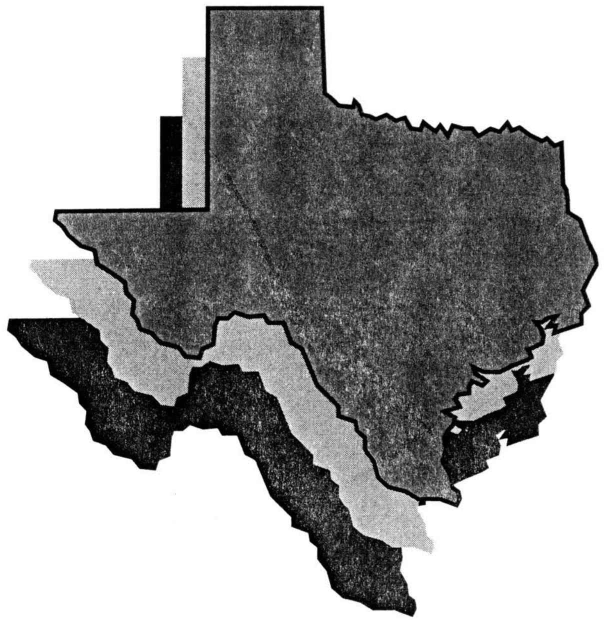
ALTERNATE POLISH VALUE AND SOUNDNESS SPECIFICATIONS FOR BITUMINOUS COARSE AGGREGATES

Report Number
7-3994



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Construction Division/Research and Technology Transfer Section
P.O. Box 5080 • Austin • Texas • 78763-5080 • Phone 512-465-7403, FAX 512-465-7486

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16. Abstract

Polish value and 5-cycle magnesium sulfate soundness are the primary quality requirements in current TxDOT specifications for bituminous coarse aggregates. However, the current TxDOT procedures for polish value and soundness testing do not adequately identify aggregate sources in two critical categories – (I) aggregates with high polish value but poor skid performance, and (II) aggregates with low polish value but good performance.

Primary findings and recommendations of this study include the following:

1. TxDOT's current polish value specification and skid history program are inadequate to support its wet weather skid accident reduction program.
2. Equipment and procedural deficiencies in TxDOT's Test Method Tex-438-A, "Accelerated Polish Test for Coarse Aggregate," are significant. Correction of these deficiencies together with the use of residual polish value will greatly improve the repeatability and reliability of polish value testing.
3. A highly significant predication equation for skid performance has been developed using a combination of residual polish value and 5-cycle magnesium sulfate soundness loss of bituminous coarse aggregates.
4. Guidelines for aggregate selection and alternate polish value and soundness specifications are developed to encompass design, material and construction variables.
5. Blending aggregates to achieve differential wear and durable surface friction is a viable option to satisfy both the engineering and economic considerations.

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Final Report/Project 7-3994

Alternate Polish Value and Soundness Specifications for Bituminous Coarse Aggregates

By

Chien N. Fu, P.E.
Special Project Engineer

and

Hua Chen
Research Assistant

Prepared for

Texas Department of Transportation

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DISCLAIMER

The contents of this report reflect the views of the authors who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official view of the policies of the Texas Department of Transportation (TxDOT) or the Federal Highway Administration (FHWA). This report does not constitute a standard, specification, or regulation, nor is it intended for construction, bidding, or permit purposes.

CHAPTER I – EXECUTIVE SUMMARY

1.0 General

In the fall of 1997, the Texas Department of Transportation initiated a 3-year in-house research project – 7-3994, "Develop Alternate Polish Value and Soundness Specifications to Optimize the Utilization of Bituminous Coarse Aggregates." Under direction of the TxDOT administration, this project was terminated upon August 31, 1998. This report summarizes (1) the background and deficiencies of the current polish value specification and test procedures, (2) the research methodology and preliminary findings derived by this study, and (3) other parameters that need to be considered to balance the engineering and economic considerations in assuring the skid and structural performance of the bituminous mixture.

The following three key elements of TxDOT's wet weather skid accident reduction program (WWSARP) are the main subjects of discussion in this report:

- polish value specification;
- polish value test procedure; and,
- skid testing and skid history program.

Two improved test methods, race-track skid testing and residual polish value, developed by the researchers are used for data collection throughout this study. The preliminary findings of this study include:

- a revised correlation between the skid number and the laboratory polish value;
- a new polish value baseline for consideration in revising the existing polish value specification;
- an improved polish value test procedure which provides more repeatable results; and,
- a prediction equation for the skid performance of coarse aggregate in a pavement surfacing.

Data and analyses provided herewith are based on (1) historical materials and project information on existing pavements and (2) additional field and laboratory tests. Specific data pertaining to the aggregate properties, mix design, pavement service age, and traffic conditions for any given project was not available at the time this study was concluded. Further confirmation of the aggregate skid performance and its correlation with the residual polish value, as measured by the new test method, and other pertinent material properties will require construction and monitoring of test sections.

This study does not address the stripping potential of bituminous aggregates. A separate research project should be initiated to evaluate the moisture susceptibility of bituminous mixtures. Due to early termination of the project and reduced scope, the following tasks were not accomplished:

- evaluation of aggregate soundness and its effect(s) on the structural performance of the asphalt pavement;

- review and refine data of university research to salvage previous research efforts;
- construction and monitoring of test sections to validate the findings of this study; and,
- any other improvement areas encountered during the course of this study.

1.1 Findings

1. It is incorrect to base TxDOT's polish value specification on a correlation between an average polish value of 28 and a skid number (SN_{40}) of 32. This correlation was established in Research Report 126-2, which considered polish value or micro texture of the coarse aggregate being the sole contributor to the overall skid performance. The contribution of macro texture to the skid performance was ignored in the original research and the development of the specification. Preliminary finding of this study shows that a SN_{40} of 32 equates to an average polish value of 31 (by current procedure) for softer limestone aggregates – at a traffic level of greater than 8 million vehicle passes per lane (VPPL). The conservatism originally built into the policy/specification by layered and biased statistical applications is no longer adequate to address the increasing friction demand of the highway surfacing due to greatly increased traffic volume and vehicular speed.

2. The current polish value test procedure Tex-438-A, "Accelerated Polish Test For Coarse Aggregate," is deficient in its ability to adequately identify sources in two critical categories:

   - Category I – aggregates with high polish value but poor skid performance
     The sources in this category impose a significant economic disincentive to the state due to higher present cost for high PV aggregates and the additional/unexpected cost associated with_resurfacing needed earlier than anticipated. It also presents a safety concern with rapidly declining pavement surface friction and greatly increased highway speed. Several limestone sources with high polish value (PV = 32 or greater under the current procedure) have shown poor skid performance for several interstate projects completed within the past two to three years in the Abilene, Brownwood, and Paris Districts.

   - Category II – aggregates with low polish value but good skid performance
     These sources impose an economic disincentive to the state as the local materials with good skid performance and soundness quality are not being utilized to its fullest potential.

3. An improved polish value test procedure has been developed by this study. The preliminary findings show that a residual polish value of 29 should be used as the lower threshold to ensure a SN_{40} of 32 at a traffic level of greater than 8 million VPPL. It is of great significance to note that the overall skid performance (SN_{40}) can by greatly enhanced by the macrotexture that is dependent upon the aggregate's durability, particle shape, and angularity. For crushed gravel and some harder limestone and other aggregate types, the macrotexture's contribution to the overall skid performance is supported by the field and laboratory data. The new procedure

provides adjustment in polish values which partially address the two categories noted above. A highly significant prediction equation for the skid performance is developed by considering both the residual polish value and 5-cycle magnesium sulfate soundness loss. To ensure the contribution from macrotexture, a system approach of evaluating material properties, design methodology, and construction technique would be required.

4. The lower threshold residual polish value (by the improved test procedure) of 29 may be considered as the new baseline for the necessary revision to the current polish value specification. The new polish value test procedure and specification will not function effectively with the current aggregate quality monitoring program (AQMP). To ensure the frictional durability of the surfacing aggregates, the AQMP needs to be expanded to include effective quality control and quality assurance procedures.

5. Blending aggregates to achieve differential wear has provided satisfactory skid performance. The sandstone and limestone blends have provided excellent surface friction in Austin, Houston, and San Antonio Districts. Pavement surfacing with limestone and flint blend has provided very durable friction surface on high traffic roadways in San Antonio District (see Table 5.1).

6. The current skid program is adequate for maintenance applications but not for design and aggregate prequalification. The interpretation of the regression analysis for skid history program is (a) not compatible with the high confidence level used for the polish value specification, (b) from a design standpoint, not adequate to address a wet weather skid accident reduction program, and (c) ineffective in predicting the skid performance of surfacing aggregates with high variability in polish value and 5-cycle magnesium sulfate soundness.

1.2 Recommendations

1. Begin using the guidelines for aggregate selection and pavement surfacing design strategies, which are presented in Table 7.1 with considerations given to residual polish value, 5-cycle magnesium sulfate soundness, acid insoluble residue, crushed face count, and traffic applications. These guidelines are developed with a goal to encompass design, material and construction variables and to develop an order of priority in design procedures and specifications to satisfy the engineering and economic considerations.

2. Implement the proposed polish value procedure as soon as practical. The considerations presented in Section 3.3 should be investigated before final implementation of the proposed procedure. The polish value specification should be revised to reflect the minimum acceptable skid performance. Enhancement of the skid performance should be incorporated into material selection and design strategies.

3. Verify the proposed polish value and 5-cycle soundness specifications (Table 7.2) by constructing and monitoring test sections in different regions of the state. The performance criteria of the test sections should include skid and structural performance.

4. Expand the focus of the current aggregate quality monitoring program (AQMP) to incorporate a more effective quality control and quality assurance procedure. The improved program should be developed to adequately and timely reflect the changing aggregate properties and its effects on pavement structural integrity and skid performance. This program needs to be based on risk management and flexible to accommodate any possible changes to or adoption of new test procedure(s).

5. Discontinue the use of the skid history program for aggregate prequalification. The aggregate sources currently on the skid history program should be reverted to the polish value program as soon as practical.

6. Develop and implement an immediate action plan to identify the high risk areas associated with rapidly declining SN_{40} due to (1) aggregate sources currently having high polish value but poor skid performance, and/or (2) high traffic roadways in the urban districts which, in compliance with TxDOT's 8/1/97 directive, have changed their polish value specification from 35 to 32. Allow the urban districts to specify aggregates of known skid performance in the interim for high traffic roadways until a new polish value specification is developed and implemented.

7. Consider the blending of aggregates to achieve differential wear and durable surface friction as a viable option to satisfy both the engineering and economic considerations.

8. Develop a public education program, similar to "Don't Mess with Texas." This program should be focused on increasing the traveling public's awareness in reducing wet weather skid accidents.

CHAPTER II – INTRODUCTION

2.0 General

An in-house research project titled "Develop Alternate Polish Value and Soundness Specifications for Optimal Utilization of Bituminous Coarse Aggregates" was established by the Texas Department of Transportation (TxDOT) in September of 1997. This 3-year project was initiated to examine the engineering and economic considerations to resolve the following issues:

- TxDOT's Wet Weather Skid Accident Reduction Program – which includes primarily a polish value specification and secondarily a skid history program;

- Use of Local Materials – which is mainly directed at the aggregate usage and its specifications for polish value and 5-cycle magnesium sulfate soundness; and,

- Cost and Benefit Analysis – which requires the examination of the aggregate usage and its effects on pavement's structural and skid performance.

Under directive of TxDOT administration, this project was terminated upon August 31, 1998.

2.1 Purpose and Scope

The main focus of the early effort by this study has been to examine the deficiencies of, and potential improvement solutions to, the polish value specification and test procedure. This report summarizes the background, methodology, data and analyses, and conclusion of the preliminary findings of this study. The following objectives were accomplished upon termination of this project:

- Identify limitations and constraint of current TxDOT procedures pertaining to the wet weather skid accident reduction program;

- Identify factors affecting the reliability of polish value and skid testing;

- Improve the polish value test procedure and quantify polish value's contribution to the skid performance of pavement surfacing aggregate;

- Develop an improved correlation between aggregate polish value and pavement skid performance;

- Establish comparison in polish value testing between the TxDOT and ASTM procedure; and,

- Develop recommendations and available options for consideration in improving the identified deficiencies.

CHAPTER III – BACKGROUND

3.0 Wet Weather Skid Accident Reduction Program

TxDOT's wet weather skid accident reduction program (WWSARP) was developed and implemented in 1974. The WWSARP consists of primarily a polish value specification, which is based on laboratory test, and secondarily a skid history program for the bituminous surface aggregates. Throughout the initial development and later revision of the polish value specification, much conservatism has been applied due to the high variability found in aggregate sources and production as well as the polish value test method. The large margin of conservatism in the polish value specification was further amplified by the use of rated source polish value (RSPV) which added another layer of statistical confidence over what already existed in the specification. However, the rapid growth in vehicular traffic on the Texas highways in the past 25 years has offset much of the conservatism in the specification. Additionally, the premise of the original research, from which the polish value specification was derived, is no longer valid and applicable to today's environment (highway traffic and speed) and that of year 2000 and beyond. The polish value specification has limited the use of many locally available and high quality aggregates. This presents a significant economic disadvantage to the department in terms of materials supply and availability as well as the performance and life cycle cost of the asphaltic pavement surfacing.

The skid history program was first developed in 1975. Although skid testing is performance-based, the program has been mainly applied to a geologically similar aggregate type (South Texas Pleistocene gravel) to waive the polish value required by the specification. The current program lacks written guidelines to clearly detail the acceptance and maintenance procedures, and it has been deficient in maintaining the continuity and consistency in data collection and evaluation. The skid testing has been historically used as one of the tools for pavement evaluation and for planning and programming of needed pavement maintenance. The effectiveness of the skid history program is limited due to the method of skid data collection and regression analysis.

3.1 Polish Value Specification

Per Administrative Circular 22-74, the department adopted polish value specifications through recommendations of research project 126-2. In 126-2 report, a British Pendulum Number (field BPN) of 28 was correlated to a skid number (SN_{40}) of 32. After initial implementation of an experimental specification in Bryan District, the researcher found that (1) a polish value of 28 represents the "average" condition at a source and (2) there was a day-to-day variation in polish value at the source. Considering the variation, the polish value number for specification was increased to assure a surfacing aggregate would have a polish value of at least 28. It was found that the average standard deviation of polish value for all sources investigated was about 2. This number was multiplied by three (3) and added to 28, and a PV of 34 was recommended for the specification. The use of three standard deviations was to include 99.7 percent or almost all of the random variation. A subsequent meeting with FHWA determined three polish value categories of 35, 33 and 30 as the basis of AC 22-74.

In 1982, Dr. Don Ivy of TTI conducted a review of the polish value specification, and he recommended to lower the polish value specification by adding two standard deviations to the original PV baseline of 28. The use of two standard deviations would have a probability of including 95% of the random variation experienced in all sources. By adding two standard deviations to 28, the PV categories were set at 32, 30 and 28. Dr. Ivy recommended "the documentation based on performance as measured with the skid test trailer should be maintained" Administrative Circular 28-83 was issued as a result of Dr. Ivy's recommendation.

The correlation between a polish of 28 and a skid number (SN_{40}) of 32, as established by Research Report 126-2, is not valid. In Research Report 126-2 the BPN and SN_{40} correlation was developed based solely upon field data, and the effect of micro and macro texture on skid performance was not considered in the correlation. Additionally, it was incorrect to (a) consider SN_{50} being the same as SN_{40} and (b) convert field BPN at 5-inch travel length to BPN at 3-inch travel length with a multiplier of 0.6. These have been found to be unsupported by the current state-of-knowledge in both test methods.

3.2 Rated Source Polish Value Program

The department developed and implemented rated source polish value (RSPV) in 1977. The program includes calculating and publishing RSPV which utilizes a 90% confidence factor (percentile value) in a Student T's equation to statistically ensure that 90% of the test result outcome will be equal to or greater than the RSPV.

The recommendations of adding three and two standard deviations to a polish value of 28 to address the material variation of all sources are not equitable. This approach has penalized those sources that have produced aggregate products with more consistent polish values. This also has served as a disincentive for those nonuniform quality aggregate producers to develop and implement a quality control plan. The department has applied 90 percent confidence through RSPV specification on top of the 95% and 99.7% confidence (with two and three standard deviations, respectively) already applied to the PV baseline of 28. This two-tiered quality assurance procedure, which is statistically unsound, has dictated the market for bituminous surfacing aggregates' usage by the department. This procedure has also imposed a varying degree of economic disadvantage upon the department and some aggregate suppliers. The approach of adding two or three standard deviations (industry average) on top of the original baseline not only greatly penalizes the consistent PV sources but also encourages random variation in the production of surfacing aggregates.

3.3 Polish Value Test

The current polish value test procedure does not adequately identify sources in two critical categories as shown in Figure 3.1: (I) aggregates with high polish value but poor skid performance, and (II) aggregates with low polish value but good performance. The sources in category I imposes a significant economic disincentive. This disincentive is due to a higher present cost for high PV aggregates and the additional cost for more frequent resurfacing as the pavement surface friction declines rapidly. The sources in category II imposes an economic disincentive to the state as the local materials with good skid performance and soundness quality are not being utilized to its fullest potential.

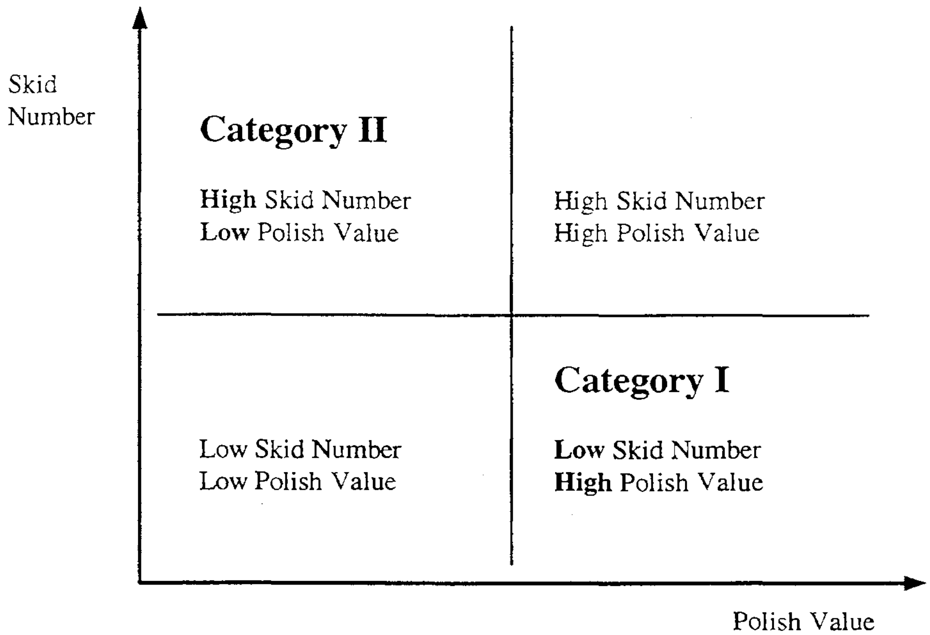

Figure 3.1 – Relationship between current laboratory Polish Value and SN_{40}

Test Method Tex-438-A, "Accelerated Polish Value Test For Coarse Aggregate" uses the average value of the second through the fifth pendulum drops (BPN). The polish value is reported as the average of the average BPNs in a set of seven polish coupons. The researchers have found that the BPN continues to decrease as the pendulum swing is continued beyond the fifth swing and as the slider rubber further polishes the aggregates. It is proposed that a residual polish value be defined as the first constant BPN that has been reached four consecutive times as the pendulum swing continues. Figure 3.2 illustrates the concept of residual polish value. The rate of BPN decrease and number of pendulum drops required to reach the residual condition help to partially explain (1) the harder siliceous aggregates with low average polish value but good skid performance and (2) the softer limestone aggregate with high average polish value but poor skid performance. The researchers have found that the residual polish value is a better indicator of the road wear induced by the tire rubber. The residual condition of field BPN is usually reached within the first four to six pendulum swings. The determination of laboratory residual PV could require up to 20 swings.

Recent development in polish value research indicates that the use of a pneumatic cross-hatch tire produces a differential wear pattern on the polish value test coupons. The differential wear, shown on Figure 3.3 contributes significantly to the high variability of polish value test results. It also causes some of the softer aggregates with poor skid performance to show apparent higher polish values. The polish values produced by the current procedure overestimate the skid performance of the softer limestone aggregates. The use of a solid tire, which is a standard accessory of the original equipment, produces:

- more uniform wear of the test coupons as it actually occurs on the roadway;
- residual polish values that better reflects the microtexture of the surfacing aggregates;
- residual polish values that better reflect the more consistent and higher SN_{40} of the harder surfacing aggregates;
- lower residual polish values that better reflect the lower SN_{40} of the soft limestone surfacing aggregates; and,
- more repeatable test results when the use of solid tire is combined with (a) testing of coupons for residual PV, and (b) coupons fabrication requiring a split procedure – the current procedure requires hand-picking the most cubical aggregates for coupon fabrication.

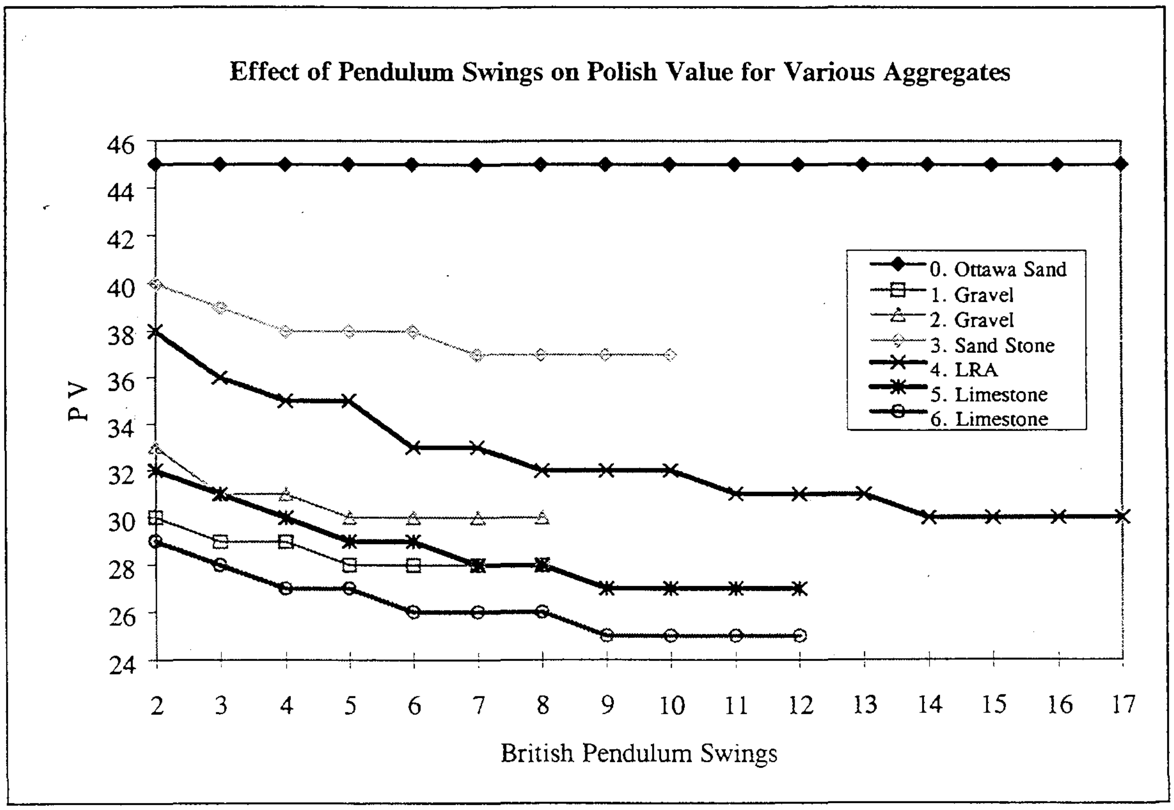

Figure 3.2 – Average polish value versas residual polish value

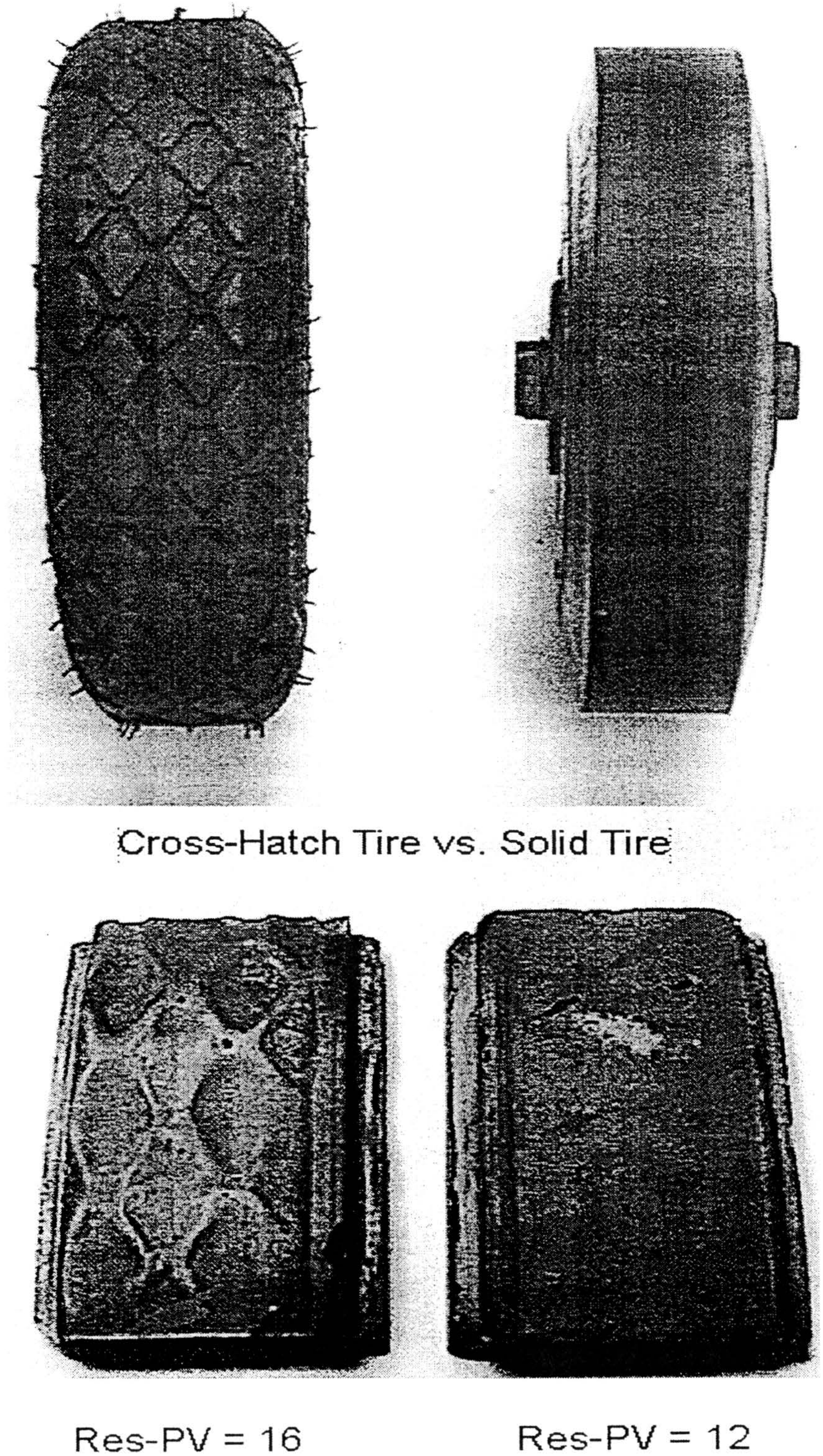

Figure 3.3 – Difference in polishing between cross-hatch tire and solid tire

Due to early termination of the project, the repeatability and further improvement of the proposed procedure were not investigated. In addition to the use of solid tire, residual PV, and split-sample coupon fabrication, the following considerations need to be investigated before final implementation of the proposed procedure:

- The British Standard BS 812:1989 recommends that two control coupons be fabricated and tested with the test sample for each polish wheel set-up. The control coupons are to be fabricated with a material of known polish value from England. This helps to limit the variability of the test results as well as the excessive wear of the solid tire. TxDOT procedure should consider the inclusion of control coupons in polish value testing. Instead of using a control aggregate from England, previous work by the researchers shows that control coupons fabricated with 20-30 Ottawa sand have produced consistent results.

- Test coupons should be placed on the polishing wheel in a random order to reduce test variability due to differential wear. The number of test coupons may be reduced to four or six per sample to accommodate the inclusion of control coupons.

- The progressive wear of the solid tire can affect the polish value test results. The British Standard BS 812:1989 recommends that the tire be replaced after each 20 to 30 runs (60 to 90 hours). This equates to only 10 runs by the TxDOT procedure which is highly impractical for high volume production testing by TxDOT. Deterioration and wear of the solid tire has been reported to contribute to a 4-points decrease in polish value after only ten runs. To negate the effect of wear of the solid tire on test results, TxDOT should investigate the possibility of using a conditioned tire for production testing – in combination with the use of control coupons.

- The solid tire used for data collection by this study was previously conditioned un-intentionally by numerous trial runs, and the researchers did not observe significant change in polish value test results. A work plan should be formulated to study the extent of solid-tire conditioning that is needed to produce consistent polishing of the aggregate coupons.

- Limited investigation by the researchers shows that TxDOT procedure introduces more severe polishing to the test samples; however, the ratio of water and grit feed for TxDOT procedure is much higher than the British procedure. TxDOT procedure uses 50 to 70 ml of water to 5±2 grams of grit per minute. The British procedure uses approximately the same amount of water to 27±7 grams of corn emery for the initial 3-hour polishing. The effectiveness of TxDOT procedure may be improved by altering the water and grit feed rate for sample polishing.

3.4 Skid Testing and Skid History Program

Skid testing by using locked-wheel trailer (ASTM E 274) has been historically used as one of the tools for general evaluation of pavement conditions and for planning and programming of needed pavement maintenance. The quality and reliability of the skid test results can be greatly affected by the seasonal effect in rainfall and temperature, and the variability in operator, equipment, test location, and pavement conditions. The statistical regression method used to analyze the skid history also bears a low level of confidence and should not be used for aggregate prequalification. The skid history program is not compatible with the high level of confidence that lies within the polish value specification.

The skid history program lacks clearly written guidelines and procedures for the acceptance and maintenance of sources on the program. The skid history program has been mainly applied to the geologically similar South Texas Pleistocene gravels. However, many sources have been added to this exempted group without any source-specific skid performance data. Much of the conflict and inconsistency in the method by which the skid data have been historically analyzed need to be resolved before a current moratorium on skid history approval can be removed. There is no assurance in the skid history program for the skid performance of aggregate types/sources that are highly variable in material properties. The skid history program is always too late in catching up with changing aggregate properties that directly affect the skid performance of the surfacing aggregate.

3.5 Previous TxDOT Studies

There have been several recent research studies by TxDOT. These studies have similar, but segmented, focus and much of the data collected by these studies is biased due to test methods. The research methodologies addressed neither the reliability of data nor anticipated the variability in aggregate properties. Because of the variables identified and recent improvements made in polish value, soundness, and skid testing, the usefulness of previous research effort was to be evaluated and consolidated by this study. However, because of early termination of this project, additional laboratory and field tests are not performed to improve the data used by the following previous research projects.

3.5.1 Research Project 490, "Investigation of the Frictional Resistance of Seal-Coat Pavement Surfaces" – This project used much of the 4-cycle soundness test results initially and later some of the 5-cycle soundness test results provided by the department. To improve the reliability of soundness testing, the use of normalized gradation was instituted in the Test Method Tex-411-A in late 1994. The soundness test data used in Project 490 does not have a compatible baseline. It is reported that a high percentage of the samples were precoated aggregates, and this fact may present a difference in the soundness results from that of uncoated aggregates. The procedure used in polish value, soundness, and skid testing presents concerns, to a great extent, in the reliability of the data collected and analyzed by this study. The variability of polish value and skid testing and the recent improvements are addressed in this report.

3.5.2 Research Project 1222-1F, "Establishment of Acceptable Limits for 4-Cycle MSS and Modified Wet-Ball Mill Tests for Aggregates Used in Seal Coats and HMAC Surfaces" – This project used mostly the 4-cycle soundness test results. Limited data on the 5-cycle soundness test results has the same subjectivity due to the use of un-normalized gradation. Recent in-house research has determined that the results of the wet ball mill (WBM) test is subjective to the gradation of the test sample. The test results in WBM loss and percent increase are affected by both the gradation of the sample retained on the No. 40 sieve as well as the amount of binder (minus No. 40 sieve) in the sample. The procedure used in soundness and wet-ball mill testing presents concerns, to a great extent, in the variability of the data collected and analyzed.

3.5.3 Research Project 0-1459, "Use of Pavement Skid History as the Basis for TxDOT Skid Reduction Program" – This project used rated source statistical values for polish value and soundness as reported in the department's aggregate quality monitoring program. Material specific soundness and polish values are not used for correlation with the skid test results. The procedure used in polish value, soundness, and skid testing presents concerns, to a great extent, in the reliability of the data collected and analyzed. Additionally, the relatively low cumulative VPPL (vehicle passes per lane) available for most of the sections, combined with the routine skid test method used for data collection, significantly prevents meaningful conclusions being drawn from the skid history.

3.5.4 Research Project 0-187-9, "Continued Monitoring of Pavement Test Sections" – This project is a continue monitoring of Research Project 1222-1F.

3.5.5 Research Project 0-187-10, "Continued Monitoring of Seal Coat Sections" – This project is a continue monitoring of Research Project 490.

CHAPTER IV – RESEARCH METHODOLOGY

4.0 General

A general-to-specific approach was taken to establish the relationship between skid number (SN_{40}) and polish value. The concept of a three-way relationship is presented on Figure 4.1. The British portable pendulum tester (Figure 4.2) is capable of measuring the laboratory polish value on a curved coupon and the BPN on a flat surface for both field and laboratory applications. The BPN is used as the common denominator to establish an indirect relationship between polish value and SN_{40}.

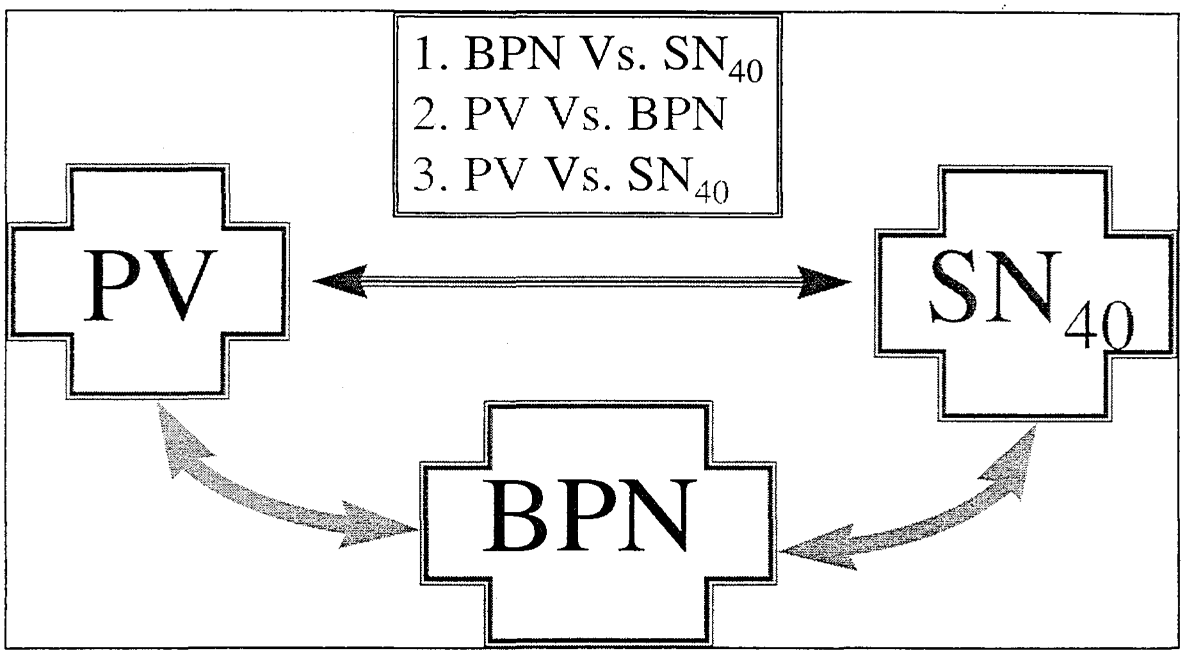

Figure 4.1 – Basic concept of 3-way correlation among SN_{40}, BPN and PV

The field data used to develop correlation No. 1 below was collected from the existing projects. Data used in correlation No. 2 included recent laboratory test results of selected aggregate sources. It is recognized that the third correlation inherits the variability from the (1) historical pavement and project information and (2) lack of specific material properties for the aggregate used in pavement construction.

1. Direct correlation between skid number (SN_{40}) and British pendulum number (BPN) measurements collected in the field;

2. Direct correlation between BPN and polish value measurements collected in the laboratory; and,

3. Indirect correlation between SN_{40} and laboratory polish value.

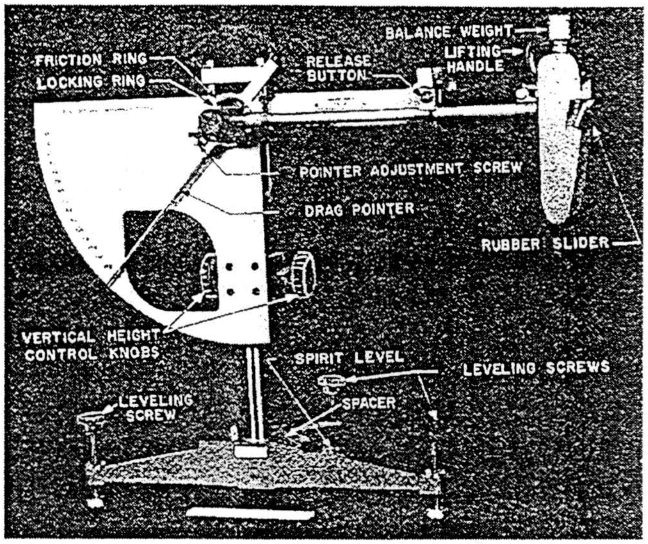

Figure 4.2 – Portable British pendulum tester

To reduce the variability of field and laboratory data, improved field and laboratory test procedures were developed by the research team. Selection of aggregate sources and projects for testing and evaluation is based on the consistency of historical materials test history and service conditions of the existing pavements. The research team also established field and laboratory procedures to examine the following factors:

- the effect of temperature on BPN;
- the effectiveness of polishing using a proposed polish value test procedure; and,
- the effect of vehicle operating speed on skid test results.

4.1 Selection of Aggregate Sources and Projects

Twenty-one aggregate sources were initially identified to encompass the major aggregate types and the typical range of material properties in polish value and 5-cycle magnesium sulfate soundness. Using the producer codes of the selected aggregate sources, a search was conducted on the department mainframe computer. This data search identified projects (CSJ) in the past 8 to 10 years that have been issued with a polish value test report. The identified CSJ was sorted by district and producer code, and the districts were contacted to provide additional input concerning (1) number of lanes, (2) ADT, (3) date in service, (4) single aggregate source or blended aggregate source, (5) type of bituminous surface, and (6) availability for skid testing, etc. Upon receipt of input from districts, a complete database was compiled to identify current projects for skid and field BPN tests. The selected projects encompass a wide range of cumulative VPPL for HMAC and surface treatments. Aggregate samples from the selected sources were collected and tested in the laboratory for polish value, soundness, and acid insoluble to establish the background material properties.

4.2 Race Track Skid Procedure

To improve the reliability of skid testing, a race-track skid test procedure was developed to collect multiple SN_{40} values at each selected location. The repetitive water spray and scrubbing, as skid testing is continued on the same skid path, helps to eliminate much of the seasonal and operator variability of the standard procedure. A greater consistency has been found in the SN_{40} numbers collected at each location by using this method. The race-track procedure requires gathering data for initial conditioning runs and subsequent test runs until a set of five skid numbers that is within a two-point spread is obtained. The detailed procedure and associate control elements for race-track skid testing is presented in Appendix A.

4.3 Improved Polish Value Test Procedure

The research team focused on three key elements that have the greatest effect on the polish value testing and the significance of its test result. These three elements are:

- coupon fabrication;
- polishing of aggregate coupons; and
- polish value determination by using the average of the initial British pendulum numbers vs. the residual value.

The current Test Method Tex-438-A requires the operator to hand-pick the most cubical aggregate for coupon fabrication. To minimize the operator subjectivity and better reflect the aggregate placement and its texture in a asphalt pavement, a split method was devised in lieu of the hand-pick method.

The residual polish value concept was developed by the research team through previous in-house research effort. Residual PV is defined as the constant BPN that has been reached four consecutive times as the pendulum swing is continued. The current test procedure reports the average polish value as the average of the second through the fifth BPN measurements. Figure 3.2 shows the difference between average polish value and residual polish value. Observations made in residual polish value testing include the following:

- The BPN measurement continues to decrease as the pendulum swing is continued beyond the fifth swing;

- The slider rubber further polishes the aggregate coupon as the pendulum swing is continued;
- The rate of BPN decline and the difference between average PV and residual PV are more pronounced for softer limestone;
- The trend of field BPN measurements compares more favorably with laboratory residual condition; and,
- The residual polish value is a better reflection of the field polishing as the vehicle tire rubber induces a fine polishing to the pavement surfaces.

The research team also found that polish value test results is skewed to a great extent by the use of a cross-hatch tire to polish the aggregate coupons. The use of a cross-hatch tire for polishing of the coupons induces a very distinctive wear pattern as shown on Figure 3.3. The differential wear on blank polyester coupons, which greatly dissimulate the wear and polishing of the pavement surface, resulted in a four (4) point increase in residual polish value. The researchers found that the use of a solid tire, which is typically supplied by the vendor, produces polish value results that are much more repeatable and representative of the friction performance of the aggregates in a pavement. In this study, laboratory data was collected by using both cross-hatch and solid tires to establish their comparison.

4.4 Develop Laboratory Procedure for Testing of BPN and Its Correlation with Polish Value

The BPN test measures the relative friction of a given material in terms of energy loss. As the rubber slider on the pendulum foot travels in direct contact with an aggregate coupon, the energy loss experienced by the pendulum is represented by:

- the friction property of the material;
- the displacement of the pendulum arm spring which dictates the normal force applied to rubber slider; and,
- the travel distance at which the slider rubber maintains contact with the aggregate coupon.

The correlation between BPN on a flat coupon and polish value on curved coupon (standard 8-inch radius of curvature) is established on the premise that both methods produce the same energy loss. To simulate the energy loss experienced by the portable British pendulum tester on the same material, standard 8-inch-radius curved coupons and 7-inch-long flat coupons were fabricated.

Nineteen aggregate sources (Table 4.1) representing the major aggregate type and a wide range of polish value were selected for this simulation and correlation. As shown on Figure 4.3, two regular molds for the 3-1/2-inch-long coupon were jointed to fabricate 7-inch-long coupons with a standard 8-inch radius of curvature. The coupons were polished for 9 hours using Test Method Tex-438-A. Upon completion of the accelerated polishing, the coupons were tested for polish values (average and residual). In order to determine the BPN values of the same polished coupon, but on a flat

TABLE 4.1 – List of Aggregate Sources Selected for PV and BPN Correlation Study

Source	Lab. No.	Producer Code	Producer	Pit Name	Aggregate Type
1	98630042	2110905	Upper Valley	D. Garcia	Siliceous Gravel
2	98630032	2106706	Bay Inc.	Sweet 16	Siliceous Gravel
3	97630964	0050437	Meridian	Apple	Sandstone
4	97630936	1523205	Vulcan	Smyth	Limestone Rock Asphalt
5	97630911	1501503	Redland Stone	Beckmann	Limestone
6	98630014	1402702	Word, Dean	Dow Chemical	Dolomite
7	97630948	0224902	Pioneer Aggregates	Bridgeport	Limestone
8	98630260	0822107	Vulcan Materials	Black	Limestone
9	97630931	1504603	Gifford-Hill	New Braunfels	Limestone
10	98630132	1504605	Colorado Materials	Hunter	Limestone
11	97630995	0050114	Gifford-Hill	Little River	Siliceous Gravel
12	98630035	2106701	Wright Matlerials	Realitos	Siliceous Gravel
13	97630994	0050106	Granite Mountain	Sweet Home	Igneous
14	97630978	1817502	Texas Industry.	Streetman	Light-weight

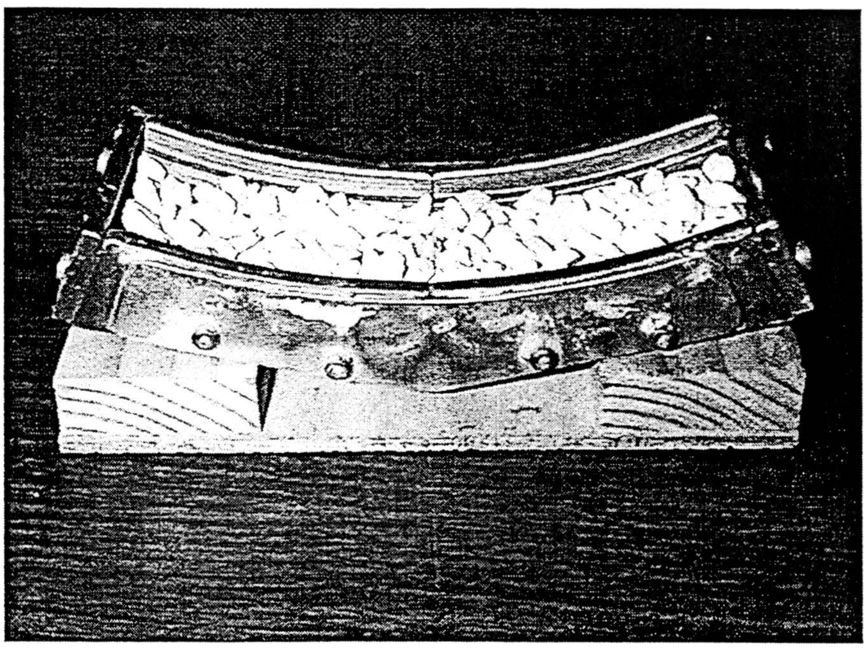

Figure 4.3 – Jointed mold to fabricate 7-inch-long coupons

surface, the curved coupons were heated in the 230 °F oven for 20 to 30 minutes and flattened in a wooden clamp. Figure 4.4 illustrates the comparison between the 7-inch-long curved and flat coupons. The flat coupons were tested for BPN at various travel distances ranging from 3-1/4 to 3-7/8 inches. The BPN values obtained at various travel distances were used to establish the best correlation between BPN (on flat coupon) and Polish Value (on curved coupon). As shown on Figures 5.7 and 5.8, the BPN measured at a travel of distance of 3-7/8 inches provides the best correlation (similar energy loss experienced by the portable British pendulum tester) with the polish value of the same material in a curved coupon. The travel distance of 3-7/8 inches was established for BPN testing in the field at the same locations/skid path where race-track skid data were collected.

ASTM procedure for polish value and BPN testing was also included in an effort to collect laboratory polish value and field BPN data. The relationship between ASTM polish value and BPN is presented on Figure 5.9. The fundamental difference between TxDOT and ASTM test procedures are illustrated in Table 4.2.

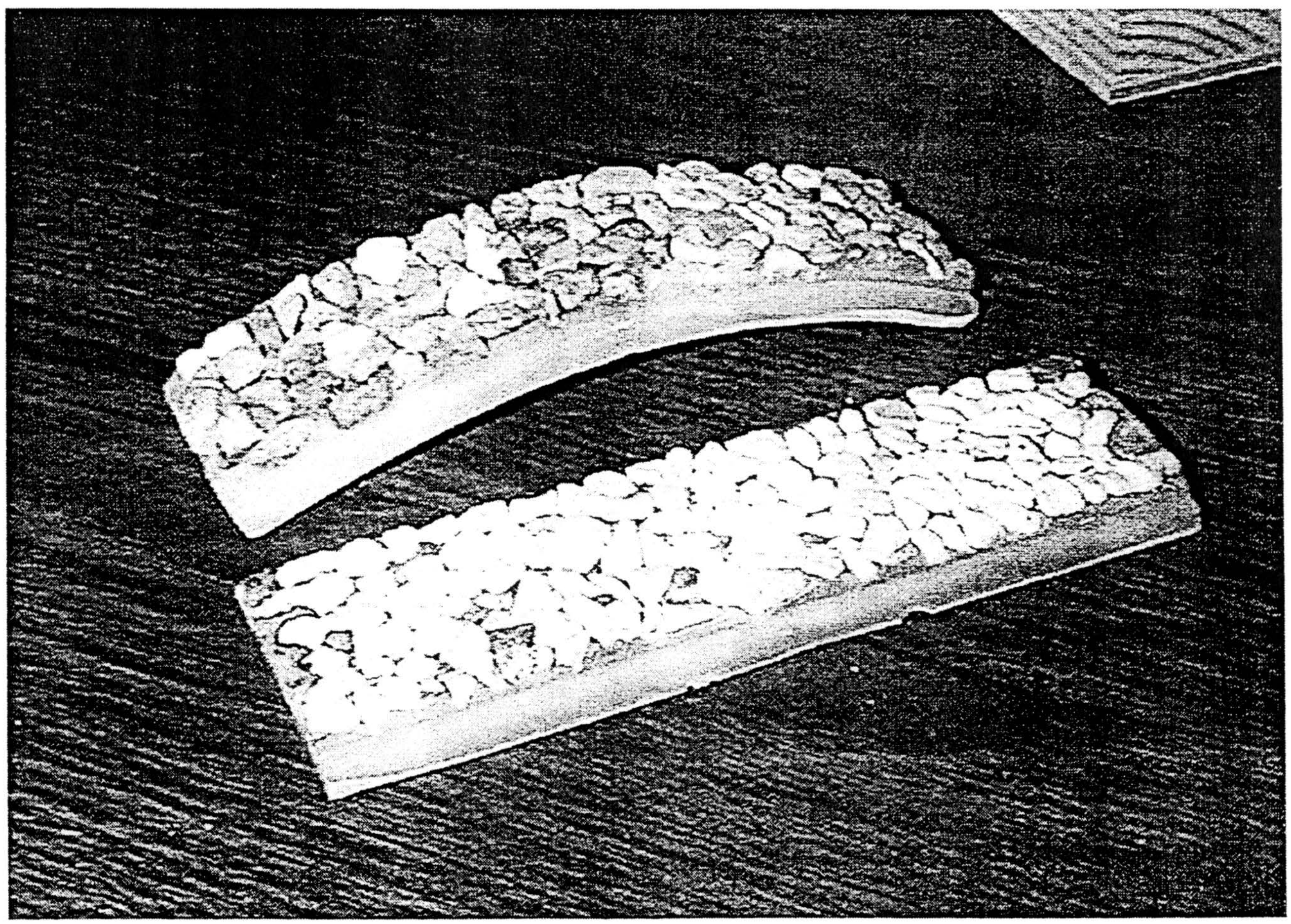

Figure 4.4 – Comparison between 7-inch-long curved and flat coupons

TABLE 4.2 – Comparison Between TxDOT and ASTM Polish Value Test Procedures

Requirements	TxDOT Tex-438-A	ASTM E 3319 & E 303
Test Specimen per Aggregate Sample	7 coupons	4 coupons
Polishing Time	9 hours	10 hours
Slider Rubber (shore A durameter)	71 ± 3	58 ± 2
Report	average polish value	individual BPNs
Travel Distance - field test	no requirement*	5"

* A travel distance of 3-7/8" was used by this study for field BPN data collection.

4.5 Skid Test Projects and Develop Field Correlation Between SN_{40} and BPN

Race-track method was used to assure that uniform and reliable skid data are collected and to reduce the variation in SN_{40} due to seasonal effects. Figure 4.5 shows the format of data that were identified for skid test input.

SKID/POLISH VALUE PROJECT
SKID LOG SHEET Ambient Temp: 91 SAT-10B

DATE: 7/10/98 OPERATOR: McGhee TRUCK NO: 29-3641-G TRLR No: 9945B

DISTRICT : 15 COUNTY: 007 HIGHWAY: IH-37 DIR. N LANE: L1

CSJ: 0073-05-057 TREAD DEPTH: 10 (mm) TORQUE ARM: 572

RUN #	LOCATION 1	LOCATION 2	LOCATION 3	LOCATION 4
1	38	39	38	39
2	38	40	39	39
3	39	41	39	39
4	38	38	38	38
5	38	37	37	38
6		39		
7		39		
8				
FINAL AVERAGE	38.2	38.4	38.2	38.6

NOTES: Start at RM 91 + 0.1 / 93 + 0.3

Figure 4.5 – Example form and data field identified for skid test input

In the same skid path, BPN data was also collected using both the TxDOT and ASTM procedure. A travel distance of 3-7/8 inches was used for TxDOT procedure, and a travel distance of 5 inches was used for the ASTM (E 303) procedure. Figure 4.6 shows the fields of data that were identified for BPN test input.

3994 Project – Field Test Data Sheet

Date(m/d/y)	Logger
ID#	Photo No.
CSJ	District
Highway	Traffic |---Low---------------------High--|
Total No. of Lanes	% Truck
Road Condition: 1.Rutting 2.Polished Aggr. 3.Bleeding 4.Raveling 5.Crack 6.Others	
Coarse Aggregate 1.Limestone 2.Gravel 3.Sandstone 4.Light-Weight 5.LRA 6.Igneous	
Surface Type 1.Surface Treatment 2.HMAC 3.Microsurface 4. Plant Mix Seal 5. Others	
Notes:	

Location		**Air Temp(ºF)**		**Pavement Temp(ºF)**	
BPN (3″7/8) TxDOT					
BPN (5″) ASTM					
MTM					

Location		**Air Temp(ºF)**		**Pavement Temp(ºF)**	
BPN (3″7/8) TxDOT					
BPN (5″) ASTM					
MTM					

Location		**Air Temp(ºF)**		**Pavement Temp(ºF)**	
BPN (3″7/8) TxDOT					
BPN (5″) ASTM					
MTM					

Location		**Air Temp(ºF)**		**Pavement Temp(ºF)**	
BPN (3″7/8) TxDOT					
BPN (5″) ASTM					
MTM					

Figure 4.6 – Example form and data field identified for BPN test input

4.6 Develop Correlation Between Skid Number (SN_{40}) and Polish Value

An indirect correlation between SN_{40} and polish value can be established by using the BPN as the common denominator of the two correlation established above. The field correlation between SN_{40} and BPN is based on the residual condition. For the laboratory correlation between BPN and polish value, the correlation are separated into (1) the correlation between residual BPN (3-7/8" travel distance) and average polish value – proposed procedure using solid tire; (2) the correlation between residual BPN (3-7/8" travel distance) and residual polish value – proposed procedure using solid tire; and, (3) the correlation between residual BPN (5" travel distance) and residual polish value – ASTM procedure using a slider rubber with a durometer (Shore Type A) reading of 58 +/- 2.

The first correlation is needed to establish a comparison with the baseline of current polish value specification – a SN_{40} of 32 correlates to an average polish value of 28. The second correlation is needed to establish a revised baseline for the revised polish value specification based on the improved polish value test procedure. The third correlation is needed to establish a comparison between the TxDOT and ASTM procedures.

4.7 Evaluation of Temperature Effect on BPN

The temperature effect on BPN was evaluated by measuring the BPN of 7-inch-long flat coupons in an environmental chamber. Aggregate sources 1 through 6 in Table 4.1 representing limestone, gravel, and sandstone were tested at different temperature settings ranging from 44 to 95 °F. A travel distance of 3-7/8 inches was used to replicate the field procedure. Figure 4.7a shows an average increase of 1.1 BPN per 10 °F temperature decrease for TxDOT procedure. Figure 4.7b shows an average increase of 1.5 BPN per 10 °F for the ASTM procedure.

4.8 Effectiveness of Laboratory Polishing Using a Solid Tire

To investigate the effectiveness of laboratory polishing using a solid tire, coupons fabricated with aggregate sources 1 through 6 in Table 4.1 were polished incrementally. The aggregate coupons were tested initially for average and residual polish values in an unpolished condition and at each three (3) hour increments thereafter up to a total of 15 hours. The measured polish values decreased as the incremental polishing continued. The effectiveness of polishing is evidenced by the leveling of the polish values. Figure 4.8 shows that the leveling of polish values is reached upon 9 hours.

4.9 Effect of Speed Gradient on Pavement Friction

To examine the effect of diminishing supply of pavement surface friction with increasing vehicle operating speed, skid tests were conducted at different operating speeds for selected limestone and gravel pavements. The skid numbers were collected using the race-track method, and skid tests were conducted at the same locations at 40, 50, 60, and 70 mph. At a few selected locations, skid tests were also conducted at 20 and 30 mph. Figures 4.9 and 4.10 present the correlation of SN_{40} with SN_{50}, SN_{60}, and SN_{70}. A summary of skid test data for speed gradient and available friction evaluation is presented in Appendix B.

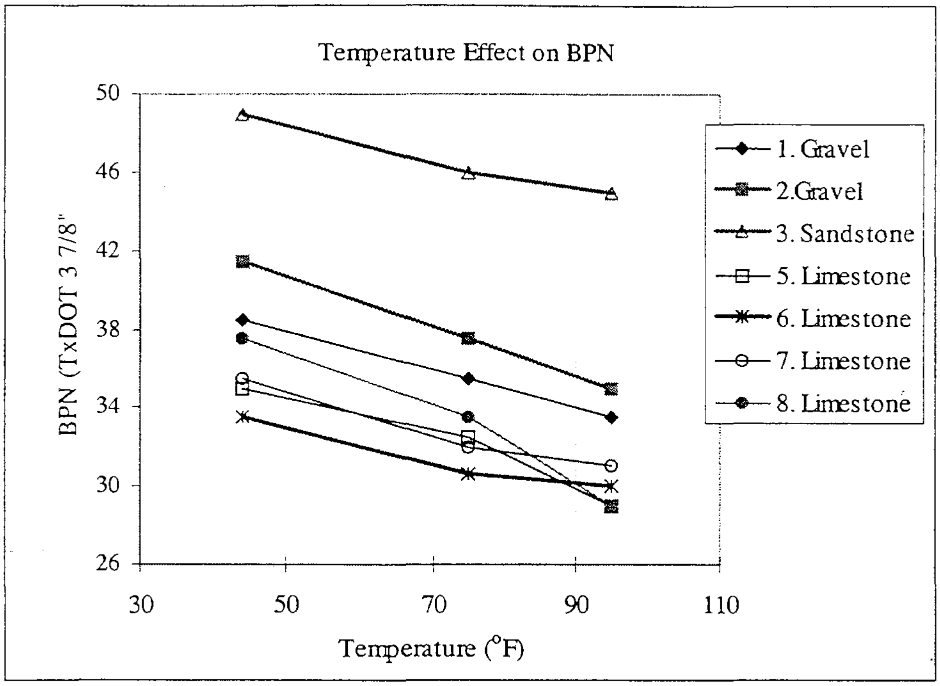

Figure 4.7a – Effect of temperature on TxDOT BPN measurements

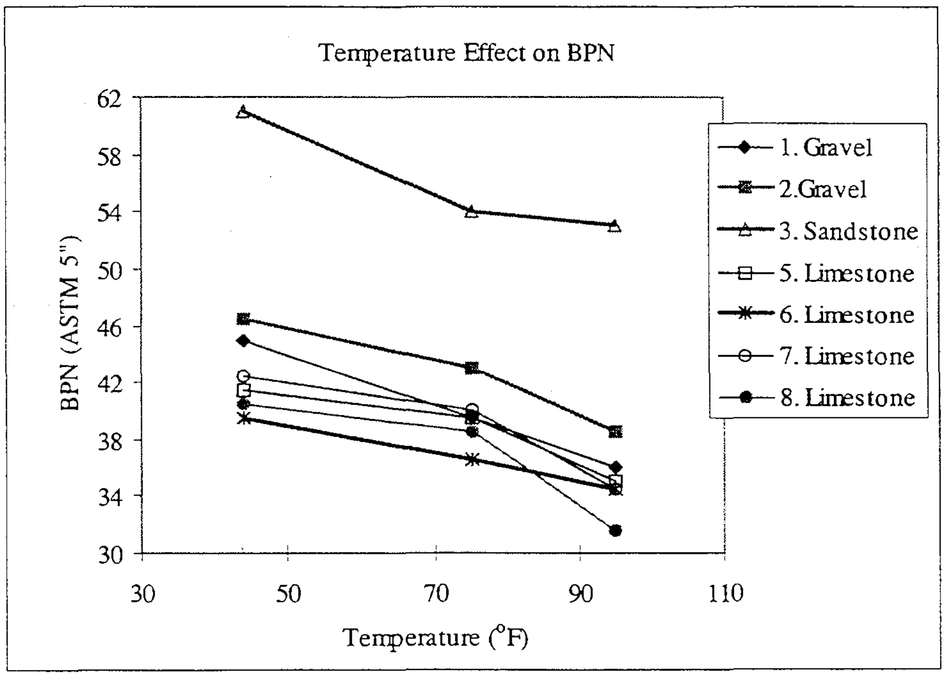

Figure 4.7b – Effect of temperature on ASTM BPN measurements

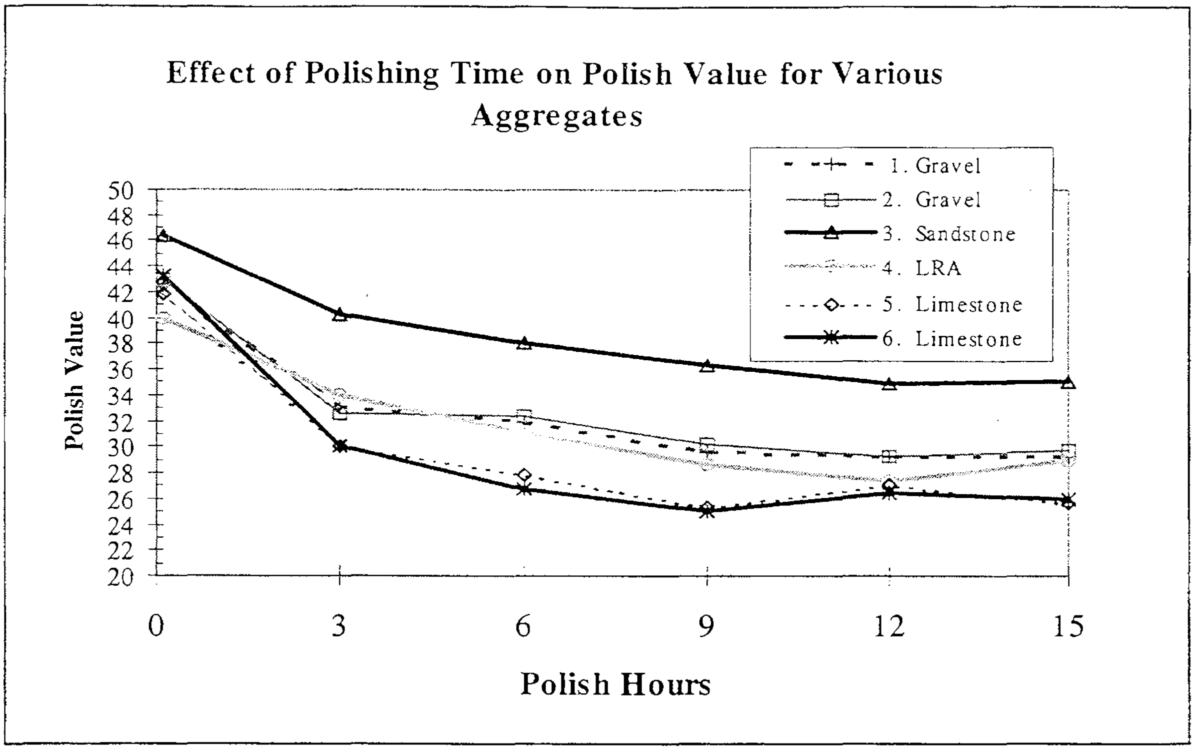

Figure 4.8 – Effect of polishing hours on polish value

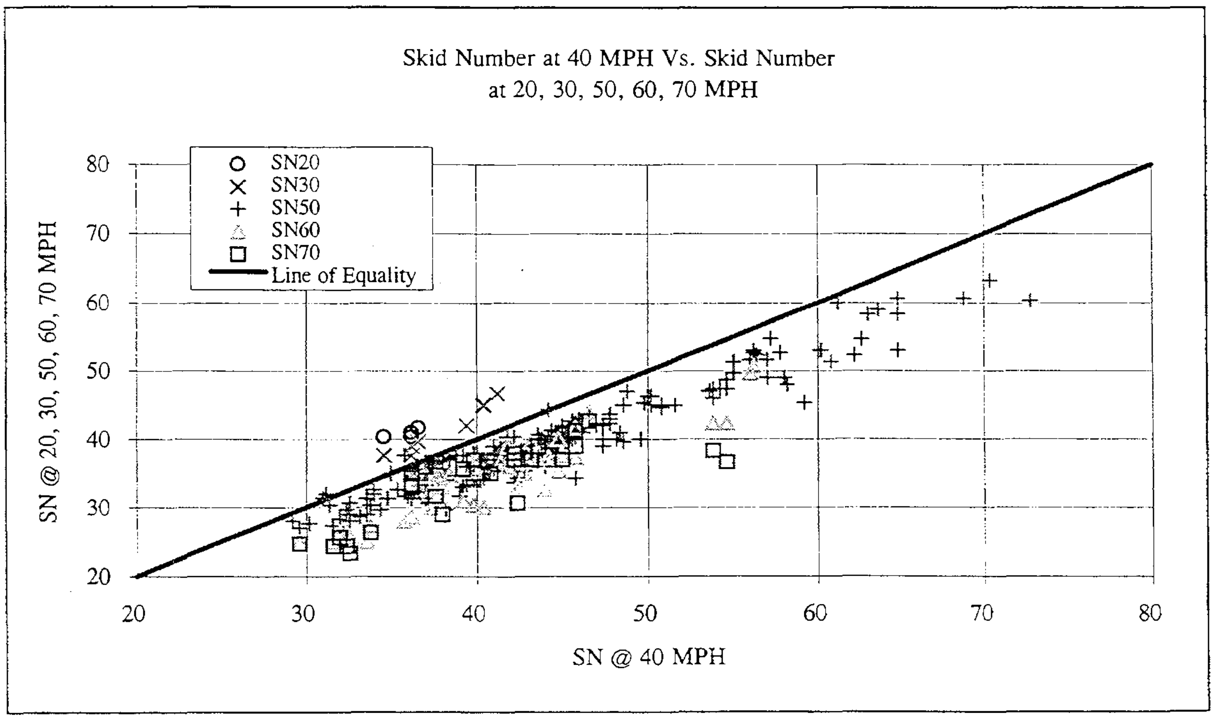

Figure 4.9 – Field data collected for correlation of SN_{40} with SN_{50}, SN_{60}, and SN_{70}

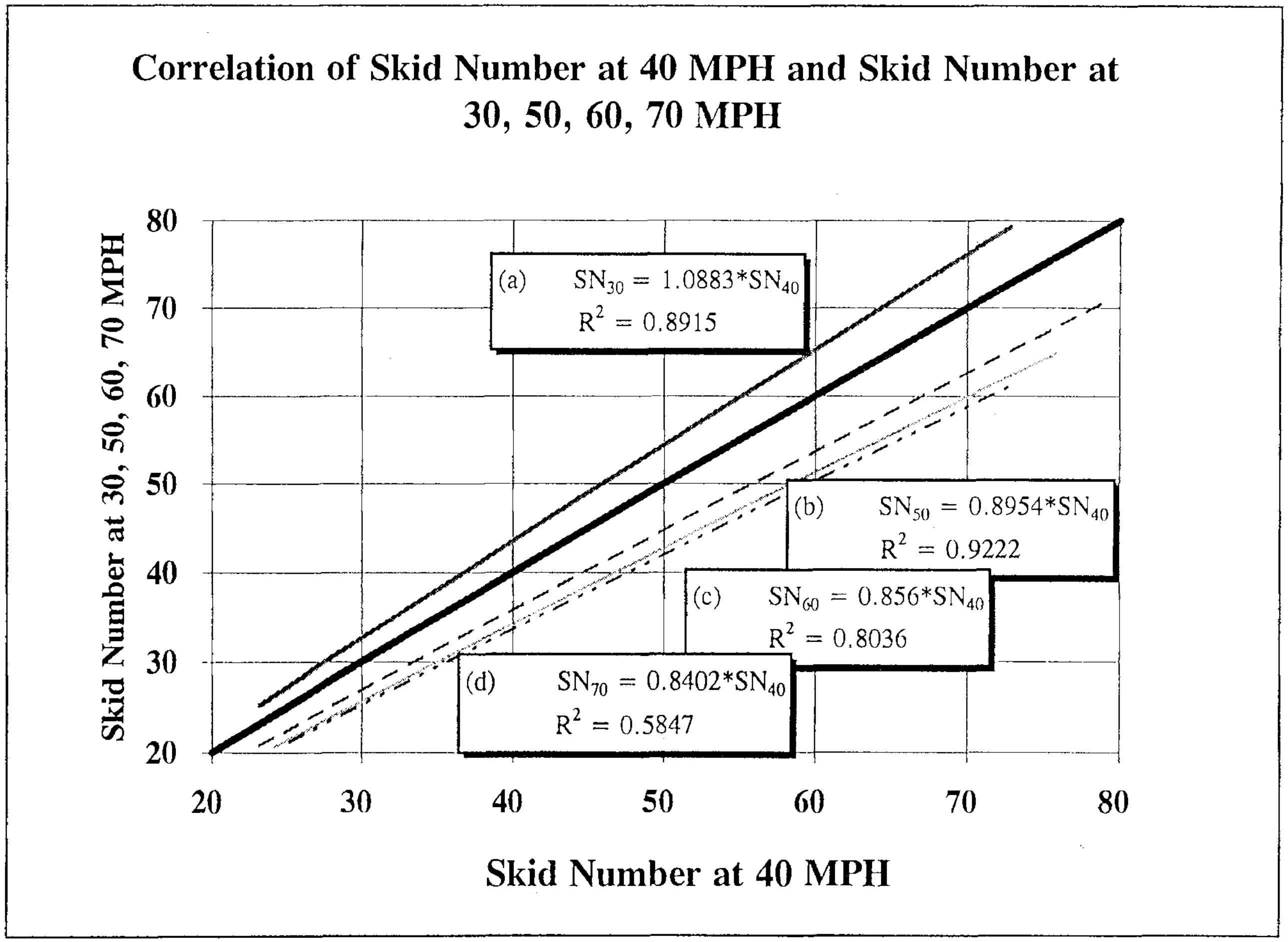

Figure 4.10 – Correlation of SN_{40} with SN_{50}, SN_{60}, and SN_{70}

CHAPTER V – DATA AND ANALYSES

5.0 Overall Data and Trend

This research project identified 142 projects and 39 aggregate sources for field evaluation of SN_{40} and BPN. At the conclusion of this study, a database of 881 records was compiled. A summary of this database is presented in Appendix C. To evaluate the performance trend of these materials, the database was separated into two main aggregate categories – limestone and gravel. The $SN_{40,}$ BPN, VPPL, and section I.D. for limestone and gravel are presented in separate figures and charts. The data collected for the nontraditional surfacing aggregates is also presented in separate tables in this chapter.

As shown on Figures 5.1a and 5.1b, a leveling SN_{40} of near 30 is typical of the limestone aggregate. It should be noted that some limestone aggregates have varying properties at different time periods when these projects were constructed. The variation of material properties in PV, soundness, and other parameters directly contribute to the varying skid data collected from the field. Figure 5.2 shows an example of the source variability in a limestone quarry. Additionally, the scheduled sampling and testing by the aggregate quality monitoring program (AQMP) does not necessarily reflect the quality of materials received and used for construction of the projects.

Figures 5.3a and 5.3b present the $SN_{40,}$ BPN, VPPL, and section I.D. of the crushed gravel group. This group includes gravel sources originated from the northeast, west, and south Texas. Despite the random variation of the field data presented in Figures 5.3a and 5.3b, it is observed that the SN_{40} of the gravel leveled in the mid 30s to low 40s. It should be noted that PV, soundness, and other material properties for gravel are comparatively less variable than the limestone. The hardness and crushing technique of the gravel affect the particle shape (angularity and crushed faces), which has a significant effect upon the macro texture and the overall friction performance of the pavement surfacing.

To determine the effect of traffic (VPPL) upon field polishing and SN_{40}, the statistical mean, median, and mode of SN_{40} were determined at different VPPL levels. Figure 5.4 illustrates the trend of decreasing mean and median of the SN_{40} with increasing VPPL. It is evident to note from Figure 5.4 that the gravel and limestone reached a leveling mean SN_{40} of 45 and 34, respectively, at about 8 million VPPL. The means of both leveling SN_{40} are associated with a standard deviation of approximately 4. The SN_{40} frequency distribution data and graphs are presented in Appendix D. The data are further separated into projects that has experienced greater than 8 million VPPL. This group of SN_{40} and BPN data represents a polished condition, which is simulated by the laboratory polish value procedure.

5.1 Correlation of Field Data Between SN_{40} and BPN

The field BPN were collected using both the TxDOT and ASTM procedures. The correlation between SN_{40} and BPN (for projects that have experienced greater than 8 million VPPL) is shown

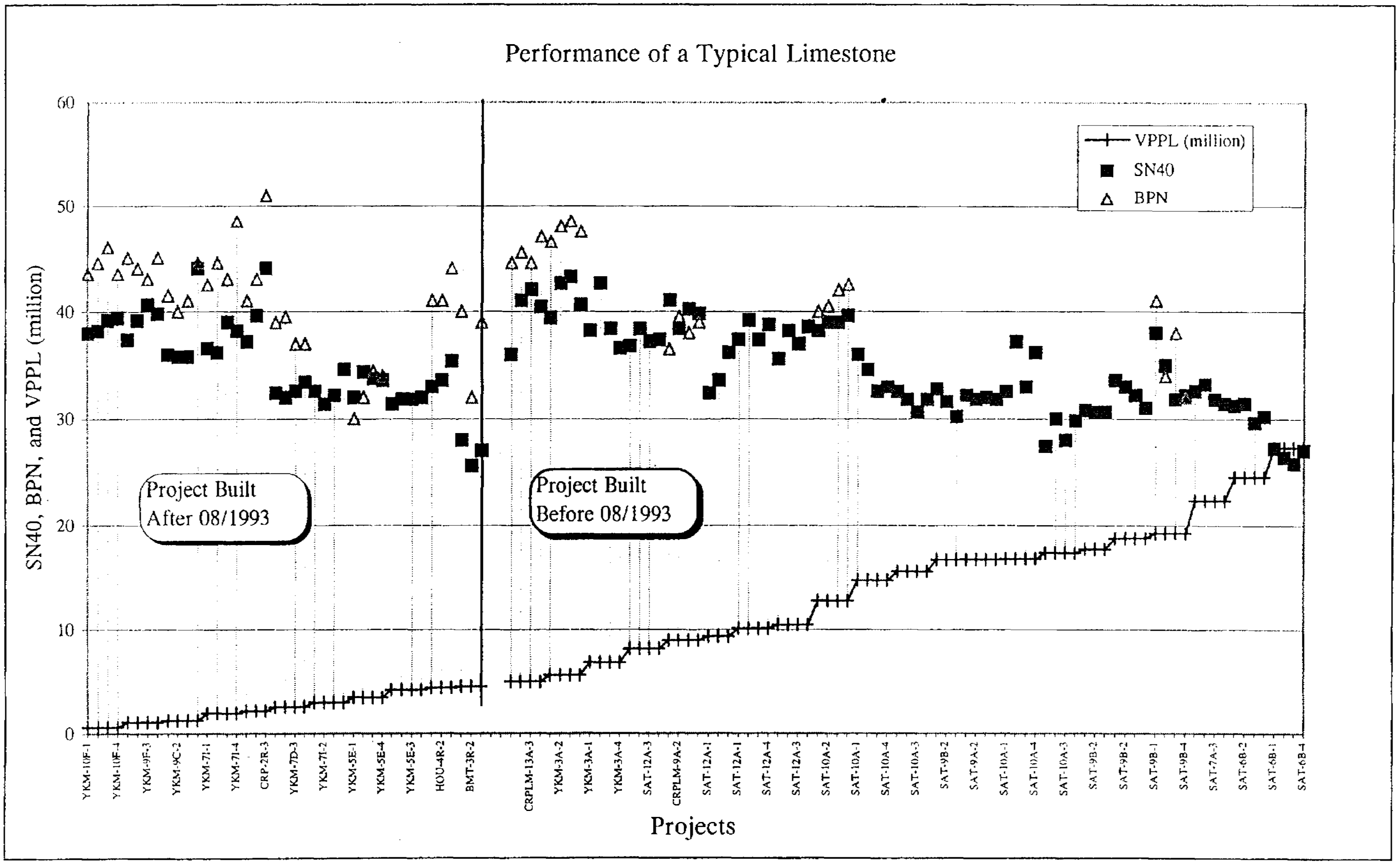

Figure 5.1a – Typical skid performance of limestone aggregate

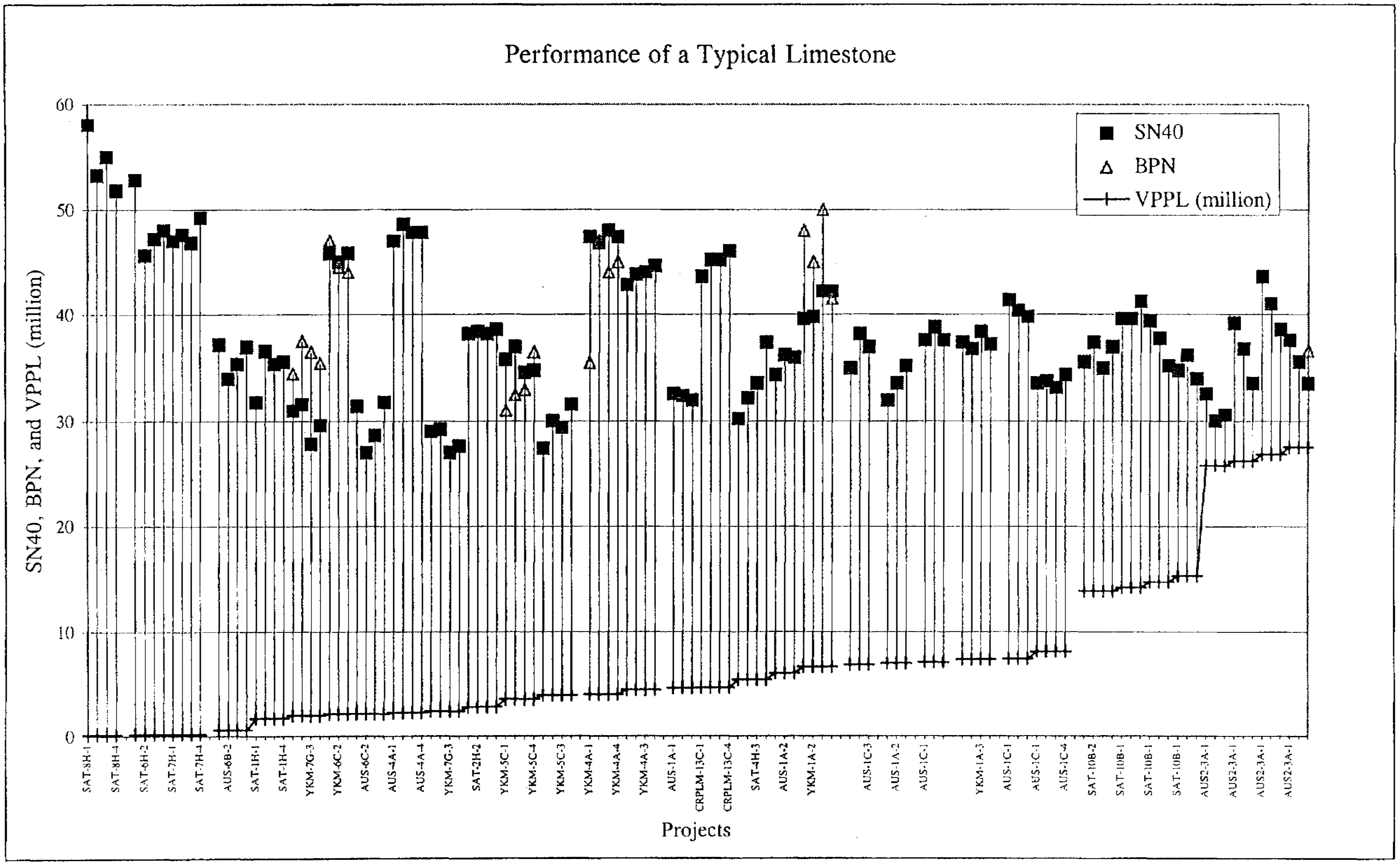

Figure 5.1b – Typical skid performance of limestone aggregate

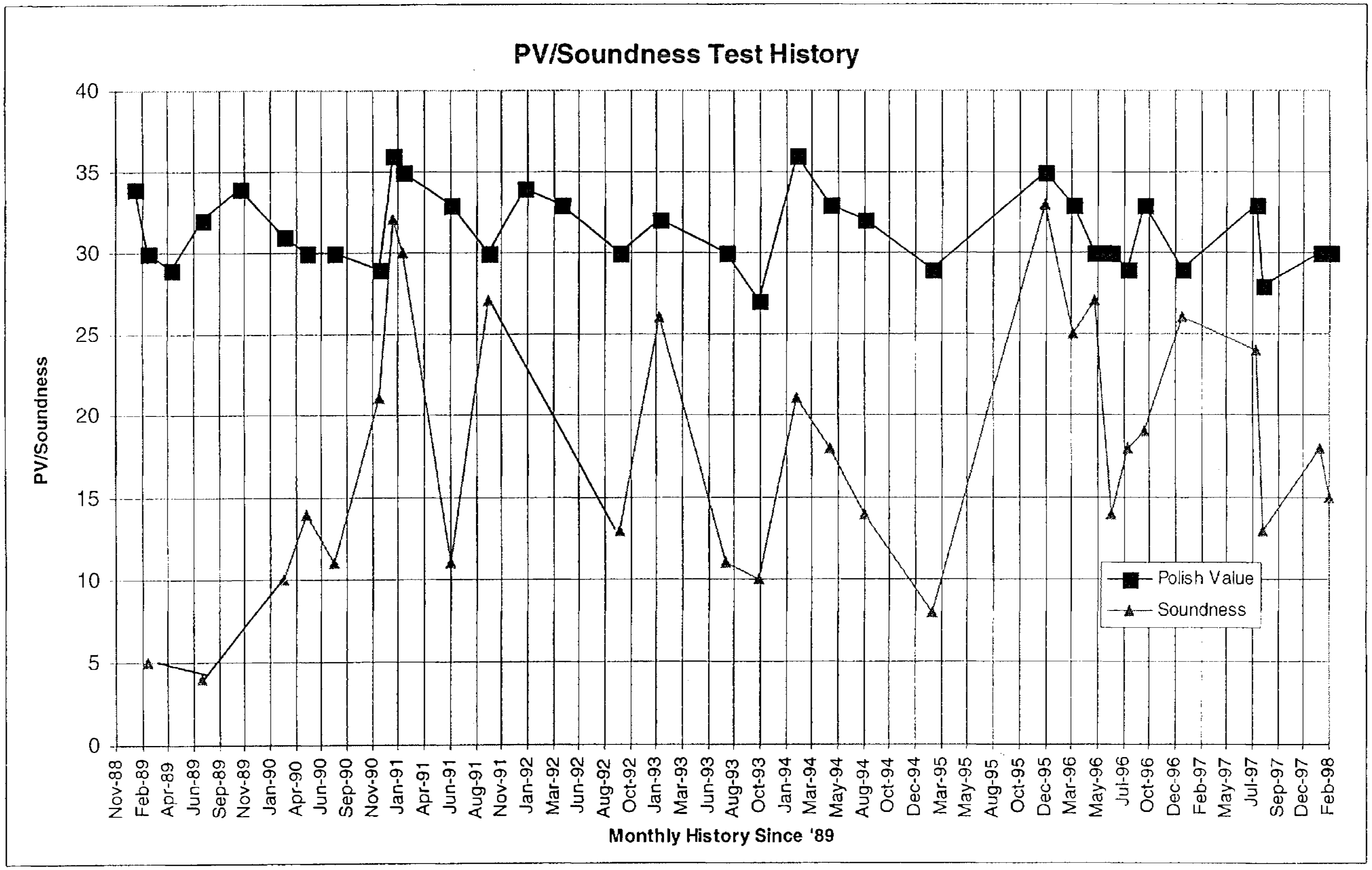

Figure 5.2 – PV and soundness test history of a limestone source

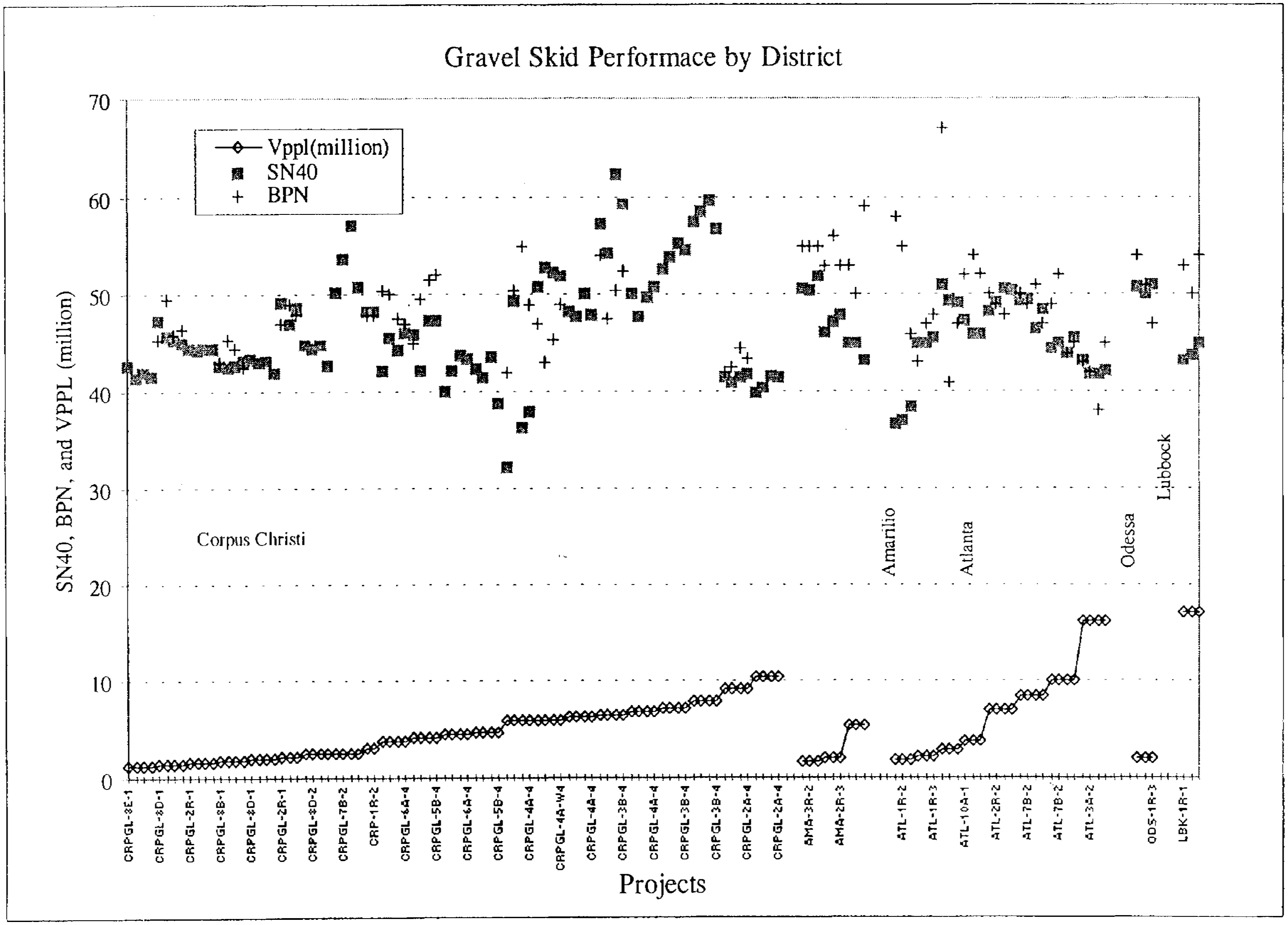

Figure 5.3a – Typical skid performance of crushed gravel aggregate

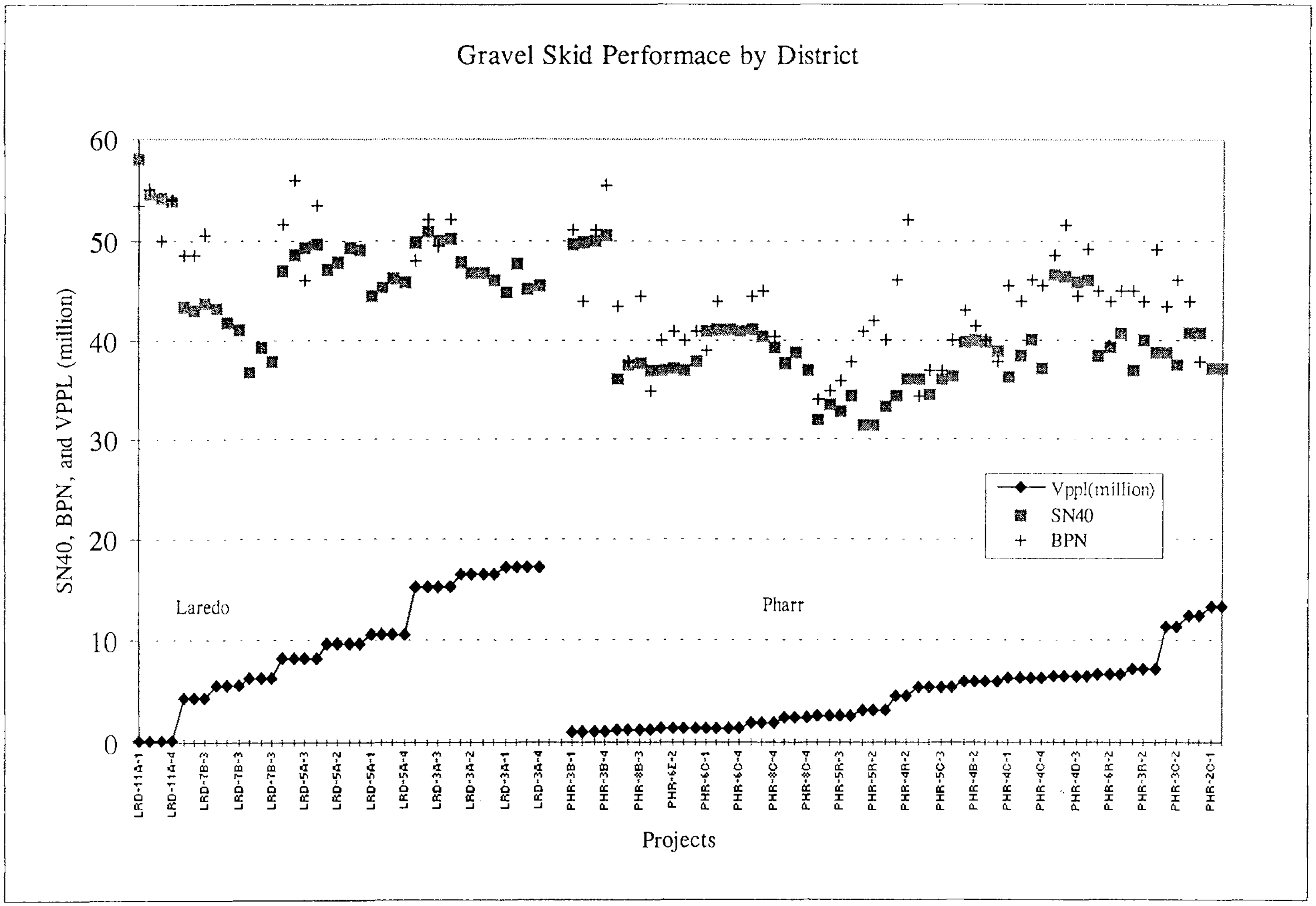

Figure 5.3b – Typical skid performance of crushed gravel aggregate

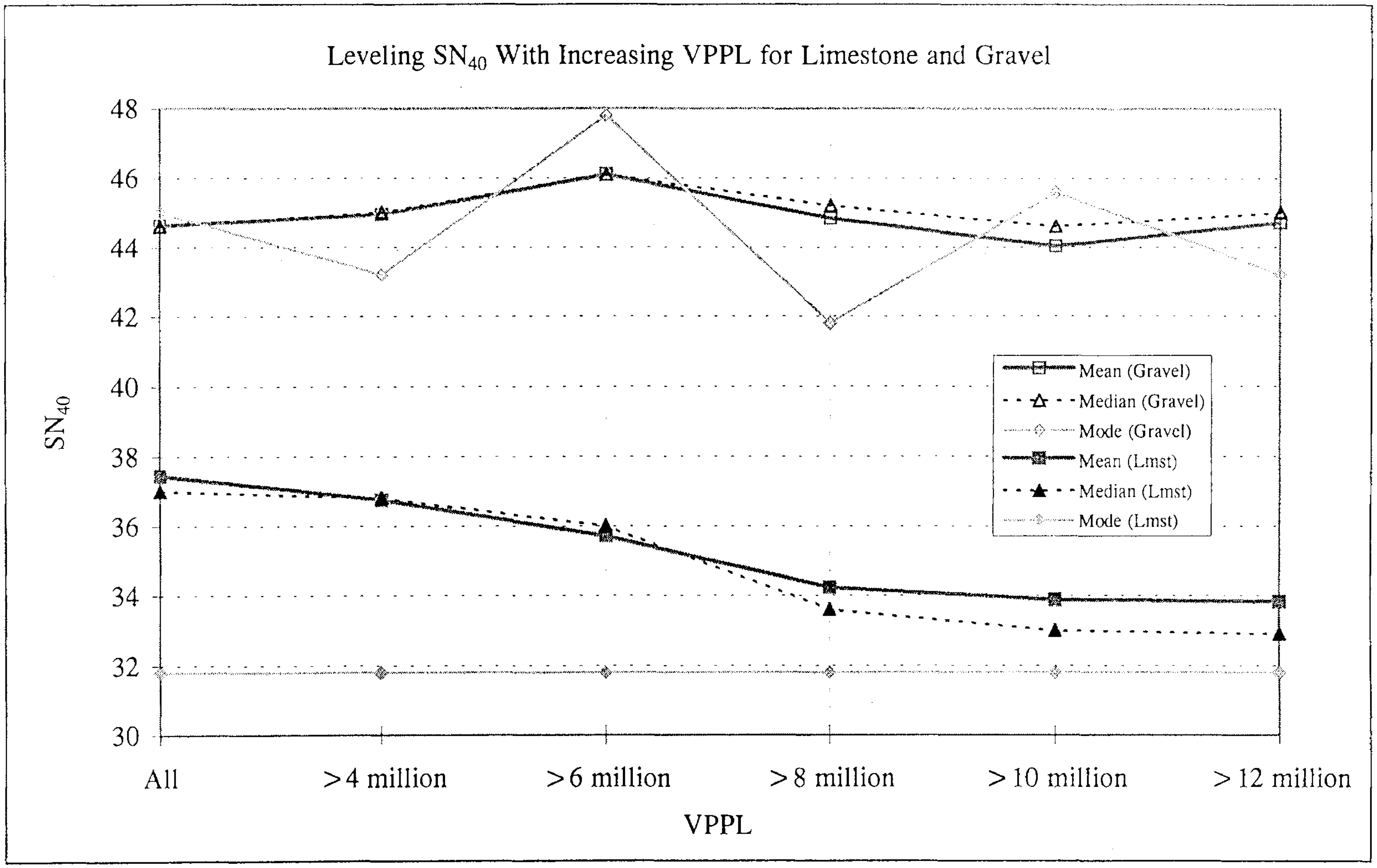

Figure 5.4 – Leveling SN_{40} with increasing VPPL for limestone and gravel

by Figures 5.5 and 5.6. The correlation between SN_{40} and TxDOT BPN presents a reasonably good correlation with an r^2 of 0.71. The correlation between the SN_{40} and ASTM BPN shows a lower r^2 of 0.44. It should be noted that both SN_{40} and BPN measurements are affected by temperature. Studies by other researchers showed that the temperature effect on SN_{40} can vary from 1.5 to 3 skid numbers per 10 °F change in temperature. However, this study lacks temperature measurements that are necessary for adjustment of field data due to temperature effect.

5.2 Correlation of Laboratory Data Between Polish Value and BPN

The polish values and BPNs measured from the 7-inch-long coupons were used to establish this correlation for both the TxDOT and ASTM procedures. As evidenced by Figures 5.7 and 5.8, the correlation of BPN with polish value has r^2 of 0.88 and 0.95 for the TxDOT average and residual conditions, respectively. The correlation of the two parameters using the ASTM residual test data produced a r^2 of 0.95 as shown on Figure 5.9. Summary of laboratory data for BPN and polish value correlation is presented in Appendix E.

It should be noted that the correlation established herewith are based on polish values produced by solid tire. It is not appropriate to use the cross-hatch tire as it induces differential wear and skews the polish value and BPN test results.

5.3 Correlation Between SN_{40} and TxDOT Average Polish Value

The correlations shown in Figures 5.5 and 5.7 provide the vehicle to establish an indirect correlation between the SN_{40} and TxDOT average polish value. The correlation equation shown in Figure 5.7 was applied to the BPN and SN_{40} correlation to derive the indirect correlation. This correlation was developed for the sole purpose to compare with the baseline of the current polish value specification. The correlation shown on Figure 5.10 suggests that, while using the average polish value, an average polish value of 31 should have been the baseline for the current specification.

5.4 Correlation Between SN_{40} and TxDOT Residual Polish Value

The correlation equation shown in Figure 5.8 was applied to the BPN and SN_{40} correlation to derive the indirect correlation between SN_{40} and TxDOT residual PV. This correlation was developed to establish a new baseline for consideration of revising the current polish value specification. According to Figure 5.11, a SN_{40} of 32 correlates to a residual PV of 29.

5.5 Correlation Between SN_{40} and ASTM Residual Polish Value

The correlation between SN_{40} and ASTM residual PV is shown by Figure 5.12. The relationships shown in Figures 5.6 and 5.9 were used to establish a correlation between a SN_{40} of 32 and an ASTM residual PV of 23.

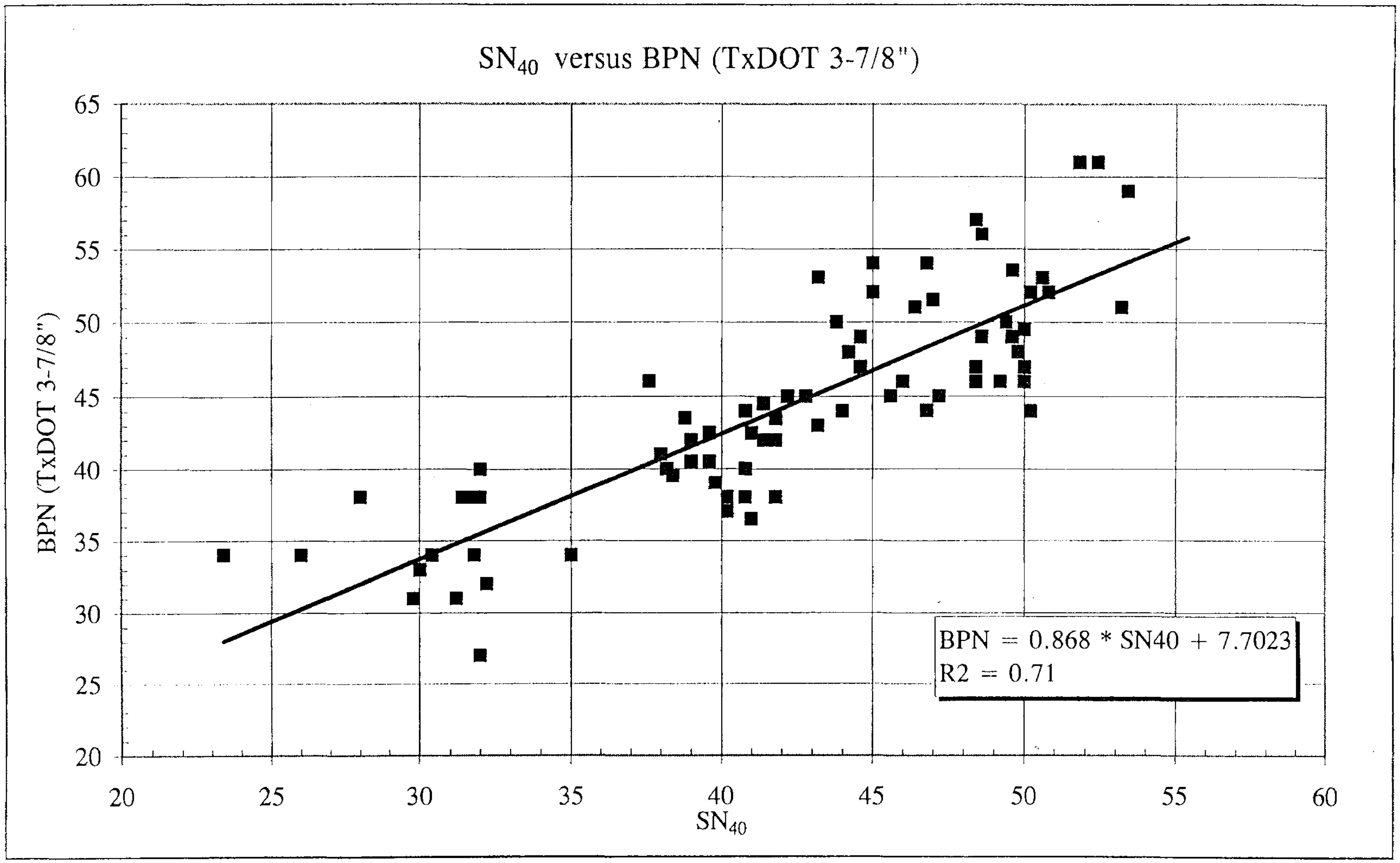

Figure 5.5 – Correlation of field data between SN_{40} and TxDOT BPN

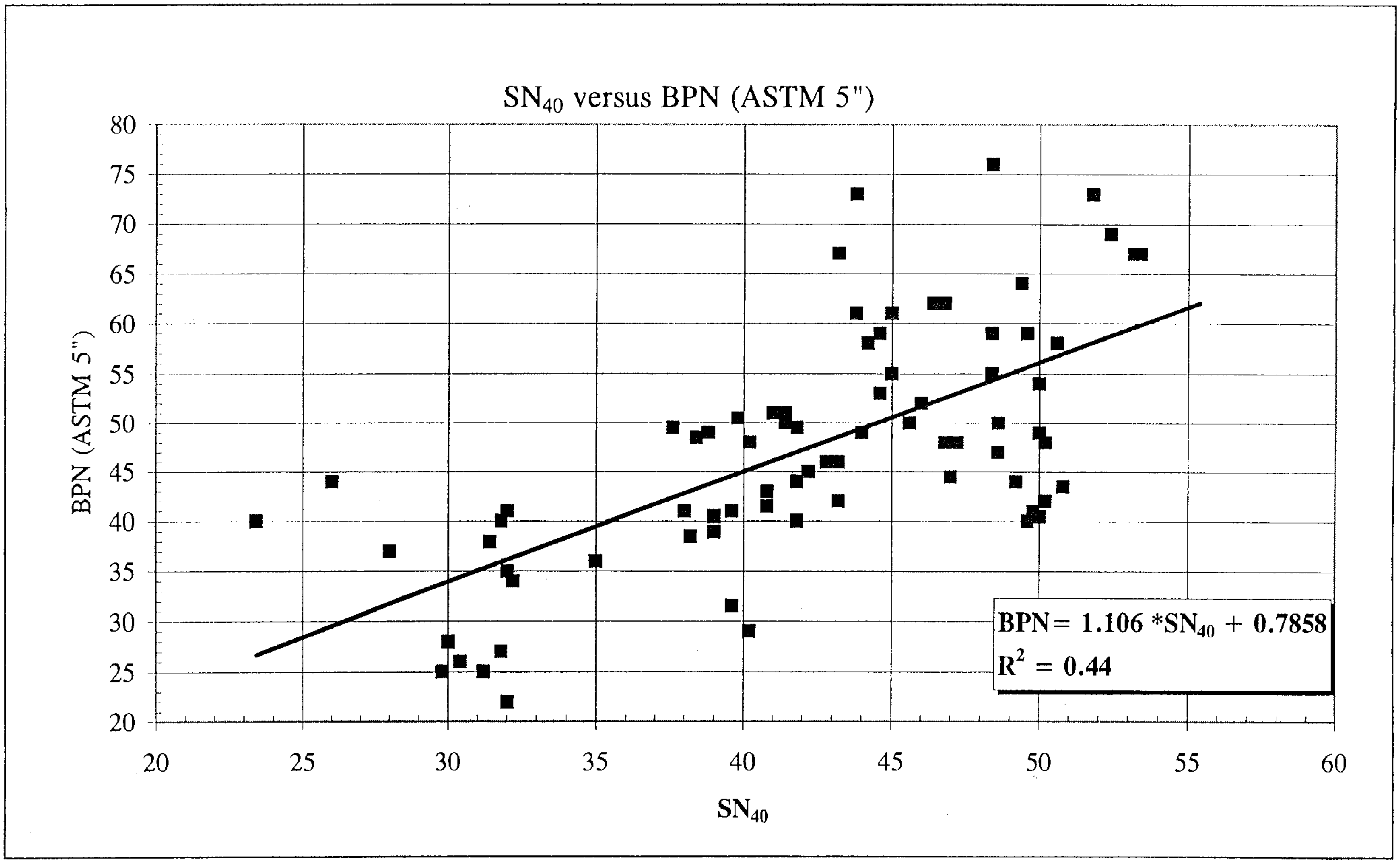

Figure 5.6 – Correlation of field data between SN_{40} and ASTM BPN

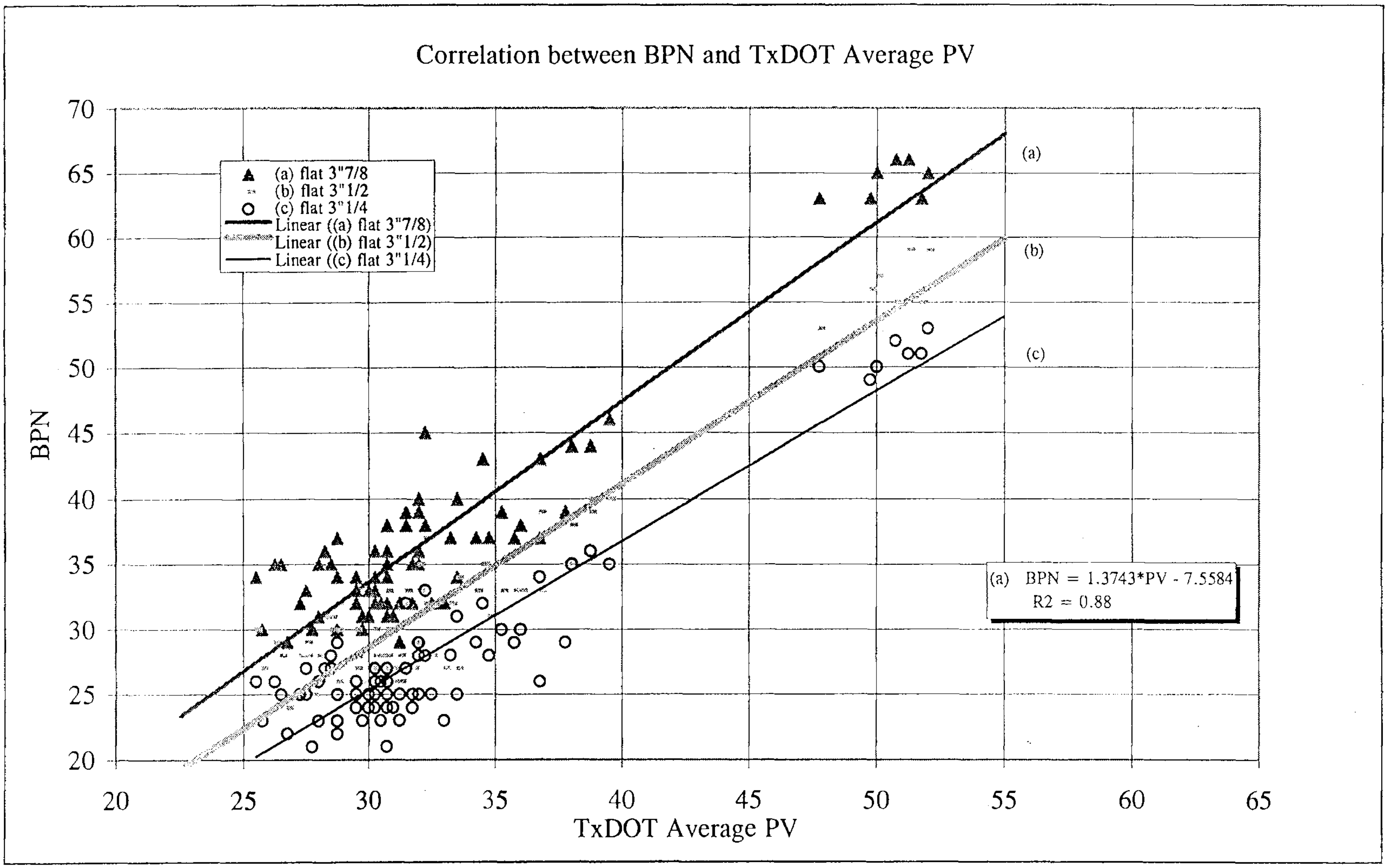

Figure 5.7 – Correlation between BPN and TxDOT average PV

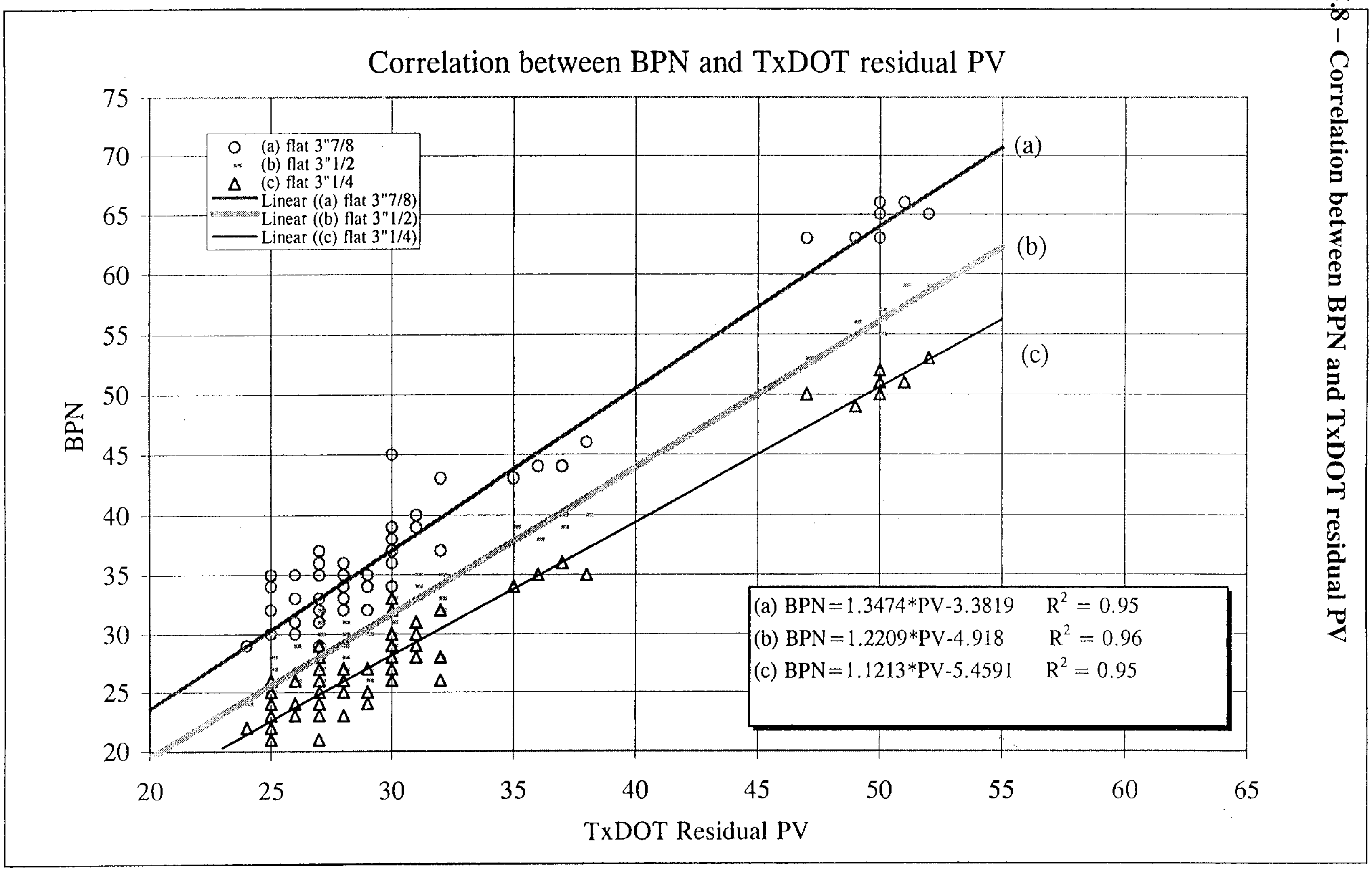

Figure 5.8 – Correlation between BPN and TxDOT residual PV

Figure 5.8 – Correlation between BPN and TxDOT residual PV

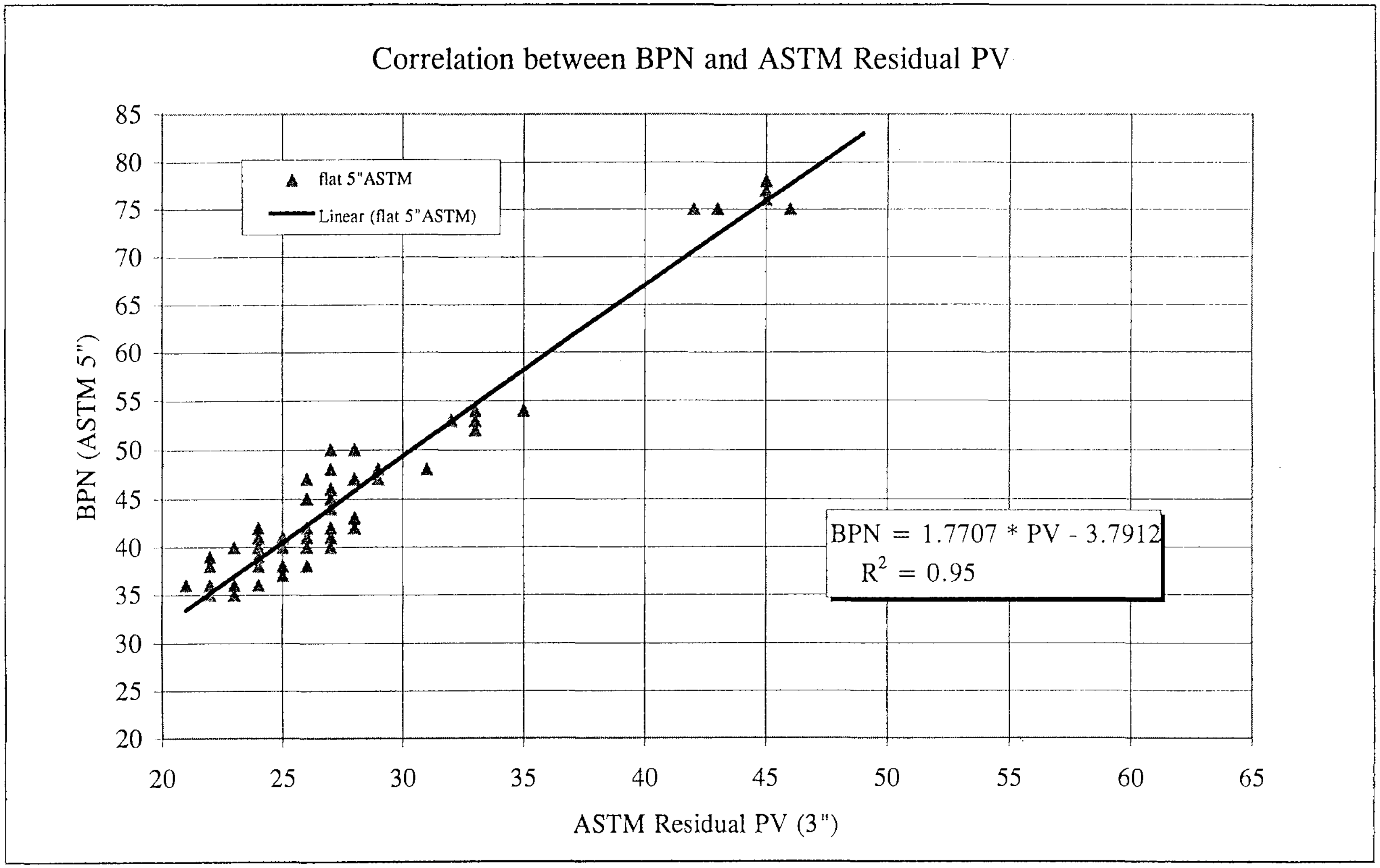

Figure 5.9 – Correlation between BPN and ASTM residual PV

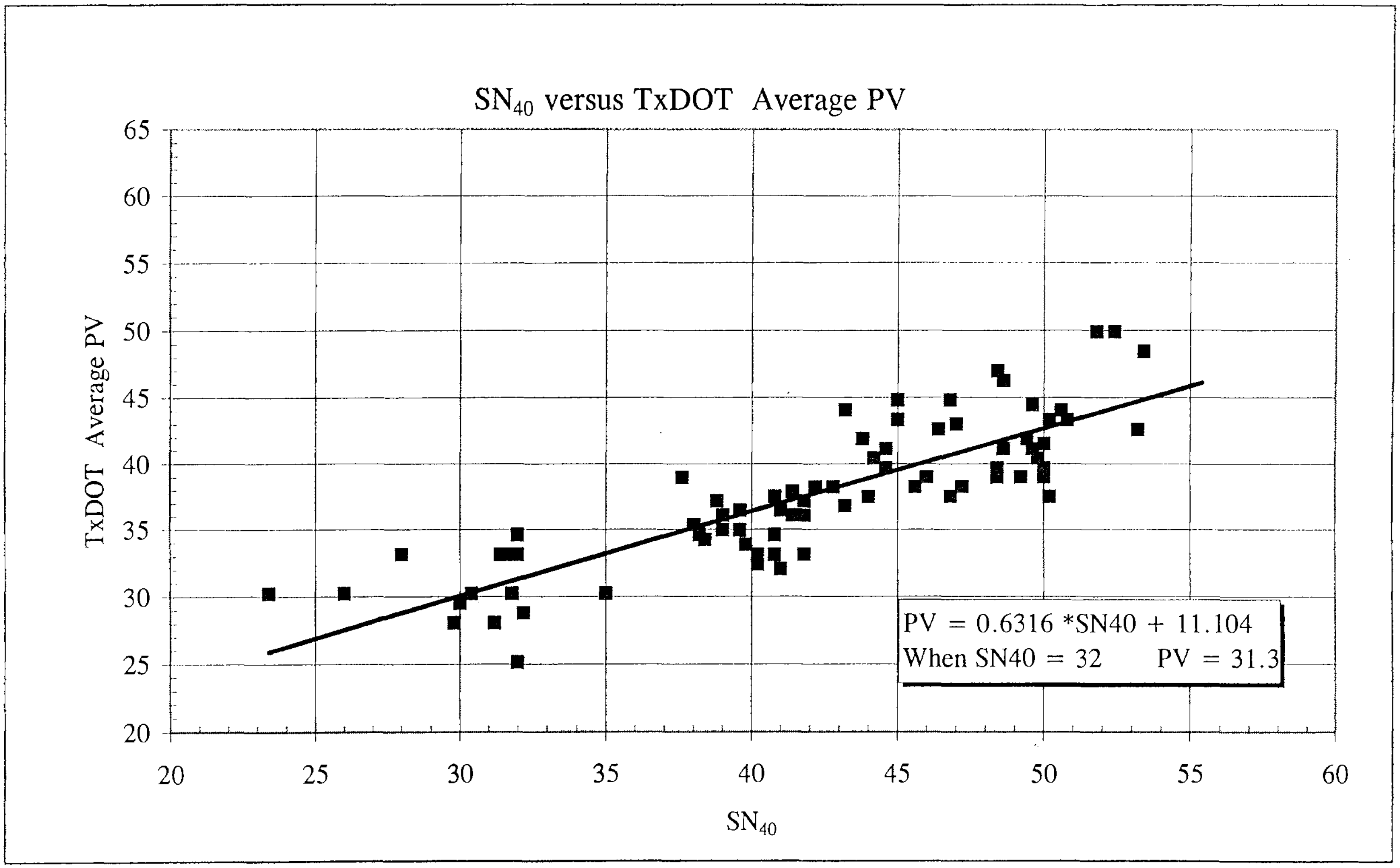

Figure 5.10 – Correlation between SN_{40} and TxDOT average polish value

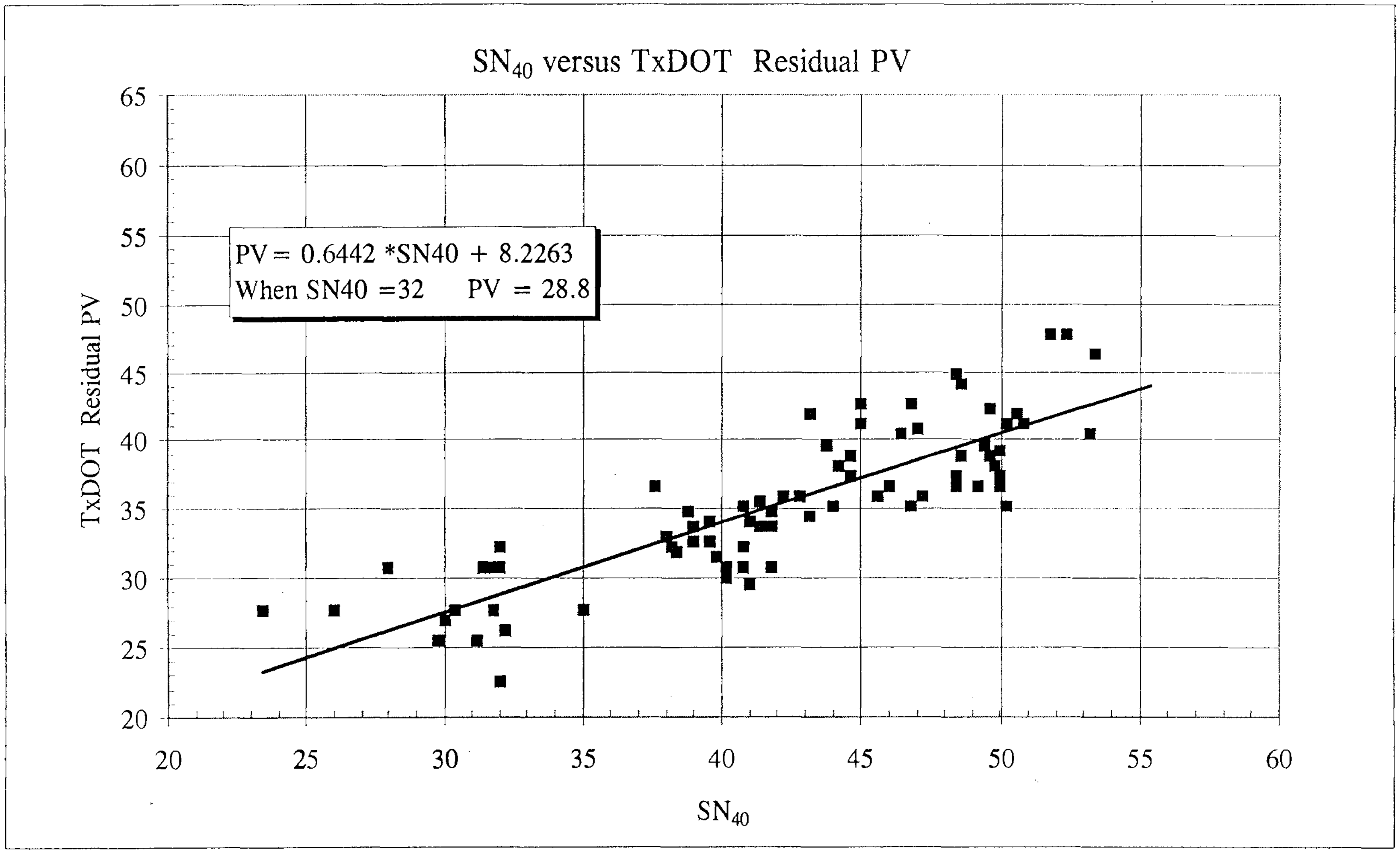

Figure 5.11 – Correlation between SN_{40} and TxDOT residual polish value

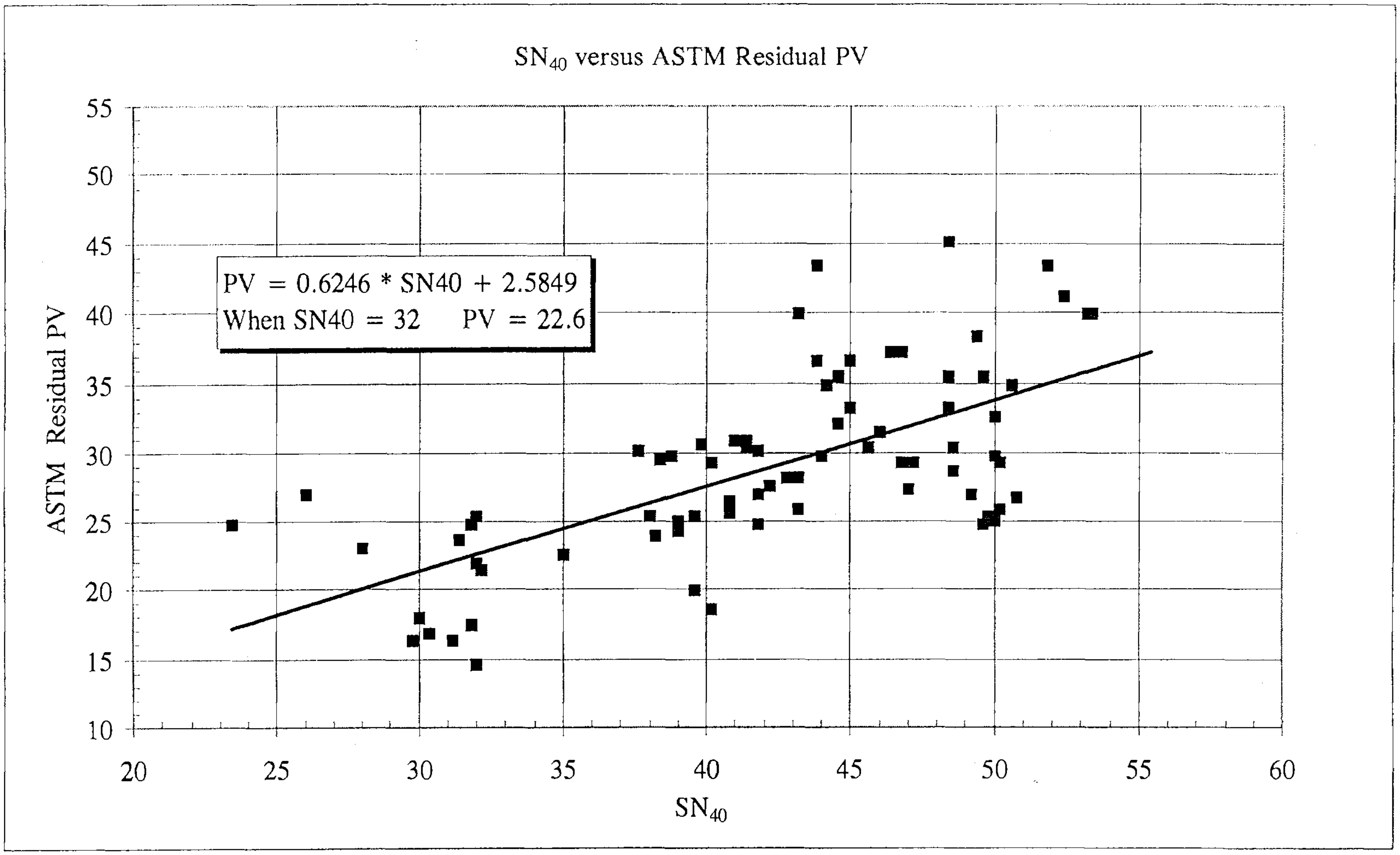

Figure 5.12 – Correlation between SN_{40} and ASTM residual polish value

5.6 Skid Data of Nontraditional Surfacing Aggregates

The skid performance data for nontraditional surfacing aggregates were also collected and evaluated by this study. These materials include flint (gravel) and limestone blend, limestone rock asphalt, limestone and sandstone blend, igneous materials, and light-weight aggregates. The skid data are presented in a summary table format in the following sections.

5.6.1 Blended Aggregate of Flint and Limestone

Prior to 1992, San Antonio District routinely blended flint (crushed gravel) and limestone as the surfacing aggregate for much of the high traffic roadways. Field reconnaissance of some of the high traffic sections in San Antonio District revealed that these pavement surfaces consisted of such blend. Visual observation of these sections confirmed that the harder flint has maintained a varying degree of differential wear on the pavement surface. The cumulative vehicle passes per lane and the race-track skid data for these projects are presented in Table 5.1.

Table 5.1 – Skid Performance of Flint and Limestone Blend

CSJ	Location	Skid Date	SN_{40}	VPPL	Service Date	Site Notes
2230-02-005	SAT-11B-1	05/13/97	36	8,991,450	11/01/90	
	SAT-11B-2		36			
	SAT-11B-3		34			
	SAT-11B-4		37			
2452-02-023	SAT-8B-1	02/02/97	33	20,273,000	04/01/91	Some uncrushed flint, some shelling, ≥3/8" size aggregates over 20% polished
	SAT-8B-2		34			
	SAT-8B-3		32			
	SAT-8B-4		32			
0521-06-058	SAT-4A-1	05/15/97	31	36,431,267	08/01/91	Very fine mix design, Ty F possibly a maintenance mix.
	SAT-4A-2		32			
	SAT-4A-3		32			
	SAT-4A-4		32			
0024-07-036	SAT-3A-1	05/14/97	36	37,764,000	10/01/88	Well crushed coarse and fine aggregates some polishing, no flushing, no shelling good condition
	SAT-3A-2		37			
	SAT-3A-3		36			
	SAT-3A-4		37			
0025-02-140	SAT-2A-1	02/06/97	33	38,102,400	08/01/91	Differential Wear evident
	SAT-2A-2		34			
	SAT-2A-3		33			
	SAT-2A-4		33			

5.6.2 Limestone Rock Asphalt (LRA)

Like any surfacing aggregate, the skid performance of LRA is dependent to a great extent upon the flushing condition of the pavement surface. The data presented in Tables 5.2 and 5.3 represent surface treatment sections with little or no flushing.

Table 5.2 – Skid Performance of Limestone Rock Asphalt (LRA) Typical Projects

CSJ	Location	Skid Date	SN_{40}	BPN	VPPL	PaveTemp °F	AirTemp °F	Surface Type	Service Date
0058-04	TYL-2L-1	6/10/98	29		406,450			LRA-PB4	6/1/96
	TYL-2L-2		37						
	TYL-2L-3		39						
	TYL-2L-4		37						
0054-04	TYL-1L-1	6/10/98	28		628,150			LRA-PB4	6/1/96
	TYL-1L-2		43						
	TYL-1L-3		42						
0109-04	LFK-1L-1	6/10/98	51		1,547,000			LRA-PB4	6/1/95
	LFK-1L-2		55						
	LFK-1L-3		54						
	LFK-1L-4		56						
0698-02-035	PHR-7A-1	8/14/97	45	52	2,154,250	129	97	LRA-PB4	4/1/94
	PHR-7A-2		45	50		132	97		
	PHR-7A-3		44	49		132	96		
	PHR-7A-4		43	49		132	96		
0738-01-039	CRPLM-16B-1	4/8/97	60		2,751,250			LRA-PB4 Mod.	5/29/92
	CRPLM-16B-2		61						
	CRPLM-16B-3		57						
	CRPLM-16B-4		62						
0165-02	TYL-3L-1	6/11/98	55		2,820,300			LRA-PB4 Mod.	6/1/95
	TYL-3L-2		47						
	TYL-3L-3		54						
	TYL-3L-4		55						
490-LFK-34I	LFK-34I-1	4/1/98	60	61	3,573,360		70	LRA-PB3	8/8/86
	LFK-34I-2		60	59			70	shot w/AC-10P	
	LFK-34I-3		58	55			70		
	LFK-34I-4		59	61			70		
490-LFK-34I	LFK-34I-1	6/10/98	65		3,632,160			LRA-PB3	8/8/86
	LFK-34I-2		51					shot w/AC-10P	
	LFK-34I-3		49						
	LFK-34I-4		56						
490-LFK-34O	LFK-34O-1	4/1/98	63	54	5,360,040		57	LRA-PB3	8/8/86
	LFK-34O-2		64	50			57	shot w/AC-10P	
	LFK-34O-3		63	46			57		
	LFK-34O-4		64	56			57		
490-LFK-34O	LFK-34O-1	6/10/98	50		5,448,240			LRA-PB4	8/8/86
	LFK-34O-2		48						
	LFK-34O-3		45						
	LFK-34O-4		49						
0327-08-071	PHR-5A-1	8/21/97	36		4,952,000			LRA-PB4	4/1/94
	PHR-5A-2		38						
0327-08-071	PHR-5A-1	2/11/98	37		5,648,000			LRA-PB4	4/1/94
	PHR-5A-2		39						

An interesting observation made by the researchers is that the modified Grade 4 is less prone to flushing than the Standard Grade 3 aggregate.

Table 5.3 – Skid Performance of Limestone Rock Asphalt (LRA) Test Sections
FM 1022 at Uvalde Quarry –Truck Traffic
("A" for outbound lane — loaded truck traffic, "B" for inbound lane – unloaded truck traffic)

CSJ	Location	Skid Date	SN_{40}	BPN	VPPL	PaveTemp °F	AirTemp °F	Surface Type	Service Date
1230-01-9A	LRA-9A-1	5/27/98	73		2,800			LRA-PB4	4/1/98
1230-01-1A	LRA-1A-1	5/27/98	57	53	127,600	107	89	LRA-CMHBC	6/1/91
	LRA-1A-3		62	61		115	89		
1230-01-1B	LRA-1B-1	5/27/98	66	55	127,600	119	89	LRA-CMHBC	6/1/91
	LRA-1B-3		62	57		118	89		
1230-01-2A	LRA-2A-1	5/27/98	66	56	127,600	108	92	LRA-CMHBF	6/1/91
	LRA-2A-3		66	59		115	92		
1230-01-2B	LRA-2B-1	5/27/98	57	55	127,600	121	92	LRA-CMHBF	6/1/91
	LRA-2B-3		62	58		121	92		
1230-01-3A	LRA-3A-1	5/27/98	63	62	127,600	111	82	LRA-PB4	6/1/91
	LRA-3A-3		59	57		113	82		
1230-01-3B	LRA-3B-1	5/27/98	71	66	127,600	114	82	LRA-PB4	6/1/91
	LRA-3B-3		72	69		115	82		
1230-01-4A	LRA-4A-1	5/27/98	73	58	127,600	114	90	LRA-Type D	6/1/91
	LRA-4A-3		72	56		115	90		
1230-01-4B	LRA-4B-1	5/27/98	75	57	127,600	115	93	LRA-Type D	6/1/91
	LRA-4B-3		75	62		118	93		
1230-01-5A	LRA-5A-1	5/27/98	66	63	127,600	113	89	LRA-Type CC	6/1/91
	LRA-5A-3		62	42		115	89		
1230-01-5B	LRA-5B-1	5/27/98	75	56	127,600	119	97	LRA-Type CC	6/1/91
1230-01-6A	LRA-6A-1	5/27/98	64	60	127,600	119	88	LRA-Type C	6/1/91
	LRA-6A-3		66	62		121	88		
1230-01-6B	LRA-6B-1	5/27/98	66	51	127,600	118	88	LRA-Type C	6/1/91
1230-01-7A	LRA-7A-1	5/27/98	74	59	127,600	114	92	LRA-Type CS	6/1/91
1230-01-7B	LRA-7B-1	5/27/98	65	62	127,600	113	92	LRA-Type CS	6/1/91
1230-01-8A	LRA-8A-1	5/27/98	73	56	127,600	121	97	LRA- Type DS	6/1/91
1230-01-8B	LRA-8B-1	5/27/98	73		127,600			LRA-Type DS	6/1/91

Note: PB4 is Item 302 single course chip seal
Type D, C, and CC are TxDOT Item 330 mixes
Type CS and DS are TxDOT Item 332 mixes

5.6.3 Blended Aggregate Sandstone and Limestone

Blended sandstone and limestone has been used as the surfacing aggregates for high traffic roadways in Austin, Houston, and San Antonio Districts. Table 5.4 presents the race-track skid data and cumulative vehicle passes per lane for some of these projects. The researchers also observed evidence of differential wear in this type of blended surfacing.

Table 5.4 — Skid Performance of Sandstone and Limestone Blend

CSJ	Location	Skid Date	SN40	BPN	VPPL	Service Date	PaveTemp (°F)
0389-06-059	HUS-H146-N1	12/10/96	43	42	6,531,000	11/01/91	67
	HUS-H146-N2		46	41			67
	HUS-H146-N3		47	41			70
	HUS-H146-N4		45	42			72
1607-01-026	HUS-FM1764-1	12/10/96	40	37	19,245,000	12/01/89	79
	HUS-FM1764-2		40	41			79

5.6.4 Igneous Aggregate

Two experimental sections in Atlanta and Tyler Districts provided skid performance data of an igneous aggregate source. Granite Mountain, Sweet Home source in Arkansas has been historically tested with low polish value in the mid to high 20's. The race-track skid and traffic data presented in Table 5.5 show that adequate skid performance can be maintained from the use of this igneous aggregate source.

Table 5.5 — Skid Performance of Igneous Aggregate

CSJ	Location	Skid Date	SN_{40}	BPN	VPPL	Service Date	PaveTemp (°F)	AirTemp (°F)
0520-03	ATL-1A-1	09/15/97	52		383,900	10/01/96		
	ATL-1A-2		51					
	ATL-1A-3		53					
	ATL-1A-4		49					
0520-03	ATL-1A-1	01/13/98	57		515,900	10/01/96		
	ATL-1A-2		52					
	ATL-1A-3		50					
	ATL-1A-4		50					
0520-03	ATL-1A-1	06/09/98	47	45	677,600	10/01/96	113	93
	ATL-1A-2		46	51			116	92
	ATL-1A-3		47	47			116	92
	ATL-1A-4		45					
0495-07-051	TYL-6C-1	09/16/97	41	37	4,854,000	06/30/95	101	90
	TYL-6C-2		42	39			101	90
	TYL-6C-3		45	40			101	90
	TYL-6C-4		43	37			101	90
0495-07-051	TYL-6C-1	01/14/98	43	50	5,574,000	06/30/95		48
	TYL-6C-2		42	51				48
	TYL-6C-3		41	51				48
	TYL-6C-4		39	50				48
0495-07-051	TYL-6C-1	06/11/98	42	43	6,462,000	06/30/95	92	83
	TYL-6C-2		42	39			90	84
	TYL-6C-3		45	47			90	80
	TYL-6C-4		45	44			90	80

5.6.5 Light-Weight Aggregate

The skid performance of light-weight aggregate was evaluated by race-track skid test of selected projects. The project information with its corresponding SN_{40} for light-weight aggregate surfacing are presented in Table 5.6.

Table 5.6 — Skid Performance of Light-Weight Aggregate

CSJ	Location	Skid Date	SN40	BPN	VPPL	Service Date	AirTemp (°F)
0175-08-034	LFK-3R-1	12/10/97	59		4,673,581	08/01/93	
	LFK-3R-2		57				
	LFK-3R-3		58				
0175-08-034	LFK-3R-1	04/02/98	54	40	5,005,312	08/01/93	75
	LFK-3R-2		54	39			75
	LFK-3R-3		53	44			75
0175-08-034	LFK-3R-1	06/10/98	59		5,207,873	08/01/93	
	LFK-3R-2		58				
	LFK-3R-3		57				
1407-03-005	LFK-1R-1	12/10/97	64		9,055,361	09/01/93	
	LFK-1R-2		65				
1407-03-005	LFK-1R-1	04/02/98	52	61	9,710,874	09/01/93	65
	LFK-1R-2		52	61			65
	LFK-1R-3		53	59			65
1407-03-005	LFK-1R-1	06/10/98	61		10,111,143	09/01/93	
	LFK-1R-2		58				
	LFK-1R-3		59				
	LFK-1R-4		60				
490-LFK-33I	LFK-33I-1	04/01/98	62	64	3,573,360	08/08/86	70
	LFK-33I-2		60	66			70
	LFK-33I-3		50	73			70
	LFK-33I-4		56	64			70
490-LFK-33I	LFK-33I-1	06/10/98	67		3,632,160	08/08/86	
	LFK-33I-2		64				
	LFK-33I-3		61				
	LFK-33I-4		63				
490-LFK-33O	LFK-33O-1	04/01/98	48	65	5,360,040	08/08/86	58
	LFK-33O-2		46	63			58
	LFK-33O-3		46	67			58
	LFK-33O-4		47	59			58
490-LFK-33O	LFK-33O-1	06/10/98	67		5,448,240	08/08/86	
	LFK-33O-2		69				
	LFK-33O-3		70				
	LFK-33O-4		70				

CHAPTER VI – DISCUSSION AND CONCLUSIONS

6.0 General

Polish value and soundness are the primary quality requirements in TxDOT specifications for bituminous coarse aggregates. For the desired skid and structural performance, these two aggregate properties have the most significant effect on the life-cycle cost and performance of the asphaltic concrete pavements. However, for most aggregate types that are available in Texas, past laboratory experience has placed these two parameters in diametrically opposed positions in attaining the desired skid and structural performance. Aggregate with high polish value and typically high soundness loss, which is undesirable from the standpoint of durability, uniformity, strength, and structural performance, has been associated with good friction performance. Through the findings of this study, the skid performance data and new laboratory polish value test procedure confirmed that some soft limestone with high soundness loss and high polish value do not perform as expected. It is also found that more consistent and better skid performance is attained through the use of crushed siliceous gravel and some harder limestone aggregate. This finding is also consistent with the practices of other states in Arkansas, Maryland, Alabama, New York, West Virginia, Georgia, and Mississippi.

Although there have been other previous TxDOT studies attempting to correlate polish value and soundness loss with skid and structural performance, these studies have been segmented in scope with emphasis on material properties only. This research study reexamined the current policy, procedures, and specifications associated with polish value, skid and soundness testing. The findings of this study present strong evidence of a need to encompass design, material, and construction variables and develop an order of priority in design procedures and specifications to satisfy the engineering and economic considerations. The discussion presented herein attempts to emphasize a system approach such that the overall effectiveness of the program can be maintained.

6.1 Factors Affecting Friction

Before a meaningful discussion can be presented in pavement friction and its measurements, one must understand the factors affecting the interaction between the tire and pavement surface. It should be noted that the laboratory polish value measures primarily the friction component derived from the microtexture, and the SN_{40} measurements can be significantly affected by both the micro- and macrotexture. The standard testing procedures for PV and SN_{40} do not clearly separate the contribution of micro- and macrotexture to the test results. What further compounds the issue of friction supply experienced by a sliding vehicle is the conglomeration of at least the following:

- tire rubber characteristics in elasticity and damping, both of which are affected by the temperature;
- pavement surface conditions – micro- and macrotexture, contamination, and temperature; and,
- the highway speed and tire conditions of the braking vehicle.

The friction supply diminishes with rising temperature. Higher temperature increases the elasticity and reduces the damping effect of the tire rubber, and this is similarly illustrated by the temperature effect shown on Figure 4.9. The increase in vehicular speed reduces the effective adhesion between the tire rubber and pavement surface; however, it enhances the damping effect of the tire rubber and its interaction with the macro texture at a speed of greater than 60 mph (illustrated by Figure 4.10). It should be realized that any increase in vehicular speed, aside from its direct effect on friction supply, increases pavement wear as well.

6.1.1 Micro- versus Macrotexture

The interaction between tire rubber and pavement surface produces relative friction due chiefly to adhesion and hysteresis. As shown on Figure 6.1, the microtexture provides the adhesion component through the effective tire-aggregate contact surface. The hysteresis component is a function of energy losses within the tire rubber as the deformed tire mass slides over and around the protruded coarse aggregate. The micro texture, as measured by polish value, is easily affected by dust, road film of oil and grease, and lubrication. Loss of macrotexture may result from the progressive embedment of the coarse aggregate in the bituminous surfacing or from the failure of the binder to weather at an appropriate rate. To attain a high level of pavement friction, it is essential for the coarse aggregate to be both polish and wear resistant. A satisfactory friction level in a pavement can be maintained through adequate specification (PV, soundness, LA, etc.) and proper design and construction techniques. The ability of a pavement to retain a large portion of the initial friction over its lifetime is as important a property of the surface as are good riding qualities and structural integrity.

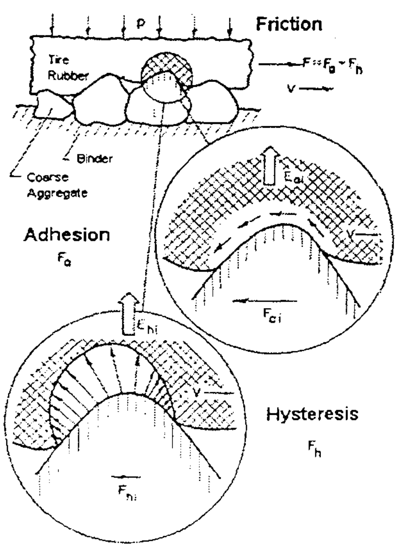

Figure 6.1 – Rubber tire friction: adhesion and hysteresis

The effect of macro- and microtexture is illustrated by Figure 6.2. The deviation of field BPN and SN_{40} from the line of equality is a reflection of macrotexture's contribution to the overall SN_{40} measurement. It is significant to note from the BPN and SN_{40} correlation that the effect of macro-texture for limestone aggregate diminishes with increasing softness and VPPL. For the harder limestone and gravel the effect of macro texture is less affected by increasing VPPL. By using the statistical mean of SN_{40} for the limestone and gravel shown in Figure 5.4, a separation of the typical ranges of SN_{40} is further defined by Figure 6.3. The significance of Figures 5.4 And 6.3 includes the following:

- The macrotexture contributes significantly to the better skid performance of the harder crushed gravel and igneous aggregates;
- A high percentage of the SN_{40} attainable by the limestone is dictated by the microtexture (PV);
- For limestone the contribution of macro texture to the SN_{40} diminishes with increasing softness (soundness loss);
- For soft limestone, the SN_{40} approaches the polish value as the traffic reaches 8 million VPPL; and,
- For light-weight and LRA aggregates, the microtexture dictates much of the material's skid performance.

Effort was also made by this study to measure the surface texture using a minitexture meter. The method and results of texture measurement were unable to provide a basis for qualitative interpretation of the measured race-track SN_{40}. However, it is worthwhile to note that the overall skid performance of CMHB-C and Type C mixes does not compare more favorably than the conventional dense-graded Type D mixtures. This finding is consistent with the findings of other researchers in that dense-graded friction course provides more favorable skid performance. It is observed that the close packing of the larger coarse aggregate in the surface of a CMHB-C and Type C mixture provides a significant bridging effect (negative macrotexture); and the pavement surface lacks positive relief (protrusion of the coarse aggregates) which deforms the tire rubber and mobilizes the hysteresis effect. This observation is made from pavement sections of similar age, traffic application, and constructed with the same coarse aggregate. The comparison of SN_{40} and minitexture meter readings for CMHB vs. Type D and Type C vs. plant mix seal are shown on Figure 6.4. Macro texture measurement using laser technique (on going research project 7-2981) has the potential to quantify its contribution to SN_{40}; however, the application of the technique must be able to distinguish the difference in positive and negative macrotexture.

6.2 Polish Value Specification

The current polish value specification is statistically biased and founded on an invalid baseline. The baseline is faulted due to errors of previous research data and the inadequacy in test procedure. The conservatism originally built into the policy/specification by layered and biased statistical applications is no longer adequate to address the increasing friction demand of the highway surfacing due to greatly increased traffic volume and vehicular speed. The ineffectiveness of the current specification is attributed by:

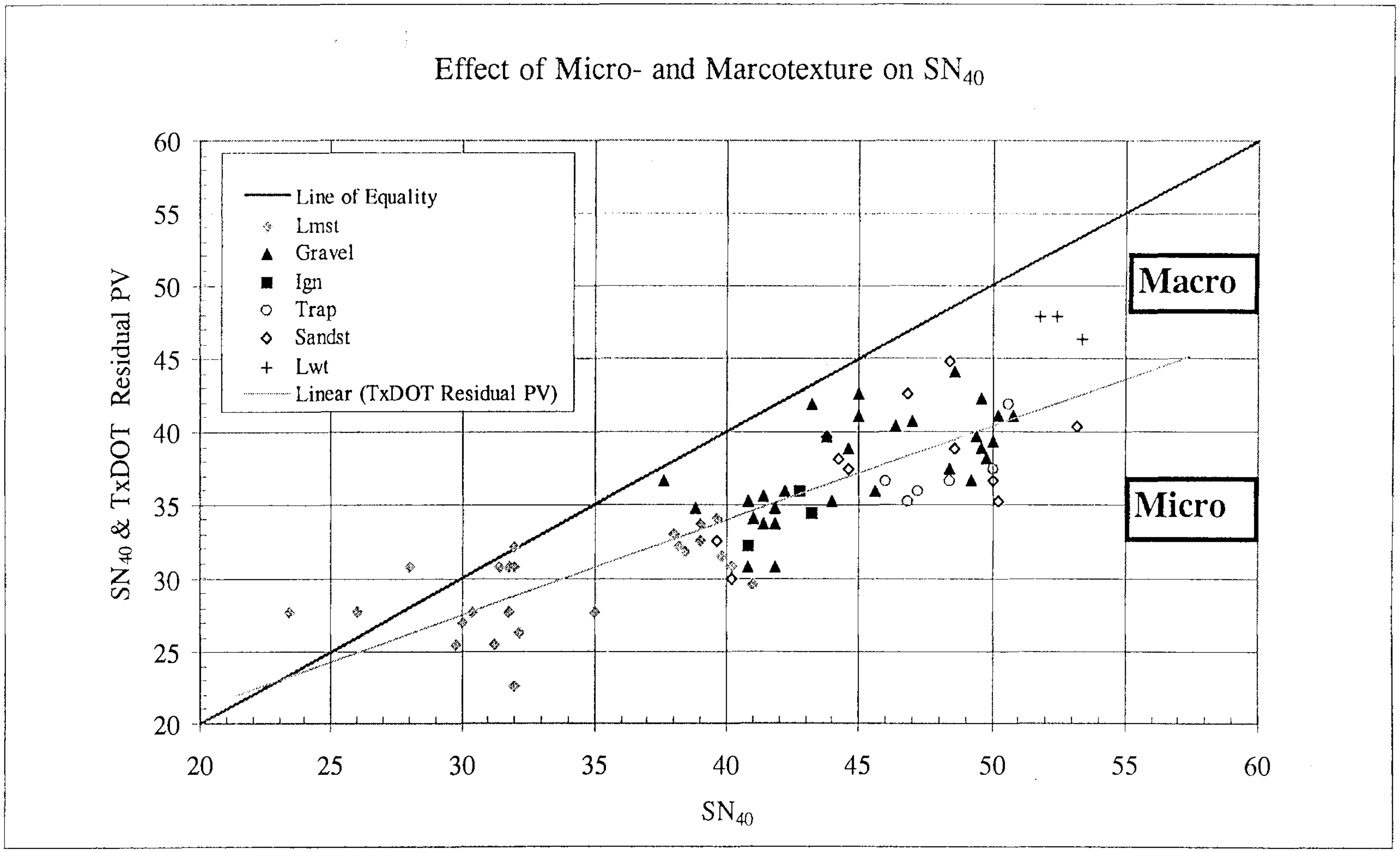

Figure 6.2 – Effect of micro- and macrotexture on SN_{40}

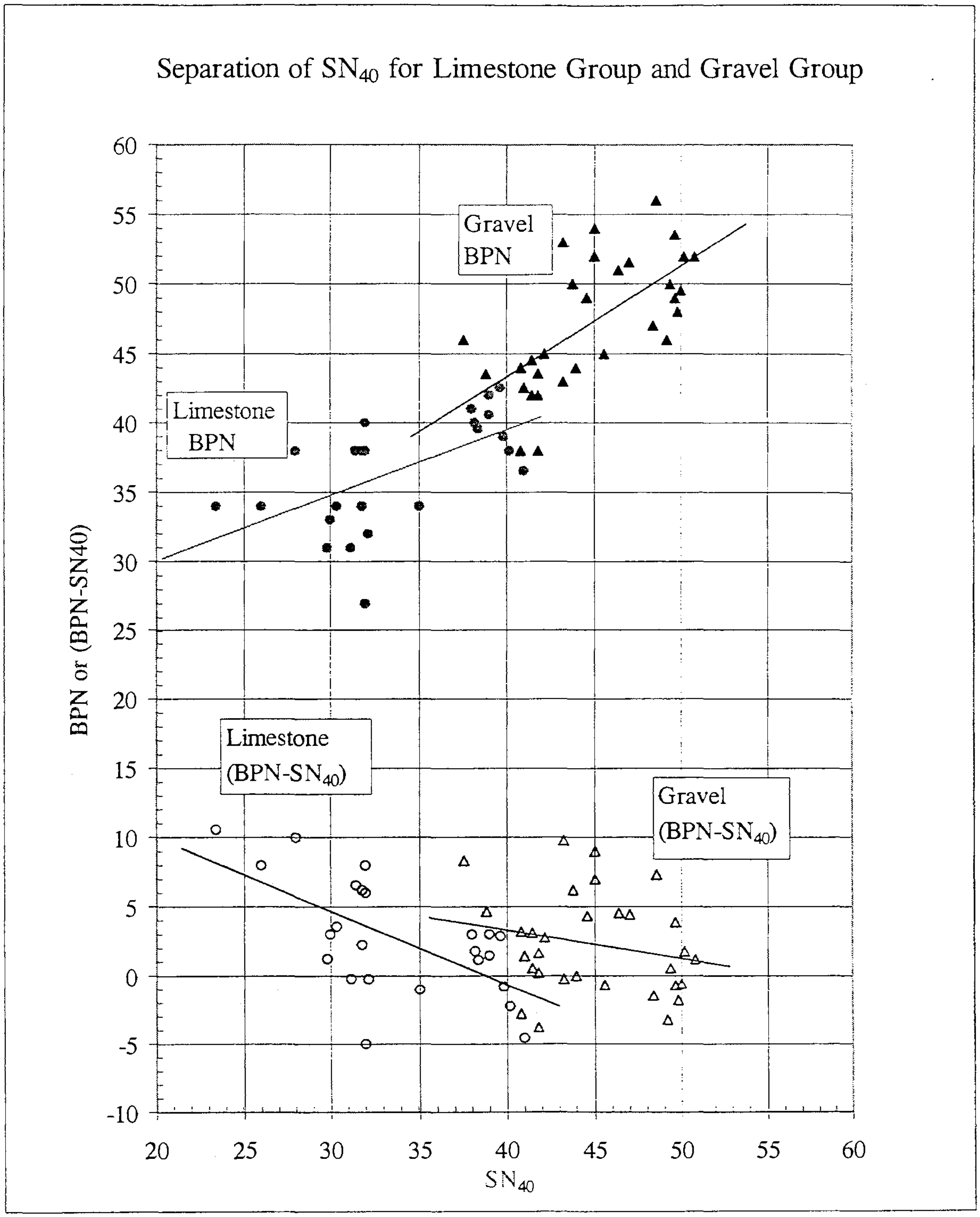

Figure 6.3 – Separation of SN_{40} for limestone group and gravel group

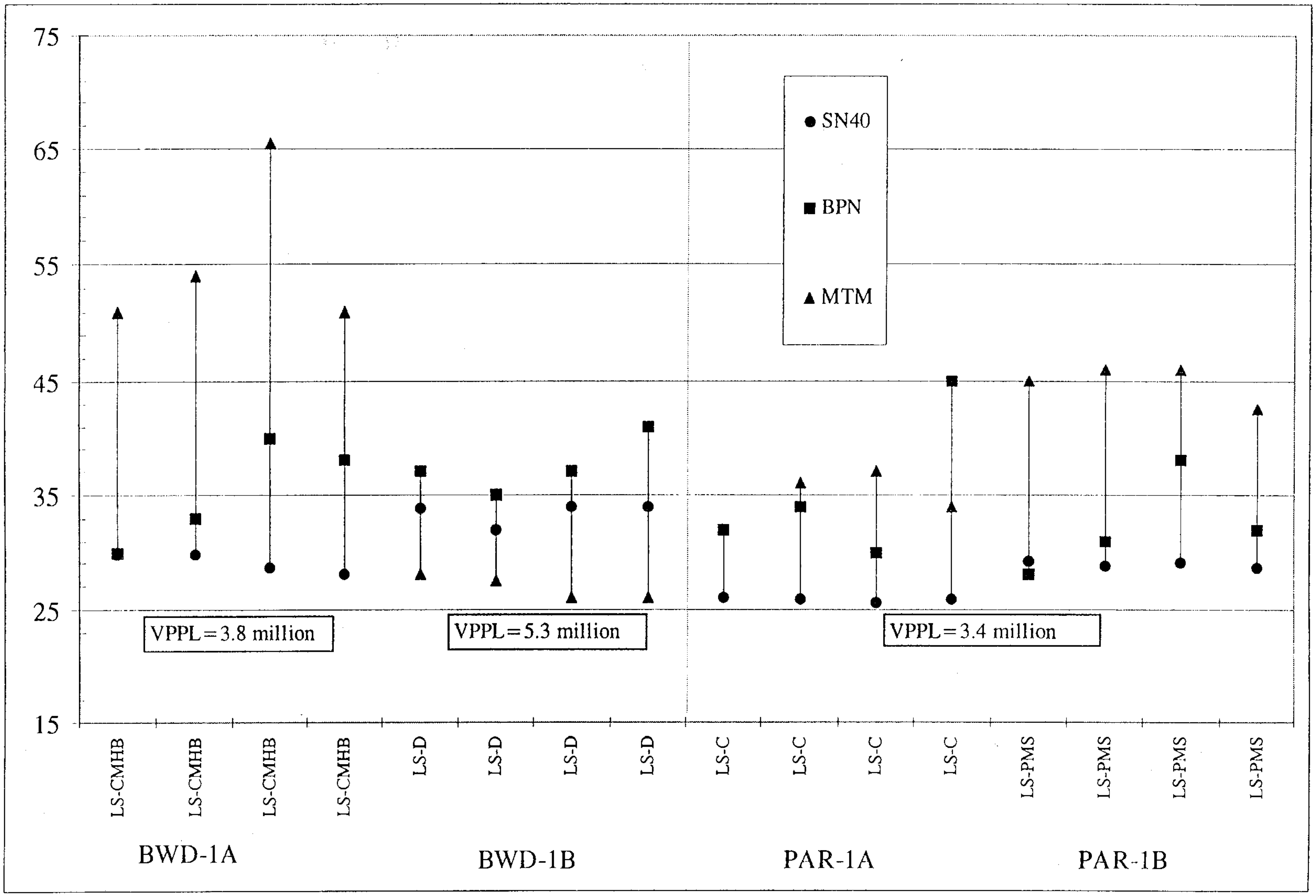

Figure 6.4 – Effect of mixture type on SN_{40}

- lack of an effective skid monitoring program to confirm the friction performance as predicted by the laboratory polish value test for the surfacing aggregates;
- maintenance operations often times promptly address the roadway slipperiness, and therefor TxDOT lacks a system to provide needed performance feedback to the design personnel;
- lack of a closed-loop system or follow-up mechanism to effectively incorporate performance feedback from the districts to adequately address the improvement needs by the responsible division(s); and,
- lack of dedicated resources in the division(s) to resolve the variability and discrepancies between skid and polish value testing.

6.2.1. Economic and Engineering Impact

In at least the past 25 years, the polish value specification has limited the use of many locally available aggregate sources with good friction properties. The findings of this study show the crushed gravel has more consistent and much better skid performance than the limestone. The skid data of blended flint and limestone, which is shown by Table 5.1, also supports the exceptional skid performance of crushed gravel. However, this study did not address the stripping potential of gravel.

It is found that some of the high PV limestone surfacing aggregates have the SN_{40} declining very rapidly within the first one to three years. The data presented in Table 6.1 demonstrates projects constructed with limestone surfacing aggregates which have been tested and rated with high polish values. However, the skid data shows that SN_{40} has already declined to the mid to high 20s for pavement surfacing constructed within the past 1-1/2 to 2-1/2 years. It is alarming to recognize the rapid decline in SN_{40} for these projects which are associated with a relatively low level of traffic.

The economic disadvantage imposed to the department by the faulty polish value specification has been enormous in terms of :

- Local materials with good skid performance have not been utilized to their fullest potential;
- Producers charge the department an additional $4 per ton (state-wide average) for softer surfacing aggregates with rapidly declining skid performance;
- Resurfacing is needed earlier than anticipated due to the rapid decline of SN_{40}; and,
- Inequity is inherent in the two-tier statistical application for the initial specification and the RSPV program.

6.2.2 Urban District Impact

Prior to August 1997, a polish value of at least 35 was specified by Austin, Houston, Dallas, and Fort Worth Districts for the high traffic roadway surfacing aggregate. These districts historically utilized sandstone, trap rock, light-weight aggregates, and other aggregates or blends of known skid performance to provided adequate pavement surface friction. The August 1, 1997, TxDOT directive prohibited all districts from specifying a polish value of greater than 32.

Table 6.1 Race-Track SN_{40} of Selected Limestone Sources and Projects

District	HWY	County	VPPL (millions)	Date in Service	Location 1 SN_{40}	Location 2 SN_{40}	Location 3 SN_{40}	Location 4 SN_{40}
Paris	IH-30	Hunt	**4.3**	12/96	29	29	29	28
					29	28	29	30
Source - Pioneer Bridgeport, RSPV=32					29	28	29	29
Mix - Plant Mix Seal					30	30	29	28
					29	29	29	28
Paris	IH-30	Hunt	**4.3**	12/96	29	28	27	25
					26	26	27	25
Source - Pioneer Bridgeport, RSPV=32					26	25	25	26
Mix - Type-C					27	25	25	22
					26	27	26	27
					25	26	25	26
Brw'd	IH-20	Eastland	**2.8**	8/95	30	29	30	27
					30	29	28	28
					29	31	28	27
Source - Pioneer Bridgeport, RSPV=32					30	30	28	29
Mix - CMHB-C					32	30	29	29
					30			
Abilene	IH-20	Callahan	10	7/95	24	26	28	
					24	26	29	
					23	26	26	
Source - Vulcan Black, RSPV=33					23	26	28	
Mix - Type-D					23	26	28	
							27	
Abilene	IH-20	Michell	**5.5**	7/95	27	27	25	
					25	26	25	
					26	27	26	
Source - Price Clement, RSPV=32					28	27	26	
Mix - Type D					28	27	24	
					28			

The data presented in Table 6.1 presents strong evidence of rapid decline in pavement friction for roadways surfaced with polish value 32 aggregate. The polish value requirement for the urban districts has been lowered and the driver behavior, used to the better friction, has not been modified. The result will be increased accidents if not managed properly with close monitoring and a contingency plan. To manage this risk, the following actions should be considered:

- Identify pavement surfacing with moderate to high traffic applications that has been constructed since August 1997 with a sole limestone source meeting the new polish value requirement;
- Develop a skid monitoring program to closely track the skid performance of these roadways;
- Develop a contingency plan to address the possible programming and need for re-surfacing; and,
- Allow the urban districts to deviate from the new PV requirement and have the freedom to specify materials of known skid performance; and,.
- Introduce a public education program to increase awareness in driver behavior and expectation.

6.2.3 Average Daily Traffic

The current polish value specification, as shown on Table 6.2 , is based on average daily traffic (ADT). The following are several limitations found in applying ADT to the polish value specification:

- ADT does not reflect the actual vehicle passes experienced on a per lane basis as the pavement friction diminishes with increasing VPPL – an inequity exists between a two-lane roadway with an ADT of 4000 and a four-lane roadway of 6000 ADT;
- The laboratory polish value determined after nine (9) hours of accelerated polishing represents a much more polished state than what the actual roadway experiences in a low traffic situation – a 2-lane roadway with 1000 ADT experiences only 1.8 million VPPL in 10 years; and,
- The ADT does not reflect the actual traffic distribution of a multilane roadway.

Table 6.2 – Current Polish Value Specification

Average Daily Traffic (ADT)	Polish Value Requirement
Less than 750	no requirement
750 to 2000	at least 28
2000 to 5000	at least 30
Greater than 5000	at least 32

6.3 Polish Value Test Procedure and Specification

The current polish value test procedure Tex-438-A cannot adequately identify sources in two critical categories: (I) aggregates with high polish value but poor skid performance, and (II) aggregates with low polish value but good skid performance. With the use of a solid tire for accelerated polishing and testing for residual PV, the improved test method is capable of differentiating the primary friction property attributed by the micro texture. The observed difference in measured residual PV and SN_{40} is due primarily to the macro texture in a pavement surface. The macro texture is dependent to a great extent upon the mix design and aggregate particle shape, size, angularity, and hardness which dictates much of the hysteresis effect of tire and pavement interaction.

6.3.1 Baseline for Polish Value Specification and SN_{40} Prediction

The correlation established by this study equates a SN_{40} of 32 to a residual PV of 29. This value can only be used as a lower threshold for the surfacing aggregate in a specification to assure the micro-texture's contribution to the overall skid performance. It would be profoundly erroneous to ignore the effect of the macrotexture in a skid performance equation. The aggregate soundness may be a determining factor in sustaining the desired macrotexture and durable friction performance. The lower threshold of PV 29 allows partial adjustments to be made to better reflect the microtexture's contribution to the overall skid performance; however, it has the following limitations:

- The laboratory polish value does not reflect the contribution from the macrotexture in a pavement surface;
- The laboratory polish value determined after nine (9) hours of accelerated polishing represents a much more polished state than what the actual roadway experienced in a low traffic situation; and;
- The range of polish value measured by the TxDOT procedure is not wide enough to effectively separate the field skid performance, which is also a function of macrotexture.

Considering both the micro- and macrotexture, a prediction equation for SN_{40} is developed based on residual polish value and 5-cycle magnesium soundness loss. Figure 6.5a shows that better skid performance (SN_{40}) is associated with higher residual PV and lower soundness loss. The prediction equation presented below and in Figure 6.5b allows calculation of SN_{40} with the residual PV of the proposed procedure and the 5-cycle soundness loss of the individual size aggregate of 3/8" to #4. The total soundness loss is not used because of the negative effects and skewed test result as discussed in section 6.5. In a limestone quarry, blending of #4 to #10 size aggregate with a lower individual soundness loss helps to reduce the total loss in soundness testing; however, it does not necessarily improve the quality or the skid performance of the material. Additionally, the use of soundness loss for the 3/8" to #4 size aggregate is more consistent with the aggregate size used for polish value testing.

$$SN_{40} = 19.0 - 0.40 * (\text{5-cycle Soundness Loss}) + 0.83 * (\text{Residual PV}) \quad \text{----------} \quad r^2 = 0.98$$

It should be noted that this prediction equation is derived from limited and two different sets of field and laboratory data. The SN_{40} are grouped and averaged for the individual sources for projects that have been subjected to a VPPL of greater than 8 million. The time period of materials produced for construction of these projects spans over several years. While the residual PV and soundness test results are obtained from recent samples and testing, these laboratory test results may not be representative of the aggregates and projects tested for SN_{40}. The variability of aggregate production and the resulting products can be highly variable as evidenced by the findings of this study. To verify this prediction equation, it is critical to construct and monitor test sections such that project specific material properties, traffic information, and skid data can be collected.

6.3.2 Interaction with Aggregate Quality Monitoring Program

1. Polish value as well as other aggregate quality tests are not effectively monitored by the aggregate quality monitoring program (AQMP). The variability in mining and processing of aggregate in a limestone quarry, as evidenced by Figure 5.2, can produce materials of varying polish values. Under the current program, aggregate used on a project may not represent the quality rating published semi-annually in the rated source quality catalog (RSQC). To ensure the frictional durability of the surfacing aggregates, the AQMP needs to be extended beyond formality testing and reporting.

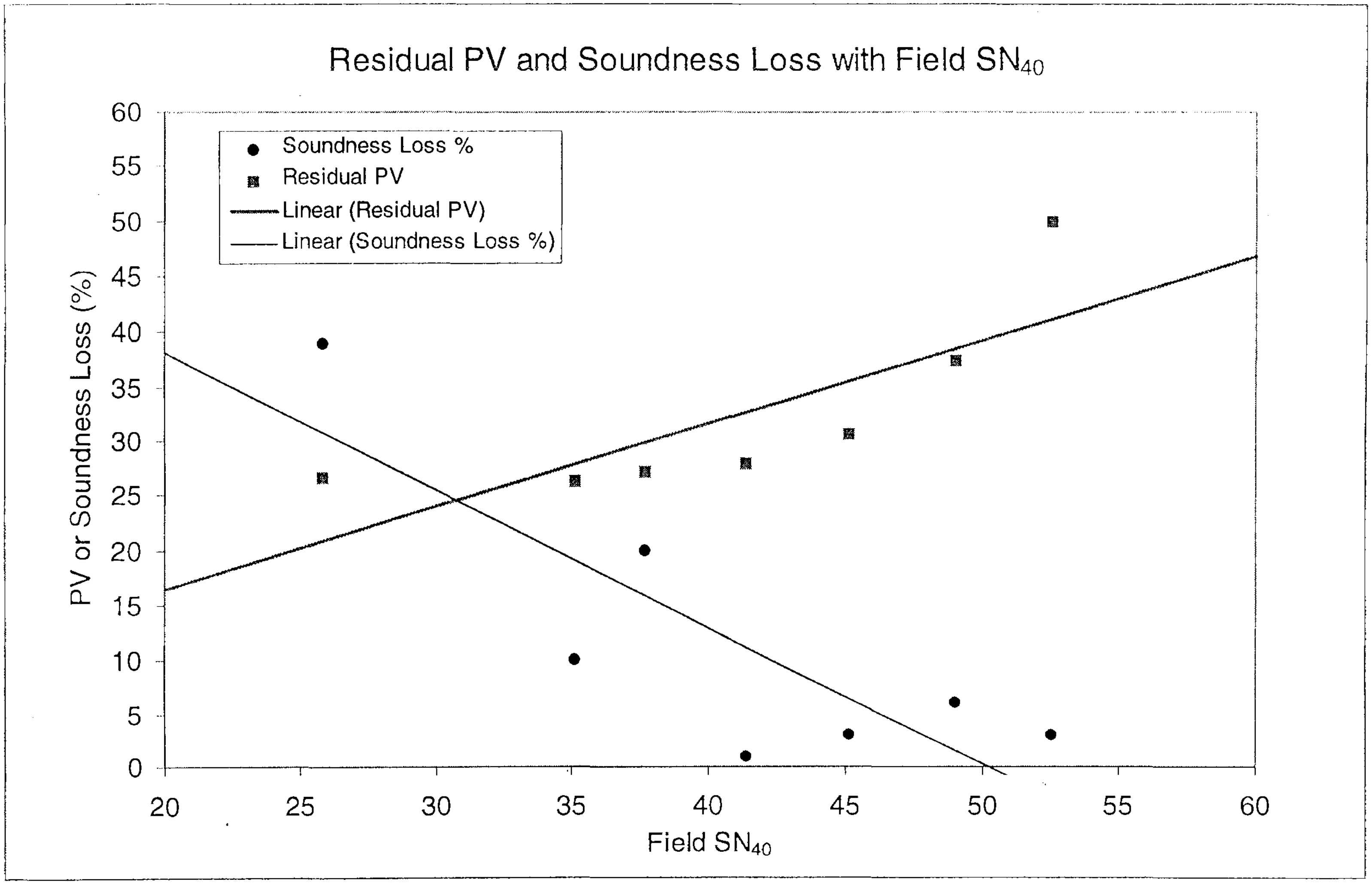

Figure 6.5a – Relationship of SN_{40} with residual PV and soundness loss

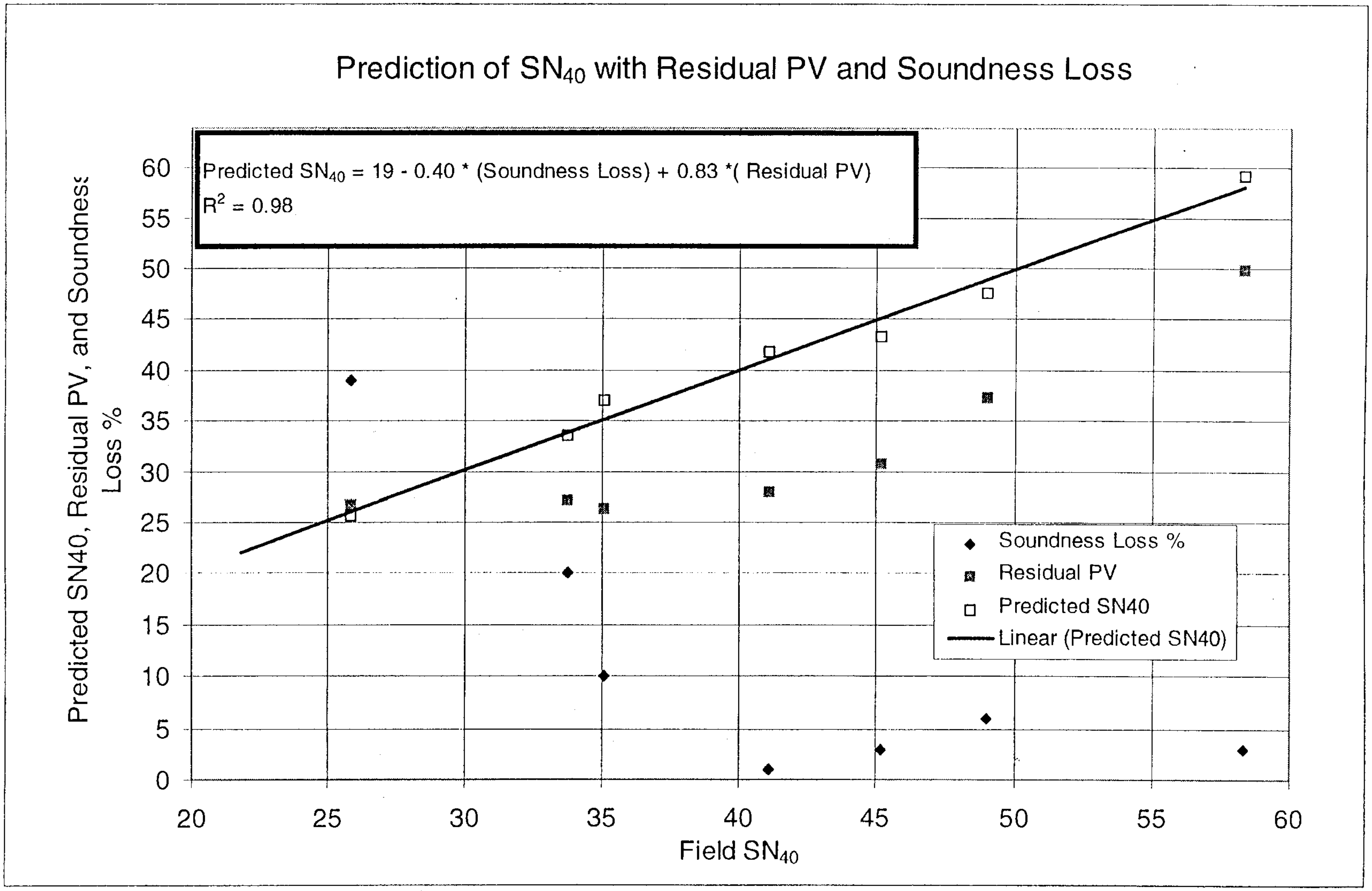

Figure 6.5b – Prediction of SN_{40} based on residual PV and soundness loss

The AQMP was devised, through scheduled testing and prequalification, to minimize stockpile testing at a project and delay of material testing and acceptance. The program has achieved the goal of reduced laboratory testing and expediency of test reporting; however, the effectiveness of the program is questionable in the following areas:

- The published RSPV is guaranteed for the effective duration of the RSPV, and the evidence of polish value decline is not acted upon immediately to minimize the safety and economic impact;
- The scheduled sampling and testing of once every 3 to 6 months for all sources does not effectively reflect the method of risk management for sources with high variability and high volume production;
- The data-gathering period ending four months before the RSQC effective date can result in prolonged loss in the time period between the start of the data-gathering period and the effective date of the next RSQC;
- There is not an effective check and monitoring mechanism in the field to verify that materials received actually meet or exceed the specification requirements;
- TxDOT bears the burden of quality control testing and quality assurance with greatly reduced sampling and testing;
- The application of a Student T's equation requiring only five most recent test results and 90 percent confidence leads to a greater risk of accepting inferior materials;
- Responsibility assumed by TxDOT through AQMP and method specification releases the producers' responsibility of effectively controlling and maintaining the quality of the material;
- The dependency of producers upon TxDOT to prequalify the materials hinders the necessary knowledge to be acquired by the contractors and producers to support performance-based and warranty specifications;
- Lack of an effective quality control and quality assurance for aggregates prevents the department from developing effective QC/QA programs for HMAC, PCC, and base materials; and,
- The current QM program can not adapt in a timely fashion to the changing or new test procedures.

6.3.3 Comparison Between TxDOT and ASTM Procedure

A comparison between TxDOT and ASTM procedure for polish value testing established the following:

- TxDOT's procedure provides a better correlation between the field BPN and laboratory PV measurements, and the TxDOT procedure is less sensitive to temperature effect in the field,
- The stiffer slider rubber used by TxDOT procedure provides a wider range of measurements, which allows better sensitivity in depicting the differences in aggregate friction properties;
- The TxDOT rubber is a better simulation of the actual tire rubber stiffness; and,
- The TxDOT rubber is in closer agreement with the stiffness of the tire used for accelerated polishing.

6.4 Skid Testing and Monitoring

TxDOT and most other states follow ASTM E 274 for skid testing and data collection. The variability associated with the test results presents limitation on its use as a design tool. The variability of the test results is affected to a great extent upon (a) temperature, (b) test location homogeneity, (c) debris and contamination, (d) operator, (e) equipment calibration, (f) speed of operation, (g) wear of the skid tire, and (h) pressure of skid tire. Although the race-track method developed by this study helped to improve the repeatability and reliability of the results, the race-track method is not logistically practical for routine skid testing and monitoring. In addition to the lack of reliability in the method that has historically been used for routine testing, the effectiveness of skid monitoring is further reduced due to the variability in aggregate production, traffic pattern, and the uniqueness of mix design in each district. Other factors that need to be considered for a state-wide program include at least the following:

- some districts do not have a routine skid testing and/or monitoring program;
- the wet weather accidents may be a result of pavement surface blemish such as flushing, rutting, or poor drainage due to inadequate cross slope; and,
- in a real life situation, there are great differences in the driver and the vehicle braking system, as well as the traction rating and condition of the tires in a vehicle.

6.4.1 Skid History Program

The skid history program was establish in 1975 to allow adjustment to be made for those aggregate sources with low polish value but good skid performance. However, the program has not been effective due to the following:

- The skid history program as of today does not have a written procedure(s) for program administration in source acceptance, monitoring, and program maintenance.

- Limited effort has been given by TxDOT to use skid history program to make needed adjustment(s) to those sources with high polish value but poor skid performance (example – Table 6.1).

- Grouping of South Texas Pleistocene gravel sources by geological origin is not adequate due to the fact that the skid performance of the gravel is much affected by the macrotexture, which is dependent upon the particle shape and the percentage of particles with adequately crushed faces.

- The aggregate sources currently on the skid history program have not been monitored for recent skid performance, with the exception of those projects/sources identified by the San Antonio District and this research project.

- There is no assurance in the skid history program for the skid performance of aggregate types/sources which are highly variable in material properties (example: Figure 5.2). The skid history program is ineffective in timely reflecting the changing aggregate properties that directly affect the skid performance of the surfacing aggregate.

- The regression analysis used for skid history program is greatly skewed by (a) the lack of reliability in skid data that is collected through the traditional method for pavement management, (b) the combination of data representing a relatively long period of production and different aggregate properties; (c) the interpretation from a log-log scale which is extremely sensitive to the reliability of the analyses; and (d) the extension of projected performance beyond the range of known data.

- The use of a pavement management tool, which is intended for maintenance applications, to pre-qualify aggregates and for design consideration.

To further illustrate the inequity of the skid history program, Figure 6.6 is presented. In Figure 6.6, it is shown that a better prediction, but of less statistical significance ($r^2 = 0.1$) was produced by eliminating the data for the first 1 million VPPL. While the original regression analysis presented a better statistical significance ($r^2 = 0.5$), the projected performance was lower for the south Texas Pleistocene gravel. Despite the difference in the predicted performance by the skid history, the actual performance of the crushed gravel is better than these predictions.

The ineffectiveness of the skid history program is illustrated by Figures 6.7, 6.8, and 6.9. Figure 6.7 presents the skid history of a limestone source with data originally collected in Yoakum district in 1995. With the known SN_{40} of only up to 1.7 million VPPL, the projection was extended to 33 millions VPPL. The statistical insignificance of this analysis is represented by a r^2 of 0.07, and yet the projected SN_{40} extended almost 20 times beyond the last known VPPL. With the race-track SN_{40} collected by this study, for the same limestone source, the predicted performance is greatly decreased with a much higher statistical significance ($r^2 = 0.63$).

To recognize the effect of varying aggregate properties on the SN_{40} (limestone source shown on Figure 5.2), the SN_{40} representing the recent two-year production was used to compile the skid history shown on Figures 6.8 and 6.9. Figure 6.8 illustrates a much more statistically significant prediction ($r^2 = 0.85$) for greatly reduced VPPL projection for projects in San Antonio District. Figure 6.9 similarly presents the contrasts between the 1995 skid history and the recent skid history for projects in Austin District.

6.5 Aggregate Blending and Its Effects

Blending of aggregates in a surface friction course can produce positive as well as negative results. The differential wear produced by blending flint or sandstone with limestone creates the desired macrotexture, and it promotes the increased frictional performance of the pavement surface. The differential wear procedure as Part II of Tex-438-A is adequate to ensure the intended macrotexture enhancement and improved skid performance.

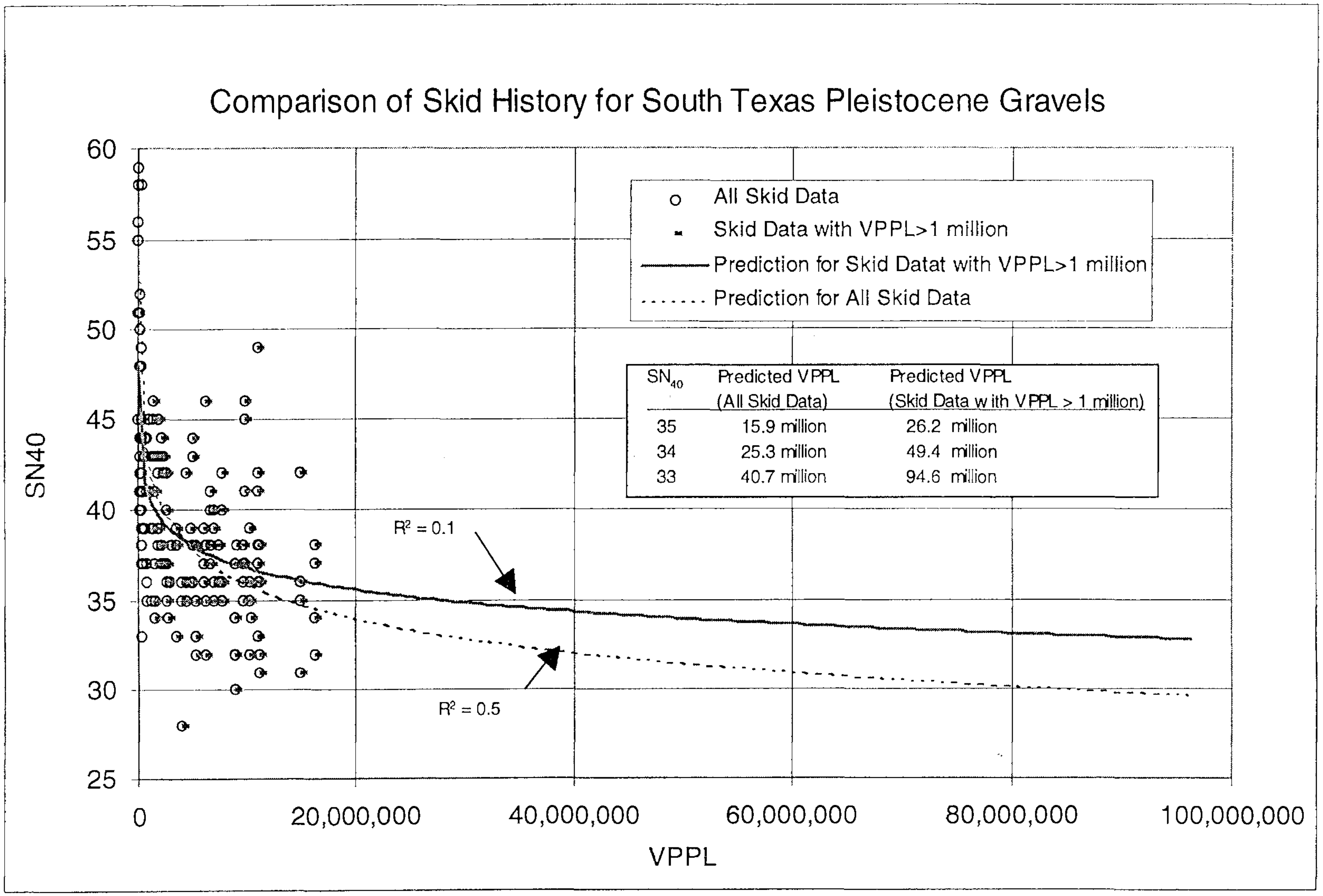

Figure 6.6 – Comparison of skid history for south Texas Pleistocene gravel

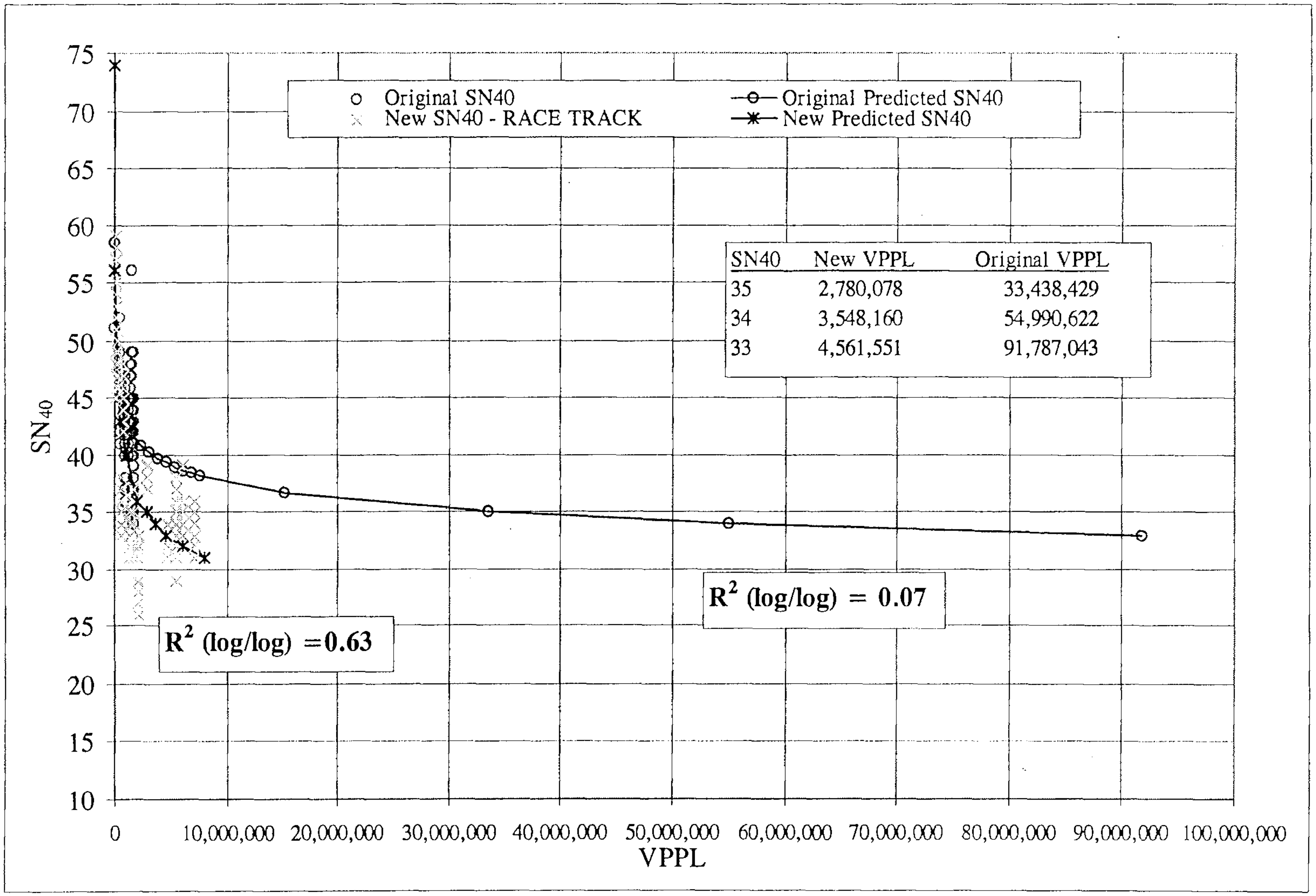

Figure 6.7 – Skid history of a limestone source

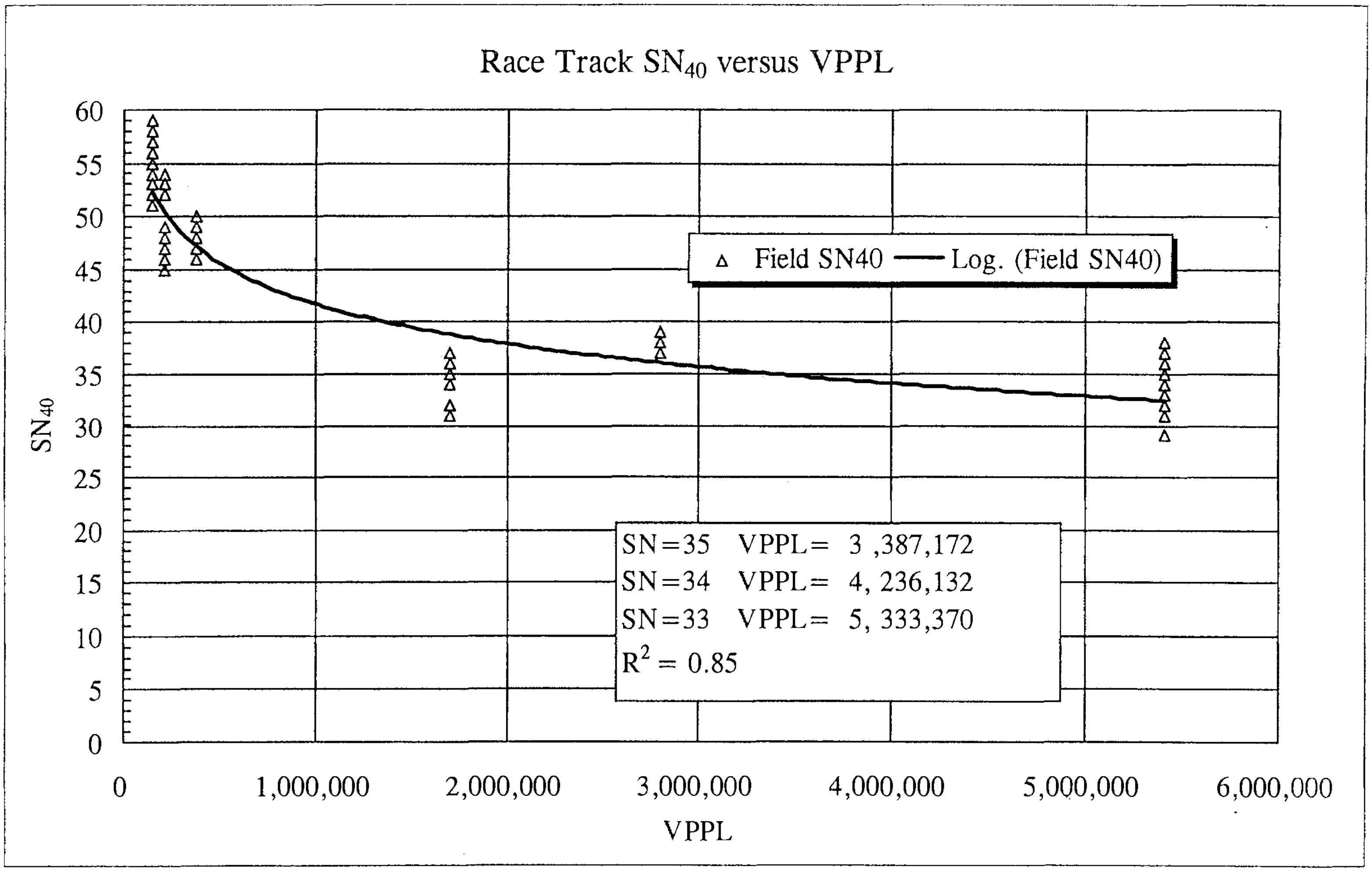

Figure 6.8 – Skid history of a limestone source for recent 2-year projects in San Antonio District

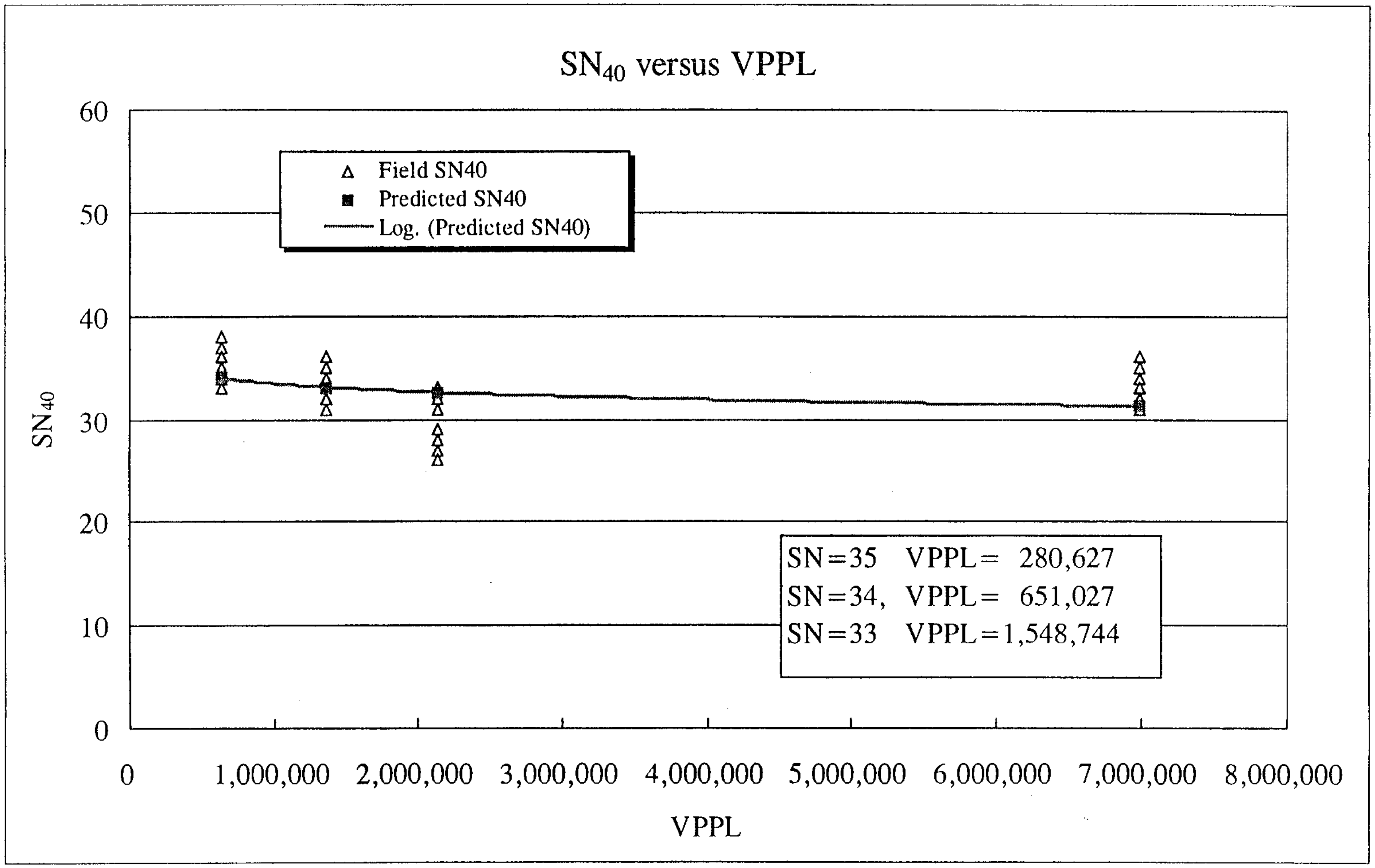

Figure 6.9 – Skid history of a limestone source for recent 2-year projects in Austin District

Blending of hard and soft limestone aggregates can result in reduced aggregate quality in both soundness and skid performance. Some limestone producers blend hard and soft aggregates in a quarry to reduce the total soundness loss. The resulting soundness loss may be substantially lower than the specification maximum; however, the final product does not necessarily represent a better quality material in terms of durability, particle shape, and consistency. There has been evidence to show aggregate crushing under the roller, increased inconsistency in asphalt content for hot mix production, and reduced skid performance due mostly to the incompatible blend of hard and soft limestone. To address the inherent variability of soundness testing and the negative effect of blending, one available option for consideration is to test aggregate soundness on the plus #4 material only. Testing of the plus #4 size aggregate for soundness is more consistent with the 3/8" to 1/4" material used for polish value testing. Testing of the minus #4 material separately for soundness would also allow more effective quality assurance of the screening materials – the soundness quality of the screenings as required by the current specification is measured by the total soundness loss of the coarse aggregate. Another available option for consideration is to lower the soundness specification values to discourage in-pit blending. This option would also allow a more logical specification application of requiring higher quality aggregates for high-traffic roadways and lower quality aggregate for low-volume roads.

CHAPTER VII – RECOMMENDATIONS

The findings of this study present strong evidence of a need to encompass design, material and construction variables and develop an order of priority in design procedures and specifications to satisfy the engineering and economic considerations. It should be noted that further confirmation of the findings will require construction and monitoring of test sections. The recommendations presented below are based on preliminary data collected in the first year of an original 3-year study.

Polish Value Testing and Specification – The current polish value test procedure and specifications are faulty. It is recommended that the new polish value procedure be implemented as soon as practical after addressing some of the concerns presented in this report. The polish value specification should be revised with a lower threshold polish value (residual PV) of 29.

Material selection and Design Strategy – The very premise of current TxDOT specification is "one-size-fits all." There is a lack of specific tools at the project level to encourage matching of the material qualities to the intended application of pavement structures. To balance the engineering and economic considerations in providing safe and effective pavement surfacing, an examination of the overall material supply and demand is required. In order for the pavement surface (as well as the pavement layer system) to function properly, every project must be evaluated and engineered separately to allow the most effective use of available materials to arrive at the optimal performance. The SN_{40} prediction equation is reduced into a table format with considerations given to residual PV and 5-cycle magnesium sulfate soundness loss of surfacing aggregate. The guidelines presented by Table 7.1 are recommended with an emphasis of a system approach in evaluating material quality, design and construction considerations, and performance monitoring. A proposed trial specification for residual PV and 5-cycle magnesium sulfate soundness is presented in Table 7.2. A performance feedback network should be developed so that the overall effectiveness of the system can be maintained.

Aggregate Quality Monitoring Program – The focus of the current aggregate quality monitoring program (AQMP) should be extended beyond formality and reduced testing frequency. A more effective quality control and quality assurance program should be developed to adequately and timely reflect the changing aggregate properties and its effects on pavement structural integrity and skid performance. This program needs to be flexible to accommodate any possible changes to or adoption of new test procedure(s).

Skid History Program – It is recommended that aggregate sources currently on the skid history program be reverted to the polish value program as soon as practical. The new polish value program should allow adequate adjustment to reflect the skid performance of these aggregate sources.

Contingency Actions – An immediate action plan should be developed and implemented to identify the risk of high traffic roadways in the urban districts. This plan should include the roadways surfaced with limestone aggregates under a polish value specification of not greater than 32 – under

TxDOT directive of 8/1/97. Pavement surfacing with limestone aggregates of high soundness loss should also be monitored. It is recommended that the urban districts be allowed to specify aggregates of known skid performance in the interim for high traffic roadways until a new polish value specification is developed.

Public Education – It is recommended that a public education program, similar to "Don't Mess with Texas," be developed. This program should be focused on increasing the traveling public's awareness in reducing wet weather skid accidents - driver behavior and expectations, pavement friction supply and demand, effect of speed on available friction, tire traction, seasonal effect, stopping distance, etc.

Test Section Construction and Monitoring – Test sections need to be constructed and monitored in different regions in the state to establish performance criteria in different geographical areas. The performance criteria should include skid and structural performance. Among the test section matrices presented in Appendix F, San Antonio District is committed to continue the test section construction and monitoring despite early termination of this project. It is recommended that TxDOT administration support the construction and monitoring of other test sections.

Additional Research – The analyses and conclusions presented in this report are drawn from data collected through a broad and general approach. Additional study and construction and monitoring of test sections are required to collect specific materials and performance data to validate the findings of this study. Specific data to be collected from the test sections should include at least aggregate properties, traffic application, mix design and its associated macrotexture (project 7-2981), temperature, field BPN, race-track SN_{40}, and residual polish value generated with the improved test method, and structural and functional performance of the pavement. The temperature effect upon SN_{40} should be determined such that the SN_{40} collected for use by the Pavement Management Information System (PMIS) and future research can be normalized.

Table 7.1 – Material Selection and Design Strategies for Bituminous Surfacing – Wet Weather Skid Accident Reduction

Aggregate	Material Properties				Design Application/Options		Construction	Skid Monitoring*	
Type	5-cy Soundness	Polish Value	Blend Option	C.F.C.	VPPL, X10^6	Mix Design	Rolling	Type & interval - mo.	
Limestone & Dolomite	25< $MgSO_4$≤30	PV ≥29			<12	C/D	M.	PMIS	12
		PV <29	S.S. or Cr. Gr.		<12	D.	M.	PMIS	12
		27≤ PV <29			<3.5	All	M.	PMIS	12
	20< $MgSO_4$≤25	PV ≥29			<20	All	M.	PMIS	24
		PV <29	S.S. or Cr. Gr.		<20	D	H.	PMIS	24
		27≤ PV <29			<8	D/PMS	H.	Monitor	6
		PV <27			<3.5	All	H.	PMIS	24
	≤ 20	PV ≥29			≥20	All	H.	PMIS	24
		PV <29	Blend/diff. wear		≥20	D	H.	PMIS	24
		27≤ PV <29			<8	D/PMS	H.	Monitor	6
		PV <27			<3.5	All	H.	PMIS	12
Crushed Gravel AIR >15%	≤ 15	PV ≥29		≥ 85%	≥20 - no strip	D	H.	PMIS	24
		PV ≥29	Ls. Scn./anti-strip		≥20 - strip	D	H.	PMIS	24
		27≤ PV <29			<20 - no strip	D	H.	Monitor	12
		PV <27			<12	C/D	H.	PMIS	12
Crushed Gravel AIR <15%	≤ 15	PV ≥29		≥ 85%	<12	D	H.	PMIS	24
		27≤ PV <29			<8	D	H.	Monitor	12
		PV <27			<3.5	C/D	H.	PMIS	24
Igneous	≤ 15	PV ≥29			>20	All	H.	PMIS	24
		27≤ PV <29			<8	D/PMS	H.	Monitor	6
		PV <27			<3.5	All	H.	PMIS	24
Sandstone	≤ 20	PV ≥29			>20	All	H.	PMIS	12
Lt. Wt.	≤ 15	PV ≥29			>20	All	M.	PMIS	24
L.R.A.	≤ 30	PV ≥29			<12		M.	Monitor	12

S.S. : Sandstone; Cr. Gr. : Crushed Gravel; AIR : Acid Insoluble Residue; Ls. Scn. : Limestone Screening; CFC : Crushed Face Count
5-cycle Soundness : magnesium sulfate soundness
* In addition to visual survey to identify evidence of flushing, raveling, and rutting.
For material not meeting requirements in this table, use on roadways with anticipated VPPL of less than 1 million.

Table 7.2 – **Proposed Specifications for Polish Value and 5-cycle Magnesium Sulfate Soundness***

Surface Aggregate Classification	VPPL (millions)	Aggregate Type	Blend Option & other requirements	Aggregate Properties	
				Residual PV	5-Cy. Soundness*
A	≥ 20	Limestone/Dolomite		≥ 29	≤ 20
		Limestone/Dolomite	Sandstone or Crushed Gravel & meet Differential Wear	< 29	≤ 20
		Crushed Gravel	pass stripping test & A.I.R.≥ 15%	≥ 29	< 15
		Igneous		≥ 29	< 15
		Sandstone		≥ 29	≤ 20
		Light Weight		≥ 29	≤ 15
B	< 20	Limestone/Dolomite		≥ 29	20 < $MgSO_4$ ≤ 25
		Limestone/Dolomite	Sandstone or Crushed Gravel & meet Differential Wear	< 29	20 < $MgSO_4$ ≤ 25
		Crushed Gravel	pass stripping test & A.I.R.≥ 15%	27≤ PV< 29	< 15
C	< 12	Limestone/Dolomite		≥ 29	25 < $MgSO_4$ ≤ 30
		Limestone/Dolomite	Sandstone or Crushed Gravel	< 29	25 < $MgSO_4$ ≤ 30
		Crushed Gravel	pass stripping test & A.I.R.≥ 15%	< 27	≤ 15
		Crushed Gravel	pass stripping test & A.I.R.< 15%	≥ 29	≤ 15
		L.R.A		≥ 29	≤ 30
D	< 8	Limestone/Dolomite		27≤ PV< 29	≤ 25
		Crushed Gravel	pass stripping test & A.I.R.< 15%	27≤ PV< 29	≤ 15
		Igneous		27≤ PV< 29	≤ 15
E	< 3.5	Limestone/Dolomite		27≤ PV< 29	25 < $MgSO_4$ ≤ 30
		Limestone/Dolomite		< 27	≤ 25
		Crushed Gravel	pass stripping test & A.I.R.< 15%	< 27	≤ 15
		Igneous		< 27	≤ 15
F	< 1	As shown on plans for materials not meeting requirements shown in this table.			

***5-cycle magnesium sulfate soundness total loss per normalized gradation and individual loss for 3/8" to #4 size aggregate.**

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APPENDIX A

Appendix A

Experimental Procedure for Race-Track Skid and British Pendulum Testing

Sample Locations

Randomly select four (4) test locations for each project. The locations will be the outside lane and inside wheel path for multilane roadways. Each test location should be examined to assure that pavement is in good condition, in tangent section, and has no significant difference in elevation. It should be evident at the test locations that the contribution of the coarse aggregate to the skid resistance of the pavement is being measured. Mark the test locations with white paint in the inside wheel path and also identification on the outside shoulder for the ease of test location identification. Take notes of test locations in descriptive terms, use Texas reference markers, or coordinates through the use of a hand-held GPS.

Skid Test Equipment

The skid test equipment shall be calibrated and maintained in accordance with ASTM E-274. Every effort will be made to minimize the variance in skid test results due to the skid test equipment or the operator. The same skid unit will be used for all the tests. The unit will be calibrated prior to the start of the test program. At the end of each week of skid testing, the unit will retest a location skidded at the first of the week to verify consistency of the calibration. A significant variation in the results will require a full recalibration of the equipment. The operator of the skid test equipment will be fully trained and knowledgeable of skid test procedures and the equipment. To minimize the variation due to the operator, every effort will be made to use the same operator as much as possible.

The equipment will be maintained in excellent condition. Tire diameter is a critical component of the accuracy of the skid test results. Cold tire pressure on the skid trailer will be checked each morning and will be adjusted to exactly 28 psi. Tread depth will be measured and recorded each morning prior to starting the day=s testing. The skid tire will be replaced when tread wear exceeds 0.25 inch.

Race-Track Skid Test Procedure

The objective is to measure the skid resistance in the left wheel path of the outside lane at each sample location. Repetitive skids will be made at each sample location to (1) thoroughly wet and scrub the pavement, (2) obtain a high level of repeatability of the skid test data, and (3) minimize the seasonal effects on the test results. Every effort will be made for each skid track to begin and end at the same points. Test data will be recorded for each skid test. Skid testing will be maintained at 40 mph +/- 1 mph (SN40). The data from any skid test where the speed falls outside this range will be rejected and discarded. No testing will occur when the air temperature is at or below 35 EF and falling.

Successive skid tests will be continued at each sample location until a set of five (5) skid numbers which are within a 2-point spread is obtained. Only the average of the five skid numbers with a 2-point spread will be used for evaluation, and any high or low data point(s) outside of the 2-point spread will be considered as an outlier(s) and will be discarded.

Portable British Pendulum Test

Two portable British pendulum tests (BPT) will be perform within the skid path of each skid test location. The BPT setups will be located within the wheel path of pavement actually skid tested. The test locations should be randomly selected, exhibit coarse aggregate of relatively uniform height, and be representative of the surrounding pavement surface. At each BPT test setup, both TxDOT and ASTM slider rubber will be used. Average and residual British pendulum numbers (BPN) will be measured with TxDOT slider at a travel distance of 3-7/8 inches and with ASTM slider at a travel distance of 5 inches. All tests will use an 1-1/4-inch-wide slider foot.

Other Data Requirements

During the portable British pendulum testing, the air temperature and pavement surface temperature will be measured and recorded in Fahrenheit to the nearest degree. Measurements of pavement surface texture will be attempted through the use of a mini texture meter (MTM).

APPENDIX B

Appendix B: Summary of Skid Number at 20, 30, 40, 50, 60, 70 MPH

Location	SN_{40}	SN_{20}	SN_{30}	SN_{50}	SN_{60}	SN_{70}
PHR-5C-1	36.2	40.3	39.0	35.3	34.0	33.3
PHR-5C-2	34.6	40.3	37.7			
PHR-5C-3	36.2	41.0	37.7	34.3	33.7	33.0
PHR-5C-4	36.6	41.7	39.7			
AUS-1C-1	37.6			35.0	34.0	31.7
CRPGL-3B-2	53.8			47.3	42.3	38.3
CRPGL-3B-4	54.6			48.7	42.3	36.7
CRPGL-5B-1	42.4			34.3	33.0	30.7
CRPGL-5B-3	43.6			40.7	36.7	39.0
PHR-4D-1	46.6			43.7	44.0	42.7
PHR-4D-3	45.8			42.3	41.7	41.3
PHR-8B-1	36.2			34.3	34.0	35.0
PHR-8B-2	37.6			36.3	34.7	36.7
PHR-8B-4	37.0			36.7	34.7	36.0
TYL-6C-1	40.8					35.0
TYL-6C-2	42.2				38.3	38.0
TYL-6C-4	43.2				39.7	37.0
YKM-10F-1	38.0			35.7	30.7	29.0
YKM-10F-3	39.2			33.0	31.0	35.7
YKM-1A-2	39.8			37.7	37.0	37.0
YKM-1A-4	42.2			37.7	37.7	37.0
YKM-5E-1	32.0			28.3	26.3	25.7
YKM-5E-3	33.8			30.3	27.3	26.3
YKM-6C-2	45.0			41.7	37.7	37.0
YKM-6C-4	45.8			41.7	37.3	39.0
YKM-7D-1	32.4			29.7	26.3	24.3
YKM-7D-3	32.6			29.0	25.7	23.3
YKM-7G-2	31.6			27.3	25.0	24.3
YKM-7G-4	29.6			27.0	25.0	24.7
AUS-1C-3	37.6			34.7		
AUS-1D-1	37.4			35.3		
AUS-1D-2	37.4			34.7		
AUS-1D-3	36.2			34.7		
AUS-1D-4	37.8			36.7		
AUS-2A-1	31.0			31.3		
AUS-2A-2	31.4			30.3		
AUS-2A-3	31.2			32.0		
AUS-2A-4	30.2			27.7		
AUS-4A-1	47.0			42.0		
AUS-4A-2	48.6			45.0		
AUS-4A-3	47.8			43.0		
AUS-4A-4	47.8			42.3		
AUS-6B-1	37.2			30.7		
AUS-6B-2	34.0			32.0		
AUS-6B-3	35.4			32.7		
AUS-6B-4	37.0			31.3		

Location	SN_{40}	SN_{20}	SN_{30}	SN_{50}	SN_{60}	SN_{70}
AUS-6C-2	29.2			28.0		
AUS-6C-3	33.2			28.7		
AUS-6C-4	32.6			30.7		
CRPGL-2A-1	41.4			38.0		
CRPGL-2A-2	41.0			39.0		
CRPGL-2A-3	41.4			38.7		
CRPGL-2A-4	41.8			38.3		
CRPGL-3B-3	62.2			52.3		
CRPGL-3B-4	59.2			45.3		
CRPGL-4A-1	32.2			26.3		
CRPGL-4A-3	36.2			32.7		
CRPGL-4A-4	37.8			34.3		
CRPGL-5A-1	58.2			48.0		
CRPGL-5A-2	55.0			51.3		
CRPGL-5A-3	56.2			53.0		
CRPGL-5A-4	55.0			49.7		
CRPGL-5B-1	46.0			41.3		
CRPGL-5B-2	42.2			40.3		
CRPGL-5B-3	47.4			40.0		
CRPGL-5B-4	47.4			39.0		
CRPGL-6A-1	42.2			36.0		
CRPGL-6A-2	45.6			40.0		
CRPGL-6A-3	44.4			41.3		
CRPGL-6A-4	46.2			41.0		
CRPGL-7B-1	50.2			46.3		
CRPGL-7B-2	53.6			47.0		
CRPGL-7B-3	57.0			51.7		
CRPGL-7B-4	50.8			45.0		
CRPGL-7C-1	39.2			37.7		
CRPGL-7C-2	38.8			37.7		
CRPGL-7C-3	38.2			34.7		
CRPGL-7C-4	41.2			37.0		
CRPGL-8B-2	42.6			38.3		
CRPGL-8B-3	42.8			38.0		
CRPGL-8B-4	43.2			37.7		
CRPGL-8D-1	47.4			42.0		
CRPGL-8D-2	45.8			40.3		
CRPGL-8D-3	45.4			40.3		
CRPGL-8D-4	45.0			40.3		
CRPGL-8E-1	42.8			35.3		
CRPGL-8E-3	42.0			37.0		
CRPGL-8E-4	41.6			36.7		
CRPGL-8F-1	48.4			41.0		
CRPGL-8F-2	45.6			42.0		
CRPGL-8F-3	44.4			39.7		
CRPGL-8F-4	48.8			47.0		
CRPLM-10A-1	45.8			34.3		
CRPLM-10A-2	44.0			36.0		
CRPLM-10A-2	41.0			37.7		

Location	SN_{40}	SN_{20}	SN_{30}	SN_{50}	SN_{60}	SN_{70}
CRPLM-10A-3	45.6			42.7		
CRPLM-10A-4	41.0			38.0		
CRPLM-10A-4	43.0			38.7		
CRPLM-12C-1	41.4			38.3	36.7	
CRPLM-12C-2	43.2			39.0	37.7	
CRPLM-12C-3	41.8			40.3	39.0	
CRPLM-12C-4	41.8			37.7	36.0	
CRPLM-13A-2	41.0			35.7		
CRPLM-13A-3	42.0			38.7		
CRPLM-13A-4	40.4			35.7		
CRPLM-13A-W1	56.4			52.3		
CRPLM-13A-W2	62.6			54.7		
CRPLM-13A-W3	57.8			52.7		
CRPLM-13A-W4	61.2			60.0		
CRPLM-13C-1	43.6			39.3		
CRPLM-13C-3	45.2			39.7		
CRPLM-14B-1	44.2			44.3		
CRPLM-14B-2	47.8			43.7		
CRPLM-14B-3	51.6			45.0		
CRPLM-14C-1	57.2			54.7		
CRPLM-14C-2	57.0			49.0		
CRPLM-14C-3	60.8			51.3		
CRPLM-14C-4	60.2			53.0		
CRPLM-16A-1	72.8			60.3		
CRPLM-16A-2	68.8			60.7		
CRPLM-16A-3	70.4			63.3		
CRPLM-16A-4	64.8			60.7		
CRPLM-2A-1	56.2			52.7	50.7	
CRPLM-2A-3	56.0			51.7	49.7	
CRPLM-4A-1	40.4			34.3		
CRPLM-4A-2	40.4			37.0		
CRPLM-4A-3	40.0			34.0		
CRPLM-4A-4	40.4			35.0		
CRPLM-5A-1	35.0			35.0		
CRPLM-5A-2	42.2			33.7		
CRPLM-5A-3	41.2			35.3		
CRPLM-5A-4	38.2			29.7		
CRPLM-9A-1	41.0			35.7		
CRPLM-9A-2	38.4			37.0		
CRPLM-9A-3	40.2			34.0		
CRPLM-9A-4	39.8			34.0		
LRD-10A-1	64.8			58.3		
LRD-10A-4	64.8			53.0		
LRD-10B-2	41.4			38.3		
LRD-10B-3	46.0			43.0		
LRD-10B-4	43.8			40.0		
LRD-11A-1	58.0			49.0		
LRD-11A-2	54.6			47.3		
LRD-11A-3	54.2			47.3		

Location	SN_{40}	SN_{20}	SN_{30}	SN_{50}	SN_{60}	SN_{70}
LRD-11A-4	53.8			46.0		
LRD-2A-1	48.2			40.0		
LRD-2A-2	45.4			40.0		
LRD-2A-3	44.6			38.3		
LRD-2A-4	44.8			41.0		
LRD-2A-S1	45.2			40.0		
LRD-2A-S2	44.4			38.0		
LRD-2A-S3	44.2			40.3		
LRD-2A-S4	45.2			40.3		
LRD-3A-1	49.8			45.3		
LRD-3A-2	50.8			44.7		
LRD-3A-3	50.0			46.3		
LRD-3A-4	50.2			45.0		
LRD-5A-1	47.0			42.3		
LRD-5A-2	48.6			39.7		
LRD-5A-4	49.6			40.0		
LRD-7B-2	43.0			37.3		
LRD-7B-3	43.8			37.7		
PHR-4A-1	38.2			34.0		
PHR-4A-2	37.4			33.0	30.0	
PHR-4A-3	36.2			31.3	28.7	
PHR-4A-4	33.6			29.0	25.0	
PHR-4B-1	39.8			38.0	35.3	
PHR-4B-3	39.8			37.7	36.0	
PHR-4C-1	36.4			35.7	33.7	
PHR-4C-2	38.4			37.3	34.7	
PHR-4C-3	40.0			38.0	37.0	
PHR-4C-4	37.2			34.3		
PHR-5B-1	41.6			38.7		
PHR-5B-4	45.0			42.0		
PHR-6E-1	37.0			33.3		
PHR-6E-2	37.2				32.0	
PHR-6E-3	37.0			34.0		
PHR-6E-4	38.0			33.7	33.0	
PHR-7A-1	44.8			39.3	35.3	
PHR-7A-3	44.2			38.7	37.3	
PHR-7A-4	42.8			38.3	35.0	
PHR-8B-3	37.8			35.3	35.0	
PHR-8C-1	41.2		46.7			
PHR-8C-3	40.4		45.0			
PHR-8C-4	39.4		42.0	36.0		
SAT-10A-1	36.0			31.7		
SAT-10A-3	32.6			28.0		
SAT-13B-1	34.8			31.3		
SAT-13B-3	34.0			32.7		
TYL-6C-3	44.8				40.0	
YKM-10L-1	39.8			35.0	30.3	
YKM-10L-3	40.4			34.7	30.0	
YKM-3A-1	39.4			33.3		

Location	SN_{40}	SN_{20}	SN_{30}	SN_{50}	SN_{60}	SN_{70}
YKM-3A-4	40.6			36.3		
YKM-5E-2	34.4			29.7		
YKM-5E-4	33.6			31.3		
YKM-7I-1	36.6			32.3		
YKM-7I-3	39.0			31.7		
YKM-9C-1	36.0			31.7		
YKM-9C-2	35.8				28.0	
YKM-9C-3	35.8			37.7		
YKM-9C-4	44.0				32.7	
YKM-9I-1	63.6			59.0		
YKM-9I-3	63.0			58.3		

APPENDIX C

Appendix C : Summary of Research Test Data

	CSJ	Surface Type	Location	Skid Date	SN_{40}	BPN	VPPL	Producer	ADT	Lanes	ServiceDate	PaveTemp	AirTemp
1	0520-03	IGNEOUS-HMAC	ATL-1A-1	06/09/98	47	45	677,600	0050106	2,200	2	10/01/96	113	93
2	0520-03	IGNEOUS-HMAC	ATL-1A-1	09/15/97	52		383,900	0050106	2,200	2	10/01/96		
3	0520-03	IGNEOUS-HMAC	ATL-1A-1	01/13/98	57		515,900	0050106	2,200	2	10/01/96		
4	0520-03	IGNEOUS-HMAC	ATL-1A-2	06/09/98	46	51	677,600	0050106	2,200	2	10/01/96	116	92
5	0520-03	IGNEOUS-HMAC	ATL-1A-2	09/15/97	51		383,900	0050106	2,200	2	10/01/96		
6	0520-03	IGNEOUS-HMAC	ATL-1A-2	01/13/98	52		515,900	0050106	2,200	2	10/01/96		
7	0520-03	IGNEOUS-HMAC	ATL-1A-3	06/09/98	47	47	677,600	0050106	2,200	2	10/01/96	116	92
8	0520-03	IGNEOUS-HMAC	ATL-1A-3	01/13/98	50		515,900	0050106	2,200	2	10/01/96		
9	0520-03	IGNEOUS-HMAC	ATL-1A-3	09/15/97	53		383,900	0050106	2,200	2	10/01/96		
10	0520-03	IGNEOUS-HMAC	ATL-1A-4	06/09/98	45		677,600	0050106	2,200	2	10/01/96		
11	0520-03	IGNEOUS-HMAC	ATL-1A-4	09/15/97	49		383,900	0050106	2,200	2	10/01/96		
12	0520-03	IGNEOUS-HMAC	ATL-1A-4	01/13/98	50		515,900	0050106	2,200	2	10/01/96		
13	0495-07-051	IGNEOUS-HMAC	TYL-6C-1	09/16/97	41	37	4,854,000	0050106	24,000	4	06/30/95	101	90
14	0495-07-051	IGNEOUS-HMAC	TYL-6C-1	06/11/98	42	43	6,462,000	0050106	24,000	4	06/30/95	92	83
15	0495-07-051	IGNEOUS-HMAC	TYL-6C-1	01/14/98	43	50	5,574,000	0050106	24,000	4	06/30/95		48
16	0495-07-051	IGNEOUS-HMAC	TYL-6C-2	01/14/98	42	51	5,574,000	0050106	24,000	4	06/30/95		48
17	0495-07-051	IGNEOUS-HMAC	TYL-6C-2	09/16/97	42	39	4,854,000	0050106	24,000	4	06/30/95	101	90
18	0495-07-051	IGNEOUS-HMAC	TYL-6C-2	06/11/98	42	39	6,462,000	0050106	24,000	4	06/30/95	90	84
19	0495-07-051	IGNEOUS-HMAC	TYL-6C-3	01/14/98	41	51	5,574,000	0050106	24,000	4	06/30/95		48
20	0495-07-051	IGNEOUS-HMAC	TYL-6C-3	06/11/98	45	47	6,462,000	0050106	24,000	4	06/30/95	90	80
21	0495-07-051	IGNEOUS-HMAC	TYL-6C-3	09/16/97	45	40	4,854,000	0050106	24,000	4	06/30/95	101	90
22	0495-07-051	IGNEOUS-HMAC	TYL-6C-4	01/14/98	39	50	5,574,000	0050106	24,000	4	06/30/95		48
23	0495-07-051	IGNEOUS-HMAC	TYL-6C-4	09/16/97	43	37	4,854,000	0050106	24,000	4	06/30/95	101	90
24	0495-07-051	IGNEOUS-HMAC	TYL-6C-4	06/11/98	45	44	6,462,000	0050106	24,000	4	06/30/95	90	80
25	0610-06-050	GRAVEL-HMAC	ATL-10A-1	06/08/98	47	52	3,708,750	0050114	23,000	4	09/01/96	81	80
26	0610-06-050	GRAVEL-HMAC	ATL-10A-1	01/13/98	51	67	2,869,250	0050114	23,000	4	09/01/96		
27	0610-06-050	GRAVEL-HMAC	ATL-10A-2	06/08/98	46	54	3,708,750	0050114	23,000	4	09/01/96	80	78
28	0610-06-050	GRAVEL-HMAC	ATL-10A-2	01/13/98	49	41	2,869,250	0050114	23,000	4	09/01/96		
29	0610-06-050	GRAVEL-HMAC	ATL-10A-3	06/08/98	46	52	3,708,750	0050114	23,000	4	09/01/96	51	51
30	0610-06-050	GRAVEL-HMAC	ATL-10A-3	01/13/98	49	47	2,869,250	0050114	23,000	4	09/01/96		
31	0061-01-019	GRAVEL-HMAC	ATL-1R-1	01/13/98	37	58	1,819,238	0050114	3,925	2	07/01/95		46
32	0061-01-019	GRAVEL-HMAC	ATL-1R-1	06/08/98	45	43	2,105,763	0050114	3,925	2	07/01/95	93	87
33	0061-01-019	GRAVEL-HMAC	ATL-1R-2	01/13/98	37	55	1,819,238	0050114	3,925	2	07/01/95		46
34	0061-01-019	GRAVEL-HMAC	ATL-1R-2	06/08/98	45	47	2,105,763	0050114	3,925	2	07/01/95	93	87
35	0061-01-019	GRAVEL-HMAC	ATL-1R-3	01/13/98	38	46	1,819,238	0050114	3,925	2	07/01/95		46
36	0061-01-019	GRAVEL-HMAC	ATL-1R-3	06/08/98	46	48	2,105,763	0050114	3,925	2	07/01/95	94	84
37	0218-01-065	GRAVEL-HMAC	ATL-2R-1	01/13/98	48	50	6,984,018	0050114	15,068	2	07/01/95		43

	CSJ	Surface Type	Location	Skid Date	SN_{40}	BPN	VPPL	Producer	ADT	Lanes	ServiceDate	PaveTemp	AirTemp
38	0218-01-065	GRAVEL-HMAC	ATL-2R-2	01/13/98	49	49	6,984,018	0050114	15,068	2	07/01/95		43
39	0218-01-065	GRAVEL-HMAC	ATL-2R-3	01/13/98	51	48	6,984,018	0050114	15,068	2	07/01/95		43
40	0218-01-065	GRAVEL-HMAC	ATL-2R-4	01/13/98	50		6,984,018	0050114	15,068	2	07/01/95		
41	0063-01-048	GRAVEL-HMAC	ATL-3A-1	06/09/98	43	43	16,146,000	0050114	23,000	4	10/01/90	110	86
42	0063-01-048	GRAVEL-HMAC	ATL-3A-2	06/09/98	42	42	16,146,000	0050114	23,000	4	10/01/90	109	86
43	0063-01-048	GRAVEL-HMAC	ATL-3A-3	06/09/98	42	38	16,146,000	0050114	23,000	4	10/01/90	110	86
44	0063-01-048	GRAVEL-HMAC	ATL-3A-4	06/09/98	42	45	16,146,000	0050114	23,000	4	10/01/90	106	92
45	0610-07-065	GRAVEL-HMAC	ATL-7B-1	06/08/98	45	49	10,081,500	0050114	47,000	4	02/01/96	85	81
46	0610-07-065	GRAVEL-HMAC	ATL-7B-1	01/13/98	49	50	8,366,000	0050114	47,000	4	02/01/96		
47	0610-07-065	GRAVEL-HMAC	ATL-7B-2	06/08/98	45	52	10,081,500	0050114	47,000	4	02/01/96	87	54
48	0610-07-065	GRAVEL-HMAC	ATL-7B-2	01/13/98	50	49	8,366,000	0050114	47,000	4	02/01/96		
49	0610-07-065	GRAVEL-HMAC	ATL-7B-3	06/08/98	44	44	10,081,500	0050114	47,000	4	02/01/96	87	85
50	0610-07-065	GRAVEL-HMAC	ATL-7B-3	01/13/98	46	51	8,366,000	0050114	47,000	4	02/01/96		
51	0610-07-065	GRAVEL-HMAC	ATL-7B-4	06/08/98	46	45	10,081,500	0050114	47,000	4	02/01/96	87	85
52	0610-07-065	GRAVEL-HMAC	ATL-7B-4	01/13/98	48	47	8,366,000	0050114	47,000	4	02/01/96		
53	0221-05-061A	SANDST-HMAC	ATL-3R-1	01/13/98	57	59	2,508,462	0050437	5,412	2	07/01/95		59
54	0221-05-061A	SANDST-HMAC	ATL-3R-1	06/08/98	60	57	2,903,538	0050437	5,412	2	07/01/95	95	80
55	0221-05-061A	SANDST-HMAC	ATL-3R-2	01/13/98	56	54	2,508,462	0050437	5,412	2	07/01/95		59
56	0221-05-061A	SANDST-HMAC	ATL-3R-2	06/08/98	62	49	2,903,538	0050437	5,412	2	07/01/95	94	82
57	0221-05-061A	SANDST-HMAC	ATL-3R-3	06/08/98	59	54	2,903,538	0050437	5,412	2	07/01/95	97	86
58	2075-02-035	SANDST-HMAC	TYL-2R-1	01/14/98	44	50	11,487,490	0050437	26,530	2	09/01/95		41
59	2075-02-035	SANDST-HMAC	TYL-2R-1	06/15/98	50	46	13,503,770	0050437	26,530	2	09/01/95	92	83
60	2075-02-035	SANDST-HMAC	TYL-2R-2	06/15/98	50	44	13,503,770	0050437	26,530	2	09/01/95	93	89
61	2075-02-035	SANDST-HMAC	TYL-2R-2	01/14/98	53	51	11,487,490	0050437	26,530	2	09/01/95		41
62	2075-02-035	SANDST-HMAC	TYL-2R-3	01/14/98	48	57	11,487,490	0050437	26,530	2	09/01/95		41
63	2075-02-035	SANDST-HMAC	TYL-2R-3	06/15/98	49	49	13,503,770	0050437	26,530	2	09/01/95	93	84
64	0197-03-048	TRAP-HMAC	DAL-2R-1	06/15/98	47	45	18,057,527	0050438	17,338	2	10/01/92	112	84
65	0197-03-048	TRAP-HMAC	DAL-2R-1	01/14/98	48	46	16,739,839	0050438	17,338	2	10/01/92		74
66	0197-03-048	TRAP-HMAC	DAL-2R-2	06/15/98	46	46	18,057,527	0050438	17,338	2	10/01/92	121	90
67	0197-03-048	TRAP-HMAC	DAL-2R-2	01/14/98	51	53	16,739,839	0050438	17,338	2	10/01/92		74
68	0197-03-048	TRAP-HMAC	DAL-2R-3	06/15/98	47	44	18,057,527	0050438	17,338	2	10/01/92	121	90
69	0197-03-048	TRAP-HMAC	DAL-2R-3	01/14/98	50	47	16,739,839	0050438	17,338	2	10/01/92		74
70	0014-03-1T	IGNEOUS-HMAC	FTW-1T-1	06/16/98	49	46	1,589,000	0050439	22,700	4	09/09/97	95	78
71	0014-03-1T	IGNEOUS-HMAC	FTW-1T-2	06/16/98	48	47	1,589,000	0050439	22,700	4	09/09/97	96	85
72	0014-03-1T	IGNEOUS-HMAC	FTW-1T-3	06/16/98	48	51	1,589,000	0050439	22,700	4	09/09/97	96	85
73	0014-03-1T	IGNEOUS-HMAC	FTW-1T-4	06/16/98	45	46	1,589,000	0050439	22,700	4	09/09/97	95	86
74	0710-01-036	LIMESTONE-HMAC	BMT-1R-1	04/01/98	44	57	3,402,471	0050601	3,289	2	08/01/92		62
75	0710-01-036	LIMESTONE-HMAC	BMT-1R-2	04/01/98	47	54	3,402,471	0050601	3,289	2	08/01/92		62
76	0710-01-036	LIMESTONE-HMAC	BMT-1R-3	04/01/98	46	48	3,402,471	0050601	3,289	2	08/01/92		62
77	0028-04-061	LIMESTONE-HMAC	BMT-4R-1	04/01/98	40	44	2,826,060	0050601	5,624	2	07/01/95		44
78	0028-04-061	LIMESTONE-HMAC	BMT-4R-2	04/01/98	44	45	2,826,060	0050601	5,624	2	07/01/95		44

	CSJ	Surface Type	Location	Skid Date	SN_{40}	BPN	VPPL	Producer	ADT	Lanes	ServiceDate	PaveTemp	AirTemp
79	0028-04-061	LIMESTONE-HMAC	BMT-4R-3	04/01/98	42	44	2,826,060	0050601	5,624	2	07/01/95		44
80	2523-02-041	LIMESTONE-HMAC	HOU-1R-1	04/01/98	44	45	4,044,233	0050601	7,003	2	02/01/95		79
81	2523-02-041	LIMESTONE-HMAC	HOU-1R-2	04/01/98	42	41	4,044,233	0050601	7,003	2	02/01/95		79
82	2523-02-041	LIMESTONE-HMAC	HOU-1R-3	04/01/98	45	44	4,044,233	0050601	7,003	2	02/01/95		79
83	0014-03-3T	LIMESTONE-HMAC	FTW-3T-1	06/16/98	35	44	1,589,000	0218409	22,700	4	09/09/97	100	91
84	0014-03-3T	LIMESTONE-HMAC	FTW-3T-2	06/16/98	35	42	1,589,000	0218409	22,700	4	09/09/97	100	91
85	0014-03-3T	LIMESTONE-HMAC	FTW-3T-3	06/16/98	37	45	1,589,000	0218409	22,700	4	09/09/97	100	91
86	0007-03-00W	LIMESTONE-CMHBC	BWD-1A-1	03/25/98	30	30	3,867,250	0224902	15,500	4	07/01/95		62
87	0007-03-00W	LIMESTONE-CMHBC	BWD-1A-2	03/25/98	30	33	3,867,250	0224902	15,500	4	07/01/95		62
88	0007-03-00W	LIMESTONE-CMHBC	BWD-1A-3	03/25/98	29	40	3,867,250	0224902	15,500	4	07/01/95		62
89	0007-03-00W	LIMESTONE-CMHBC	BWD-1A-4	03/25/98	28	38	3,867,250	0224902	15,500	4	07/01/95		62
90	1315-02-008	LIMESTONE-HMAC	DAL-9B-1	09/22/97	37		1,888,700	0224902	5,050	1	09/13/96		
91	1315-02-008	LIMESTONE-HMAC	DAL-9B-1	06/15/98	37	40	3,232,000	0224902	5,050	1	09/13/96	106	88
92	1315-02-008	LIMESTONE-HMAC	DAL-9B-1	01/14/98	39	45	2,464,400	0224902	5,050	1	09/13/96		52
93	1315-02-008	LIMESTONE-HMAC	DAL-9B-2	06/15/98	37	42	3,232,000	0224902	5,050	1	09/13/96	97	89
94	1315-02-008	LIMESTONE-HMAC	DAL-9B-2	09/22/97	37		1,888,700	0224902	5,050	1	09/13/96		
95	1315-02-008	LIMESTONE-HMAC	DAL-9B-2	01/14/98	39	42	2,464,400	0224902	5,050	1	09/13/96		52
96	1315-02-008	LIMESTONE-HMAC	DAL-9B-3	06/15/98	37	44	3,232,000	0224902	5,050	1	09/13/96	110	90
97	1315-02-008	LIMESTONE-HMAC	DAL-9B-3	09/22/97	38		1,888,700	0224902	5,050	1	09/13/96		
98	1315-02-008	LIMESTONE-HMAC	DAL-9B-3	01/14/98	46	48	2,464,400	0224902	5,050	1	09/13/96		52
99	1315-02-008	LIMESTONE-HMAC	DAL-9B-4	09/22/97	35		1,888,700	0224902	5,050	1	09/13/96		
100	1315-02-008	LIMESTONE-HMAC	DAL-9B-4	06/15/98	37	45	3,232,000	0224902	5,050	1	09/13/96	101	89
101	1315-02-008	LIMESTONE-HMAC	DAL-9B-4	01/14/98	38	44	2,464,400	0224902	5,050	1	09/13/96		52
102	0014-03-2T	LIMESTONE-HMAC	FTW-2T-1	06/16/98	36	43	1,589,000	0224902	22,700	4	09/09/97	97	83
103	0014-03-2T	LIMESTONE-HMAC	FTW-2T-2	06/16/98	37	48	1,589,000	0224902	22,700	4	09/09/97	97	83
104	0014-03-2T	LIMESTONE-HMAC	FTW-2T-3	06/16/98	35	43	1,589,000	0224902	22,700	4	09/09/97	101	86
105	0009-13-00W	LIMESTONE-Ty C	PAR-1A-1	03/24/98	26	32	3,420,000	0224902	30,000	4	12/23/96		81
106	0009-13-00W	LIMESTONE-Ty C	PAR-1A-2	03/24/98	26	34	3,420,000	0224902	30,000	4	12/23/96		81
107	0009-13-00W	LIMESTONE-Ty C	PAR-1A-3	03/24/98	26	30	3,420,000	0224902	30,000	4	12/23/96		81
108	0009-13-00W	LIMESTONE-Ty C	PAR-1A-4	03/24/98	26	45	3,420,000	0224902	30,000	4	12/23/96		81
109	0007-03-00E	LIMESTONE-Ty D	BWD-1B-1	03/25/98	34	37	5,281,625	0224902	15,500	4	07/01/94		62
110	0007-03-00E	LIMESTONE-Ty D	BWD-1B-2	03/25/98	32	35	5,281,625	0224902	15,500	4	07/01/94		62
111	0007-03-00E	LIMESTONE-Ty D	BWD-1B-3	03/25/98	34	37	5,281,625	0224902	15,500	4	07/01/94		62
112	0007-03-00E	LIMESTONE-Ty D	BWD-1B-4	03/25/98	34	41	5,281,625	0224902	15,500	4	07/01/94		62
113	0009-13-00E	PMS	PAR-1B-1	03/24/98	29	28	3,420,000	0224902	30,000	4	12/23/96		83
114	0009-13-00E	PMS	PAR-1B-2	03/24/98	29	31	3,420,000	0224902	30,000	4	12/23/96		82
115	0009-13-00E	PMS	PAR-1B-3	03/24/98	29	38	3,420,000	0224902	30,000	4	12/23/96		87
116	0009-13-00E	PMS	PAR-1B-4	03/24/98	29	32	3,420,000	0224902	30,000	4	12/23/96		77
117	0455-01-039	GRAVEL-HMAC	AMA-3R-1	04/29/98	51	55	1,553,116	0411807	3,007	2	07/01/95		64
118	0455-01-039	GRAVEL-HMAC	AMA-3R-2	04/29/98	50	55	1,553,116	0411807	3,007	2	07/01/95		64
119	0455-01-039	GRAVEL-HMAC	AMA-3R-3	04/29/98	52	55	1,553,116	0411807	3,007	2	07/01/95		64

	CSJ	Surface Type	Location	Skid Date	SN_{40}	BPN	VPPL	Producer	ADT	Lanes	ServiceDate	PaveTemp	AirTemp
120	0379-01-031	GRAVEL-HMAC	AMA-2R-1	04/29/98	46	53	2,027,263	0411808	3,925	2	07/01/95		68
121	0379-01-031	GRAVEL-HMAC	AMA-2R-2	04/29/98	47	56	2,027,263	0411808	3,925	2	07/01/95		68
122	0379-01-031	GRAVEL-HMAC	AMA-2R-3	04/29/98	48	53	2,027,263	0411808	3,925	2	07/01/95		68
123	0004-02-047	GRAVEL-HMAC	ODS-1R-1	05/01/98	51	54	1,889,301	0619502	4,007	2	10/01/95		78
124	0004-02-047	GRAVEL-HMAC	ODS-1R-2	05/01/98	50	51	1,889,301	0619502	4,007	2	10/01/95		74
125	0004-02-047	GRAVEL-HMAC	ODS-1R-3	05/01/98	51	47	1,889,301	0619502	4,007	2	10/01/95		81
126	0005-08-078	LIMESTONE-HMAC	ABL-2R-1	04/27/98	27	40	5,617,404	0708802	10,897	2	07/01/95		63
127	0005-08-078	LIMESTONE-HMAC	ABL-2R-2	04/27/98	27	35	5,617,404	0708802	10,897	2	07/01/95		63
128	0005-08-078	LIMESTONE-HMAC	ABL-2R-3	04/27/98	25	39	5,617,404	0708802	10,897	2	07/01/95		63
129	0006-07-061	LIMESTONE-HMAC	ABL-1R-1	04/27/98	23	34	10,333,198	0822107	20,045	2	07/01/95		74
130	0006-07-061	LIMESTONE-HMAC	ABL-1R-2	04/27/98	26	34	10,333,198	0822107	20,045	2	07/01/95		74
131	0006-07-061	LIMESTONE-HMAC	ABL-1R-3	04/27/98	28	38	10,333,198	0822107	20,045	2	07/01/95		74
132	0092-05-042	LIMESTONE-HMAC	DAL-1R-1	06/16/98	32	40	15,698,582	0914708	24,958	2	01/05/95	114	98
133	0092-05-042	LIMESTONE-HMAC	DAL-1R-1	01/14/98	38		13,789,295	0914708	24,958	2	01/05/95		
134	0092-05-042	LIMESTONE-HMAC	DAL-1R-2	06/16/98	31	38	15,698,582	0914708	24,958	2	01/05/95	114	98
135	0092-05-042	LIMESTONE-HMAC	DAL-1R-2	01/14/98	38		13,789,295	0914708	24,958	2	01/05/95		
136	0092-05-042	LIMESTONE-HMAC	DAL-1R-3	06/16/98	32	38	15,698,582	0914708	24,958	2	01/05/95	114	98
137	0092-05-042	LIMESTONE-HMAC	DAL-1R-3	01/14/98	38		13,789,295	0914708	24,958	2	01/05/95		
138	0367-04	SANDST-HMAC	HOU-2R-1	04/01/98	44	48	17,270,400	1402704	16,448	2	07/01/92		76
139	0367-04	SANDST-HMAC	HOU-2R-2	04/01/98	45	47	17,270,400	1402704	16,448	2	07/01/92		76
140	0367-04	SANDST-HMAC	HOU-2R-3	04/01/98	47	54	17,270,400	1402704	16,448	2	07/01/92		76
141	1149-01-012	LIMESTONE-SEAL	AUS-1D-1	04/22/98	33		9,772,000	1422702	5,600	2	10/01/88		
142	1149-01-012	LIMESTONE-SEAL	AUS-1D-1	02/03/98	36		9,553,600	1422702	5,600	2	10/01/88		
143	1149-01-012	LIMESTONE-SEAL	AUS-1D-1	03/26/97	37		8,674,400	1422702	5,600	2	10/01/88		
144	1149-01-012	LIMESTONE-SEAL	AUS-1D-2	04/22/98	36		9,772,000	1422702	5,600	2	10/01/88		
145	1149-01-012	LIMESTONE-SEAL	AUS-1D-2	02/03/98	36		9,553,600	1422702	5,600	2	10/01/88		
146	1149-01-012	LIMESTONE-SEAL	AUS-1D-2	03/26/97	37		8,674,400	1422702	5,600	2	10/01/88		
147	1149-01-012	LIMESTONE-SEAL	AUS-1D-3	02/03/98	35		9,553,600	1422702	5,600	2	10/01/88		
148	1149-01-012	LIMESTONE-SEAL	AUS-1D-3	04/22/98	35		9,772,000	1422702	5,600	2	10/01/88		
149	1149-01-012	LIMESTONE-SEAL	AUS-1D-3	03/26/97	36		8,674,400	1422702	5,600	2	10/01/88		
150	1149-01-012	LIMESTONE-SEAL	AUS-1D-4	02/03/98	36		9,553,600	1422702	5,600	2	10/01/88		
151	1149-01-012	LIMESTONE-SEAL	AUS-1D-4	04/22/98	36		9,772,000	1422702	5,600	2	10/01/88		
152	1149-01-012	LIMESTONE-SEAL	AUS-1D-4	03/26/97	38		8,674,400	1422702	5,600	2	10/01/88		
153	490-LFK-32I	LIMESTONE-AC10	LFK-32I-1	04/01/98	46	46	3,573,360	1424603	840	1	08/08/86		61
154	490-LFK-32I	LIMESTONE-AC10	LFK-32I-1	06/10/98	46		3,632,160	1424603	840	1	08/08/86		
155	490-LFK-32I	LIMESTONE-AC10	LFK-32I-2	04/01/98	43	57	3,573,360	1424603	840	1	08/08/86		61
156	490-LFK-32I	LIMESTONE-AC10	LFK-32I-2	06/10/98	45		3,632,160	1424603	840	1	08/08/86		
157	490-LFK-32I	LIMESTONE-AC10	LFK-32I-3	06/10/98	45		3,632,160	1424603	840	1	08/08/86		
158	490-LFK-32I	LIMESTONE-AC10	LFK-32I-3	04/01/98	46	49	3,573,360	1424603	840	1	08/08/86		61
159	490-LFK-32I	LIMESTONE-AC10	LFK-32I-4	06/10/98	45		3,632,160	1424603	840	1	08/08/86		
160	490-LFK-32I	LIMESTONE-AC10	LFK-32I-4	04/01/98	47	50	3,573,360	1424603	840	1	08/08/86		61

	CSJ	Surface Type	Location	Skid Date	SN_{40}	BPN	VPPL	Producer	ADT	Lanes	ServiceDate	PaveTemp	AirTemp
161	490-LFK-32O	LIMESTONE-LATEX	LFK-32O-1	04/01/98	35	50	5,360,040	1424603	1,260	1	08/08/86		54
162	490-LFK-32O	LIMESTONE-LATEX	LFK-32O-1	06/10/98	36		5,448,240	1424603	1,260	1	08/08/86		
163	490-LFK-32O	LIMESTONE-LATEX	LFK-32O-2	06/10/98	37		5,448,240	1424603	1,260	1	08/08/86		
164	490-LFK-32O	LIMESTONE-LATEX	LFK-32O-2	04/01/98	37	54	5,360,040	1424603	1,260	1	08/08/86		54
165	490-LFK-32O	LIMESTONE-LATEX	LFK-32O-3	06/10/98	31		5,448,240	1424603	1,260	1	08/08/86		
166	490-LFK-32O	LIMESTONE-LATEX	LFK-32O-3	04/01/98	32	44	5,360,040	1424603	1,260	1	08/08/86		54
167	490-LFK-32O	LIMESTONE-LATEX	LFK-32O-4	04/01/98	33	54	5,360,040	1424603	1,260	1	08/08/86		54
168	490-LFK-32O	LIMESTONE-LATEX	LFK-32O-4	06/10/98	33		5,448,240	1424603	1,260	1	08/08/86		
169	2230-02-005	LIMESTONE-FLINT	SAT-11B-1	05/13/97	36		8,991,450	1501503	15,080	4	11/01/90		
170	2230-02-005	LIMESTONE-FLINT	SAT-11B-2	05/13/97	36		8,991,450	1501503	15,080	4	11/01/90		
171	2230-02-005	LIMESTONE-FLINT	SAT-11B-3	05/13/97	34		8,991,450	1501503	15,080	4	11/01/90		
172	2230-02-005	LIMESTONE-FLINT	SAT-11B-4	05/13/97	37		8,991,450	1501503	15,080	4	11/01/90		
173	0025-02-140	LIMESTONE-FLINT	SAT-2A-1	02/06/97	33		38,102,400	1501503	75,600	4	08/01/91		
174	0025-02-140	LIMESTONE-FLINT	SAT-2A-2	02/06/97	34		38,102,400	1501503	75,600	4	08/01/91		
175	0025-02-140	LIMESTONE-FLINT	SAT-2A-3	02/06/97	33		38,102,400	1501503	75,600	4	08/01/91		
176	0025-02-140	LIMESTONE-FLINT	SAT-2A-4	02/06/97	33		38,102,400	1501503	75,600	4	08/01/91		
177	0024-07-036	LIMESTONE-FLINT	SAT-3A-1	05/14/97	36		37,764,000	1501503	48,000	4	10/01/88		
178	0024-07-036	LIMESTONE-FLINT	SAT-3A-2	05/14/97	37		37,764,000	1501503	48,000	4	10/01/88		
179	0024-07-036	LIMESTONE-FLINT	SAT-3A-3	05/14/97	36		37,764,000	1501503	48,000	4	10/01/88		
180	0024-07-036	LIMESTONE-FLINT	SAT-3A-4	05/14/97	37		37,764,000	1501503	48,000	4	10/01/88		
181	0521-06-058	LIMESTONE-FLINT	SAT-4A-1	05/15/97	31		36,431,267	1501503	103,400	6	08/01/91		
182	0521-06-058	LIMESTONE-FLINT	SAT-4A-2	05/15/97	32		36,431,267	1501503	103,400	6	08/01/91		
183	0521-06-058	LIMESTONE-FLINT	SAT-4A-3	05/15/97	32		36,431,267	1501503	103,400	6	08/01/91		
184	0521-06-058	LIMESTONE-FLINT	SAT-4A-4	05/15/97	32		36,431,267	1501503	103,400	6	08/01/91		
185	2452-02-023	LIMESTONE-FLINT	SAT-8B-1	02/02/97	33		20,273,000	1501503	38,000	4	04/01/91		
186	2452-02-023	LIMESTONE-FLINT	SAT-8B-2	02/02/97	34		20,273,000	1501503	38,000	4	04/01/91		
187	2452-02-023	LIMESTONE-FLINT	SAT-8B-3	02/02/97	32		20,273,000	1501503	38,000	4	04/01/91		
188	2452-02-023	LIMESTONE-FLINT	SAT-8B-4	02/02/97	32		20,273,000	1501503	38,000	4	04/01/91		
189	0593-01-071	LIMESTONE-HMAC	BMT-3R-1	04/01/98	28	40	4,532,048	1501503	9,019	2	07/01/95		72
190	0593-01-071	LIMESTONE-HMAC	BMT-3R-2	04/01/98	26	32	4,532,048	1501503	9,019	2	07/01/95		72
191	0593-01-071	LIMESTONE-HMAC	BMT-3R-3	04/01/98	27	39	4,532,048	1501503	9,019	2	07/01/95		72
192	0100-07-042	LIMESTONE-HMAC	CRP-2R-1	02/16/98	37	41	2,180,338	1501503	3,925	2	02/01/95		
193	0100-07-042	LIMESTONE-HMAC	CRP-2R-2	02/16/98	40	43	2,180,338	1501503	3,925	2	02/01/95		
194	0100-07-042	LIMESTONE-HMAC	CRP-2R-3	02/16/98	44	51	2,180,338	1501503	3,925	2	02/01/95		
195	1557-01-025	LIMESTONE-HMAC	CRPLM-13A-1	03/14/97	36	45	4,997,900	1501503	4,600	2	04/02/91	73	72
196	1557-01-025	LIMESTONE-HMAC	CRPLM-13A-2	03/14/97	41	46	4,997,900	1501503	4,600	2	04/02/91	73	72
197	1557-01-025	LIMESTONE-HMAC	CRPLM-13A-3	03/14/97	42	45	4,997,900	1501503	4,600	2	04/02/91	73	72
198	1557-01-025	LIMESTONE-HMAC	CRPLM-13A-4	03/14/97	40	47	4,997,900	1501503	4,600	2	04/02/91	75	72
199	1052-02-052	LIMESTONE-HMAC	CRPLM-9A-1	03/19/97	41	37	8,989,500	1501503	6,500	2	08/22/89	89	68
200	1052-02-052	LIMESTONE-HMAC	CRPLM-9A-2	03/19/97	38	40	8,989,500	1501503	6,500	2	08/22/89	87	68
201	1052-02-052	LIMESTONE-HMAC	CRPLM-9A-3	03/19/97	40	38	8,989,500	1501503	6,500	2	08/22/89	90	68

	CSJ	Surface Type	Location	Skid Date	SN_{40}	BPN	VPPL	Producer	ADT	Lanes	ServiceDate	PaveTemp	AirTemp
202	1052-02-052	LIMESTONE-HMAC	CRPLM-9A-4	03/19/97	40	39	8,989,500	1501503	6,500	2	08/22/89	91	68
203	12SH-00-361	LIMESTONE-HMAC	HOU-4R-1	04/01/98	33	41	4,411,641	1501503	8,277	2	05/01/95		74
204	12SH-00-361	LIMESTONE-HMAC	HOU-4R-2	04/01/98	34	41	4,411,641	1501503	8,277	2	05/01/95		74
205	12SH-00-361	LIMESTONE-HMAC	HOU-4R-3	04/01/98	35	44	4,411,641	1501503	8,277	2	05/01/95		74
206	0328-04-035	LIMESTONE-HMAC	SAT-10A-1	05/28/98	27		17,381,070	1501503	19,740	2	08/01/93		
207	0328-04-035	LIMESTONE-HMAC	SAT-10A-1	11/25/97	33		15,564,990	1501503	19,740	2	08/01/93		
208	0328-04-035	LIMESTONE-HMAC	SAT-10A-1	03/30/98	33		16,798,740	1501503	19,740	2	08/01/93		
209	0328-04-035	LIMESTONE-HMAC	SAT-10A-1	09/02/97	36		14,735,910	1501503	19,740	2	08/01/93		
210	0328-04-035	LIMESTONE-HMAC	SAT-10A-1	02/13/97	38	40	12,752,040	1501503	19,740	2	08/01/93	48	47
211	0328-04-035	LIMESTONE-HMAC	SAT-10A-2	05/28/98	30		17,381,070	1501503	19,740	2	08/01/93		
212	0328-04-035	LIMESTONE-HMAC	SAT-10A-2	11/25/97	32		15,564,990	1501503	19,740	2	08/01/93		
213	0328-04-035	LIMESTONE-HMAC	SAT-10A-2	09/02/97	35		14,735,910	1501503	19,740	2	08/01/93		
214	0328-04-035	LIMESTONE-HMAC	SAT-10A-2	03/30/98	37		16,798,740	1501503	19,740	2	08/01/93		
215	0328-04-035	LIMESTONE-HMAC	SAT-10A-2	02/13/97	39	41	12,752,040	1501503	19,740	2	08/01/93	49	47
216	0328-04-035	LIMESTONE-HMAC	SAT-10A-3	05/28/98	28		17,381,070	1501503	19,740	2	08/01/93		
217	0328-04-035	LIMESTONE-HMAC	SAT-10A-3	11/25/97	31		15,564,990	1501503	19,740	2	08/01/93		
218	0328-04-035	LIMESTONE-HMAC	SAT-10A-3	09/02/97	33		14,735,910	1501503	19,740	2	08/01/93		
219	0328-04-035	LIMESTONE-HMAC	SAT-10A-3	03/30/98	33		16,798,740	1501503	19,740	2	08/01/93		
220	0328-04-035	LIMESTONE-HMAC	SAT-10A-3	02/13/97	39	42	12,752,040	1501503	19,740	2	08/01/93	50	47
221	0328-04-035	LIMESTONE-HMAC	SAT-10A-4	05/28/98	30		17,381,070	1501503	19,740	2	08/01/93		
222	0328-04-035	LIMESTONE-HMAC	SAT-10A-4	11/25/97	32		15,564,990	1501503	19,740	2	08/01/93		
223	0328-04-035	LIMESTONE-HMAC	SAT-10A-4	09/02/97	33		14,735,910	1501503	19,740	2	08/01/93		
224	0328-04-035	LIMESTONE-HMAC	SAT-10A-4	03/30/98	36		16,798,740	1501503	19,740	2	08/01/93		
225	0328-04-035	LIMESTONE-HMAC	SAT-10A-4	02/13/97	40	43	12,752,040	1501503	19,740	2	08/01/93	50	47
226	0024-06-052	LIMESTONE-HMAC	SAT-12A-1	11/25/97	32		9,353,300	1501503	24,200	4	09/01/93		
227	0024-06-052	LIMESTONE-HMAC	SAT-12A-1	05/27/98	36		10,460,450	1501503	24,200	4	09/01/93		
228	0024-06-052	LIMESTONE-HMAC	SAT-12A-1	05/14/97	37		8,173,550	1501503	24,200	4	09/01/93		
229	0024-06-052	LIMESTONE-HMAC	SAT-12A-1	03/30/98	37		10,109,550	1501503	24,200	4	09/01/93		
230	0024-06-052	LIMESTONE-HMAC	SAT-12A-2	11/25/97	34		9,353,300	1501503	24,200	4	09/01/93		
231	0024-06-052	LIMESTONE-HMAC	SAT-12A-2	05/27/98	38		10,460,450	1501503	24,200	4	09/01/93		
232	0024-06-052	LIMESTONE-HMAC	SAT-12A-2	05/14/97	38		8,173,550	1501503	24,200	4	09/01/93		
233	0024-06-052	LIMESTONE-HMAC	SAT-12A-2	03/30/98	39		10,109,550	1501503	24,200	4	09/01/93		
234	0024-06-052	LIMESTONE-HMAC	SAT-12A-3	11/25/97	36		9,353,300	1501503	24,200	4	09/01/93		
235	0024-06-052	LIMESTONE-HMAC	SAT-12A-3	05/27/98	37		10,460,450	1501503	24,200	4	09/01/93		
236	0024-06-052	LIMESTONE-HMAC	SAT-12A-3	05/14/97	37		8,173,550	1501503	24,200	4	09/01/93		
237	0024-06-052	LIMESTONE-HMAC	SAT-12A-3	03/30/98	37		10,109,550	1501503	24,200	4	09/01/93		
238	0024-06-052	LIMESTONE-HMAC	SAT-12A-4	05/14/97	37		8,173,550	1501503	24,200	4	09/01/93		
239	0024-06-052	LIMESTONE-HMAC	SAT-12A-4	05/27/98	39		10,460,450	1501503	24,200	4	09/01/93		
240	0024-06-052	LIMESTONE-HMAC	SAT-12A-4	03/30/98	39		10,109,550	1501503	24,200	4	09/01/93		
241	0072-08-079	LIMESTONE-HMAC	SAT-6B-1	11/25/97	27		27,285,100	1501503	56,200	4	08/01/92		
242	0072-08-079	LIMESTONE-HMAC	SAT-6B-1	05/13/97	31		24,531,300	1501503	56,200	4	08/01/92		

	CSJ	Surface Type	Location	Skid Date	SN_{40}	BPN	VPPL	Producer	ADT	Lanes	ServiceDate	PaveTemp	AirTemp
243	0072-08-079	LIMESTONE-HMAC	SAT-6B-2	11/25/97	26		27,285,100	1501503	56,200	4	08/01/92		
244	0072-08-079	LIMESTONE-HMAC	SAT-6B-2	05/13/97	31		24,531,300	1501503	56,200	4	08/01/92		
245	0072-08-079	LIMESTONE-HMAC	SAT-6B-3	11/25/97	26		27,285,100	1501503	56,200	4	08/01/92		
246	0072-08-079	LIMESTONE-HMAC	SAT-6B-3	05/13/97	30		24,531,300	1501503	56,200	4	08/01/92		
247	0072-08-079	LIMESTONE-HMAC	SAT-6B-4	11/25/97	27		27,285,100	1501503	56,200	4	08/01/92		
248	0072-08-079	LIMESTONE-HMAC	SAT-6B-4	05/13/97	30		24,531,300	1501503	56,200	4	08/01/92		
249	2452-03-048	LIMESTONE-HMAC	SAT-7A-1	05/13/97	33		22,340,000	1501503	40,000	4	04/01/91		
250	2452-03-048	LIMESTONE-HMAC	SAT-7A-2	05/13/97	33		22,340,000	1501503	40,000	4	04/01/91		
251	2452-03-048	LIMESTONE-HMAC	SAT-7A-3	05/13/97	32		22,340,000	1501503	40,000	4	04/01/91		
252	2452-03-048	LIMESTONE-HMAC	SAT-7A-4	05/13/97	31		22,340,000	1501503	40,000	4	04/01/91		
253	0073-08-109	LIMESTONE-HMAC	SAT-9A-1	05/14/97	32		16,712,967	1501503	57,400	6	08/01/92		
254	0073-08-109	LIMESTONE-HMAC	SAT-9A-2	05/14/97	32		16,712,967	1501503	57,400	6	08/01/92		
255	0073-08-109	LIMESTONE-HMAC	SAT-9A-3	05/14/97	32		16,712,967	1501503	57,400	6	08/01/92		
256	0073-08-109	LIMESTONE-HMAC	SAT-9A-4	05/14/97	32		16,712,967	1501503	57,400	6	08/01/92		
257	2452-03-070	LIMESTONE-HMAC	SAT-9B-1	11/25/97	31		17,735,400	1501503	33,400	4	02/01/92		
258	2452-03-070	LIMESTONE-HMAC	SAT-9B-1	07/24/97	33		16,700,000	1501503	33,400	4	02/01/92		
259	2452-03-070	LIMESTONE-HMAC	SAT-9B-1	03/30/98	34		18,779,150	1501503	33,400	4	02/01/92		
260	2452-03-070	LIMESTONE-HMAC	SAT-9B-1	05/27/98	38	41	19,263,450	1501503	33,400	4	02/01/92	102	83
261	2452-03-070	LIMESTONE-HMAC	SAT-9B-2	11/25/97	31		17,735,400	1501503	33,400	4	02/01/92		
262	2452-03-070	LIMESTONE-HMAC	SAT-9B-2	07/24/97	32		16,700,000	1501503	33,400	4	02/01/92		
263	2452-03-070	LIMESTONE-HMAC	SAT-9B-2	03/30/98	33		18,779,150	1501503	33,400	4	02/01/92		
264	2452-03-070	LIMESTONE-HMAC	SAT-9B-2	05/27/98	35	34	19,263,450	1501503	33,400	4	02/01/92	95	83
265	2452-03-070	LIMESTONE-HMAC	SAT-9B-3	07/24/97	30		16,700,000	1501503	33,400	4	02/01/92		
266	2452-03-070	LIMESTONE-HMAC	SAT-9B-3	11/25/97	31		17,735,400	1501503	33,400	4	02/01/92		
267	2452-03-070	LIMESTONE-HMAC	SAT-9B-3	05/27/98	32	38	19,263,450	1501503	33,400	4	02/01/92	98	83
268	2452-03-070	LIMESTONE-HMAC	SAT-9B-3	03/30/98	32		18,779,150	1501503	33,400	4	02/01/92		
269	2452-03-070	LIMESTONE-HMAC	SAT-9B-4	03/30/98	31		18,779,150	1501503	33,400	4	02/01/92		
270	2452-03-070	LIMESTONE-HMAC	SAT-9B-4	05/27/98	32	32	19,263,450	1501503	33,400	4	02/01/92	96	83
271	0605-01-049	LIMESTONE-HMAC	YKM-10F-1	06/25/97	38	44	613,800	1501503	2,200	2	12/15/95	99	91
272	0605-01-049	LIMESTONE-HMAC	YKM-10F-2	06/25/97	38	45	613,800	1501503	2,200	2	12/15/95	101	91
273	0605-01-049	LIMESTONE-HMAC	YKM-10F-3	06/25/97	39	46	613,800	1501503	2,200	2	12/15/95	108	91
274	0605-01-049	LIMESTONE-HMAC	YKM-10F-4	06/25/97	39	44	613,800	1501503	2,200	2	12/15/95	110	91
275	0709-02-035	LIMESTONE-HMAC	YKM-3A-1	04/16/98	38		6,863,400	1501503	8,200	2	09/15/93		
276	0709-02-035	LIMESTONE-HMAC	YKM-3A-1	06/24/97	39	47	5,649,800	1501503	8,200	2	09/15/93	108	84
277	0709-02-035	LIMESTONE-HMAC	YKM-3A-2	06/24/97	43	48	5,649,800	1501503	8,200	2	09/15/93	110	84
278	0709-02-035	LIMESTONE-HMAC	YKM-3A-2	04/16/98	43		6,863,400	1501503	8,200	2	09/15/93		
279	0709-02-035	LIMESTONE-HMAC	YKM-3A-3	04/16/98	38		6,863,400	1501503	8,200	2	09/15/93		
280	0709-02-035	LIMESTONE-HMAC	YKM-3A-3	06/24/97	43	49	5,649,800	1501503	8,200	2	09/15/93	111	84
281	0709-02-035	LIMESTONE-HMAC	YKM-3A-4	04/16/98	37		6,863,400	1501503	8,200	2	09/15/93		
282	0709-02-035	LIMESTONE-HMAC	YKM-3A-4	06/24/97	41	48	5,649,800	1501503	8,200	2	09/15/93	107	84
283	0265-08-055	LIMESTONE-HMAC	YKM-5E-1	04/16/98	31		4,209,800	1501503	9,700	4	07/15/93		

	CSJ	Surface Type	Location	Skid Date	SN_{40}	BPN	VPPL	Producer	ADT	Lanes	ServiceDate	PaveTemp	AirTemp
284	0265-08-055	LIMESTONE-HMAC	YKM-5E-1	06/16/97	32	30	3,472,600	1501503	9,700	4	07/15/93	95	95
285	0265-08-055	LIMESTONE-HMAC	YKM-5E-2	04/16/98	32		4,209,800	1501503	9,700	4	07/15/93		
286	0265-08-055	LIMESTONE-HMAC	YKM-5E-2	06/16/97	34	32	3,472,600	1501503	9,700	4	07/15/93	93	95
287	0265-08-055	LIMESTONE-HMAC	YKM-5E-3	04/16/98	32		4,209,800	1501503	9,700	4	07/15/93		
288	0265-08-055	LIMESTONE-HMAC	YKM-5E-3	06/16/97	34	35	3,472,600	1501503	9,700	4	07/15/93	94	95
289	0265-08-055	LIMESTONE-HMAC	YKM-5E-4	04/16/98	32		4,209,800	1501503	9,700	4	07/15/93		
290	0265-08-055	LIMESTONE-HMAC	YKM-5E-4	06/16/97	34	34	3,472,600	1501503	9,700	4	07/15/93	99	95
291	0089-08-080	LIMESTONE-HMAC	YKM-7D-1	06/24/97	32	39	2,562,200	1501503	18,400	4	12/15/95	115	89
292	0089-08-080	LIMESTONE-HMAC	YKM-7D-2	06/24/97	32	40	2,562,200	1501503	18,400	4	12/15/95	105	89
293	0089-08-080	LIMESTONE-HMAC	YKM-7D-3	06/24/97	33	37	2,562,200	1501503	18,400	4	12/15/95	112	89
294	0089-08-080	LIMESTONE-HMAC	YKM-7D-4	06/24/97	33	37	2,562,200	1501503	18,400	4	12/15/95	115	89
295	0089-15-008	LIMESTONE-HMAC	YKM-7I-1	04/16/98	33		2,985,500	1501503	7,000	2	12/15/95		
296	0089-15-008	LIMESTONE-HMAC	YKM-7I-1	06/24/97	37	43	1,949,500	1501503	7,000	2	12/15/95	101	89
297	0089-15-008	LIMESTONE-HMAC	YKM-7I-2	04/16/98	31		2,985,500	1501503	7,000	2	12/15/95		
298	0089-15-008	LIMESTONE-HMAC	YKM-7I-2	06/24/97	36	45	1,949,500	1501503	7,000	2	12/15/95	101	89
299	0089-15-008	LIMESTONE-HMAC	YKM-7I-3	04/16/98	32		2,985,500	1501503	7,000	2	12/15/95		
300	0089-15-008	LIMESTONE-HMAC	YKM-7I-3	06/24/97	39	43	1,949,500	1501503	7,000	2	12/15/95	98	89
301	0089-15-008	LIMESTONE-HMAC	YKM-7I-4	04/16/98	35		2,985,500	1501503	7,000	2	12/15/95		
302	0089-15-008	LIMESTONE-HMAC	YKM-7I-4	06/24/97	38	49	1,949,500	1501503	7,000	2	12/15/95	101	89
303	0089-10-011	LIMESTONE-HMAC	YKM-9C-1	06/24/97	36	42	1,253,250	1501503	4,500	2	12/15/95	121	93
304	0089-10-011	LIMESTONE-HMAC	YKM-9C-2	06/24/97	36	40	1,253,250	1501503	4,500	2	12/15/95	120	93
305	0089-10-011	LIMESTONE-HMAC	YKM-9C-3	06/24/97	36	41	1,253,250	1501503	4,500	2	12/15/95	121	93
306	0089-10-011	LIMESTONE-HMAC	YKM-9C-4	06/24/97	44	45	1,253,250	1501503	4,500	2	12/15/95	124	93
307	0432-02-065	LIMESTONE-HMAC	YKM-9F-1	06/25/97	37	45	1,088,100	1501503	7,800	4	12/15/95	120	90
308	0432-02-065	LIMESTONE-HMAC	YKM-9F-2	06/25/97	39	44	1,088,100	1501503	7,800	4	12/15/95	122	90
309	0432-02-065	LIMESTONE-HMAC	YKM-9F-3	06/25/97	41	43	1,088,100	1501503	7,800	4	12/15/95	125	90
310	0432-02-065	LIMESTONE-HMAC	YKM-9F-4	06/25/97	40	45	1,088,100	1501503	7,800	4	12/15/95	123	90
311	1135-01-013	LIMESTONE-SEAL	AUS-7D-1	02/05/97	38	40	324,810	1501503	1,620	2	01/01/96	53	
312	1135-01-013	LIMESTONE-SEAL	AUS-7D-2	02/05/97	37	36	324,810	1501503	1,620	2	01/01/96	54	
313	1135-01-013	LIMESTONE-SEAL	AUS-7D-3	02/05/97	37	41	324,810	1501503	1,620	2	01/01/96	52	
314	1135-01-013	LIMESTONE-SEAL	AUS-7D-4	02/05/97	38	37	324,810	1501503	1,620	2	01/01/96	50	
315	0421-04-026	LIMESTONE-SEAL	SAT-14A-1	05/28/98	42		1,989,500	1501503	2,300	2	09/01/93		
316	0421-04-026	LIMESTONE-SEAL	SAT-14A-1	03/30/98	44		1,921,650	1501503	2,300	2	09/01/93		
317	0421-04-026	LIMESTONE-SEAL	SAT-14A-1	02/14/97	50	58	1,451,300	1501503	2,300	2	09/01/93	51	50
318	0421-04-026	LIMESTONE-SEAL	SAT-14A-2	05/28/98	38		1,989,500	1501503	2,300	2	09/01/93		
319	0421-04-026	LIMESTONE-SEAL	SAT-14A-2	03/30/98	42		1,921,650	1501503	2,300	2	09/01/93		
320	0421-04-026	LIMESTONE-SEAL	SAT-14A-2	02/14/97	62	58	1,451,300	1501503	2,300	2	09/01/93	53	50
321	0421-04-026	LIMESTONE-SEAL	SAT-14A-3	05/28/98	39		1,989,500	1501503	2,300	2	09/01/93		
322	0421-04-026	LIMESTONE-SEAL	SAT-14A-3	03/30/98	43		1,921,650	1501503	2,300	2	09/01/93		
323	0421-04-026	LIMESTONE-SEAL	SAT-14A-3	02/14/97	58	54	1,451,300	1501503	2,300	2	09/01/93	56	50
324	0421-04-026	LIMESTONE-SEAL	SAT-14A-4	05/28/98	41		1,989,500	1501503	2,300	2	09/01/93		

	CSJ	Surface Type	Location	Skid Date	SN_{40}	BPN	VPPL	Producer	ADT	Lanes	ServiceDate	PaveTemp	AirTemp
325	0421-04-026	LIMESTONE-SEAL	SAT-14A-4	03/30/98	42		1,921,650	1501503	2,300	2	09/01/93		
326	0421-04-026	LIMESTONE-SEAL	SAT-14A-4	02/14/97	58	53	1,451,300	1501503	2,300	2	09/01/93	53	50
327	0535-08-064	MicroSurface	YKM-8D-1	07/09/97	60	53	2,154,000	1501503	24,000	4	07/15/96	99	89
328	0535-08-064	MicroSurface	YKM-8D-2	07/09/97	62	52	2,154,000	1501503	24,000	4	07/15/96	102	89
329	0535-08-064	MicroSurface	YKM-8D-3	07/09/97	60	53	2,154,000	1501503	24,000	4	07/15/96	115	89
330	0535-08-064	MicroSurface	YKM-8D-4	07/09/97	58	52	2,154,000	1501503	24,000	4	07/15/96		89
331	0577-01-022	LIMESTONE-SEAL	AUS-7B-1	02/05/97	38	46	243,535	1501506	530	2	08/01/94	46	44
332	0577-01-022	LIMESTONE-SEAL	AUS-7B-2	02/05/97	39	50	243,535	1501506	530	2	08/01/94	47	44
333	0577-01-022	LIMESTONE-SEAL	AUS-7B-3	02/05/97	35	47	243,535	1501506	530	2	08/01/94	48	44
334	0577-01-022	LIMESTONE-SEAL	AUS-7B-4	02/05/97	38	48	243,535	1501506	530	2	08/01/94	51	44
335	1549-04-017	LIMESTONE-HMAC	CRPLM-10A-1	02/19/98	35		8,029,280	1504603	13,400	5	12/07/89		
336	1549-04-017	LIMESTONE-HMAC	CRPLM-10A-1	08/21/97	40		7,541,520	1504603	13,400	5	12/07/89		
337	1549-04-017	LIMESTONE-HMAC	CRPLM-10A-1	04/09/97	46	42	7,182,400	1504603	13,400	5	12/07/89	83	
338	1549-04-017	LIMESTONE-HMAC	CRPLM-10A-2	02/19/98	37		8,029,280	1504603	13,400	5	12/07/89		
339	1549-04-017	LIMESTONE-HMAC	CRPLM-10A-2	08/21/97	41		7,541,520	1504603	13,400	5	12/07/89		
340	1549-04-017	LIMESTONE-HMAC	CRPLM-10A-2	04/09/97	44	45	7,182,400	1504603	13,400	5	12/07/89	84	
341	1549-04-017	LIMESTONE-HMAC	CRPLM-10A-3	02/19/98	32		8,029,280	1504603	13,400	5	12/07/89		
342	1549-04-017	LIMESTONE-HMAC	CRPLM-10A-3	08/21/97	41		7,541,520	1504603	13,400	5	12/07/89		
343	1549-04-017	LIMESTONE-HMAC	CRPLM-10A-3	04/09/97	46	50	7,182,400	1504603	13,400	5	12/07/89	90	
344	1549-04-017	LIMESTONE-HMAC	CRPLM-10A-4	02/19/98	35		8,029,280	1504603	13,400	5	12/07/89		
345	1549-04-017	LIMESTONE-HMAC	CRPLM-10A-4	08/21/97	41		7,541,520	1504603	13,400	5	12/07/89		
346	1549-04-017	LIMESTONE-HMAC	CRPLM-10A-4	04/09/97	43	42	7,182,400	1504603	13,400	5	12/07/89	88	
347	0326-01-032	LIMESTONE-HMAC	CRPLM-12C-1	09/03/97	41		5,529,150	1504603	3,300	2	07/01/88		
348	0326-01-032	LIMESTONE-HMAC	CRPLM-12C-1	02/19/98	43		5,808,000	1504603	3,300	2	07/01/88		
349	0326-01-032	LIMESTONE-HMAC	CRPLM-12C-2	09/03/97	43		5,529,150	1504603	3,300	2	07/01/88		
350	0326-01-032	LIMESTONE-HMAC	CRPLM-12C-2	02/19/98	45		5,808,000	1504603	3,300	2	07/01/88		
351	0326-01-032	LIMESTONE-HMAC	CRPLM-12C-3	09/03/97	42		5,529,150	1504603	3,300	2	07/01/88		
352	0326-01-032	LIMESTONE-HMAC	CRPLM-12C-3	02/19/98	44		5,808,000	1504603	3,300	2	07/01/88		
353	0326-01-032	LIMESTONE-HMAC	CRPLM-12C-4	09/03/97	42		5,529,150	1504603	3,300	2	07/01/88		
354	0326-01-032	LIMESTONE-HMAC	CRPLM-12C-4	02/19/98	44		5,808,000	1504603	3,300	2	07/01/88		
355	0025-09-061	LIMESTONE-HMAC	SAT-2B-1	05/15/97	36		38,453,800	1504603	24,200	2	09/01/88		
356	0025-09-061	LIMESTONE-HMAC	SAT-2B-2	05/15/97	34		38,453,800	1504603	24,200	2	09/01/88		
357	0025-09-061	LIMESTONE-HMAC	SAT-2B-3	05/15/97	35		38,453,800	1504603	24,200	2	09/01/88		
358	0025-09-061	LIMESTONE-HMAC	SAT-2B-4	05/15/97	36		38,453,800	1504603	24,200	2	09/01/88		
359	0206-07-048	LIMESTONE-HMAC	TYL-4R-1	06/09/98	37		2,620,560	1504603	4,880	2	07/01/95		
360	0206-07-048	LIMESTONE-HMAC	TYL-4R-2	06/09/98	36		2,620,560	1504603	4,880	2	07/01/95		
361	0206-07-048	LIMESTONE-HMAC	TYL-4R-3	06/09/98	36		2,620,560	1504603	4,880	2	07/01/95		
362	3205-02-012	LIMESTONE-HMAC	YKM-10C-1	07/09/97	36	44	715,000	1504603	2,500	2	12/15/95	126	94
363	3205-02-012	LIMESTONE-HMAC	YKM-10C-2	07/09/97	38	40	715,000	1504603	2,500	2	12/15/95	125	94
364	3205-02-012	LIMESTONE-HMAC	YKM-10C-3	07/09/97	37	40	715,000	1504603	2,500	2	12/15/95	125	94
365	3205-02-012	LIMESTONE-HMAC	YKM-10C-4	07/09/97	37	39	715,000	1504603	2,500	2	12/15/95	126	94

	CSJ	Surface Type	Location	Skid Date	SN_{40}	BPN	VPPL	Producer	ADT	Lanes	ServiceDate	PaveTemp	AirTemp
366	1090-05-011	LIMESTONE-HMAC	YKM-10L-1	06/25/97	40	45	334,800	1504603	1,350	2	02/15/96	130	
367	1090-05-011	LIMESTONE-HMAC	YKM-10L-2	06/25/97	35	46	334,800	1504603	1,350	2	02/15/96	129	
368	1090-05-011	LIMESTONE-HMAC	YKM-10L-3	06/25/97	40	42	334,800	1504603	1,350	2	02/15/96	120	
369	1090-05-011	LIMESTONE-HMAC	YKM-10L-4	06/25/97	40	45	334,800	1504603	1,350	2	02/15/96	128	
370	0409-01-023	MicroSurface	YKM-9I-1	07/10/97	64	54	974,100	1504603	3,400	2	12/15/95	100	84
371	0409-01-023	MicroSurface	YKM-9I-2	07/10/97	61	57	974,100	1504603	3,400	2	12/15/95	112	84
372	0409-01-023	MicroSurface	YKM-9I-3	07/10/97	63	52	974,100	1504603	3,400	2	12/15/95	115	84
373	0409-01-023	MicroSurface	YKM-9I-4	07/10/97	62	55	974,100	1504603	3,400	2	12/15/95	119	84
374	3136-01-081	LIMESTONE-CMHB	AUS-1C-1	04/23/98	34		8,155,350	1504605	18,900	4	08/01/93		
375	3136-01-081	LIMESTONE-CMHB	AUS-1C-1	07/23/97	35		6,860,700	1504605	18,900	4	08/01/93		
376	3136-01-081	LIMESTONE-CMHB	AUS-1C-1	09/09/97	38		7,087,500	1504605	18,900	4	08/01/93		
377	3136-01-081	LIMESTONE-CMHB	AUS-1C-1	11/18/97	41		7,418,250	1504605	18,900	4	08/01/93		
378	3136-01-081	LIMESTONE-CMHB	AUS-1C-2	04/23/98	34		8,155,350	1504605	18,900	4	08/01/93		
379	3136-01-081	LIMESTONE-CMHB	AUS-1C-2	07/23/97	38		6,860,700	1504605	18,900	4	08/01/93		
380	3136-01-081	LIMESTONE-CMHB	AUS-1C-2	09/09/97	39		7,087,500	1504605	18,900	4	08/01/93		
381	3136-01-081	LIMESTONE-CMHB	AUS-1C-2	11/18/97	40		7,418,250	1504605	18,900	4	08/01/93		
382	3136-01-081	LIMESTONE-CMHB	AUS-1C-3	04/23/98	33		8,155,350	1504605	18,900	4	08/01/93		
383	3136-01-081	LIMESTONE-CMHB	AUS-1C-3	07/23/97	37		6,860,700	1504605	18,900	4	08/01/93		
384	3136-01-081	LIMESTONE-CMHB	AUS-1C-3	09/09/97	38		7,087,500	1504605	18,900	4	08/01/93		
385	3136-01-081	LIMESTONE-CMHB	AUS-1C-3	11/18/97	40		7,418,250	1504605	18,900	4	08/01/93		
386	3136-01-081	LIMESTONE-CMHB	AUS-1C-4	04/23/98	34		8,155,350	1504605	18,900	4	08/01/93		
387	0266-01-062	LIMESTONE-CMHB	YKM-4A-1	04/16/98	43		4,477,275	1504605	6,700	4	12/21/90		
388	0266-01-062	LIMESTONE-CMHB	YKM-4A-1	07/10/97	47	36	4,008,275	1504605	6,700	4	12/21/90	131	92
389	0266-01-062	LIMESTONE-CMHB	YKM-4A-2	04/16/98	44		4,477,275	1504605	6,700	4	12/21/90		
390	0266-01-062	LIMESTONE-CMHB	YKM-4A-2	07/10/97	47	47	4,008,275	1504605	6,700	4	12/21/90	126	92
391	0266-01-062	LIMESTONE-CMHB	YKM-4A-3	04/16/98	44		4,477,275	1504605	6,700	4	12/21/90		
392	0266-01-062	LIMESTONE-CMHB	YKM-4A-3	07/10/97	48	44	4,008,275	1504605	6,700	4	12/21/90	132	92
393	0266-01-062	LIMESTONE-CMHB	YKM-4A-4	04/16/98	45		4,477,275	1504605	6,700	4	12/21/90		
394	0266-01-062	LIMESTONE-CMHB	YKM-4A-4	07/10/97	47	45	4,008,275	1504605	6,700	4	12/21/90	132	92
395	3136-01-102A	LIMESTONE-HMAC	AUS-1A-1	02/03/98	32		6,984,000	1504605	72,000	6	07/01/96		
396	3136-01-102A	LIMESTONE-HMAC	AUS-1A-1	07/23/97	33		4,644,000	1504605	72,000	6	07/01/96		
397	3136-01-102A	LIMESTONE-HMAC	AUS-1A-1	11/18/97	34		6,060,000	1504605	72,000	6	07/01/96		
398	3136-01-102A	LIMESTONE-HMAC	AUS-1A-2	07/23/97	32		4,644,000	1504605	72,000	6	07/01/96		
399	3136-01-102A	LIMESTONE-HMAC	AUS-1A-2	02/03/98	34		6,984,000	1504605	72,000	6	07/01/96		
400	3136-01-102A	LIMESTONE-HMAC	AUS-1A-2	11/18/97	36		6,060,000	1504605	72,000	6	07/01/96		
401	3136-01-102A	LIMESTONE-HMAC	AUS-1A-3	07/23/97	32		4,644,000	1504605	72,000	6	07/01/96		
402	3136-01-102A	LIMESTONE-HMAC	AUS-1A-3	02/03/98	35		6,984,000	1504605	72,000	6	07/01/96		
403	3136-01-102A	LIMESTONE-HMAC	AUS-1A-3	11/18/97	36		6,060,000	1504605	72,000	6	07/01/96		
404	0286-02-004	LIMESTONE-HMAC	AUS-4A-1	03/27/97	47		2,261,600	1504605	1,600	2	06/30/89		
405	0286-02-004	LIMESTONE-HMAC	AUS-4A-2	03/27/97	49		2,261,600	1504605	1,600	2	06/30/89		
406	0286-02-004	LIMESTONE-HMAC	AUS-4A-3	03/27/97	48		2,261,600	1504605	1,600	2	06/30/89		

	CSJ	Surface Type	Location	Skid Date	SN_{40}	BPN	VPPL	Producer	ADT	Lanes	ServiceDate	PaveTemp	AirTemp
407	0286-02-004	LIMESTONE-HMAC	AUS-4A-4	03/27/97	48		2,261,600	1504605	1,600	2	06/30/89		
408	3210-01-006	LIMESTONE-HMAC	AUS-6B-1	03/26/97	37		625,100	1504605	3,800	2	05/01/96		
409	3210-01-006	LIMESTONE-HMAC	AUS-6B-2	03/26/97	34		625,100	1504605	3,800	2	05/01/96		
410	3210-01-006	LIMESTONE-HMAC	AUS-6B-3	03/26/97	35		625,100	1504605	3,800	2	05/01/96		
411	3210-01-006	LIMESTONE-HMAC	AUS-6B-4	03/26/97	37		625,100	1504605	3,800	2	05/01/96		
412	0113-09-047	LIMESTONE-HMAC	AUS-6C-1	07/23/97	31		2,145,000	1504605	55,000	6	12/01/96		
413	0113-09-047	LIMESTONE-HMAC	AUS-6C-2	07/23/97	27		2,145,000	1504605	55,000	6	12/01/96		
414	0113-09-047	LIMESTONE-HMAC	AUS-6C-3	07/23/97	29		2,145,000	1504605	55,000	6	12/01/96		
415	0113-09-047	LIMESTONE-HMAC	AUS-6C-4	07/23/97	32		2,145,000	1504605	55,000	6	12/01/96		
416	0265-01-076	LIMESTONE-HMAC	AUS2-3A-1	07/23/97	33		25,756,171	1504605	36,111	4	09/30/89		
417	0265-01-076	LIMESTONE-HMAC	AUS2-3A-1	02/03/98	38		27,516,582	1504605	36,111	4	09/30/89		
418	0265-01-076	LIMESTONE-HMAC	AUS2-3A-1	09/10/97	39		26,198,531	1504605	36,111	4	09/30/89		
419	0265-01-076	LIMESTONE-HMAC	AUS2-3A-1	11/18/97	44		26,821,445	1504605	36,111	4	09/30/89		
420	0265-01-076	LIMESTONE-HMAC	AUS2-3A-2	07/23/97	30		25,756,171	1504605	36,111	4	09/30/89		
421	0265-01-076	LIMESTONE-HMAC	AUS2-3A-2	02/03/98	36		27,516,582	1504605	36,111	4	09/30/89		
422	0265-01-076	LIMESTONE-HMAC	AUS2-3A-2	09/10/97	37		26,198,531	1504605	36,111	4	09/30/89		
423	0265-01-076	LIMESTONE-HMAC	AUS2-3A-2	11/18/97	41		26,821,445	1504605	36,111	4	09/30/89		
424	0265-01-076	LIMESTONE-HMAC	AUS2-3A-3	07/23/97	31		25,756,171	1504605	36,111	4	09/30/89		
425	0265-01-076	LIMESTONE-HMAC	AUS2-3A-3	09/10/97	34		26,198,531	1504605	36,111	4	09/30/89		
426	0265-01-076	LIMESTONE-HMAC	AUS2-3A-3	02/03/98	34		27,516,582	1504605	36,111	4	09/30/89		
427	0265-01-076	LIMESTONE-HMAC	AUS2-3A-3	11/18/97	39		26,821,445	1504605	36,111	4	09/30/89		
428	0074-06-156	LIMESTONE-HMAC	CRPLM-13C-1	03/17/97	44		4,683,000	1504605	42,000	6	05/18/95		
429	0074-06-156	LIMESTONE-HMAC	CRPLM-13C-2	03/17/97	45		4,683,000	1504605	42,000	6	05/18/95		
430	0074-06-156	LIMESTONE-HMAC	CRPLM-13C-3	03/17/97	45		4,683,000	1504605	42,000	6	05/18/95		
431	0074-06-156	LIMESTONE-HMAC	CRPLM-13C-4	03/17/97	46		4,683,000	1504605	42,000	6	05/18/95		
432	0215-02-341	LIMESTONE-HMAC	SAT-10B-1	03/30/98	35		15,324,560	1504605	8,920	2	11/01/88		
433	0215-02-341	LIMESTONE-HMAC	SAT-10B-1	05/13/97	36		13,892,900	1504605	8,920	2	11/01/88		
434	0215-02-341	LIMESTONE-HMAC	SAT-10B-1	11/25/97	39		14,767,060	1504605	8,920	2	11/01/88		
435	0215-02-341	LIMESTONE-HMAC	SAT-10B-1	07/24/97	40		14,214,020	1504605	8,920	2	11/01/88		
436	0215-02-341	LIMESTONE-HMAC	SAT-10B-2	03/30/98	36		15,324,560	1504605	8,920	2	11/01/88		
437	0215-02-341	LIMESTONE-HMAC	SAT-10B-2	05/13/97	37		13,892,900	1504605	8,920	2	11/01/88		
438	0215-02-341	LIMESTONE-HMAC	SAT-10B-2	11/25/97	38		14,767,060	1504605	8,920	2	11/01/88		
439	0215-02-341	LIMESTONE-HMAC	SAT-10B-2	07/24/97	40		14,214,020	1504605	8,920	2	11/01/88		
440	0215-02-341	LIMESTONE-HMAC	SAT-10B-3	03/30/98	34		15,324,560	1504605	8,920	2	11/01/88		
441	0215-02-341	LIMESTONE-HMAC	SAT-10B-3	05/13/97	35		13,892,900	1504605	8,920	2	11/01/88		
442	0215-02-341	LIMESTONE-HMAC	SAT-10B-3	11/25/97	35		14,767,060	1504605	8,920	2	11/01/88		
443	0215-02-341	LIMESTONE-HMAC	SAT-10B-3	07/24/97	41		14,214,020	1504605	8,920	2	11/01/88		
444	0215-02-341	LIMESTONE-HMAC	SAT-10B-4	05/13/97	37		13,892,900	1504605	8,920	2	11/01/88		
445	0072-14-012	LIMESTONE-HMAC	SAT-1H-1	07/10/98	32		1,700,300	1504605	9,800	4	08/15/96		
446	0072-14-012	LIMESTONE-HMAC	SAT-1H-2	07/10/98	37		1,700,300	1504605	9,800	4	08/15/96		
447	0072-14-012	LIMESTONE-HMAC	SAT-1H-3	07/10/98	35		1,700,300	1504605	9,800	4	08/15/96		

	CSJ	Surface Type	Location	Skid Date	SN_{40}	BPN	VPPL	Producer	ADT	Lanes	ServiceDate	PaveTemp	AirTemp
448	0072-14-012	LIMESTONE-HMAC	SAT-1H-4	07/10/98	36		1,700,300	1504605	9,800	4	08/15/96		
449	0073-05-057	LIMESTONE-HMAC	SAT-2H-1	07/10/98	38		2,799,525	1504605	16,300	4	08/22/96		
450	0073-05-057	LIMESTONE-HMAC	SAT-2H-2	07/10/98	38		2,799,525	1504605	16,300	4	08/22/96		
451	0073-05-057	LIMESTONE-HMAC	SAT-2H-3	07/10/98	38		2,799,525	1504605	16,300	4	08/22/96		
452	0073-05-057	LIMESTONE-HMAC	SAT-2H-4	07/10/98	39		2,799,525	1504605	16,300	4	08/22/96		
453	0016-11-013	LIMESTONE-HMAC	SAT-4H-1	07/10/98	30		5,410,200	1504605	19,050	2	12/19/96		
454	0016-11-013	LIMESTONE-HMAC	SAT-4H-2	07/10/98	32		5,410,200	1504605	19,050	2	12/19/96		
455	0016-11-013	LIMESTONE-HMAC	SAT-4H-3	07/10/98	34		5,410,200	1504605	19,050	2	12/19/96		
456	0016-11-013	LIMESTONE-HMAC	SAT-4H-4	07/10/98	37		5,410,200	1504605	19,050	2	12/19/96		
457	0216-02-034	LIMESTONE-HMAC	SAT-6H-1	07/10/98	53		206,700	1504605	5,300	4	02/04/98		
458	0216-02-034	LIMESTONE-HMAC	SAT-6H-2	07/10/98	46		206,700	1504605	5,300	4	02/04/98		
459	0216-02-034	LIMESTONE-HMAC	SAT-6H-3	07/10/98	47		206,700	1504605	5,300	4	02/04/98		
460	0216-02-034	LIMESTONE-HMAC	SAT-6H-4	07/10/98	48		206,700	1504605	5,300	4	02/04/98		
461	0216-02-034	LIMESTONE-HMAC	SAT-7H-1	07/10/98	47		206,700	1504605	5,300	4	02/04/98		
462	0216-02-034	LIMESTONE-HMAC	SAT-7H-2	07/10/98	48		206,700	1504605	5,300	4	02/04/98		
463	0216-02-034	LIMESTONE-HMAC	SAT-7H-3	07/10/98	47		206,700	1504605	5,300	4	02/04/98		
464	0216-02-034	LIMESTONE-HMAC	SAT-7H-4	07/10/98	49		206,700	1504605	5,300	4	02/04/98		
465	1273-01-023	LIMESTONE-HMAC	SAT-8H-1	07/10/98	58		147,000	1504605	2,100	2	02/20/98		
466	1273-01-023	LIMESTONE-HMAC	SAT-8H-2	07/10/98	53		147,000	1504605	2,100	2	02/20/98		
467	1273-01-023	LIMESTONE-HMAC	SAT-8H-3	07/10/98	55		147,000	1504605	2,100	2	02/20/98		
468	1273-01-023	LIMESTONE-HMAC	SAT-8H-4	07/10/98	52		147,000	1504605	2,100	2	02/20/98		
469	0143-09-052	LIMESTONE-HMAC	YKM-1A-1	04/16/98	37		7,367,250	1504605	4,700	2	09/15/89		
470	0143-09-052	LIMESTONE-HMAC	YKM-1A-1	06/17/97	40	48	6,655,200	1504605	4,700	2	09/15/89	106	85
471	0143-09-052	LIMESTONE-HMAC	YKM-1A-2	04/16/98	37		7,367,250	1504605	4,700	2	09/15/89		
472	0143-09-052	LIMESTONE-HMAC	YKM-1A-2	06/17/97	40	45	6,655,200	1504605	4,700	2	09/15/89	103	85
473	0143-09-052	LIMESTONE-HMAC	YKM-1A-3	04/16/98	38		7,367,250	1504605	4,700	2	09/15/89		
474	0143-09-052	LIMESTONE-HMAC	YKM-1A-3	06/17/97	42	50	6,655,200	1504605	4,700	2	09/15/89	104	85
475	0143-09-052	LIMESTONE-HMAC	YKM-1A-4	04/16/98	37		7,367,250	1504605	4,700	2	09/15/89		
476	0143-09-052	LIMESTONE-HMAC	YKM-1A-4	06/17/97	42	42	6,655,200	1504605	4,700	2	09/15/89	121	85
477	0265-08-043	LIMESTONE-HMAC	YKM-5C-1	04/16/98	27		3,944,525	1504605	5,300	4	02/20/90		
478	0265-08-043	LIMESTONE-HMAC	YKM-5C-1	06/16/97	36	31	3,541,725	1504605	5,300	4	02/20/90	103	97
479	0265-08-043	LIMESTONE-HMAC	YKM-5C-2	04/16/98	30		3,944,525	1504605	5,300	4	02/20/90		
480	0265-08-043	LIMESTONE-HMAC	YKM-5C-2	06/16/97	37	33	3,541,725	1504605	5,300	4	02/20/90	112	97
481	0265-08-043	LIMESTONE-HMAC	YKM-5C-3	04/16/98	29		3,944,525	1504605	5,300	4	02/20/90		
482	0265-08-043	LIMESTONE-HMAC	YKM-5C-3	06/16/97	35	33	3,541,725	1504605	5,300	4	02/20/90	114	97
483	0265-08-043	LIMESTONE-HMAC	YKM-5C-4	04/16/98	32		3,944,525	1504605	5,300	4	02/20/90		
484	0265-08-043	LIMESTONE-HMAC	YKM-5C-4	06/16/97	35	37	3,541,725	1504605	5,300	4	02/20/90	114	97
485	0325-01-018	LIMESTONE-HMAC	YKM-6C-1	06/26/97	46	47	2,140,925	1504605	1,450	2	05/26/89	110	90
486	0325-01-018	LIMESTONE-HMAC	YKM-6C-2	06/26/97	45	45	2,140,925	1504605	1,450	2	05/26/89	115	90
487	0325-01-018	LIMESTONE-HMAC	YKM-6C-4	06/26/97	46	44	2,140,925	1504605	1,450	2	05/26/89	120	90
488	0088-05-066	LIMESTONE-HMAC	YKM-7G-1	04/16/98	29		2,404,100	1504605	2,900	2	10/01/93		

	CSJ	Surface Type	Location	Skid Date	SN_{40}	BPN	VPPL	Producer	ADT	Lanes	ServiceDate	PaveTemp	AirTemp
489	0088-05-066	LIMESTONE-HMAC	YKM-7G-1	06/27/97	31	35	1,979,250	1504605	2,900	2	10/01/93	125	90
490	0088-05-066	LIMESTONE-HMAC	YKM-7G-2	04/16/98	29		2,404,100	1504605	2,900	2	10/01/93		
491	0088-05-066	LIMESTONE-HMAC	YKM-7G-2	06/27/97	32	38	1,979,250	1504605	2,900	2	10/01/93	90	81
492	0088-05-066	LIMESTONE-HMAC	YKM-7G-3	04/16/98	27		2,404,100	1504605	2,900	2	10/01/93		
493	0088-05-066	LIMESTONE-HMAC	YKM-7G-3	06/27/97	28	37	1,979,250	1504605	2,900	2	10/01/93	95	81
494	0088-05-066	LIMESTONE-HMAC	YKM-7G-4	04/16/98	28		2,404,100	1504605	2,900	2	10/01/93		
495	0088-05-066	LIMESTONE-HMAC	YKM-7G-4	06/27/97	30	36	1,979,250	1504605	2,900	2	10/01/93		81
496	0471-05-023	LIMESTONE-SEAL	AUS-2A-1	03/16/97	31		7,454,300	1504605	4,600	2	05/01/88		
497	0471-05-023	LIMESTONE-SEAL	AUS-2A-1	04/22/98	32		8,378,900	1504605	4,600	2	05/01/88		
498	0471-05-023	LIMESTONE-SEAL	AUS-2A-1	02/03/98	32		8,199,500	1504605	4,600	2	05/01/88		
499	0471-05-023	LIMESTONE-SEAL	AUS-2A-2	03/16/97	31		7,454,300	1504605	4,600	2	05/01/88		
500	0471-05-023	LIMESTONE-SEAL	AUS-2A-2	04/22/98	32		8,378,900	1504605	4,600	2	05/01/88		
501	0471-05-023	LIMESTONE-SEAL	AUS-2A-2	02/03/98	34		8,199,500	1504605	4,600	2	05/01/88		
502	0471-05-023	LIMESTONE-SEAL	AUS-2A-3	03/16/97	31		7,454,300	1504605	4,600	2	05/01/88		
503	0471-05-023	LIMESTONE-SEAL	AUS-2A-3	02/03/98	32		8,199,500	1504605	4,600	2	05/01/88		
504	0471-05-023	LIMESTONE-SEAL	AUS-2A-3	04/22/98	32		8,378,900	1504605	4,600	2	05/01/88		
505	0471-05-023	LIMESTONE-SEAL	AUS-2A-4	03/16/97	30		7,454,300	1504605	4,600	2	05/01/88		
506	0471-05-023	LIMESTONE-SEAL	AUS-2A-4	02/03/98	32		8,199,500	1504605	4,600	2	05/01/88		
507	0471-05-023	LIMESTONE-SEAL	AUS-2A-4	04/22/98	32		8,378,900	1504605	4,600	2	05/01/88		
508	0115-04-027	LIMESTONE-SEAL	AUS-3A-1	02/04/97	34	48	2,450,370	1504605	1,830	2	10/06/89	55	
509	0115-04-027	LIMESTONE-SEAL	AUS-3A-2	02/04/97	33	40	2,450,370	1504605	1,830	2	10/06/89	60	
510	0115-04-027	LIMESTONE-SEAL	AUS-3A-3	02/04/97	34	46	2,450,370	1504605	1,830	2	10/06/89	65	
511	0115-04-027	LIMESTONE-SEAL	AUS-3A-4	02/04/97	35	44	2,450,370	1504605	1,830	2	10/06/89	73	
512	0115-03-018	LIMESTONE-SEAL	AUS-5A-1	01/14/98	32		1,354,700	1504605	3,800	2	02/01/96		
513	0115-03-018	LIMESTONE-SEAL	AUS-5A-1	02/03/97	47	43	699,200	1504605	3,800	2	02/01/96	81	
514	0115-03-018	LIMESTONE-SEAL	AUS-5A-2	01/14/98	32		1,354,700	1504605	3,800	2	02/01/96		
515	0115-03-018	LIMESTONE-SEAL	AUS-5A-2	02/03/97	46	40	699,200	1504605	3,800	2	02/01/96	84	
516	0115-03-018	LIMESTONE-SEAL	AUS-5A-3	01/14/98	32		1,354,700	1504605	3,800	2	02/01/96		
517	0115-03-018	LIMESTONE-SEAL	AUS-5A-3	02/03/97	45	39	699,200	1504605	3,800	2	02/01/96	87	
518	0115-03-018	LIMESTONE-SEAL	AUS-5A-4	01/14/98	35		1,354,700	1504605	3,800	2	02/01/96		
519	0115-03-018	LIMESTONE-SEAL	AUS-5A-4	02/03/97	44	46	699,200	1504605	3,800	2	02/01/96	84	
520	0954-02-011	LIMESTONE-SEAL	AUS-6D-1	02/04/97	36	32	578,200	1504605	1,400	2	11/01/94	82	
521	0954-02-011	LIMESTONE-SEAL	AUS-6D-2	02/04/97	37	40	578,200	1504605	1,400	2	11/01/94	81	
522	0954-02-011	LIMESTONE-SEAL	AUS-6D-3	02/04/97	37	38	578,200	1504605	1,400	2	11/01/94	67	
523	0954-02-011	LIMESTONE-SEAL	AUS-6D-4	02/04/97	38	39	578,200	1504605	1,400	2	11/01/94	75	
524	0805-03-015	LIMESTONE-SEAL	AUS-7C-1	02/03/97	53	47	289,800	1504605	1,050	2	08/01/95	72	
525	0805-03-015	LIMESTONE-SEAL	AUS-7C-2	02/03/97	51	46	289,800	1504605	1,050	2	08/01/95	81	
526	0805-03-015	LIMESTONE-SEAL	AUS-7C-3	02/03/97	51	49	289,800	1504605	1,050	2	08/01/95	84	
527	0805-03-015	LIMESTONE-SEAL	AUS-7C-4	02/03/97	49	46	289,800	1504605	1,050	2	08/01/95	75	
528	490-LFK-34I	LRA-AC10	LFK-34I-1	04/01/98	60	61	3,573,360	1523205	840	1	08/08/86		70
529	490-LFK-34I	LRA-AC10	LFK-34I-1	06/10/98	65		3,632,160	1523205	840	1	08/08/86		

	CSJ	Surface Type	Location	Skid Date	SN_{40}	BPN	VPPL	Producer	ADT	Lanes	ServiceDate	PaveTemp	AirTemp
530	490-LFK-34I	LRA-AC10	LFK-34I-2	06/10/98	51		3,632,160	1523205	840	1	08/08/86		
531	490-LFK-34I	LRA-AC10	LFK-34I-2	04/01/98	60	59	3,573,360	1523205	840	1	08/08/86		70
532	490-LFK-34I	LRA-AC10	LFK-34I-3	06/10/98	49		3,632,160	1523205	840	1	08/08/86		
533	490-LFK-34I	LRA-AC10	LFK-34I-3	04/01/98	58	55	3,573,360	1523205	840	1	08/08/86		70
534	490-LFK-34I	LRA-AC10	LFK-34I-4	06/10/98	56		3,632,160	1523205	840	1	08/08/86		
535	490-LFK-34I	LRA-AC10	LFK-34I-4	04/01/98	59	61	3,573,360	1523205	840	1	08/08/86		70
536	490-LFK-34O	LRA-AC10LATEX	LFK-34O-1	06/10/98	50		5,448,240	1523205	1,260	1	08/08/86		
537	490-LFK-34O	LRA-AC10LATEX	LFK-34O-1	04/01/98	63	54	5,360,040	1523205	1,260	1	08/08/86		57
538	490-LFK-34O	LRA-AC10LATEX	LFK-34O-2	06/10/98	48		5,448,240	1523205	1,260	1	08/08/86		
539	490-LFK-34O	LRA-AC10LATEX	LFK-34O-2	04/01/98	64	50	5,360,040	1523205	1,260	1	08/08/86		57
540	490-LFK-34O	LRA-AC10LATEX	LFK-34O-3	06/10/98	45		5,448,240	1523205	1,260	1	08/08/86		
541	490-LFK-34O	LRA-AC10LATEX	LFK-34O-3	04/01/98	63	46	5,360,040	1523205	1,260	1	08/08/86		57
542	490-LFK-34O	LRA-AC10LATEX	LFK-34O-4	06/10/98	49		5,448,240	1523205	1,260	1	08/08/86		
543	490-LFK-34O	LRA-AC10LATEX	LFK-34O-4	04/01/98	64	56	5,360,040	1523205	1,260	1	08/08/86		57
544	1230-01-6A	LRA-C	LRA-6A-1	05/27/98	64	60	127,600	1523205	50	1	06/01/91	119	88
545	1230-01-6A	LRA-C	LRA-6A-3	05/27/98	66	62	127,600	1523205	50	1	06/01/91	121	88
546	1230-01-6B	LRA-C	LRA-6B-1	05/27/98	66	51	127,600	1523205	50	1	06/01/91	118	88
547	1230-01-1A	LRA-CMHBC	LRA-1A-1	05/27/98	57	53	127,600	1523205	50	1	06/01/91	107	89
548	1230-01-1A	LRA-CMHBC	LRA-1A-3	05/27/98	62	61	127,600	1523205	50	1	06/01/91	115	89
549	1230-01-1B	LRA-CMHBC	LRA-1B-1	05/27/98	66	55	127,600	1523205	50	1	06/01/91	119	89
550	1230-01-1B	LRA-CMHBC	LRA-1B-3	05/27/98	62	57	127,600	1523205	50	1	06/01/91	118	89
551	1230-01-4A	LRA-CMHBD	LRA-4A-1	05/27/98	73	58	127,600	1523205	50	1	06/01/91	114	90
552	1230-01-4A	LRA-CMHBD	LRA-4A-3	05/27/98	72	56	127,600	1523205	50	1	06/01/91	115	90
553	1230-01-4B	LRA-CMHBD	LRA-4B-1	05/27/98	75	57	127,600	1523205	50	1	06/01/91	115	93
554	1230-01-4B	LRA-CMHBD	LRA-4B-3	05/27/98	75	62	127,600	1523205	50	1	06/01/91	118	93
555	1230-01-2A	LRA-CMHBF	LRA-2A-1	05/27/98	66	56	127,600	1523205	50	1	06/01/91	108	92
556	1230-01-2A	LRA-CMHBF	LRA-2A-3	05/27/98	66	59	127,600	1523205	50	1	06/01/91	115	92
557	1230-01-2B	LRA-CMHBF	LRA-2B-1	05/27/98	57	55	127,600	1523205	50	1	06/01/91	121	92
558	1230-01-2B	LRA-CMHBF	LRA-2B-3	05/27/98	62	58	127,600	1523205	50	1	06/01/91	121	92
559	1230-01-3A	LRA-CPS	LRA-3A-1	05/27/98	63	62	127,600	1523205	50	1	06/01/91	111	82
560	1230-01-3A	LRA-CPS	LRA-3A-3	05/27/98	59	57	127,600	1523205	50	1	06/01/91	113	82
561	1230-01-3B	LRA-CPS	LRA-3B-1	05/27/98	71	66	127,600	1523205	50	1	06/01/91	114	82
562	1230-01-3B	LRA-CPS	LRA-3B-3	05/27/98	72	69	127,600	1523205	50	1	06/01/91	115	82
563	1230-01-7A	LRA-CS	LRA-7A-1	05/27/98	74	59	127,600	1523205	50	1	06/01/91	114	92
564	1230-01-7B	LRA-CS	LRA-7B-1	05/27/98	65	62	127,600	1523205	50	1	06/01/91	113	92
565	1230-01-9A	LRA-CSPV4	LRA-9A-1	05/27/98	73		2,800	1523205	50	1	04/01/98		
566	1230-01-8A	LRA-DS	LRA-8A-1	05/27/98	73	56	127,600	1523205	50	1	06/01/91	121	97
567	1230-01-8B	LRA-DS	LRA-8B-1	05/27/98	73		127,600	1523205	50	1	06/01/91		
568	0109-04	LRA-HMAC	LFK-1L-1	06/10/98	51		1,547,000	1523205	5,600	4	06/01/95		
569	0109-04	LRA-HMAC	LFK-1L-2	06/10/98	55		1,547,000	1523205	5,600	4	06/01/95		
570	0109-04	LRA-HMAC	LFK-1L-3	06/10/98	54		1,547,000	1523205	5,600	4	06/01/95		

	CSJ	Surface Type	Location	Skid Date	SN_{40}	BPN	VPPL	Producer	ADT	Lanes	ServiceDate	PaveTemp	AirTemp
571	0109-04	LRA-HMAC	LFK-1L-4	06/10/98	56		1,547,000	1523205	5,600	4	06/01/95		
572	0327-08-071	LRA-HMAC	PHR-5A-1	08/21/97	36		4,952,000	1523205	8,000	2	04/01/94		
573	0327-08-071	LRA-HMAC	PHR-5A-1	02/11/98	37		5,648,000	1523205	8,000	2	04/01/94		
574	0327-08-071	LRA-HMAC	PHR-5A-2	08/21/97	38		4,952,000	1523205	8,000	2	04/01/94		
575	0327-08-071	LRA-HMAC	PHR-5A-2	02/11/98	39		5,648,000	1523205	8,000	2	04/01/94		
576	0698-02-035	LRA-HMAC	PHR-7A-1	08/14/97	45	52	2,154,250	1523205	3,500	2	04/01/94	129	97
577	0698-02-035	LRA-HMAC	PHR-7A-2	08/14/97	45	50	2,154,250	1523205	3,500	2	04/01/94	132	97
578	0698-02-035	LRA-HMAC	PHR-7A-3	08/14/97	44	49	2,154,250	1523205	3,500	2	04/01/94	132	96
579	0698-02-035	LRA-HMAC	PHR-7A-4	08/14/97	43	49	2,154,250	1523205	3,500	2	04/01/94	132	96
580	0054-04	LRA-HMAC	TYL-1L-1	06/10/98	28		628,150	1523205	1,700	2	06/01/96		
581	0054-04	LRA-HMAC	TYL-1L-2	06/10/98	43		628,150	1523205	1,700	2	06/01/96		
582	0054-04	LRA-HMAC	TYL-1L-3	06/10/98	42		628,150	1523205	1,700	2	06/01/96		
583	0058-04	LRA-HMAC	TYL-2L-1	06/10/98	29		406,450	1523205	1,100	2	06/01/96		
584	0058-04	LRA-HMAC	TYL-2L-2	06/10/98	37		406,450	1523205	1,100	2	06/01/96		
585	0058-04	LRA-HMAC	TYL-2L-3	06/10/98	39		406,450	1523205	1,100	2	06/01/96		
586	0058-04	LRA-HMAC	TYL-2L-4	06/10/98	37		406,450	1523205	1,100	2	06/01/96		
587	0165-02	LRA-HMAC	TYL-3L-1	06/11/98	55		2,820,300	1523205	5,100	2	06/01/95		
588	0165-02	LRA-HMAC	TYL-3L-2	06/11/98	47		2,820,300	1523205	5,100	2	06/01/95		
589	0165-02	LRA-HMAC	TYL-3L-3	06/11/98	54		2,820,300	1523205	5,100	2	06/01/95		
590	0165-02	LRA-HMAC	TYL-3L-4	06/11/98	55		2,820,300	1523205	5,100	2	06/01/95		
591	1230-01-5A	LRA-MIXCC	LRA-5A-1	05/27/98	66	63	127,600	1523205	50	1	06/01/91	113	89
592	1230-01-5A	LRA-MIXCC	LRA-5A-3	05/27/98	62	42	127,600	1523205	50	1	06/01/91	115	89
593	1230-01-5B	LRA-MIXCC	LRA-5B-1	05/27/98	75	56	127,600	1523205	50	1	06/01/91	119	97
594	0738-01-039	LRA-SEAL	CRPLM-16B-1	04/08/97	60		2,751,250	1523205	3,100	2	05/29/92		
595	0738-01-039	LRA-SEAL	CRPLM-16B-2	04/08/97	61		2,751,250	1523205	3,100	2	05/29/92		
596	0738-01-039	LRA-SEAL	CRPLM-16B-3	04/08/97	57		2,751,250	1523205	3,100	2	05/29/92		
597	0738-01-039	LRA-SEAL	CRPLM-16B-4	04/08/97	62		2,751,250	1523205	3,100	2	05/29/92		
598	0253-04-098	IGNEOUS-HMAC	SAT-3R-1	03/31/98	41	40	29,923,367	1523206	29,819	2	10/01/92	95	85
599	0253-04-098	IGNEOUS-HMAC	SAT-3R-1	05/28/98	42		30,788,118	1523206	29,819	2	10/01/92		
600	0253-04-098	IGNEOUS-HMAC	SAT-3R-2	03/31/98	43	43	29,923,367	1523206	29,819	2	10/01/92	95	85
601	0253-04-098	IGNEOUS-HMAC	SAT-3R-2	05/28/98	48		30,788,118	1523206	29,819	2	10/01/92		
602	0253-04-098	IGNEOUS-HMAC	SAT-3R-3	03/31/98	43	45	29,923,367	1523206	29,819	2	10/01/92	95	85
603	0253-04-098	IGNEOUS-HMAC	SAT-3R-3	05/28/98	44		30,788,118	1523206	29,819	2	10/01/92		
604	1407-03-005	LIGHTWEIT-HMAC	LFK-1R-1	04/02/98	52	61	9,710,874	1817502	17,403	3	09/01/93		65
605	1407-03-005	LIGHTWEIT-HMAC	LFK-1R-1	06/10/98	61		10,111,143	1817502	17,403	3	09/01/93		
606	1407-03-005	LIGHTWEIT-HMAC	LFK-1R-1	12/10/97	64		9,055,361	1817502	17,403	3	09/01/93		
607	1407-03-005	LIGHTWEIT-HMAC	LFK-1R-2	04/02/98	52	61	9,710,874	1817502	17,403	3	09/01/93		65
608	1407-03-005	LIGHTWEIT-HMAC	LFK-1R-2	06/10/98	58		10,111,143	1817502	17,403	3	09/01/93		
609	1407-03-005	LIGHTWEIT-HMAC	LFK-1R-2	12/10/97	65		9,055,361	1817502	17,403	3	09/01/93		
610	1407-03-005	LIGHTWEIT-HMAC	LFK-1R-3	04/02/98	53	59	9,710,874	1817502	17,403	3	09/01/93		65
611	1407-03-005	LIGHTWEIT-HMAC	LFK-1R-3	06/10/98	59		10,111,143	1817502	17,403	3	09/01/93		

	CSJ	Surface Type	Location	Skid Date	SN_{40}	BPN	VPPL	Producer	ADT	Lanes	ServiceDate	PaveTemp	AirTemp
612	1407-03-005	LIGHTWEIT-HMAC	LFK-1R-4	06/10/98	60		10,111,143	1817502	17,403	3	09/01/93		
613	0175-08-034	LIGHTWEIT-HMAC	LFK-3R-1	04/02/98	54	40	5,005,312	1817502	8,807	3	08/01/93		75
614	0175-08-034	LIGHTWEIT-HMAC	LFK-3R-1	12/10/97	59		4,673,581	1817502	8,807	3	08/01/93		
615	0175-08-034	LIGHTWEIT-HMAC	LFK-3R-1	06/10/98	59		5,207,873	1817502	8,807	3	08/01/93		
616	0175-08-034	LIGHTWEIT-HMAC	LFK-3R-2	04/02/98	54	39	5,005,312	1817502	8,807	3	08/01/93		75
617	0175-08-034	LIGHTWEIT-HMAC	LFK-3R-2	12/10/97	57		4,673,581	1817502	8,807	3	08/01/93		
618	0175-08-034	LIGHTWEIT-HMAC	LFK-3R-2	06/10/98	58		5,207,873	1817502	8,807	3	08/01/93		
619	0175-08-034	LIGHTWEIT-HMAC	LFK-3R-3	04/02/98	53	44	5,005,312	1817502	8,807	3	08/01/93		75
620	0175-08-034	LIGHTWEIT-HMAC	LFK-3R-3	06/10/98	57		5,207,873	1817502	8,807	3	08/01/93		
621	0175-08-034	LIGHTWEIT-HMAC	LFK-3R-3	12/10/97	58		4,673,581	1817502	8,807	3	08/01/93		
622	490-LFK-33I	LIGHTWTAC10	LFK-33I-1	04/01/98	62	64	3,573,360	1817502	840	1	08/08/86		70
623	490-LFK-33I	LIGHTWTAC10	LFK-33I-1	06/10/98	67		3,632,160	1817502	840	1	08/08/86		
624	490-LFK-33I	LIGHTWTAC10	LFK-33I-2	04/01/98	60	66	3,573,360	1817502	840	1	08/08/86		70
625	490-LFK-33I	LIGHTWTAC10	LFK-33I-2	06/10/98	64		3,632,160	1817502	840	1	08/08/86		
626	490-LFK-33I	LIGHTWTAC10	LFK-33I-3	04/01/98	50	73	3,573,360	1817502	840	1	08/08/86		70
627	490-LFK-33I	LIGHTWTAC10	LFK-33I-3	06/10/98	61		3,632,160	1817502	840	1	08/08/86		
628	490-LFK-33I	LIGHTWTAC10	LFK-33I-4	04/01/98	56	64	3,573,360	1817502	840	1	08/08/86		70
629	490-LFK-33I	LIGHTWTAC10	LFK-33I-4	06/10/98	63		3,632,160	1817502	840	1	08/08/86		
630	490-LFK-33O	LIGHTWTAC10LATE	LFK-33O-1	04/01/98	48	65	5,360,040	1817502	1,260	1	08/08/86		58
631	490-LFK-33O	LIGHTWTAC10LATE	LFK-33O-1	06/10/98	67		5,448,240	1817502	1,260	1	08/08/86		
632	490-LFK-33O	LIGHTWTAC10LATE	LFK-33O-2	04/01/98	46	63	5,360,040	1817502	1,260	1	08/08/86		58
633	490-LFK-33O	LIGHTWTAC10LATE	LFK-33O-2	06/10/98	69		5,448,240	1817502	1,260	1	08/08/86		
634	490-LFK-33O	LIGHTWTAC10LATE	LFK-33O-3	04/01/98	46	67	5,360,040	1817502	1,260	1	08/08/86		58
635	490-LFK-33O	LIGHTWTAC10LATE	LFK-33O-3	06/10/98	70		5,448,240	1817502	1,260	1	08/08/86		
636	490-LFK-33O	LIGHTWTAC10LATE	LFK-33O-4	04/01/98	47	59	5,360,040	1817502	1,260	1	08/08/86		58
637	490-LFK-33O	LIGHTWTAC10LATE	LFK-33O-4	06/10/98	70		5,448,240	1817502	1,260	1	08/08/86		
638	0172-08-043	LIMESTONE-HMAC	DAL-8A-1	09/26/97	40		4,216,150	1817504	10,600	4	05/19/93		
639	0172-08-043	LIMESTONE-HMAC	DAL-8A-2	09/26/97	38		4,216,150	1817504	10,600	4	05/19/93		
640	0172-08-043	LIMESTONE-HMAC	DAL-8A-3	09/26/97	38		4,216,150	1817504	10,600	4	05/19/93		
641	0172-08-043	LIMESTONE-HMAC	DAL-8A-4	09/26/97	40		4,216,150	1817504	10,600	4	05/19/93		
642	0191-01-054	LIMESTONE-HMAC	TYL-3R-1	06/10/98	36	46	5,760,925	1817504	10,718	2	07/01/95	90	83
643	0191-01-054	LIMESTONE-HMAC	TYL-3R-2	06/10/98	36	46	5,760,925	1817504	10,718	2	07/01/95	91	85
644	0191-01-054	LIMESTONE-HMAC	TYL-3R-3	06/10/98	38	46	5,760,925	1817504	10,718	2	07/01/95	89	85
645	0492-01-022	LIMESTONE-HMAC	TYL-5A-1	06/11/98	31	38	3,488,000	1817504	4,000	2	09/01/93	112	93
646	0492-01-022	LIMESTONE-HMAC	TYL-5A-1	09/16/97	33		2,952,000	1817504	4,000	2	09/01/93		
647	1549-04-018	GRAVEL-HMAC	CRPGL-2A-1	02/19/98	40		10,376,100	2106701	8,100	2	02/14/91		
648	1549-04-018	GRAVEL-HMAC	CRPGL-2A-1	04/09/97	41	42	9,096,300	2106701	8,100	2	02/14/91	82	
649	1549-04-018	GRAVEL-HMAC	CRPGL-2A-2	02/19/98	40		10,376,100	2106701	8,100	2	02/14/91		
650	1549-04-018	GRAVEL-HMAC	CRPGL-2A-2	04/09/97	41	43	9,096,300	2106701	8,100	2	02/14/91	83	
651	1549-04-018	GRAVEL-HMAC	CRPGL-2A-3	04/09/97	41	45	9,096,300	2106701	8,100	2	02/14/91	84	
652	1549-04-018	GRAVEL-HMAC	CRPGL-2A-3	02/19/98	42		10,376,100	2106701	8,100	2	02/14/91		

	CSJ	Surface Type	Location	Skid Date	SN_{40}	BPN	VPPL	Producer	ADT	Lanes	ServiceDate	PaveTemp	AirTemp
653	1549-04-018	GRAVEL-HMAC	CRPGL-2A-4	02/19/98	41		10,376,100	2106701	8,100	2	02/14/91		
654	1549-04-018	GRAVEL-HMAC	CRPGL-2A-4	04/09/97	42	44	9,096,300	2106701	8,100	2	02/14/91	85	
655	0254-03-048	GRAVEL-HMAC	CRPGL-2R-1	04/10/97	45		1,680,075	2106701	5,700	4	01/17/94		
656	0254-03-048	GRAVEL-HMAC	CRPGL-2R-1	02/18/98	49	47	2,127,525	2106701	5,700	4	01/17/94		
657	0254-03-048	GRAVEL-HMAC	CRPGL-2R-2	04/10/97	44		1,680,075	2106701	5,700	4	01/17/94		
658	0254-03-048	GRAVEL-HMAC	CRPGL-2R-2	02/18/98	47	49	2,127,525	2106701	5,700	4	01/17/94		
659	0254-03-048	GRAVEL-HMAC	CRPGL-2R-3	04/10/97	45		1,680,075	2106701	5,700	4	01/17/94		
660	0254-03-048	GRAVEL-HMAC	CRPGL-2R-3	02/18/98	49	48	2,127,525	2106701	5,700	4	01/17/94		
661	0254-03-048	GRAVEL-HMAC	CRPGL-2R-4	04/10/97	45		1,680,075	2106701	5,700	4	01/17/94		
662	0102-03-065	GRAVEL-HMAC	CRPGL-3B-1	08/22/97	53		7,121,700	2106701	19,300	5	08/03/92		
663	0102-03-065	GRAVEL-HMAC	CRPGL-3B-1	03/19/97	57	54	6,519,540	2106701	19,300	5	08/03/92	73	77
664	0102-03-065	GRAVEL-HMAC	CRPGL-3B-1	02/17/98	57		7,812,640	2106701	19,300	5	08/03/92		
665	0102-03-065	GRAVEL-HMAC	CRPGL-3B-2	08/22/97	54		7,121,700	2106701	19,300	5	08/03/92		
666	0102-03-065	GRAVEL-HMAC	CRPGL-3B-2	03/19/97	54	48	6,519,540	2106701	19,300	5	08/03/92	86	77
667	0102-03-065	GRAVEL-HMAC	CRPGL-3B-2	02/17/98	59		7,812,640	2106701	19,300	5	08/03/92		
668	0102-03-065	GRAVEL-HMAC	CRPGL-3B-3	08/22/97	55		7,121,700	2106701	19,300	5	08/03/92		
669	0102-03-065	GRAVEL-HMAC	CRPGL-3B-3	02/17/98	60		7,812,640	2106701	19,300	5	08/03/92		
670	0102-03-065	GRAVEL-HMAC	CRPGL-3B-3	03/19/97	62	51	6,519,540	2106701	19,300	5	08/03/92	80	77
671	0102-03-065	GRAVEL-HMAC	CRPGL-3B-4	08/22/97	55		7,121,700	2106701	19,300	5	08/03/92		
672	0102-03-065	GRAVEL-HMAC	CRPGL-3B-4	02/17/98	57		7,812,640	2106701	19,300	5	08/03/92		
673	0102-03-065	GRAVEL-HMAC	CRPGL-3B-4	03/19/97	59	53	6,519,540	2106701	19,300	5	08/03/92	80	77
674	0373-02-069	GRAVEL-HMAC	CRPGL-5B-1	09/02/97	42		4,579,760	2106701	13,100	5	11/19/92		
675	0373-02-069	GRAVEL-HMAC	CRPGL-5B-1	03/19/97	46	45	4,142,220	2106701	13,100	5	11/19/92		62
676	0373-02-069	GRAVEL-HMAC	CRPGL-5B-2	09/02/97	41		4,579,760	2106701	13,100	5	11/19/92		
677	0373-02-069	GRAVEL-HMAC	CRPGL-5B-2	03/19/97	42	50	4,142,220	2106701	13,100	5	11/19/92		62
678	0373-02-069	GRAVEL-HMAC	CRPGL-5B-3	09/02/97	44		4,579,760	2106701	13,100	5	11/19/92		
679	0373-02-069	GRAVEL-HMAC	CRPGL-5B-3	03/19/97	47	52	4,142,220	2106701	13,100	5	11/19/92		62
680	0373-02-069	GRAVEL-HMAC	CRPGL-5B-4	09/02/97	39		4,579,760	2106701	13,100	5	11/19/92		
681	0373-02-069	GRAVEL-HMAC	CRPGL-5B-4	03/19/97	47	52	4,142,220	2106701	13,100	5	11/19/92		62
682	0102-11-007	GRAVEL-HMAC	CRPGL-7B-1	04/10/97	50		2,573,550	2106701	8,600	4	12/30/93		
683	0102-11-007	GRAVEL-HMAC	CRPGL-7B-2	04/10/97	54		2,573,550	2106701	8,600	4	12/30/93		
684	0102-11-007	GRAVEL-HMAC	CRPGL-7B-3	04/10/97	57		2,573,550	2106701	8,600	4	12/30/93		
685	0102-11-007	GRAVEL-HMAC	CRPGL-7B-4	04/10/97	51		2,573,550	2106701	8,600	4	12/30/93		
686	1052-02-060	GRAVEL-HMAC	CRPGL-8B-1	03/13/97	43	43	1,751,600	2106701	5,800	2	07/18/95	111	83
687	1052-02-060	GRAVEL-HMAC	CRPGL-8B-2	03/13/97	43	46	1,751,600	2106701	5,800	2	07/18/95	106	83
688	1052-02-060	GRAVEL-HMAC	CRPGL-8B-3	03/13/97	43	45	1,751,600	2106701	5,800	2	07/18/95	108	83
689	1052-02-060	GRAVEL-HMAC	CRPGL-8B-4	03/13/97	43	43	1,751,600	2106701	5,800	2	07/18/95	106	83
690	0254-01-106	GRAVEL-HMAC	CRPGL-8D-1	08/22/97	43		1,966,200	2106701	11,300	4	09/26/95		
691	0254-01-106	GRAVEL-HMAC	CRPGL-8D-1	02/18/98	45		2,474,700	2106701	11,300	4	09/26/95		
692	0254-01-106	GRAVEL-HMAC	CRPGL-8D-1	03/10/97	47	46	1,500,075	2106701	11,300	4	09/26/95	90	78
693	0254-01-106	GRAVEL-HMAC	CRPGL-8D-2	08/22/97	43		1,966,200	2106701	11,300	4	09/26/95		

	CSJ	Surface Type	Location	Skid Date	SN_{40}	BPN	VPPL	Producer	ADT	Lanes	ServiceDate	PaveTemp	AirTemp
694	0254-01-106	GRAVEL-HMAC	CRPGL-8D-2	02/18/98	45		2,474,700	2106701	11,300	4	09/26/95		
695	0254-01-106	GRAVEL-HMAC	CRPGL-8D-2	03/10/97	46	50	1,500,075	2106701	11,300	4	09/26/95	97	78
696	0254-01-106	GRAVEL-HMAC	CRPGL-8D-3	08/22/97	43		1,966,200	2106701	11,300	4	09/26/95		
697	0254-01-106	GRAVEL-HMAC	CRPGL-8D-3	02/18/98	45		2,474,700	2106701	11,300	4	09/26/95		
698	0254-01-106	GRAVEL-HMAC	CRPGL-8D-3	03/10/97	45	46	1,500,075	2106701	11,300	4	09/26/95	100	78
699	0254-01-106	GRAVEL-HMAC	CRPGL-8D-4	08/22/97	42		1,966,200	2106701	11,300	4	09/26/95		
700	0254-01-106	GRAVEL-HMAC	CRPGL-8D-4	02/18/98	43		2,474,700	2106701	11,300	4	09/26/95		
701	0254-01-106	GRAVEL-HMAC	CRPGL-8D-4	03/10/97	45	47	1,500,075	2106701	11,300	4	09/26/95	100	78
702	2343-01-019	GRAVEL-HMAC	CRPGL-4A-1	03/13/97	32	42	5,938,440	2106705	12,300	5	08/03/90	83	65
703	2343-01-019	GRAVEL-HMAC	CRPGL-4A-1	08/22/97	48		6,336,960	2106705	12,300	5	08/03/90		
704	2343-01-019	GRAVEL-HMAC	CRPGL-4A-1	02/19/98	50		6,782,220	2106705	12,300	5	08/03/90		
705	2343-01-019	GRAVEL-HMAC	CRPGL-4A-2	08/22/97	48		6,336,960	2106705	12,300	5	08/03/90		
706	2343-01-019	GRAVEL-HMAC	CRPGL-4A-2	02/19/98	48		6,782,220	2106705	12,300	5	08/03/90		
707	2343-01-019	GRAVEL-HMAC	CRPGL-4A-2	03/13/97	49	51	5,938,440	2106705	12,300	5	08/03/90	95	65
708	2343-01-019	GRAVEL-HMAC	CRPGL-4A-3	03/13/97	36	55	5,938,440	2106705	12,300	5	08/03/90	95	65
709	2343-01-019	GRAVEL-HMAC	CRPGL-4A-3	02/19/98	50		6,782,220	2106705	12,300	5	08/03/90		
710	2343-01-019	GRAVEL-HMAC	CRPGL-4A-3	08/22/97	50		6,336,960	2106705	12,300	5	08/03/90		
711	2343-01-019	GRAVEL-HMAC	CRPGL-4A-4	03/13/97	38	49	5,938,440	2106705	12,300	5	08/03/90	99	65
712	2343-01-019	GRAVEL-HMAC	CRPGL-4A-4	08/22/97	48		6,336,960	2106705	12,300	5	08/03/90		
713	2343-01-019	GRAVEL-HMAC	CRPGL-4A-4	02/19/98	51		6,782,220	2106705	12,300	5	08/03/90		
714	2343-01-019	GRAVEL-HMAC	CRPGL-4A-W1	03/13/97	51	47	5,938,440	2106705	12,300	5	08/03/90	100	79
715	2343-01-019	GRAVEL-HMAC	CRPGL-4A-W2	03/13/97	53	43	5,938,440	2106705	12,300	5	08/03/90	102	79
716	2343-01-019	GRAVEL-HMAC	CRPGL-4A-W3	03/13/97	52	46	5,938,440	2106705	12,300	5	08/03/90	107	79
717	2343-01-019	GRAVEL-HMAC	CRPGL-4A-W4	03/13/97	52	49	5,938,440	2106705	12,300	5	08/03/90	109	79
718	1069-01-023	GRAVEL-HMAC	CRPGL-6A-1	02/19/98	40		4,548,600	2106705	4,200	2	03/16/92		
719	1069-01-023	GRAVEL-HMAC	CRPGL-6A-1	03/13/97	42	51	3,828,300	2106705	4,200	2	03/16/92	78	72
720	1069-01-023	GRAVEL-HMAC	CRPGL-6A-2	02/19/98	42		4,548,600	2106705	4,200	2	03/16/92		
721	1069-01-023	GRAVEL-HMAC	CRPGL-6A-2	03/13/97	46	50	3,828,300	2106705	4,200	2	03/16/92	78	72
722	1069-01-023	GRAVEL-HMAC	CRPGL-6A-3	02/19/98	44		4,548,600	2106705	4,200	2	03/16/92		
723	1069-01-023	GRAVEL-HMAC	CRPGL-6A-3	03/13/97	44	48	3,828,300	2106705	4,200	2	03/16/92	77	72
724	1069-01-023	GRAVEL-HMAC	CRPGL-6A-4	02/19/98	43		4,548,600	2106705	4,200	2	03/16/92		
725	1069-01-023	GRAVEL-HMAC	CRPGL-6A-4	03/13/97	46	47	3,828,300	2106705	4,200	2	03/16/92	78	72
726	0100-08-069	GRAVEL-HMAC	CRP-1R-1	02/16/98	48	48	2,973,921	2106706	6,154	4	11/01/92		
727	0100-08-069	GRAVEL-HMAC	CRP-1R-2	02/16/98	48	48	2,973,921	2106706	6,154	4	11/01/92		
728	3116-01-003	GRAVEL-HMAC	CRPGL-8E-1	04/08/97	43		1,298,400	2106706	2,400	2	04/22/94		
729	3116-01-003	GRAVEL-HMAC	CRPGL-8E-2	04/08/97	41		1,298,400	2106706	2,400	2	04/22/94		
730	3116-01-003	GRAVEL-HMAC	CRPGL-8E-3	04/08/97	42		1,298,400	2106706	2,400	2	04/22/94		
731	3116-01-003	GRAVEL-HMAC	CRPGL-8E-4	04/08/97	42		1,298,400	2106706	2,400	2	04/22/94		
732	1804-02-014	GRAVEL-HMAC	PHR-2C-1	02/11/98	37		13,290,000	2110901	20,000	4	11/02/90		
733	1804-02-014	GRAVEL-HMAC	PHR-2C-1	08/13/97	41	44	12,380,000	2110901	20,000	4	11/02/90	138	102
734	1804-02-014	GRAVEL-HMAC	PHR-2C-2	02/11/98	37		13,290,000	2110901	20,000	4	11/02/90		

	CSJ	Surface Type	Location	Skid Date	SN_{40}	BPN	VPPL	Producer	ADT	Lanes	ServiceDate	PaveTemp	AirTemp
735	1804-02-014	GRAVEL-HMAC	PHR-2C-2	08/13/97	41	38	12,380,000	2110901	20,000	4	11/02/90	126	95
736	3468-01-006	GRAVEL-HMAC	PHR-3C-1	08/14/97	39	44	11,263,000	2110901	7,000	2	10/22/88	109	85
737	3468-01-006	GRAVEL-HMAC	PHR-3C-2	08/14/97	38	46	11,263,000	2110901	7,000	2	10/22/88	113	87
738	1586-01-029	GRAVEL-HMAC	PHR-4C-1	08/14/97	36	46	6,380,500	2110901	7,000	2	08/17/92	132	97
739	1586-01-029	GRAVEL-HMAC	PHR-4C-2	08/14/97	38	44	6,380,500	2110901	7,000	2	08/17/92	135	97
740	1586-01-029	GRAVEL-HMAC	PHR-4C-3	08/14/97	40	46	6,380,500	2110901	7,000	2	08/17/92	138	100
741	1586-01-029	GRAVEL-HMAC	PHR-4C-4	08/14/97	37	46	6,380,500	2110901	7,000	2	08/17/92	135	98
742	0528-01-062	GRAVEL-HMAC	PHR-5C-1	08/13/97	36	35	5,482,500	2110901	10,000	4	08/12/91	128	93
743	0528-01-062	GRAVEL-HMAC	PHR-5C-2	08/13/97	35	37	5,482,500	2110901	10,000	4	08/12/91	135	96
744	0528-01-062	GRAVEL-HMAC	PHR-5C-3	08/13/97	36	37	5,482,500	2110901	10,000	4	08/12/91	137	98
745	0528-01-062	GRAVEL-HMAC	PHR-5C-4	08/13/97	37	40	5,482,500	2110901	10,000	4	08/12/91	138	97
746	0872-02-015	GRAVEL-HMAC	PHR-6C-1	08/21/97	41	39	1,461,000	2110901	1,200	2	12/21/90	96	88
747	0872-02-015	GRAVEL-HMAC	PHR-6C-2	08/21/97	41	44	1,461,000	2110901	1,200	2	12/21/90	97	88
748	0872-02-015	GRAVEL-HMAC	PHR-6C-3	08/21/97	41		1,461,000	2110901	1,200	2	12/21/90		
749	0872-02-015	GRAVEL-HMAC	PHR-6C-4	08/21/97	41		1,461,000	2110901	1,200	2	12/21/90		
750	1429-01-020	GRAVEL-SEAL	PHR-3B-1	08/14/97	50	51	984,800	2110901	1,600	2	04/01/94	97	83
751	1429-01-020	GRAVEL-SEAL	PHR-3B-2	08/14/97	50	44	984,800	2110901	1,600	2	04/01/94	99	86
752	1429-01-020	GRAVEL-SEAL	PHR-3B-3	08/14/97	50	51	984,800	2110901	1,600	2	04/01/94	102	86
753	1429-01-020	GRAVEL-SEAL	PHR-3B-4	08/14/97	50	56	984,800	2110901	1,600	2	04/01/94	102	88
754	0517-07-026	GRAVEL-HMAC	PHR-4D-1	08/12/97	47	49	6,562,000	2110903	4,000	2	08/18/88	104	84
755	0517-07-026	GRAVEL-HMAC	PHR-4D-2	08/12/97	46	52	6,562,000	2110903	4,000	2	08/18/88	108	86
756	0517-07-026	GRAVEL-HMAC	PHR-4D-3	08/12/97	46	45	6,562,000	2110903	4,000	2	08/18/88	110	87
757	0517-07-026	GRAVEL-HMAC	PHR-4D-4	08/12/97	46	49	6,562,000	2110903	4,000	2	08/18/88	113	87
758	0698-03-035	GRAVEL-HMAC	PHR-6E-1	08/14/97	37	40	1,403,500	2110903	1,000	2	12/07/89	125	98
759	0698-03-035	GRAVEL-HMAC	PHR-6E-2	08/14/97	37	41	1,403,500	2110903	1,000	2	12/07/89	122	97
760	0698-03-035	GRAVEL-HMAC	PHR-6E-3	08/14/97	37	40	1,403,500	2110903	1,000	2	12/07/89	129	96
761	0698-03-035	GRAVEL-HMAC	PHR-6E-4	08/14/97	38	41	1,403,500	2110903	1,000	2	12/07/89	126	97
762	0039-01-040	GRAVEL-HMAC	PHR-4B-1	08/12/97	40	43	5,990,750	2110904	31,000	4	07/01/95	138	99
763	0039-01-040	GRAVEL-HMAC	PHR-4B-2	08/12/97	40	42	5,990,750	2110904	31,000	4	07/01/95	135	102
764	0039-01-040	GRAVEL-HMAC	PHR-4B-3	08/12/97	40	40	5,990,750	2110904	31,000	4	07/01/95	137	103
765	0039-01-040	GRAVEL-HMAC	PHR-4B-4	08/12/97	39	38	5,990,750	2110904	31,000	4	07/01/95		
766	0039-10-054	GRAVEL-HMAC	PHR-5R-1	02/11/98	31	41	3,204,500	2110904	13,000	4	06/01/95		
767	0039-10-054	GRAVEL-HMAC	PHR-5R-1	08/20/97	32	34	2,635,750	2110904	13,000	4	06/01/95	121	102
768	0039-10-054	GRAVEL-HMAC	PHR-5R-2	02/11/98	31	42	3,204,500	2110904	13,000	4	06/01/95		
769	0039-10-054	GRAVEL-HMAC	PHR-5R-2	08/20/97	34	35	2,635,750	2110904	13,000	4	06/01/95	127	102
770	0039-10-054	GRAVEL-HMAC	PHR-5R-3	08/20/97	33	36	2,635,750	2110904	13,000	4	06/01/95	129	102
771	0039-10-054	GRAVEL-HMAC	PHR-5R-3	02/11/98	33	40	3,204,500	2110904	13,000	4	06/01/95		
772	0039-10-054	GRAVEL-HMAC	PHR-5R-4	08/20/97	34	38	2,635,750	2110904	13,000	4	06/01/95	129	102
773	0331-01-024	GRAVEL-HMAC	PHR-6R-1	02/11/98	38	45	6,618,393	2110904	7,851	2	07/01/93		
774	0331-01-024	GRAVEL-HMAC	PHR-6R-2	02/11/98	39	44	6,618,393	2110904	7,851	2	07/01/93		
775	0331-01-024	GRAVEL-HMAC	PHR-6R-3	02/11/98	41	45	6,618,393	2110904	7,851	2	07/01/93		

	CSJ	Surface Type	Location	Skid Date	SN_{40}	BPN	VPPL	Producer	ADT	Lanes	ServiceDate	PaveTemp	AirTemp
776	0669-03-011	GRAVEL-SEAL	PHR-8B-1	08/13/97	36	44	1,178,400	2110904	1,600	2	08/01/93	102	84
777	0669-03-011	GRAVEL-SEAL	PHR-8B-2	08/13/97	38	38	1,178,400	2110904	1,600	2	08/01/93	110	89
778	0669-03-011	GRAVEL-SEAL	PHR-8B-3	08/13/97	38	45	1,178,400	2110904	1,600	2	08/01/93	110	90
779	0669-03-011	GRAVEL-SEAL	PHR-8B-4	08/13/97	37	35	1,178,400	2110904	1,600	2	08/01/93	116	92
780	0039-03-055	GRAVEL-HMAC	PHR-3R-1	02/10/98	37	45	7,194,970	2110905	15,068	2	07/01/95		
781	0039-03-055	GRAVEL-HMAC	PHR-3R-2	02/10/98	40	44	7,194,970	2110905	15,068	2	07/01/95		
782	0039-03-055	GRAVEL-HMAC	PHR-3R-3	02/10/98	39	49	7,194,970	2110905	15,068	2	07/01/95		
783	0255-12-002	GRAVEL-HMAC	PHR-4R-1	02/10/98	34	46	4,509,510	2110905	9,444	2	07/01/95		
784	0255-12-002	GRAVEL-HMAC	PHR-4R-2	02/10/98	36	52	4,509,510	2110905	9,444	2	07/01/95		
785	0039-03-078	GRAVEL-HMAC	PHR-8C-1	02/10/98	38		2,497,500	2110905	13,500	4	02/01/96		
786	0039-03-078	GRAVEL-HMAC	PHR-8C-1	08/13/97	41	45	1,886,625	2110905	13,500	4	02/01/96	142	100
787	0039-03-078	GRAVEL-HMAC	PHR-8C-3	02/10/98	39		2,497,500	2110905	13,500	4	02/01/96		
788	0039-03-078	GRAVEL-HMAC	PHR-8C-3	08/13/97	40	45	1,886,625	2110905	13,500	4	02/01/96	132	97
789	0039-03-078	GRAVEL-HMAC	PHR-8C-4	02/10/98	37		2,497,500	2110905	13,500	4	02/01/96		
790	0039-03-078	GRAVEL-HMAC	PHR-8C-4	08/13/97	39	41	1,886,625	2110905	13,500	4	02/01/96	131	97
791	0542-01-037	GRAVEL-HMAC	LRD-3A-1	02/09/98	45		17,110,000	2124013	29,000	5	01/12/90		
792	0542-01-037	GRAVEL-HMAC	LRD-3A-1	10/20/97	48		16,460,400	2124013	29,000	5	01/12/90		
793	0542-01-037	GRAVEL-HMAC	LRD-3A-1	02/26/97	50	48	15,091,600	2124013	29,000	5	01/12/90	69	60
794	0542-01-037	GRAVEL-HMAC	LRD-3A-2	10/20/97	47		16,460,400	2124013	29,000	5	01/12/90		
795	0542-01-037	GRAVEL-HMAC	LRD-3A-2	02/09/98	48		17,110,000	2124013	29,000	5	01/12/90		
796	0542-01-037	GRAVEL-HMAC	LRD-3A-2	02/26/97	51	52	15,091,600	2124013	29,000	5	01/12/90	70	60
797	0542-01-037	GRAVEL-HMAC	LRD-3A-3	02/09/98	45		17,110,000	2124013	29,000	5	01/12/90		
798	0542-01-037	GRAVEL-HMAC	LRD-3A-3	10/20/97	47		16,460,400	2124013	29,000	5	01/12/90		
799	0542-01-037	GRAVEL-HMAC	LRD-3A-3	02/26/97	50	50	15,091,600	2124013	29,000	5	01/12/90	72	60
800	0542-01-037	GRAVEL-HMAC	LRD-3A-4	02/09/98	46		17,110,000	2124013	29,000	5	01/12/90		
801	0542-01-037	GRAVEL-HMAC	LRD-3A-4	10/20/97	46		16,460,400	2124013	29,000	5	01/12/90		
802	0542-01-037	GRAVEL-HMAC	LRD-3A-4	02/26/97	50	52	15,091,600	2124013	29,000	5	01/12/90	72	60
803	0086-01-038	GRAVEL-HMAC	LRD-5A-1	02/10/98	44		10,515,200	2124014	12,800	2	08/12/93		
804	0086-01-038	GRAVEL-HMAC	LRD-5A-1	02/25/97	47	52	8,275,200	2124014	12,800	2	08/12/93	54	50
805	0086-01-038	GRAVEL-HMAC	LRD-5A-1	10/20/97	47		9,792,000	2124014	12,800	2	08/12/93		
806	0086-01-038	GRAVEL-HMAC	LRD-5A-2	02/10/98	45		10,515,200	2124014	12,800	2	08/12/93		
807	0086-01-038	GRAVEL-HMAC	LRD-5A-2	10/20/97	48		9,792,000	2124014	12,800	2	08/12/93		
808	0086-01-038	GRAVEL-HMAC	LRD-5A-2	02/25/97	49	56	8,275,200	2124014	12,800	2	08/12/93	56	50
809	0086-01-038	GRAVEL-HMAC	LRD-5A-3	02/10/98	46		10,515,200	2124014	12,800	2	08/12/93		
810	0086-01-038	GRAVEL-HMAC	LRD-5A-3	02/25/97	49	46	8,275,200	2124014	12,800	2	08/12/93	56	50
811	0086-01-038	GRAVEL-HMAC	LRD-5A-3	10/20/97	49		9,792,000	2124014	12,800	2	08/12/93		
812	0086-01-038	GRAVEL-HMAC	LRD-5A-4	02/10/98	46		10,515,200	2124014	12,800	2	08/12/93		
813	0086-01-038	GRAVEL-HMAC	LRD-5A-4	10/20/97	49		9,792,000	2124014	12,800	2	08/12/93		
814	0086-01-038	GRAVEL-HMAC	LRD-5A-4	02/25/97	50	54	8,275,200	2124014	12,800	2	08/12/93	56	50
815	0086-14-009	GRAVEL-HMAC	LRD-7B-1	02/10/98	37		6,347,000	2124014	11,000	2	12/14/94		
816	0086-14-009	GRAVEL-HMAC	LRD-7B-1	10/20/97	43		5,725,500	2124014	11,000	2	12/14/94		

	CSJ	Surface Type	Location	Skid Date	SN_{40}	BPN	VPPL	Producer	ADT	Lanes	ServiceDate	PaveTemp	AirTemp
817	0086-14-009	GRAVEL-HMAC	LRD-7B-1	02/26/97	43	49	4,427,500	2124014	11,000	2	12/14/94	55	60
818	0086-14-009	GRAVEL-HMAC	LRD-7B-2	02/10/98	39		6,347,000	2124014	11,000	2	12/14/94		
819	0086-14-009	GRAVEL-HMAC	LRD-7B-2	10/20/97	42		5,725,500	2124014	11,000	2	12/14/94		
820	0086-14-009	GRAVEL-HMAC	LRD-7B-2	02/26/97	43	49	4,427,500	2124014	11,000	2	12/14/94	56	60
821	0086-14-009	GRAVEL-HMAC	LRD-7B-3	02/10/98	38		6,347,000	2124014	11,000	2	12/14/94		
822	0086-14-009	GRAVEL-HMAC	LRD-7B-3	10/20/97	41		5,725,500	2124014	11,000	2	12/14/94		
823	0086-14-009	GRAVEL-HMAC	LRD-7B-3	02/26/97	44	51	4,427,500	2124014	11,000	2	12/14/94	55	60
824	0037-10-021	GRAVEL-HMAC	LRD-11A-1	02/27/97	58	54	95,200	2124016	1,600	2	10/31/96	84	71
825	0037-10-021	GRAVEL-HMAC	LRD-11A-2	02/27/97	55	55	95,200	2124016	1,600	2	10/31/96	86	71
826	0037-10-021	GRAVEL-HMAC	LRD-11A-3	02/27/97	54	50	95,200	2124016	1,600	2	10/31/96	87	71
827	0037-10-021	GRAVEL-HMAC	LRD-11A-4	02/27/97	54	54	95,200	2124016	1,600	2	10/31/96	85	71
828	1046-01-014	LIMESTONE-HMAC	ELP-1R-1	05/05/98	30	41	5,441,331	2407201	7,003	2	02/01/94		72
829	1046-01-014	LIMESTONE-HMAC	ELP-1R-2	05/05/98	31	44	5,441,331	2407201	7,003	2	02/01/94		77
830	1046-01-014	LIMESTONE-HMAC	ELP-1R-3	05/05/98	29	48	5,441,331	2407201	7,003	2	02/01/94		79
831	2552-02-006	LIMESTONE-HMAC	ELP-2R-1	05/05/98	28	37	4,695,502	2407201	6,154	2	03/01/94		86
832	2552-02-006	LIMESTONE-HMAC	ELP-2R-2	05/05/98	26	39	4,695,502	2407201	6,154	2	03/01/94		87
833	2552-02-006	LIMESTONE-HMAC	ELP-2R-3	05/05/98	28	37	4,695,502	2407201	6,154	2	03/01/94		87
834	0052-07-048	GRAVEL-HMAC	LBK-1R-1	04/27/98	43	53	17,078,166	2517307	10,404	2	05/01/89		50
835	0052-07-048	GRAVEL-HMAC	LBK-1R-2	04/27/98	44	50	17,078,166	2517307	10,404	2	05/01/89		50
836	0052-07-048	GRAVEL-HMAC	LBK-1R-3	04/27/98	45	54	17,078,166	2517307	10,404	2	05/01/89		60
837	1607-01-026	LIMESTONE-HMAC	HUS-FM1764-1	12/10/96	40	37	19,245,000	blend	30,000	4	12/01/89	79	74
838	1607-01-026	LIMESTONE-HMAC	HUS-FM1764-2	12/10/96	40	41	19,245,000	blend	30,000	4	12/01/89	79	74
839	0389-06-059	LIMESTONE-HMAC	HUS-H146-N1	12/10/96	43	42	6,531,000	blend	14,000	4	11/01/91	67	
840	0389-06-059	LIMESTONE-HMAC	HUS-H146-N2	12/10/96	46	41	6,531,000	blend	14,000	4	11/01/91	67	
841	0389-06-059	LIMESTONE-HMAC	HUS-H146-N3	12/10/96	47	41	6,531,000	blend	14,000	4	11/01/91	70	
842	0389-06-059	LIMESTONE-HMAC	HUS-H146-N4	12/10/96	45	42	6,531,000	blend	14,000	4	11/01/91	72	
843	0050-05-042	LIMESTONE-HMAC	HUS-H290-E1	12/11/96	30	31	12,920,000	blend	19,000	4	07/01/89	79	76
844	0050-05-042	LIMESTONE-HMAC	HUS-H290-E2	12/11/96	31	31	12,920,000	blend	19,000	4	07/01/89	77	
845	0050-05-042	LIMESTONE-HMAC	HUS-H290-E3	12/11/96	32	27	12,920,000	blend	19,000	4	07/01/89	78	
846	0050-05-042	LIMESTONE-HMAC	HUS-H290-E4	12/11/96	30	34	12,920,000	blend	19,000	4	07/01/89	80	
847	0050-05-042	LIMESTONE-HMAC	HUS-H290-W1	12/11/96	32	34	12,920,000	blend	19,000	4	07/01/89	68	
848	0050-05-042	LIMESTONE-HMAC	HUS-H290-W2	12/11/96	30	33	12,920,000	blend	19,000	4	07/01/89	68	
849	0275-08-025	GRAVEL-HMAC	AMA-1R-1	04/29/98	45	53	5,460,904	Z040001	11,248	2	09/01/95		59
850	0275-08-025	GRAVEL-HMAC	AMA-1R-2	04/29/98	45	50	5,460,904	Z040001	11,248	2	09/01/95		59
851	0275-08-025	GRAVEL-HMAC	AMA-1R-3	04/29/98	43	59	5,460,904	Z040001	11,248	2	09/01/95		59
852	0015-07-053	LIMESTONE-HMAC	WAC-1A-1	09/26/97	40		5,221,260	Z090004	35,640	6	05/01/95		
853	0015-07-053	LIMESTONE-HMAC	WAC-1A-1	06/17/98	46	38	6,789,420	Z090004	35,640	6	05/01/95	113	96
854	0015-07-053	LIMESTONE-HMAC	WAC-1A-1	01/26/98	49		5,945,940	Z090004	35,640	6	05/01/95		
855	0015-07-053	LIMESTONE-HMAC	WAC-1A-2	09/26/97	42		5,221,260	Z090004	35,640	6	05/01/95		
856	0015-07-053	LIMESTONE-HMAC	WAC-1A-2	06/17/98	45	43	6,789,420	Z090004	35,640	6	05/01/95	113	95
857	0015-07-053	LIMESTONE-HMAC	WAC-1A-2	01/26/98	49		5,945,940	Z090004	35,640	6	05/01/95		

	CSJ	Surface Type	Location	Skid Date	SN_{40}	BPN	VPPL	Producer	ADT	Lanes	ServiceDate	PaveTemp	AirTemp
858	0015-07-053	LIMESTONE-HMAC	WAC-1A-3	09/26/97	38		5,221,260	Z090004	35,640	6	05/01/95		
859	0015-07-053	LIMESTONE-HMAC	WAC-1A-3	06/17/98	45	45	6,789,420	Z090004	35,640	6	05/01/95	113	95
860	0015-07-053	LIMESTONE-HMAC	WAC-1A-3	01/26/98	49		5,945,940	Z090004	35,640	6	05/01/95		
861	0015-07-053	LIMESTONE-HMAC	WAC-1A-4	09/26/97	40		5,221,260	Z090004	35,640	6	05/01/95		
862	0183-04-037	LIMESTONE-HMAC	WAC-3A-1	09/26/97	43		3,571,200	Z090004	6,200	2	08/01/94		
863	0183-04-037	LIMESTONE-HMAC	WAC-3A-2	09/26/97	42		3,571,200	Z090004	6,200	2	08/01/94		
864	0183-04-037	LIMESTONE-HMAC	WAC-3A-3	09/26/97	39		3,571,200	Z090004	6,200	2	08/01/94		
865	0183-04-037	LIMESTONE-HMAC	WAC-3A-4	09/26/97	43		3,571,200	Z090004	6,200	2	08/01/94		
866	0419-02-032	LIMESTONE-HMAC	WAC-4A-1	09/26/97	50		3,095,200	Z090004	7,300	2	06/01/95		
867	0419-02-032	LIMESTONE-HMAC	WAC-4A-1	06/17/98	56	57	4,058,800	Z090004	7,300	2	06/01/95	107	95
868	0419-02-032	LIMESTONE-HMAC	WAC-4A-1	01/26/98	59	51	3,540,500	Z090004	7,300	2	06/01/95		77
869	0419-02-032	LIMESTONE-HMAC	WAC-4A-2	09/26/97	50		3,095,200	Z090004	7,300	2	06/01/95		
870	0419-02-032	LIMESTONE-HMAC	WAC-4A-2	06/17/98	56	54	4,058,800	Z090004	7,300	2	06/01/95	113	94
871	0419-02-032	LIMESTONE-HMAC	WAC-4A-2	01/26/98	59	52	3,540,500	Z090004	7,300	2	06/01/95		77
872	0419-02-032	LIMESTONE-HMAC	WAC-4A-3	09/26/97	48		3,095,200	Z090004	7,300	2	06/01/95		
873	0419-02-032	LIMESTONE-HMAC	WAC-4A-3	01/26/98	56	51	3,540,500	Z090004	7,300	2	06/01/95		77
874	0419-02-032	LIMESTONE-HMAC	WAC-4A-3	06/17/98	56	56	4,058,800	Z090004	7,300	2	06/01/95	106	95
875	0419-02-032	LIMESTONE-HMAC	WAC-4A-4	09/26/97	50		3,095,200	Z090004	7,300	2	06/01/95		
876	0419-02-032	LIMESTONE-HMAC	WAC-4A-4	06/17/98	54	57	4,058,800	Z090004	7,300	2	06/01/95	103	92
877	0419-02-032	LIMESTONE-HMAC	WAC-4A-4	01/26/98	58		3,540,500	Z090004	7,300	2	06/01/95		
878	0014-23-022	LIMESTONE-HMAC	WAC-5A-1	09/26/97	35		2,405,638	Z090004	14,470	4	12/01/95		
879	0014-23-022	LIMESTONE-HMAC	WAC-5A-2	09/26/97	37		2,405,638	Z090004	14,470	4	12/01/95		
880	0014-23-022	LIMESTONE-HMAC	WAC-5A-3	09/26/97	34		2,405,638	Z090004	14,470	4	12/01/95		
881	0014-23-022	LIMESTONE-HMAC	WAC-5A-4	09/26/97	35		2,405,638	Z090004	14,470	4	12/01/95		

APPENDIX D

Appendix D : Skid Number Frequency Distribution

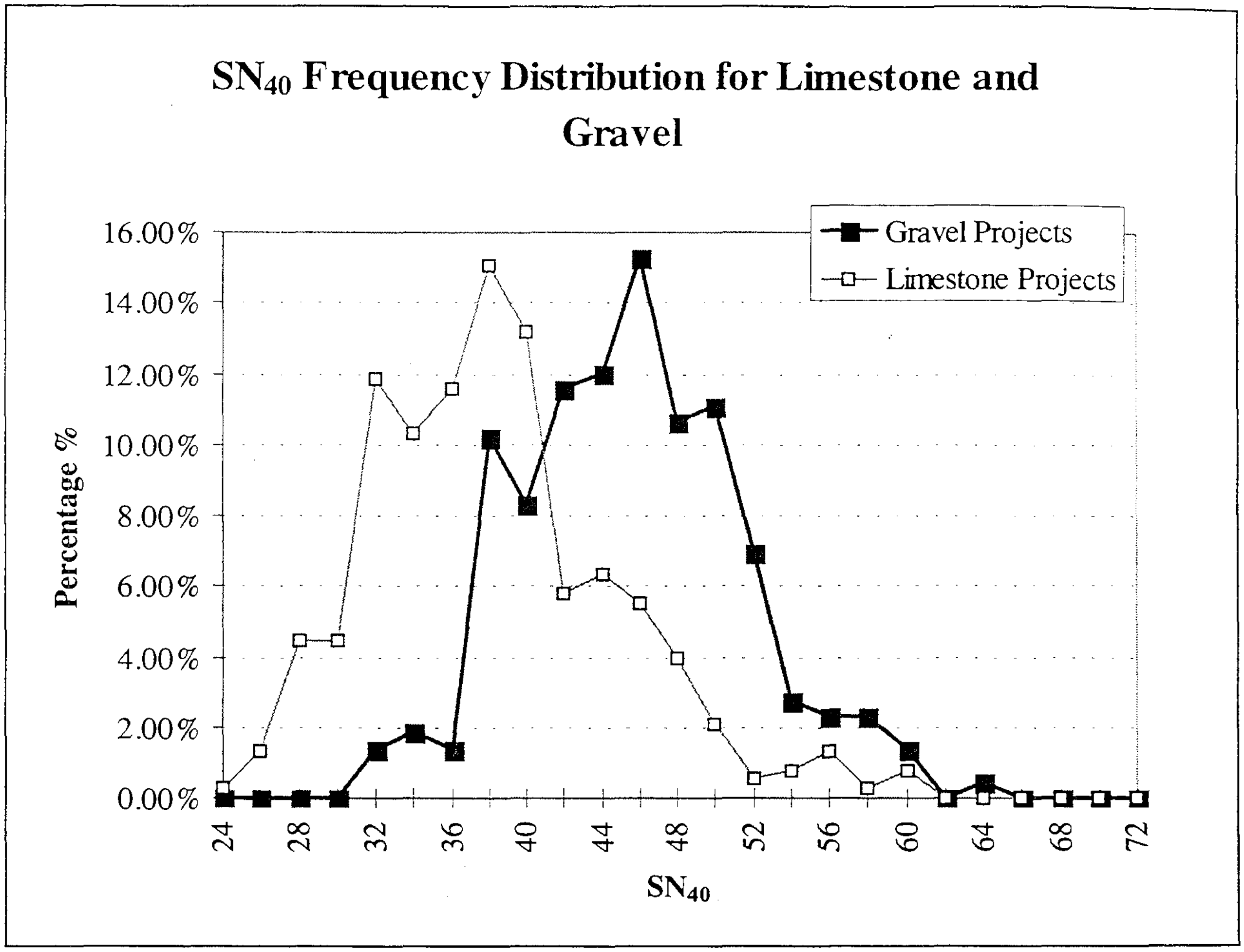
(1) SN_{40} Frequency Distribution for Different Traffic Level - Limestone HMAC

SN_{40}\VPPL	>12 million	>10 million	>8 million	>6 million	>4 million	All
24	.00%	.96%	0.81%	0.61%	0.42%	0.26%
26	1.08%	1.92%	1.63%	1.21%	2.08%	1.32%
28	5.38%	5.77%	4.88%	3.64%	4.58%	4.49%
30	6.45%	5.77%	4.88%	3.64%	3.33%	4.49%
32	27.96%	25.00%	21.14%	16.36%	14.58%	11.87%
34	18.28%	16.35%	18.70%	14.55%	12.50%	10.29%
36	12.90%	12.50%	13.01%	12.12%	9.17%	11.61%
38	9.68%	11.54%	13.82%	15.15%	13.33%	15.04%
40	13.98%	16.35%	16.26%	17.58%	13.75%	13.19%
42	3.23%	2.88%	4.07%	6.06%	7.92%	5.80%
44	1.08%	.96%	0.81%	4.24%	7.50%	6.33%
46	.00%	.00%	0.00%	3.64%	5.42%	5.54%
48	.00%	.00%	0.00%	1.21%	2.50%	3.96%
50	.00%	.00%	0.00%	0.00%	1.25%	2.11%
52	.00%	.00%	0.00%	0.00%	0.00%	0.53%
54	.00%	.00%	0.00%	0.00%	0.42%	0.79%
56	.00%	.00%	0.00%	0.00%	1.25%	1.32%
58	.00%	.00%	0.00%	0.00%	0.00%	0.26%
60	.00%	.00%	0.00%	0.00%	0.00%	0.79%
62	.00%	.00%	0.00%	0.00%	0.00%	0.00%
64	.00%	.00%	0.00%	0.00%	0.00%	0.00%
66	.00%	.00%	0.00%	0.00%	0.00%	0.00%
68	.00%	.00%	0.00%	0.00%	0.00%	0.00%
70	.00%	.00%	0.00%	0.00%	0.00%	0.00%
72	.00%	.00%	0.00%	0.00%	0.00%	0.00%
Std	3.75	3.98	3.89	4.62	5.94	6.51
Mean	33.81	33.88	34.23	35.71	36.75	37.45
Median	32.80	33.00	33.60	36.00	36.80	37.00
Mode	31.80	31.80	31.80	31.80	31.80	31.80

(2) SN40 Frequency Distribution for Different Traffic Levels - Gravel HMAC

SN_{40} \ VPPL	>12 million	>10 million	>8 million	>6 million	>4 million	All
24	.00%	.00%	0.00%	0.00%	0.00%	0.00%
26	.00%	.00%	0.00%	0.00%	0.00%	0.00%
28	.00%	.00%	0.00%	0.00%	0.00%	0.00%
30	.00%	.00%	0.00%	0.00%	0.00%	0.00%
32	.00%	.00%	0.00%	0.00%	0.00%	1.39%
34	.00%	.00%	0.00%	0.00%	0.75%	1.85%
36	.00%	.00%	0.00%	0.00%	1.50%	1.39%
38	8.70%	8.11%	5.66%	8.51%	10.53%	10.19%
40	.00%	5.41%	3.77%	9.57%	11.28%	8.33%
42	17.39%	18.92%	20.75%	12.77%	11.28%	11.57%
44	17.39%	13.51%	9.43%	5.32%	12.03%	12.04%
46	21.74%	29.73%	20.75%	13.83%	12.03%	15.28%
48	17.39%	13.51%	16.98%	14.89%	12.03%	10.65%
50	8.70%	5.41%	18.87%	17.02%	12.78%	11.11%
52	8.70%	5.41%	3.77%	5.32%	5.26%	6.94%
54	.00%	.00%	0.00%	2.13%	3.01%	2.78%
56	.00%	.00%	0.00%	3.19%	2.26%	2.31%
58	.00%	.00%	0.00%	3.19%	2.26%	2.31%
60	.00%	.00%	0.00%	3.19%	2.26%	1.39%
62	.00%	.00%	0.00%	0.00%	0.00%	0.00%
64	.00%	.00%	0.00%	1.06%	0.75%	0.46%
66	.00%	.00%	0.00%	0.00%	0.00%	0.00%
68	.00%	.00%	0.00%	0.00%	0.00%	0.00%
70	.00%	.00%	0.00%	0.00%	0.00%	0.00%
72	.00%	.00%	0.00%	0.00%	0.00%	0.00%
Std (Gravel)	3.83	3.57	3.67	5.82	5.88	5.89
Mean (Gravel)	44.71	44.03	44.83	46.10	44.95	44.63
Median (Gravel)	45.00	44.60	45.20	46.10	45.00	44.60
Mode (Gravel)	43.20	45.60	41.80	47.80	43.20	45.00

(3) SN_{40} Frequency Distribution Graphic



APPENDIX E

Appendix E Summary of Laboratory Data for BPN and PV

Residual PV		HourPolished	Slider						
		Solid-0 hour	Solid-9 hour						
Priority ID	Coupon ID	Curved 3"	Curved 3" ASTM	Curved 3"Avg.	Curved 3"	Flat 3"1/4	Flat 3"1/2	Flat 3"7/8	Flat 5"ASTM
1	7"flat-A	45	25	28.5	27	28	30	35	37
	7"flat-B	40	25	26.25	26	26	29	35	38
	7"flat-C	46	27	31.5	30	27	32	38	40
	7"flat-D	43	26	30	29				
	7"flat-E	43	26	30.25	30	27	30	36	41
	7"flat-F	42	24	27.5	27	25	28	33	42
	7"flat-G	42	23	29	28				
2	7"flat-A	45		31.25	30				
	7"flat-B	43	27	32	30	28	29	36	41
	7"flat-C	44	27	33.25	32	28	32	37	45
	7"flat-D	43	27	29.5	28	26	30	34	41
	7"flat-E	45	25	32.25	30	28	32	38	41
	7"flat-F	43	27	30.75	29	27	30	35	42
	7"flat-G	43	26	30.75	30	27	33	38	41
3	7"flat-A	50	33	39.75	37				
	7"flat-B	52	33	38.75	37	36	40	44	52
	7"flat-C	51	37	41.75	41				
	7"flat-D	50	33	38	36	35	38	44	53
	7"flat-E	51	33	36.75	35	34	39	43	54
	7"flat-F	50	32	38.75	37	36	39	44	53
	7"flat-G	51	35	39.5	38	35	40	46	54
4	7"flat-A	40	27	35.25	31	30	33	39	46
	7"flat-B	42	27	36	30	30	33	38	50
	7"flat-C	49	31	36.75	32	26	33	37	48
	7"flat-D	45	29	34.25	30	29	33	37	47
	7"flat-E	43	28	34.75	30	28	31	37	43
	7"flat-F	42	27	35.75	30	29	33	37	44
	7"flat-G	40	29	37.75	31	29	35	39	47
5	7"flat-A	43	23	30.25	27	24	29	33	36
	7"flat-B	46	28	32	28	25	29	35	42
	7"flat-C	44	26	30.25	28	25	28	34	41
	7"flat-D	43	25	30.25	27	26	28	33	41
	7"flat-E	46	25	31	27	24	26	31	38
	7"flat-F	42	24	30	26	24	27	33	40
	7"flat-G	40	26	30.5	27	26	28	32	41
6	7"flat-A	45	23	28	26	23	26	31	35
	7"flat-B	45	26	30.75	29	25	26	32	40
	7"flat-C	46	24	29.75	26	23	26	30	38
	7"flat-D	46	22	27.75	25	21	25	30	35
	7"flat-E	45	22	25.75	23				
	7"flat-F	44	22	25.75	25	23	27	30	35
	7"flat-G	41	23	25.75	24				
7	7"flat-A	42	25	33	28	23	27	32	40
	7"flat-B	40	25	30	27	25	27	31	37
	7"flat-C	40	26	33.5	30				
	7"flat-D	40	26	31.75	29	24	27	32	42
	7"flat-E	40	27	32.5	27	25	28	32	40
	7"flat-F	40							
	7"flat-G	41	25	30.25	28	25	27	32	40

Residual PV		HourPolished	Slider						
		Solid-0 hour	Solid-9 hour						
Priority ID	Coupon ID	Curved 3"	Curved 3" ASTM	Curved 3"Avg.	Curved 3"	Flat 3"1/4	Flat 3"1/2	Flat 3"7/8	Flat 5"ASTM
8	7"flat-A	45	25	31.75	27				
	7"flat-B	46	25	31.75	27	25	29	35	38
	7"flat-C	45	22	31.25	27	25	28	32	39
	7"flat-D	45	21	29.5	25	24	27	32	36
	7"flat-E	45							
	7"flat-F	45	23	31	27	24	27	31	36
	7"flat-G	45	24	30.75	27	21	27	36	39
9	7"flat-A	40	22	29.75	26	23	26	31	36
	7"flat-B	45	23	30.5	27	23	26	32	35
	7"flat-C	39	24	31.25	27	23	26	29	36
	7"flat-D	45	24	33.5	29	25	27	34	41
	7"flat-E	40	21	28.75	25	22	26	30	36
	7"flat-F	41	26	30.75	27	24	28	31	38
	7"flat-G	38	22	26.75	24	22	24	29	38
11	7"flat-A	45	26	32	31	28	35	40	45
	7"flat-B	46	26	32	30	29	33	39	47
	7"flat-C	43	27	31.5	30	32	33	39	48
	7"flat-D	52	28	33.5	31	31	34	40	47
	7"flat-E	46	29	34.5	32	32	35	43	48
	7"flat-F	46	28	32.25	30	33	37	45	50
	7"flat-G								
12	7"flat-A	39	26	30.75	30	26	28	34	41
	7"flat-B	38	25	28	28	26	28	35	
	7"flat-C	35	22	25.5	25				
	7"flat-D	39	25	30.5	30				
	7"flat-E	37	23	29.5	28	25	28	33	
	7"flat-F	37	24	28.25	28	27	31	36	42
	7"flat-G	38	23	27.25	27	25	28	32	40
13	7"flat-A	44	22	28.75	26	23	26	30	38
	7"flat-B	42	25	28.75	28	25	30	34	41
	7"flat-C	46	24	28.75	27	29	32	37	41
	7"flat-D	42	22	25.5	25	26	30	34	36
	7"flat-E	45	23	27.5	27	27	29	33	35
	7"flat-F	43	24	28.5	27	27	31	35	41
	7"flat-G	41	22	26.5	25	25	28	35	38
14	7"flat-A	46	43	51.75	50	51	55	63	75
	7"flat-B	49	45	50	50	50	57	65	76
	7"flat-C	45	45	50.75	50	52	55	66	78
	7"flat-D	45	43	49.75	49	49	56	63	75
	7"flat-E	47	42	47.75	47	50	53	63	75
	7"flat-F	48	46	52	52	53	59	65	75
	7"flat-G	50	45	51.25	51	51	59	66	77

APPENDIX F

Appendix F

Experimental Sections Work Plan

General – This work plan is developed to address the construction, testing, evaluation, monitoring, and possible remedial actions in conjunction with the proposed experimental sections to be constructed in Austin, Brownwood, and San Antonio districts. The experimental sections are needed to support the TxDOT in-house research project 7-3994, "Develop Alternate Polish Value and Soundness Specification Requirements for Optimal Utilization of Bituminous Coarse Aggregates." This research study will be conducted with the primary objective of encompassing design, material and construction variables and developing an order of priority in TxDOT design procedures and specifications to satisfy the engineering and economic considerations. The specific objectives of the proposed work include:

a. quantify the contribution of polish value to the skid life of bituminous coarse aggregates as it relates to different traffic condition and pavement surface macrotexture;
b. define the acceptable soundness loss values as it relates to different mix design procedure, construction methodology, and anticipated traffic conditions and design life;
c. evaluate alternate polish value and soundness specification requirements for optimal utilization of bituminous coarse aggregates; and,
d. develop a best-value design strategy based on quantifiable priorities in expected pavement performance, material quality and availability, and design and construction methodology.

Work Plan – The work plan presented herein address tasks 10 and 11 of the following 14 tasks to be accomplished by the research.

Task 1 – Review and Refine Data of Previous Research
Task 2 – Identify Selected Aggregate Sources for Skid Testing
Task 3 – Identify Existing Projects for Skid Testing
Task 4 – Skid Test Projects and Correlate SN with Field BPN
Task 5 – Develop Correlation Between Laboratory BPN and Polish Value
Task 6 – Develop Correlation Between Skid Number (SN_{40}) and Polish Value
Task 7 – Evaluate Contribution of Aggregate Properties to Skid Performance
Task 8 – Convert Average Polish Value to Residual Polish Value
Task 9 – Identify Aggregate Sources and Projects for Test Section Construction
Task 10 – Construction of Test Sections
Task 11 – Monitoring of Test Sections
Task 12 – Evaluation of Data Collected from Test Sections
Task 13 – Develop New Design Guide and Specifications
Task 14 – Implementation

Construction of Test Sections – All experimental sections to be constructed in Austin, Brownwood, and San Antonio Districts will be established through change order of existing projects. Each test section in Austin and San Antonio districts will be ½ mile long using the designated coarse aggregate source(s) and mix design. The test sections in Brownwood district will be one mile long each. The surfacing coarse aggregate will be the only variable in the design and construction of the test sections. The proposed test section matrices are as follows:

Austin District – IH-35 Widening, Williamson County (Estimated ADT Per Lane @ 20,000)

Selected Aggregate Sources	Material properties		Mix Design	
	RSPV	RSSM	CMHB	Type C
Word, Dean - Dow Chem.	26	13	X	X
Texas Crushed Stone - Feld	32	34	X	X
Alamo Concrete - Weir	31	25	X	X
Vulcan - Bullard	39	9	X	X
Blend - Delta/Dean Word (**control**)	n/a	na	X	**Control**

San Antonio District – IH-35 Widening, New Braunfels (Estimated ADT Per Lane @ 20,000)

Selected Aggregate Sources	Material properties		Mix Design	
	RSPV	RSSM	CMHB	Type C
Capital Aggregates	na	2	X	X
Vulcan Material - Helotes	31	20	X	X
Gifford Hill - New Braunfels	30	16	X	X
Colorado - Hunter	29	30	X	X
Redland - Beckman	32	24	X	X
Blend - Delta/Gifford Hill - New Braunfels (**Control Material**)	n/a	na	X	**Control**

San Antonio District - IH-35 South, (Estimated ADT Per Lane @ 6000)

Selected Aggregate Sources	Material properties		Mix Design	
	RSPV	RSSM	CMHB	Type C
South Texas Aggregate (gravel)	28	4	X	X
Blend - S. Tx. Aggr. & Delta (**Control**)	n/a	na	X	**Control**

Brownwood District – IH-20, Eastland County (Estimated ADT Per Lane @ 3800)
0007-03-068

Aggregate Sources	Material properties		Mix Design	
	PV	$MgSO_4$	Superpave C	Type C
To be determine by contractor	28 max.	30 max.		X
To be determine by contractor	32 min.	30 max.		X
To be determine by contractor	28 max	30 max.	X	
To be determine by contractor	32 min.	30 max.	X	
To be determine by contractor	28 max.	25 max.	Microsurface	
To be determine by contractor	32 min.	25 max.	Microsurface **(Control)**	

Mix Design: To assure the consistency of the design of the surface mix, the CST/M Bituminous Branch will assist the districts in mix designs. For each test section, the coarse aggregate to be used in the surface mix will be the only variable.

Laboratory Testing: Samples of selected aggregate sources for use in construction of test sections will be taken from project stockpiles. The aggregate samples will be tested in the laboratory for average polish value and residual polish value with cross-hatch tire polishing, residual polish value with solid tire polishing, acid insoluble residue (with particle size and petrographic analyses), crushed face count, and 5-cycle magnesium sulfate soundness.

Field Monitoring: The conditions of the test sections will be surveyed and measured for the following:

- post compaction aggregate degradation by sampling a saw-cut section from the pavement and comparing the extracted aggregate gradation with the plant mix gradation;
- in-service aggregate degradation by sampling a saw-cut section from the pavement at each 2,000,000 vehicle passes (to be converted to E18kSAL) and comparing the extracted gradation with the post-compaction gradation of the mixture
- skid performance by using race-track skid method at each 2,000,000 vehicle passes (to be converted to E18kSAL);
- structural performance by measuring rut depth and profile changes at each 2,000,000 vehicle passes (to be converted to E18kSAL).

Traffic Monitoring: Weigh-In-Motion device will be installed to measure vehicle passes and axle loads (traffic monitoring for conversion to ESAL) for the major test sections in Austin, San Antonio, and Brownwood Districts.

Remedial Actions: All aggregate sources selected for test section construction will meet the standard specification requirement for 5-cycle magnesium soundness, 30% maximum. It is anticipated that some of the sections may encounter lower than desirable skid performance. It is planned that when the skid number of a section reaches a value of less than 30 (normalized at a temperature of 77°F) the section will be resurfaced with either a microsurface or a plant mix seal to ensure the safety of the traveling public.

Other Elements: The Austin and San Antonio District test sections may include a ½-mile-long section to evaluate the benefit of a thick-lift and large-stone-base layer. The base material for test section construction will consist of a 12-inch-thick compacted base layer with maximum aggregate size of 3 inches. The use of 10- to 12-inch-thick compacted lift for base has been proven feasible and effective by a few states, and it is believed that the use of large stone will further accomplish the following:

- improved base material quality by reduced moisture susceptiblility;
- improve base strength through incorporation of larger and more durable aggregates;
- more economical incentive to the producer with reduced equipment wear from crushing;
- more economic incentive to the contractor with reduced construction time;
- more economic incentive to the state due to the cost reduction in base production and construction; and,
- stronger base layer and reduced stress distribution to the underlying layers due to increased shear strength in the large stone base.

The thick-lift, large-stone-base test section will be monitored with nondestructive testing equipment such as falling weight deflectormeter (FWD) at the traffic levels designated for the monitoring and testing of the entire test section. It is not anticipated that any premature failure will take place due to the incorporation of the thick-lift large-stone base. The construction of the base test section will be established through field change orders.

Please contact the following for any questions related to the planning, construction, testing, and monitoring of these test sections:

Frank Jaster, P.E. – Project Director
Chien N. Fu, P.E. – Research Supervisor