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Final Report

PERFORMANCE EVALUATION OF VARIOUS HMA REHABILITATION STRATEGIES

Scott Shuler and Christopher Schmidt

December 2008

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16. Abstract: This study evaluates the performance of eight hot mix asphalt (HMA) rehabilitation strategies utilized by the Colorado Department of Transportation (CDOT). The rehabilitation strategies are: 2 to 4-inch overlay without pretreatment; planing and overlay; stone matrix asphalt overlay; full-depth reclamation and overlay; heater scarification and overlay; heater remix and overlay; heater repaving and overlay; and cold-in-place recycling and overlay.

Performance was evaluated with respect to six independent variables: (1) Performance Grade (PG) binder temperature range, (2) traffic volume, (3) highway classification, (4) maximum aggregate size, (5) CDOT region, and (6) climate.

Data analyzed in the study was obtained from the CDOT Pavement Management System Program. Results of this analysis indicate that the cold planning and overlay strategy outperforms the other rehabilitation methods with two to four-inch overlays performing second best. The heater scarification and overlay strategy performed poorest of the eight strategies. The average time required for these pavements to reach the pre-rehabilitation condition was from six to fourteen years based on a linear regression model. However, this model may overestimate rehabilitation life span since it is likely that a linear relationship is not valid for the entire rehabilitation strategy life cycle.

Pavements were rehabilitated before reaching the zero service life threshold except when fatigue cracking was present. In the case of fatigue cracking, four rehabilitation strategies studied exceeded the zero service life threshold. This indicates that rehabilitation would have been warranted earlier in the life of these pavements. As a result, the expected life of the rehabilitation strategies utilized on these pavements may be shorter than could be expected had rehabilitation been done before distress reached this high level. This may explain why the heater scarification and overlay strategy performed poorer than other techniques since fatigue distress prior to rehabilitation on these projects exceeded the zero remaining service life threshold by nearly 20 percent.

Implementation: Continued transfer of pavement performance data from the Pavement Management Systems Program database is recommended to strengthen the validity of the data analysis.

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by

Scott Shuler and Christopher Schmidt
Colorado State University

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Colorado Department of Transportation
DTD Applied Research Branch and Innovation Branch
4201 E. Arkansas Ave.
Denver, CO 80222
(303) 757-9506

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EXECUTIVE SUMMARY

This study evaluates the performance of eight hot mix asphalt rehabilitation strategies utilized by the Colorado Department of Transportation (CDOT). These strategies are: two to 4-inch overlay without pretreatment; planing and overlay; stone matrix asphalt overlay; full-depth reclamation and overlay; heater scarification and overlay; heater remix and overlay; heater repaving and overlay; and cold-in-place recycling and overlay.

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Pavements were rehabilitated before reaching the zero-service life threshold except when fatigue cracking was present. In the case of fatigue cracking, four of the rehabilitation strategies studied exceeded the zero-service life threshold. This indicates that rehabilitation would have been warranted earlier in the life of these pavements. As a result, the expected life of the rehabilitation strategies utilized on these pavements may be shorter than could be expected had rehabilitation been done before distress reached this high level. This may explain why the heater scarification and overlay strategy performed poorer than other techniques since fatigue distress prior to rehabilitation on these projects exceeded the zero remaining service life threshold by nearly 20 percent.

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1.0 INTRODUCTION

The Colorado Department of Transportation (CDOT) is responsible for maintaining and rehabilitating approximately 23,105 lane miles of the 136, 287 lane miles in the state annually. Rehabilitation of these pavements is done periodically to maintain an acceptable level of serviceability. The cost of rehabilitation varies based on damage severity and the rehabilitation method. The budgets for rehabilitation of these pavements in fiscal years 2006 and 2007 were $132.9 and $153.0 millions, respectively.

This study is intended to provide an evaluation of the performance for eight of the rehabilitation methods utilized by CDOT for hot mix asphalt pavements. It is believed that each of these rehabilitation methods performs differently depending on how and where the method is being utilized. However, there has not been an extensive study examining the performance of each method, so relative performance and cost effectiveness of the rehabilitation strategies are not well understood. The purpose of this research is to quantify the performance of the eight rehabilitation strategies used in Colorado so that a better understanding can be gained regarding which rehabilitation strategies perform the best under specific conditions.

1.1 Hot Mix Asphalt (HMA) Rehabilitation Strategies

Below are definitions of the eight rehabilitation strategies investigated:

Cold Planing and Overlay

Cold planing and overlay involves removing the top portion of the existing pavement with a milling machine at ambient temperatures. This milled material is removed and later recycled. The milled pavement surface is then covered with a new hot mix asphalt pavement. This overlay is usually between 2 and 6 inches thick.

Two to Four-Inch Overlay

In a 2 to 4-inch overlay, a flexible pavement overlay is added to the existing pavement and then finished by leveling with a roller. The flexible pavement overlay used in this definition is considered to be HMA.

Stone Matrix Asphalt (SMA)

SMA is hot mixed asphalt with a gap graded aggregate gradation and a mastic fine aggregate fraction.

Full-Depth Reclamation and Overlay

Full-depth reclamation and overlay is done by completely grinding up the existing pavement and base course at ambient temperatures to the subgrade. This ground up mixture is then compacted and a hot mixed asphalt pavement is placed on top.

Heater Scarification and Overlay

Heater scarification and overlay begins with the process of heating up the pavement, using teeth to scarify the pavement, and then spraying a rejuvenating agent on the scarified surface. The rejuvenating agent and the scarified asphalt pavement are mixed together and the resulting material is leveled using a screed. After this rejuvenated material is leveled and compacted a hot mixed asphalt wearing course is placed.

Heater Remix and Overlay

The heater remix and overlay process is done by heating the pavement and using a cutting drum to mill the existing surface to a depth of between 1.5 inches to 2 inches. The aggregate gathered from the milling has a rejuvenating agent added and then the HMA is added. All of this material is brought into a hopper and mixed together to form a single mix. The mixture is then spread out and compacted.

Heater Repaving and Overlay

With this process the pavement is heated, scarified and a rejuvenating agent is added to the scarified material before it is mixed and leveled. Immediately after this process is performed, a layer of HMA is placed over the heated recycled surface. A screed is used to level the pavement and everything is compacted. Scarification is usually between 0.75 inches to 1.5 inches deep. This process helps to form a strong bond between the two layers of pavement.

Cold In-Place Recycling and Overlay

Cold in-place recycling and overlay involves the process of removing the surface of the existing pavement by grinding at ambient temperatures. This material is screened, crushed, and mixed with emulsified asphalt, then placed with conventional paving equipment and compacted. This process is all done in one continuous operation from grinding to laydown. After the compaction, and some curing, a hot mixed asphalt overlay is placed.

1.2 Scope and Goals of Research

The goal of this research is to determine the performance of eight rehabilitation strategies utilized by CDOT. The objectives were:

- Determine the average amount of distress per year;
- Determine the condition of the pavements prior to rehabilitation;
- Determine the rate of deterioration per year;
- Determine the coefficient of determination of the regression equations derived;
- Determine the average amount of highway segments used per year;
- Determine which rehabilitation strategies perform best under various conditions; and
- Provide instructions for updating the data in this study.

Independent variables evaluated for each of the rehabilitation strategies were:

  - Polymer modified (PG range >90 °C) vs. non-polymer modified (PG range <90 °C);
  - Traffic volume;
  - National Highway System classification ;

- Hot mix aggregate gradation;
- CDOT Region; and
- Climate.

Polymer Modified

Asphalts used in hot mixed asphalt in Colorado are graded according to the Superpave PG system. When the range of temperatures specified by this system is greater than 90 °C, the asphalt is generally considered to require modification by polymers. When this temperature range is less than 90 °C, the asphalt is generally considered to be a straight run petroleum asphalt without polymer modification.

Traffic Volume

The highways are split into three different traffic volumes based on 20-year, 18 kip equivalent single axle loads (ESALs):

- Low Traffic < 0.3 million ESALs;
- Moderate Traffic 0.3 to 11 million ESALs; and
- High Traffic > 11 million ESALs.

National Highway System

There are two different highway classifications for the purpose of this study. A highway that is classified as NHS is a highway that is listed on the National Highway System and one that is classified as non-NHS is classified as not on the National Highway System. The National Highway System (NHS) is a system of highways around the country that have been determined to be high priority routes. Highways classified as NHS are likely to get funding from the federal government for improvements and new construction. The NHS was enacted to make sure that the major arterials of our nation were being maintained and in good working condition. Figure 1 is a map of the NHS in Colorado.

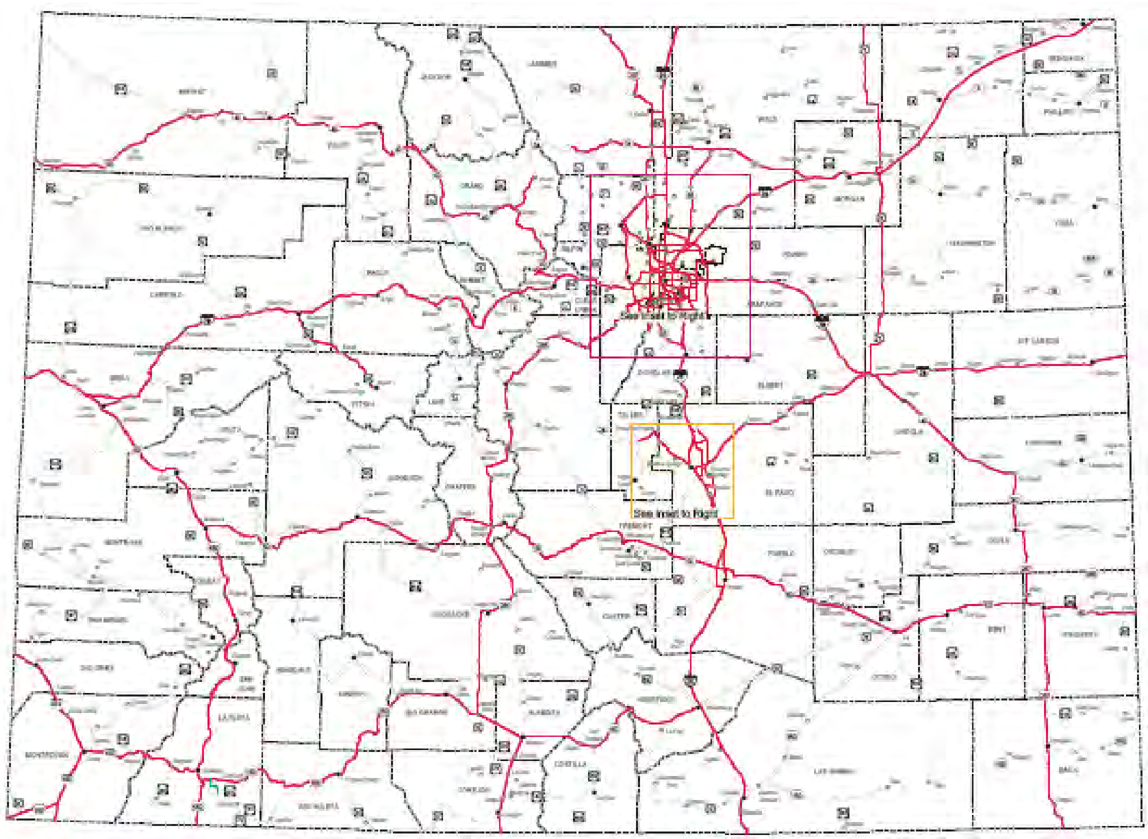

Figure 1 National Highway System in Colorado

Hot Mix Aggregate Gradation

Two hot mix aggregate gradations were evaluated in this study. The ‘S’ gradation has a nominal maximum aggregate size of 1 inch. The ‘SX’ gradation has a nominal maximum aggregate size of ¾ inch.

CDOT Regions

The Colorado Department of Transportation divides the state into six engineering regions as shown in Figure 2.

Climates

The environments in the state of Colorado are broken down into four different zones: a very cool environment has an average high air temperature of less than 81 °F, a cool environment with a average high air temperature between 81 – 88 °F, a moderate environment that has an average high air temperature between 88 – 97 °F, and a hot

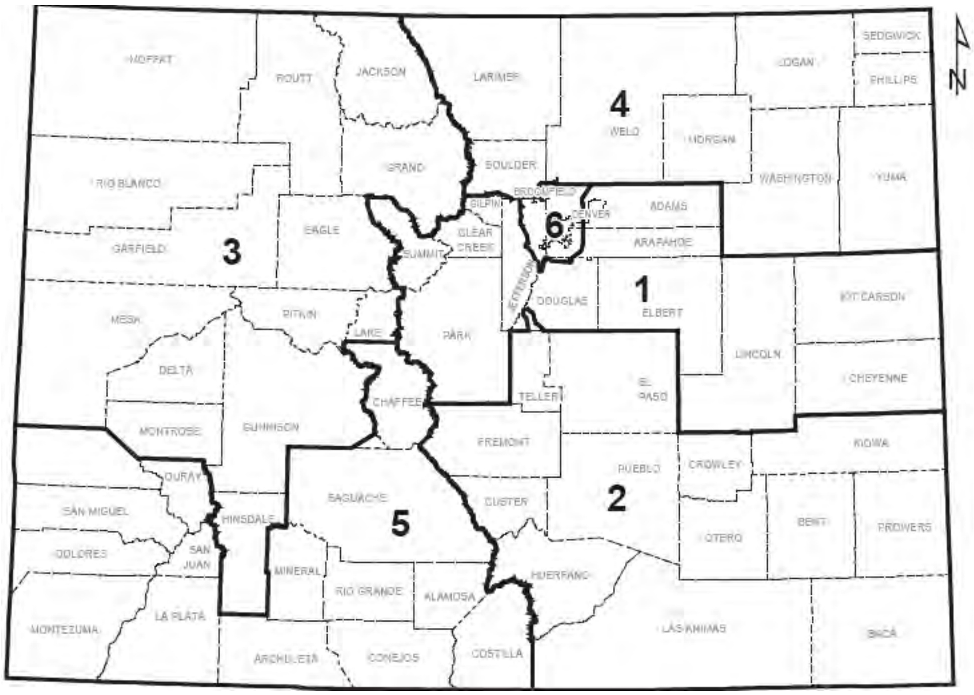

Figure 2 CDOT Engineering Regions

environment that has an average high air temperature of greater than 97 °F (Goldbaum 2008).

The rate of change for each of the criteria below will be evaluated for each rehabilitation strategy and each independent variable described above.

- Smoothness
- Rutting
- Fatigue
- Transverse Cracking
- Longitudinal Cracking

2.0 LITERATURE REVIEW

Throughout the years, there have been many studies conducted on pavement management, materials testing, and pavement costs in different parts of the United States. Some of these studies were done in a laboratory setting while some were administered using test strips on actual highways. Good management is vital to the longevity of pavement. Testing of practical types of rehabilitation techniques used in various environments and situations is part of building a successful pavement management plan. Actual test strips using real traffic patterns have been used to better understand how a pavement rehabilitation plan works best under different circumstances. Many state agencies have tested various materials used in their state for the effectiveness both in regards to cost and performance. Methodologies for testing and building performance curves vary between studies.

2.1 Texas Study

A study conducted by the Texas Department of Transportation (TxDOT) hypothesized that concrete pavements with HMA overlays prolong the life of a pavement (Chen, Scullion & Bilyeu, 2006).

In Texas, currently 2% of their state-maintained road system is jointed concrete pavement. TxDOT built a number of test sections around the state to improve the quality of the pavement after rehabilitation (Chen, Scullion & Bilyeu, 2006). The biggest issue with jointed concrete is the tendency to have reflective cracking, which can impact the structural integrity of a pavement because of the tendency of moisture to deposit in the cracks in the pavement (Chen, Scullion & Bilyeu, 2006). In the colder months, water deposited in the cracks can enter a freeze-thaw cycle and damage the pavement dramatically. The State of Texas was involved in testing various methods to help with the problem over the years, but the results of those methods have varied greatly (Chen, Scullion & Bilyeu, 2006).

The treatment methods tested by TxDOT included:

- Crack-retarding grid;
- Crack-retarding asphalt layer;
- Petromat fabric underseal;
- Crumb rubber modified asphalt;
- Flexible base; and
- Arkansas mix.

TxDOT expects their pavements to last at least eight years after the rehabilitation is performed. The study found that some pavements did not perform to the eight-year expectancy and had to be replaced within one year (Chen, Scullion & Bilyeu, 2006).

One flaw with the experiment was that the integrity of the test strips could have been compromised because the test strips were short sections of highway. The majority of the contractors were set up to do longer sections of highway. This could potentially have an impact on the quality of the pavements placed (Chen, Scullion & Bilyeu, 2006).

All six of the methods were tested on various test strips throughout the state and the distresses were measured annually. Sections of the test strips were removed and used as samples that were taken to a laboratory and analyzed (Chen, Scullion & Bilyeu, 2006). No performance measures were given in the study. It was concluded that the crack-retarding grid performance was disappointing because of the relationship between it and premature failures (Chen, Scullion & Bilyeu, 2006). Both the Arkansas mix and flexible base performed well. Joint movement was slowed when using a flexible base. Reflective cracking was also slowed when a flexible base was used. When petromatic fabric was used, reflective cracking was shown to have slowed (Chen, Scullion & Bilyeu, 2006). Strata, which is an asphalt-rich polymer modified binder and fine aggregate hot mix (Chen, Scullion, & Bilyeu, 2006), also has shown good performance. Break-and-seat sections showed disappointing results, mostly due to a weak sub grade (Chen, Scullion & Bilyeu, 2006).

2.2 Pennsylvania Study

In another study, Morian and Cubermledge evaluated techniques for selecting correct pavement rehabilitation strategies in Pennsylvania. They identified the important information for analyzing the best rehabilitation techniques to use in their state. They claim that understanding the project's history is most important. A thorough assessment of traffic history, evaluation of materials used, general understanding of past construction practices, history of climate, and an understanding of the type of subgrade are also important to know, when analyzing the performance of different rehabilitation techniques (Morian & Cumberledge, 1997).

Steps are also given that address how to choose the most cost effective rehabilitation technique. These steps include: evaluate the existing pavement distress, determine cause of distress, and consider multiple techniques to address distress, evaluate effectiveness of other techniques, and then determine what technique will prove to be the most cost effective (Morian & Cumberledge, 1997). Matrices and performance curves are built from data and used as a tool for selecting the proper technique to use on a given section of highway (Morian & Cumberledge, 1997).

Pennsylvania's Overall Pavement Index (OPI) was used to provide data. The OPI is designed to reflect the overall condition of the pavements and includes using four indexes: ride index, structural index, surface distress index, and safety index. Each index has a weight assigned to it to make up the overall pavement index. Ride index is a measurement from the International Roughness Index. Structural index is a combination of cracking, joint failing, broken pavements, and surface defects. Surface distress index is comprised of seal failures, transverse cracking, rutting, surface defects, and joint spalling. Safety index includes joint spalling, transverse cracking, faulting, broken pavements, patching, surface defects, rutting, and shoulder drop-off. Each item included in the indexes is given a weight of the total index and thus some items are included in one or more indexes (Morian & Cumberledge, 1997).

Measurements are taken from the highway and then organized and plotted on graphs. Graphs show the distress versus time and that over time distresses tend to get worse. A case study that included the analysis of a cold in-place recycling of asphalt was conducted for the study over a twelve year period. It was determined that the pavements tended to perform as expected (Morian & Cumberledge, 1997).

2.3 Nevada Study

In another study by the Nevada Department of Transportation (NDOT), a network optimization system (NOS) was developed. This system is used to evaluate alternate rehabilitation techniques and then recommend the most efficient and cost effective technique for different sections of highway (Hand, Sebaaly & Epps, 1999).

Present serviceability index (PSI) is the performance measure that was used by NDOT to measure amounts of distresses. PSI is a calculation of rut depth, slope variances, cracking, and patching. Performance models were developed from the PSI numbers for the overlay and the mill/overlay rehabilitation techniques used. (Hand, Sebaaly, & Epps, 1999). Projects were selected around the state to be used in the study. Three restrictions were used when choosing sections: a minimum number of replicated sections, a minimum project length of three kilometers, and only projects with enough quality data were chosen (Hand, Sebaaly & Epps, 1999).

The data used to build the performance curves was gathered from NDOT's pavement management system and other historical databases NDOT has on file. Data from the pavement management system is organized by direction of lane mile. Box plots were then used to plot the data on a graph to show the percentage of allowable distress over time (Hand, Sebaaly & Epps, 1999).

Data was separated into different segments around the state. Segments were chosen from similar highways for analysis reasons. Beginning and ending milepost, existing pavement structure, existing structural number, traffic loads, and environmental conditions are also included in the database (Hand, Sebaaly & Epps, 1999).

Linear regression analysis was used to develop performance models for overlay and mill/overlay rehabilitation treatments. PSI was used as a measurement of performance, and models were developed as this measurement relates to pavement age, traffic loads, material properties, and environmental conditions (Hand, Sebaaly & Epps, 1999). No performance models were included in the study. A generic process was explained to create performance models for rehabilitation strategies.

A large database is needed in order to build accurate performance curves for different sites in Nevada. Engineering and good judgments must be used to build good performance models. The user of the system must also have an understanding of the way the system works so that the limitations are known (Hand, Sebaaly & Epps, 1999).

3.0 METHODOLOGY

Data analyzed in this study was obtained from the pavement management database of the Colorado Department of Transportation. This database houses the results of pavement condition surveys collected annually by automated photo survey and laser profilometer equipment. Data has been collected and stored in the database using this technology since 1999. Data from 1999 to 2006 were analyzed in this study. Pavement condition is recorded in increments of 0.10 mile for various lengths of highway ranging from one to six miles. Each of these 0.10-mile increments represents a data point. The condition of each roadway was represented by calculating a moving average from five of these data points for the length of roadway evaluated each year. The change in condition was then determined by comparing the average of the moving averages from year to year. The example shown in Table 1 indicates an increase in roughness of 36.5 in/mi from 1998 to 1999 for the roadway shown.

Both asphalt and concrete pavement distresses are measured in 0.10 mile increments showing the direction of travel. Highways are classified as either being located on the National Highway System (NHS) or not being located on the National Highway System (non-NHS).

The first step was to search the databases for distress data from 1999 to 2006 and transfer the eight years of data into an Excel database. This database was used to organize the data into the separate highway sections and years. Other spreadsheets/databases were produced for each of the different pavement rehabilitation strategies shown in Table 1.

Table 1 Numbers of Segments for Each Rehabilitation Strategy

	Type of Rehabilitation	# of Segments
1	Cold Planing and Overlay	57
2	Two to Four Inch Overlay	73
3	Stone Matrix Asphalt (SMA) Overlay	5
4	Full Depth Reclamation (FDR) and Overlay	6
5	Heater Scarification and Overlay	19
6	Heater Remix and Overlay	6
7	Heater Repaving and Overlay	4
8	Cold Recycle and Overlay	5
	Total	**175**

After the data sets were organized by year and rehabilitation techniques, the moving average for every 0.50 mile was calculated for each of the highway segments. The highways were also organized by direction or travel. This eliminates directional factors affecting results. The maximum moving average for each direction was calculated. This process was done for all 175 highways for eight years.

Data were then organized into highway segments and years. A summary sheet was provided for each year sorted by highway segment, which shows the maximum moving average for each highway segment and year. The data were then broken down into six separate criteria of interest to CDOT. These criteria are outlined in Figure 3.

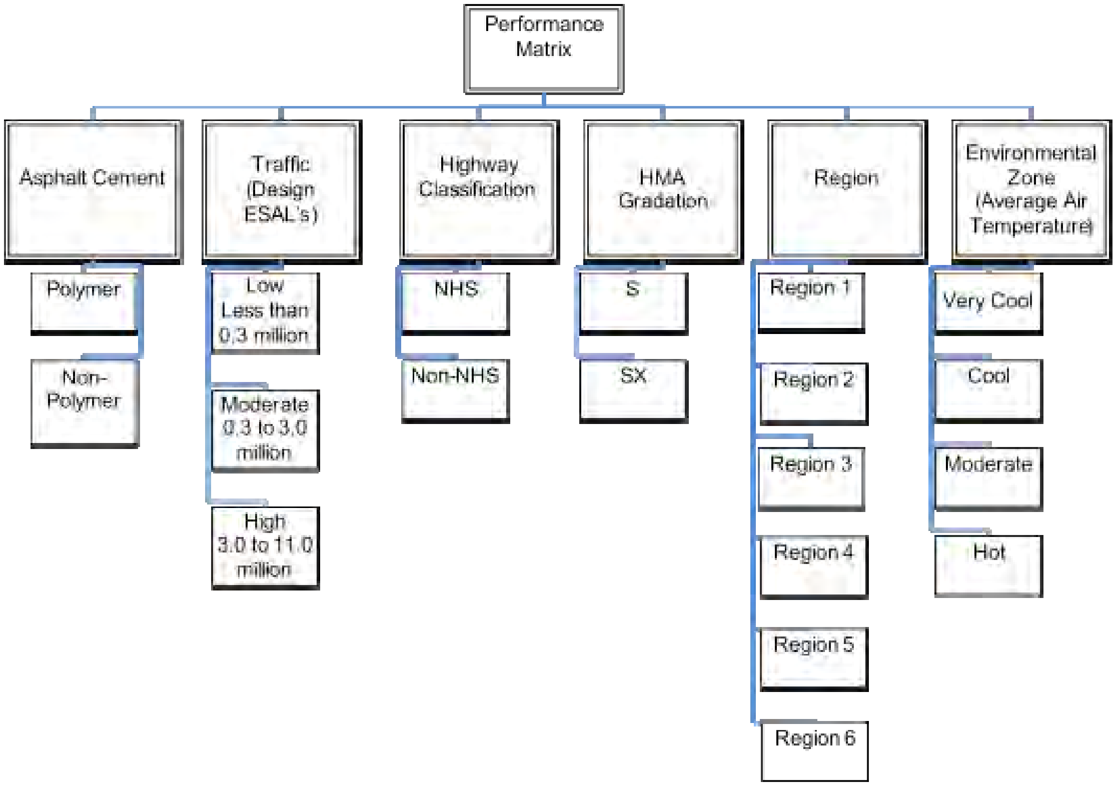

Figure 3 Independent variables

A summary sheet was created for each of the eight rehabilitation strategies.
After the highway sections were analyzed, using each of the six criteria, a slope for a distress versus time curve was calculated for each of the highway segments. Two guidelines were established in order to decide to accept or reject the data from the segment. The first guideline was that the regression equation should have a coefficient of determination (R-squared value) of greater than 0.50, which is a guideline already in use by CDOT for other projects. The second guideline was that no negative slopes would be used for the analysis. A negative slope means that the pavement was correcting itself, or getting better over time.

After data were sorted, the average level of distress was calculated for each year. This was then used to calculate the slope of deterioration from year to year. The cumulative slope of deterioration could then be calculated and graphed for each of the 19 separate criteria times 5 distresses per criteria = 95 graphs plus 5 graphs showing the behavior of each distress without application of variables. A robust statistical analysis was not possible for all combinations and permutations due to a lack of data. Instead trend analysis was used to show how the rehabilitation methods affected performance of the pavements over time.

Tables are also provided showing the change in deterioration over time, the coefficient of determination, and the average number of samples used to obtain these statistics.

3.1 Data Analysis

An example is provided below to show how the data was analyzed in this study. Table 2 is an example of roadway smoothness data for the years 1998 and 1999.

Table 2 Calculating Average Roadway Condition with Time

Survey Date: 1998

Begin MP	Ending MP	IRI, in/mi	Avg IRI, in/mi
95.5	95.6	123	
95.6	95.7	130	
95.7	95.8	86	
95.8	95.9	130	
95.9	96	138	121.4
96	96.1	134	123.6
96	96.1	171	131.8
96.1	96.2	94	133.4
96.2	96.3	93	126
96.3	96.4	212	140.8
96.4	96.5	49	123.8
96.5	96.6	80	105.6
96.6	96.7	91	105
96.7	96.8	91	104.6
96.8	96.9	44	71
96.9	97	82	77.6
		Avg >	113.7

Survey Date: 1999

BMP	EMP	IRI	Avg IRI, in/mi
95.5	95.6	94	
95.6	95.7	87	
95.7	95.8	130	
95.8	95.9	179	
95.9	96	122	122.4
96	96.1	127	129
96	96.1	112	134
96.1	96.2	167	141.4
96.2	96.3	178	141.2
96.3	96.4	198	156.4
96.4	96.5	80	147
96.5	96.6	249	174.4
96.6	96.7	109	162.8
96.7	96.8	100	147.2
96.8	96.9	290	165.6
96.9	97	157	181
		Avg >	150.2

Each roadway in the study was evaluated this way for each year of condition surveys.

A total of 149 roadways were evaluated in this study separated by the three rehabilitation methods as shown in Table 3.

Table 3 Rehabilitation Methods for Roadways Studied

Rehabilitation Method	Roadways Studied
Two Inch Overlay	73
Cold Planing ad Overlay	57
Heater Scarification and Overlay	19
Total	**149**

3.1.1 Data Reduction

The analysis was done from one year prior to rehabilitation to six years after rehabilitation. This way, the condition of the pavements prior to rehabilitation could be captured in the analysis so that the amount of time required to return the pavements to pre-rehabilitation condition could be determined. This allows calculating the service length of each of the rehabilitation strategies. That is, if a pavement had 500 square feet of fatigue cracking at the time of rehabilitation and fatigue cracking reappears after rehabilitation at the rate of 100 square feet per year, then it will take five years for the pavement to return to the pre-rehabilitated condition with respect to fatigue cracking.

An example is provided below to demonstrate how the data was analyzed.

Data shown in Table 4 represent eighteen roadways with smoothness data reported for the cold planing and overlay rehabilitation strategy.

Table 4 Smoothness Analysis for Planing and Overlay, IRI, in/mi

Roadway	Year (0)	Year (+1)
1	146.6	157.8
2	74.0	119.8
3	115.6	118.0
4	120.0	93.4
5	91.0	100.6
6	95.2	85.8
7	68.6	80.8
8	71.0	111.6
9	77.4	110.6
10	61.6	113.8
11	113.6	128.8
12	136.4	132.0
13	68.0	112.0
14	116.8	132.0

15	100.0	85.0
16	98.0	107.8
17	213.0	176.0
18	81.8	86.0
Average	**102.7**	**114.0**

The average change in smoothness from Year +1 to Year 0 is (114.0 in/mile - 102.7 in/mile) = 11.3 in/mi. When the data for each year from +1 to +6 are analyzed this way, the results shown in Table 5 are obtained..

Table 5 Change in Smoothness Each Year for Planing and Overlay Projects

Year	Smoothness Change, inches/mile/year
0 to 1	11.3
1 to 2	6.3
2 to 3	10.2
3 to 4	7.7
4 to 5	3.3
5 to 6	15.6

The cumulative change in smoothness with time can then be determined as shown in Table 6.

Table 6 Cumulative Smoothness Change for Planing and Overlay Projects

Year	Smoothness Change, inches/mile/year (from Table 3)	Cumulative Smoothness Change, inches/mile/year
0	0	0
1	11.3	11.3
2	6.3	17.6
3	10.2	27.8
4	7.7	35.5
5	3.3	38.8
6	15.6	54.4

If the cumulative smoothness change is regressed linearly from Year 0 to Year 6, the result is:

$$\Delta \text{ IRI} = 8.42\ T$$

Where,

Δ IRI	= Change in IRI in inches per mile
T	= Time after rehabilitation, yrs

The same analysis was done for each of the other rehabilitation methods with respect to smoothness resulting in the following expressions when all projects are considered:

Overlay	Δ IRI = 8.20 T
Cold Planing	Δ IRI = 8.42 T
Heater Scarification	Δ IRI = 14.59 T

Therefore, based on this data, the IRI for heater scarification increases 1.78 times (14.59/8.20) faster compared with the IRI for the overlay rehabilitation method.

This analysis was also done for the other performance output variables for each rehabilitation method. The results are shown in Table 7 for all projects which include information on coefficient of determination and number of projects utilized in the regression.

Zero-Remaining Service Life (ZRSL) is the point at which the level of distress present in the roadway exceeds what is considered acceptable. Those values are shown below and will be indicated on the performance curves as bold horizontal lines to provide a baseline when the pavements were actually rehabilitated with respect to ZRSL.

- Smoothness, IRI — 300 inches/mile
- Rutting — 0.55 inches
- Fatigue — 1,800 square feet
- Transverse Cracking — 55 cracks per 0.1 mile
- Longitudinal Cracking — 1,400 linear feet

Table 7 Linear Regression for Change in Performance for First Six Years

		Slope	R^2	n, Avg
Smoothness	Cold Planing	8.42	0.82	16
	Overlay	8.20	0.81	28
	Heater Scarification	14.59	0.83	11
	Average	10.26		
Rutting	Cold Planing	0.03	0.83	29
	Overlay	0.05	0.70	45
	Heater Scarification	0.06	0.79	10
	Average	0.04		
Fatigue Cracking	Cold Planing	86.42	0.50	28
	Overlay	191.35	0.42	44
	Heater Scarification	241.37	0.65	10
	Average	171.49		
Transverse Cracking	Cold Planing	2.38	0.71	40
	Overlay	3.72	0.64	57
	Heater Scarification	6.47	0.73	13
	Average	4.19		
Longitudinal Cracking	Cold Planing	53.14	0.66	28
	Overlay	55.01	0.61	37
	Heater Scarification	96.79	0.68	10
	Average	68.31		

4.0 RESULTS

All of the pavement performance data is represented in Figures 4 through 103 and Tables 8 through 107 for smoothness, rutting, fatigue, transverse, and longitudinal cracking with respect to each rehabilitation method. Each of these figures represents the absolute value of the respective performance measure with the exception of smoothness, which is represented as the change in smoothness over time. This was done because the absolute value for smoothness is the only parameter that does not start from zero after rehabilitation. When data variability in the pavement management database resulted in a coefficient of determination less than 0.50 or when distress decreased with time, this data was not included in the analysis.

The rate of change of distress over time represented in the tables and figures has been calculated as a linear function. The average number of highway segments (n) which contributed to these statistics is also shown to provide an indication of analysis robustness.

Year 0 (zero) in the graphs is the time of rehabilitation. Year -1 (negative 1) represents the condition of the pavements one year prior to rehabilitation. The condition of the pavements is presented at Year -1 to show the level of deterioration prior to rehabilitation. This is important when calculating the service length of each of the rehabilitation strategies. That is, if a pavement had 500 square feet of fatigue cracking at the time of rehabilitation and fatigue cracking re-appears after rehabilitation at the rate of 100 square feet per year, then it will take five years for the pavement to return to the pre-rehabilitated condition with respect to fatigue cracking.

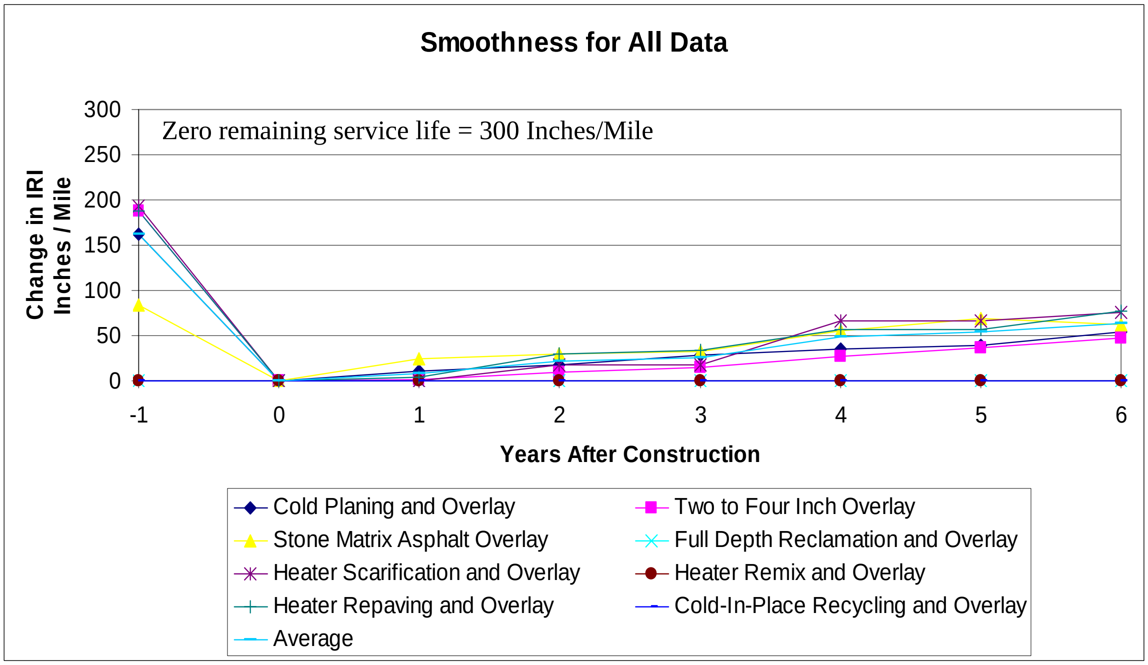

Figure 4 Rate of change for smoothness after six years all data included

Table 8 Smoothness Performance – All Data

Treatment	Year										
	-1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	162.21	0	11.30	17.56	27.73	35.44	38.76	54.32	8.4203	0.816	16.29
Two to Four Inch Overlay	187.2889	0	0.72	9.76	15.45	27.63	35.97	47.04	8.195986	0.814	27.71
Stone Matrix Asphalt Overlay	83.6	0	24.31	30.35	32.57	56.03	69.40	61.93	10.77405	0.903	4.43
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	193.36	0	-	18.21	18.21	66.09	66.66	75.79	14.59141	0.832	10.86
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	187.3	0	4.00	30.07	33.13	57.20	57.20	77.33	13.05476	0.912	2.86
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	162.75	0	8.06	21.19	25.42	48.48	53.60	63.28	11.0073		

Smoothness

The three rehabilitation strategies that did not meet the predetermined criteria are full depth reclamation and overlay, heater remix and overlay, and cold-in-place recycling and overlay. Two to 4-inch overlay and cold planing and overlay had better smoothness than the other rehabilitation strategies. Heater scarification and overlay had the worst smoothness data.

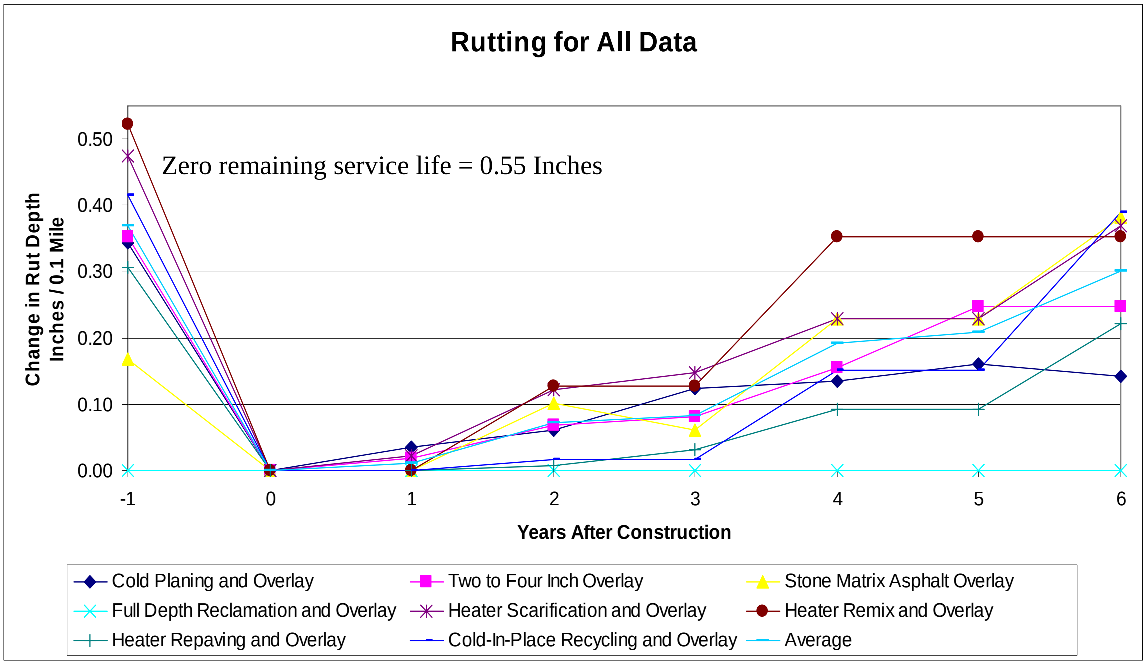

Figure 5 Permanent deformation performance after six years all data included

Table 9 Rutting Performance – All Data

Treatment	Year										
	-1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	0.34	0	0.03	0.06	0.12	0.13	0.16	0.14	0.026824	0.831	29
Two to Four Inch Overlay	0.351744	0	0.02	0.07	0.08	0.15	0.25	0.25	0.045873	0.698	44.57
Stone Matrix Asphalt Overlay	0.1675	0	-	0.10	0.06	0.23	0.23	0.38	0.061821	0.909	3.57
Full Depth Reclamation and Overlay	-	-	-	-	-	-	-	-	-	-	-
Heater Scarification and Overlay	0.474444	0	0.02	0.12	0.15	0.23	0.23	0.37	0.058148	0.787	10.43
Heater Remix and Overlay	0.521667	0	-	0.13	0.13	0.35	0.35	0.35	0.070833	0.838	3.71
Heater Repaving and Overlay	0.307	0	-	0.01	0.03	0.09	0.09	0.22	0.033429	0.936	2.86
Cold-In-Place Recycling and Overlay	0.4155	0	-	0.02	0.02	0.15	0.15	0.39	0.057375	0.908	3
Average	0.322547	0	0.009	0.063	0.073	0.168	0.183	0.263	0.044288		

Rutting

Full depth reclamation and overlay is the only rehabilitation strategy that did not have enough samples to be analyzed. Cold planing and overlay had the best performance over time than any other rehabilitation strategy. The other rehabilitation strategies performed similarly.

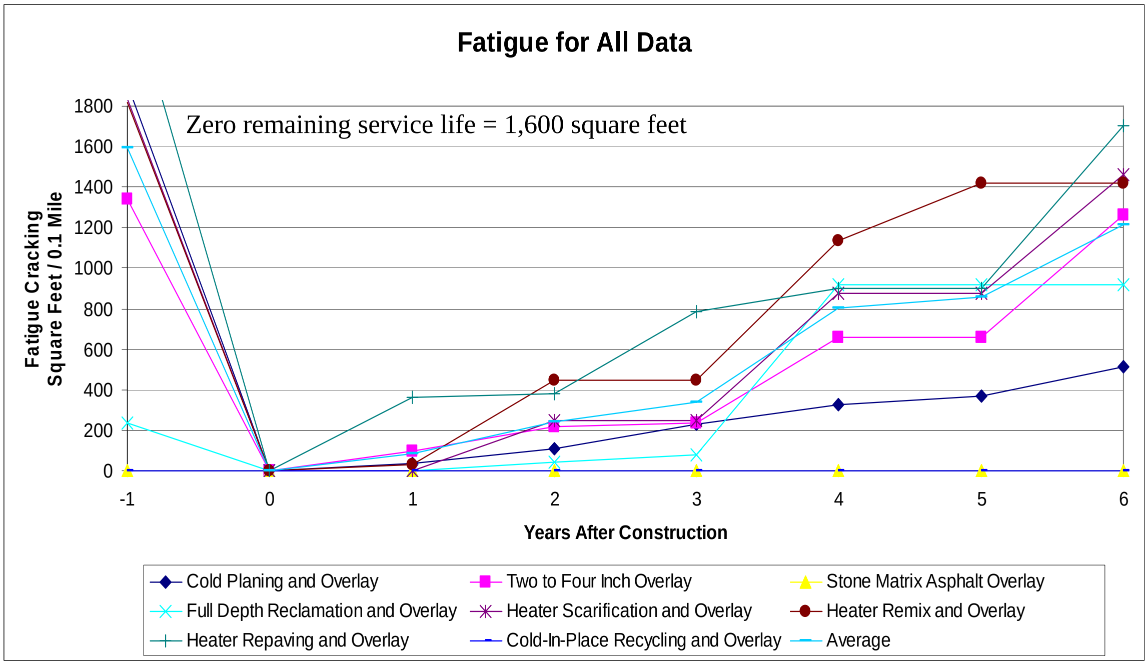

Figure 6 Fatigue cracking performance after six years all data included

Table 10 Fatigue Performance – All Data

Treatment	Year										
	-1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	1907.81	0	36.44	111.19	230.64	327.59	366.22	514.56	86.41586	0.499	27.86
Two to Four Inch Overlay	1339.005	0	94.15	214.48	233.78	657.95	657.95	1,262.22	191.3479	0.416	43.71
Stone Matrix Asphalt Overlay	-	-	-	-	-	-	-	-	-	-	-
Full Depth Reclamation and Overlay	234.8	0	-	41.36	80.04	917.24	917.24	917.24	195.0743	0.202	4
Heater Scarification and Overlay	1833.6	0	-	250.50	250.50	875.74	875.74	1,460.54	241.3692	0.646	10
Heater Remix and Overlay	1816.76	0	31.17	448.73	448.73	1,135.48	1,419.46	1,419.46	275.7748	0.57	5.43
Heater Repaving and Overlay	2429.1	0	361.45	377.60	783.00	899.35	899.35	1,702.05	239.4179	0.697	3.71
Cold-In-Place Recycling and Overlay	-	-	-	-	-	-	-	-	-	-	-
Average	1195.134	0	65.40034	180.4829	253.337	601.6674556	641.99393	909.5092397	153.675		

Fatigue

Both stone matrix asphalt overlay and cold-in-place recycling and overlay did not meet the criteria and are not used in analysis. Cold planing and overlay showed at least half the amount of fatigue cracking over time than all of the other rehabilitation strategies. Heater remix and overlay showed the most amount of fatigue cracking per year as shown in Figure 6 and Table 10.

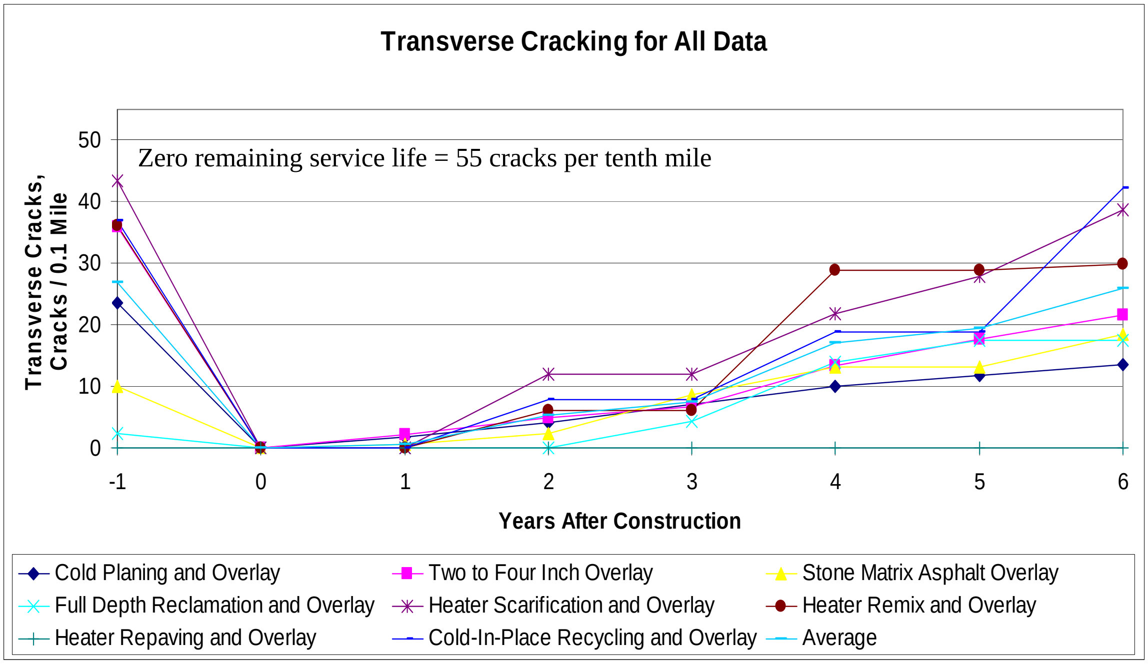

Figure 7 Transverse cracking performance after six years all data included

Table 11 Transverse Cracking Performance – All Data

Treatment	Year										
	-1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	23.65	0	1.78	4.06	7.13	9.93	11.86	13.49	2.375503	0.712	40.14
Two to Four Inch Overlay	36.02609	0	2.21	4.83	6.59	13.28	17.61	21.64	3.721093	0.635	57.29
Stone Matrix Asphalt Overlay	10.05	0	0.67	2.37	8.68	13.24	13.24	18.51	3.269286	0.601	4.43
Full Depth Reclamation and Overlay	2.4	0	-	0.10	4.35	13.99	17.50	17.50	3.62034	0.687	4.86
Heater Scarification and Overlay	43.36364	0	0.06	12.06	12.06	21.75	27.87	38.61	6.468827	0.733	12.71
Heater Remix and Overlay	36.13333	0	-	6.14	6.14	28.86	28.86	29.76	6.062117	0.597	6.14
Heater Repaving and Overlay	-	-	-	-	-	-	-	-	-	-	-
Cold-In-Place Recycling and Overlay	36.93333	0	-	7.93	7.93	18.93	18.93	42.33	6.280357	0.595	4.43
Average	23.57001	0	0.590227	4.683851	6.610384	14.99846	16.98403	22.72971	3.97469		

Transverse Cracking

Heater repaving and overlay is the only rehabilitation strategy that did not have enough samples. Cold planing and overlay showed the least amount of transverse cracking per year than all other rehabilitation strategies. Both heater scarification and overlay and cold-in-place recycling and overlay showed the most amount transverse cracking per year.

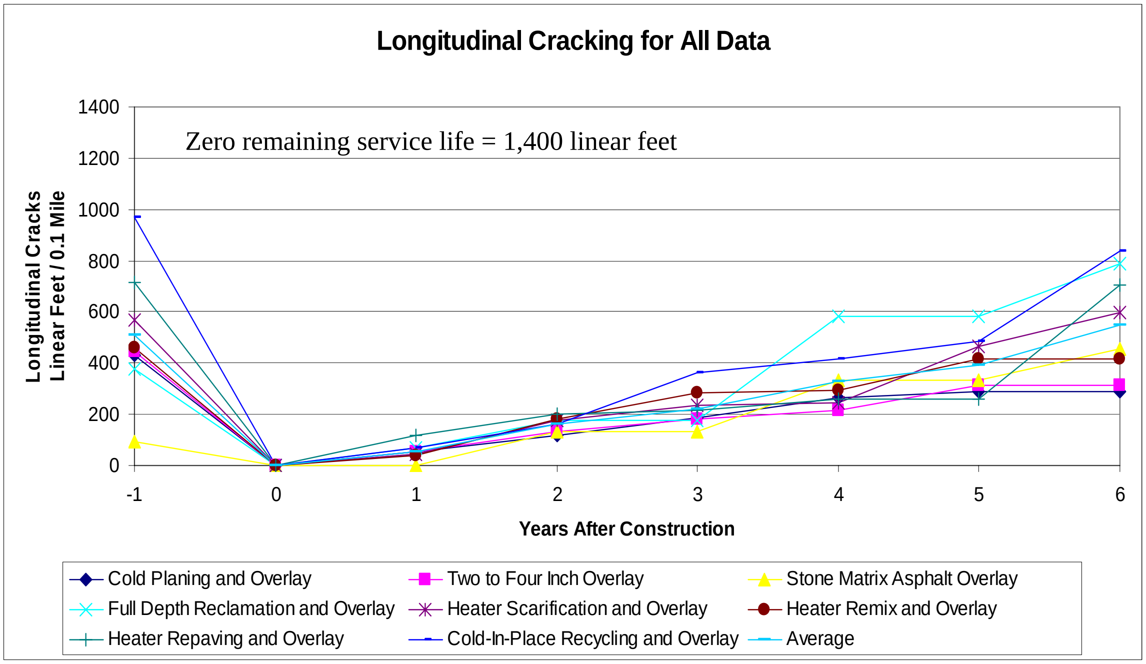

Figure 8 Longitudinal cracking performance after six years all data included

Table 12 Longitudinal Cracking Performance – All Data

Treatment	Year										
	-1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	432.48	0	52.96	119.66	186.79	262.42	290.82	289.85	53.14437	0.659	28
Two to Four Inch Overlay	446.8919	0	53.10	130.46	182.54	213.78	312.61	312.61	55.00615	0.609	36.71
Stone Matrix Asphalt Overlay	92.2	0	2.40	131.45	131.45	334.92	334.92	454.52	79.71607	0.571	2.71
Full Depth Reclamation and Overlay	378.8	0	66.63	177.96	177.96	584.41	584.41	789.41	136.0798	0.523	4.57
Heater Scarification and Overlay	568.3889	0	41.63	174.72	234.35	245.15	464.99	597.65	96.78978	0.679	10
Heater Remix and Overlay	462.44	0	39.46	183.37	282.15	293.40	415.33	415.33	75.27806	0.759	5.57
Heater Repaving and Overlay	716.4	0	115.10	199.05	214.50	261.65	261.65	705.45	88.2875	0.808	3.14
Cold-In-Place Recycling and Overlay	969.5333	0	70.46	160.44	360.56	414.48	483.36	836.11	128.1489	0.659	4.43
Average	508.3918	0	55.21782	159.6373	221.2873	326.2757	393.5115	550.1172	89.05633		

Longitudinal Cracking

All rehabilitation strategies met the minimum number of samples per year. Cold planing and overlay and 2 to 4-inch overlay showed the least amount of longitudinal cracking per year. Full-depth reclamation and overlay had significantly more longitudinal cracking per year than all of the other rehabilitation strategies.

CUMULATIVE INCREASE IN DISTRESS WITH RELATION TO POLYMER AND NON-POLYMER MODIFIED OVERLAYS

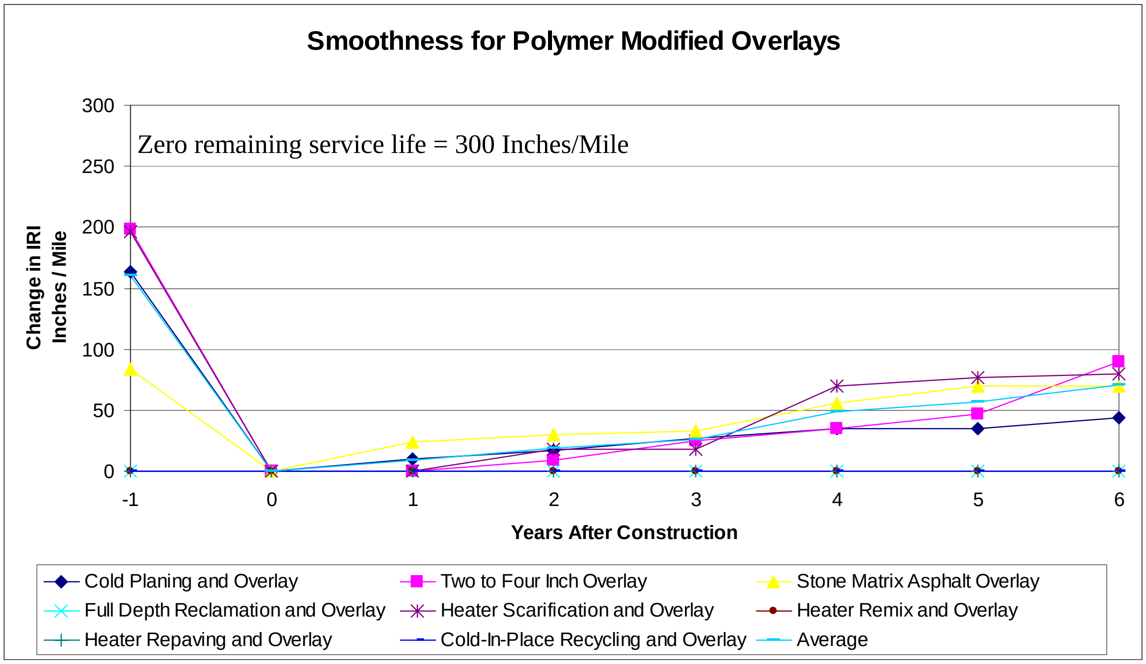

Figure 9 Rate of change for smoothness after six years with relation to polymer modified pavements

Table 13 Smoothness Performance – Polymer Data

	POLYMER										
Treatment					**Year**						
	-1	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**Slope**	**R^2**	**n, Avg**
Cold Planing and Overlay	163.26	0.00	9.82	16.65	27.36	35.01	35.01	43.63	7.129555	0.786	9.71
Two to Four Inch Overlay	198.5	0	-	9.17	24.97	34.43	47.02	89.92	13.89464	0.801	5.29
Stone Matrix Asphalt Overlay	83.6	0	24.31	30.35	32.57	56.03	69.40	69.40	11.57405	0.903	4.43
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	196.275	0	-	18.32	18.32	69.99	76.78	80.02	15.90362	0.838	9.57
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	160	0	8.53	18.62	25.81	48.87	57.05	70.74	12.12547		

Smoothness - Polymer

Full depth reclamation and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed better performance over time with regards to smoothness than other rehabilitation strategies. Heater scarification and overlay showed the worst performance over time. The other processes that met the predetermined criteria all performed similarly.

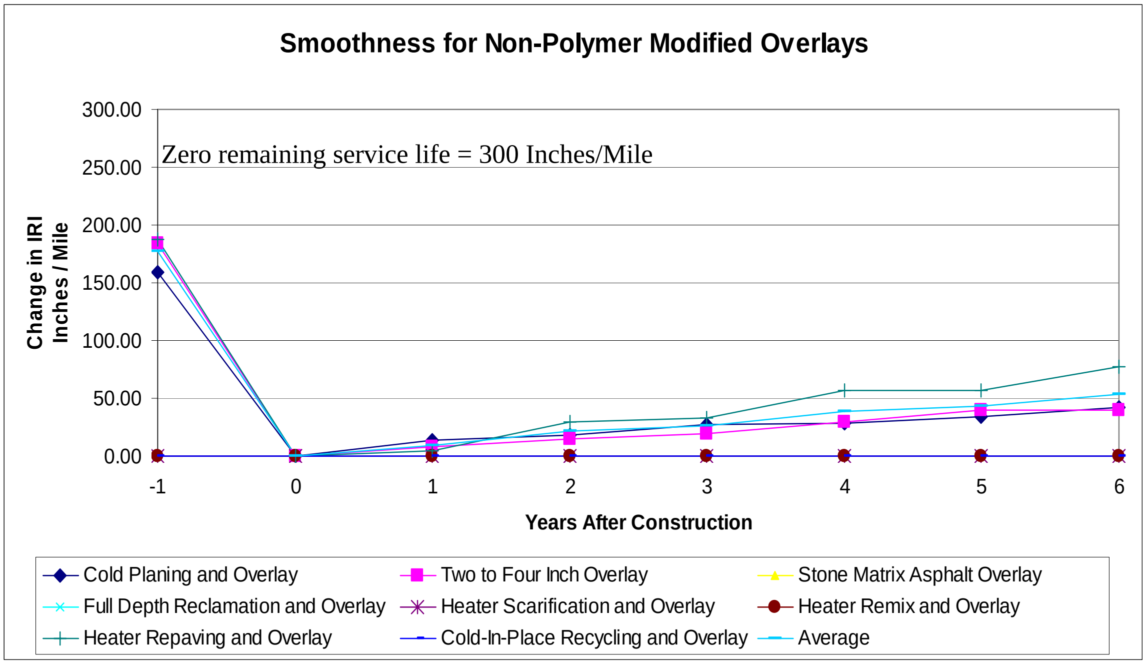

Figure 10 Rate of change for smoothness after six years with relation to non-polymer modified pavements

Table 14 Smoothness Performance –Non-Polymer Data

Treatment	NON-POLYMER										
	Year										
	-1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	159.60	0	14.08	18.64	27.12	28.76	33.56	42.52	6.308571	0.832	4.57
Two to Four Inch Overlay	184.0857	0	8.42	15.06	19.74	29.81	39.85	39.85	7.041079	0.819	17.86
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	187.3	0	4.00	30.07	33.13	57.20	57.20	77.33	13.05476	0.912	2.86
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	177	0	8.83	21.25	26.67	38.59	43.54	53.23	8.801471		

Smoothness – Non-Polymer

Stone matrix asphalt and overlay, full depth reclamation and overlay, heater scarification and overlay, heater remix and overlay, and cold-in-place recycling and overlay did not have enough samples per year to be part of analysis. Cold planing and overlay and 2 to 4-inch overlay showed the best performance with regards to smoothness. Heater repaving and overlay showed the worst performance over time by almost twice as much per year.

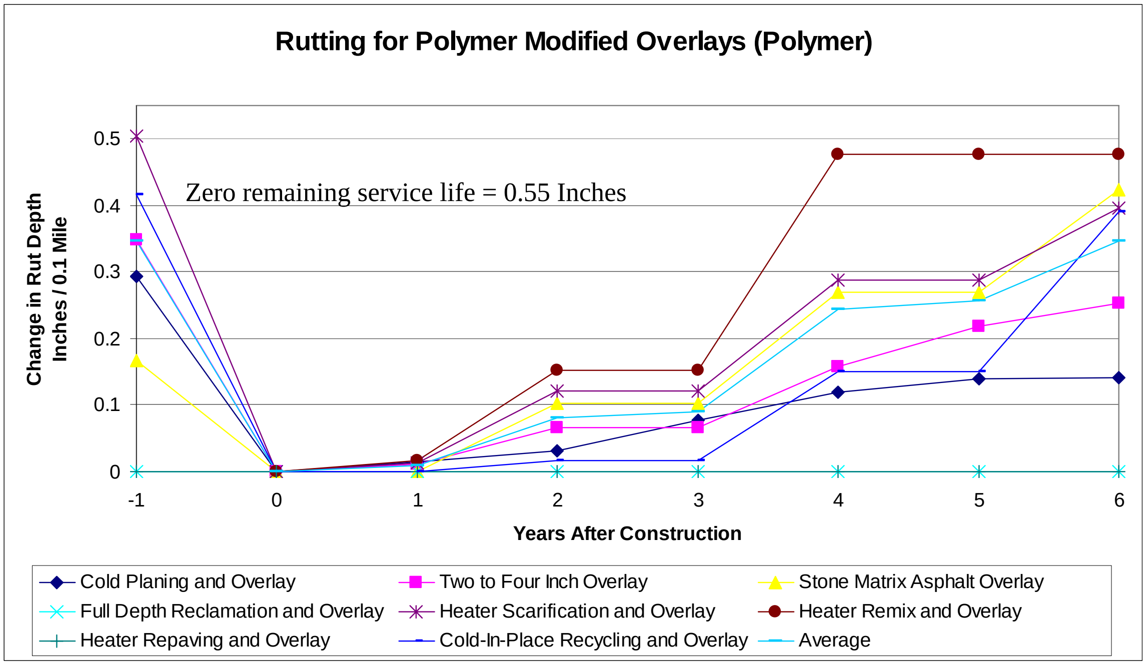

Figure 11 Permanent deformation performance after six years with relation to polymer modified pavements

Table 15 Rutting Performance – Polymer Data

Treatment	POLYMER				Year						
	-1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	0.293857	0.00	0.01	0.03	0.08	0.12	0.14	0.14	0.027146	0.878	17.71
Two to Four Inch Overlay	0.3488	0	0.01	0.07	0.07	0.16	0.22	0.25	0.045097	0.844	17.29
Stone Matrix Asphalt Overlay	0.1675	0	-	0.10	0.10	0.27	0.27	0.42	0.070607	0.909	3.57
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	0.5048	0	0.01	0.12	0.12	0.29	0.29	0.40	0.068056	0.85	8.14
Heater Remix and Overlay	----	0	0.02	0.15	0.15	0.48	0.48	0.48	0.095452	0.643	3.43
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	0.4155	0	-	0.02	0.02	0.15	0.15	0.39	0.057375	0.908	3
Average	0.346091	0	0.009	0.081	0.089	0.244	0.257	0.347	0.060622		

Rutting – Polymer

Stone matrix asphalt overlay, full depth reclamation and overlay, and heater repaving and overlay were not analyzed. Cold planing and overlay had considerably less amounts of rutting than the other rehabilitation strategies. Heater remix and overlay had the most amount of rutting per year.

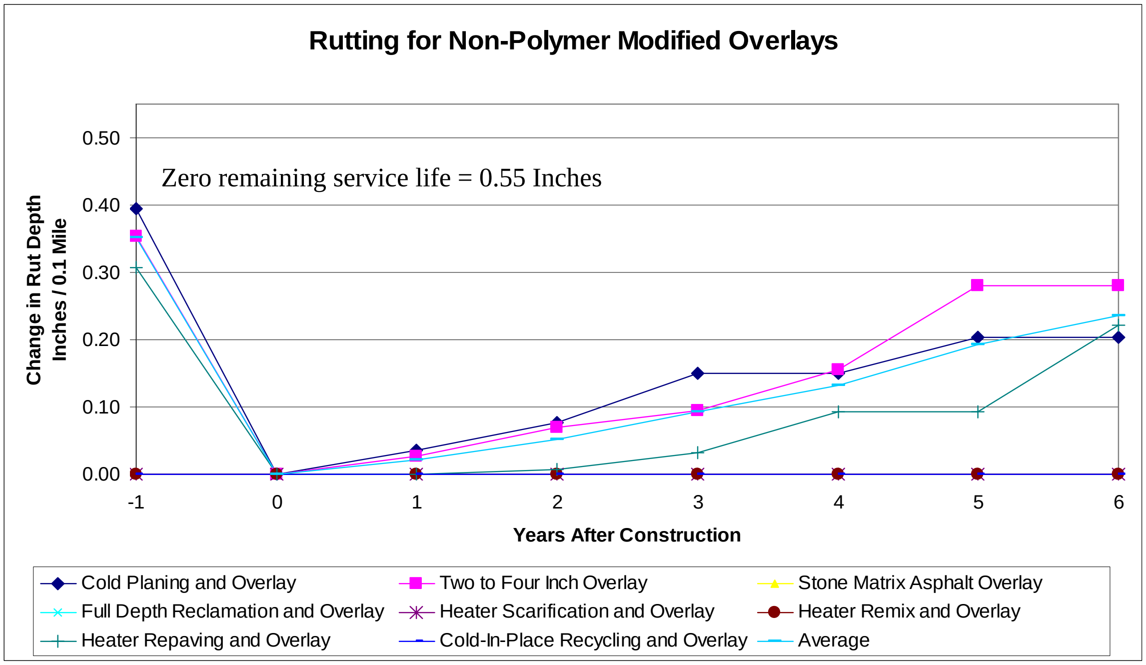

Figure 12 Permanent deformation performance after six years with relation to non-polymer modified pavements

Table 16 Rutting Performance – Non-Polymer Data

NON-POLYMER											
Treatment	Year										
	-1	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**Slope**	**R^2**	**n, Avg**
Cold Planing and Overlay	0.394923	0	0.04	0.08	0.15	0.15	0.20	0.20	0.036407	0.904	11.71
Two to Four Inch Overlay	0.352759	0	0.03	0.07	0.10	0.15	0.28	0.28	0.051271	0.636	27.29
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	0.307	0	-	0.01	0.03	0.09	0.09	0.22	0.033429	0.936	2.86
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	0	0	0.02	0.05	0.09	0.13	0.19	0.24	0.040369		

Rutting – Non-Polymer

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater scarification and overlay, heater remix and overlay, and cold-in-place recycling and overlay are not represented. Both cold planing and overlay and heater repaving and overlay performed similarly and had less amounts of rutting per year than the other rehabilitation strategies. Two to 4-inch overlay had the most amount of rutting per year.

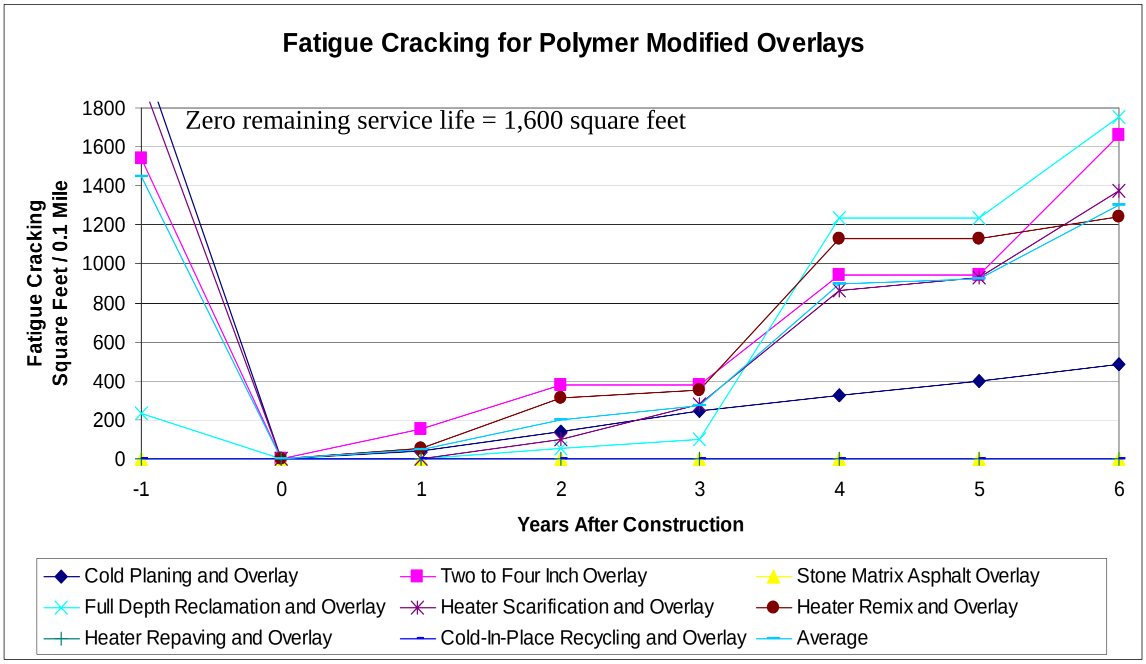

Figure 13 Fatigue cracking performance after six years with relation to polymer modified pavements

Table 17 Fatigue Performance – Polymer Data

Treatment	POLYMER										
	Year										
	-1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	2077.318	0.00	41.44	138.32	242.82	328.40	397.56	483.34	84.01194	0.436	17.29
Two to Four Inch Overlay	1541.089	0	155.23	380.73	380.73	944.47	944.47	1,662.64	254.6479	0.446	15.57
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	234.8	0	-	54.50	100.00	1,232.20	1,232.20	1,752.80	317.875	0.273	3
Heater Scarification and Overlay	1944.314	0	-	100.88	275.93	866.23	928.59	1,376.45	241.139	0.643	8.29
Heater Remix and Overlay		0	50.90	312.35	351.70	1,126.15	1,126.15	1,242.25	238.9661	0.643	3.43
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	1449.38	0	49.51485	197.3564	270.2376	899.491	925.79391	1303.4969	227.328		

Fatigue – Polymer

Stone matrix asphalt overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay had considerably less fatigue cracking than the other rehabilitation strategies. The coefficient of determination shows that the data is not represented very well with regards to all rehabilitation strategies as shown in Table 17.

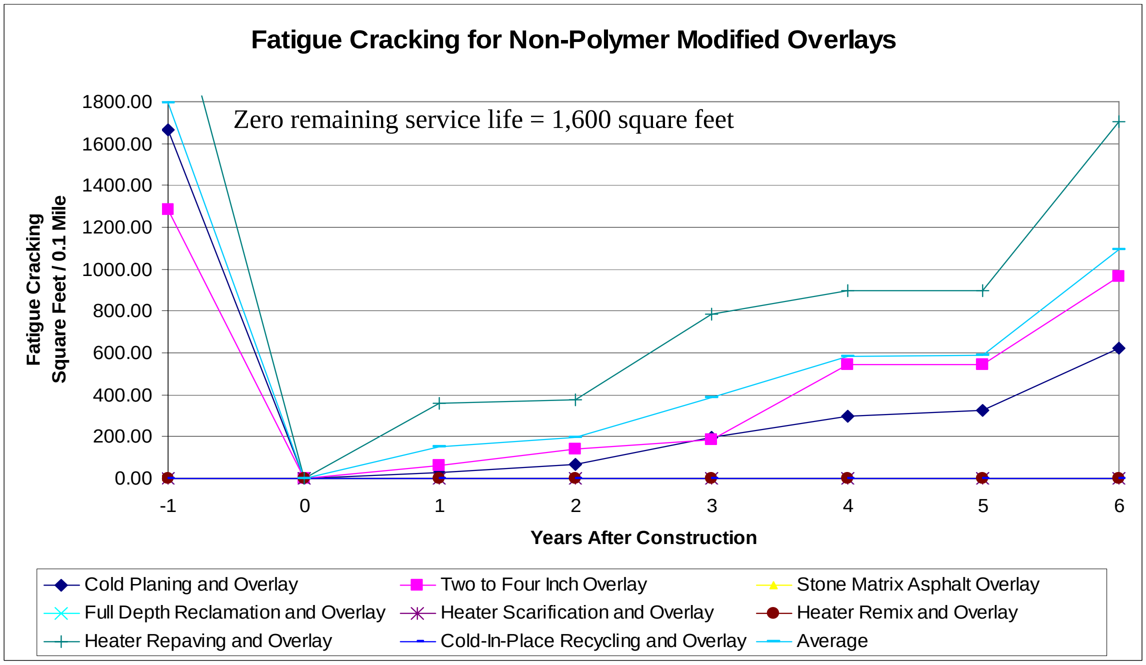

Figure 14 Fatigue cracking performance after six years with relation to non-polymer modified pavements

Table 18 Fatigue Performance – Non-Polymer Data

Treatment	NON-POLYMER				Year						
	-1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	1667.67	0	28.93	68.41	197.31	299.74	325.88	620.82	95.98946	0.653	11.29
Two to Four Inch Overlay	1282.169	0	61.05	138.75	183.73	544.34	544.34	962.00	152.0779	0.424	28.17
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	2429.1	0	361.45	377.60	783.00	899.35	899.35	1,702.05	239.4179	0.697	3.71
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	1793	0	150.48	194.92	388.02	581.14	589.86	1094.96	162.4951		

Fatigue – Non-Polymer

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater scarification and overlay, heater remix and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed significantly less amount of fatigue cracking per year than the other two rehabilitation strategies represented. Heater repaving and overlay showed the most amount of fatigue cracking per year as shown in Table 18.

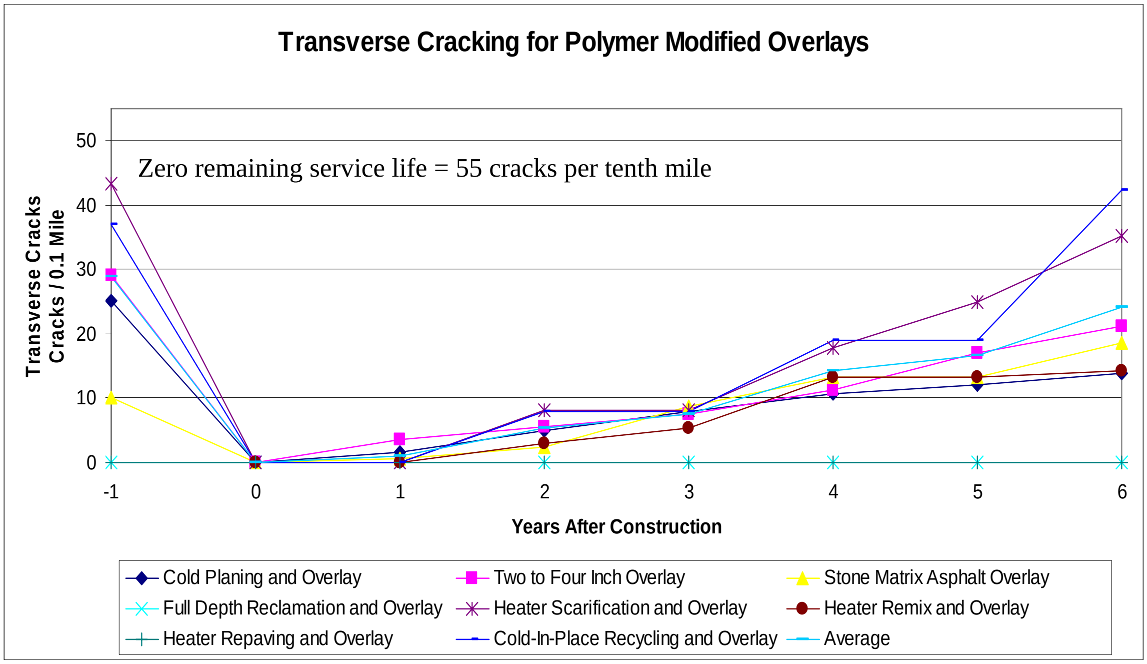

Figure 15 Transverse cracking performance after six years with relation to polymer modified pavements

Table 19 Transverse Cracking Performance – Polymer Data

Treatment	POLYMER Year										
	-1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	25.104	0	1.60	5.00	7.93	10.73	12.01	13.82	2.42921	0.702	25.57
Two to Four Inch Overlay	29.16	0	3.50	5.50	7.54	11.30	16.99	21.17	3.439269	0.674	19.43
Stone Matrix Asphalt Overlay	10.05	0	0.67	2.37	8.68	13.24	13.24	18.51	3.269286	0.601	4.43
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	43.425	0	-	8.07	8.07	17.89	24.99	35.17	5.904275	0.761	10.57
Heater Remix and Overlay	----	0	-	2.88	5.40	13.32	13.32	14.22	2.847857	0.859	4.14
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	36.93333	0	-	7.93	7.93	18.93	18.93	42.33	6.280357	0.595	4.43
Average	28.93447	0	0.959596	5.289845	7.591555	14.23481	16.57962	24.20317	4.028376		

Transverse Cracking – Polymer

Full-depth reclamation and overlay and heater repaving and overlay are not represented. Cold planing and overlay showed the least amount of transverse cracking per year. Cold-in-place recycling and overlay had the most transverse cracking per year as shown in Table 19.

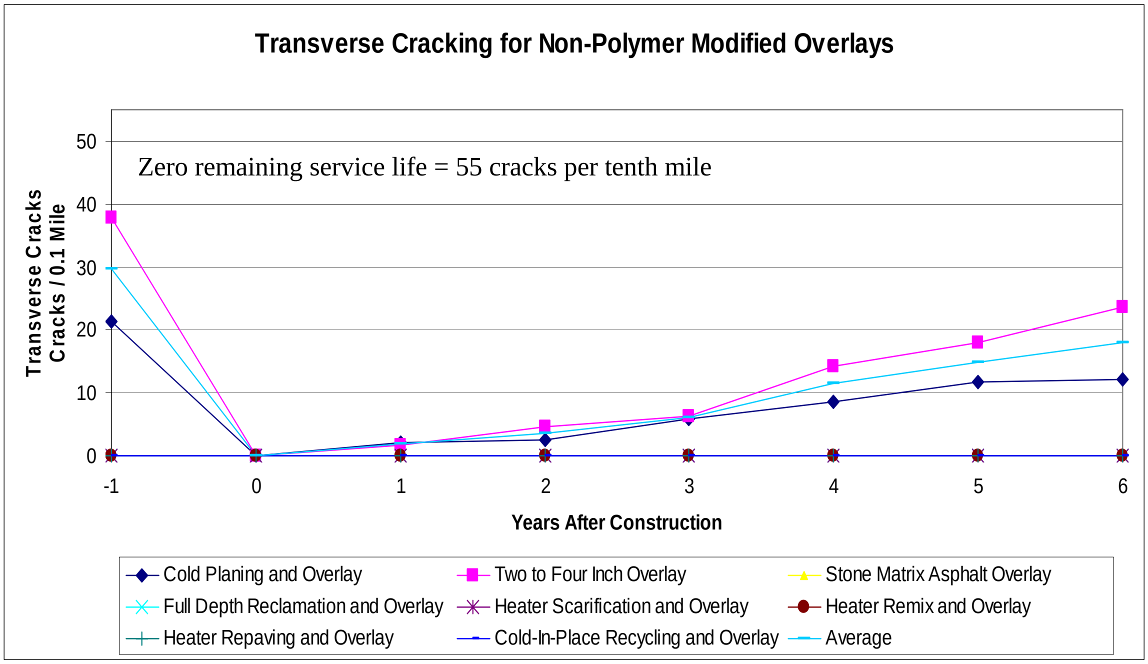

Figure 16 Transverse cracking performance after six years with relation to non-polymer modified pavements

Table 20 Transverse Cracking Performance – Non-Polymer Data

NON-POLYMER											
Treatment					**Year**						
	-1	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**Slope**	**R^2**	**n, Avg**
Cold Planing and Overlay	21.3875	0	2.09	2.53	5.84	8.61	11.61	12.17	2.20057	0.743	14.57
Two to Four Inch Overlay	37.93333	0	1.63	4.54	6.19	14.21	18.05	23.72	4.060033	0.7	37.86
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----		----	----	----	----	----	----	----	----
Average	30	0	1.86	3.53	6.02	11.41	14.83	17.94	3.130301		

Transverse Cracking – Non-Polymer

Stone matrix asphalt and overlay, full-depth reclamation and overlay, heater scarification and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed half as much transverse cracking per year than 2 to 4-inch overlay as shown in Table 20.

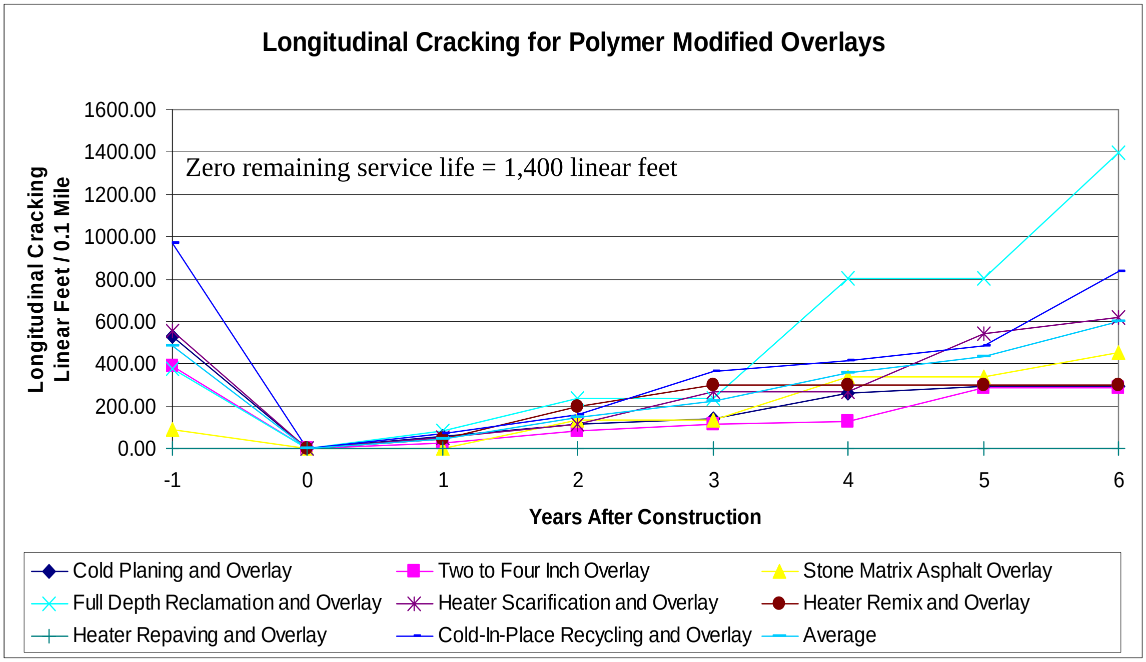

Figure 17 Longitudinal cracking performance after six years with relation to polymer modified pavements

Table 21 Longitudinal Cracking Performance – Polymer Data

Treatment	POLYMER				Year						
	-1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	528.94	0	55.13	112.42	140.58	258.40	292.81	292.81	53.56283	0.642	15
Two to Four Inch Overlay	387.7429	0	23.86	80.24	117.91	129.18	287.89	287.89	51.45222	0.508	9.86
Stone Matrix Asphalt Overlay	92.2	0	2.40	131.45	131.45	334.92	334.92	454.52	79.71607	0.571	2.71
Full Depth Reclamation and Overlay	378.8	0	80.02	236.37	236.37	804.45	804.45	1,396.55	221.6643	0.674	3
Heater Scarification and Overlay	556.15	0	50.76	116.65	265.43	268.05	542.72	615.50	106.494	0.698	9.57
Heater Remix and Overlay	----	0	44.64	197.44	297.24	297.24	297.24	297.24	53.45429	0.753	4
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	969.5333	0	70.46	160.44	360.56	414.48	483.36	836.11	128.1489	0.659	4.43
Average	485.5606	0	46.75267	147.85716	221.36306	358.10185	434.76967	597.23056	99.21323		

Longitudinal Cracking – Polymer

Heater repaving and overlay is the only rehabilitation strategy not represented. Cold planing and overlay, 2 to 4 inch overlay, and heater remix and overlay all showed similar amounts of longitudinal cracking per year and performed better than the other rehabilitation strategies. Full depth reclamation and overlay showed significantly more longitudinal cracking per year than the other rehabilitation strategies as shown in Table 21.

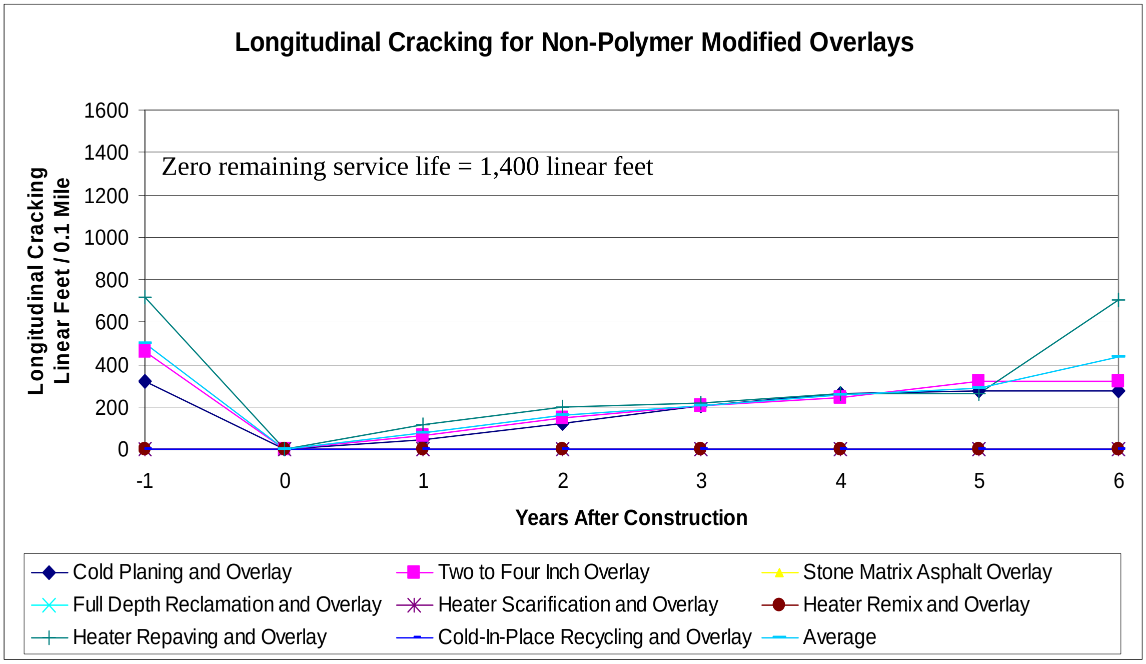

Figure 18 Longitudinal cracking performance after six years with relation to non-polymer modified pavements

Table 22 Longitudinal Cracking Performance – Non-Polymer Data

Treatment	NON-POLYMER Year -1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	322.2429	0	43.51	123.44	204.61	263.79	272.57	272.57	50.57859	0.695	12.57
Two to Four Inch Overlay	460.6933	0	63.02	148.22	204.03	243.83	321.05	321.05	56.24277	0.652	26.86
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	716.4	0	115.10	199.05	214.50	261.65	261.65	705.45	88.2875	0.808	3.14
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	500	0	73.88	156.90	207.71	256.42	285.09	433.02	65.03629		

Longitudinal Cracking – Non-Polymer

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater scarification and overlay, heater remix and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed the least amount of longitudinal cracking per year. Heater repaving and overlay showed the most amount of longitudinal cracking per year as shown in Table 22.

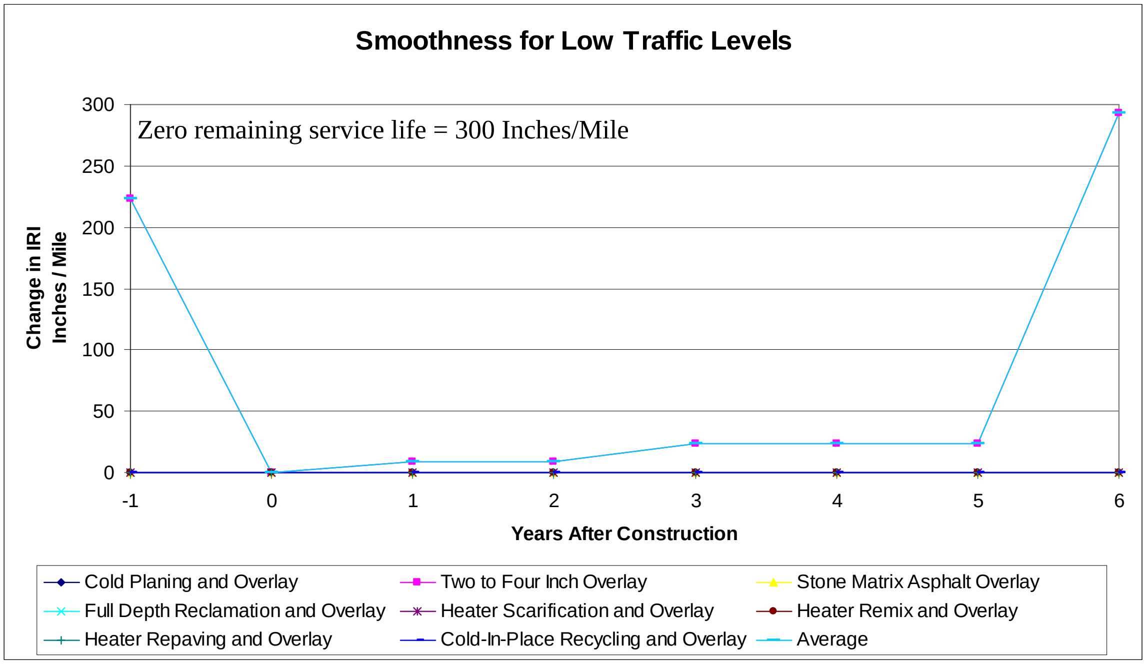

Figure 19 Rate of change for smoothness after six years with relation to traffic counts of less than 0.3 million ESAL

Table 23 Smoothness Performance – Low Traffic Data

Treatment	Low Year -1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	----	----	----	----	----	----	----	----	----	----	----
Two to Four Inch Overlay	223.5333	0	8.76	8.76	23.13	23.13	23.13	293.53	32.98857	0.818	4.43
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	224	0	8.76	8.76	23.13	23.13	23.13	293.53	32.98857		

Smoothness – Low Traffic

Two to 4-inch overlay is the only rehabilitation strategy represented in this section so an analysis could not be done on other strategies.

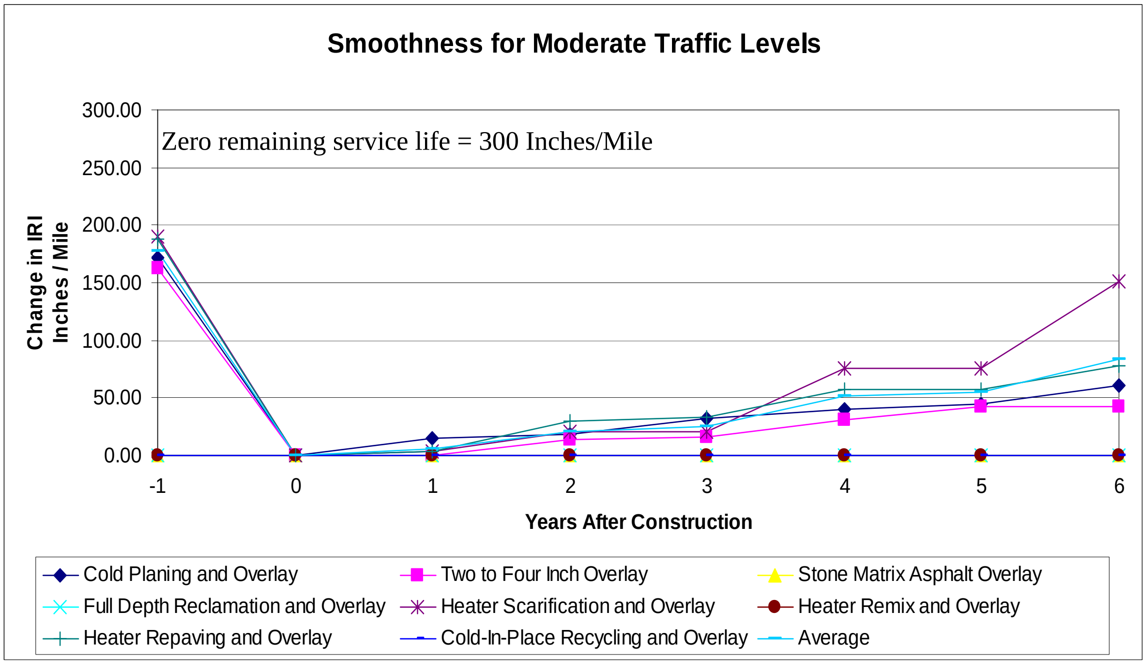

Figure 20 Rate of change for smoothness after six years with relation to traffic counts from 0.3 to 3 million ESAL

Table 24 Smoothness Performance – Moderate Traffic Data

Treatment	Moderate										
	Year										
	-1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	171.80	0	14.74	18.70	32.53	40.01	45.14	60.87	9.453912	0.824	12.86
Two to Four Inch Overlay	163.0909	0	-	13.22	15.80	31.31	42.67	42.67	8.26588	0.828	17.57
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	189.9333	0	3.44	20.05	20.05	75.87	75.87	151.27	23.37585	0.819	6.29
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	187.3	0	4.00	30.07	33.13	57.20	57.20	77.33	13.05476	0.912	2.86
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	178	0	5.54	20.51	25.38	51.10	55.22	83.04	13.5376		

Smoothness – Moderate Traffic

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater remix and overlay, and cold-in-place recycling and overlay are not represented. Two to 4-inch overlay showed the best performance for smoothness over time. Heater scarification and overlay showed significantly worse performance than the other rehabilitation strategies as shown in Table 24.

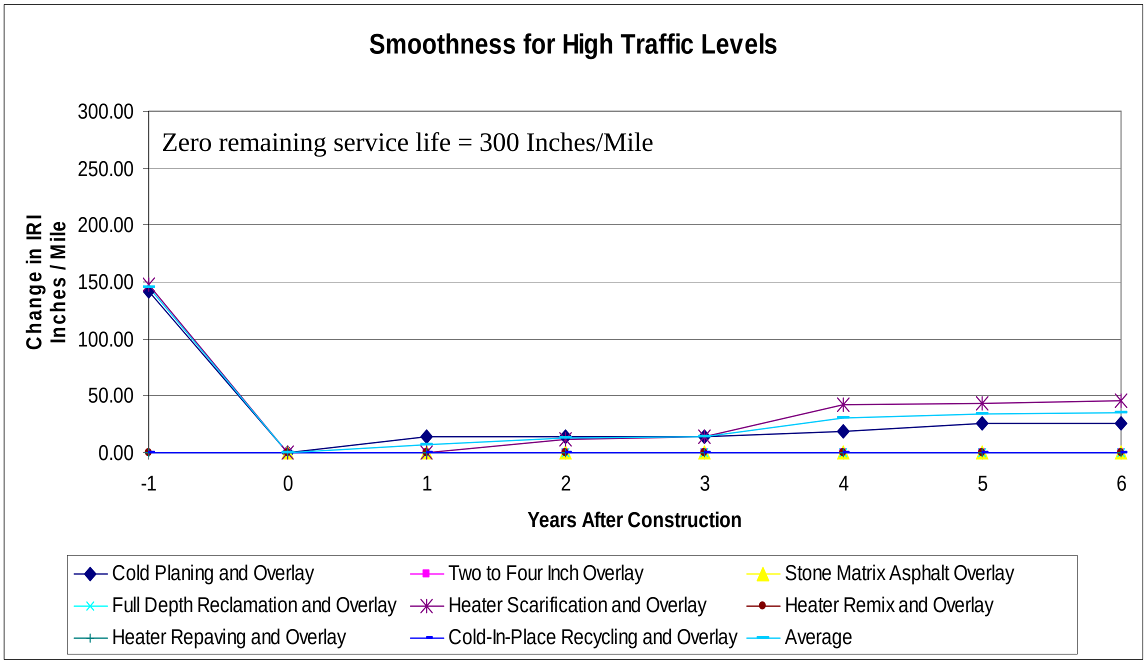

Figure 21 Rate of change for smoothness after six years with relation to traffic counts from 3 to 11 million ESAL

Table 25 Smoothness Performance – High Traffic Data

Treatment	High				Year						
	-1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	141.98	0	14.30	14.30	14.30	18.63	25.57	25.57	3.69881	0.829	3.43
Two to Four Inch Overlay	----	----	----	----	----	----	----	----	----	----	----
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	147.8	0	-	12.16	14.36	42.72	43.47	45.60	9.081905	0.899	4.14
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	145	0	7.15	13.23	14.33	30.68	34.52	35.58	6.390357		

Smoothness – High Traffic

Two to 4-inch overlay, stone matrix asphalt overlay, full-depth reclamation and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed significantly better performance than heater scarification and overlay as shown in Table 25.

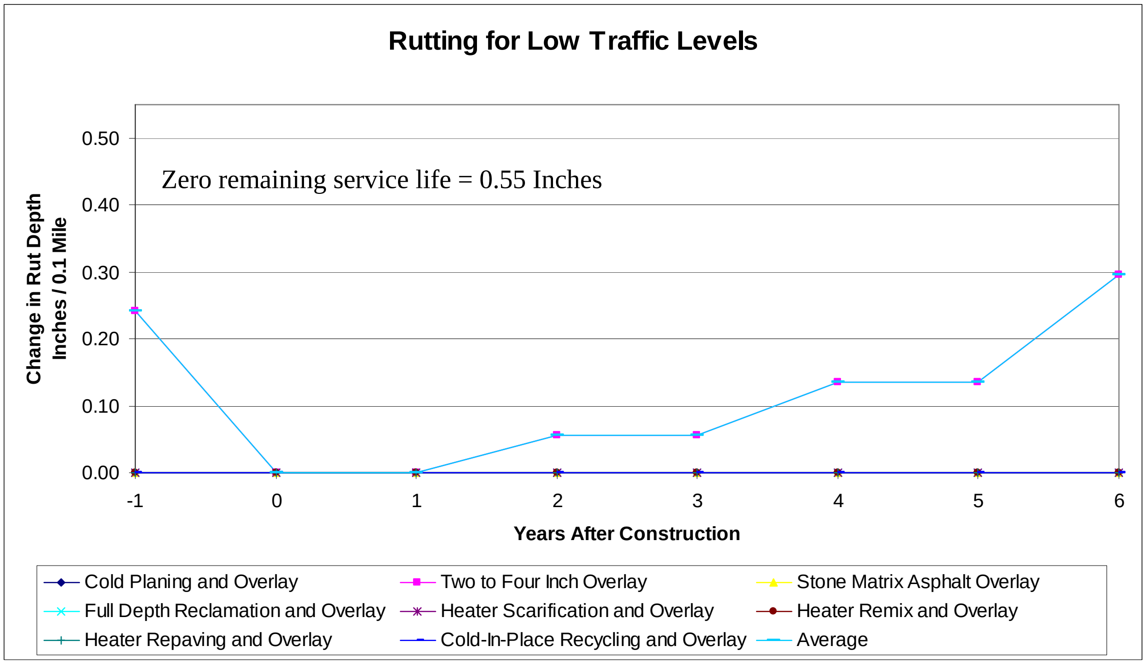

Figure 22 Permanent deformation performance after six years with relation to traffic counts of less than 0.3 million ESAL

Table 26 Rutting Performance – Low Traffic Data

Treatment	Low Year -1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	----	----	----	----	----	----	----	----	----	----	----
Two to Four Inch Overlay	0.241333	0	-	0.06	0.06	0.14	0.14	0.30	0.044147	0.782	7.86
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	0	0	0.00	0.06	0.06	0.14	0.14	0.30	0.044147		

Rutting – Low Traffic

Two to 4-inch overlay is the only rehabilitation strategy represented in this section so an analysis could not be done.

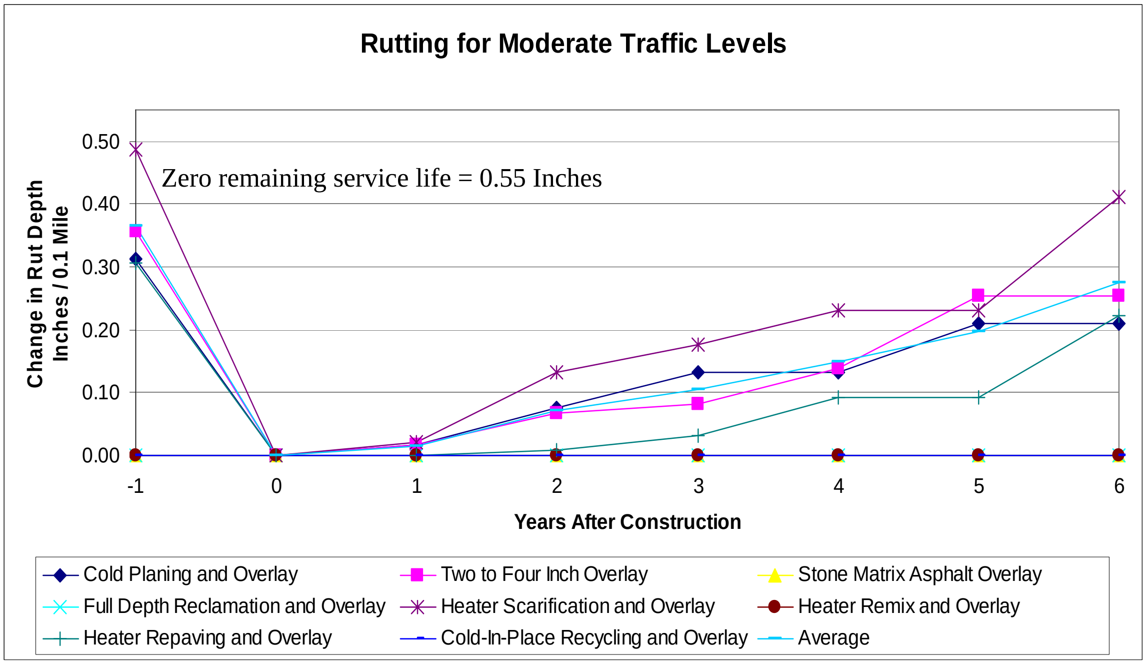

Figure 23 Permanent deformation performance after six years with relation to traffic counts from 0.3 to 3 million ESAL

Table 27 Rutting Performance – Moderate Traffic Data

Treatment	Moderate				Year						
	-1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	0.312308	0	0.02	0.08	0.13	0.13	0.21	0.21	0.038381	0.901	14.43
Two to Four Inch Overlay	0.357652	0	0.02	0.07	0.08	0.14	0.25	0.25	0.046804	0.615	27.14
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	0.48725	0	0.02	0.13	0.18	0.23	0.23	0.41	0.062598	0.774	8.57
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	0.307	0	-	0.01	0.03	0.09	0.09	0.22	0.033429	0.936	2.86
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	0	0	0.01	0.07	0.11	0.15	0.20	0.27	0.045303		

Rutting – Moderate Traffic

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater remix and overlay, and cold-in-place recycling and overlay are not represented. Both cold planing and overlay and heater repaving and overlay showed the least amount of rutting per year than the other rehabilitation strategies. Heater scarification and overlay showed the most amount of rutting per year as shown in Table 27.

Figure 24 Permanent deformation performance after six years with relation to traffic counts from 3 to 11 million ESAL

Table 28 Rutting Performance – High Traffic Data

Treatment	High				Year						
	-1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	0.399077	0	0.04	0.04	0.09	0.15	0.15	0.18	0.031613	0.857	13
Two to Four Inch Overlay	0.474286	0	0.06	0.10	0.12	0.24	0.30	0.34	0.05914	0.908	9.57
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	0	0	0.05	0.07	0.10	0.20	0.23	0.26	0.045377		

Rutting – High Traffic

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater scarification and overlay, heater remix and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed less amounts of rutting per year than 2 to 4 inch overlay as shown in Table 28.

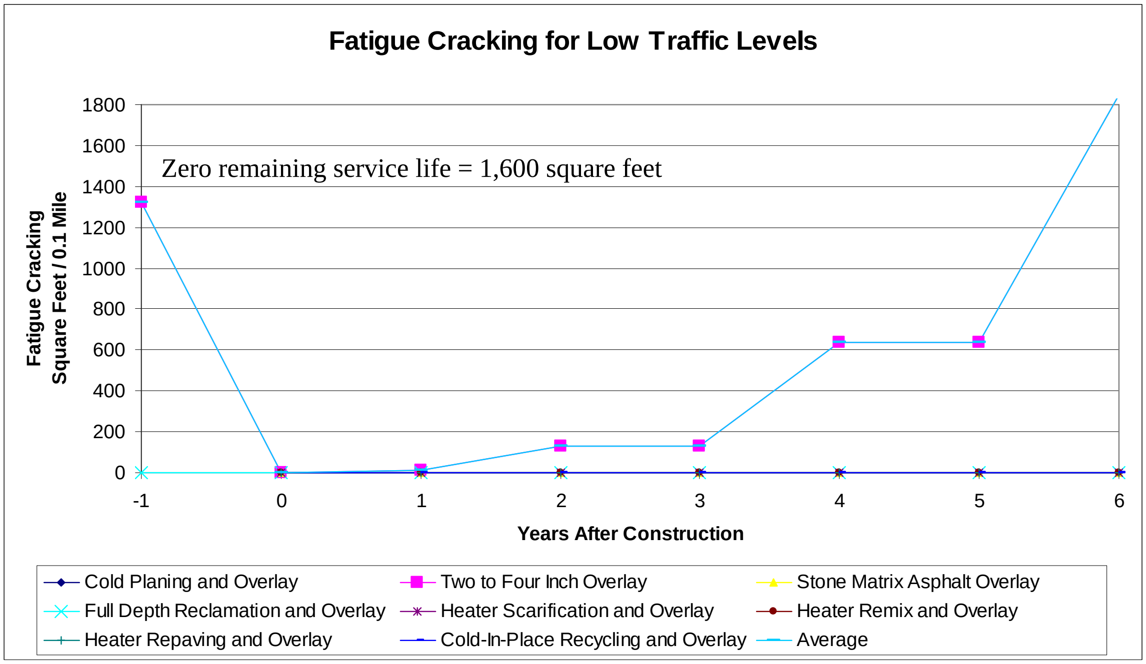

Figure 25 Fatigue cracking performance after six years with relation to traffic counts of less than 0.3 million ESAL

Table 29 Fatigue Performance – Low Traffic Data

Treatment	Low Year -1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	----	----	----	----	----	----	----	----	----	----	----
Two to Four Inch Overlay	1320.96	0	14.42	131.24	131.24	638.51	638.51	1,845.87	260.4668	0.282	10
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	1321	0	14.42	131.24	131.24	638.51	638.51	1845.87	260.4668		

Fatigue – Low Traffic

Two to 4-inch overlay is the only rehabilitation strategy represented in this section so an analysis could not be done.

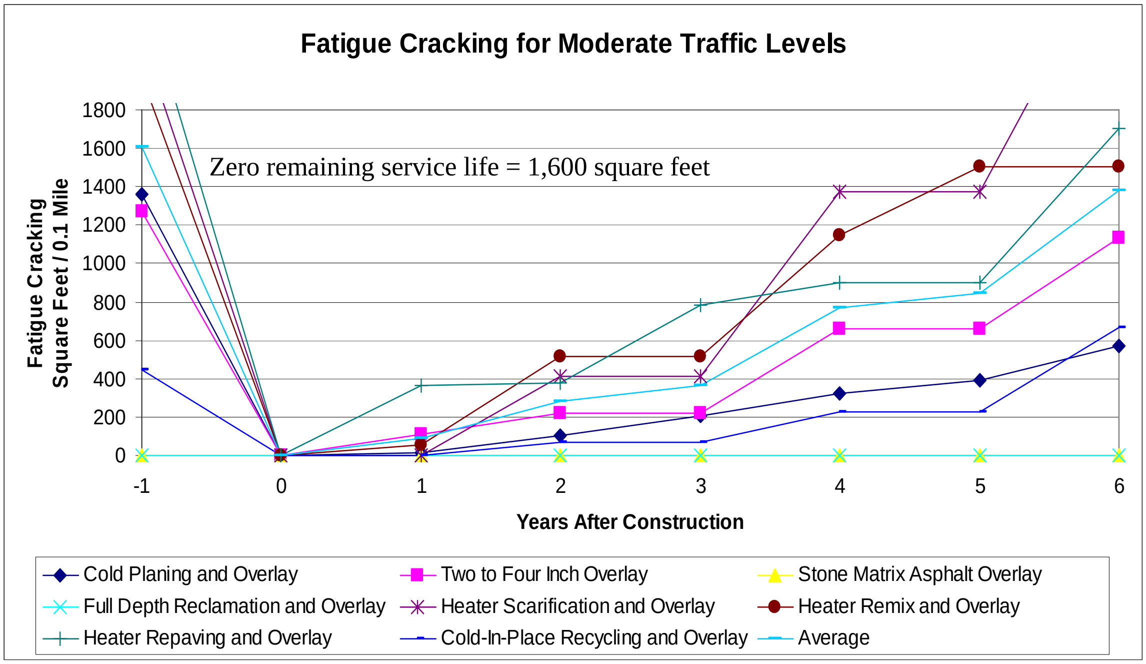

Figure 26 Fatigue cracking performance after six years with relation to traffic counts from 0.3 to 3 million ESAL

Table 30 Traffic Fatigue Performance – Moderate Traffic Data

Treatment	Moderate			Year							
	-1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	1363.65	0	17.11	100.37	203.12	321.00	392.37	567.01	95.43421	0.458	20.14
Two to Four Inch Overlay	1267.979	0	112.04	218.36	218.36	656.11	656.11	1,136.94	176.312	0.417	30.43
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	2168.343	0	2.15	408.93	408.93	1,376.90	1,376.90	2,715.12	423.6718	0.608	5.43
Heater Remix and Overlay	1971.15	0	56.69	513.60	513.60	1,145.83	1,503.60	1,503.60	287.0303	0.539	4.71
Heater Repaving and Overlay	2429.1	0	361.45	377.60	783.00	899.35	899.35	1,702.05	239.4179	0.697	3.71
Cold-In-Place Recycling and Overlay	444.2	0	-	71.07	71.07	223.47	223.47	667.67	92.94048	0.765	0.86
Average	1607	0	91.57	281.66	366.35	770.44	841.97	1382.06	219.1344		

Fatigue – Moderate Traffic

Stone matrix asphalt overlay, full-depth reclamation and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed significantly less amount of fatigue cracking per year than the other rehabilitation strategies. Heater scarification and overlay showed significantly more amounts of fatigue cracking than the other rehabilitation strategies. The coefficient of determination shows that the data is not represented very well overall as shown in Table 30.

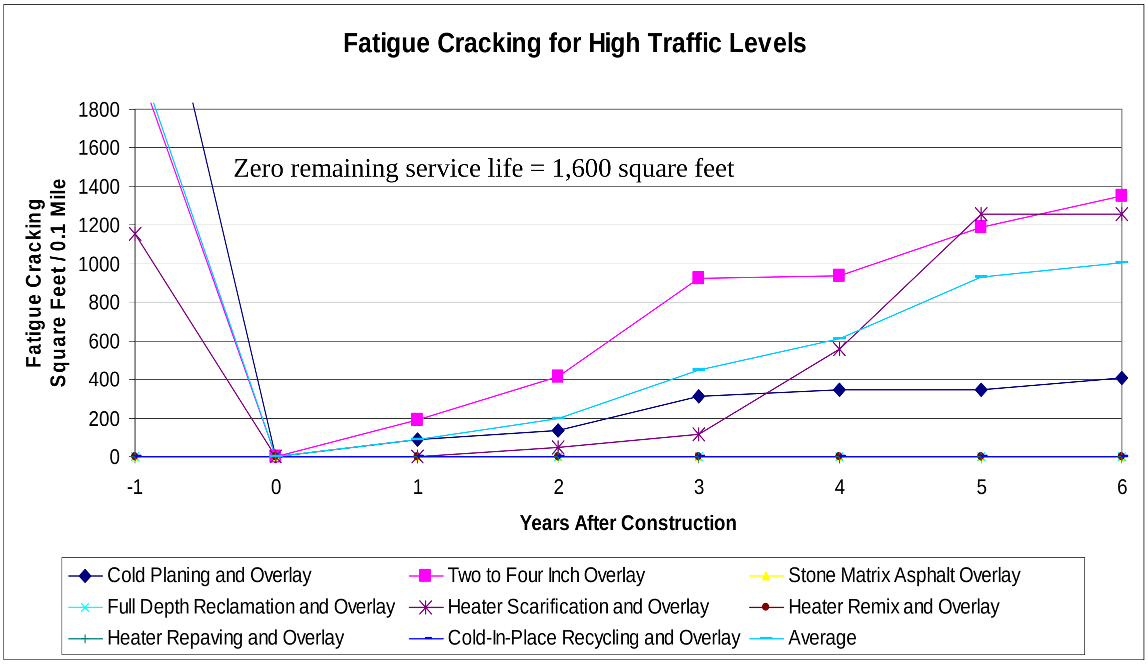

Figure 27 Fatigue cracking performance after six years with relation to traffic counts from 3 to 11 million ESAL

Table 31 Traffic Fatigue Performance – High Traffic Data

Treatment	High -1	0	1	2	Year 3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	3113.933	0	86.28	138.48	309.34	343.80	343.80	407.73	69.41194	0.672	7.71
Two to Four Inch Overlay	2062.067	0	187.97	411.12	926.62	940.12	1,187.67	1,348.67	234.8	0.873	3.29
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	1155.3	0	-	46.12	113.04	555.24	1,253.55	1,253.55	242.0305	0.759	4.14
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	2110	0	91.42	198.57	449.67	613.05	928.34	1003.31	182.0808		

Fatigue – High Traffic

Stone matrix asphalt overlay, full depth reclamation and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed a significant less amount of fatigue cracking than the other rehabilitation strategies. Both 2 to 4 inch overlay and heater scarification and overlay showed similar amounts of fatigue cracking per year and performed the worst as shown in Table 31.

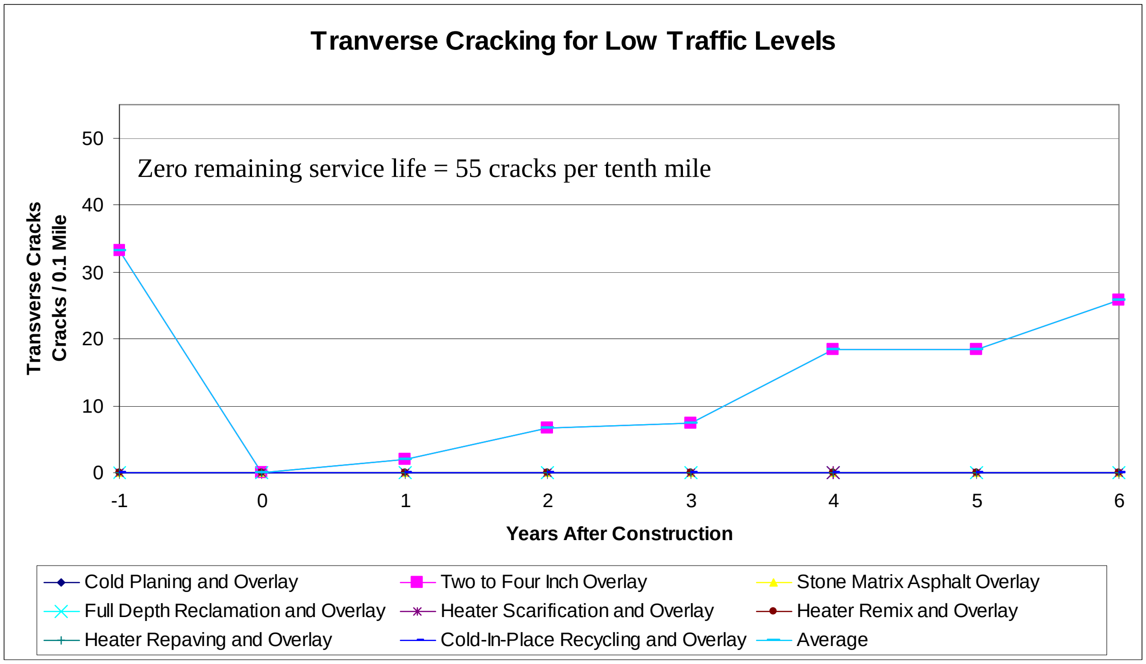

Figure 28 Transverse cracking performance after six years with relation to traffic counts of less than 0.3 million ESAL

Table 32 Transverse Cracking Performance – Low Traffic Data

Treatment	Low				Year						
	-1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	----		----	----	----	----	----	----	----	----	----
Two to Four Inch Overlay	33.21818	0	1.91	6.73	7.48	18.42	18.42	25.78	4.35875	0.715	13.29
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	33	0	1.91	6.73	7.48	18.42	18.42	25.78	4.35875		

Transverse Cracking – Low Traffic

Two to 4-inch overlay is the only rehabilitation strategy represented in this section so an analysis could not be done**.**

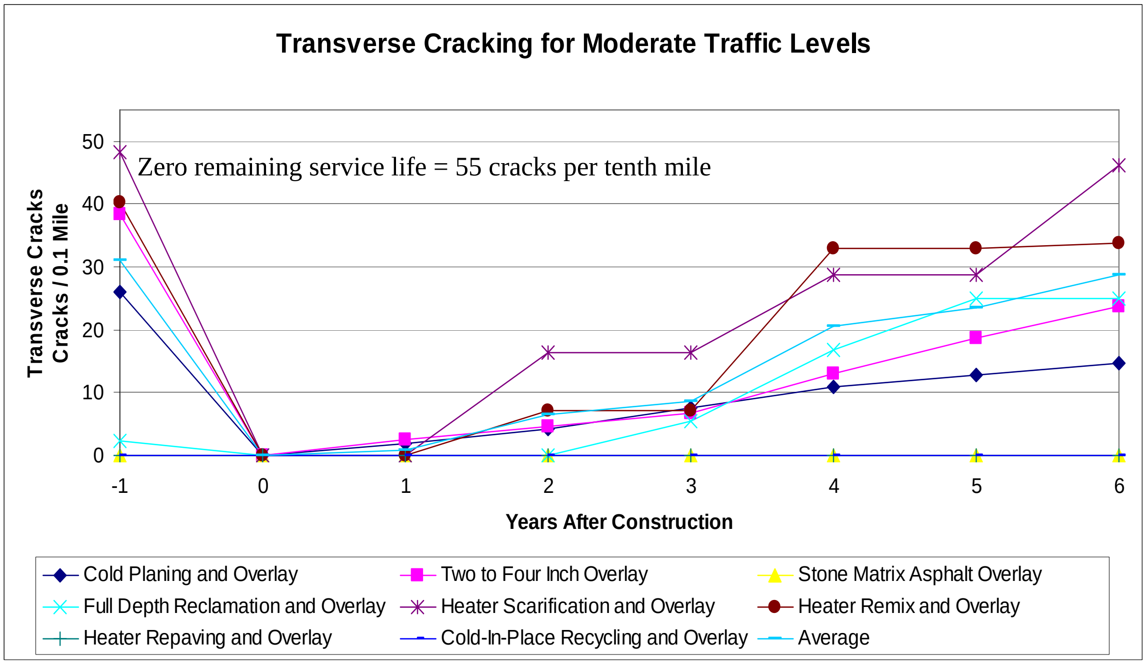

Figure 29 Transverse cracking performance after six years with relation to traffic counts from 0.3 to 3 million ESAL

Table 33 Traffic Transverse Cracking Performance – Moderate Traffic Data

Moderate											
Treatment	**Year**										
	-1	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**Slope**	**R^2**	**n, Avg**
Cold Planing and Overlay	26.1037	0	1.85	4.11	7.61	10.89	12.73	14.68	2.591981	0.744	27.43
Two to Four Inch Overlay	38.46429	0	2.55	4.58	6.62	13.07	18.68	23.74	3.99878	0.684	34.71
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	2.4	0	-	-	5.56	16.86	24.96	24.96	5.059286	0.711	3.86
Heater Scarification and Overlay	48.23333	0	-	16.29	16.29	28.76	28.76	46.16	7.444841	0.696	6.71
Heater Remix and Overlay	40.35	0	-	7.11	7.11	32.87	32.87	33.77	6.886701	0.566	4.71
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	31	0	0.88	6.42	8.64	20.49	23.60	28.66	5.196318		

Transverse Cracking – Moderate Traffic

Stone matrix asphalt overlay, heater remix and overlay, and heater repaving and overlay are not represented. Cold planing and overlay had the lease amount of transverse cracking per year than the other rehabilitation strategies. Heater scarification and overlay had the most amount of transverse cracking per year as shown in Table 33.

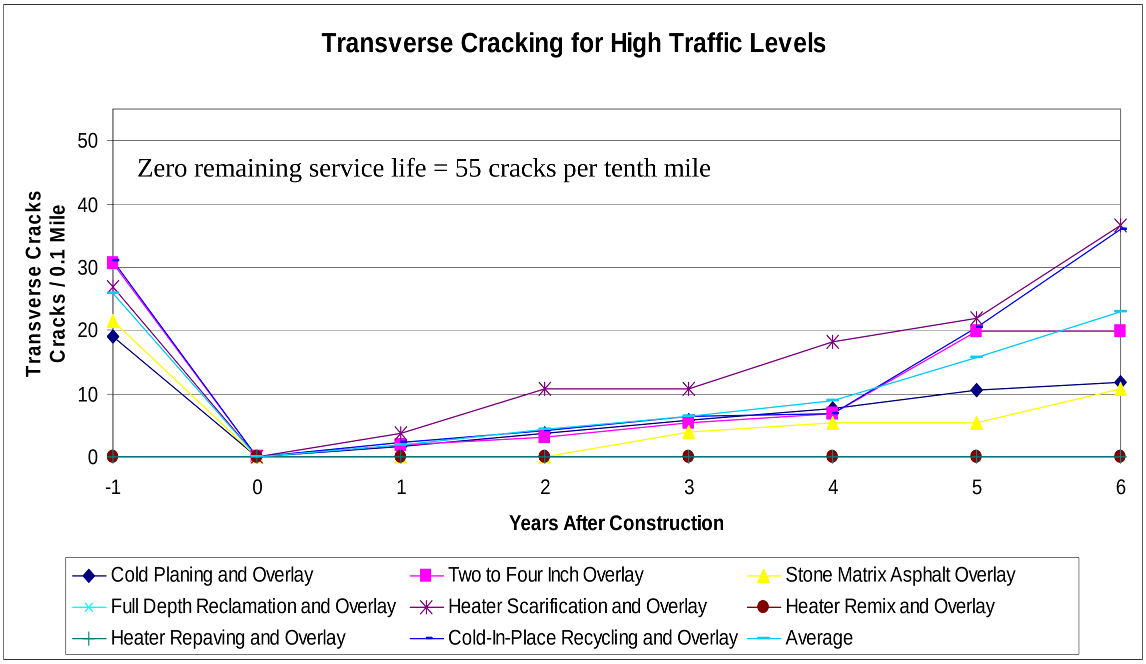

Figure 30 Transverse cracking performance after six years with relation to traffic counts from 3 to 11 million ESAL

Table 34 Transverse Cracking Performance – High Traffic Data

Treatment	High				Year						
	-1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	18.92857	0	1.56	3.74	5.82	7.74	10.59	11.82	2.053537	0.711	12.71
Two to Four Inch Overlay	30.68571	0	1.79	3.19	5.42	6.81	19.82	19.82	3.540631	0.708	9.29
Stone Matrix Asphalt Overlay	21.6	0	-	-	4.00	5.47	5.47	10.73	1.735714	0.806	2.71
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	26.8	0	3.73	10.77	10.77	18.10	21.82	36.52	5.466071	0.894	5.14
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	31	0	2.20	4.20	6.33	6.80	20.53	36.07	5.266667	0.629	3
Average	26	0	1.86	4.38	6.47	8.98	15.64	22.99	3.612524		

Transverse Cracking – High Traffic

Full-depth reclamation and overlay, heater remix and overlay, and heater repaving and overlay are not represented. Stone matrix asphalt overlay had the least amount of transverse cracking per year with cold planing and overlay having a similar amount of cracking. Both heater scarification and overlay and cold-in-place recycling and overlay had the most amounts of transverse cracking per year as shown in Table 34.

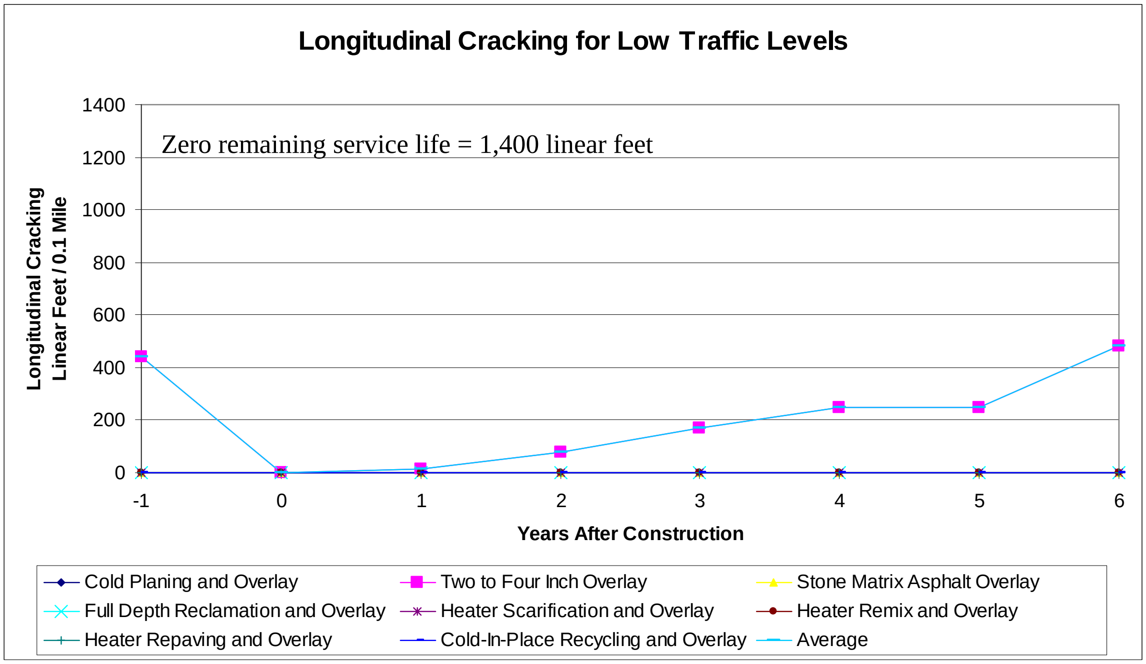

Figure 31 Longitudinal cracking performance after six years with relation to traffic counts of less than 0.3 million ESAL

Table 35 Longitudinal Cracking Performance – Low Traffic Data

	Low										
Treatment	Year										
	-1	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**Slope**	**R^2**	**n, Avg**
Cold Planing and Overlay	----	----	----	----	----	----	----	----	----	----	----
Two to Four Inch Overlay	440.05	0	12.71	78.10	171.96	246.66	246.66	482.96	74.47743	0.645	9.14
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	440	0	12.71	78.10	171.96	246.66	246.66	482.96	74.47743		

Longitudinal Cracking – Low Traffic

Two to 4-inch overlay is the only rehabilitation strategy represented in this section so an analysis could not be done.

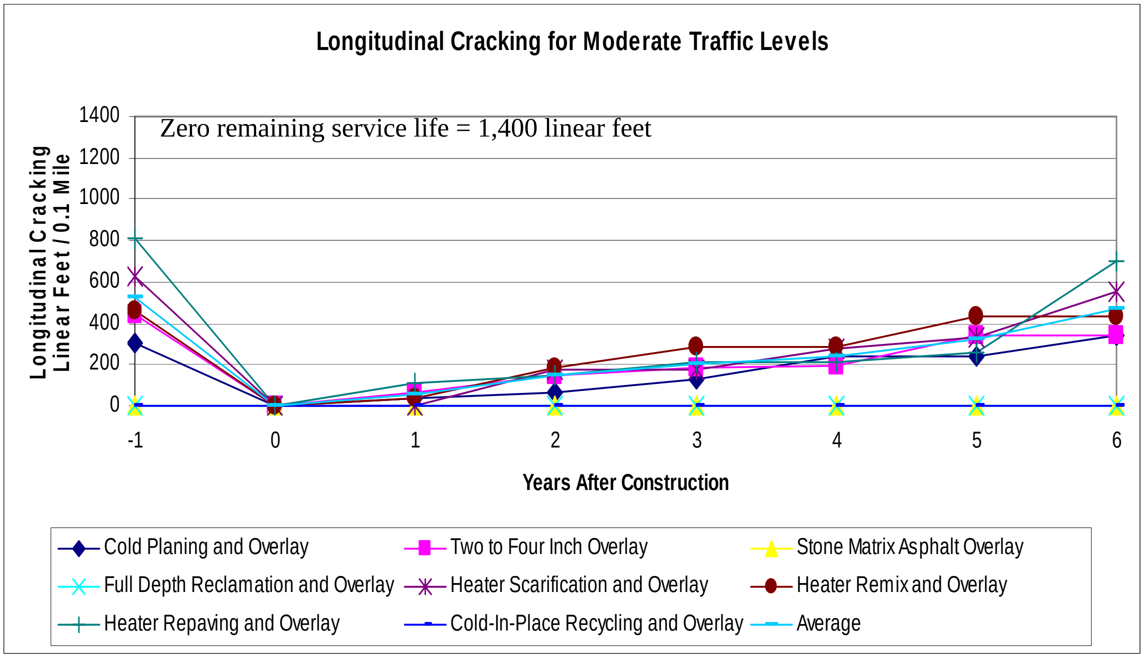

Figure 32 Longitudinal cracking performance after six years with relation to traffic counts from 0.3 to 3 million ESAL

Table 36 Traffic Longitudinal Cracking Performance – Moderate Traffic Data

Treatment	Moderate				Year						
	-1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	300.30	0	36.38	66.91	132.46	242.97	242.97	344.80	57.9879	0.659	19.57
Two to Four Inch Overlay	446.0174	0	69.01	147.95	184.41	190.10	339.13	339.13	57.13473	0.595	24.14
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	626.1583	0	-	175.29	175.29	276.84	336.02	554.07	86.99324	0.596	7.29
Heater Remix and Overlay	456	0	39.51	180.40	289.59	289.59	429.73	429.73	77.81449	0.739	4.86
Heater Repaving and Overlay	814.6	0	115.10	146.77	214.50	214.50	256.17	699.97	87.49167	0.8	2.86
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	529	0	52.00	143.46	199.25	242.80	320.80	473.54	73.48441		

Longitudinal Cracking – Moderate Traffic

Stone matrix asphalt and overlay, full-depth reclamation and overlay, and cold-in-place recycling and overlay are not represented. Both cold planing and overlay and 2 to 4-inch overlay showed the least amounts of longitudinal cracking per year than the other rehabilitation strategies. Heater scarification and overlay and heater repaving and overlay had the most amounts of longitudinal cracking per year as shown in Table 36.

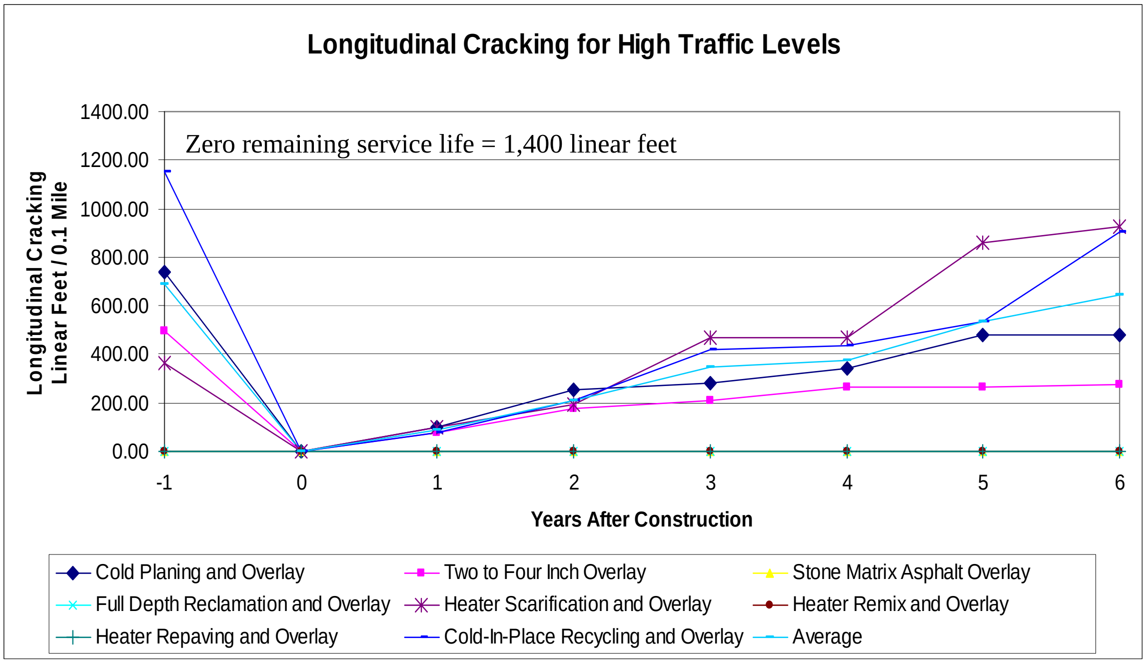

Figure 33 Longitudinal cracking performance after six years with relation to traffic counts from 3 to 11 million ESAL

Table 37 Longitudinal Cracking Performance – High Traffic Data

Treatment	High			Year							
	-1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	740.91	0	101.16	251.89	279.44	340.04	478.99	478.99	81.45625	0.755	7.43
Two to Four Inch Overlay	498	0	78.45	179.05	210.65	264.75	264.75	277.55	46.10536	0.648	3.43
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	365	0	100.77	192.45	468.65	468.65	862.48	925.28	163.409	0.778	4.14
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	1151.1	0	79.07	207.67	421.53	433.33	534.20	902.53	137.269	0.711	3
Average	689	0	89.86	207.76	345.07	376.69	535.10	646.09	107.0599		

Longitudinal Cracking – High Traffic

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater remix and overlay, and heater repaving and overlay are not represented. Two to 4-inch overlay showed a significantly less amount of longitudinal cracking per year than the other rehabilitation strategies. Heater scarification and overlay showed the most amounts of longitudinal cracking per year as shown in Table 37.

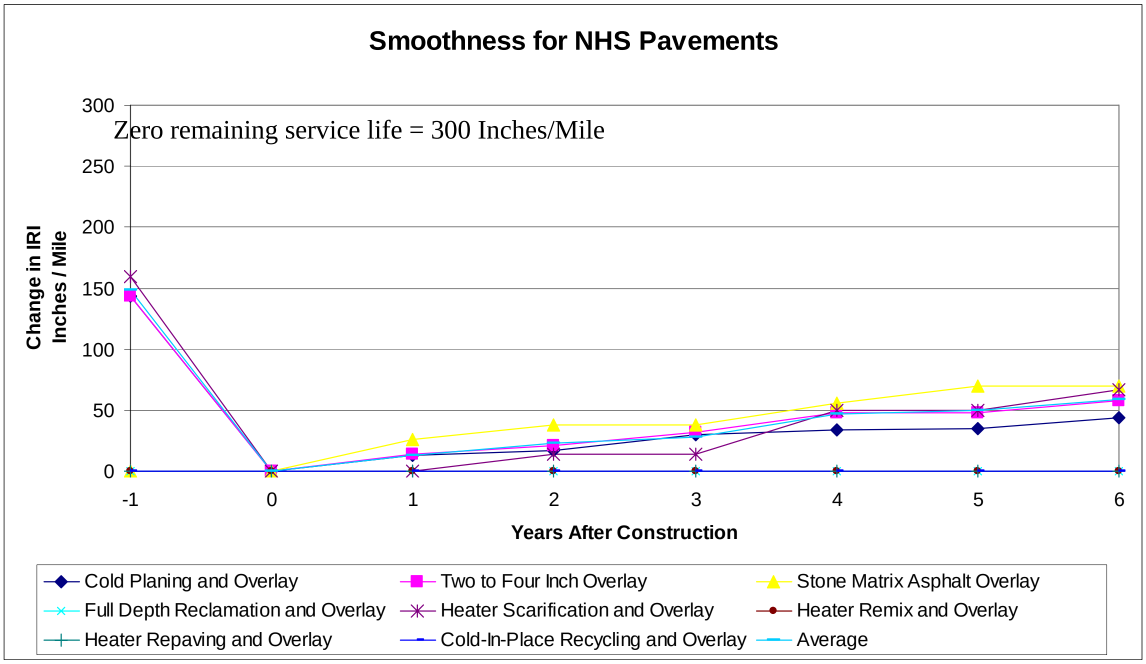

Figure 34 Rate of change for smoothness after six years relating to being located on the National Highway System (NHS)

Table 38 Smoothness Performance – NHS Data

Treatment	NHS			Year							
	-1	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**Slope**	**R^2**	**n, Avg**
Cold Planing and Overlay	143.22	0.00	12.63	17.34	29.51	33.71	34.52	43.39	6.797341	0.803	12.86
Two to Four Inch Overlay	143.4286	0	14.23	21.33	31.94	47.43	47.43	57.44	9.457781	0.859	7.29
Stone Matrix Asphalt Overlay	----	0	26.33	37.67	37.67	55.42	69.35	69.35	11.1369	0.898	3
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	159.5667	0	-	13.84	13.84	50.00	50.00	66.90	12.03056	0.861	7.29
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	149	0	13	23	28	47	50	59	9.855645		

Smoothness – NHS

Full-depth reclamation and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed the best performance over time. Heater scarification and overlay has the worst performance over time as shown in Table 38.

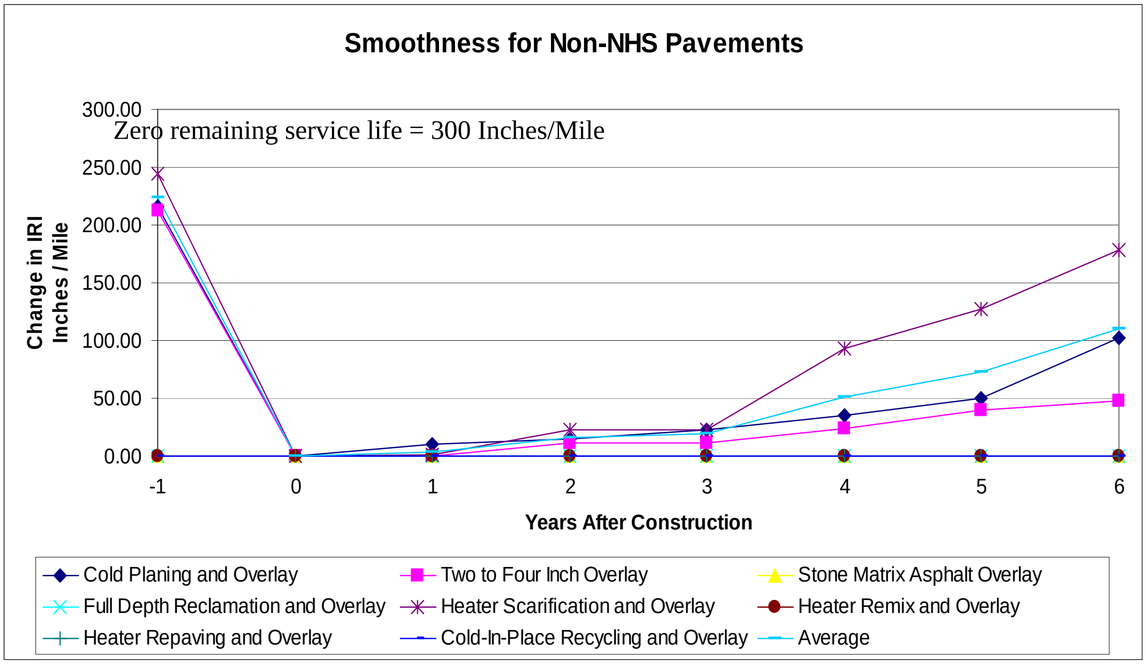

Figure 35 Rate of change for smoothness after six years relating to not being located on the National Highway System (NHS)

Table 39 Smoothness Performance – Non-NHS Data

Non NHS											
Treatment	**Year**										
	-1	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**Slope**	**R^2**	**n, Avg**
Cold Planing and Overlay	215.85	0	10.09	15.10	22.49	35.28	50.38	102.45	14.5756	0.881	3.57
Two to Four Inch Overlay	212.5167	0	-	11.44	11.52	24.05	40.27	47.74	8.442381	0.796	16
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	244.05	0	1.61	22.83	22.83	92.65	127.13	178.93	30.62976	0.845	3.57
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay		----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	224	0	4	16	19	51	73	110	17.88258		

Smoothness – Non-NHS

Stone matrix asphalt overlay, full depth reclamation and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. 2 to 4 inch overlay showed the best performance with regards to smoothness. Heater scarification and overlay showed a significantly larger amount of distress each year than the other rehabilitation strategies as shown in Table 39**.**

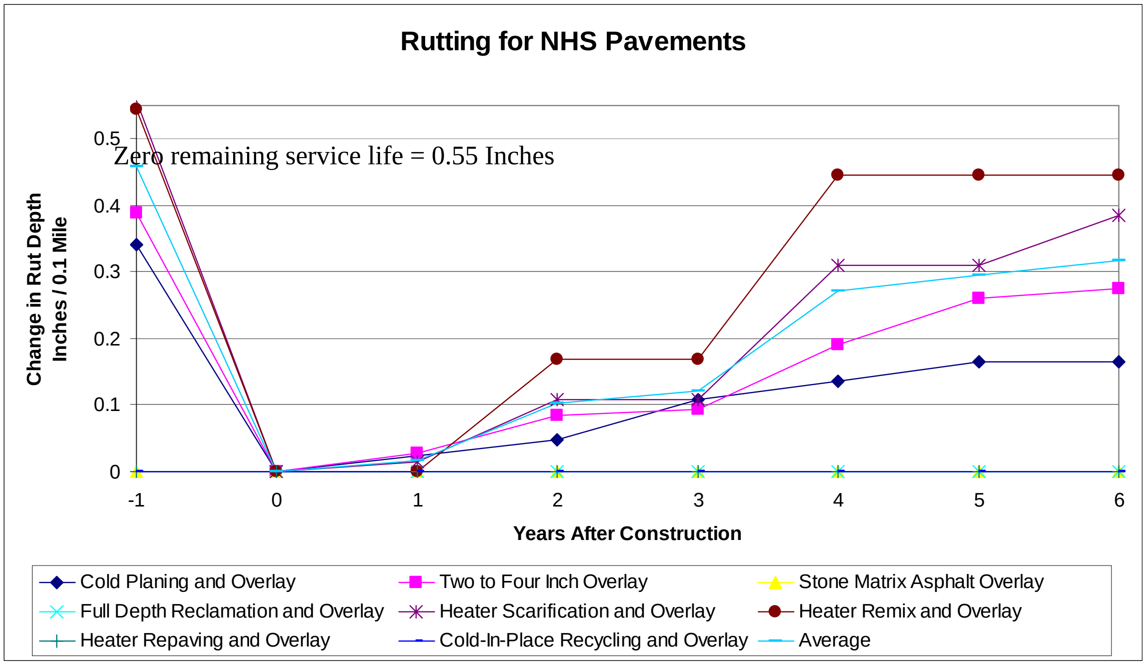

Figure 36 Permanent deformation performance after six years relating to being located on the National Highway System (NHS)

Table 40 Rutting Performance – NHS Data

Treatment	NHS				Year						
	-1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	0.341778	0.00	0.02	0.05	0.11	0.14	0.16	0.16	0.030905	0.866	20.71
Two to Four Inch Overlay	0.388333	0	0.03	0.08	0.09	0.19	0.26	0.28	0.050054	0.683	26.14
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay		----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	0.557	0	0.02	0.11	0.11	0.31	0.31	0.38	0.069419	0.856	5
Heater Remix and Overlay	0.544	0	-	0.17	0.17	0.45	0.45	0.45	0.089604	0.875	33
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	0.46	0.00	0.02	0.10	0.12	0.27	0.30	0.32	0.059995		

Rutting – NHS

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed the least amount of rutting per year. Heater remix and overlay showed significantly more rutting per year than the other rehabilitation strategies **as** shown in Table 40**.**

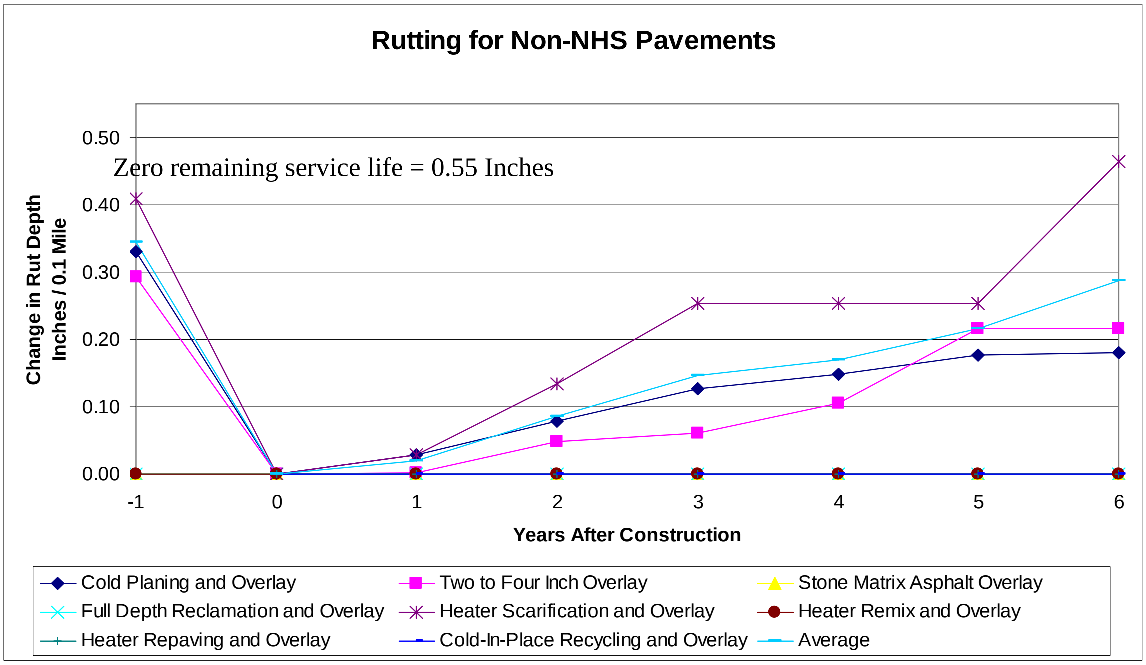

Figure 37 Permanent deformation performance after six years relating to not being located on the National Highway System (NHS)

Table 41 Rutting Performance – Non-NHS Data

Non NHS											
Treatment					**Year**						
	-1	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**Slope**	**R^2**	**n, Avg**
Cold Planing and Overlay	0.33	0	0.03	0.08	0.13	0.15	0.18	0.18	0.03242	0.915	7
Two to Four Inch Overlay	0.2932	0	0.00	0.05	0.06	0.11	0.22	0.22	0.040552	0.788	18.43
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	0.4084	0	0.03	0.13	0.25	0.25	0.25	0.47	0.070244	0.728	5.43
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay		----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay		----	----	----	----	----	----	----	----	----	----
Average	0.34	0.00	0.02	0.09	0.15	0.17	0.22	0.29	0.047739		

Rutting – Non-NHS

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed the least amount of rutting per year than the other rehabilitation strategies. Heater scarification and overlay showed the most amount of rutting per year as shown in Table 41**.**

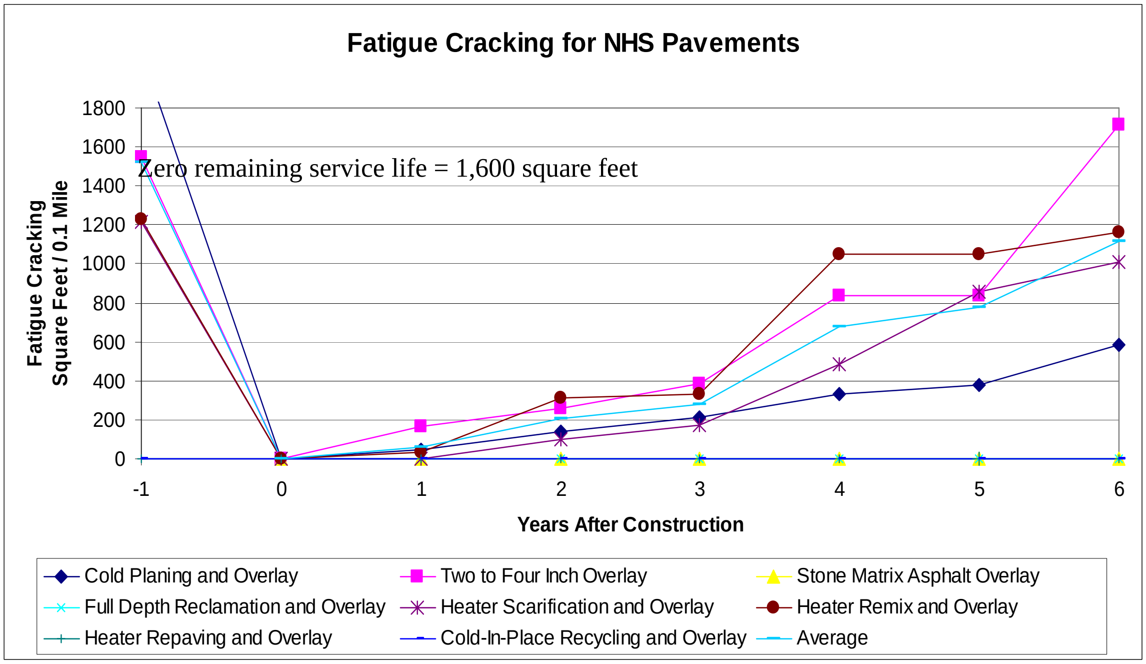

Figure 38 Fatigue cracking performance after six years relating to being located on the National Highway System (NHS)

Table 42 Fatigue Performance – NHS Data

Treatment	NHS Year -1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	2088.01	0.00	45.13	142.56	213.80	334.95	378.45	581.59	92.99288	0.365	20.29
Two to Four Inch Overlay	1547.695	0	163.17	259.27	385.32	833.86	833.86	1,710.58	251.7036	0.511	18.43
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	1213.65	0	-	102.11	174.54	481.87	860.06	1,010.11	183.2226	0.714	5.29
Heater Remix and Overlay	1226	0	36.40	312.35	329.76	1,046.52	1,046.52	1,162.62	222.9382	0.659	3.86
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	1518.84	0.00	61.18	204.07	275.86	674.30	779.72	1116.23	187.7143		

Fatigue – NHS

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed significantly less fatigue cracking per year than any other rehabilitation strategy. Two to 4-inch overlay showed the most amount of fatigue cracking as shown in Table 42.

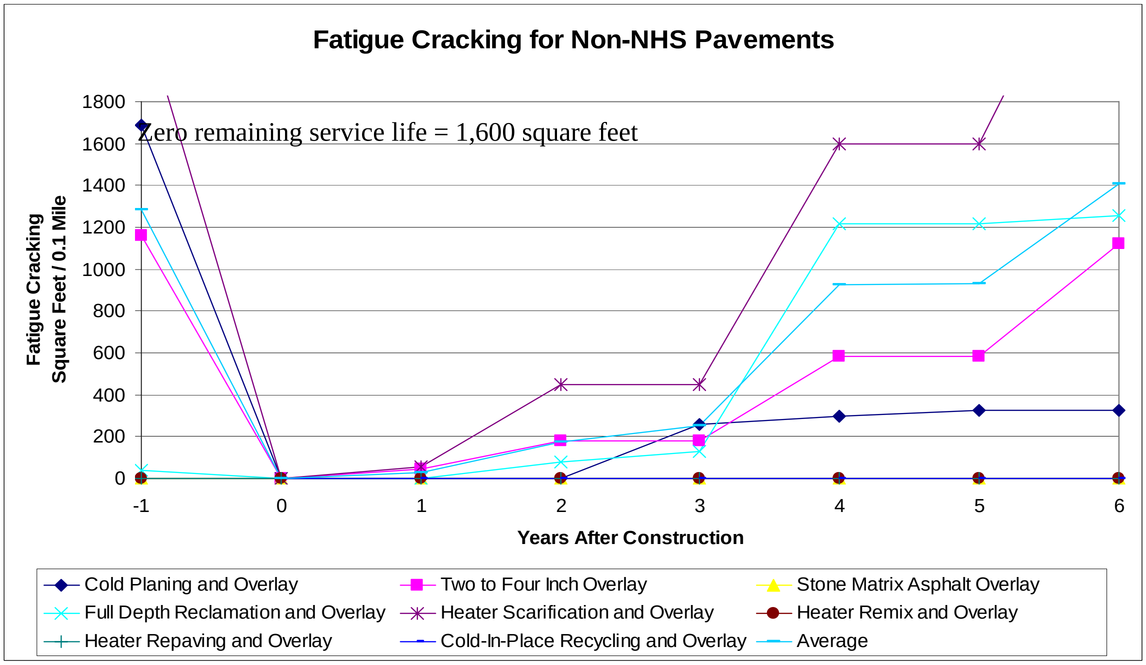

Figure 39 Fatigue cracking performance after six years relating to not being located on the National Highway System (NHS)

Table 43 Fatigue Performance – Non-NHS Data

Treatment	Non NHS				Year						
	-1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	1689.575	0	0.98	0.98	256.75	299.19	323.79	323.79	68.39994	0.359	7.57
Two to Four Inch Overlay	1158.773	0	46.61	179.05	179.05	582.70	582.70	1,122.83	173.0111	0.353	25.29
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	41.9	0	0	75.75	126.4	1218.6833	1218.6833	1255.9833	262.4375	0.203	3
Heater Scarification and Overlay	2246.9	0	55.88	449.04	449.04	1,599.48	1,599.48	2,920.38	464.2421	0.529	4.71
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay		----	----	----	----	----	----	----	----	----	----
Average	1284	0	26	176	253	925	931	1406	242.0227		

Fatigue – Non-NHS

Stone matrix asphalt overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed significantly less fatigue cracking per year when compared to the other rehabilitation strategies. Heater scarification and overlay had significantly more amounts of fatigue cracking per year than all the other rehabilitation strategies as shown in Table 43.

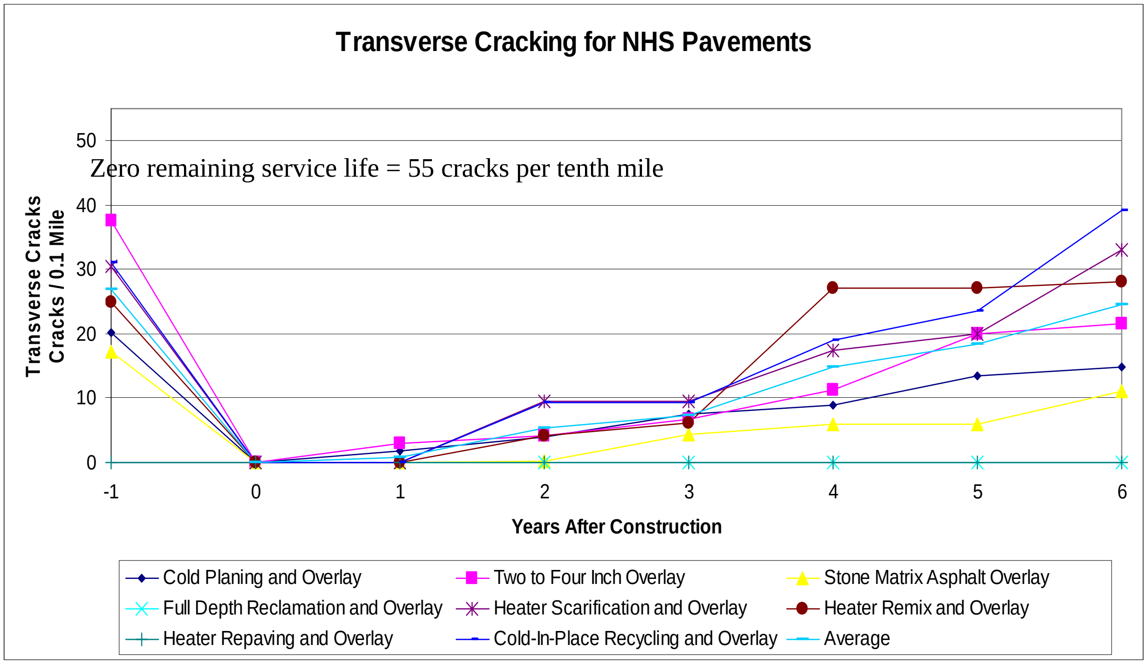

Figure 40 Transverse cracking performance after six years relating to being located on the National Highway System (NHS)

Table 44 Transverse Cracking Performance – NHS Data

Treatment	NHS Year -1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	20.12857	0	1.81	4.05	7.55	8.86	13.54	14.77	2.591344	0.744	28
Two to Four Inch Overlay	37.625	0	2.89	4.17	6.67	11.36	20.04	21.62	3.798929	0.682	26.57
Stone Matrix Asphalt Overlay	17.2	0	-	0.15	4.40	5.87	5.87	11.13	1.816071	0.791	3
Full Depth Reclamation and Overlay		----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	30.4	0	-	9.58	9.58	17.33	19.96	32.97	5.235408	0.811	6.86
Heater Remix and Overlay	24.95	0	-	4.20	6.13	27.15	27.15	28.05	5.763776	0.579	5
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	31	0	-	9.37	9.37	18.95	23.57	39.10	6.214881	0.619	3.43
Average	26.88393	0	0.783715	5.251905	7.283199	14.9188	18.35392	24.60709	4.236735		

Transverse Cracking – NHS

Full depth reclamation and overlay and heater repaving and overlay are not represented. Stone matrix asphalt overlay showed the least amount of transverse cracking than the other rehabilitation strategies. Cold-in-place recycling and overlay showed a significantly greater amount of transverse cracking than the other rehabilitation strategies as shown in Table 44**.**

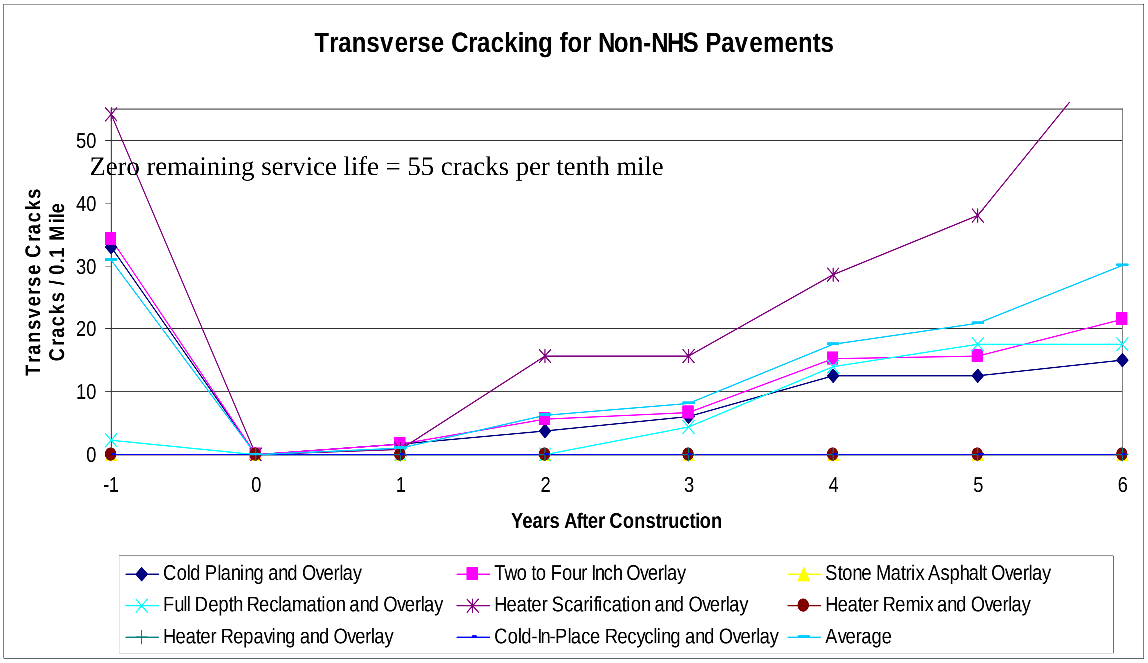

Figure 41 Transverse cracking performance after six years relating to not being located on the National Highway System (NHS)

Table 45 Transverse Cracking Performance – Non-NHS Data

Treatment	Non NHS										
	Year										
	-1	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**Slope**	**R^2**	**n, Avg**
Cold Planing and Overlay	33.01667	0	1.65	3.84	6.08	12.58	12.58	15.05	2.705078	0.654	11.57
Two to Four Inch Overlay	34.28182	0	1.65	5.69	6.59	15.27	15.60	21.55	3.648061	0.695	30.71
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	2.4	0	0	0.095238	4.348571	13.98857	17.49524	17.49524	3.62034	0.687	4.86
Heater Scarification and Overlay	54.16667	0	0.87	15.63	15.63	28.67	38.04	66.59	10.25619	0.723	5.86
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay		----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	31	0	1	6	8	18	21	30	5.057417		

Transverse Cracking – Non-NHS

Stone matrix asphalt overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed the least amount of transverse cracking per year. Heater scarification and overlay showed a significantly more amount of transverse cracking per year when compared to the other rehabilitation strategies as shown in Table 45**.**

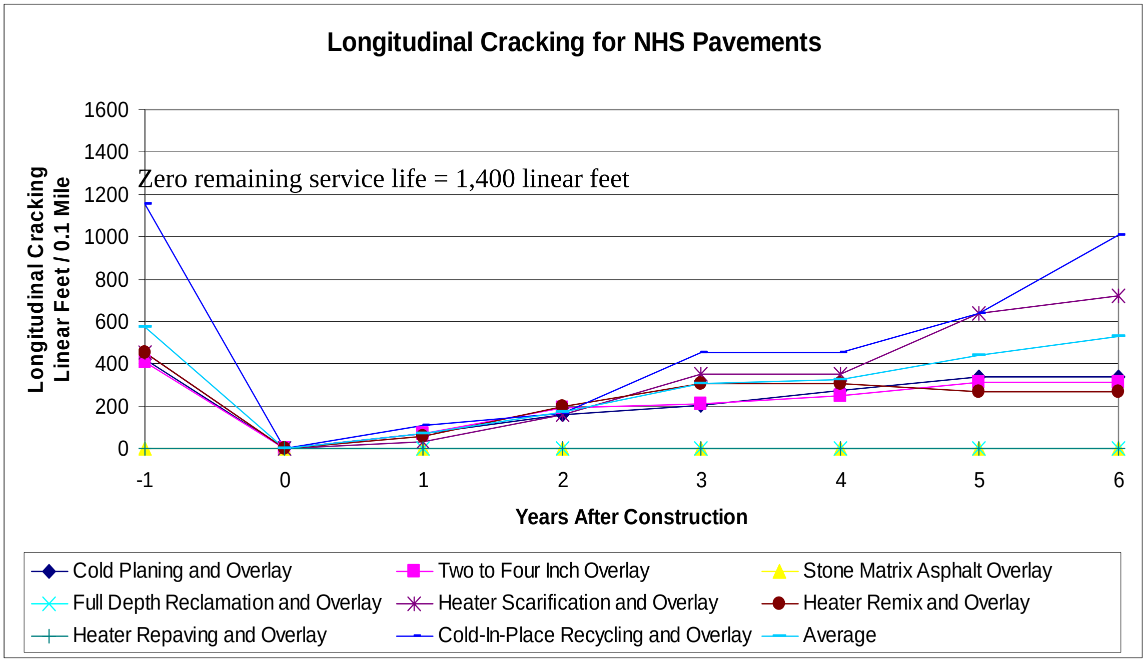

Figure 42 Longitudinal cracking performance after six years relating to being located on the National Highway System (NHS)

Table 46 Longitudinal Cracking Performance – NHS Data

Treatment	NHS				Year						
	-1	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**Slope**	**R^2**	**n, Avg**
Cold Planing and Overlay	418.5	0	67.02	160.45	205.64	275.92	335.72	335.72	59.28639	0.707	21.29
Two to Four Inch Overlay	406.5895	0	73.26	191.00	210.94	246.58	309.79	309.79	52.0714	0.682	17.29
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay		----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	452.35	0	34.16	159.28	349.32	349.32	639.37	721.62	127.3317	0.713	5.43
Heater Remix and Overlay	450.5	0	54.68	197.44	307.31	307.31	269.67	269.67	48.17405	0.772	4.43
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	1151.1	0	110.05	162.80	452.52	452.52	639.85	1,008.18	156.2095	0.703	3.43
Average	575.8079	0	67.83375	174.1953	305.1446	326.327	438.879	528.9957	88.61462		

Longitudinal Cracking – NHS

Stone matrix asphalt overlay, full-depth reclamation and overlay, and heater repaving and overlay are not represented. Heater remix and overlay showed the least amount of longitudinal cracking per year when compared with the other rehabilitation strategies. Cold-in-place recycling and overlay showed the greatest amount of longitudinal cracking per year as shown in Table 46.

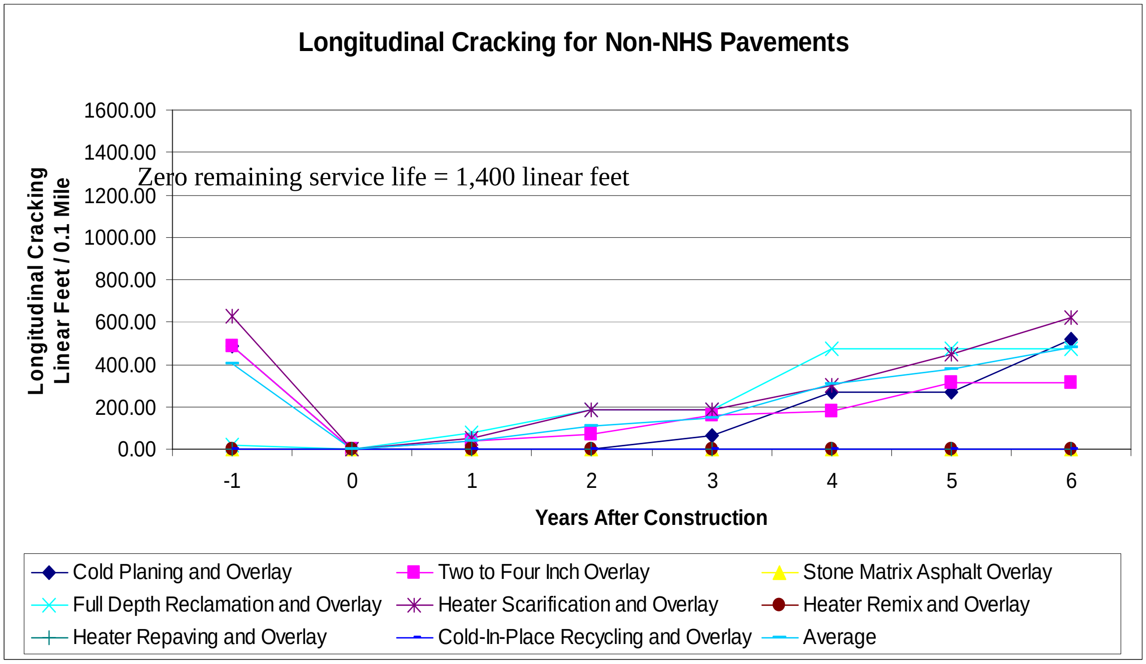

Figure 43 Longitudinal cracking performance after six years relating to not being located on the National Highway System (NHS)

Table 47 Longitudinal Cracking Performance – Non-NHS Data

Treatment	Non NHS Year -1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	488.40	0	-	-	66.83	265.87	265.87	516.52	83.82679	0.582	5.71
Two to Four Inch Overlay	489.4333	0	39.47	70.15	159.37	181.22	315.73	315.73	57.52882	0.546	19.43
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	20.6	0	76	185.4	185.4	474.8667	474.8667	474.8667	89.70714	0.423	3.57
Heater Scarification and Overlay	626.4083	0	48.46	184.35	184.35	302.87	450.45	619.25	99.2954	0.586	6.43
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	406	0	40.98	109.97	148.99	306.21	376.73	481.59	82.58954		

Longitudinal Cracking – Non-NHS

Stone matrix asphalt overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. 2 to 4 inch overlay showed the least amount of longitudinal cracking per year. Heater scarification and overlay showed the greatest amount of longitudinal cracking per year when compared to other rehabilitation strategies. The coefficient of determination shows that the slopes are not a good representation of the data overall as shown in Table 47.

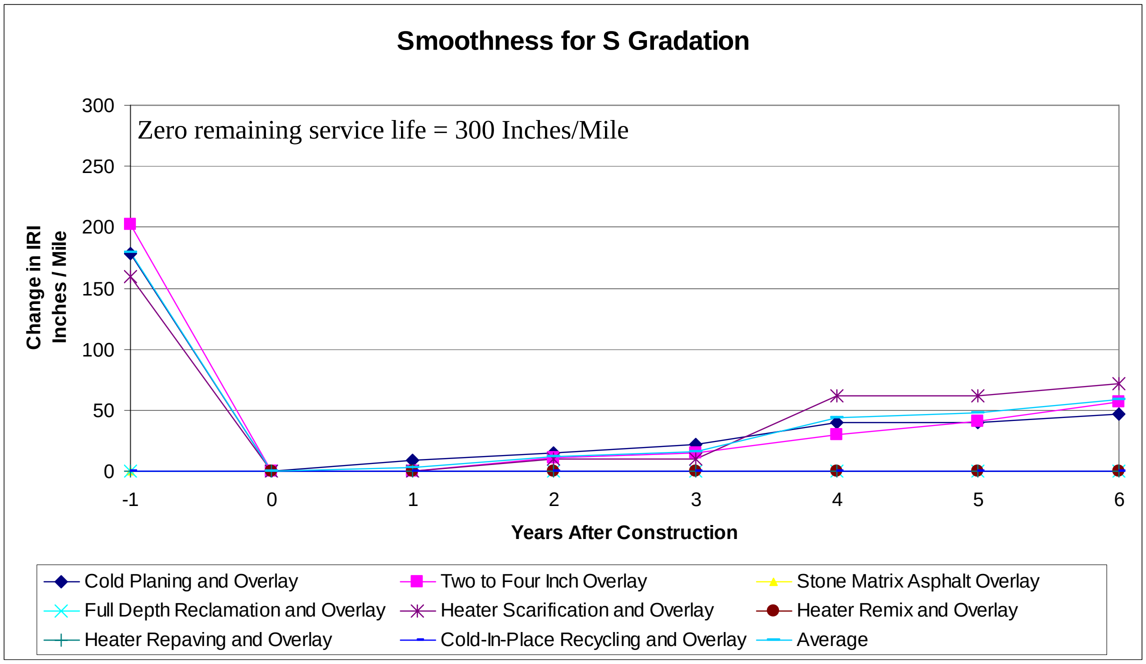

Figure 44 Rate of change for smoothness after six years with relation to having an aggregate size of no greater than 1 inch in diameter

Table 48 Smoothness Performance – S Data

				S							
Treatment					**Year**						
	-1	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**Slope**	**R^2**	**n, Avg**
Cold Planing and Overlay	178.34	0.00	8.53	14.92	21.92	39.63	39.63	46.95	8.135206	0.798	10.86
Two to Four Inch Overlay	201.8889	0	-	10.89	15.30	30.30	40.53	57.15	9.712063	0.817	13.71
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	159.1667	0	-	10.01	10.01	62.27	62.27	72.26	14.05644	0.844	8
Heater Remix and Overlay		----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	180	0	3	12	16	44	47	59	10.63457		

Smoothness – S

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed the best performance per year when compared to the other rehabilitation strategies. Heater scarification and overlay showed the worst performance per year as shown in Table 48.

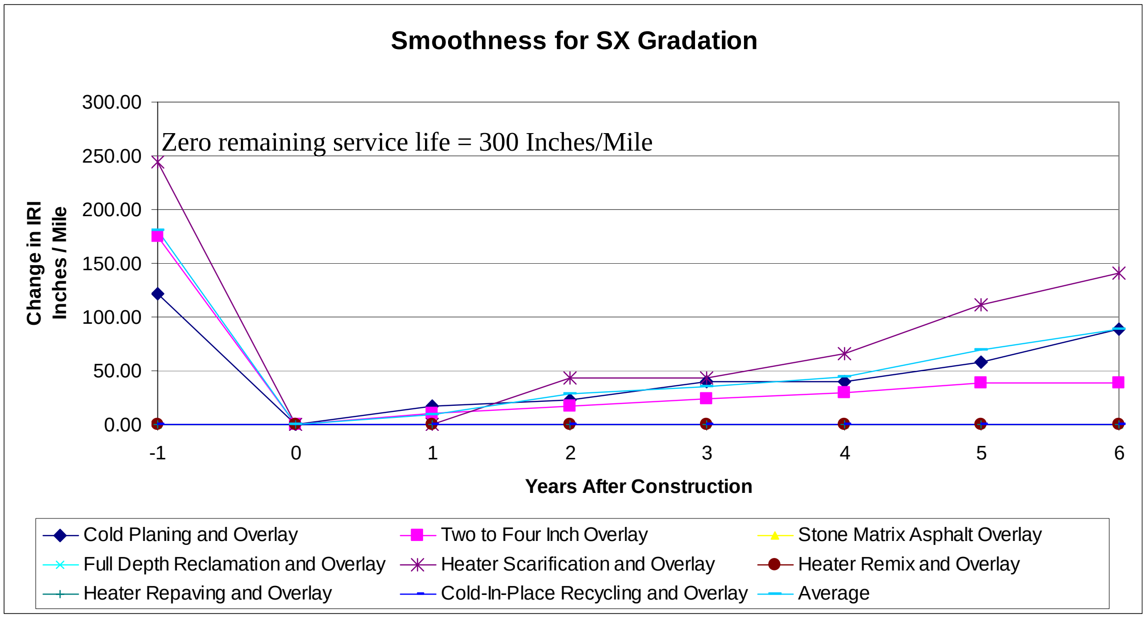

Figure 45 Rate of change for smoothness after six years with relation to having an aggregate size of no greater than 0.75 inch diameter

Table 49 Smoothness Performance - SX Data

Treatment	SX				Year						
	-1	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**Slope**	**R^2**	**n, Avg**
Cold Planing and Overlay	121.90	0	16.83	22.83	39.36	39.36	57.50	88.68	12.99643	0.834	5.43
Two to Four Inch Overlay	175.4	0	9.83	17.46	24.06	29.54	38.38	38.38	6.582937	0.813	9.43
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	244.65	0	-	43.35	43.35	65.55	111.72	140.35	23.81012	0.818	2.86
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	181	0	9	28	36	45	69	89	14.46316		

Smoothness – SX

Stone matrix asphalt overlay, full depth reclamation and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Two to 4-inch overlay showed the best performance per year. Heater scarification and overlay showed the worst performance per year when compared to the other rehabilitation strategies as shown in Table 49.

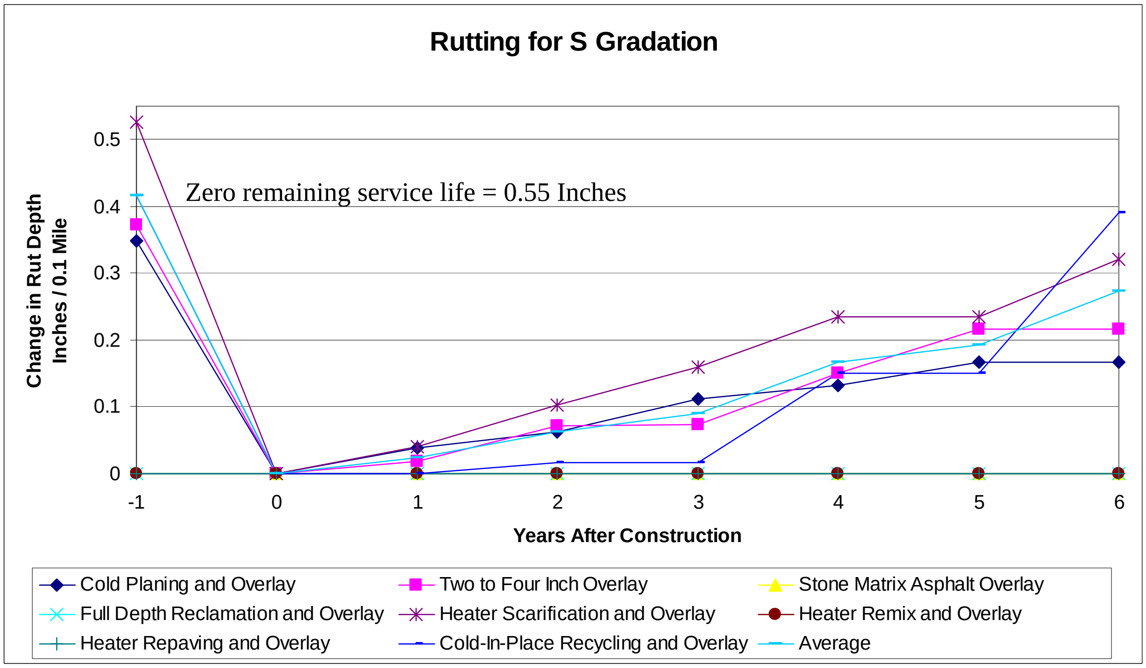

Figure 46 Permanent deformation performance after six year with relation to having an aggregate size of no greater than 1 inch in diameter

Table 50 Rutting Performance – S Data

Treatment	S				Year						
	-1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	0.34776	0.00	0.04	0.06	0.11	0.13	0.17	0.17	0.029711	0.841	26.71
Two to Four Inch Overlay	0.373	0	0.02	0.07	0.07	0.15	0.22	0.22	0.040089	0.814	24
Stone Matrix Asphalt Overlay		----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	0.527	0	0.04	0.10	0.16	0.24	0.24	0.32	0.053026	0.773	8
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	0.4155	0	-	0.02	0.02	0.15	0.15	0.39	0.057375	0.908	3
Average	0.42	0.00	0.02	0.06	0.09	0.17	0.19	0.27	0.04505		

Rutting – S

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater remix and overlay, and heater repaving and overlay are not represented. Cold planing and overlay showed the least amount of rutting per year. Both heater scarification and overlay, and cold-in-place recycling and overlay have a similar rate of rutting per year and performed the worst as shown in Table 50.

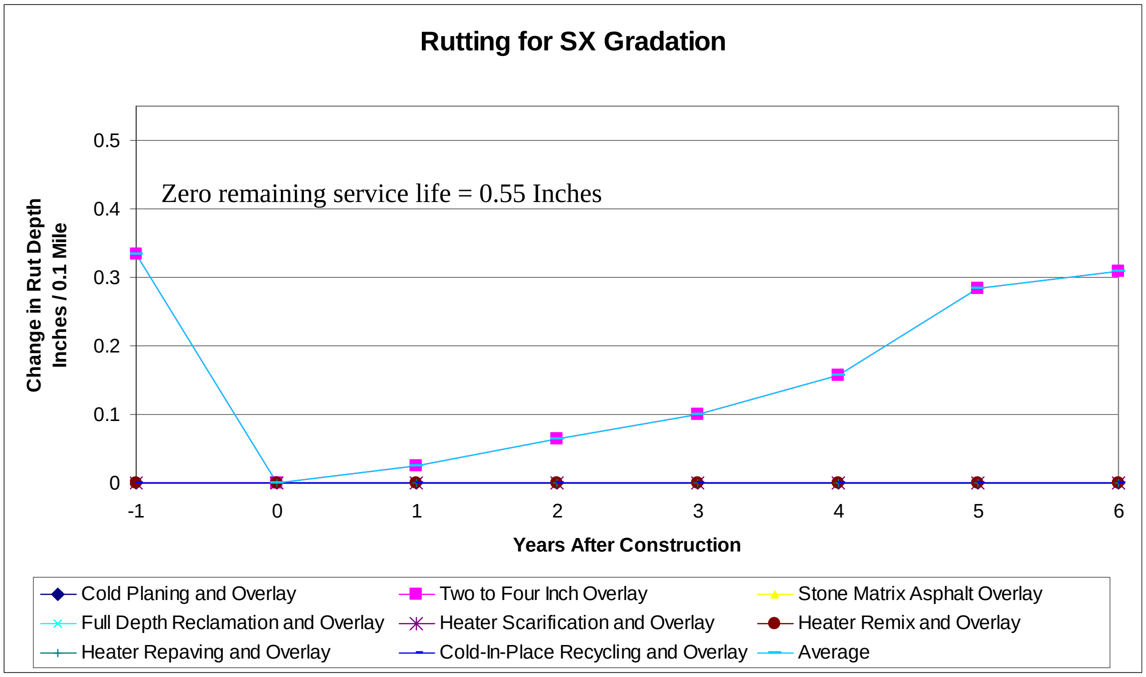

Figure 47 Permanent deformation performance after six years with relation to having an aggregate size of no greater than 0.75 inch diameter

Table 51 Rutting Performance – SX Data

Treatment	SX Year -1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	----	----	----	----	----	----	----	----	----	----	----
Two to Four Inch Overlay	0.333524	0.00	0.03	0.06	0.10	0.16	0.28	0.31	0.054829	0.659	20.57
Stone Matrix Asphalt Overlay		----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay		----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay		----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	0.33	0.00	0.03	0.06	0.10	0.16	0.28	0.31	0.054829		

Rutting – SX

Two to 4-inch overlay is the only rehabilitation strategy represented in this section so an analysis could not be done as shown in Table 51.

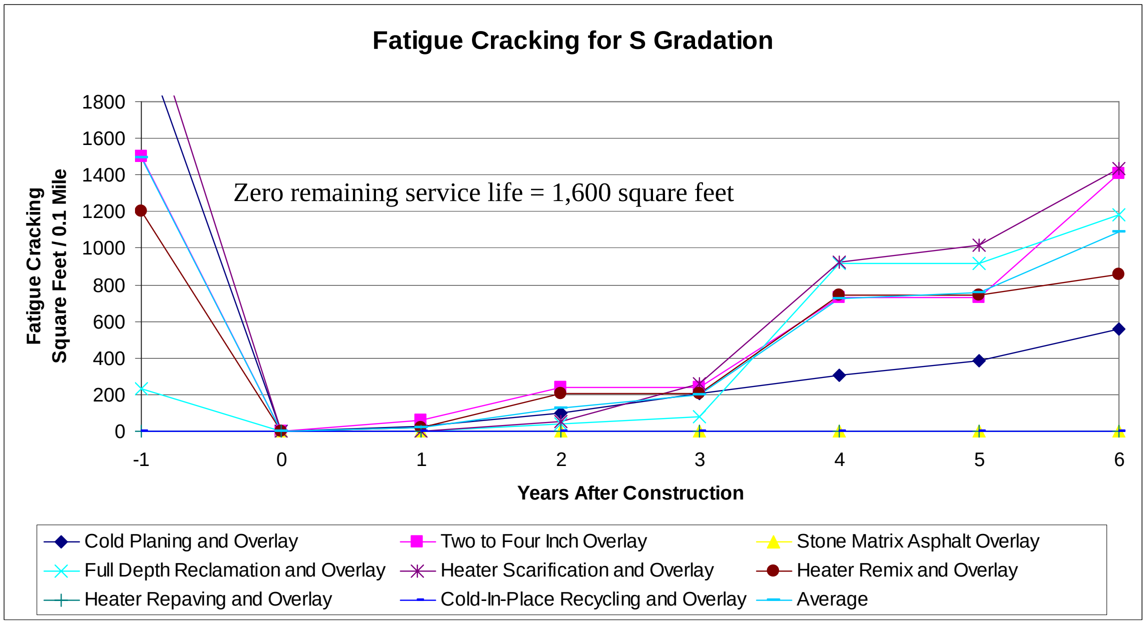

Figure 48 Fatigue cracking performance after six years with relation to having an aggregate size of no greater than 1 inch in diameter

Table 52 Fatigue Performance – S Data

Treatment	S Year										
	-1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	2151.475	0.00	25.81	102.51	203.97	307.65	382.64	555.56	92.33872	0.498	25.14
Two to Four Inch Overlay	1499.867	0	58.74	240.91	240.91	729.14	729.14	1,410.49	216.446	0.321	24.14
Stone Matrix Asphalt Overlay		----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	234.8	0	-	41.36	80.04	917.24	917.24	1,184.77	223.7386	0.202	4
Heater Scarification and Overlay	2389.28	0	-	52.94	258.98	922.84	1,018.14	1,433.06	257.3343	0.642	7.29
Heater Remix and Overlay	1199.2	0	19.13	204.53	204.53	741.87	741.87	857.97	162.7393	0.76	2.71
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	1494.92	0.00	20.74	128.45	197.69	723.75	757.81	1088.37	190.5194		

Fatigue – S

Stone matrix asphalt overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed significantly less amounts of fatigue cracking each year when compared to the other rehabilitation strategies. Heater scarification and overlay showed the greatest amount of fatigue cracking per year. The coefficient of determination shows that the slope is not a good representation of the data as a whole as shown in Table 52.

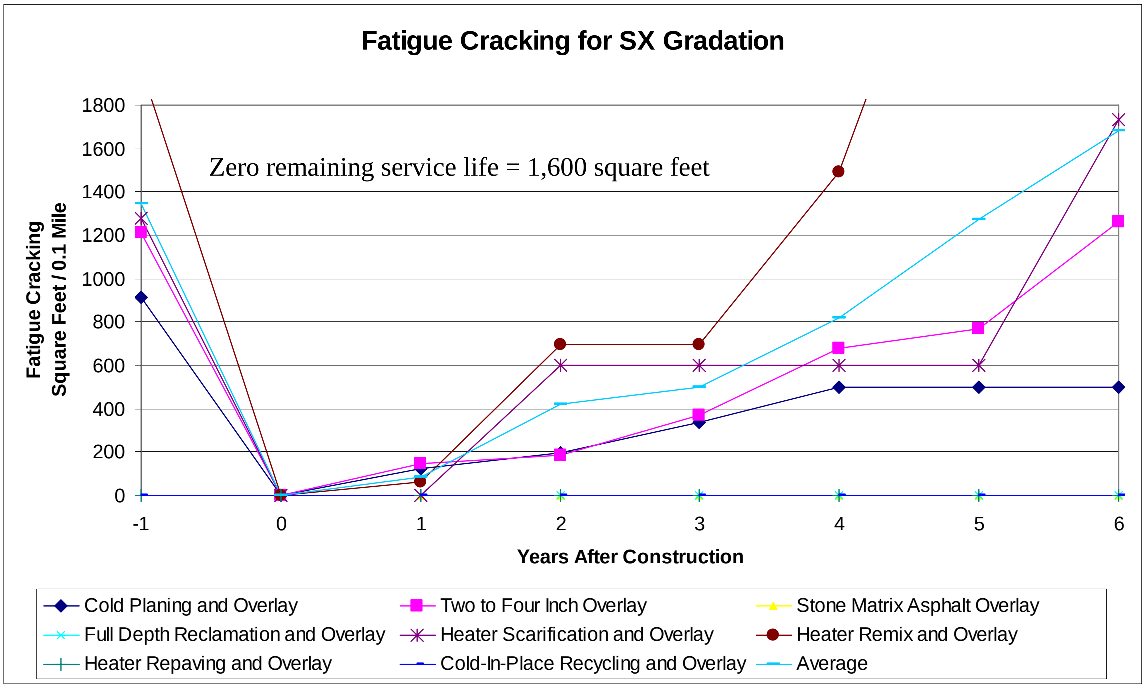

Figure 49 Fatigue cracking performance after six years with relation to having an aggregate size of no greater than 0.75 inch diameter

Table 53 Fatigue Performance – SX Data

Treatment	SX Year -1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	915.75	0	124.83	195.60	335.53	496.53	496.53	501.13	90.99048	0.457	2.71
Two to Four Inch Overlay	1213.113	0	144.26	187.14	369.10	680.81	768.03	1,262.05	197.4055	0.552	19.57
Stone Matrix Asphalt Overlay		----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay		----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	1277.92	0	-	600.95	600.95	600.95	600.95	1,733.05	228.6089	0.65	2.71
Heater Remix and Overlay	1971.15	0	58.93	692.93	692.93	1,491.73	3,235.53	3,235.53	602.0934	0.597	2.71
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	1344	0	82	419	500	818	1275	1683	279.7746		

Fatigue – SX

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed a significantly less amount of fatigue cracking per year than the other rehabilitation strategies. Heater remix and overlay showed significantly greater amounts of fatigue cracking when compared to the other rehabilitation strategies as shown in Table 53.

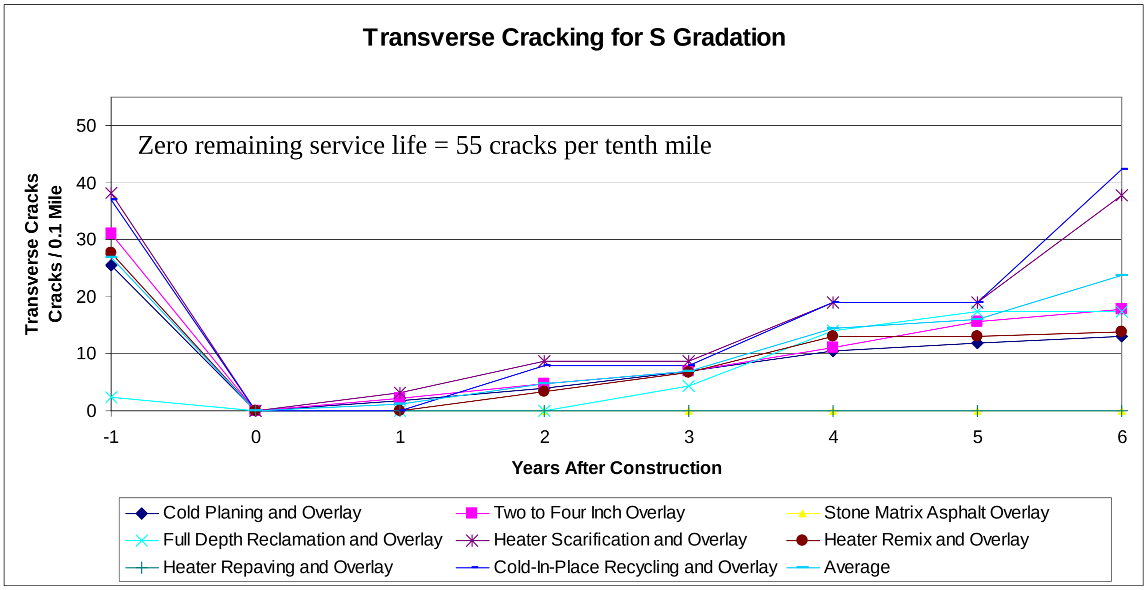

Figure 50 Transverse cracking performance after six years with relation to having an aggregate size of no greater than 1 inch in diameter

Table 54 Transverse Cracking Performance – S Data

Treatment	S Year -1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	25.50286	0	1.74	3.97	6.94	10.45	11.93	13.14	2.367002	0.708	36
Two to Four Inch Overlay	31.13684	0	2.14	4.76	6.89	11.06	15.70	17.74	3.094635	0.761	30.86
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	2.4	0	-	0.10	4.35	13.99	17.50	17.50	3.62034	6.87	4.86
Heater Scarification and Overlay	38.14286	0	3.19	8.74	8.74	19.04	19.04	37.71	5.539913	0.809	9
Heater Remix and Overlay	27.7	0	-	3.40	6.65	13.00	13.00	13.90	2.760714	0.908	13.43
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	36.93333	0	-	7.93	7.93	18.93	18.93	42.33	6.280357	0.595	4.43
Average	26.96931	0	1.178169	4.81543	6.915755	14.41066	16.01577	23.71891	3.943827		

Transverse Cracking – S

Stone matrix asphalt overlay, and heater repaving and overlay are not represented. Both cold planing and overlay and heater remix and overlay have the least amounts of transverse cracking per year. Cold-in-place recycling and overlay showed the greatest amount of transverse cracking per year as shown in Table 54.

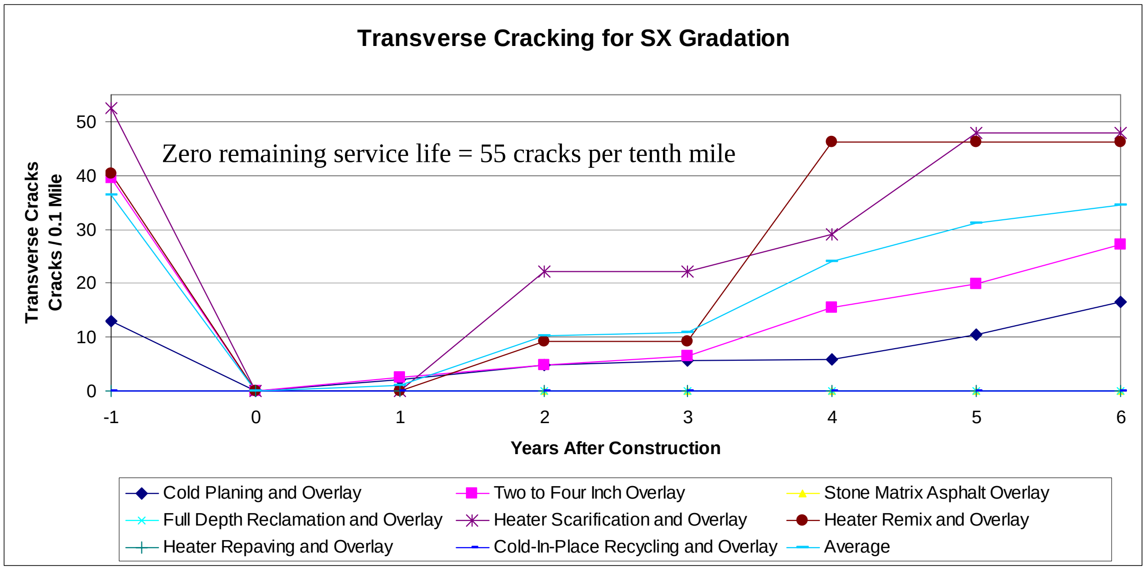

Figure 51 Transverse cracking performance after six years with relation to having an aggregate size of no greater than 0.75 inch diameter

Table 55 Transverse Cracking Performance – SX Data

Treatment	SX										
	Year										
	-1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	12.86667	0	2.04	4.80	5.72	5.84	10.38	16.48	2.398571	0.758	4.14
Two to Four Inch Overlay	39.46667	0	2.51	4.80	6.43	15.47	19.93	27.25	4.544367	0.689	26.43
Stone Matrix Asphalt Overlay		----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay		----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	52.5	0	-	22.13	22.13	29.13	47.83	47.83	8.791667	0.748	3.71
Heater Remix and Overlay	40.35	0	-	9.23	9.23	46.15	46.15	46.15	9.560238	0.611	2.71
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	36	0	1	10	11	24	31	34	6.323711		

Transverse Cracking – SX

Stone matrix asphalt overlay, full depth reclamation and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed significantly less amounts of transverse cracking than the other rehabilitation strategies. Heater remix and overlay showed the greatest amount of transverse cracking per year as shown in Table 55.

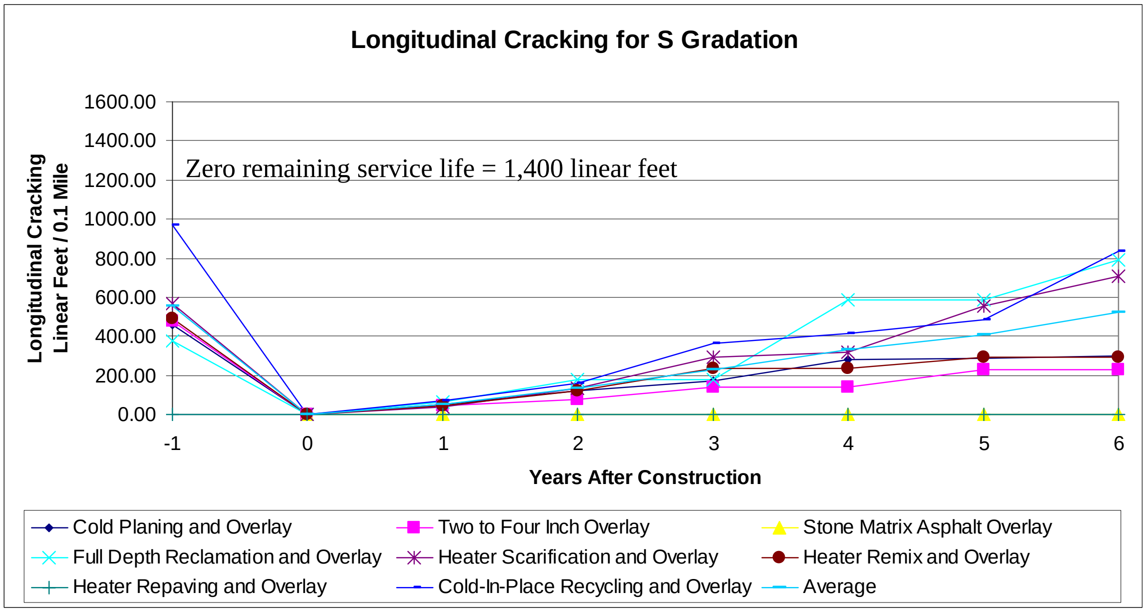

Figure 52 Longitudinal cracking performance after six years with relation to having an aggregate size of no greater than 1 inch in diameter

Table 56 Longitudinal Cracking Performance – S Data

Treatment	S				Year						
	-1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	460.47	0	52.90	121.53	171.33	280.67	288.45	298.65	54.50697	0.681	25.14
Two to Four Inch Overlay	480.3714	0	46.68	76.49	140.80	140.80	229.85	229.85	40.00758	0.468	17.14
Stone Matrix Asphalt Overlay		----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	378.8	0	66.63	177.96	177.96	584.41	584.41	789.41	136.0798	0.523	4.57
Heater Scarification and Overlay	569.0667	0	39.96	133.31	295.65	319.72	552.00	705.84	118.8573	0.706	9
Heater Remix and Overlay	488.2	0	41.73	123.33	238.93	238.93	293.07	293.07	53.48095	0.809	2.71
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	969.5333	0	70.46	160.44	360.56	414.48	483.36	836.11	128.1489	0.659	4.43
Average	557.7401	0	53.06005	132.1766	230.8724	329.8366	405.1899	525.4868	88.51358		

Longitudinal Cracking – S

Stone matrix asphalt overlay, and heater repaving and overlay are not represented. Both 2 to 4 inch overlay and cold planing and overlay showed the least amount of longitudinal cracking per year. Both full depth reclamation and overlay, and cold-in-place recycling and overlay showed the greatest amounts of longitudinal cracking per year as shown in Table 56.

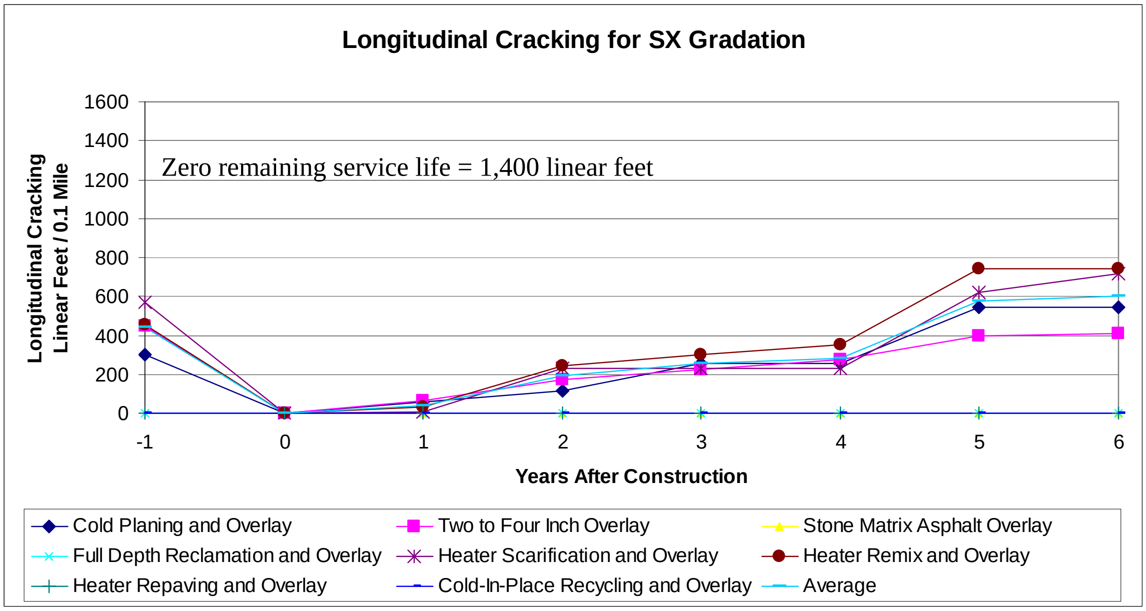

Figure 53 Longitudinal cracking performance after six years with relation to having an aggregate size of no greater than 0.75 inch diameter

Table 57 Longitudinal Cracking Performance – SX Data

Treatment	SX Year -1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	303.76	0	56.60	115.05	255.00	255.00	542.40	542.40	97.8125	0.514	2.86
Two to Four Inch Overlay	445.1	0	63.53	174.57	226.20	278.17	398.09	406.72	71.17396	0.752	19.29
Stone Matrix Asphalt Overlay		----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	567.44	0	9.27	229.79	229.79	229.79	619.09	719.79	120.6786	0.598	2.86
Heater Remix and Overlay	456	0	33.10	243.40	300.64	352.75	740.20	740.20	133.7196	0.861	2.86
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	443	0	40.62	190.70	252.91	278.93	574.94	602.28	105.8462		

Longitudinal Cracking – SX

Stone matrix asphalt overlay, full depth reclamation and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. 2 to 4 inch overlay showed the least amount of longitudinal cracking per year. Heater remix and overlay showed significantly more longitudinal cracking per year when compared with the other rehabilitation strategies as shown in Table 57.

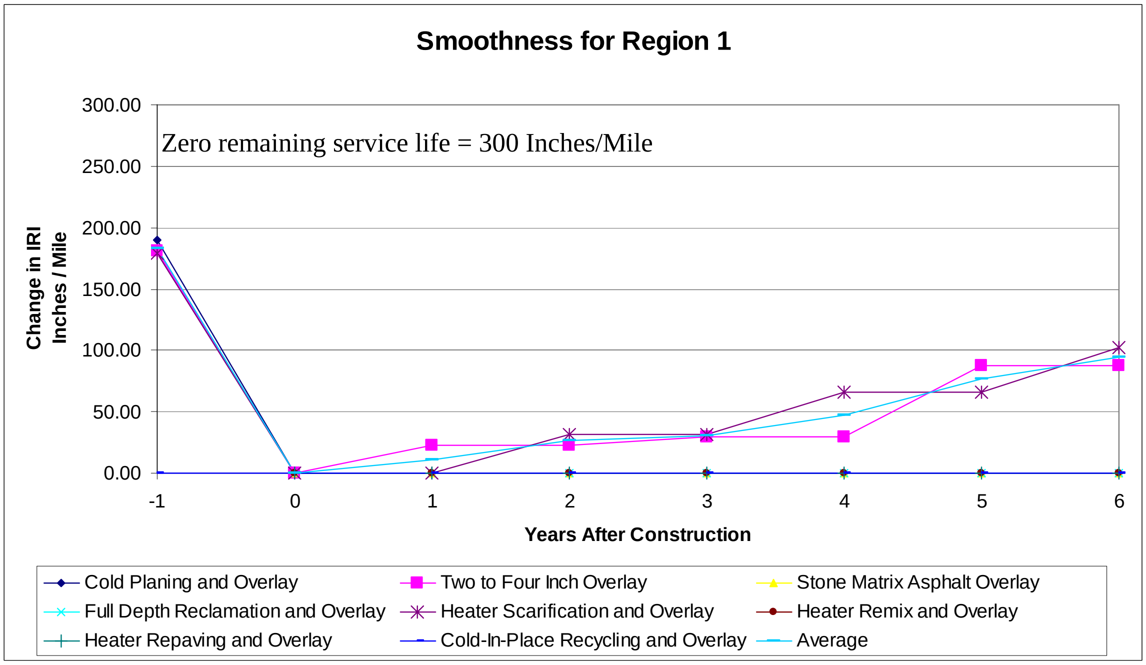

Figure 54 Rate of change for smoothness after six years in relation to Region 1

Table 58 Smoothness Performance – Region 1 Data

Treatment	Region 1 -1	Year 0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	189.56	----	----	----	----	----	----	----	----	----	----
Two to Four Inch Overlay	180.8	0	22	22	29	29	87	87	14.27041	0.794	4.29
Stone Matrix Asphalt Overlay		----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay		----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	178.5667	0	0	31	31	66	66	102	16.82214	0.817	7
Heater Remix and Overlay		----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay		----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	183	0	11	27	30	47	76	95	15.54628		

Smoothness – Region 1

Cold planing and overlay, stone matrix asphalt overlay, full depth reclamation and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. 2 to 4 inch and heater scarification and overlay are the only two rehabilitation strategies represented and both performed similarly as shown in Table 58.

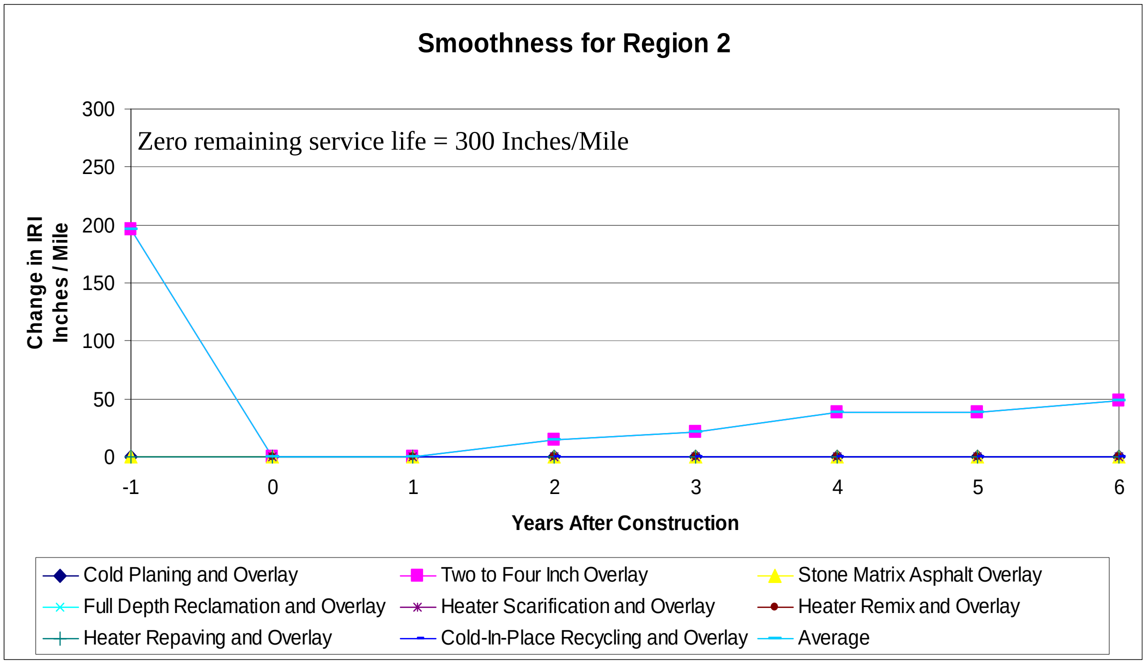

Figure 55 Rate of change for smoothness after six years in relation to Region 2

Table 59 Smoothness Performance – Region 2 Data

Treatment	Region 2			Year							
	-1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	----	----	----	----	----	----	----	----	----	----	----
Two to Four Inch Overlay	196	0	-	14.11	21.29	38.62	38.62	48.90	8.87398	0.828	5.43
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay		----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay		----	----	----	----	----	----	----	----	----	----
Heater Remix and Overlay		----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay		----	----	----	----	----	----	----	----	----	----
Average	196	0	0.00	14.11	21.29	38.62	38.62	48.90	8.87398		

Smoothness – Region 2

Two to 4-inch overlay is the only rehabilitation strategy represented in this section so an analysis could not be done.

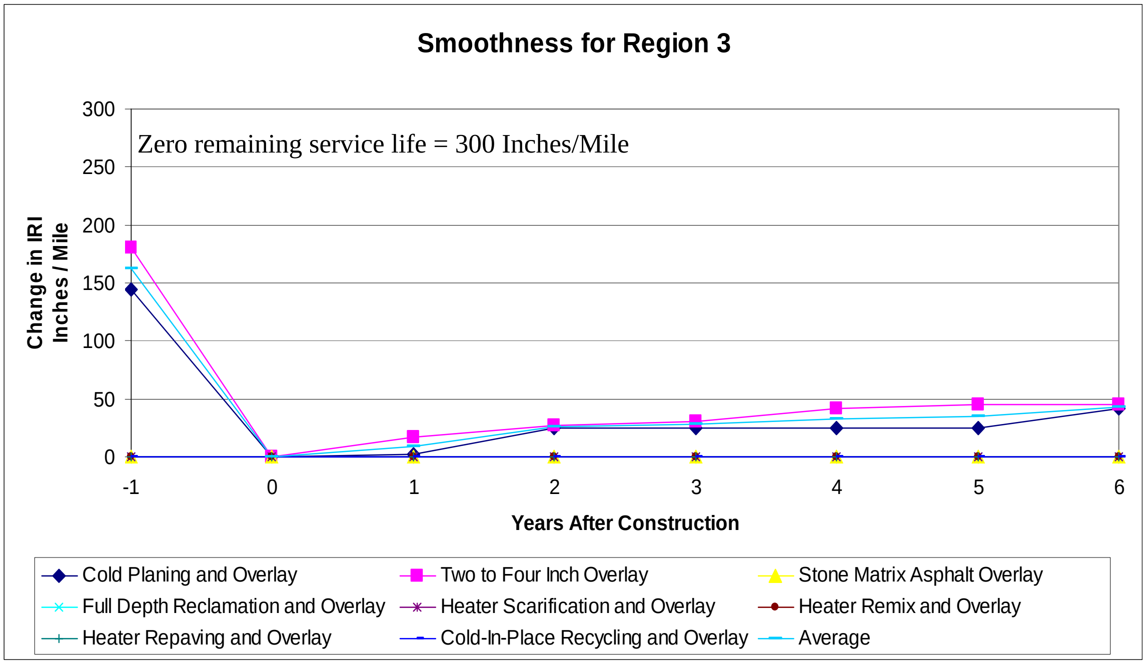

Figure 56 Rate of change for smoothness after six years in relation to Region 3

Table 60 Smoothness Performance – Region 3 Data

Treatment	Region 3										
	Year										
	-1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	143.8667	0	1.93	24.67	24.67	24.67	24.67	41.40	6.059524	0.834	3
Two to Four Inch Overlay	180.175	0	16.37	26.99	30.69	41.52	44.98	44.98	7.382273	0.844	6.71
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	162	0	9.15	25.83	27.68	33.09	34.83	43.19	6.720899		

Smoothness – Region 3

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater scarification and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. The cold planing and overlay and the 2 to 4-inch overlay are the only two rehabilitation strategies represented and they performed similarly as shown in Table 60.

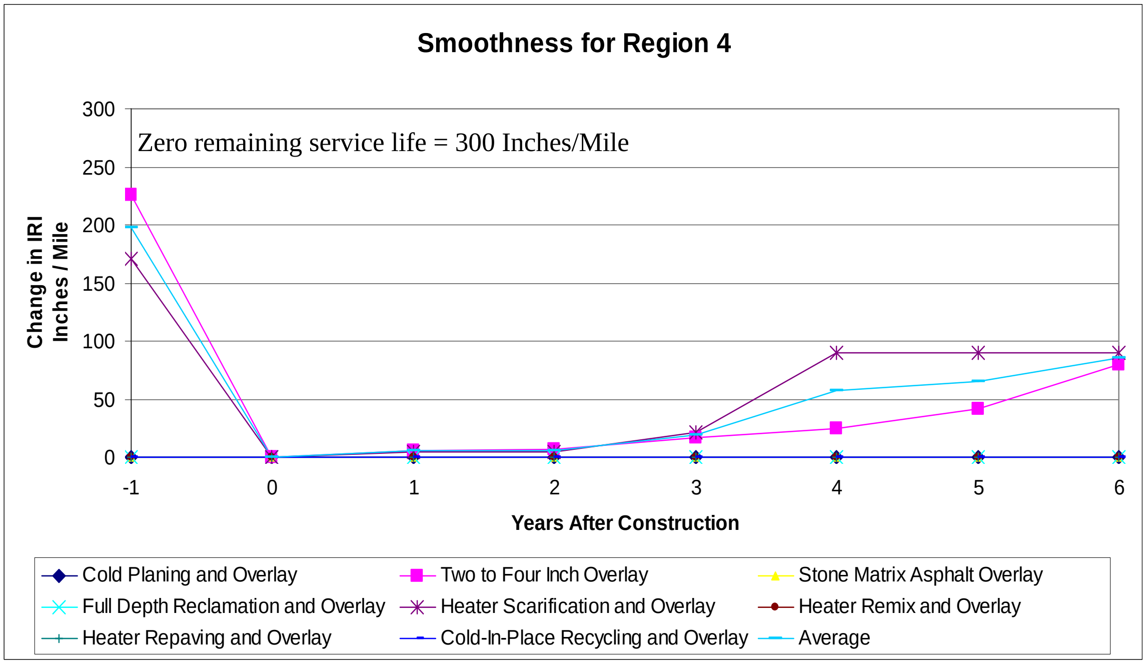

Figure 57 Rate of change for smoothness after six years in relation to Region 4

Table 61 Smoothness Performance – Region 4 Data

Treatment	Region 4 Year -1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	----	----	----	----	----	----	----	----	----	----	----
Two to Four Inch Overlay	225.3	0	5.37	6.88	16.80	25.16	41.04	79.88	11.75952	0.792	4.57
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	170.5333	0	5.03	5.03	21.33	89.95	89.95	89.95	18.73571	0.868	3
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	198	0	5.20	5.95	19.07	57.55	65.49	84.91	15.24762		

Smoothness – Region 4

Cold planing and overlay, stone matrix asphalt overlay, full depth reclamation and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. 2 to 4 inch overlay showed the best performance when compared with other rehabilitation strategies. Heater scarification and overlay performed the worst as shown in Table 61.

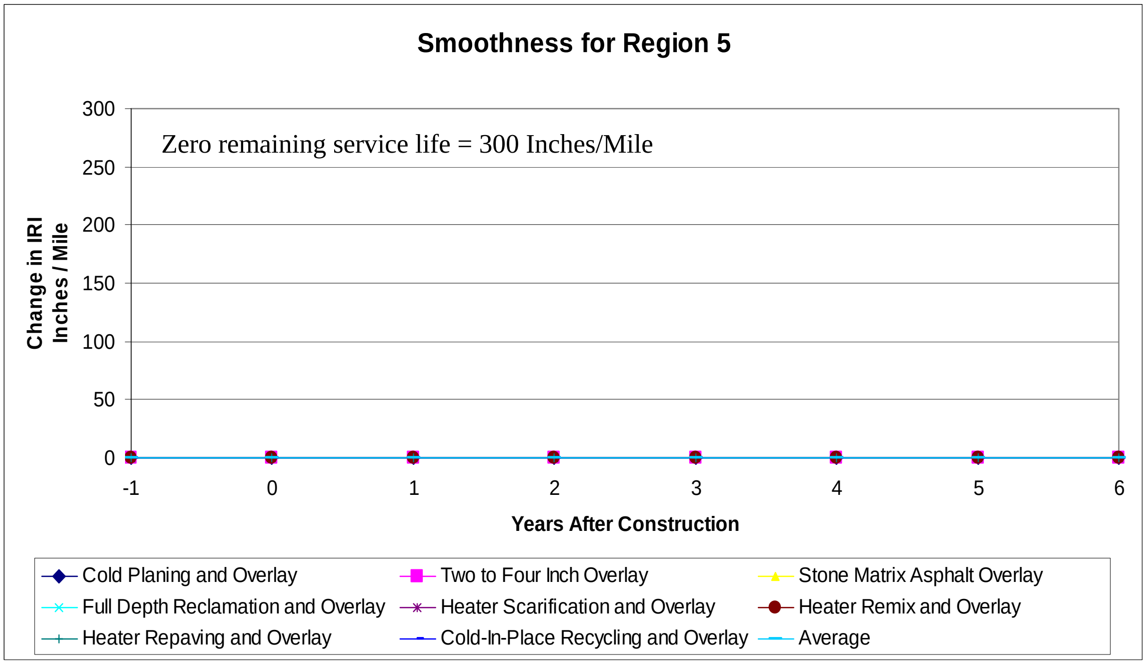

Figure 58 Rate of change for smoothness after six years in relation to Region 5

Table 62 Smoothness Performance – Region 5 Data

Region 5											
Treatment	**Year**										
	-1	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**Slope**	**R^2**	**n, Avg**
Cold Planing and Overlay	----	----	----	----	----	----	----	----	----	----	----
Two to Four Inch Overlay	----	----	----	----	----	----	----	----	----	----	----
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!		

Smoothness – Region 5

None of the rehabilitation strategies met the predetermined criteria so an analysis could not be performed.

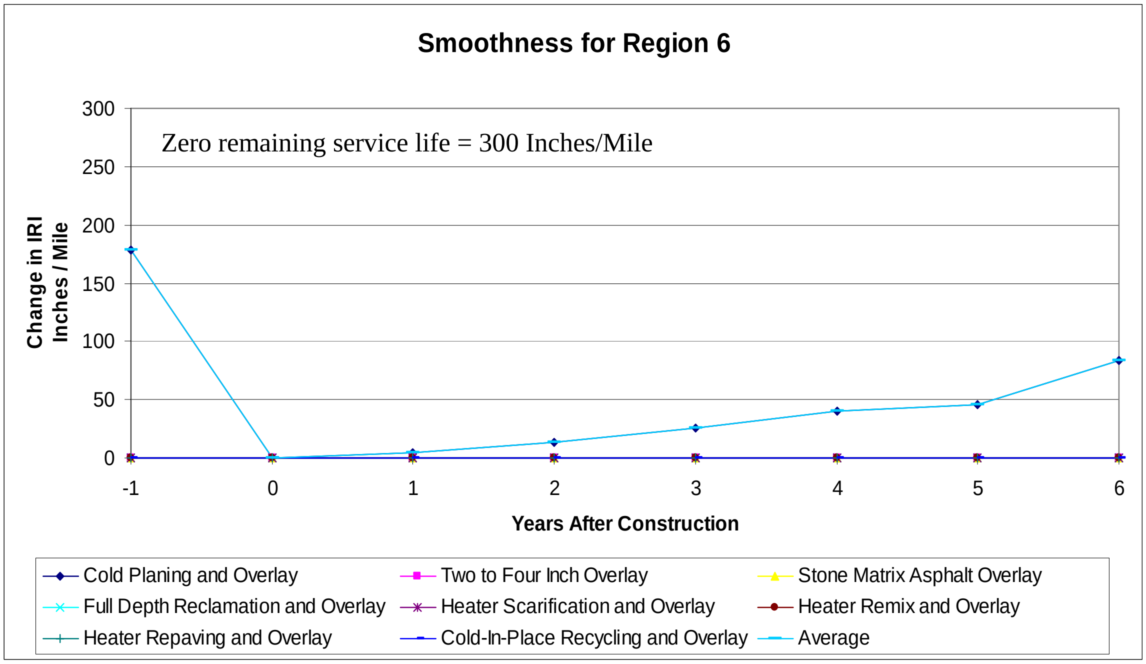

Figure 59 Rate of change for smoothness after six years in relation to Region 6

Table 63 Smoothness Performance – Region 6 Data

Treatment	Region 6			Year							
	-1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	178.9636	0	4.02	13.60	25.09	40.49	45.72	83.89	12.92744	0.839	7.29
Two to Four Inch Overlay	----	----	----	----	----	----	----	----	----	----	----
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	179	0	4.02	13.60	25.09	40.49	45.72	83.89	12.92744		

Smoothness – Region 6

Cold planing and overlay is the only rehabilitation strategy represented in this section so an analysis could not be done.

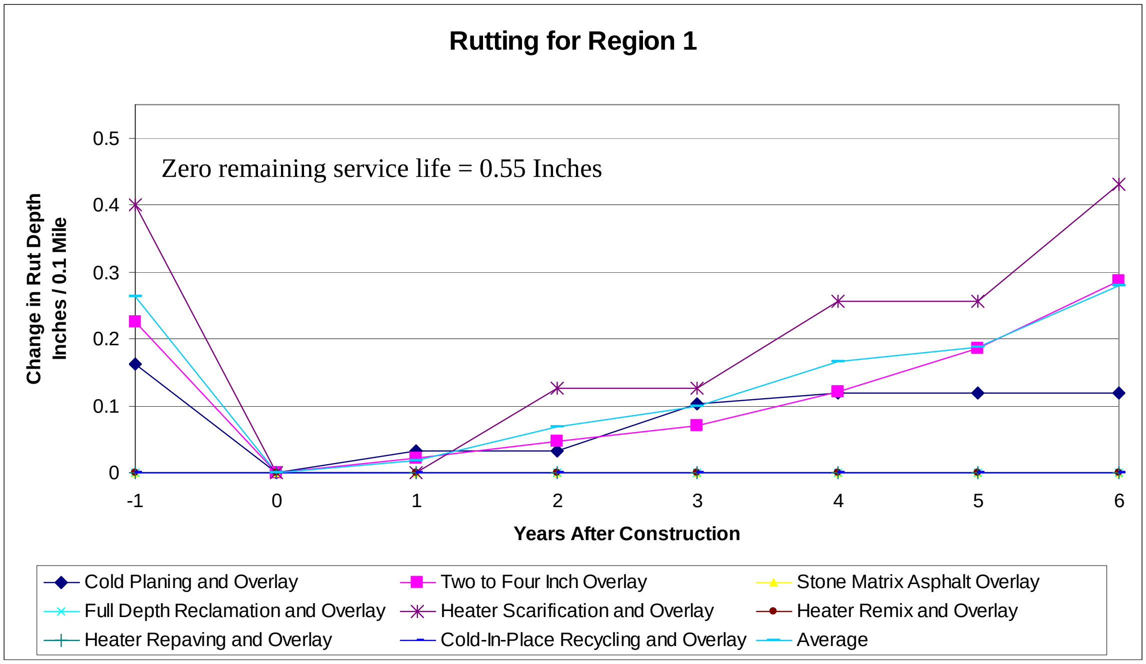

Figure 60 Permanent deformation performance after six years in relation to Region 1

Table 64 Rutting Performance – Region 1 Data

Treatment	Region 1				Year						
	-1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	0.163	0.00	0.03	0.03	0.10	0.12	0.12	0.12	0.02206	0.771	5.57
Two to Four Inch Overlay	0.2256	0	0.02	0.05	0.07	0.12	0.19	0.29	0.045076	0.914	7.57
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	0.4012	0	-	0.13	0.13	0.26	0.26	0.43	0.069187	0.871	6.43
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	0	0	0.02	0.07	0.10	0.17	0.19	0.28	0.045441		

Rutting – Region 1

Stone matrix asphalt overlay, full depth reclamation and overlay, heater remix and overlay, heater repaving and overlay, cold-in-place recycling and overlay are not represented. Cold planing and overlay showed the least amount of rutting per year. Heater scarification and overlay showed significantly more rutting per year than the other rehabilitation strategies as shown in Table 64.

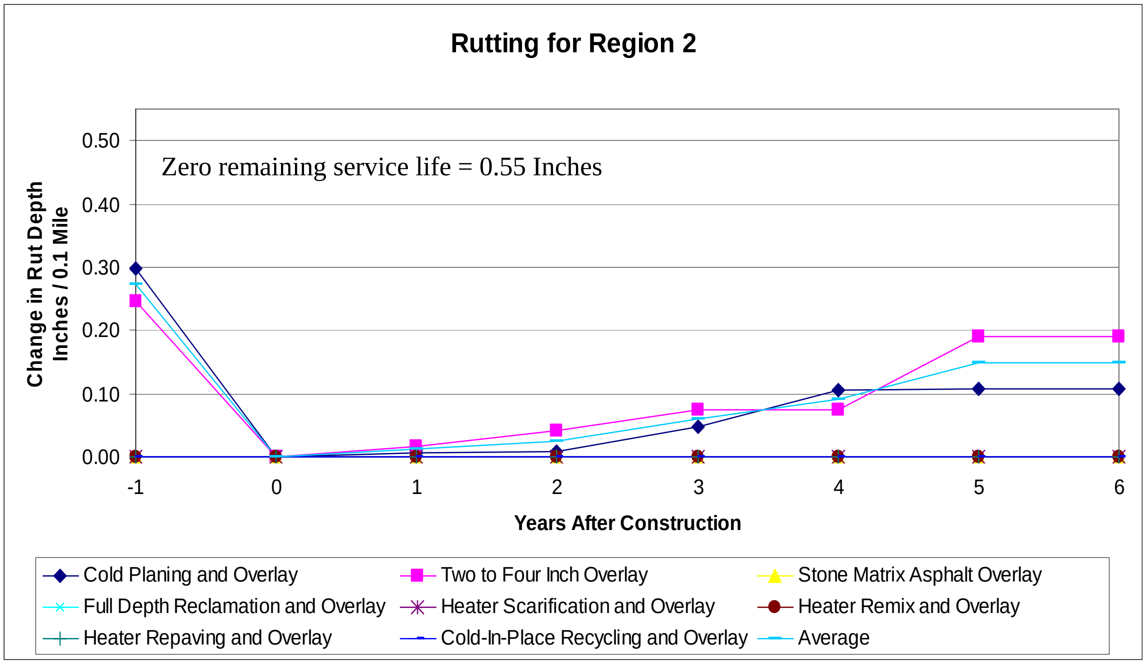

Figure 61 Permanent deformation performance after six years in relation to Region 2

Table 65 Rutting Performance – Region 2 Data

Treatment	Region 2 Year -1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	0.298	0	0.01	0.01	0.05	0.11	0.11	0.11	0.022299	0.869	4.14
Two to Four Inch Overlay	0.246	0	0.02	0.04	0.07	0.07	0.19	0.19	0.033968	0.852	6.43
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	0	0	0.01	0.02	0.06	0.09	0.15	0.15	0.028133		

Rutting – Region 2

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater scarification and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Both cold planing and overlay and 2 to 4-inch overlay performed similarly and are the only two rehabilitation strategies that met the predetermined criteria so an analysis could not be completed as shown in Table 65.

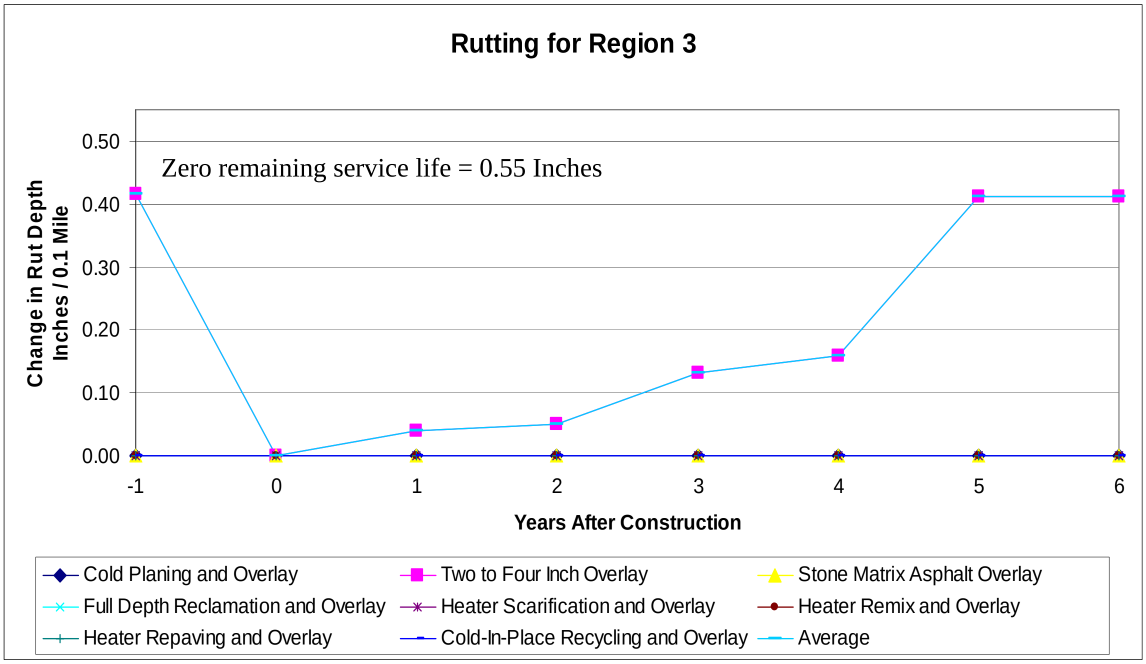

Figure 62 Permanent deformation performance after six years in relation to Region 3

Table 66 Rutting Performance – Region 3 Data

Treatment	Region 3 Year -1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	----	----	----	----	----	----	----	----	----	----	----
Two to Four Inch Overlay	0.4154	0	0.04	0.05	0.13	0.16	0.41	0.41	0.0746	0.611	11.43
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	0	0	0.04	0.05	0.13	0.16	0.41	0.41	0.0746		

Rutting – Region 3

Two to 4-inch overlay is the only rehabilitation strategy represented in this section so an analysis could not be done.

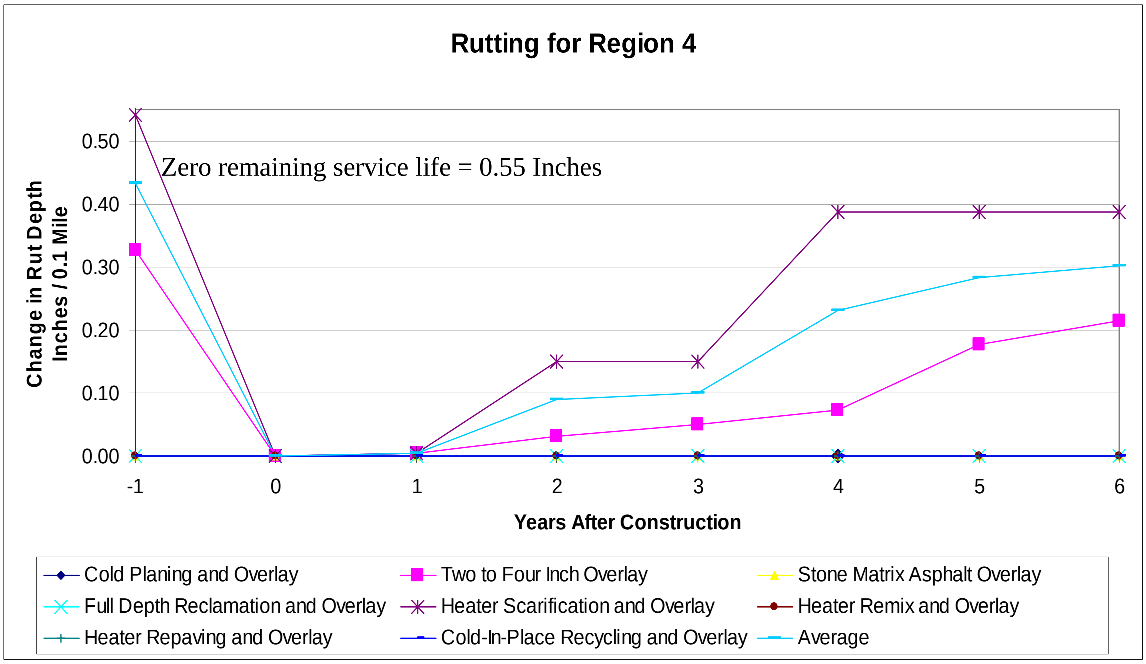

Figure 63 Permanent deformation performance after six years in relation to Region 4

Table 67 Rutting Performance – Region 4 Data

	Region 4										
Treatment					**Year**						
	-1	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**Slope**	**R^2**	**n, Avg**
Cold Planing and Overlay	----	----	----	----	----	----	----	----	----	----	----
Two to Four Inch Overlay	0.3265	0	0.00	0.03	0.05	0.07	0.18	0.21	0.036879	0.834	8.57
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	0.542	0	0.00	0.15	0.15	0.39	0.39	0.39	0.077586	0.859	3
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	0	0	0.00	0.09	0.10	0.23	0.28	0.30	0.057232		

Rutting – Region 4

Cold planing and overlay, stone matrix asphalt overlay, full depth reclamation and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. 2 to 4 inch overlay showed significantly less amounts of rutting per year than heater scarification and overlay as shown in Table 67.

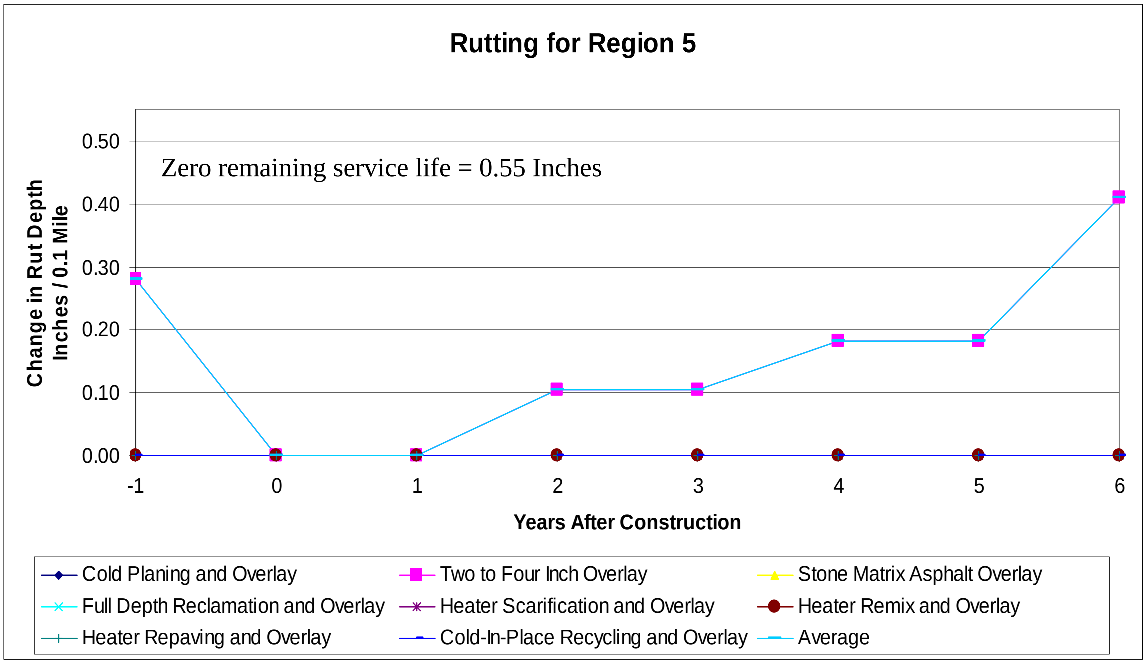

Figure 64 Permanent deformation performance after six years in relation to Region 5

Table 68 Rutting Performance – Region 5 Data

Treatment	Region 5 Year -1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	----	----	----	----	----	----	----	----	----	----	----
Two to Four Inch Overlay	0.28	0	-	0.10	0.10	0.18	0.18	0.41	0.059667	0.896	3.29
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	0	0	0.00	0.10	0.10	0.18	0.18	0.41	0.059667		

Rutting – Region 5

Two to 4-inch overlay is the only rehabilitation strategy represented in this section so an analysis could not be done.

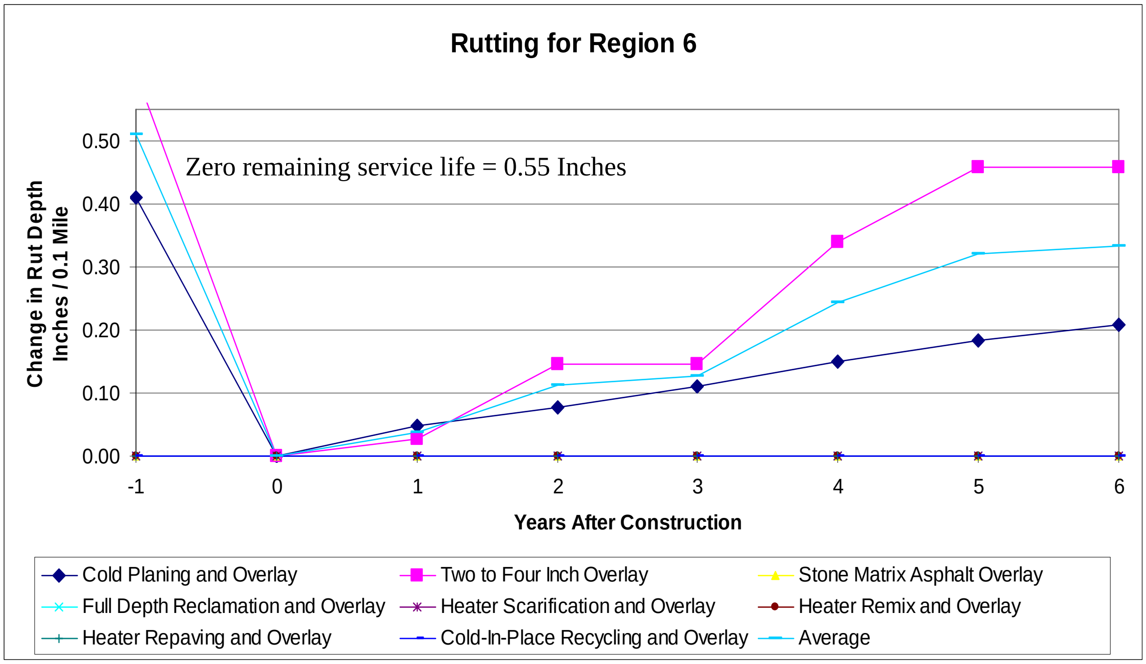

Figure 65 Permanent deformation performance after six years in relation to Region 6

Table 69 Rutting Performance – Region 6 Data

Treatment	Region 6				Year						
	-1	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**Slope**	**R^2**	**n, Avg**
Cold Planing and Overlay	0.4108	0	0.05	0.08	0.11	0.15	0.18	0.21	0.034709	0.869	15
Two to Four Inch Overlay	0.608667	0	0.03	0.15	0.15	0.34	0.46	0.46	0.086786	0.864	5.57
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	1	0	0.04	0.11	0.13	0.24	0.32	0.33	0.060748		

Rutting – Region 6

Stone matrix asphalt overlay, full depth reclamation and overlay, heater scarification and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed a significantly less amount of rutting per year than 2 to 4 inch overlay as shown in Table 69.

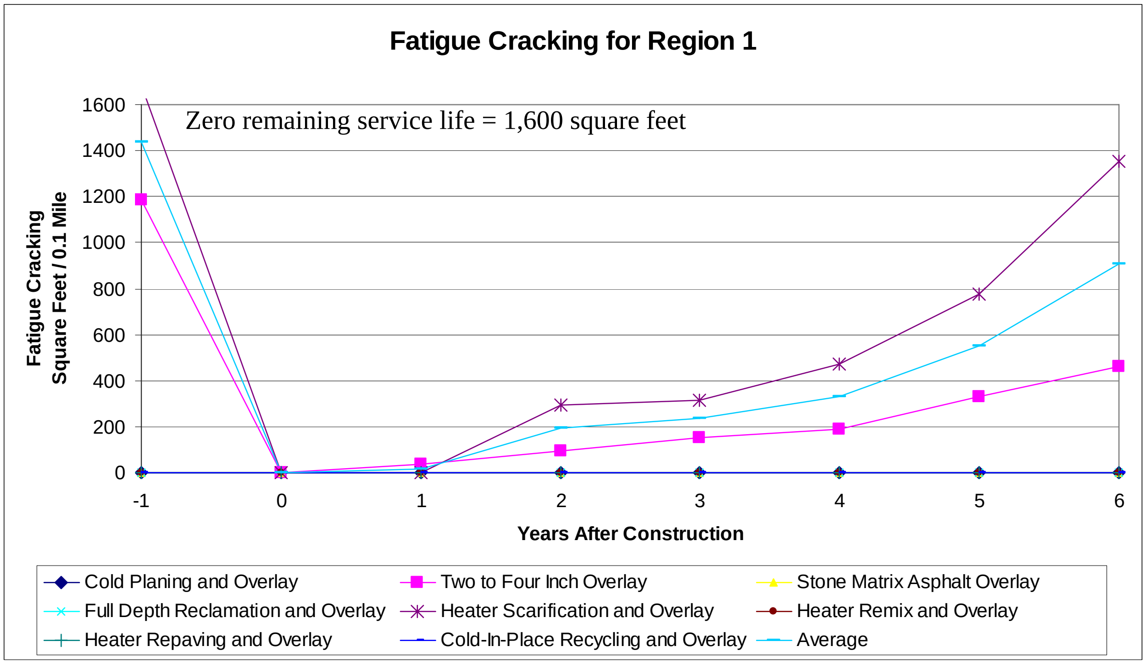

Figure 66 Fatigue cracking performance after six years in relation to Region 1

Table 70 Fatigue Performance – Region 1 Data

Treatment	Region 1 Year -1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	----	----	----	----	----	----	----	----	----	----	----
Two to Four Inch Overlay	1185.218	0	35.66	95.53	153.53	190.49	328.43	460.18	73.60826	0.483	9.29
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	1684.743	0	-	296.17	316.17	471.04	777.59	1,351.04	206.542	0.673	8.14
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	1435	0	17.83	195.85	234.85	330.76	553.01	905.61	140.0751		

Fatigue – Region 1

Cold planing and overlay, stone matrix asphalt overlay, full-depth reclamation and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Two to 4-inch overlay showed significantly less amounts of fatigue cracking than heater scarification and overlay as shown in Table 70.

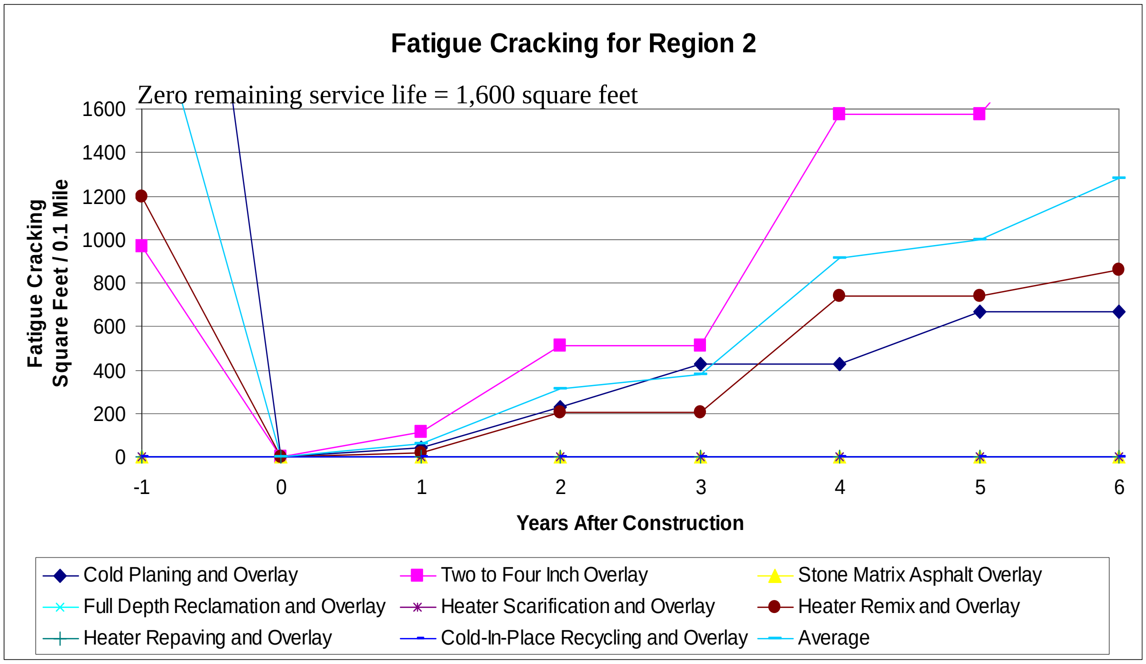

Figure 67 Fatigue cracking performance after six years in relation to Region 2

Table 71 Fatigue Performance – Region 2 Data

Treatment	Region 2										
	Year										
	-1	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**Slope**	**R^2**	**n, Avg**
Cold Planing and Overlay	4710.333	0	39.74	226.97	426.77	430.06	669.89	669.89	124.0378	0.549	6.43
Two to Four Inch Overlay	966.65	0	114.94	512.77	512.77	1,578.44	1,578.44	2,322.24	391.4078	0.395	4.86
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Remix and Overlay	1199.2	0	19.13	204.53	204.53	741.87	741.87	857.97	162.7393	0.76	2.71
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	2292	0	57.94	314.76	381.36	916.79	996.73	1283.37	226.0616		

Fatigue – Region 2

Stone matrix asphalt and overlay, full depth reclamation and overlay, heater scarification and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed the least amount of fatigue cracking per year. Two to 4-inch overlay showed significantly more fatigue cracking per year than the other rehabilitation strategies as shown in Table 71.

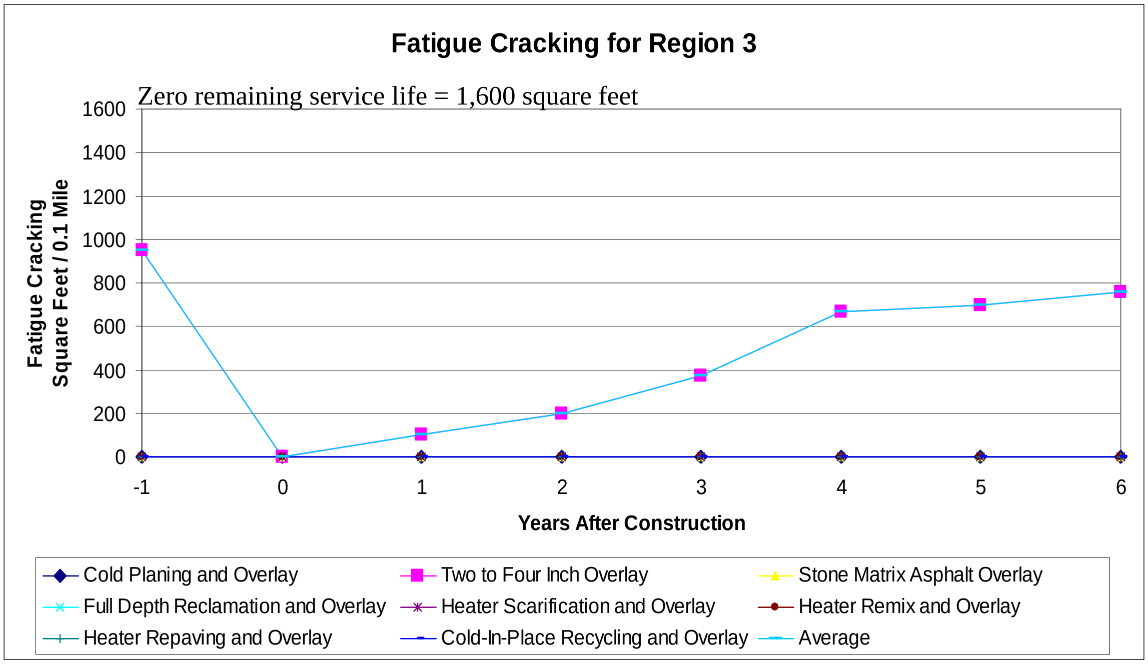

Figure 68 Fatigue cracking performance after six years in relation to Region 3

Table 72 Fatigue Performance – Region 3 Data

	Region 3										
Treatment	Year										
	-1	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**Slope**	**R^2**	**n, Avg**
Cold Planing and Overlay	----	----	----	----	----	----	----	----	----	----	----
Two to Four Inch Overlay	948.3857	0	102.63	198.60	370.35	669.93	698.85	756.61	140.4856	0.684	12.86
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	948	0	102.63	198.60	370.35	669.93	698.85	756.61	140.4856		

Fatigue – Region 3

Two to 4-inch overlay is the only rehabilitation strategy represented in this section so an analysis could not be done.

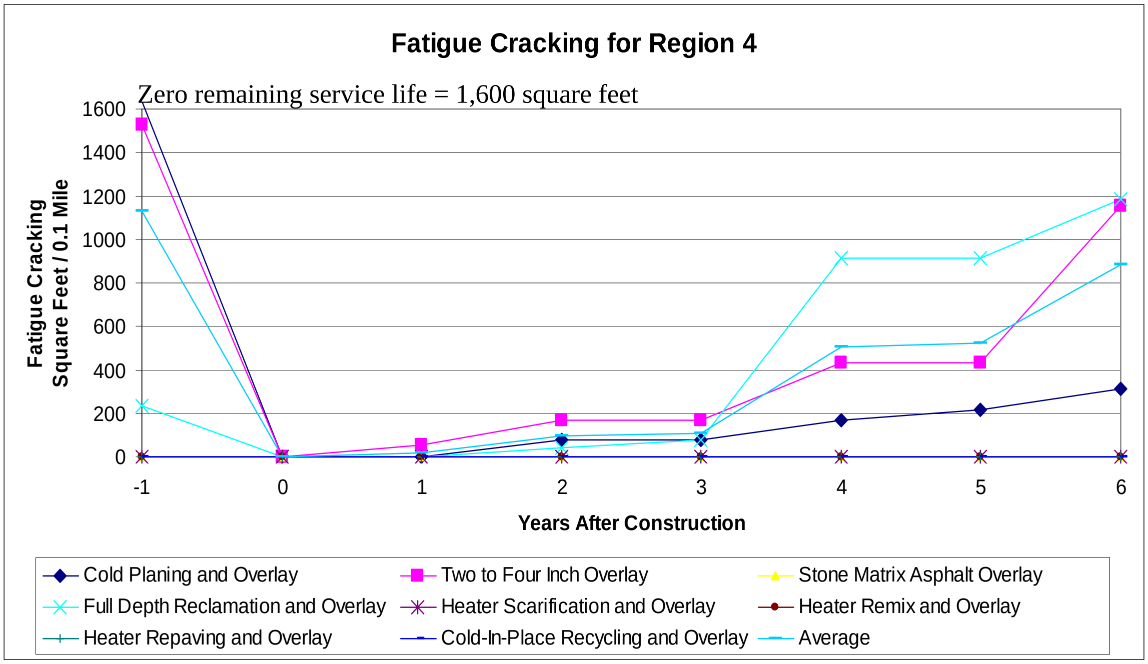

Figure 69 Fatigue cracking performance after six years in relation to Region 4

Table 73 Fatigue Performance – Region 4 Data

Region 4											
Treatment	**Year**										
	-1	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**Slope**	**R^2**	**n, Avg**
Cold Planing and Overlay	1638.8	0	-	79.37	79.37	168.82	214.92	312.42	52.01905	0.629	2.86
Two to Four Inch Overlay	1527.44	0	52.02	169.20	169.20	434.18	434.18	1,153.69	160.3699	0.296	10.86
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	234.8	0	-	41.36	80.04	917.24	917.24	1,184.77	223.7386	0.202	4
Heater Scarification and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	1134	0	17.34	96.64	109.54	506.75	522.11	883.63	145.3758		

Fatigue – Region 4

Stone matrix asphalt overlay, heater scarification and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed significantly less fatigue cracking per year than the other rehabilitation strategies. Full depth reclamation and overlay showed the most amount of fatigue cracking per year as shown in Table 73.

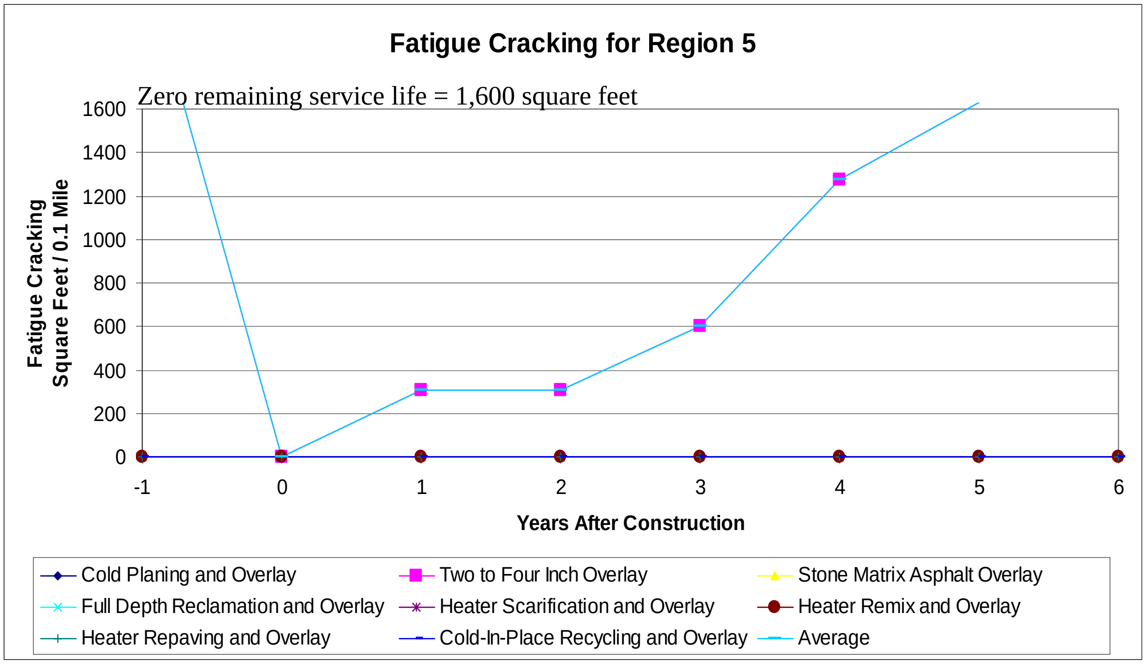

Figure 70 Fatigue cracking performance after six years in relation to Region 5

Table 74 Fatigue Performance – Region 5 Data

Region 5											
Treatment	**Year**										
	-1	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**Slope**	**R^2**	**n, Avg**
Cold Planing and Overlay	----	----	----	----	----	----	----	----	----	----	----
Two to Four Inch Overlay	2305.867	0	307.83	307.83	600.01	1,277.91	1,631.76	4,346.76	594.9371	0.549	3.29
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	2306	0	307.83	307.83	600.01	1277.91	1631.76	4346.76	594.9371		

Fatigue – Region 5

Two to 4-inch overlay is the only rehabilitation strategy represented in this section so an analysis could not be done.

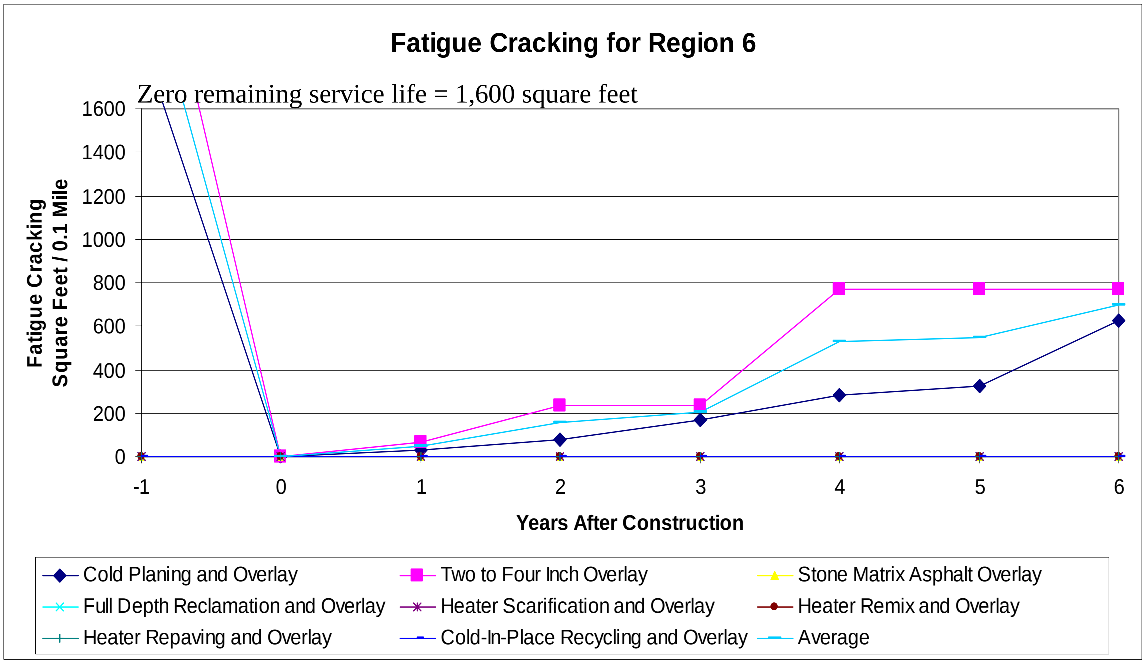

Figure 71 Fatigue cracking performance after six years in relation to Region 6

Table 75 Fatigue Performance – Region 6 Data

Region 6											
Treatment	**Year**										
	-1	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**Slope**	**R^2**	**n, Avg**
Cold Planing and Overlay	1917.2	0	31.15	75.61	169.16	284.90	325.66	626.73	95.66131	0.644	14.43
Two to Four Inch Overlay	2738.1	0	64.70	235.65	235.65	771.85	771.85	771.85	152.3589	0.597	2.86
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	2328	0	47.92	155.63	202.41	528.38	548.76	699.29	124.0101		

Fatigue – Region 6

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater scarification and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed less fatigue cracking per year than 2 to 4 inch overlay as shown in Table 75.

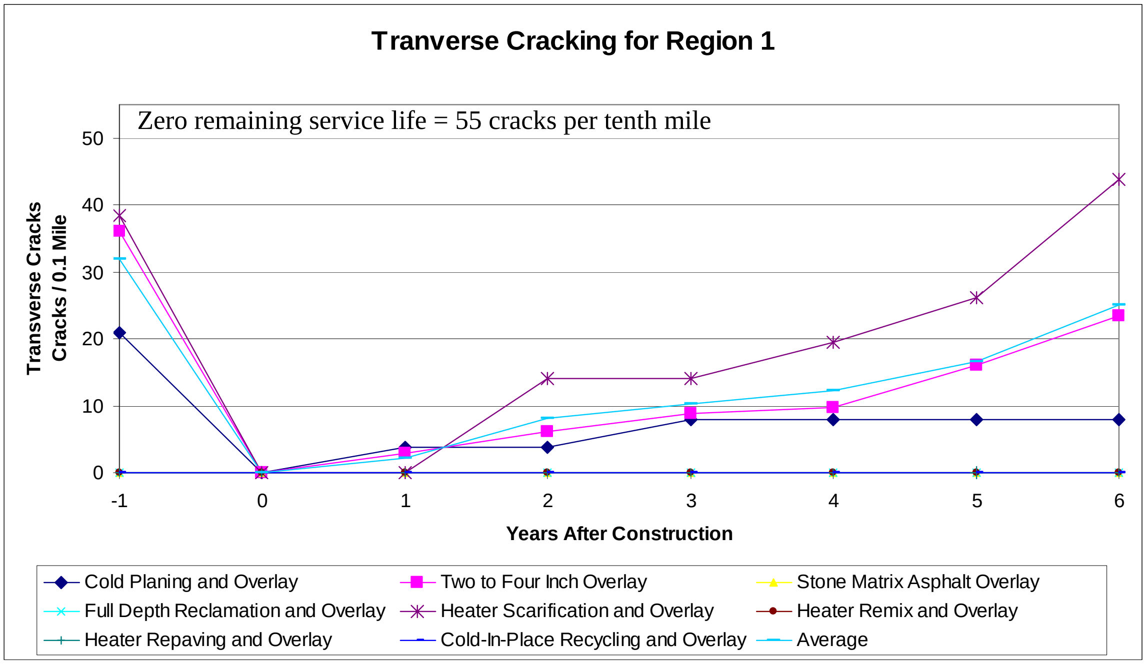

Figure 72 Transverse cracking performance after six years in relation to Region 1

Table 76 Transverse Cracking Performance – Region 1 Data

Treatment	Region 1 Year -1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	21	0.00	3.80	3.80	7.90	7.90	7.90	7.90	1.285714	0.661	3
Two to Four Inch Overlay	36.11111	0	2.81	6.20	8.84	9.66	15.96	23.36	3.566039	0.809	9.14
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	38.4	0	-	14.10	14.10	19.46	26.06	43.73	6.738393	0.717	9.57
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	32	0	2.20	8.03	10.28	12.34	16.64	25.00	3.863382		

Transverse Cracking – Region 1

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed the least amount of transverse cracking per year. Heater scarification and overlay showed significantly more transverse cracking than any other rehabilitation strategy as shown in Table 76.

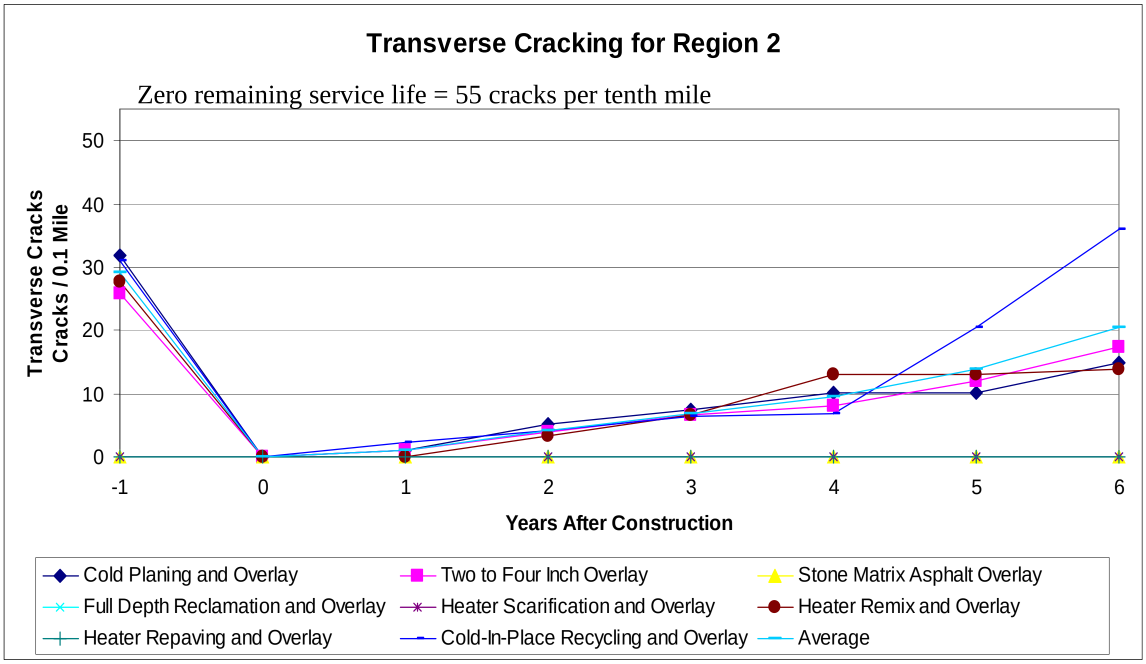

Figure 73 Transverse cracking performance after six years in relation to Region 2

Table 77 Transverse Cracking Performance – Region 2 Data

	Region 2										
Treatment					**Year**						
	-1	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**Slope**	**R^2**	**n, Avg**
Cold Planing and Overlay	31.92	0	0.96	5.21	7.47	10.13	10.13	14.81	2.417985	0.692	8.14
Two to Four Inch Overlay	25.77143	0	1.07	3.88	6.67	8.03	12.09	17.30	2.789371	0.797	10.14
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Remix and Overlay	27.7	0	-	3.40	6.65	13.00	13.00	13.90	2.760714	0.908	3.43
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	31	0	2.20	4.20	6.33	6.80	20.53	36.07	5.266667	0.629	3
Average	29	0	1.06	4.17	6.78	9.49	13.94	20.52	3.308684		

Transverse Cracking – Region 2

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater scarification and overlay, and heater repaving and overlay are not represented. Cold planing and overlay, 2 to 4 inch overlay, and heater remix and overlay all showed close to the same amount of transverse cracking per year. Cold-in-place recycling and overlay showed around twice as much transverse cracking per year than the other rehabilitation strategies as shown in Table 77.

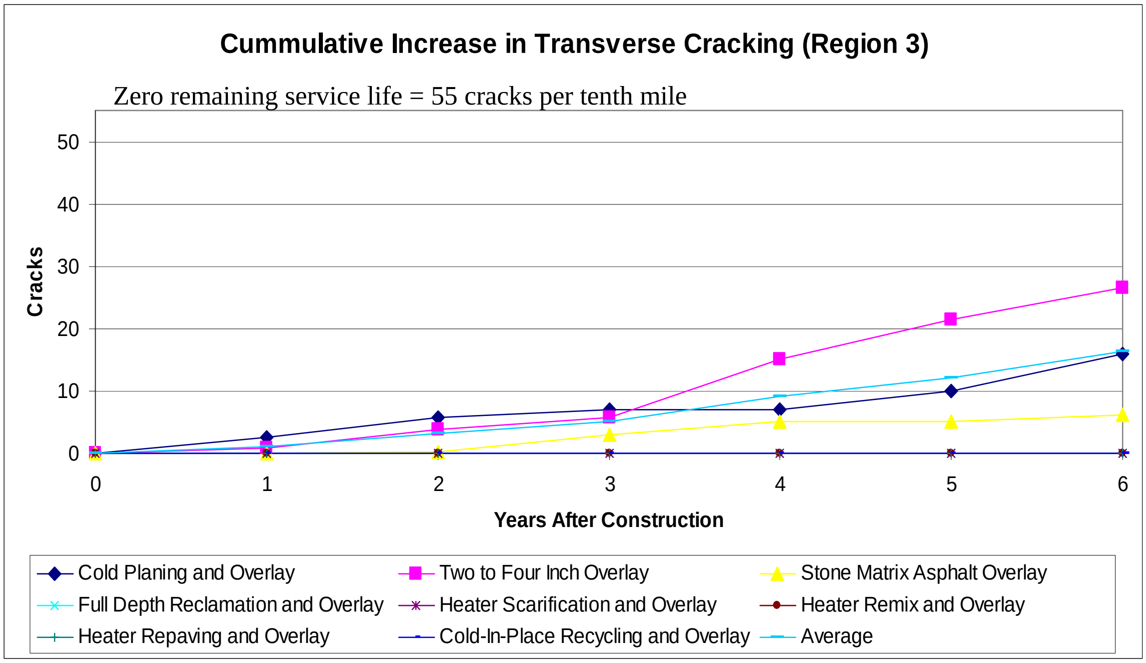

Figure 74 Transverse cracking performance after six years in relation to Region 3

Table 78 Transverse Cracking Performance – Region 3 Data

Treatment	Region 3				Year						
	-1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	12.45	0	2.50	5.80	6.95	6.95	9.90	16.00	2.283929	0.841	3.43
Two to Four Inch Overlay	40.90588	0	0.94	3.78	5.74	14.97	21.51	26.56	4.715153	0.724	17.86
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	27	0	1.72	4.79	6.34	10.96	15.71	21.28	3.499541		

Transverse Cracking – Region 3

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater scarification and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed the least amount of transverse cracking per year. Two to 4-inch overlay showed the most transverse cracking per year as shown in Table 78.

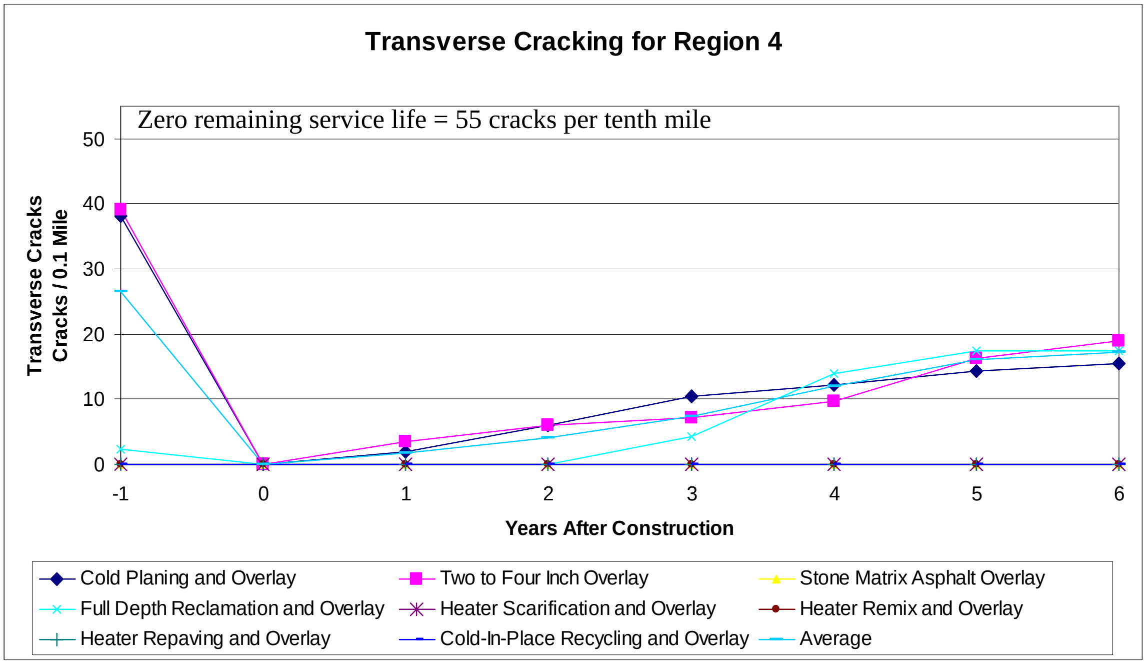

Figure 75 Transverse cracking performance after six years in relation to Region 4

Table 79 Transverse Cracking Performance – Region 4 Data

Treatment	Region 4				Year						
	-1	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**Slope**	**R^2**	**n, Avg**
Cold Planing and Overlay	38.15	0	1.95	6.08	10.48	12.28	14.40	15.56	2.778095	0.709	5.71
Two to Four Inch Overlay	39.06667	0	3.43	6.10	7.25	9.61	16.33	18.92	3.074329	0.748	10.71
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	2.4	0	-	0.10	4.35	13.99	17.50	17.50	3.62034	0.687	4.86
Heater Scarification and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	27	0	1.79	4.09	7.36	11.96	16.08	17.33	3.157588		

Transverse Cracking – Region 4

Stone matrix asphalt overlay, heater scarification and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Both cold planing and overlay, and 2 to 4 inch overlay performed similarly. Full depth reclamation and overlay showed a greater amount of transverse cracking than the other two rehabilitation strategies as shown in Table 79.

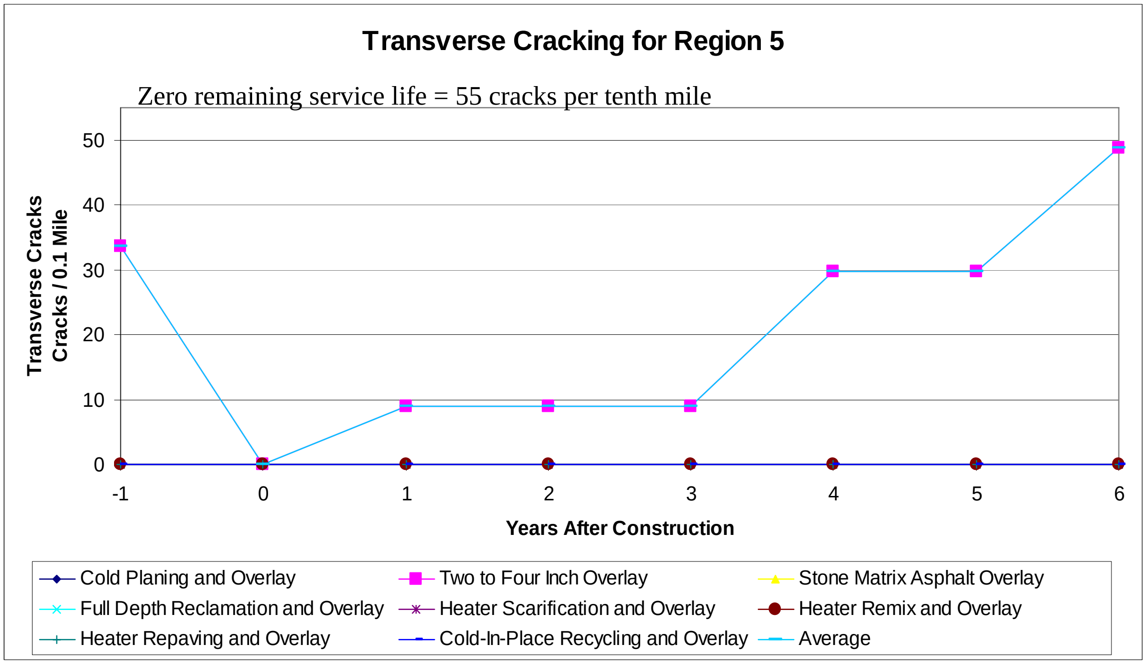

Figure 76 Transverse cracking performance after six years in relation to Region 5

Table 80 Transverse Cracking Performance – Region 5 Data

Treatment	Region 5 -1	0	1	2	Year 3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	----	----	----	----	----	----	----	----	----	----	----
Two to Four Inch Overlay	33.56	0	8.88	9.00	9.00	29.70	29.70	48.83	7.458571	0.613	3.86
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	34	0	8.88	9.00	9.00	29.70	29.70	48.83	7.458571		

Transverse Cracking – Region 5

2 to 4 inch overlay is the only rehabilitation strategy represented in this section so an analysis could not be done.

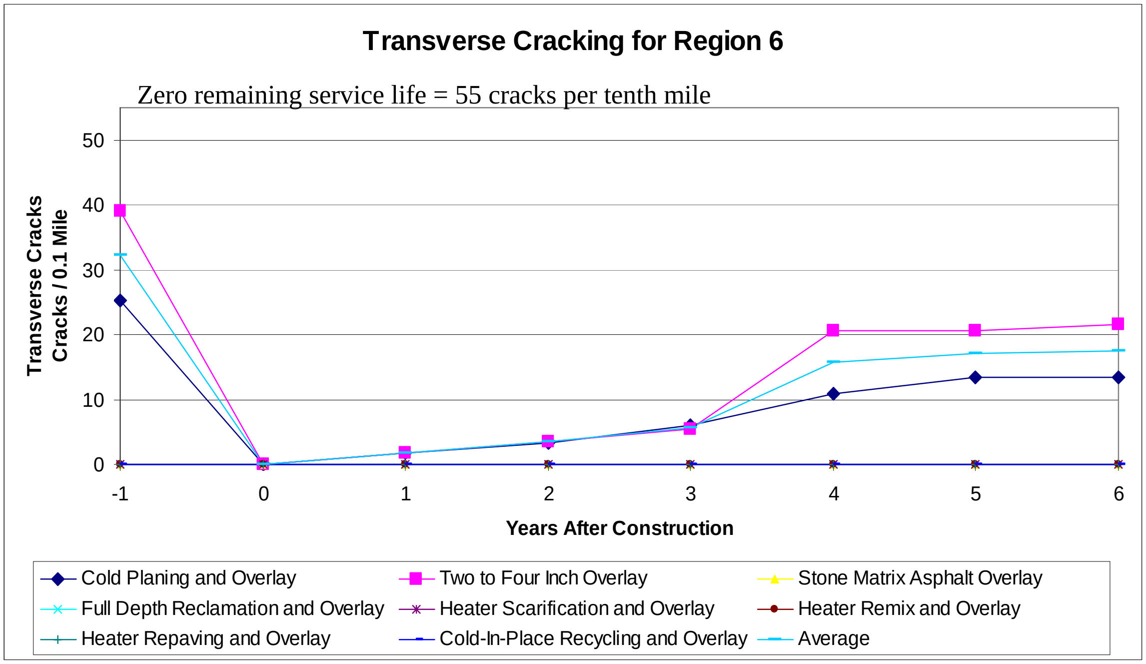

Figure 77 Transverse cracking performance after six years in relation to Region 6

Table 81 Transverse Cracking Performance – Region 6 Data

Treatment	Region 6				Year						
	-1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	25.31429	0	1.70	3.31	5.93	10.84	13.39	13.39	2.538845	0.731	19.14
Two to Four Inch Overlay	39.16	0	1.70	3.50	5.47	20.63	20.63	21.53	4.271429	0.618	4.86
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	32	0	1.70	3.41	5.70	15.73	17.01	17.46	3.405137		

Transverse Cracking – Region 6

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater scarification and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed the least amount of transverse cracking per year. Two to 4-inch overlay showed the greatest amount of transverse cracking per year as shown in Table 81.

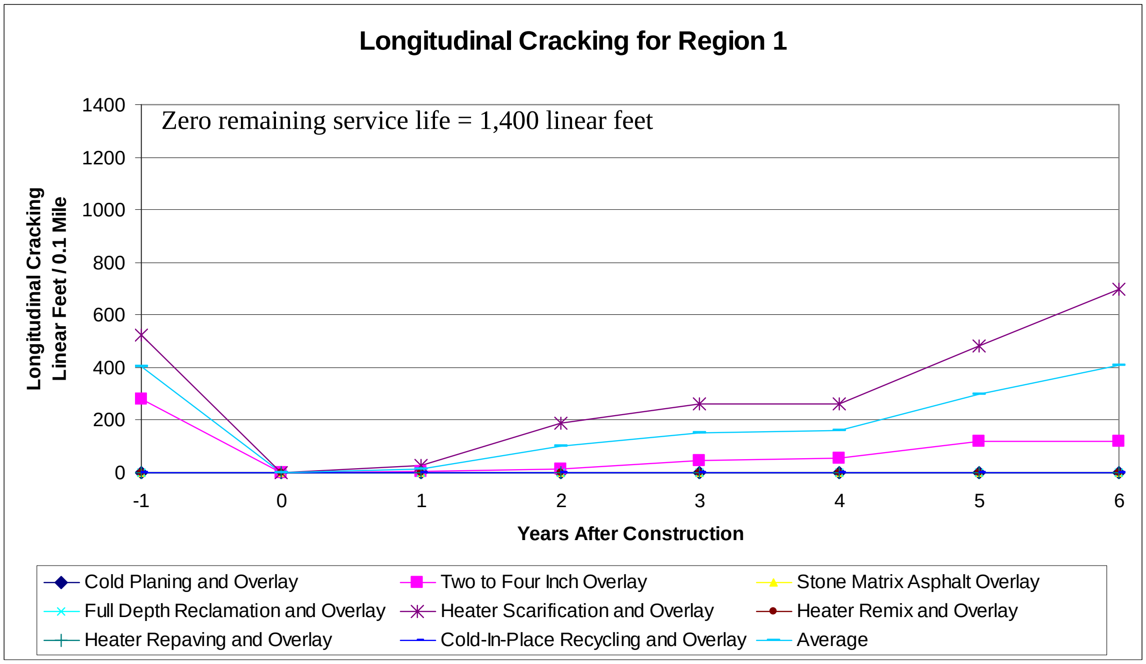

Figure 78 Longitudinal cracking performance after six years in relation to Region 1

Table 82 Longitudinal Cracking Performance – Region 1 Data

Region 1 Treatment	Year -1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	----	----	----	----	----	----	----	----	----	----	----
Two to Four Inch Overlay	280.0286	0	4	13	44	55	119	119	22.35149	0.613	6.57
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	524.8	0	26	190	262	262	481	698	109.8685	0.701	8.57
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	402	0	15	101	153	158	300	408	66.11001		

Longitudinal Cracking – Region 1

Cold planing and overlay, stone matrix asphalt overlay, full-depth reclamation and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Two to 4-inch overlay showed significantly less longitudinal cracking per year compared to the other rehabilitation strategies. Heater scarification and overlay showed the greatest amount of longitudinal cracking per year as shown in Table 82.

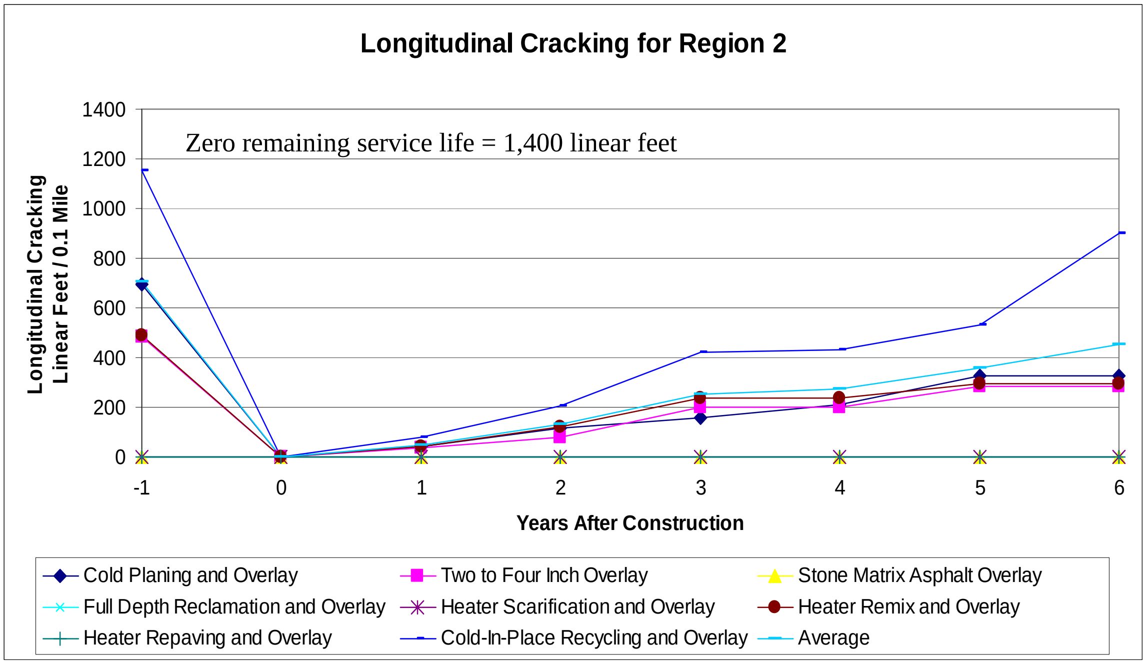

Figure 79 Longitudinal cracking performance after six years in relation to Region 2

Table 83 Longitudinal Cracking Performance – Region 2 Data

Treatment	Region 2 -1	0	1	2	Year 3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	697.1333	0	40	117	160	213	327	327	58.87236	0.734	6.71
Two to Four Inch Overlay	486.1429	0	39	77	200	200	286	286	52.66088	0.655	4.14
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Remix and Overlay	488.2	0	42	123	239	239	293	293	53.48095	0.809	2.71
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	1151.1	0	79	208	422	433	534	903	137.269	0.711	3
Average	706	0	50	131	255	271	360	452	75.57081		

Longitudinal Cracking – Region 2

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater scarification and overlay, heater remix and overlay, and heater repaving and overlay are not represented. Cold planing and overlay and 2 to 4 inch overlay showed the least amounts of longitudinal cracking per year. Cold-in-place recycling and overlay showed significantly more longitudinal cracking per year as shown in Table 83.

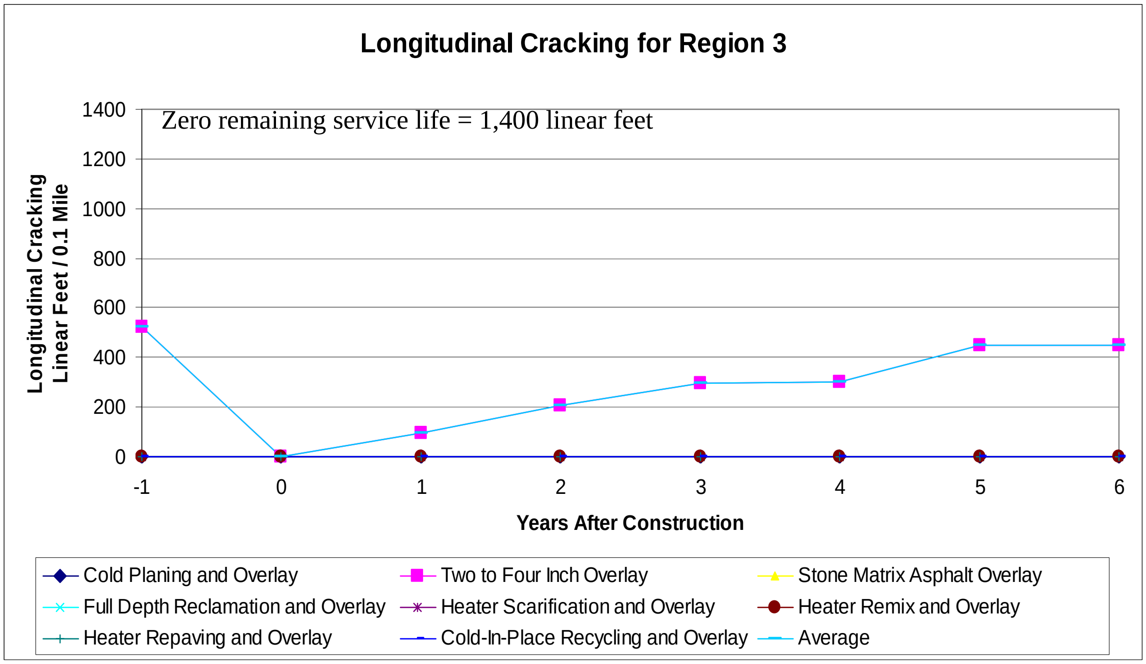

Figure 80 Longitudinal cracking performance after six years in relation to Region 3

Table 84 Longitudinal Cracking Performance – Region 3 Data

Treatment	Region 3 Year -1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	----	----	----	----	----	----	----	----	----	----	----
Two to Four Inch Overlay	522.5286	0	94	208	295	302	451	451	77.12623	0.821	14.43
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	523	0	94	208	295	302	451	451	77.12623		

Longitudinal Cracking – Region 3

Two to 4-inch overlay is the only rehabilitation strategy represented in this section so an analysis could not be done.

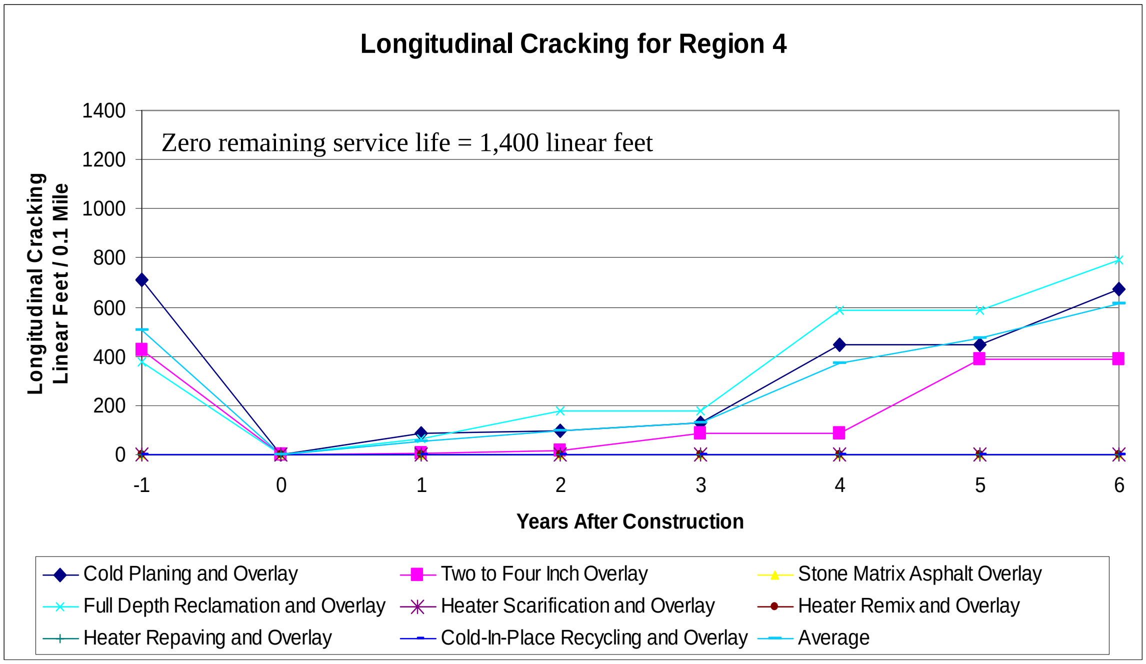

Figure 81 Longitudinal cracking performance after six years in relation to Region 4

Table 85 Longitudinal Cracking Performance – Region 4 Data

Treatment	Region 4				Year						
	-1	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**Slope**	**R^2**	**n, Avg**
Cold Planing and Overlay	712.8	0	86	97	131	447	447	671	110.1304	0.65	3.29
Two to Four Inch Overlay	425.15	0	7	18	84	84	386	386	70.86466	0.446	6.14
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	378.8	0	67	178	178	584	584	789	136.0798	0.523	4.57
Heater Scarification and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	506	0	53	98	131	372	473	616	105.6916		

Longitudinal Cracking – Region 4

Stone matrix asphalt overlay, heater scarification and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Two to 4-inch overlay showed the least amount of longitudinal cracking per year. Full-depth reclamation and overlay showed the greatest amount of longitudinal cracking per year as shown in Table 85.

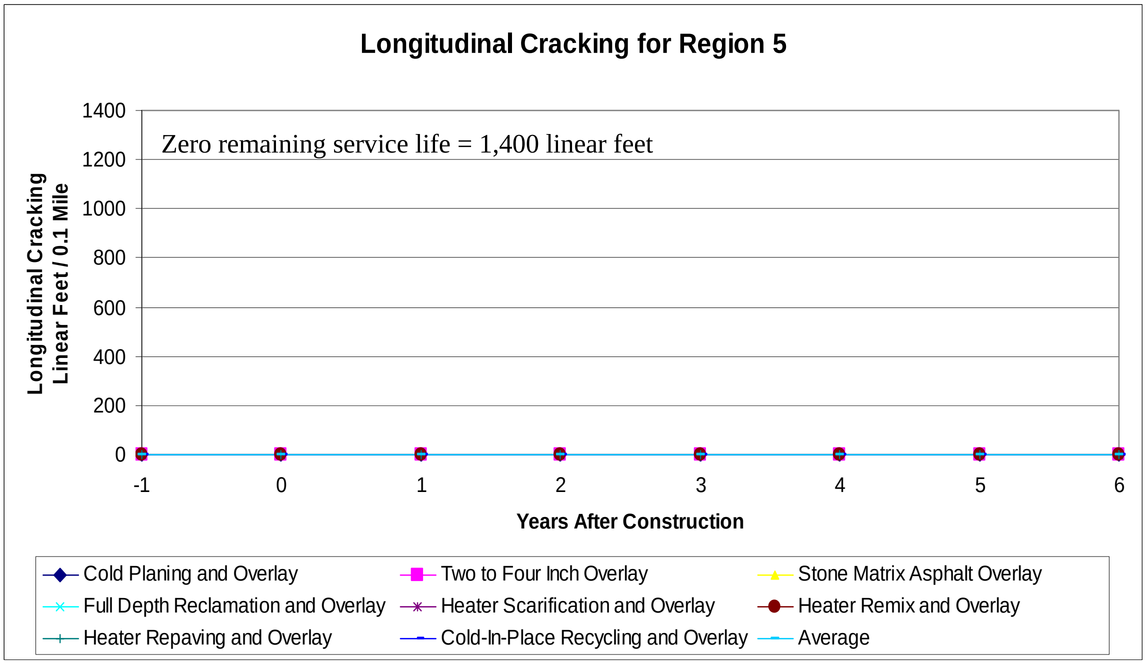

Figure 82 Longitudinal cracking performance after six years in relation to Region 5

Table 86 Longitudinal Cracking Performance – Region 5 Data

	Region 5										
Treatment	**Year**										
	-1	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**Slope**	**R^2**	**n, Avg**
Cold Planing and Overlay	----	----	----	----	----	----	----	----	----	----	----
Two to Four Inch Overlay	----	----	----	----	----	----	----	----	----	----	----
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!		

Longitudinal Cracking – Region 5

None of the rehabilitation strategies met the predetermined criteria so an analysis could not be performed.

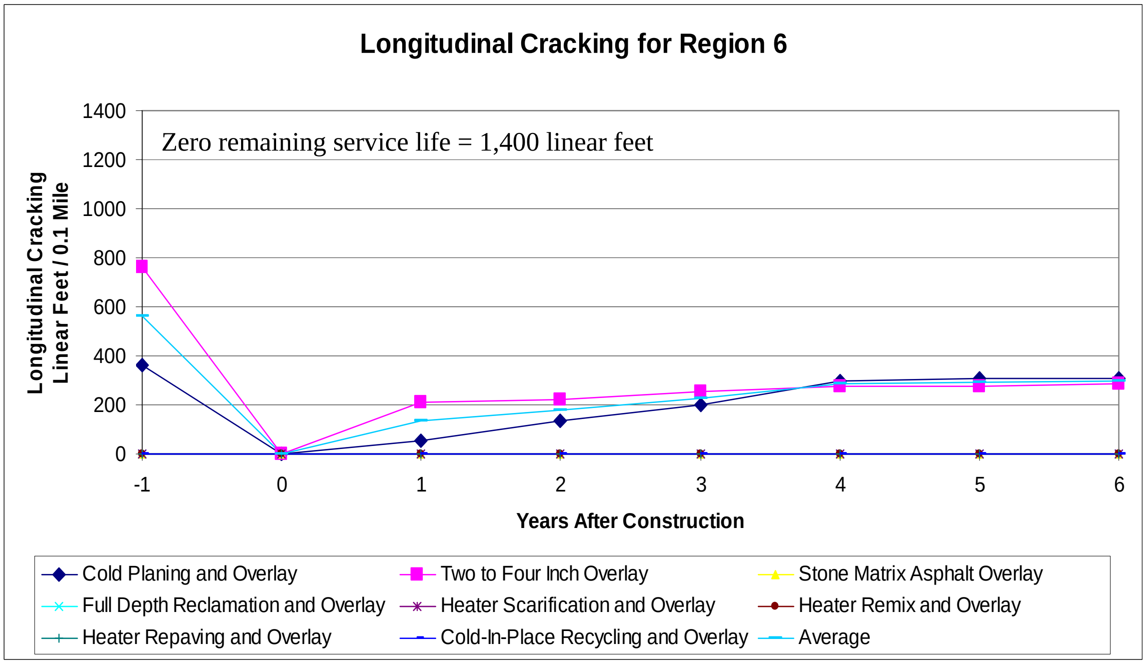

Figure 83 Longitudinal cracking performance after six years in relation to Region 6

Table 87 Longitudinal Cracking Performance – Region 6 Data

Treatment	Region 6 Year -1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	361.1625	0	56	134	201	299	311	311	57.33556	0.728	14
Two to Four Inch Overlay	761.9	0	211	221	255	274	274	286	37.02381	0.633	2.71
Stone Matrix Asphalt Overlay	----	----	----	----	----	----	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Scarification and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Remix and Overlay	----	----	----	----	----	----	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	----	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	----	----	----	----	----	----
Average	562	0	134	178	228	286	292	298	47.17968		

Longitudinal Cracking – Region 6

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater scarification and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Two to 4-inch overlay showed the least amount of longitudinal cracking per year compared to the other rehabilitation strategies. Cold planing and overlay showed the most amount of longitudinal cracking per year as shown in Table 87.

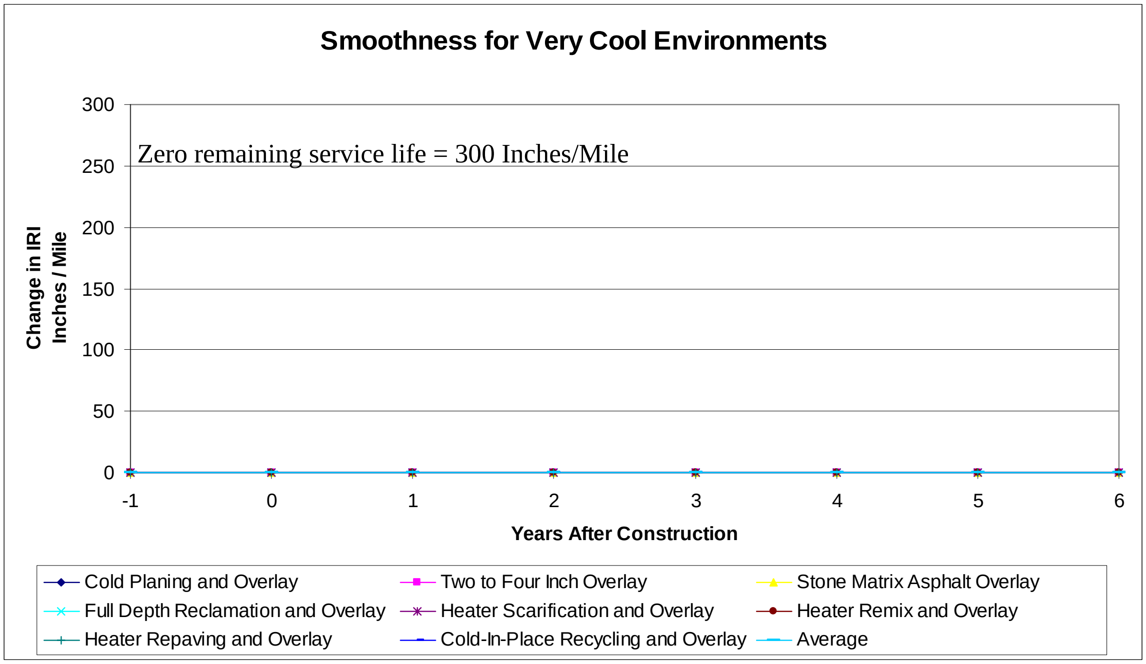

Figure 84 Rate of change for smoothness after six years with relation to average high temperatures of less than 81 degrees F

Table 88 Smoothness Performance – Very Cool Data

Very Cool											
Treatment	**Year**										
	-1	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**Slope**	**R^2**	**n, Avg**
Cold Planing and Overlay	----	----	----	----	----	---	----	----	----	----	----
Two to Four Inch Overlay	----	----	----	----	----	---	----	----	----	----	----
Stone Matrix Asphalt Overlay	----	----	----	----	----	---	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	---	----	----	----	----	----
Heater Scarification and Overlay	----	----	----	----	----	---	----	----	----	----	----
Heater Remix and Overlay	----	----	----	----	----	---	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	---	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	---	----	----	----	----	----
Average	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!		

Smoothness – Very Cool

None of the rehabilitation strategies met the predetermined criteria so an analysis could not be performed.

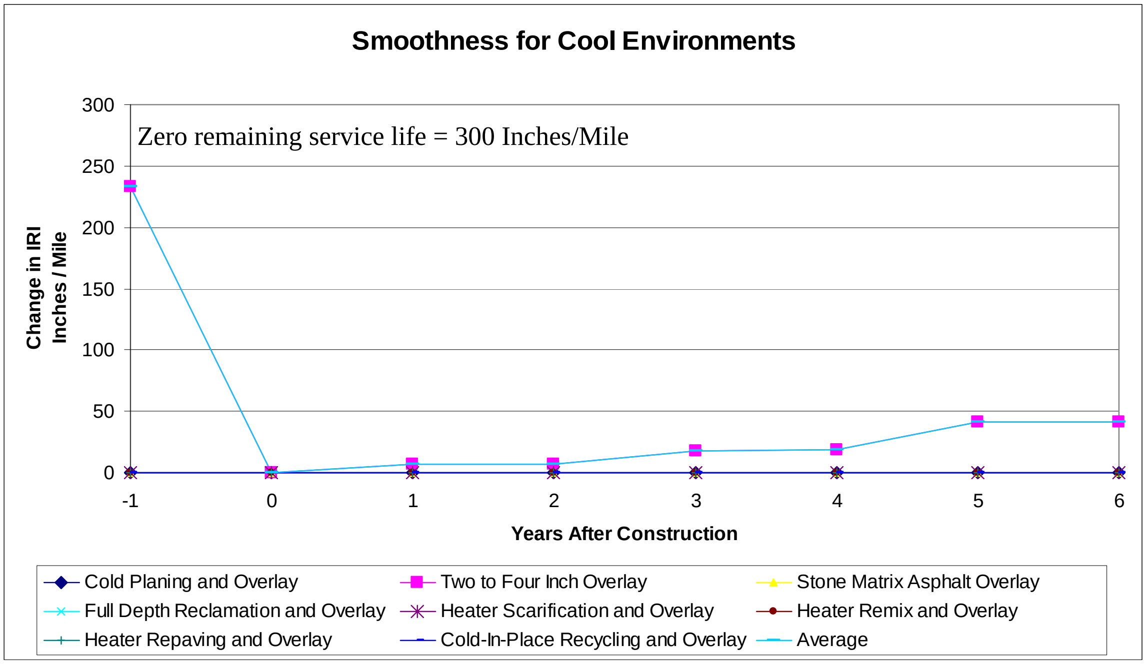

Figure 85 Rate of change for smoothness after six years with relation to average high temperatures from 81 to 88 degrees F

Table 89 Smoothness Performance – Cool Data

	Cool										
Treatment					**Year**						
	-1	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**Slope**	R^2	**n, Avg**
Cold Planing and Overlay	----	----	----	----	----	---	----	----	----	----	----
Two to Four Inch Overlay	233.3	0	6.68	6.68	17.74	18.68	41.12	41.12	7.293571	0.792	6
Stone Matrix Asphalt Overlay	----	----	----	----	----	---	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	---	----	----	----	----	----
Heater Scarification and Overlay	----	----	----	----	----	---	----	----	----	----	----
Heater Remix and Overlay	----	----	----	----	----	---	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	---	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	---	----	----	----	----	----
Average	233	0	6.68	6.68	17.74	18.68	41.12	41.12	7.293571		

Smoothness – Cool

Two to 4-inch overlay is the only rehabilitation strategy represented in this section so an analysis could not be done.

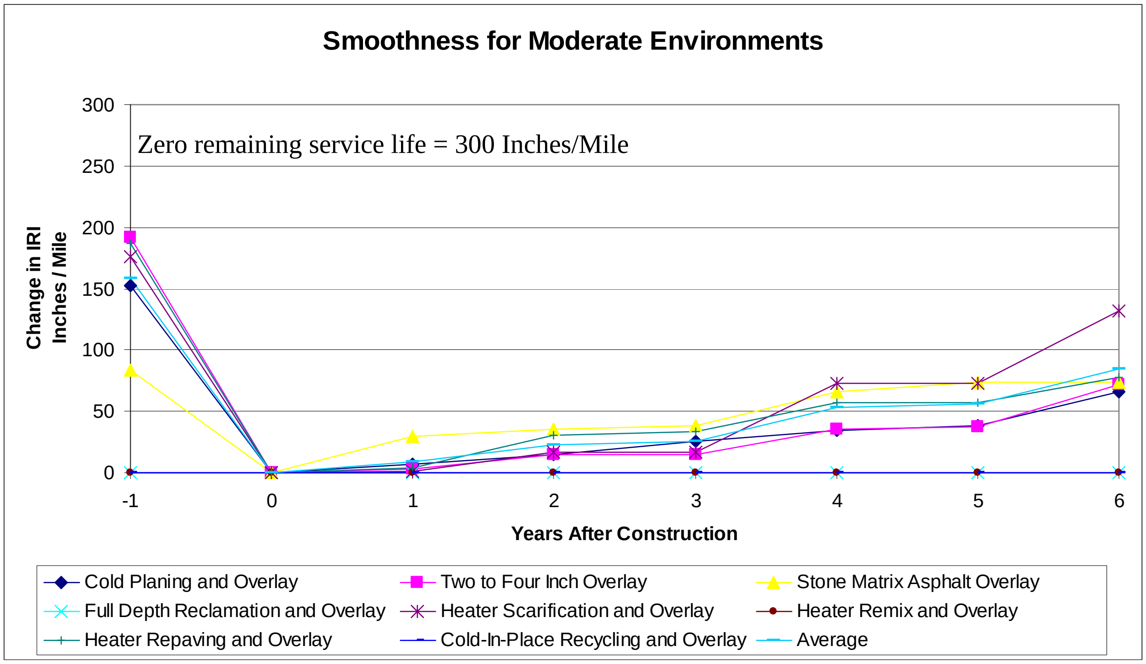

Figure 86 Rate of change for smoothness after six years with relation to average high temperatures from 88 to 97 degrees F

Table 90 Smoothness Performance – Moderate Data

Treatment	Moderate										
	Year										
	-1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	152.3889	0.00	7.14	14.88	25.20	34.22	38.60	65.56	9.96203	0.82	12.14
Two to Four Inch Overlay	191.3778	0	2.57	14.68	14.68	35.65	37.52	72.02	10.96205	0.807	10.71
Stone Matrix Asphalt Overlay	83.6	0	29.04	35.08	38.12	66.04	74.13	74.13	12.26952	0.907	4
Full Depth Reclamation and Overlay	----	----	----	----	----	---	----	----	----	----	----
Heater Scarification and Overlay	175.8889	0	0.85	16.72	16.72	72.40	72.40	131.55	21.19378	0.813	8.29
Heater Remix and Overlay	----	----	----	----	----	---	----	----	----	----	----
Heater Repaving and Overlay	187.30	0	4.00	30.07	33.13	57.20	57.20	77.33	13.05476	0.912	2.86
Cold-In-Place Recycling and Overlay	----	----	----	----	----	---	----	----	----	----	----
Average	158	0	8.72	22.29	25.57	53.10	55.97	84.12	13.48843		

Smoothness – Moderate

Full-depth reclamation and overlay, heater remix and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed the greatest performance when compared to the other rehabilitation strategies. Heater scarification and overlay showed the worst performance as shown in Table 90.

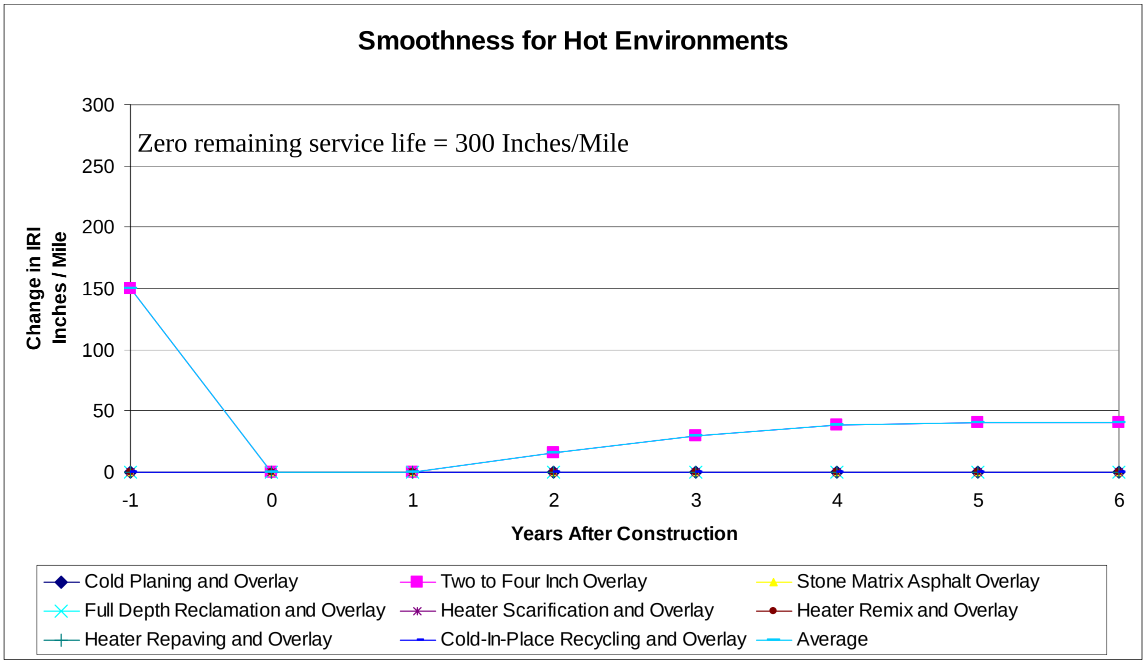

Figure 87 Rate of change for smoothness after six years with relation to average high temperatures greater than 97 degrees F

Table 91 Smoothness Performance – Hot Data

Treatment	Hot Year -1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	----	----	----	----	----	---	----	----	----	----	----
Two to Four Inch Overlay	150.2	0	-	15.62	29.87	38.42	39.97	39.97	7.951786	0.873	4.67
Stone Matrix Asphalt Overlay	----	----	----	----	----	---	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	---	----	----	----	----	----
Heater Scarification and Overlay	----	----	----	----	----	---	----	----	----	----	----
Heater Remix and Overlay	----	----	----	----	----	---	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	---	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	---	----	----	----	----	----
Average	150	0	0.00	15.62	29.87	38.42	39.97	39.97	7.951786		

Smoothness – Hot

Two to 4-inch overlay is the only rehabilitation strategy represented in this section so an analysis could not be done.

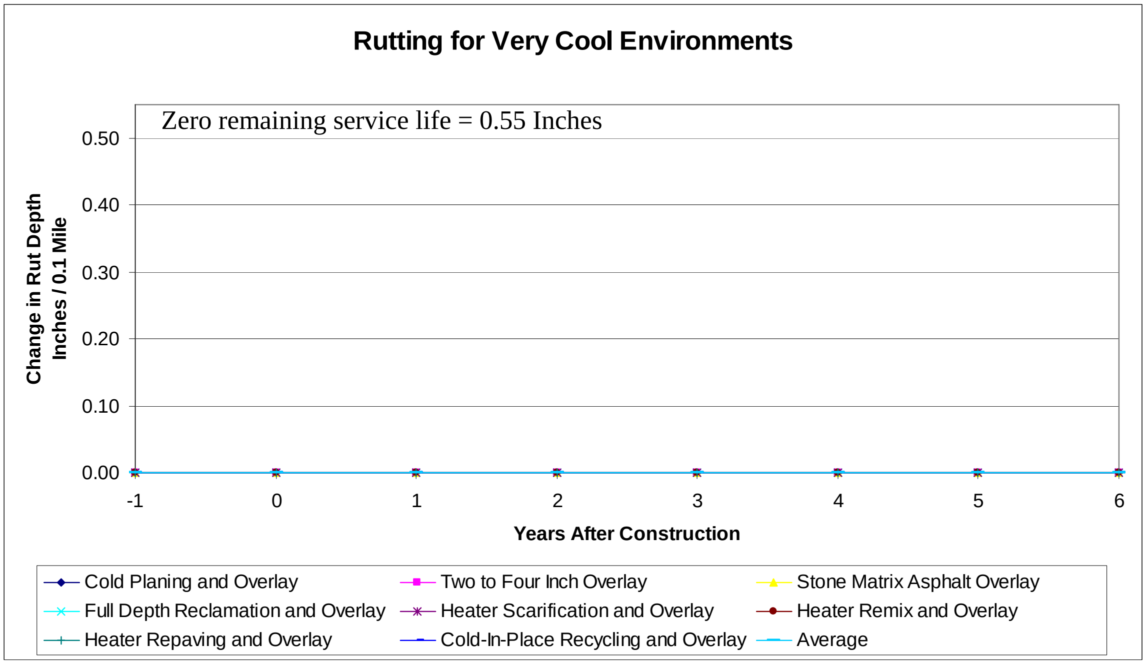

Figure 88 Permanent deformation performance after six years with relation to average high temperatures of less than 81 degrees F

Table 92 Rutting Performance – Very Cool Data

Treatment	Very Cool										
	Year										
	-1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	----	----	----	----	----	---	----	----	----	----	----
Two to Four Inch Overlay	----	----	----	----	----	---	----	----	----	----	----
Stone Matrix Asphalt Overlay	----	----	----	----	----	---	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	---	----	----	----	----	----
Heater Scarification and Overlay	----	----	----	----	----	---	----	----	----	----	----
Heater Remix and Overlay	----	----	----	----	----	---	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	---	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	---	----	----	----	----	----
Average	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!		

Rutting – Very Cool

None of the rehabilitation strategies met the predetermined criteria so an analysis could not be performed.

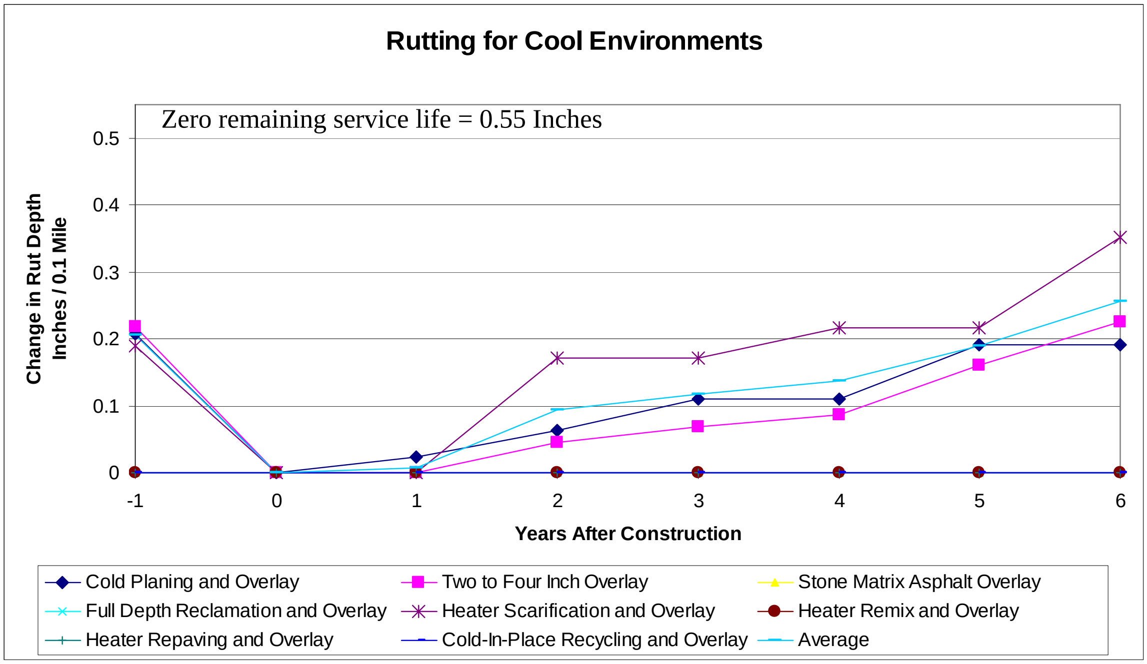

Figure 89 Permanent deformation performance after six years with relation to average high temperatures from 81 to 88 degrees F

Table 93 Rutting Performance – Cool Data

Cool											
Treatment	Year										
	-1	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**Slope**	**R^2**	**n, Avg**
Cold Planing and Overlay	0.208	0.00	0.02	0.06	0.11	0.11	0.19	0.19	0.03408	0.809	3.57
Two to Four Inch Overlay	0.2175	0	-	0.05	0.07	0.09	0.16	0.23	0.037019	0.874	11.71
Stone Matrix Asphalt Overlay	----	----	----	----	----	---	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	---	----	----	----	----	----
Heater Scarification and Overlay	0.19	0	-	0.17	0.17	0.22	0.22	0.35	0.054607	0.818	2.86
Heater Remix and Overlay	----	----	----	----	----	---	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	---	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	---	----	----	----	----	----
Average	0	0	0.01	0.09	0.12	0.14	0.19	0.26	0.041902		

Rutting – Cool

Stone matrix asphalt overlay, full depth-reclamation and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay and 2 to 4 inch overlay showed similar amounts of rutting per year and performed better than heater scarification and overlay as shown in Table 93.

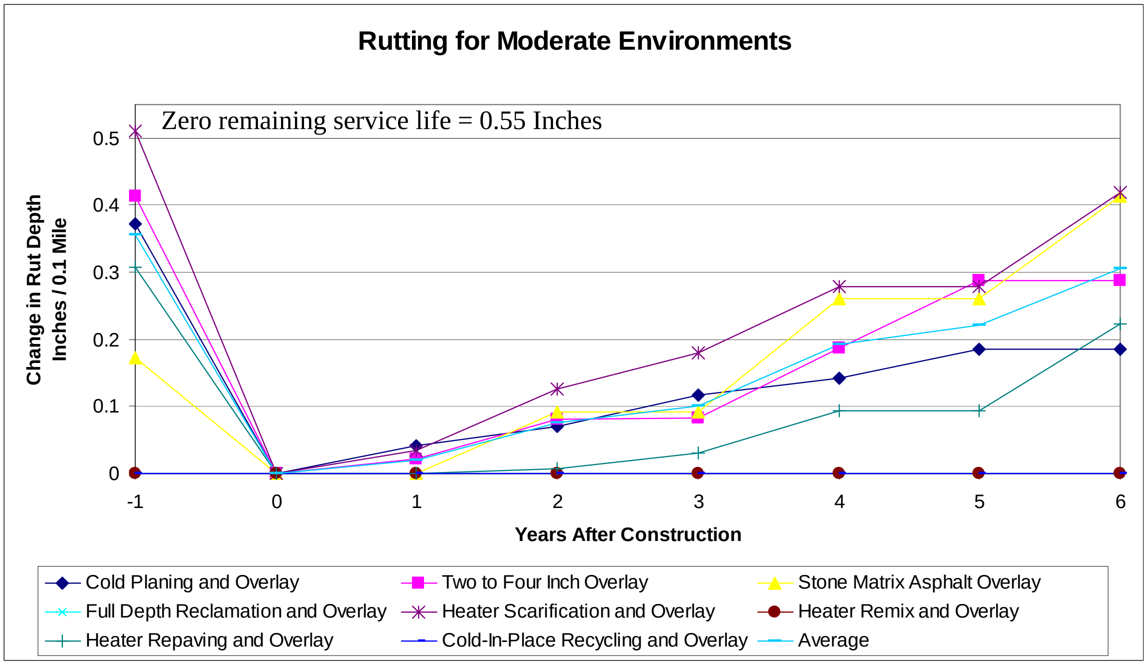

Figure 90 Permanent deformation performance after six years with relation to average high temperatures from 88 to 97 degrees F

Table 94 Rutting Performance – Moderate Data

	Moderate										
Treatment					**Year**						
	-1	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**Slope**	**R^2**	**n, Avg**
Cold Planing and Overlay	0.372545	0.00	0.04	0.07	0.12	0.14	0.19	0.19	0.032713	0.865	19.57
Two to Four Inch Overlay	0.41425	0	0.02	0.08	0.08	0.19	0.29	0.29	0.053666	0.675	28.71
Stone Matrix Asphalt Overlay	0.172667	0	-	0.09	0.09	0.26	0.26	0.41	0.068911	0.909	3.29
Full Depth Reclamation and Overlay	----	----	----	----	----	---	----	----	----	----	----
Heater Scarification and Overlay	0.51	0	0.03	0.13	0.18	0.28	0.28	0.42	0.067976	0.798	7.57
Heater Remix and Overlay	----	----	----	----	----	---	----	----	----	----	----
Heater Repaving and Overlay	0.307	0	-	0.01	0.03	0.09	0.09	0.22	0.033429	0.936	2.86
Cold-In-Place Recycling and Overlay	----	----	----	----	----	---	----	----	----	----	----
Average	0	0	0.02	0.08	0.10	0.19	0.22	0.31	0.051339		

Rutting – Moderate

Full-depth reclamation and overlay, heater remix and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay and heater repaving and overlay showed the least amounts of rutting per year. Heater scarification and overlay and stone matrix asphalt overlay showed the greatest amounts of rutting per year as shown in Table 94.

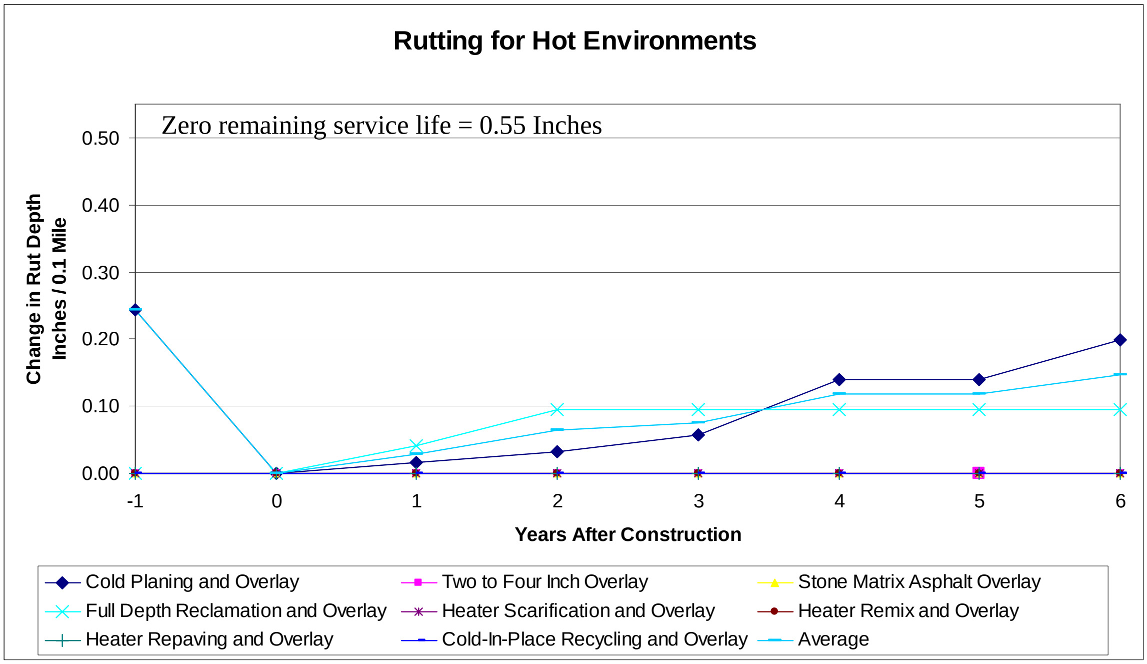

Figure 91 Permanent deformation performance after six years with relation to average high temperatures greater than 97 degrees F

Table 95 Rutting Performance – Hot Data

Treatment	Hot Year -1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	0.2445	0	0.02	0.03	0.06	0.14	0.14	0.20	0.034065	0.836	5.86
Two to Four Inch Overlay	----	----	----	----	----	---	----	----	----	----	----
Stone Matrix Asphalt Overlay	----	----	----	----	----	---	----	----	----	----	----
Full Depth Reclamation and Overlay	----	0	0.04	0.10	0.10	0.10	0.10	0.10	0.013964		
Heater Scarification and Overlay	----	----	----	----	----	---	----	----	----	----	----
Heater Remix and Overlay	----	----	----	----	----	---	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	---	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	---	----	----	----	----	----
Average	0	0	0.03	0.06	0.08	0.12	0.12	0.15	0.024015		

Rutting – Hot

Cold planing and overlay is the only rehabilitation strategy represented in this section so an analysis could not be done.

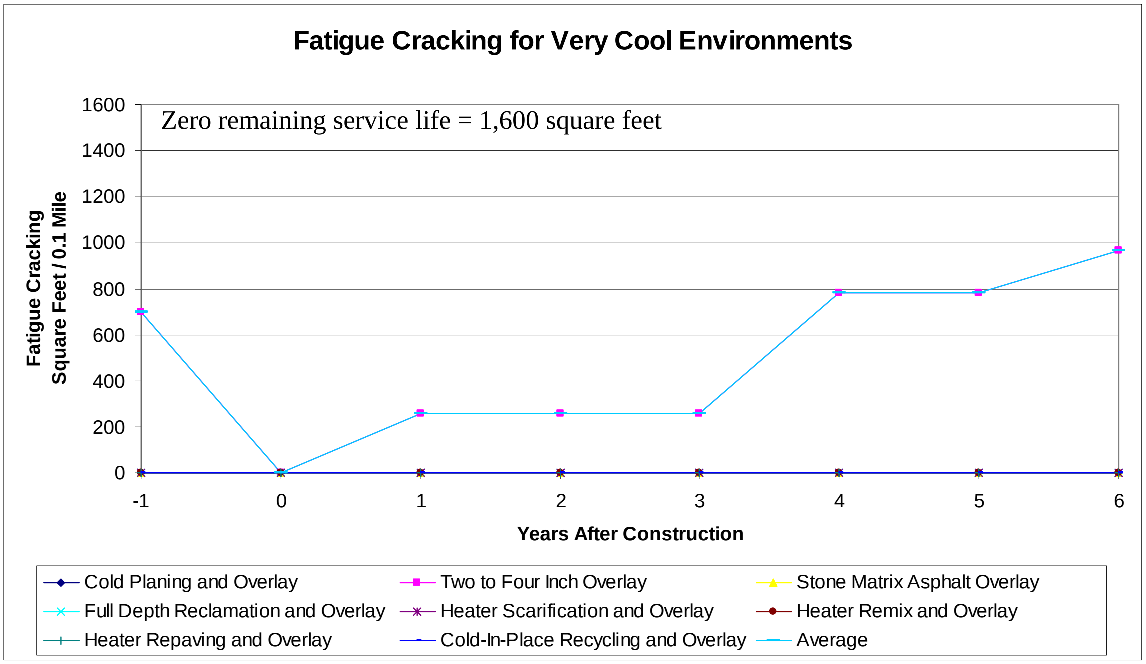

Figure 92 Fatigue cracking performance after six years with relation to average high temperatures of less than 81 degrees F

Table 96 Fatigue Performance – Very Cool Data

	Very Cool										
Treatment					**Year**						
	-1	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**Slope**	**R^2**	**n, Avg**
Cold Planing and Overlay	----	----	----	----	----	---	----	----	----	----	----
Two to Four Inch Overlay	697.8667	0	254.50	259.38	259.38	780.52	780.52	967.32	159.8256	0.713	3.71
Stone Matrix Asphalt Overlay	----	----	----	----	----	---	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	---	----	----	----	----	----
Heater Scarification and Overlay	----	----	----	----	----	---	----	----	----	----	----
Heater Remix and Overlay	----	----	----	----	----	---	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	---	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	---	----	----	----	----	----
Average	698	0	254.50	259.38	259.38	780.52	780.52	967.32	159.8256		

Fatigue – Very Cool

Two to 4-inch overlay is the only rehabilitation strategy represented in this section so an analysis could not be done.

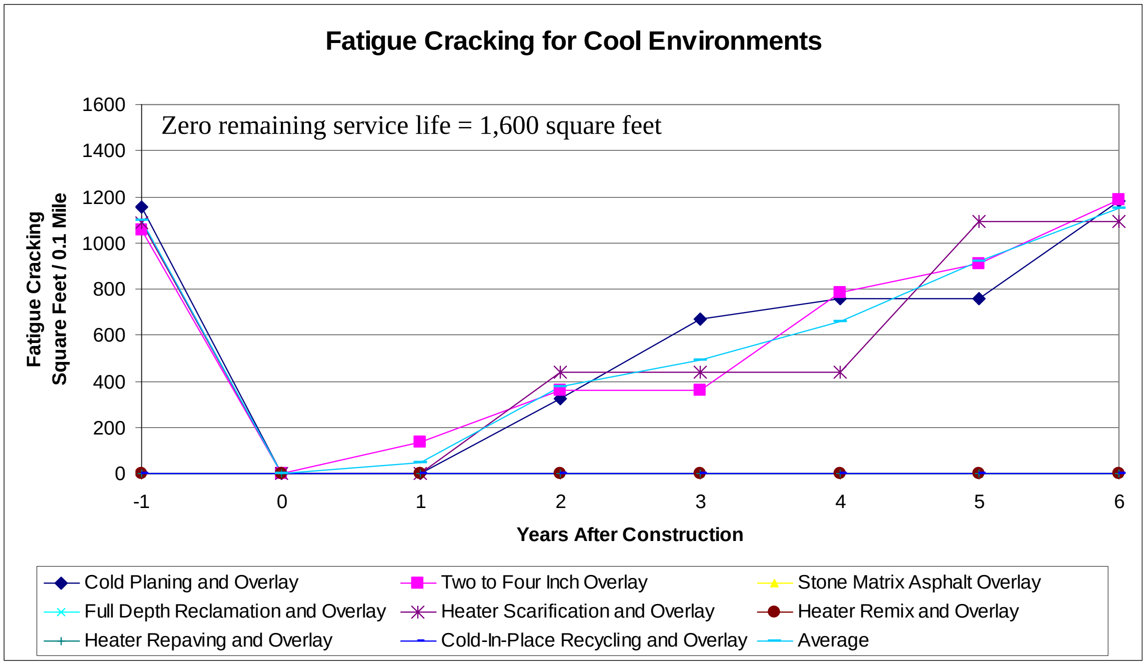

Figure 93 Fatigue cracking performance after six years with relation to average high temperatures from 81 to 88 degrees F

Table 97 Fatigue Performance – Cool Data

Treatment	Cool				Year						
	-1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	1158	0.00	-	326.07	671.67	758.80	758.80	1,179.17	195.994	0.639	2.86
Two to Four Inch Overlay	1056.017	0	134.52	358.98	358.98	783.55	908.47	1,185.88	197.5039	0.531	11.43
Stone Matrix Asphalt Overlay	----	----	----	----	----	---	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	---	----	----	----	----	----
Heater Scarification and Overlay	1085	0	-	437.15	437.15	437.15	1,090.50	1,090.50	194.7321	0.8	3.71
Heater Remix and Overlay	----	----	----	----	----	---	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	---	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	---	----	----	----	----	----
Average	1100	0	44.84	374.06	489.26	659.83	919.26	1151.85	196.0767		

Fatigue – Cool

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. All rehabilitation strategies that met the predetermined criteria showed similar amounts of fatigue cracking per year. Heater scarification and overlay had the greatest amount of significance with the data as shown in Table 97.

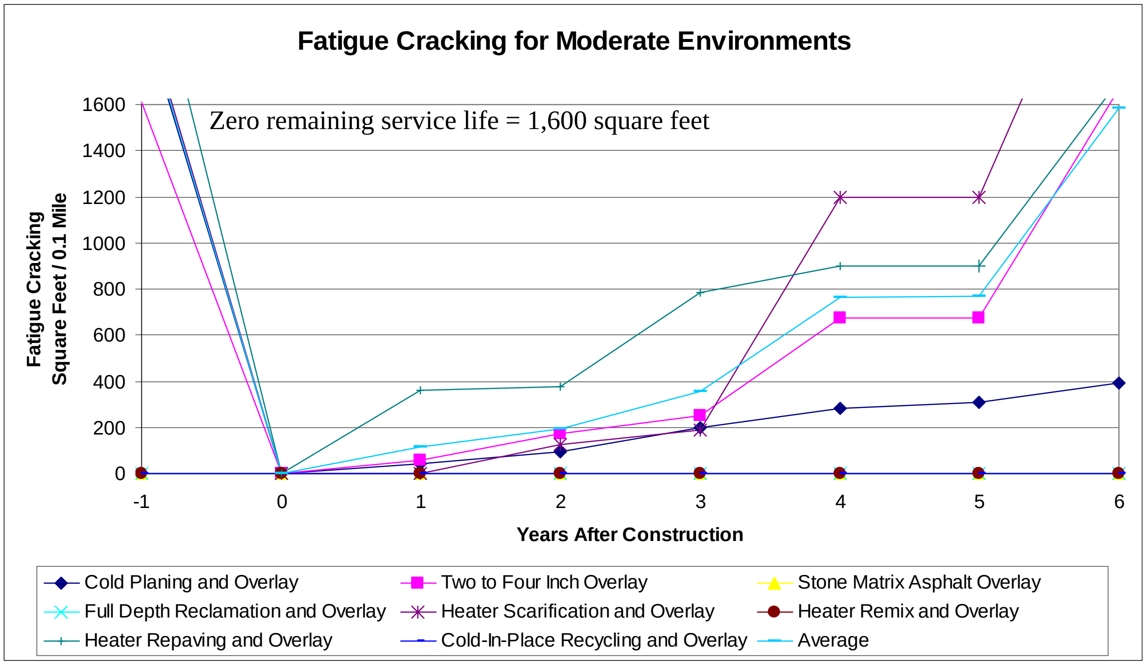

Figure 94 Fatigue cracking performance after six years with relation to average high temperatures from 88 to 97 degrees F

Table 98 Fatigue Performance – Moderate Data

Treatment	Moderate Year -1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	2005.2	0.00	43.65	92.36	196.45	282.88	308.08	391.11	67.59637	0.624	23.71
Two to Four Inch Overlay	1608.513	0	58.71	174.19	251.92	676.45	676.45	1,666.85	240.6537	0.398	23.86
Stone Matrix Asphalt Overlay	----	----	----	----	----	---	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	---	----	----	----	----	----
Heater Scarification and Overlay	2050.5	0	-	124.45	190.49	1,197.95	1,197.95	2,582.42	400.5947	0.649	5.86
Heater Remix and Overlay	----	----	----	----	----	---	----	----	----	----	----
Heater Repaving and Overlay	2429.1	0	361.45	377.60	783.00	899.35	899.35	1,702.05	239.4179	0.697	3.71
Cold-In-Place Recycling and Overlay	----	----	----	----	----	---	----	----	----	----	----
Average	2023	0	115.95	192.15	355.46	764.16	770.46	1585.61	237.0657		

Fatigue – Moderate

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater remix and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed significantly less amounts of fatigue cracking a year than the other rehabilitation strategies. Heater scarification and overlay showed a significantly higher rate of fatigue cracking per year as shown in Table 98.

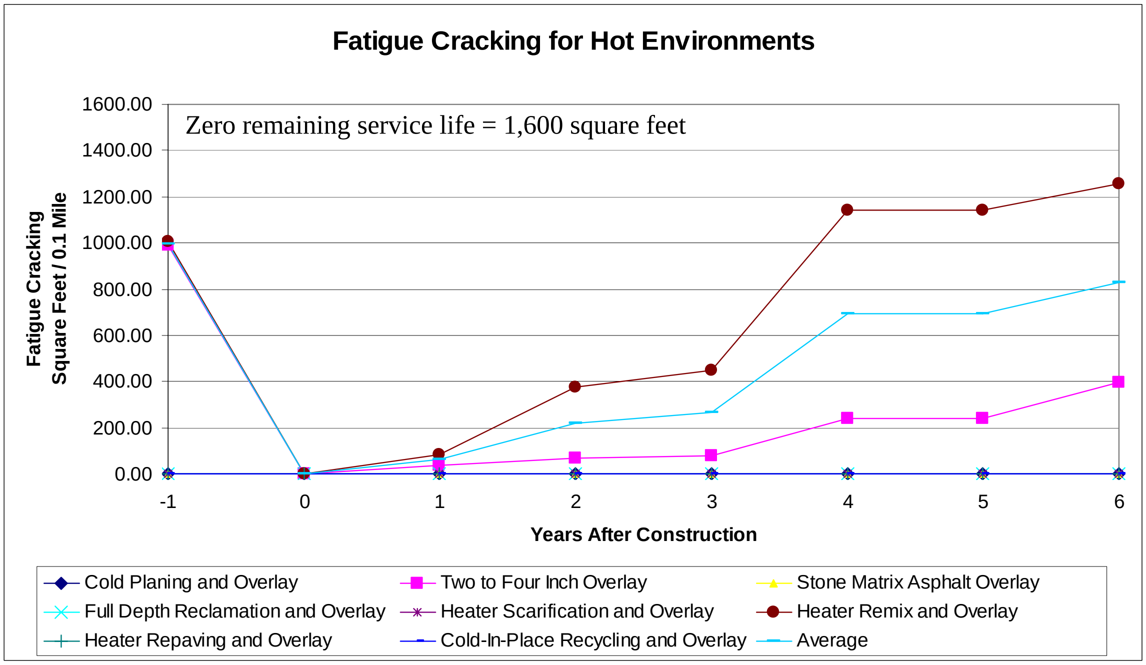

Figure 95 Fatigue cracking performance after six years with relation to average high temperatures greater than 97 degrees F

Table 99 Fatigue Performance – Hot Data

Treatment	Hot Year -1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	----	----	----	----	----	---	----	----	----	----	----
Two to Four Inch Overlay	988.5	0	38.54	67.64	80.00	241.44	241.44	396.94	63.22908	0.357	6
Stone Matrix Asphalt Overlay	----	----	----	----	----	---	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	---	----	----	----	----	----
Heater Scarification and Overlay	----	----	----	----	----	---	----	----	----	----	----
Heater Remix and Overlay	1006.4	0.00	85.80	375.00	447.40	1,142.07	1,142.07	1,258.17	237.6464	0.609	2.71
Heater Repaving and Overlay	----	----	----	----	----	---	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	---	----	----	----	----	----
Average	997	0	62.17	221.32	263.70	691.75	691.75	827.55	150.4378		

Fatigue – Hot

Cold planing and overlay, stone matrix asphalt overlay, full-depth reclamation and overlay, heater scarification and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Two to 4-inch overlay showed significantly less fatigue cracking then the heater remix and overlay rehabilitation strategy as shown in Table 99.

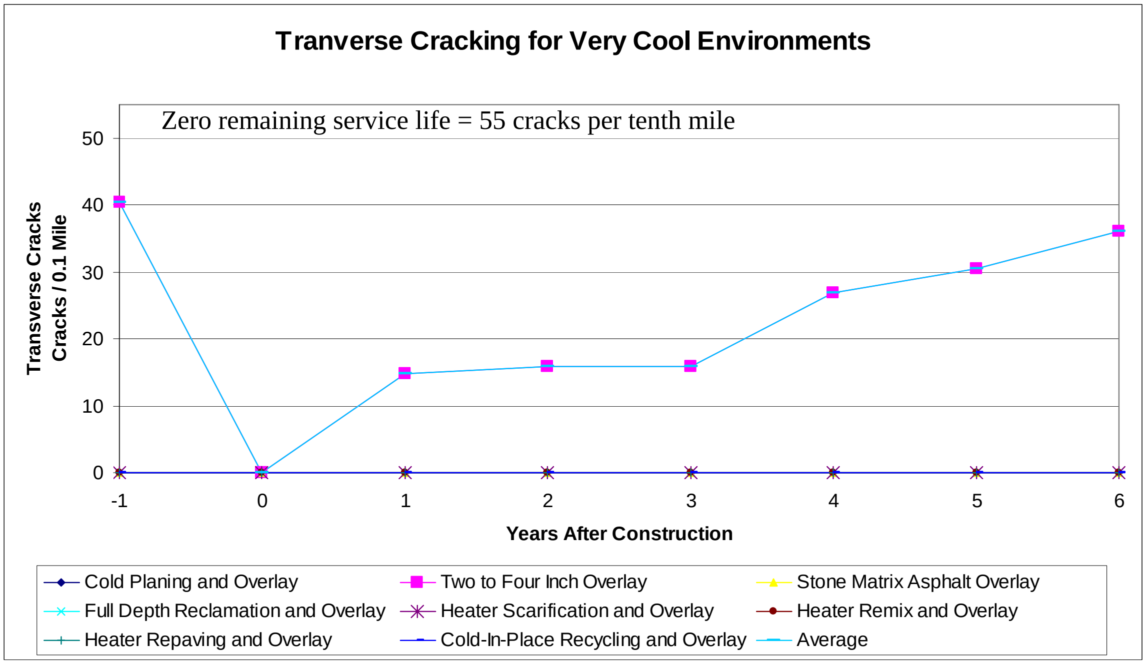

Figure 96 Transverse cracking performance after six years with relation to average high temperatures of less than 81 degrees F

Table 100 Transverse Cracking Performance – Very Cool Data

Treatment	Very Cool										
	Year										
	-1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	----	----	----	----	----	---	----	----	----	----	----
Two to Four Inch Overlay	40.48	0	14.75	15.85	15.85	26.85	30.39	36.02	5.368929	0.86	4.57
Stone Matrix Asphalt Overlay	----	----	----	----	----	---	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	---	----	----	----	----	----
Heater Scarification and Overlay	----	----	----	----	----	---	----	----	----	----	----
Heater Remix and Overlay	----	----	----	----	----	---	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	---	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	---	----	----	----	----	----
Average	40	0	14.75	15.85	15.85	26.85	30.39	36.02	5.368929		

Transverse Cracking – Very Cool

Two to 4-inch overlay is the only rehabilitation strategy represented in this section so an analysis could not be done.

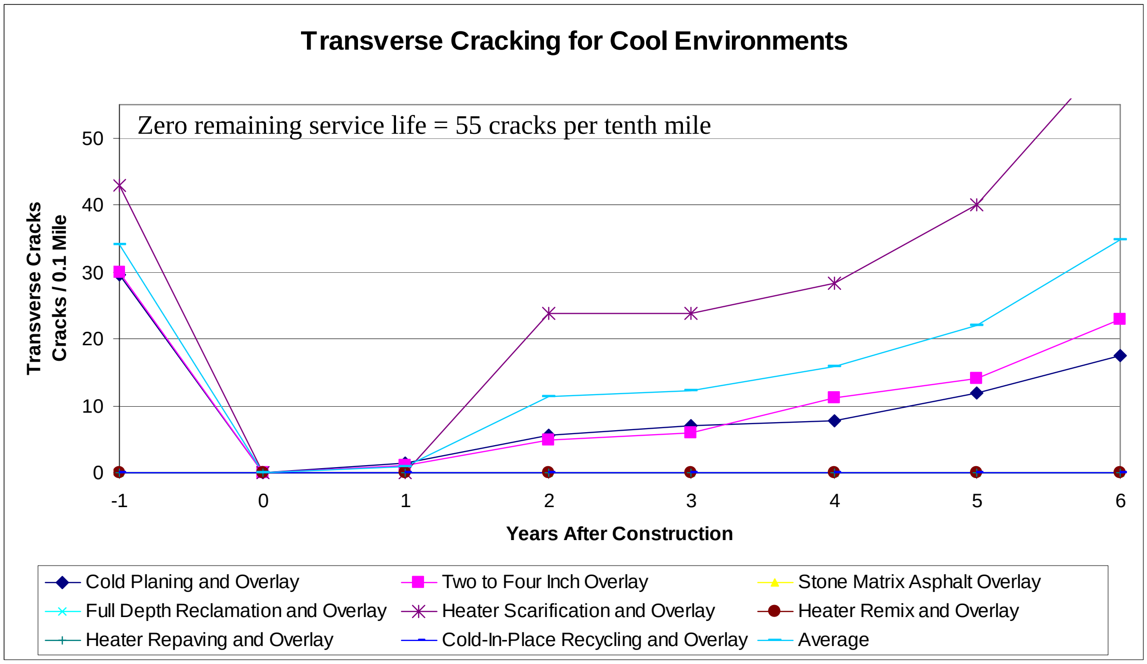

Figure 97 Transverse cracking performance after six years with relation to average high temperatures from 81 to 88 degrees F

Table 101 Transverse Cracking Performance – Cool Data

				Cool							
Treatment					**Year**						
	-1	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**Slope**	**R^2**	**n, Avg**
Cold Planing and Overlay	29.5	0.00	1.40	5.50	7.00	7.80	11.90	17.50	2.707143	0.784	3.71
Two to Four Inch Overlay	29.92308	0	1.16	4.81	5.97	11.21	14.07	22.83	3.596628	0.711	15
Stone Matrix Asphalt Overlay	----	----	----	----	----	---	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	---	----	----	----	----	----
Heater Scarification and Overlay	43	0	-	23.73	23.73	28.37	39.97	64.27	9.905952	0.688	3.57
Heater Remix and Overlay	----	----	----	----	----	---	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	---	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	---	----	----	----	----	----
Average	34	0	0.85	11.35	12.24	15.79	21.98	34.87	5.403241		

Transverse Cracking – Cool

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed the least amount of transverse cracking per year. Heater scarification and overlay showed significantly more transverse cracking per year than the other rehabilitation strategies as shown in Table 101.

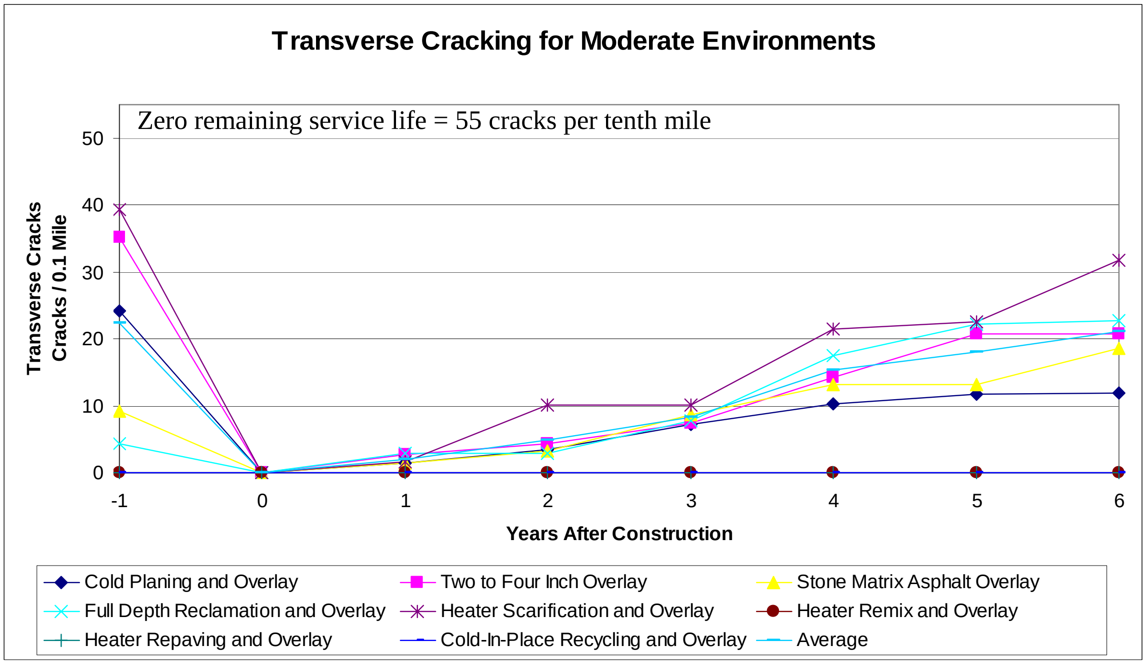

Figure 98 Transverse cracking performance after six years with relation to average high temperatures from 88 to 97 degrees F

Table 102 Transverse Cracking Performance – Moderate Data

	Moderate										
Treatment					Year						
	-1	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**Slope**	**R^2**	**n, Avg**
Cold Planing and Overlay	24.16757	0.00	1.52	3.50	7.29	10.22	11.68	11.84	2.23504	0.683	33
Two to Four Inch Overlay	35.24	0	2.66	4.38	7.40	14.31	20.67	20.67	3.854581	0.695	30.43
Stone Matrix Asphalt Overlay	9.133333	0	1.44	3.20	8.68	13.24	13.24	18.51	3.184286	0.611	4.14
Full Depth Reclamation and Overlay	4.4	0	2.95	2.95	7.75	17.55	22.18	22.68	4.325595	0.749	3
Heater Scarification and Overlay	39.28889	0	1.56	10.04	10.04	21.43	22.48	31.72	5.298481	0.753	8.29
Heater Remix and Overlay	----	----	----	----	----	---	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	---	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	---	----	----	----	----	----
Average	22	0	2.03	4.81	8.23	15.35	18.05	21.08	3.779597		

Transverse Cracking – Moderate

Heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed the least amount of transverse cracking per year. Heater scarification and overlay showed the greatest amount of transverse cracking per year as shown in Table 102.

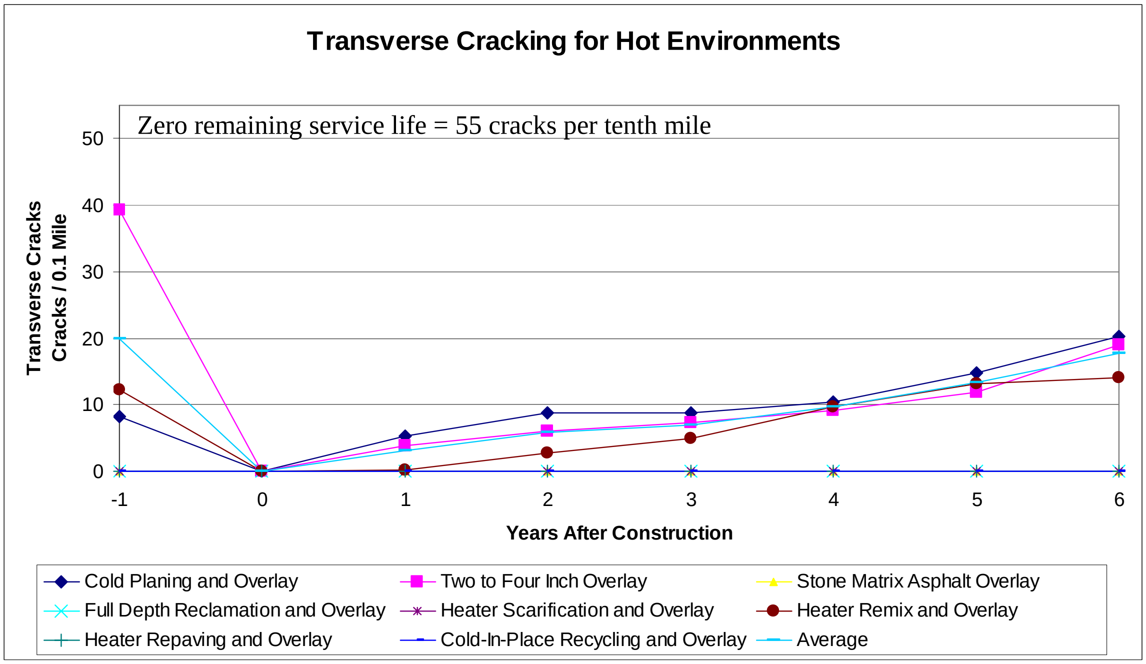

Figure 99 Transverse cracking performance after six years with relation to average high temperatures greater than 97 degrees F

Table 103 Transverse Cracking Performance – Hot Data

Treatment	Hot / Year -1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	8.3	0	5.38	8.68	8.68	10.33	14.88	20.35	2.917857	0.845	3.43
Two to Four Inch Overlay	39.3	0	3.92	5.98	7.39	9.23	11.90	18.92	2.71252	0.795	8
Stone Matrix Asphalt Overlay	----	----	----	----	----	---	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	---	----	----	----	----	----
Heater Scarification and Overlay	----	----	----	----	----	---	----	----	----	----	----
Heater Remix and Overlay	12.2	0.00	0.20	2.73	4.93	9.67	13.20	14.10	2.686905	0.882	2.71
Heater Repaving and Overlay	----	----	----	----	----	---	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	---	----	----	----	----	----
Average	20	0	3.17	5.80	7.00	9.74	13.33	17.79	2.772427		

Transverse Cracking – Hot

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater scarification and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. The three rehabilitation strategies that met the predetermined criteria all showed similar amounts of transverse cracking per year as shown in Table 103.

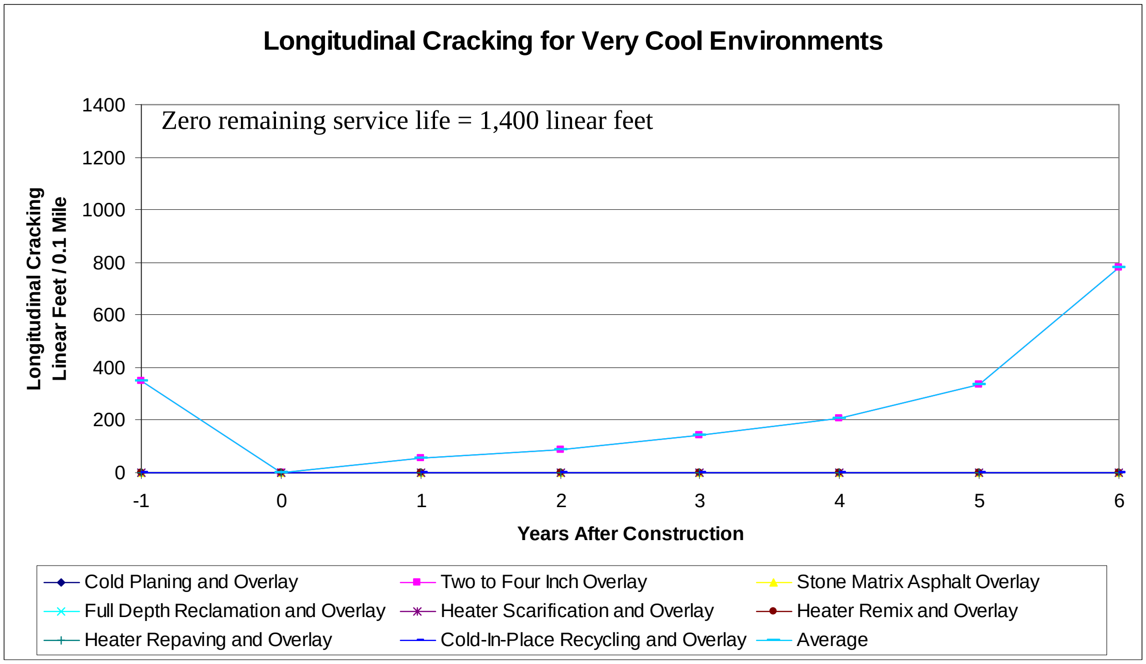

Figure 100 Longitudinal cracking performance after six years with relation to average high temperatures of less than 81 degrees F

Table 104 Longitudinal Cracking Performance – Very Cool Data

Treatment	Very Cool -1	0	1	2	Year 3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	----	----	----	----	----	---	----	----	----	----	----
Two to Four Inch Overlay	350.75	0	56.15	88.63	144.55	208.68	333.21	781.48	107.808	0.882	3.43
Stone Matrix Asphalt Overlay	----	----	----	----	----	---	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	---	----	----	----	----	----
Heater Scarification and Overlay	----	----	----	----	----	---	----	----	----	----	----
Heater Remix and Overlay	----	----	----	----	----	---	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	---	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	---	----	----	----	----	----
Average	351	0	56.15	88.63	144.55	208.68	333.21	781.48	107.808		

Longitudinal Cracking – Very Cool

Two to 4-inch overlay is the only rehabilitation strategy represented in this section so an analysis could not be done.

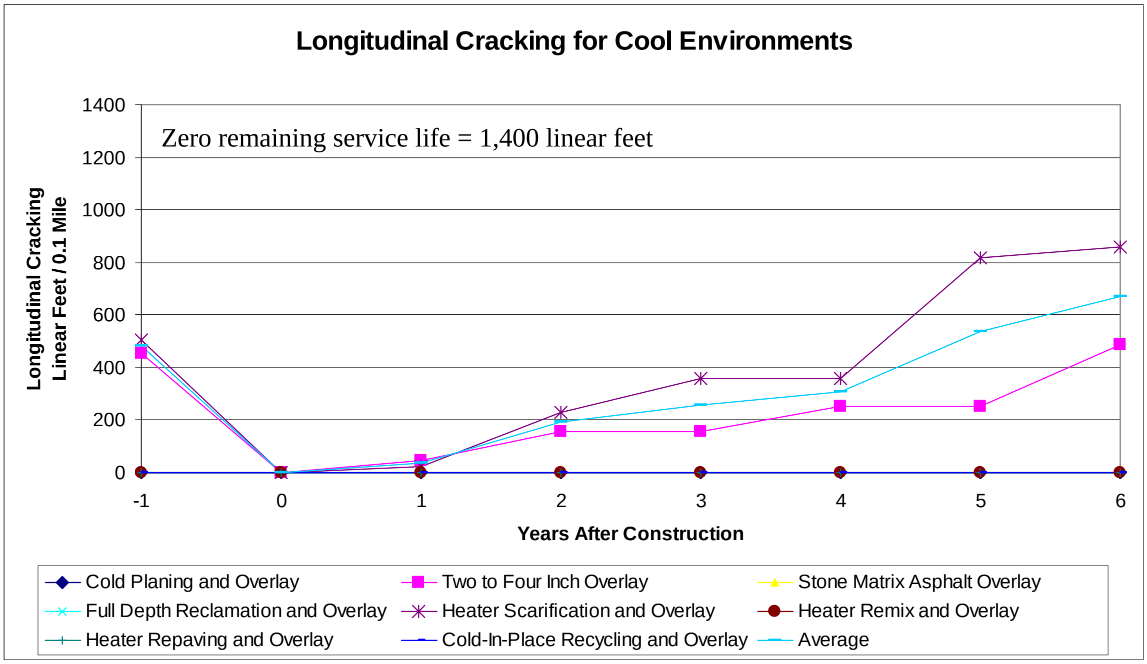

Figure 101 Longitudinal cracking performance after six years with relation to average high temperatures from 81 to 88 degrees F

Table 105 Longitudinal Cracking Performance – Cool Data

Treatment	Cool Year										
	-1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	----	----	----	----	----	---	----	----	----	----	----
Two to Four Inch Overlay	455.5333	0	48.04	154.70	155.05	253.93	253.93	487.67	70.49972	0.703	7.86
Stone Matrix Asphalt Overlay	----	----	----	----	----	---	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	---	----	----	----	----	----
Heater Scarification and Overlay	504.4	0	23.64	228.43	358.55	358.55	818.17	856.28	153.1436	0.763	4
Heater Remix and Overlay	----	----	----	----	----	---	----	----	----	----	----
Heater Repaving and Overlay	----	----	----	----	----	---	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	---	----	----	----	----	----
Average	480	0	35.84	191.57	256.80	306.24	536.05	671.98	111.8216		

Longitudinal Cracking – Cool

Cold planing and overlay, stone matrix asphalt overlay, full-depth reclamation and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Two to 4-inch overlay showed significantly less longitudinal cracking than heater scarification and overlay, the other rehabilitation strategy that met the criteria as shown in Table 105.

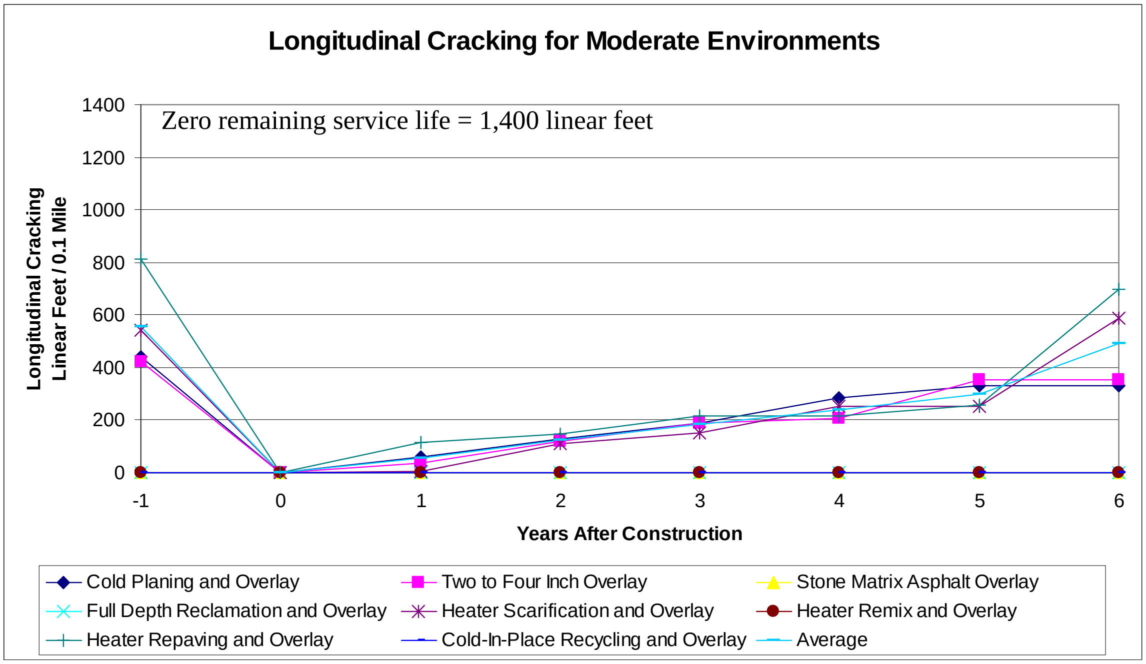

Figure 102 Longitudinal cracking performance after six years with relation to average high temperatures from 88 to 97 degrees F

Table 106 Longitudinal Cracking Performance – Moderate Data

	Moderate										
Treatment					**Year**						
	-1	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**Slope**	**R^2**	**n, Avg**
Cold Planing and Overlay	439.79	0.00	59.48	126.36	186.62	285.14	332.02	332.02	60.71151	0.718	23.57
Two to Four Inch Overlay	420.4632	0	38.51	118.85	188.74	208.16	353.36	353.36	63.53889	0.57	20.17
Stone Matrix Asphalt Overlay	----	----	----	----	----	---	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	---	----	----	----	----	----
Heater Scarification and Overlay	543.3467	0	3.63	111.10	149.84	252.68	252.68	588.38	85.88589	0.697	7.43
Heater Remix and Overlay	----	----	----	----	----	---	----	----	----	----	----
Heater Repaving and Overlay	814.6	0	115.10	146.77	214.50	214.50	256.17	699.97	87.49167	0.8	2.86
Cold-In-Place Recycling and Overlay	----	----	----	----	----	---	----	----	----	----	----
Average	555	0	54.18	125.77	184.93	240.12	298.56	493.43	74.40699		

Longitudinal Cracking – Moderate

Full-depth reclamation and overlay, Heater remix and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay and 2 to 4-inch overlay showed the least amounts of longitudinal cracking per year. Heater scarification and overlay, and heater repaving and overlay showed the greatest amounts of longitudinal cracking per year as shown in Table 105.

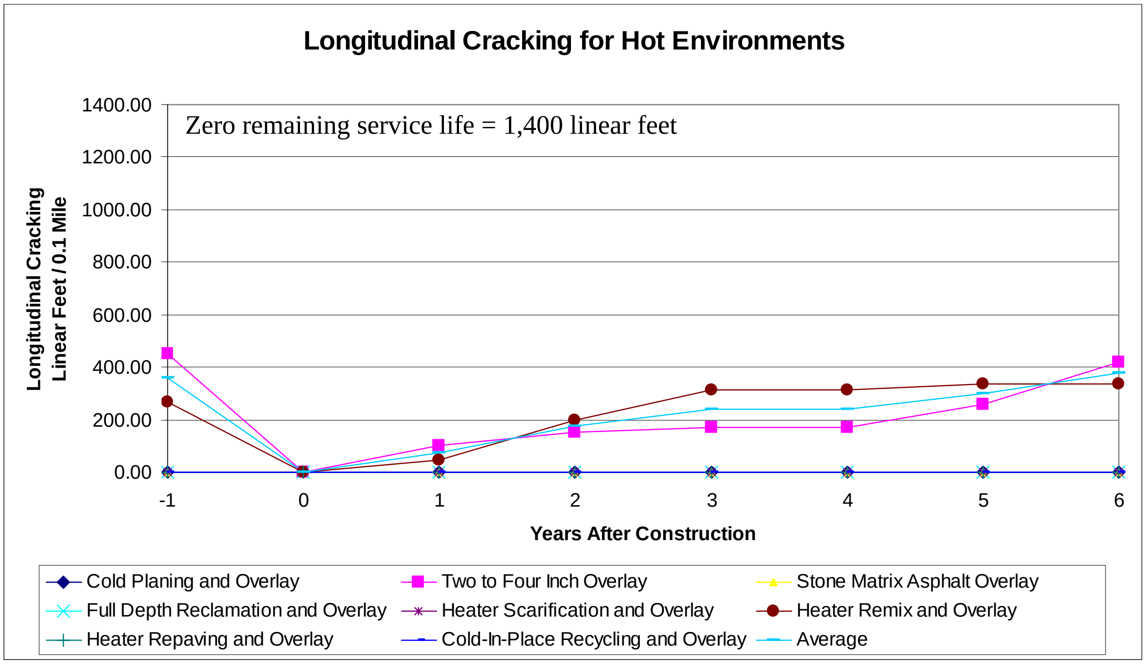

Figure 103 Longitudinal cracking performance after six years with relation to average high temperatures greater than 97 degrees F

Table 107 Longitudinal Cracking Performance – Hot Data

Treatment	Hot Year -1	0	1	2	3	4	5	6	Slope	R^2	n, Avg
Cold Planing and Overlay	----	----	----	----	----	---	----	----	----	----	----
Two to Four Inch Overlay	449.4	0	99.15	153.67	169.40	169.40	257.95	417.24	56.60935	0.496	5.83
Stone Matrix Asphalt Overlay	----	----	----	----	----	---	----	----	----	----	----
Full Depth Reclamation and Overlay	----	----	----	----	----	---	----	----	----	----	----
Heater Scarification and Overlay	----	----	----	----	----	---	----	----	----	----	----
Heater Remix and Overlay	267.9	0	46.27	197.25	313.60	313.60	336.30	336.30	60.90417	0.723	3.29
Heater Repaving and Overlay	----	----	----	----	----	---	----	----	----	----	----
Cold-In-Place Recycling and Overlay	----	----	----	----	----	---	----	----	----	----	----
Average	359	0	72.71	175.46	241.50	241.50	297.13	376.77	58.75676		

Longitudinal Cracking – Hot

Cold planing and overlay, full-depth reclamation and overlay, heater scarification and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Two to 4-inch overlay showed less longitudinal cracking per year. Heater remix and overlay showed the greatest amount of longitudinal cracking per year as shown in Table 107.

5.0 ANALYSIS

Analysis was done to determine which rehabilitation strategy performed best and which strategy performed worst. Analysis was also done to determine the average time it takes for each distress to return to its condition prior to rehabilitation when there is no application of variables to data.

Numbers provided in Tables 108 and 109 represent the number of times a rehabilitation strategy performed best and worst respectively. For analysis purposes, rehabilitation strategies are summarized by how many times they performed the best and worst. In the other instances when rehabilitation strategies performed with the average or did not meet predetermined criteria they are not reported in Tables 108 and 109.

Performance is measured by the overall deterioration over time. The rate of deterioration over time is represented as a linear slope. The slope is the main contributing factor in determining if a rehabilitation strategy performed well. Table 108 shows how many times rehabilitation strategies performed better than others in various situations.

Cold planing and overlay had the most occurrences of performing best compared to the other rehabilitation strategies. Therefore, cold planing and overlay performed best in the majority of the graphs and tables. This conclusion was made by looking at the slopes of the deteriorations. The slope for the rate of deterioration over time for cold planing and overlay in the majority of the situations was less than those of other strategies.

Table 108 Summary of Graphs and Tables Performing Best

Rehabilitation Strategy	Number of Graphs Performed Best
Cold Planing and Overlay	53
2 to 4-Inch Overlay	27
Heater Remix and Overlay	5
Heater Repaving and Overlay	3
Stone Matrix Asphalt Overlay	2
Heater Scarification and Overlay	1
Full Depth Reclamation and Overlay	0
Cold-In-Place Recycling and Overlay	0

For example, Table 4 "Fatigue Performance – All Data" shows that cold planing and overlay has a slope of deterioration over time of 86.42 square feet of fatigue cracking per 0.1 mile. The other rehabilitation strategies slope of deterioration range from 191 to 275.77 square feet of fatigue cracking per 0.1 mile. Therefore, cold planing and overlay showed better performance than other rehabilitation strategies for this example. The same analysis was done for all 100 data tables and graphs. Table 108 summarizes what the results were.

Table 109 is a representation of the number of time each rehabilitation strategy showed the most amounts of deterioration over time. The majority of the projects that showed the greatest slopes of deterioration over time were rehabilitated using the heater scarification and overlay strategy.

Table 109 Summary of Graphs and Tables Performing Worst

Rehabilitation Strategy	Number of Graphs Performed Worst
Heater Scarification and Overlay	34
2 to 4-Inch Overlay	12
Heater Remix and Overlay	9
Cold-in-Place Recycling and Overlay	9
Full Depth Reclamation and Overlay	6
Heater Repaving and Overlay	6
Cold Planing and Overlay	2
Stone Matrix Asphalt Overlay	1

For example, Table 24 "Fatigue Performance – Moderate Traffic Data" shows that heater scarification and overlay has a slope of deterioration of 423.67 square feet of fatigue cracking per 0.1 mile. The rest of the rehabilitation strategies have slopes of deterioration ranging from 92.94 to 287.03 square feet of fatigue cracking per 0.1 mile. Heater scarification and overlay showed greater amounts of fatigue cracking per year than the other rehabilitation strategies so heater scarification and overlay performed the worst. The same analysis was done for all 100 data tables and graphs. Table 109 summarizes the results.

There were twenty data tables and graphs that had only one rehabilitation strategy that met the predetermined criteria. Four data tables and graphs did not have any rehabilitation strategies that met the predetermined criteria and therefore contain no data points or lines.

Analysis was also done to determine the amount of time it takes for a distress to return to its condition prior to rehabilitation. To calculate the time it takes a distress to reach the condition prior to rehabilitation, the distress in year negative one is divided by the linear slope. On the average, when looking at all the data without application of the variables, the following calculations and conclusions can be made:

Smoothness in year negative one is 162.75 in/mile. The slope of the graph shows a deterioration of 11.0073 in/mile/year. The number of years it takes for smoothness to return to its condition prior to rehabilitation is approximately 14 years (162.75 in/mile) / (11.0073 in/mile/year).

Rutting in year negative one is 0.322547 in/mile. The slope of the graph shows a deterioration of 0.044288 in/mile/year. The number of years it takes for rutting to return to its condition prior to rehabilitation is approximately 7 years (0.322547 inches/mile) / (.044288 in/mile/year).

Fatigue cracking in year negative one is 1195.134 square feet. The slope of the graph shows a deterioration of 153.675 square feet/year. The number of years it takes for rutting to return to its condition prior to rehabilitation is approximately 8 years (1195.134 square feet) / (153.675 square feet/year).

Transverse cracking in year negative one is 23.75 cracks. The slope of the graph shows a deterioration of 3.97469 cracks/year. The number of years it takes for transverse cracking to return to its condition prior to rehabilitation is approximately 6 years (23.57 cracks) / (3.97469 cracks/year).

Longitudinal cracking in year negative one is 506.3918 linear feet. The slope of the graph shows a deterioration of 89.06 linear feet/year. The number of years it takes longitudinal cracking to return to its condition prior to rehabilitation is approximately 6 years (506.3918 linear feet) / (89.05633 linear feet / year). With the exception of smoothness the average time it takes the distress to return to its condition prior to rehabilitation is between 6 and 8 years. Smoothness takes approximately 14 years to return to its condition prior to rehabilitation.

The condition of the pavements prior to rehabilitation is important to understand when analyzing this data. Pavements in the poorest condition prior to rehabilitation should not be expected to perform as well as pavements rehabilitated before they reach very poor condition. Therefore, the following analysis was performed to show not only the average pavement condition prior to rehabilitation, but also the range of pavement condition for each rehabilitation strategy. Figures 104 to 108 indicate the average pavement condition for each rehabilitation strategy, the average for all strategies, and the threshold of zero-remaining service life.

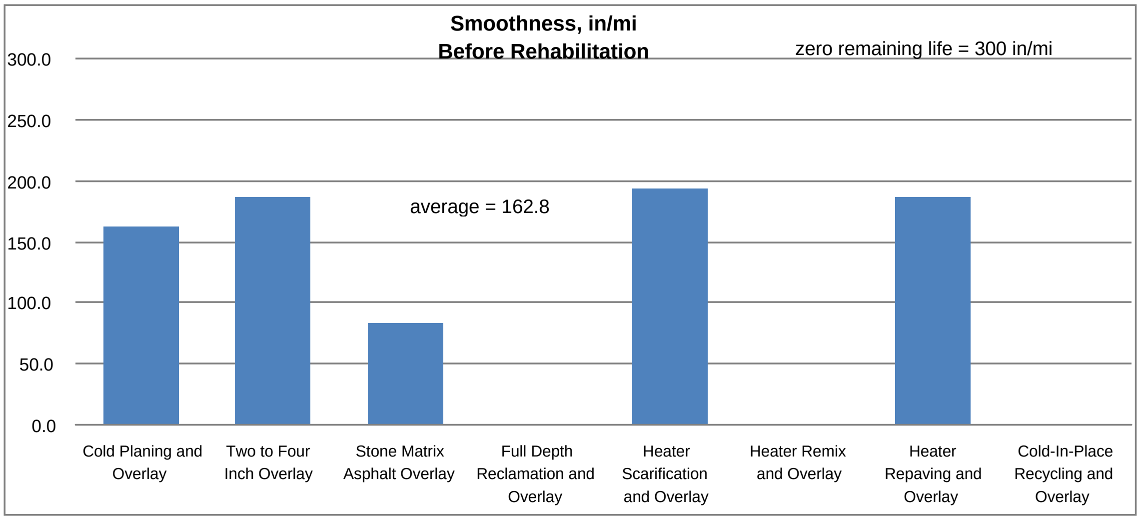

Figure 104 – Average smoothness before rehabilitation

All of the rehabilitation strategies were applied before pavements reached the smoothness zero-remaining service life threshold of 300 inches per mile.

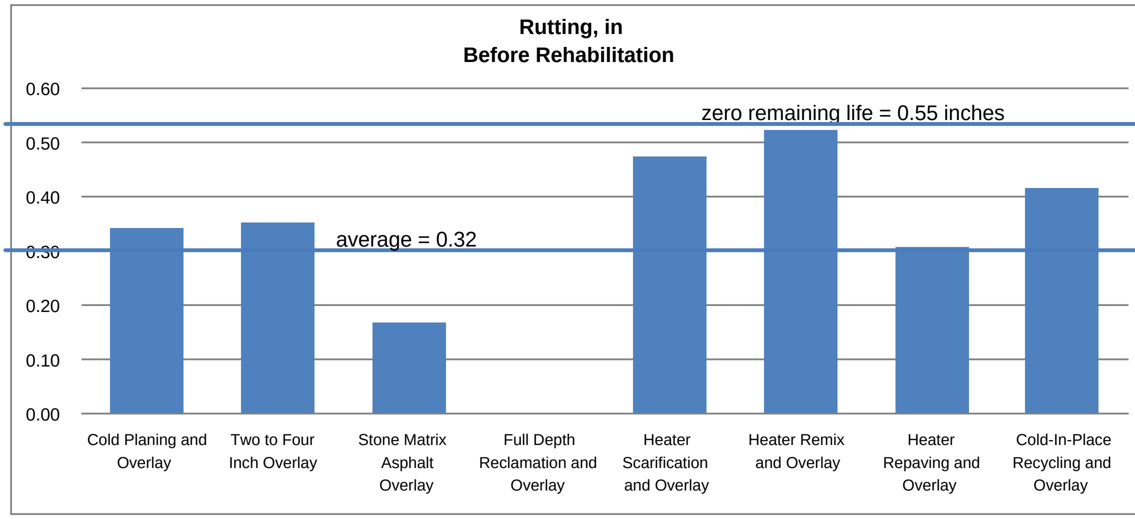

Figure 105 – Average Rutting Before Rehabilitation

All of the rehabilitation strategies were applied before pavements reached the rutting zero-remaining service life threshold of 0.55 inch. However, the heater remix and overlay strategy nearly reached the zero-remaining service life threshold with an average rut depth of 0.52 inch.

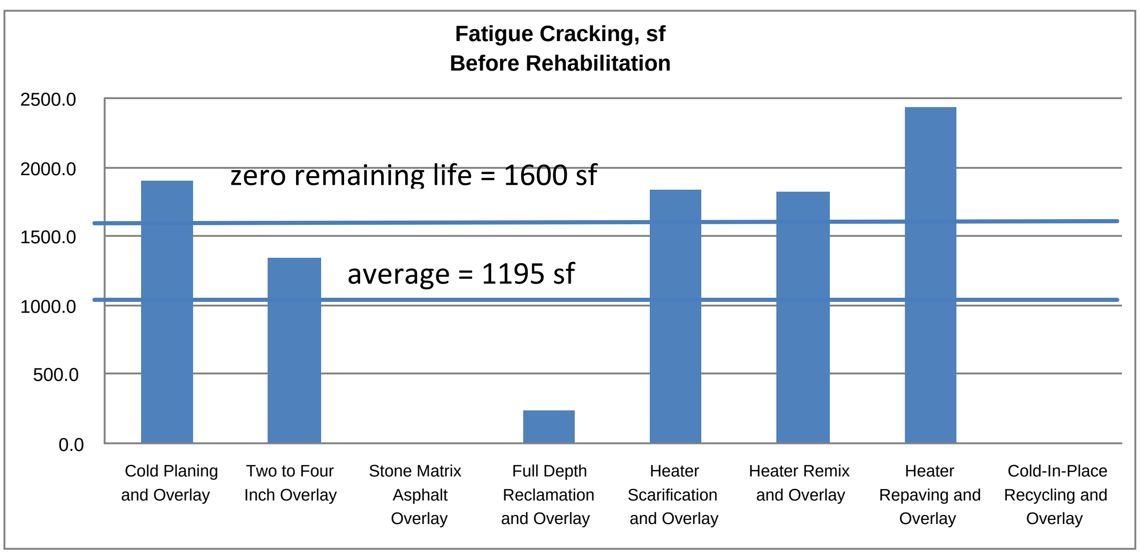

Figure 106 – Average Fatigue Cracking Before Rehabilitation

Four strategies were applied after the pavements reached the zero-remaining service life threshold of 1600 square feet of fatigue cracking. These were cold planing and overlay, heater scarification and overlay, heater remix and overlay, and heater repaving and overlay, at 1908, 1834, 1817, and 2429 square feet, respectively. This level of distress represents approximately 19, 15, 14, and 52 percent in excess, respectively, of the zero-remaining service life distress level of 1600 square feet of fatigue cracking.

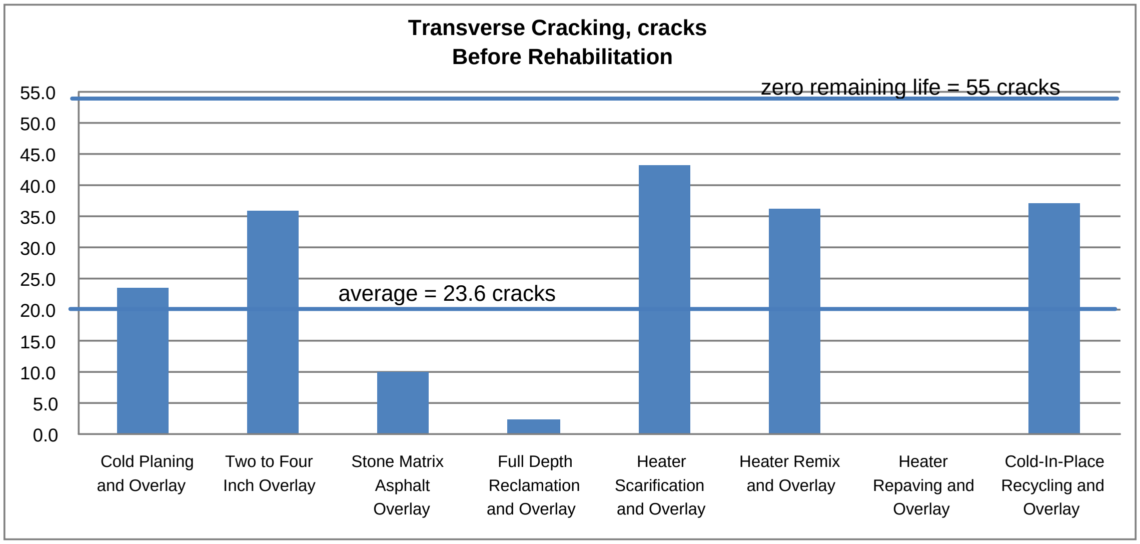

Figure 107 – Average Transverse Cracking Before Rehabilitation

All of the rehabilitation strategies were applied before pavements reached the transverse cracking zero-remaining service life threshold of 55 cracks per 0.10 mile.

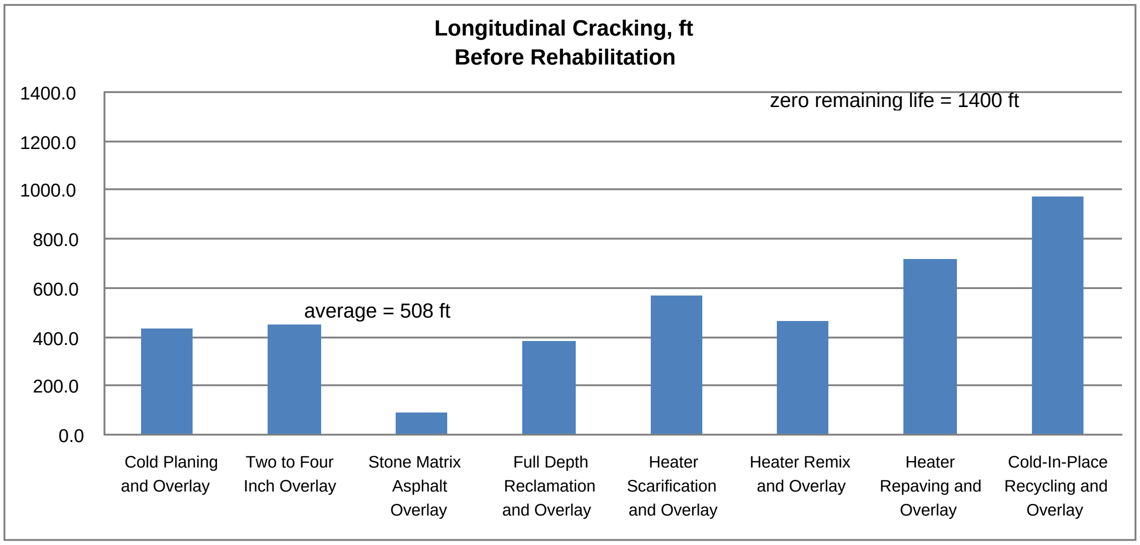

Figure 108 – Average Longitudinal Cracking Before Rehabilitation

All of the rehabilitation strategies were applied before pavements reached the smoothness zero-remaining service life threshold of 1400 feet.

6.0 CONCLUSIONS

1. The pavement management database is a useful tool for analyzing the performance of various rehabilitation strategies with respect to the rate at which various types of pavement distress reoccur.
2. There was not enough data in the database to evaluate each rehabilitation strategy for each independent variable. However, when all of the data was analyzed the following results were observed: cold planing and overlay tends to outperform the average of all rehabilitation methods and two to four-inch overlays are a close second with respect to the rate of change of distress with time. Heater scarification and overlay tends to perform poorer than the average strategy with respect to the rate of change of distress with time.
3. Pavement condition tended to be below the Zero-Remaining Service Life Threshold (ZRSL) for all performance indicators except fatigue cracking. The

condition of the pavements where cold planing and heater scarification were utilized exceeded the ZRSL threshold.

4. Rehabilitation would have been warranted earlier in the life of the pavements that reached ZRSL at the time of rehabilitation. As a result, the expected life of the rehabilitation strategies utilized on these pavements may have been shorter than could be expected had rehabilitation been done before distress reached this high level.
5. Although a linear regression was used successfully to compare the rates of change of distress through time for the first six years of pavement service life for this research, it is likely a more complex model would be needed to predict performance beyond this time.

7.0 FUTURE RESEARCH

A more complete analysis of CDOT's pavement management database is needed to ensure a sample size big enough for all criteria to be represented adequately. Some rehabilitation techniques did not have adequate amounts of data or the data that was included with those techniques did not meet the predetermined criterion.

Data needs to be continually updated as CDOT collects pavement distress data. A program or process that can automatically select data from the Access database is needed so the entire highway network can be analyzed annually.

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APPENDIX A

INSTRUCTIONS FOR CONVERTING ORIGINAL PMS ACCESS DATABASE DATA TO EXCEL

A detailed procedure for replication and continuation of this project is required for the Colorado Department of Transportation to update its records. This is required in order to help improve the efficiency of the current pavement rehabilitation strategies around the state. Steps to replicate study and add to the data pool are listed below and described in more detail later.

1. Retrieve highway data from database.
2. Copy information into excel spreadsheet and organize by year and highway segment.
3. Separate highway segments into directions.
4. Calculate a moving average of every 0.5 miles.
5. Calculate maximum moving average for each direction and segment.
6. Organize data into spreadsheet using maximum moving average by year and highway.
7. Determine what “year 0” is.
8. Separate data by distresses within each rehabilitation strategy.
9. Organize by year.
10. Calculate slope using slope function.
11. Calculate R^2 using coefficient of determination function.
12. Manually sift through data to determine what segments meet criteria.
13. Calculate the average distress per year using the average function.
14. Calculate the slope from year to year using the slope function.
15. Calculate the cumulative slope for all rehabilitation strategies and distresses.
16. Using the “linest” function in Excel, calculate the coefficient of determination value for each line created.
17. Create table that shows the amount of distress each year based on slope for each criteria.
18. Calculate the average number of samples each year for each rehabilitation strategy by distress.
19. Graphically show cumulative slope for each rehabilitation strategy by distress and criteria.
20. Calculate the slope for each line.
21. Analyze data as needed.

CDOT keeps a detailed record of highway conditions organized by highway number and milepost. This pavement management system is organized and updated in a Microsoft Access database. The first step of the research is to search the database for the predetermined sections of highways. These sections of highways need to be highlighted and copied. The data is then pasted into a Microsoft Excel spreadsheet and organized tabularly by year and within each tab organized by highway segments. See Figure 109 for example.

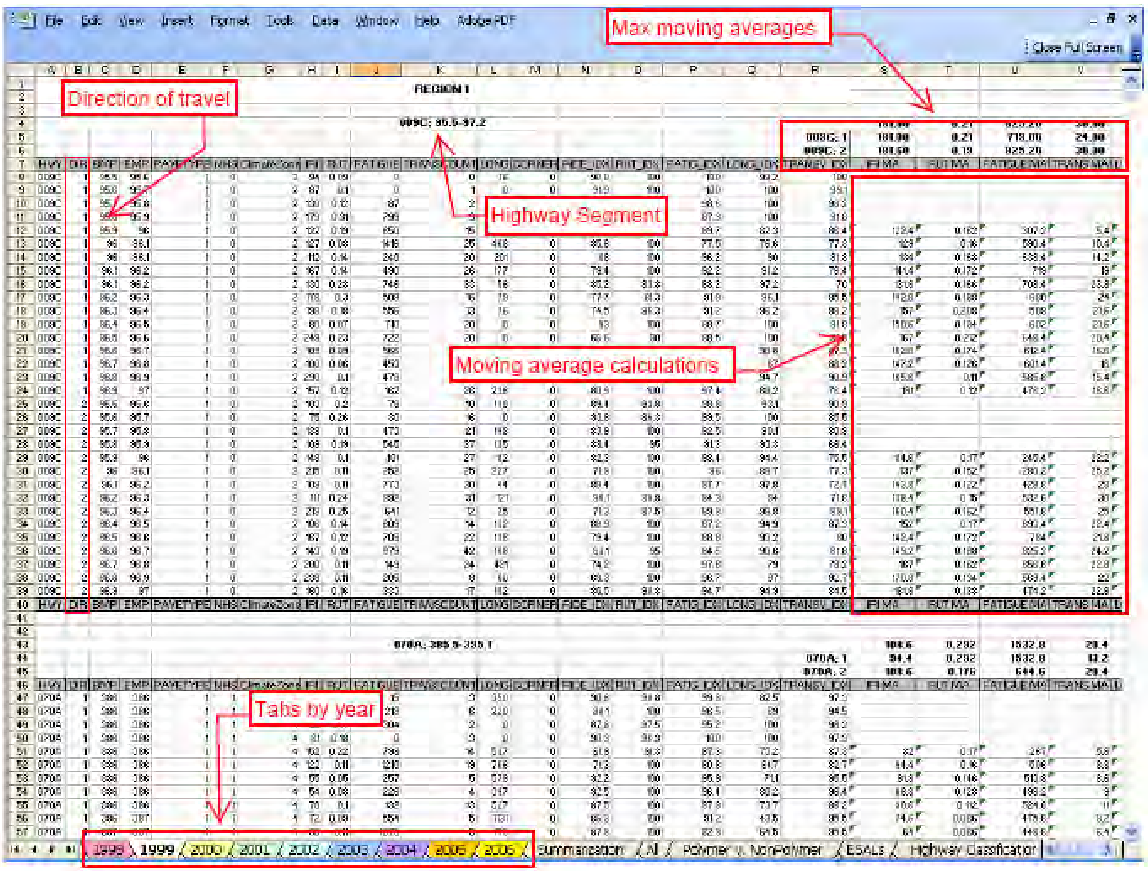

Figure 109 Example highway segment spreadsheet

After data is transferred into the Excel file, sort highways by direction so that a moving average can be calculated for each highway and each direction. To sort data use the “sort” function in Excel found under the data drop down tool menu. Select the data and then sort it by direction in ascending order.

After all data is sorted, use the “Average” function in Excel to calculate a moving average of every 0.5 mile for both directions of traffic. After calculating the moving average for all highway segments, the maximum moving average is found using the “max” function in Excel. The maximum moving average is calculated for both directions of travel and for each highway segment.

A separate worksheet is used to organize data by year and maximum moving average shown in Figure 110. Data is then separated by year, region, and highway segment. Link worksheets to ensure that changes are reflected on all worksheets.

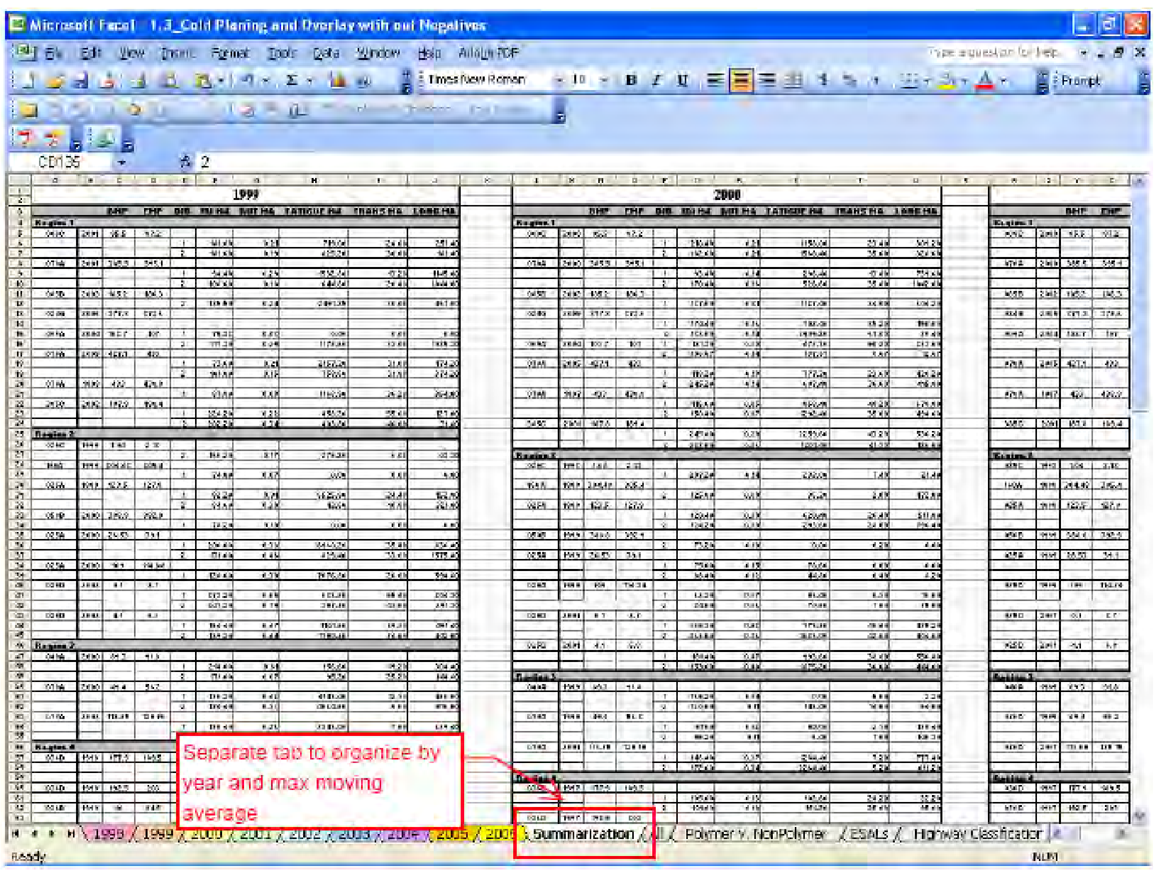

Figure 110 Example summarization spreadsheet

Organize data into the different variables starting with year zero and ending with year six. Using historical information, determine which year was the last year the section of highway received rehabilitation. That year will be represented as year zero. Separate sorted data by distresses and then calculate the slope for all highway sections using the "slope" function within Excel. The coefficient of determination is also calculated using the "rsq" (r squared) function within Excel.

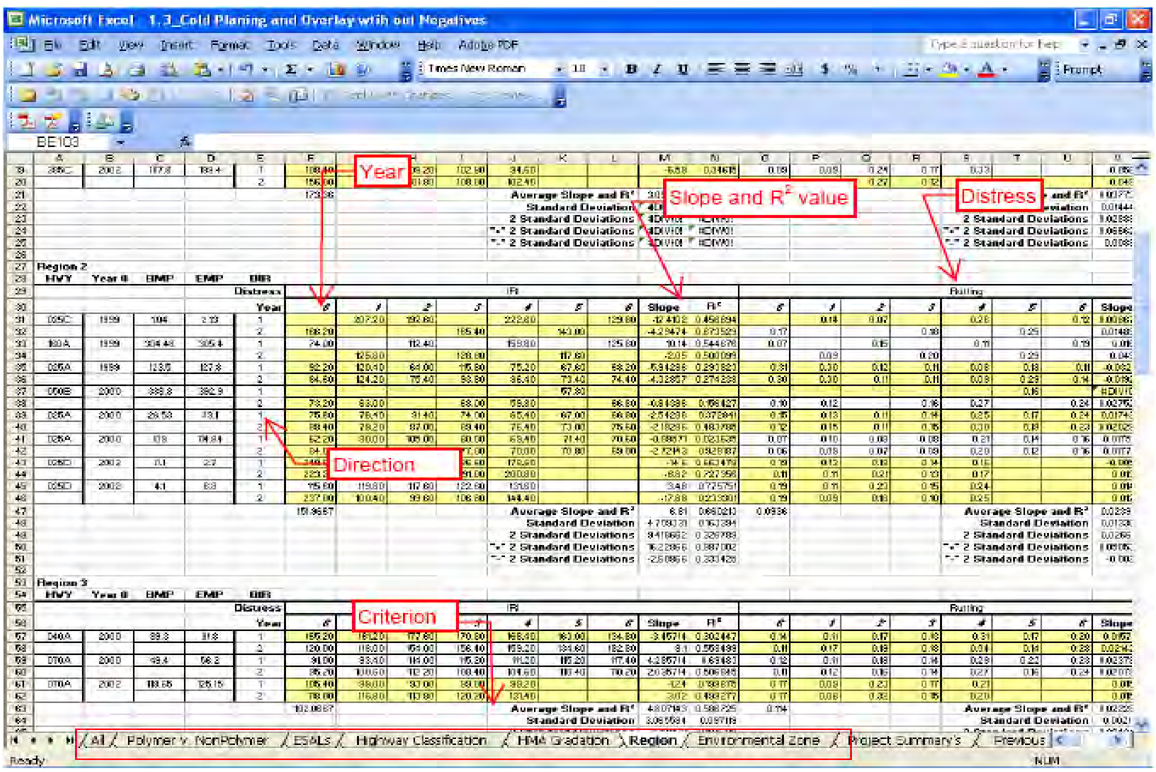

Figure 111 Example criterion spreadsheet

Determine which highways meet the 0.5 R^2 value and have a positive slope. With this information calculate what the average distress for the highway segments for each year using the average function. The slope for each year is then calculated from this information. The n,Average, which is the average number of highway segments in each year, is also calculated utilizing the count function in Excel.

Calculate the coefficient of determination using the “linest” function in Excel for all the data used to determine how accurate the calculated slopes are. This information is presented in a table that shows the cumulative slope for each year, the overall slope of the line, the coefficient of determination, and the n,Average. The cumulative slope is then shown graphically. Data can then be analyzed by rehabilitation strategy.