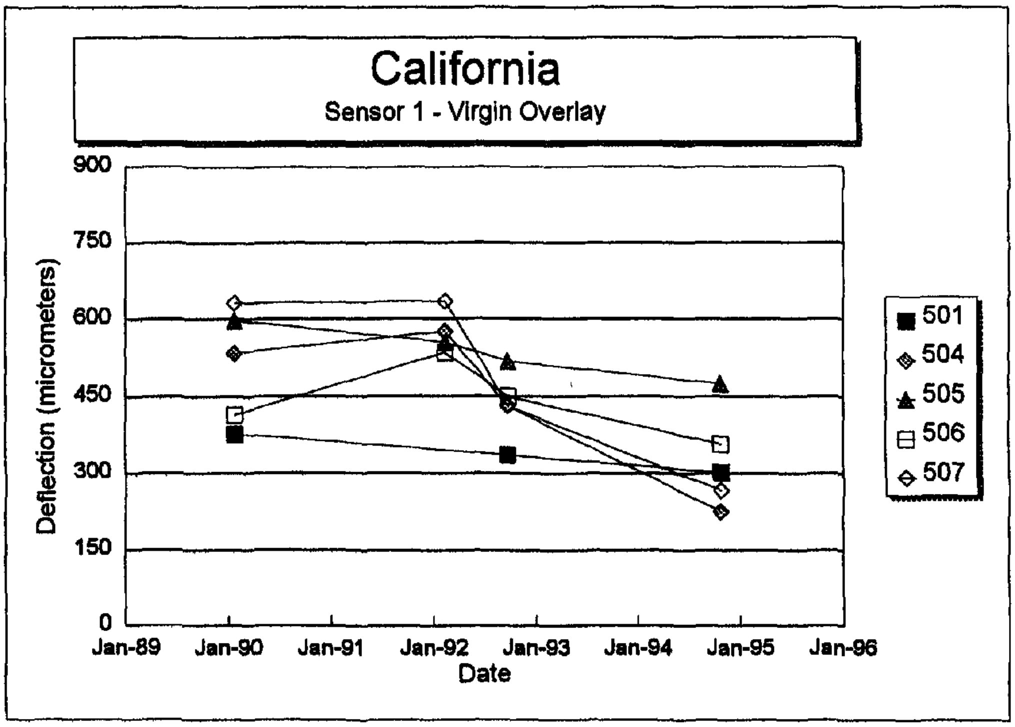
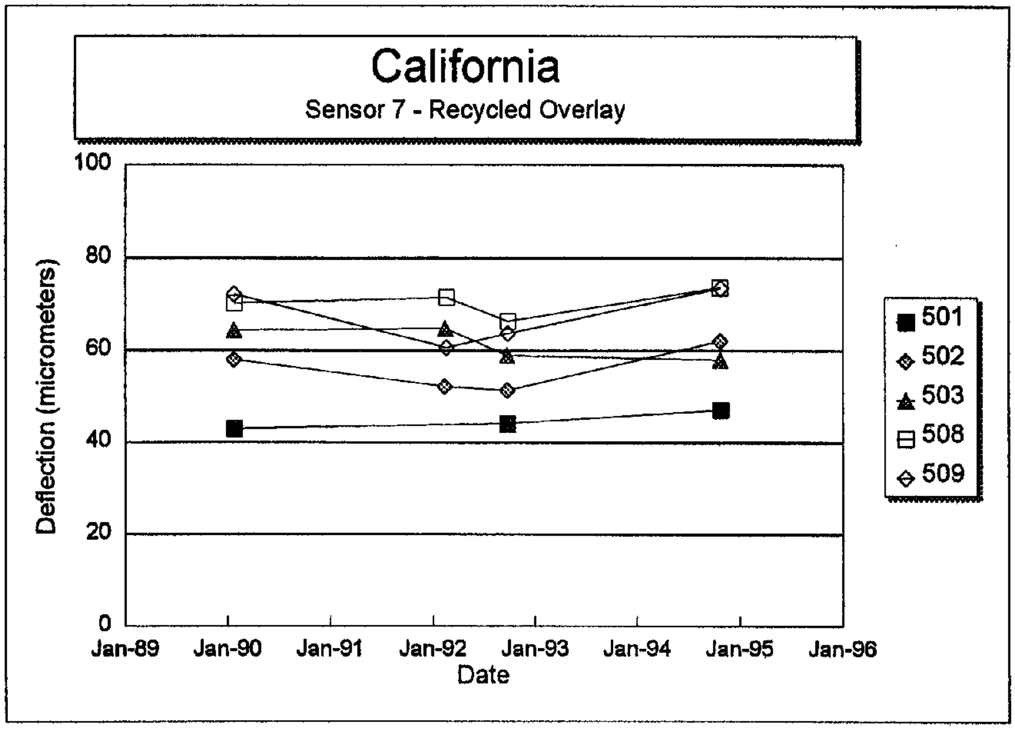


Figure 71. Sensor 1 deflection versus time for each section of the California SPS-5 project.



Note: Section 501 is a non-overlayed control section.

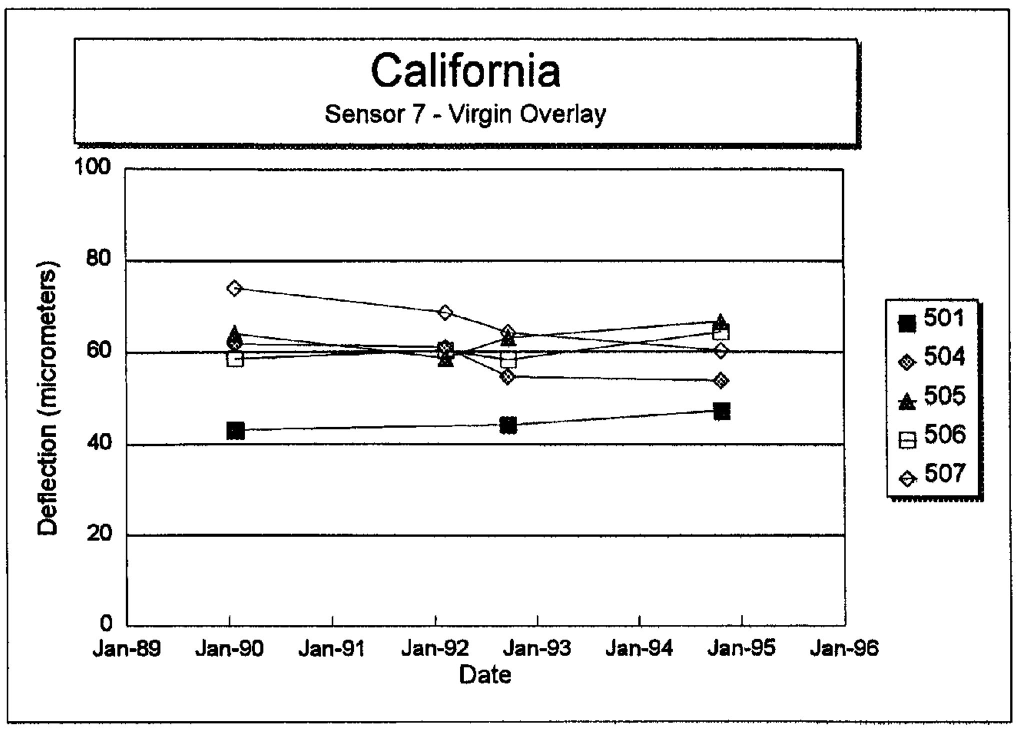
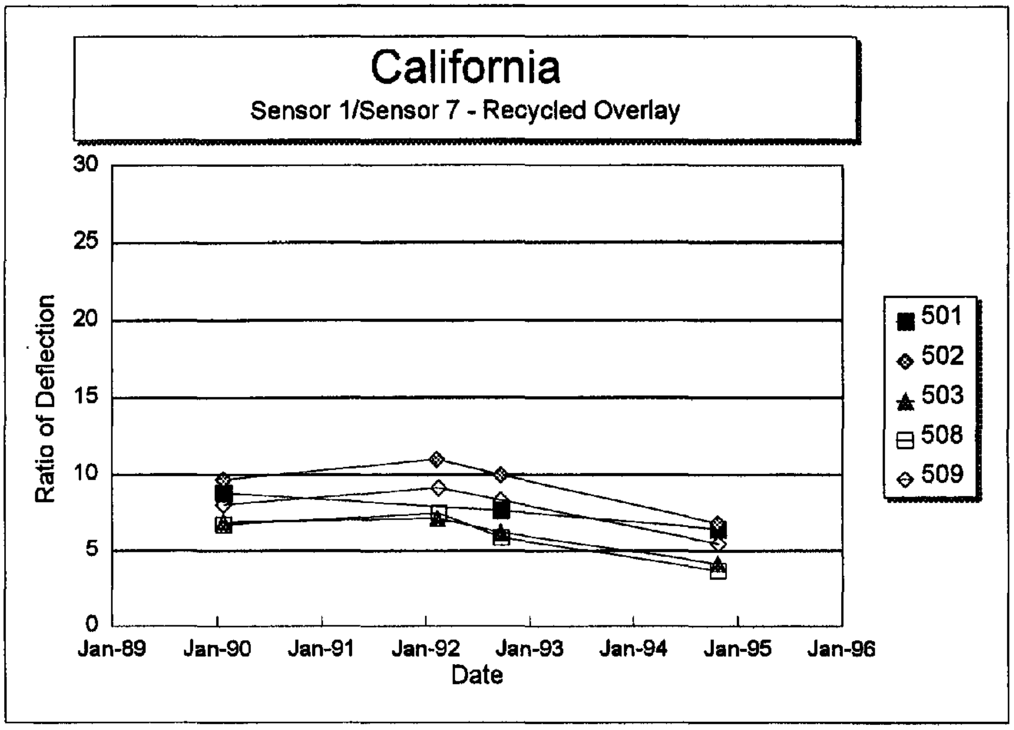


Figure 72. Sensor 7 deflection versus time for each section of the California SPS-5 project.



Note: Section 501 is a non-overlayed control section.

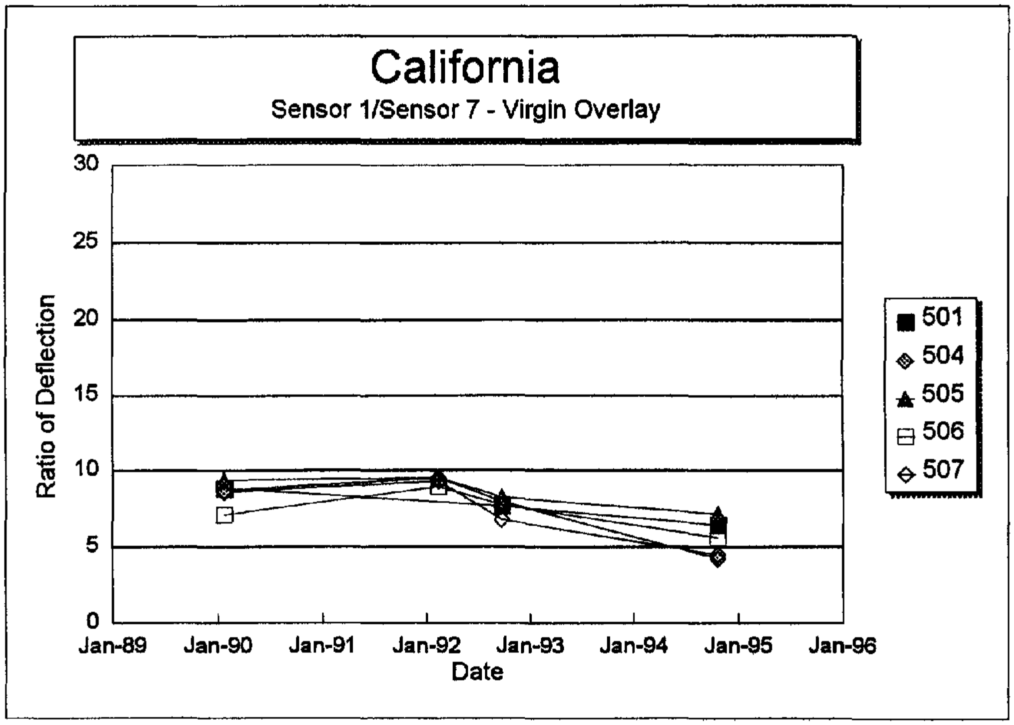
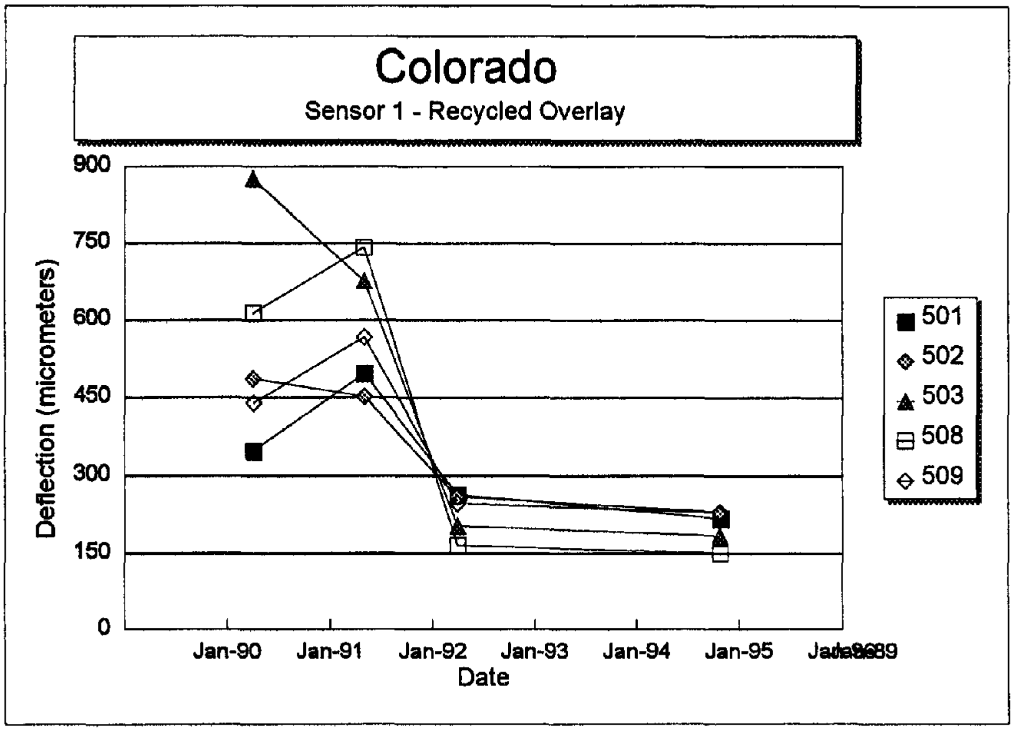


Figure 73. Sensor 1 deflection divided by Sensor 7 deflection versus time for each section of the California SPS-5 project.



Note: Section 501 is a non-overlayed control section.

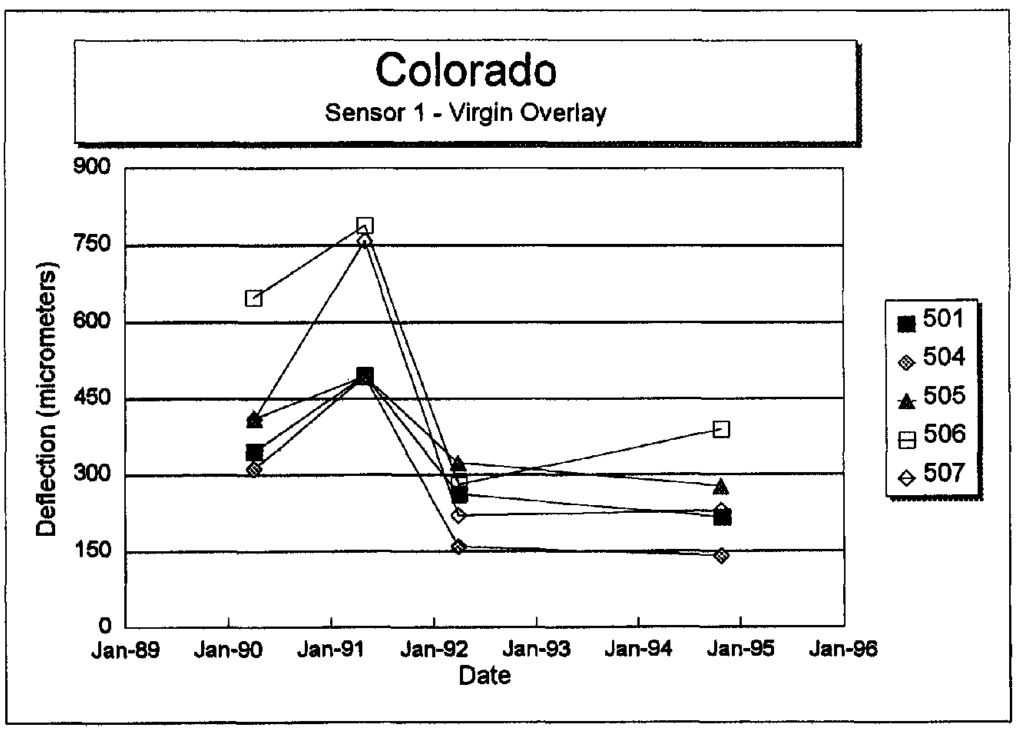
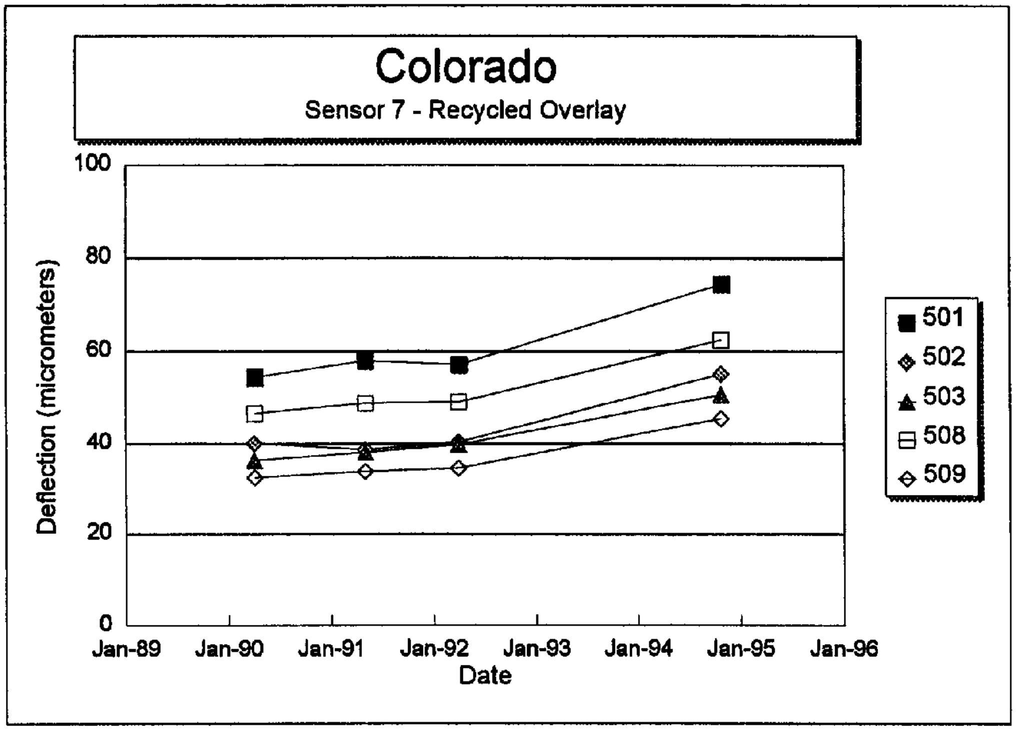


Figure 74. Sensor 1 deflection versus time for each section of the Colorado SPS-5 project.



Note: Section 501 is a non-overlayed control section.

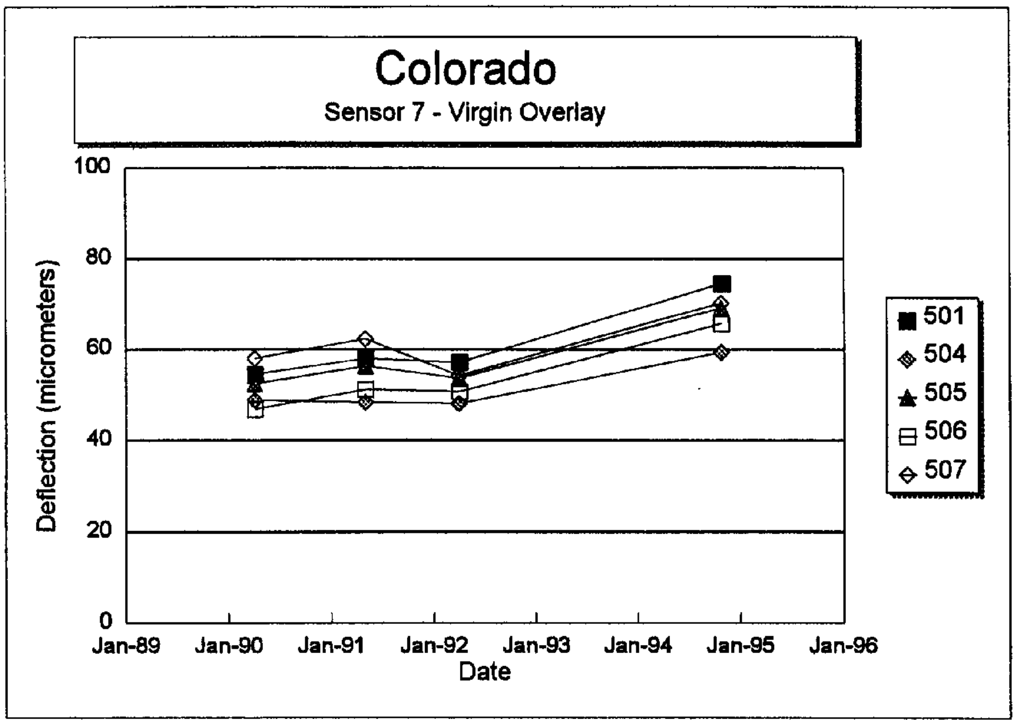
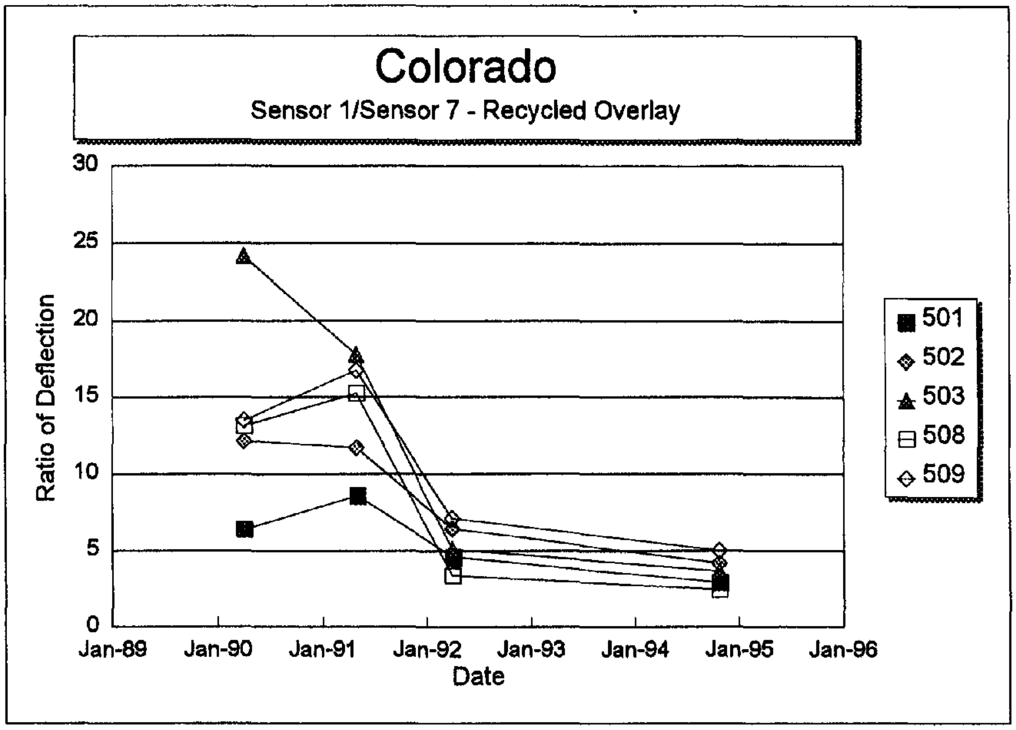


Figure 75. Sensor 7 deflection versus time for each section of the Colorado SPS-5 project.



Note: Section 501 is a non-overlayed control section.

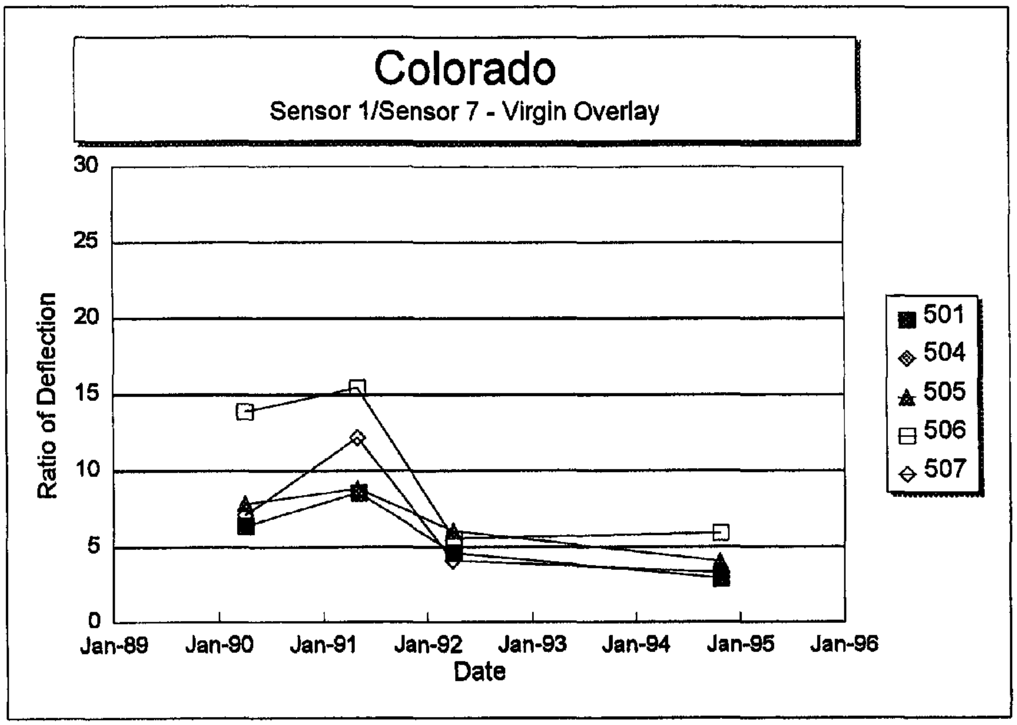
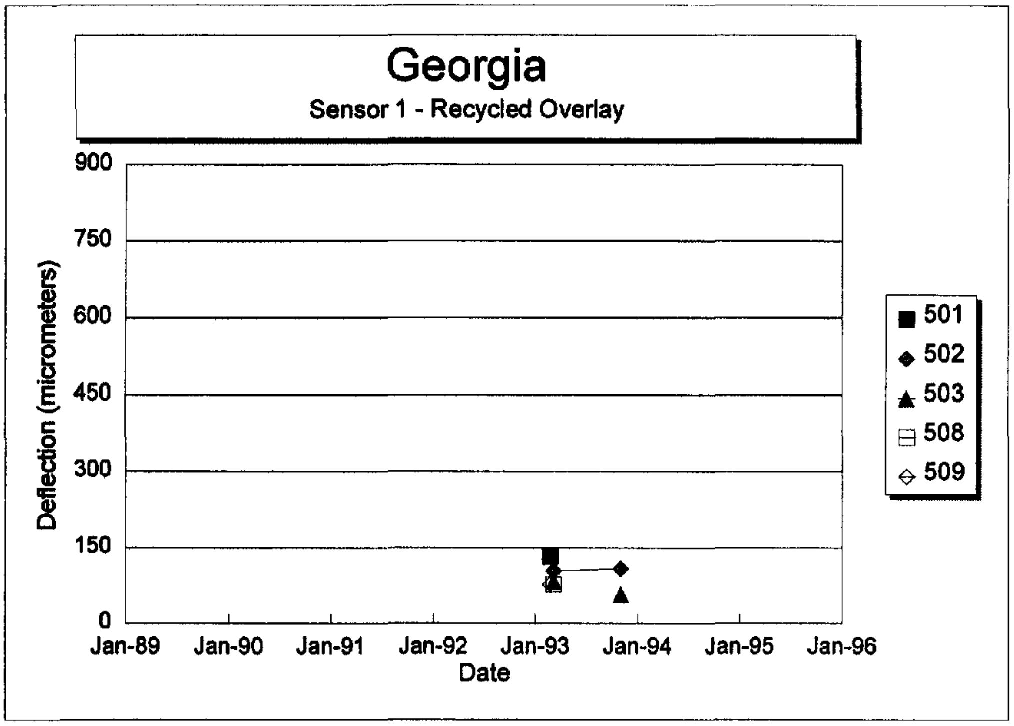


Figure 76. Sensor 1 deflection divided by Sensor 7 deflection versus time for each section of the Colorado SPS-5 project.



Note: Section 501 is a non-overlayed control section.

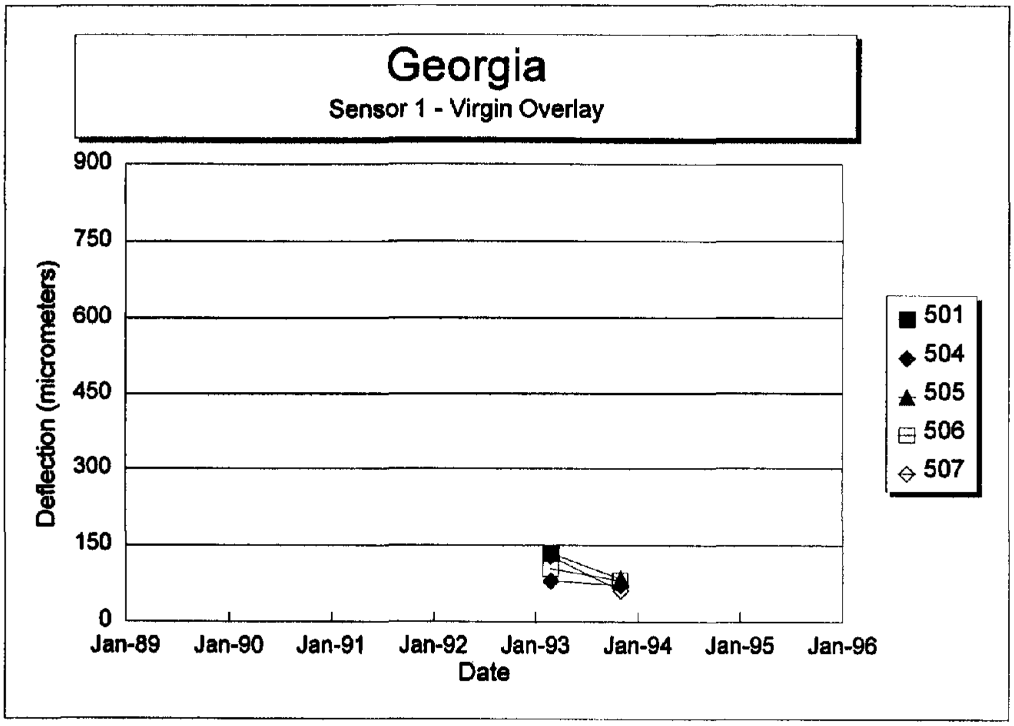
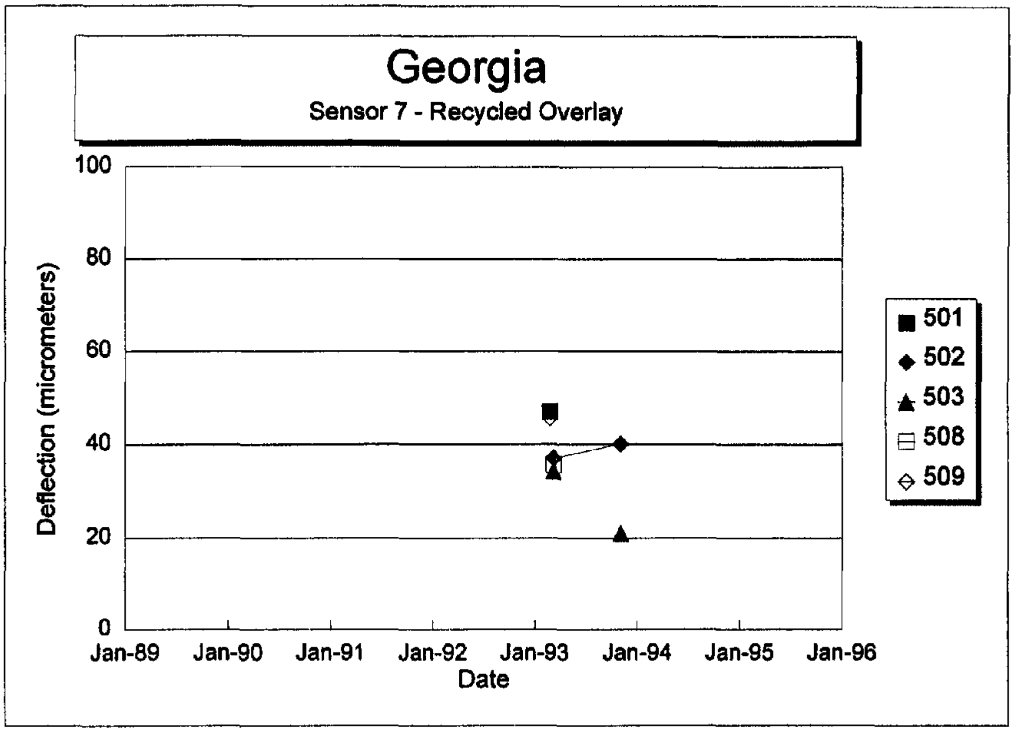


Figure 77. Sensor 1 deflection versus time for each section of the Georgia SPS-5 project.



Note: Section 501 is a non-overlayed control section.

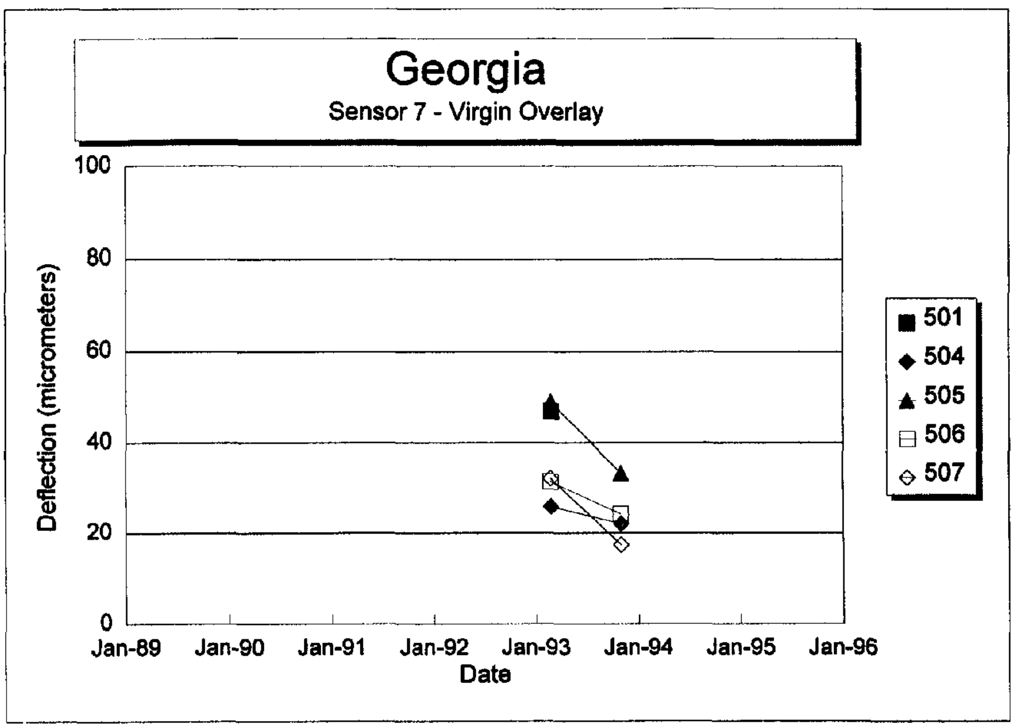
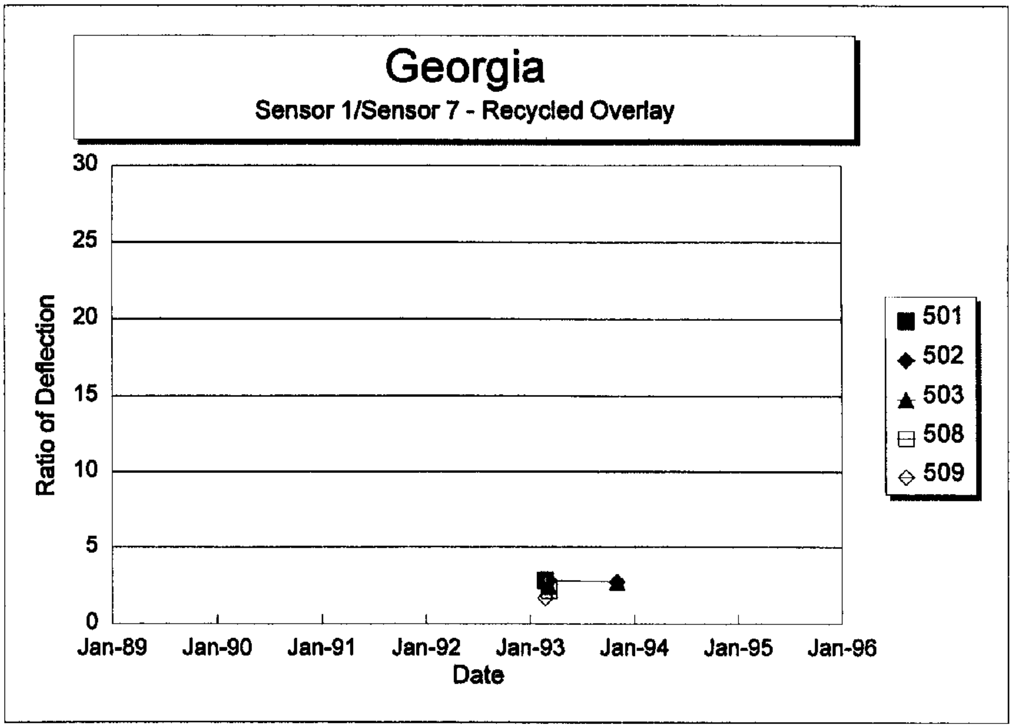


Figure 78. Sensor 7 deflection versus time for each section of the Georgia SPS-5 project.



Note: Section 501 is a non-overlayed control section.

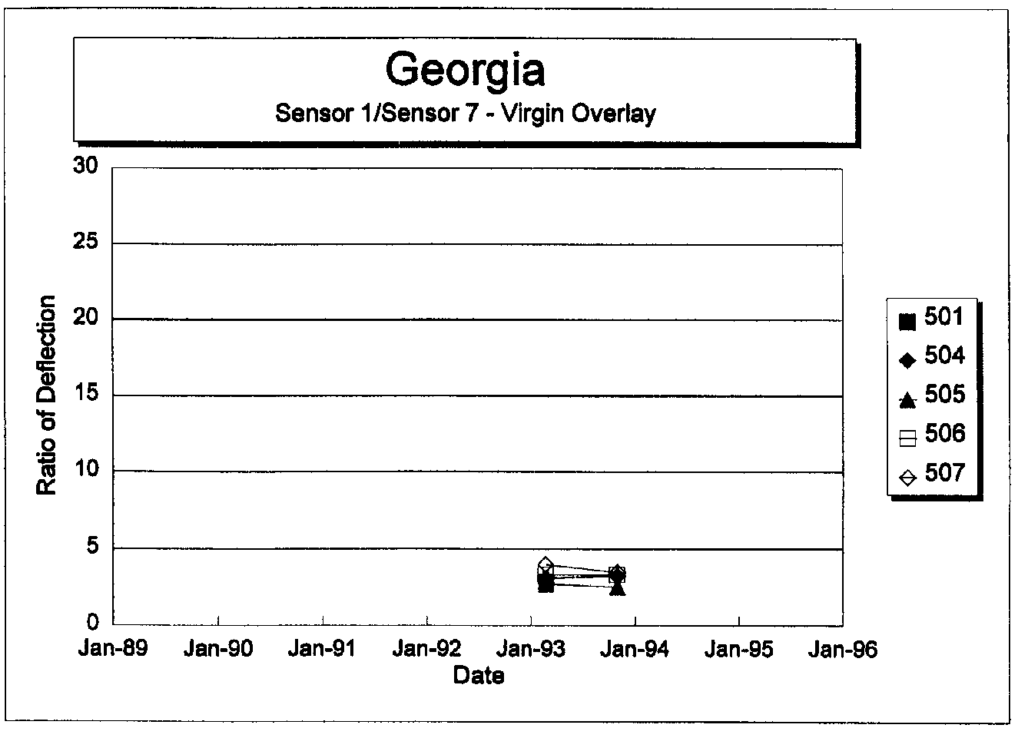
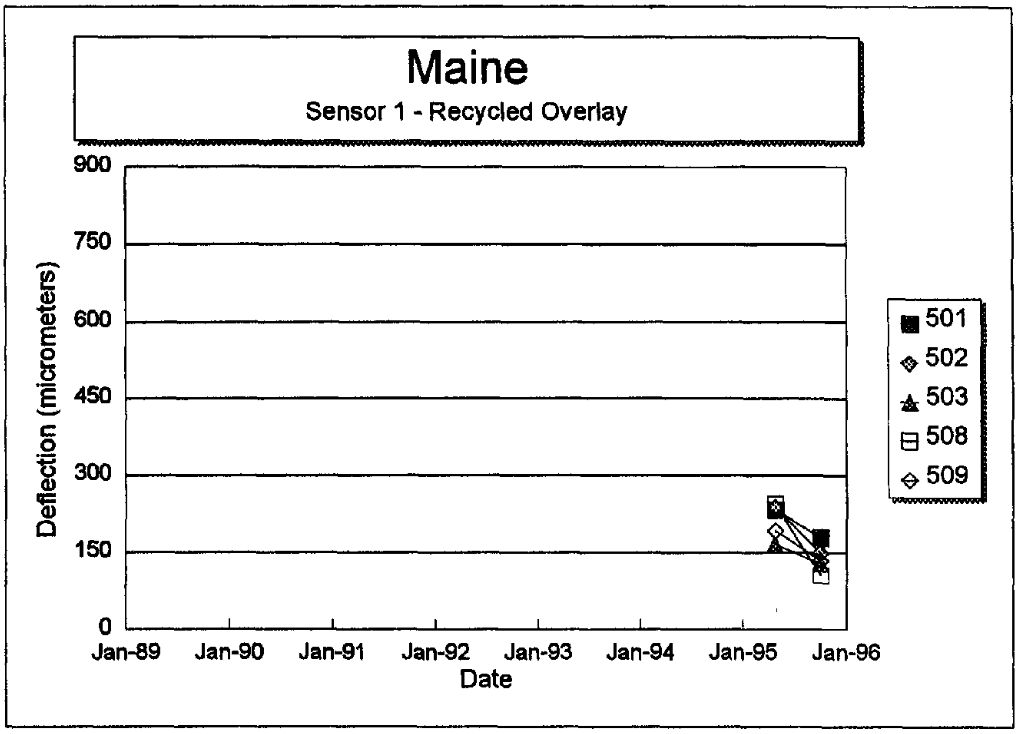


Figure 79. Sensor 1 deflection divided by Sensor 7 deflection versus time for each section of the Georgia SPS-5 project.



Note: Section 501 is a non-overlayed control section.

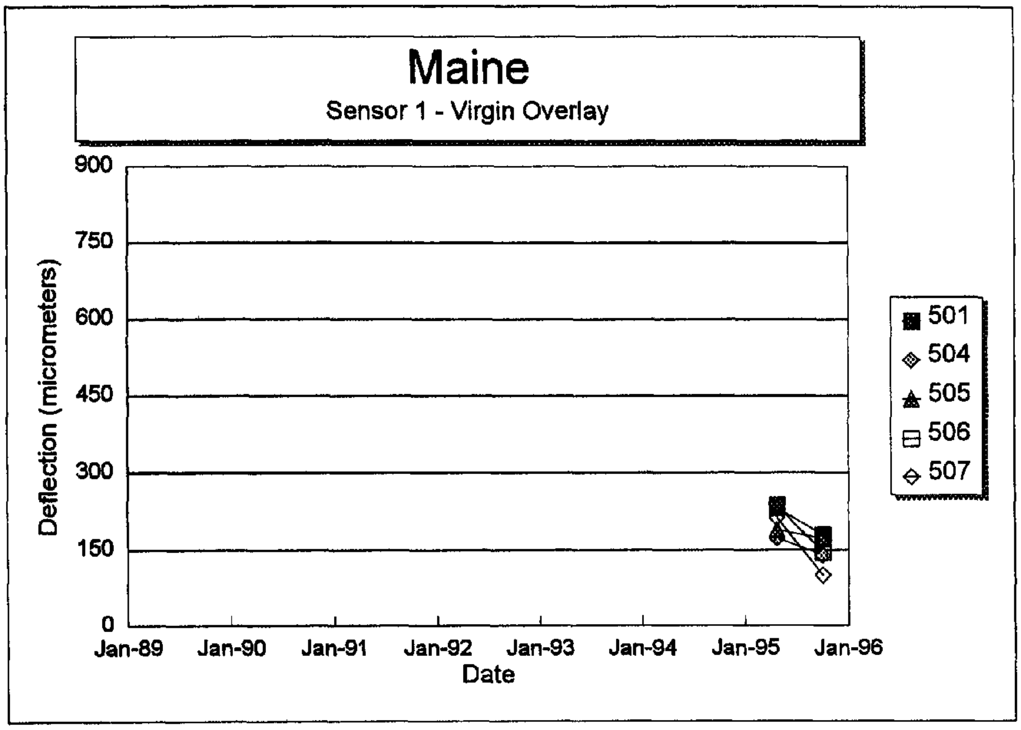
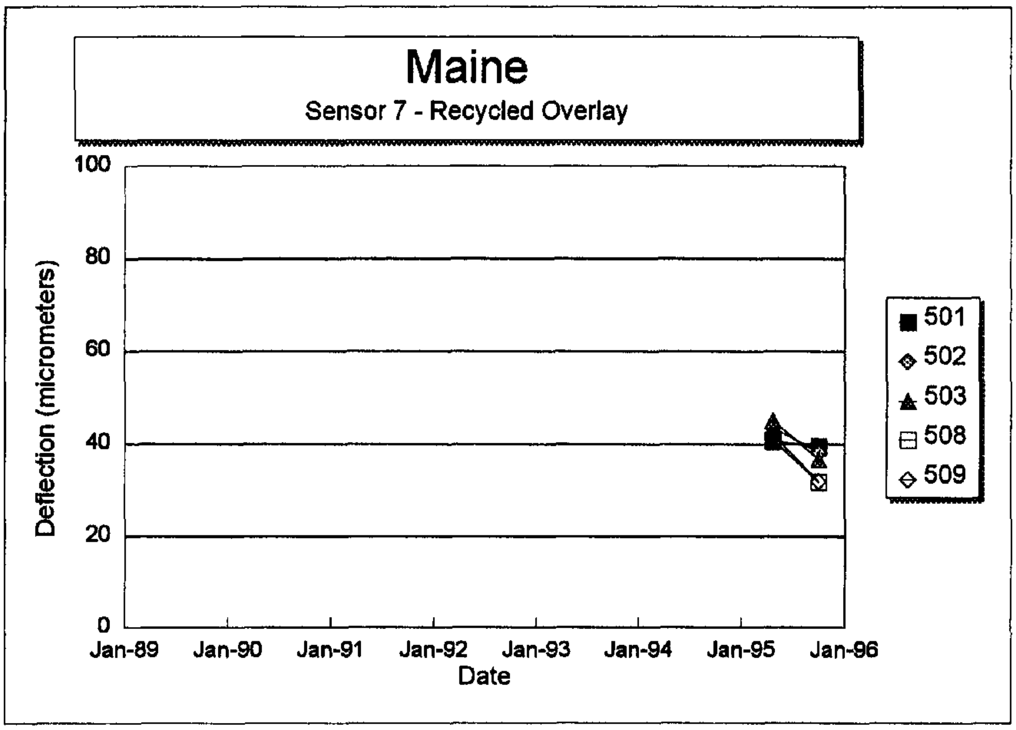


Figure 80. Sensor 1 deflection versus time for each section of the Maine SPS-5 project.



Note: Section 501 is a non-overlayed control section.

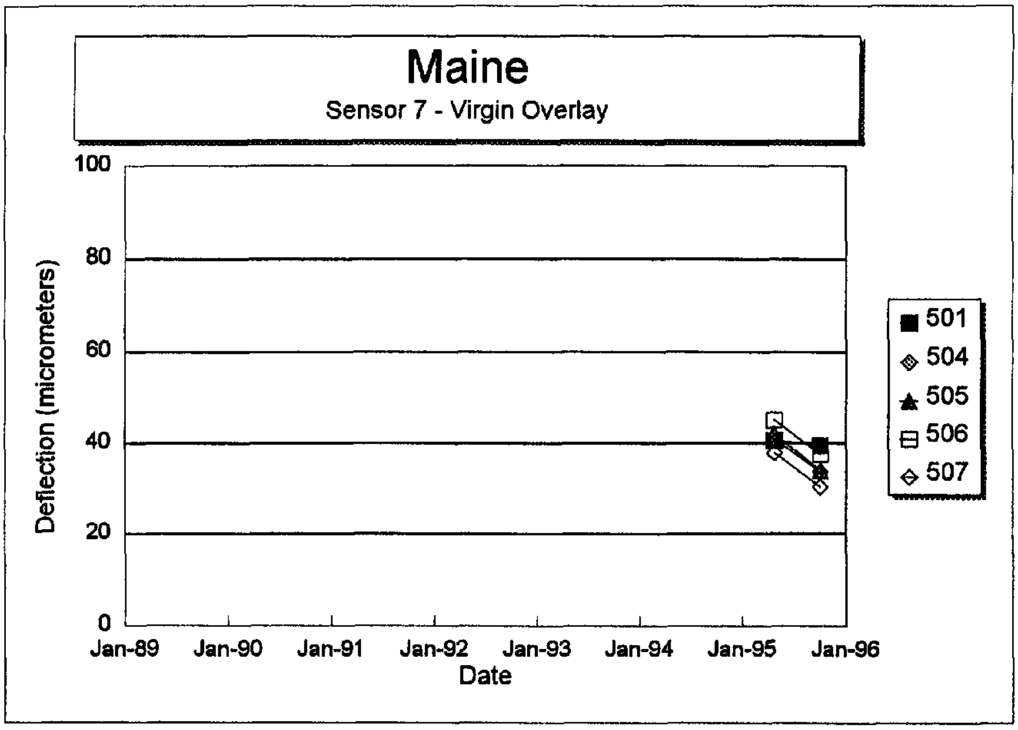
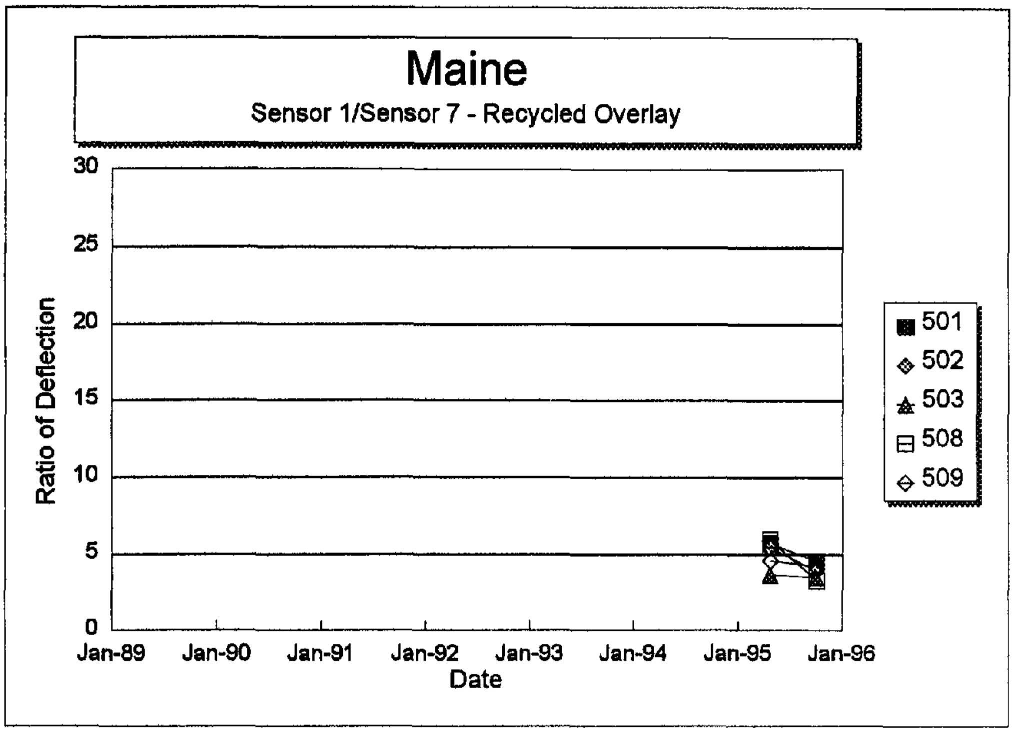


Figure 81. Sensor 7 deflection versus time for each section of the Maine SPS-5 project.



Note: Section 501 is a non-overlayed control section.

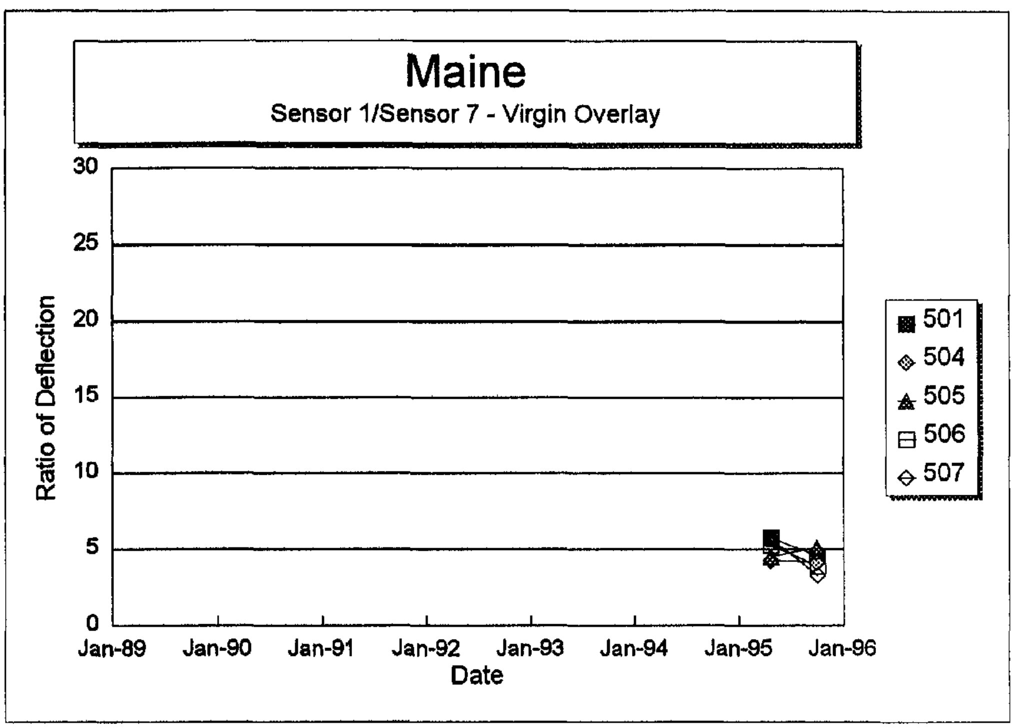
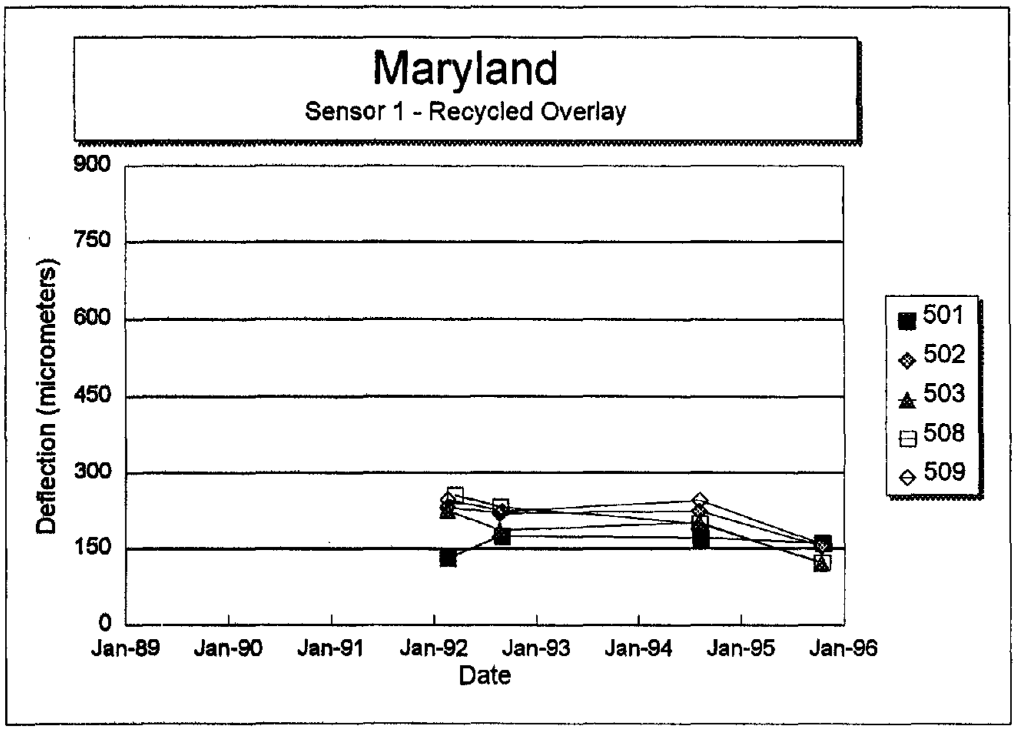


Figure 82. Sensor 1 deflection divided by Sensor 7 deflection versus time for each section of the Maine SPS-5 project.



Note: Section 501 is a non-overlayed control section.

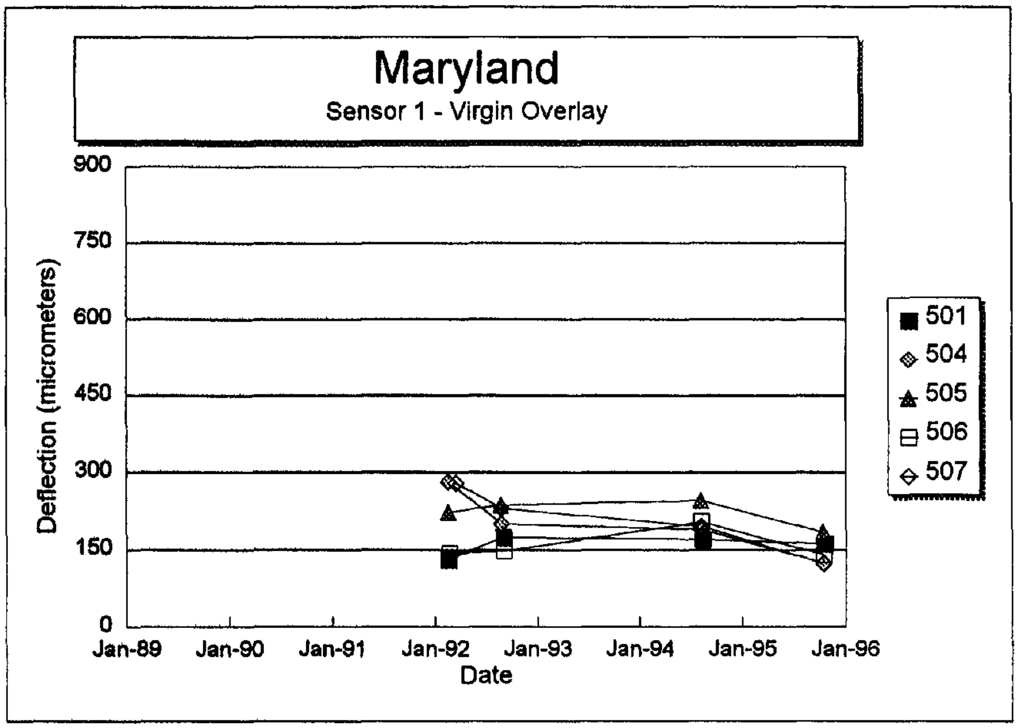
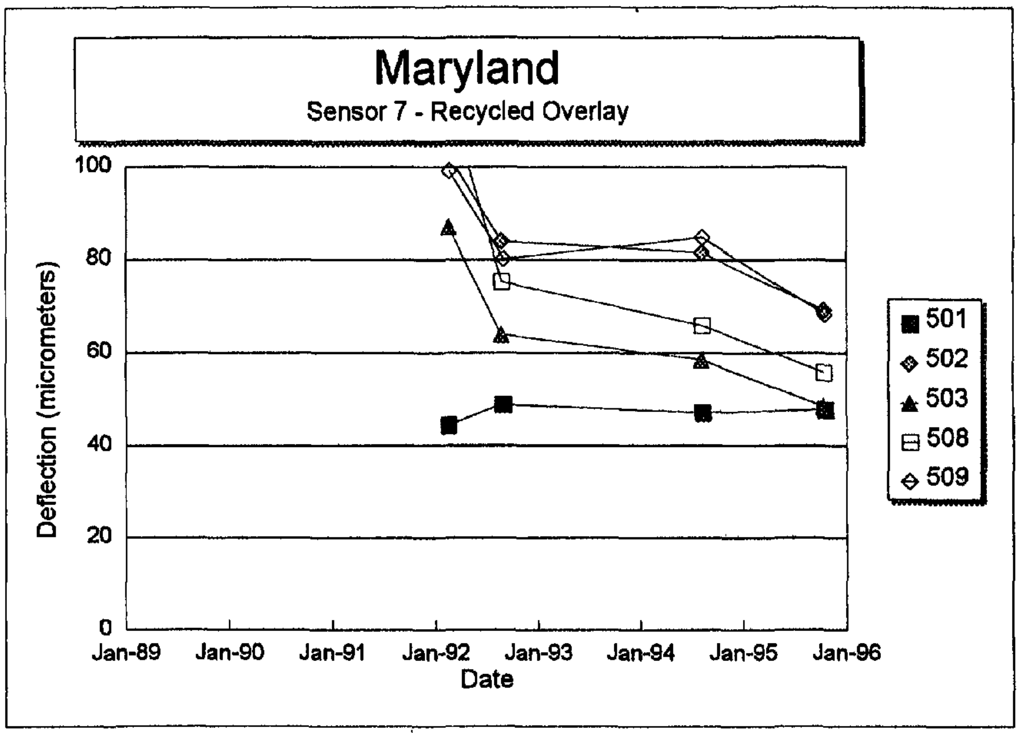


Figure 83. Sensor 1 deflection versus time for each section of the Maryland SPS-5 project.



Note: Section 501 is a non-overlayed control section.

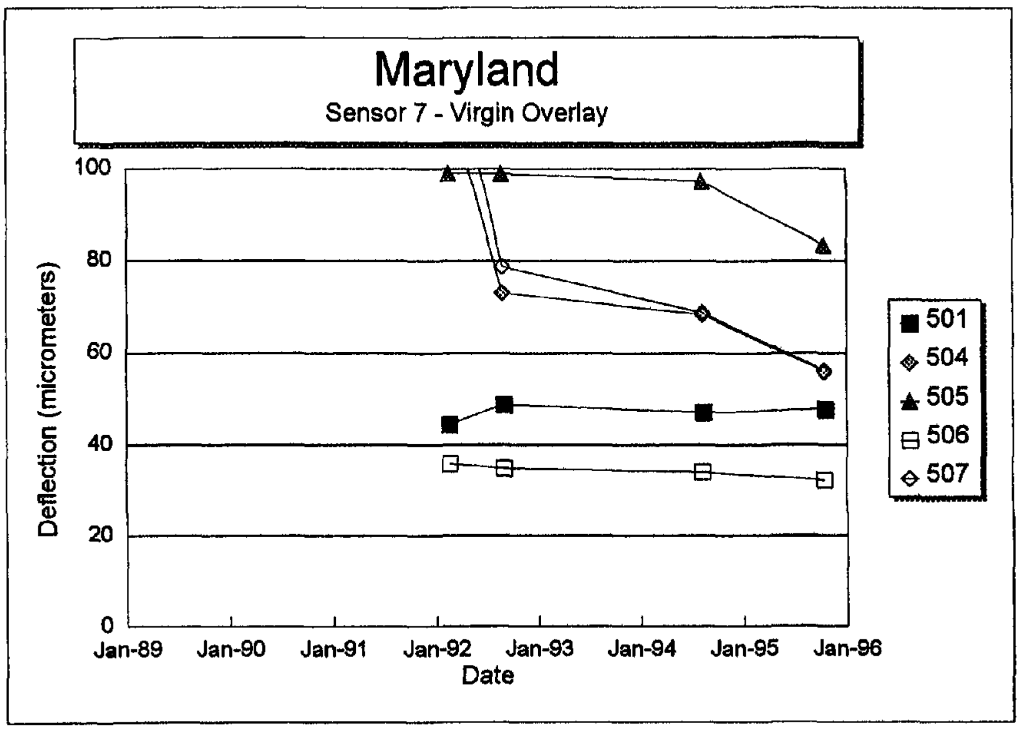
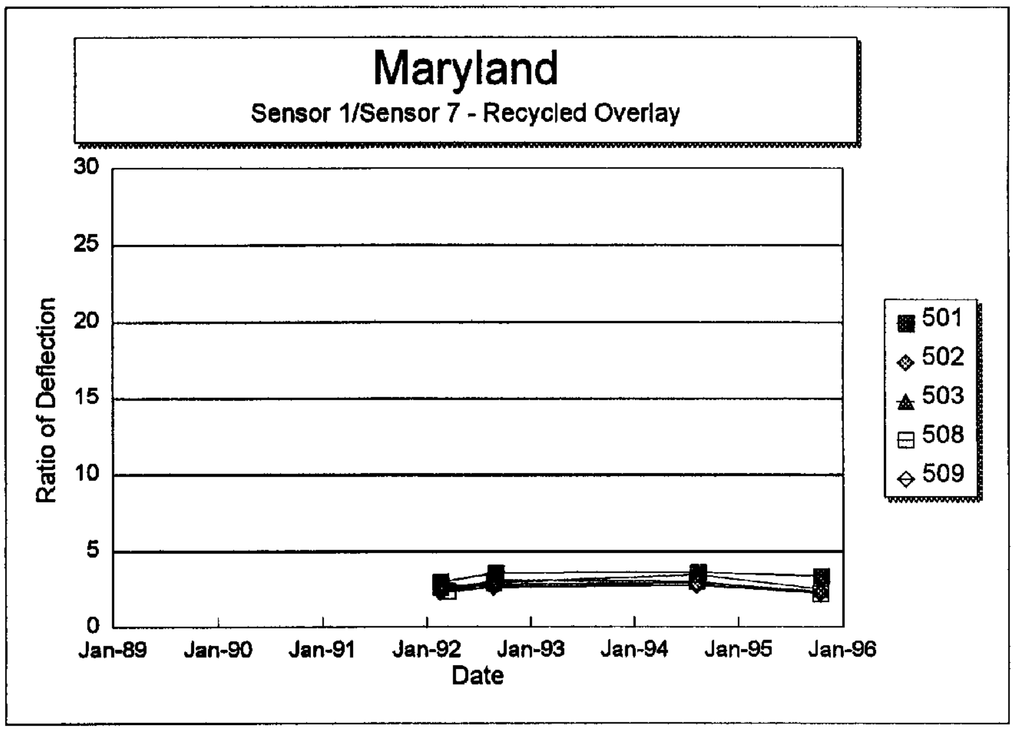


Figure 84. Sensor 7 deflection versus time for each section of the Maryland SPS-5 project.



Note: Section 501 is a non-overlayed control section.

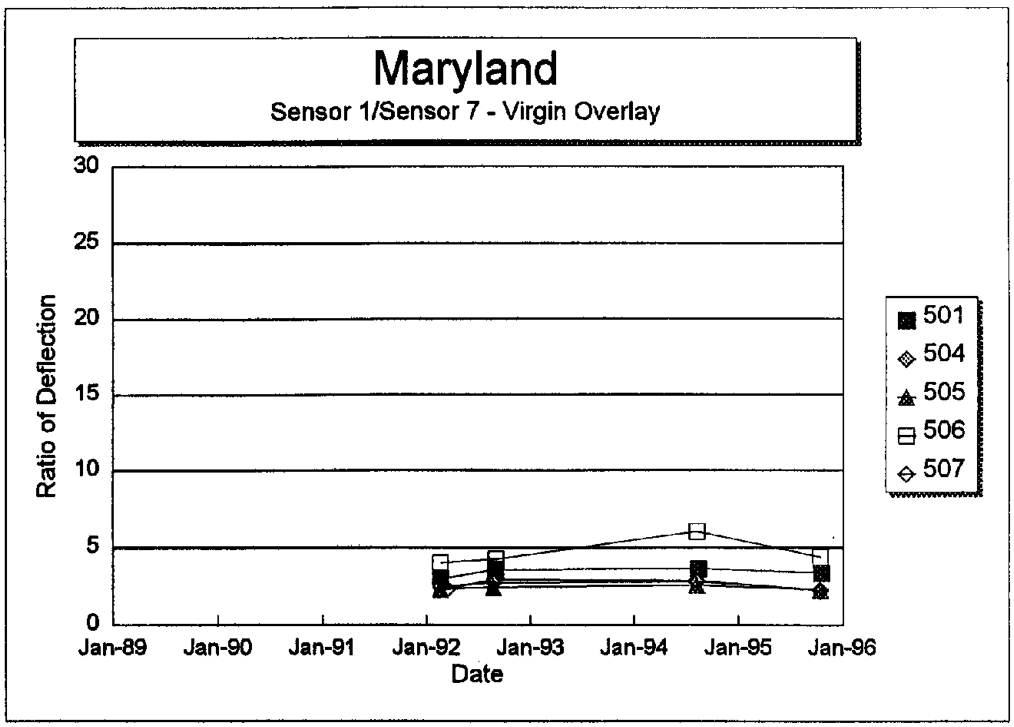
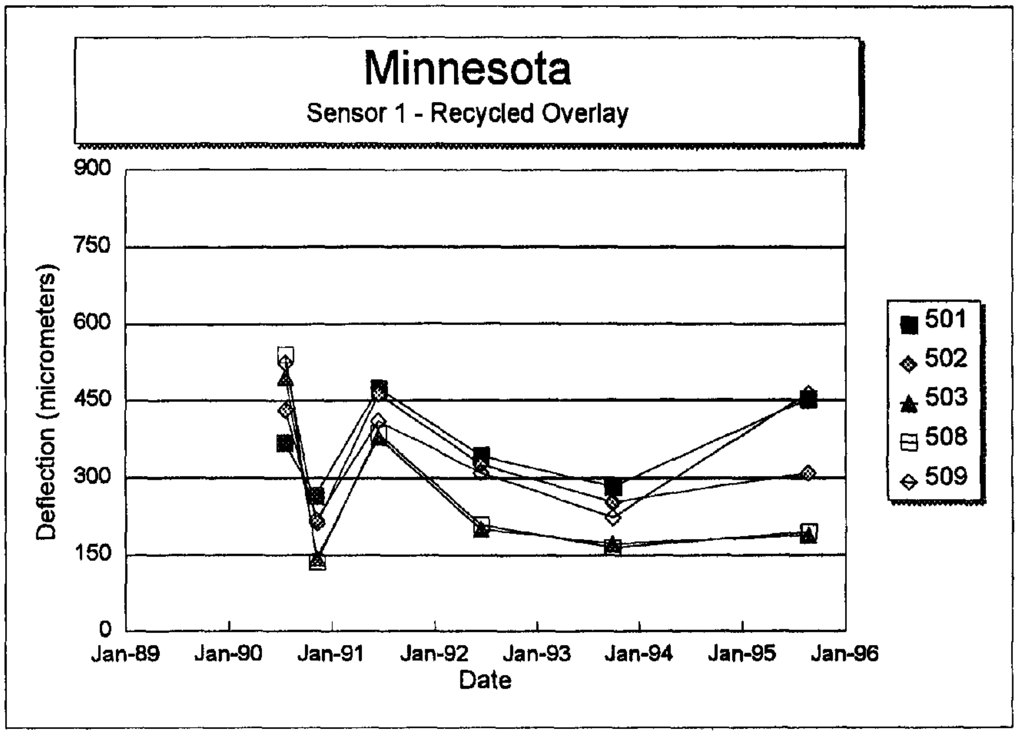


Figure 85. Sensor 1 deflection divided by Sensor 7 deflection versus time for each section of the Maryland SPS-5 project.



Note: Section 501 is a non-overlayed control section.

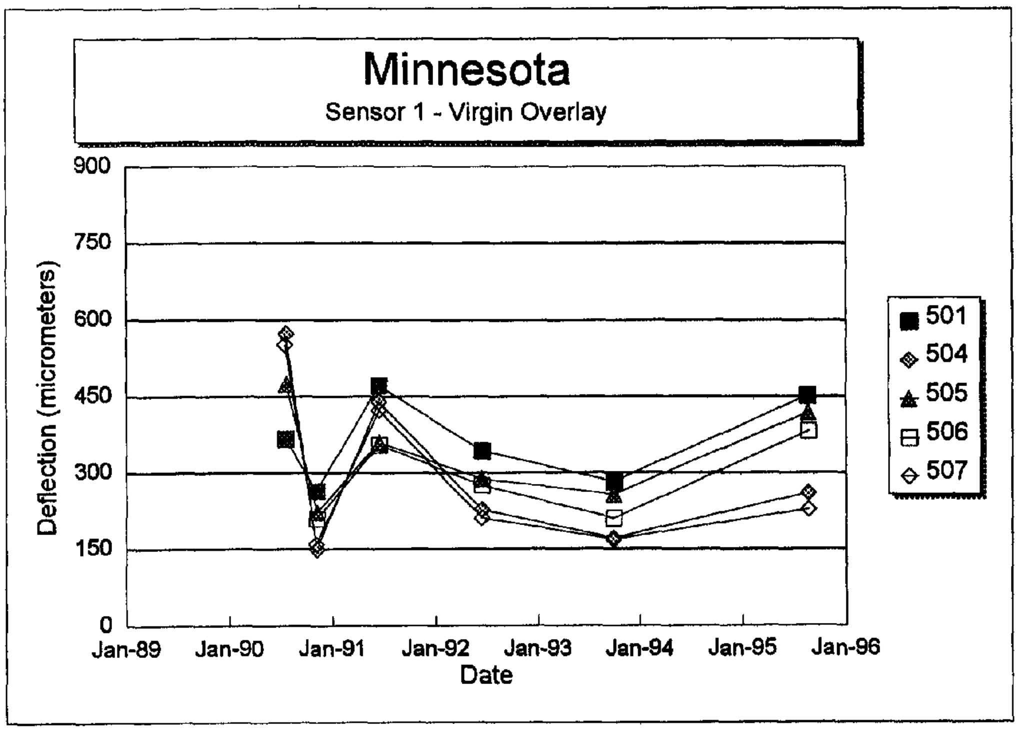
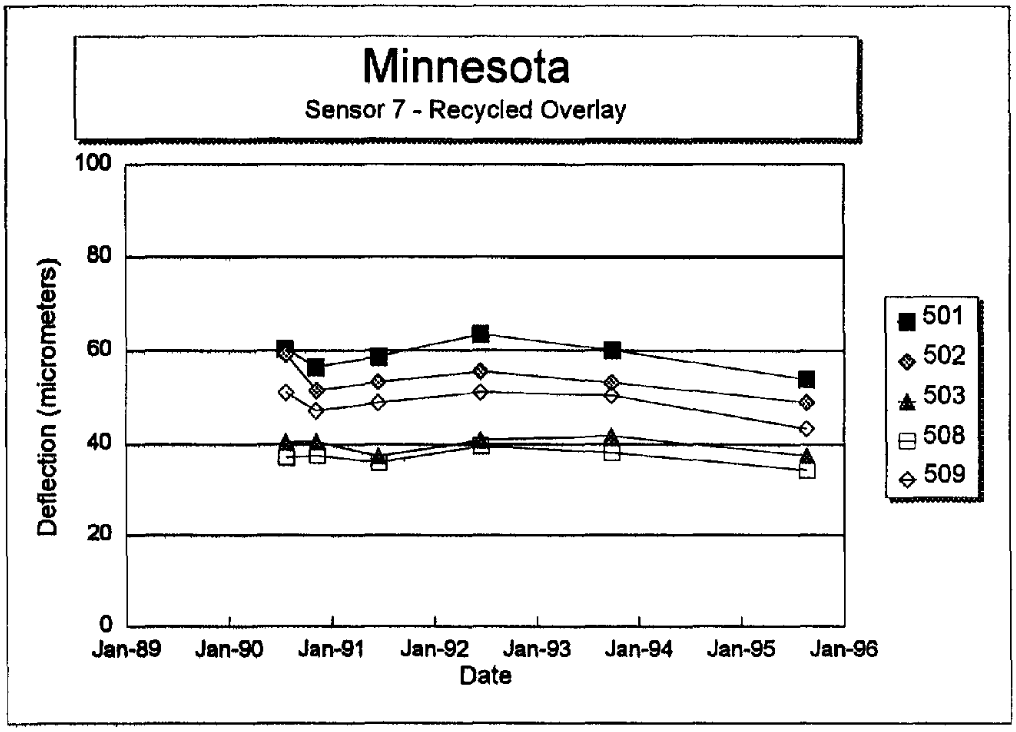


Figure 86. Sensor 1 deflection versus time for each section of the Minnesota SPS-5 project.



Note: Section 501 is a non-overlayed control section.

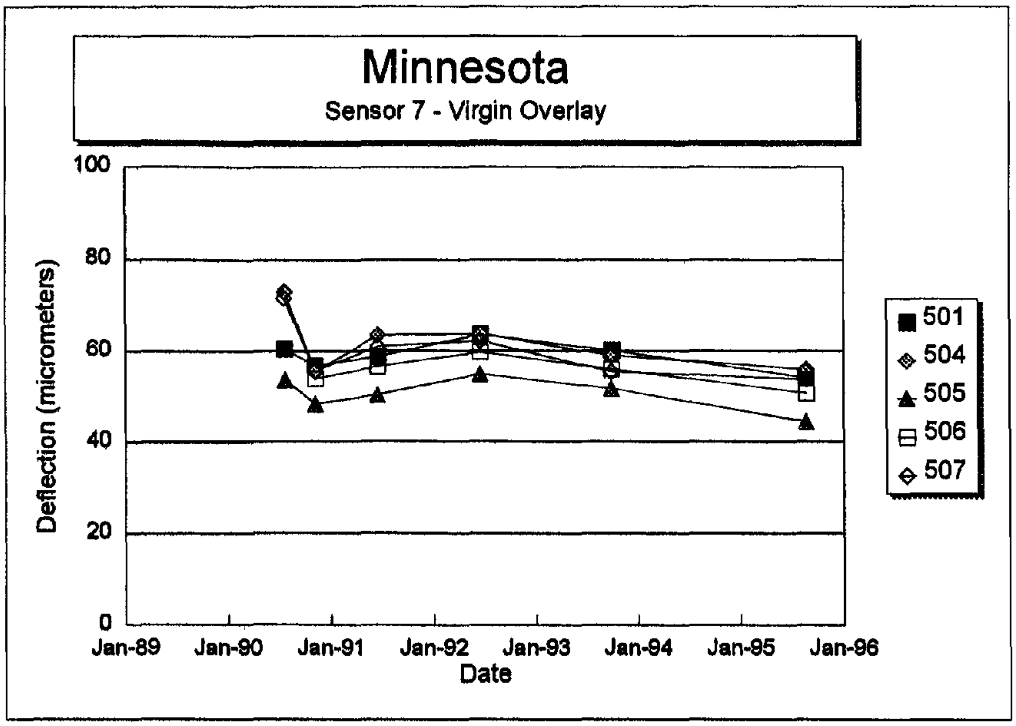
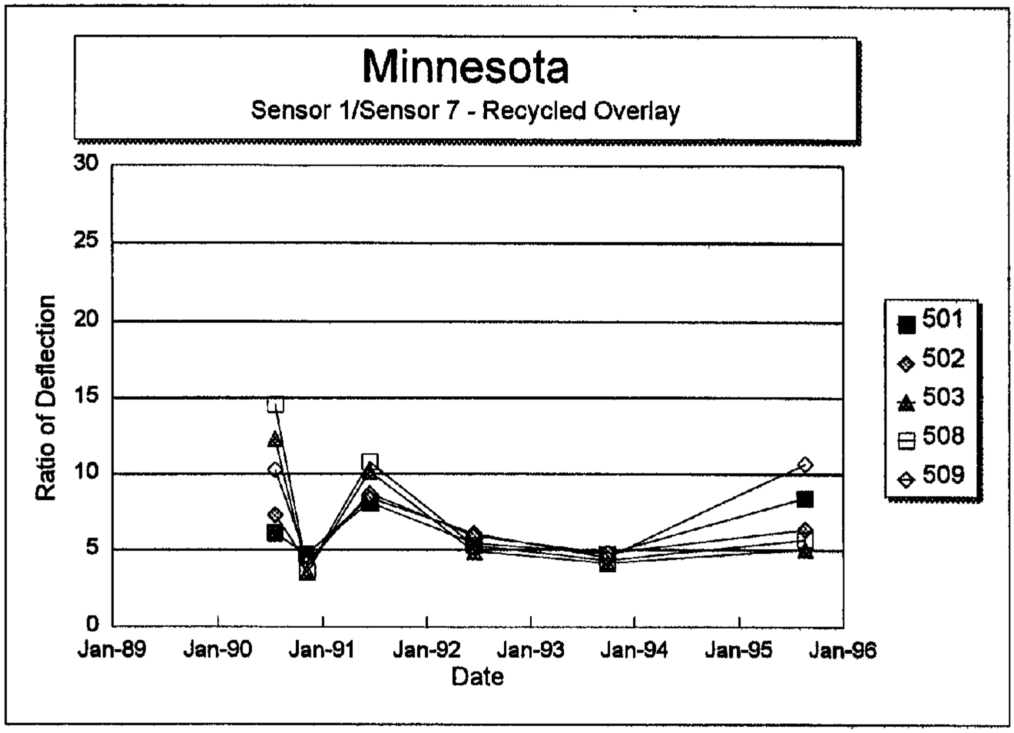


Figure 87. Sensor 7 deflection versus time for each section of the Minnesota SPS-5 project.



Note: Section 501 is a non-overlayed control section.

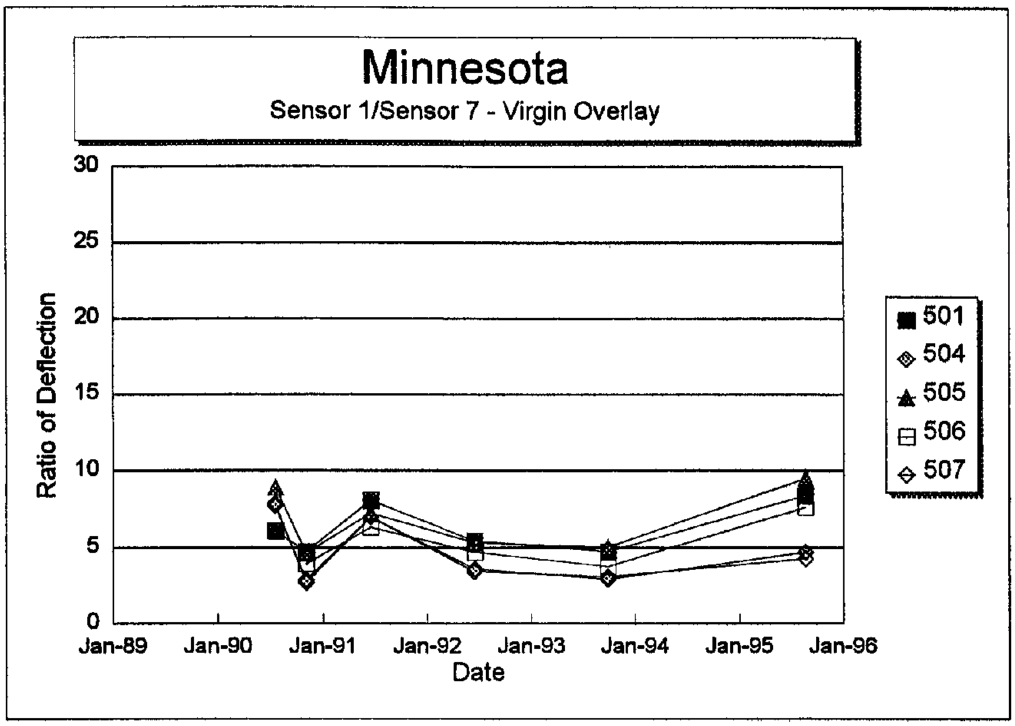
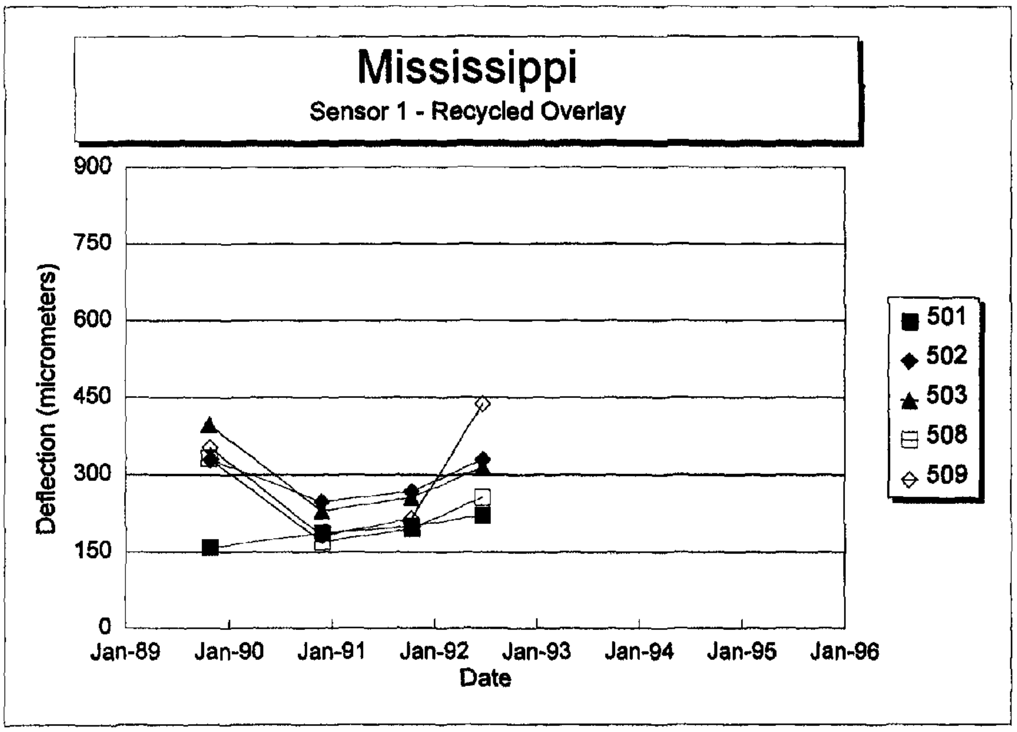


Figure 88. Sensor 1 deflection divided by Sensor 7 deflection versus time for each section of the Minnesota SPS-5 project.



Note: Section 501 is a non-overlayed control section.

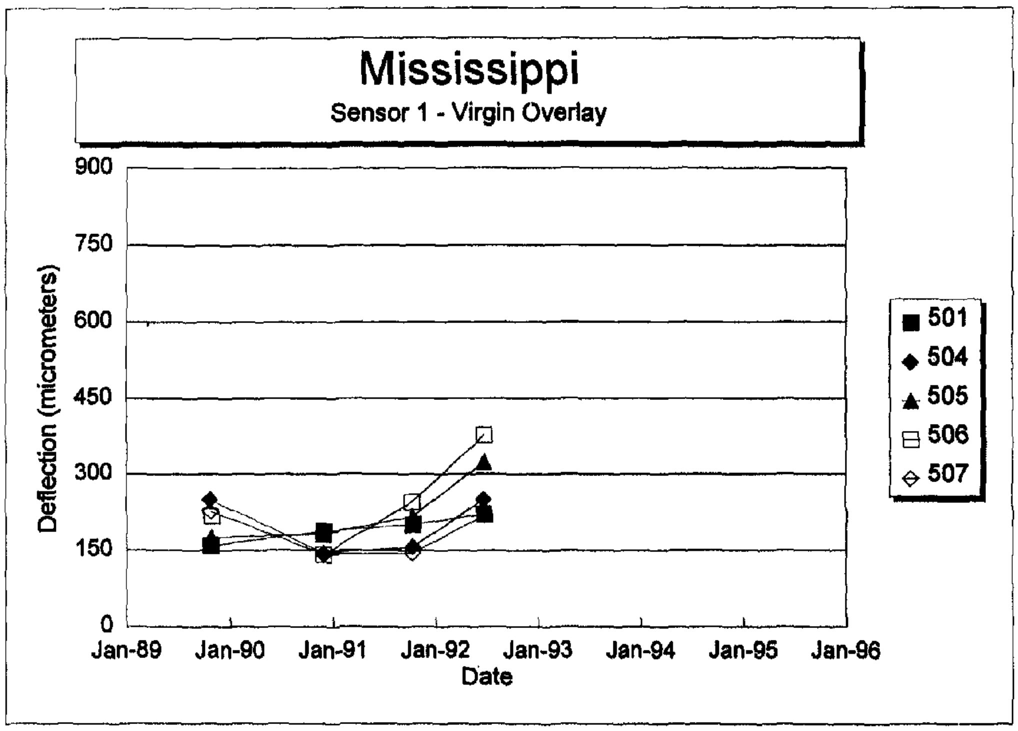
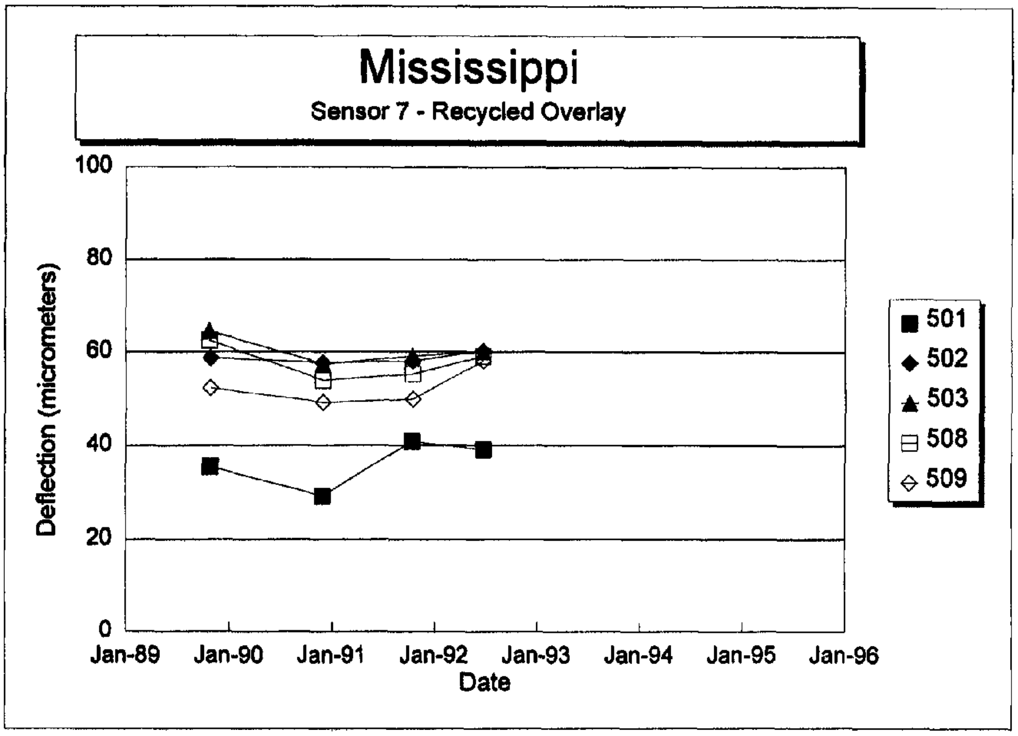


Figure 89. Sensor 1 deflection versus time for each section of the Mississippi SPS-5 project.



Note: Section 501 is a non-overlayed control section.

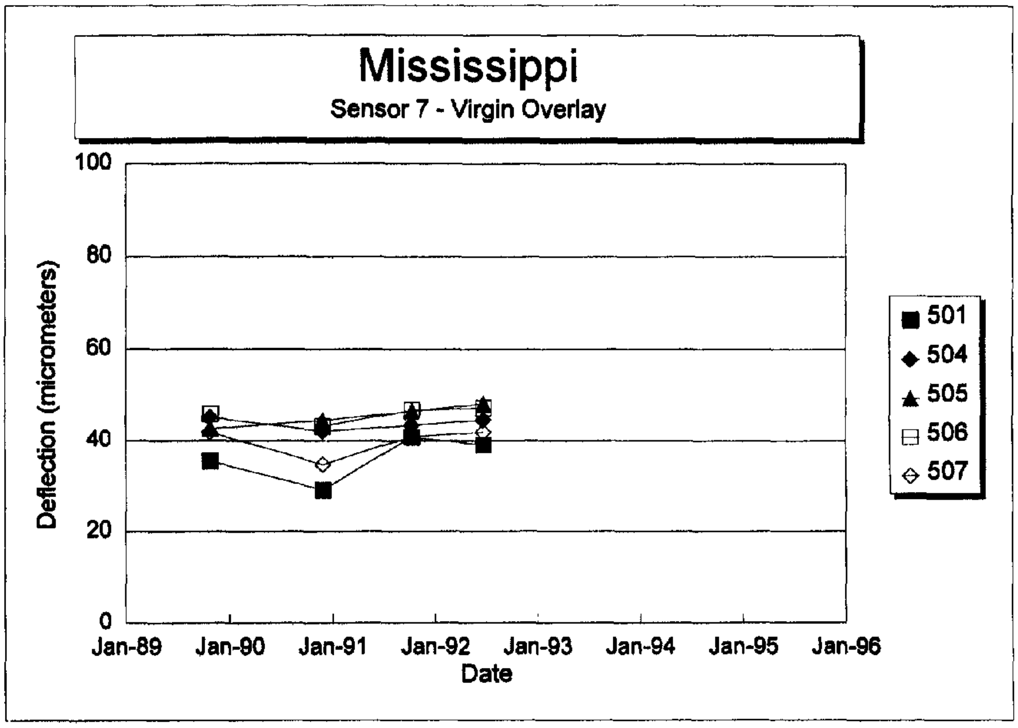
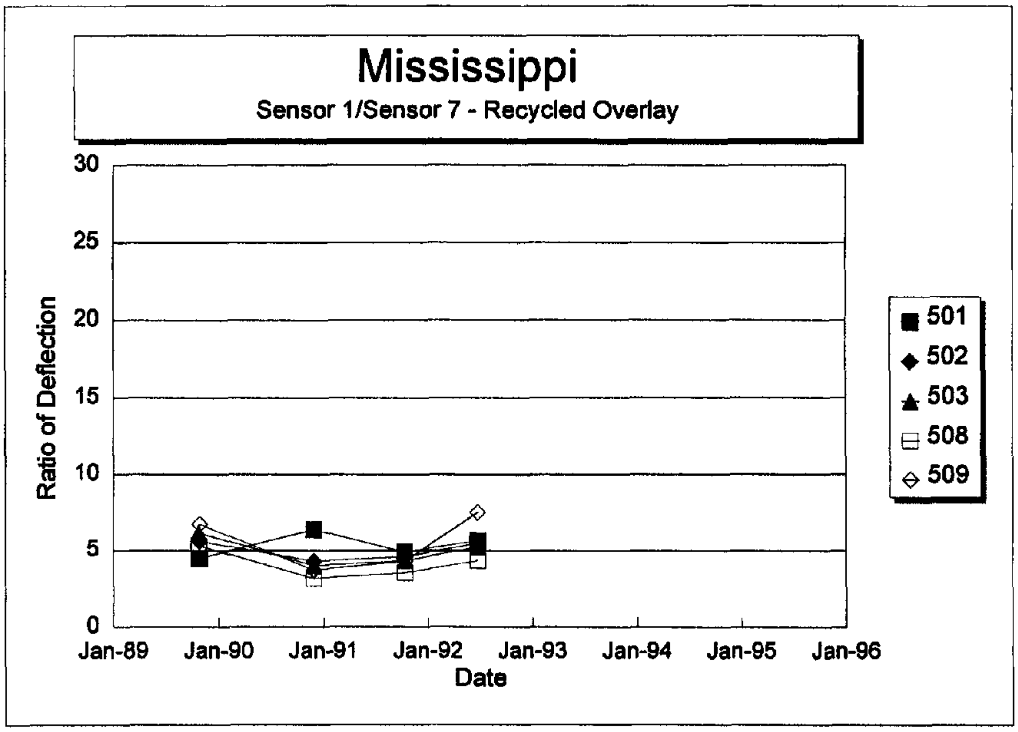


Figure 90. Sensor 7 deflection versus time for each section of the Mississippi SPS-5 project.



Note: Section 501 is a non-overlayed control section.

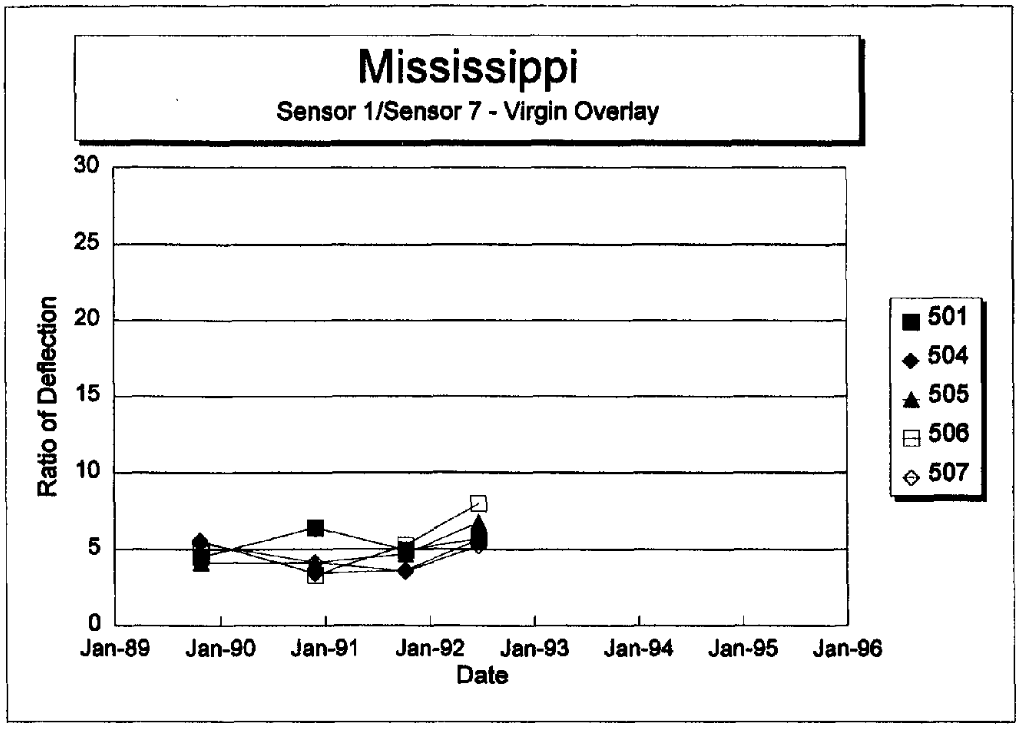
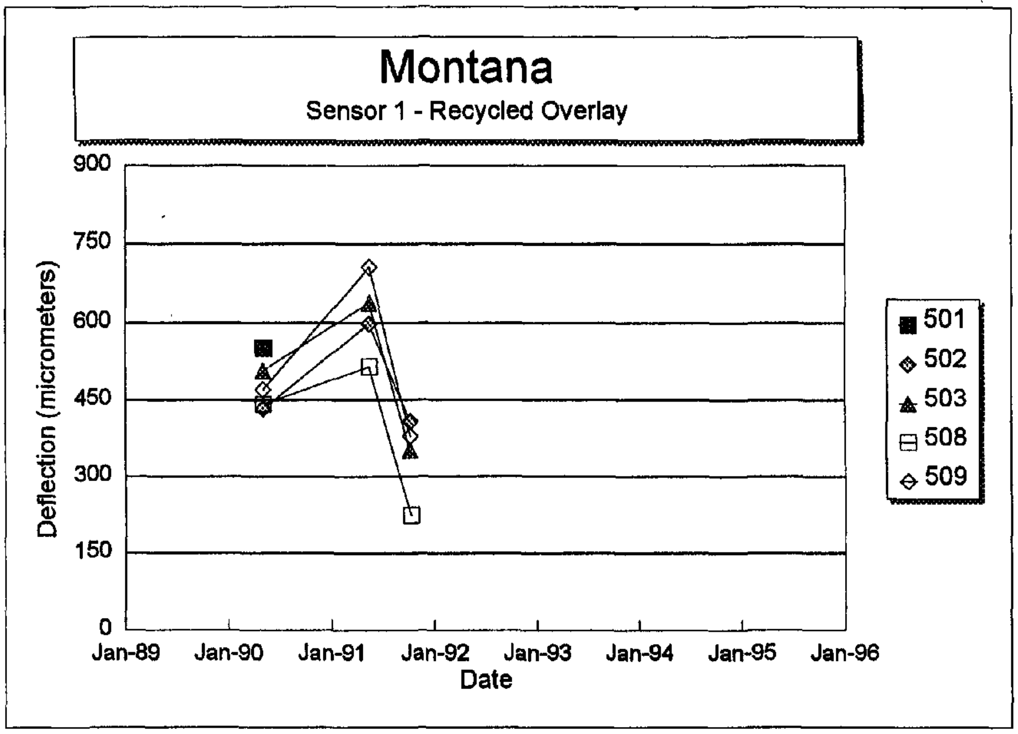


Figure 91. Sensor 1 deflection divided by Sensor 7 deflection versus time for each section of the Mississippi SPS-5 project.



Note: Section 501 is a non-overlayed control section.

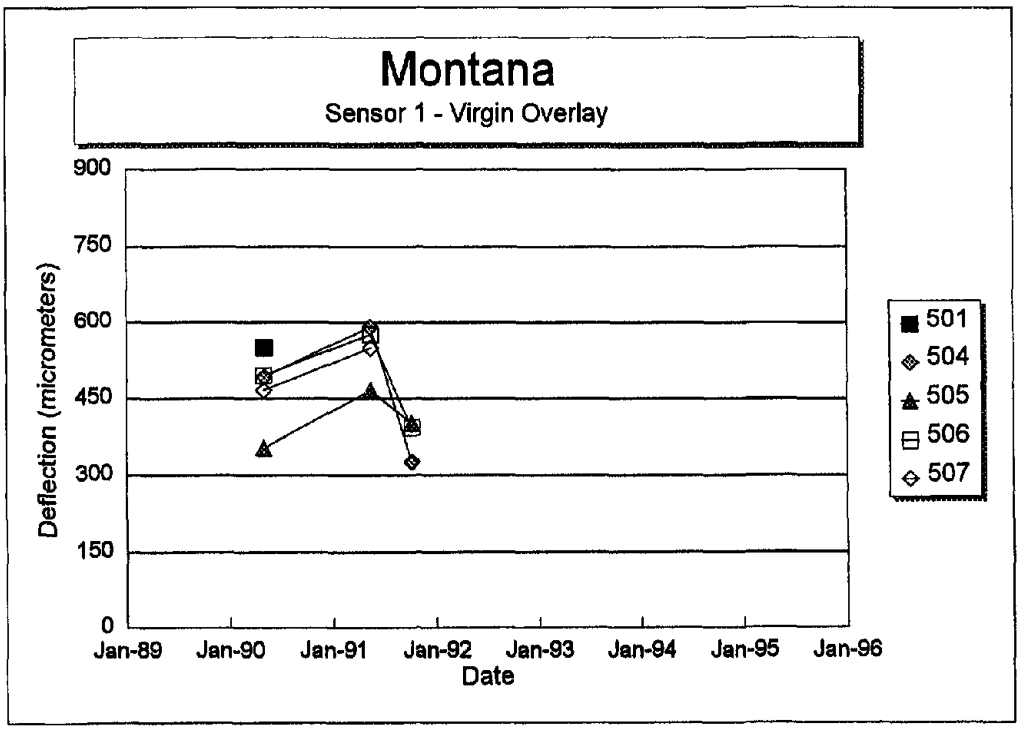
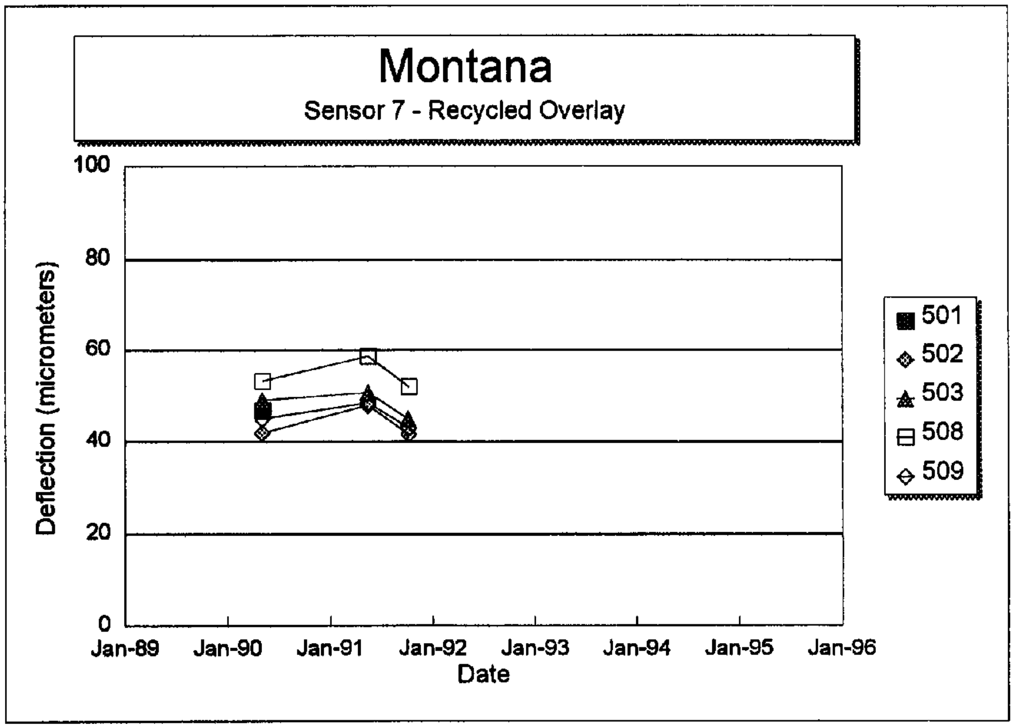


Figure 92. Sensor 1 deflection versus time for each section of the Montana SPS-5 project.



Note: Section 501 is a non-overlayed control section.

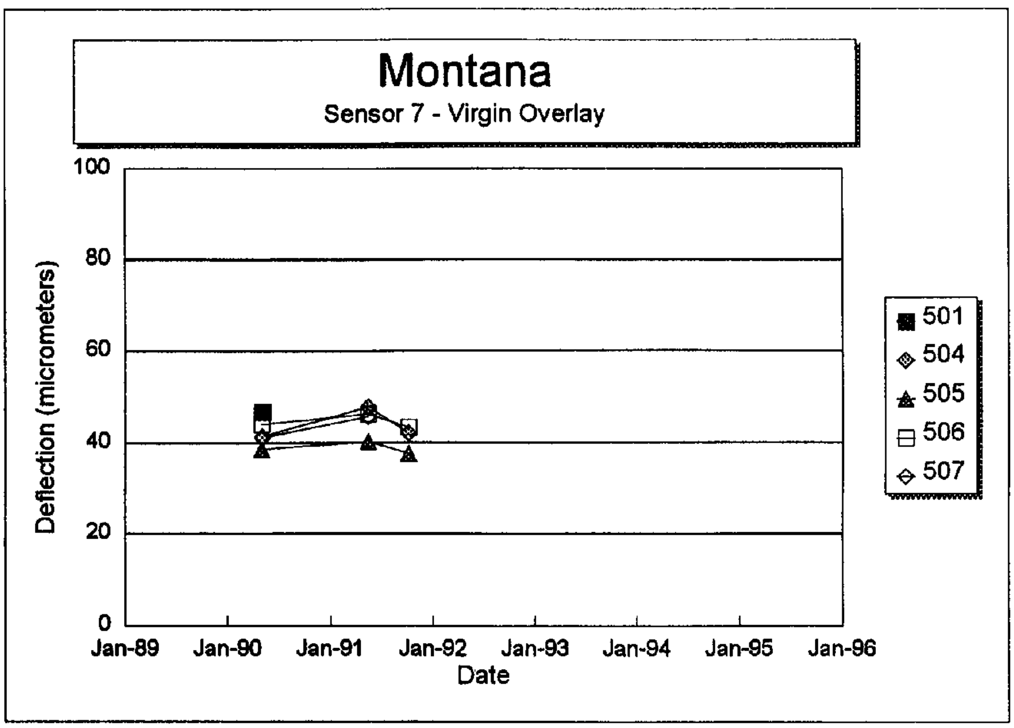
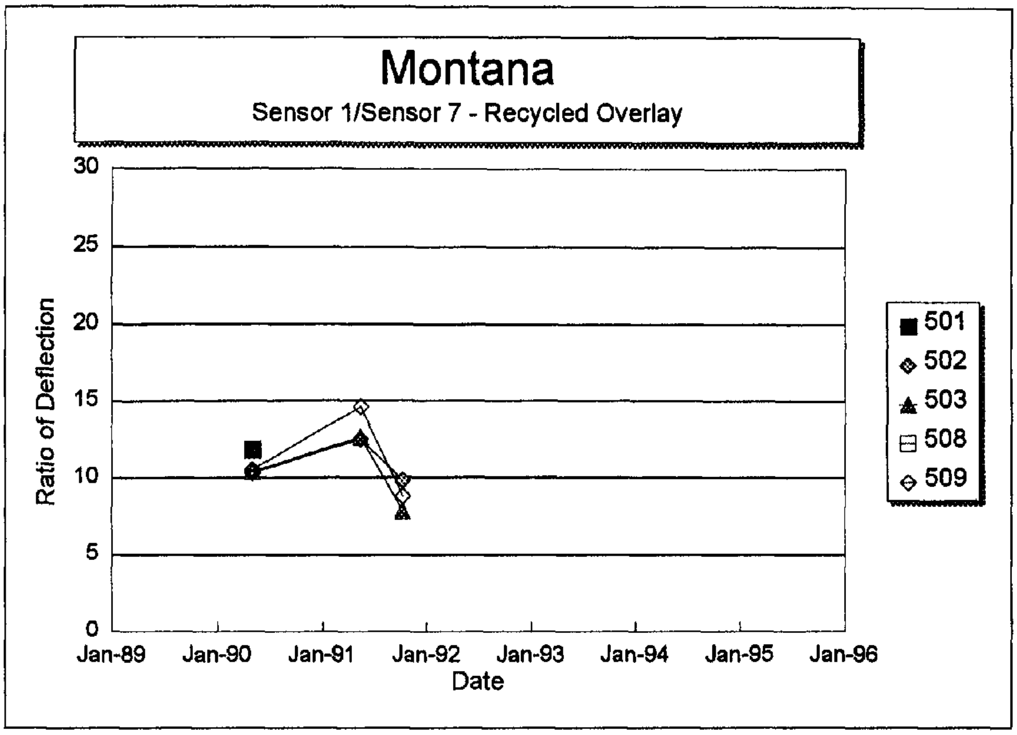


Figure 93. Sensor 7 deflection versus time for each section of the Montana SPS-5 project.



Note: Section 501 is a non-overlayed control section.

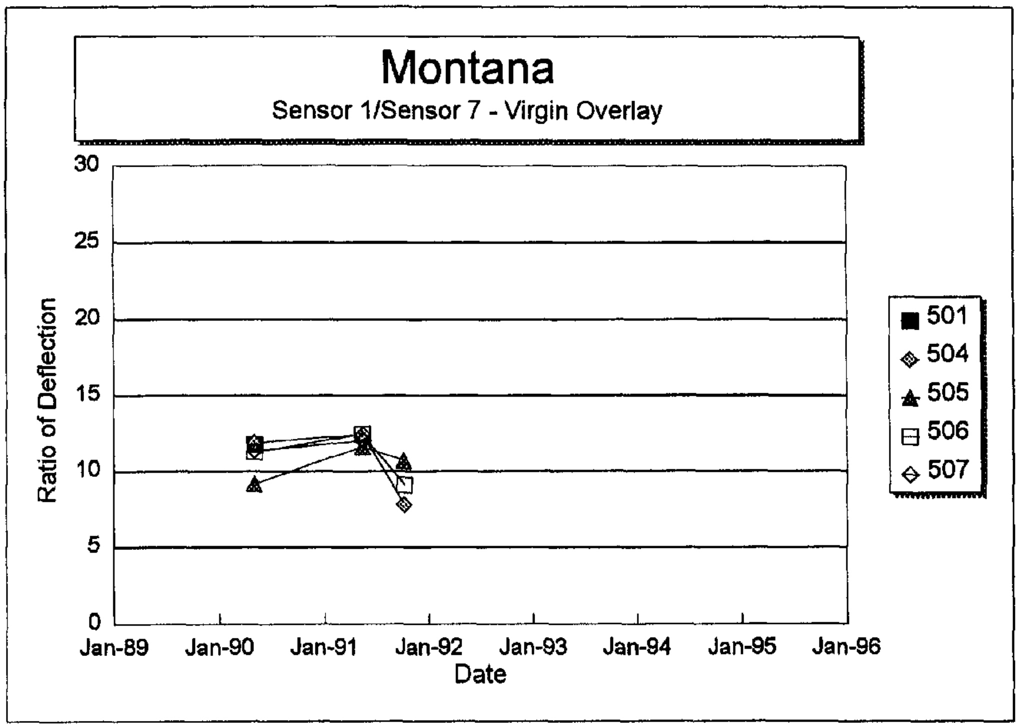
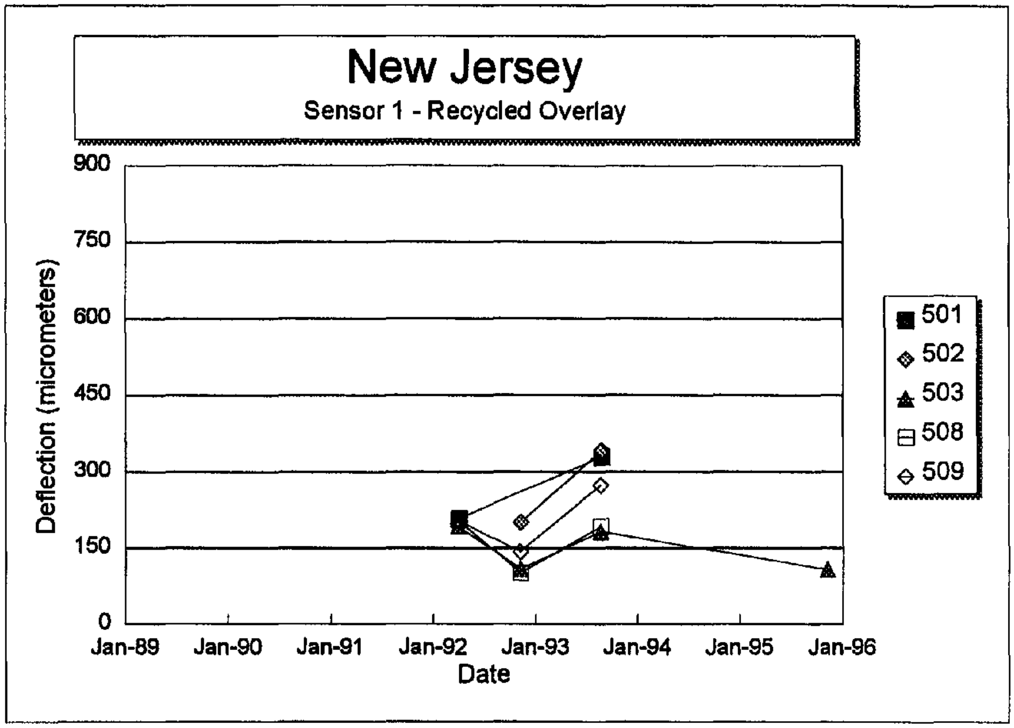


Figure 94. Sensor 1 deflection divided by Sensor 7 deflection versus time for each section of the Montana SPS-5 project.



Note: Section 501 is a non-overlayed control section.

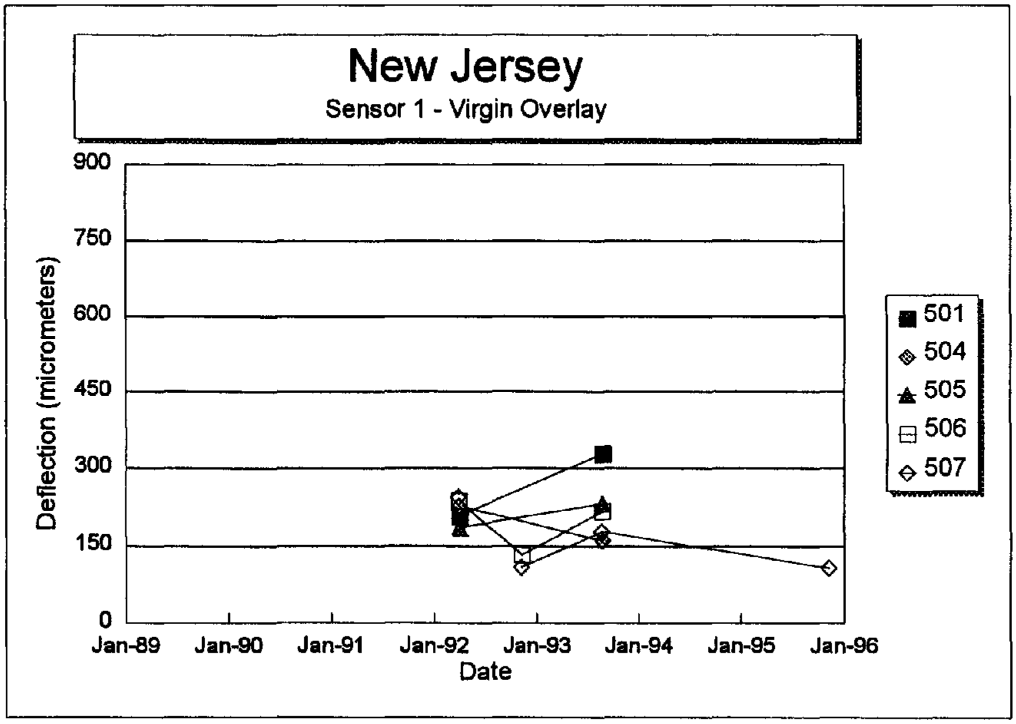
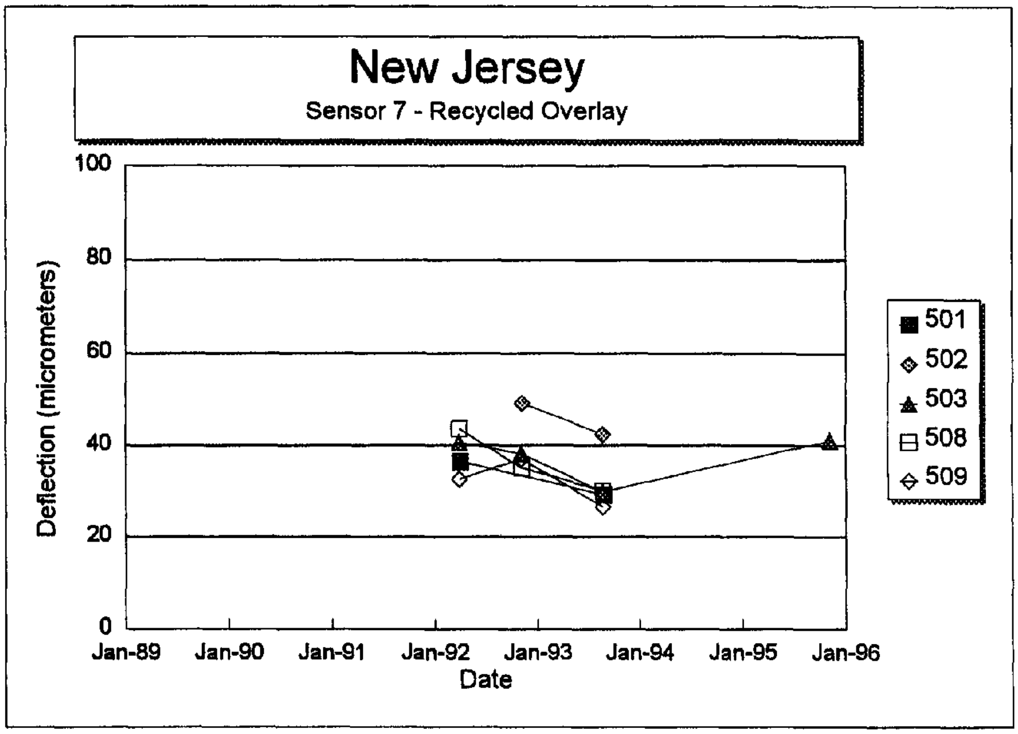


Figure 95. Sensor 1 deflection versus time for each section of the New Jersey SPS-5 project.



Note: Section 501 is a non-overlayed control section.

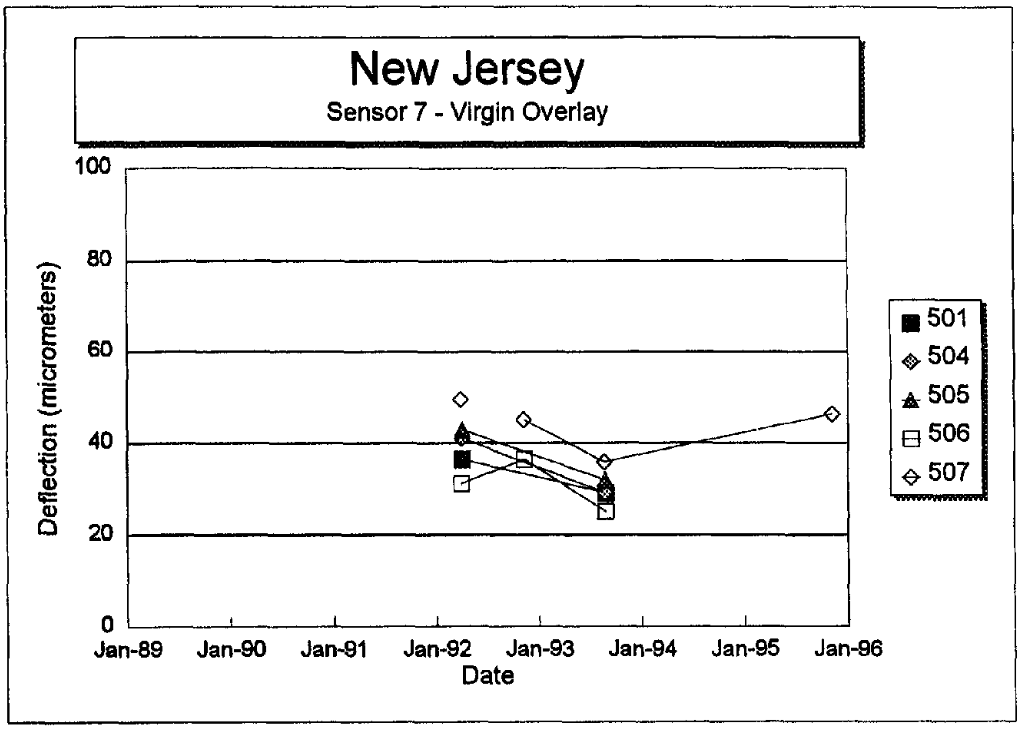
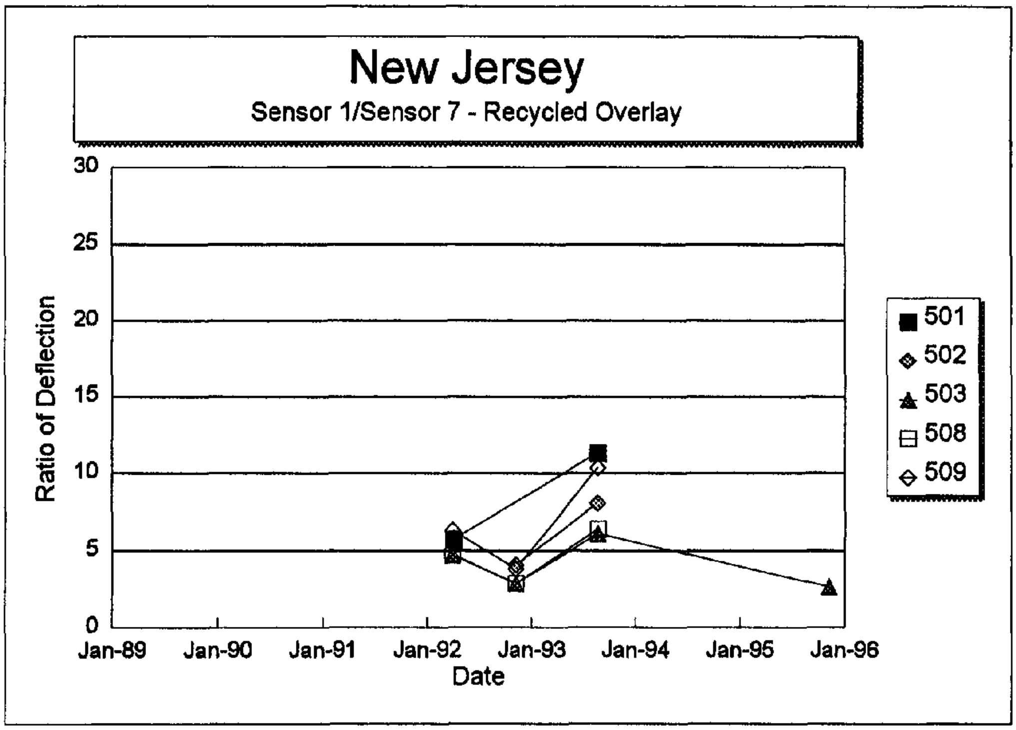


Figure 96. Sensor 7 deflection versus time for each section of the New Jersey SPS-5 project.



Note: Section 501 is a non-overlayed control section.

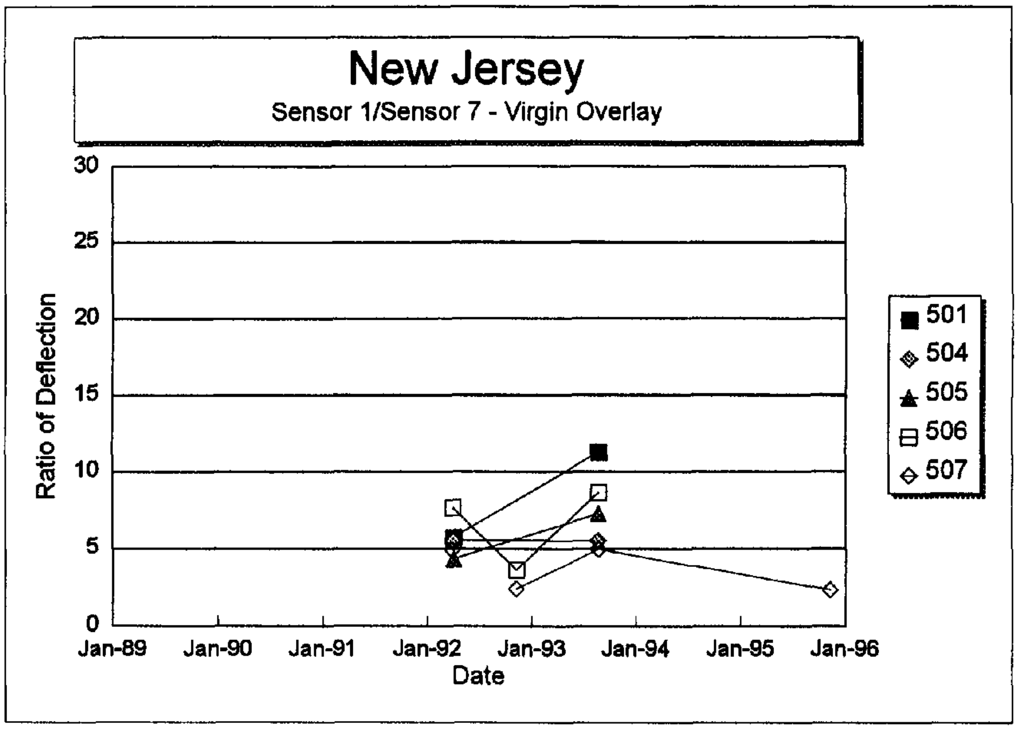
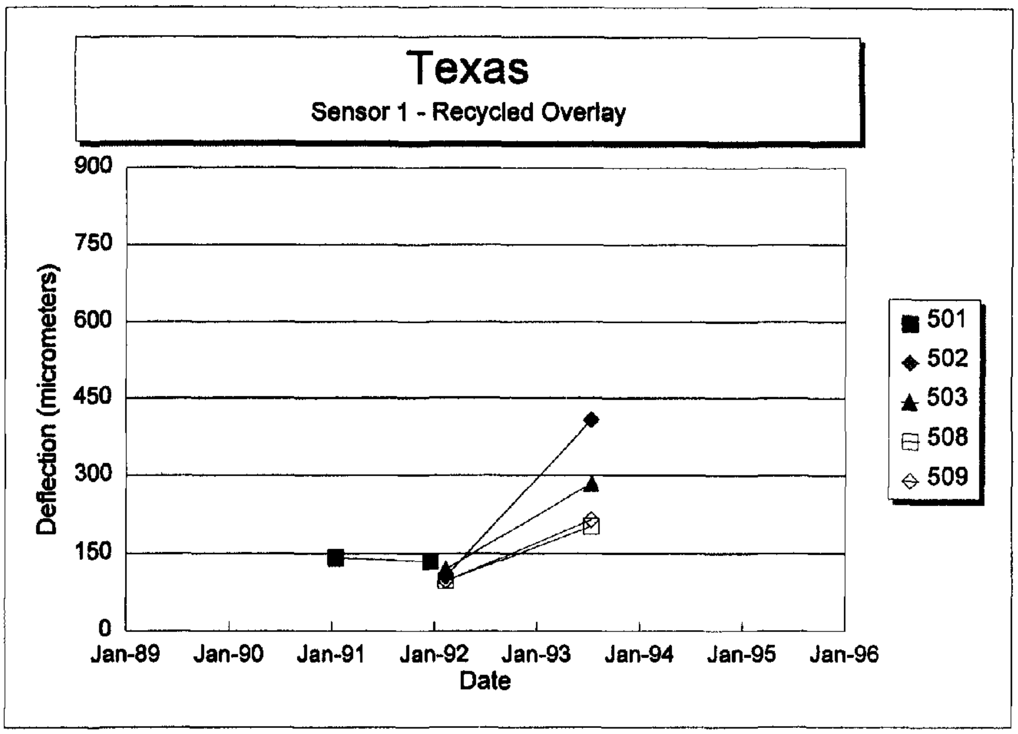


Figure 97. Sensor 1 deflection divided by Sensor 7 deflection versus time for each section of the New Jersey SPS-5 project.



Note: *Section 501 is a non-overlayed control section.*

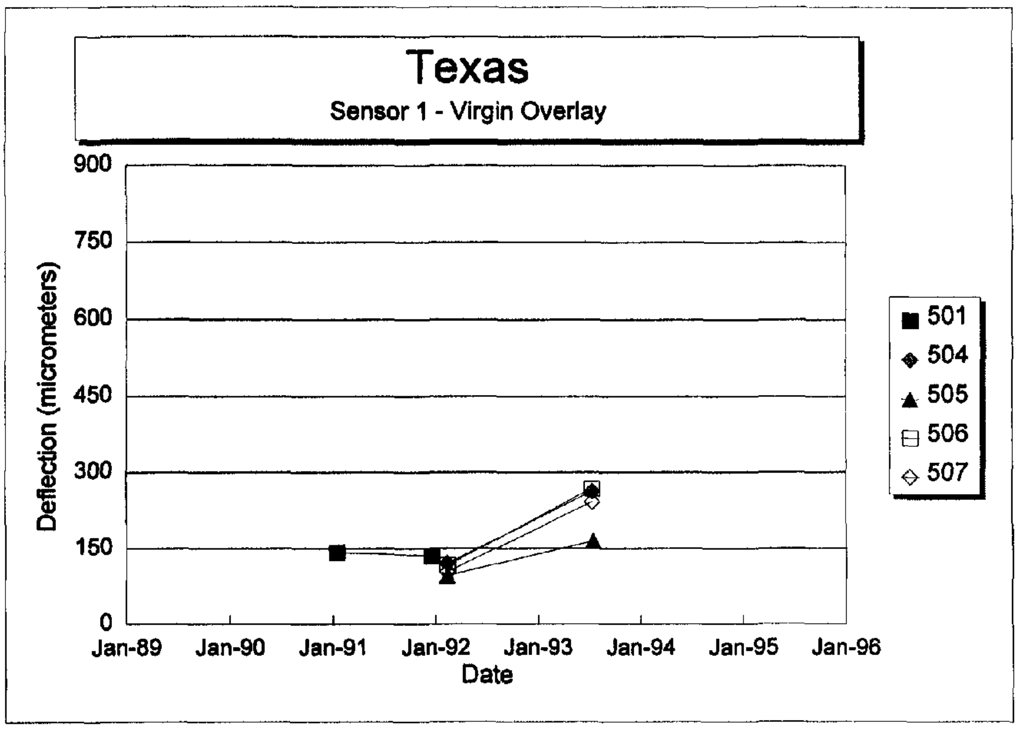
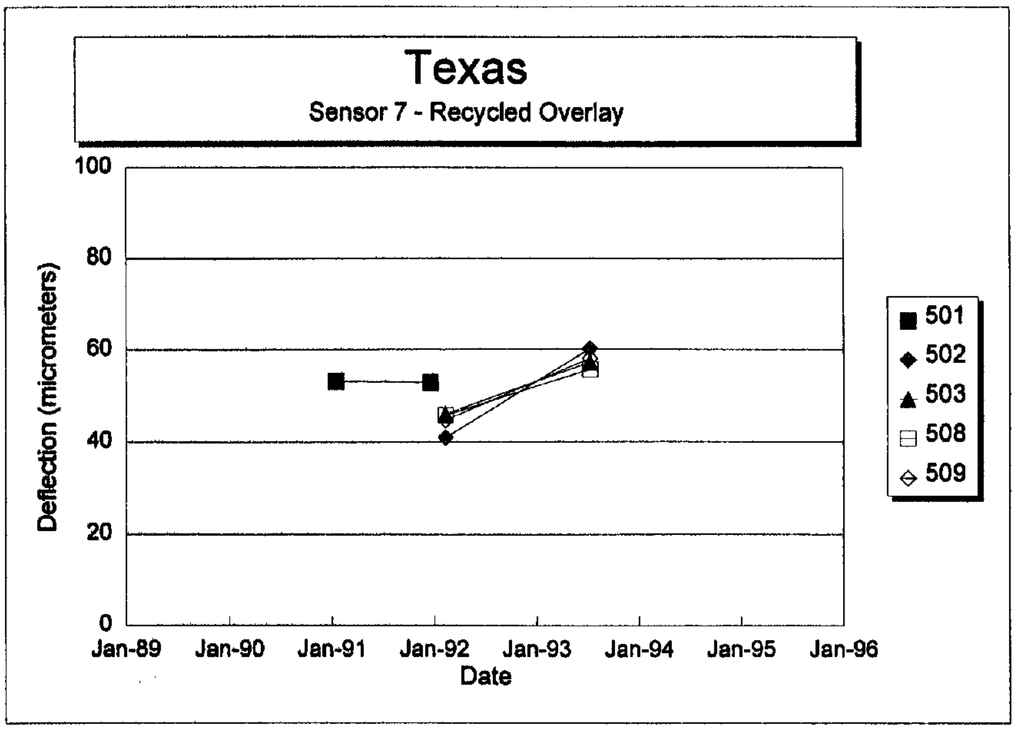


Figure 98. Sensor 1 deflection versus time for each section of the Texas SPS-5 project.



Note: Section 501 is a non-overlayed control section.

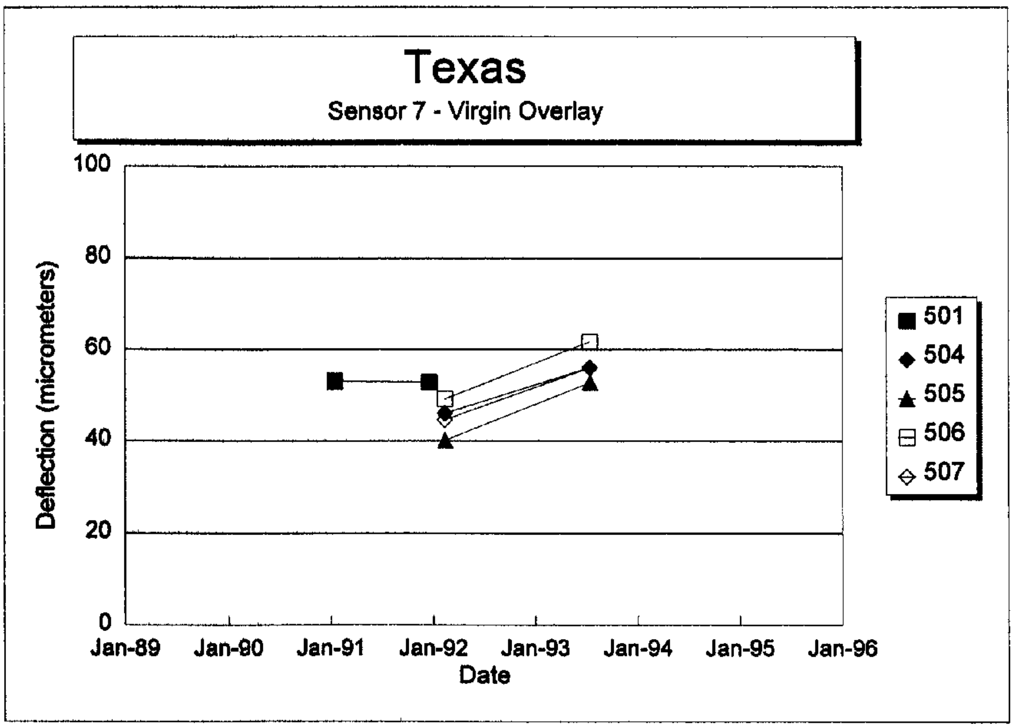
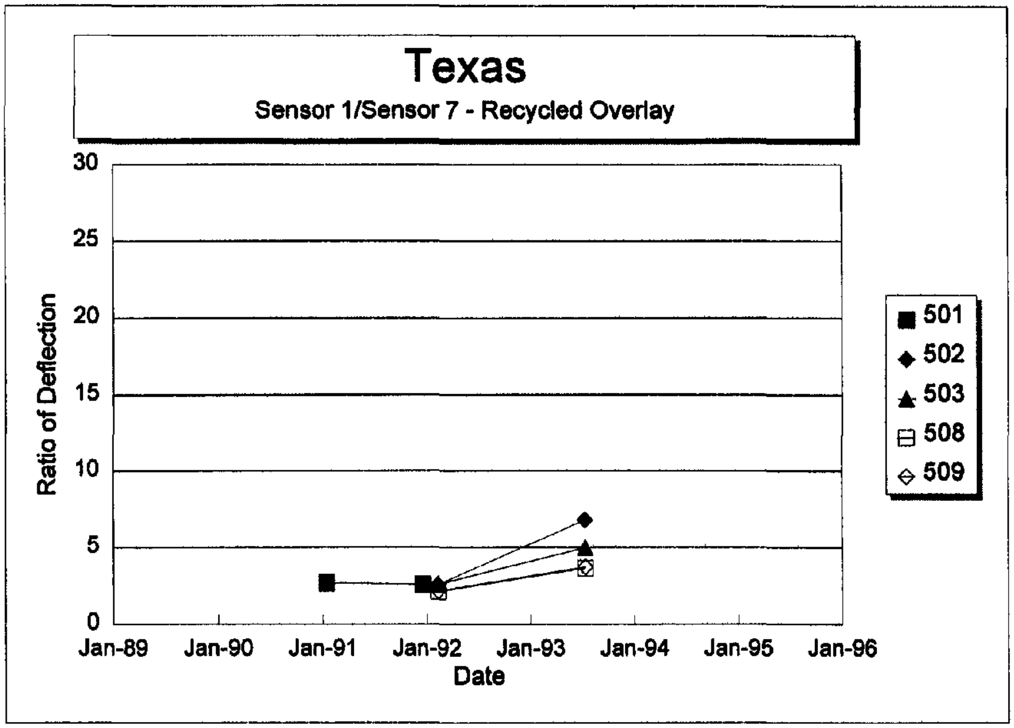


Figure 99. Sensor 7 deflection versus time for each section of the Texas SPS-5 project.



Note: Section 501 is a non-overlayed control section.

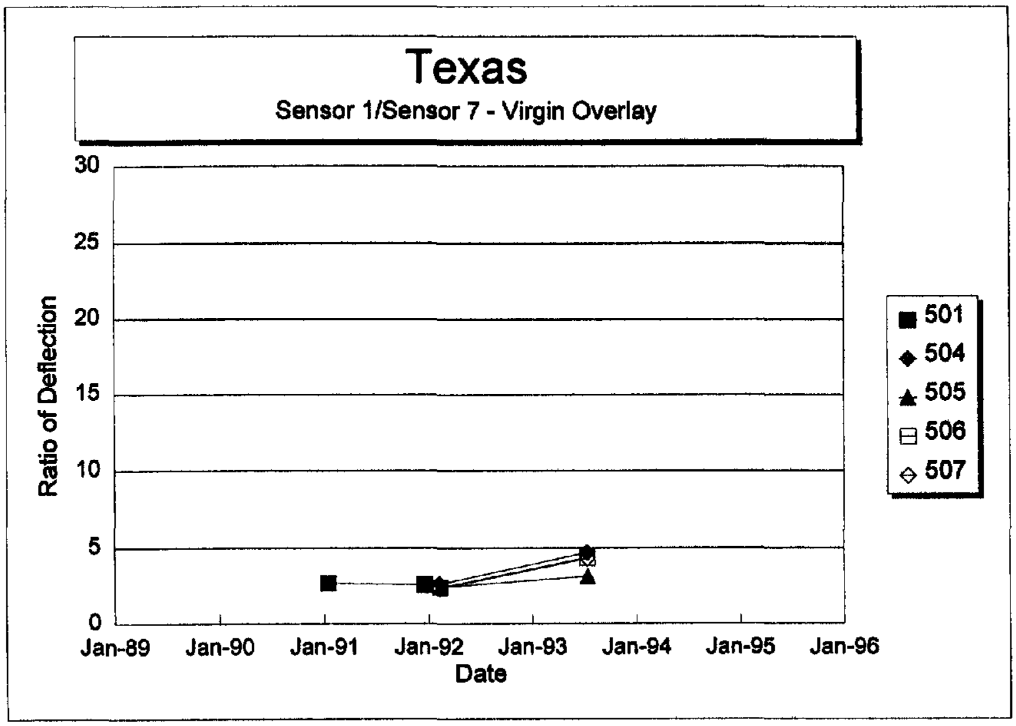
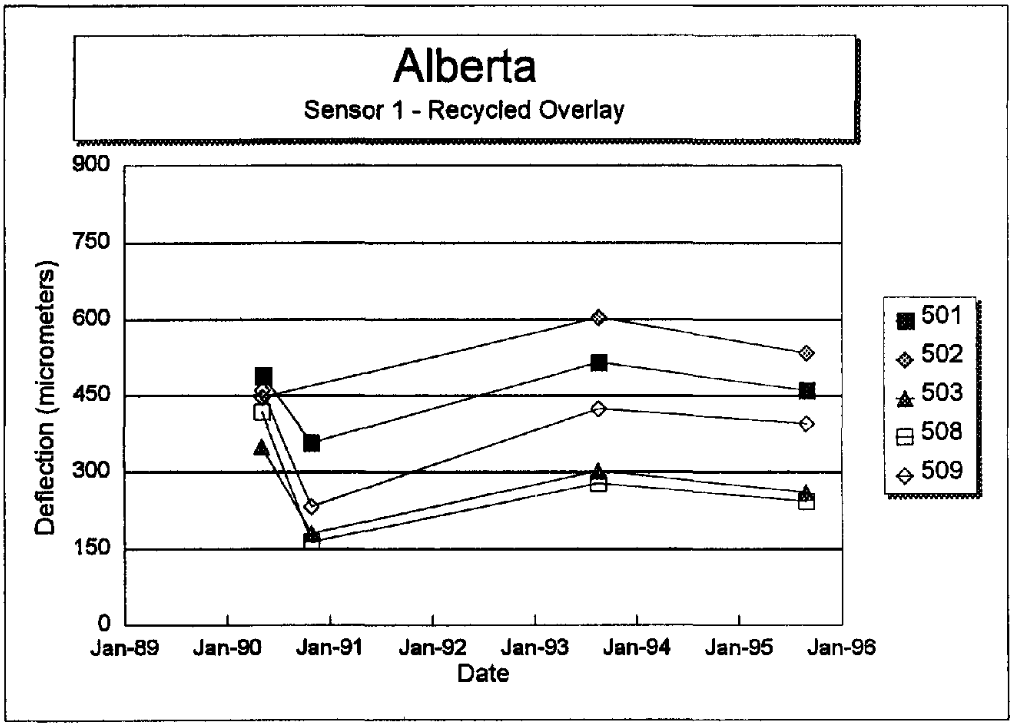


Figure 100. Sensor 1 deflection divided by Sensor 7 deflection versus time for each section of the Texas SPS-5 project.



Note: Section 501 is a non-overlayed control section.

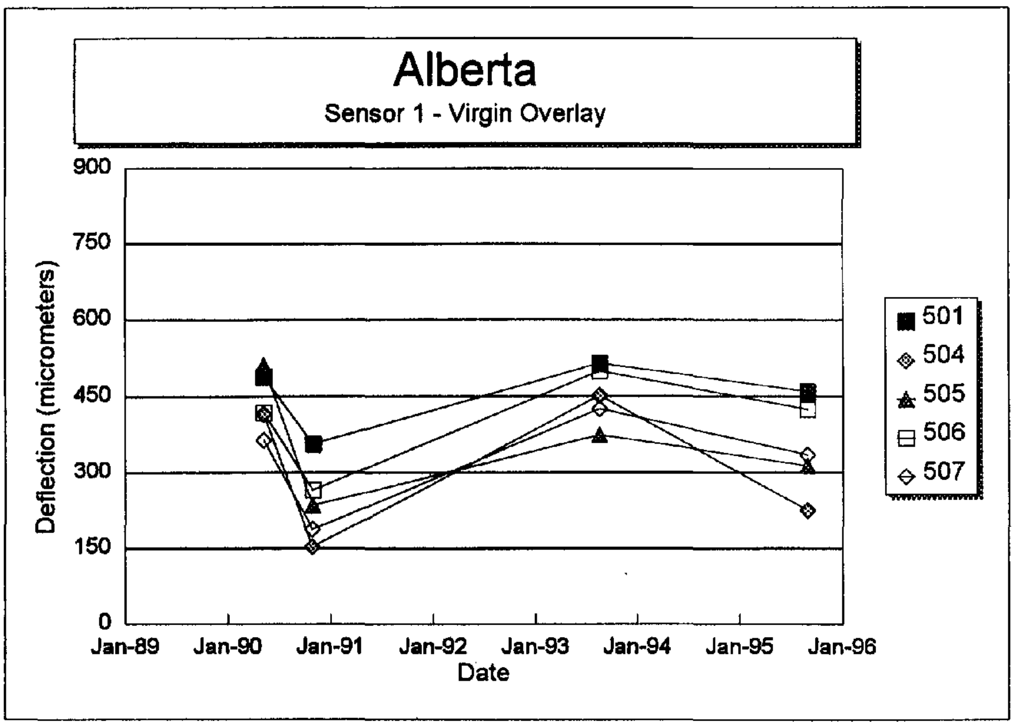
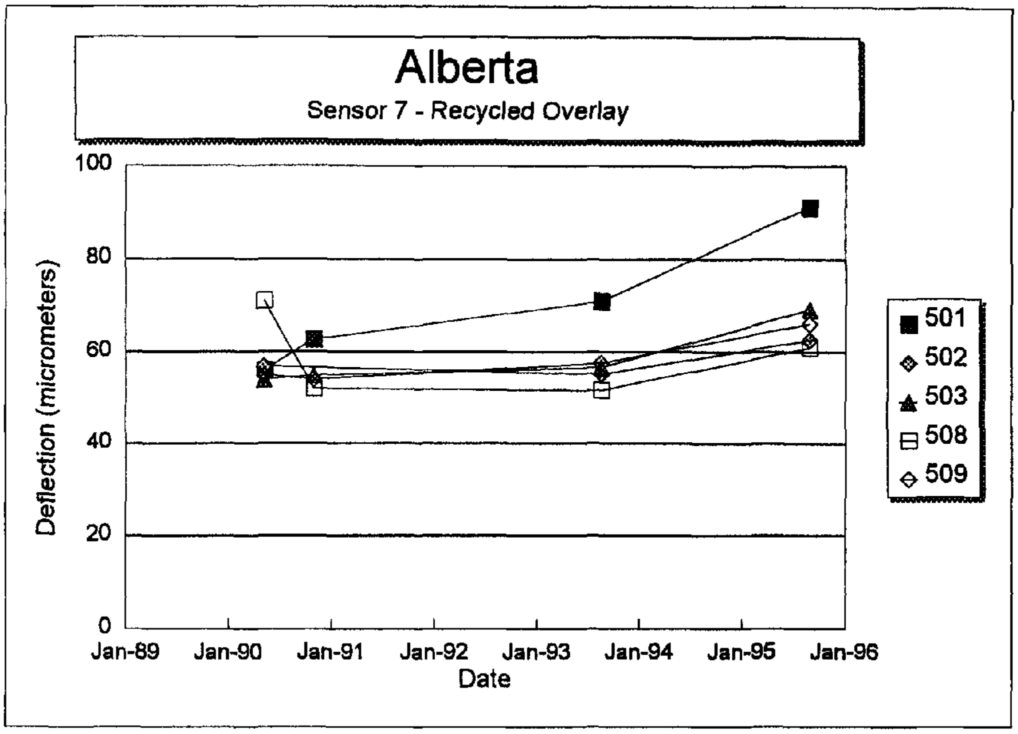


Figure 101. Sensor 1 deflection versus time for each section of the Alberta SPS-5 project.



Note: Section 501 is a non-overlayed control section.

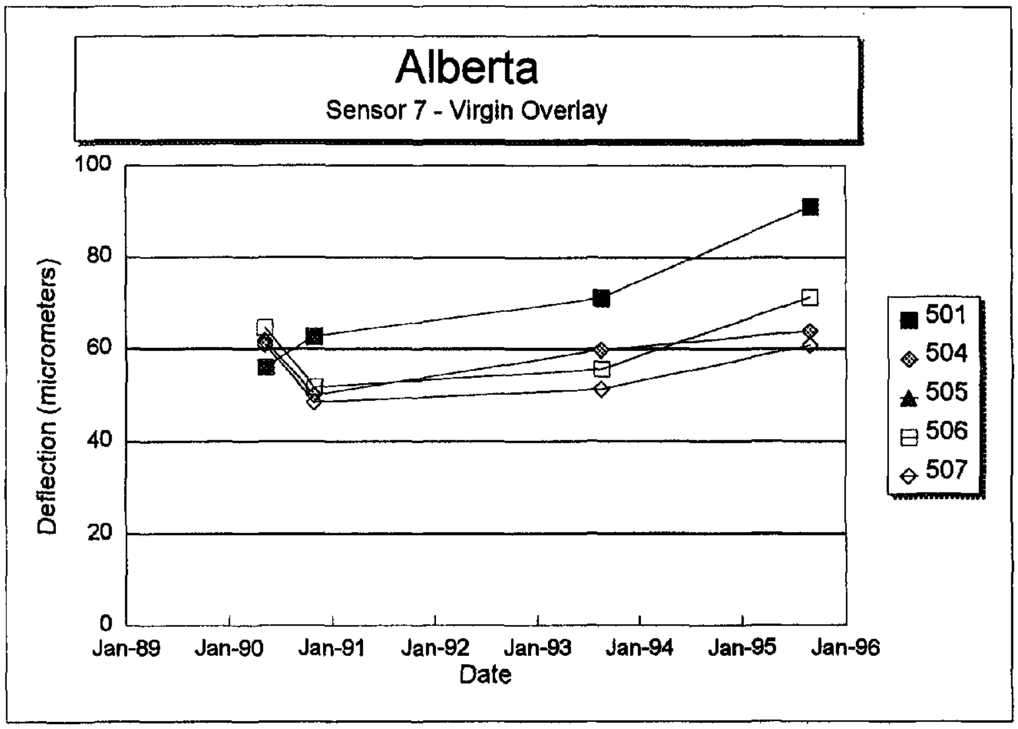
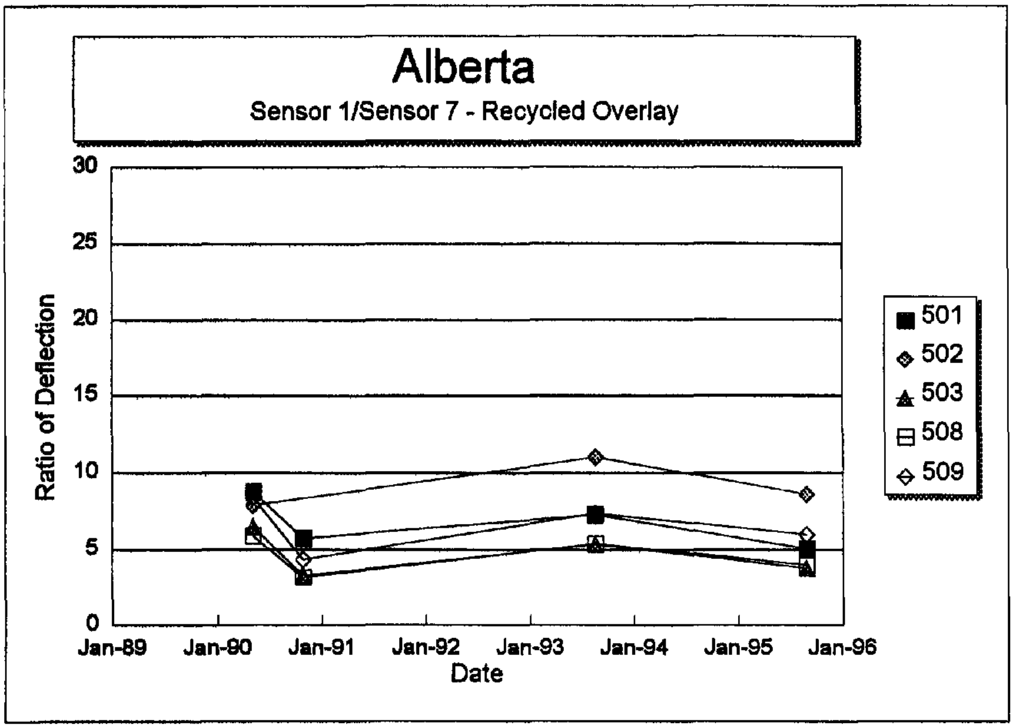


Figure 102. Sensor 7 deflection versus time for each section of the Alberta SPS-5 project.



Note: Section 501 is a non-overlayed control section.

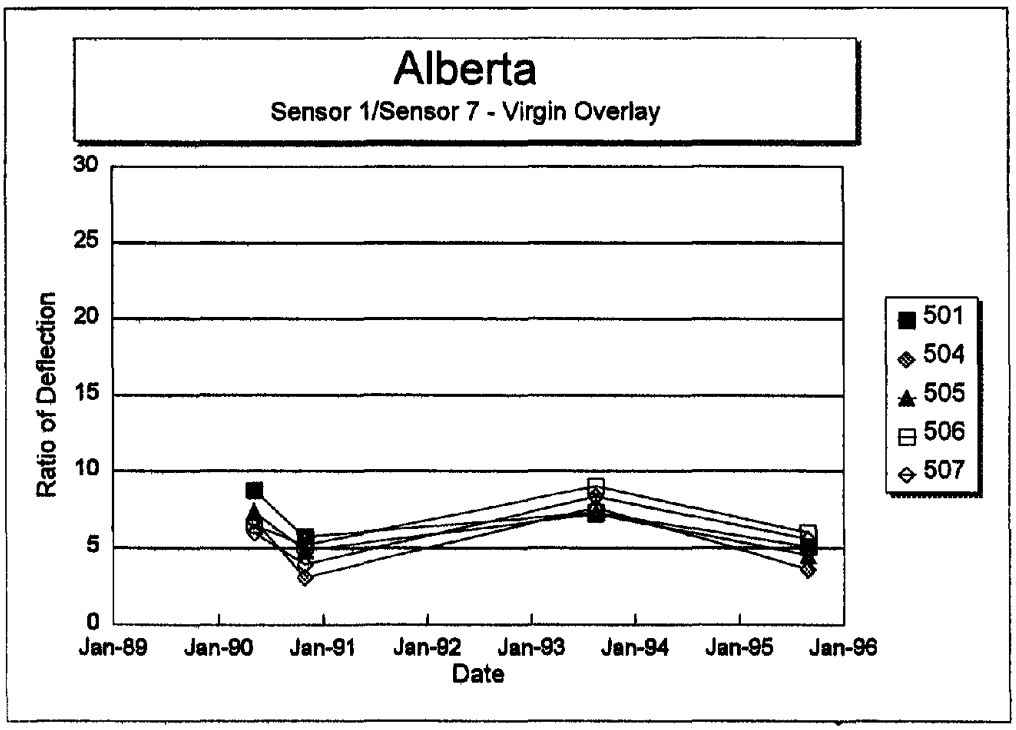
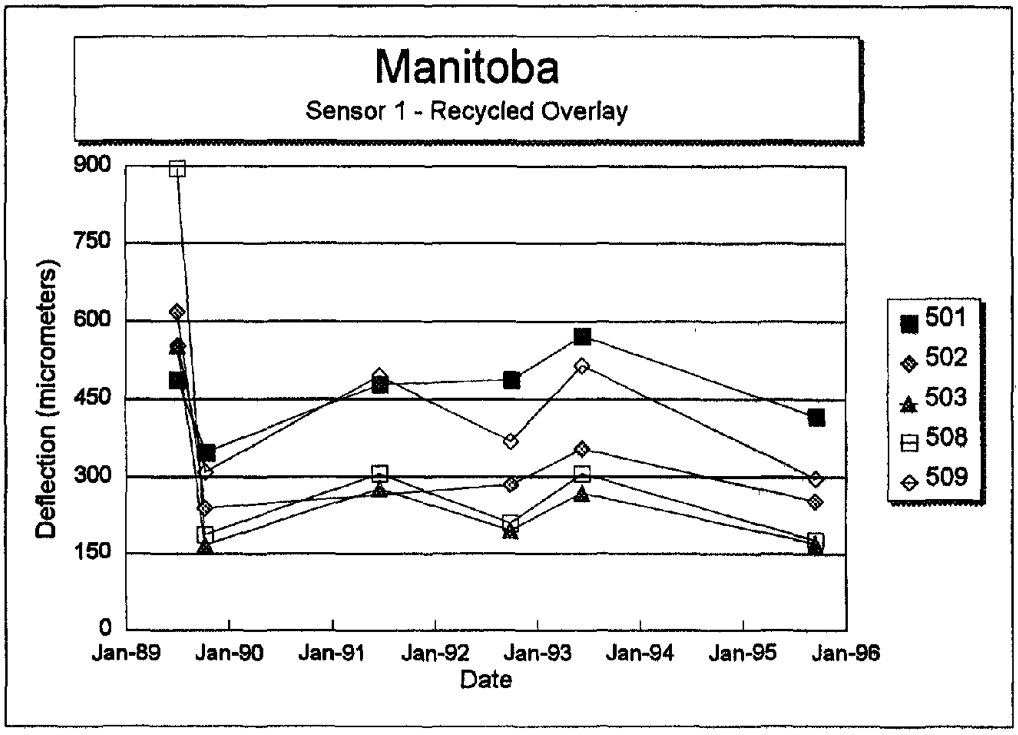


Figure 103. Sensor 1 deflection divided by Sensor 7 deflection versus time for each section of the Alberta SPS-5 project.



Note: Section 501 is a non-overlayed control section.

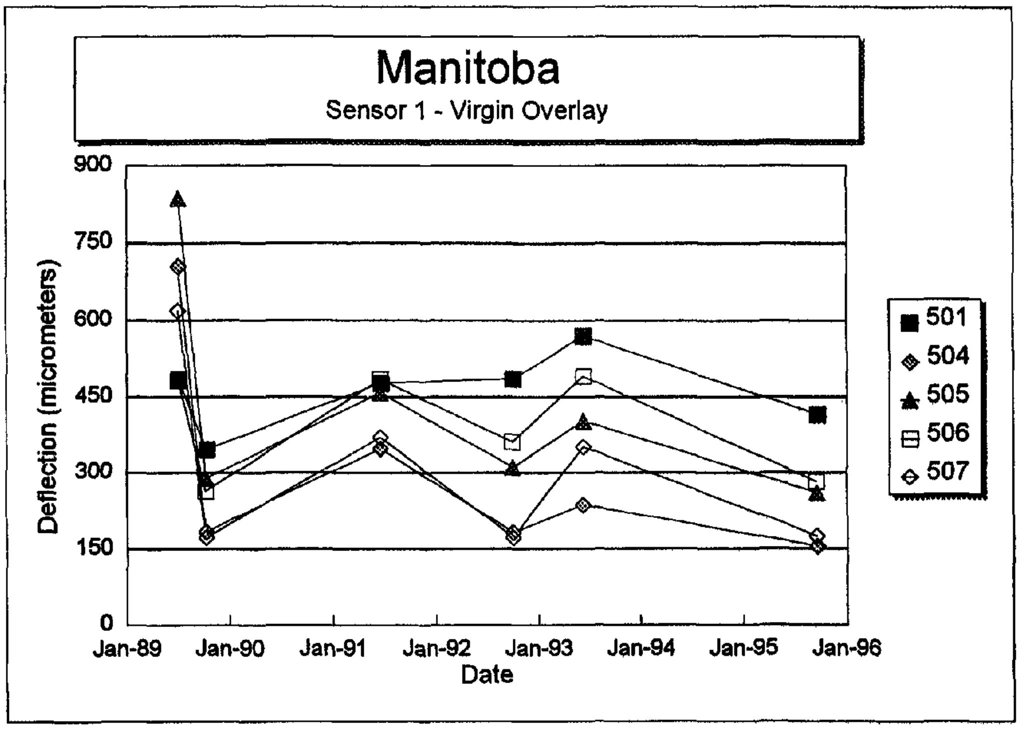
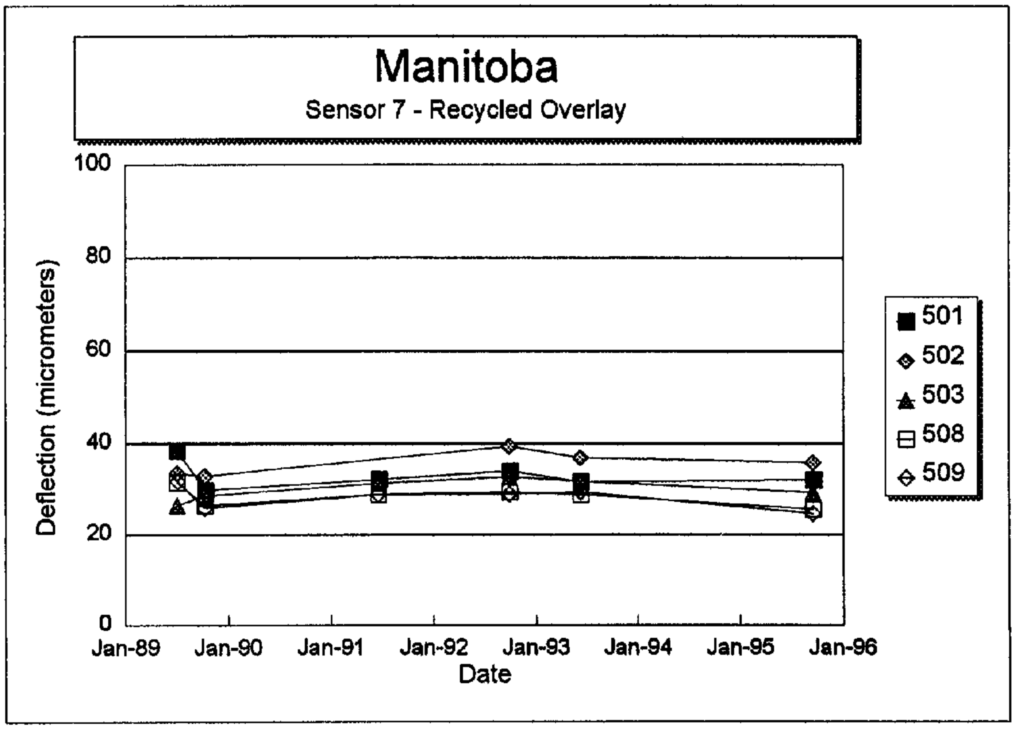


Figure 104. Sensor 1 deflection versus time for each section of the Manitoba SPS-5 project.



Note: Section 501 is a non-overlayed control section.

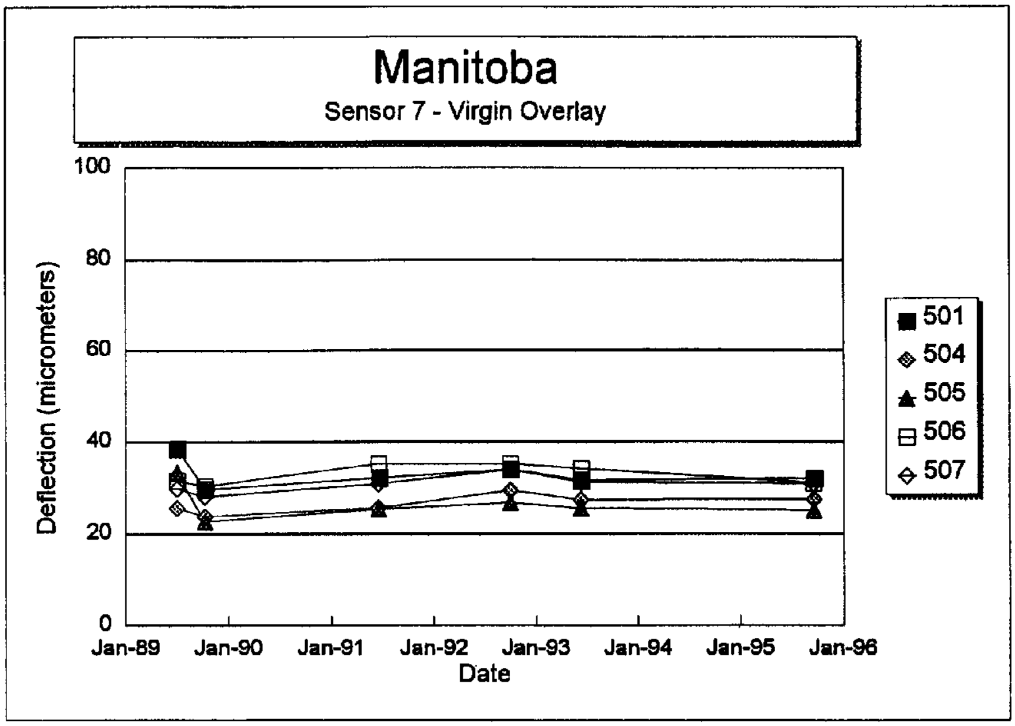
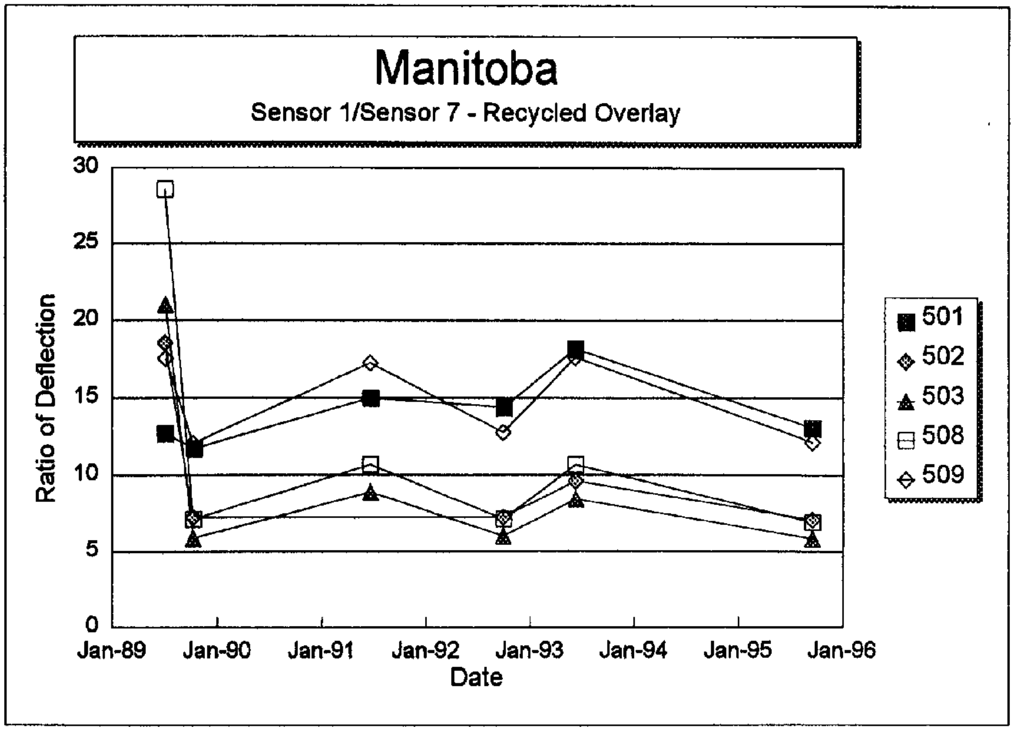


Figure 105. Sensor 7 deflection versus time for each section of the Manitoba SPS-5 project.



Note: Section 501 is a non-overlayed control section.

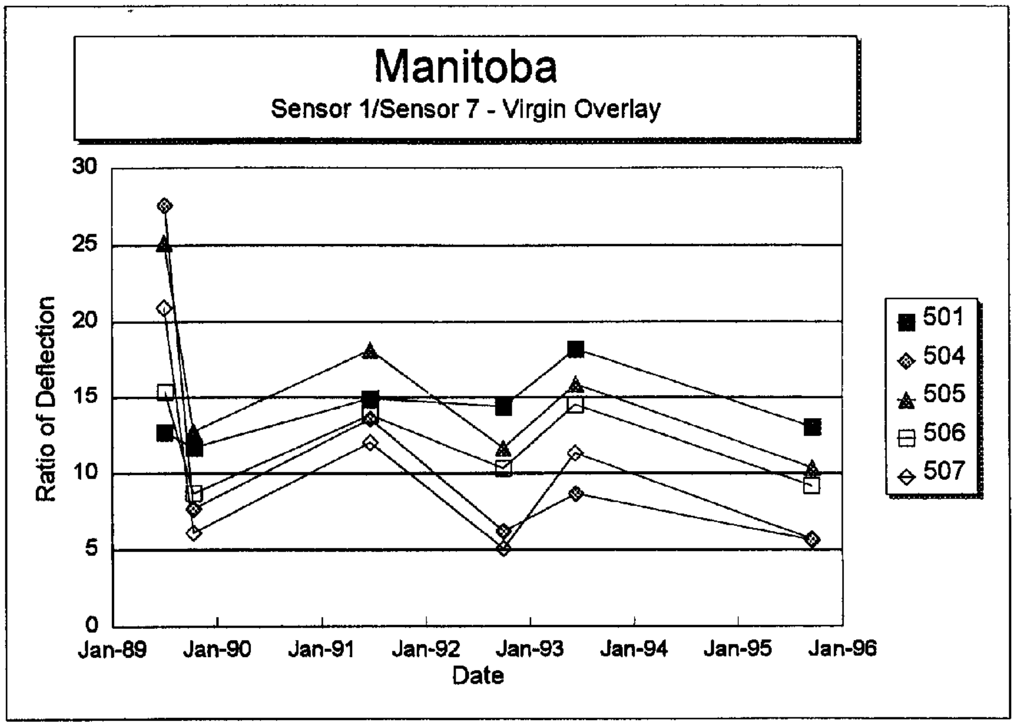


Figure 106. Sensor 1 deflection divided by Sensor 7 deflection versus time for each section of the Manitoba SPS-5 project.

APPENDIX B. TABLES AND PLOTS OF DISTRESSES OCCURRING ON SPS-6 PROJECTS

Table 11. Quantities of Jointed Concrete Pavement (JCP) distress by test section for individual distress surveys on SPS-6 projects.

ST	SH	REHA	*	SURVEY	1	2n	2a	3	3s	4n	4l	4ls	j	5tn	5ln	5ll	6	7n	7l	9	5fn	5fa	5rn	5ra
4	601	Oct-90	P	Nov-89	0	0	0	173	0	20	218	0	N	0	0	0	0	36	518	0	0	0	0	0
4	602	Oct-90	P	Nov-89	0	0	0	103	0	22	235	0	N	0	0	0	0	34	322	0	0	0	0	0
4	603	Oct-90	P	Nov-89	0	0	0	191	0	11	103	0	N	0	0	0	0	34	484	0	0	0	0	0
4	604	Oct-90	P	Nov-89	0	0	0	75	0	20	215	0	N	0	0	0	0	29	316	0	0	0	0	0
4	605	Oct-90	P	Nov-89	0	0	0	27	0	12	134	0	N	0	0	0	0	33	364	0	0	0	0	0
4	606	Oct-90	P	Nov-89	0	0	0	25	0	19	210	0	N	0	0	0	0	32	202	0	0	0	0	0
4	607	Oct-90	P	Nov-89	0	0	0	60	0	3	29	0	N	0	0	0	0	29	169	0	0	0	0	0
4	608	Oct-90	P	Nov-89	0	0	0	85	0	7	52	0	N	0	0	0	0	23	190	0	0	0	0	0
4	601	Oct-90	M	Sep-91	5	11	12	69	0	20	46	0	N	0	0	0	42	30	63	0	47	20	0	0
4	602	Oct-90	M	Sep-91	8	4	2.4	47	0	33	85	0	N	0	0	0	37	0	0	0	2	0.3	90	17
4	605	Oct-90	M	Apr-91	25	1	0.4	36	0	2	2.4	0	N	0	0	0	0	6	12	0	0	0	66	714
4	605	Oct-90	M	Sep-91	5	9	1.6	16	0	24	80	0	N	0	0	0	49	14	18	0	9	2.6	52	17
6	602	Nov-92	M	May-92	0	0	0	0	0	18	56	0	N	0	0	0	0	0	0	0	0	0	0	0
6	602	Nov-92	M	Oct-92	0	0	0	0	0	37	88	62	N	0	1	0	60	0	0	0	0	0	13	161
6	603	Nov-92	M	May-92	14	0	0	21	0	17	50	0	Y	32	0	0	0	7	2.3	0	2	15	0	0
6	604	Nov-92	M	May-92	4	0	0	81	0	45	116	0	N	0	0	0	0	0	0	0	2	0.2	0	0
6	605	Nov-92	M	Oct-92	0	0	0	5	0	3	11	0	N	0	0	0	68	0	0	0	0	0	0	0
6	606	Nov-92	M	May-92	1	0	0	11	0	23	62	0	N	0	0	0	0	11	5.1	0	0	0	0	0
6	607	Nov-92	M	May-92	13	0	0	41	0	47	111	0	Y	32	0	0	0.4	10	4.7	0	0	0	0	0
6	608	Nov-92	M	May-92	5	0	0	24	0	34	108	0	N	0	0	0	0	0	0	0	0	0	0	0
17	601	Jun-91	M	Dec-91	1	0	0	0	0	20	69	0	Y	5	1	153	4	1	1.5	6	0	0	0	0
17	601	Jun-90	M	Aug-93	2	0	0	0.5	0	23	79	0	Y	5	1	153	0	2	2	0	0	0	0	0
17	602	Jun-90	M	Dec-91	1	0	0	0	0	46	143	0	Y	3	1	0	0	0	0	0	0	0	1	6.7
17	602	Jun-90	M	Aug-93	4	0	0	0	0	56	160	148	Y	13	1	0	2.4	0	0	0	0	0	0	0
17	605	Jun-90	M	Dec-91	0	0	0	0	0	32	107	101	Y	0	1	0	18	1	0.6	0	0	0	10	95
17	605	Jun-90	M	Aug-93	0	0	0	0	0	47	137	101	Y	27	1	0	19	2	1	0	0	0	10	95
18	601	Aug-90	M	Sep-92	0	25	112	2	0	5	16	0	Y	25	1	153	0	0	0	153	0	0	0	0
18	602	Aug-90	M	Sep-92	2	26	50	0	0	0	0	0	Y	50	1	153	0	9	5.8	0	0	0	25	173
18	602	Aug-90	M	Aug-93	2	26	50	2.3	0	0	0	0	Y	50	1	153	0	5	4	0	0	0	25	173
18	605	Aug-90	M	Sep-92	0	26	54	9.1	0	0	0	0	Y	50	1	153	0	25	21	0	0	0	25	170
18	605	Aug-90	M	Aug-93	2	26	31	0	0	0	0	0	Y	50	1	153	0	19	12	0	0	0	25	168
19	601	Sep-89	M	Sep-92	0	0	0	0	0	41	87	25	N	0	2	152	10	0	0	0	18	41	7	56
19	601	Sep-89	M	Aug-93	2	0	0	0	0	0	0	0	N	0	0	0	0	0	0	0	0	0	0	0
19	601	Sep-89	M	Aug-93	0	0	0	0	0	43	86	40	N	0	2	153	10	0	0	0	15	23	15	120
19	602	Sep-89	M	Sep-92	0	2	0.5	0	0	49	133	73	N	0	2	0	0	0	0	0	44	26	20	117
19	602	Sep-89	M	Aug-93	0	1	0.2	0	0	50	161	57	N	0	2	304	0	0	0	0	37	17	28	161
19	605	Sep-89	M	Sep-92	0	0	0	0	0	32	87	52	N	0	2	0	1	0	0	0	53	44	29	264
19	605	Sep-89	M	Aug-93	0	0	0	0	0	38	86	45	N	0	2	0	9.8	0	0	0	50	32	37	224
19	607	Sep-89	M	Aug-89	0	0	0	311	0	82	374	0	Y	12	2	0	0	0	0	0	9	59	7	510
19	608	Sep-89	M	Aug-89	0	0	0	463	0	109	523	0	Y	7	2	0	0	1	2	0	1	1	15	549
26	601	Aug-90	M	Aug-92	0	0	0	0	0	42	135	0	N	0	1	153	153	0	0	0	7	2.3	5	31
26	601	Aug-90	M	Jun-93	0	4	4	0	0	44	139	0	Y	10	0	153	154	0	0	305	7	2.2	5	34
26	602	Aug-90	M	Aug-92	0	0	0	6.5	0	81	262	0	Y	8	1	305	6	6	10	549	35	19	3	26
26	602	Aug-90	M	Jun-93	0	16	29	7.5	0	78	262	0	Y	15	1	305	0	8	12	610	35	26	4	34
26	605	Aug-90	M	Aug-92	0	0	0	1.3	0	34	122	0	Y	5	2	0	8.1	5	4.8	0	5	1.4	27	181
26	605	Aug-90	M	Jun-93	0	5	9.3	1.8	0	34	119	0	Y	20	2	610	8.1	5	4.8	610	0	0	27	202

Table 11. Quantities of Jointed Concrete Pavement (JCP) distress by test section for individual distress surveys on SPS-6 projects (continued).

ST	SH	REHA	*	SURVEY	1	2n	2a	3	3s	4n	4l	4ls	j	5tn	5ln	5ll	6	7n	7l	9	5fn	5fa	5rn	5ra
29	601	Aug-92	M	Aug-91	0	2	1.7	0	0	10	37	0	Y	0	0	0	0	0	0	0	0	0	2	13
29	601	Aug-92	M	Oct-93	1	3	0.7	0	0	11	38	0	Y	11	1	0	0	14	23	0	0	0	3	47
29	602	Aug-92	M	Aug-91	0	16	7.6	0	0	25	71	0	Y	0	0	0	0	0	0	0	0	0	2	29
29	602	Aug-92	M	Apr-92	0	0	0	0	0	0	0	0	Y	0	0	0	0	0	0	0	0	0	0	0
29	602	Aug-92	M	Oct-93	0	7	1.4	9.4	0	27	94	0	Y	23	1	0	0	10	5	0	0	0	17	141
29	603	Aug-92	M	Aug-91	1	10	2.4	0	0	11	39	0	Y	0	0	0	0	0	0	0	0	0	4	39
29	603	Aug-92	M	Mar-92	0	0	0	0	0	0	0	0	Y	0	0	0	0	0	0	0	0	0	0	0
29	604	Aug-92	M	Aug-91	0	11	7.7	0	0	15	57	0	Y	0	0	0	0	0	0	0	0	0	1	6.7
29	604	Aug-92	M	Mar-92	0	0	0	0	0	0	0	0	Y	0	0	0	0	0	0	0	0	0	0	0
29	605	Aug-92	M	Aug-91	0	12	0	0	0	24	0	0	Y	1	0	0	0	1	0	0	0	0	6	129
29	605	Aug-92	M	Apr-92	0	0	0	0	0	0	0	0	Y	0	0	0	0	0	0	0	0	0	0	0
29	605	Aug-92	M	Oct-93	0	5	3.3	5.8	0	16	61	0	Y	0	2	82	1	28	11	0	0	0	30	419
29	606	Aug-92	M	Aug-91	0	7	3.8	0	0	8	25	0	Y	0	0	0	0	1	1.2	0	0	0	4	37
29	606	Aug-92	M	Mar-92	0	0	0	0	0	0	0	0	Y	0	0	0	0	0	0	0	0	0	0	0
29	607	Aug-92	M	Aug-91	0	9	6.7	1.5	0	19	70	0	Y	0	0	0	0	0	0	0	0	0	3	69
29	607	Aug-92	M	Apr-92	0	0	0	0	0	0	0	0	Y	0	0	0	0	0	0	0	0	0	0	0
29	608	Aug-92	M	Aug-91	0	10	16	0	0	22	78	0	Y	0	0	0	0	0	0	0	0	0	0	0
29	608	Aug-92	M	Apr-92	0	0	0	0	0	0	0	0	Y	0	0	0	0	0	0	0	0	0	0	0
40	601	Aug-92	M	Jul-92	0	0	0	3	0	0	0	0	Y	6	1	0	0	5	3.8	0	1	0.2	3	20
40	601	Aug-92	M	Nov-92	0	0	0	3	0	1	3.6	0	Y	6	1	0	0	5	3.8	0	1	0.2	3	20
40	601	Aug-92	M	Mar-94	0	0	0	0	0	1	3.7	3.7	Y	6	1	0	0	1	1.1	0	1	0.5	3	22
40	601	Aug-92	M	Nov-94	0	0	0	3.8	0	1	3.7	3.7	Y	6	1	0	0	1	1.1	0	1	0.5	2	22
40	602	Aug-92	M	Jul-92	0	0	0	9.8	3.3	10	23	6.6	Y	7	1	0	0	4	2.3	0	0	0	10	56
40	602	Aug-92	M	Nov-92	0	0	0	9.8	3.3	9	21	3	Y	7	2	0	0	4	2.3	0	1	0.2	10	56
40	602	Aug-92	M	Mar-94	0	0	0	6.3	6.3	8	22	14	Y	7	2	0	0	1	0.5	0	1	0.3	7	54
40	602	Aug-92	M	Nov-94	0	0	0	6.8	6.5	7	20	12	Y	7	2	0	0	2	1.8	0	2	0.6	10	54
40	603	Aug-92	M	Jul-92	0	0	0	7.6	0	0	0	0	Y	6	1	0	0	3	1.5	0	0	0	2	10
40	604	Aug-92	M	Jul-92	1	0	0	13	0	4	11	0	Y	4	1	0	0	2	1	0	0	0	4	34
40	605	Aug-92	M	Jul-92	0	0	0	14	0	1	1	0	Y	12	1	0	0	5	2.5	0	0	0	7	36
40	605	Aug-92	M	Nov-92	1	0	0	14	0	1	1	0	Y	12	2	0	0	5	2.5	0	0	0	7	36
40	605	Aug-92	M	Mar-94	1	0	0	8.8	0	1	1.5	0	Y	12	2	0	0	7	3.5	0	1	0.4	7	36
40	605	Aug-92	M	Nov-94	0	0	0	8.1	0	1	1.5	0	Y	12	2	0	0	6	4.6	0	3	0.6	7	37
40	606	Aug-92	M	Jul-92	0	0	0	15	0	1	3.6	0	Y	4	1	0	0	3	1.5	0	0	0	5	23
40	607	Aug-92	M	Jul-92	0	0	0	0	0	1	1	0	Y	7	1	0	0	3	2.5	0	3	4.1	2	10
40	608	Aug-92	M	Jul-92	0	0	0	0	0	0	0	0	Y	10	1	0	0.5	4	5.7	0	3	1.9	2	10
42	601	Sep-92	M	Nov-89	4	0	0	0	0	2	1.2	0	Y	16	2	7	6.7	4	3	557	8	2.6	0	0
42	601	Sep-92	M	Jun-94	0	0	0	0	0	0	0	0	Y	9	1	132	42	5	1.6	300	16	8	2	12
42	602	Sep-92	M	Nov-89	0	0	0	0	0	0	0	0	Y	8	2	0.6	0.6	1	0.6	279	6	1.4	0	0
42	602	Sep-92	M	Jun-94	1	0	0	47	0	9	20	0	Y	13	1	304	5	0	0	999	14	6.3	0	0
42	603	Sep-92	M	Nov-89	0	0	0	0	0	2	5.8	0	Y	9	2	6	6.4	0	0	279	3	3	0	0
42	604	Sep-92	M	Nov-89	0	0	0	0	0	0	0	0	Y	8	2	15	15	1	1.2	279	1	0.5	0	0
42	605	Sep-92	M	Nov-89	1	0	0	5.8	0	0	0	0	Y	16	2	5.8	0	5	3.6	557	11	2.4	0	0
42	605	Sep-92	M	Jun-94	0	0	0	5.5	0	4	10	0	Y	27	1	0	216	8	1.3	0	20	11	18	143
42	606	Sep-92	M	Nov-89	0	0	0	0	0	1	4.3	0	Y	9	2	3.7	9.4	2	2.4	279	3	5.8	0	0
42	607	Sep-92	M	Nov-89	0	0	0	4	0	2	8.5	0	Y	9	2	9	9.1	2	4.8	279	0	0	0	0
42	608	Sep-92	M	Nov-89	0	0	0	0	0	1	3.7	0	Y	9	2	0	0.5	0	0	279	0	0	0	0
46	601	Sep-92	M	Oct-92	3	14	27	1.5	0	5	12	0	Y	25	1	152	0	10	14	0	0	0	1	24
46	601	Sep-92	M	Aug-95	4	22	71	9.5	0	4	9.4	3.8	Y	9	1	152	1	11	13	0	0	0	3	37
46	602	Sep-92	M	Oct-92	6	0	0	0	0	1	3.7	3.7	Y	54	2	2.5	0.5	0	0	0	0	0	12	111
46	602	Sep-92	M	Aug-95	5	8	27	0	0	4	6.3	4	Y	54	0	0	2	9	6.7	0	0	0	6	36
46	605	Sep-92	M	Oct-92	6	0	0	0	0	0	0	0	Y	57	1	305	0	0	0	0	0	0	149	15
46	605	Sep-92	M	Aug-95	2	6	3.7	0	0	2	3.7	0	Y	57	1	305	0	0	0	0	0	0	13	78
46	608	Sep-92	M	Aug-95	2	6	3.7	0	0	3	3.7	0	Y	57	1	305	0	0	0	0	0	0	13	78

Table 11. Quantities of Jointed Concrete Pavement (JCP) distress by test section for individual distress surveys on SPS-6 projects (continued).

JCP DISTRESS CODES:	1	Corner Breaks, number
	2n	Durability Cracking, number of affected slabs
	2a	Durability Cracking, area affected (m^2)
	3	Longitudinal Cracking (m)
	3s	Longitudinal Cracking, sealed (m)
	4n	Transverse Cracks, number
	4l	Transverse Cracks, length (m)
	4ls	Transverse Cracks, length sealed (m)
	j	Transverse Joints sealed, yes or no
	5tn	Transverse Joints sealed, number
	5ln	Longitudinal Joints sealed, number
	5ll	Longitudinal Joints sealed, length damaged (m)
	6	Spalling of Longitudinal Joints (m)
	7n	Spalling of Transverse Joints, number
	7l	Spalling of Transverse Joints, length (m)
	9	Polished Aggregate (m^2)
	15fn	Flexible Patching, number
	15fa	Flexible Patching, area (m^2)
	15rn	Rigid Patching, number
	15ra	Rigid Patching, area (m^2)
TEST SECTION NUMBERS:	601	Control
	602	Concrete Pavement Restoration
	603	4-in (102-mm) AC Overlay
	604	4-in (102-mm) AC Overlay, with "Saw & Seal"
	605	Concrete Pavement Restoration, with Edgedrains
	606	4-in (102-mm) AC Overlay, with Edgedrains
	607	4-in (102-mm) AC Overlay, with Breaking & Seating and Edgedrains
	608	8-in (203-mm) AC Overlay, with Breaking & Seating and Edgedrains
SURVEY TYPES:	M	Manual Survey
	P	PASCO Film

Table 11. Quantities of Jointed Concrete Pavement (JCP) distress by test section for individual distress surveys on SPS-6 projects (continued).

STATE CODE:	4	Arizona
	6	California
	17	Illinois
	18	Indiana
	19	Iowa
	26	Michigan
	29	Missouri
	40	Oklahoma
	42	Pennsylvania
	46	South Dakota

Table 12. Quantities of Asphalt Concrete Pavement (ACP) distress by test section for individual distress surveys on SPS-6 projects after rehabilitation.

ST	SHRP	REHAB	*	SURVEY	4a	4as	4b	4bs	5tn	5tl	5tls	5ll	5lls	6n	6l	6ls	11
4	603	Aug-90	M	Sep-91	0	0	52	0	0	0	0	0	0	20	48	0	29
4	603	Aug-90	M	Sep-94	0	0	0	0	22	77	0	0	0	10	18	0	0
4	604	Oct-90	M	Sep-91	0	0	0	0	0	0	0	0	0	34	124	0	0
4	604	Oct-90	M	Sep-94	0	0	0	0	0	0	0	226	0	35	123	123	0
4	606	Oct-90	M	Sep-91	0	0	43	0	0	0	0	0	0	13	41	0	0
4	606	Oct-90	M	Sep-94	0	0	19	0	17	57	0	148	0	10	12	0	0
4	607	Oct-90	M	Sep-91	0	0	0	0	0	0	0	0	0	5	16	0	0
4	607	Oct-90	M	Sep-94	0	0	1.8	0	0	0	0	145	0	13	33	0	0
4	608	Oct-90	M	Sep-91	0	0	0	0	0	0	0	0	0	0	0	0	0
4	608	Oct-90	M	Sep-94	0	0	0	0	0	0	0	74	0	2	0.6	0	0
4	609	Oct-90	M	Sep-91	0	0	15	0	0	0	0	0	0	0	0	0	75
4	610	Oct-90	M	Sep-91	0	0	17	0	0	0	0	0	0	3	15	0	0
4	611	Oct-90	M	Sep-91	0	0	0	0	0	0	0	0	0	3	9.1	0	0
6	603	Nov-92	M	Aug-95	0	0	152	0	0	0	0	0	0	6	6.9	0	0
6	604	Nov-92	M	Aug-95	0	0	0	0	0	0	0	0	0	31	115	115	0
6	606	Nov-92	M	Aug-95	0	0	11	0	0	0	0	0	0	12	11	0	0
6	607	Nov-92	M	Aug-95	0	0	152	0	0	0	0	0	0	0	0	0	0
6	608	Nov-92	M	Aug-95	0	0	0	0	0	0	0	0	0	0	0	0	0
17	603	Jun-91	M	Dec-91	0	0	0	0	5	18	0	0	0	0	0	0	0
17	603	Jun-91	M	Aug-93	0	0	24	0	5	18	0	0	0	1	3.5	0	0
17	604	Jun-90	M	Dec-91	0	0	0	0	6	22	22	27	20	0	0	0	0
17	604	Jun-90	M	Aug-93	0	0	153	0	6	21	21	0	0	0	0	0	0
17	606	Jun-90	M	Dec-91	0	0	0	0	0	0	0	15	0	5	15	0	0
17	606	Jun-90	M	Aug-93	0	0	305	0	0	0	0	0	0	4	14	0	0
17	607	Jun-90	M	Dec-91	0	0	0	0	0	0	0	5.2	0	0	0	0	0
17	607	Jun-90	M	Aug-93	0	0	7.3	0	0	0	0	0	0	0	0	0	0
17	608	Jun-90	M	Dec-91	0	0	0	0	0	0	0	0	0	0	0	0	0
17	608	Jun-90	M	Aug-93	0	0	19	0	0	0	0	0	0	0	0	0	0

Table 12. Quantities of Asphalt Concrete Pavement (ACP) distress by test section for individual distress surveys on SPS-6 projects after rehabilitation (continued).

ST	SHRP	REHAB	*	SURVEY	4a	4as	4b	4bs	5tn	5tl	5tls	5ll	5lls	6n	6l	6ls	11
18	603	Aug-90	M	Jun-91	0	0	0	0	0	0	0	0	0	0	0	0	0
18	603	Aug-90	M	Sep-92	0	0	0	0	0	0	0	0	0	6	20	0	0
18	603	Aug-90	M	Aug-93	0	0	0	0	0	0	0	0	0	6	23	0	0
18	604	Aug-90	M	Jun-91	0	0	0	0	50	185	185	0	0	0	0	0	0
18	604	Aug-90	M	Sep-92	0	0	0	0	50	188	188	0	0	0	0	0	0
18	604	Aug-90	M	Aug-93	0	0	0	0	50	188	188	0	0	0	0	0	0
18	606	Aug-90	M	Jun-91	0	0	0	0	0	0	0	0	0	0	0	0	0
18	606	Aug-90	M	Sep-92	0	0	0	0	0	0	0	0	0	4	9.5	0	0
18	606	Aug-90	M	Aug-93	0	0	0	0	0	0	0	0	0	10	27	0	0
18	607	Aug-90	M	Jun-91	0	0	0	0	0	0	0	0	0	0	0	0	0
18	607	Aug-90	M	Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0
18	607	Aug-90	M	Aug-93	0	0	0	0	0	0	0	0	0	6	16	0	0
18	608	Aug-90	M	Jun-91	0	0	0	0	0	0	0	0	0	0	0	0	0
18	608	Aug-90	M	Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0
18	608	Aug-90	M	Aug-93	0	0	1	0	0	0	0	0	0	0	0	0	0
19	603	Sep-89	M	Sep-92	0	0	200	200	0	0	0	0	0	12	35	35	0
19	603	Sep-89	M	Sep-93	0	0	200	200	0	0	0	0	0	12	38	0	0
19	604	Sep-89	M	Sep-92	0	0	120	120	0	0	0	0	0	0	0	0	0
19	604	Sep-89	M	Sep-93	0	0	120	120	0	0	0	0	0	18	63	56	0
19	606	Sep-89	M	Sep-92	0	0	55	0	0	0	0	0	0	10	36	0	0
19	606	Sep-89	M	Sep-93	4.5	0	55	0	0	0	0	0	0	12	38	0	0
19	607	Sep-89	M	Sep-92	0	0	299	200	0	0	0	0	0	4	12	12	0
19	607	Sep-89	M	Aug-93	304	0	200	0	0	0	0	0	0	5	12	12	0
19	608	Sep-89	M	Sep-92	300	250	0	0	0	0	0	0	0	3	11	11	0
19	608	Sep-89	M	Sep-93	0	0	300	250	0	0	0	0	0	4	11	7	0
26	603	Aug-90	M	Jun-93	0	0	0.5	0	6	17	0	0	0	0	0	0	0
26	604	Aug-90	M	Jun-93	0	0	9.5	0	9	33	33	0	0	2	0.8	0	3.6
26	606	Aug-90	M	Jun-93	0	0	0	0	4	14	0	0	0	3	1	0	0
26	607	Aug-90	M	Jun-93	0	0	0	0	0	0	0	0	0	0	0	0	0
26	608	Aug-90	M	Jun-93	0	0	0	0	0	0	0	0	0	0	0	0	0
29	603	Aug-92	M	Oct-93	0	0	0	0	0	0	0	0	0	0	0	0	0
29	604	Aug-92	M	Oct-93	0	0	38	0	20	73	73	153	0	0	0	0	0
29	606	Aug-92	M	Oct-93	0	0	0	0	0	0	0	0	0	1	3.8	0	0
29	607	Aug-92	M	Oct-93	1	0	0	0	0	0	0	0	0	1	3	0	0
29	608	Aug-92	M	Oct-93	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 12. Quantities of Asphalt Concrete Pavement (ACP) distress by test section for individual distress surveys on SPS-6 projects after rehabilitation (continued).

ST	SHRP	REHAB	*	SURVEY	4a	4as	4b	4bs	5tn	5tl	5tls	5ll	5lls	6n	6l	6ls	11
40	603	Aug-92	M	Nov-92	0	0	0	0	0	0	0	0	0	0	0	0	0
40	603	Aug-92	M	Mar-94	0	0	0	0	9	29	0	0	0	0	0	0	0
40	603	Aug-92	M	Nov-94	0	0	0	0	10	36	36	0	0	0	0	0	0
40	604	Aug-92	M	Nov-92	0	0	0	0	0	0	0	0	0	0	0	0	0
40	604	Aug-92	M	Mar-94	0	0	0	0	9	25	0	0	0	0	0	0	0
40	604	Aug-92	M	Nov-94	0	0	0	0	8	29	29	0	0	0	0	0	0
40	606	Aug-92	M	Nov-92	0	0	0	0	0	0	0	0	0	0	0	0	0
40	606	Aug-92	M	Mar-94	0	0	0	0	13	35	0	0	0	0	0	0	0
40	606	Aug-92	M	Nov-94	0	0	1.2	1.2	8	30	30	0	0	3	11	11	0
40	607	Aug-92	M	Nov-92	0	0	0	0	0	0	0	0	0	0	0	0	0
40	607	Aug-92	M	Mar-94	1.6	0	0	0	1	1.3	0	0	0	1	1.2	0	0
40	607	Aug-92	M	Nov-94	1.6	1	0	0	0	0	0	0	0	4	4.2	3	0
40	608	Aug-92	M	Nov-92	0	0	0	0	0	0	0	0	0	0	0	0	0
40	608	Aug-92	M	Mar-94	0	0	0	0	0	0	0	0	0	0	0	0	0
40	608	Aug-92	M	Nov-94	0	0	0	0	0	0	0	0	0	0	0	0	0
42	603	Sep-92	M	Jun-94	0	0	0	0	9	32	0	0	0	0	0	0	0
42	604	Sep-92	M	Jun-94	0	0	0	0	0	0	0	0	0	0	0	0	0
42	606	Sep-92	M	Jun-94	0	0	0	0	7	25	0	0	0	0	0	0	0
42	607	Sep-92	M	Jun-94	0.5	0	0	0	1	3.5	0	0	0	0	0	0	0
42	608	Sep-92	M	Jun-94	0	0	0	0	0	0	0	0	0	0	0	0	0
46	603	Sep-92	M	Oct-92	0	0	152	152	0	0	0	0	0	0	0	0	0
46	604	Sep-92	M	Oct-92	0	0	152	152	0	0	0	0	0	0	0	0	0
46	606	Sep-92	M	Oct-92	0	0	152	152	0	0	0	0	0	0	0	0	0
46	607	Sep-92	M	Oct-92	0	0	152	152	0	0	0	0	0	0	0	0	0
46	608	Sep-92	M	Oct-92	0	0	152	152	0	0	0	0	0	0	0	0	0

Table 12. Quantities of Asphalt Concrete Pavement (ACP) distress by test section for individual distress surveys on SPS-6 projects after rehabilitation (continued).

ACP DISTRESS CODES:	4a	Longitudinal Cracking in the wheelpath (m)
	4as	Longitudinal Cracking in the wheelpath, sealed (m)
	4b	Longitudinal Cracking not in the wheelpath (m)
	4bs	Longitudinal Cracking not in the wheelpath, sealed (m)
	5tn	Transverse Reflection Cracks, number
	5tl	Transverse Reflection Cracks, length (m)
	5tls	Transverse Reflection Cracks, length sealed (m)
	5ll	Longitudinal Reflection Cracking, length (m)
	5lls	Longitudinal Reflection Cracking, length sealed (m)
	6n	Transverse Cracks, number
	6l	Transverse Cracks, length (m)
	6ls	Transverse Cracks, length sealed (m)
	11	Bleeding (m^2)

TEST SECTION NUMBER:	603	4-in (102-mm) AC Overlay
	604	4-in (102-mm) AC Overlay, with "Saw & Seal"
	606	4-in (102-mm) AC Overlay, with Edgedrains
	607	4-in (102-mm) AC Overlay, with Breaking & Seating with Edgedrains
	608	8-in (203-mm) AC Overlay, with Breaking & Seating and Edgedrains

SURVEY TYPES:	M	Manual Survey
	P	PASCO Film

STATE CODES:	4	Arizona
	6	California
	17	Illinois
	18	Indiana
	19	Iowa
	26	Michigan
	29	Missouri
	40	Oklahoma
	42	Pennsylvania
	46	South Dakota

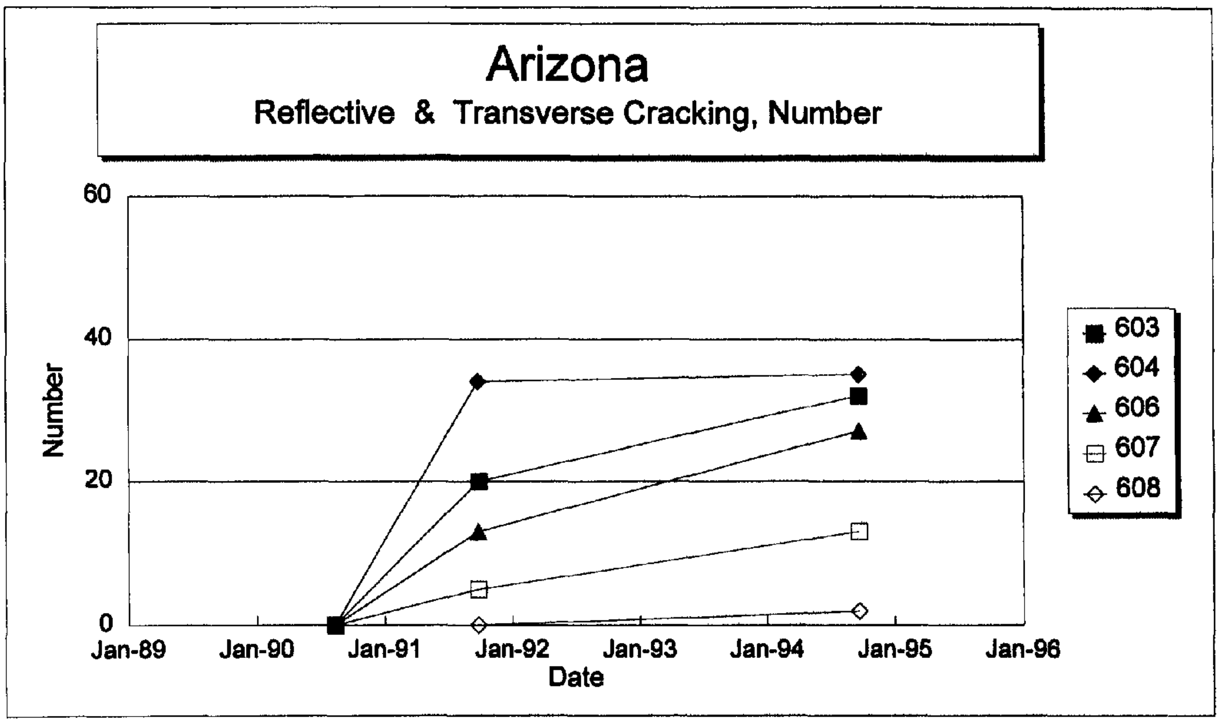


Figure 107. Total number of reflective and transverse cracks versus time on each HMAC section of the Arizona SPS-6 project.

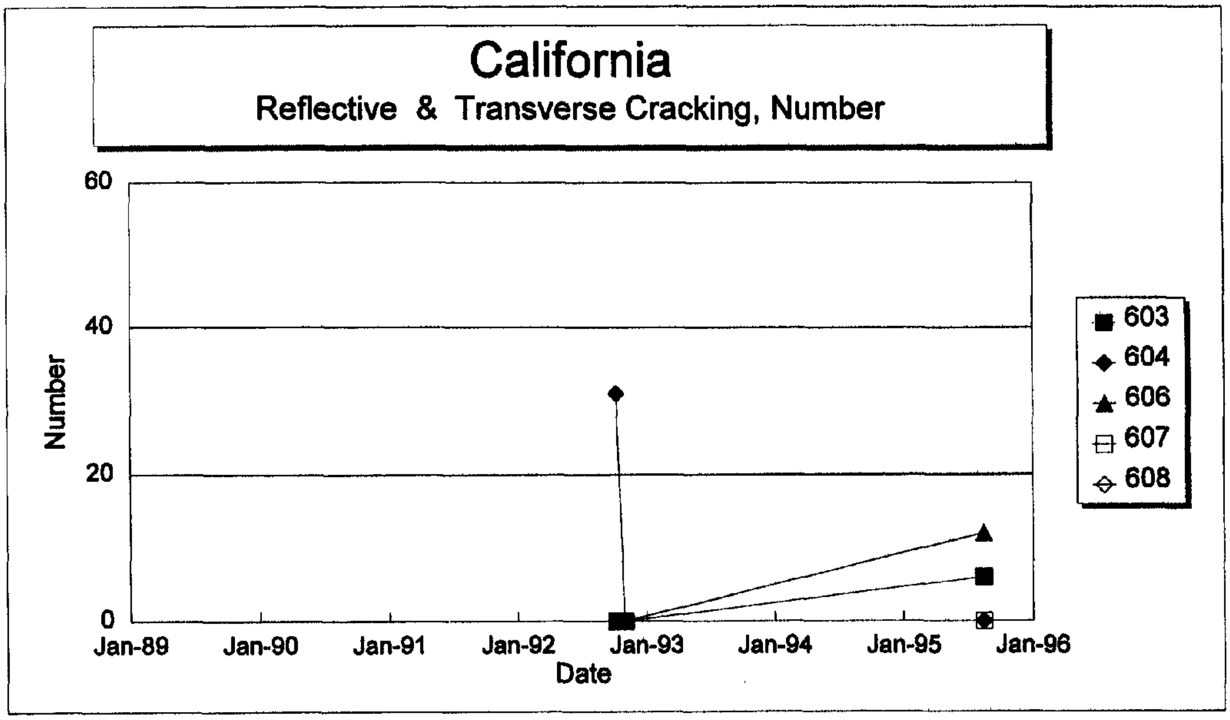


Figure 108. Total number of reflective and transverse cracks versus time on each HMAC section of the California SPS-6 project.

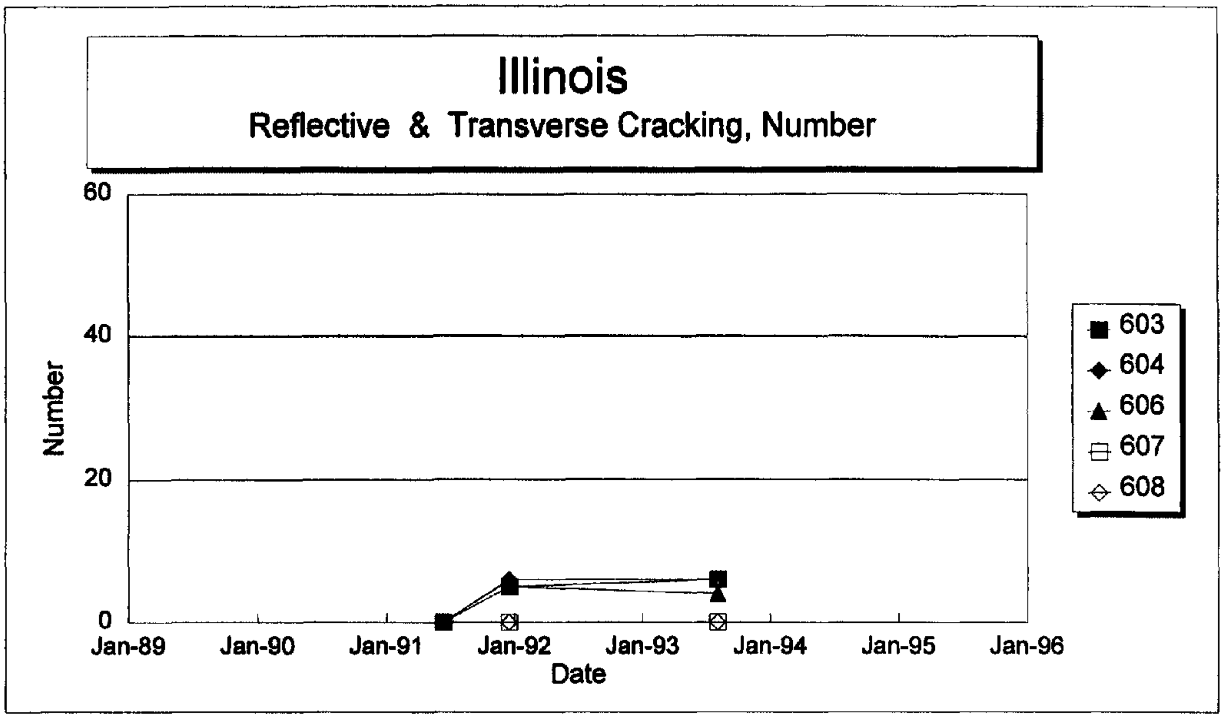


Figure 109. Total number of reflective and transverse cracks versus time on each HMAC section of the Illinois SPS-6 project.

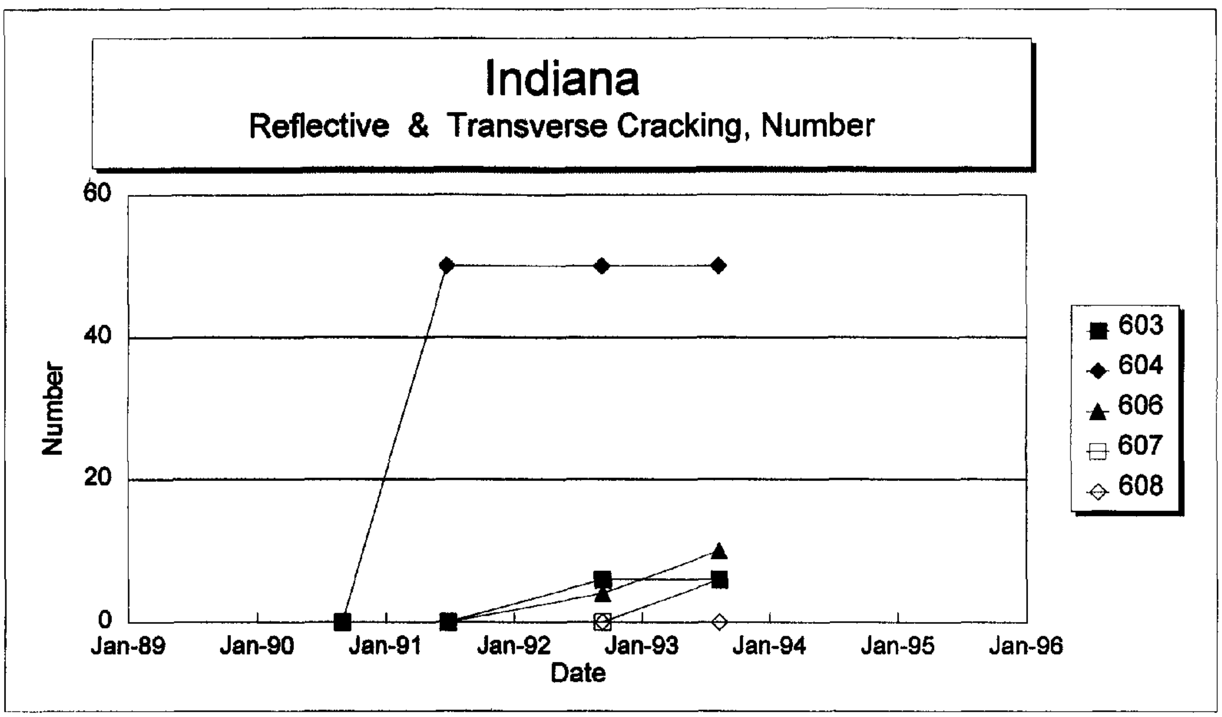


Figure 110. Total number of reflective and transverse cracks versus time on each HMAC section of the Indiana SPS-6 project.

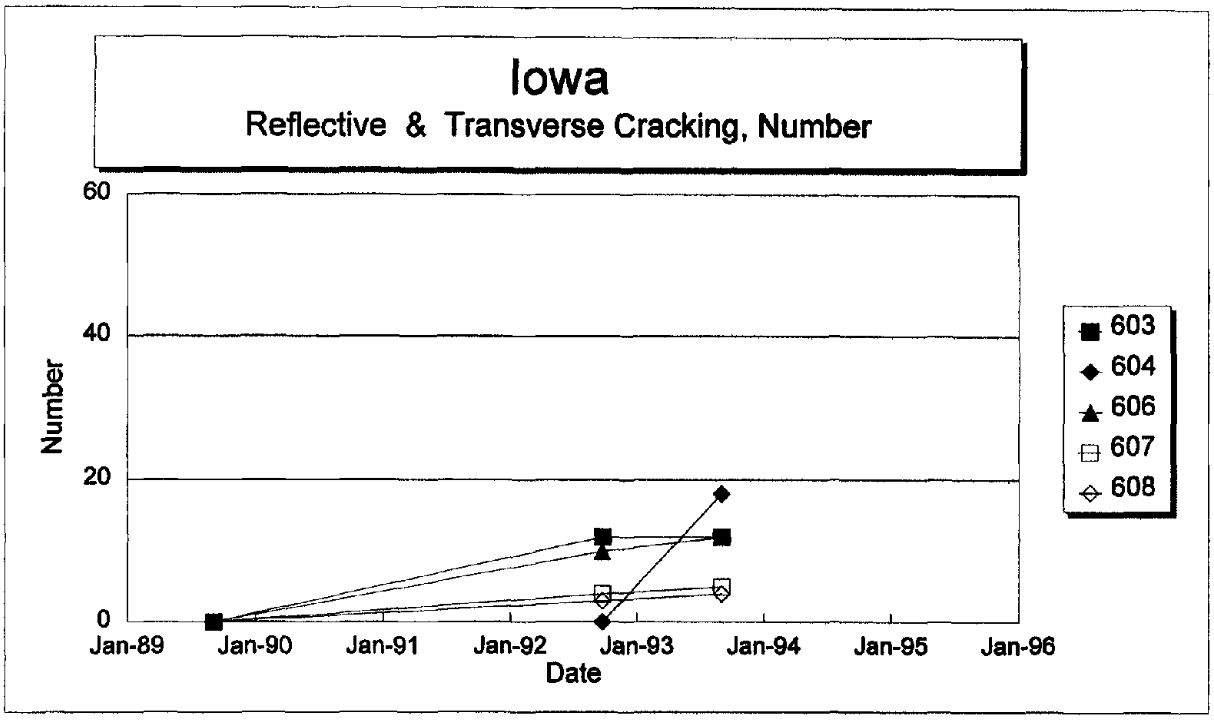


Figure 111. Total number of reflective and transverse cracks versus time on each HMAC section of the Iowa SPS-6 project.

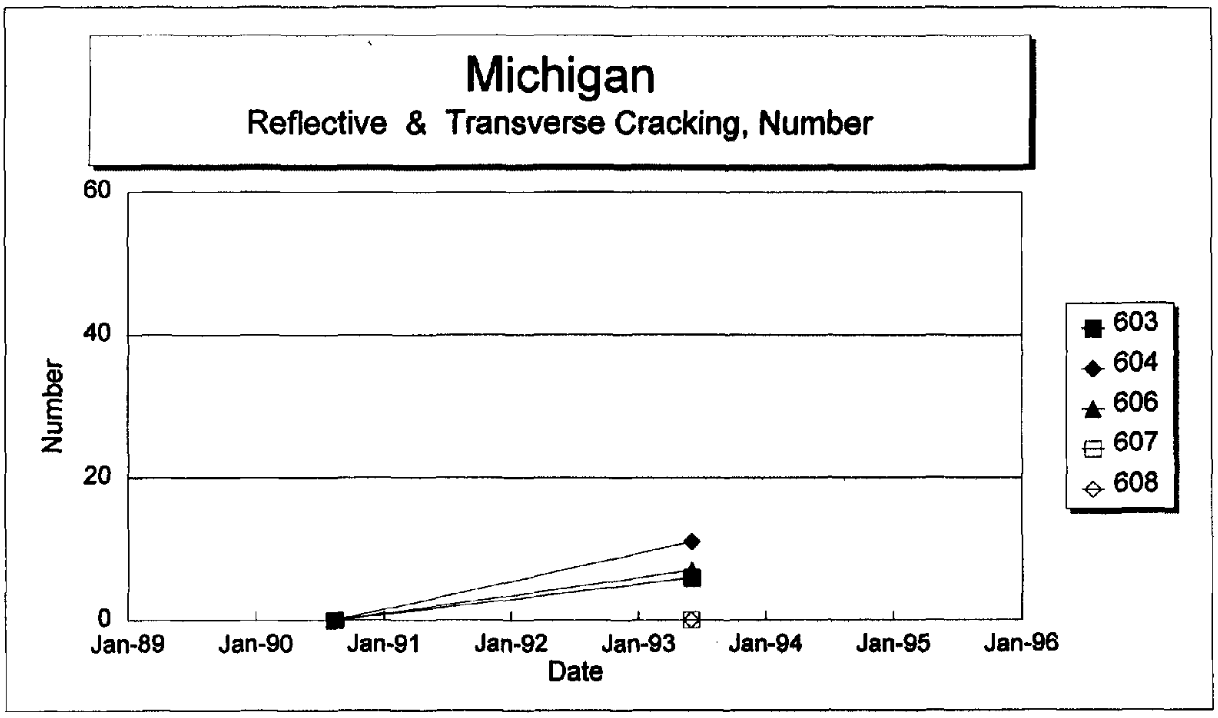


Figure 112. Total number of reflective and transverse cracks versus time on each HMAC section of the Michigan SPS-6 project.

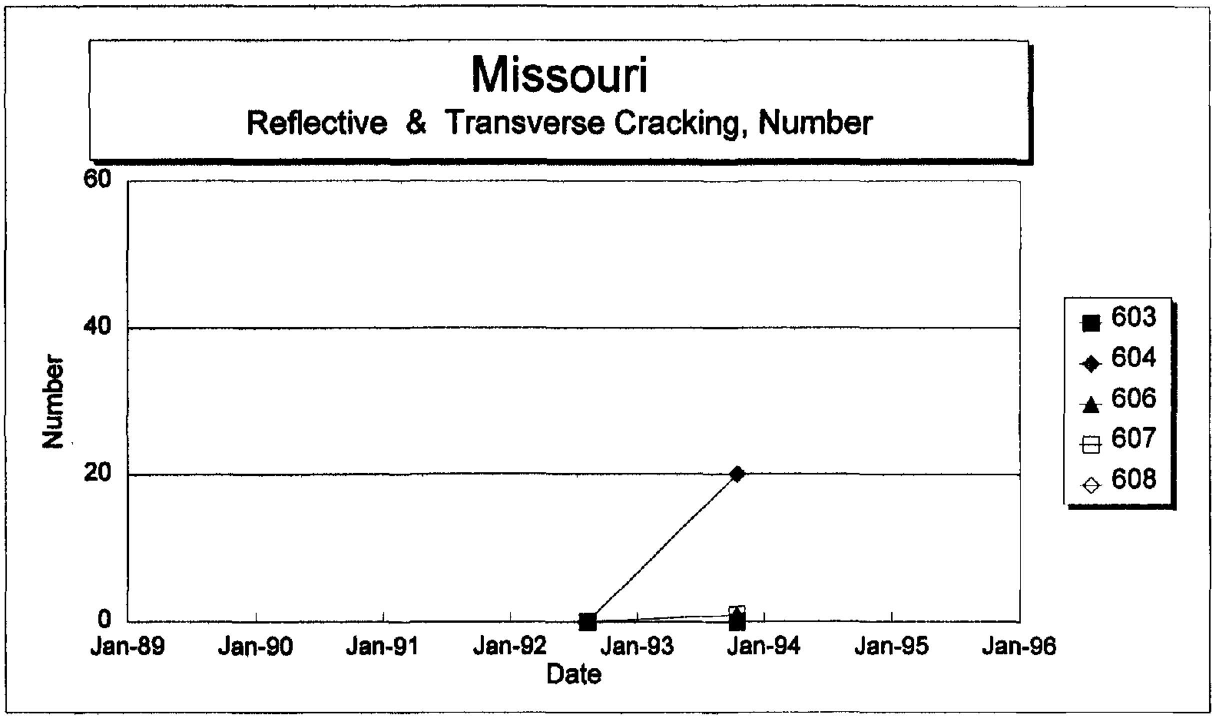


Figure 113. Total number of reflective and transverse cracks versus time on each HMAC section of the Missouri SPS-6 project.

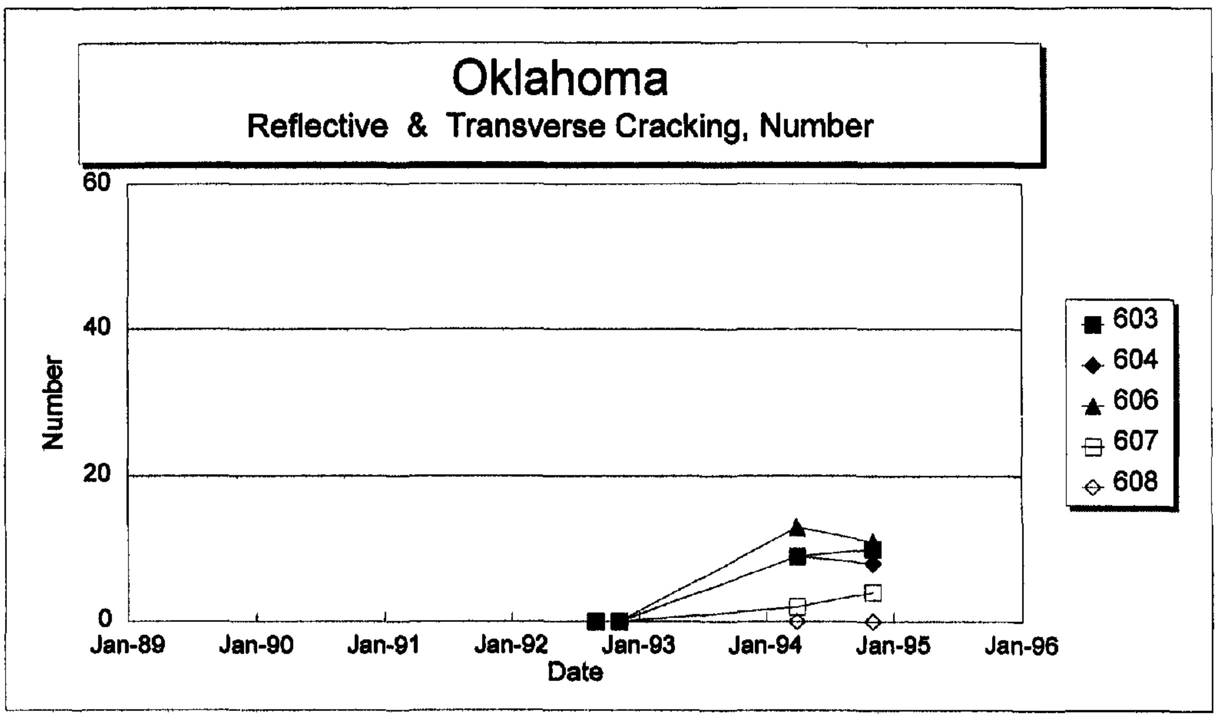


Figure 114. Total number of reflective and transverse cracks versus time on each HMAC section of the Oklahoma SPS-6 project.

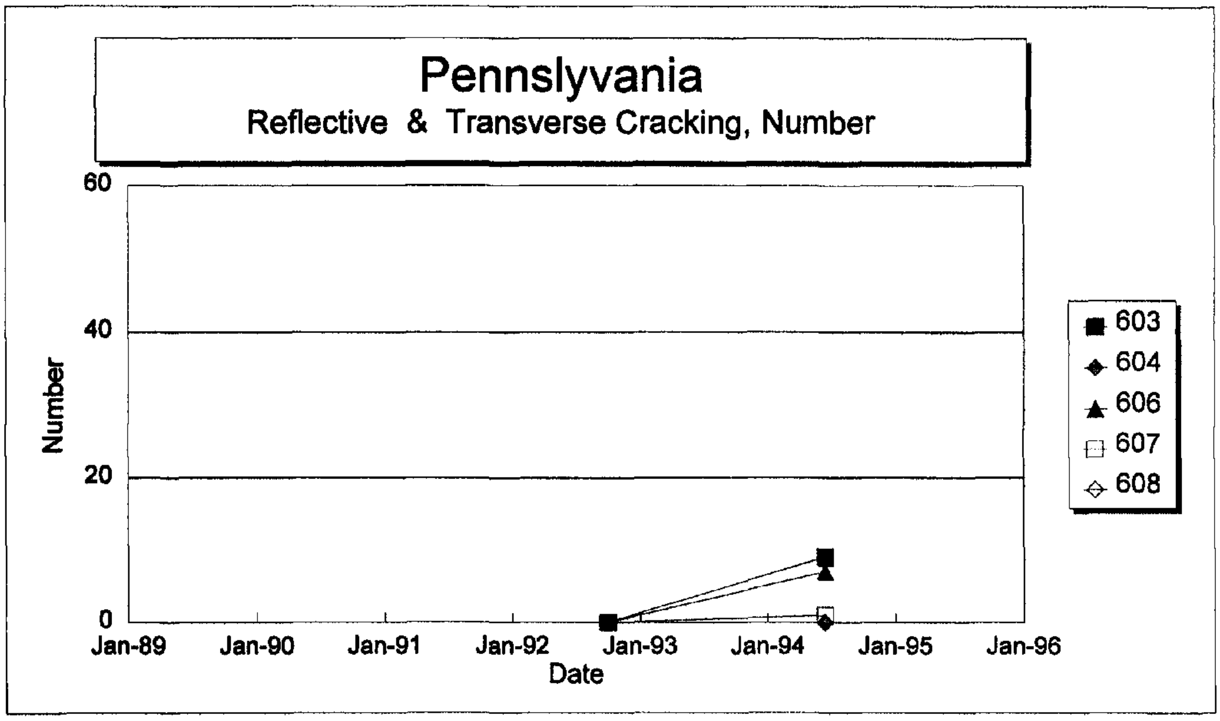


Figure 115. Total number of reflective and transverse cracks versus time on each HMAC section of the Pennsylvania SPS-6 project.

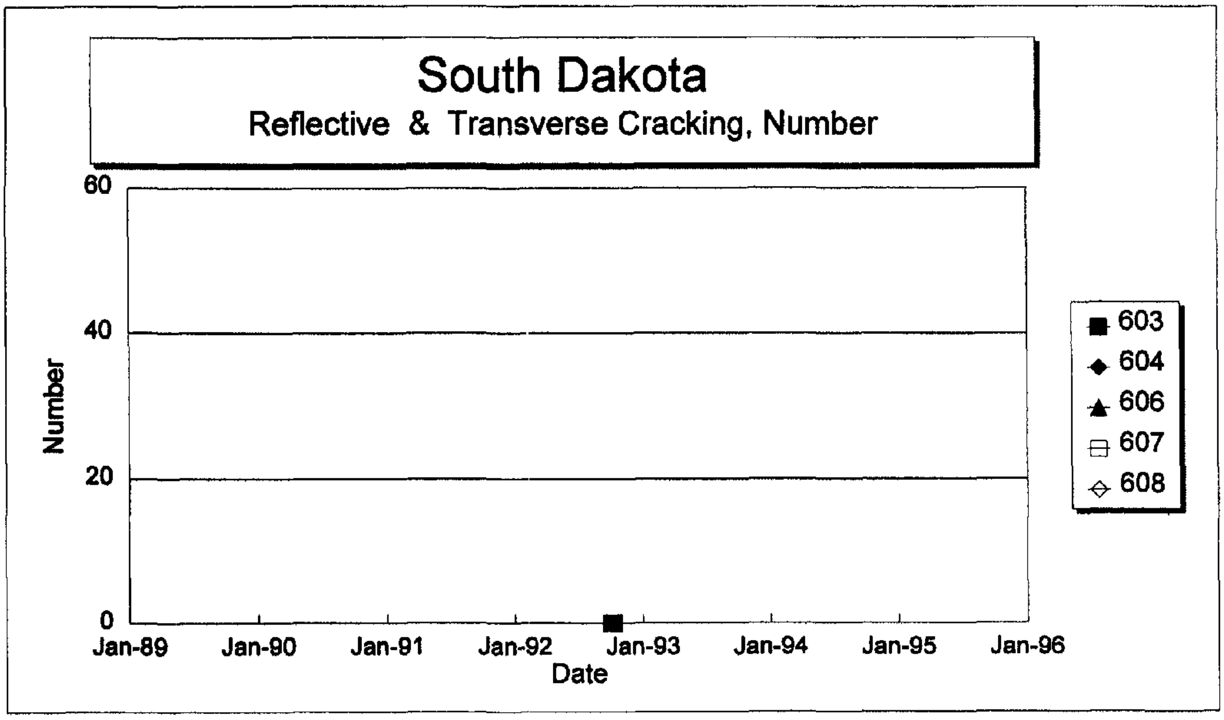
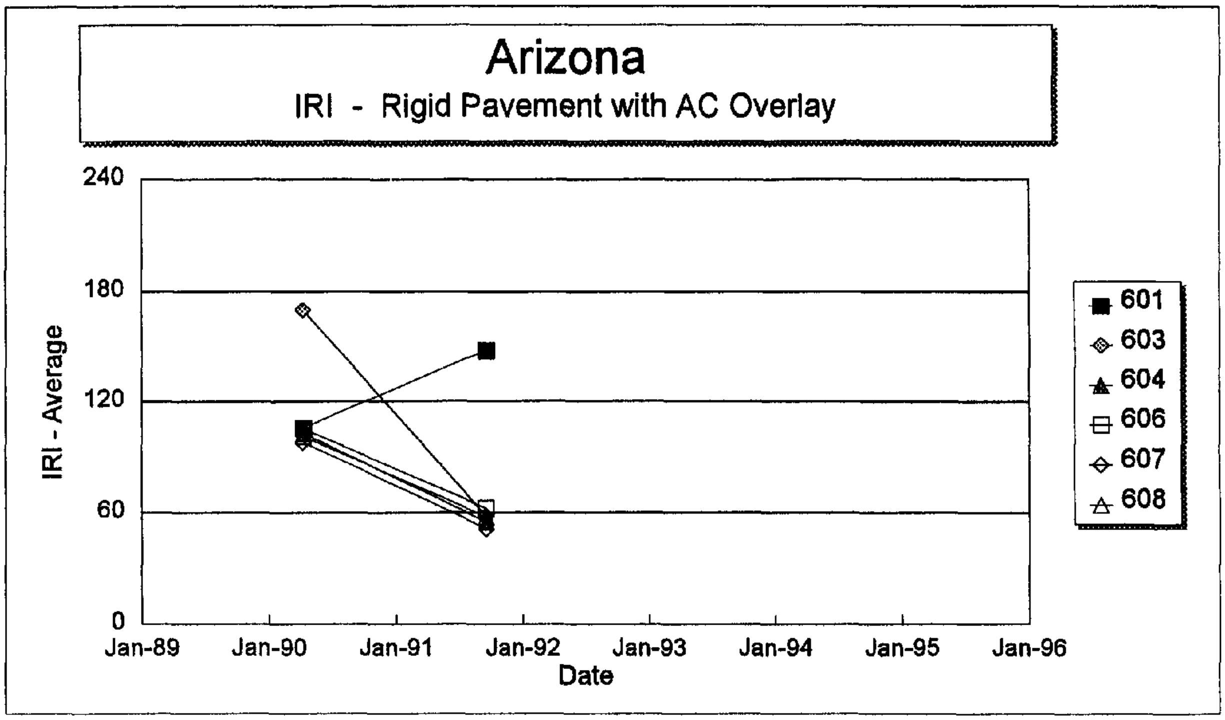


Figure 116. Total number of reflective and transverse cracks versus time on each HMAC section of the South Dakota SPS-6 project.



Note: Section 601 is a non-treated control section.

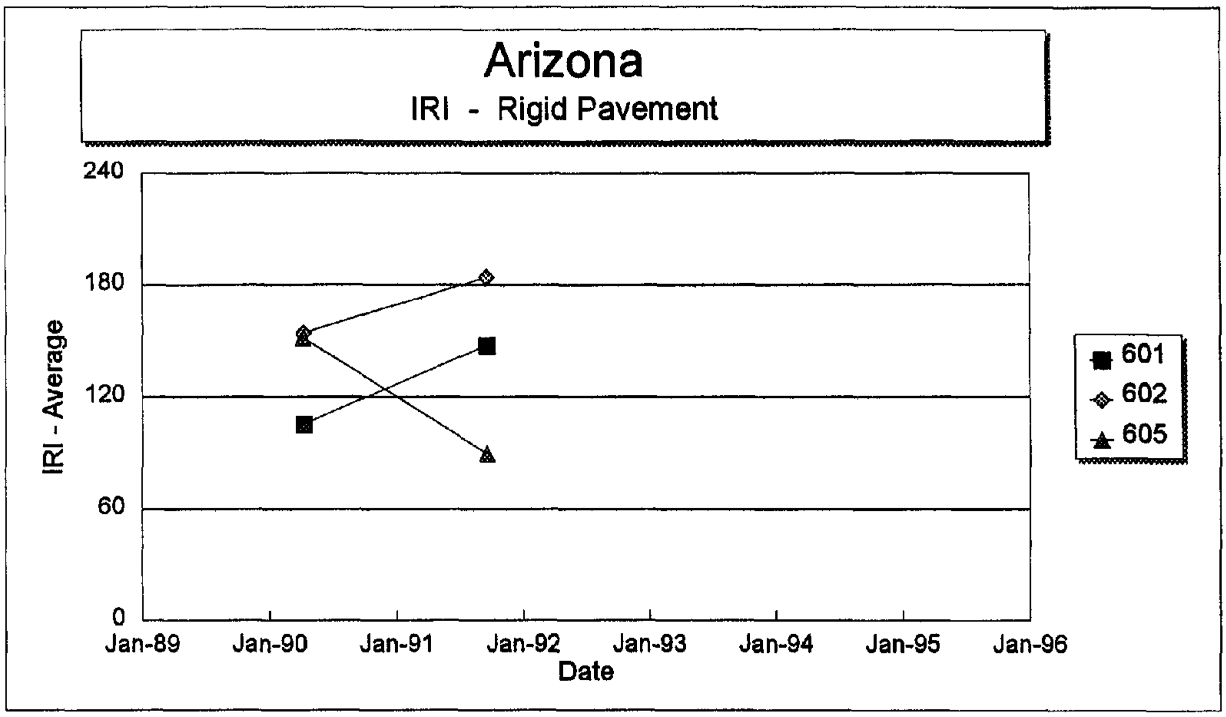
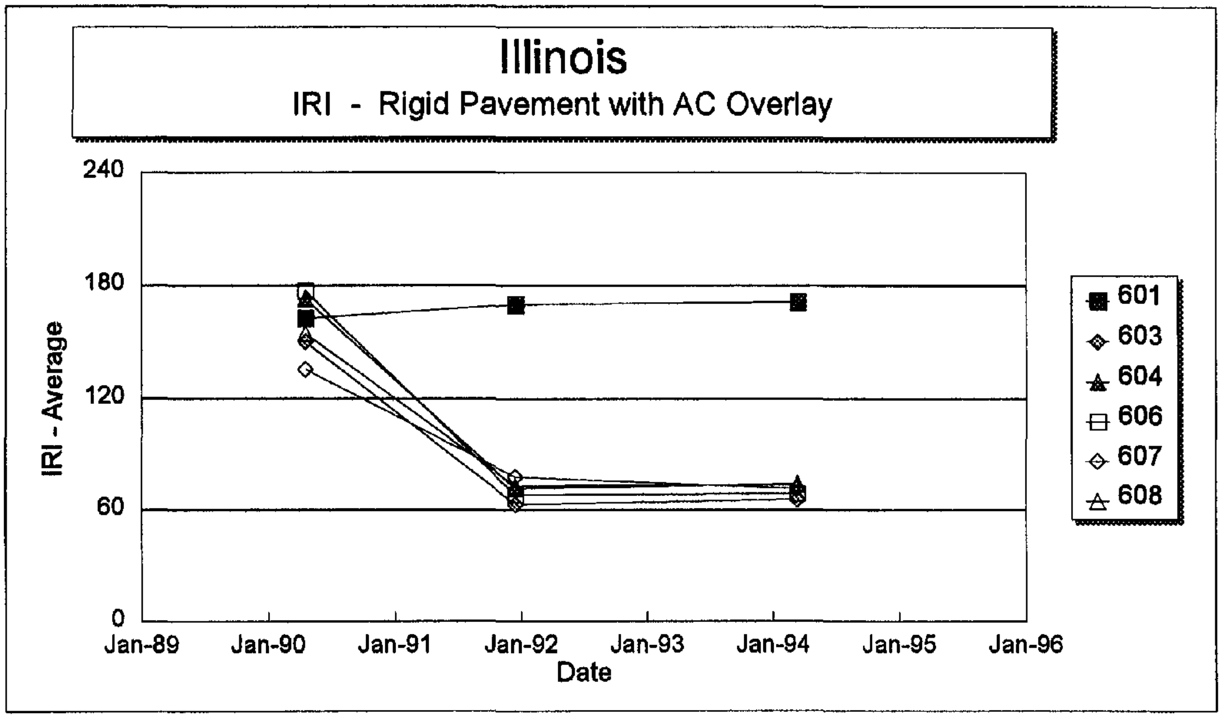


Figure 117. International Roughness Index versus time on each section of the Arizona SPS-6 project.



Note: Section 601 is a non-treated control section.

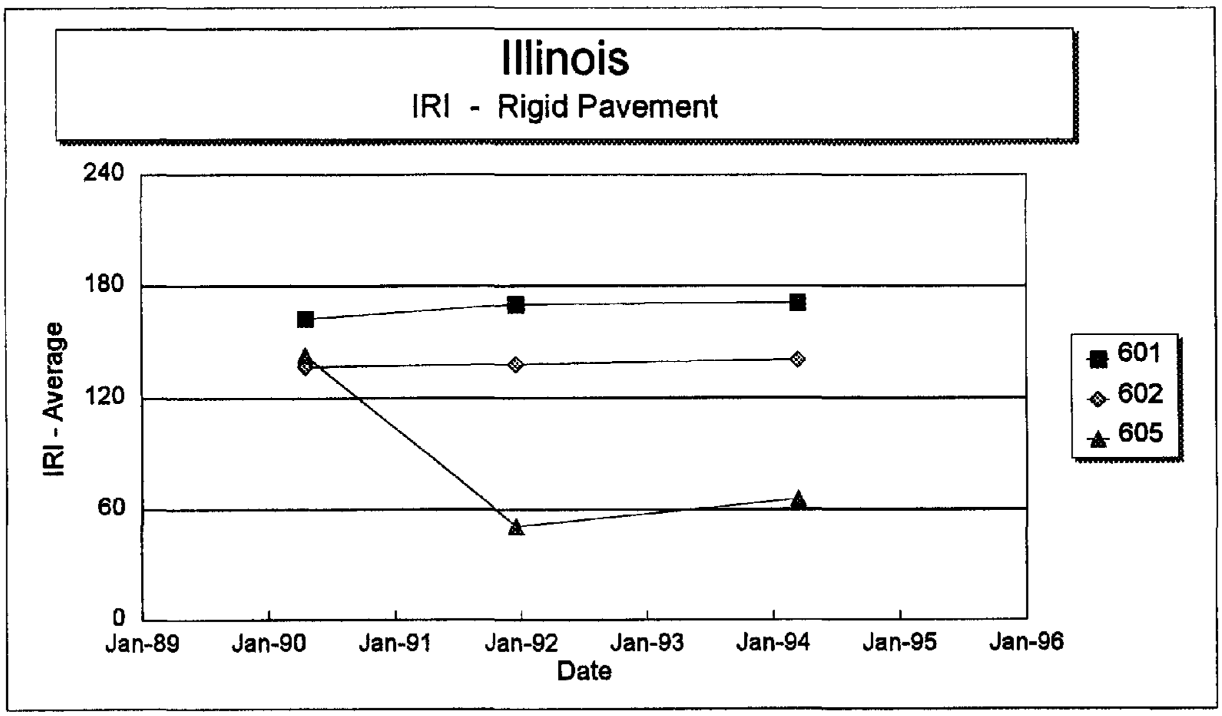
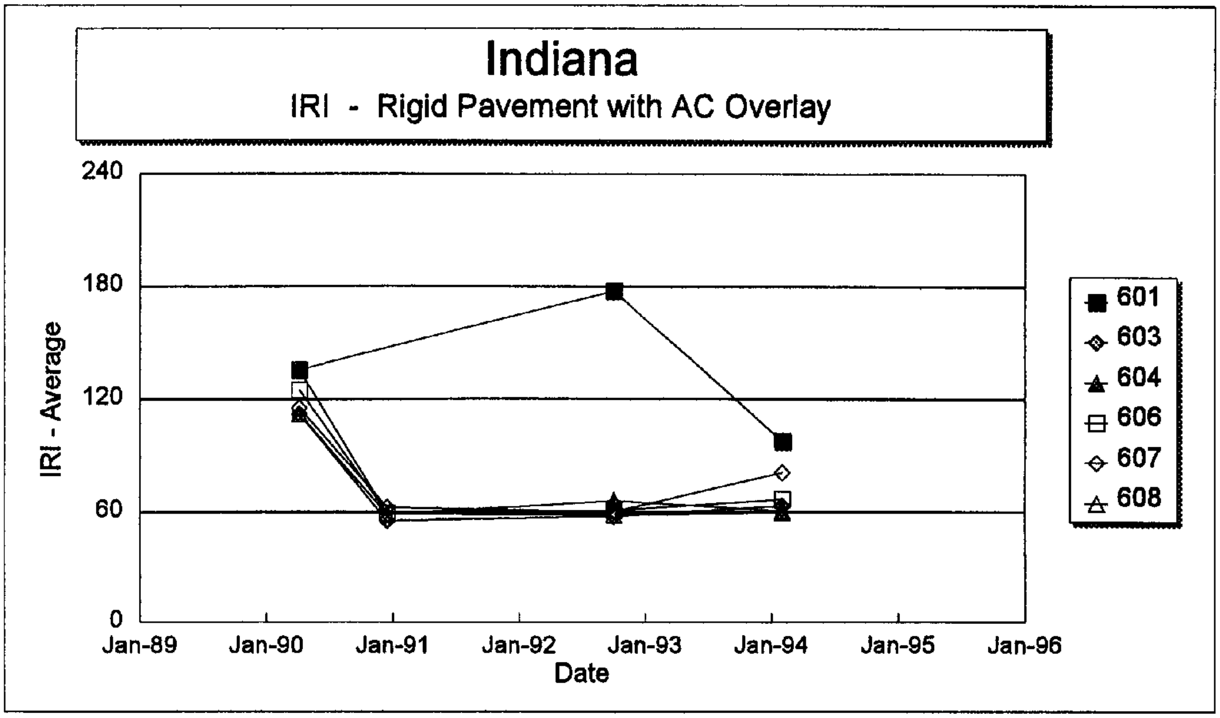


Figure 118. International Roughness Index versus time on each section of the Illinois SPS-6 project.



Note: Section 601 is a non-treated control section.

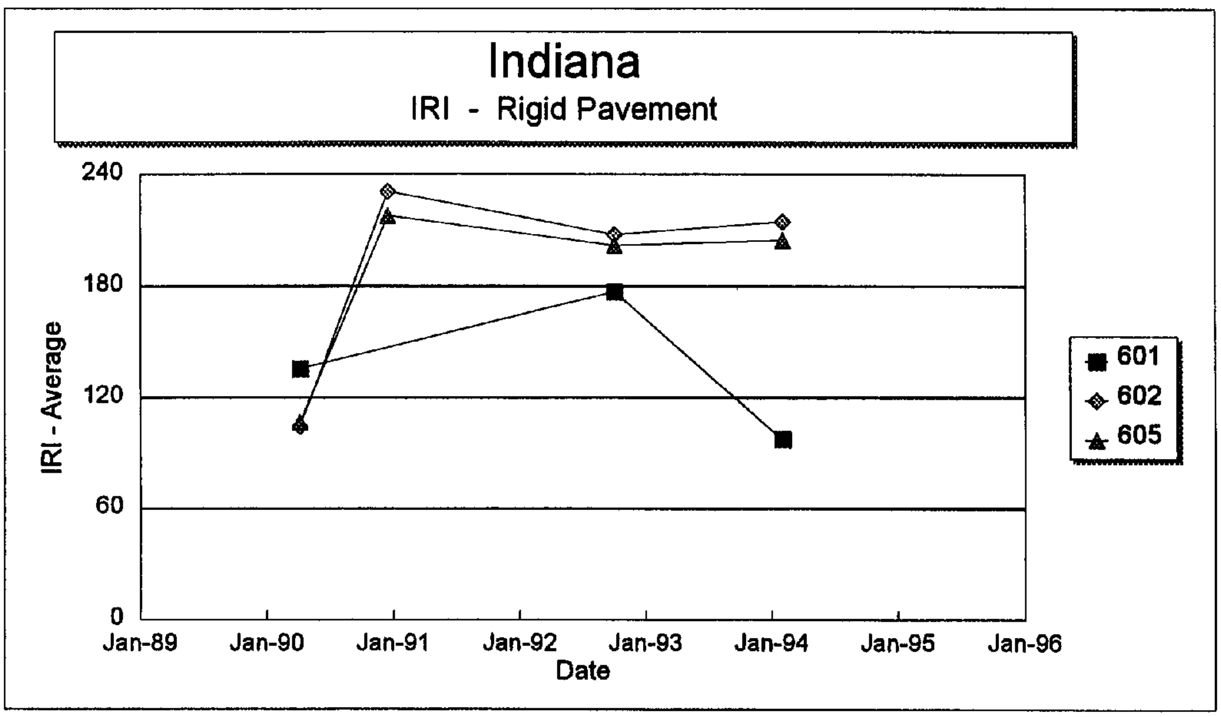
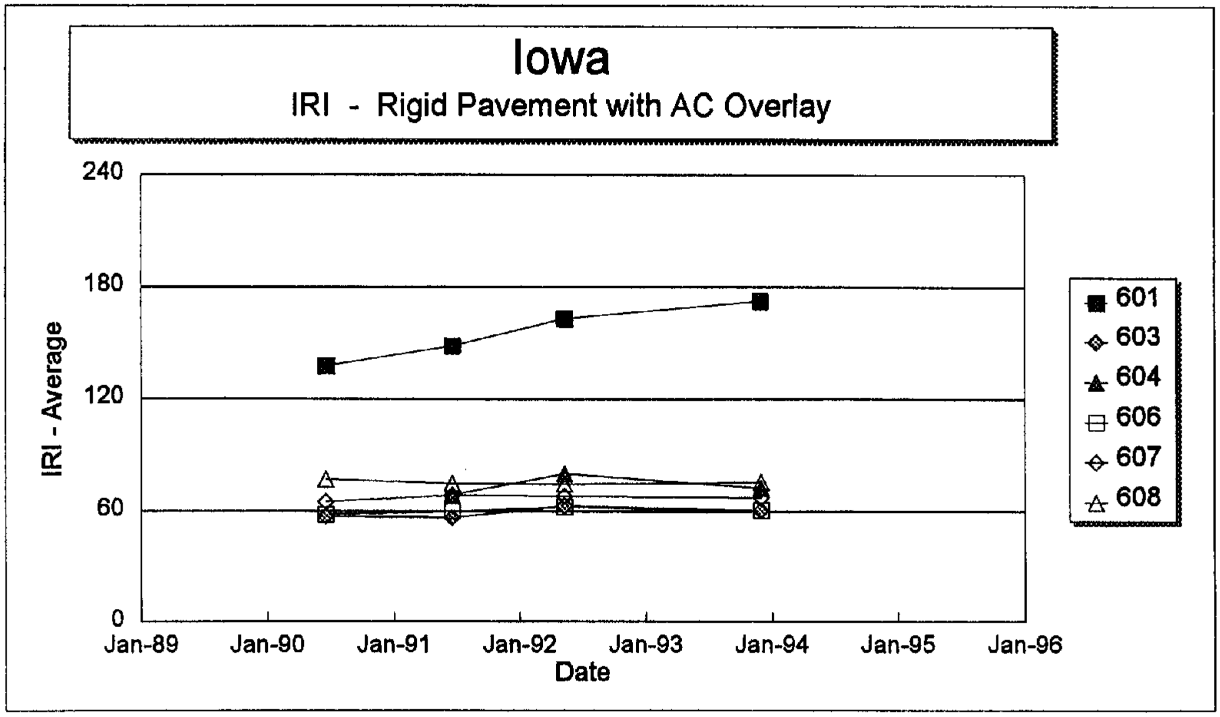


Figure 119. International Roughness Index versus time on each section of the Indiana SPS-6 project.



Note: Section 601 is a non-treated control section.

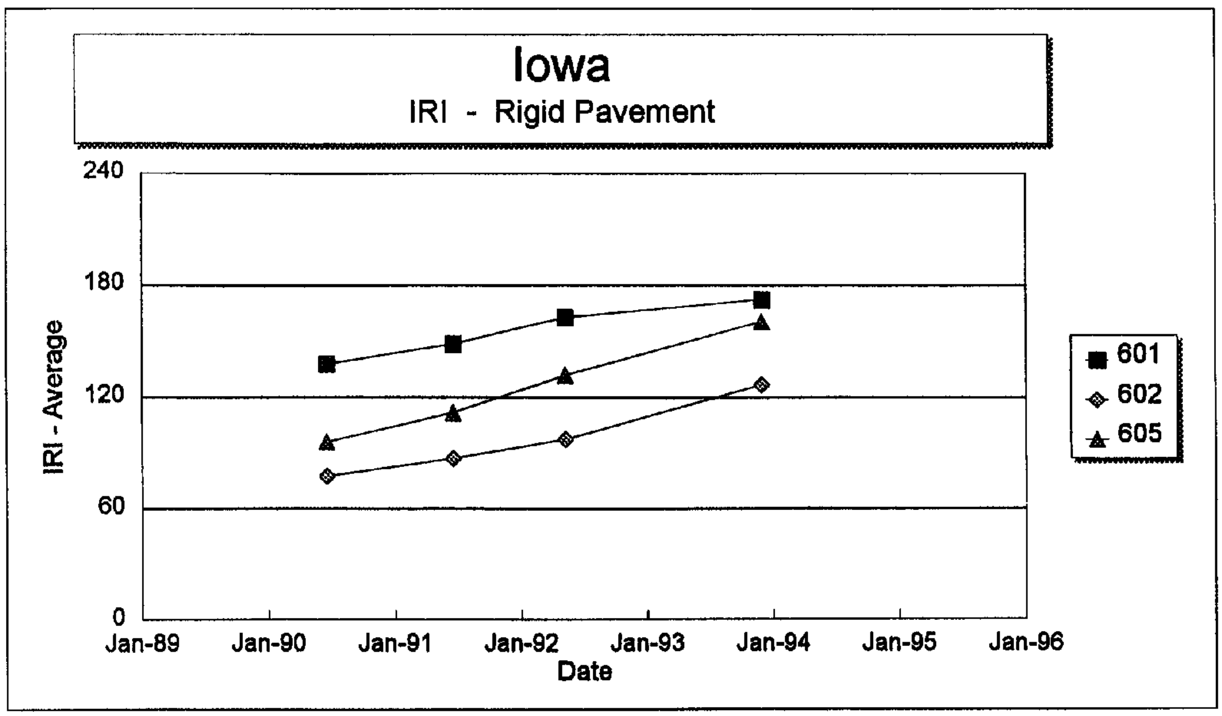
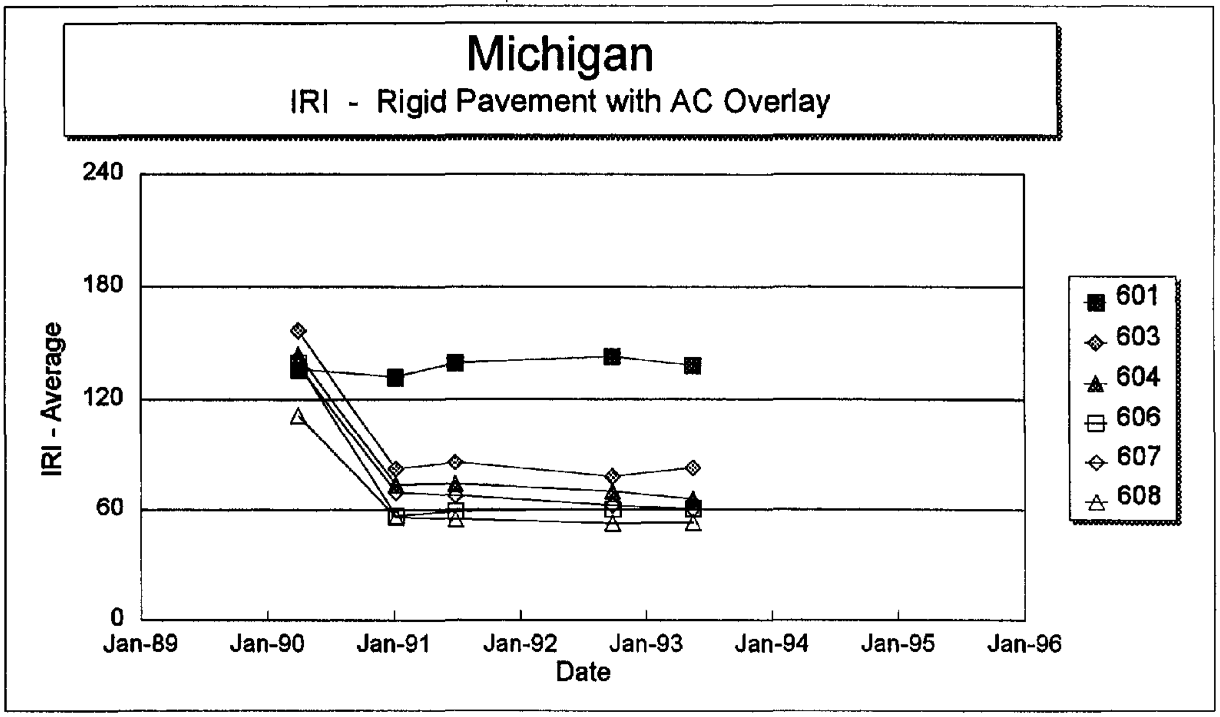


Figure 120. International Roughness Index versus time on each section of the Iowa SPS-6 project.



Note: Section 601 is a non-treated control section.

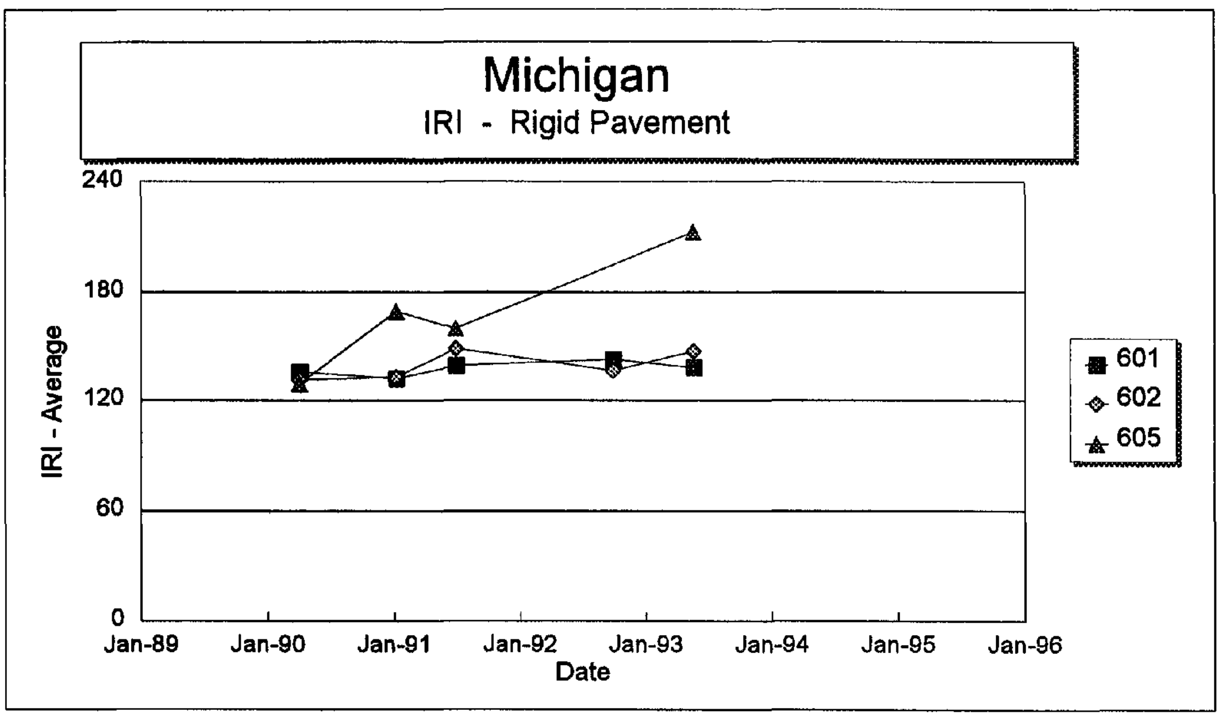
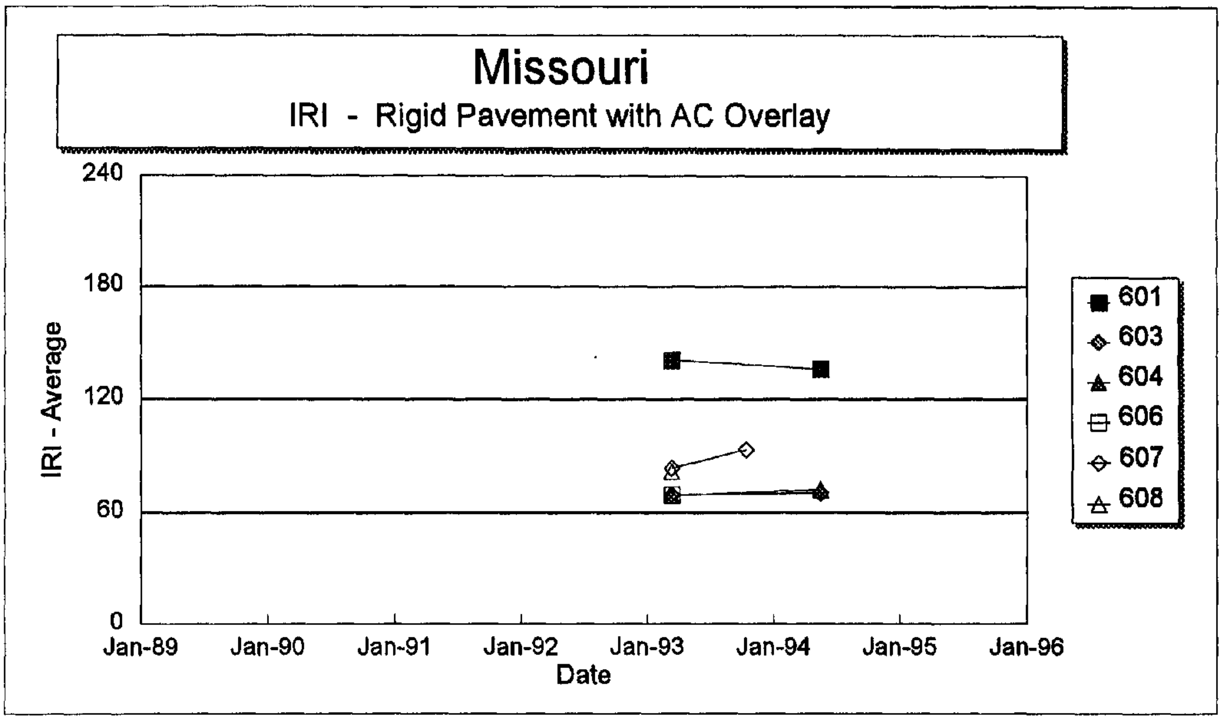


Figure 121. International Roughness Index versus time on each section of the Michigan SPS-6 project.



Note: Section 601 is a non-treated control section.

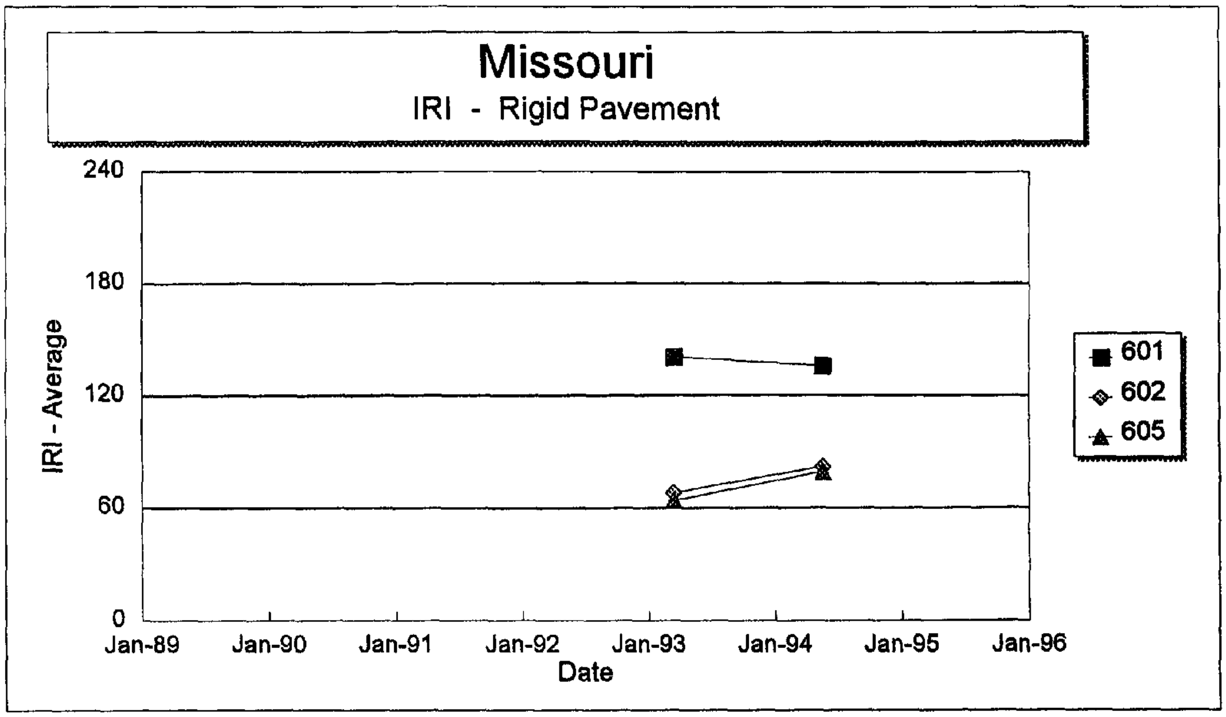
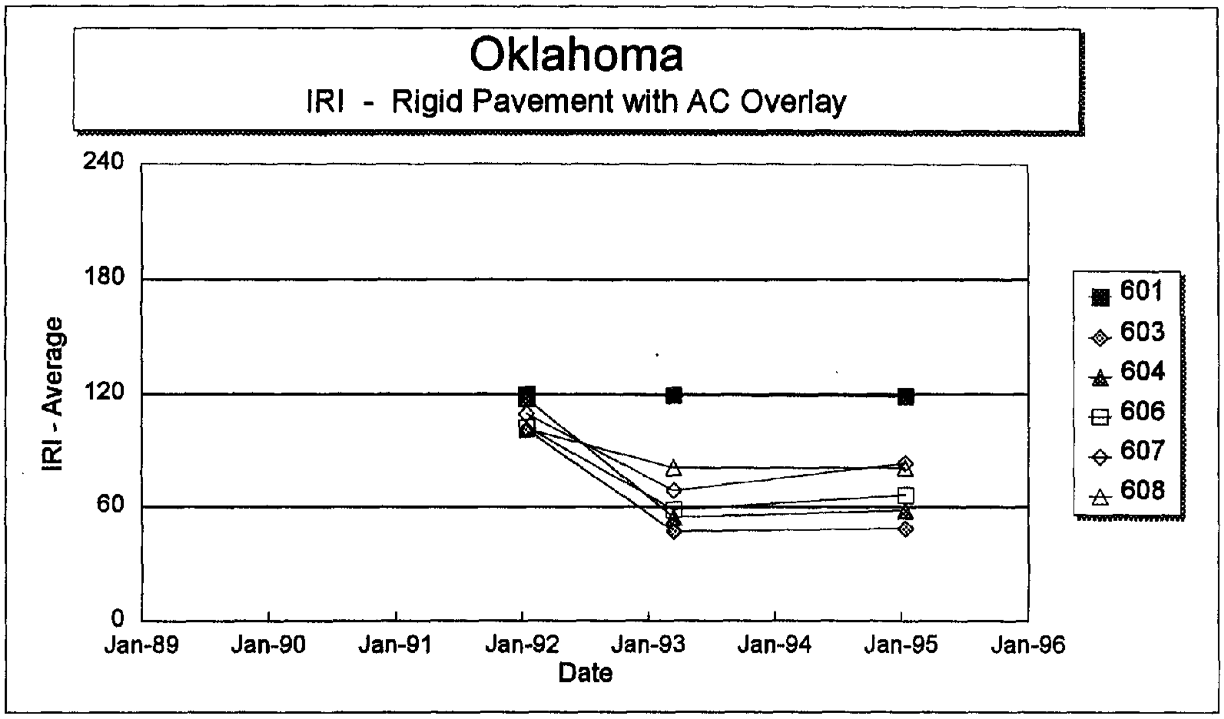


Figure 122. International Roughness Index versus time on each section of the Missouri SPS-6 project.



Note: Section 601 is a non-treated control section.

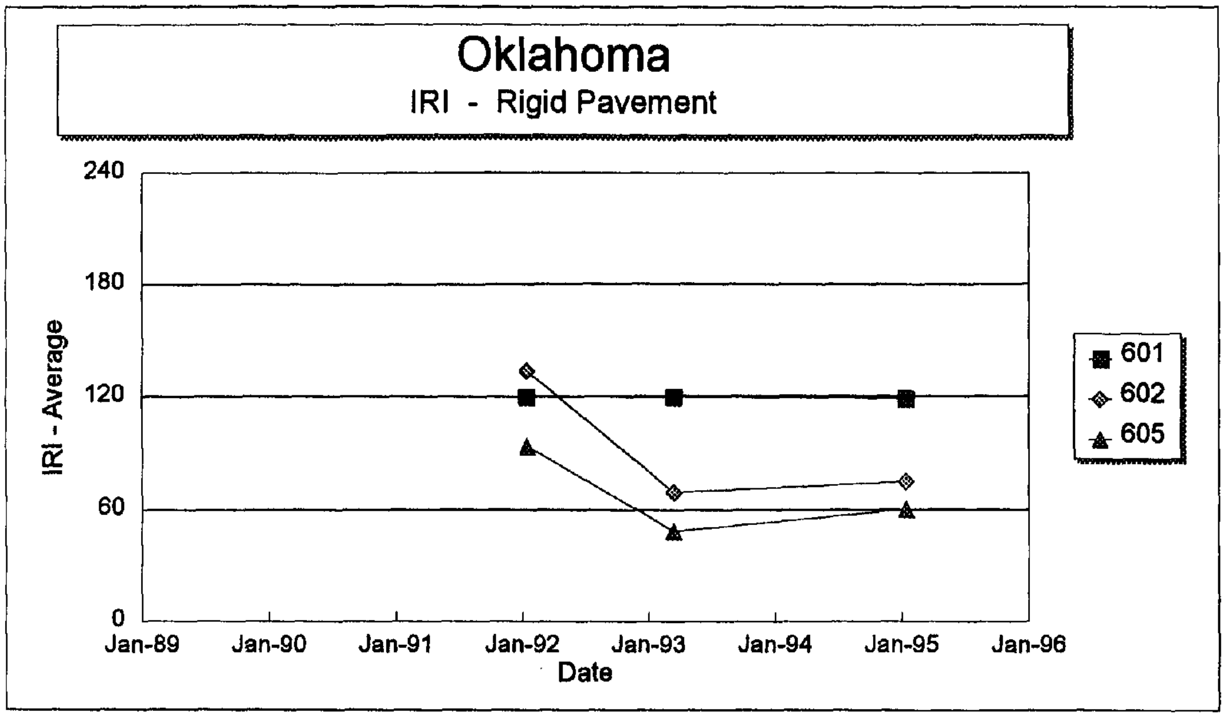
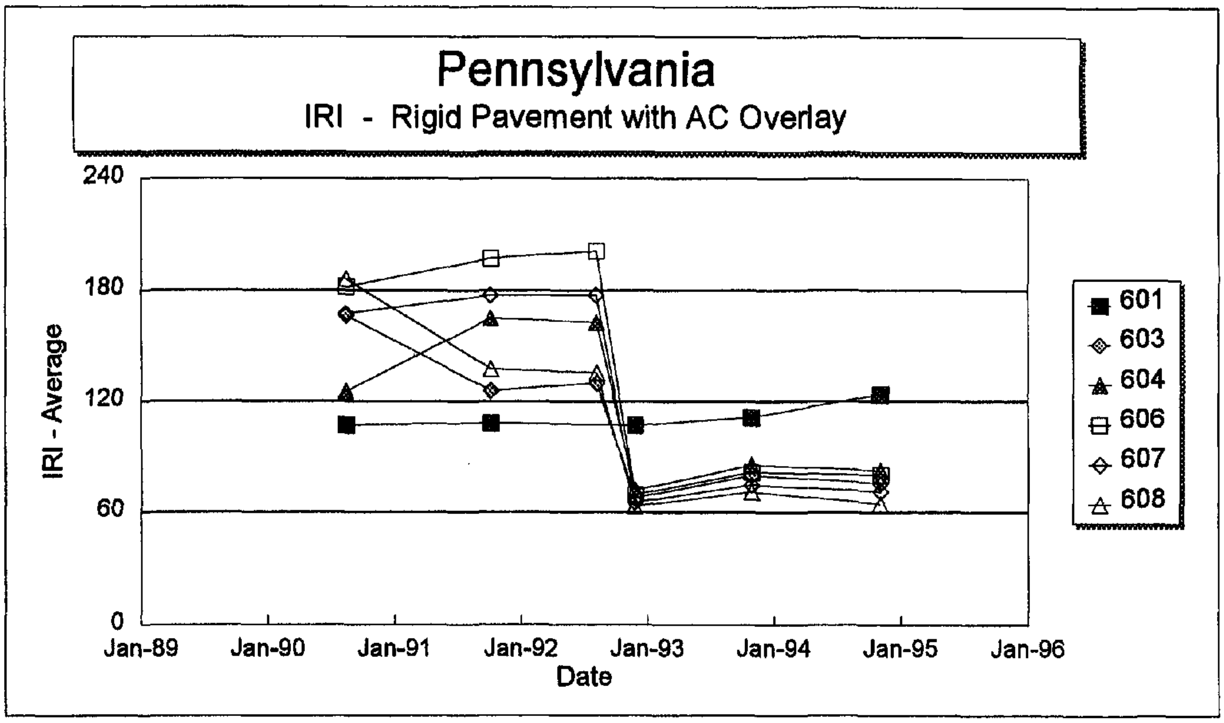


Figure 123. International Roughness Index versus time on each section of the Oklahoma SPS-6 project.



Note: Section 601 is a non-treated control section.

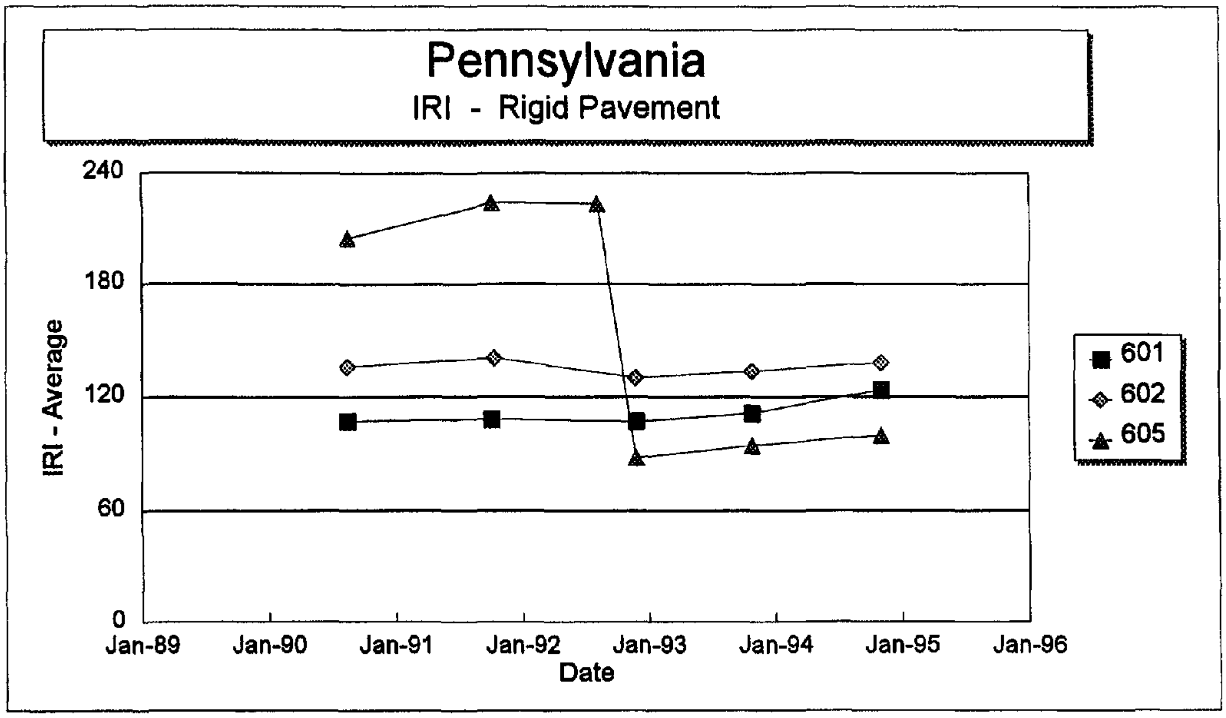
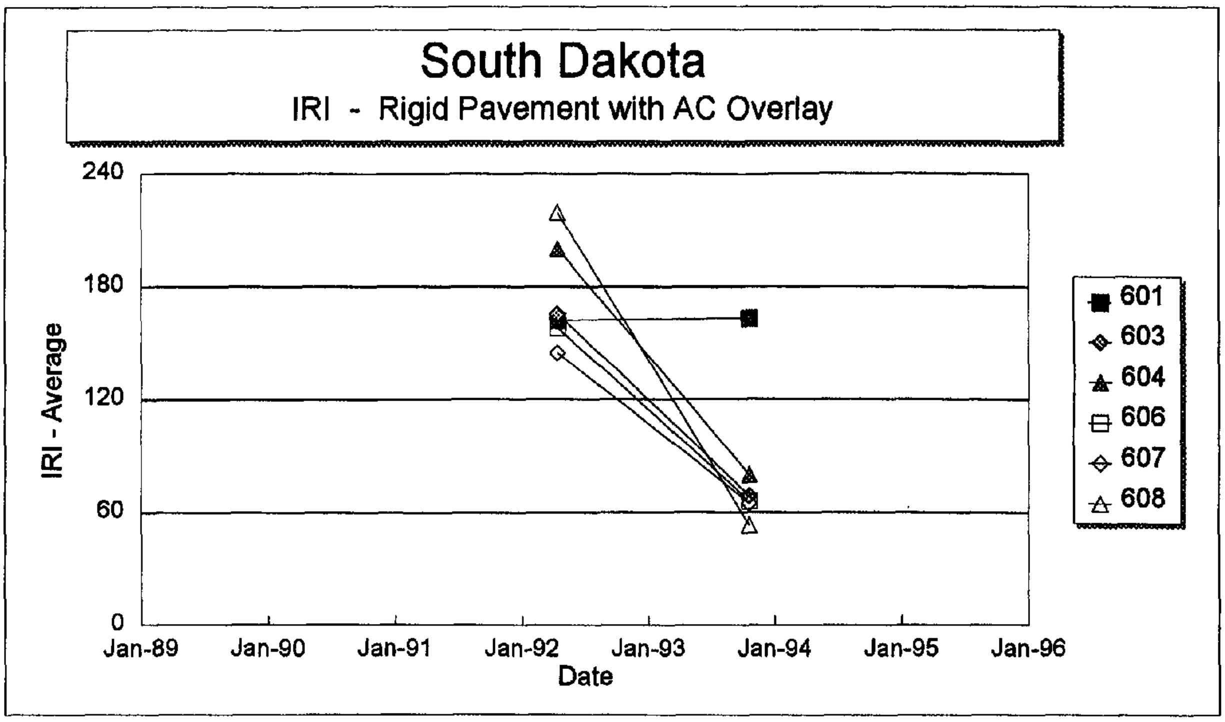


Figure 124. International Roughness Index versus time on each section of the Pennsylvania SPS-6 project.



Note: Section 601 is a non-treated control section.

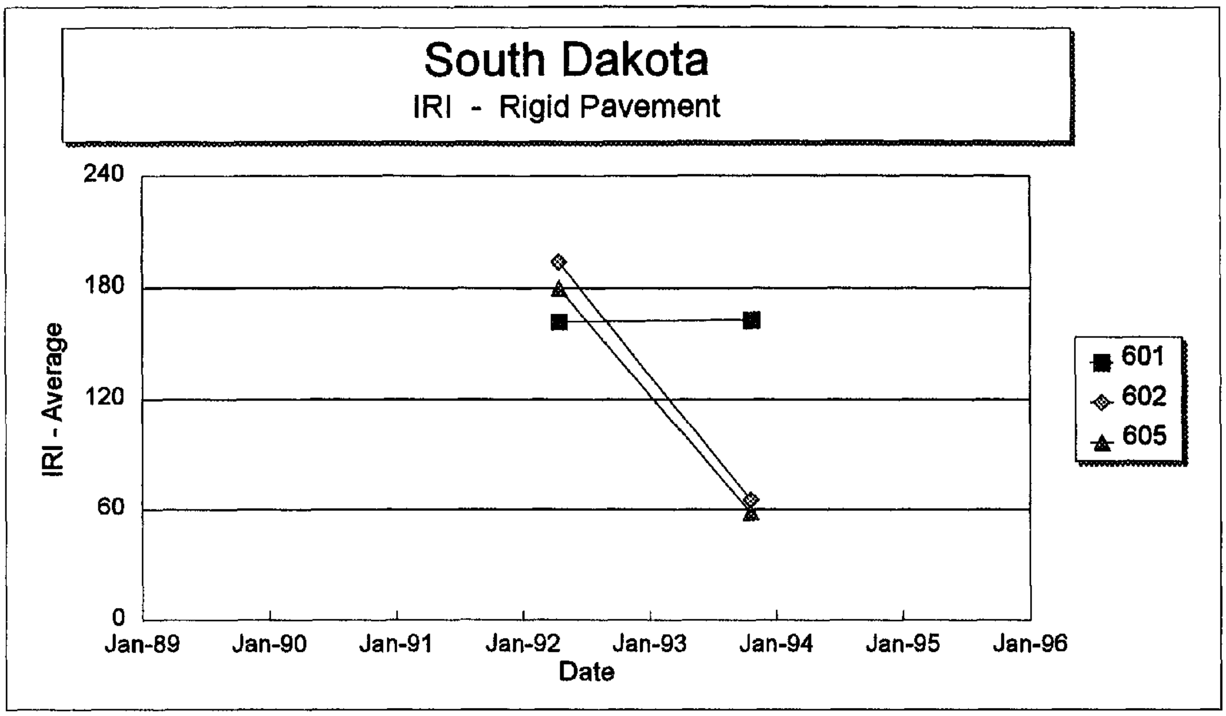
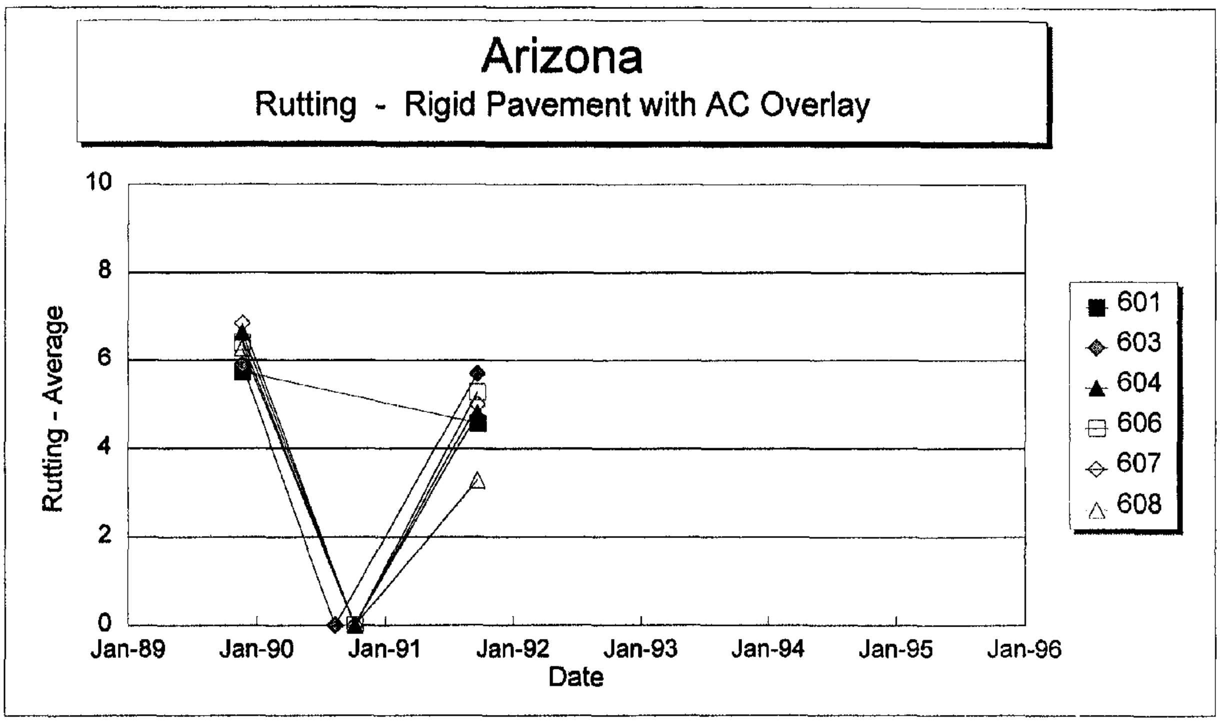


Figure 125. International Roughness Index versus time on each section of the South Dakota SPS-6 project.



Note: Section 601 is a non-treated control section.

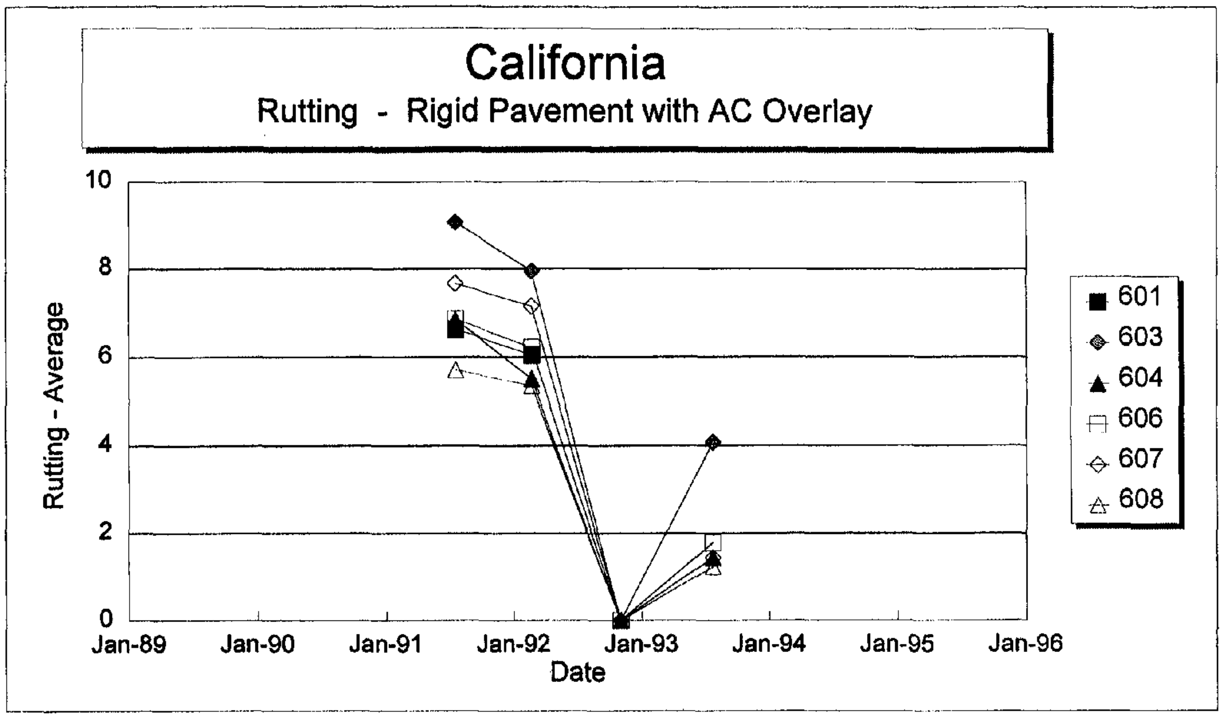
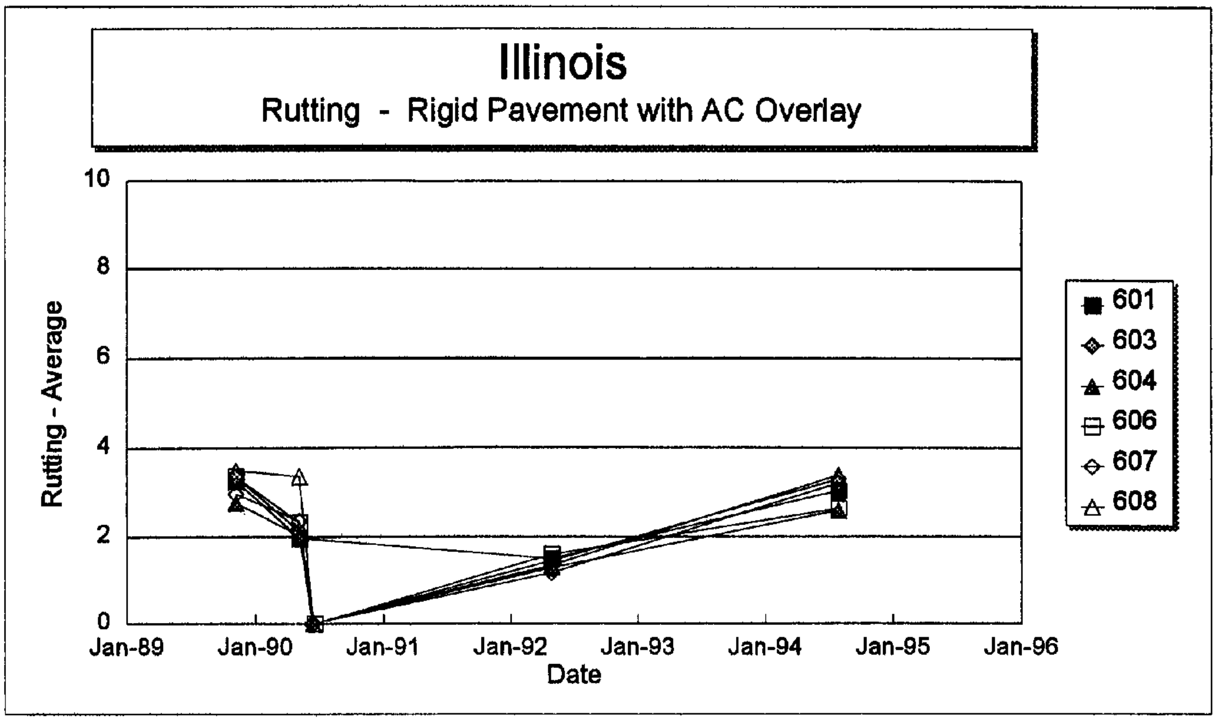


Figure 126. Rut depth versus time on each HMAC section of the Arizona and California SPS-6 projects.



Note: Section 601 is a non-treated control section.

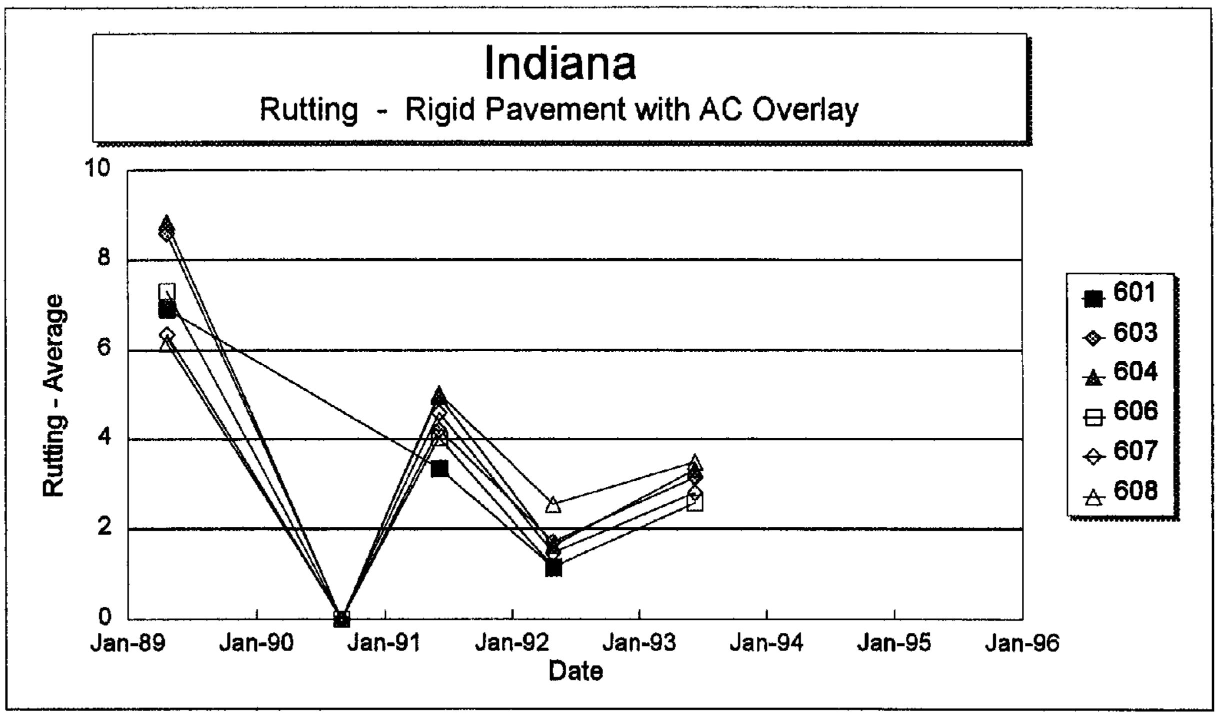
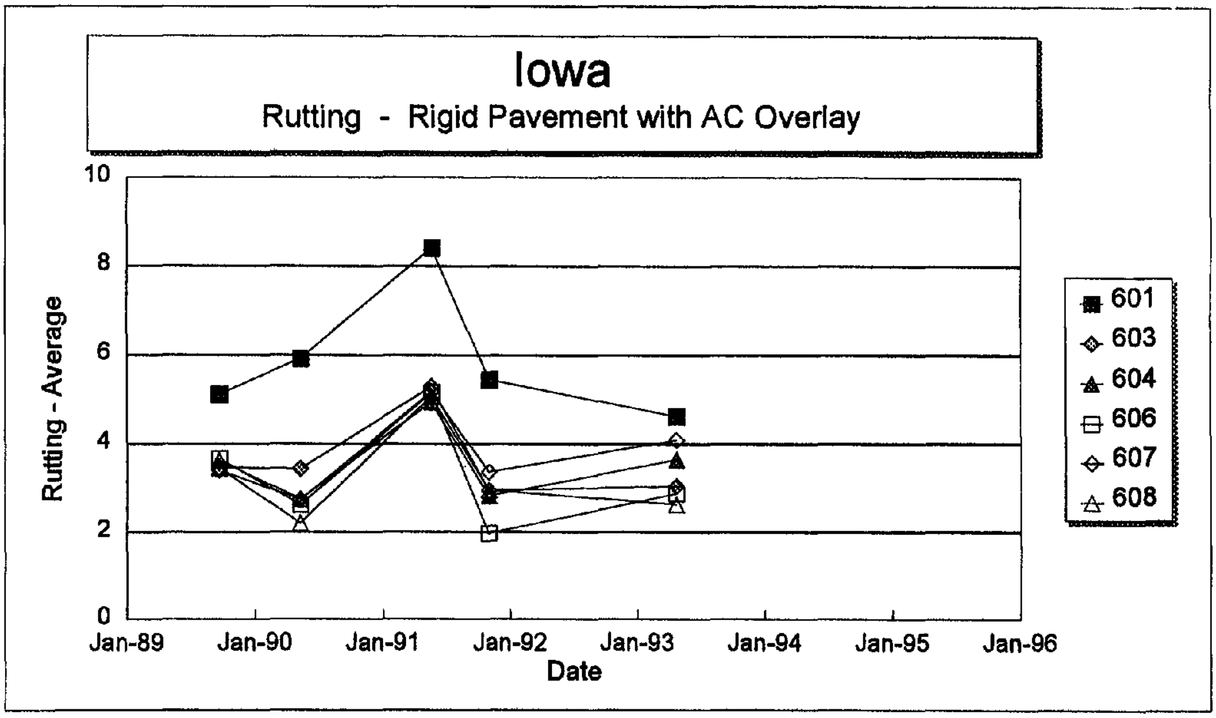


Figure 127. Rut depth versus time on each HMAC section of the Illinois and Indiana SPS-6 projects.



Note: Section 601 is a non-treated control section.

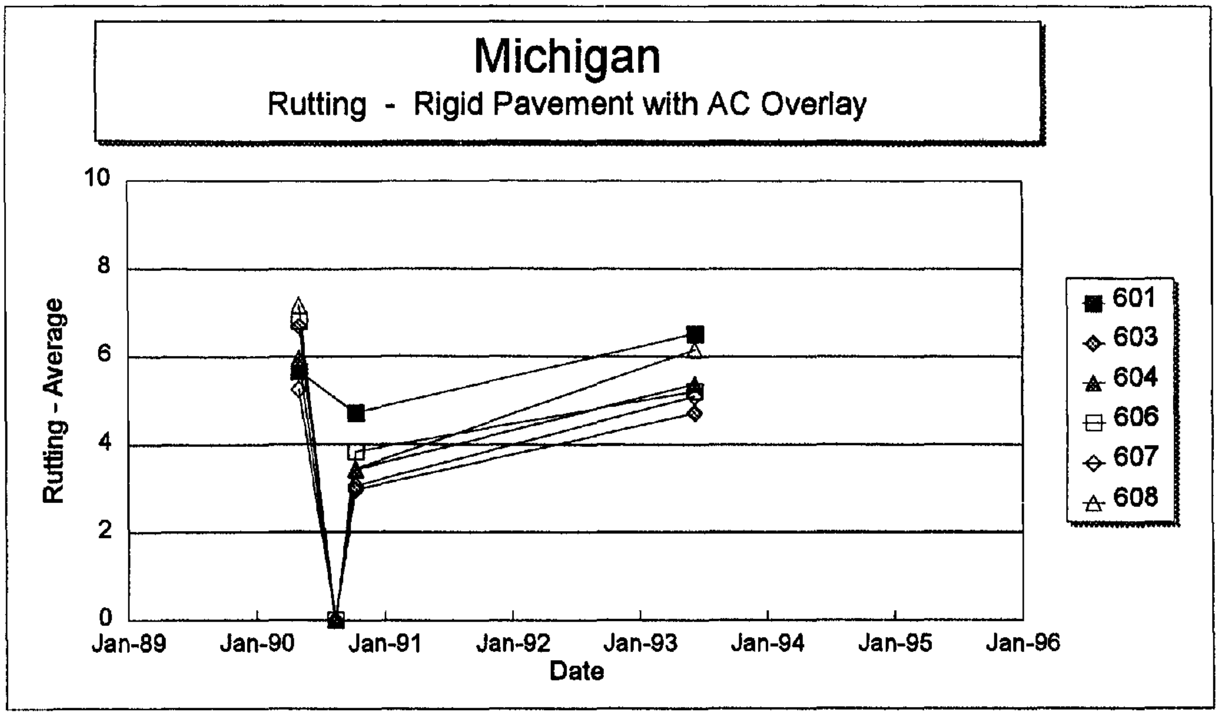
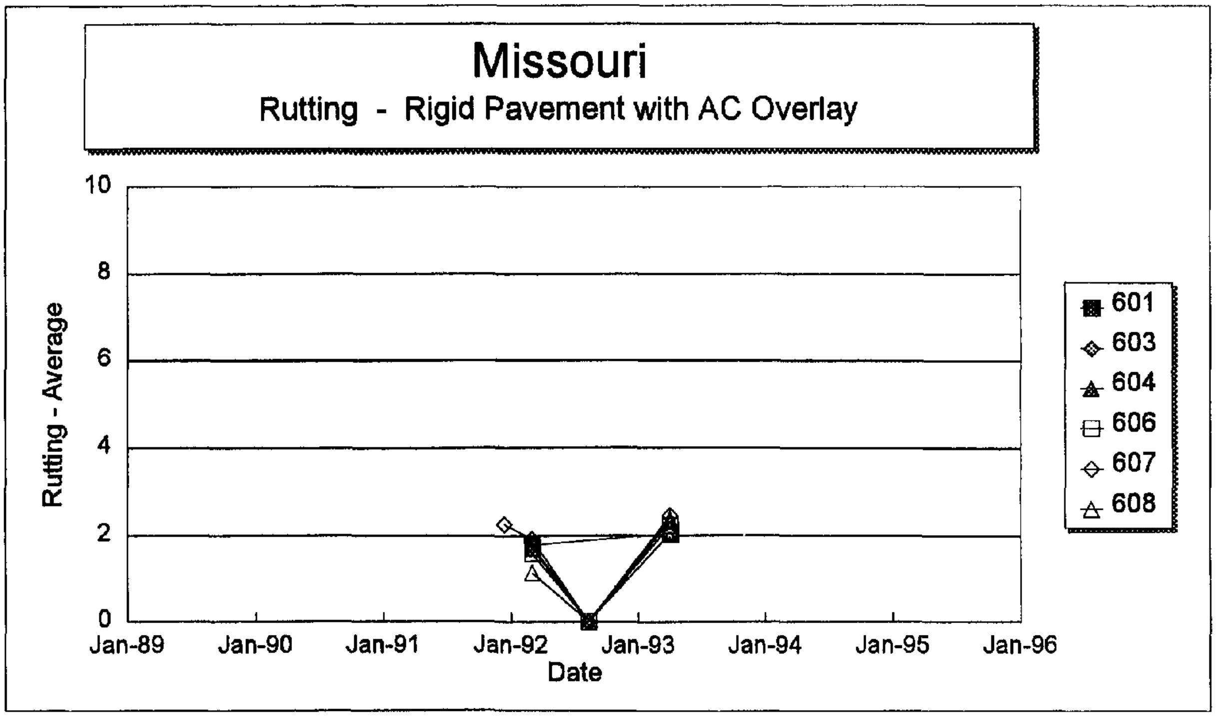


Figure 128. Rut depth versus time on each HMAC section of the Iowa and Michigan SPS-6 projects.



Note: Section 601 is a non-treated control section.

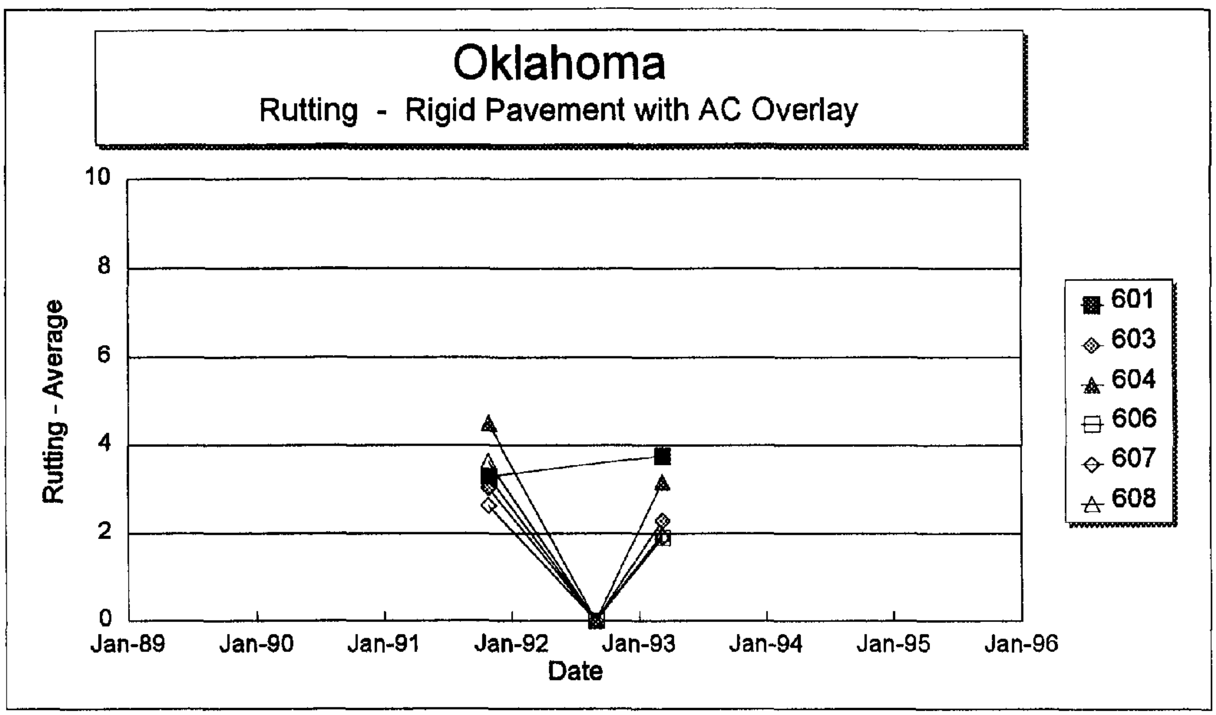
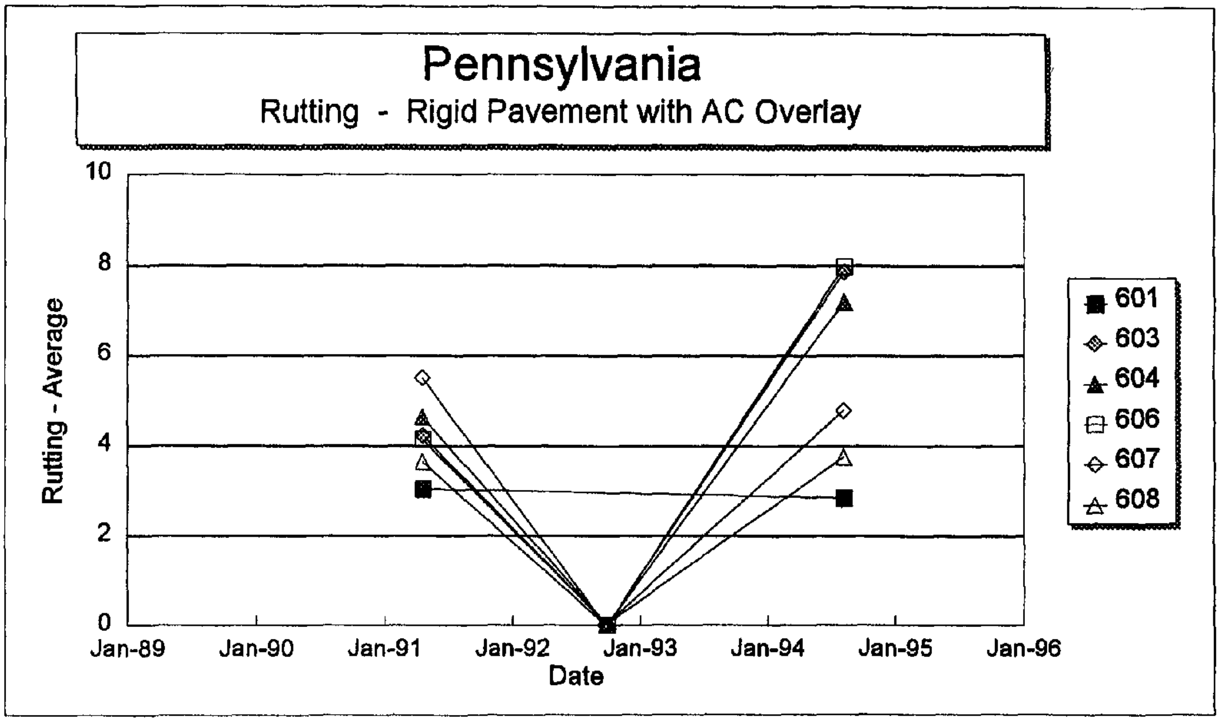


Figure 129. Rut depth versus time on each HMAC section of the Missouri and Oklahoma SPS-6 projects.



Note: Section 601 is a non-treated control section.

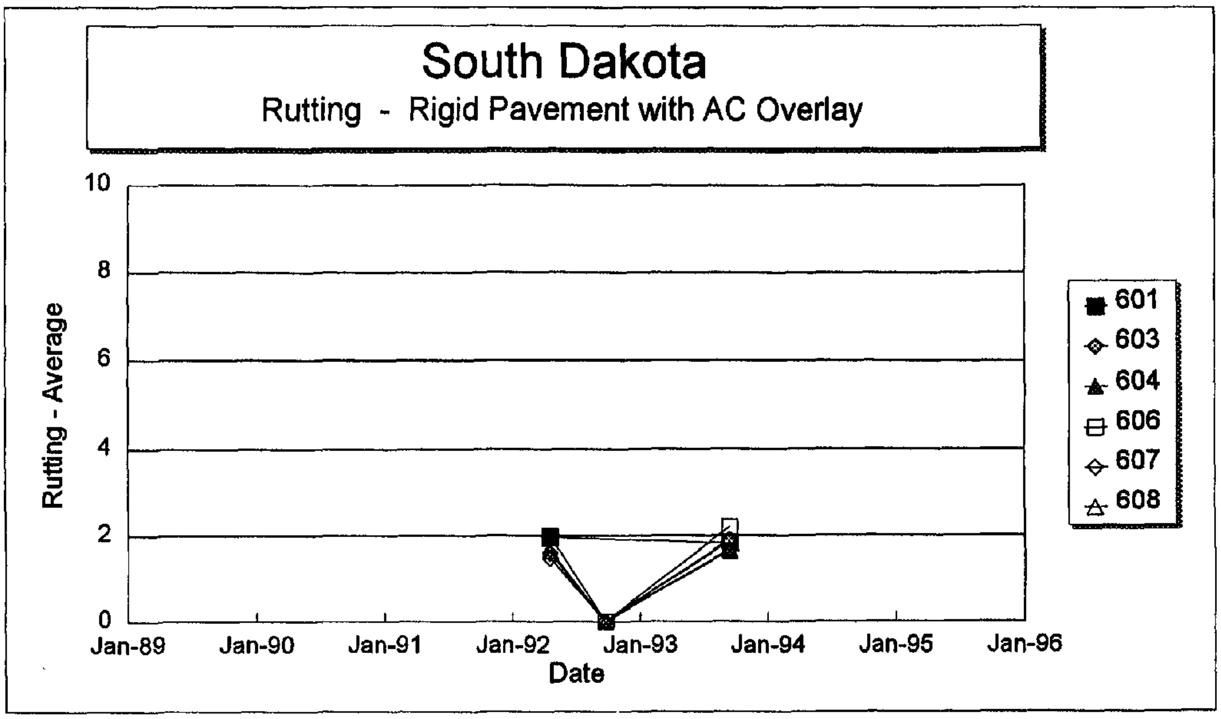
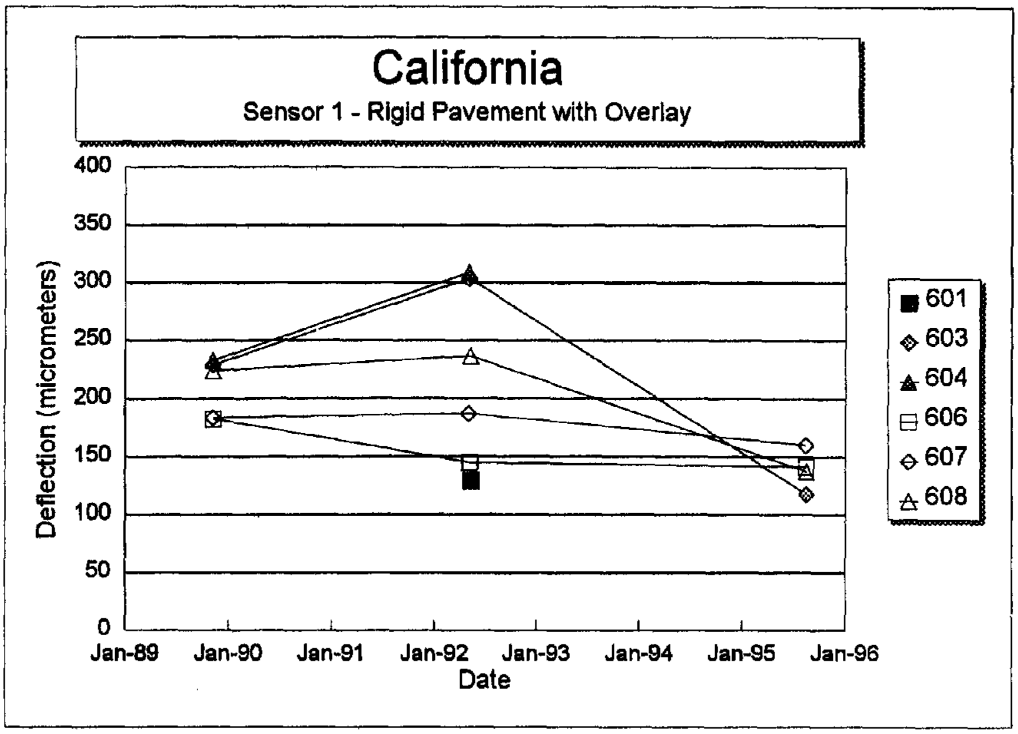


Figure 130. Rut depth versus time on each HMAC section of the Pennsylvania and South Dakota SPS-6 projects.



Note: Section 501 is a non-overlayed control section.

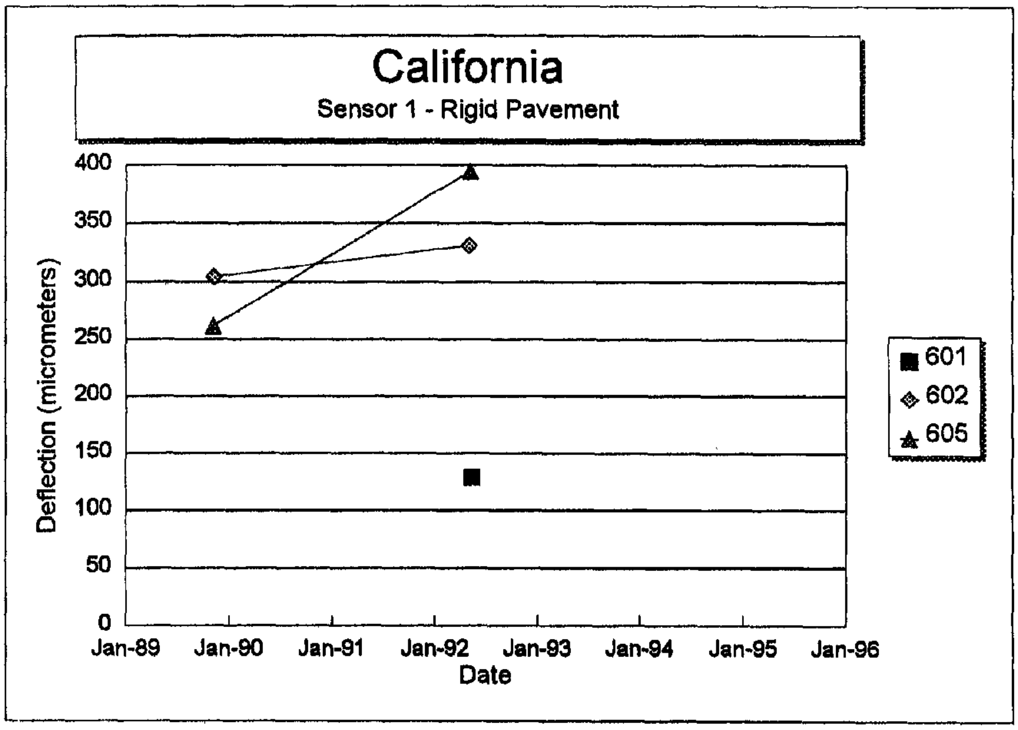
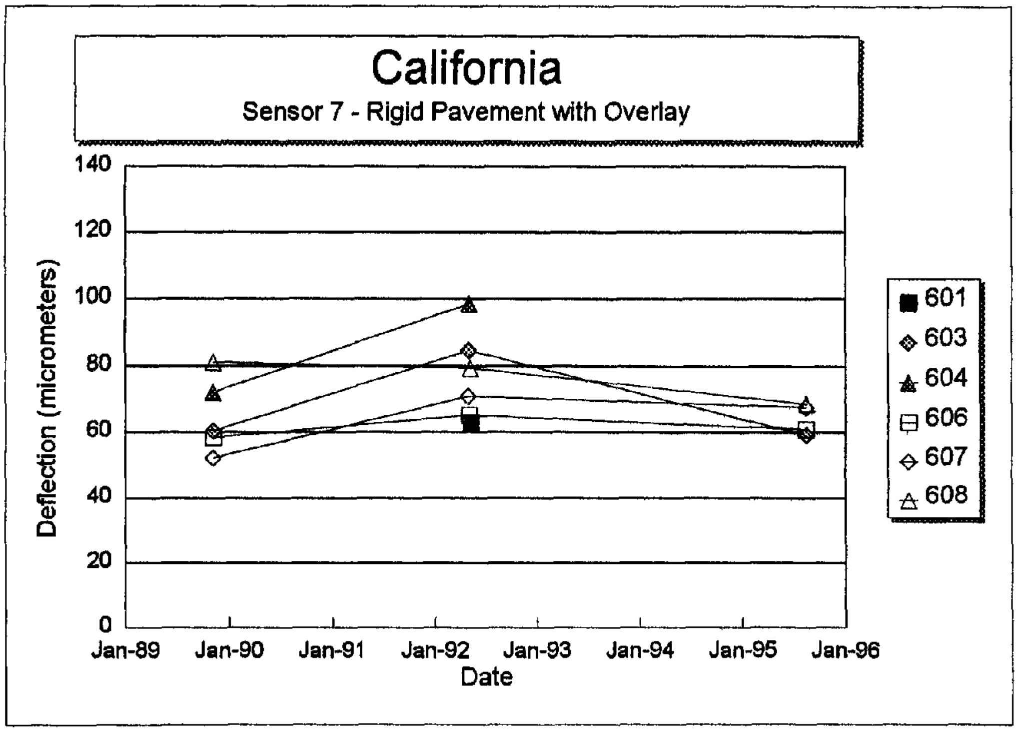


Figure 131. Sensor 1 deflection versus time for each section of the California SPS-6 project.



Note: Section 501 is a non-overlayed control section.

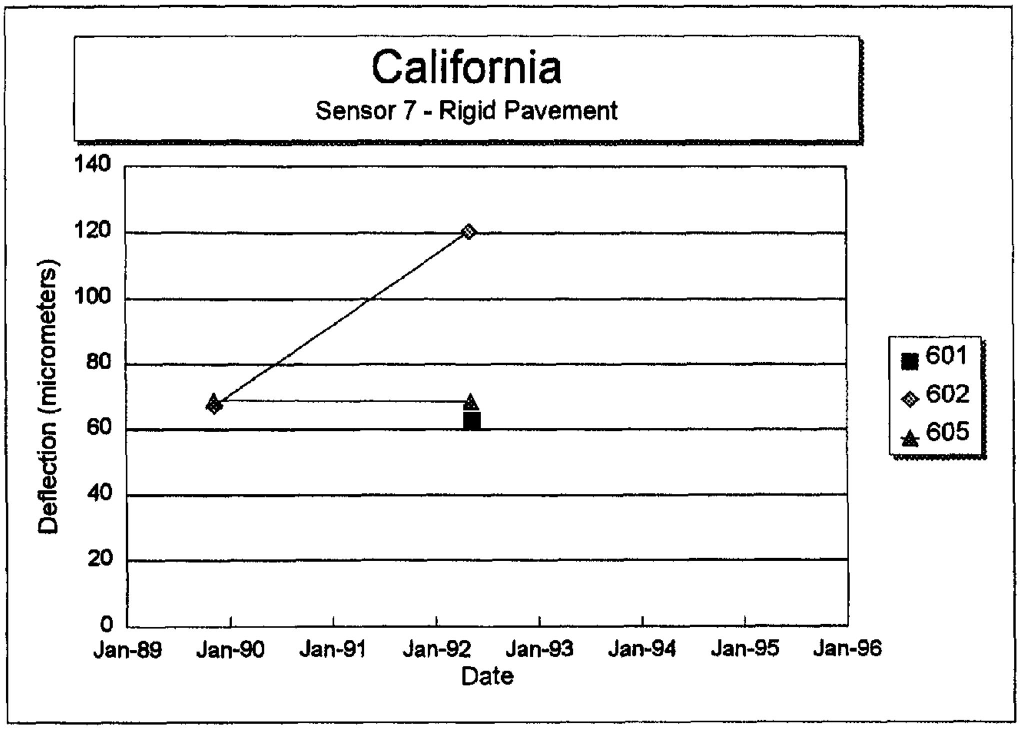
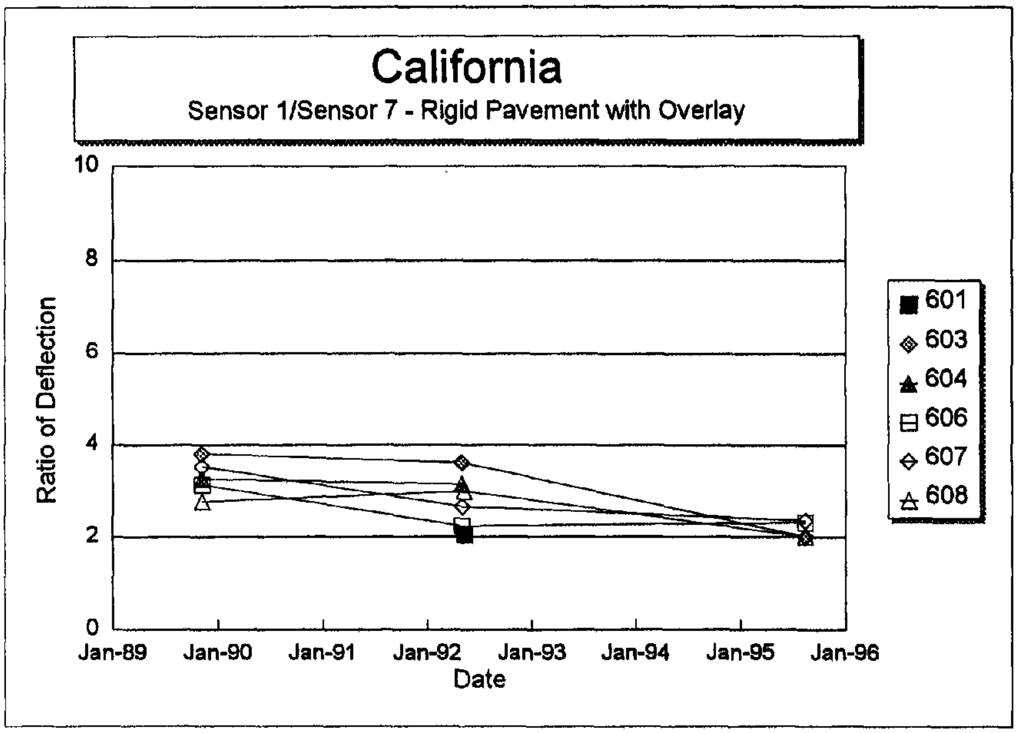


Figure 132. Sensor 7 deflection versus time for each section of the California SPS-6 project.



Note: Section 501 is a non-overlayed control section.

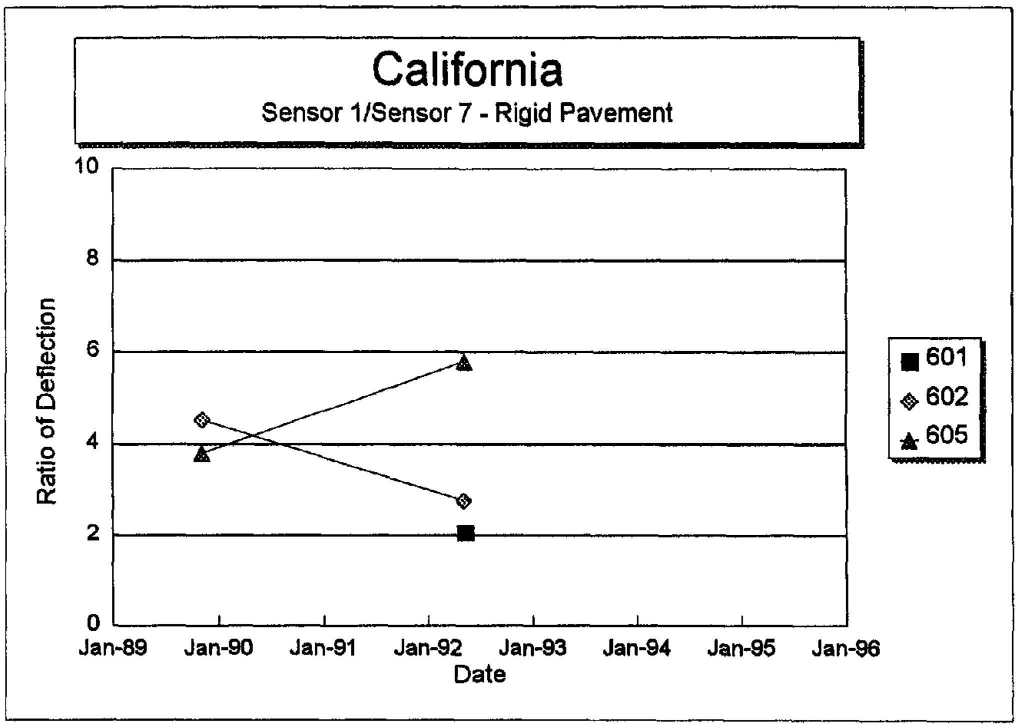
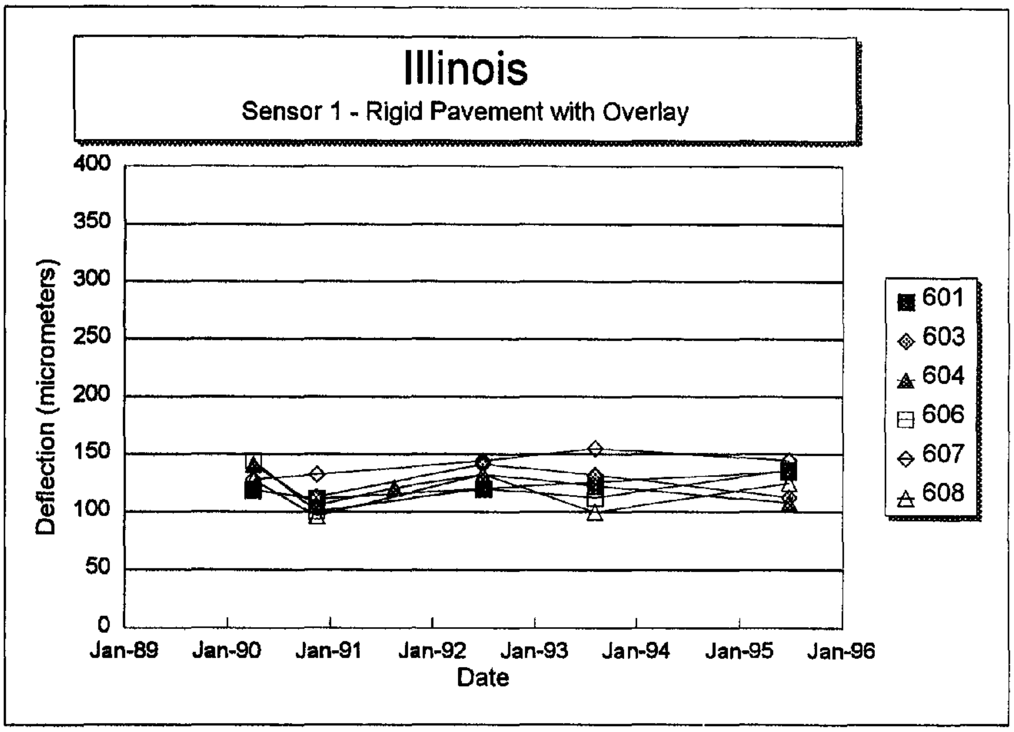


Figure 133. Sensor 1 deflection divided by Sensor 7 deflection versus time for each section of the California SPS-6 project.



Note: Section 601 is a non-overlayed control section.

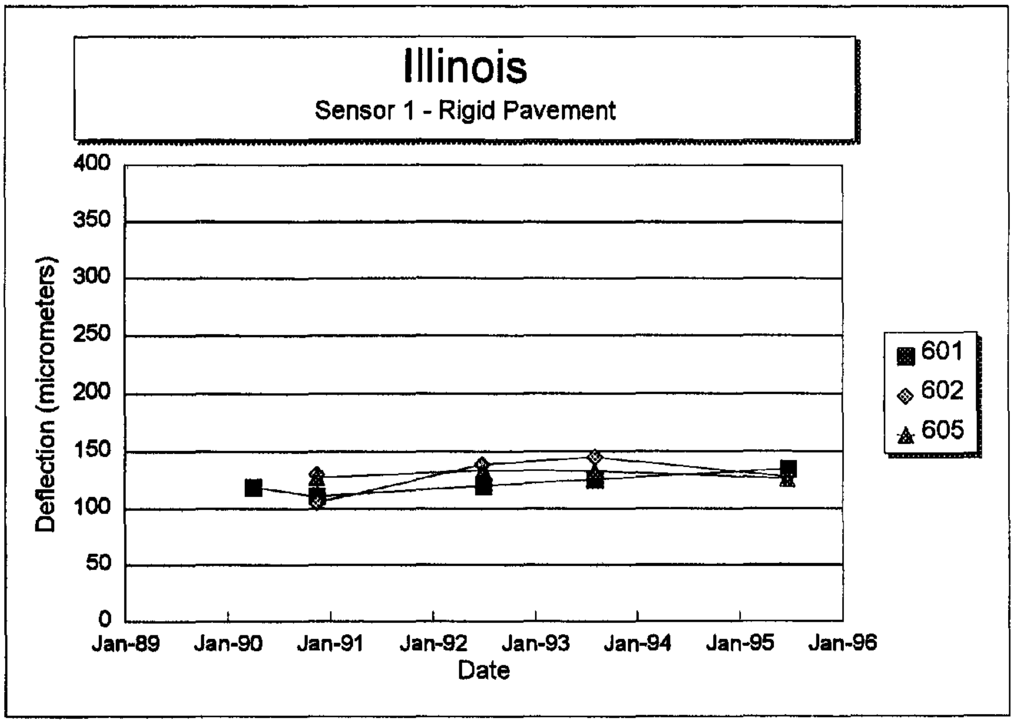
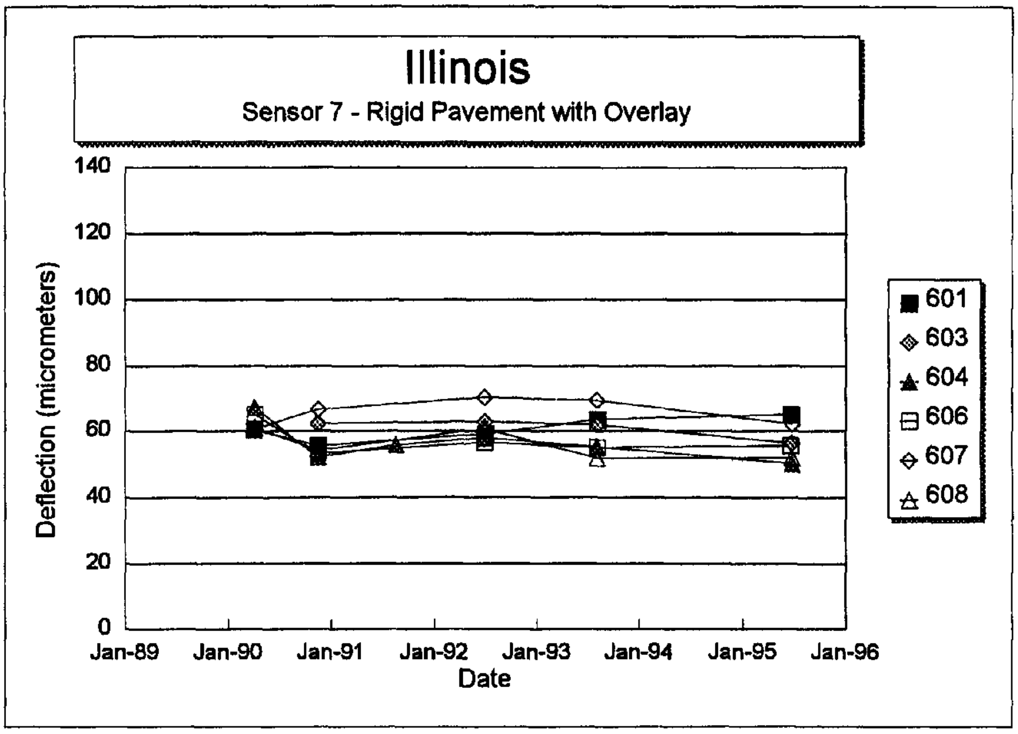


Figure 134. Sensor 1 deflection versus time for each section of the Illinois SPS-6 project.



Note: Section 601 is a non-overlayed control section.

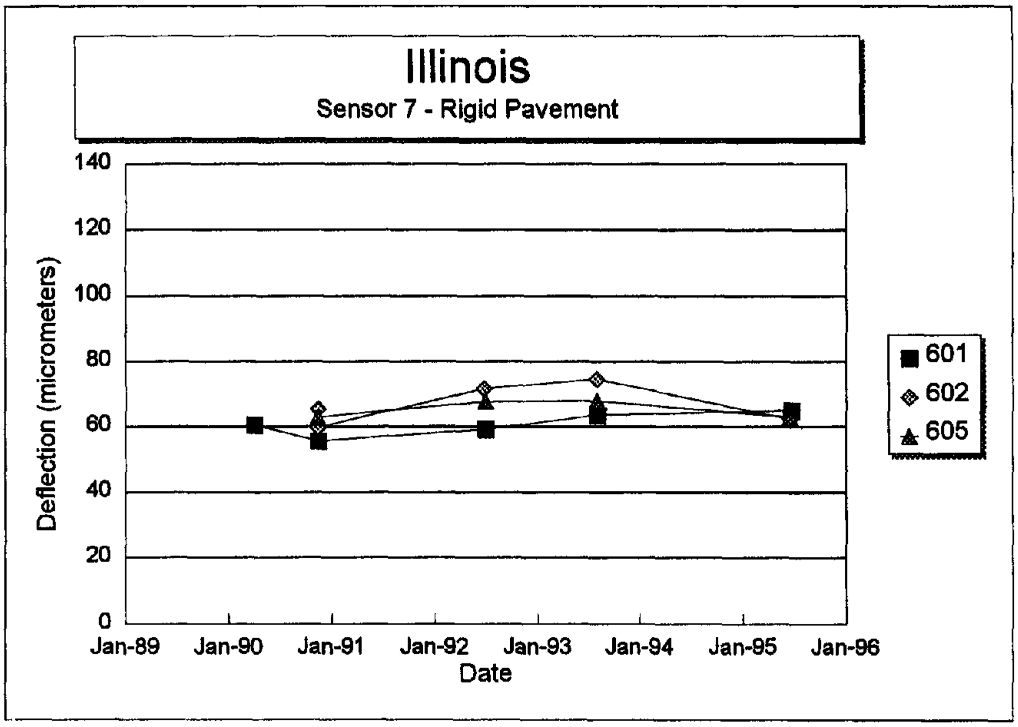
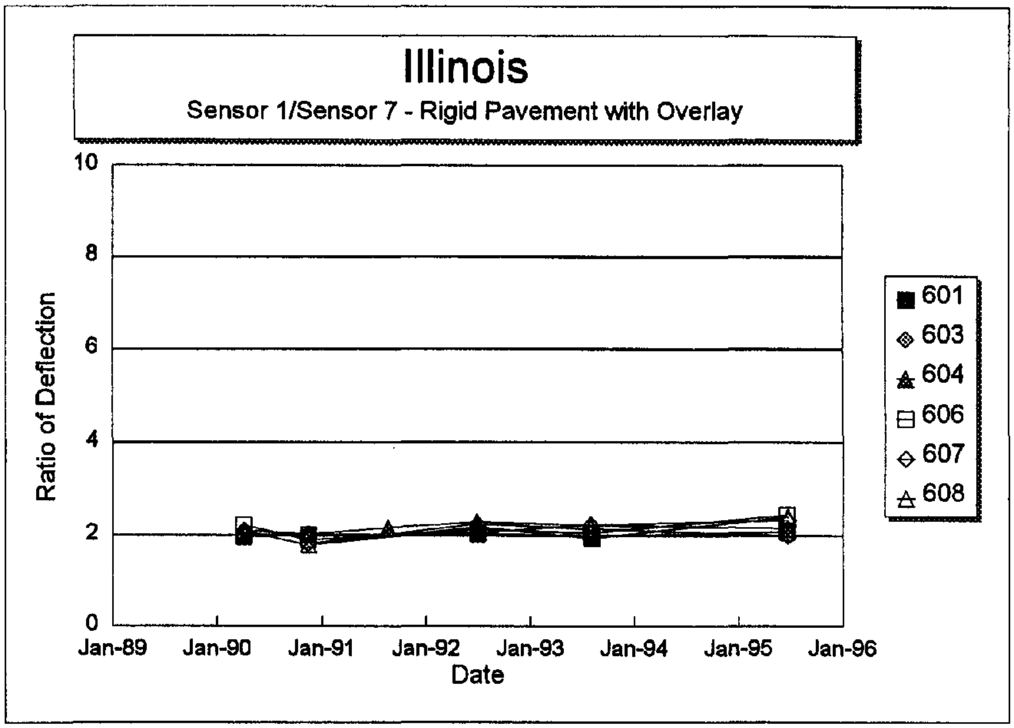


Figure 135. Sensor 7 deflection versus time for each section of the Illinois SPS-6 project.



Note: Section 601 is a non-overlayed control section.

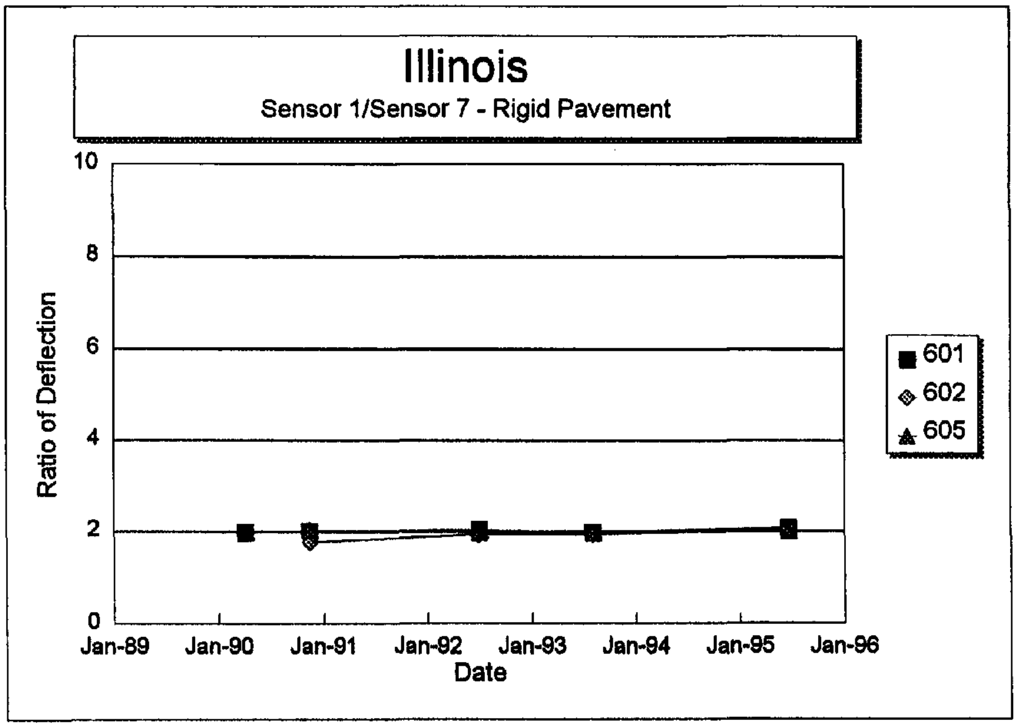
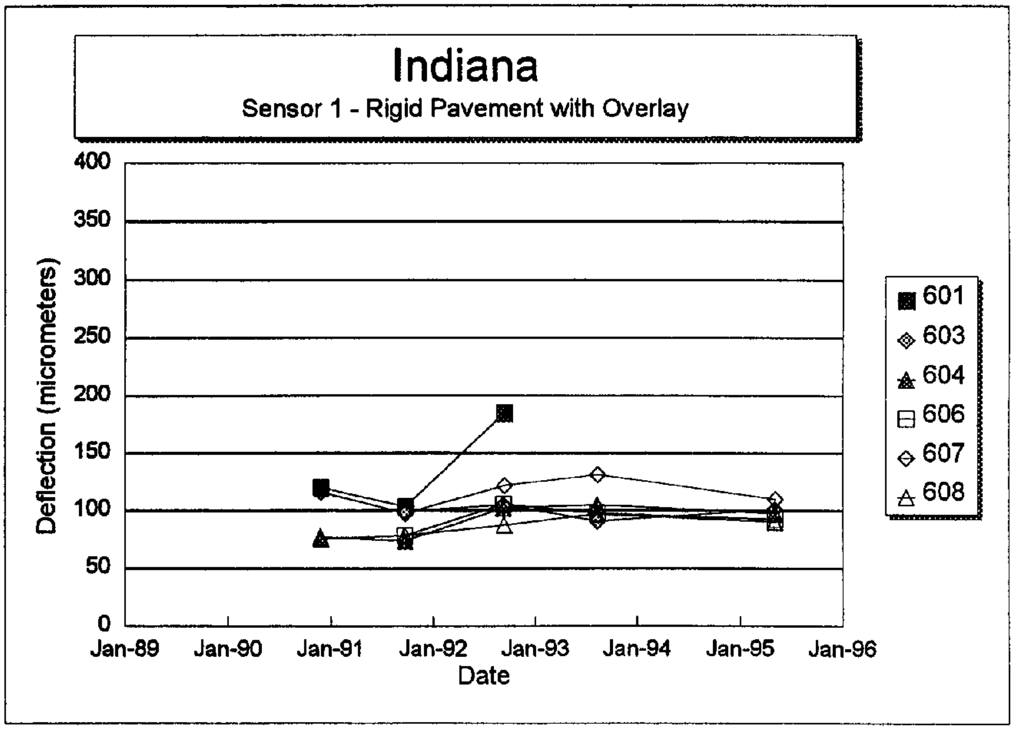


Figure 136. Sensor 1 deflection divided by Sensor 7 deflection versus time for each section of the Illinois SPS-6 project.



Note: Section 601 is a non-overlayed control section.

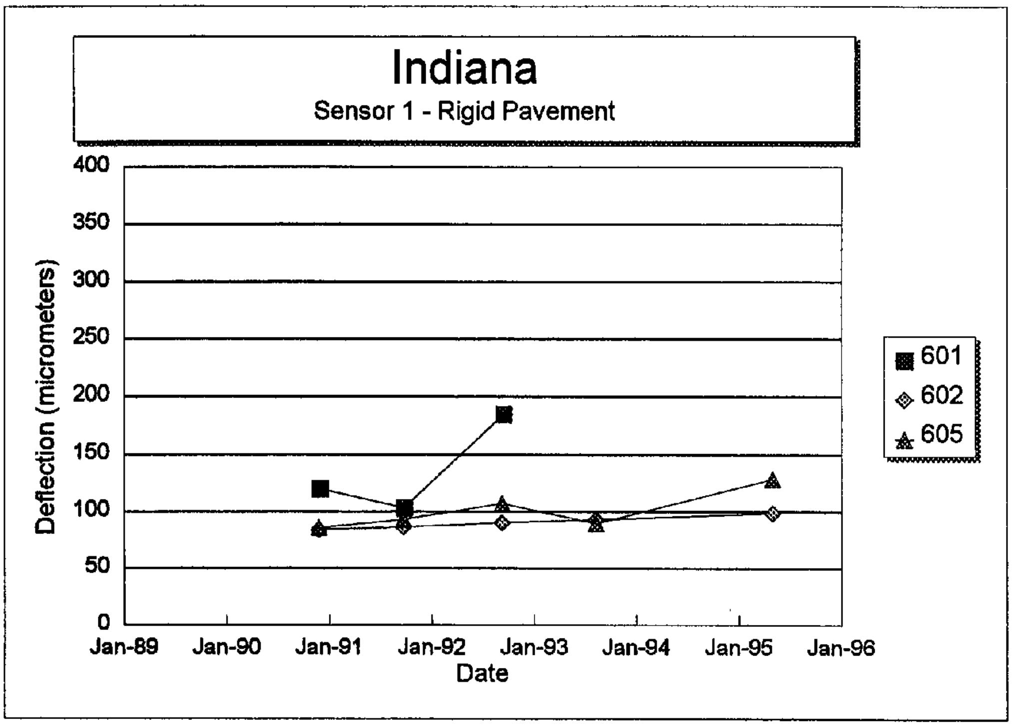
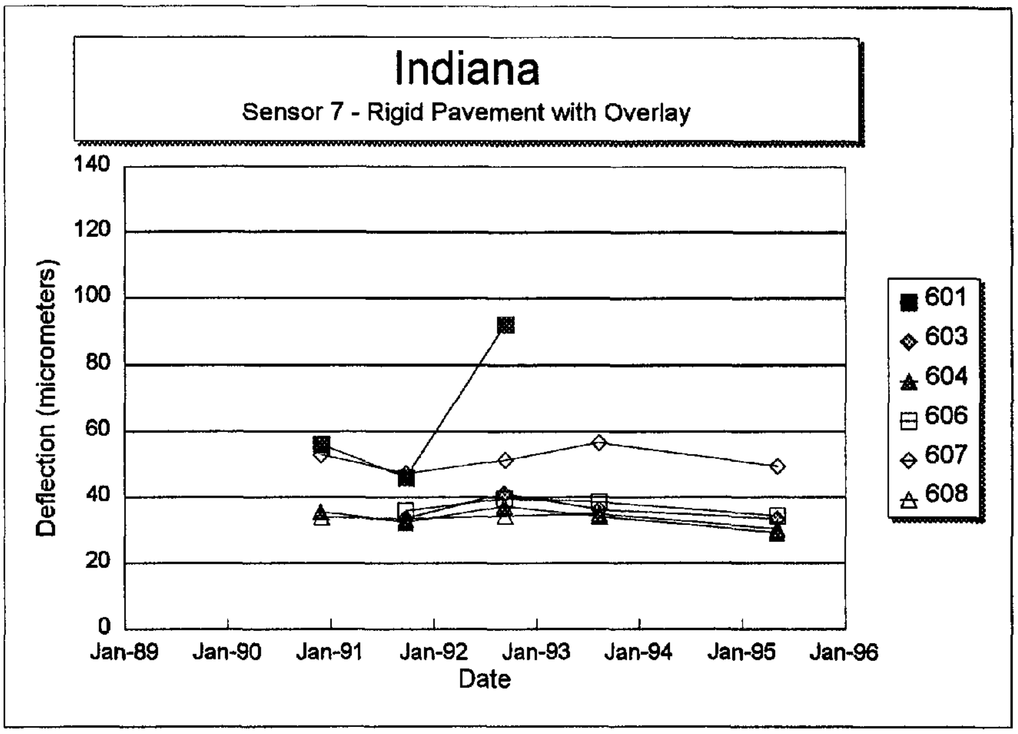


Figure 137. Sensor 1 deflection versus time for each section of the Indiana SPS-6 project.



Note: Section 601 is a non-overlayed control section.

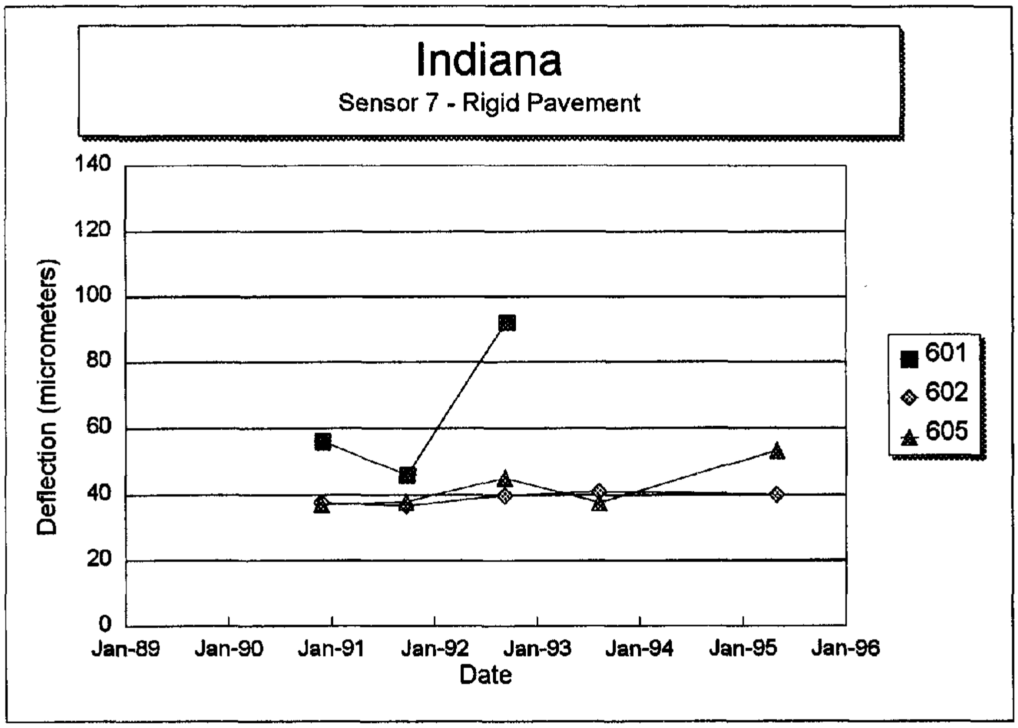
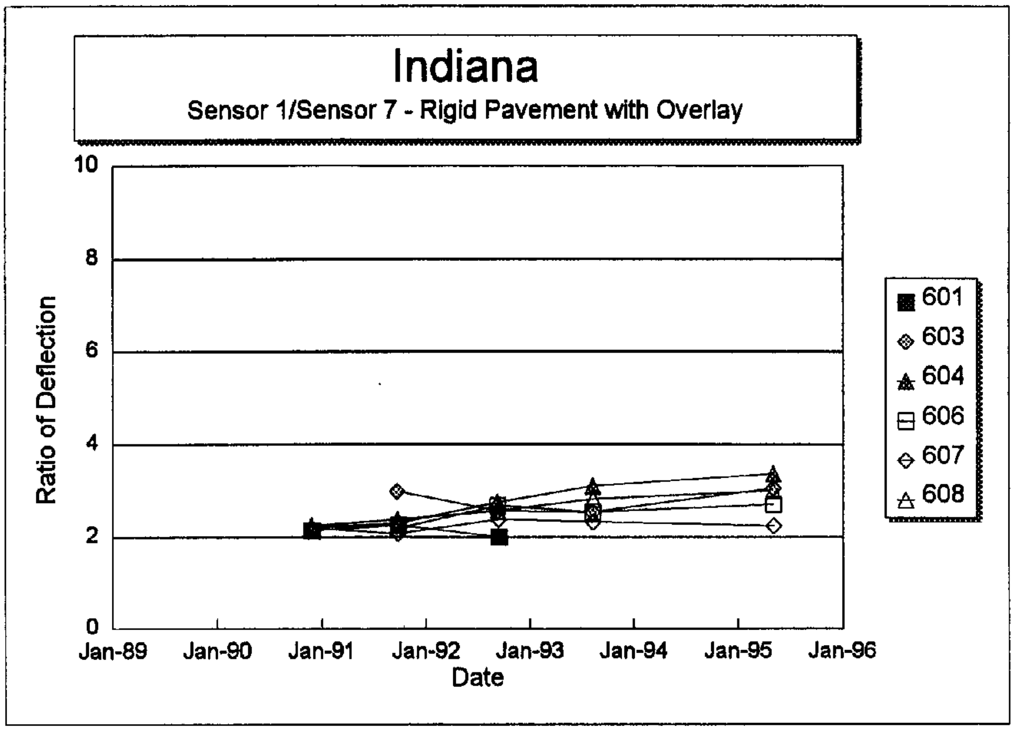


Figure 138. Sensor 7 deflection versus time for each section of the Indiana SPS-6 project.



Note: Section 601 is a non-overlayed control section.

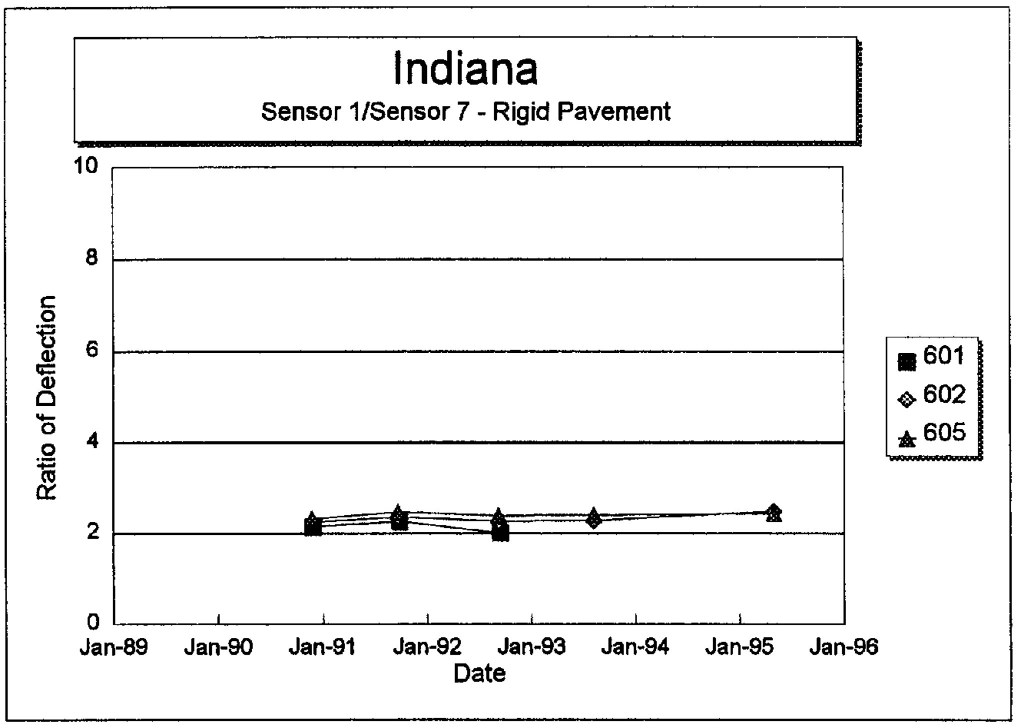
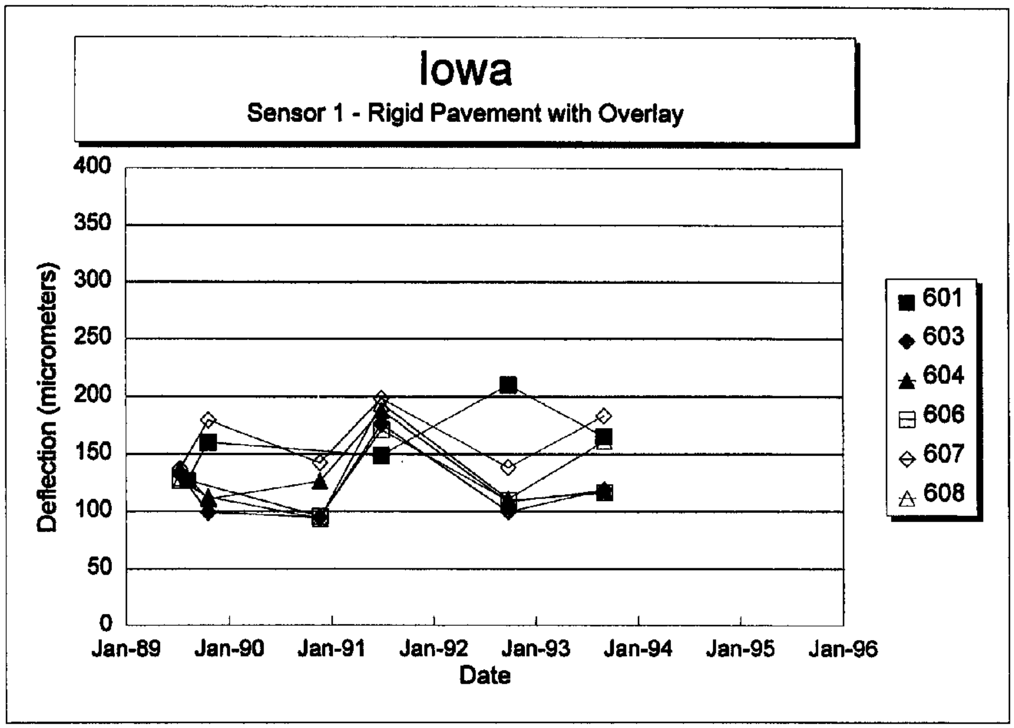


Figure 139. Sensor 1 deflection divided by Sensor 7 deflection versus time for each section of the Indiana SPS-6 project.



Note: Section 601 is a non-overlayed control section.

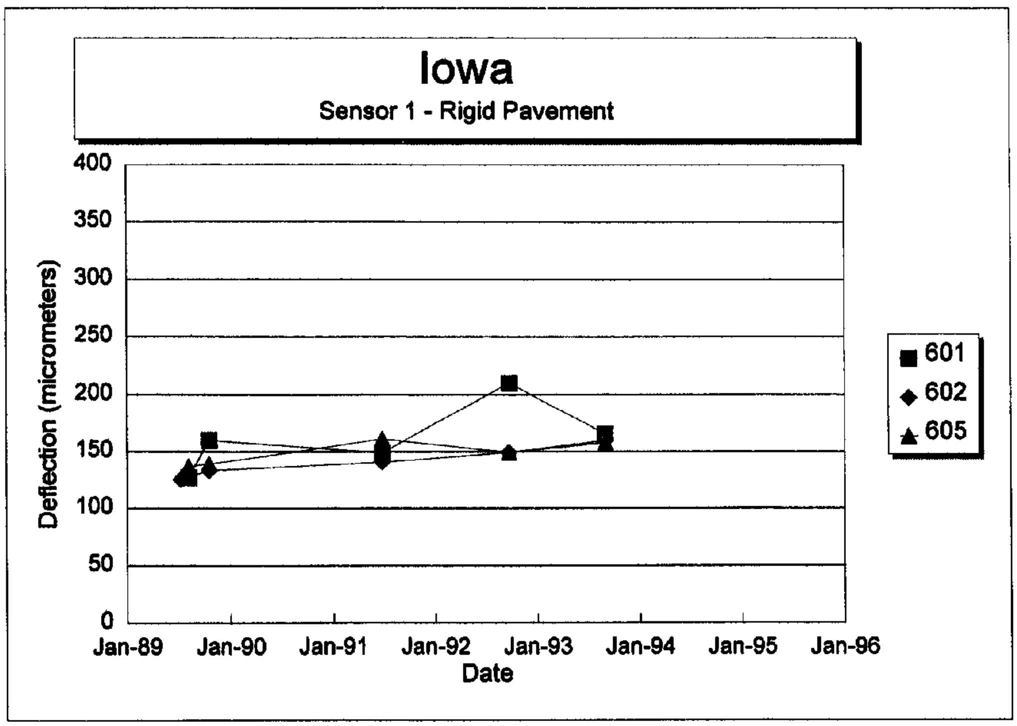
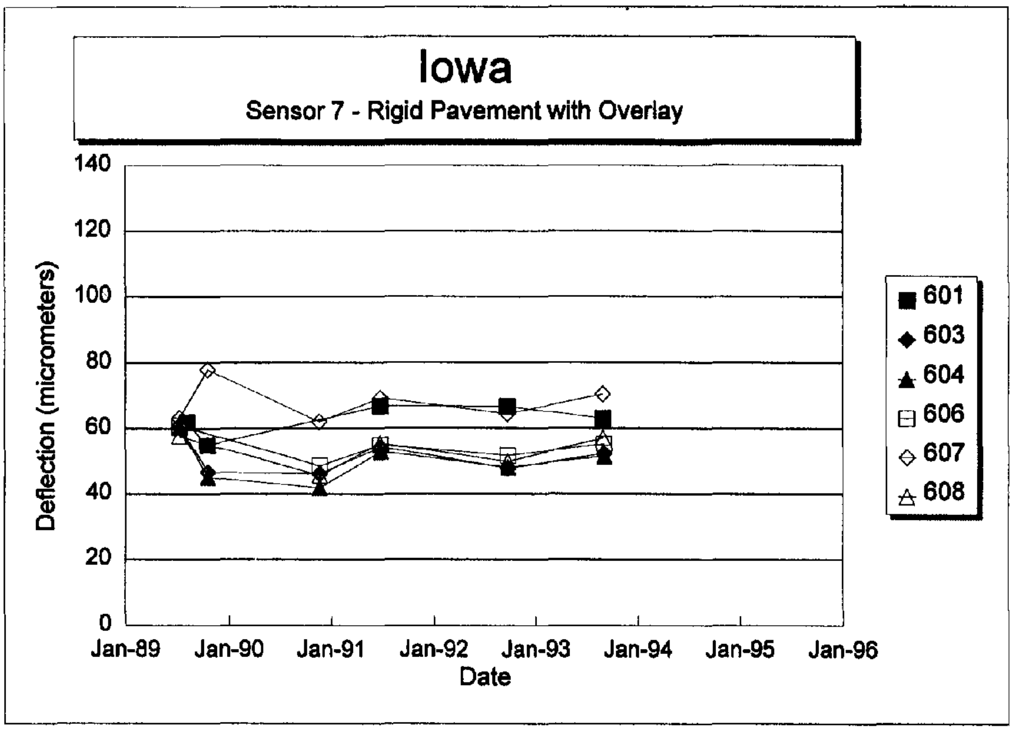


Figure 140. Sensor 1 deflection versus time for each section of the Iowa SPS-6 project.



Note: Section 601 is a non-overlayed control section.

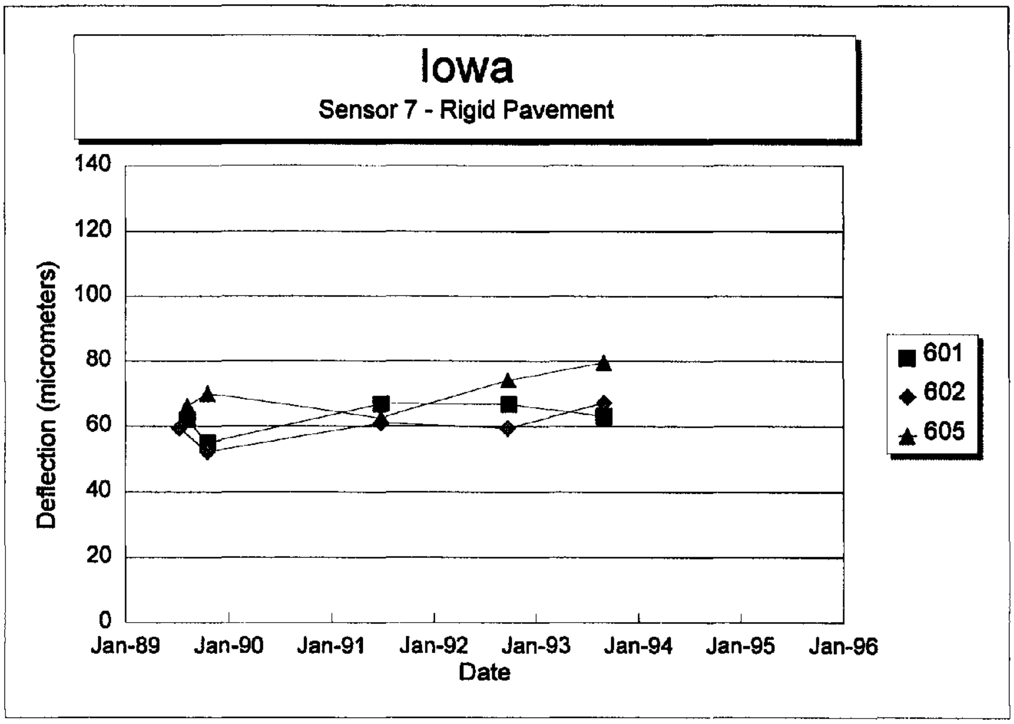
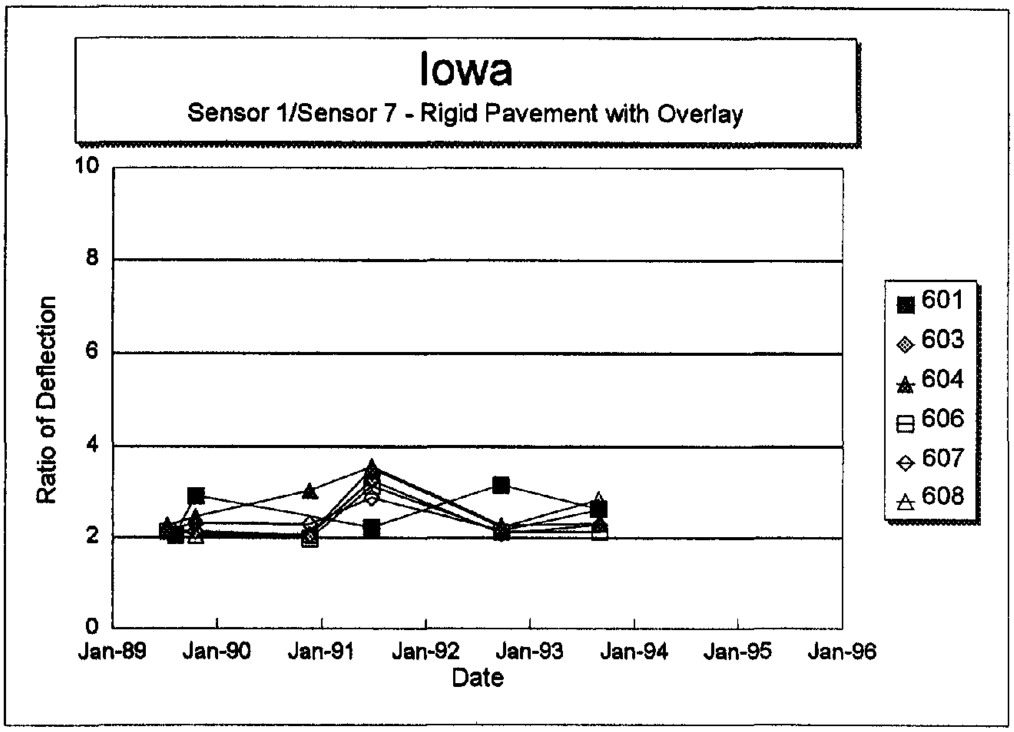


Figure 141. Sensor 7 deflection versus time for each section of the Iowa SPS-6 project.



Note: Section 601 is a non-overlayed control section.

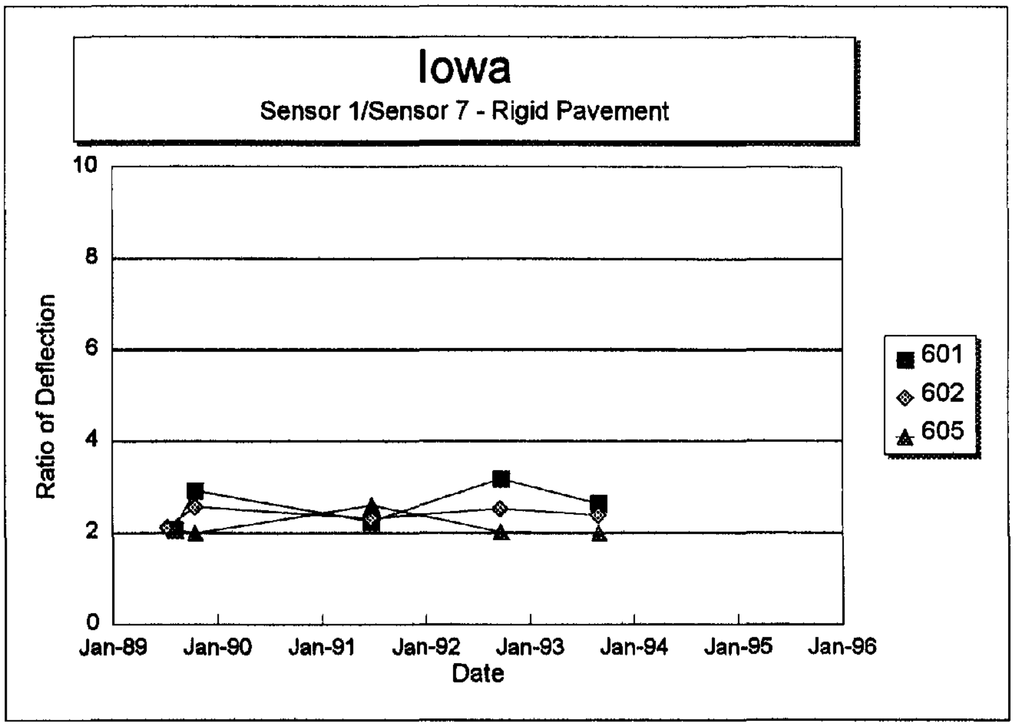
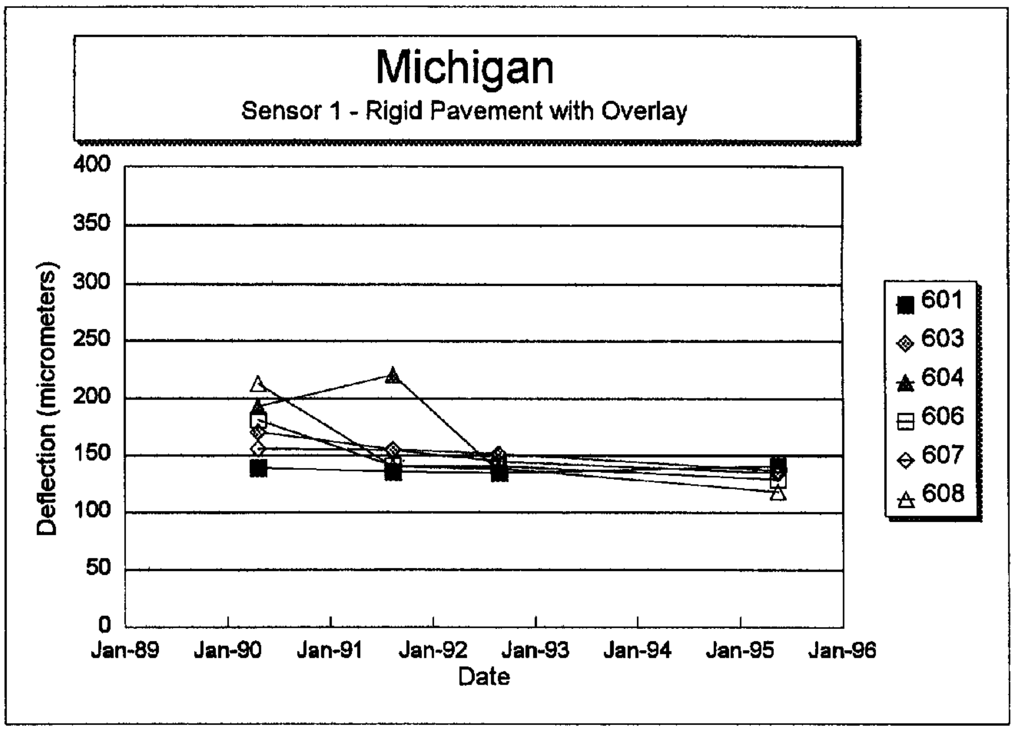


Figure 142. Sensor 1 deflection divided by Sensor 7 deflection versus time for each section of the Iowa SPS-6 project.



Note: Section 601 is a non-overlayed control section.

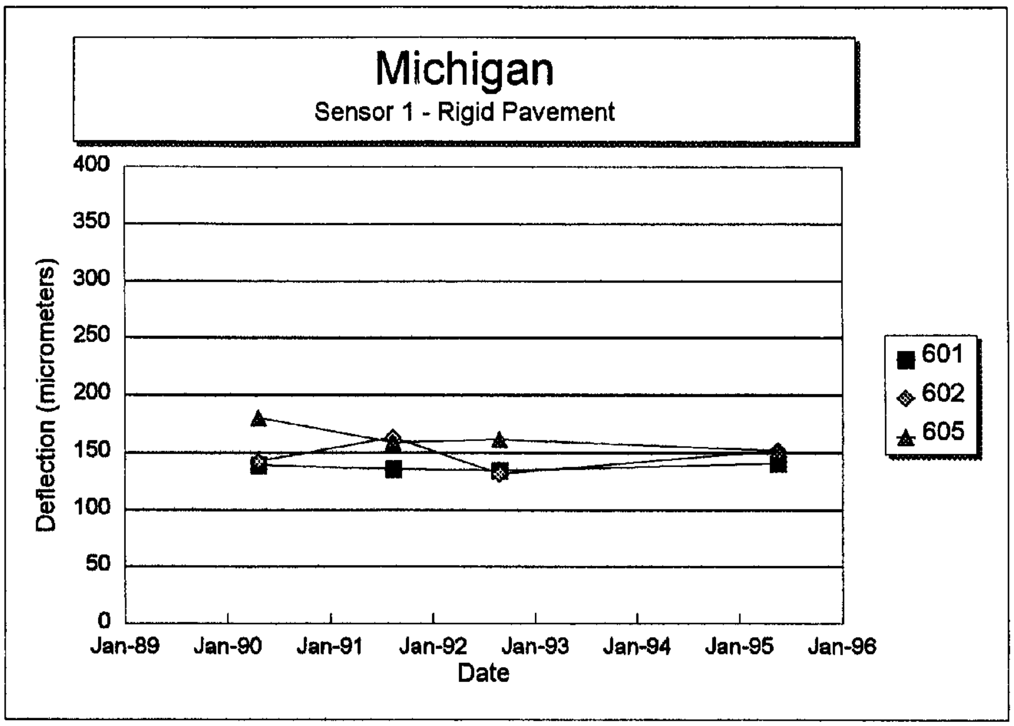
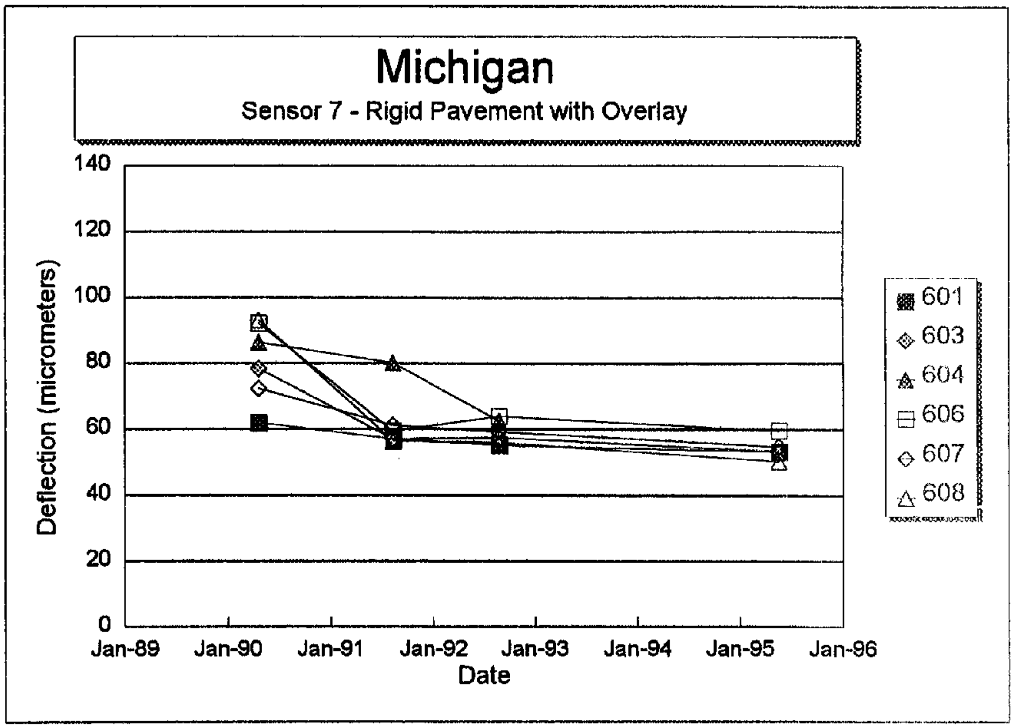


Figure 143. Sensor 1 deflection versus time for each section of the Michigan SPS-6 project.



Note: Section 601 is a non-overlayed control section.

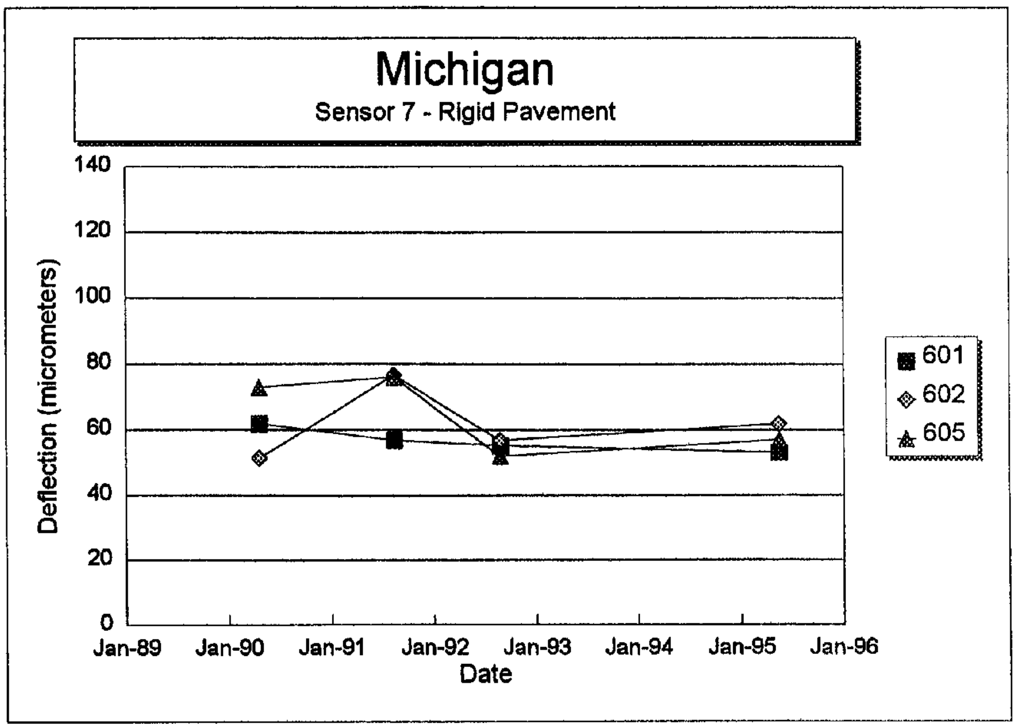
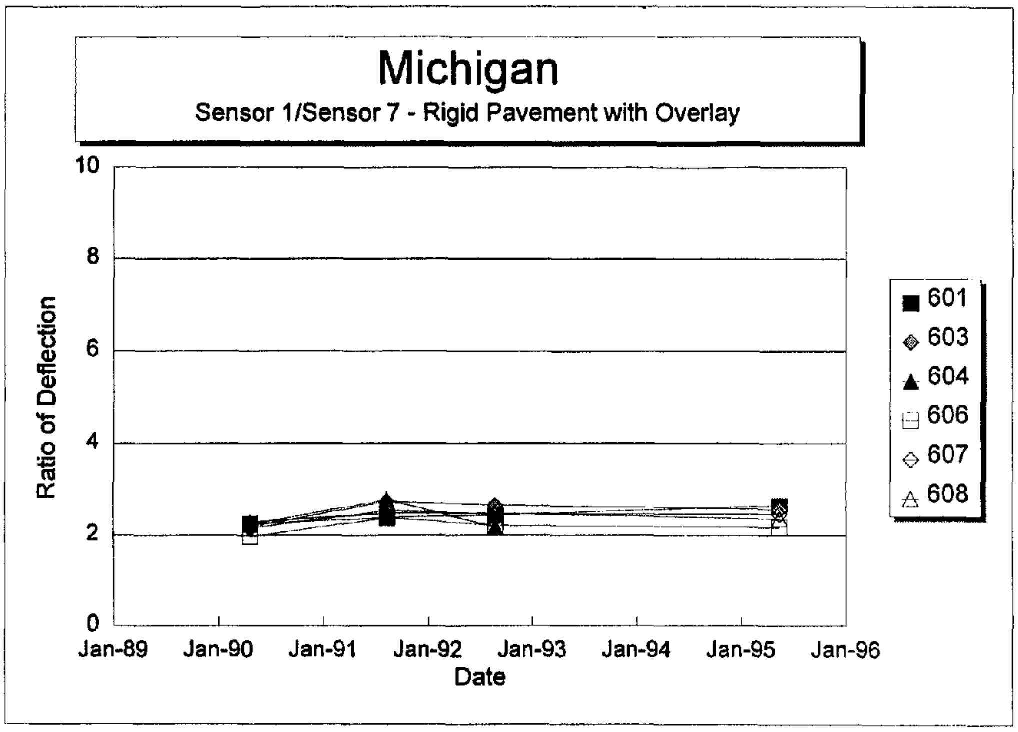


Figure 144. Sensor 7 deflection versus time for each section of the Michigan SPS-6 project.



Note: Section 601 is a non-overlayed control section.

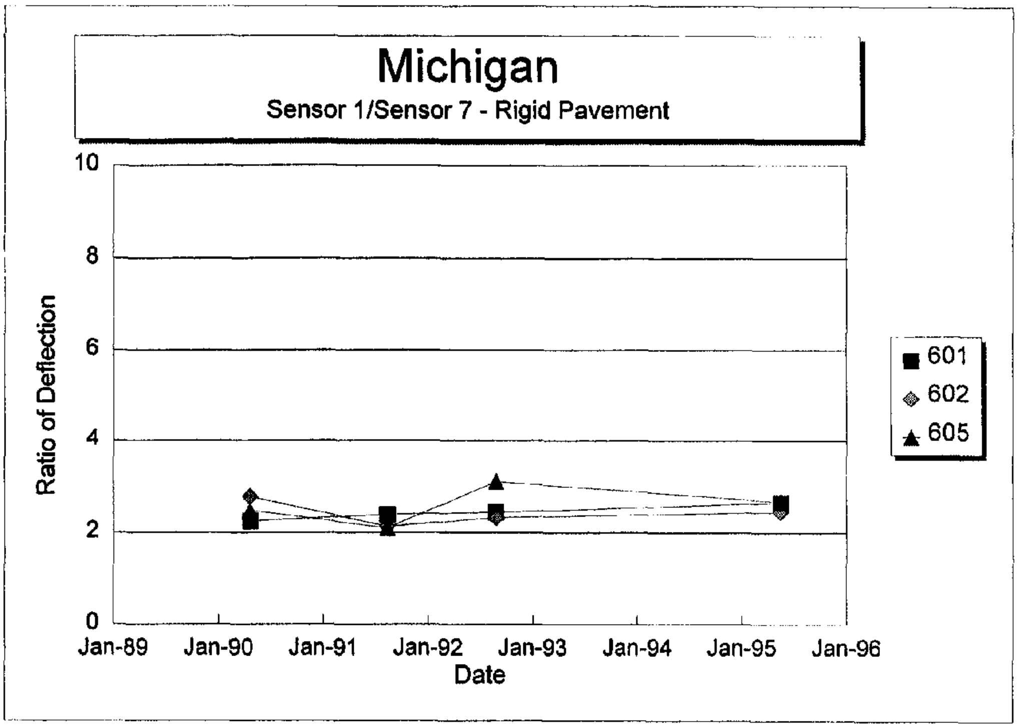
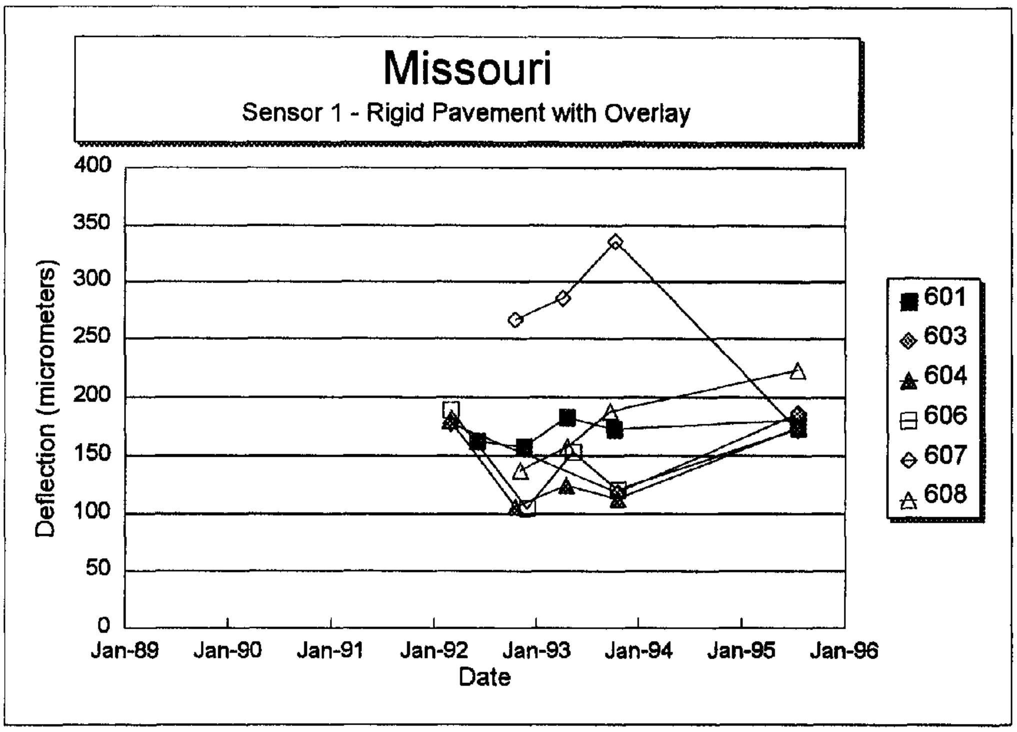


Figure 145. Sensor 1 deflection divided by Sensor 7 deflection versus time for each section of the Michigan SPS-6 project.



Note: Section 601 is a non-overlayed control section.

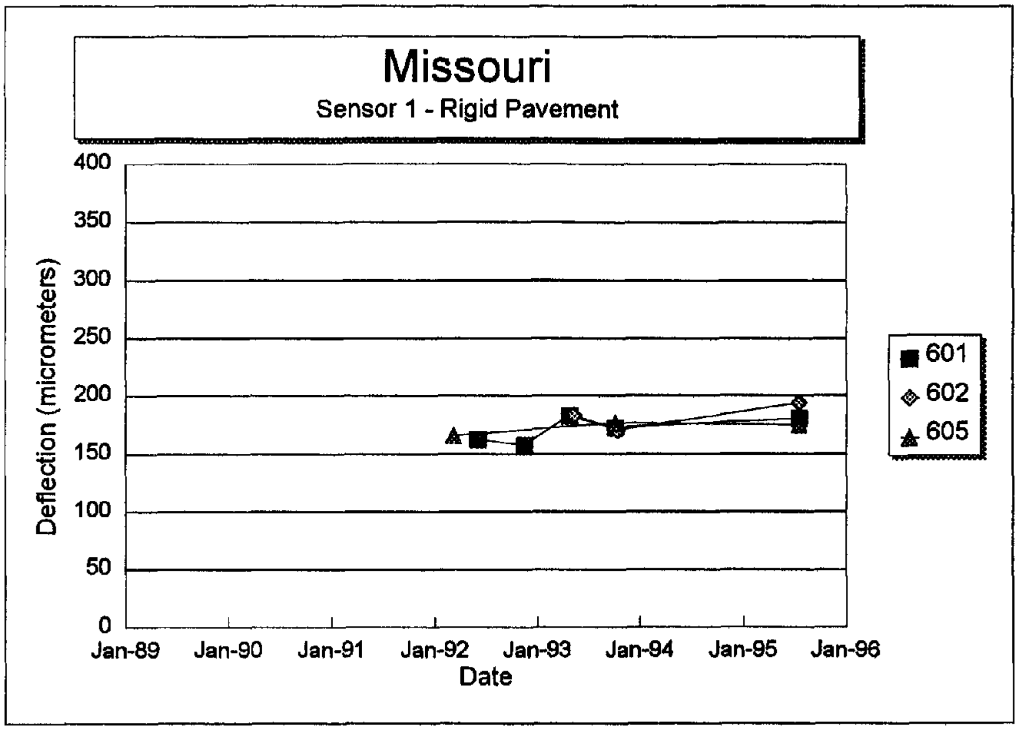
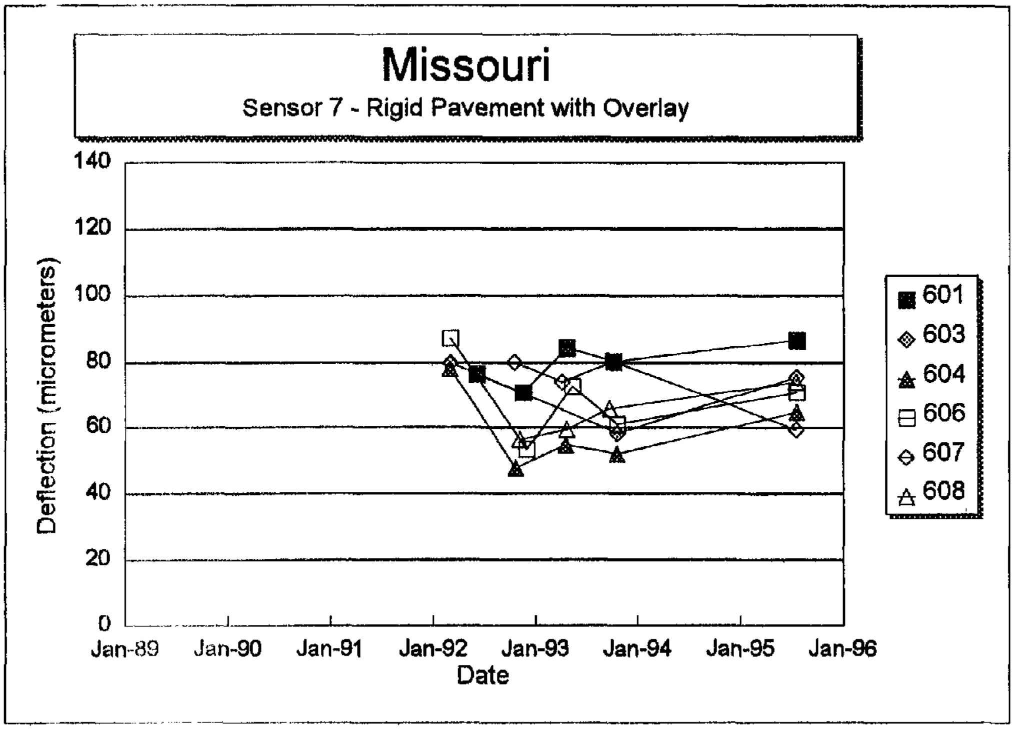


Figure 146. Sensor 1 deflection versus time for each section of the Missouri SPS-6 project.



Note: Section 601 is a non-overlayed control section.

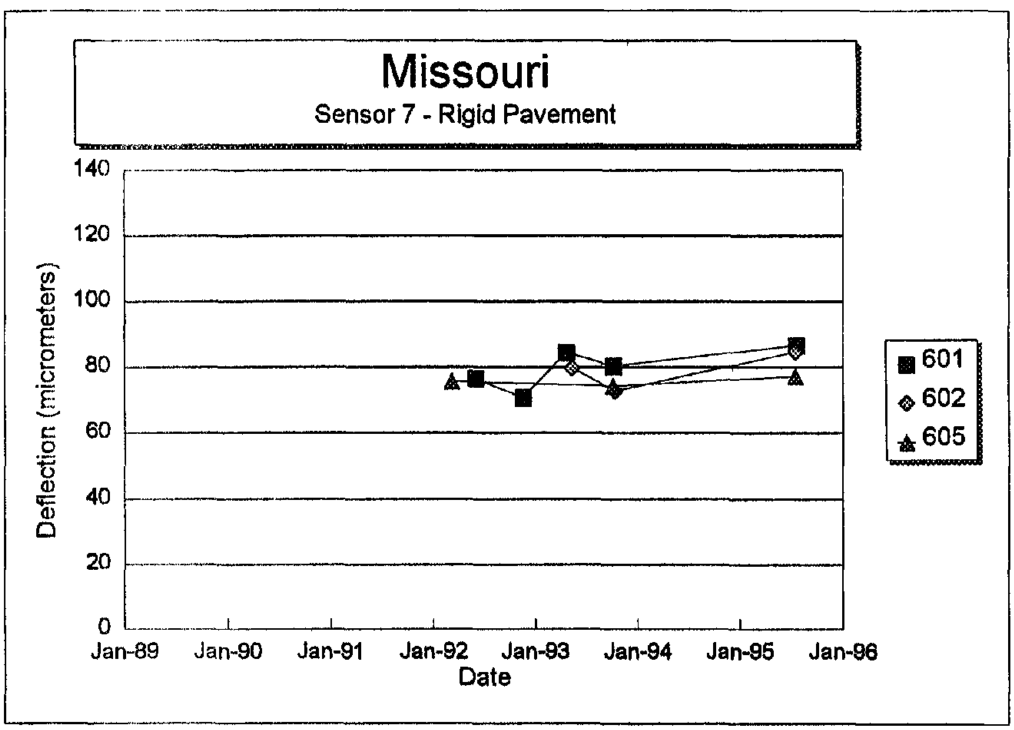
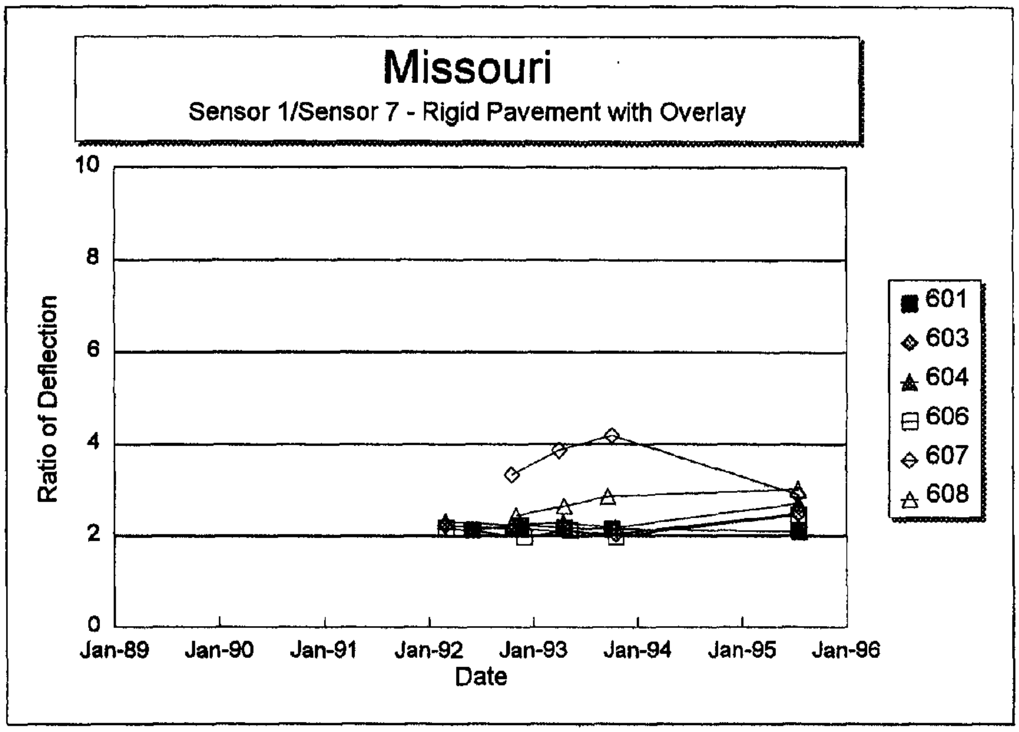


Figure 147. Sensor 7 deflection versus time for each section of the Missouri SPS-6 project.



Note: Section 601 is a non-overlayed control section.

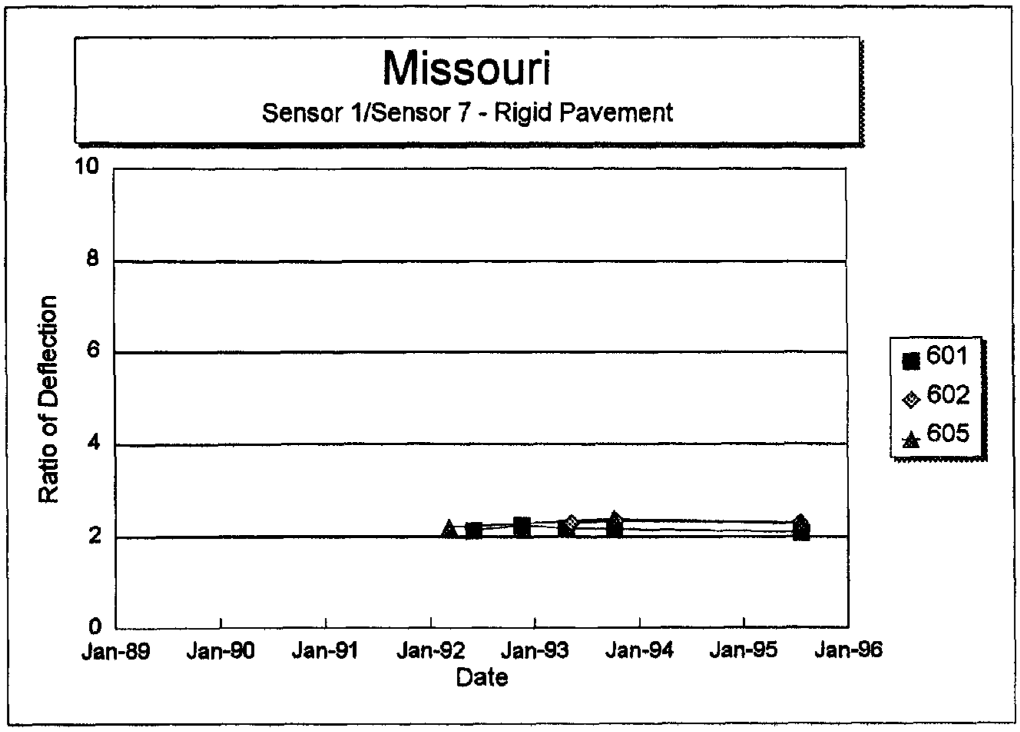
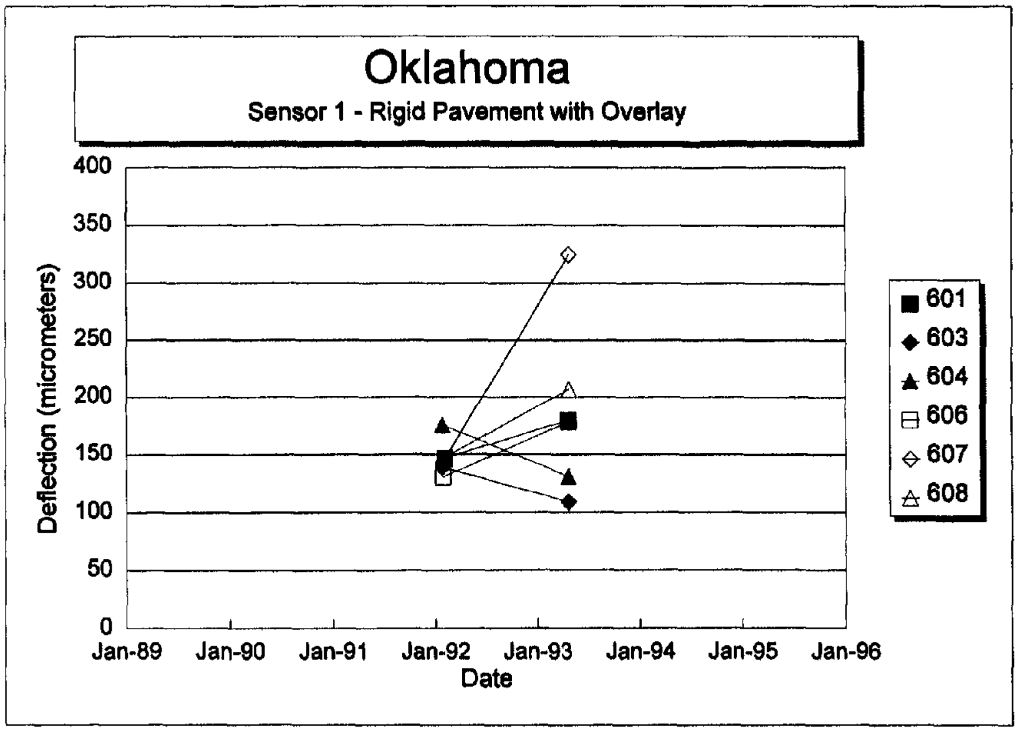


Figure 148. Sensor 1 deflection divided by Sensor 7 deflection versus time for each section of the Missouri SPS-6 project.



Note: Section 601 is a non-overlayed control section.

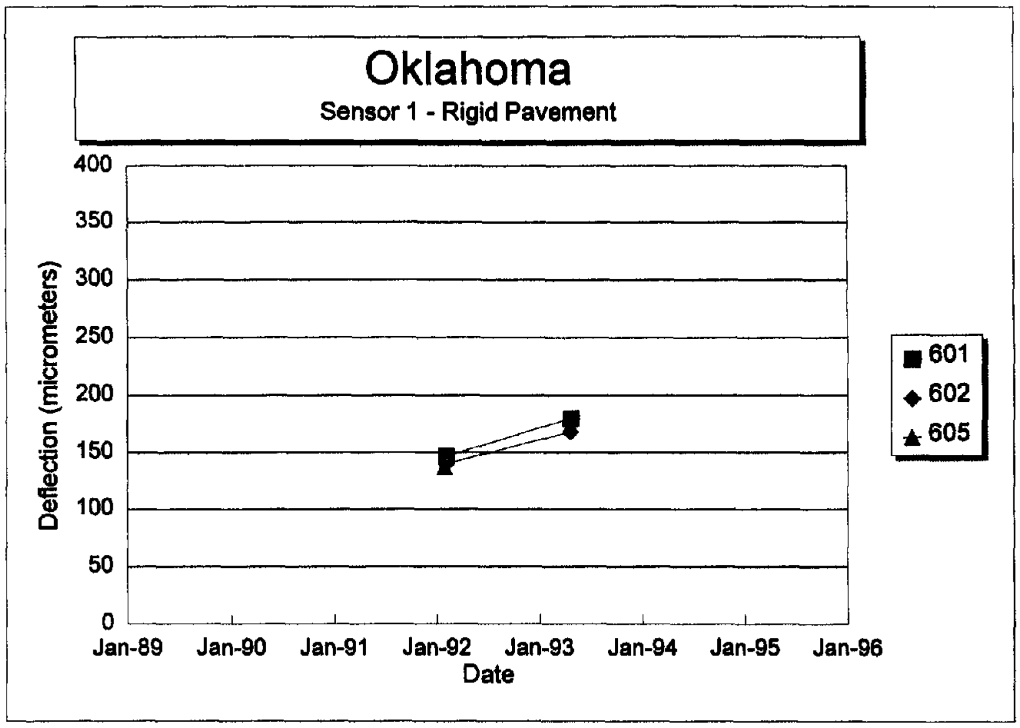
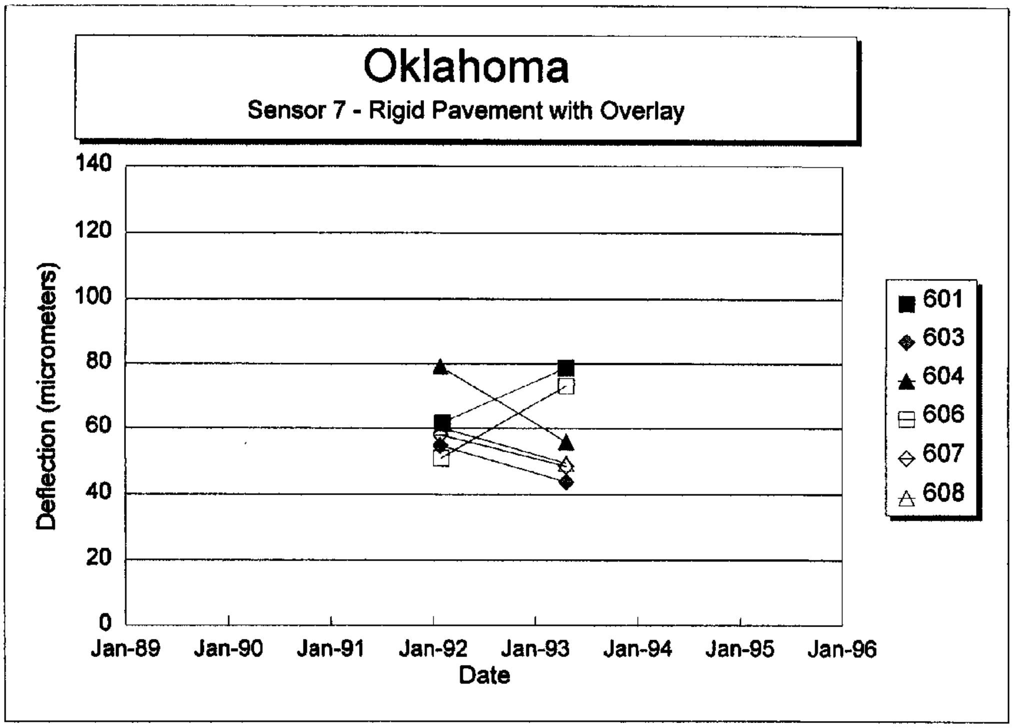


Figure 149. Sensor 1 deflection versus time for each section of the Oklahoma SPS-6 project.



Note: Section 601 is a non-overlayed control section.

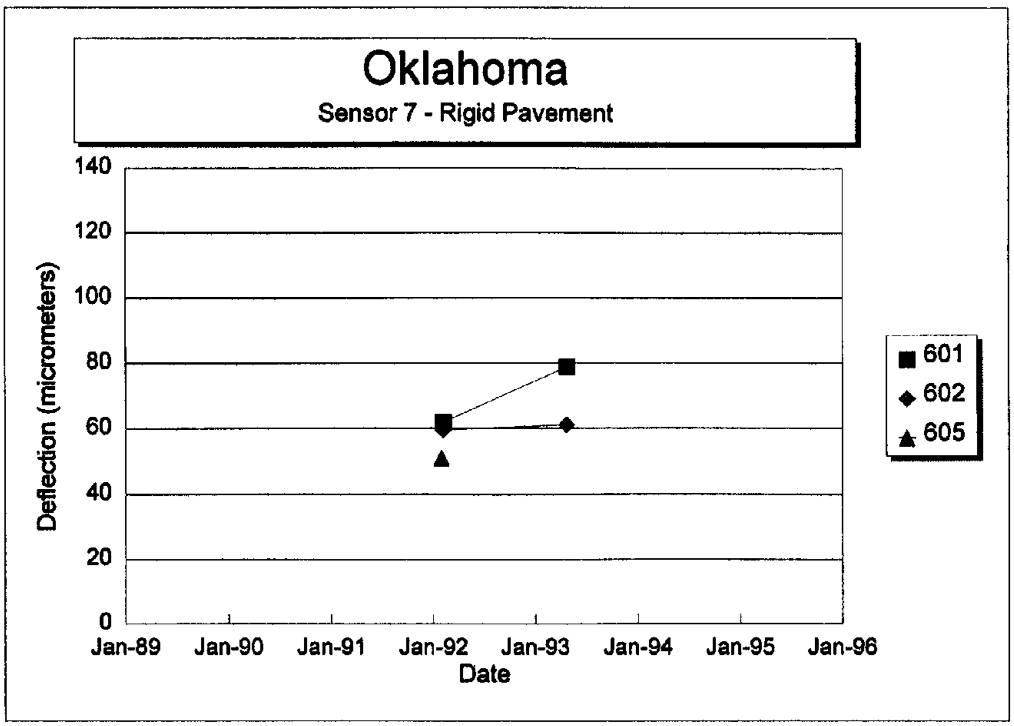
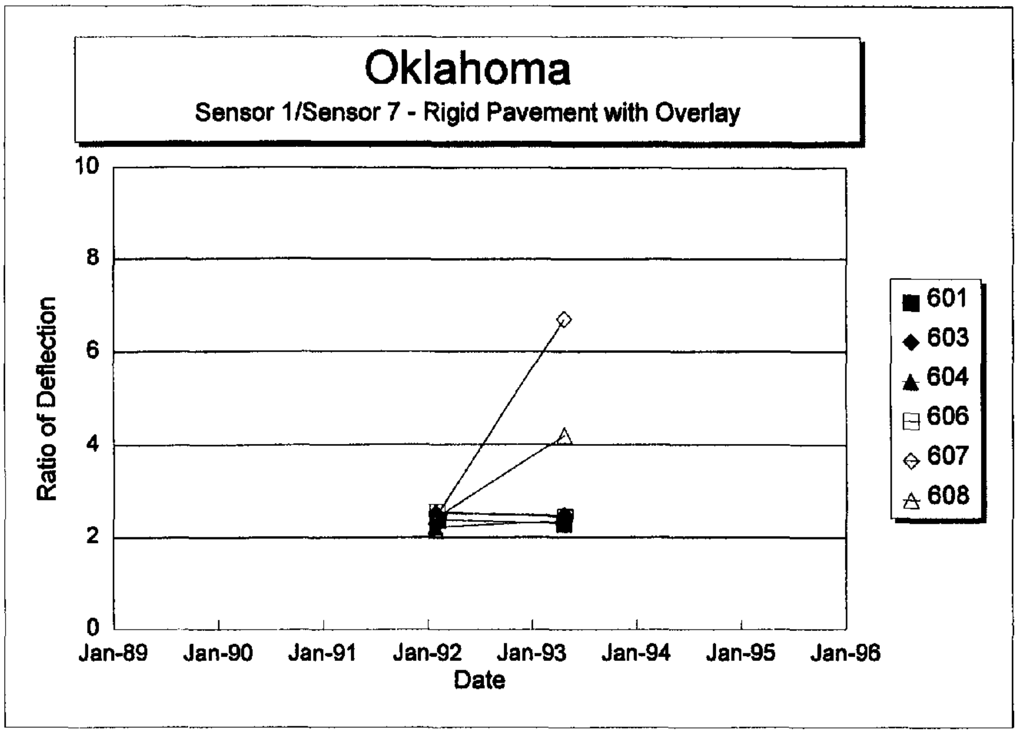


Figure 150. Sensor 7 deflection versus time for each section of the Oklahoma SPS-6 project.



Note: Section 601 is a non-overlayed control section.

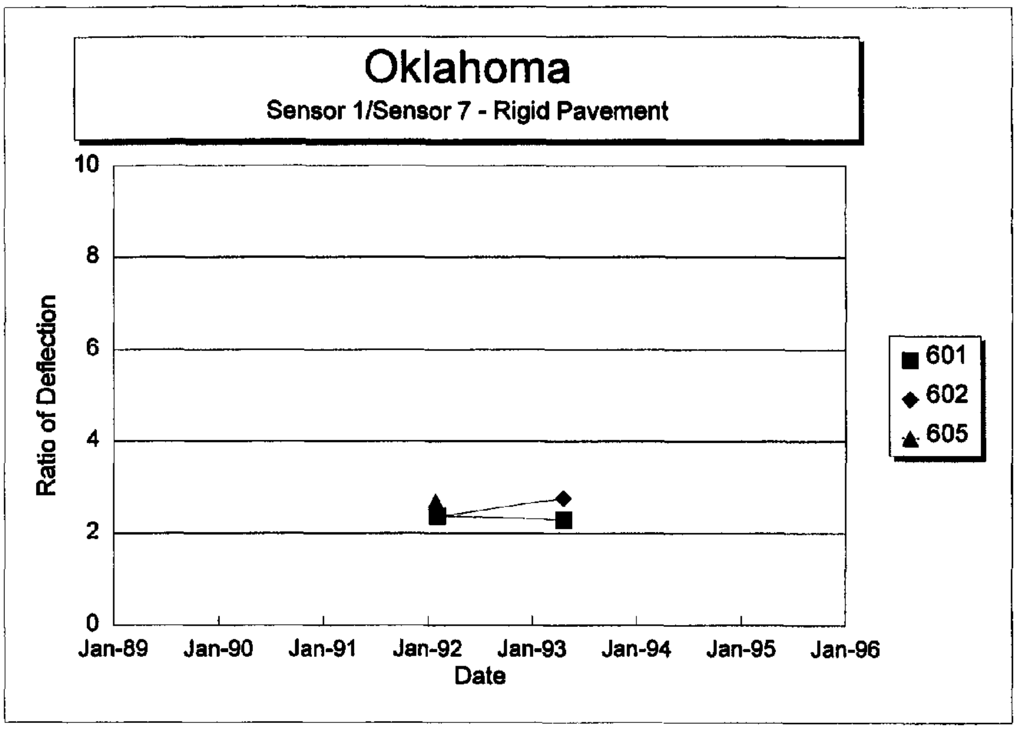
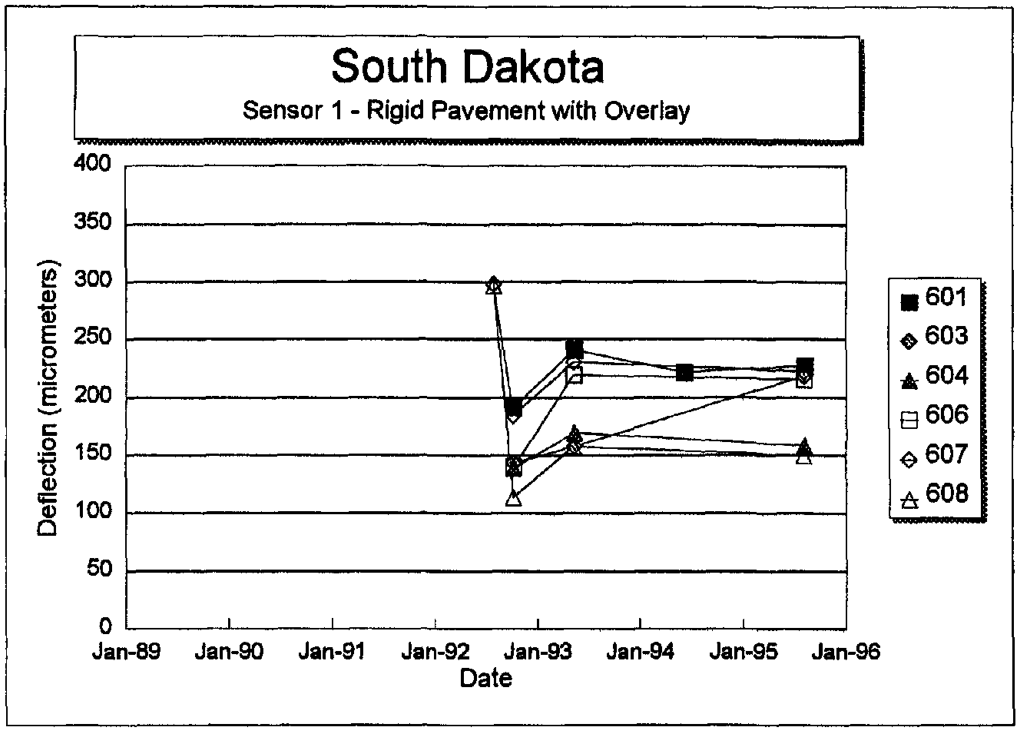


Figure 151. Sensor 1 deflection divided by Sensor 7 deflection versus time for each section of the Oklahoma SPS-6 project.



Note: Section 601 is a non-overlayed control section.

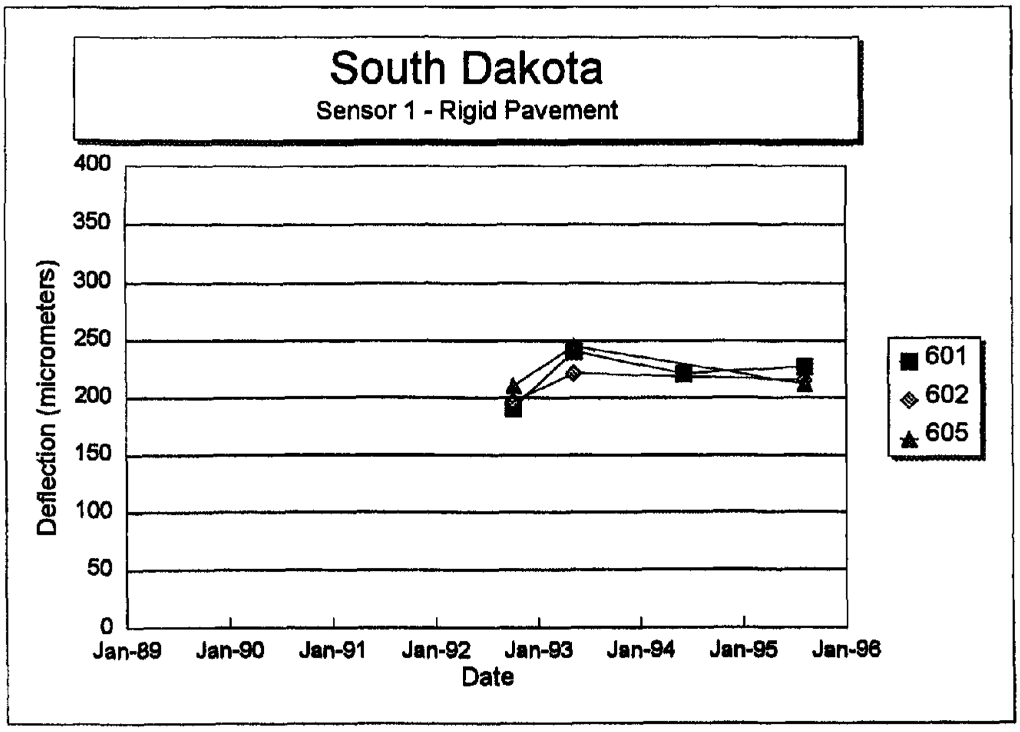
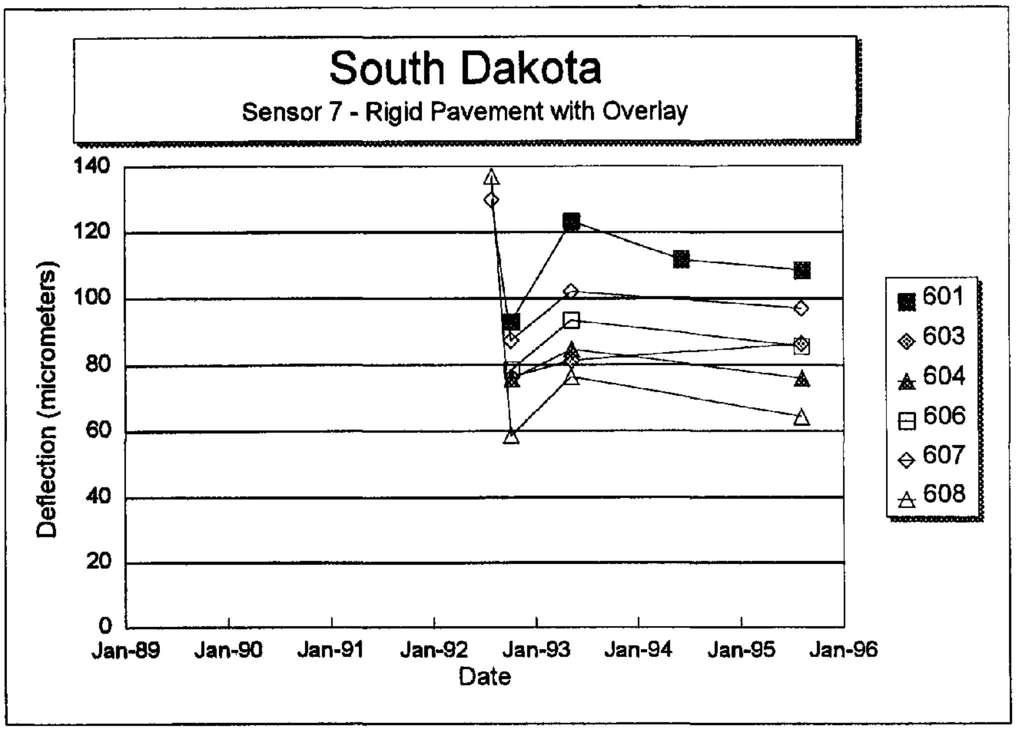


Figure 152. Sensor 1 deflection versus time for each section of the South Dakota SPS-6 project.



Note: Section 601 is a non-overlayed control section.

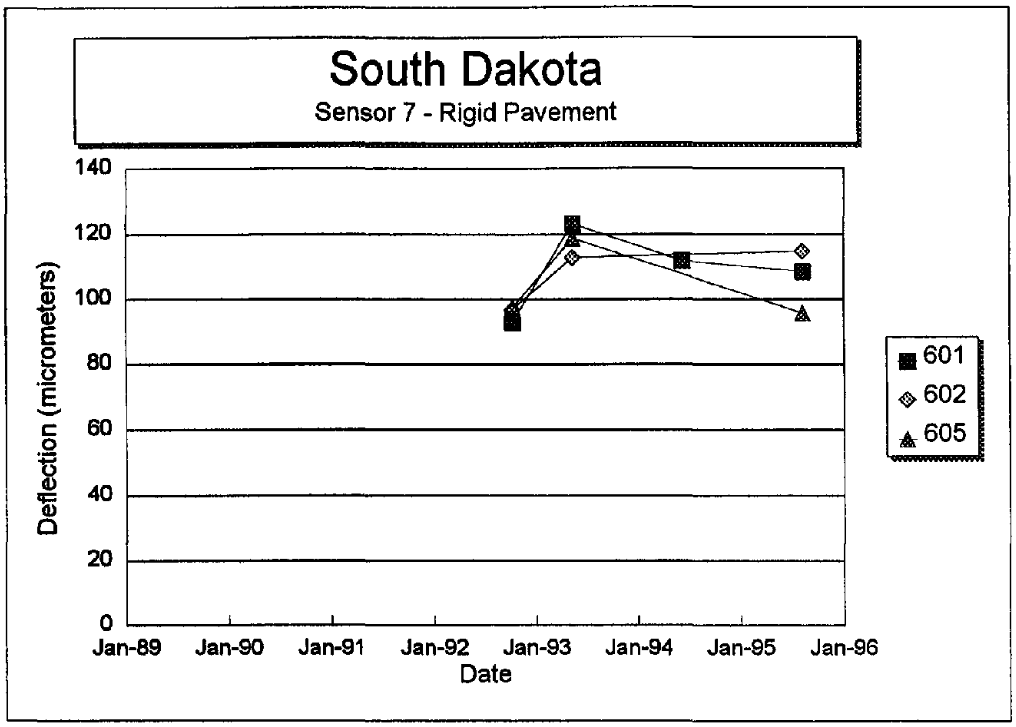
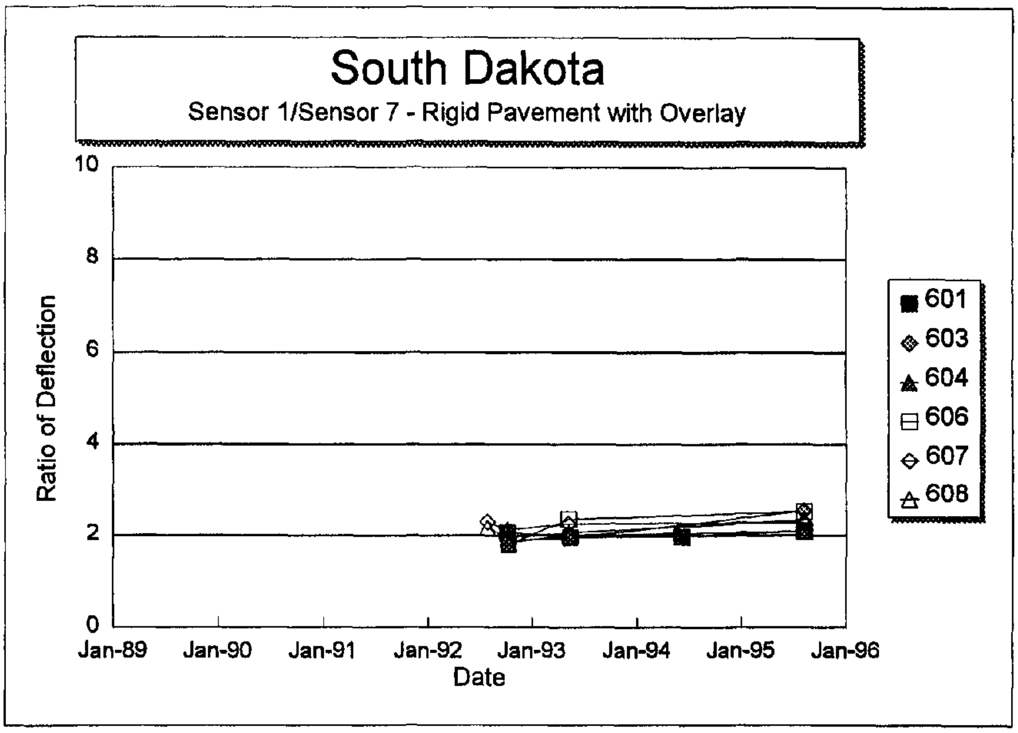


Figure 153. Sensor 7 deflection versus time for each section of the South Dakota SPS-6 project.



Note: Section 601 is a non-overlayed control section.

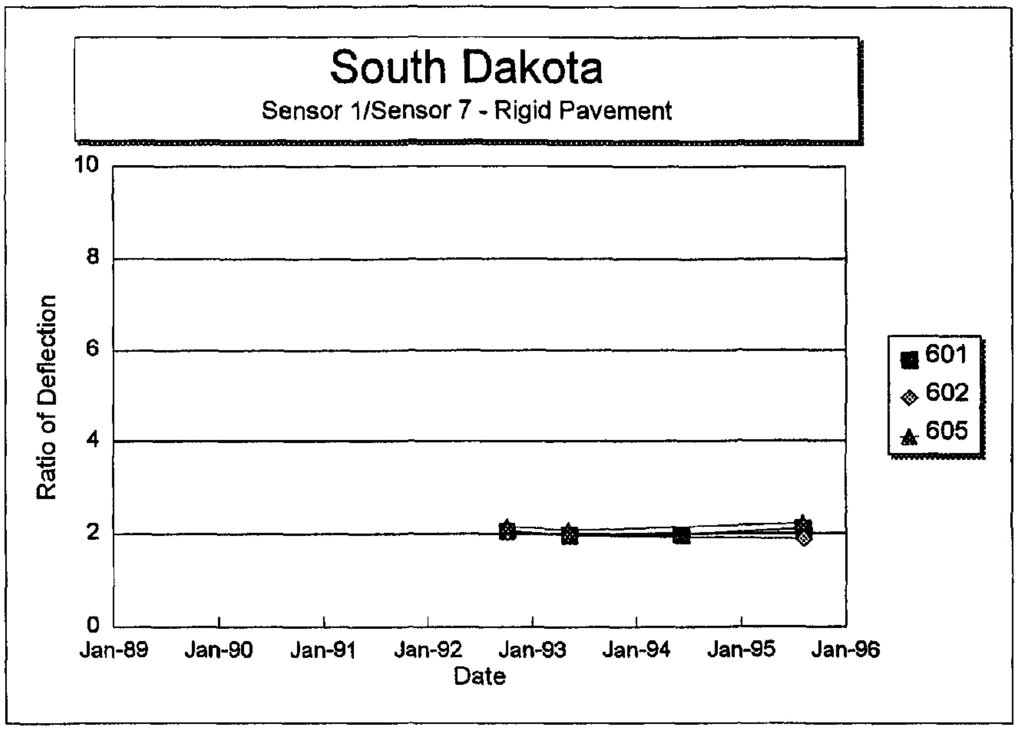


Figure 154. Sensor 1 deflection divided by Sensor 7 deflection versus time for each section of the South Dakota SPS-6 project.

APPENDIX C. TABLES AND PLOTS OF DISTRESSES OCCURRING ON SPS-7 PROJECTS

Table 13. Quantities of Continuously Reinforced Concrete (CRC) pavement distress by test section for individual distress surveys on SPS-7 projects.

ST	SHRP	REHAB	SURVEY	21	2ls	3n	3l	5	8	1fn	11fa	1rn	11ra	12	13	14n	14l	15n	15l
19	701	Sep-92	Aug-93	0	0	237	471	0	0	0	0	0	0	0	0	0	0	0	0
19	702	Sep-92	Aug-92	0	0	37	130	0	0	0	0	0	0	0	0	0	0	0	0
19	702	Sep-92	Aug-93	0	0	71	194	0	0	0	0	0	0	0	0	0	0	0	0
19	703	Sep-92	Aug-92	0	0	6	21	0	0	0	0	0	0	0	0	0	0	0	0
19	703	Sep-92	Aug-93	0.8	0	81	139	0	0	0	0	0	0	0	0	0	0	0	0
19	704	Sep-92	Jul-92	5	0	123	288	0	0	0	0	5	81	0	0	0	0	0	0
19	704	Sep-92	Aug-92	0	0	6	21	0	0	0	0	0	0	0	0	0	0	0	0
19	704	Sep-92	Aug-93	0	0	50	160	0	0	0	0	0	0	0	0	0	0	0	0
19	705	Sep-92	Jul-92	4.5	0	204	403	0	0	0	0	6	13	0	5	0	0	0	0
19	705	Sep-92	Aug-92	0	0	1	3.5	0	0	0	0	0	0	0	0	0	0	0	0
19	705	Sep-92	Aug-93	0	0	36	118	0	0	0	0	0	0	0	0	0	0	0	0
19	706	Sep-92	Jul-92	0	0	129	339	0	1	0	0	1	0.3	0	0	0	0	1	0
19	706	Sep-92	Aug-92	0	0	39	137	0	0	0	0	0	0	0	0	0	0	0	0
19	706	Sep-92	Aug-93	0	0	96	260	0	0	0	0	0	0	0	0	0	0	0	0
19	707	Sep-92	Jul-92	2.8	0	111	256	0	0	0	0	2	74	0	0	0	0	1	153
19	707	Sep-92	Aug-92	0	0	52	182	0	0	0	0	0	0	0	0	0	0	0	0
19	707	Sep-92	Aug-93	0	0	52	174	0	0	0	0	0	0	0	0	0	0	0	0
19	708	Sep-92	Aug-92	3	0	53	186	0	0	0	0	0	0	0	0	0	0	0	0
19	708	Sep-92	Aug-93	0	0	97	292	0	0	0	0	0	0	0	0	0	0	0	0
19	709	Sep-92	Aug-92	0	0	59	207	0	0	0	0	0	0	0	0	0	0	0	0
19	709	Sep-92	Aug-93	0	0	102	318	0	0	0	0	0	0	0	0	0	0	0	0
19	710	Sep-92	Aug-92	0	0	39	137	0	0	0	0	0	0	0	0	0	0	0	0
19	710	Sep-92	Aug-93	0	0	46	144	0	0	0	0	0	0	0	0	0	0	0	0

Table 13. Quantities of Continuously Reinforced Concrete (CRC) pavement distress by test section for individual distress surveys on SPS-7 projects (continued).

ST	SHRP	REHAB	SURVEY	2l	2ls	3n	3l	5	8	11fn	11fa	11rn	11ra	12	13	14n	14l	15n	15l
22	702	Apr-92	Apr-92	0.9	0	126	429	0	0	0	0	1	37	4	0	0	0	0	0
22	702	Apr-92	Dec-92	2.5	0	78	237	0	0	0	0	0	0	0	0	0	0	0	0
22	702	Apr-92	Jul-94	0	0	87	307	0	0	0	0	0	0	0	0	0	0	2	0
22	703	Apr-92	Apr-92	0	0	141	488	0	0	0	0	0	0	0	0	0	0	0	0
22	703	Apr-92	Dec-92	0	0	60	203	0	0	0	0	0	0	0	0	0	0	2	2.6
22	703	Apr-92	Jul-94	0	0	85	306	0	0	0	0	0	0	0	0	13	19	2	0
22	704	Apr-92	Apr-92	0	0	140	491	0	0	0	0	0	0	0	0	0	0	0	0
22	704	Apr-92	Dec-92	0	0	67	216	0	0	0	0	0	0	0	0	0	0	2	3.2
22	704	Apr-92	Jul-94	0	0	104	364	0	0	0	0	0	0	0	0	0	0	2	0
22	705	Apr-92	Apr-92	0	0	133	516	0	0	0	0	0	0	0	0	0	0	0	0
22	705	Apr-92	Apr-92	0	0	146	473	0	0	0	0	0	0	0	0	0	0	0	0
22	705	Apr-92	Dec-92	0	0	59	186	0	0	0	0	0	0	0	0	0	0	2	25
22	705	Apr-92	Jul-94	0	0	86	271	0	0	0	0	0	0	0	0	2	16	2	0
22	706	Apr-92	Apr-92	0	0	88	306	0	1	0	0	0	0	0	0	0	0	0	0
22	706	Apr-92	Dec-92	0	0	84	301	0	0	0	0	0	0	0	0	0	0	0	0
22	706	Apr-92	Jul-94	0	0	89	316	0	0	0	0	0	0	3	0	5	10	2	0
22	707	Apr-92	Apr-92	0	0	94	330	0	0	0	0	0	0	0	0	0	0	0	0
22	707	Apr-92	Dec-92	0	0	78	268	0	0	0	0	0	0	0	0	0	0	2	5.5
22	707	Apr-92	Jul-94	1.1	0	86	299	0	0	0	0	0	0	3	0	4	122	2	0
22	708	Apr-92	Apr-92	0	0	87	316	0	0	0	0	0	0	0	0	0	0	0	0
22	708	Apr-92	Dec-92	0	0	91	321	0	0	0	0	0	0	0	0	0	0	2	18
22	708	Apr-92	Jul-94	2.3	0	95	340	0	0	0	0	0	0	0	0	22	79	2	0
22	709	Apr-92	Apr-92	0	0	95	345	0	0	0	0	0	0	0	0	0	0	0	0
22	709	Apr-92	Apr-92	0	0	71	316	0	0	0	0	0	0	0	0	0	0	0	0
22	709	Apr-92	Dec-92	0	0	126	448	0	0	0	0	1	21	0	0	0	0	2	13
22	709	Apr-92	Jul-94	0	0	128	459	0	0	1	22	0	0	0	0	4	17	2	0
27	701	Oct-90	Aug-93	0	0	430	207	183	0	2	0.2	0	0	0	4.5	0	0	0	0
27	702	Oct-90	Aug-93	0	0	110	388	0	0	0	0	0	0	0	0	0	0	1	0
27	703	Oct-90	Aug-93	0	0	106	381	0	0	0	0	0	0	0	0	0	0	1	2
27	704	Oct-90	Aug-93	0	0	112	394	0	0	0	0	0	0	0	0	0	0	1	3
27	705	Oct-90	Aug-93	0	0	107	380	0	0	0	0	0	0	0	0	0	0	1	0
27	706	Oct-90	Aug-93	0	0	76	264	0	0	0	0	0	0	0	0	0	0	1	0
27	707	Oct-90	Aug-93	0	0	71	244	0	0	0	0	0	0	0	0	0	0	1	13
27	708	Oct-90	Aug-93	0	0	77	279	0	0	0	0	0	0	0	0	0	0	1	0
27	709	Oct-90	Aug-93	0	0	87	307	0	0	0	0	0	0	0	0	0	0	1	0

Table 13. Quantities of Continuously Reinforced Concrete (CRC) pavement distress by test section for individual distress surveys on SPS-7 projects (continued).

CRC DISTRESS CODES:

2l	Longitudinal Cracking (m)
2ls	Longitudinal Cracking, sealed (m)
3n	Transverse Cracks, number
3l	Transverse Cracks, length (m)
5	Polished Aggregate (m^2)
8	Transverse Construction Joint Deterioration, number
11fn	Flexible Patching, number
11fa	Flexible Patching, area (m^2)
11rn	Rigid Patching, number
11ra	Rigid Patching, area (m^2)
12	Punchouts, number
13	Spalling of Longitudinal Joints (m)
14n	Water Bleeding and Pumping, number
14l	Water Bleeding and Pumping, length (m)
15n	Longitudinal Joints sealed, number
15l	Longitudinal Joints sealed, length damaged (m)

TEST SECTION NUMBERS:

701 Control

	Surface	Grouted	Overlay (in)
702	Milling	Yes	3
703	Milling	No	3
704	Shot–Blasting	No	3
705	Shot–Blasting	Yes	3
706	Shot–Blasting	Yes	5
707	Shot–Blasting	No	5
708	Milling	No	5
709	Milling	Yes	5

1 in = 25.4 mm

STATE CODES:

19	Iowa
22	Louisiana
27	Minnesota

Table 14. Quantities of Jointed Concrete Pavement (JCP) distress by test section for individual distress surveys on SPS-7 projects.

ST	SHRP	REHAB	SURVEY	1	3	3s	4n	4l	4ls	j	5tn	5ln	5ll	6	7n	7l	9	5fn	15fa	5rn	15ra
29	701	Jun-90	Jul-91	0	7	0	0	0	0	Y	25	1	0	0	3	0.4	305	0	0	0	0
29	701	Jun-90	Jun-92	0	5.8	0	0	0	0	Y	25	2	305	0.5	0	0	229	0	0	0	0
29	701	Jun-90	Sep-94	0	9.2	0	2	1.8	0	Y	25	1	151	2.1	4	1.8	0	0	0	0	0
29	702	Jun-90	Jul-91	0	0	0	55	198	0	Y	25	1	0	0	0	0	0	0	0	0	0
29	702	Jun-90	Jun-92	0	0	0	3	11	0	Y	25	1	0	12	0	0	0	0	0	0	0
29	702	Jun-90	Sep-94	0	0	0	61	140	0	Y	25	1	0	4	0	0	0	0	0	0	0
29	703	Jun-90	Jul-91	0	0	0	12	44	0	Y	25	1	0	0	0	0	0	0	0	0	0
29	703	Jun-90	Jun-92	0	0	0	11	40	0	Y	24	1	0	58	0	0	0	0	0	0	0
29	703	Jun-90	Sep-94	0	0	0	29	59	0	Y	24	1	0	36	0	0	0	0	0	0	0
29	704	Jun-90	Jul-91	0	61	0	112	336	0	Y	25	1	0	17	0	0	0	0	0	0	0
29	704	Jun-90	Jun-92	0	27	0	15	0	0	Y	25	1	0	0	0	0	0	0	0	0	0
29	704	Jun-90	Sep-94	8	39	0	129	306	0	Y	25	1	0	28	0	0	0	0	0	0	0
29	705	Jun-90	Jul-91	0	21	0	282	0	0	Y	25	1	0	0	0	0	0	0	0	0	0
29	705	Jun-90	Jun-92	0	7	0	6	9	0	Y	25	1	0	44	0	0	0	0	0	0	0
29	705	Jun-90	Sep-94	2	83	0	69	103	0	Y	25	1	0	6.5	0	0	0	0	0	0	0
29	706	Jul-90	Jul-91	0	213	0	86	277	0	Y	25	1	0	0	0	0	0	0	0	0	0
29	706	Jul-90	Jun-92	0	243	0	98	296	0	Y	25	1	0	45	0	0	0	0	0	0	0
29	706	Jul-90	Sep-94																		
29	707	Jul-90	Jul-91	5	172	0	80	274	0	Y	25	1	0	0	0	0	0	0	0	0	0
29	707	Jul-90	Jun-92	0	170	0	95	281	0	Y	25	1	0	59	0	0	0	0	0	0	0
29	707	Jul-90	Sep-94	8	197	0	105	274	0	Y	25	1	0	11	0	0	0	0	0	0	0
29	708	Jul-90	Jul-91	0	17	0	74	256	0	Y	25	1	0	0	15	0	0	0	0	0	0
29	708	Jul-90	Jun-92	0	26	0	76	264	0	Y	25	1	0	91	18	1.5	0	0	0	0	0
29	708	Jul-90	Sep-94	1	41	0	81	271	0	Y	25	1	0	43	0	0	0	0	0	0	0
29	709	Jul-90	Jul-91	0	2	0	125	454	0	Y	25	1	0	0	0	0	0	0	0	0	0
29	709	Jul-90	Jun-92	0	0	0	117	427	0	Y	25	1	0	50	0	0	0	0	0	0	0
29	709	Jul-90	Sep-94	0	0	0	148	491	0	Y	25	1	0	18	0	0	0	0	0	0	0

Table 14. Quantities of Jointed Concrete Pavement (JCP) distress by test section for individual distress surveys on SPS-7 projects (continued).

JCP DISTRESS CODES:

1	Corner Breaks, number
3	Longitudinal Cracking (m)
3s	Longitudinal Cracking, sealed (m)
4n	Transverse Cracks, number
4l	Transverse Cracks, length (m)
4ls	Transverse Cracks, length sealed (m)
j	Transverse Joints Sealed, yes or no
5tn	Transverse Joints sealed, number
5ln	Longitudinal Joints sealed, number
5ll	Longitudinal Joints sealed, length damaged (m)
6	Spalling of Longitudinal Joints (m)
7n	Spalling of Transverse Joints, number
7l	Spalling of Transverse Joints, length (m)
9	Polished Aggregate (m^2)
15fn	Flexible Patching, number
15fa	Flexible Patching, area (m^2)
15rn	Rigid Patching, number
15ra	Rigid Patching, area (m^2)

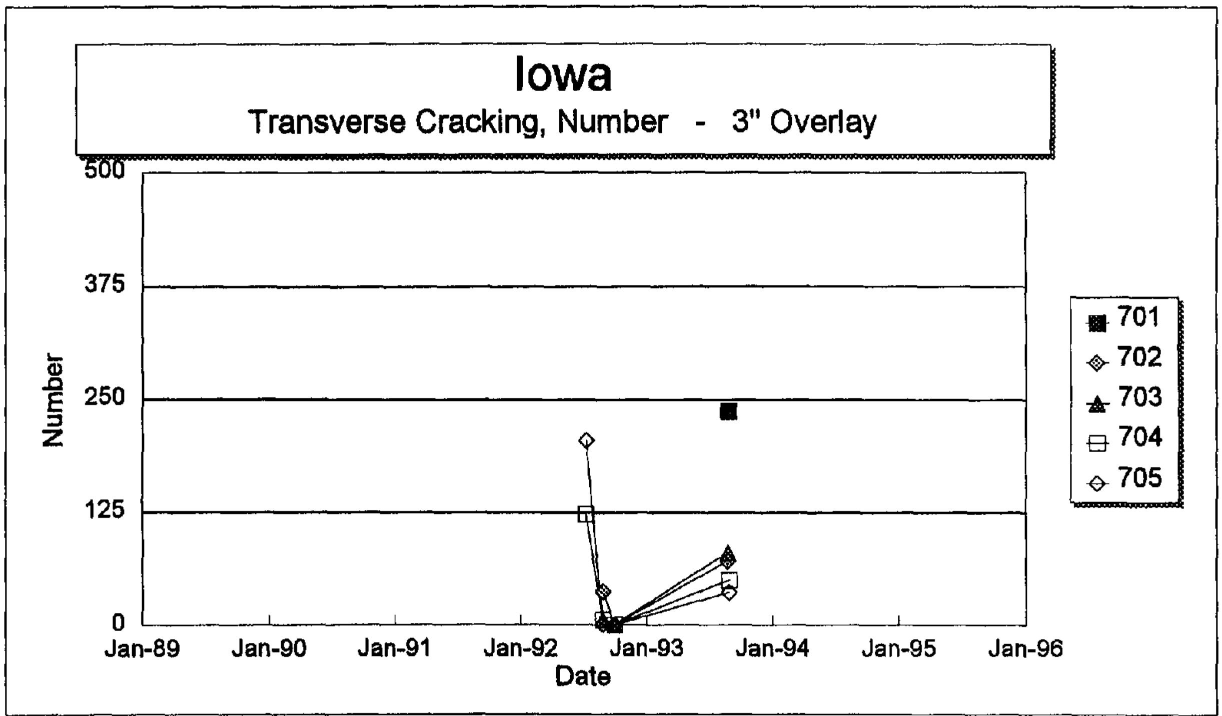
TEST SECTION NUMBERS:

701 Control

	Surface	Grouted	Overlay (in)
702	Milling	Yes	3
703	Milling	No	3
704	Shot–Blasting	No	3
705	Shot–Blasting	Yes	3
706	Shot–Blasting	Yes	5
707	Shot–Blasting	No	5
708	Milling	No	5
709	Milling	Yes	5

1 in = 25.4 mm

STATE CODES: 29 Missouri



1 in = 25.4 mm

Note: Section 701 is a non-overlayed control section.

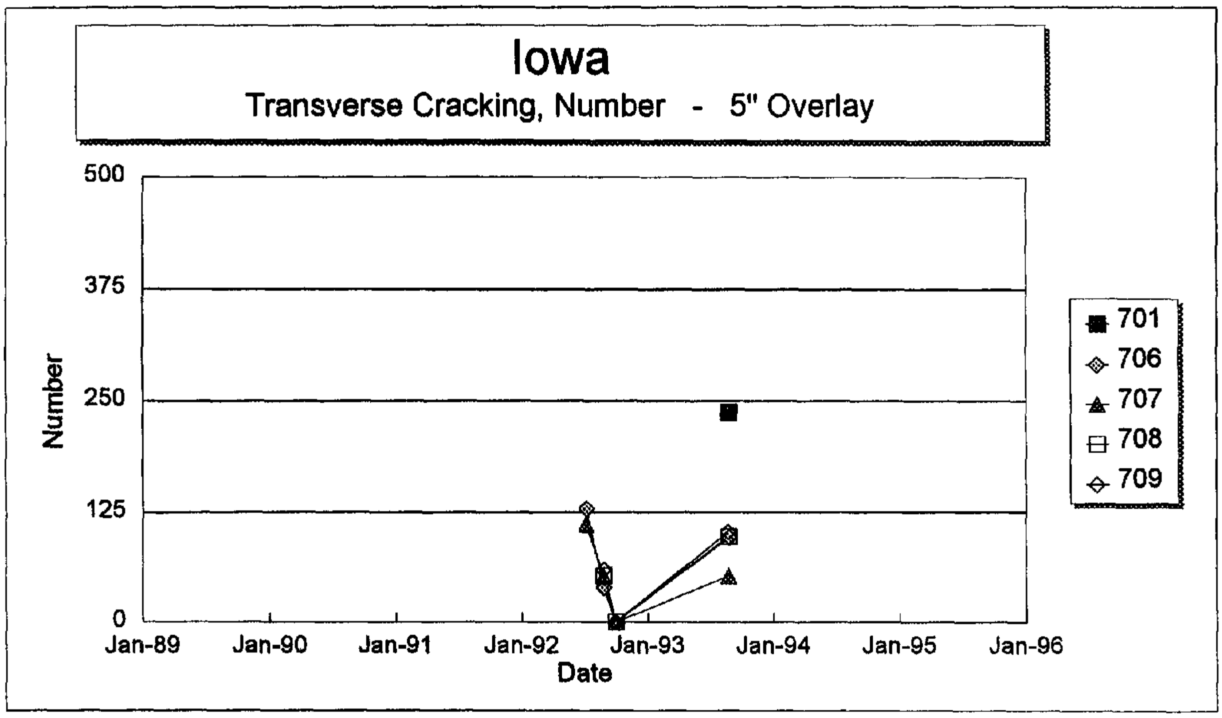
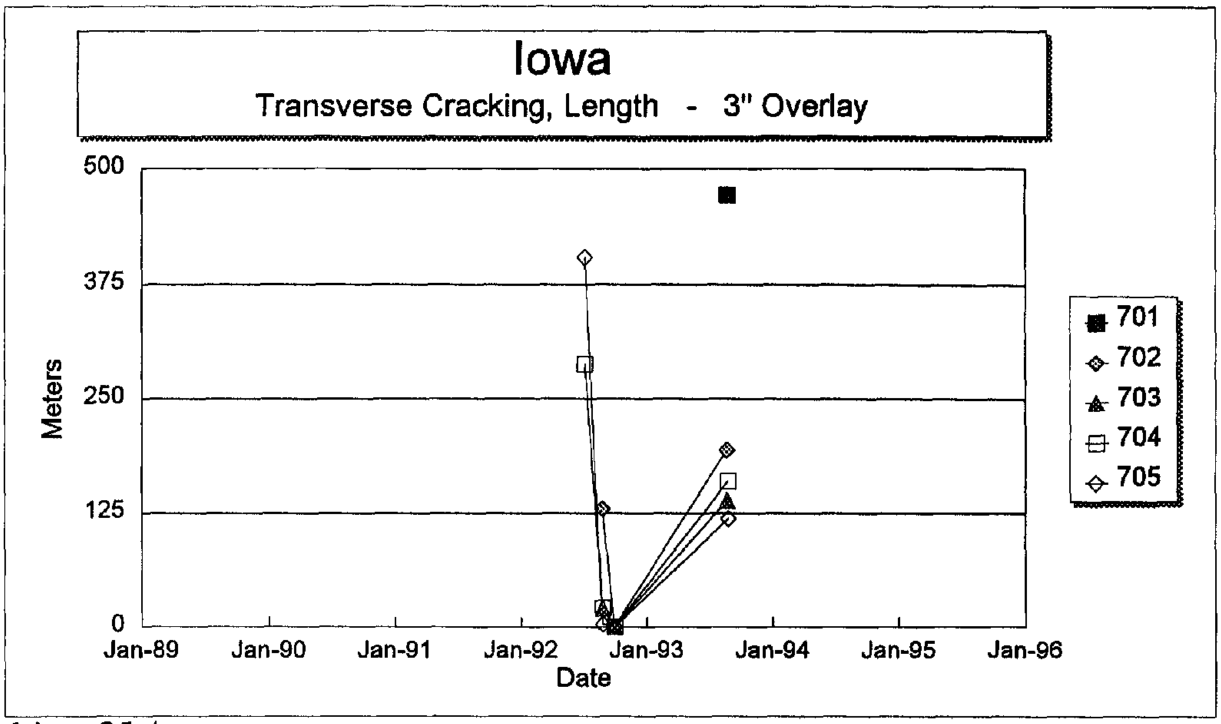


Figure 155. Total number of transverse cracks versus time on each section of the Iowa SPS-7 project.



1 in = 25.4 mm

Note: Section 701 is a non-overlayed control section.

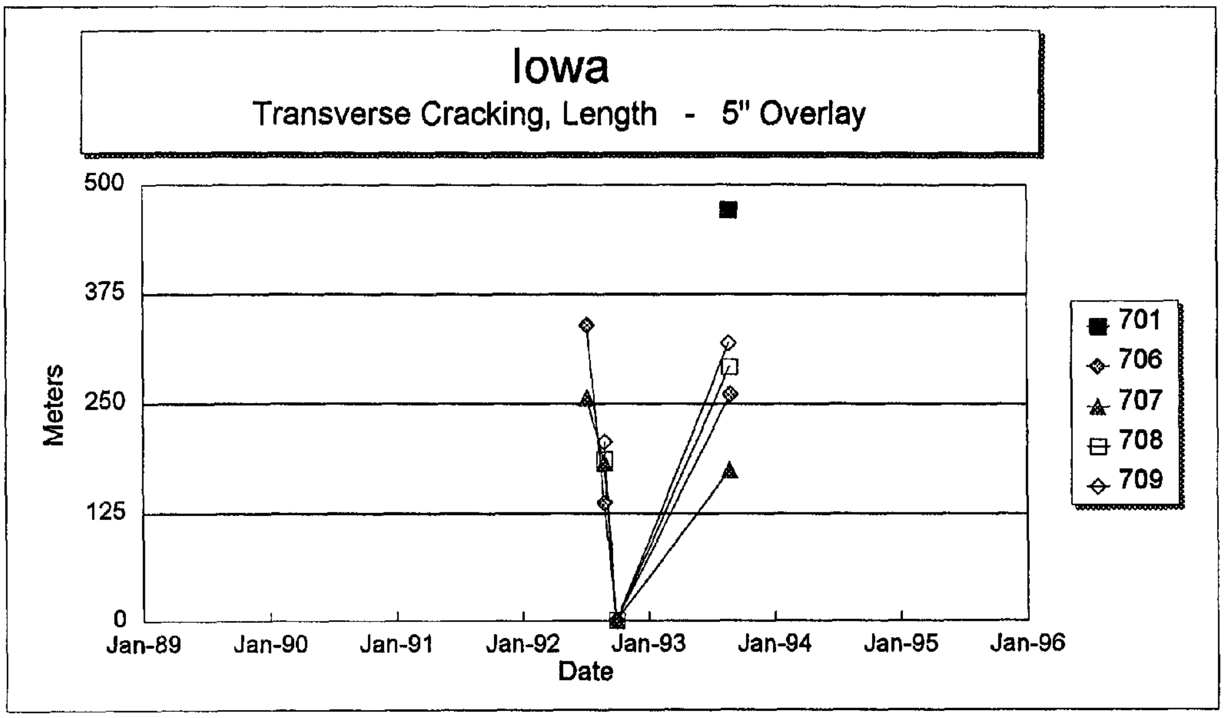
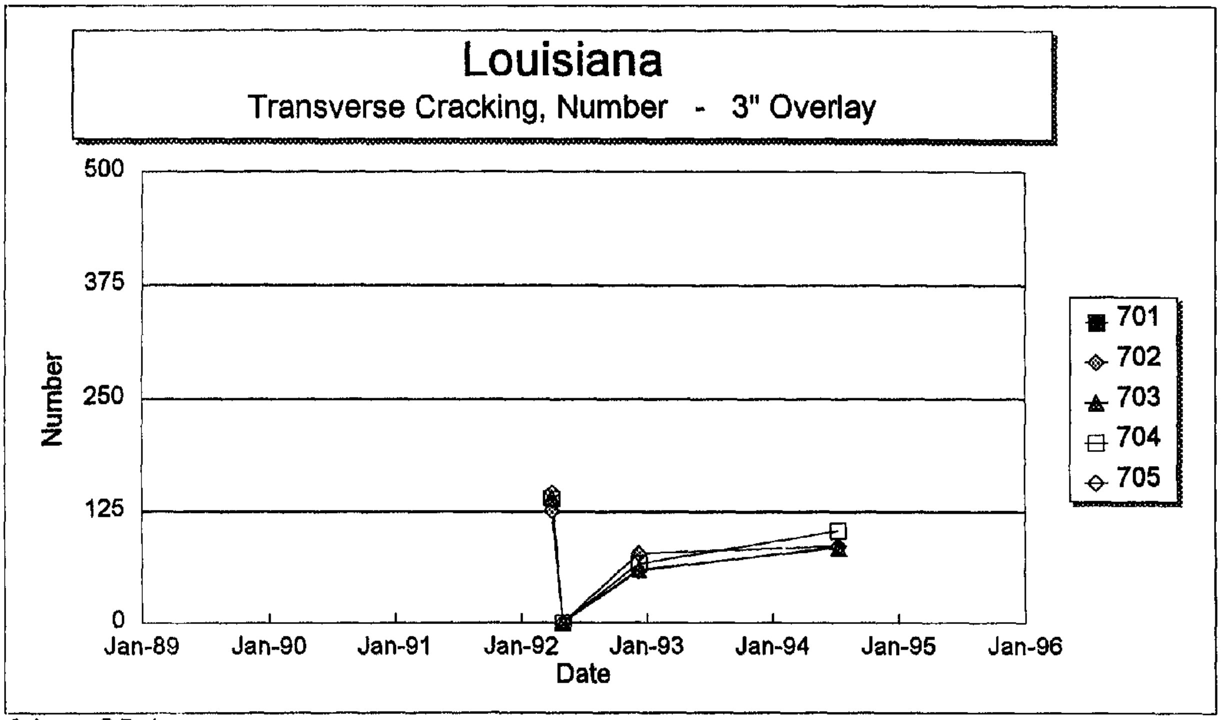


Figure 156. Total length of transverse cracks versus time on each section of the Iowa SPS-7 project.



1 in = 25.4 mm

Note: Section 701 is a non-overlayed control section.

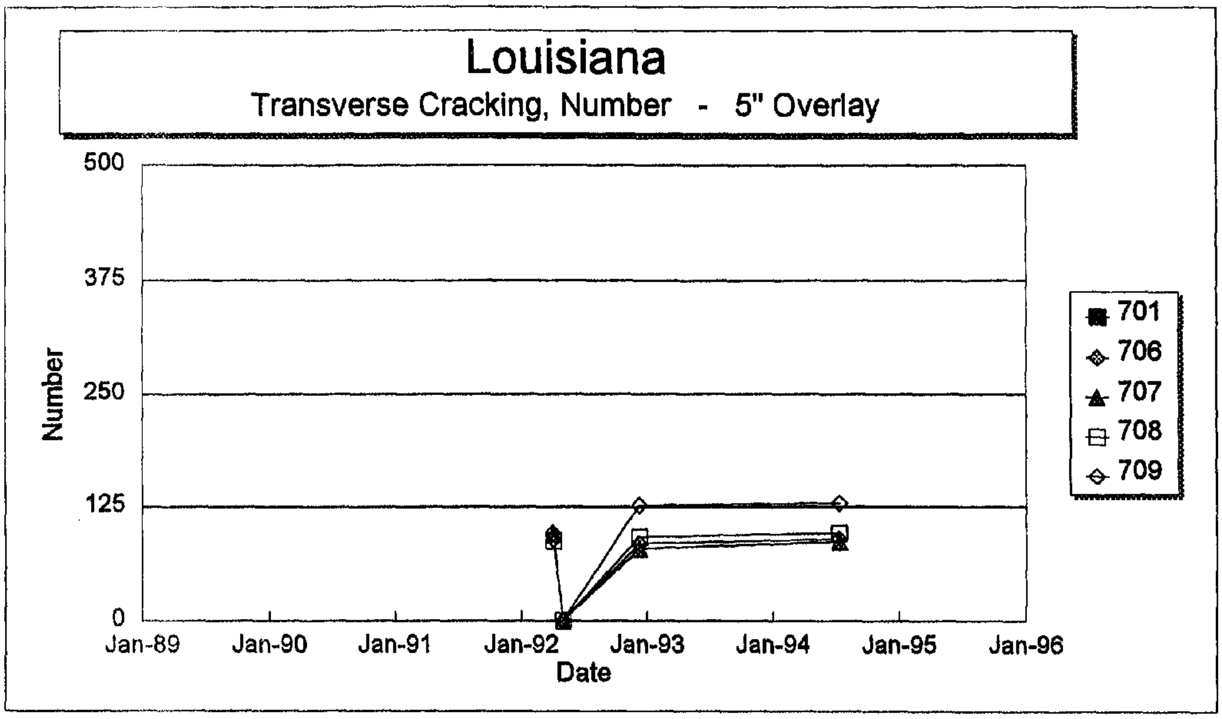
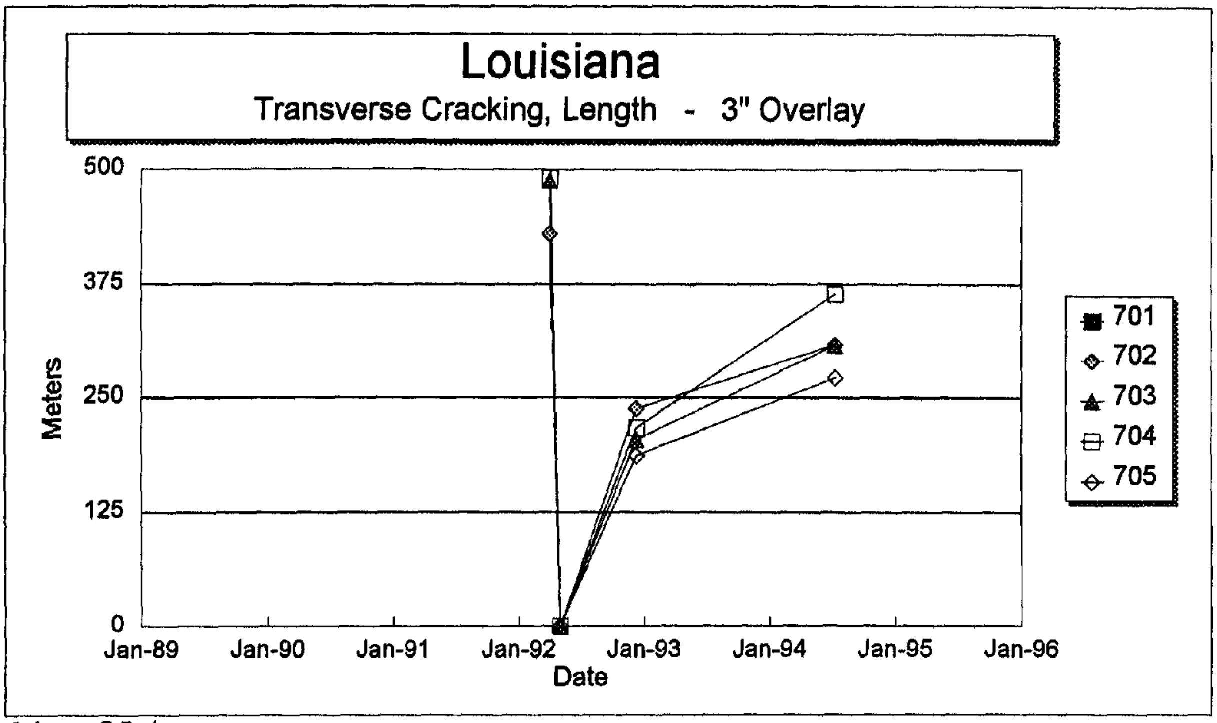


Figure 157. Total number of transverse cracks versus time on each section of the Louisiana SPS-7 project.



1 in = 25.4 mm

Note: Section 701 is a non-overlayed control section.

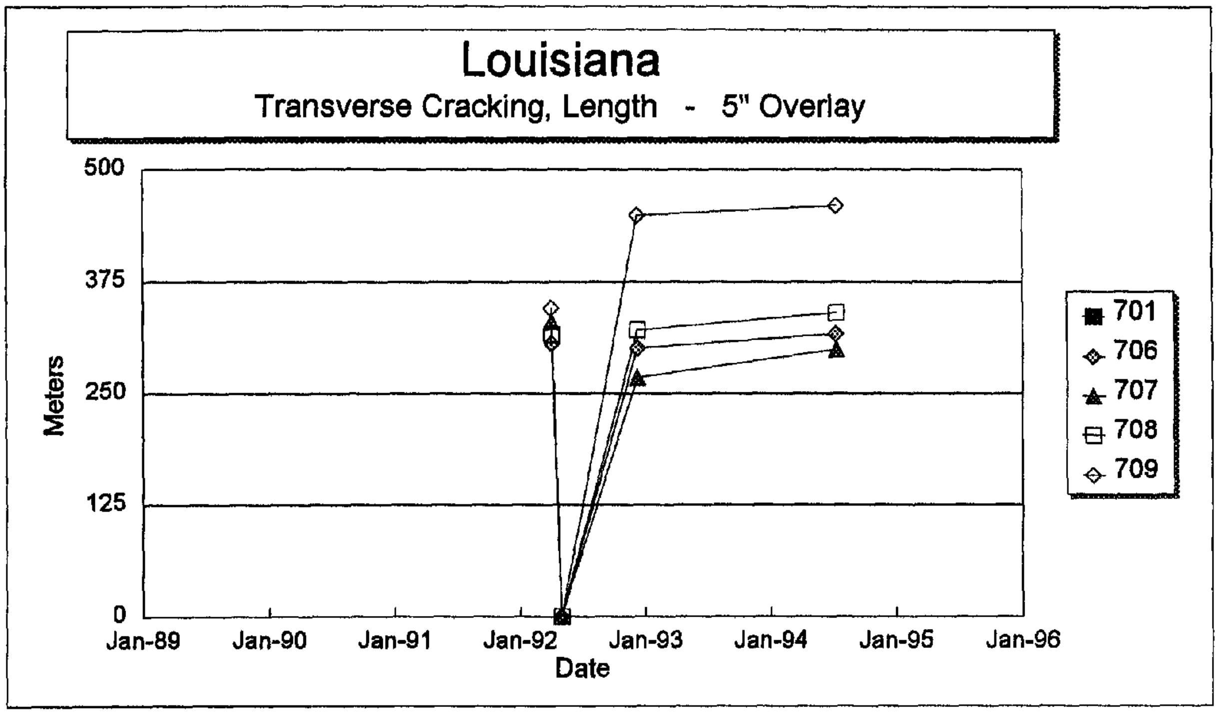
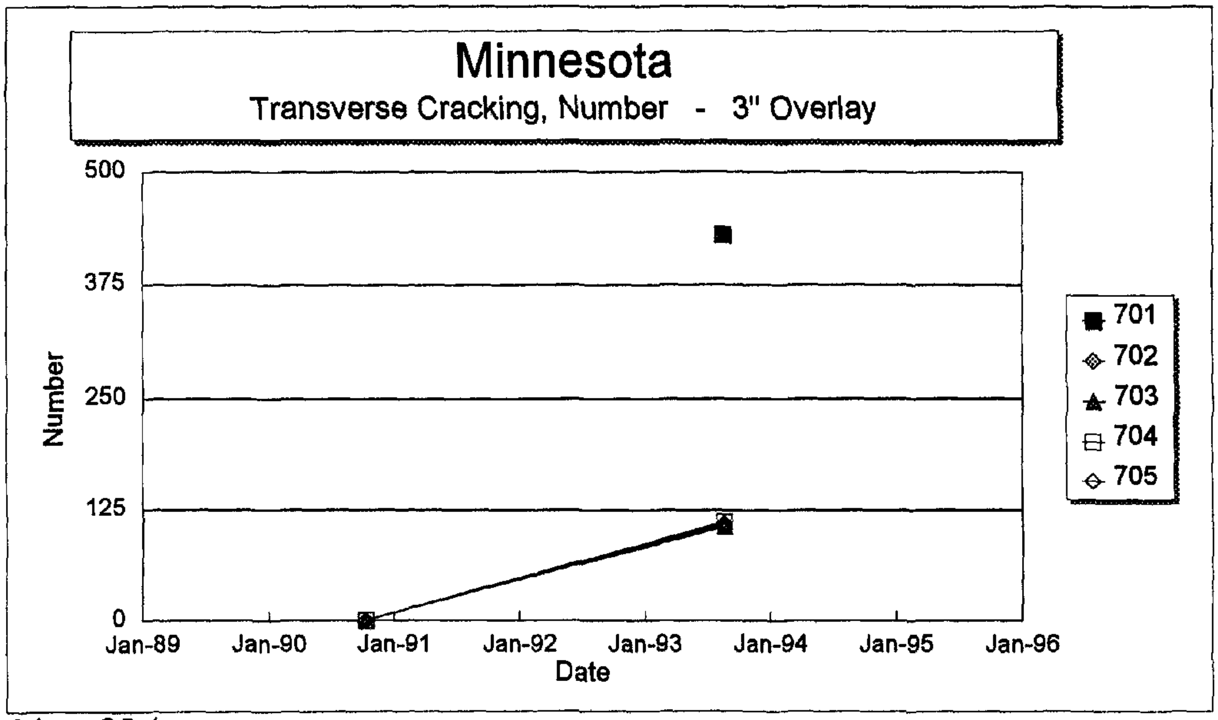


Figure 158. Total length of transverse cracks versus time on each section of the Louisiana SPS-7 project.



1 in = 25.4 mm

Note: Section 701 is a non-overlayed control section.

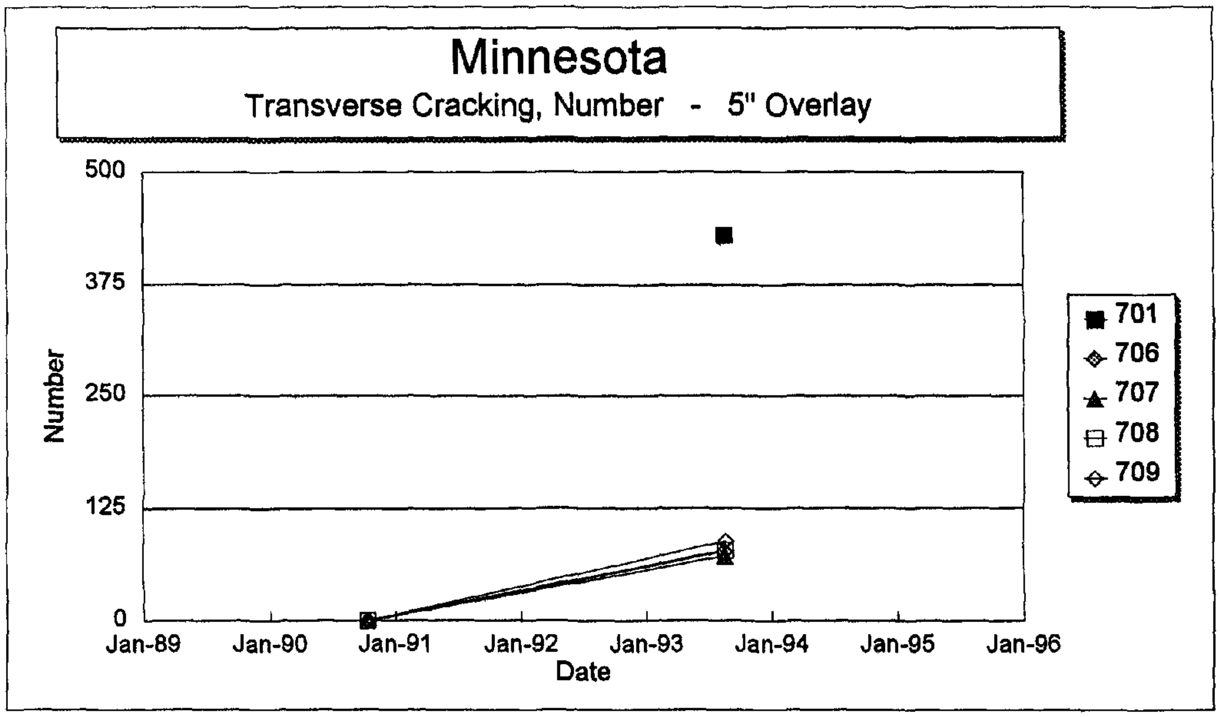
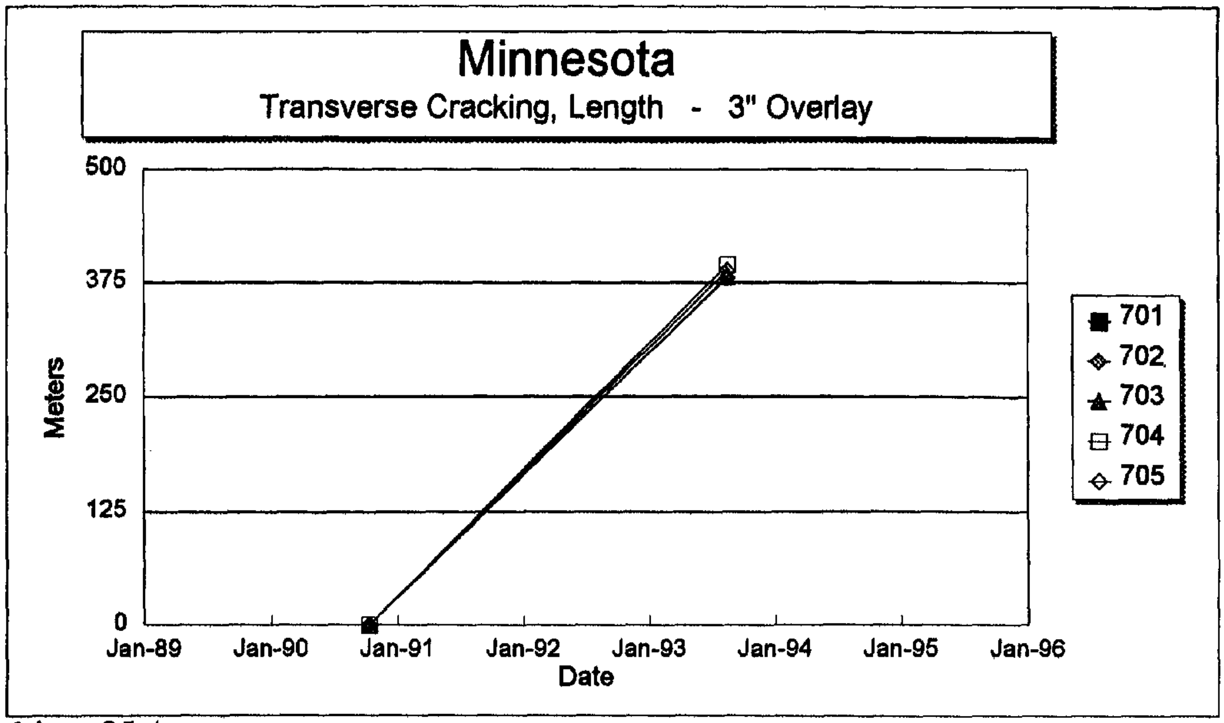


Figure 159. Total number of transverse cracks versus time on each section of the Minnesota SPS-7 project.



1 in = 25.4 mm

Note: Section 701 is a non-overlayed control section.

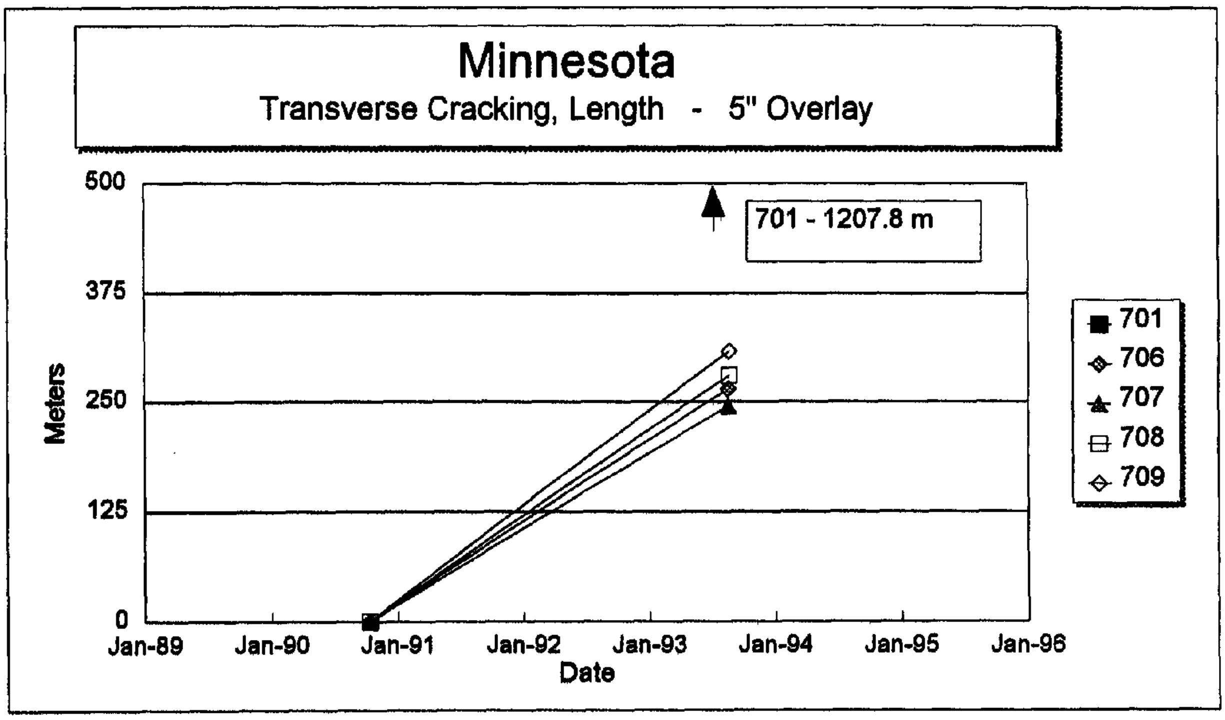
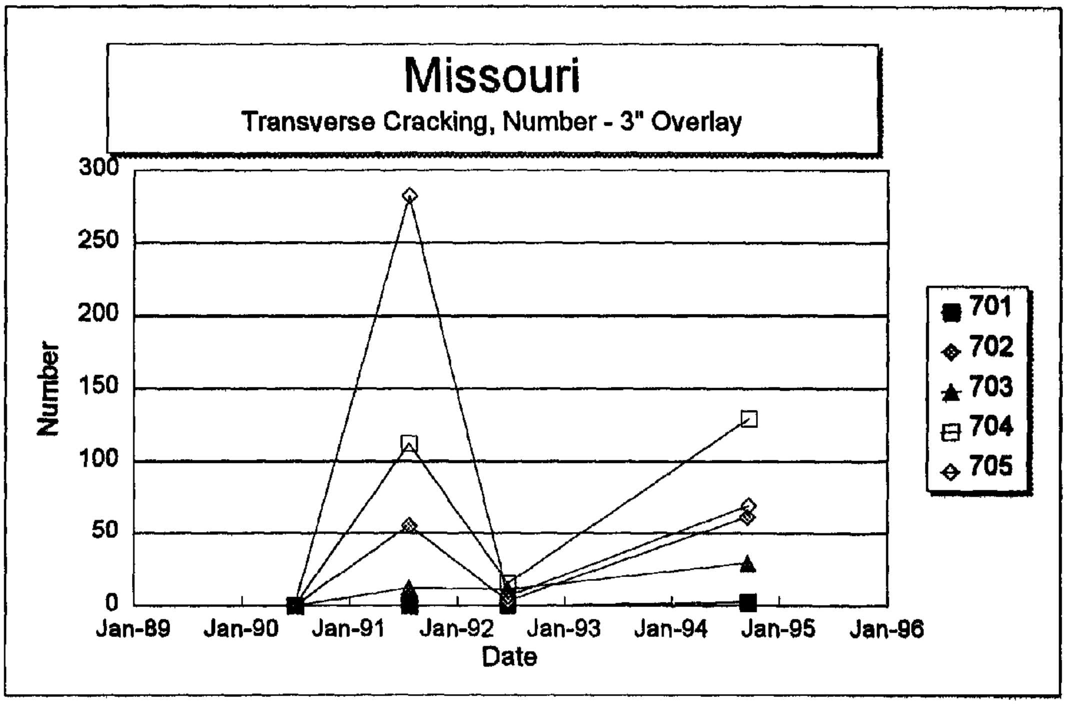


Figure 160. Total length of transverse cracks versus time on each section of the Minnesota SPS-7 project.



1 in = 25.4 mm

Note: Section 701 is a non-overlayed control section.

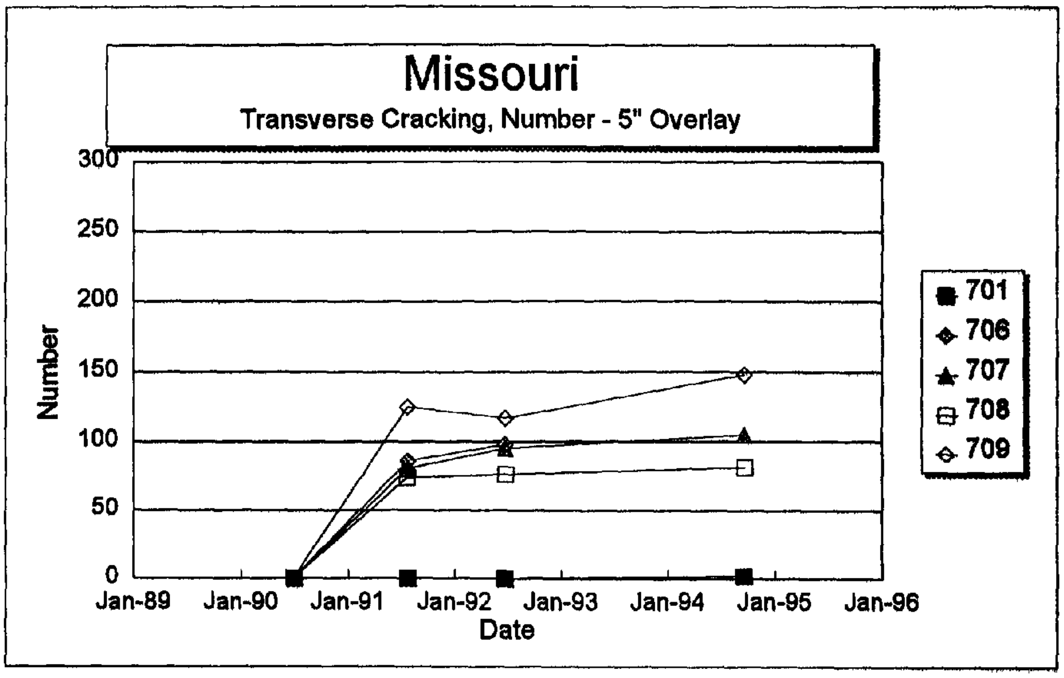
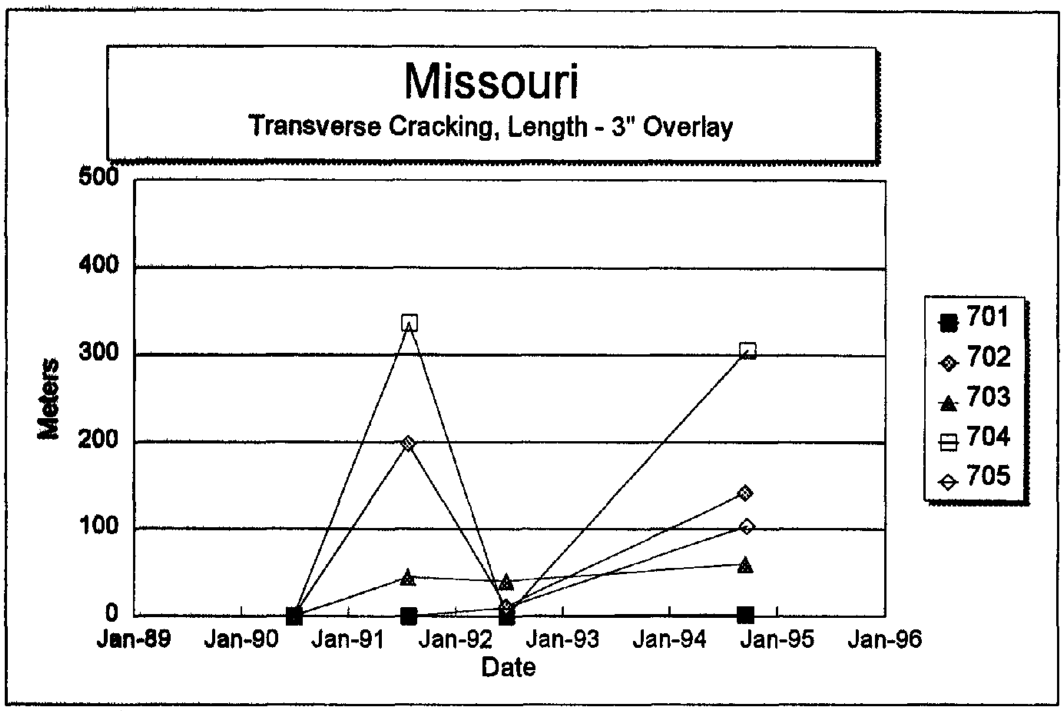


Figure 161. Total number of transverse cracks versus time on each section of the Missouri SPS-7 project.



1 in = 25.4 mm

Note: Section 701 is a non-overlayed control section.

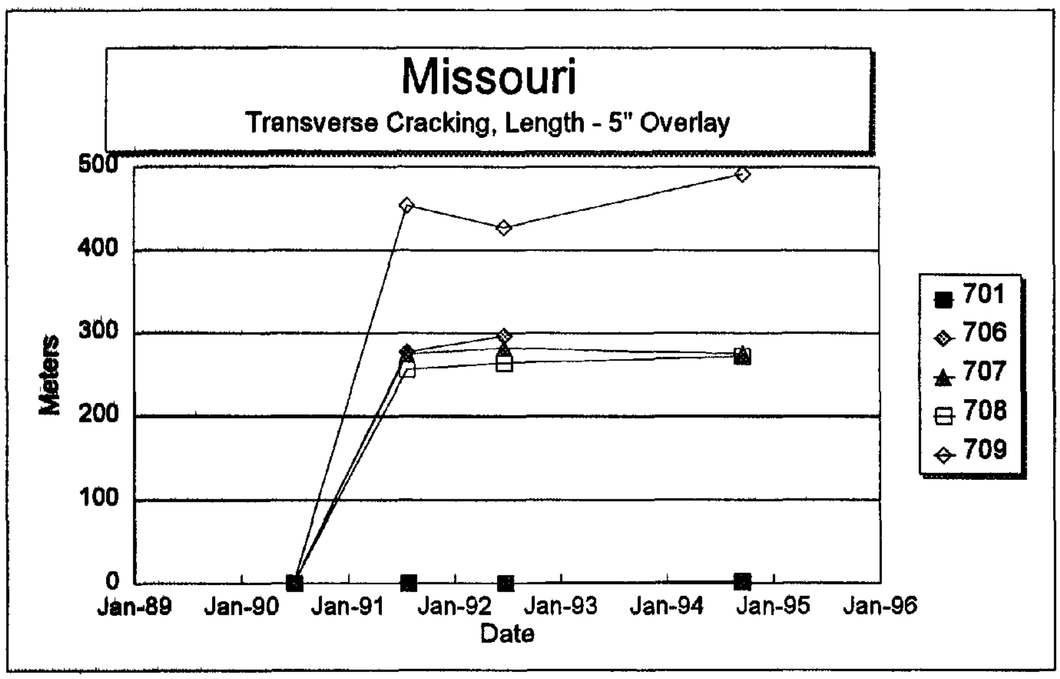
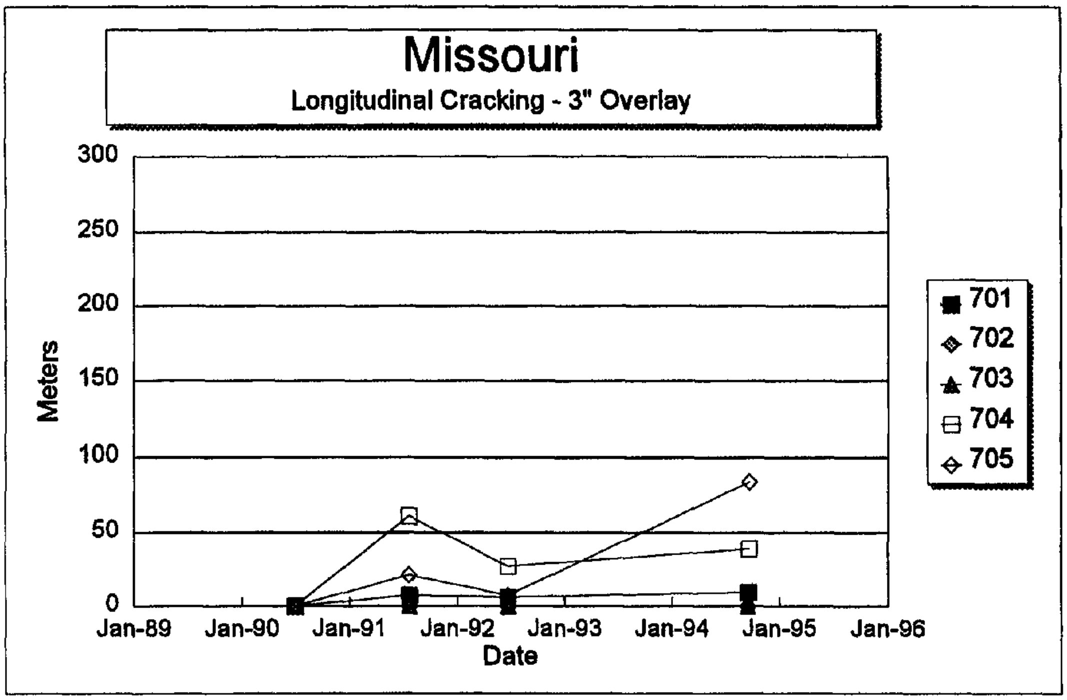


Figure 162. Total length of transverse cracks versus time on each section of the Missouri SPS-7 project.



1 in = 25.4 mm

Note: Section 701 is a non-overlayed control section.

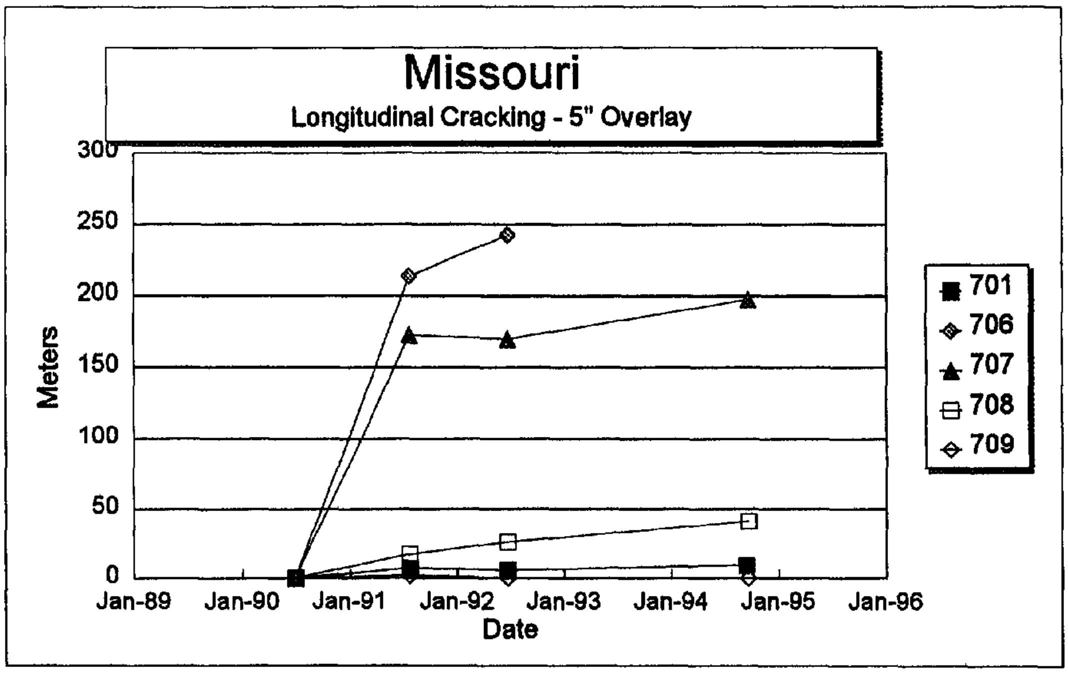
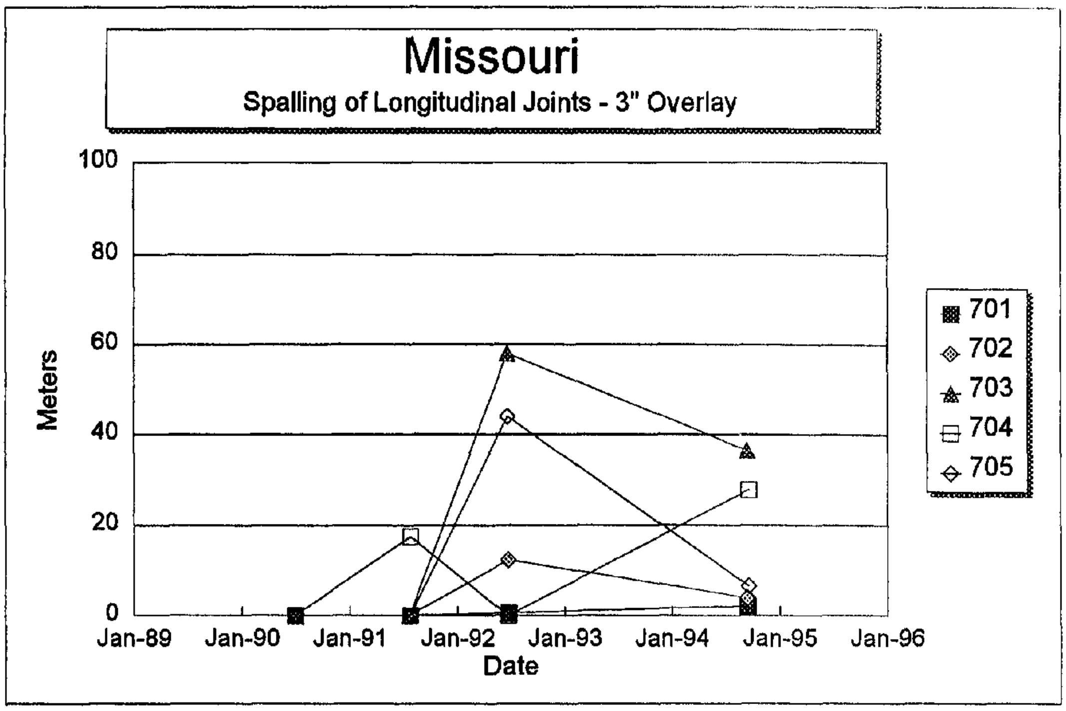


Figure 163. Total length of longitudinal cracks versus time on each section of the Missouri SPS-7 project.



1 in = 25.4 mm

Note: Section 701 is a non-overlayed control section.

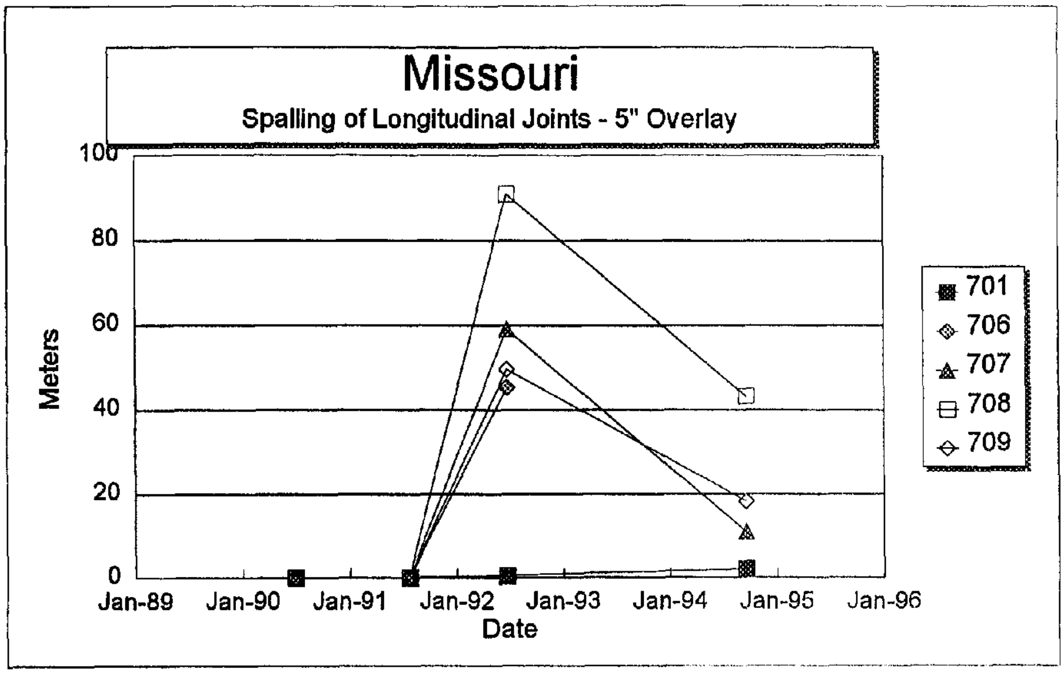
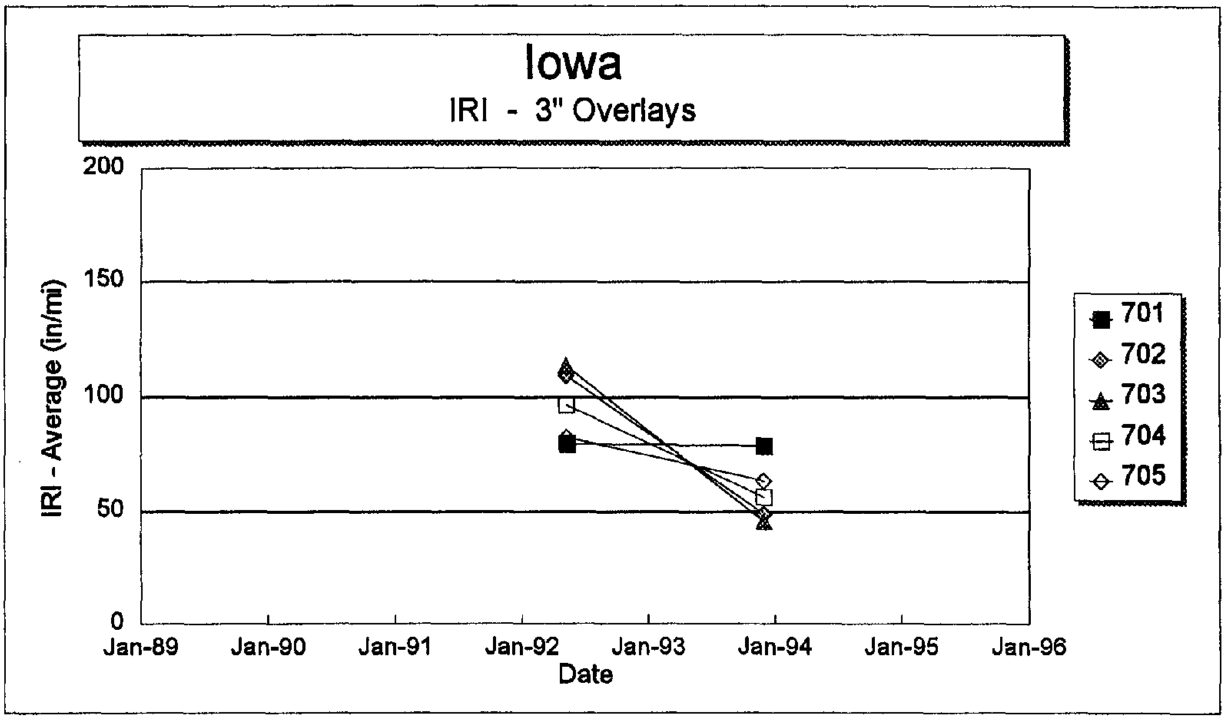


Figure 164. Total length of spalling on longitudinal joints versus time on each section of the Missouri SPS-7 project.



1 in = 25.4 mm
1 in/mi = 16 mm/km
Note: Section 701 is a non-overlayed control section.

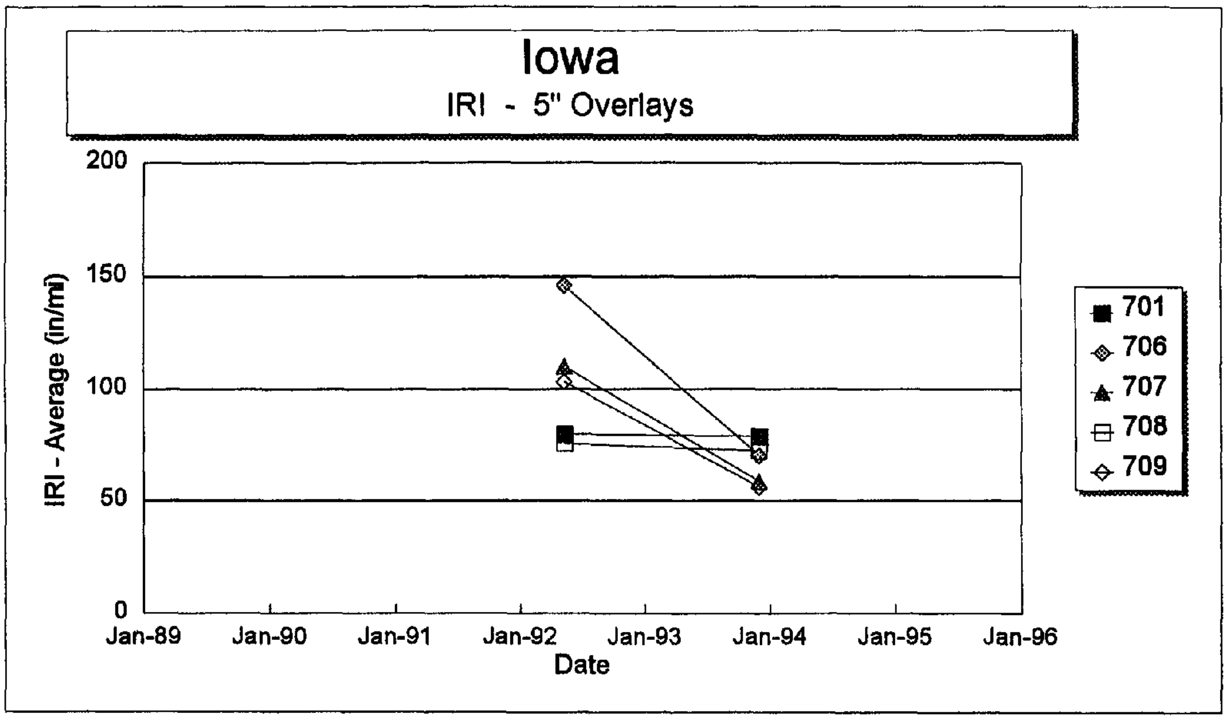
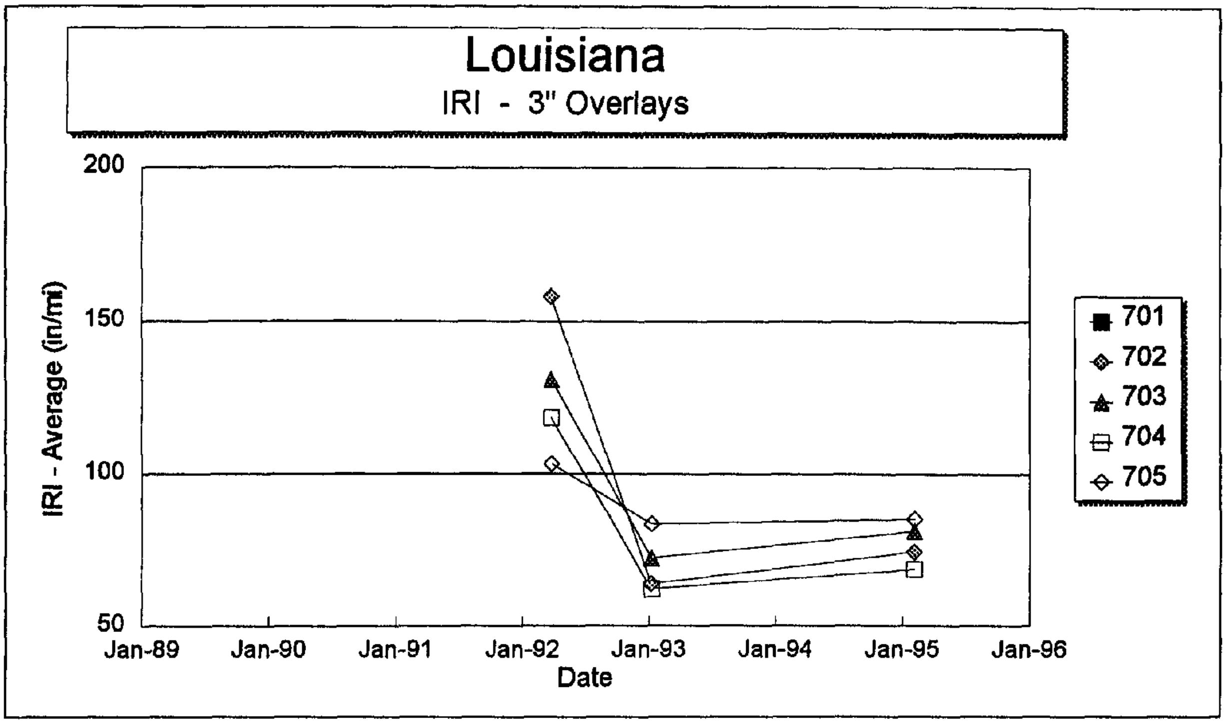


Figure 165. International Roughness Index versus time on each section of the Iowa SPS-7 project.



1 in = 25.4 mm
1 in/mi = 16 mm/km
Note: Section 701 is a non-overlayed control section.

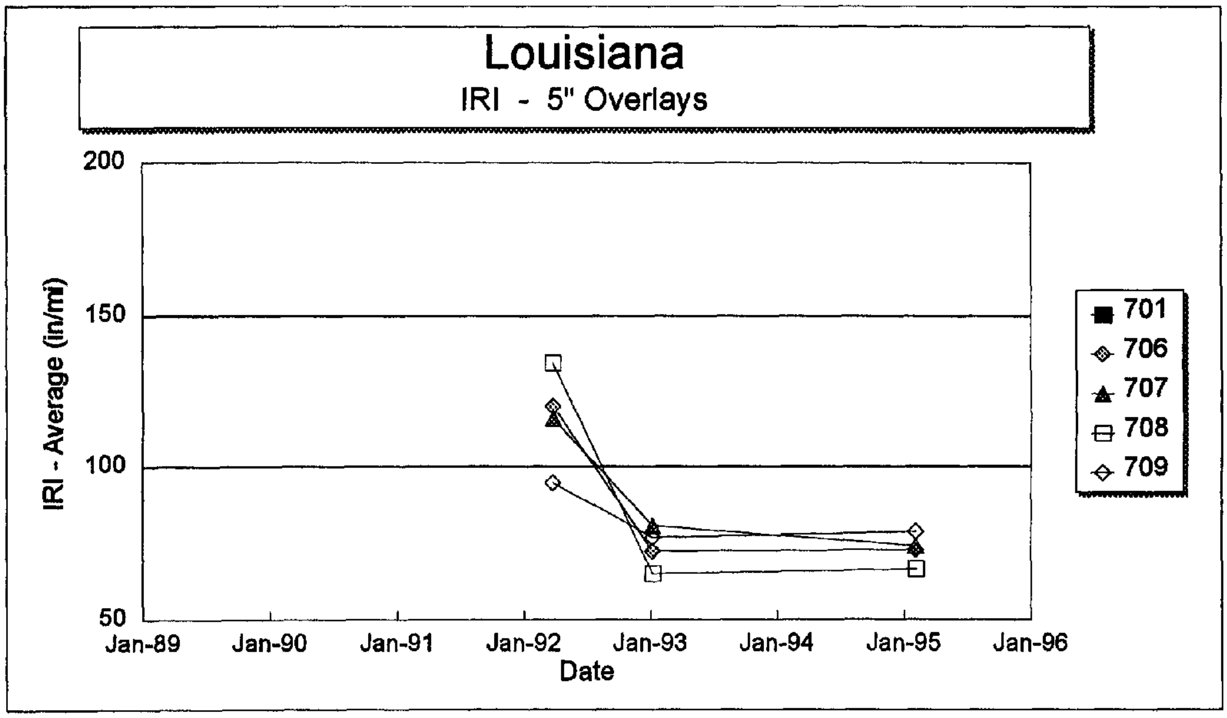
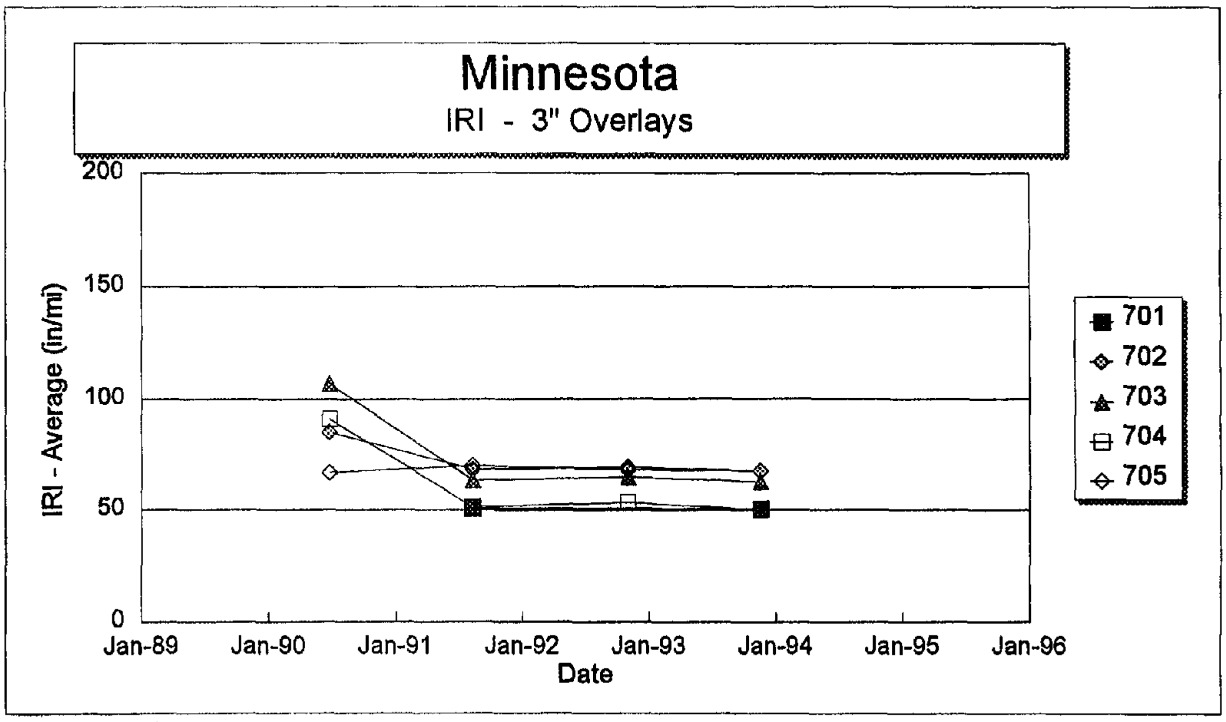


Figure 166. International Roughness Index versus time on each section of the Louisiana SPS-7 project.



1 in = 25.4 mm
1 in/mi = 16 mm/km
Note: Section 701 is a non-overlayed control section.

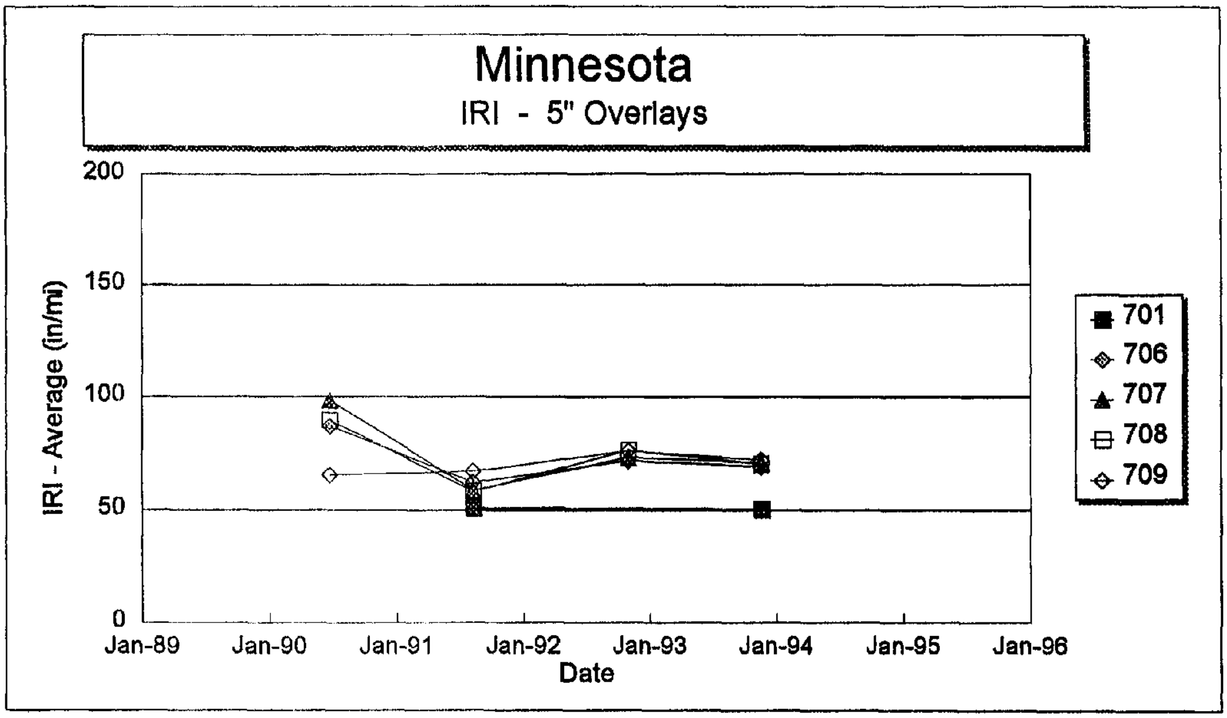
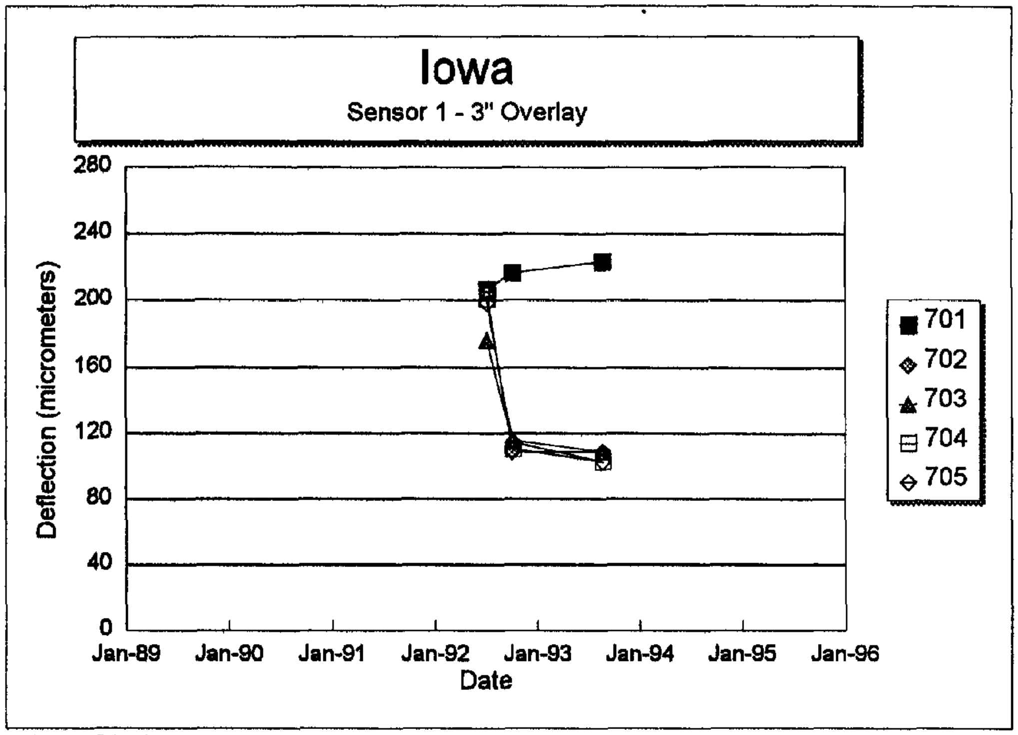


Figure 167. International Roughness Index versus time on each section of the Minnesota SPS-7 project.



1 in = 25.4 mm

Note: Section 701 is a non-overlayed control section.

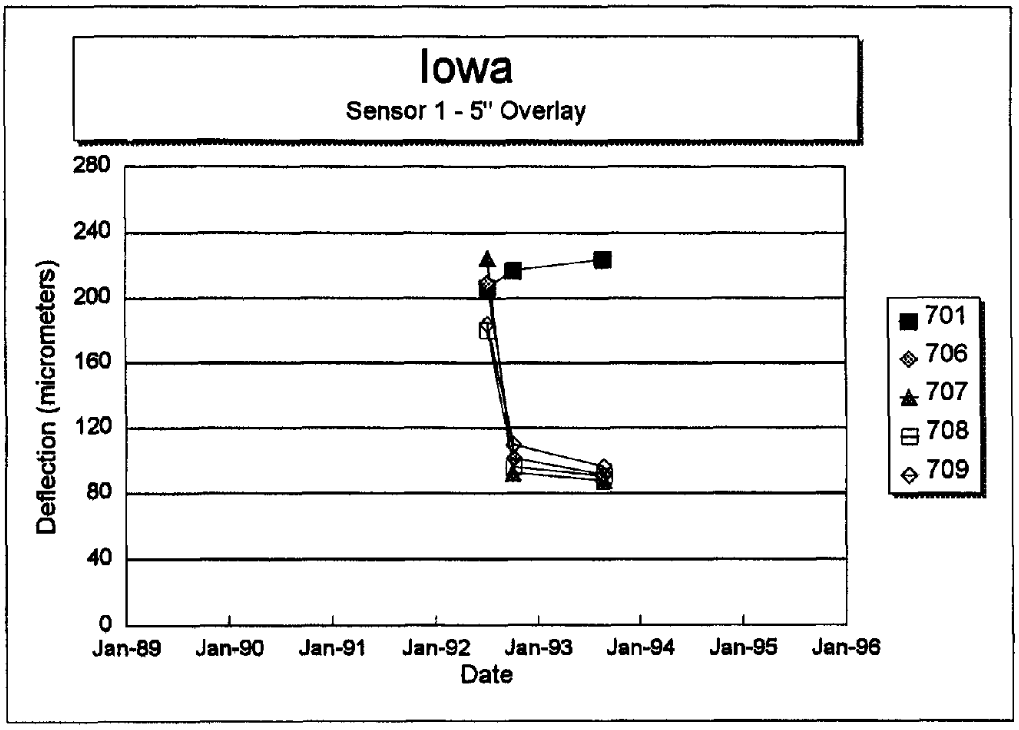
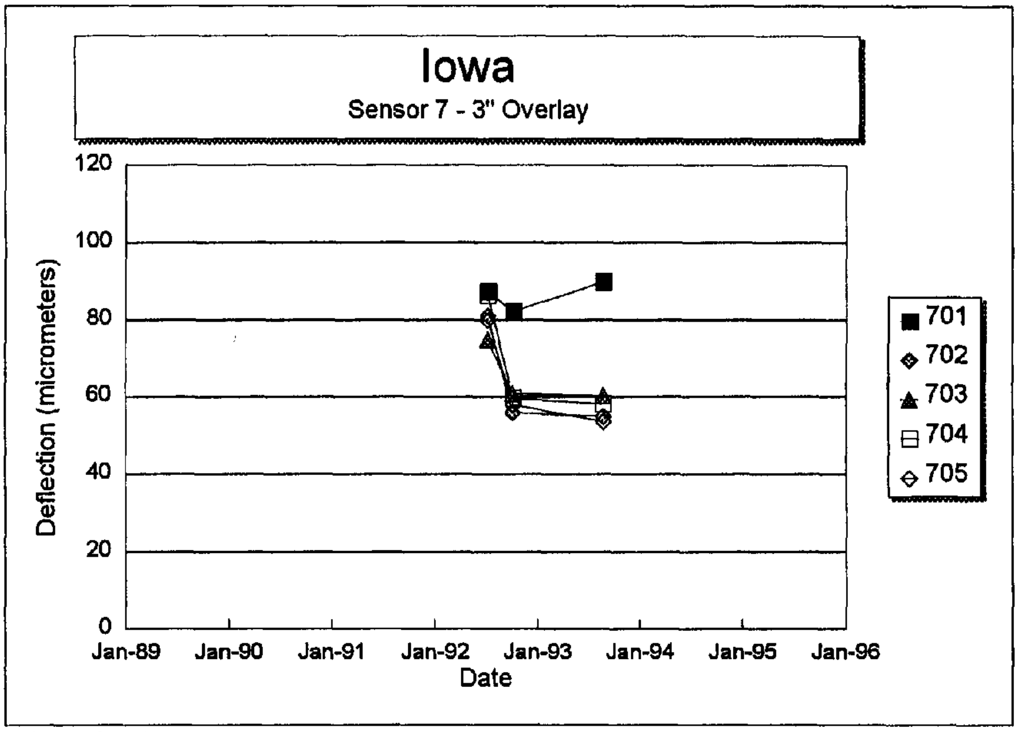


Figure 168. Sensor 1 deflection versus time for each section of the Iowa SPS-7 project.



1 in = 25.4 mm

Note: Section 701 is a non-overlayed control section.

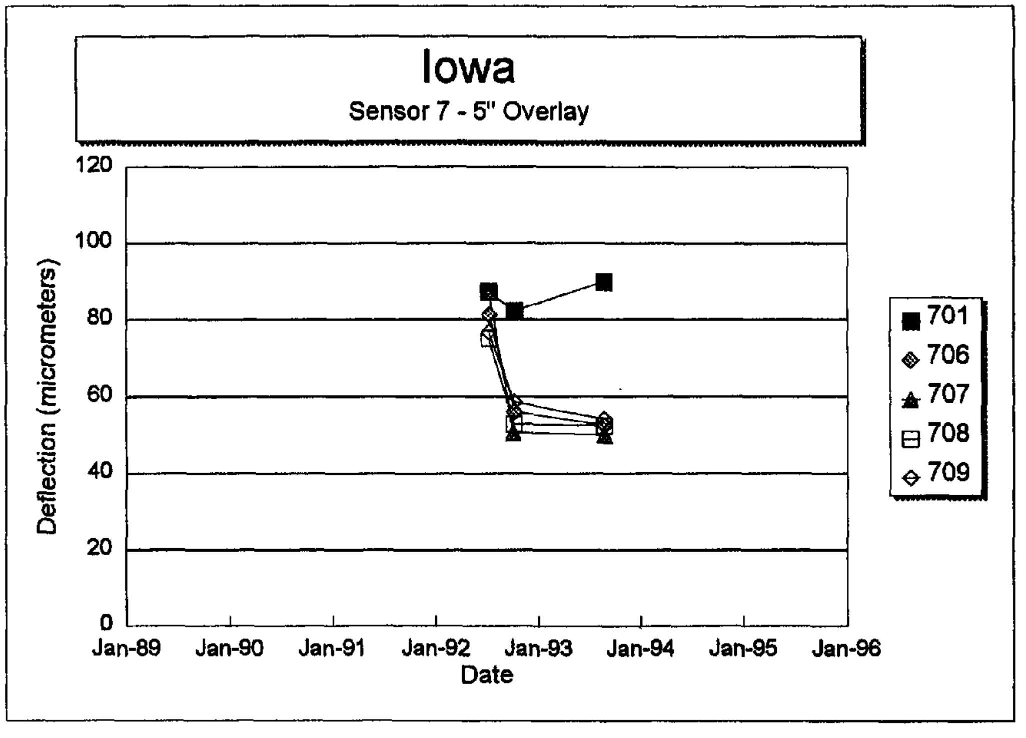
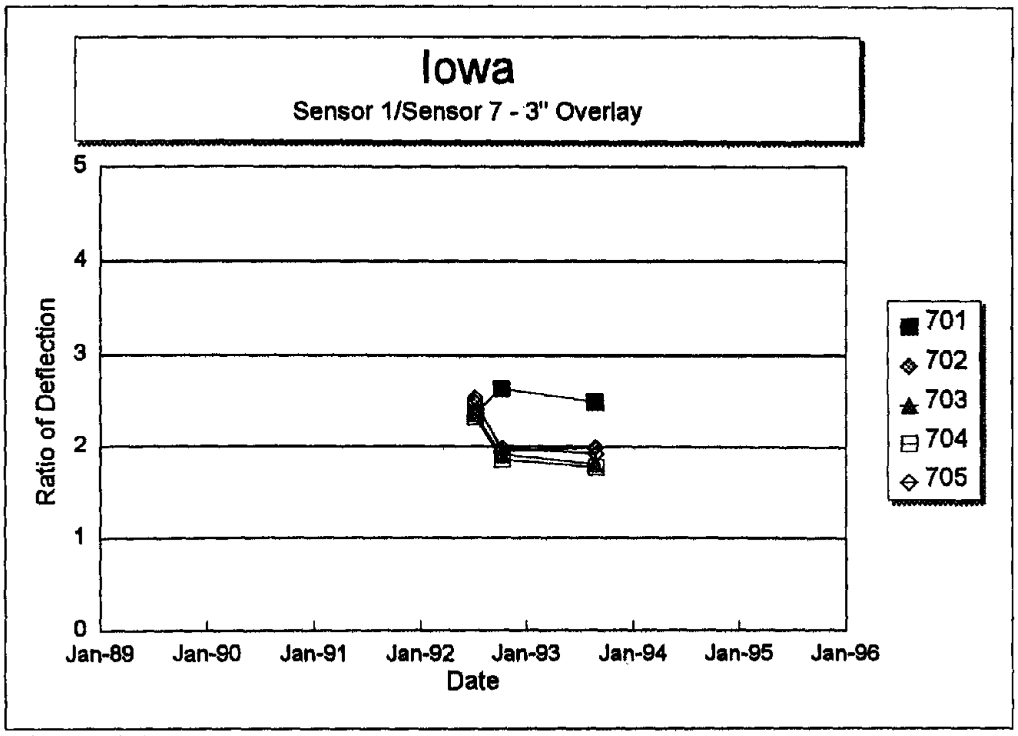


Figure 169. Sensor 7 deflection versus time for each section of the Iowa SPS-7 project.



1 in = 25.4 mm

Note: Section 701 is a non-overlayed control section.

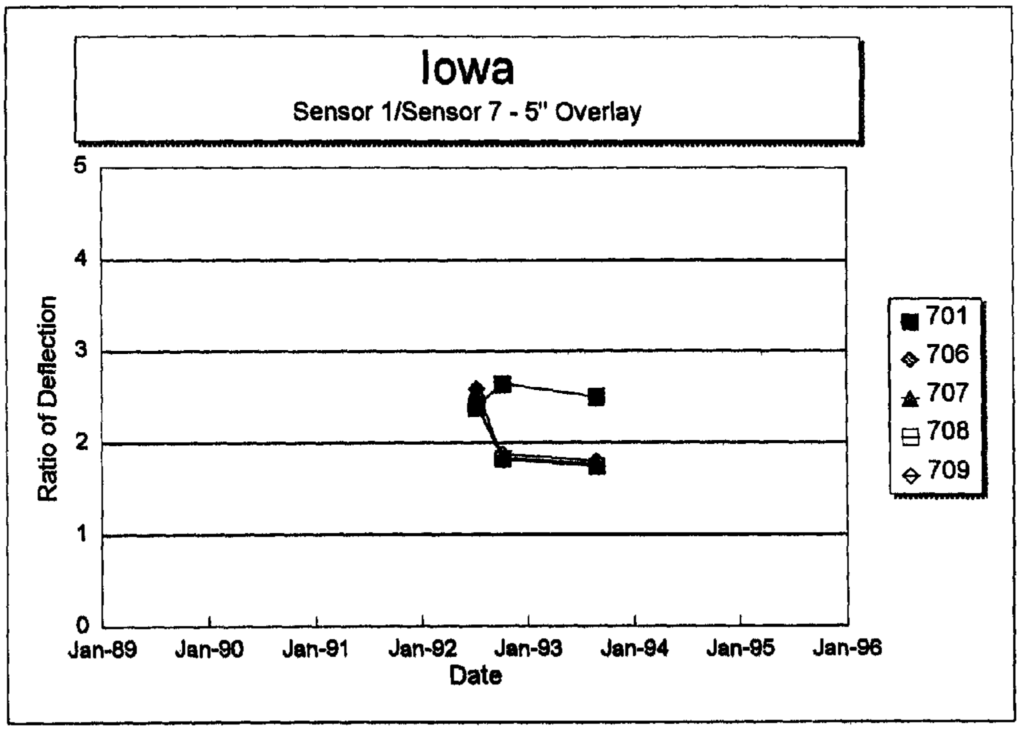
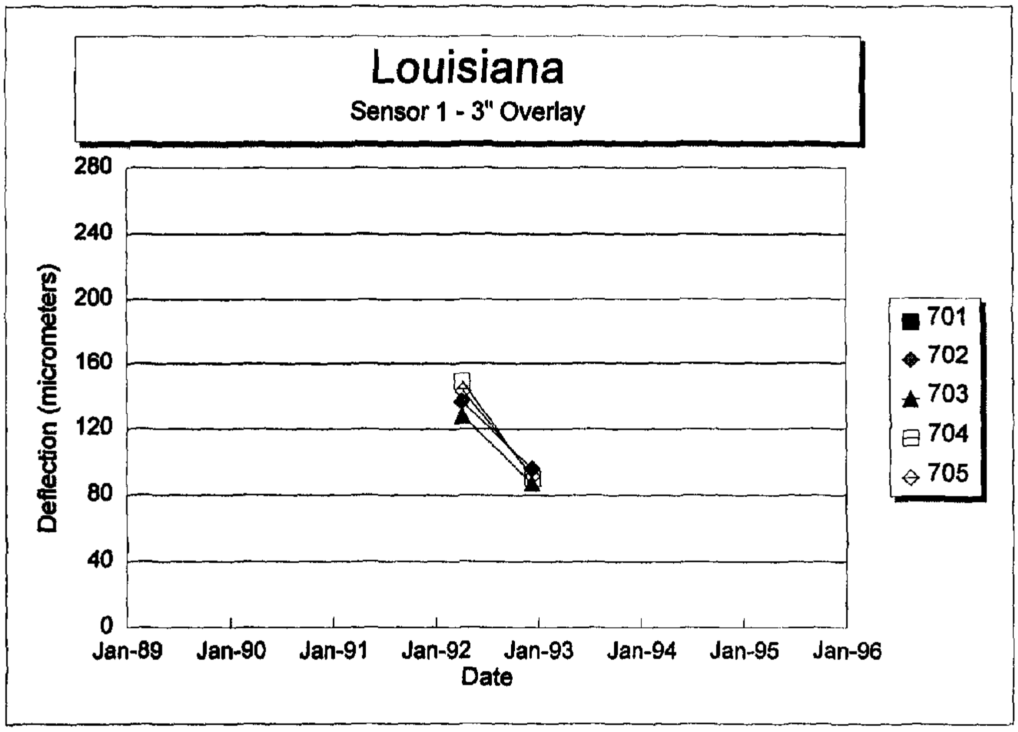


Figure 170. Sensor 1 deflection divided by Sensor 7 deflection versus time for each section of the Iowa SPS-7 project.



1 in = 25.4 mm

Note: Section 701 is a non-overlayed control section.

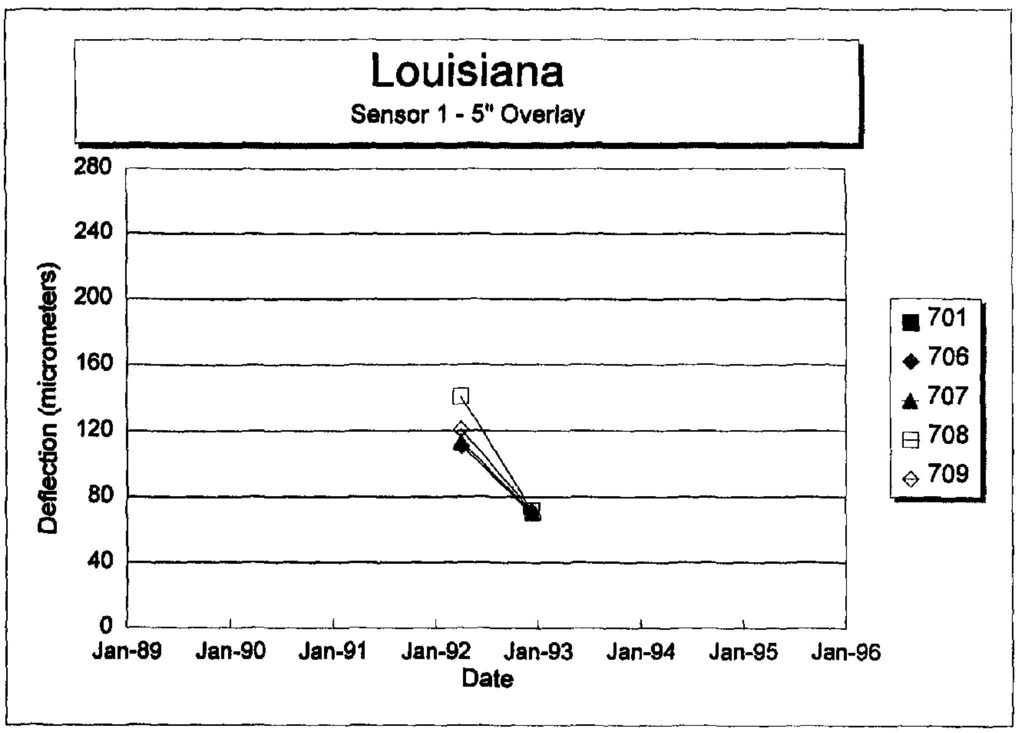
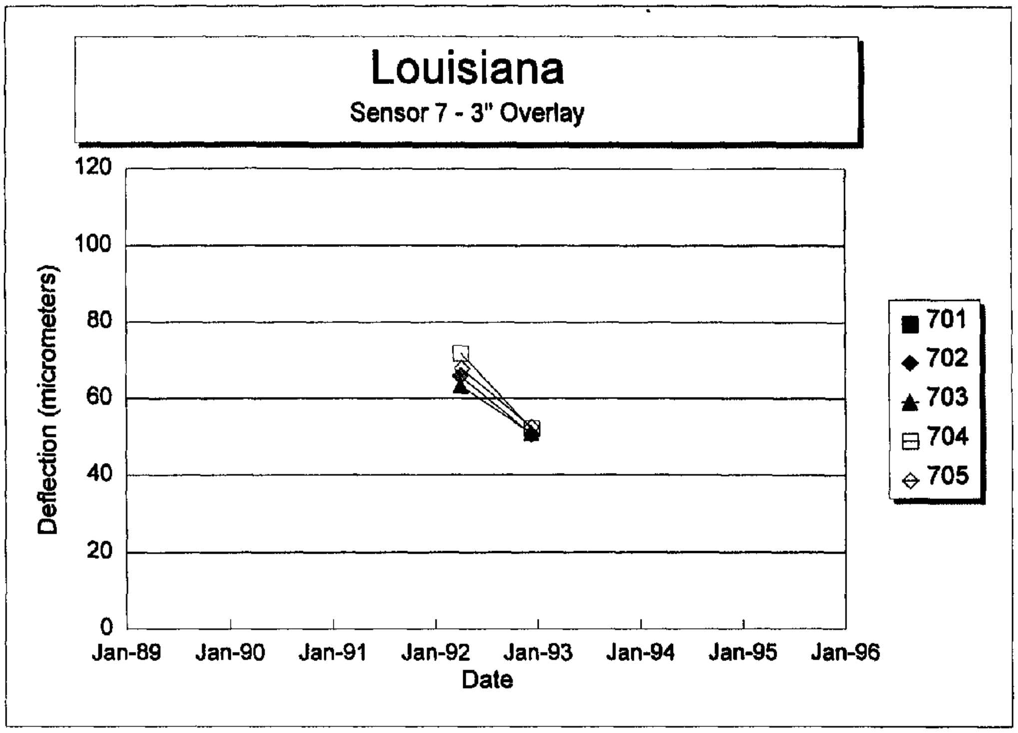


Figure 171. Sensor 1 deflection versus time for each section of the Louisiana SPS-7 project.



1 in = 25.4 mm

Note: Section 701 is a non-overlayed control section.

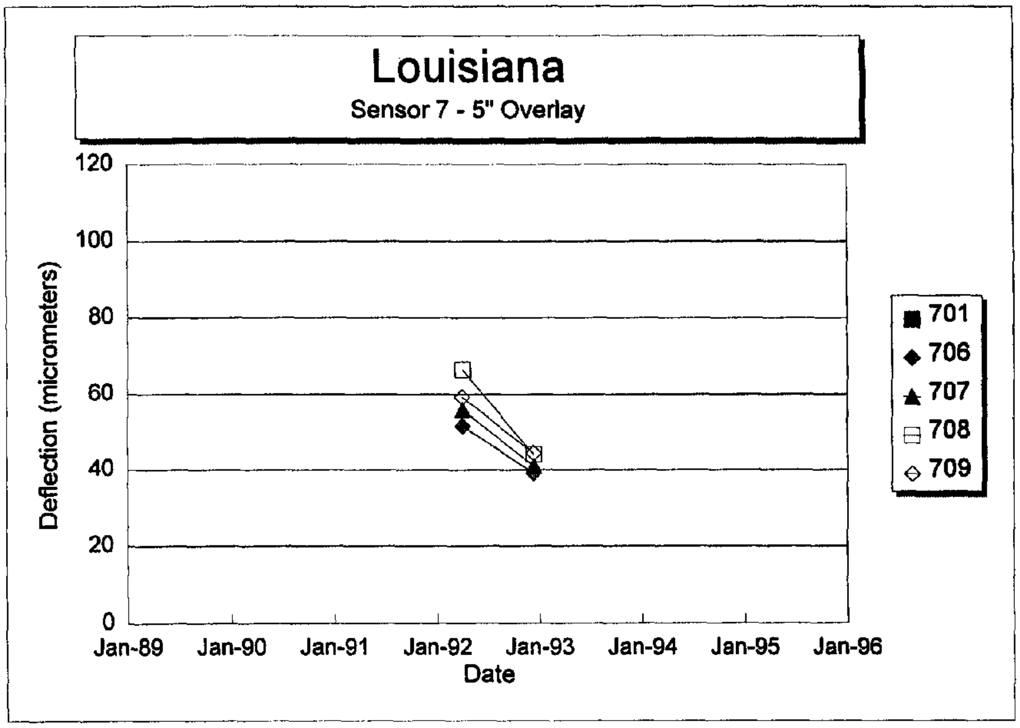
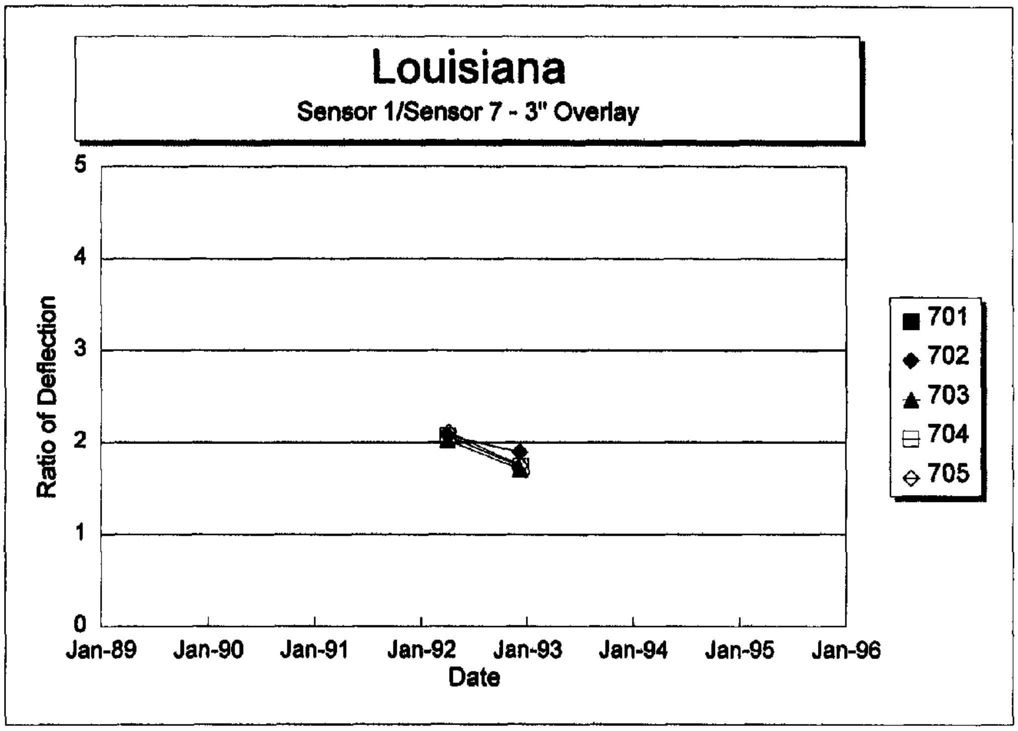


Figure 172. Sensor 7 deflection versus time for each section of the Louisiana SPS-7 project.



1 in = 25.4 mm

Note: Section 701 is a non-overlayed control section.

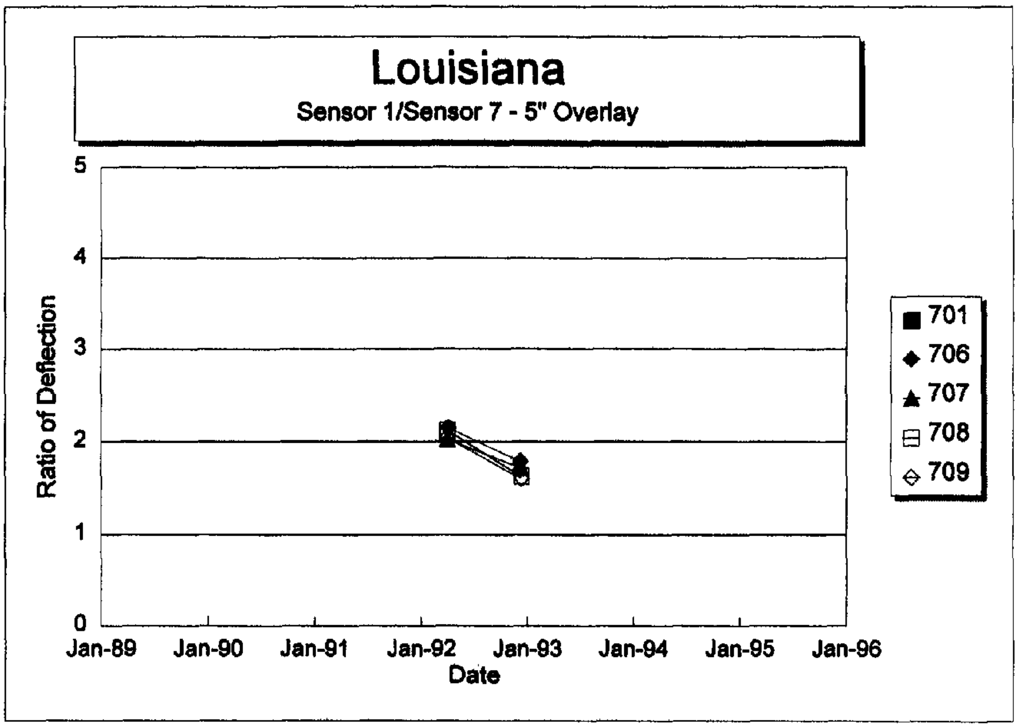
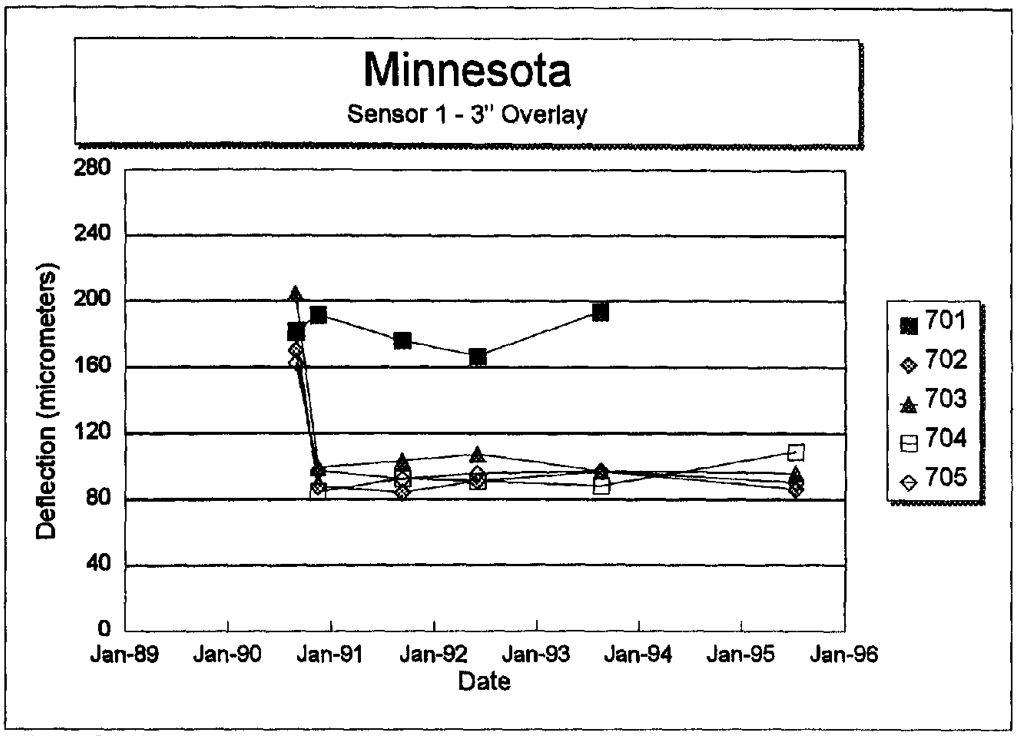


Figure 173. Sensor 1 deflection divided by Sensor 7 deflection versus time for each section of the Louisiana SPS-7 project.



1 in = 25.4 mm

Note: Section 701 is a non-overlayed control section.

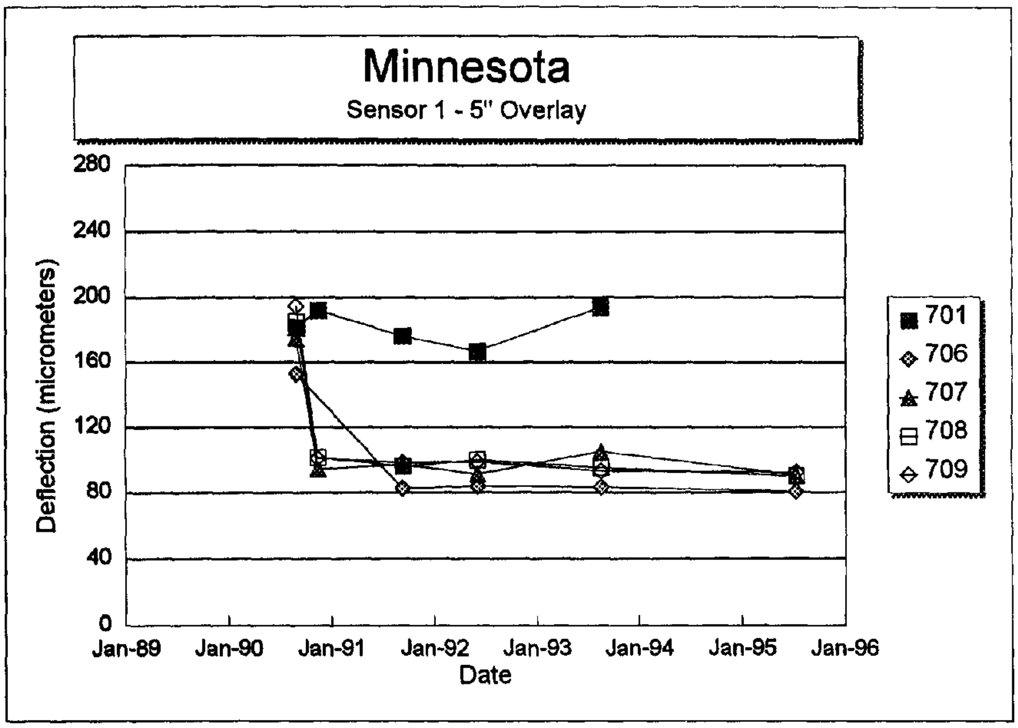
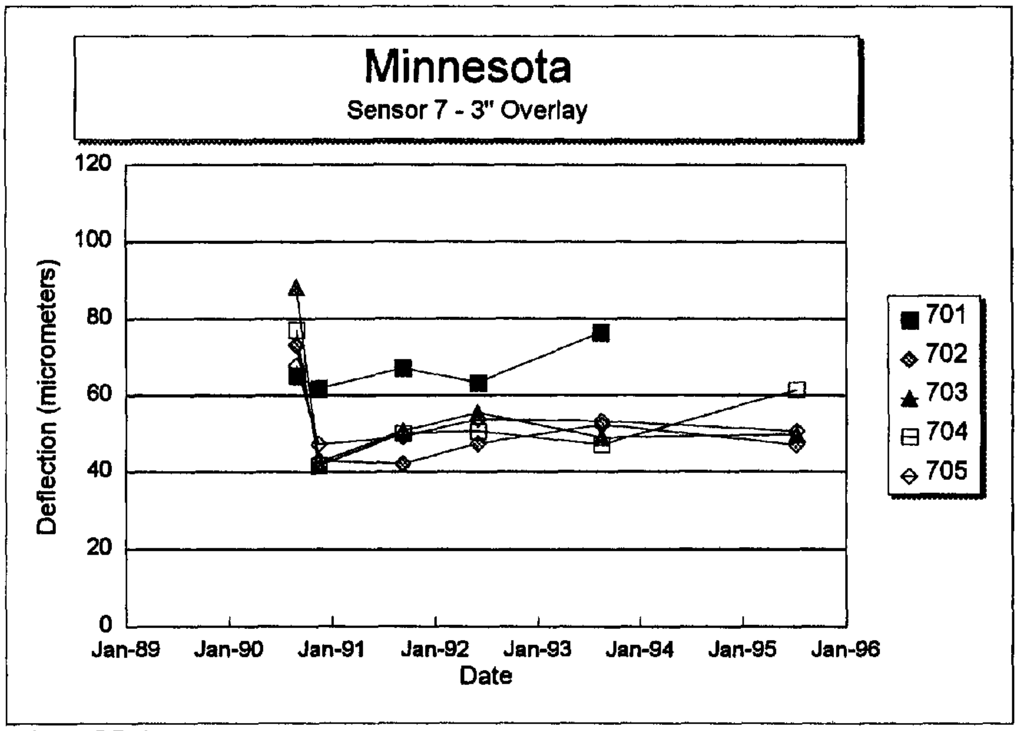


Figure 174. Sensor 1 deflection versus time for each section of the Minnesota SPS-7 project.



1 in = 25.4 mm

Note: Section 701 is a non-overlayed control section.

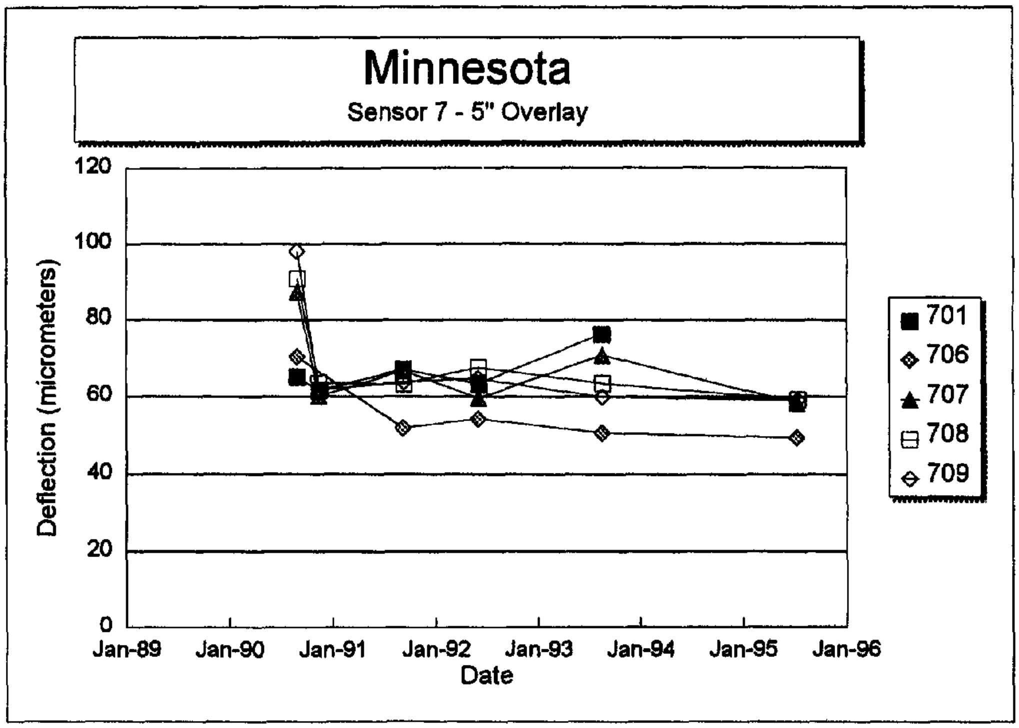
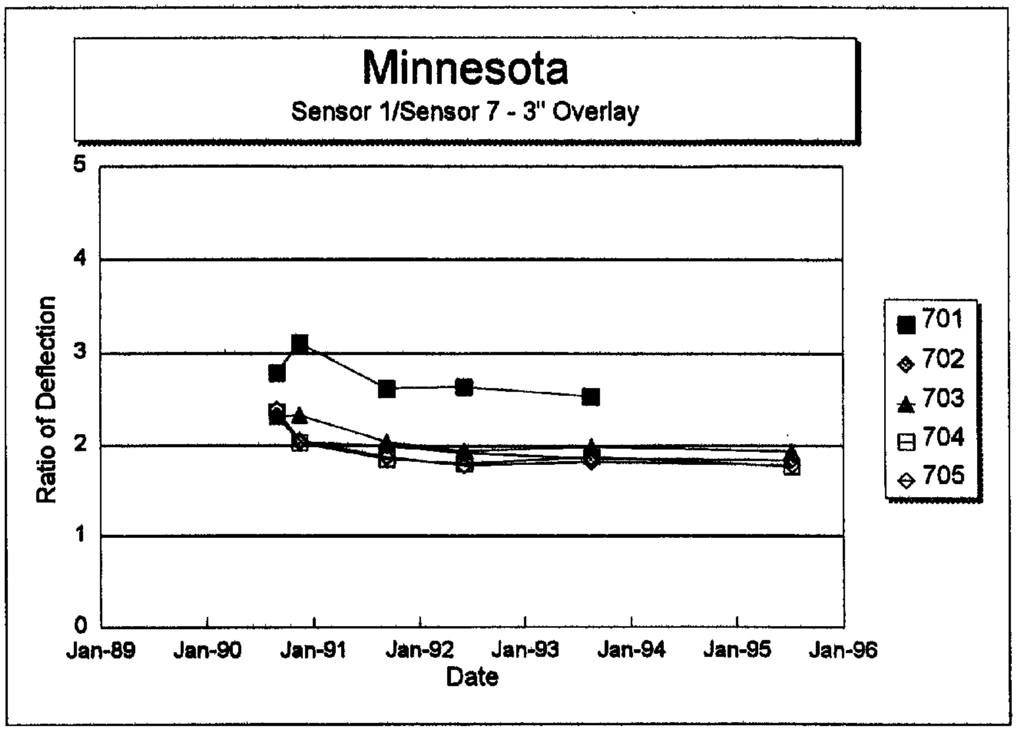


Figure 175. Sensor 7 deflection versus time for each section of the Minnesota SPS-7 project.



1 in = 25.4 mm

Note: Section 701 is a non-overlayed control section.

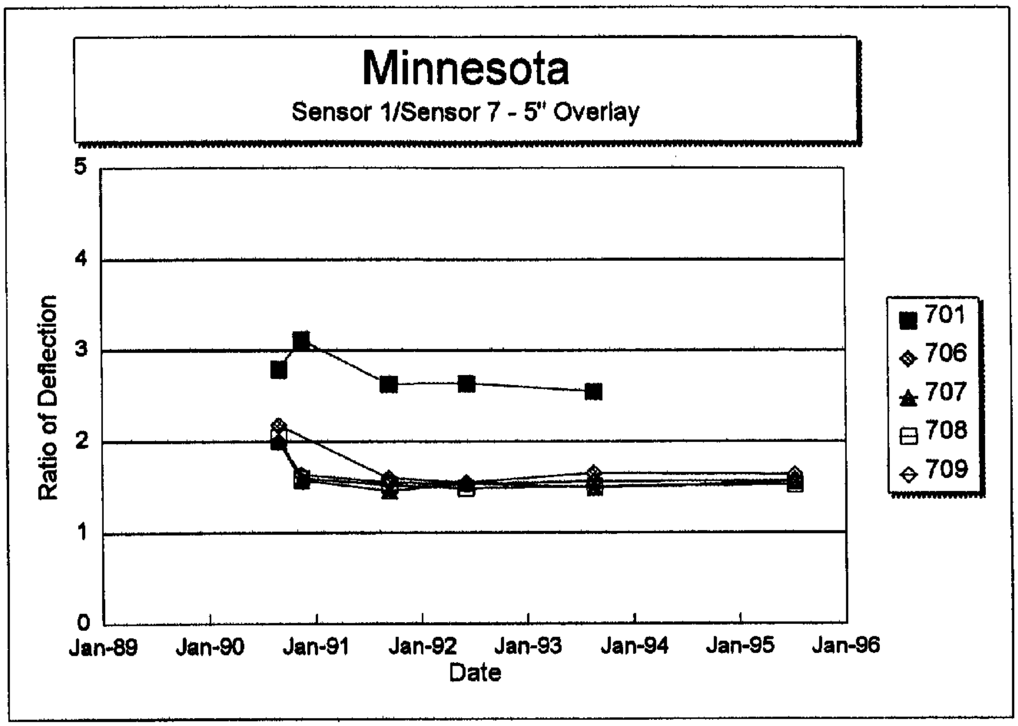
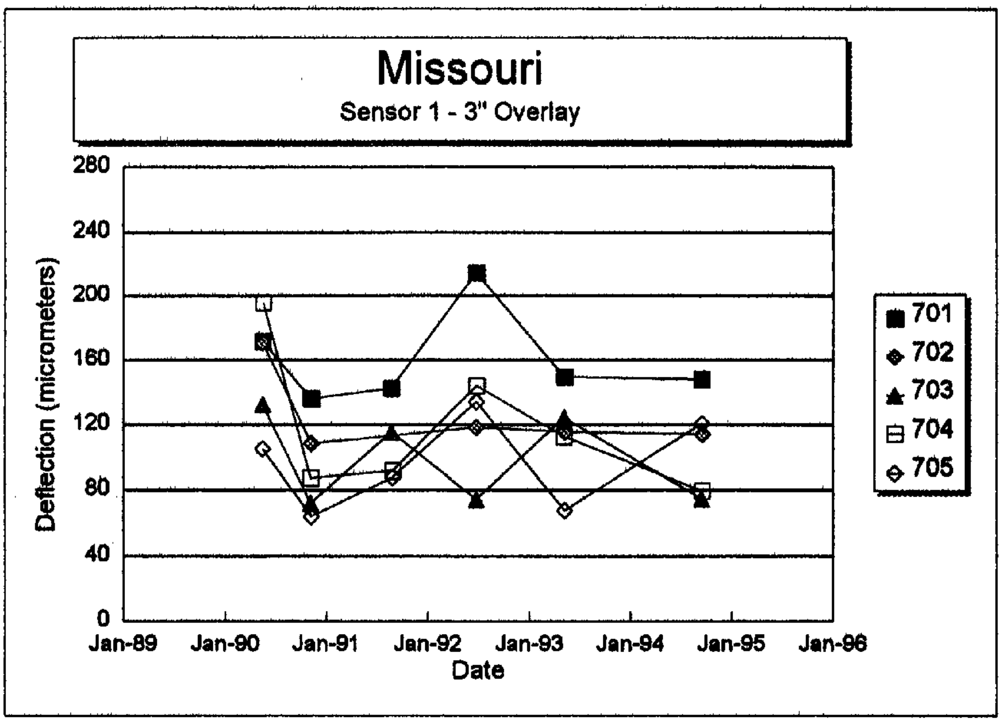


Figure 176. Sensor 1 deflection divided by Sensor 7 deflection versus time for each section of the Minnesota SPS-7 project.



1 in = 25.4 mm

Note: Section 701 is a non-overlayed control section.

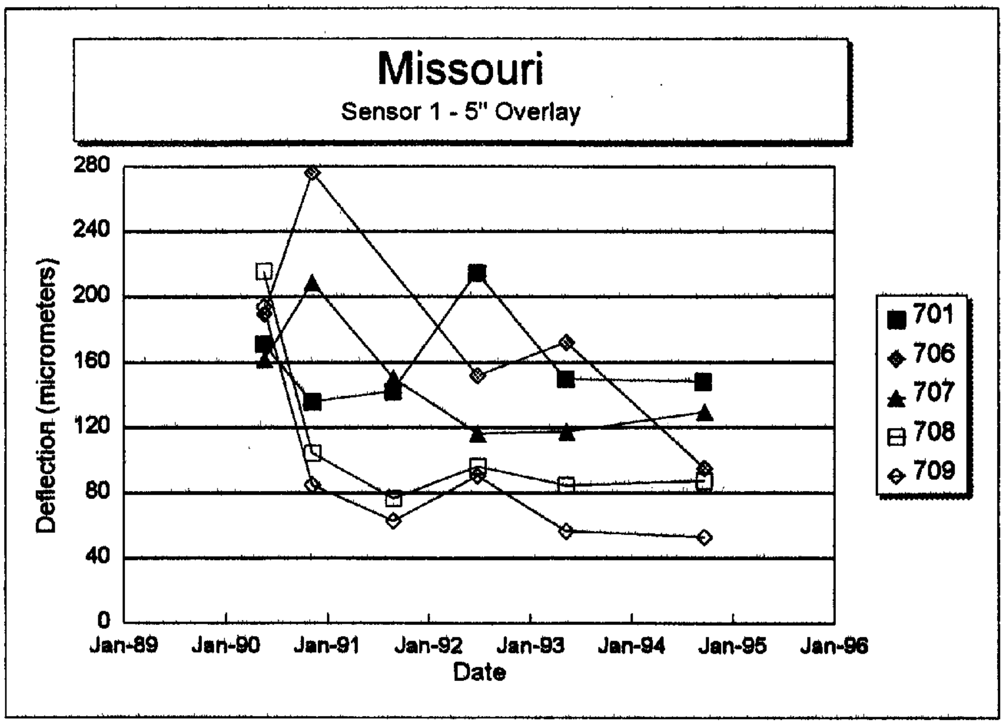
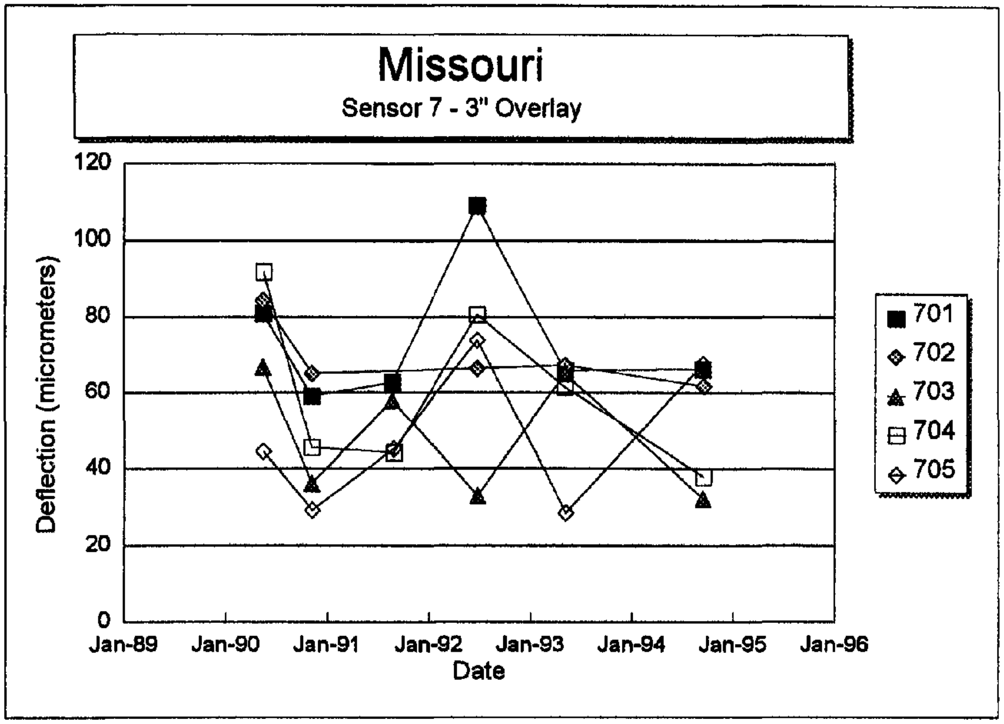


Figure 177. Sensor 1 deflection versus time for each section of the Missouri SPS-7 project.



1 in = 25.4 mm

Note: Section 701 is a non-overlayed control section.

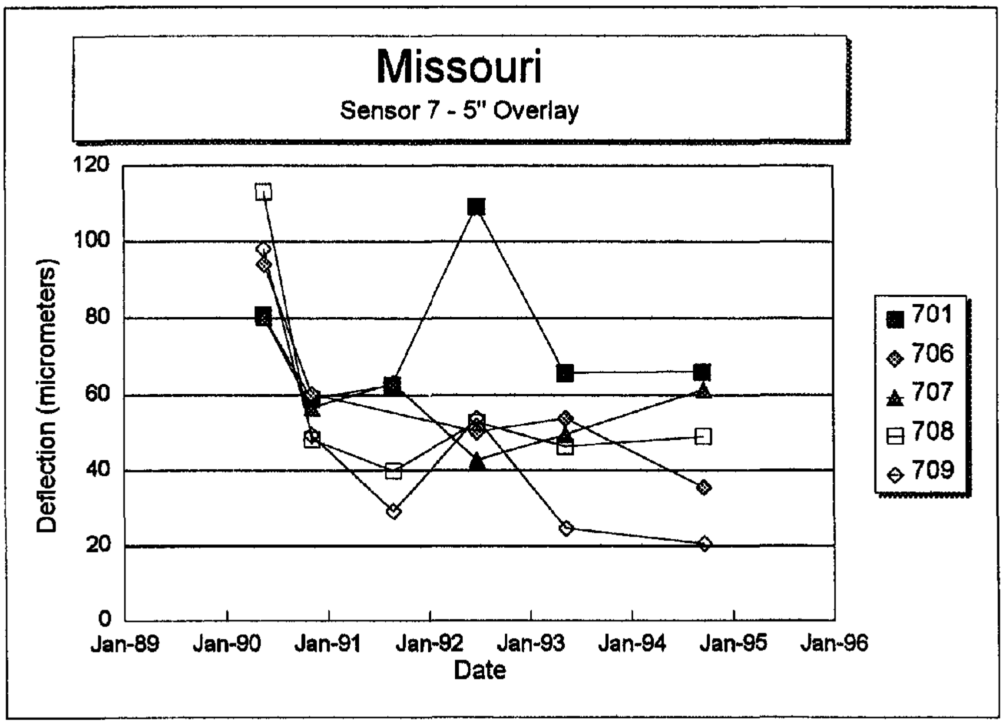
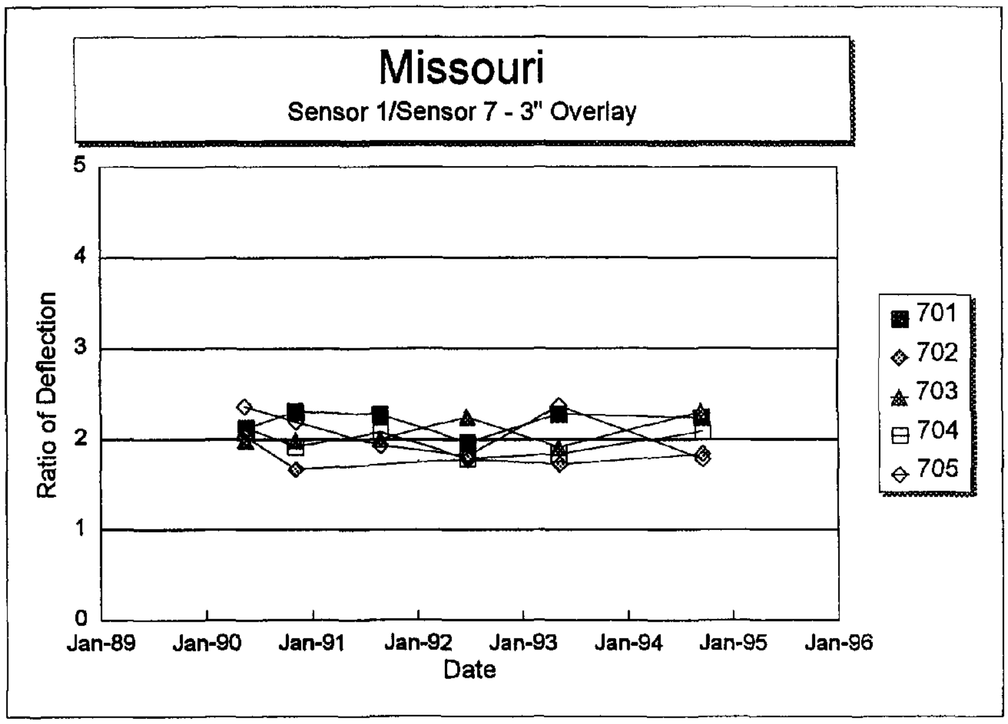


Figure 178. Sensor 7 deflection versus time for each section of the Missouri SPS-7 project.



1 in = 25.4 mm

Note: Section 701 is a non-overlayed control section.

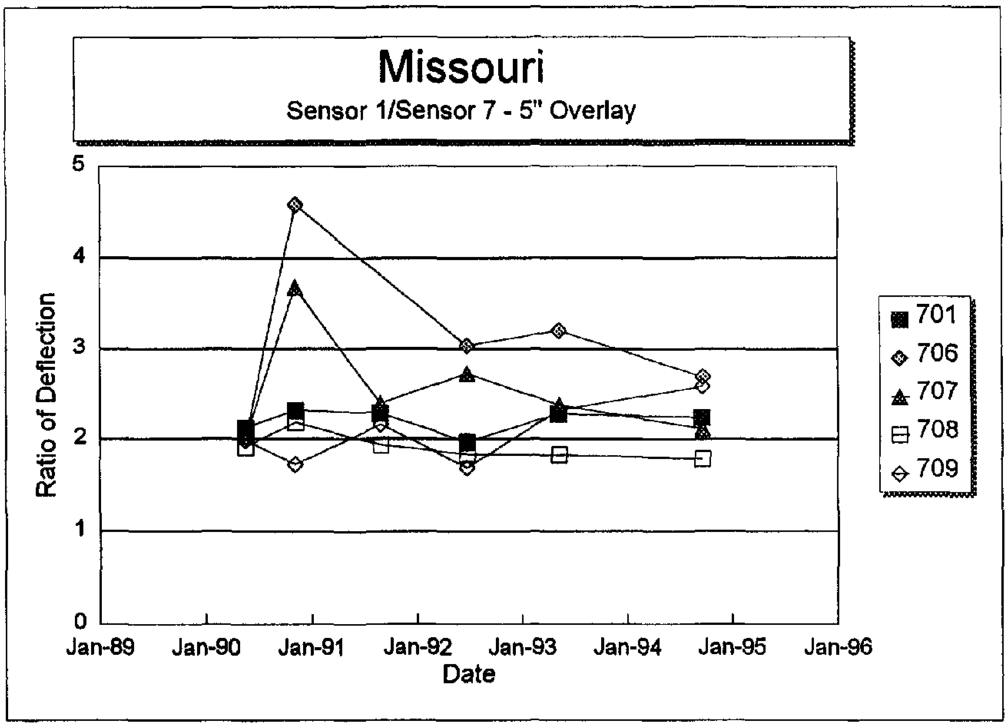


Figure 179. Sensor 1 deflection divided by Sensor 7 deflection versus time for each section of the Missouri SPS-7 project.

REFERENCES

1. J.F. Daleiden, M.D. Sargent, D.A. Ooten, "Rehabilitation of a Jointed Portland Cement Concrete Pavement," Paper Presented at the 1995 Annual Transportation Research Board Meeting.

2. J.F. Daleiden, M.D. Sargent, M.P. Gardner, "Asphalt Maintenance Effectiveness," Paper Presented at the 1994 Annual Transportation Research Board Meeting.

3. "Specific Pavement Studies: Experimental Design and Research Plan for Experiment SPS-5, Rehabilitation of Asphalt Concrete Pavements," April 1989.

4. "Specific Pavement Studies: Experimental Design and Research Plan for Experiment SPS-6, Rehabilitation of Jointed Portland Cement Concrete Pavement," April 1989.

5. "Specific Pavement Studies: Experimental Design and Research Plan for Experiment SPS-7, Bonded Portland Cement Concrete Overlays," February 1990.

6. B.M. Killingsworth, A.L. Simpson, J.B. Rauhut, E. Owusu-Antwi, R. Ahmad, M.I. Darter, O.J. Pendleton. *Early Analyses of LTPP General Pavement Studies Data — Data Processing and Evaluation*, Report No. SHRP-P-684. Strategic Highway Research Program, National Research Council, Washington, D.C., May 1994.

7. A.L. Simpson, J.B. Rauhut, P.R. Jordahl, E. Owusu-Antwi, M.I. Darter, R. Ahmad, O.J. Pendleton. *Early Analyses of LTPP General Pavement Studies Data — Sensitivity Analyses for Selected Pavement Distresses*, Report No. SHRP-P-393. Strategic Highway Research Program, National Research Council, Washington, D.C., May 1994.

8. J.B. Rauhut, A.L. Simpson, J.F. Daleiden, M.I. Darter, E. Owusu-Antwi, O.J. Pendleton. *Early Analyses of LTPP General Pavement Studies Data — Lessons Learned and Recommendations for Future Analyses of LTPP Data*, Report No. SHRP-P-680. Strategic Highway Research Program, National Research Council, Washington, D.C., May 1994.