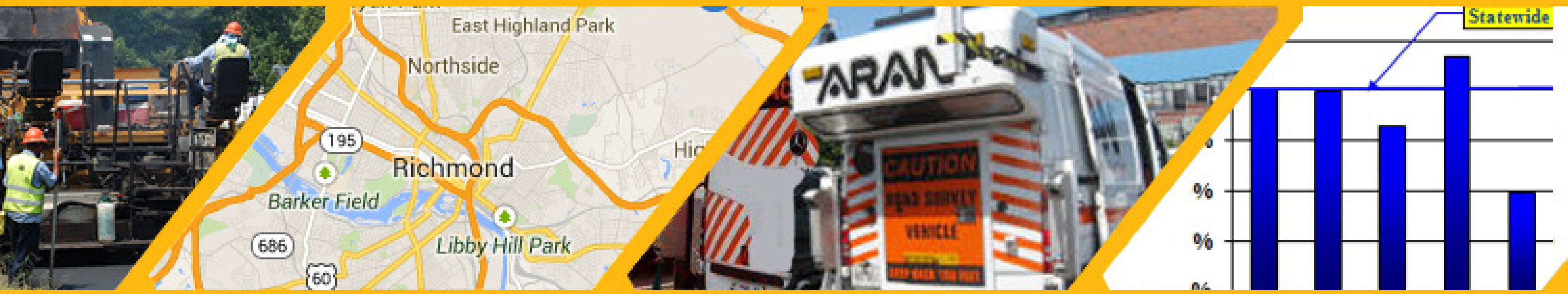
VIRGINIA DEPARTMENT OF TRANSPORTATION



STATE OF THE PAVEMENT 2013

MAINTENANCE DIVISION

NOVEMBER 2013

Comments should be directed to
Emmett Heltzel, **P.E.**
State Maintenance Engineer

Virginia Department of Transportation
1401 E. Broad St, Richmond, Virginia, 23219
Phone: (804) 786-2949
E-mail:Emmett.Heltzel@vdot.virginia.gov

VDOT

EXECUTIVE SUMMARY

The Virginia Department of Transportation (VDOT) is responsible for more than 126,000 lane miles of roadway. Virginia's current highway network is the result of more than 100 years of investment in infrastructure that provides safe, easy movement of people and goods and enhances the economy of the Commonwealth. Preserving this investment is a core function of VDOT.

This report describes the pavement condition and ride quality on Virginia's pavements based on data collected, processed and analyzed during the early months of 2013. It also provides trend analysis over the last five years of pavement condition ratings. The information in this report is used to understand variations in pavement condition and ride quality by pavement type, highway system, maintenance district and county.

This report provides background information on the methodology of data collection, quality assurance of data, derivation of condition measures, and the use of pavement condition data to assess pavement sufficiency statewide.

The report is organized into two major areas: (i) pavement condition data collection, data processing and quality assurance, and (ii) statewide pavement condition and ride quality summary. Appendices provide detailed pavement condition and ride quality data and the distribution of key distresses by district and pavement types.

The data presented in this report comprise a "snapshot" of pavement conditions during the early months of 2013. The data displayed highlights the pavement condition and ride quality summary. These results are broken down into further detail in the main body of this report. Throughout this report the abbreviations in Table I are used to denote the construction districts. Table II below shows the mileage by system maintained by each district based on the last published mileage tables.

Table I: Abbreviations for VDOT Districts

District Number	District Name	Abbreviation
1	Bristol	1/BR
2	Salem	2/SA
3	Lynchburg	3/LY
4	Richmond	4/RI
5	Hampton Roads	5/HR
6	Fredericksburg	6/FR
7	Culpeper	7/CU
8	Staunton	8/ST
9	Northern Virginia	9/NO

Table II: Lane Mileage by District and System

District	Interstate	Primary	Secondary	Frontage	Total
Bristol	530	2,966	12,296	113	15,905
Salem	493	2,668	14,716	104	17,981
Lynchburg	0	2,814	12,385	43	15,242
Richmond	1,323	3,426	13,879	75	18,703
Hampton Roads	874	1,801	7,118	92	9,885
Fredericksburg	281	2,140	9,186	24	11,631
Culpeper	279	1,870	8,250	52	10,451
Staunton	940	2,476	10,490	75	13,981
Nova	726	1,724	10,463	77	12,990
Statewide	5,446	21,885	98,783	655	126,769

PAVEMENT DATA COLLECTION, DATA PROCESSING & QUALITY CONTROL/QUALITY ASSURANCE

The pavement condition data presented in this report were collected and processed by VDOT's contractor, Fugro-Roadware Inc., using continuous digital imaging and automated crack detection technology. For data collection purposes, Fugro-Roadware uses vehicles equipped with special cameras to capture downward pavement images for crack detection as well as forward images for the collection of right of way images for assets and shoulder condition data. Roughness and rutting data are simultaneously captured with sensors mounted on the van. Downward images collected during the survey are processed with specialized automated crack detection software for the identification of cracks. Further analysis of the digital images is necessary for the identification of other distresses, such as patching, bleeding or delamination.

Data are collected by the above-mentioned method on the entire Interstate and Primary highway systems, and approximately 20% of Secondary system of highway network, each year. The distresses are interpreted according to the methodology detailed in the VDOT Distress Identification Manual[(1)], processed, and summarized in a pre-defined format. Quality Control (QC) is conducted by the contractor and Quality Assurance (QA) and Independent Validation and Verification (IV&V) is performed by a third party consultant - Quality Engineering Solutions (QES). This consultant independently rates and verifies approximately 5% of all the data collected by the data collection contractor. For the Interstate and Primary systems the ratings on pavement sections are also compared with the previous year's ratings on the same sections and any major differences in ratings are further investigated. The data are processed, verified and delivered in batches. VDOT then accepts the data based on predefined acceptance criteria mentioned in the quality review document.

Individual distress data are aggregated into two Pavement Condition Indices, the Load-related Distress Rating (LDR) and Non-load-related Distress Rating (NDR). The

LDR incorporates pavement distresses that are related to vehicle load related damages (e.g. fatigue cracking, patching, rutting, etc.) to pavement. The NDR is comprised of distresses (e.g. transverse and longitudinal cracking, longitudinal joint separation, bleeding, etc.) considered to be primarily non-load related, i.e., caused by weathering of pavement surface or material and/or construction deficiency. Both indices are on a scale of 0 to 100 with 100 representing a pavement with no visible distresses. The details of the index calculation methodology for asphalt surfaced pavements are provided in a VDOT report(2) published in 2002.

A third index – the Critical Condition Index (CCI) is calculated as the lower of the LDR and NDR. These indices were first derived in 1998 based on the PAVER methodology developed by the US Army Corps of Engineers, and have undergone extensive validation process using the Long Term Pavement Performance (LTPP) data collected through the Strategic Highway Research Program (SHRP) of FHWA and through a process of consensus building using numerous VDOT pavement experts. It should be noted that LDR and NDR are used only for asphalt-surfaced pavements. For jointed concrete pavements the Slab Distress Rating (SDR) is used while the Concrete Punchout Rating (CPR) and the Concrete Distress Rating (CDR) are used for continuously reinforced concrete pavements. However, the same concept of CCI applies to the latter two pavement types. More details about concrete pavement condition indices are documented in another published VDOT report(3).

As shown below in Table III, CCI values are grouped into five ranges corresponding to condition categories: excellent, good, fair, poor and very poor. In general, pavement sections with a CCI value below 60 (poor and very poor) are considered 'deficient' and should be further evaluated for maintenance and rehabilitation actions. Pavement sections with a CCI value of at least 60 (fair or better) are considered 'sufficient'.

Table III : Pavement Condition Category Based on CCI

Pavement Condition	Index Scale (CCI)
Excellent	90 and above
Good	70-89
Fair	60-69
Poor	50-59
Very Poor	49 and below

Pavement roughness is generally defined as an expression of the aggregation of irregularities in the pavement surface, per linear mile, that adversely affect the ride quality of a vehicle (and thus the user). Roughness is an important pavement characteristic because it affects not only ride quality but also vehicle delay costs, fuel consumption and maintenance costs. Pavement roughness or ride quality, expressed in the International Roughness Index (IRI), is derived from sensor data collected by the van simultaneously with the video images. IRI data has been analyzed and reported separately in this report. Table IV below contains a qualitative pavement ride quality

Table IV : Pavement Ride Quality Based on IRI

Ride Quality	IRI Rating (inch/mile)	
	Interstate & Primary	Secondary Roads
Excellent	< 60	< 95
Good	60 to 99	95 to 169
Fair	100 to 139	170 to 219
Poor	140 to 199	220 to 279
Very Poor	≥ 200	≥ 280

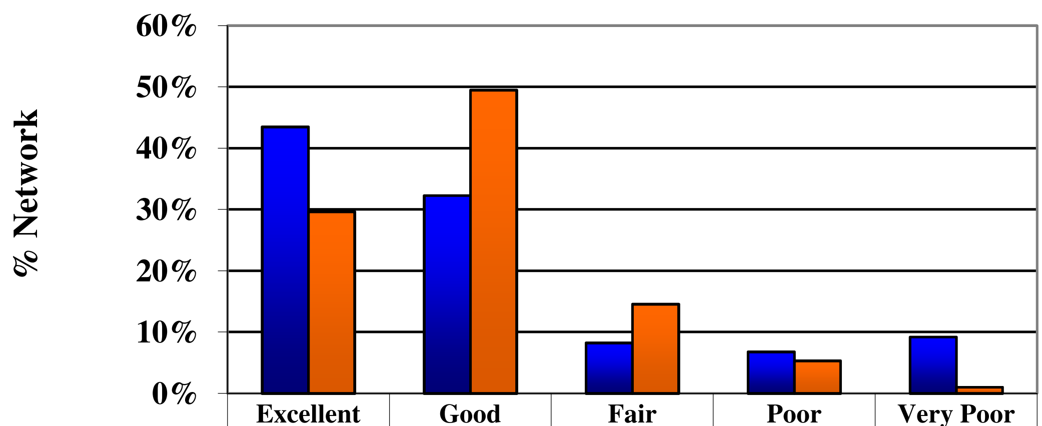
term and corresponding quantitative IRI values. VDOT uses the categories summarized in Table IV for its Interstate, Primary, and Secondary systems.

Ranges of IRI that correspond to qualitative descriptors of ride quality were built upon similar categories promulgated by FHWA[(4)] and incorporated consensus opinions from VDOT pavement experts regarding what thresholds were considered appropriate to represent acceptable roughness levels on Virginia highways. Interstate and Primary pavement sections with an average IRI of 140 or more or a Secondary pavement section with an average of IRI of 220 or more are considered ‘deficient’ in terms of ride quality.

STATEWIDE PAVEMENT CONDITION AND RIDE QUALITY SUMMARY

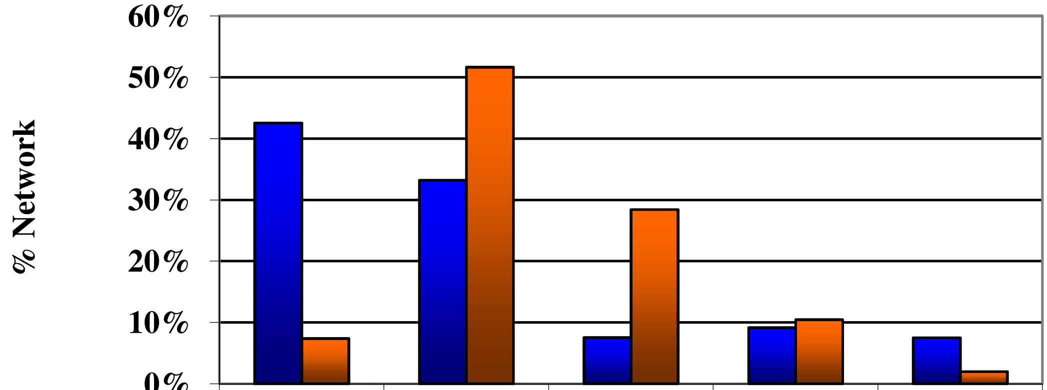
For the Interstate, Primary, and Secondary systems, the statewide pavement condition and ride quality summary is presented in the Figures I, II and III. Tables III and IV above provided definitions of the pavement condition and ride quality categories shown in the figures.

Figure I : Pavement Condition and Ride Quality - Interstate



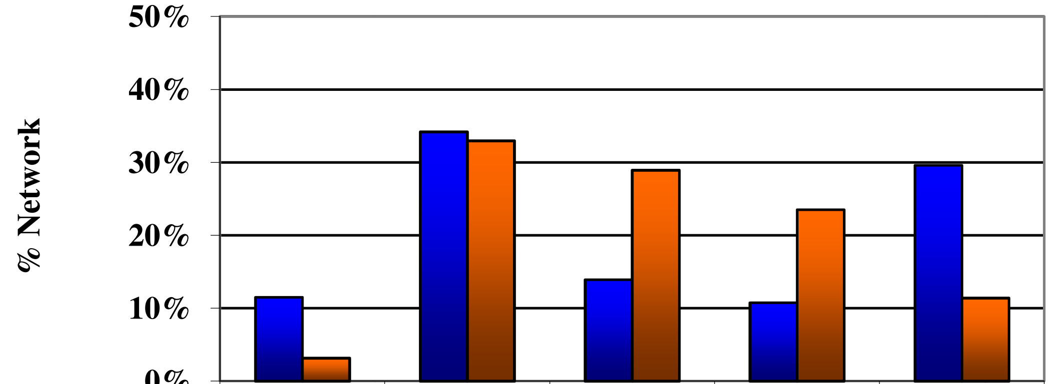
	Excellent	Good	Fair	Poor	Very Poor
Condition	43.5%	32.3%	8.2%	6.8%	9.2%
Ride Quality	29.6%	49.5%	14.6%	5.3%	1.0%

Figure II : Pavement Condition and Ride Quality - Primary



	Excellent	Good	Fair	Poor	Very Poor
Condition	42.6%	33.2%	7.5%	9.2%	7.5%
Ride Quality	7.4%	51.7%	28.4%	10.5%	2.0%

Figure III : Pavement Condition and Ride Quality - Secondary (Samples)



	Excellent	Good	Fair	Poor	Very Poor
Condition	11.5%	34.2%	13.9%	10.8%	29.6%
Ride Quality	3.2%	33.0%	28.9%	23.5%	11.4%

Interstate Pavement Condition and Ride Quality by District

The following graphic shows the pavement ratings for the Interstate pavement system. Following this graphic, the detailed ratings for the system are reported.

The statewide performance target for percentage of Interstate pavements rated sufficient, i.e., in fair condition or better, is 82% or more. Similarly, the performance target for statewide sufficient ride quality on the Interstate systems is 85% or better. Figure IV shows the percent sufficient on the Interstate system by district based on pavement condition and ride quality. About 84% of the Interstate network has been rated to be in 'sufficient' condition and 93.7% has sufficient ride quality. These are illustrated in Figure IV with each district's pavement condition and ride quality along with statewide statistics. Figure V presents the total number of deficient lane miles in each district on the Interstate system.

The number of miles maintained by each district varies considerably, therefore, one district may have a larger percentage of miles in sufficient condition but fewer lane miles sufficient than another. The percent of lane miles rated sufficient varies from as high as 100% in Fredericksburg District to as low as 75.1% in Richmond District. Richmond District maintains the largest number of Interstate lane miles while Lynchburg District does not maintain any Interstate pavements. On the Interstate system, the ride quality sufficiency varies from as high as 99.5% in Fredericksburg District to as low as 81.5% in Hampton Roads District.

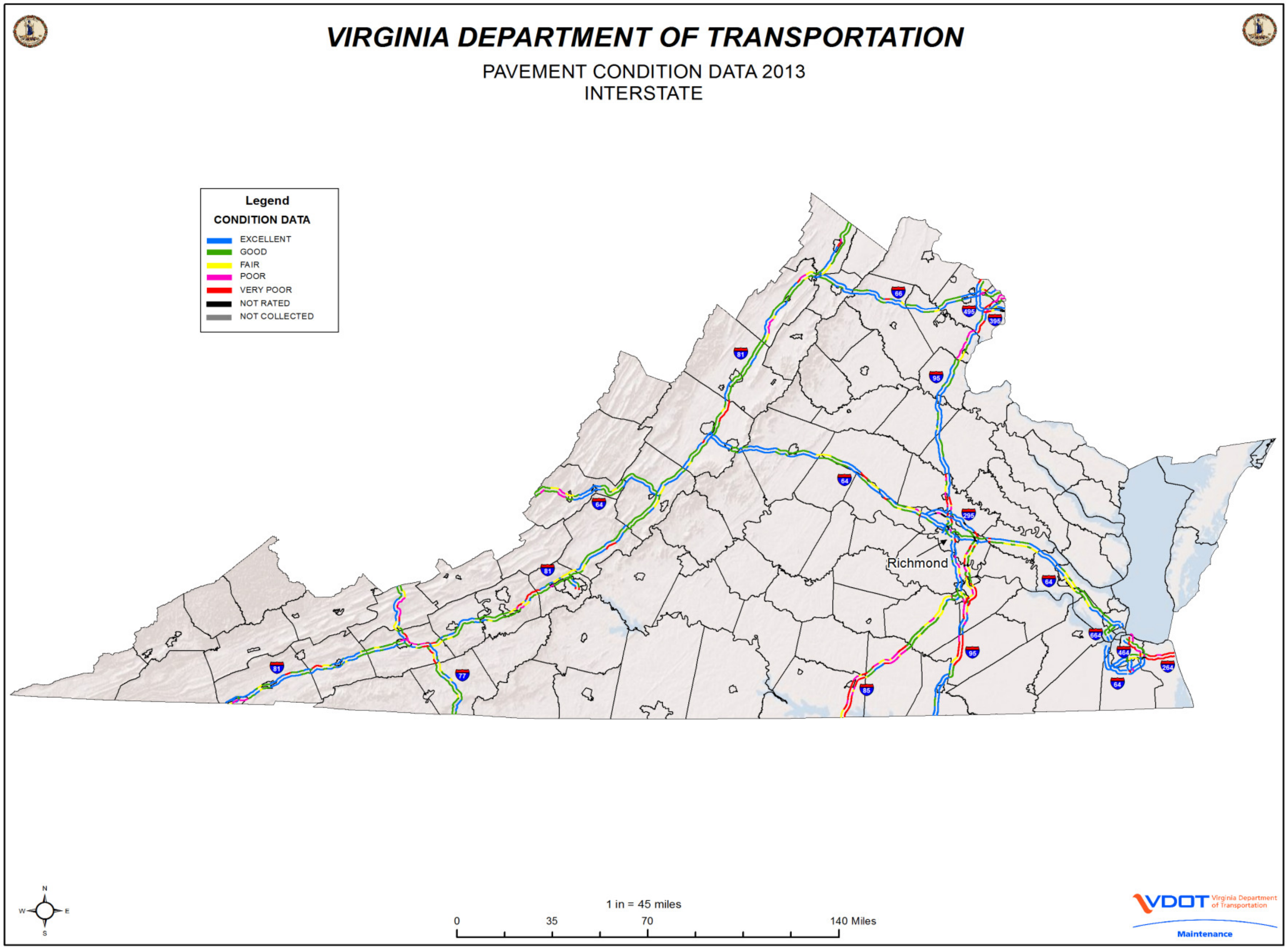
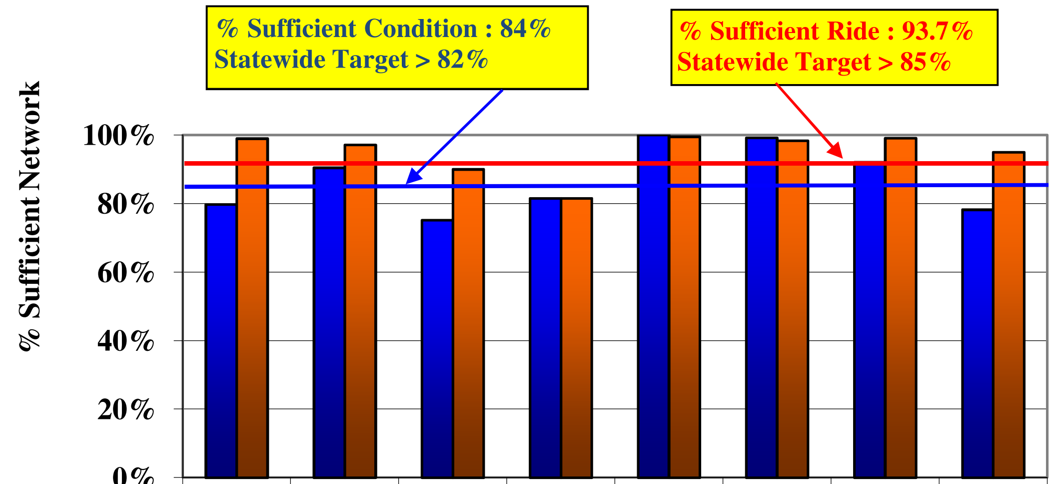
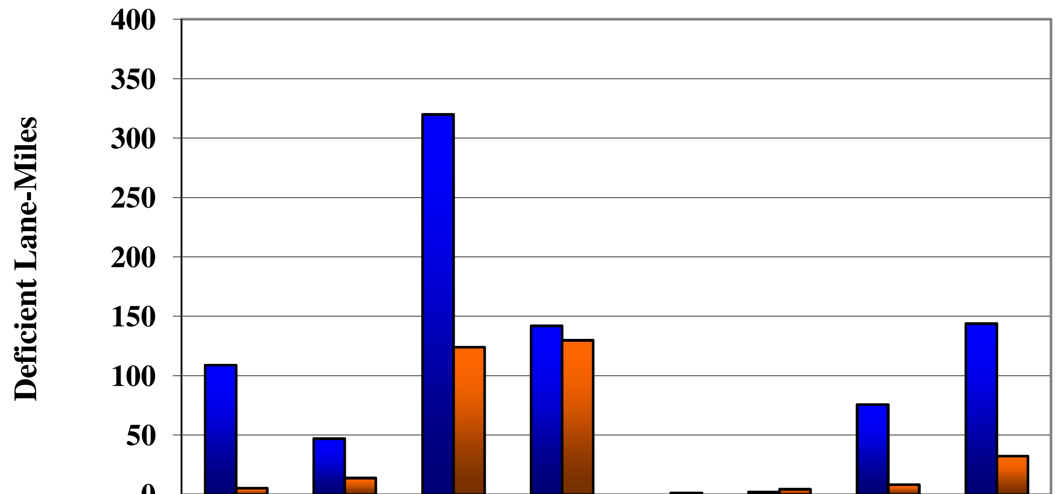

VIRGINIA DEPARTMENT OF TRANSPORTATION
PAVEMENT CONDITION DATA 2013
INTERSTATE
Legend
CONDITION DATA
EXCELLENT
GOOD
FAIR
POOR
VERY POOR
NOT RATED
NOT COLLECTED
Richmond
1 in = 45 miles
0
35
70
140 Miles
VDOT Virginia Department of Transportation
Maintenance

Figure IV: Percent Sufficient by District - Interstate



	1/BR	2/SA	4/RI	5/HR	6/FR	7/CU	8/ST	9/NO
Condition	79.7%	90.4%	75.1%	81.5%	100.0%	99.2%	92.1%	78.2%
Ride Quality	98.9%	97.1%	90.0%	81.5%	99.5%	98.3%	99.1%	95.0%

Figure V: Deficient Lane Miles by District - Interstate



	1/BR	2/SA	4/RI	5/HR	6/FR	7/CU	8/ST	9/NO
Condition	109	47	320	142	0	2	76	144
Ride Quality	6	14	124	130	1	4	8	32

Primary Pavement Condition and Ride Quality by District

The following graphic shows the pavement ratings for the Primary pavement system.

Figures VI and VII show pavement condition and ride quality summaries for the Primary pavement network. Figure VI shows the percent of sufficient network by district based on pavement condition and ride quality along with statewide figures. Figure VII shows the number of deficient lane-miles in each district. Current VDOT performance targets are for 82 percent or more of pavements to be in sufficient condition and for 85 percent or more to have a sufficient ride quality. Based on the data, approximately 83.3% of the Primary network has been rated to be in sufficient condition and 87.5% has sufficient ride quality.

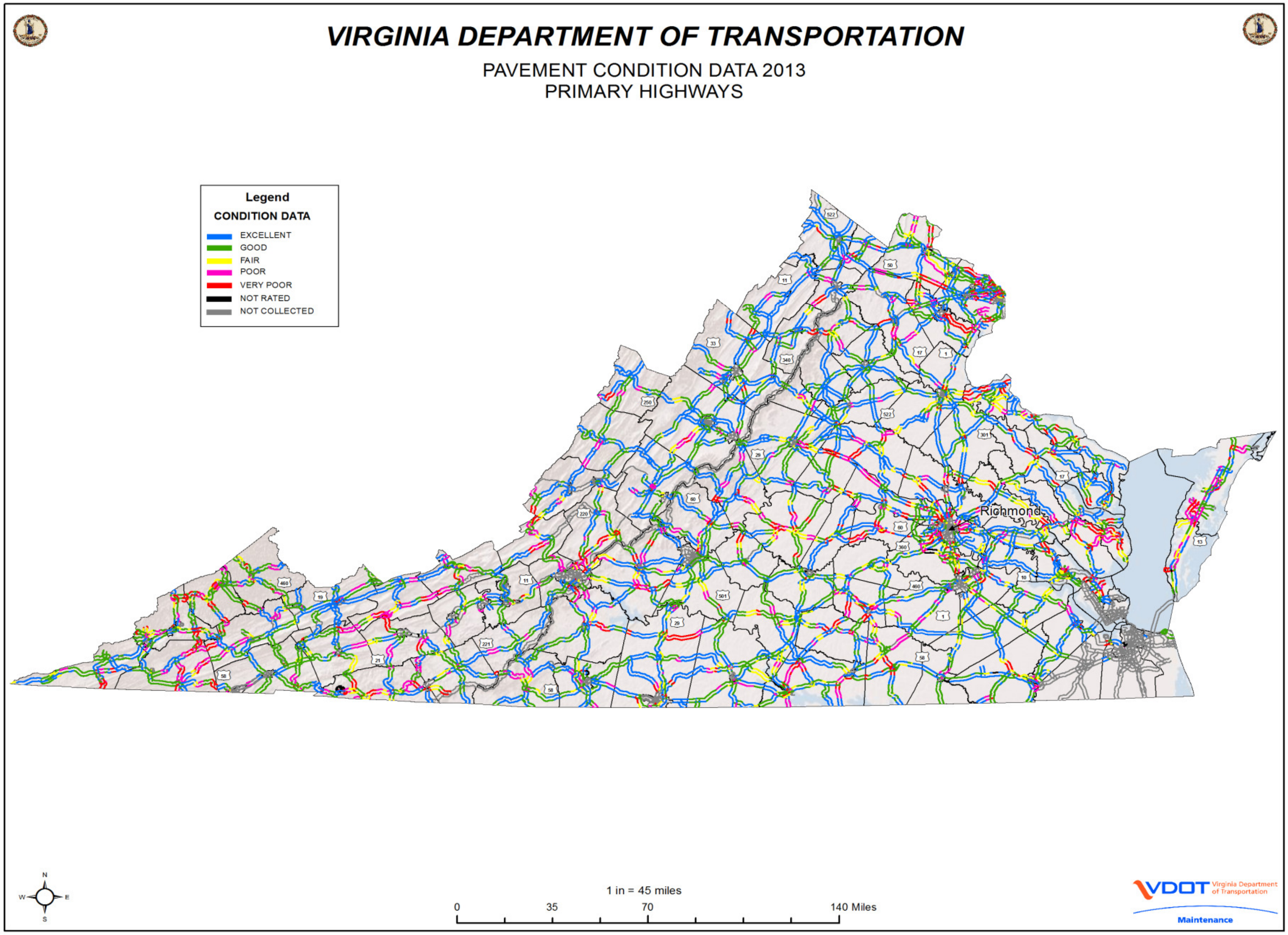
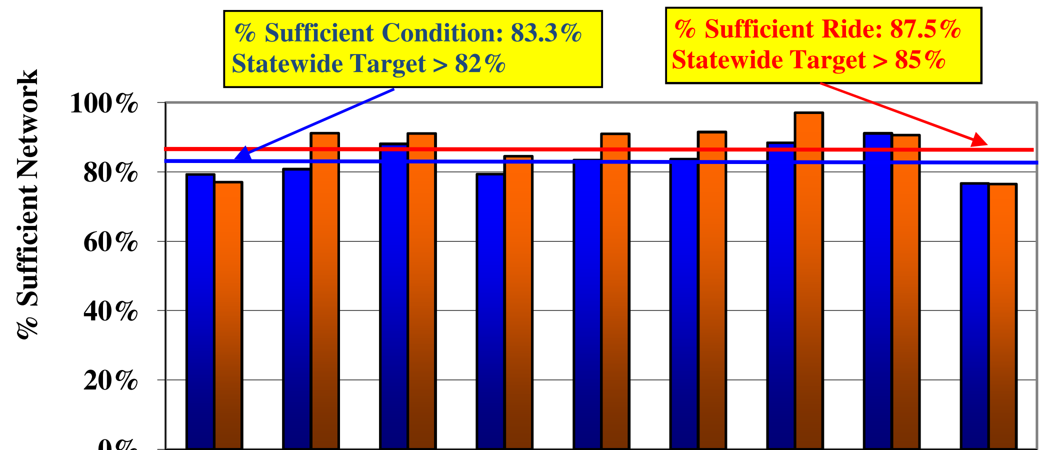
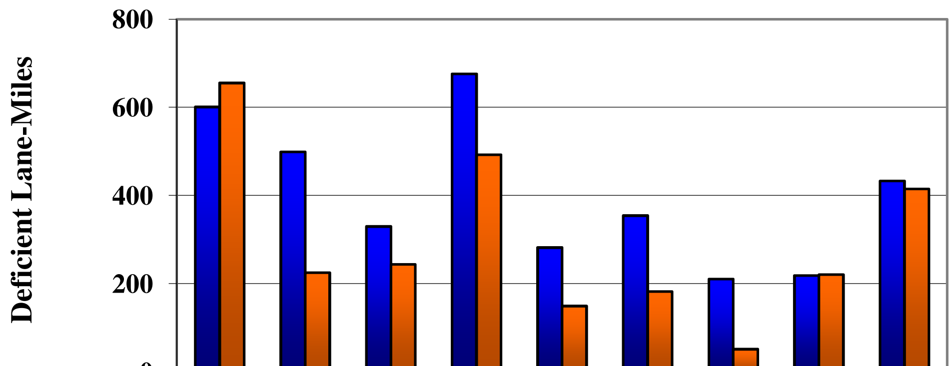

VIRGINIA DEPARTMENT OF TRANSPORTATION
PAVEMENT CONDITION DATA 2013
PRIMARY HIGHWAYS
Legend
CONDITION DATA
EXCELLENT
GOOD
FAIR
POOR
VERY POOR
NOT RATED
NOT COLLECTED
Richmond
1 in = 45 miles
0
35
70
140 Miles
VDOT Virginia Department of Transportation
Maintenance

Figure VI: Percent Sufficient by District - Primary



	1/BR	2/SA	3/LY	4/RI	5/HR	6/FR	7/CU	8/ST	9/NO
Condition	79.3%	80.8%	88.1%	79.4%	83.5%	83.7%	88.5%	91.2%	76.7%
Ride Quality	77.1%	91.2%	91.1%	84.6%	91.0%	91.5%	97.1%	90.6%	76.6%

Figure VII: Deficient Lane Miles by District - Primary



	1/BR	2/SA	3/LY	4/RI	5/HR	6/FR	7/CU	8/ST	9/NO
Condition	601	499	330	676	282	355	211	219	433
Ride Quality	656	225	244	493	149	182	52	221	415

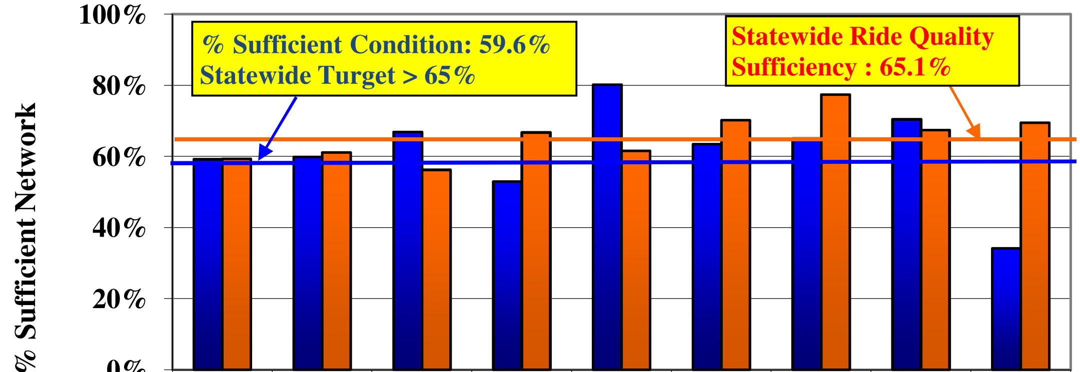
Secondary Pavement Condition and Ride Quality by District

As previously mentioned, the Secondary pavement network was not surveyed in its entirety. In 2013, data in each county was collected and processed for a total of 16,192 lane miles of the VDOT maintained, hard-surfaced Secondary network. VDOT maintains approximately 83,185 lane miles of hard-surfaced Secondary pavements.

Figure VIII shows the percent sufficient network by district based on pavement condition and ride quality. Figure IX represents the number of lane miles surveyed and the number of deficient lane miles in terms of condition and ride quality. Since samples for Secondary pavements were selected from every county of the state, this figure, although not based on the survey of the entire network, is a good representation of the Secondary pavement condition across the state. Based on these figures, Northern Virginia District has the lowest percentage of its Secondary rated as sufficient (34.2%), followed by Richmond and Bristol Districts. Hampton Roads District has the highest percent of sufficient Secondary pavements. Statewide, 59.6% of the sampled Secondary system was found to have pavement condition rated sufficient.

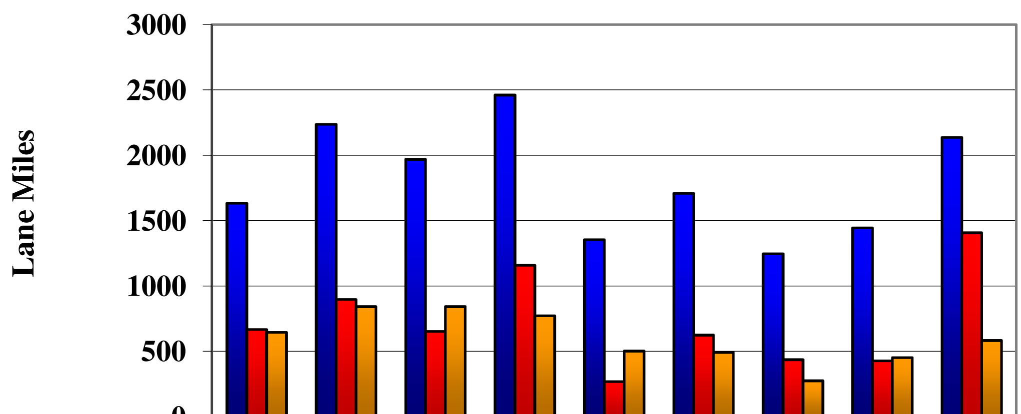
Based on ride quality, the sufficient ratings range from a low of 56.2% sufficient in Lynchburg District to a high of 77.4% in Culpeper District. Statewide 65.1% of the rated samples on the Secondary system were found to have sufficient ride quality.

Figure VIII: Percent Sufficient by District - Secondary (Samples)



	1/BR	2/SA	3/LY	4/RI	5/HR	6/FR	7/CU	8/ST	9/NO
Condition	59.2%	59.9%	66.9%	52.9%	80.2%	63.5%	65.0%	70.5%	34.2%
Ride Quality	59.3%	61.1%	56.2%	66.7%	61.6%	70.2%	77.4%	67.5%	69.5%

Figure IX: Surveyed, Deficient Condition and Deficient Ride Quality Lane Miles by District - Secondary (Samples)

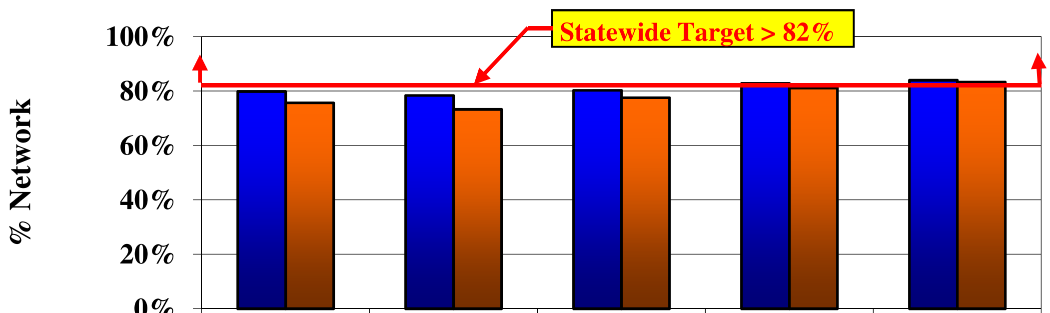


	1/BR	2/SA	3/LY	4/RI	5/HR	6/FR	7/CU	8/ST	9/NO
Surveyed	1633	2237	1969	2462	1355	1709	1246	1444	2138
Deficient Condition	666	897	652	1159	268	624	436	427	1407
Deficient Ride Quality	645	842	842	772	501	490	274	452	582

Statewide Pavement Deficiency Trends

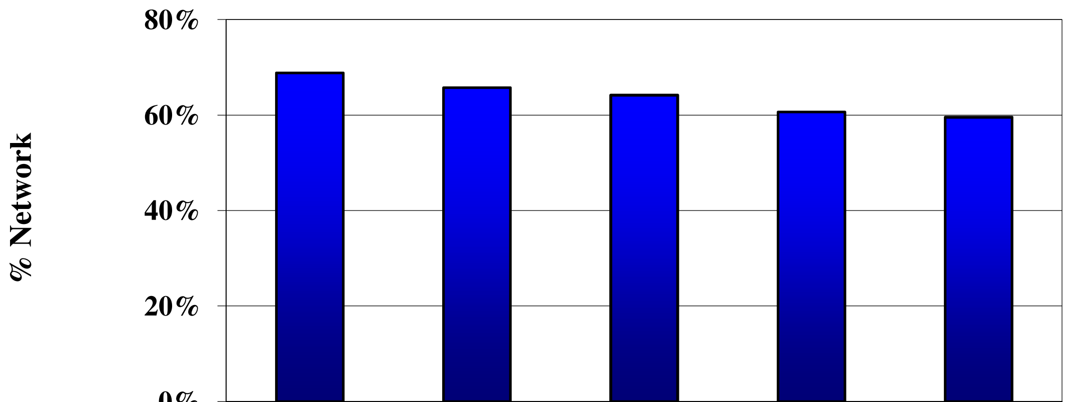
The trends over recent years in Interstate and Primary percent sufficient network are shown in Figure X; trends for the Secondary pavements are shown in Figure XI. The higher the percentage of sufficient pavements, the better is the pavement network condition in general. In Figure X, the statewide performance targets of 82% sufficient are shown for interstate and primary pavements.

Figure X: Trend in Percent Sufficient - Interstate and Primary



	2009	2010	2011	2012	2013
Interstate	79.9%	78.4%	80.3%	82.9%	84.0%
Primary	75.7%	73.3%	77.6%	81.2%	83.3%

Figure XI: Trend in Percent Suficient - Secondary (Samples)



	2009	2010	2011	2012	2013
%Sufficient	68.9%	65.8%	64.2%	60.7%	59.6%

CURRENT AND FUTURE USES OF THE DATA

Pavement condition data presented in this report are used for multiple purposes – both internal and external to VDOT, including:

1. Needs-Based Budgeting. Pavement condition data are used to estimate the cost to achieve and sustain pavement performance targets, and to recommend allocation of available maintenance funds across districts. Thus, the pavement condition data are an important input into the Pavement Management System (PMS) to develop estimates of pavement maintenance and rehabilitation needs based on an optimization analysis. These needs are subsequently used for the development of the biennial maintenance budget and the work plan generated by the optimization serves as a guide to district personnel for the selection of pavement maintenance strategy for the yearly pavement maintenance schedules. Once a particular section of pavement is selected for maintenance, a detailed project level analysis is conducted to determine the specific treatment.

The data are also used to feed the maintenance decision trees to determine the unconstrained maintenance needs for the pavement assets. Unconstrained needs analysis establishes the maintenance and rehabilitation needs to appropriately correct the existing pavement conditions where available funding for work would not be considered a constraint. It provides an idea of the amount and type of work needed on the whole network. For this needs determination, each section's distress quantities and severities, and CCI are input from the condition survey data into the unconstrained decision trees(5). Traffic level, structural condition, and maintenance history are also used as additional inputs to the selection of maintenance treatments wherever the data are available. In many cases the unconstrained needs are used as the first indicator of the scope of necessary maintenance which is further refined by field inspections, detailed project level analysis, and overall needs of the network.

2. Planning for Preventive Maintenance and Resurfacing. The surface distress condition data are used to identify and prioritize recommended candidate pavement sections for preventative maintenance activities. These recommendations are based on decision trees developed for the needs analysis, as described above.

The pavement data are used for selection of pavement sections and maintenance strategies for yearly pavement maintenance schedules. Automated data that provide high consistency and efficiency are used to aid in prioritizing Maintenance Resurfacing by the districts. Typically, the districts have used the data in combination with their local knowledge of pavement conditions to select pavement projects.

Information about specific distresses can be used to determine appropriate maintenance and rehabilitation actions for consideration. For example, a pavement with serious load related distress would typically require a resurface or "mill and fill" treatment, whereas a preventive maintenance treatment would be more appropriate for a pavement with primarily non-load related distresses.

3. Pavement Performance Reporting. The pavement condition data play a major role in preparation of two legislatively mandated reports. One report is the biennial infrastructure condition report required by Section 33.1-23.02(B.3) of the Code of Virginia. The second report, required by Section 33.1-13.03 each year, concerns the condition of and needs for maintaining and operating the existing transportation infrastructure based on an asset management methodology.

The data are also used for tracking performance measures on the dashboard and are reported to the Commonwealth Transportation Board (CTB) yearly. The dashboard uses the condition data to display the percent of pavement in fair or better condition for each district, county and system in the form of a gauge, and also as a bar chart. The gauge points to the percent of pavement in non-deficient condition, with a tic mark to show the last year's results. All pavements on the Interstate and Primary road systems in Virginia are assessed each year and rated in one of the following categories: Excellent, Good, Fair, Poor, or Very Poor. Segments of pavement classified as Poor and Very Poor are considered deficient, all others are non-deficient. VDOT's goal, as established by the Commonwealth Transportation Board's policy, is to have a minimum of 82% of Interstate and Primary pavement; and 65% of Secondary pavement in Excellent, Good, or Fair condition.

The percent of pavement with fair or better ride quality is also displayed in a separate gauge. The performance target for sufficient ride quality is 85% for Interstate and Primary pavements, meaning that VDOT's goal is to have at least 85% of the pavements with fair or better ride quality.

4. Federal HPMS Reporting. Pavement condition data are included in VDOT's Highway Performance Monitoring System (HPMS) data submission to FHWA. This report is the basis for the federal apportionment of Virginia's share of federal funds. VDOT provides the FHWA with the length, roughness and lane-miles on state maintained roads in various functional systems for assessing and reporting highway performance. HPMS data are also used for assessing and reporting highway system performance under FHWA's strategic planning process and are the source for a substantial portion of the information published in Highways Statistics and in other FHWA publications and media. Finally, the HPMS data are widely used throughout the transportation community, including other governmental interest, business and industry, institutions of higher learning, the media and general public. More details can be found in the HPMS Field Manual(6). HPMS data specifications have expanded to include requirements to report surface distress quantifications as well as additional pavement structural information for a statistical sample of highway sections. The data collected in the annual pavement condition survey will be used to meet many of the new reporting requirements.

5. Research Needs. Pavement data are made available to a variety of customers both internal and external to VDOT to meet research, analysis and planning needs. The data are also used for other purposes including determination of performance of various types of paving materials/mix designs as well as in initial screening to identify locations for detailed project level analysis when planning maintenance and rehabilitation activities.

Accumulation of consistent and quality pavement condition data over time will also allow VDOT to predict future pavement performance trends more accurately, enabling VDOT to more efficiently manage the pavement assets. It will also help the agency measure maintenance cost effectiveness, study the influence of new construction materials on pavement performance, and can serve as a basis for future vehicle cost responsibility studies.

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STATE OF THE PAVEMENT - 2013

BACKGROUND

The Virginia Department of Transportation (VDOT) maintains the third largest public road network in this country, covering a total of about 58,333 miles consisting of about 1,120 miles of Interstate highways, 8,048 miles of Primary highways and 48,837 miles of Secondary roads. The pavement management program in Virginia began with the establishment of a pavement inventory. That phase took place in the 1970s with the manual gathering of pavement records including those of construction history and rehabilitation projects. The merging of those early pavement records and the then existing highway inventory eventually evolved into what was known in VDOT as the Highway Traffic Records Information/Inventory System (HTRIS). While, as the name implies, HTRIS was heavily oriented toward traffic engineering needs, it also was the first repository for pavement construction and rehabilitation records or pavement inventory. The Roadway Network System (RNS) created a replacement system for the aging HTRIS mainframe system. The new system now incorporates a relational database that provides universal enterprise data access, links geo-spatial data and business attributes to the roadway centerlines, and provides web accessibility to users currently unable to retrieve critical roadway data. In 2013 Roadway Inventory Management System (RIMS) is the new system of record for VDOT's road data inventory. As this initiative evolves, new business processes will be established that will streamline data editing and maintenance and will clarify and clean data and allow efficient data sharing across applications.

A second stage of pavement management activity in the state took place in the early 1980s and involved the development of a first generation pavement condition assessment methodology. This methodology, used throughout most of the 1980s and early 1990s, was a windshield survey based index procedure called the distress maintenance rating (DMR) with a rating scale of 0 to 100, with 100 being a pavement with no visual surface distress. The procedure gave consideration only to pavement surface distresses with heavy emphasis on cracking and patching. In the mid-1990s VDOT began to collect pavement distress data through the use of videotaped images. To make use of data collected from those tapes, VDOT also made interim use of the pavement condition index (PCI) defined and used by the U.S. Army Corps of Engineers[(7)]. After several trial years, the PCI was deemed too general for Virginia conditions and a VDOT specific method was developed. Briefly, that system recognizes that pavement distresses fall into two basic categories; they are either load related (caused by the application of vehicular loadings) or they are not load related (caused by the exposure of pavement elements to the environment). This realization gave rise to the development of two separate indices to describe pavement surface distresses. These are the load related distress rating (LDR) and the non-load related distress rating (NDR). These two indices also use 0 to 100 scales and are the basis for asphalt pavement surface condition evaluation in VDOT.

The advent of pavement data collection through contracted, automated means led to a need to standardize the procedures for the purposes of consistency and as a contractual instrument for bidding purposes. The document providing this standardization, *A Guide To Evaluating Pavement Distress Through The Use Of Digital Images* [1], was developed and made available to vendors bidding on contract data collection.

Pavement distress condition throughout the state is crucially important information and one of the most important products of the Pavement Management Program. Dissemination of that product throughout the agency is a major reason the 1998 condition report [8], the 2002-2004 reports [9]-[11], the 2006 report [12], and the 2008-2012 condition reports[13]-[17] were assembled. One of the uses of this information is to aid in the maintenance activities of the agency. Another value of disseminating this information is to receive feedback from users on the pavement management and the asset management systems. This feedback will be used to identify and address changes that may enhance the continued implementation of the Pavement Management System.

PURPOSE AND SCOPE

The present document is more of a "fact sheet" than an in-depth research report; the intention is to provide the reader with an overall assessment of the condition of pavements throughout the Commonwealth. The condition of pavements in terms of condition states, deficient pavement network, summaries of key distresses, and ride quality are included in this report.

Previously, only the surface distress, roughness and rutting data were collected, which had limitations. Any consideration of the structural integrity of the pavements had to be deduced from the nature of the distresses (e.g., early alligator or fatigue cracking would suggest a pavement is subject to loadings in excess of its design capacity).

The surface distress data are collected and analyzed on all of the Interstate and Primary pavements, and a 20-25% sample of the hard-surfaced Secondary pavement network.

PAVEMENT DATA COLLECTION, DATA PROCESSING & QC/QA

The pavement condition data presented in this report were collected and processed by a contractor (Fugro-Roadware Inc.) using continuous digital imaging and automated crack detection technology. For data collection purposes, Fugro-Roadware uses vehicles equipped with special cameras to capture downward pavement images for crack detection, and a forward perspective view. Roughness and rutting data are simultaneously captured with the sensors mounted on the van. The data are collected at highway speeds as the vans are driven along the pavement. Downward images collected during the survey are processed with specialized automated crack detection software

(Wise-Crax) for the identification of cracks. Further analysis of digital images is necessary for the identification of other distresses; such as patching, bleeding or delamination. The following sections describe the major data items that are collected, and the results of the 2013 surveys.

DISTRESS DATA ELEMENTS COLLECTED

Distresses were collected for various pavement types following the protocols specified in the distress data collection manual: "A Guide to Evaluating Pavement Distress Through the Use of Digital Images[1]." The data elements collected are provided in Appendix A for all of the following pavement types: continuously reinforced concrete pavement (CRCP), jointed concrete pavement (JCP) and asphalt-surfaced concrete pavement (ACP) that further includes bituminous (BIT), bituminous over jointed concrete (BOJ), and bituminous over continuously reinforced concrete (BOC) pavements. Detailed distress data in terms of extents and severities are collected and summarized for each 0.1 mile as well as for each homogeneous section. For ease of interpretation, the data are also summarized in the "ACP-INPUT" format which is used in the decision matrices to determine maintenance and rehabilitation recommendations. This is similar in format to the "windshield" data obtained while data were collected by windshield surveys before automated data collection method was adopted. The details of the various formats of the data for different types of pavements are provided in Appendix A, and the distribution of key distresses can be found in Appendix B.

QUALITY ASSURANCE

An independent QA process is an important consideration for quality data. For the 2013 data collection, the QA process began with evaluation of control sections comprised of ACP, CRCP and JCP for Interstate, Primary and Secondary systems. Image evaluations were completed on 14 control sections distributed over the system and pavement types. The control sections were used to calibrate the pavement distress rating process and also to establish the precision and bias values for the roughness and rutting measurements.

For the rutting and roughness comparison, the precision (repeatability), as specified in the terminology of ASTM E177[18] and the bias, based upon the average value or "ground truth", were used for QA checks. A data-collection vehicle is considered to have passed the QA checks if it is capable of collecting rutting and roughness data within the specified repeatability limits.

For the production ratings, batches of data, including Interstate, Primary and Secondary system ACP, JCP and CRCP pavements, were delivered to, and reviewed by the Independent data Verification and Validation (IV&V) contractor. Five percent of the data delivered in each batch were randomly chosen for QA and rated independently by the IV&V contractor. A batch is considered to have passed the QA checks when the CCI index values from the production data fall within 10 points of the CCI values from the IV&V ratings for 90% of the pavement length. In addition to the random 5% QA checks, a "high-level" data review consisted of reasonableness and a completeness check was also conducted for each delivery table. The ratings on pavement sections were also compared with the previous year's ratings on the same sections. Any major differences in ratings were further investigated.

PAVEMENT INVENTORY EVALUATED

The 2013 automated condition surveys began in November, 2012 and were completed, including the QA evaluations, by late July of 2013. The following sections summarize the inventory evaluated and the results of those surveys, including the establishment of a scale of relative condition evaluation.

The surveys were conducted in the rightmost traffic lane, usually designated lane 1 in the VDOT pavement inventory, while the tabulations, graphs, and discussions below were extended to a lane mile basis. For example, a one-mile long pavement section with three lanes in the direction of rating would be reported as three lane miles. Using the method described above, about 5,259 lane miles on Interstate and 21,626 lanes miles on Primary (25,999 lanes miles of ACP pavements and 886 lanes miles of JCP and CRCP pavements) are accounted for in 2013 surveys.

Because of the size of the Secondary system, the entire condition data collection is completed in a four to five-year time window, starting from the year 2007 and with a different 20-25% portion of the network each consecutive year. For this purpose, 20-25% of the lane miles are chosen for survey in each county, and approximately 16,192 lane miles of Secondary pavements were surveyed in 2013.

PAVEMENT CONDITION - 2013

The 2013 automated condition surveys began in November, 2012 and were completed, including the QA evaluations, by late July of 2013. The following sections summarize the inventory evaluated and the results of those surveys, including the establishment of a scale of relative condition evaluation.

CONDITION EVALUATION CRITERIA

Table 1 provides a scale for evaluation for the 2013 pavement surface distress condition survey results. The index scale provided in that table is the result of experience with previous windshield surveys and reflects earlier action of the VDOT Pavement Management Engineering Team (PMET). The PMET action was a decision that pavements with a condition index of less than 60, referred to as the deficient pavements, would be evaluated further for possible higher types of maintenance and rehabilitation.

The condition state of pavement shown in Table 1 is based on CCI values. For asphalt surfaced pavements LDR and NDR are used and CCI is defined as the lower of the two values. The slab distress rating (SDR) is used for JCP pavements and the Concrete Punchout Rating (CPR) and the Concrete Distress Rating (CDR) are collected for CRCP pavements. However, the same concept of CCI and the same scale in Table 1 apply to the latter two pavement types as well: SDR is directly equivalent to CCI for JCP pavements; and the lower of CDR and CPR is equivalent to CCI for CRCP pavements. More details about these concrete pavement condition indices are documented in another VDOT report[3]. In general, pavements rating less than 60 by either index are considered to be deficient, i.e., they need some kind of attention, more specifically, some heavier type of maintenance/rehabilitation actions. The deficient pavement in each county and district for Interstate and Primary pavements is presented in Appendix C. Appendix D shows that maps of condition of Interstate and Primary pavements.

Table 1: Pavement Condition Definition

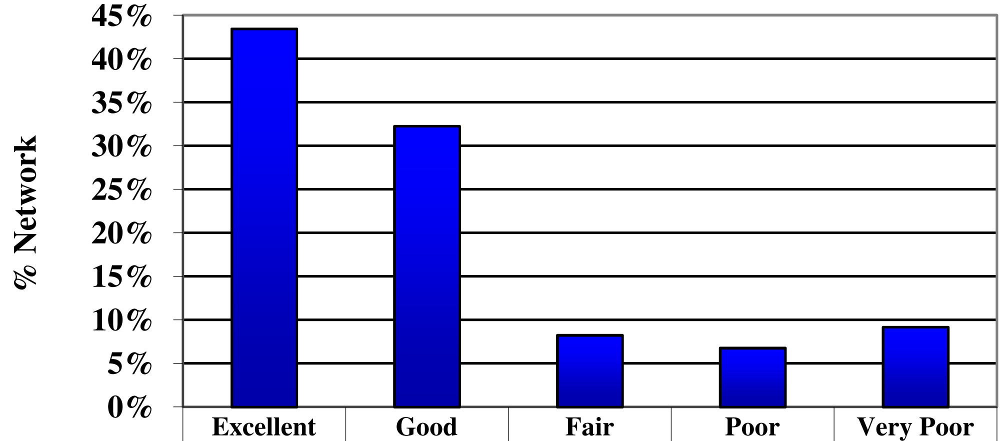
Pavement Condition	Index Scale (CCI)
Excellent	90 and above
Good	70-89
Fair	60-69
Poor	50-59
Very Poor	49 and below

THE CONDITION OF INTERSTATE PAVEMENT

The percentage of pavements in different condition states is shown in Figure 1 for the Interstate system. It shows that more than 82 percent of the Interstate pavements are in fair or better condition on statewide basis. The distribution of Interstate condition states on a district basis is presented in Figure 2. Here all of the condition states are represented as percentages in the chart along with numerical values.

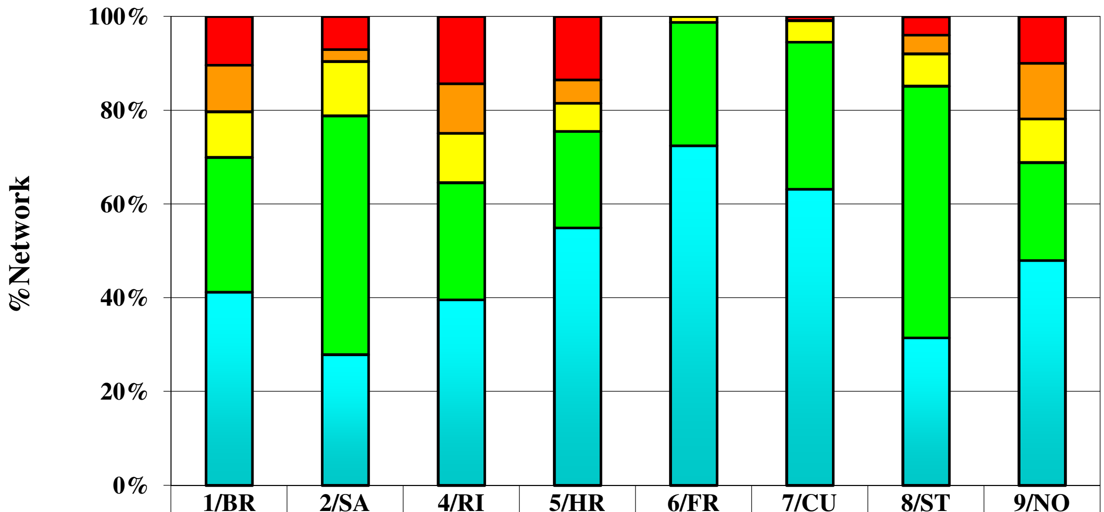
Figure 3 is a bar chart that presents the Interstate deficient lane miles in each district. This chart also presents the deficient lane miles by pavement type: Asphalt Concrete (AC), Continuously Reinforced Concrete (CRC) and Jointed Reinforced Concrete (JRC) in each district. Deficient pavements typically need some type of higher maintenance and rehabilitation treatments. Since the deficient lane miles presented in Figure 3, are part of different Interstate network sizes in different districts, the percentage of deficient pavements is presented in Figure 4. The percentage of deficient pavements equals one hundred minus the percentage of sufficient pavements.

Figure 1 : Pavement Condition - Interstate



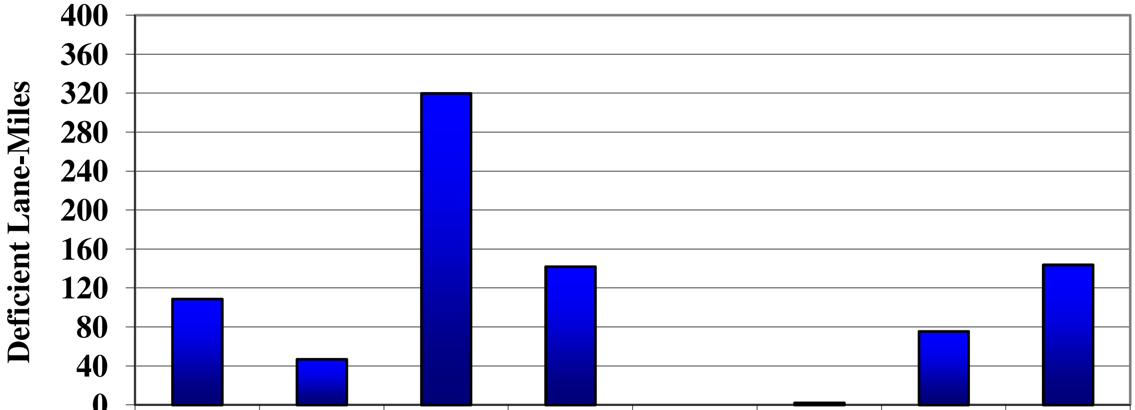
	Excellent	Good	Fair	Poor	Very Poor
Condition	43.5%	32.3%	8.2%	6.8%	9.2%

Figure 2 : Pavement Condition by District - Interstate



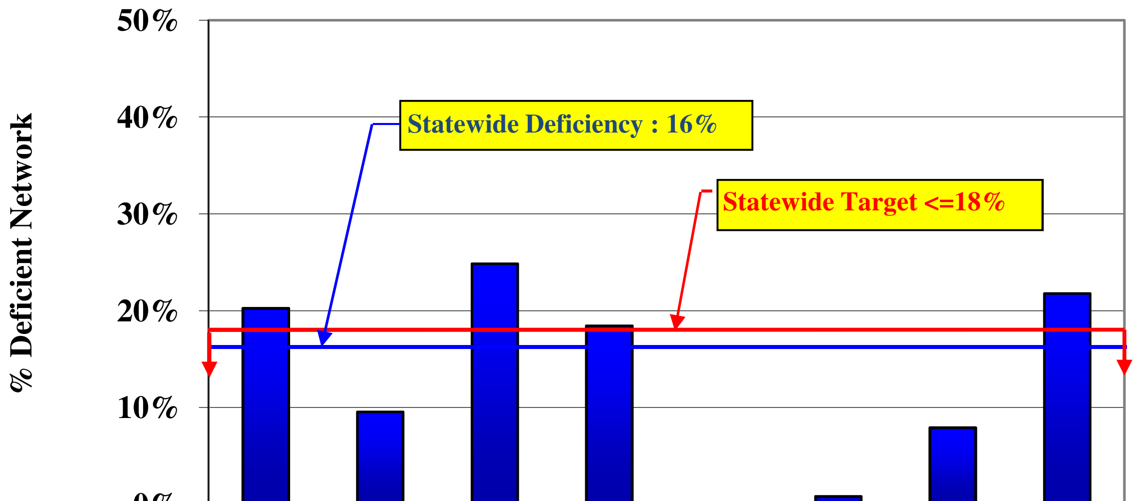
	1/BR	2/SA	4/RI	5/HR	6/FR	7/CU	8/ST	9/NO
Very Poor	10.4%	7.0%	14.3%	13.5%	0.0%	0.8%	3.9%	10.0%
Poor	9.9%	2.6%	10.6%	5.0%	0.0%	0.0%	4.0%	11.8%
Fair	9.8%	11.6%	10.5%	6.0%	1.2%	4.6%	6.9%	9.3%
Good	28.7%	50.9%	25.0%	20.6%	26.3%	31.4%	53.7%	20.9%
Excellent	41.2%	27.9%	39.6%	54.9%	72.5%	63.2%	31.5%	48.0%

Figure 3: Deficient Lane Miles by District - Interstate



	1/BR	2/SA	4/RI	5/HR	6/FR	7/CU	8/ST	9/NO
Total	109	47	320	142	0	2	76	144
ACP	109	47	247	49	0	2	76	144
CRCP	N/A	N/A	70	8	N/A	N/A	N/A	N/A
JRCP	N/A	N/A	3	85	N/A	N/A	N/A	0

Figure 4: Percent Deficiency by District - Interstate



	1/BR	2/SA	4/RI	5/HR	6/FR	7/CU	8/ST	9/NO
% Deficient	20.3%	9.6%	24.9%	18.5%	0.0%	0.8%	7.9%	21.8%

A performance target of a maximum of 18% deficient pavements is established for Interstate pavements. A lower value of percent deficient is preferred since it indicates lower percentage of pavements in poor and very poor condition, i.e., higher percentage of pavements in fair or better condition. In Figure 4 the statewide performance target of 18% deficient is represented by a line, and the current percent deficient of 16% for Interstate pavements is represented by another line. It can be seen that four districts are below performance target of maximum 18% deficiency. District 6 shows the lowest percentage deficient, at 0%, whereas the highest percentage, 24.9%, is found in District 4.

ASPHALT SURFACED PAVEMENT

For asphalt surfaced pavements some of the key distresses are presented in Table 2 for each district. Alligator cracking and patching area are presented as percentages of the total area of pavement. Rutting is presented in terms of average value while transverse and longitudinal cracking are presented in terms of linear feet per lane mile. Distress types, quantities and severities are important factors in recommending maintenance and rehabilitation actions. Also, these distresses provide an indication of the type of damage to the pavements. Alligator cracking and rutting are induced by traffic loads while longitudinal and transverse cracking are typically caused by environmental effects, use of improper materials, construction deficiencies, etc.

Table 2, below, quantifies certain key distresses found on the Interstate Asphalt Pavements by district. For example, the table shows that the percentage of alligator cracking varies from a low value of 0.1% in Fredericksburg District to a high of 2.9% in Northern Virginia district. Also, it can be seen that, by district, the variation of average rutting values is relatively small from a lowest value of 0.13 inch to a highest value of 0.18 inch.

Table 2: Major Distresses on Interstate Asphalt Pavement

Key Distresses	1/BR	2/SA	4/RI	5/HR	6/FR	7/CU	8/ST	9/NO
Alligator Cracking (% total area)	2.3%	1.2%	2.5%	1.3%	0.1%	0.5%	0.8%	2.9%
Patching (% total area)	0.5%	1.1%	0.8%	0.3%	0.1%	0.1%	1.8%	0.8%
Rutting (inches)	0.17	0.18	0.15	0.15	0.13	0.15	0.17	0.13
Transverse Cracking (ft/lane mile)	234	403	1011	404	283	211	167	730
Longitudinal Cracking (ft/lane mile)	2065	1619	1097	517	57	562	2096	882

CONTINUOUSLY REINFORCED CONCRETE PAVEMENT

For CRC pavements the percentage of asphalt patching, punchout area, PCC patching, and transverse cracking are presented in Table 3. A punchout is a serious distress that occurs in a CRC pavement constituting structural failure, and asphalt patch on concrete pavement is considered temporary in nature until a more permanent concrete patch can be applied. Punchouts, asphalt patching, and concrete patching are presented in terms of percent area of pavement. In the case of transverse cracking, both average length per mile and average spacing between transverse cracking are presented. It should be noted that the areas where cluster cracking occur are excluded for the determination of average spacing between transverse cracks. Richmond and Hampton Roads are the only two districts with CRC pavements on the Interstate system.

Table 3: Major Distresses on Interstate CRC Pavement

Key Distresses		4/RI	5/HR
Asphalt Patching (% total area)		0.3%	0.2%
Punchout (% total area)		0.3%	0.1%
PCC Patching (% total area)		16.7%	11.9%
Transverse Cracking	ft/lane mile	6,930	5,598
	Spacing (ft)	7.7	10.1

JOINTED REINFORCED CONCRETE PAVEMENT

The percent of slabs of jointed concrete pavements with transverse cracks, corner breaks, PCC patching, and asphalt patching are presented in Table 4. On the Interstate system, JRC pavements are present only in Richmond, Hampton Roads, and Northern Virginia districts. Corner breaks and transverse cracks are some of the distresses that help in the determination of the required treatment type. Asphalt and PCC patching on jointed concrete pavements indicate the areas of deterioration of the slabs. Shattered slabs indicate severe damage to slabs, and they are not included in the table since the percentage of their occurrence is very low.

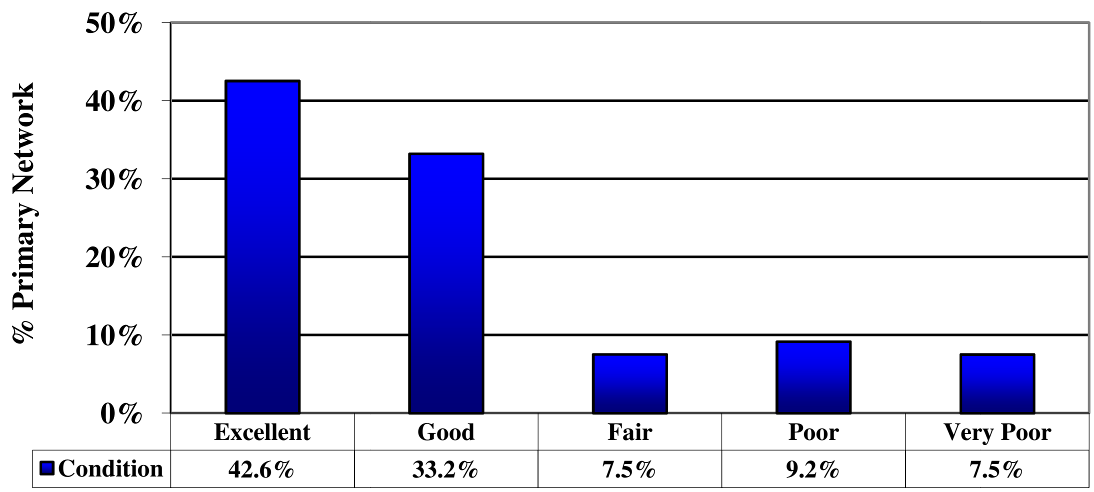
Table 4: Major Distresses on Interstate JRC Pavement

Key Distresses	4/RI	5/HR	9/NO
Transverse Cracking (% slabs)	12.2%	11.0%	0.6%
Corner Breaks (% slabs)	2.1%	0.9%	1.3%
PCC Patching (% slabs)	3.3%	1.3%	0.1%
Asphalt Patching (% slabs)	18.4%	9.8%	2.2%

CONDITION OF PRIMARY PAVEMENT

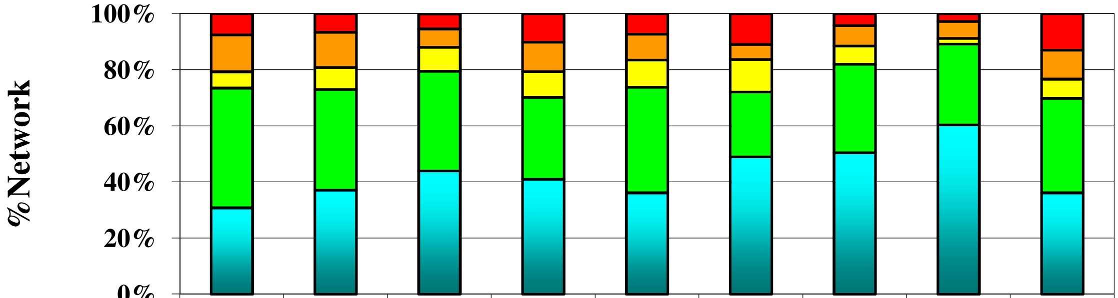
The statewide distribution of pavement condition on the Primary system is presented in Figure 5. It can be seen that the percentage of pavements in fair or better condition is 83.3%.

Figure 5: Pavement Condition - Primary



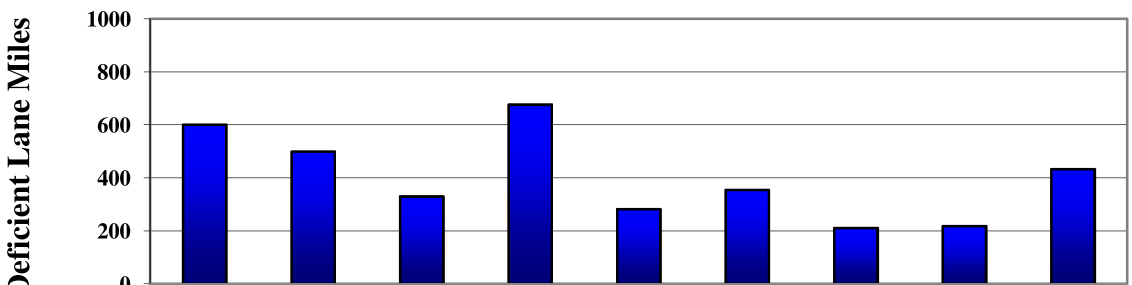
The distribution of pavement condition states on Primary system by district is shown in Figure 6. From the chart it can be seen that the overall pavement condition distribution is best in Staunton district with the worst conditions observed in Northern Virginia.

Figure 6 : Pavement Condition by District - Primary



	1/BR	2/SA	3/LY	4/RI	5/HR	6/FR	7/CU	8/ST	9/NO
Very Poor	7.5%	6.6%	5.3%	10.1%	7.3%	11.0%	4.2%	2.7%	13.0%
Poor	13.2%	12.6%	6.6%	10.5%	9.2%	5.3%	7.3%	6.1%	10.3%
Fair	5.8%	7.8%	8.5%	9.2%	9.7%	11.6%	6.5%	2.0%	6.8%
Good	42.7%	35.9%	35.6%	29.2%	37.6%	23.2%	31.5%	28.8%	33.7%
Excellent	30.8%	37.1%	44.0%	41.0%	36.2%	48.9%	50.5%	60.4%	36.2%

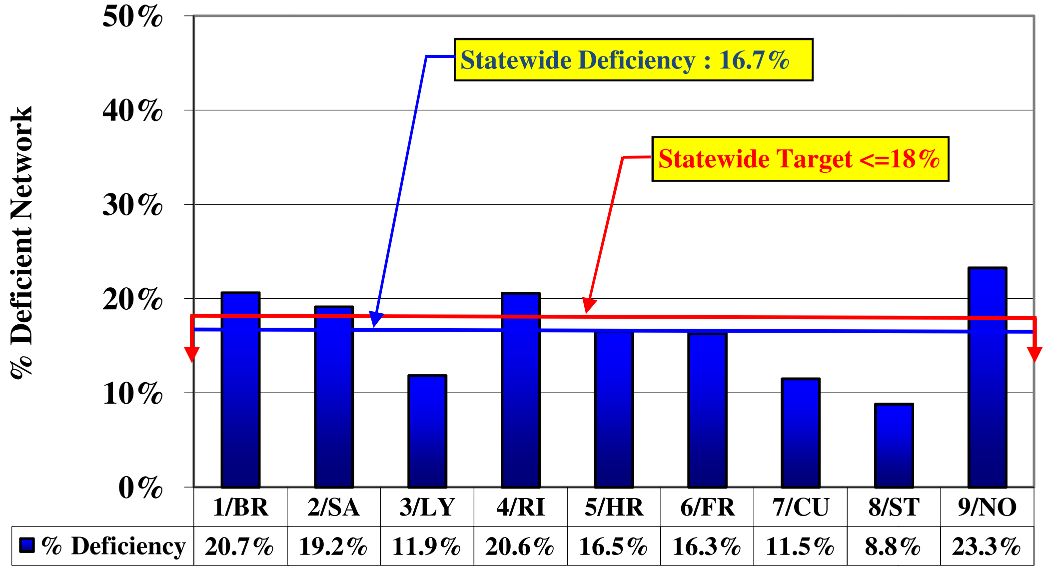
Figure 7: Deficient Lane Miles by District - Primary



	1/BR	2/SA	3/LY	4/RI	5/HR	6/FR	7/CU	8/ST	9/NO
Total	601	499	330	676	282	355	211	219	433
ACP	601	499	327	621	271	355	211	219	432
CRCP	N/A	N/A	1	36	4	N/A	N/A	N/A	N/A
JRCP	N/A	N/A	2	19	7	N/A	N/A	N/A	1

Figure 7 presents the deficient lane miles in each district, with numerical values by pavement type. Again, each district maintains a different size network, so the total deficient lane miles vary from district to district based on both the relative size and condition of each network. For Primary pavements, Culpeper District has the least number of deficient lane-miles (211) while Richmond District has the highest (676).

Figure 8: Percent Deficiency by District - Primary



The percent deficient lane mile in each district is presented in Figure 8. The performance target of a maximum of 18% pavement rated as deficient as well as the statewide average percent deficiency of 16.7% are also shown in the figure. Districts 3, 5, 6, 7, and 8 are below the target, Districts 1, 2, 4, and 9 are above the target. The percentage of deficient pavements varies from a low of 8.8% in District 8 to a maximum of 23.3% in District 9.

ASPHALT SURFACED PAVEMENT

Some of the key distresses for asphalt surfaced pavements are presented in Table 5. These include percentage of alligator cracking, patching, rutting, transverse cracking and longitudinal cracking. Distress types, severities, and quantities constitute important inputs in the determination of maintenance/rehabilitation types needed.

Table 5: Major Distresses on Primary Asphalt Pavement

Key Distresses	1/BR	2/SA	3/LY	4/RI	5/HR	6/FR	7/CU	8/ST	9/NO
Alligator Cracking (% total area)	2.9%	3.2%	2.8%	4.0%	3.2%	3.3%	3.3%	1.3%	4.0%
Patching (% total area)	2.2%	2.1%	1.8%	1.1%	0.4%	1.0%	0.5%	2.0%	1.2%
Rutting (inches)	0.15	0.14	0.13	0.14	0.14	0.14	0.13	0.13	0.13
Transverse Cracking (ft/lane mile)	606	1206	1097	1301	1406	1275	672	264	1135
Longitudinal Cracking (ft/lane mile)	594	822	356	671	369	314	323	211	701

CONTINUOUSLY REINFORCED CONCRETE PAVEMENT

Some of the key distresses in CRC pavements include: asphalt patching, punchouts, PCC patching, and transverse cracking and are presented in Table 6. In the case of transverse cracking, both the average length per mile and average spacing between the cracks are presented. For the determination of average spacing between the transverse cracks, the area of cluster cracking is excluded. Smaller quantities of transverse cracks per lane mile imply that the spacing between the cracks would be larger. Lynchburg, Richmond, and Hampton Roads are the only three districts with CRC pavements on the Primary system.

Table 6: Major Distresses on Primary CRC Pavement

Key Distresses		D3 LY	D4 RI	D5 HR
Asphalt Patching (% total area)		0.0%	0.7%	0.0%
Punchout (% total area)		0.0%	0.2%	0.0%
PCC Patching (% total area)		0.2%	15.0%	0.1%
Transverse Cracking	ft/lane mile	9,727	5,448	4,146
	Spacing (ft)	5.8	10.1	13.6

JOINTED REINFORCED CONCRETE PAVEMENT

The percentage of slabs with transverse cracks, corner breaks, PCC patching, and asphalt patching are presented in Table 7. As expected, it can be seen from the tables that transverse cracking and PCC patching are common distresses on JRC pavements. Only four districts have JRC pavements on the Primary system.

Table 7: Major Distresses on Primary JRC Pavement

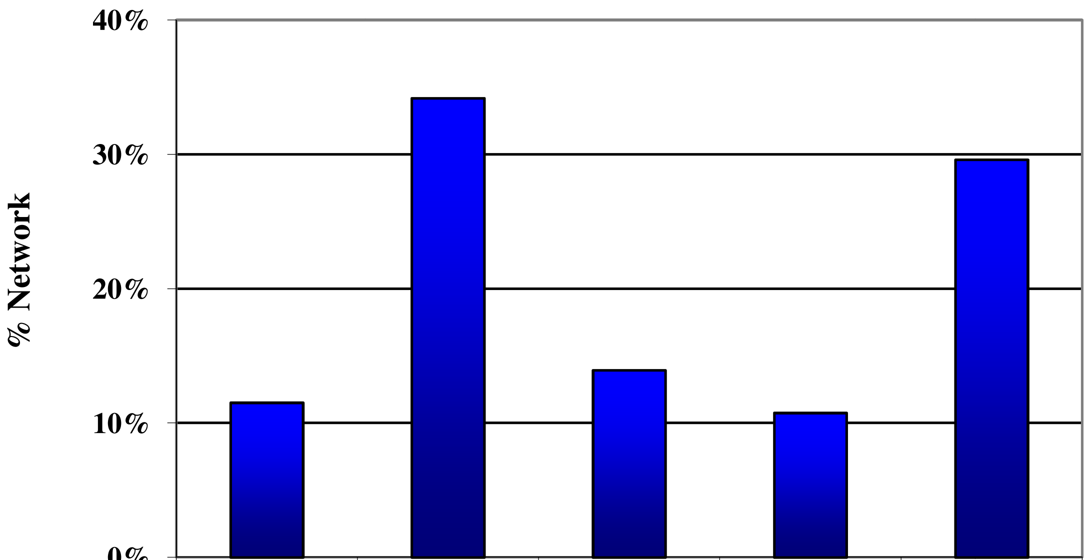
Key Distresses	D3 LY	D4 RI	D5 HR	D9 NO
Transverse Cracking (% slabs)	24.6%	9.7%	13.1%	10.5%
Corner Breaks (% slabs)	0.1%	1.5%	1.6%	2.5%
PCC Patching (% slabs)	0.4%	2.6%	3.7%	9.2%
Asphalt Patching (% slabs)	2.1%	12.2%	5.8%	17.5%

CONDITION OF SECONDARY PAVEMENT

The Secondary pavement network is not surveyed in its entirety due to the size of the state maintained Secondary network which makes complete collection impractical due to the time and cost required for such an effort. Instead, data for approximately 20 to 25 percent of the VDOT maintained Secondary network, in every county, are collected and processed each year; all of the statistics in the charts and tables are based on the sample collected in 2013. Since samples for Secondary survey were selected from every county of the state, the charts and tables presented here, although not based on the survey of the entire network, are a good representation of the Secondary pavement condition across the state.

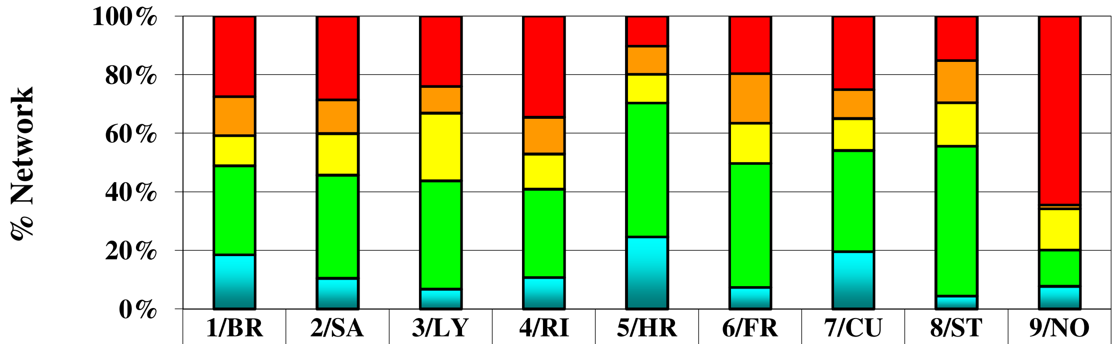
Figure 9 shows the statewide condition distribution of the Secondary network while Figure 10 presents the distribution on district basis.

Figure 9: Pavement Condition - Secondary (Samples)



	Excellent	Good	Fair	Poor	Very Poor
Condition	11.5%	34.2%	13.9%	10.8%	29.6%

Figure 10 : Pavement Condition by District - Secondary (Samples)



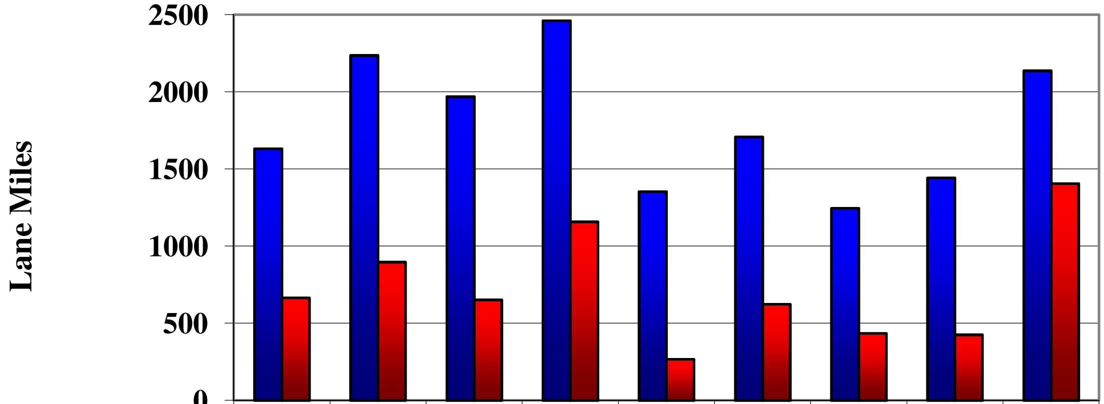
	1/BR	2/SA	3/LY	4/RI	5/HR	6/FR	7/CU	8/ST	9/NO
Very Poor	27.5%	28.6%	24.0%	34.5%	10.2%	19.6%	25.1%	15.1%	64.5%
Poor	13.3%	11.5%	9.1%	12.6%	9.6%	16.9%	9.9%	14.4%	1.3%
Fair	10.3%	14.2%	23.1%	12.0%	9.8%	13.7%	10.9%	14.9%	14.0%
Good	30.4%	35.2%	37.0%	30.2%	45.8%	42.4%	34.5%	51.2%	12.4%
Excellent	18.5%	10.5%	6.8%	10.7%	24.6%	7.4%	19.6%	4.4%	7.8%

Figure 11 shows the number of lane-miles surveyed in each district as well as the number of lane-miles rated as 'deficient'. Figure 12 represents the percent deficient in terms of lane miles surveyed. Based on these figures, Northern Virginia District has the highest percentage of its Secondary network rated as deficient while Hampton Roads District has the lowest.

Within the sampled Secondary network, the rated lane miles of plant mix surfaces and non-plant mix surfaces are shown in Figure 13. On the samples surveyed, some districts have more plant mix lanes miles while non-plant mix lane miles are more in other districts.

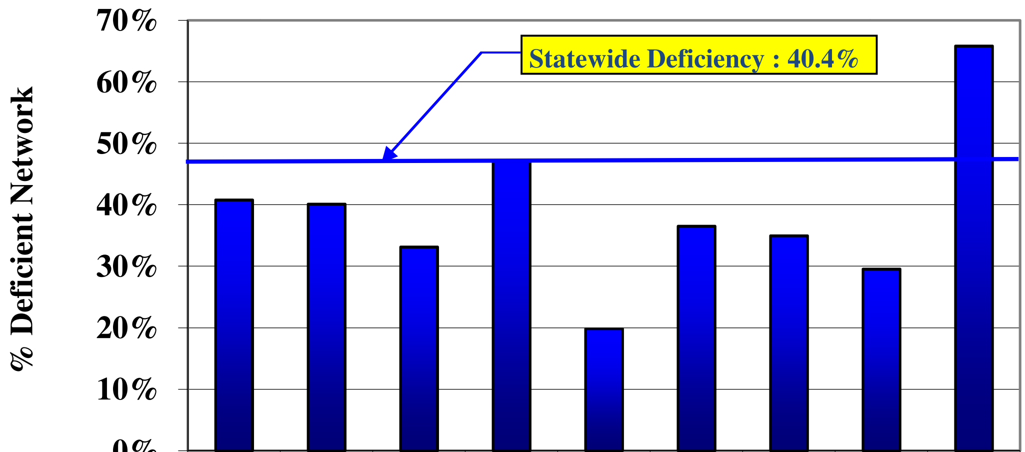
The percentage of deficient Secondary plant mix and non-plant mix lane miles are presented in Figure 14. In general, it can be seen that the percent deficient of non-plant mix pavements is larger than that of plant mix. Richmond district shows lower non-plant mix percent deficient than plant mix percent deficient.

Figure 11: Surveyed and Deficient Lane Miles by District - Secondary (Samples)



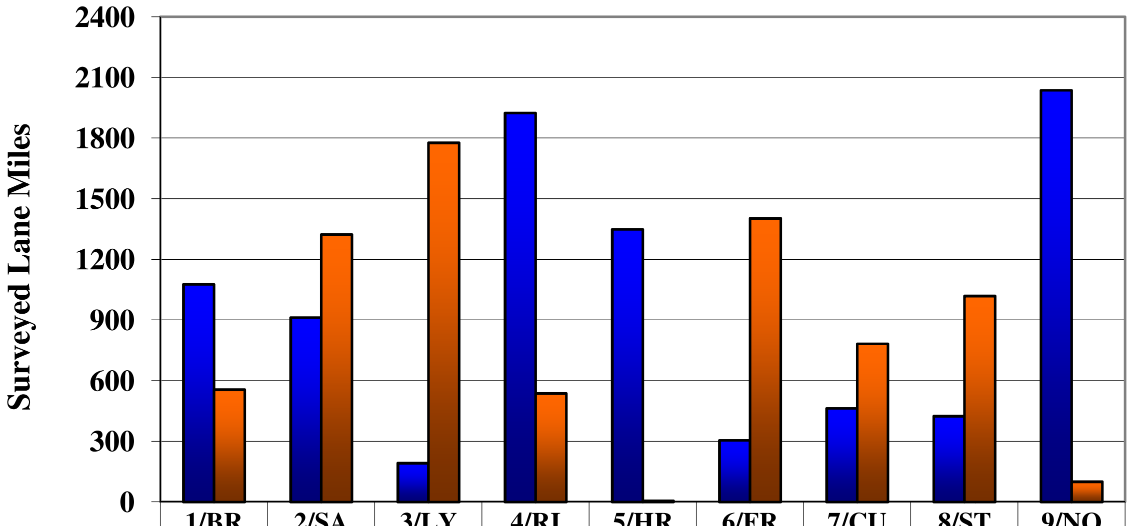
	1/BR	2/SA	3/LY	4/RI	5/HR	6/FR	7/CU	8/ST	9/NO
Surveyed	1633	2237	1969	2462	1355	1709	1246	1444	2138
Deficient	666	897	652	1159	268	624	436	427	1407

Figure 12: Percent Deficiency by District - Secondary (Samples)



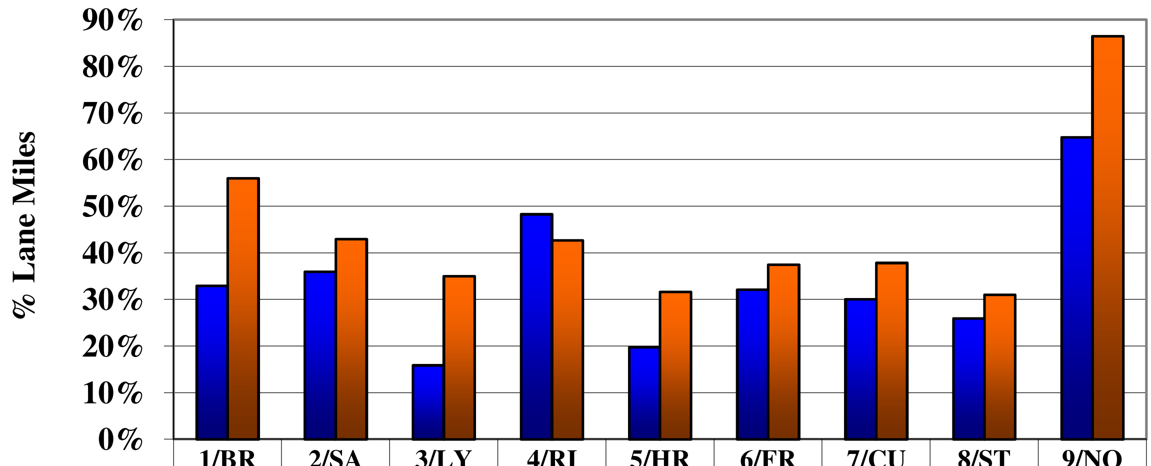
	1/BR	2/SA	3/LY	4/RI	5/HR	6/FR	7/CU	8/ST	9/NO
% Deficient	40.8%	40.1%	33.1%	47.1%	19.8%	36.5%	35.0%	29.5%	65.8%

Figure 13: Surveyed Lane Miles - Secondary (Samples) with Plant Mix (PM) & Non-Plant Mix (NPM) Surface



	1/BR	2/SA	3/LY	4/RI	5/HR	6/FR	7/CU	8/ST	9/NO
PM	1077	913	192	1925	1349	305	464	425	2037
NPM	556	1324	1777	537	6	1404	783	1019	101

Figure 14: Percent Deficiency by District and Pavement Type - Secondary (Samples)



	1/BR	2/SA	3/LY	4/RI	5/HR	6/FR	7/CU	8/ST	9/NO
PM	32.9%	36.0%	15.9%	48.3%	19.8%	32.1%	30.1%	26.0%	64.8%
NPM	56.0%	43.0%	35.0%	42.7%	31.7%	37.5%	37.9%	31.0%	86.5%

PLANT MIX SECONDARY PAVEMENT

Some of the key distress types are shown in Table 8 for plant mix surfaced pavements on the Secondary network.

Table 8: Major Distresses on PM Surfaced Pavement

Key Distresses	D1 BR	D2 SA	D3 LY	D4 RI	D5 HR	D6 FR	D7 CU	D8 ST	D9 NO
Alligator Cracking (% total area)	4.6%	5.0%	2.1%	5.2%	2.4%	5.2%	5.7%	3.0%	10.7%
Patching (% total area)	2.2%	4.3%	1.6%	6.0%	0.7%	3.1%	1.3%	5.1%	3.9%
Rutting (inches)	0.15	0.17	0.17	0.17	0.19	0.11	0.14	0.16	0.13
Transverse Cracking (ft/lane mile)	654	1709	864	1754	511	1302	1808	722	4680
Longitudinal Cracking (ft/lane mile)	552	472	191	660	293	560	671	282	1769

NON-PLANT MIX SECONDARY PAVEMENT

Some of the key distress types are shown in Table 9 for non-plant mix surfaced Secondary pavements.

Table 9: Major Distresses on NPM Secondary Pavement

Key Distresses	D1 BR	D2 SA	D3 LY	D4 RI	D5 HR	D6 FR	D7 CU	D8 ST	D9 NO
Alligator Cracking (% total area)	7.3%	4.2%	2.4%	4.5%	2.8%	3.3%	4.0%	2.0%	12.5%
Patching (% total area)	4.7%	7.9%	8.0%	6.0%	2.2%	4.2%	5.9%	6.7%	4.0%
Rutting (inches)	0.21	0.23	0.27	0.21	0.13	0.20	0.21	0.20	0.13
Transverse Cracking (ft/lane mile)	938	958	613	1372	1027	1016	1227	362	5445
Longitudinal Cracking (ft/lane mile)	754	410	314	440	688	449	513	210	2084

PAVEMENT RIDE QUALITY - 2013

RIDE QUALITY EVALUATION CRITERIA

Pavement roughness is generally defined as an expression of the aggregation of irregularities in the pavement surface per linear mile that adversely affect the ride quality of a vehicle (and thus the user). Roughness is an important pavement characteristic because it affects not only ride quality but also vehicle delay costs, fuel consumption and maintenance costs; also, the general public perception of a good road is one that provides a smooth ride. Ride quality is expressed in terms of International Roughness Index (IRI) measured in inches/mile.

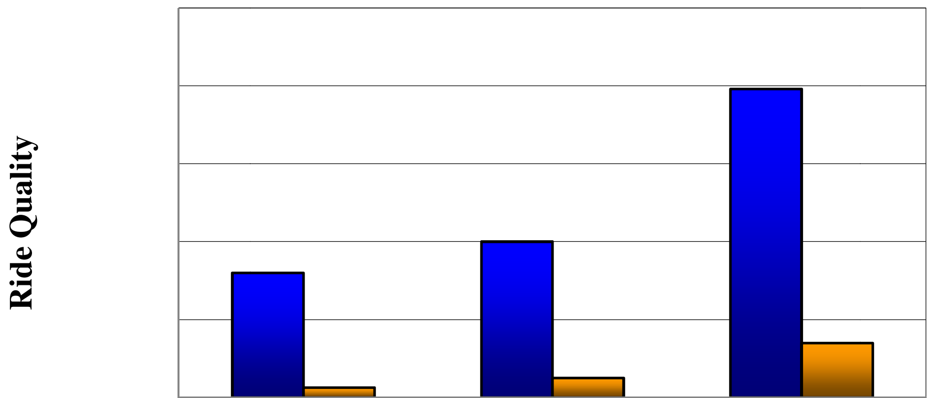
Table 10 contains two IRI scales used for evaluation of the 2013 pavement ride quality survey: one set for Interstate and Primary highways, and the other for Secondary roads. It needs to be pointed out that ranges of IRI values corresponding to qualitative descriptors of ride quality were built upon similar categories promulgated by FHWA [(4)] and incorporated consensuses from VDOT pavement experts regarding what thresholds were considered appropriate to represent acceptable roughness levels on Virginia highways. Pavements with poor and very poor ride quality are said to have deficient ride quality. The distribution of deficient ride quality in different counties is presented in Appendix E.

Table 10 : Pavement Ride Quality Definition

Ride Quality Category	IRI Rating (inch/mile)	
	Interstate & Primary	Secondary
Excellent	< 60	< 95
Good	60 to 99	95 to 169
Fair	100 to 139	170 to 219
Poor	140 to 199	220 to 279
Very Poor	≥ 200	≥ 280

The average IRI values for Interstate, Primary and Secondary system are presented in Figure 15, along with the percentage of pavement network with deficient ride quality, i.e., the ride quality is poor or very poor. On Interstate and Primary pavements the data are collected on the entire network but on the Secondary pavements the data are collected on a sampling basis.

Figure 15: Statewide Ride Quality
(Interstate, Primary & Secondary Pavement)

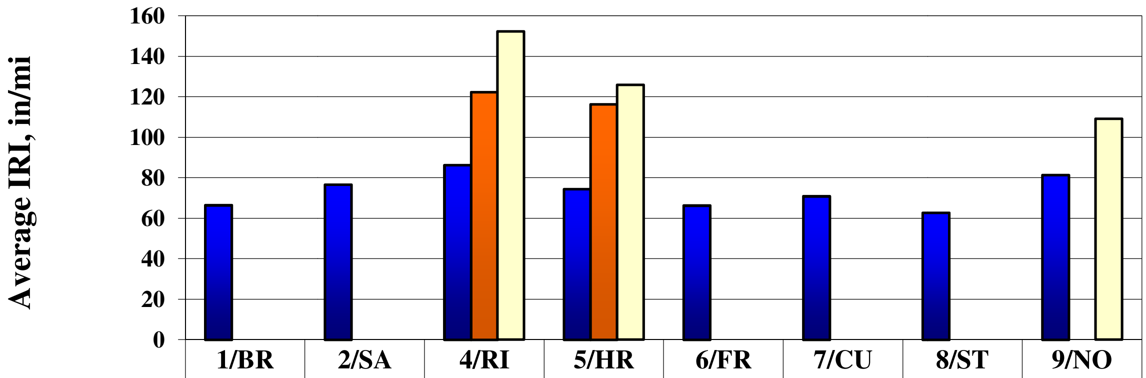


	Interstate	Primary	Secondary
Average IRI	80	100	198
% Deficient	6.3 %	12.5 %	34.9 %

INTERSTATE PAVEMENT RIDE QUALITY

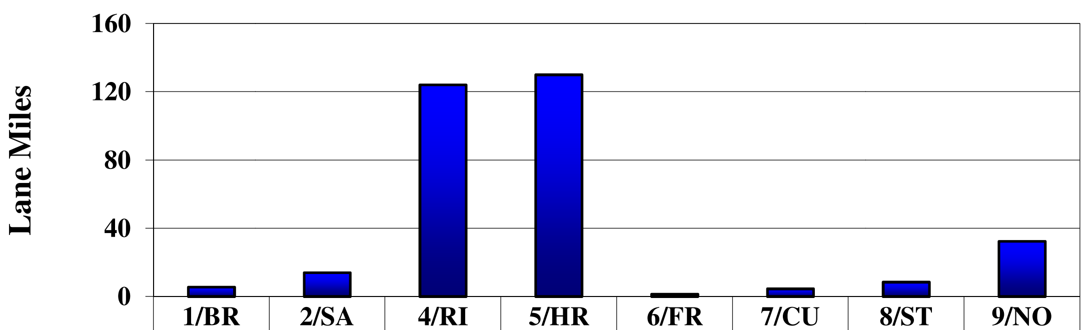
For Interstate pavements, the average IRI values are presented in Figure 16. It can be seen that typically average IRI values are the lowest for AC pavements, higher for CRC pavements, and highest for JRC pavements. Lane miles of deficient ride quality by pavement type are presented in Figure 17.

Figure 16: Average IRI by District and Pavement Type - Interstate



	1/BR	2/SA	4/RI	5/HR	6/FR	7/CU	8/ST	9/NO
ACP	66	77	86	74	66	71	63	81
CRCP	N/A	N/A	122	116	N/A	N/A	N/A	N/A
JRCP	N/A	N/A	152	126	N/A	N/A	N/A	109

Figure 17: No. of Deficient Lane Miles Due to Ride Quality by Pavement Type - Interstate

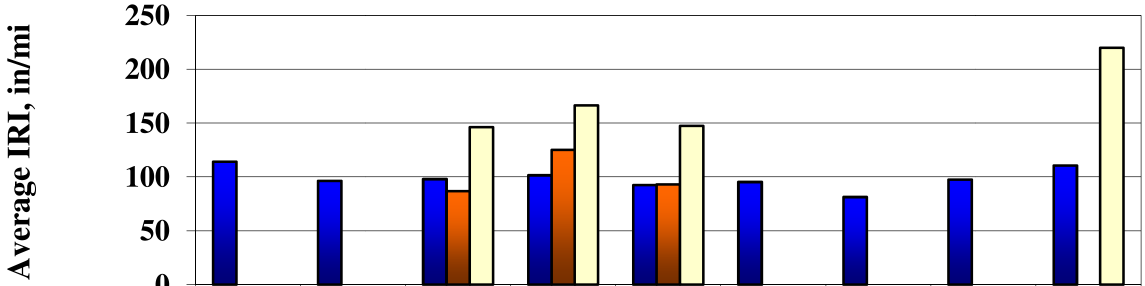


	1/BR	2/SA	4/RI	5/HR	6/FR	7/CU	8/ST	9/NO
Deficient	6	14	124	130	1	4	8	32
ACP	6	14	60	10	1	4	8	24
CRCP	N/A	N/A	60	18	N/A	N/A	N/A	N/A
JRCP	N/A	N/A	4	102	N/A	N/A	N/A	8

PRIMARY PAVEMENTS RIDE QUALITY

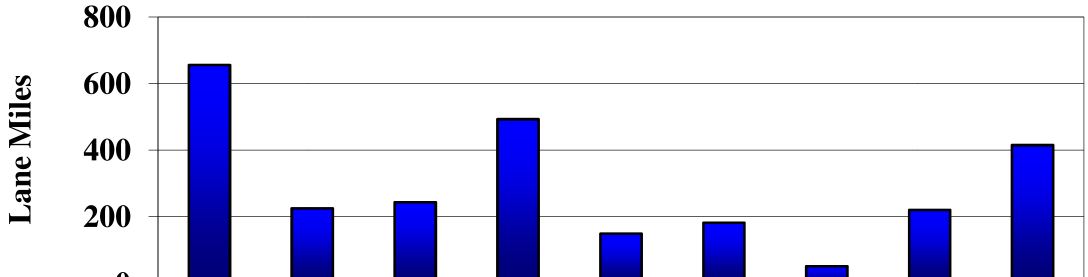
Figure 18 and Figure 19 display the average IRI values and deficient ride quality by pavement type, respectively. Again, typically, the AC pavements have the lowest IRI values, followed by CRC pavements, then JRC pavements.

Figure 18: Average IRI by District and Pavement Type - Primary



	1/BR	2/SA	3/LY	4/RI	5/HR	6/FR	7/CU	8/ST	9/NO
ACP	114	96	98	102	92	95	81	98	111
CRCP	N/A	N/A	87	125	93	N/A	N/A	N/A	N/A
JRCP	N/A	N/A	146	166	147	N/A	N/A	N/A	220

Figure 19: No. of Deficient Lane Miles Due to Ride Quality by Pavement Type - Primary

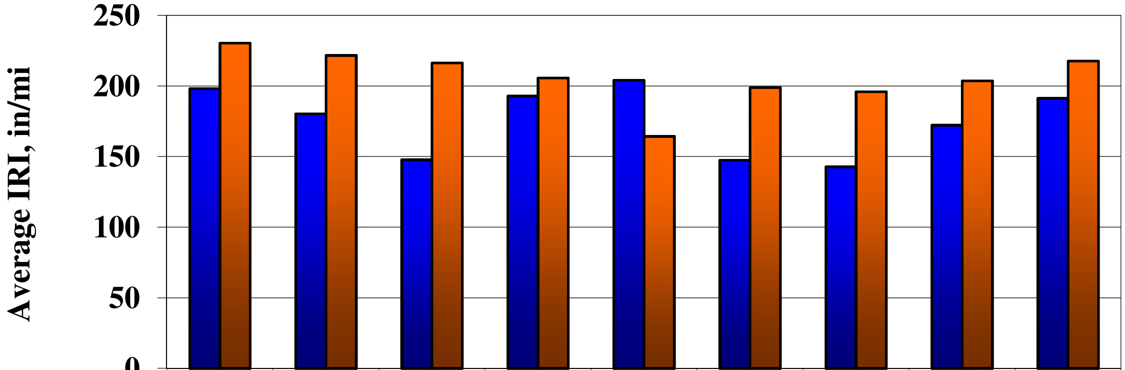


	1/BR	2/SA	3/LY	4/RI	5/HR	6/FR	7/CU	8/ST	9/NO
Deficient	656	225	244	493	149	182	52	221	415
ACP	656	225	237	403	134	182	52	221	411
CRCP	N/A	N/A	0	37	0	N/A	N/A	N/A	N/A
JRCP	N/A	N/A	7	53	15	N/A	N/A	N/A	4

SECONDARY PAVEMENTS RIDE QUALITY

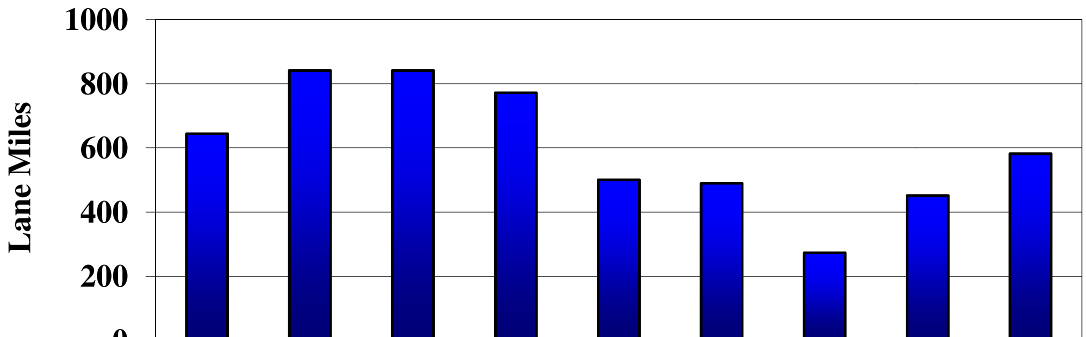
Figure 20 displays the average IRI by pavement type for Secondary pavements. It can be seen that the IRI values are higher for non-plant mix than for plant mix Secondary pavements. Figure 21 displays the deficient ride quality lane miles for plant mix and non-plant mix based on the samples.

Figure 20: Average IRI by District and Pavement Type - Secondary (Samples)



	1/BR	2/SA	3/LY	4/RI	5/HR	6/FR	7/CU	8/ST	9/NO
PM	198	180	148	193	204	147	143	172	191
NPM	230	222	216	206	164	199	196	204	218

Figure 21 : No. of Deficient Lane Miles Due to Ride Quality by Pavement Type - Secondary (Samples)



	1/BR	2/SA	3/LY	4/RI	5/HR	6/FR	7/CU	8/ST	9/NO
Deficient	645	842	842	772	501	490	274	452	582
PM	348	213	35	556	501	27	38	86	543
NPM	297	629	807	216	0	463	236	366	39

USES & LIMITATIONS OF 2013 PAVEMENT CONDITION DATA

This section describes a few of the uses of this data as well as some of the data limitations. In addition, future uses of this data are described here.

CURRENT USE OF THE DATA

Pavement condition data presented in this report are used by VDOT Central Office and District staff to plan, budget, prioritize and schedule pavement maintenance and rehabilitation work. Data are also used for internal and external performance reporting; and are made available to pavement researchers, safety planners and others within and external to VDOT. Major uses of this information are described below.

PAVEMENT NEEDS ANALYSIS

The pavement condition data are an important input into the Pavement Management System (PMS) to develop estimates of pavement maintenance and rehabilitation needs based on an optimization analysis. These needs are subsequently used for the development of the biennial maintenance budget and the work plan generated by the optimization serves as a guide to district personnel for the selection of pavement maintenance strategy for the yearly pavement maintenance schedules. Once a particular section of pavement is selected for maintenance, a detailed project level analysis is conducted to determine the specific treatment.

To develop the Interstate and Primary pavement needs, the pavement condition data are loaded into the Pavement Management System (PMS) which then optimizes the selection of pavement maintenance activities on the Interstate and Primary network. These needs estimates are provided through a process called multi-constraint optimization analysis, which develops an optimal work plan (a series of pavement maintenance activities applied to specific sections on the total network) to achieve a single objective (minimizing cost) against multiple condition-based constraints (performance targets) in a given year of the total six year analysis.

The data are also used to feed the maintenance decision trees to determine the unconstrained maintenance needs for the pavement assets. Unconstrained needs analysis establishes the maintenance and rehabilitation needs to appropriately correct the existing pavement conditions where funding would not be considered a constraint. It provides an idea of the amount and type of work needed on the whole network. For the determination of the needed treatment for a particular section the decision trees are used with distress quantity and severity, and condition index as input from the condition survey data[5]. Also, traffic level, structural condition, and maintenance history are provided as additional inputs wherever these are available for the selection of treatment. Unconstrained needs are also used in many cases as the first indicator of the needed treatment which is further refined by field inspections, detailed project level analysis, overall needs of the network and available budget.

PLANNING FOR PREVENTIVE MAINTENANCE AND RESURFACING

The surface distress condition data have been used to identify recommended candidate pavement sections for preventative maintenance activities. These recommendations are based on decision trees developed for the needs analysis, as described above.

The pavement data are used for selection of pavement sections and maintenance strategies for yearly pavement maintenance schedule. Automated data that provide high consistency and efficiency have been used to aid in prioritizing Maintenance Resurfacing by the districts. Typically, the districts have used the data in combination with their local knowledge of pavement conditions to select pavement projects.

Information about specific distresses can be used to determine appropriate maintenance and rehabilitation actions for consideration. For example, a pavement with serious load related distress would typically require a resurface or "mill and fill" treatment, whereas a preventive maintenance treatment would be more appropriate for a pavement with primarily non-load related distresses.

PAVEMENT PERFORMANCE REPORTING

The pavement condition data play a major role in preparation of two legislatively mandated reports. One report is the biennial infrastructure condition report required by Section 33.1-23.02(B.3) of the Code of Virginia. The second report, required by Section 33.1-13.03 each year, concerns the condition of and needs for maintaining and operating the existing transportation infrastructure based on an asset management methodology.

The data are also used for tracking performance measures on the dashboard and are reported to the Commonwealth Transportation Board (CTB) yearly. The dashboard uses the condition data to display the percent of pavement in fair or better condition for each district, county and system in the form of a gauge, and also as a bar chart. The gauge points to the percent of pavement in non-deficient condition, with a tic mark to show the last year's results. All pavements on the Interstate and Primary road systems in Virginia are assessed each year and rated in one of the following categories: Excellent, Good, Fair, Poor, or Very Poor. Segments of pavement classified as Poor and Very Poor are considered deficient, all others are non-deficient. The lower portion of the screen shows a bar chart with each VDOT District represented. The bars show the percentage of pavement in each District that is in Fair or better condition. If a District is selected using data filters then the bar chart shows each county in the District, and that county's percentage of non-deficient pavement. VDOT's goal is to have a minimum of 82% of Interstate and Primary pavement in Excellent, Good, or Fair condition.

The percent of pavement with fair or better ride quality is also displayed in a separate gauge. Performance target for deficient ride quality is 85% for Interstate and Primary pavements, i.e., VDOT's goal is to have at least 85% of the pavements with fair or better ride quality. Thus the dashboard presents the information in an easy to understand form with the users being able to obtain information of the current performance and previous year's performance against the performance target. These data are available on the internet, and can be viewed by general public.

FEDERAL HPMS REPORTING

Pavement condition data are included in VDOT's Highway Performance Monitoring System (HPMS) data submission to FHWA. This report is the basis for the federal apportionment of Virginia's share of federal funds. VDOT provides the FHWA with the length, roughness and lane-miles on state maintained roads in various functional systems for assessing and reporting highway performance. HPMS data are also used for assessing and reporting highway system performance under FHWA's strategic planning process and are the source for a substantial portion of the information published in Highways Statistics and in other FHWA publications and media. Finally, the HPMS data are widely used throughout the transportation community, including other governmental interest, business and industry, institutions of higher learning, the media and general public. More details can be found in the HPMS Field Manual(6).

Current HPMS requirements are that roughness data, quantified to the nearest inch/mile using the international roughness index (IRI), are reported for all pavement on the National Highway System (which includes the Interstate System) and on all Principal Arterials. IRI data are also required for sample sections on Minor Arterials. The pavement condition data are the primary source for the IRI data; however, VDOT Materials Division's Non-Destructive Testing Unit collects the IRI data for sample sections that are not a part of the annual pavement condition surveys.

HPMS data specifications will expand to include requirements to report surface distress quantifications as well as additional pavement structural information for a statistical sample of highway sections. The data collected in the annual pavement condition survey will be used to meet many of the new reporting requirements.

RESEARCH NEEDS

The pavement condition data are used to satisfy various internal and external research needs. Frequently, there are requests for pavement condition data from various divisions within VDOT, and also research units associated with VDOT.

FUTURE USE OF THE DATA

Accumulation of consistent, quality condition data over time allows VDOT to better understand the cost-effectiveness of different pavement treatment strategies. This information enables VDOT to make investment decisions that maximize pavement life and optimize use of scarce resources. Pavement performance models are a key element of VDOT's pavement management system – they are used to predict future pavement conditions and calculate the benefits of alternative treatment strategies. Historical condition data provide the basis for improvements to these performance models which in turn enhance the accuracy, reliability and usefulness of the system's recommendations. Historical data also provide a rich base of information for research into maintenance cost effectiveness, the influence of new construction materials and techniques on pavement performance, and the performance of pavements under different traffic loading and environmental conditions. Pavement performance research results may also be used for vehicle cost responsibility studies and the establishment of licensing fees related to pavement damage.

LIMITATIONS OF THE DATA

While surface condition data are very helpful in project selection they cannot be the only source of information used to determine what actually should be done to a pavement. Determining the appropriate action for a pavement that is not performing as well as desired may require projected traffic loads, maintenance history of the pavement, the analysis of cores, trenching, and the use of non-destructive testing procedures. In other words, surface distress (especially premature) might indicate the need for a more detailed investigation or testing. For example, excessive early fatigue cracking suggests structural inadequacy, but does not indicate where the inadequacy lies (foundation, base, surface, etc.) warranting the need for detailed investigation.

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APPENDIX A: DISTRESS DATA AND FORMAT

Table A1. Distress Data and Format for Asphalt Surfaced Pavement

Description	Field Name	Pavement Type	Units	Format	Comments
IRI Left WP	NIRI_L	BIT/BOJ/BOC	inches/mile	999	Save profile data - RoadRuf, Maximum IRI is 500 inches per mile
IRI Right WP	NIRI_R	BIT/BOJ/BOC	inches/mile	999	Save profile data - RoadRuf, Maximum IRI is 500 inches per mile
IRI Average	NIRI_AVG	BIT/BOJ/BOC	inches/mile	999	Save profile data - RoadRuf, Maximum IRI is 500 inches per mile
Transverse Cracking Severity 1	NT_CR1_LF	BIT/BOJ/BOC	Linear Feet	99999	A crack with the sealant in good condition such that the crack width cannot be determined, or A closed, unsealed crack.
Transverse Cracking Severity 2	NT_CR2_LF	BIT/BOJ/BOC	Linear Feet	99999	An open, unsealed crack, or Any crack (sealed or unsealed) with adjacent (within 1 foot) random cracking.
Longitudinal Cracking Severity 1	NL_CR1_LF	BIT/BOJ/BOC	Linear Feet	99999	A crack with the sealant in good condition such that the crack width cannot be estimated, or A closed, unsealed crack.
Longitudinal Cracking Severity 2	NL_CR2_LF	BIT/BOJ/BOC	Linear Feet	99999	An open, unsealed crack, or Any crack (sealed or unsealed) with adjacent random cracking.
Longitudinal Lane Joint Severity 1	NL_JT1_LF	BIT/BOJ/BOC	Linear Feet	99999	A longitudinal paving joint with the sealant in good condition such that the width cannot be estimated, or An open, unsealed joint.
Longitudinal Lane Joint Severity 2	NL_JT2_LF	BIT/BOJ/BOC	Linear Feet	99999	The longitudinal paving joint must be cracked with severe spalling or adjacent random cracking
Reflective Transverse Cracking Severity 1	NRT_CR1_LF	BOJ/BOC	Linear Feet	9999	A crack with the sealant in good condition such that the crack width cannot be determined, or A closed, unsealed crack.
Reflective Transverse Cracking Severity 2	NRT_CR2_LF	BOJ/BOC	Linear Feet	9999	A crack with width more than or equal to ¼ inches but less than ¾ inches; or A crack with width less than ¾ inches and with adjacent (within 1 foot) random cracking; and One level-1 or level-2 crack with an adjacent (within 1 foot) level-1 crack is rated as one crack of level 2.
Reflective Transverse Cracking Severity 3	NRT_CR3_LF	BOJ/BOC	Linear Feet	9999	A crack with width more than or equal to ¾ inches; or A crack with width more than ¼ inches and with deterioration for a width greater than 6 inches; and Two adjacent (within 1 foot) level-2 and/or level-3 cracks are rated as one crack of level 3.
Reflective Longitudinal Cracking Severity 1	NRL_CR1_LF	BOJ/BOC	Linear Feet	99999	A crack with the sealant in good condition such that the crack width cannot be determined, or A closed, unsealed crack.
Reflective Longitudinal Cracking Severity 2	NRL_CR2_LF	BOJ/BOC	Linear Feet	99999	A crack with width more than or equal to ¼ inches but less than ¾ inches; or A crack with width less than ¾ inches and with adjacent (within 1 foot) random cracking; and One level-1 or level-2 crack with an adjacent (within 1 foot) level-1 crack is rated as one crack of level 2.
Reflective Longitudinal Cracking Severity 3	NRL_CR3_LF	BOJ/BOC	Linear Feet	99999	A crack with width more than or equal to ¾ inches; or A crack with width more than ¼ inches and with deterioration for a width greater than 6 inches; and Two adjacent (within 1 foot) level-2 and/or level-3 cracks are rated as one crack of level 3.
Alligator Cracking Severity 1	NA_CR1_SF	BIT/BOJ/BOC	Square Feet	99999	A single sealed or unsealed longitudinal crack in the wheel path, or An area of cracks with no or few interconnecting cracks with no spalling.
Alligator Cracking Severity 2	NA_CR2_SF	BIT/BOJ/BOC	Square Feet	99999	An area of interconnecting cracks forming the characteristic alligator pattern; may have slight spalling.
Alligator Cracking Severity 3	NA_CR3_SF	BIT/BOJ/BOC	Square Feet	99999	An area of moderately or severely spalled cracks forming the characteristic alligator pattern.
Patching Area - wheel path	NPA_WP_SF	BIT/BOJ/BOC	Square Feet	999999	Area - wheel path only - Max length of patch is 1320ft
Patching Area - Non wheel path	NPA_NWP_SF	BIT/BOJ/BOC	Square Feet	999999	Area - non wheel path only - Max length of patch is 1320ft
Potholes Count	NPOT_NO	BIT/BOJ/BOC	Count	999	
Delaminations Area	NDELAM_SF	BIT/BOJ/BOC	Square Feet	9999	
Bleeding Severity 1	NBLEED1_SF	BIT/BOJ/BOC	Square Feet	9999	Pavement surface that is discolored relative to the remainder of the surface due to excessive liquid asphalt.
Bleeding Severity 2	NBLEED2_SF	BIT/BOJ/BOC	Square Feet	9999	Excessive liquid asphalt gives the pavement surface a shiny appearance; tire marks may be evident in warm weather.
Average Deeper Rut (Straight-edge)	NRUT_S_AVG	BIT/BOJ/BOC	Inch	9.99	Reject greater than 3 inches

Notes:

** Roughness Summary Values do not include low speed or bridge, construction and lane deviation values

***Distress Summary Values do not include Construction, Lane Deviations or Bridge values.

Table A2. Distress Data and Format for CRC Pavement

Description	Field Name	Pavement Type	Units	Format	Comments
IRI Left WP	NIRI_L	CRCP	inches/mile	999	Save profile data - RoadRuf, Maximum IRI is 500 inches per mile
IRI Right WP	NIRI_R	CRCP	inches/mile	999	Save profile data - RoadRuf, Maximum IRI is 500 inches per mile
IRI Average	NIRI_AVG	CRCP	inches/mile	999	Save profile data - RoadRuf, Maximum IRI is 500 inches per mile
Transverse Cracking Severity 1	NT_CR1	CRCP	Linear Feet	99999	A closed transverse crack with no spalling
Transverse Cracking Severity 2	NT_CR2	CRCP	Linear Feet	99999	An open transverse crack with no spalling
Transverse Cracking Severity 3	NT_CR3	CRCP	Linear Feet	99999	Any transverse crack with spalling
Transverse Cracking Total Number	NT_CR_NO	CRCP	Count	999	
Transverse Crack Average Spacing	NT_CR_AVG	CRCP	Linear Feet	999.9	(Tenth mile - length of Cluster cracking) / Number of Trans cracks
Longitudinal Cracking Severity 1	NL_CR1	CRCP	Linear Feet	9999	A longitudinal crack with no spalling
Longitudinal Cracking Severity 2	NL_CR2	CRCP	Linear Feet	9999	A longitudinal crack with less than or equal to ¼ of the crack length containing spalling
Longitudinal Cracking Severity 3	NL_CR3	CRCP	Linear Feet	9999	A longitudinal crack with greater than ¼ of the crack length containing spalling
Clustered Cracking Severity 1	NCL_CR1_NO	CRCP	Count	9999	Clusters of three or more transverse cracks having an average spacing greater than 1 foot and less than or equal to 2 feet
Clustered Cracking Severity 2	NCL_CR2_NO	CRCP	Count	9999	Clustered cracks with an average spacing of less than or equal to 1 foot
Clustered Cracking Severity 1	NCL_CR1_SF	CRCP	Square Feet	9999	Clusters of three or more transverse cracks having an average spacing greater than 1 foot and less than or equal to 2 feet
Clustered Cracking Severity 2	NCL_CR2_SF	CRCP	Square Feet	9999	Clustered cracks with an average spacing of less than or equal to 1 foot
Longitudinal Joint Spalling	NCL_J_SP_LF	CRCP	Linear Feet	9999	
Longitudinal Joint Fully (90%) Sealed	CCL_J_SEAL	CRCP	Yes/No	x	
Punchouts and Spalled Ycracks	NPUNCH_NO	CRCP	Count	99	Add number of "NPUNCH_SF" for count
Punchouts and Spalled Ycracks	NPUNCH_SF	CRCP	Square Feet	9999	
PCC Patch Severity 1	NC_PAT1_SF	CRCP	Square Feet	9999	The patch has no distress either in the patch or around its perimeter
PCC Patch Severity 2	NC_PAT2_SF	CRCP	Square Feet	9999	The patch has any type of severity level 1 CRCP distress either in the patch or around its perimeter
PCC Patch Severity 3	NC_PAT3_SF	CRCP	Square Feet	9999	The patch has any type of severity level 2 CRCP distress either in the patch or around its perimeter
Asphalt Patching	NA_PAT_SF	CRCP	Square Feet	9999	

Notes:

** Roughness Summary Values do not include low speed or bridge, construction and lane deviation values

***Distress Summary Values do not include Construction, Lane Deviations or Bridge values.

Table A3. Distress Data and Format for JRC Pavement

Description	Field Name	Pavement Type	Units	Format	Comments
IRI Left WP	NIRI_L	JRCP	inches/mile	999	Save profile data - RoadRuf, Maximum IRI is 500 inches per mile
IRI Right WP	NIRI_R	JRCP	inches/mile	999	Save profile data - RoadRuf, Maximum IRI is 500 inches per mile
IRI Average	NIRI_AVG	JRCP	inches/mile	999	Save profile data - RoadRuf, Maximum IRI is 500 inches per mile
Transverse Cracking Severity 1	NT_CR1_NS	JRCP	# of Slabs	9999	A crack that is well sealed so the width cannot be determined, or A closed crack that has no spalling.
Transverse Cracking Severity 2	NT_CR2_NS	JRCP	# of Slabs	9999	An open crack, or Any spalled crack.
Longitudinal Cracking Severity 1	NL_CR1_NS	JRCP	# of Slabs	9999	A crack that is well sealed so the width cannot be determined, or A closed crack that has no spalling.
Longitudinal Cracking Severity 2	NL_CR2_NS	JRCP	# of Slabs	9999	An open crack, or Any spalled crack.
PCC Patch Severity 1	NC_PAT1_NS	JRCP	# of Slabs	9999	The patch has no distress either in the patch or around its perimeter.
PCC Patch Severity 2	NC_PAT2_NS	JRCP	# of Slabs	9999	The patch has severity level 1, longitudinal cracking, transverse cracking (or any other severity level 1 distress) either in the patch or around its perimeter.
PCC Patch Severity 3	NC_PAT3_NS	JRCP	# of Slabs	9999	The patch has spalling, severity 2 longitudinal cracking or transverse cracking (or any other severity level 2 distress) either in the patch or around its perimeter.
Asphalt Patch	NA_PAT_NS	JRCP	# of Slabs	9999	
Number of Transverse Joints	NNO_T_JTS	JRCP	Count	999	
Average Slab Length	NSLAB_AVG	JRCP	Feet	999	(# of Joints -1) / Output summary length = Average Slab Length
Transverse Joint Spalled	NT_J_SP_NS	JRCP	# of Slabs	9999	
Transverse Joint Fully Sealed	NT_J_FS_NS	JRCP	# of Joints	9999	
Longitudinal Joint Spalled	NL_J_SP_NS	JRCP	# of Slabs	9999	
Longitudinal Joint Fully Sealed	NL_J_FS_NS	JRCP	# of Slabs	9999	
Corner Breaks Severity 1	NC_BRK1_NS	JRCP	# of Slabs	9999	The crack is spalled for no more than 1/4th of its length and the corner break is in one piece.
Corner Breaks Severity 2	NC_BRK2_NS	JRCP	# of Slabs	9999	The crack is spalled for more than 1/4th of its length, or The corner break is in two or more pieces.
Divided Slabs	NDIV_NS	JRCP	# of Slabs	9999	
Blowups	NBLOW_NS	JRCP	# of Slabs	9999	
Joint Fault Severity 1	NJFL_T1_PER	JRCP	Percent	999.9	0 - .49
Joint Fault Severity 2	NJFL_T2_PER	JRCP	Percent	999.9	.49 - 1.0
Joint Fault Severity 3	NJFL_T3_PER	JRCP	Percent	999.9	>1
Average Joint Fault in Left Wheel Path	NJFLT_LT_AVG	JRCP	Inch	9.99	
Average Joint Fault in Right Wheel Path	NJFLT_RT_AVG	JRCP	Inch	9.99	
Joint Fault None (<0.8")	NJFLTO_PER	JRCP	Percent	999.9	No faulting

Notes:

** Roughness Summary Values do not include low speed or bridge, construction and lane deviation values

***Distress Summary Values do not include Construction, Lane Deviations or Bridge values.

Table A4. Distress Data in ACPINPUT Table for Asphalt Concrete Pavement

Description	Field Name	Format	Comments	Calculations
Frequency of Alligator/Fatigue cracking. This is a numeric field with values of 0, 1, 2 or 3.	la_cr_freq	9	0 is none, 1 is rare, 2 is occassional and 3 is frequent:	rare = (wheel path + non wheel path alligator cracking area in SF) / (7*length), if this quantity is > 0 to 10% : Ocassional is >10% and <=50%; : frequent is >50%. Here length is (end_mp - begin_mp). The codes are 0, 1, 2 and 3.
Severity of Alligator/Fatigue cracking. This is a numeric field with values of 0, 1, or 2.	la_cr_severity	9	0 is not severe (severity 1), 1 is severe (severity 2) and 2 is very severe (severity 3).	severity of the most prevalent type; i.e. if 10% of the cracks are not severe (severity 1), 15% severe (severity 2) and 2% very severe (severity 3) then severity for the entire section is "severe".
Total number of transverse cracks in the sections. This is a numeric field with the format 99999.	tr_cr_freq	9999999	Actual Count of Cracks in Section	Total (of all severities)Linear feet /12. This includes transverse cracks, and reflective transverse cracks.
Severity of majority of the transverse cracks in the sections. This is a numeric field with values of 0, 1, or 2.	tr_cr_severity	9	If the Pavement Type is 'BIT', transverse cracks will have two severity levels; 0 for Not Severe (severity 1) and 1 for Severe (severity 2). If the pavement type is BOJ or BOC then it will have three severity levels; 0 for Not Severe (severity 1) and 1 for Severe (severity 2) and 2 for very severe (severity 3).	severity of the most prevalent type; i.e. if 1000 LF of the cracks are not severe (severity 1), 1200 LF of cracks severe (severity 2) then severity for the entire section is "severe" (severity 2).
Frequency of Rutting in the section. This is a numeric field with values of 0, 1, or 2.	rutting_freq	9	0 is None, 1 is 'Rare' and 2 is 'Widespread'	None: If all the values from the 0.1 mile table are <0.1" rutting value for the homogeneous section. Rare: if <=10% of the readings in the sections affected, i.e., from 0.1 mile tables if <=10% of the readings(records) have a rutting value of >=0.1 and <0.5". Widespread: more than 10% of the readings affected, i.e., from 0.1 mile tables if >10% of the readings(records) have a rutting value of >=0.1 and <0.5". In case there are >0.5" rutting values, it is rare if <=10% are >0.5"; and widespread if >10% are >0.5".
Severity of rutting in the section. This is a numeric field with values of 0 or 1.	rutting_severity	9	0 is for less than half inch average for section, and 1 is for more than half inch average for section	if the average reading fo the section is >= 0.1" to 0.5" then 0; if the average for the section is >0.5" then 1
Frequency of Patching in the section. This is a numeric field with values of 0 or 1.	patches_freq	9	0 is none or no patches in the section, 1 is for yes or there are patches in the section	This includes patches in both wheel path and non-wheel path.
Severity of Patching in the section. This is a numeric field with values of 0 or 1.	patches_severity	9	0 is for less than 10% of the pavement area is patched, 1 is for more than 10% of the pavement area is patched. This includes patches in both wheel paths and non wheel paths.	The area of pavement is determined by length * 12. Here a width of 12' is considered irrespective of the widths determined by other means. Here length is (end_mp - begin_mp).
Acceptable' or 'Unacceptable' based on the quality of the ride	ride_quality	9	0 is acceptable; 1 is unacceptable where IRI>140 in/mi.	if the average of left and right IRI for the whole section is >200 then -1, otherwise 0

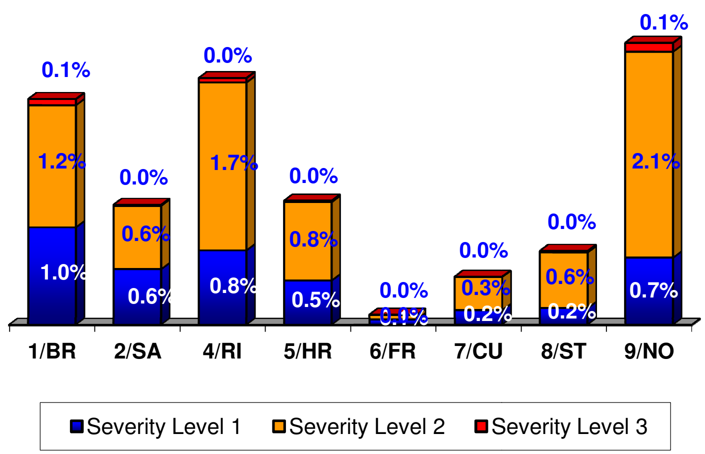
Notes:

** Roughness Summary Values do not include low speed or bridge, construction and lane deviation values

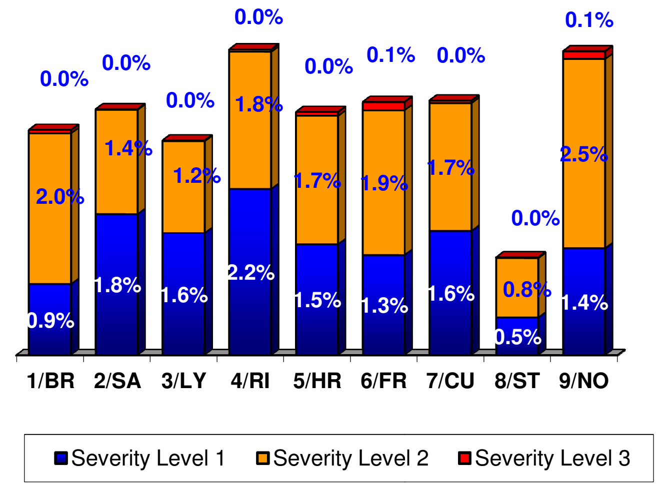
***Distress Summary Values do not include Construction, Lane Deviations or Bridge values.

APPENDIX B: DISTRIBUTION OF KEY DISTRESSES BY DISTRICTS AND SYSTEMS

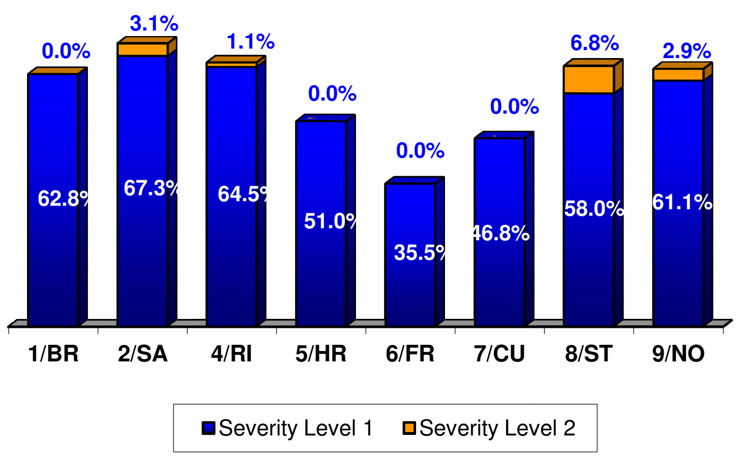
Interstate Asphalt Pavement - Alligator Cracking
(% of total area)



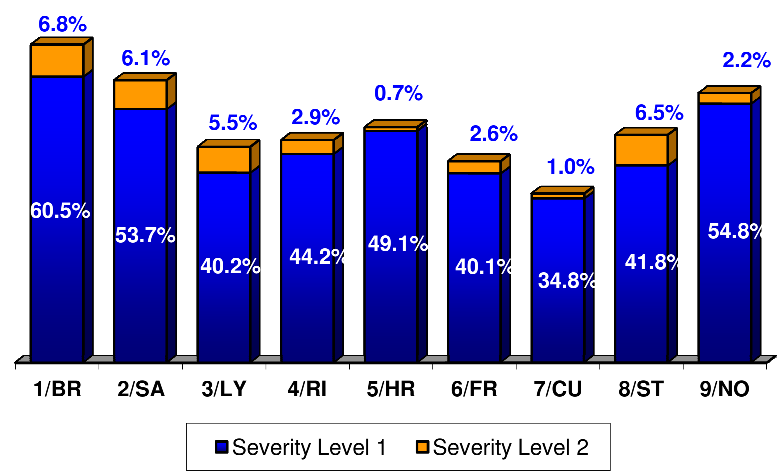
Primary Asphalt Pavement - Alligator Cracking
(% of total area)

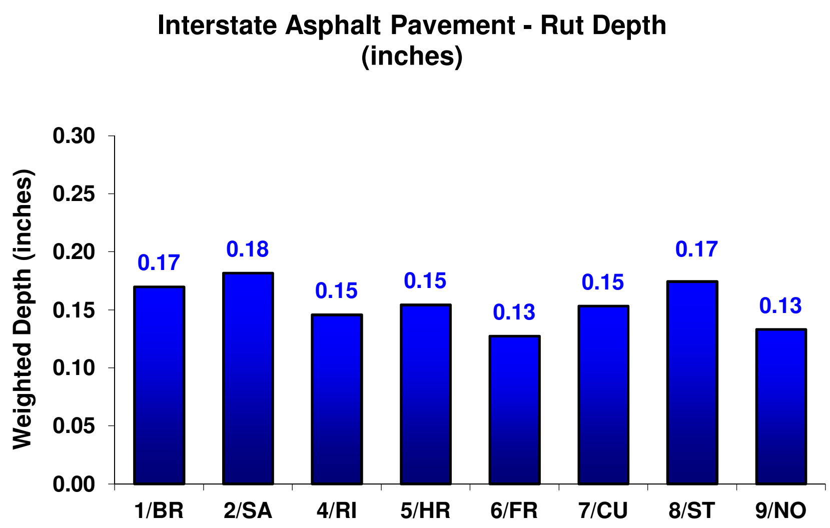


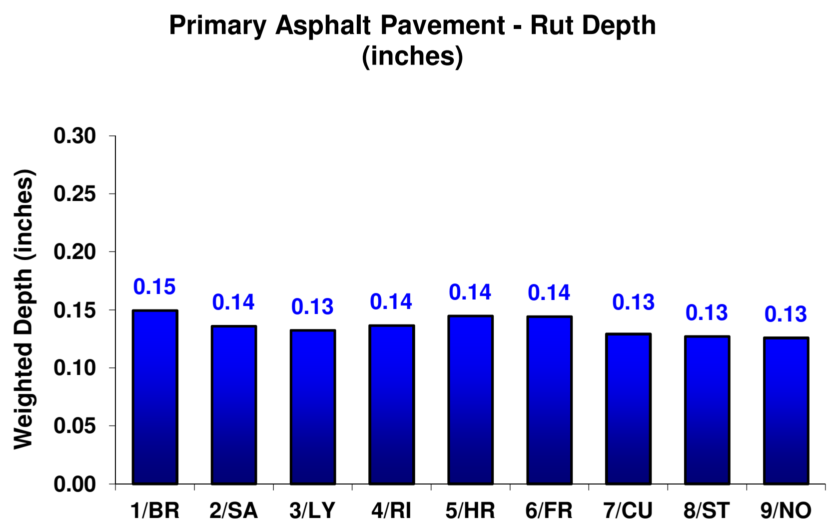
Interstate Asphalt Pavement - Patching
(% of pavement with patching, weighted by area)

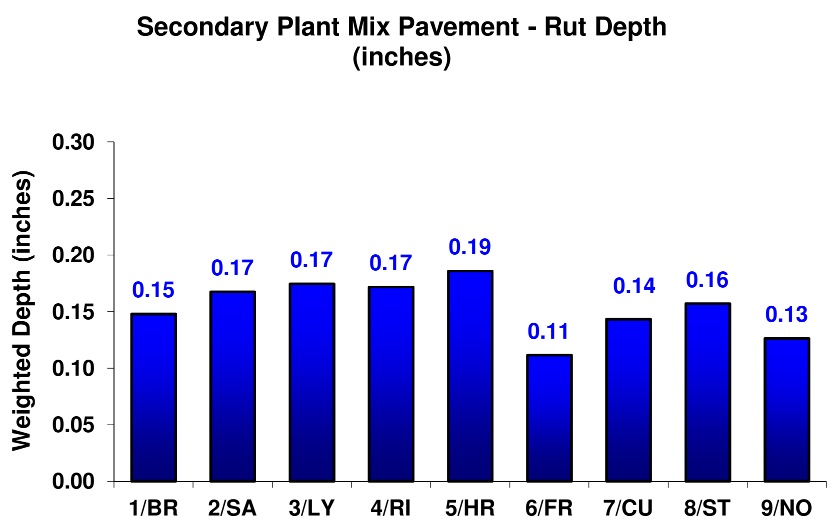


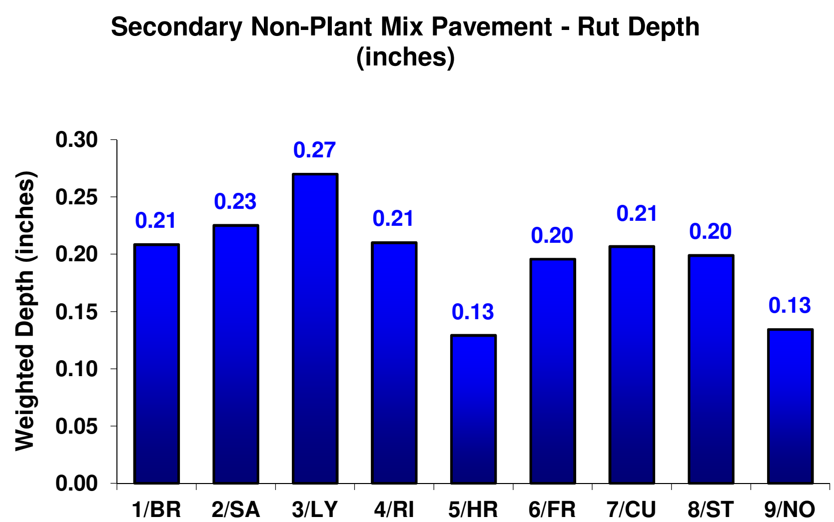
Primary Asphalt Pavement - Patching
(% of pavement with patching, weighted by area)



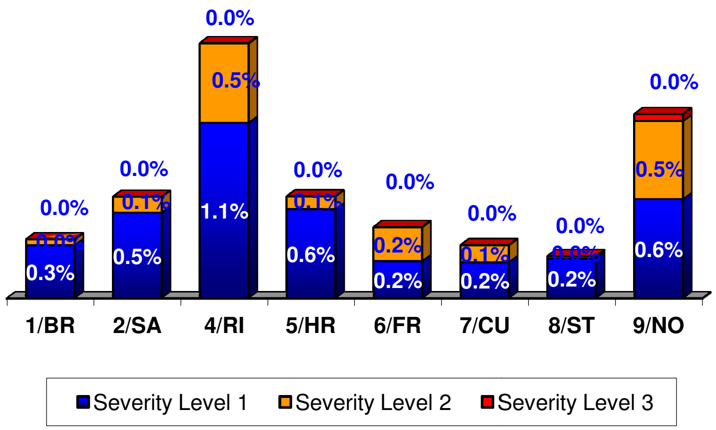

Interstate Asphalt Pavement - Rut Depth
(inches)
Weighted Depth (inches)
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.17
0.18
0.15
0.15
0.13
0.15
0.17
0.13
1/BR
2/SA
4/RI
5/HR
6/FR
7/CU
8/ST
9/NO


Primary Asphalt Pavement - Rut Depth
(inches)
Weighted Depth (inches)
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.15
0.14
0.13
0.14
0.14
0.14
0.13
0.13
0.13
1/BR
2/SA
3/LY
4/RI
5/HR
6/FR
7/CU
8/ST
9/NO

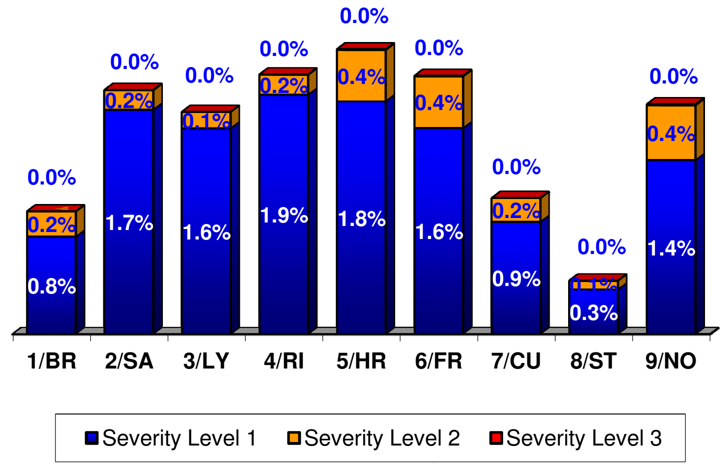

Secondary Plant Mix Pavement - Rut Depth
(inches)
Weighted Depth (inches)
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.15
0.17
0.17
0.17
0.19
0.11
0.14
0.16
0.13
1/BR
2/SA
3/LY
4/RI
5/HR
6/FR
7/CU
8/ST
9/NO


Secondary Non-Plant Mix Pavement - Rut Depth
(inches)
Weighted Depth (inches)
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.21
0.23
0.27
0.21
0.13
0.20
0.21
0.20
0.13
1/BR
2/SA
3/LY
4/RI
5/HR
6/FR
7/CU
8/ST
9/NO

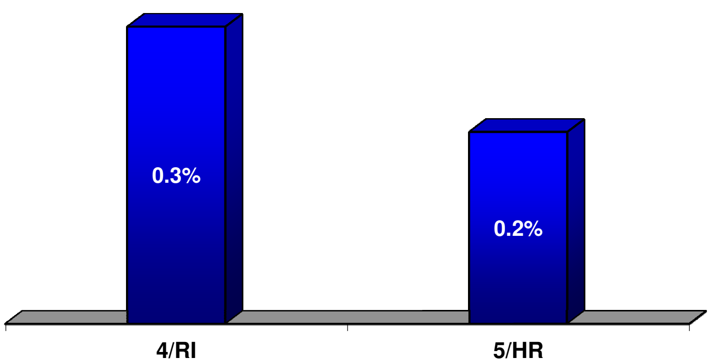
Interstate Asphalt Pavement - Transverse Cracking (% of total area)



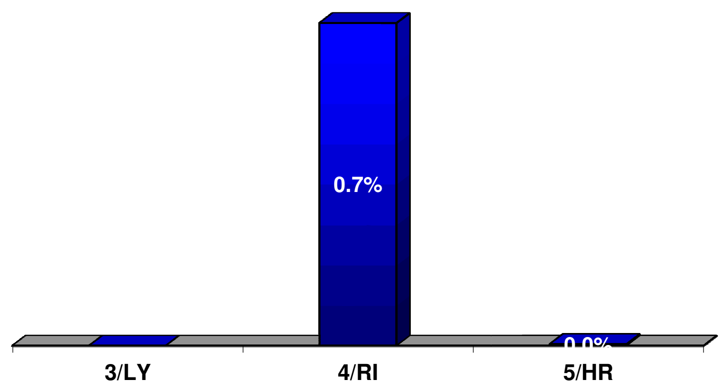
Primary Asphalt Pavement - Transverse Cracking (% of total area)

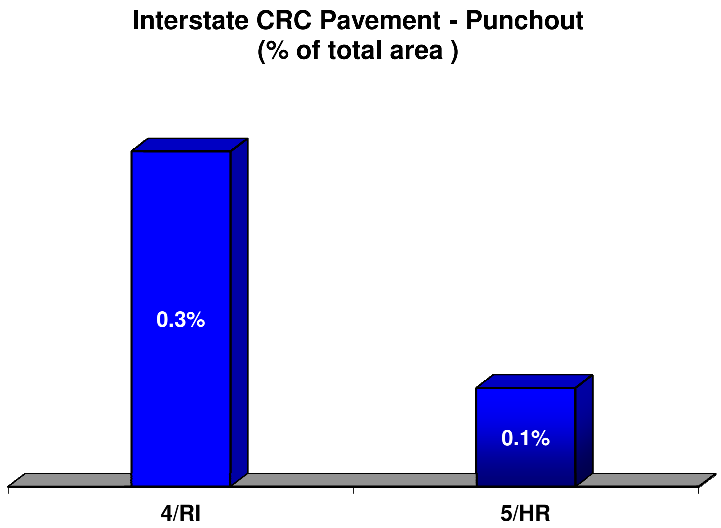


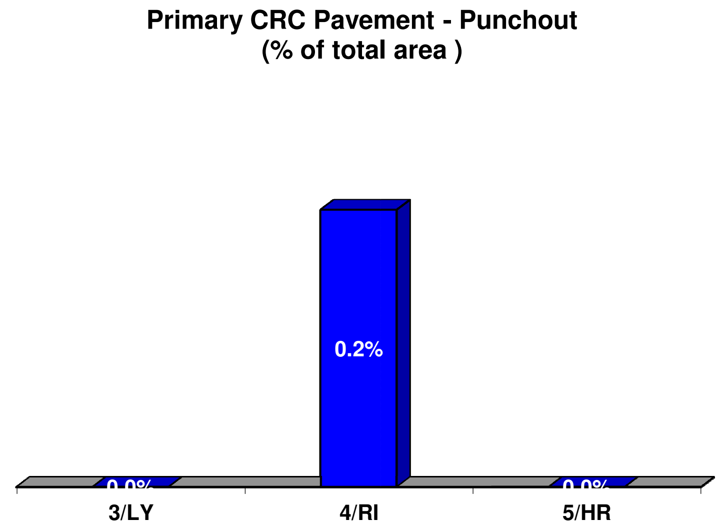
Interstate CRC Pavement - Asphalt Patching (% of total area)

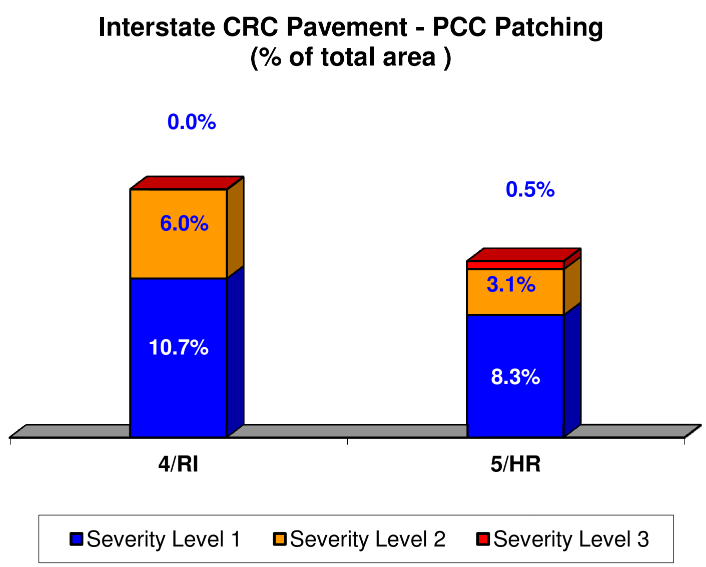


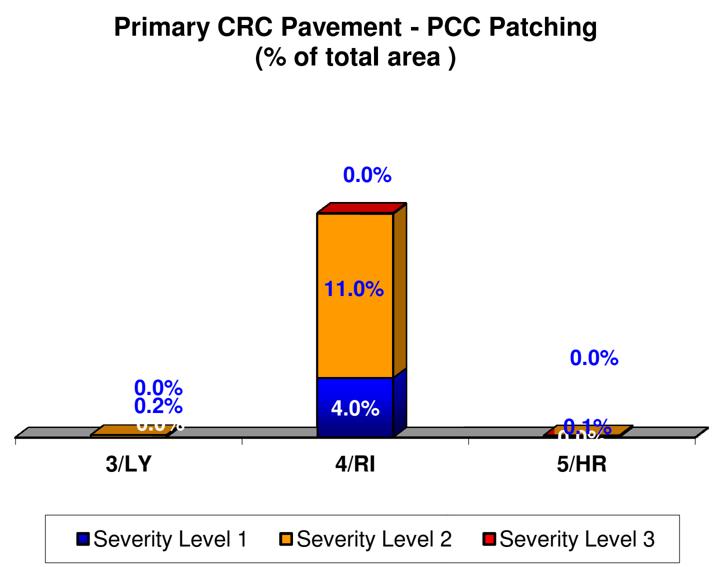
Primary CRC Pavement - Asphalt Patching (% of total area)



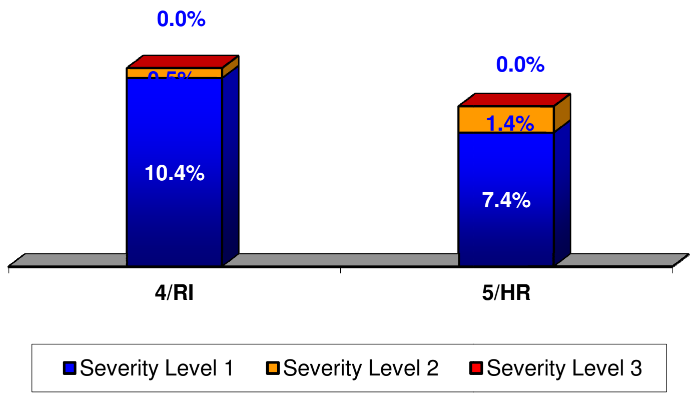

Interstate CRC Pavement - Punchout
(% of total area)
0.3%
0.1%
4/RI
5/HR


Primary CRC Pavement - Punchout
(% of total area)
0.2%
3/LY
4/RI
5/HR

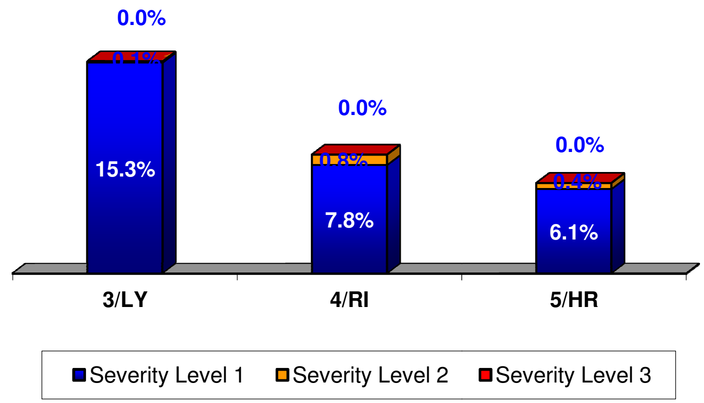

Interstate CRC Pavement - PCC Patching
(% of total area)
0.0%
6.0%
10.7%
0.5%
3.1%
8.3%
4/RI
5/HR
Severity Level 1
Severity Level 2
Severity Level 3


Primary CRC Pavement - PCC Patching
(% of total area)
0.0%
0.2%
0.0%
11.0%
4.0%
0.0%
0.1%
3/LY
4/RI
5/HR
Severity Level 1
Severity Level 2
Severity Level 3

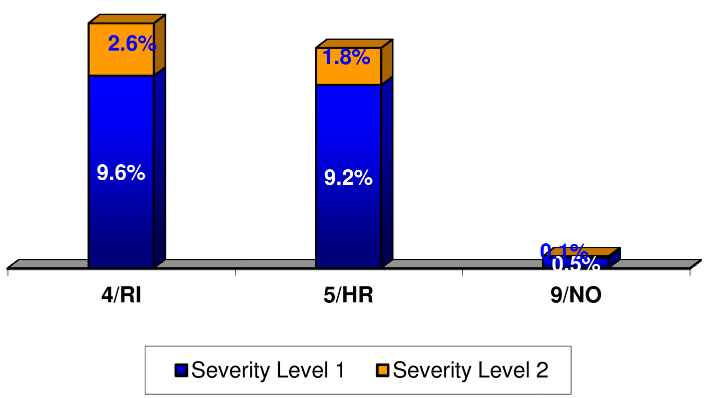
Interstate CRC Pavement-Transverse Cracking (% of total area)



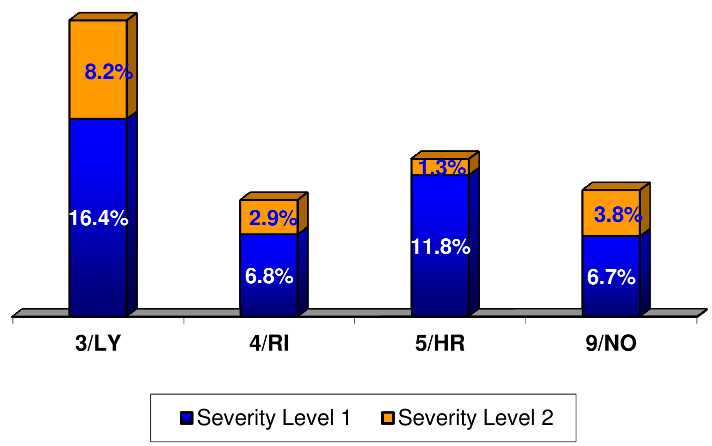
Primary CRC Pavement - Transverse Cracking (% of total area)



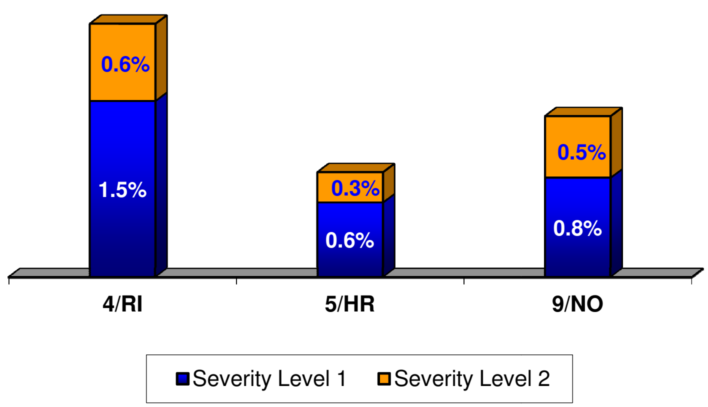
Interstate JRC Pavement - Transverse Cracking (% of total slabs)



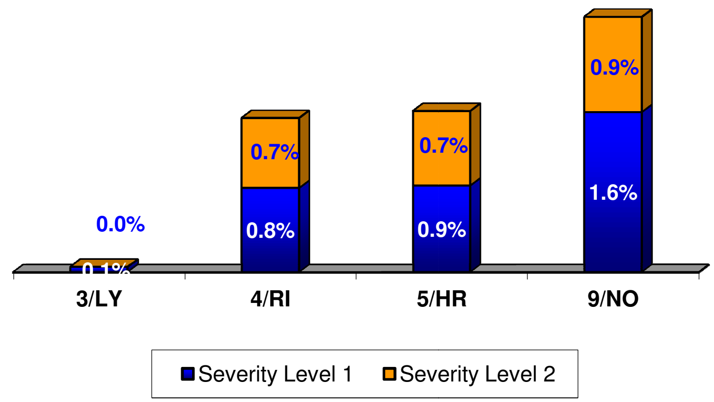
Primary JRC Pavement - Transverse Cracking (% of total slabs)



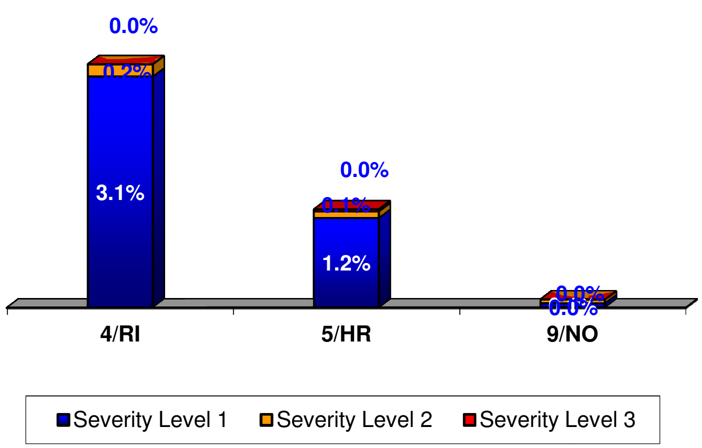
Interstate JRC Pavement - Corner Breaks (% of total slabs)



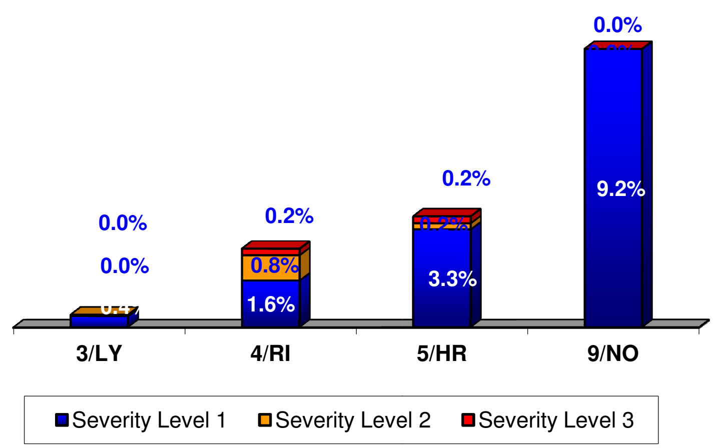
Primary JRC Pavement - Corner Breaks (% of total slabs)

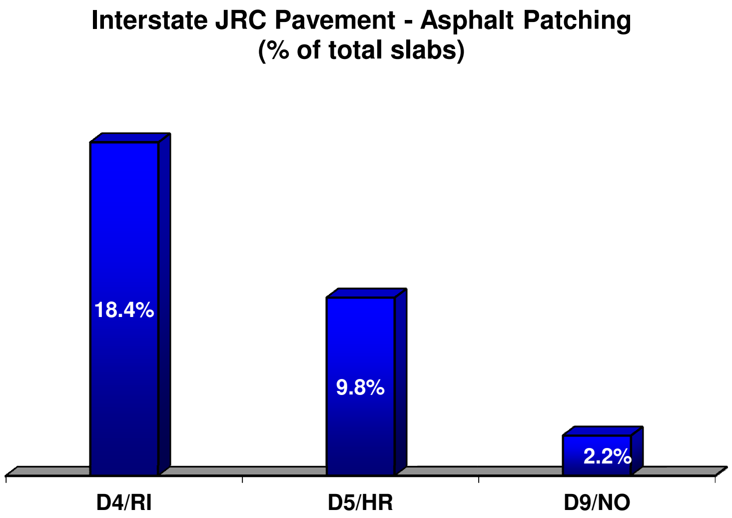


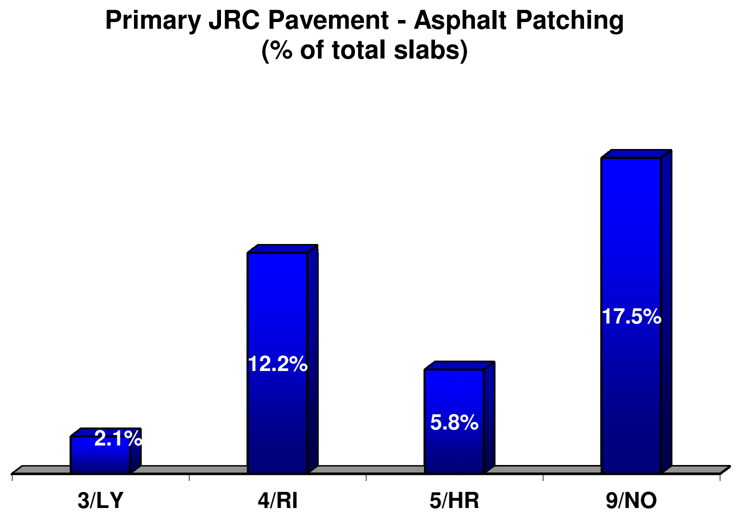
Interstate JRC Pavement - PCC Patching (% of total slabs)



Primary JRC Pavement - PCC Patching (% of total slabs)




Interstate JRC Pavement - Asphalt Patching
(% of total slabs)
18.4%
9.8%
2.2%
D4/RI
D5/HR
D9/NO


Primary JRC Pavement - Asphalt Patching
(% of total slabs)
2.1%
12.2%
5.8%
17.5%
3/LY
4/RI
5/HR
9/NO

APPENDIX C: PAVEMENT CONDITION BY DISTRICT AND COUNTY - 2013

Table C1. Pavement Condition by District and County for Interstate System – 2013

District	County No.	County Name	Lane Miles Rated, Interstate	Deficient Lane Miles	% Deficient
Bristol (1)	10	Bland	86.76	23.64	27.25%
	86	Smythe	93.18	7.52	8.07%
	95	Washington	164.90	21.78	13.21%
	98	Wythe	193.02	56.06	29.04%
District 1 Total			537.86	109.00	20.27%
Salem (2)	11	Botetourt	107.20	9.12	8.51%
	17	Carroll	103.69	1.83	1.77%
	60	Montgomery	104.10	24.86	23.88%
	77	Pulaski	70.68	0.00	0.00%
	80	Roanoke	106.99	11.28	10.54%
District 2 Total			492.66	47.09	9.56%
Richmond (4)	12	Brunswick	82.80	45.25	54.65%
	20	Chesterfield	137.31	19.35	14.09%
	26	Dinwiddie	119.29	20.33	17.04%
	37	Goochland	111.66	12.58	11.27%
	42	Hanover	164.94	41.94	25.43%
	43	Henrico	381.76	64.58	16.92%
	58	Mecklenburg	78.08	63.57	81.41%
	63	New Kent	79.97	0.77	0.96%
	74	Prince George	130.64	51.69	39.57%
District 4 Total			1286.45	320.06	24.88%
Hampton Roads (5)	40	Greensville	68.56	0.00	0.00%
	47	James City	34.76	0.00	0.00%
	61	Nansemond	13.80	0.00	0.00%
	64	Norfolk	287.51	28.57	9.94%
	75	Princess Anne	78.50	58.93	75.07%
	91	Sussex	70.34	42.68	60.68%
	99	York	215.68	11.86	5.50%
District 5 Total			769.15	142.04	18.47%
Fredericksburg (6)	16	Caroline	93.75	0.00	0.00%
	88	Spotsylvania	92.43	0.00	0.00%
	89	Stafford	91.62	0.00	0.00%
District 6 Total			277.80	0.00	0.00%
Culpeper (7)	2	Albemarle	124.82	0.00	0.00%
	30	Fauquier	87.80	2.32	2.64%
	54	Louisa	66.62	0.00	0.00%
District 7 Total			279.24	2.32	0.83%
Staunton (8)	3	Alleghany	163.98	16.00	9.76%
	7	Augusta	191.91	29.73	15.49%
	34	Frederick	102.22	8.44	8.26%
	81	Rockbridge	191.60	0.00	0.00%

District	County No.	County Name	Lane Miles Rated, Interstate	Deficient Lane Miles	% Deficient
Staunton (8)	82	Rockingham	108.36	0.00	0.00%
	85	Shenandoah	138.72	0.00	0.00%
	93	Warren	58.98	0.00	0.00%
District 8 Total			955.77	75.77	7.93%
Northern Virginia (9)	0	Arlington	69.95	21.30	30.45%
	29	Fairfax	439.50	86.92	19.78%
	76	Prince William	150.62	35.73	23.72%
District 9 Total			660.07	143.95	21.81%
Statewide			**5259.00**	**840.23**	**15.98%**

Table C2. Pavement Condition by District and County for Primary System – 2013

District	County No.	County Name	Lane Miles Rated, Primary	Deficient Lane Miles	% Deficient
Bristol (1)	10	Bland	155.72	59.72	38.34%
	13	Buchanan	185.44	44.13	23.80%
	25	Dickenson	163.16	52.32	32.07%
	38	Grayson	227.84	79.42	34.86%
	52	Lee	325.82	28.76	8.83%
	83	Russell	294.55	44.06	14.96%
	84	Scott	283.62	94.50	33.32%
	86	Smythe	176.47	31.91	18.08%
	92	Tazewell	356.80	17.86	5.01%
	95	Washington	256.31	24.62	9.61%
	97	Wise	340.32	80.65	23.70%
	98	Wythe	143.01	43.18	30.19%
District 1 Total			2909.06	601.13	20.66%
Salem (2)	9	Bedford	380.39	74.65	19.63%
	11	Botetourt	257.57	88.23	34.25%
	17	Carroll	208.01	26.34	12.66%
	22	Craig	114.84	39.50	34.40%
	31	Floyd	109.60	17.74	16.19%
	33	Franklin	243.25	39.31	16.16%
	35	Giles	226.26	57.56	25.44%
	44	Henry	335.32	36.70	10.94%
	60	Montgomery	175.80	12.79	7.27%
	70	Patrick	229.06	27.39	11.96%
	77	Pulaski	102.74	14.54	14.16%
	80	Roanoke	223.97	64.67	28.88%
District 2 Total			2606.81	499.42	19.16%
Lynchburg (3)	5	Amherst	286.28	37.81	13.21%
	6	Appomattox	140.81	14.37	10.21%
	14	Buckingham	195.16	46.12	23.63%
	15	Campbell	321.37	12.51	3.89%
	19	Charlotte	279.05	45.06	16.15%
	24	Cumberland	106.52	24.54	23.04%
	41	Halifax	432.96	37.82	8.74%
	62	Nelson	259.88	34.87	13.42%
	71	Pittsylvania	537.24	75.14	13.99%
	73	Prince Edward	221.66	1.66	0.75%
District 3 Total			2780.93	329.90	11.86%
Richmond (4)	4	Amelia	115.45	9.69	8.39%
	12	Brunswick	248.07	53.58	21.60%
	18	Charles City	88.14	4.68	5.31%
	20	Chesterfield	512.06	120.10	23.45%

District	County No.	County Name	Lane Miles Rated, Primary	Deficient Lane Miles	% Deficient
Richmond (4)	26	Dinwiddie	238.97	25.52	10.68%
	37	Goochland	186.75	44.66	23.91%
	42	Hanover	233.41	46.62	19.97%
	43	Henrico	404.59	102.07	25.23%
	55	Lunenburg	126.14	27.33	21.67%
	58	Mecklenburg	414.00	92.04	22.23%
	63	New Kent	187.29	20.35	10.87%
	67	Nottoway	218.18	58.01	26.59%
	72	Powhatan	122.93	38.38	31.22%
	74	Prince George	188.25	33.44	17.76%
District 4 Total			3284.23	676.47	20.60%
Hampton Roads (5)	1	Accomack	279.64	98.22	35.12%
	40	Greensville	79.70	11.38	14.28%
	46	Isle of Wight	201.83	13.28	6.58%
	47	James City	185.79	31.18	16.78%
	61	Nansemond	4.89	3.99	81.68%
	64	Norfolk	49.43	5.38	10.89%
	65	Northampton	158.08	46.80	29.60%
	87	Southampton	278.06	29.17	10.49%
	90	Surry	97.88	5.49	5.61%
	91	Sussex	223.14	0.00	0.00%
	99	York	149.11	37.28	25.00%
District 5 Total			1707.55	282.17	16.52%
Fredericksburg (6)	16	Caroline	292.41	8.76	2.99%
	28	Essex	172.30	37.23	21.61%
	36	Gloucester	186.86	79.71	42.66%
	48	King George	208.22	62.14	29.84%
	49	King & Queen	135.64	15.18	11.19%
	50	King William	110.74	23.66	21.36%
	51	Lancaster	126.82	11.06	8.72%
	57	Mathews	66.99	36.51	54.50%
	59	Middlesex	131.73	10.94	8.30%
	66	Northumberland	112.62	6.03	5.35%
	79	Richmond	108.55	10.13	9.33%
	88	Spotsylvania	212.88	7.40	3.48%
	89	Stafford	167.57	21.66	12.93%
	96	Westmoreland	141.30	24.20	17.13%
District 6 Total			2174.63	354.61	16.31%
Culpeper (7)	2	Albemarle	359.54	31.97	8.89%
	23	Culpeper	212.11	0.32	0.15%
	30	Fauquier	313.60	60.52	19.30%
	32	Fluvanna	102.34	8.18	7.99%
	39	Greene	90.45	14.60	16.14%
	54	Louisa	241.58	60.44	25.02%

District	County No.	County Name	Lane Miles Rated, Primary	Deficient Lane Miles	% Deficient
Culpeper (7)	56	Madison	158.62	0.00	0.00%
	68	Orange	189.20	7.20	3.80%
	78	Rappahannock	160.19	27.32	17.06%
District 7 Total			1827.63	210.55	11.52%
Staunton (8)	3	Alleghany	157.42	17.05	10.84%
	7	Augusta	406.67	35.48	8.72%
	8	Bath	149.60	14.92	9.97%
	21	Clarke	148.46	23.30	15.69%
	34	Frederick	328.12	9.56	2.91%
	45	Highland	141.96	22.96	16.17%
	69	Page	148.49	18.31	12.33%
	81	Rockbridge	275.52	5.84	2.12%
	82	Rockingham	411.21	40.73	9.90%
	85	Shenandoah	216.49	11.43	5.28%
	93	Warren	89.14	18.98	21.29%
District 8 Total			2473.08	218.56	8.84%
Northern Virginia (9)	0	Arlington	163.82	60.09	36.68%
	29	Fairfax	880.70	167.52	19.02%
	53	Loudoun	429.94	91.77	21.35%
	76	Prince William	387.54	114.10	29.44%
District 9 Total			1862.00	433.48	23.28%
Statewide			**21625.92**	**3606.29**	**16.68%**

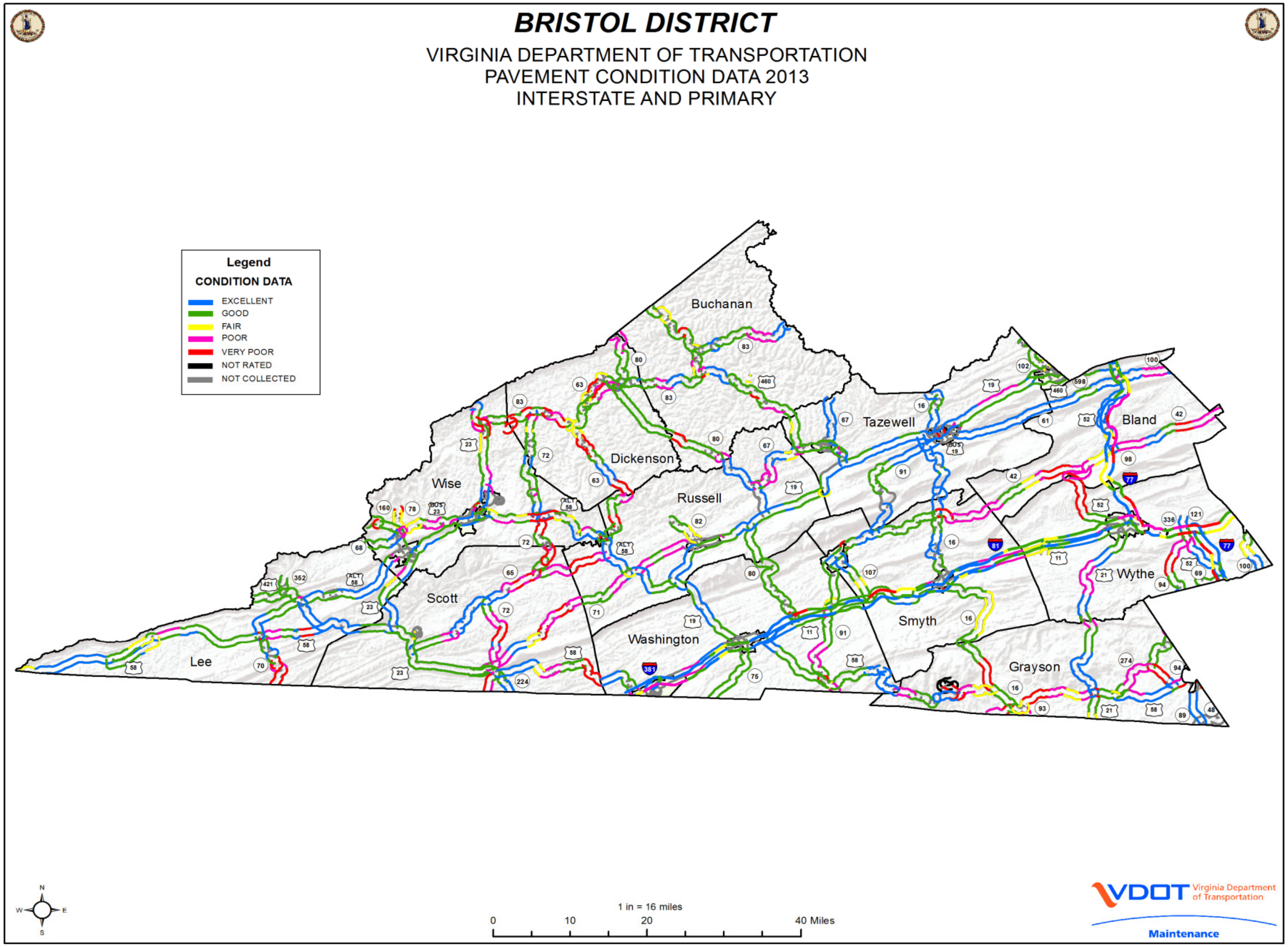
Table C3. Pavement Condition by District and County for Secondary System (Samples) – 2013

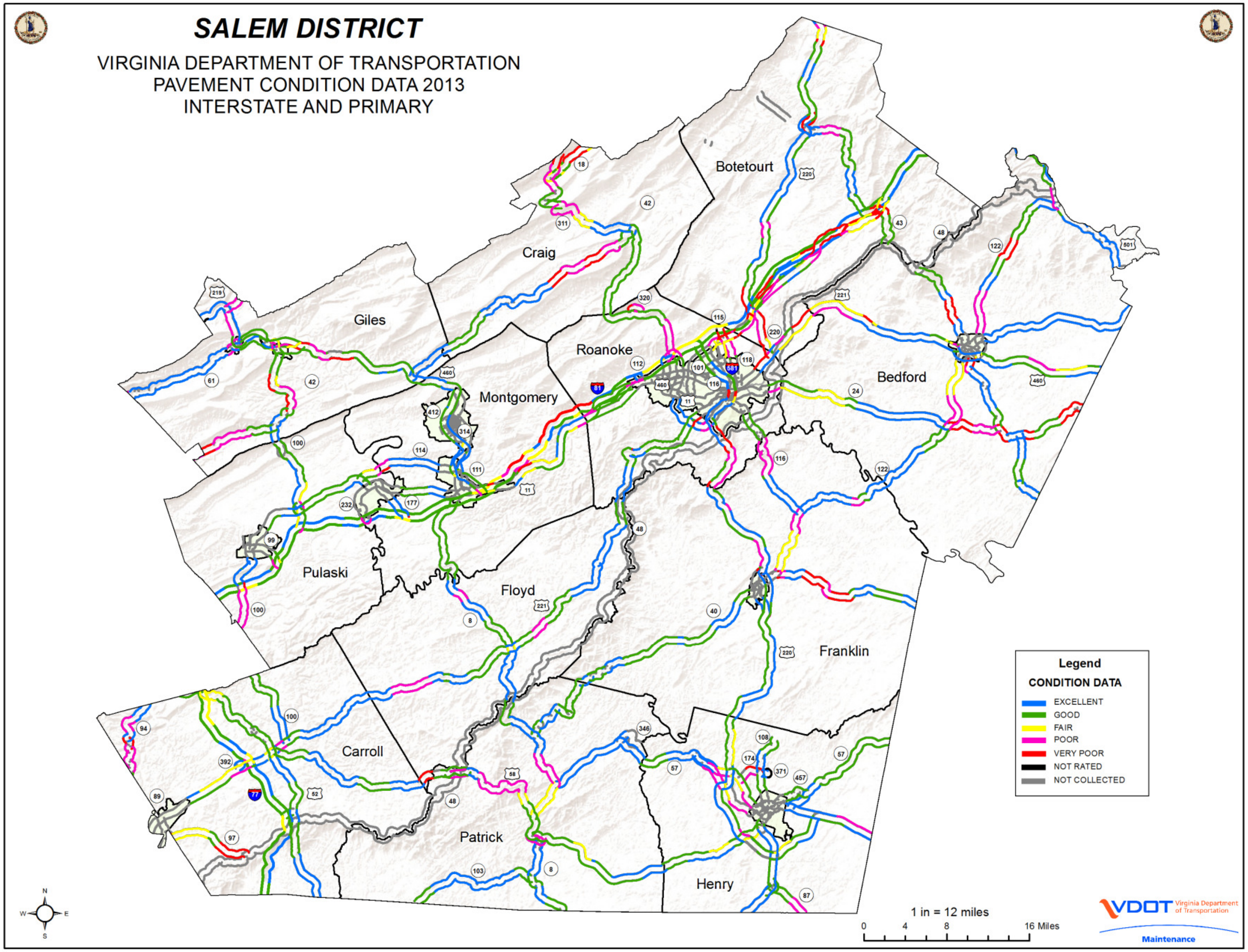
District	County No.	County Name	Lane Miles Rated, Secondary (Samples)	Deficient Lane Miles	% Deficient
Bristol (1)	10	Bland	45.54	23.12	50.75%
	13	Buchanan	136.71	70.26	51.40%
	25	Dickenson	135.19	55.05	40.72%
	38	Grayson	122.47	63.83	52.12%
	52	Lee	142.72	16.86	11.81%
	83	Russell	132.75	53.73	40.47%
	84	Scott	138.80	32.91	23.71%
	86	Smythe	140.06	59.45	42.45%
	92	Tazewell	135.69	39.97	29.46%
	95	Washington	245.93	120.95	49.18%
	97	Wise	155.11	68.30	44.03%
	98	Wythe	102.07	61.52	60.27%
District 1 Total			1633.04	665.95	40.78%
Salem (2)	9	Bedford	294.49	94.46	32.07%
	11	Botetourt	150.34	35.47	23.59%
	17	Carroll	205.48	66.17	32.20%
	22	Craig	46.90	6.86	14.63%
	31	Floyd	132.74	105.86	79.75%
	33	Franklin	378.55	119.90	31.67%
	35	Giles	74.94	32.32	43.13%
	44	Henry	283.59	160.31	56.53%
	60	Montgomery	121.27	26.10	21.52%
	70	Patrick	202.79	78.66	38.79%
	77	Pulaski	112.89	60.90	53.95%
	80	Roanoke	232.66	110.04	47.30%
District 2 Total			2236.64	897.05	40.11%
Lynchburg (3)	5	Amherst	151.10	85.50	56.57%
	6	Appomattox	160.97	34.81	21.63%
	14	Buckingham	140.05	55.38	39.55%
	15	Campbell	254.69	48.89	19.20%
	19	Charlotte	165.84	47.31	28.53%
	24	Cumberland	79.42	43.23	54.43%
	41	Halifax	314.51	81.65	25.96%
	62	Nelson	102.36	88.57	86.52%
	71	Pittsylvania	478.47	140.79	29.43%
	73	Prince Edward	121.87	26.25	21.54%
District 3 Total			1969.28	652.38	33.13%
Richmond (4)	4	Amelia	116.99	85.67	73.23%
	12	Brunswick	181.15	61.41	33.90%
	18	Charles City	48.04	8.22	17.11%
	20	Chesterfield	691.67	308.00	44.53%

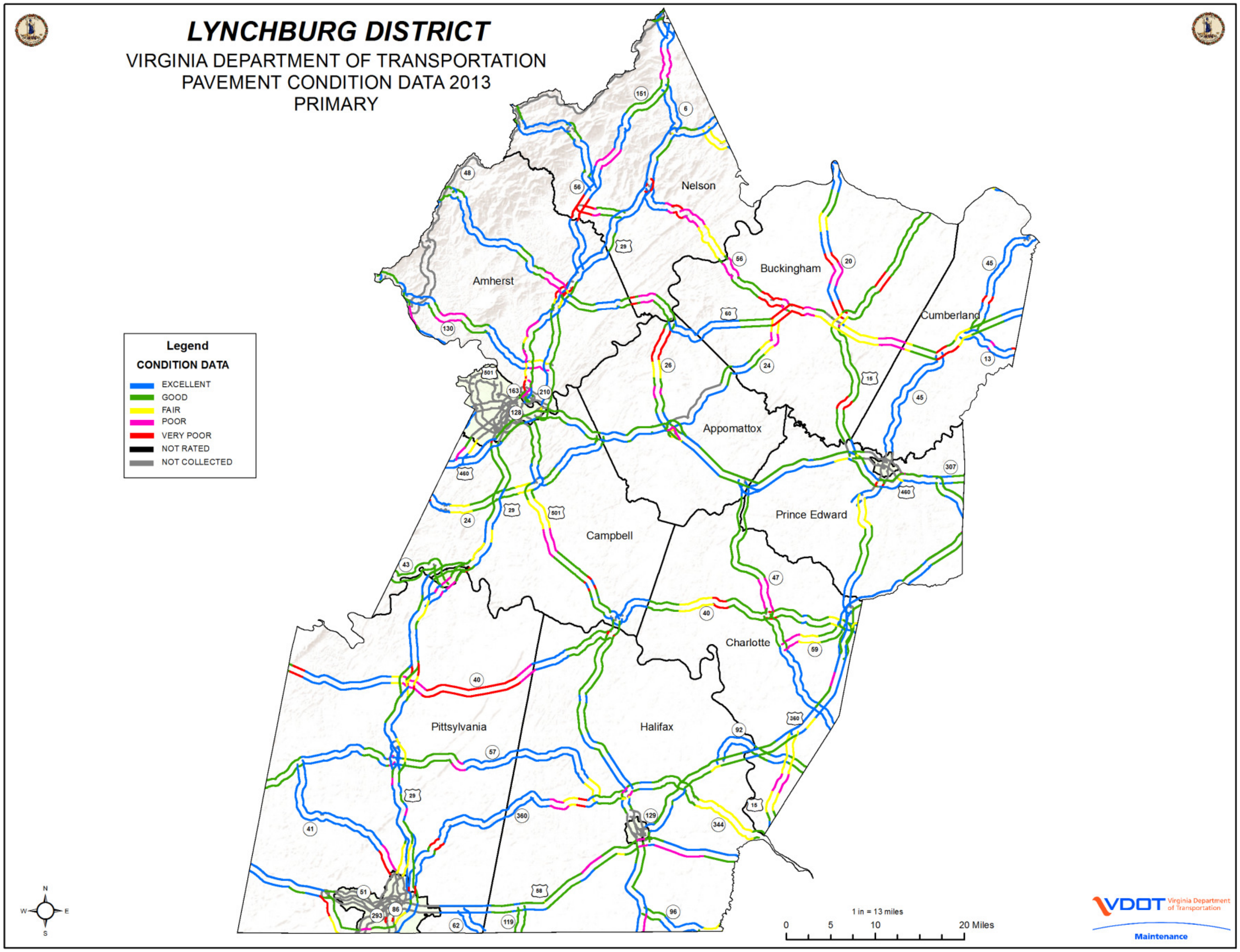
District	County No.	County Name	Lane Miles Rated, Secondary (Samples)	Deficient Lane Miles	% Deficient
Richmond (4)	26	Dinwiddie	184.40	53.75	29.15%
	37	Goochland	127.29	56.01	44.00%
	42	Hanover	335.90	239.10	71.18%
	55	Lunenburg	137.79	69.38	50.35%
	58	Mecklenburg	236.07	83.57	35.40%
	63	New Kent	76.39	23.67	30.99%
	67	Nottoway	94.04	51.64	54.91%
	72	Powhatan	112.51	56.14	49.90%
	74	Prince George	119.48	62.13	52.00%
District 4 Total			2461.72	1158.69	47.07%
Hampton Roads (5)	1	Accomack	220.95	100.40	45.44%
	40	Greensville	109.90	10.72	9.76%
	46	Isle of Wight	166.59	8.74	5.24%
	47	James City	131.29	23.03	17.54%
	61	Nansemond	0.06	0.00	0.00%
	65	Northampton	105.10	37.86	36.03%
	87	Southampton	239.12	29.97	12.54%
	90	Surry	96.50	12.24	12.68%
	91	Sussex	157.68	16.08	10.20%
	99	York	127.35	29.41	23.09%
District 5 Total			1354.54	268.45	19.82%
Fredericksburg (6)	16	Caroline	173.63	46.82	26.97%
	28	Essex	83.92	31.16	37.13%
	36	Gloucester	114.69	58.67	51.15%
	48	King George	58.76	5.90	10.04%
	49	King & Queen	90.71	38.83	42.81%
	50	King William	104.66	14.62	13.97%
	51	Lancaster	97.10	33.63	34.63%
	57	Mathews	57.61	30.30	52.60%
	59	Middlesex	55.47	17.74	31.97%
	66	Northumberland	137.20	75.51	55.04%
	79	Richmond	79.62	31.42	39.46%
	88	Spotsylvania	288.42	64.14	22.24%
	89	Stafford	247.88	94.86	38.27%
	96	Westmoreland	119.50	80.45	67.32%
District 6 Total			1709.17	624.05	36.51%
Culpeper (7)	2	Albemarle	286.68	121.43	42.36%
	23	Culpeper	138.05	41.18	29.83%
	30	Fauquier	241.04	120.51	50.00%
	32	Fluvanna	115.95	17.85	15.40%
	39	Greene	55.69	25.76	46.25%
	54	Louisa	190.78	48.53	25.44%
	56	Madison	75.79	22.08	29.13%
	68	Orange	101.66	19.73	19.40%

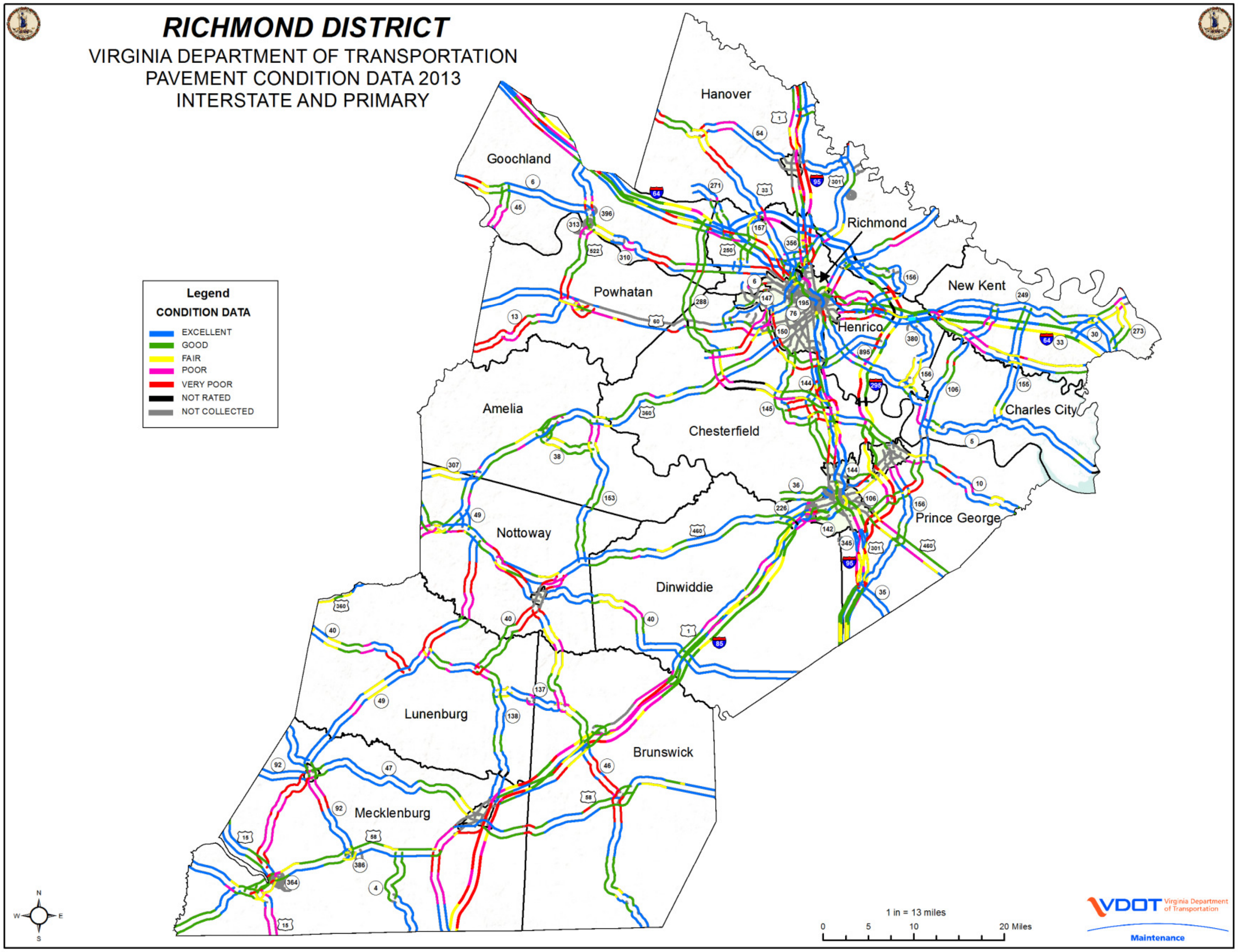
District	County No.	County Name	Lane Miles Rated, Secondary (Samples)	Deficient Lane Miles	% Deficient
	78	Rappahannock	40.78	18.67	45.78%
District 7 Total			1246.42	435.74	34.96%
Staunton (8)	3	Alleghany	93.28	53.97	57.86%
	7	Augusta	284.51	92.23	32.42%
	8	Bath	71.48	9.92	13.87%
	21	Clarke	69.05	23.48	34.01%
	34	Frederick	206.86	63.38	30.64%
	45	Highland	27.22	13.57	49.87%
	69	Page	93.91	10.75	11.44%
	81	Rockbridge	155.38	31.89	20.52%
	82	Rockingham	243.41	64.62	26.55%
	85	Shenandoah	153.16	59.70	38.98%
	93	Warren	45.66	3.02	6.61%
District 8 Total			1443.92	426.53	29.54%
Northern Virginia (9)	29	Fairfax	1251.33	903.02	72.16%
	53	Loudoun	371.36	200.89	54.10%
	76	Prince William	514.86	302.89	58.83%
District 9 Total			2137.55	1406.80	65.81%
Statewide			**16192.28**	**6535.64**	**40.36%**

APPENDIX D: PAVEMENT CONDITION MAPS FOR INTERSTATE AND PRIMARY SYSTEMS - 2013

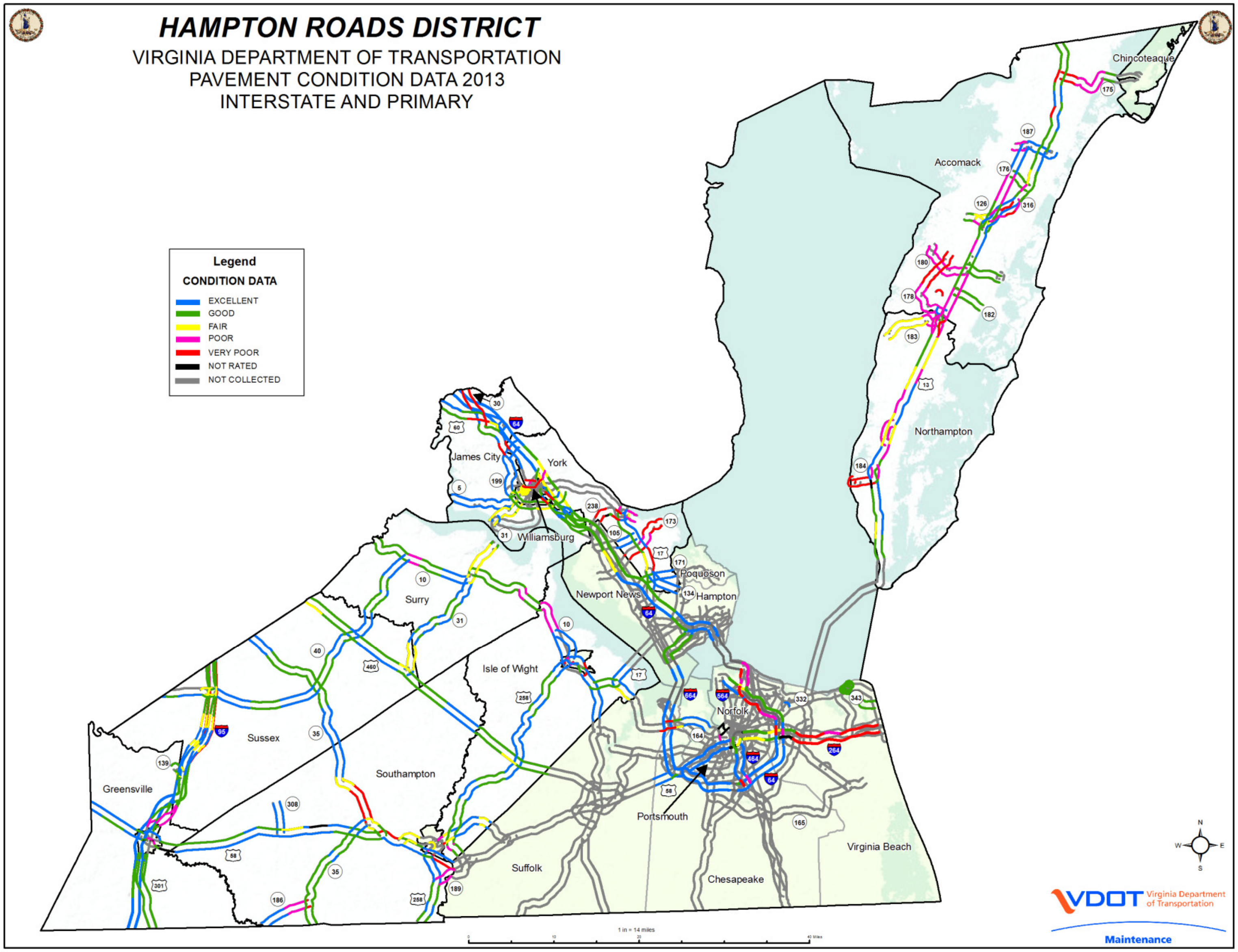

BRISTOL DISTRICT
VIRGINIA DEPARTMENT OF TRANSPORTATION
PAVEMENT CONDITION DATA 2013
INTERSTATE AND PRIMARY
Legend
CONDITION DATA
EXCELLENT
GOOD
FAIR
POOR
VERY POOR
NOT RATED
NOT COLLECTED
Buchanan
Tazewell
Bland
Dickenson
Wise
Russell
Wythe
Scott
Smyth
Lee
Washington
Grayson
1 in = 16 miles
0 10 20 40 Miles
VDOT Virginia Department of Transportation
Maintenance

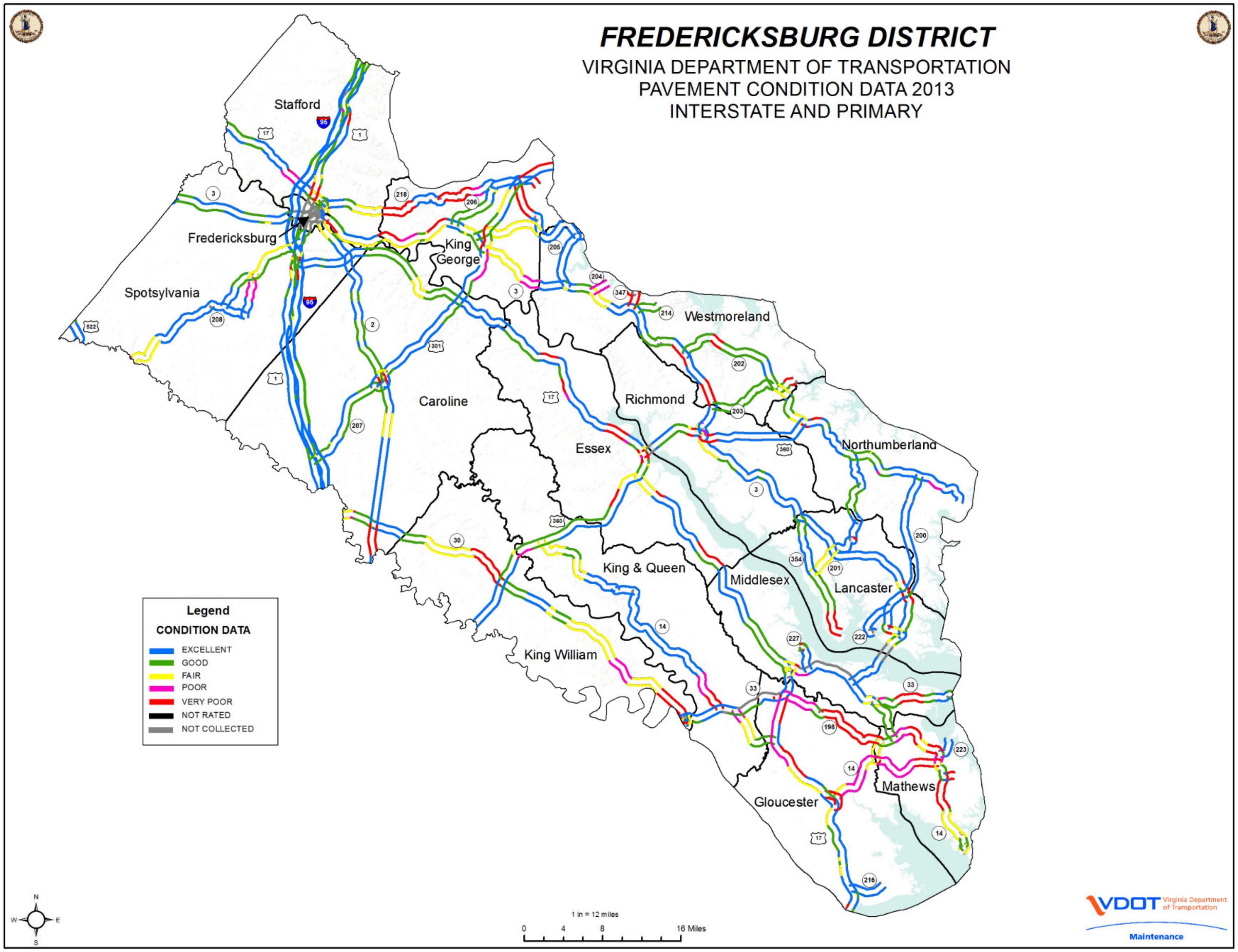

SALEM DISTRICT
VIRGINIA DEPARTMENT OF TRANSPORTATION
PAVEMENT CONDITION DATA 2013
INTERSTATE AND PRIMARY
Botetourt
Craig
Giles
Roanoke
Montgomery
Bedford
Pulaski
Floyd
Franklin
Carroll
Patrick
Henry
Legend
CONDITION DATA
EXCELLENT
GOOD
FAIR
POOR
VERY POOR
NOT RATED
NOT COLLECTED
1 in = 12 miles
0 4 8 16 Miles
VDOT Virginia Department of Transportation
Maintenance

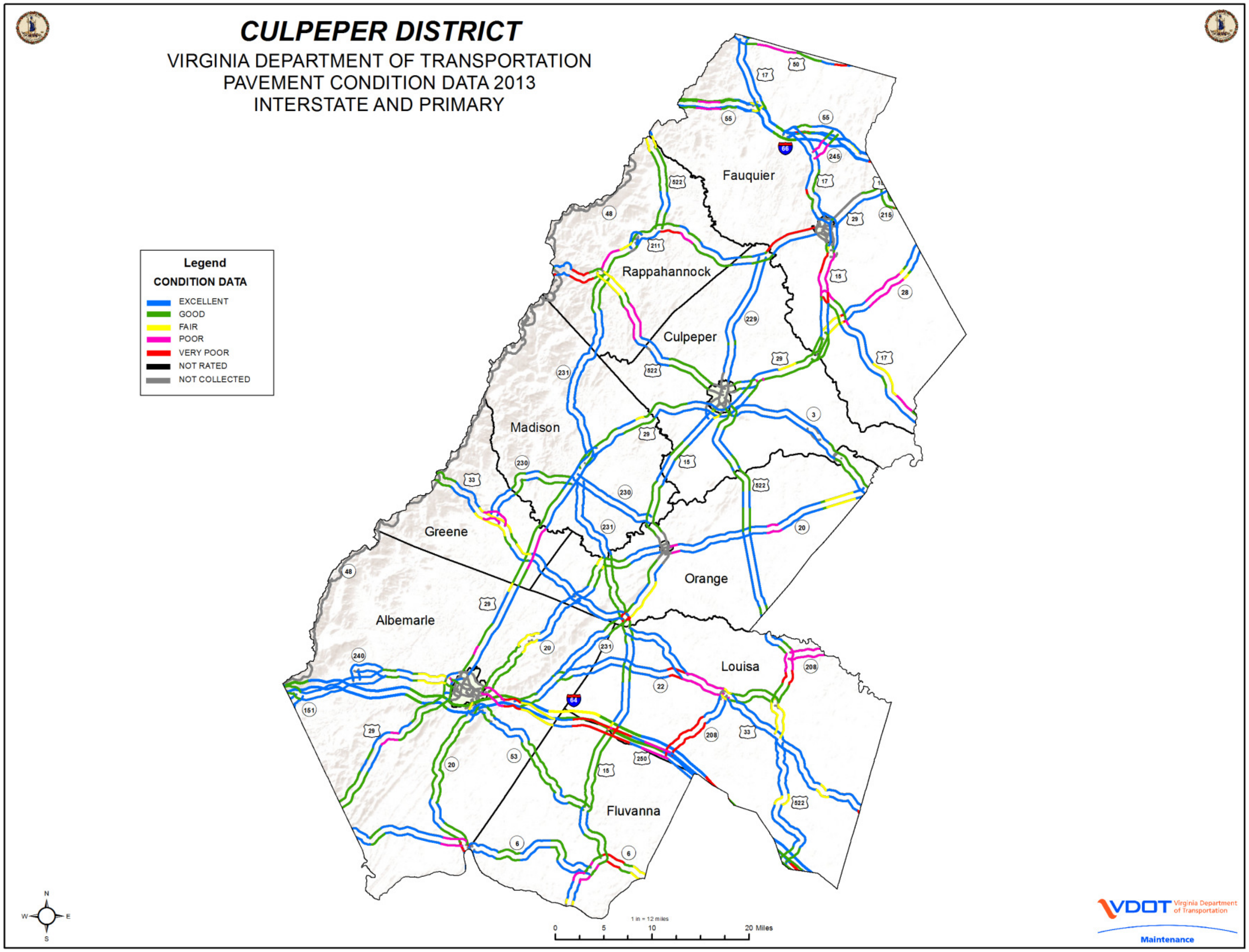

LYNCHBURG DISTRICT
VIRGINIA DEPARTMENT OF TRANSPORTATION
PAVEMENT CONDITION DATA 2013
PRIMARY
Legend
CONDITION DATA
EXCELLENT
GOOD
FAIR
POOR
VERY POOR
NOT RATED
NOT COLLECTED
Nelson
Amherst
Buckingham
Cumberland
Appomattox
Prince Edward
Campbell
Charlotte
Pittsylvania
Halifax
1 in = 13 miles
0 5 10 20 Miles
VDOT Virginia Department of Transportation
Maintenance

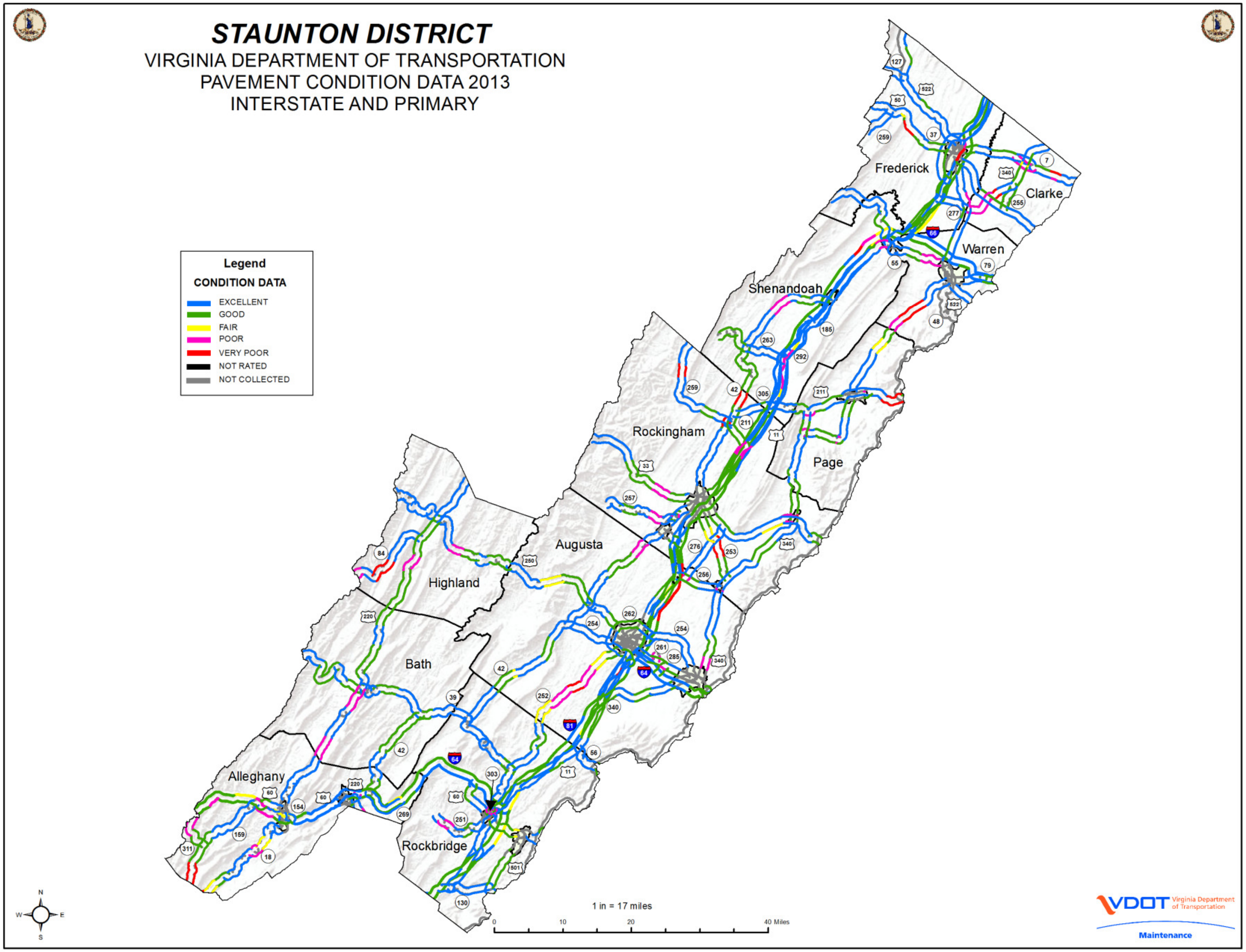


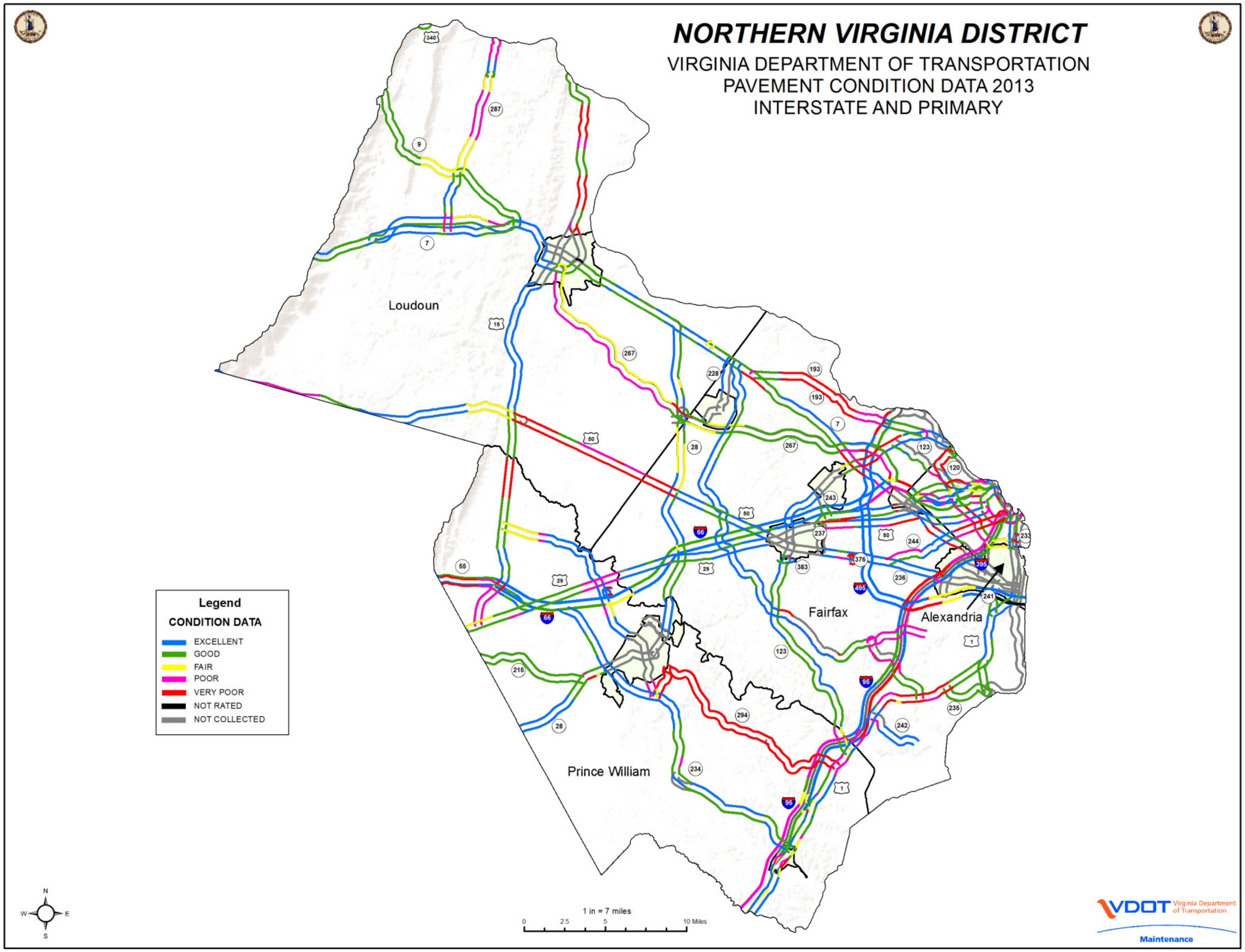
RICHMOND DISTRICT
VIRGINIA DEPARTMENT OF TRANSPORTATION
PAVEMENT CONDITION DATA 2013
INTERSTATE AND PRIMARY
Legend
CONDITION DATA
EXCELLENT
GOOD
FAIR
POOR
VERY POOR
NOT RATED
NOT COLLECTED
Goochland
Hanover
Richmond
Powhatan
New Kent
Henrico
Amelia
Chesterfield
Charles City
Nottoway
Prince George
Dinwiddie
Lunenburg
Brunswick
Mecklenburg
1 in = 13 miles
0 5 10 20 Miles
VDOT Virginia Department of Transportation
Maintenance


HAMPTON ROADS DISTRICT
VIRGINIA DEPARTMENT OF TRANSPORTATION
PAVEMENT CONDITION DATA 2013
INTERSTATE AND PRIMARY
Legend
CONDITION DATA
EXCELLENT
GOOD
FAIR
POOR
VERY POOR
NOT RATED
NOT COLLECTED
Chincoteague
Accomack
Northampton
James City
York
Williamsburg
Poquoson
Hampton
Newport News
Surry
Isle of Wight
Sussex
Southampton
Greensville
Norfolk
Portsmouth
Suffolk
Chesapeake
Virginia Beach
VDOT Virginia Department of Transportation
Maintenance


FREDERICKSBURG DISTRICT
VIRGINIA DEPARTMENT OF TRANSPORTATION
PAVEMENT CONDITION DATA 2013
INTERSTATE AND PRIMARY
Stafford
Fredericksburg
Spotsylvania
King George
Caroline
Westmoreland
Richmond
Essex
Northumberland
King & Queen
Middlesex
Lancaster
King William
Gloucester
Mathews
Legend
CONDITION DATA
EXCELLENT
GOOD
FAIR
POOR
VERY POOR
NOT RATED
NOT COLLECTED
1 in = 12 miles
0 4 8 16 Miles
VDOT Virginia Department of Transportation
Maintenance


CULPEPER DISTRICT
VIRGINIA DEPARTMENT OF TRANSPORTATION
PAVEMENT CONDITION DATA 2013
INTERSTATE AND PRIMARY
Legend
CONDITION DATA
EXCELLENT
GOOD
FAIR
POOR
VERY POOR
NOT RATED
NOT COLLECTED
Fauquier
Rappahannock
Culpeper
Madison
Greene
Orange
Albemarle
Louisa
Fluvanna
0 5 10 20 Miles
VDOT Virginia Department of Transportation
Maintenance


STAUNTON DISTRICT
VIRGINIA DEPARTMENT OF TRANSPORTATION
PAVEMENT CONDITION DATA 2013
INTERSTATE AND PRIMARY
Legend
CONDITION DATA
EXCELLENT
GOOD
FAIR
POOR
VERY POOR
NOT RATED
NOT COLLECTED
Frederick
Clarke
Warren
Shenandoah
Rockingham
Page
Augusta
Highland
Bath
Alleghany
Rockbridge
1 in = 17 miles
0 10 20 40 Miles
VDOT Virginia Department of Transportation
Maintenance


NORTHERN VIRGINIA DISTRICT
VIRGINIA DEPARTMENT OF TRANSPORTATION
PAVEMENT CONDITION DATA 2013
INTERSTATE AND PRIMARY
Legend
CONDITION DATA
EXCELLENT
GOOD
FAIR
POOR
VERY POOR
NOT RATED
NOT COLLECTED
Loudoun
Fairfax
Alexandria
Prince William
1 in = 7 miles
0 2.5 5 10 Miles
VDOT Virginia Department of Transportation
Maintenance

APPENDIX E: PAVEMENT RIDE QUALITY BY DISTRICT AND COUNTY – 2013

Table E1. Pavement Ride Quality by District and County for Interstate System – 2013

District	County No.	County Name	Lane Miles (LM) Rated, Interstate	Deficient Ride Quality, LM	% Deficient Ride Quality
Bristol (1)	10	Bland	85.06	1.34	1.57%
	86	Smythe	90.48	0.41	0.46%
	95	Washington	156.47	0.38	0.24%
	98	Wythe	187.73	3.40	1.81%
District 1 Total			519.74	5.53	1.06%
Salem (2)	11	Botetourt	104.76	7.85	7.50%
	17	Carroll	102.37	1.83	1.79%
	60	Montgomery	106.73	2.45	2.29%
	77	Pulaski	68.70	0.64	0.93%
	80	Roanoke	101.18	1.22	1.21%
District 2 Total			483.74	13.99	2.89%
Richmond (4)	12	Brunswick	81.14	16.04	19.76%
	20	Chesterfield	133.62	6.37	4.76%
	26	Dinwiddie	117.23	20.08	17.13%
	37	Goochland	111.84	0.44	0.39%
	42	Hanover	164.82	6.13	3.72%
	43	Henrico	348.02	44.09	12.67%
	58	Mecklenburg	77.02	9.56	12.42%
	63	New Kent	78.91	3.06	3.87%
	74	Prince George	122.89	18.29	14.88%
District 4 Total			1235.49	124.06	10.04%
Hampton Roads (5)	40	Greensville	66.99	0.18	0.27%
	47	James City	34.61	0.16	0.46%
	61	Nansemond	0.20	0.10	48.51%
	64	Norfolk	246.23	65.52	26.61%
	75	Princess Anne	78.59	47.20	60.06%
	91	Sussex	69.39	1.84	2.65%
	99	York	207.66	14.93	7.19%
District 5 Total			703.67	129.93	18.47%
Freder icksbu rg (6)	16	Caroline	93.22	0.68	0.73%
	88	Spotsylvania	91.12	0.17	0.18%
	89	Stafford	90.83	0.51	0.56%
District 6 Total			275.17	1.36	0.49%
Culpe per (7)	2	Albemarle	120.09	3.73	3.11%
	30	Fauquier	84.94	0.43	0.50%
	54	Louisa	65.72	0.32	0.49%
District 7 Total			270.75	4.48	1.66%
Staunton (8)	3	Alleghany	157.92	5.71	3.61%
	7	Augusta	173.45	0.42	0.24%
	34	Frederick	100.82	0.01	0.01%
	81	Rockbridge	187.16	1.58	0.85%
	82	Rockingham	107.69	0.13	0.12%

District	County No.	County Name	Lane Miles (LM) Rated, Interstate	Deficient Ride Quality, LM	% Deficient Ride Quality
	85	Shenandoah	136.10	0.25	0.19%
	93	Warren	55.06	0.32	0.59%
District 8 Total			918.20	8.42	0.92%
Northern Virginia (9)	0	Arlington	62.79	3.97	6.31%
	29	Fairfax	414.91	25.27	6.09%
	76	Prince William	168.66	3.11	1.85%
District 9 Total			646.36	32.35	5.00%
Statewide			**5053.12**	**320.12**	**6.34%**

Table E2. Pavement Ride Quality by District and County for Primary System – 2013

District	County No.	County Name	Lane Miles (LM) Rated, Primary	Deficient Ride Quality, LM	% Deficient Ride Quality
Bristol (1)	10	Bland	153.90	24.10	15.66%
	13	Buchanan	184.38	76.02	41.23%
	25	Dickenson	161.66	86.15	53.29%
	38	Grayson	227.56	44.05	19.36%
	52	Lee	320.94	34.71	10.81%
	83	Russell	292.31	52.47	17.95%
	84	Scott	279.41	70.28	25.15%
	86	Smythe	174.62	40.80	23.37%
	92	Tazewell	350.57	72.16	20.58%
	95	Washington	249.23	52.31	20.99%
	97	Wise	328.74	84.71	25.77%
	98	Wythe	140.03	17.88	12.76%
District 1 Total			2863.35	655.64	22.90%
Salem (2)	9	Bedford	375.79	43.46	11.57%
	11	Botetourt	255.09	33.60	13.17%
	17	Carroll	202.14	13.02	6.44%
	22	Craig	114.39	16.80	14.68%
	31	Floyd	108.93	2.22	2.03%
	33	Franklin	240.84	21.41	8.89%
	35	Giles	221.01	17.84	8.07%
	44	Henry	333.16	15.33	4.60%
	60	Montgomery	173.92	5.80	3.34%
	70	Patrick	229.14	23.20	10.12%
	77	Pulaski	101.56	7.94	7.81%
	80	Roanoke	206.03	24.51	11.90%
District 2 Total			2562.00	225.13	8.79%
Lynchburg (3)	5	Amherst	281.79	33.94	12.04%
	6	Appomattox	145.80	21.01	14.41%
	14	Buckingham	194.07	10.00	5.15%
	15	Campbell	320.23	36.18	11.30%
	19	Charlotte	275.80	22.01	7.98%
	24	Cumberland	106.20	2.48	2.34%
	41	Halifax	427.57	43.65	10.21%
	62	Nelson	256.91	30.38	11.83%
	71	Pittsylvania	528.22	35.43	6.71%
	73	Prince Edward	217.55	8.67	3.99%
District 3 Total			2754.14	243.75	8.85%
Richmond (4)	4	Amelia	113.68	4.70	4.13%
	12	Brunswick	231.34	29.95	12.95%
	18	Charles City	88.71	6.01	6.78%
	20	Chesterfield	541.96	132.58	24.46%
	26	Dinwiddie	214.75	17.82	8.30%

District	County No.	County Name	Lane Miles (LM) Rated, Primary	Deficient Ride Quality, LM	% Deficient Ride Quality
Richmond (4)	37	Goochland	188.11	17.15	9.11%
	42	Hanover	229.23	31.88	13.91%
	43	Henrico	375.01	111.69	29.78%
	55	Lunenburg	126.05	7.51	5.96%
	58	Mecklenburg	387.89	30.35	7.82%
	63	New Kent	185.03	58.96	31.86%
	67	Nottoway	214.90	7.21	3.35%
	72	Powhatan	118.51	14.43	12.17%
	74	Prince George	185.29	23.08	12.46%
District 4 Total			3200.46	493.32	15.41%
Hampton Roads (5)	1	Accomack	276.64	36.95	13.36%
	40	Greensville	78.05	3.80	4.87%
	46	Isle of Wight	197.87	20.21	10.21%
	47	James City	177.48	18.18	10.24%
	61	Nansemond	4.84	0.30	6.20%
	64	Norfolk	39.87	9.46	23.72%
	65	Northampton	155.04	7.08	4.57%
	87	Southampton	272.75	21.42	7.85%
	90	Surry	96.84	2.95	3.05%
	91	Sussex	220.40	13.11	5.95%
	99	York	144.62	15.92	11.01%
District 5 Total			1664.40	149.38	8.98%
Fredericksburg (6)	16	Caroline	288.81	10.84	3.75%
	28	Essex	170.73	9.61	5.63%
	36	Gloucester	184.36	11.25	6.10%
	48	King George	205.79	17.70	8.60%
	49	King & Queen	135.37	8.59	6.34%
	50	King William	108.95	6.38	5.86%
	51	Lancaster	125.35	21.52	17.17%
	57	Mathews	66.02	11.87	17.98%
	59	Middlesex	130.84	4.42	3.38%
	66	Northumberland	111.43	9.38	8.42%
	79	Richmond	105.84	8.23	7.77%
	88	Spotsylvania	217.20	18.72	8.62%
	89	Stafford	165.68	26.18	15.80%
	96	Westmoreland	139.82	17.57	12.56%
District 6 Total			2156.19	182.26	8.45%
Culpeper (7)	2	Albemarle	351.83	19.94	5.67%
	23	Culpeper	208.99	4.25	2.04%
	30	Fauquier	312.86	5.04	1.61%
	32	Fluvanna	101.91	3.18	3.12%
	39	Greene	92.23	2.98	3.23%
	54	Louisa	239.63	8.97	3.74%
	56	Madison	157.63	2.76	1.75%
	68	Orange	187.73	4.36	2.33%

District	County No.	County Name	Lane Miles (LM) Rated, Primary	Deficient Ride Quality, LM	% Deficient Ride Quality
	78	Rappahannock	156.19	0.20	0.13%
District 7 Total			1809.00	51.68	2.86%
Staunton (8)	3	Alleghany	153.86	29.48	19.16%
	7	Augusta	385.27	35.72	9.27%
	8	Bath	148.77	18.81	12.65%
	21	Clarke	145.47	9.17	6.31%
	34	Frederick	298.14	11.29	3.79%
	45	Highland	141.47	18.80	13.29%
	69	Page	136.93	8.21	6.00%
	81	Rockbridge	267.12	35.80	13.40%
	82	Rockingham	396.31	17.10	4.32%
	85	Shenandoah	195.22	17.01	8.71%
	93	Warren	88.69	19.35	21.82%
District 8 Total			2357.25	220.74	9.36%
Northern Virginia (9)	0	Arlington	147.60	110.43	74.82%
	29	Fairfax	814.04	208.22	25.58%
	53	Loudoun	441.71	26.97	6.10%
	76	Prince William	367.22	69.50	18.93%
District 9 Total			1770.57	415.12	23.45%
Statewide			**21137.36**	**2637.02**	**12.48%**

Table E3. Pavement Ride Quality by District and County for Secondary System (Samples) – 2013

District	County No.	County Name	Lane Miles (LM) Rated, Secondary (Samples)	Deficient Ride Quality, LM	% Deficient Ride Quality
Bristol (1)	10	Bland	44.79	8.89	19.84%
	13	Buchanan	134.43	52.46	39.02%
	25	Dickenson	130.90	65.30	49.89%
	38	Grayson	119.10	42.50	35.68%
	52	Lee	138.86	61.27	44.12%
	83	Russell	128.64	73.65	57.25%
	84	Scott	133.77	58.69	43.87%
	86	Smythe	137.09	36.19	26.40%
	92	Tazewell	129.80	43.27	33.34%
	95	Washington	239.30	112.17	46.87%
	97	Wise	149.60	45.54	30.44%
	98	Wythe	99.31	44.82	45.15%
District 1 Total			1585.59	644.75	40.66%
Salem (2)	9	Bedford	288.44	83.49	28.95%
	11	Botetourt	144.03	100.21	69.57%
	17	Carroll	202.99	54.10	26.65%
	22	Craig	45.03	19.19	42.62%
	31	Floyd	131.68	74.78	56.79%
	33	Franklin	362.33	87.08	24.03%
	35	Giles	73.10	29.75	40.69%
	44	Henry	278.11	131.86	47.41%
	60	Montgomery	115.42	34.72	30.08%
	70	Patrick	199.42	64.73	32.46%
	77	Pulaski	106.72	39.09	36.63%
	80	Roanoke	219.12	122.79	56.04%
District 2 Total			2166.39	841.79	38.86%
Lynchburg (3)	5	Amherst	138.21	80.44	58.20%
	6	Appomattox	156.20	90.47	57.92%
	14	Buckingham	139.11	43.49	31.26%
	15	Campbell	244.24	133.45	54.64%
	19	Charlotte	162.77	49.19	30.22%
	24	Cumberland	78.67	40.65	51.68%
	41	Halifax	310.77	79.03	25.43%
	62	Nelson	98.51	67.59	68.62%
	71	Pittsylvania	473.45	207.87	43.91%
	73	Prince Edward	121.33	49.58	40.85%
District 3 Total			1923.26	841.76	43.77%
Richmond (4)	4	Amelia	116.04	30.12	25.95%
	12	Brunswick	177.29	86.15	48.59%
	18	Charles City	47.48	21.50	45.28%
	20	Chesterfield	621.63	130.32	20.96%
	26	Dinwiddie	182.17	64.41	35.36%

District	County No.	County Name	Lane Miles (LM) Rated, Secondary (Samples)	Deficient Ride Quality, LM	% Deficient Ride Quality
Richmond (4)	37	Goochland	124.16	58.62	47.21%
	42	Hanover	294.08	145.61	49.51%
	55	Lunenburg	136.81	47.02	34.37%
	58	Mecklenburg	231.62	51.77	22.35%
	63	New Kent	70.23	28.96	41.23%
	67	Nottoway	92.15	31.30	33.96%
	72	Powhatan	110.05	13.95	12.67%
	74	Prince George	118.21	62.39	52.78%
District 4 Total			2321.92	772.12	33.25%
Hampton Roads (5)	1	Accomack	206.45	137.81	66.75%
	40	Greensville	109.47	39.30	35.90%
	46	Isle of Wight	166.46	29.73	17.86%
	47	James City	116.87	16.85	14.42%
	65	Northampton	101.99	68.87	67.53%
	87	Southampton	236.05	92.92	39.36%
	90	Surry	95.78	40.32	42.09%
	91	Sussex	155.95	60.97	39.10%
	99	York	116.78	14.72	12.61%
District 5 Total			1305.80	501.49	38.41%
Fredericksburg (6)	16	Caroline	169.05	38.69	22.89%
	28	Essex	82.43	22.60	27.42%
	36	Gloucester	106.72	54.42	50.99%
	48	King George	57.99	18.92	32.63%
	49	King & Queen	89.06	33.51	37.63%
	50	King William	103.77	24.79	23.89%
	51	Lancaster	93.45	36.04	38.57%
	57	Mathews	56.56	24.91	44.04%
	59	Middlesex	53.05	17.55	33.07%
	66	Northumberland	134.49	62.76	46.66%
	79	Richmond	78.02	39.33	50.42%
	88	Spotsylvania	280.55	19.87	7.08%
	89	Stafford	223.80	39.04	17.45%
	96	Westmoreland	117.27	57.56	49.08%
District 6 Total			1646.21	489.99	29.76%
Culpeper (7)	2	Albemarle	264.70	87.90	33.21%
	23	Culpeper	136.26	27.21	19.97%
	30	Fauquier	239.22	43.51	18.19%
	32	Fluvanna	114.65	16.65	14.52%
	39	Greene	52.98	17.99	33.96%
	54	Louisa	188.61	33.93	17.99%
	56	Madison	74.52	10.11	13.57%
	68	Orange	100.91	23.20	22.99%
	78	Rappahannock	40.28	13.25	32.86%
District 7 Total			1212.13	273.75	22.58%
	3	Alleghany	81.57	45.11	55.31%

District	County No.	County Name	Lane Miles (LM) Rated, Secondary (Samples)	Deficient Ride Quality, LM	% Deficient Ride Quality
Staunton (8)	7	Augusta	272.85	109.39	40.09%
	8	Bath	68.25	37.36	54.74%
	21	Clarke	68.37	14.91	21.80%
	34	Frederick	197.62	38.80	19.63%
	45	Highland	27.36	10.03	36.67%
	69	Page	92.82	10.74	11.57%
	81	Rockbridge	151.52	80.22	52.95%
	82	Rockingham	236.33	42.96	18.18%
	85	Shenandoah	146.04	52.55	35.98%
	93	Warren	45.83	9.86	21.53%
District 8 Total			1388.56	451.93	32.55%
Northern Virginia (9)	29	Fairfax	1113.62	434.71	39.04%
	53	Loudoun	335.09	53.39	15.93%
	76	Prince William	460.74	94.31	20.47%
District 9 Total			1909.45	582.41	30.50%
Statewide			15459.31	5399.99	34.93%