Evaluation of the Kentucky Transportation Cabinet's Maintenance Rating Program

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Kentucky Transportation Center
College of Engineering, University of Kentucky, Lexington, Kentucky

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Kentucky Transportation Cabinet
Commonwealth of Kentucky

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Research Report
KTC-21-05/SPR20-592-1F

Evaluation of the Kentucky Transportation Cabinet's Maintenance Rating Program

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16. Abstract

The Kentucky Transportation Cabinet (KYTC) relies on its Maintenance Rating Program (MRP) to systematically measure conditions on state-owned roads and rights of way. Every year, the Cabinet evaluates 300-400 road segments in each of its highway districts. Segments receive aggregate scores ranging from 0 to 100, with the target score being 80. This report appraises the MRP and discusses potential strategies for its improvement. Compared to asset management programs established at other state transportation agencies, KYTC's performs quite well. Between 1999 and 2019, MRP data show that scores improved across all road types. In 2011, the average score for all roads eclipsed 80 and has remained above this threshold since (albeit with some fluctuation). Currently, the category of rural secondary roads is the only one with an average score below 80, although it exceeded this threshold in 2015, 2016, and 2018. KYTC maintenance staff participated in a survey that gauged whether the components evaluated as part of the MRP are relevant and useful. The component which the highest percentage of respondents said is not useful is *Right-of-Way Fence* (62%). Smaller but still a considerable number of respondents said *Striping* components lack utility (31%), followed by *General Aesthetics* and *Regulatory/Warning Sign Assemblies* (about 27%). Despite the low ranking, staff will continue inspecting right-of-way fences because of their presence on divided highways and due to funding allocations. Additional guidance could be issued to mitigate the subjectivity of aesthetic judgments. Moving forward, the Cabinet will benefit from offering robust training to MRP data collectors to ensure scoring is consistent between districts and staff.

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Table of Contents

List of Figures

List of Tables

Executive Summary

The Kentucky Transportation Cabinet's (KYTC) Maintenance Rating Program (MRP) is a systematic measurement process that uses annual inspections of state-owned roadways and rights of way to assess the current condition of highway infrastructure maintenance activities. As part of MRP, every year individual KYTC districts evaluate 300 to 400 roadway segments, each of which is 500 feet in length. Segments are assigned aggregate scores ranging from 0 to 100. MRP's long-established target score is 80. Roads are grouped into four categories — Interstates, National Highway System, State Primary and Secondary, and Rural Secondary. MRP splits data collection into five categories — Roadway General, Pavement, Shoulders, Drainage, and Traffic. Each category includes several components which are inspected (see Table 4.1 on pp. 25-26 for descriptions).

With the Cabinet devoting more attention than ever to performance management and asset management, KYTC stakeholders asked Kentucky Transportation Center (KTC) researchers to review MRP and determine whether adjustments are needed, either through adding elements or modifying scoring methods. Researchers compared MRP to asset management and performance management initiatives in place at other state transportation agencies (STAs), reviewed current items on which data KYTC collects data, documented asset performance from 1999 through 2020, and surveyed Division of Maintenance staff on the program's implementation.

Research literature on maintenance has focused more on asset life-cycle optimization than quality assurance programs. Researchers have devised numerous models to predict asset conditions under different scenarios. These could be useful for identifying future needs and planning. Other STAs measure performance in categories similar to those adopted by KYTC — drainage, roadside, pavement, bridges, traffic, and other special facilities. Three methods are used to score asset condition — pass/fail, level of service, or a hybrid framework. While approaches vary between agencies, maintenance quality assurance programs are widely used to establish targets for asset performance and make decisions about resource allocation. MRP compares favorably to other STA maintenance quality assurance programs.

Analysis of 1999-2020 MRP data found that scores gradually improved across all road types. Interstates increased by over 11 points, the National Highway System by 15 points, and State Primary and Secondary roads by 7 points. By 2020 all road types (except for Rural Secondary, which scored a 78) met or exceeded the target score of 80. Rural Secondary scores eclipsed 80 in 2015, 2016, and 2018, a significant increase over the score of 69.9 logged in 1999. Across all roads, the average score has surpassed 80 since 2011, although this figure has fluctuated.

To understand areas in which MRP could be improved, 33 KYTC maintenance personnel across Kentucky took part in a survey. Appendices B and C provide the survey questions and full results and commentary received from the respondents. Figure E1 summarizes data on the usefulness of each component that is part of the MRP. *Right-of-Way Fence* was rated least useful (by 62 percent). Roughly 31 percent of respondents said that *Striping Reflectivity (White)*, *Striping Reflectivity (Yellow)*, *Guide Sign Faces*, and *Guide Sign Assemblies* are not useful. Other components that had low ratings included *General Aesthetics* and *Regulatory/Warning Sign Assemblies*. Because aesthetic judgments are unavoidably subjective, KYTC could benefit by providing additional/clarifying guidance for collecting data related to appearance. And while making observations of right-of-way fences is difficult along some corridors, because they are present on divided highways, and due to funding being allocated for their inspection, they warrant continued evaluation. Survey respondents were unanimous in their endorsements of these components: *Roadway/ Shoulder Vertical Obstructions*, *Visual Obstructions*, *Pavement Potholes*, *Pavement Drop Off to Shoulders*, and *Shoulder Drop Off*. They generate valuable information and data on them should continue to be collected and remain a point of emphasis for decision makers.

In the years ahead, working to ensure that personnel who collect MRP data receive sound training will confer enormous benefits. Training can focus on data collection practices and tips for operating in the field. This will help to maintain consistency between districts and staff. Information gathered during the quality assurance process will strengthen the MRP process, help refine training protocols, and mitigate challenges related to data consistency.

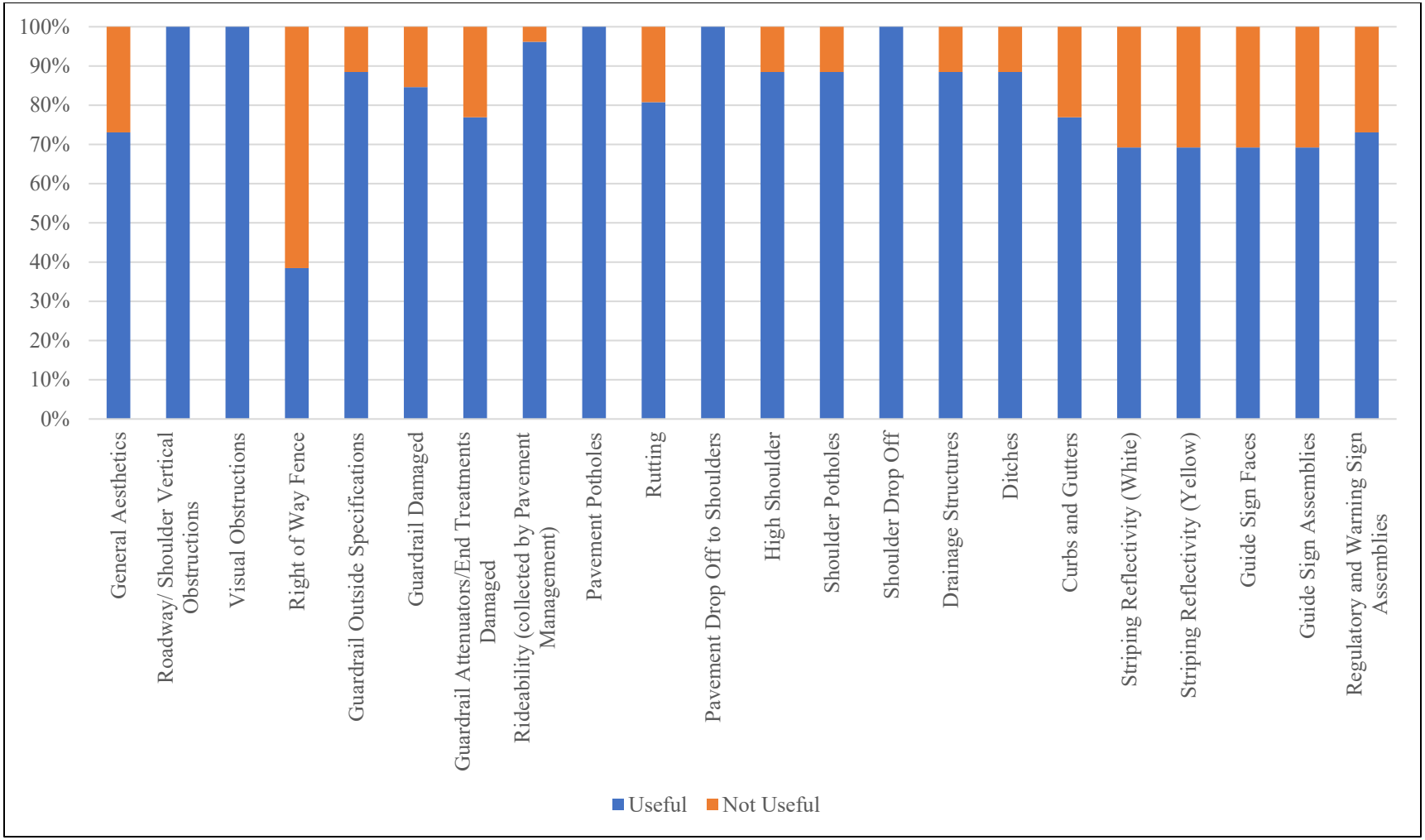


Figure E1 MRP Survey of Data Components

Chapter 1 Introduction and Background

State transportation agencies (STAs) are tasked with the critical responsibility of maintaining roads, bridges, tunnels, and other infrastructure assets. In Kentucky, the Kentucky Transportation Cabinet (KYTC) manages and maintains an expansive and portfolio of transportation assets. The agency's Maintenance Rating Program (MRP) is a systematic measurement process that uses annual inspections of state-owned roadways and rights of way to assess the current condition of highway infrastructure maintenance activities. This program provides insights not only into not only the condition of highway infrastructure but also KYTC's performance. It is a part of the Cabinet's broader effort to use performance measures to inform budgeting, decision making, and identifying where maintenance is needed.

Every year in each KYTC district, the MRP measures between 300-400 roadway segments (each of which is 500 feet in length) across four road types: Interstates, National Highway System, State Primary and Secondary, and Rural Secondary. Segments are assigned an aggregate score ranging from 0 to 100. The MRP's long-established target for the aggregate score is 80. With performance management and asset management receiving more attention than ever, KYTC stakeholders asked Kentucky Transportation Center (KTC) researchers to review the MRP and determine if modifications are needed, either through the addition of elements or the adoption of updated scoring methods. Any adjustments would be informed by how other states incorporate quality assurance programs into performance management and/or asset management. Of particular interest for the Cabinet is how other STAs perform condition assessment and inventory collection by asset class to identify asset needs and assist district-level prioritization of maintenance activities.

1.1 Study Objectives

- Document the current MRP process and compare it to quality assurance programs at other STAs as directed by KYTC
- Ensure that data incorporated into the MRP align with the agency's current focus on performance management and asset management
- Verify that the MRP provides useful information for management and district personnel (resource allocation)

1.2 Structure of the Report

Chapter 2 reviews the literature on maintenance and performance measures, while Chapter 3 covers how other STA approach maintenance quality assurance programs. Chapter 4 provides an overview of the MRP including the data collection process and comments on notable data trends. The chapter also summarizes a survey of KYTC personnel involved in the MRP. Chapter 5 presents conclusions and offers some thoughts on the MRP's future.

Chapter 2 Literature Review

This chapter reviews literature related to maintenance and quality assurance. Much of the maintenance literature deals with pavement and bridge preservation methods, although some researchers have explored scheduling and funds optimization with an eye toward efficiently managing increasing maintenance. While not directly related to rating or evaluation programs, topics on preservation efforts and programming/scheduling methodologies help us to understand why certain ratings may be assigned to different infrastructure elements.

Maintenance encompasses activities for routine infrastructure care — snow and ice removal, drainage, vegetation management, pavement patching, and other work (Gibson et al. 2020, Table 2). The Federal Highway Administration (FHWA) differentiates between maintenance, routine maintenance, and preventive maintenance.[1] *Maintenance* "describes work that is performed to maintain the condition of the transportation system or to respond to specific conditions or events that restore the highway system to a functional state of operation." *Routine maintenance* is work "performed in reaction to an event, season, or over all deterioration of the transportation asset." *Preventive maintenance* is "a cost-effective means of extending the useful life of the Federal-aid highway."

When agencies neglect asset maintenance, assets deteriorate and potentially lead to more expensive rehabilitation or replacement jobs. This is amply demonstrated by Chang et al.'s (2017) framework[2] that quantifies the impacts of delayed maintenance on performance. Even delayed maintenance activities can increase costs (Hicks et al. 2000) and result in more extensive rehabilitation or replacement. However, undertaking maintenance too soon may result in unnecessary expenditures. As Zimmerman and Peshkin (2003, p. 3) argued, "preventive maintenance programs are cost-effective because they slow the rate of pavement deterioration, essentially delaying the need for major rehabilitation activities by several years." Burningham and Stankevich (2005) also emphasized this fact, underscoring impacts on drivers from having to operate vehicles on substandard roads. The economic cost to motorists and freight movement due to vehicle damage, congestion, and other factors is often overlooked.

With respect to classification, Burningham and Stankevich divide maintenance activities into categories: routine, which are minor activities such as mowing and pothole repair; periodic, which are more time and labor-intensive activities such as pavement sealing; and urgent, which encompasses anything that requires immediate attention, such as downed trees in the roadway. To address maintenance priorities in a timely fashion (and hence avoid the cost of delays), they recommend defining responsibilities and setting performance standards for a core network of routes with high traffic counts. Moruza et al. (2017) developed a method to rank Virginia's transportation structures based on their importance to the highway network and the state's economy. Scores are labelled *importance factors* (IFs) and provide information on functionality, risk, importance, condition, and cost-effectiveness. Having a plan for tackling other infrastructure including bridges, signs, sidewalks, and other assets, as well as a defined set of goals that drive asset maintenance plans under current funding regimes, can help maintenance remain at the forefront of transportation agency priorities.

Maintenance activities can also be benchmarked using performance measures. For example, Tsang et al. (1999) reviewed several approaches to maintenance performance measures (e.g., using a balanced scorecard, comparing performance to peer agencies). Such performance measures, or any other operations metric, can be useful if they fit the operating environment and provide accurate information. Chang et al. (2017) identified performance measures across asset categories that could be useful when measuring the effectiveness, needs, and frequency of maintenance activities for each asset type. Partitioning analysis by asset class can generate individualized feedback on how maintenance activities impact assets and how they should be scheduled and prioritized going forward. Figure 3 presents a summary of strategic and network-level reports. Chang et al. (Table 1, p.11) also document expected service life and frequency of inspection for assets. Pavement inspections are recommended annually, bridges and signs every 1-2 years, pavement markings biannually, culverts longer than 10 feet every 1-2 years, and concrete

[1] https://www.fhwa.dot.gov/preservation/memos/160225.cfm

[2] The proposed framework includes determining performance measures and decision-making process. Then it integrates needs, condition assessments, and funding levels in a more detailed approach than simply ranking assets.

boxes every four years. These inspections function similar to a maintenance rating program as they gather data on asset condition, however, the focus of the framework developed is to identify maintenance activities required to reach certain targets.

Performance Measure Report Category		Pavement	Bridge	Culvert	Guardrail	Lighting	Pavement Marking	Signs
Asset condition		✓	✓	✓	✓	✓	✓	✓
Remaining service life		✓	✓	✓			✓	
Agency costs		✓	✓	✓	✓	✓	✓	✓
Asset value		✓	✓	✓	✓		✓	✓
Sustainability ratio		✓	✓	✓	✓	✓	✓	✓
Sustainability and users' costs [1]	Safety (e.g., accident costs)	✓	✓					
	Mobility (e.g., travel time, operating costs)	✓	✓					
	Environmental (e.g., CO_2 emissions)	✓	✓					

Figure 2.1 Performance Measures for Transportation Assets[3]

Chang et al. (2017) list factors related to maintenance and asset performance that could warrant consideration when ranking overall performance, including performance measures and asset condition (p. 3):

- Current asset condition
- Timing of maintenance activities
- Changes in asset condition created by the maintenance activity
- Asset design features (e.g., materials, functionality, reliability)
- Performance measures
- Communication needs (e.g., with funding entities)
- Expected levels of service
- Mechanisms of deterioration over time
- Expected asset service life
- Factors affecting the remaining asset service life (e.g., traffic volumes and loads, environmental conditions).

Pavement and bridge management systems used by many STAs can also provide condition and performance data. Ohio developed the Ohio Bridge Condition Index (OBCI), an assessment tool for bridges (Fereshtehnejad et al. 2017). Using state bridge databases, the index "evaluate[s] bridges at the element, component, bridge, and network levels and reflect[s] the impact on the condition of the system of existing defects as well as maintenance, repair, and replacement actions for the condition enhancement of individual elements" (p. 152). Generating actionable information on bridge conditions sets the stage for managing budgets, determining maintenance schedules, and communicating conditions with stakeholders. Other bridge management systems have also been developed (Thompson et al. 1998, Hawk and Small 1998, Miyamoto et al. 2000, Patidar et al. 2007). Pontis is a system used by many STAs (Frangopol et al. 2001). Bridge management systems help STAs prioritize bridge maintenance needs and choose the most cost-effective option (Thompson et al. 1998, Hawk and Small 1998). Patidar et al. (2007, Table 1, p. 20) developed a set of bridge management goals and corresponding performance measures for evaluating activities (Table 2.1).

[3] Source: Chang et al. (2017), Table 34, p. 64

Table 2.1 Bridge Management Goals and Performance Measures

Goal	Performance Measures
Preservation of Bridge Condition	a) Condition Ratings (NBI 58-60, 62) b) Health Index c) Sufficiency Rating
Traffic Safety Enhancement	a) Geometric Rating/ Functional Obsolescence b) Inventory Rating or Operating Rating
Protection from Extreme Events	a) Scour Vulnerability Rating b) Fatigue/Fracture Criticality Rating c) Earthquake Vulnerability Rating d) Other Disaster Vulnerability Rating (Collision, Overload, Human-Made)
Agency Cost Minimization	a) Initial Cost b) Life-Cycle Agency Cost
User Cost Minimization	a) Life-Cycle User Cost

Along with bridges, pavements rank among the most important agency assets and are a focus of maintenance activities. Pavement Management Systems (PMSs)[4][5] are used often to identify areas needing improvement, similar to simply utilizing pavement assessments and even to prioritize projects (Gurganus and Gharaibeh 2012, Wang et al. 2003). Grivas et al. (1993, p. 25) pointed out that "Most PMSs include specific methodologies for characterizing pavement condition, identifying treatment options, predicting condition, and evaluating the economics." These systems have several benefits (Zimmerman and Peshkin 2004, p. 13):

- Enhanced planning ability at all levels, including strategic, network, and project
- Decision making based on observed and predicted conditions rather than opinions
- Ability to generate alternative scenarios of pavement conditions based on different budget projections or management approaches.

Like past maintenance customer surveys conducted by KTC (Graves and Allen 2010, 2016; Gibson et al. 2021), Ramadhan et al. (1999) sought to understand how stakeholders ranked the importance of maintenance activities. Surveying stakeholders on the importance of various factors such as pavement condition, traffic, safety, and cost, they found that the highest priority was pavement condition followed by safety. Ranking projects, while different than simply assessing various facets of condition, shares some similarities by integrating condition or other related aspects into the ranking process. STAs use various methods to prioritize pavement preservation projects (Gurganus and Gharaibeh 2012). Gurganus and Gharaibeh (2012) developed a decision support tool that uses six parameters (p.38) to rank pavement preservations projects:[6]

1. Visual distress
2. Average daily traffic
3. Current truck average daily traffic
4. Condition score
5. Ride quality
6. Section that receives most in-house maintenance

Some positive impacts of preventive maintenance programs for pavements include (Zimmerman and Pehskin, 2004, p. 14; Zimmerman and Peshkin, 2003, p. 4):

[4] See Frangopol et al. (2007)
[5] For more on pavement management practices in some STAs see: https://www.fhwa.dot.gov/asset/pubs/hif11035/hif11035.pdf and https://www.fhwa.dot.gov/asset/pubs/hif11036/hif11036.pdf.
[6] For more on pavement scoring methods and performance measures see Papagiannakis et al. (2009).

- Delaying the onset of cracking
- Improving smoothness and surface friction
- Reducing moisture penetration
- Greater customer satisfaction
- Ability to make better-informed decisions
- More appropriate application of maintenance techniques
- Improved pavement conditions
- Increase in safety
- Reduction in overall costs

These activities, and determining when maintenance is required, can depend on certain performance thresholds based on condition as well as the capacity and scheduling of activities. Models designed to predict asset condition yield valuable data about potential future maintenance needs, which can also be evaluated against performance metrics.

The bottom line is that for STAs maintenance is an important function — it keeps infrastructure in good condition, extends its service life, and preserves traveler safety. Much of the research literature on maintenance focuses on different management programs (e.g., pavements and bridges) and strategies for optimizing scheduling and funding under constraints. Programs that measure outcomes of these endeavors are less studied in literature, however, a number of other states use programs similar to MRP. Understanding those approaches and how data are used in decision making will help contextualize KYTC's program and generate potential ideas for changes to ensure the program meets the needs of internal and external stakeholders.

Chapter 3 State Approaches to Maintenance Quality Assurance

3.1 Synthesis Studies

Two collective efforts involving multiple STAs have attempted to capture practices related to maintenance ratings. The National Maintenance Quality Assurance (MQA) Peer Exchange held in Madison, Wisconsin, in October 2004 was co-hosted by the Wisconsin DOT (WisDOT) and the Midwest Regional University Transportation Center (MRUTC). At this forum, 26 of 33 participating transportation agencies (including two Canadian provinces) reported having maintenance quality assurance programs (Adams and Smith 2005). In 2011, representatives of 17 STAs took part in the NCHRP 20-68A Domestic Scan Program (Yurek at al. 2012). Only one participant indicated that their agency did not conduct official maintenance quality surveys. This summary uses these two efforts as guidance to identify key aspects of the maintenance quality assurance programs. Additionally, we reviewed current STA websites and manuals. The summary covers the following aspects of current practices:

- Data Collection Approach
  - Number of samples
  - Items/Features Covered
  - Rating Scales
  - Collection Quality Assurance

In 2011, the Ohio Department of Transportation (ODOT) and Utah Department of Transportation (UDOT) reported collecting condition data on 100% of their roadways. Twelve other STAs reported sampling between 1.5% and 30% of their roadway assets. Table 3.1 shows the annual sampling rates for STAs which participated in the 2011 domestic scan (Yurek et al. 2012).

Table 3.1 Annual Sampling Percentage Among State DOTs (c. 2011)

Annual Sample Rate	Number of State DOTs	State DOTs
≤ 5%	8	Arizona, Iowa, Kansas, Kentucky, New York State, Texas, Washington State, Wisconsin
6% - 10%	2	Florida, Missouri
11% - 30%	2	California, Maryland
100%	2	Ohio, Utah

While in 2011, the Minnesota DOT (MnDOT) reported not conducting formal maintenance condition surveys, the agency's *Pavement Management* webpage now indicates that it surveys the entire Trunk Highway System and about 50% of the County State Aid Highway (CSAH) system each year for pavement conditions (Minnesota Department of Transportation 2020). The Texas DOT reported surveying less than 5% of its highway system during the 2011 scan. According to the agency's 2019-2023 strategic plan that percentage increased to 5% for the non-Interstate system and 10% for the Interstate System (Texas Department of Transportation 2018). The most recent strategic plan published by that Texas DOT states that its Pavement Management Information System (PMIS) now collects pavement condition data on 100% of roadbed miles. Due to cost and time limitations, just one lane of each roadbed is evaluated to represent all the lanes for the specific roadbed (Texas Department of Transportation 2020). In general, states are surveying more and find the cost of conducting the surveys is warranted. In fact, UDOT reported spending less than 1% of its maintenance budget to survey the entire highway network.

The 2005 synthesis and the 2011 domestic scan found that the items/features covered by STA maintenance rating programs had many similarities. The 2011 scan reported that commons categories include (Yurek et al. 2012):

- Drainage structures (e.g., culverts, curbs and gutters, ditches, slopes, drop inlets)
- Roadside, including fences, grass mowing, brush, litter, landscaping, and sound barriers
- Pavement, including paved shoulders, unpaved shoulders, and driving lanes
- Bridges and other structures

- Traffic (e.g., signs, pavement markings, guardrails, impact attenuators, highway lighting, signals)
- Special facilities (e.g., rest areas, tunnels, weigh stations)

Several STAs have employed a two-tier structure where items/features are categorized under similar asset categories, including Florida and North Carolina (more detail in subsequent sections). The 2011 scan found three predominant rating scales used to monitor and report maintenance quality (Yurek et al. 2012):

- Pass/Fail
- Level of Service (LOS)
- Hybrid (some combination of the two)

Among the participants in the 2011 domestic scan, the Florida DOT, Iowa DOT, Kansas DOT, and Maryland State Highway Administration (SHA) reported using the pass/fail rating scale. The pass/fail rating scale allows quick and simple data collection and communication compared to the LOS rating scale. Some states steer away from the term *fail* to avoid negative connotations associated with it.

The major disadvantage a pass/fail scale is that it does not indicate how far removed the conditions of a surveyed feature are from the desired standards. Therefore, some STAs choose to use the LOS approach despite it taking more effort to collect and analyze data. The Texas DOT evaluates each element based on scale of 1 to 5, with higher scores indicating better conditions (Figure 3.1; Gao et al. 2011).

NAME: _____

VEHICLE: _____

SECTION: 01 _____

D			front
			mid1
			mid2
			mid3
			back

Mark your seat assignment

Highway: SL 111 **Beginning TRM:** 438
Travel direction: south **Ending TRM:** 439

Pavement Score: (include items such as rutting, cracking, ride, edges, shoulder, failures, etc.)

5	Well above expectations	Comments: _____
4	Above expectations	
3	Meets expectations	_____
2	Below expectations	
1	Well Below Expectations	_____

Traffic Operations Score: (include items such as raised pavement markers, striping, attenuators, delineators, shoulder texturing, etc.)

5	Well above expectations	Comments: _____
4	Above expectations	
3	Meets expectations	_____
2	Below expectations	
1	Well Below Expectations	_____

Roadside Score: (include items such as vegetation management, trees and brush, drainage, sweeping, encroachment, guardrails, guardrail end treatment, mail boxes, etc.)

5	Well above expectations	Comments: _____
4	Above expectations	
3	Meets expectations	_____
2	Below expectations	
1	Well Below Expectations	_____

Overall Score: (rate the section relatively to a similar facility in your state)

5	Well above expectations	Comments: _____
4	Above expectations	
3	Meets expectations	_____
2	Below expectations	
1	Well Below Expectations	_____

Additional comments: _____

_____

Figure 3.1 Texas DOT Maintenance Rating Form

Due to the potential influence of survey data on budgeting decisions, most STAs include shadow programs where central office personnel re-inspect a portion of surveyed roadways. UDOT audits statistically selected sections of roadways 1-2 days after surveys by district personnel (Yurek et al. 2012).

The Ohio DOT's Organizational Performance Index (OPI) system measures performance for key functional areas within the agency, including maintenance. The OPI is based on a scale of 1 to 6, with a target value of 4. Caltrans also has a LOS rating system that employs a 0-100 scale. Scores for different features are published annually (Figure 3.2).

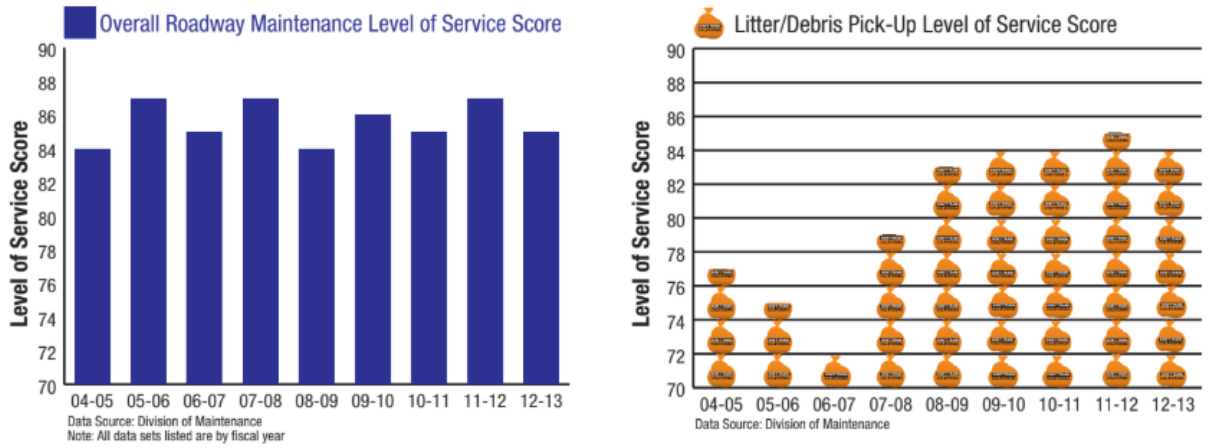


Figure 3.2 Caltrans Roadway Level of Service Historical Scores

Caltrans target scores vary according to feature. The overall roadway maintenance LOS target score is 87. The target score for litter/debris pick-up is 80, and the target scores for guardrails and striping are 95 (Caltrans 2013).

3.2 Alabama

The Alabama Department of Transportation's (ALDOT) *Level of Service Condition Assessment Data Collection Manual* (ALDOT 2015) provides guidance focused on using infrastructure condition data to develop performance-centric work plans and budgets. It contains guidance on data collection, equipment, safety measures, and maintenance condition assessment criteria. Some data can be found in existing sources but often crews collect data in the field, with districts sampling random 0.1-mile segments. Between 200 and 350 samples are collected in each district to ensure adequate and accurate representation of road types and conditions. The manual includes details about features being inspected, breaking them apart by asset type, the feature evaluated, and the measure obtained. Images accompany many of these features to help guide crews when evaluations are conducted. Table 3.2 summarizes asset classifications, maintenance features, and the criteria used to determine asset condition.

Table 3.2 Alabama DOT Maintenance Performance Measures

Asset Classification	Maintenance Feature	Maintenance Feature Condition Measure
Asphalt Pavement	Potholes (≥ 6"x6"x1")	Number of potholes per lane mile
	Raveling	% of surface area distressed
	Shoving (Upheaval/Depression)	Square feet of deficiencies per lane mile
Concrete Pavement	Spalling (≥ 6"x 6"x1")	Number of spalls per lane mile
	Faulting (≥ 1/4" high)	Number of faulted slaps per lane mile
	Joint Sealing (≥ 1/4" wide)	Linear feet of joints requiring sealing per lane mile
	Pumping	Number of slabs deficient per lane mile
	Punchouts (≥ 6"x6" surface area with full depth failure)	Number of punchouts per lane mile
Shoulders	Potholes (≥ 6"x6"x1")	Number of potholes per lane mile
	Edge Raveling (Edge Failure)	Linear feet per shoulder mile
	Sweeping	Linear feet of paved shoulder needing sweeping

	Non-Paved — Drop Off (≥ 2") (Low Shoulder)	Linear feet per shoulder mile
	Non-Paved — High Shoulder > 1" (Built-Up Shoulder)	Linear feet per shoulder mile
Drainage	Side Drains	% of pipes not functioning as intended of > 25% blocked
	Cross Drains	% of pipes not functioning as intended or > 10% blocked
	Unpaved Ditches	% of ditch length not functioning as intended (erosion or blockage)
	Paved Ditches	% of ditch length not functioning as intended or blocked
	Drop Inlets, Slotted Drains, and Catch Basins	% of inlets not functioning as intended or blocked
	Curb and Gutters	% of length not functioning as intended or misaligned
Roadside	Front Slope — Erosion Control	% of shoulder miles deficient — washouts > 12"
	Back Slope — Erosion Control	% of shoulder miles deficient — washouts > 18"
	Mowable Area	Average height of grass (in inches)
	Brush Control (blocking line of sight or signage or within the "clear zone")	% of shoulder miles with desirable brush
	Tree Removal	Number per shoulder mile
	ALDOT Fence	% of fence miles damaged (functionally deficient — requiring repair)
	Litter Control	Number of equal to or greater than fist-sized objects per shoulder mile
Traffic Services	Raised Pavement Markers	% of RPMs missing or damaged per center line mile
	Signals (e.g., bulbs malfunctioning, structurally deficient, facing wrong direction)	% of signals deficient
	Delineators	% of delineators deficient
	Object Markers	% of makers missing or damaged

	Signs — Warning and Regulatory (damaged, missing, illegible, retro-reflectivity)	% of signs deficient
	Pavement Striping (non-visible, missing, faded, chipped)	% of total length deficient
	Guardrail	% of guardrail length deficient
	Cable Rail	% of cable rail length deficient
	Impact Attenuators	% of impact attenuators needing repair
	Barrier Walls	% of barrier length deficient
	Highway Lighting (low or high mast)	% malfunctioning (LOS Condition only, no budgeting initially)
	Pavement Markings and Legends (non-visible, missing, faded, chipped)	% of symbols and legends deficient

3.3 Florida

The Florida Department of Transportation's (FDOT) MRP is detailed in its *Maintenance Rating Program Handbook*.[7] Florida's MRP was established in 1985 to ensure consistent standards and inspections throughout the state. Districts administer the program. The handbook describes how FDOT rates assets and maintenance activities. Additionally, it details methods used to evaluate conditions. Inspection data are used to plan maintenance activities and ensure consistent implementation across the state. In each year there are three reporting periods. During each reporting period, a random sample of 30 points are evaluated (or a minimum of three points per mile for facility types less than 10 miles long). FDOT classifies facilities into four groups: 1) rural limited access, 2) rural arterial, 3) urban limited access, and 4) urban arterial. The *Maintenance Rating Program Handbook* lists 5 major elements (Florida Department of Transportation 2019):

- Roadway
- Roadside
- Traffic Services
- Drainage
- Vegetation/Aesthetics

Each element has a set of characteristics that are evaluated. For example, the Roadside element is divided into five features:

- Unpaved Shoulder
- Front Slope
- Slope Pavement
- Sidewalk
- Fence

[7] https://fdotwww.blob.core.windows.net/sitefinity/docs/default-source/maintenance/rdw/mrp/mrphandbook2020.pdf?sfvrsn=1497bb43_2

The handbook reviews how to evaluate and rate different maintenance characteristics. Each handbook entry provides information on target conditions, a description of the maintenance feature, inspection guidance, conditions under which a maintenance feature would not meet MRP standards, and photos to guide inspectors. Six characteristics are evaluated on all samples: 1) potholes, 2) depressions, 3) raised pavement markers, 4) striping, 5) tree trimming, and 6) litter removal. Each sample is a 1/10-mile segment. Table 3.3 lists target maintenance conditions for each roadway element and its associated features. Once the evaluation and data collection are finished, data are entered into a data processing system which informs maintenance decisions. The handbook and its processes are reviewed and quality assurance checks are performed to ensure the handbook and the program continue to function as intended.

Table 3.3 Target Maintenance Condition for the Florida DOT

Element	Feature	Target Maintenance Condition
Roadway	Flexible Pothole	• No defect with an area greater than 0.5 square feet and no individual measurement greater than 1.5" deep • No exposure of the pervious base
	Flexible Edge Paving	• 90% of total roadway edge free of raveling No continuous section of edge raveling greater than or equal to 4" is more than 25 feet long
	Flexible Shoving	• Cumulative shoved area is not greater than 25 square feet
	Flexible Depression/Bump	• No deviation greater than 0.5" for any area greater than 1 square foot • No one measure should exceed 2"
	Flexible Paved Shoulder/Turnout	• Paved shoulders are to be rated for potholes, edge raveling, depressions, and bumps • Rate flexible turnouts for only potholes
	Rigid Pothole	• No defect with an area greater than 0.5 square feet and no individual measurement greater than 1.5" deep • No exposure of the pervious base
	Rigid Depression/Bump	• No deviation greater than 0.5" for any area greater than 1 square foot • No one measure should exceed 2"
	Rigid Joint/Cracking	• 85% of the length of transverse longitudinal joint material functions as intended, **or** • 90% of roadway slabs have no sealed cracks wider than 1/8"
	Rigid Paved Shoulder/Turnout	• Rigid paved shoulders are to be rated for potholes, depressions, bumps, joints, and cracking • Rigid turnouts are only rated for potholes and cracking

Roadside	Unpaved Shoulder	• No deviations across the shoulder wider than 5" above or below the design template • No shoulder build-ups greater than 2" anywhere across the design template for 25 continuous feet • No shoulder drop-offs more than 3" deep within 1 foot of the pavement edge for 25 continuous feet • Sand, soil, grasses, or debris are not to encroach 12" or more on the outside the paved shoulder for 25 continuous feet • No washboard areas with a total differential greater than 5" from the low spot to high spot
	Front Slope	• No depth or height deviations greater than 6"
	Slope Pavement	• No individual areas of missing, settled, or misaligned areas greater than 10 square feet
	Sidewalk	• 99.5% of sidewalk area does not have vertical misalignments greater than 0.25" or horizontal cracks greater than 0.5" • No visible hazards
	Fence	• No unrestrained free entry is allowed
Traffic Services	Raised Pavement Markers	• 70% of required markers are functional (reflective) No locations where there is more than 100 continuous feet of centerline or lane line without a reflective marker
	Striping	• 90% of the length and width of each lane line functions as intended
	Pavement Symbols	• 90% of existing symbols function as intended
	Guardrail	• Each single run functions as intended
	Signs Less Than or Equal to 30 Square Feet	• 95% of signs function as intended
	Signs Greater Than 20 Square Feet	• 85% of signs function as intended
	Object Markers and Delineators	• 80% of markers function as intended
	Lighting	• 90% of all luminaries of combined sign and highway lighting function as intended
Drainage	Side/Cross Drain	• 60% of each pipe's cross section contains no obstructions and functions as intended
	Roadside/Median Ditch	• Ditch bottom elevation cannot vary from the design elevation by more than 1/4 of the difference between the edge of pavement elevation and the ditch's design elevation
	Outfall Ditch	• Ditch bottom elevation cannot vary from the design elevation more than 1/3 of the difference between the natural ground and design flow line

	Inlets	• 85% of the opening is unobstructed
	Miscellaneous Drainage Structure	• 90% of each structure functions as intended
	Roadway Sweeping	• Material accumulation does not exceed 0.75" for more than 1 continuous foot in the traveled way, **or** • Material accumulation does not exceed 1.5" for more than 1 continuous foot in any gutter
Vegetation and Aesthetics	Roadside Mowing	• No more than 1% of mowing exceeds the specified height guidelines (including seed stalks and decorative flowers): ○ Rural Limited Access — 5"-18" ○ Rural Arterial — 5"-12" ○ Urban Limited Access — 5"-12" ○ Urban Arterial — 9" maximum
	Slope Mowing	• No more than 2% of vegetation is higher than 24" (excluding seed stalks and decorative flowers) Evaluate using standards in *A Guide for Roadside Vegetation Maintenance*
	Landscaping	• 90% of landscape vegetation is in a healthy, attractive condition
	Tree Trimming	• No trees, tree limbs, or vegetation should encroach upon the travel way or clear zone lower than 14.5 feed, or below 8.5 feet for sidewalks, curbs, and gutter clear zones
	Curb/Sidewalk Edge	• No vegetation or debris encroachment onto the curb or sidewalk for more than 6" for more than 10 continuous feet • Soil height cannot deviate more than 4" above or 2" below the top of the curb or sidewalk for more than 10 continuous feet
	Litter Removal	• Litter volume is not greater than 3 cubic feet per acre, excluding all travel way pavement • No unauthorized graffiti or stickers within the state's right of way on state-owned property • No litter hazards on the roadway, paved shoulder, or clear recovery zone
	Turf Condition	• Turf in mowing area is 75% free of unwanted vegetation • No wanted vegetation growing out of Mechanically Stabilized Earth and Sound Wall greater than 6" in length • No more than 7.5 square feet of unwanted vegetation in any 50 square foot area of paved shoulder, pavement joints, concrete traffic

		separators, curb/asphalt joints, and under guardrail • No vegetation damaging or displacing the asset structure

Agency staff determine if a feature meets the desired maintenance conditions (Figure 3.3) (Florida Department of Transportation 2019).

FLORIDA DEPARTMENT OF TRANSPORTATION
MAINTENANCE RATING PROGRAM STANDARDS

ROADWAY

THE FOLLOWING CHARACTERISTICS MEET THE DESIRED MAINTENANCE CONDITIONS WHEN:

FLEXIBLE POTHOLE:	No defect is greater than 1/2 square foot in area and no single measurement 1-1/2 inches or greater in depth. No pervious base is exposed in any hole.
FLEXIBLE EDGE RAVELING:	90% of the total roadway edge is free of raveling. No continuous section of edge raveling 4 inches or wider exceeds 25 feet in length.
FLEXIBLE SHOVING:	The shoved area does not exceed a cumulative 25 square feet.
FLEXIBLE DEPRESSION/BUMP:	No deviation exceeds 1/2 inch for any area greater than 1 square foot. No single measurement shall exceed 2 inches.
FLEXIBLE PAVED SHOULDER/TURNOUT:	Rate flexible paved shoulder for pothole, edge raveling and depression/bump. Rate flexible turnout for pothole only.
RIGID POTHOLE:	No defect is greater than 1/2 square foot in area and no single measurement 1-1/2 inches or greater in depth. No pervious base is exposed in any hole.
RIGID DEPRESSION/ BUMP:	No deviation exceeds 1/2 inch for any area greater than 1 square foot. No single measurement shall exceed 2 inches.
RIGID JOINT/ CRACKING:	85% of the length of transverse and longitudinal joint material appears to function as intended or 90% of the roadway slabs have no unsealed cracks wider than 1/8 inch.
RIGID PAVED SHOULDER/TURNOUT:	Rate rigid paved shoulder for pothole, depression/bump and joint/cracking. Rigid turnout rated for potholes and cracking only.

Figure 3.3 Florida DOT Maintenance Rating Program Standards for Roadways

Published summary reports detail grades across maintenance areas, districts, and statewide totals. Figure 3.4 gives a snapshot of the most recent summary.

MAINTENANCE RATING PROGRAM
LEVEL OF MAINTENANCE SUMMARY
ANNUAL FY 2018-2019

MAINTENANCE AREA	ROADWAY	ROADSIDE	TRAFFIC SERVICES	DRAINAGE	VEGETATION AESTHETICS	ALL FACILITIES
Bartow	97	84	84	86	84	85
Heartland	99	86	75	87	85	85
Ft. Myers	98	85	84	91	86	87
Manatee	98	80	78	84	84	79
DISTRICT 1	98	83	81	87	85	84
Gainesville	98	84	81	88	72	82
Lake City	98	83	86	85	80	87
Perry	99	88	85	91	83	87
Jacksonville	96	76	75	83	75	77
Chiefland	98	86	86	91	85	91
St. Augustine	97	77	76	88	80	82
DISTRICT 2	98	82	80	87	79	84
Ponce De Leon	99	89	82	88	88	86
Panama City						
Midway	98	82	65	77	67	70
Marianna						
Milton	100	92	85	92	94	89
DISTRICT 3	99	90	80	88	88	86
Treasure Coast	97	88	86	93	87	86
Ft. Lauderdale	95	88	82	89	82	80
West Palm	96	86	82	91	86	84
DISTRICT 4	96	88	83	91	85	83
Brevard	98	81	77	85	77	80
DeLand	96	81	75	87	78	81
Leesburg	96	86	81	86	74	81
Oviedo	94	81	77	84	79	78
Orlando	94	80	80	86	79	79
Ocala	97	87	80	84	75	83
DISTRICT 5	96	83	78	85	77	80

Figure 3.4 Florida DOT Maintenance Rating Program Summary

3.4 North Carolina

The North Carolina DOT (NCDOT) issues biannual reports on maintenance and operations performance standards. The *Maintenance Operations and Performance Analysis Report* (MOPAR) includes (North Carolina Department of Transportation 2016):

1) The annual cost to meet and sustain the established performance standards for the state highway system
2) Projected system condition and the corresponding optimal funding requirements for a seven-year plan to sustain established performance standards
3) Any significant variations in system conditions among highway divisions
4) An assessment of the level of congestion throughout the primary highway system based on traffic data
5) An analysis of existing highway division staffing levels and recommendations to ensure staffing levels are distributed appropriately based on need.
6) A cross-divisional comparison summary document

The 2016 report identified five major maintenance targets, with each target comprised of several condition elements (Figure 3.5) (North Carolina Department of Transportation 2016). NCDOT uses a scoring system similar to Kentucky. Both states have color coded scores to visualize the best- and worse-maintained features. The agency also applies a 0-100 rating scale.

Target	Condition Element	Performance Measure	Interstate	Primary	Secondary
			86	80	75
PAVEMENT	Minimum Pavement % Good	Pavement Condition Rating >= 80	90	71	61
			5	7.5	10
	Maximum Pavement % Poor	Pavement Condition Rating < 60	2	5	13

Target	Condition Element	Performance Measure	Interstate	Primary	Secondary
			2	6	15
BRIDGES AND OTHER STRUCTURES	Percent of SD Bridges	Percent of structurally deficient bridges by system and statewide target of 10% by 2030	4	9	17
			85	80	75
	NBIS Culverts	Condition Rating >= 6	99	98	97
			80	75	70
	Non-NBIS Culverts	Condition Rating = Good	96	94	85
			90	90	
	Overhead Sign Structures	Condition Rating = Good	98	97	N/A

Target	Condition Element	Performance Measure	Interstate	Primary	Secondary
			90	85	80
DRAINAGE	Unpaved Shoulders	No drop-offs greater than 3 inches and no shoulders higher than 2 inches	95	93	94
	Ditches (Lateral Ditches)	No blocked, eroded, or nonfunctioning ditches	98	95	93
	Crossline Pipe (Blocked)	Greater than 50% diameter open	89	78	79
	Crossline Pipe (Damaged)	No damage or structural deficiency effecting functionality	93	93	90
	Curb & Gutter (Blocked)	No obstruction greater than 2 inches for 2 feet	95	93	95
	Boxes (Blocked or Damaged)	Grates and outlet pipes of boxes blocked <50%. Inlets and outlets of boxes are not damaged, and grates are present and not broken.	80	87	87

Target	Condition Element	Performance Measure	Interstate	Primary	Secondary
			90	85	80
TRAFFIC	Long Line Pavement Markings	Present, visible	93	96	88
	Words and Symbols	Present, visible	71	91	91
			90	85	85
	Ground Mounted Signs	Visible and legible	97	97	95
	Pavement Markers	Present and reflective	78	61	N/A
	Overhead Signs	Visible and legible	96	95	N/A

Target	Condition Element	Performance Measure	Interstate	Primary	Secondary
			90	85	80
ROADSIDE	Vegetation (Brush & Tree)	Freeways: 45' from travelway, 5' behind guardrail, not blocking signs; Non-Freeways: Vertical clearance of 15' over roadway and 10' back of ditch centerline or shoulder point	76	83	84
	Vegetation (Turf Condition)	Areas free of erosion	93	95	96
	Stormwater Devices (NPDES)	Functioning as designed	94	83	80
			85	80	
	Landscape Plant Beds	Achieving a score of 2 or higher on the inspection form	92	92	N/A
			90	90	
	Rest Areas & Welcome Centers	Condition Rating of 90	94	93	N/A

Figure 3.5 Screenshot of the North Carolina DOT 2016 Statewide Maintenance Conditions Report Card

In 2011, NCDOT surveyed 23,000 samples during every two-year cycle (Yurek et al. 2012). The 2018 report (North Carolina Department of Transportation 2018) does not include the report card but has a variety of maintenance-based performance reporting. The overview page contains various highlights (Figure 3.6)

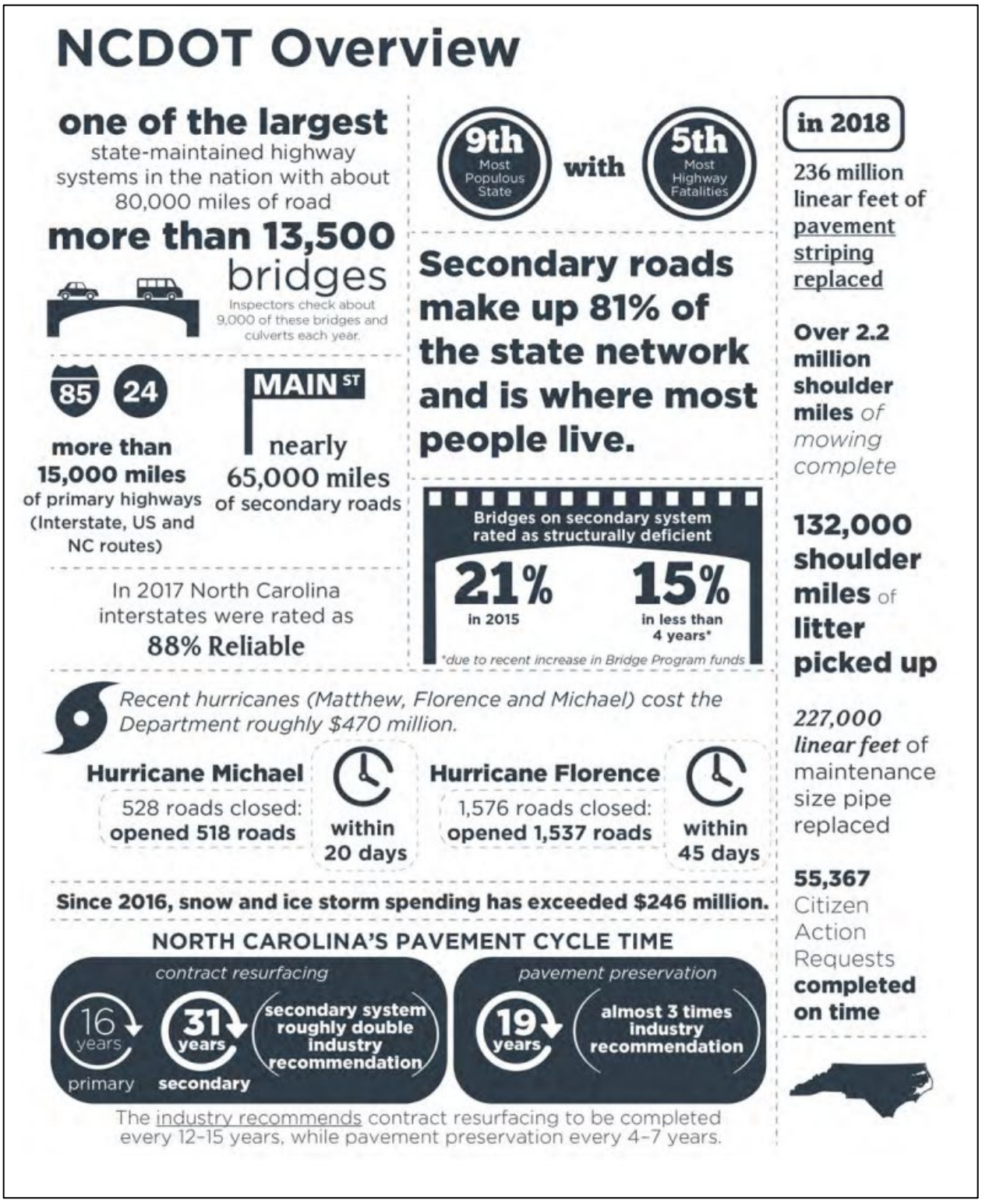


Figure 3.6 North Carolina DOT Overview from the 2018 Maintenance Operations and Performance Analysis Report

The report discusses the asset management program, current conditions and trends of interest, and provides a safety and mobility review. Asset management compares appropriations and recommended investments, staffing levels, and recommended actions. Current conditions and trends cover pavements, bridges, and care of assets. Finally,

safety and mobility review travel time, congestion, and reliability. An example of one chart included in the report is given in Figure 4.7 (North Carolina Department of Transportation 2018, Figure 11, p. 16). It shows the primary system condition along with Total Allocation, Contract Resurfacing (CR), and Pavement Preservation Funding (PP). Additional data are included in appendices (e.g., resurfacing and preservation data, structurally deficient bridges and the impact of replacements, and district-level goals across several maintenance activities).

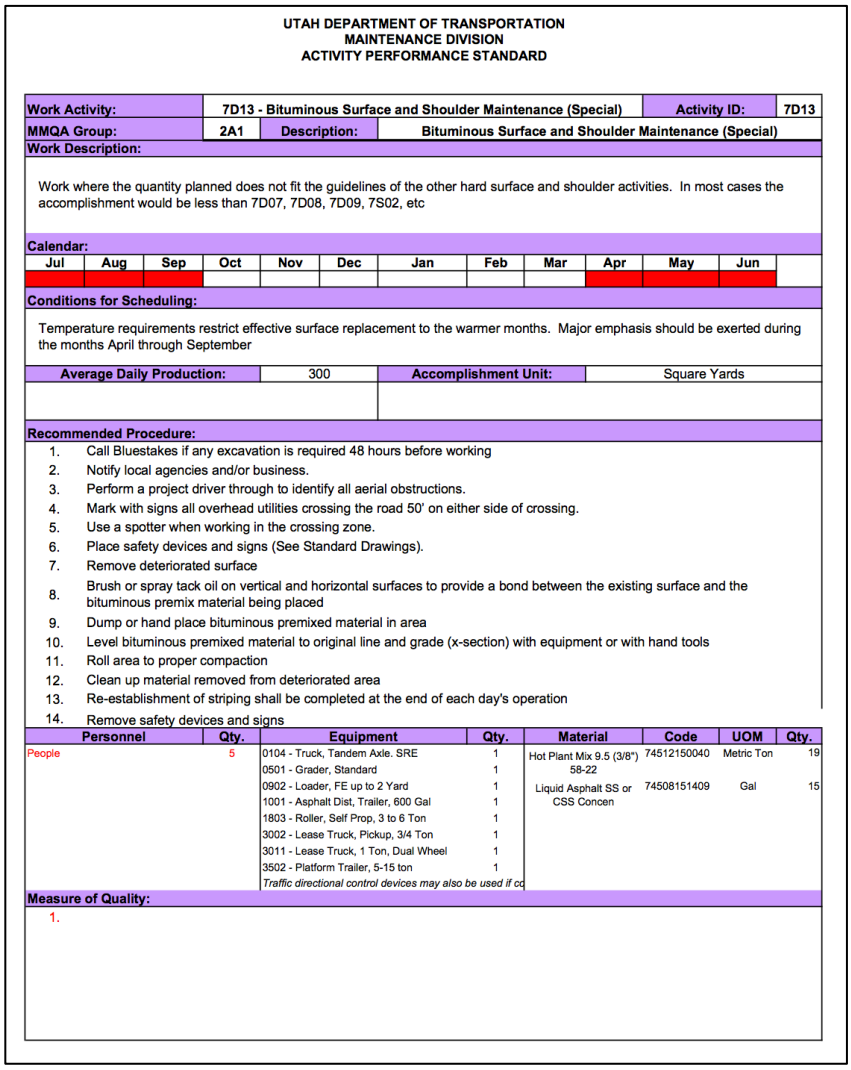
Figure 4.7 North Carolina DOT Appropriations and System Condition

3.5 Utah

UDOT's maintenance division is responsible for providing a LOS focused on economical use of the agency's resources. Published guidance documents review the approach to maintenance and maintenance performance. The most detailed information is found in the *Station Supervisor's Maintenance Handbook* (hereafter SSMH) and the *Maintenance Management Quality Assurance Plus (MMQA+) Inspection Manual.*[8]

The SSMH includes guidance on maintenance planning, scheduling maintenance activities, and activity standards. Activity standards should generally be adhered to prevent issues such as inappropriate LOS, budget overruns, and poor productivity. They are grouped into 10 categories: 1) Snow and Ice Control, 2) Hard Surface, 3) Non-Hard Surface Maintenance, 4) Roadside Maintenance, 5) Vegetation Control, 6) Drainage and Slope Repair, 7) Major Structure Maintenance, 8) Traffic Services, 9) Support, and 10) Rest Area Maintenance. These standards are further divided into activity types: (1) *S* require station approval, (2) *D* require district engineer approval, and (3) *M* covers administrative activities and also require district engineer approval. Activity performance standards listed in the SSMH are accompanied by spec sheets (Figure 3.8). Standards cover many details, including the months an activity can be performed, conditions necessary for scheduling, scheduling calendars, personnel type, equipment, materials, and a description of how quality is measured.

[8] See UDOT (2012) and UDOT (2017) for more detailed information.



UTAH DEPARTMENT OF TRANSPORTATION
MAINTENANCE DIVISION
ACTIVITY PERFORMANCE STANDARD

Work Activity:	7D13 - Bituminous Surface and Shoulder Maintenance (Special)	Activity ID:	7D13
MMQA Group:	2A1	Description:	Bituminous Surface and Shoulder Maintenance (Special)

Work Description:

Work where the quantity planned does not fit the guidelines of the other hard surface and shoulder activities. In most cases the accomplishment would be less than 7D07, 7D08, 7D09, 7S02, etc

Calendar:

Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun

Conditions for Scheduling:

Temperature requirements restrict effective surface replacement to the warmer months. Major emphasis should be exerted during the months April through September

Average Daily Production:	300	Accomplishment Unit:	Square Yards

Recommended Procedure:

1. Call Bluestakes if any excavation is required 48 hours before working
2. Notify local agencies and/or business.
3. Perform a project driver through to identify all aerial obstructions.
4. Mark with signs all overhead utilities crossing the road 50' on either side of crossing.
5. Use a spotter when working in the crossing zone.
6. Place safety devices and signs (See Standard Drawings).
7. Remove deteriorated surface
8. Brush or spray tack oil on vertical and horizontal surfaces to provide a bond between the existing surface and the bituminous premix material being placed
9. Dump or hand place bituminous premixed material in area
10. Level bituminous premixed material to original line and grade (x-section) with equipment or with hand tools
11. Roll area to proper compaction
12. Clean up material removed from deteriorated area
13. Re-establishment of striping shall be completed at the end of each day's operation
14. Remove safety devices and signs

Personnel	Qty.	Equipment	Qty.	Material	Code	UOM	Qty.
People	5	0104 - Truck, Tandem Axle. SRE	1	Hot Plant Mix 9.5 (3/8") 58-22	74512150040	Metric Ton	19
		0501 - Grader, Standard	1				
		0902 - Loader, FE up to 2 Yard	1	Liquid Asphalt SS or CSS Concen	74508151409	Gal	15
		1001 - Asphalt Dist, Trailer, 600 Gal	1				
		1803 - Roller, Self Prop, 3 to 6 Ton	1				
		3002 - Lease Truck, Pickup, 3/4 Ton	1				
		3011 - Lease Truck, 1 Ton, Dual Wheel	1				
		3502 - Platform Trailer, 5-15 ton	1				
		Traffic directional control devices may also be used if co					

Measure of Quality:

1.

Figure 3.8 Layout of Utah DOT SSMH Activity Performance Standards

The MMQA+ Program focuses on improving the agency's efforts to document its efforts to preserve Utah's infrastructure. Information generated through the MMQA+ is used to make budgeting decisions as well as prioritize and schedule maintenance activities. Letter grades are assigned for the level of maintenance, with targets ranging from A to C. Level of maintenance for each standard is informed by UDOT's strategic goals, the current grade, available funding and resources, public feedback, and engineer input. Maintenance activities evaluated as part of MMQA+ include: 1) snow and ice control; 2) non-hard surface maintenance (shoulders, curbs, gutters); 3) roadside maintenance (litter, fences); 4) vegetation control (weeds, vegetation obstructions); 5) drainage and slope repair (grading and cleaning ditches, maintaining inlets and outlets, erosion repair); 6) traffic services (pavement striping retroreflectivity, pavement messages, repair and replacement of signs and delineators, guardrails, sweeping); and 7) rest areas. Guidance for each measurement includes a description of what is measured, desired condition, what constitutes a deficient condition, and reporting guidelines. Reporting guidelines contain instructions on measurement frequency, measurement area, reporting deficiencies and overall condition, and making supplemental comments. Illustrations accompany each section of the *MMQA+ Inspection Manual* and provide examples of features in a desired condition and those in a deficient condition. Notably, MMQA+ does not cover pavements and bridges. MMQA+ data collection is done at the station level, where personnel divide routes into segments and then use guidelines to assess route conditions. With the exception of snow and ice and rest areas, data are collected twice per year. To ensure consistency across the state, each station undergoes a yearly audit. For audits, inspectors review

the routes that were rated and compare ratings to those done by station personnel. Any variances in ratings are discussed to ensure consistency.

3.6 Key Takeaways

- Maintenance quality assurance programs and maintenance rating program are widely used, but how they are implemented varies between states.
- Many states have specific target conditions that drive maintenance priorities.
- Inspection programs help set maintenance priorities:
  - Some maintenance activities are performed at regular intervals, but many are done on an as-needed basis pursuant inspection findings, or when a problem first arises
  - Funding levels often dictate what can be accomplished through quality assurance and rating programs and are thus an important factor.

Chapter 4 Overview of KYTC's Maintenance Rating Program

The Cabinet's MRP measures between 300 and 400 roadway segments (each 500 feet in length) in each district across four road types: Interstates, National Highway System (non-Interstate), State Primary and Secondary, and Rural Secondary. The 2019 MRP report defines these roadways as follows:[9]

- Interstates: Routes designated as part of the Eisenhower National System of Interstate and Defense Highways. These include three north-south interstates (I-65, I-71, I-75), two east-west interstates (I-24 and I-64), and smaller loop routes in Louisville Metro and Northern Kentucky.
- Other NHS: Non-interstate routes that are part of the National Highway System. This includes most of the state's parkways and major US routes. Some state routes (roads designated with a KY prefix) also fall within category.
- State Primary and Secondary: Includes all KY routes which not designated as an NHS or Rural Secondary.
- Rural Secondary: The system of roads usually considered farm-to-market roads.

The aggregate score given to each segment ranges from 0 to 100. The long-established target score is 80. While this applies to each district and the entire state, LOS varies by road type. For example, "Interstate highways with higher traffic volumes and higher speed limits need to be maintained at a higher level of service than Rural Secondary roads."[10] The MRP aims to measure highway infrastructure performance and provide information and data to support decision-making and planning for maintenance activities — "data collected from the MRP is used in conjunction with the cabinet's Operations Management System (OMS) to calculate the maintenance budget for each of the twelve highway districts."[11] Districts establish targets for each feature measured as part of the MRP across road types.

The *MRP Field Data Collection Manual*[12] discusses procedures for conducting surveys, providing details of necessary equipment and grouping road components into five categories (roadway general, pavement, shoulders, drainage, traffic) (Table 5.1). Pictures offer guidance on rating components. Descriptions of what each component assesses and items that should be noted when evaluating components are also listed in Table 4.1. Figure 4.1 illustrates the data collection process. Rideability is measured as part of the MRP as well; those data are provided by the Pavement Management Branch.

Table 4.1 MRP Field Data Collection Manual Categories and Components with Definitions[13]

Roadway General	Definition
General Aesthetics	The general visual character (height of grass, litter, unsightly patching, etc.) of the roadway and roadside as it would be seen by the public.
Roadway/Shoulder Vertical Obstructions	Also vertical clearance; are the roadway and shoulders free of any obstructions (trees, vegetation) with a minimum clearance of 15 feet
Visual Obstructions	Vegetation, structures, signage etc. cause horizontal or vertical visual obstructions of intersections, curves, signs, oncoming lanes, etc.

[9] *FY 2019 Maintenance Condition of Kentucky Highways* https://transportation.ky.gov/Maintenance/Documents/PavementOperations/MRP%20FY19-Statewide.pdf
[10] *FY 2019 Maintenance Condition of Kentucky Highways* https://transportation.ky.gov/Maintenance/Documents/PavementOperations/MRP%20FY19-Statewide.pdf
[11] *FY 2019 Maintenance Condition of Kentucky Highways* https://transportation.ky.gov/Maintenance/Documents/PavementOperations/MRP%20FY19-Statewide.pdf
[12] https://transportation.ky.gov/Maintenance/Documents/PavementOperations/mini%20maintenance%20rating%20manual18.pdf
[13] *Maintenance Rating Program Field Data Collection Manual* (April 2018) https://transportation.ky.gov/Maintenance/Documents/PavementOperations/mini%20maintenance%20rating%20manual18.pdf

Right-of-Way Fence	Fencing provides an effective barrier on limited access highways (Interstate, Parkways, or other highways) to deny access to people or animals.
Guardrail	
Guardrail Outside	The height is at least 25 inches and not more than 29 inches.
Guardrail Damaged	Guardrails have not been damaged due to vehicular hits or other factors.
Attenuators/End Treatments Damaged	Attenuators/End Treatments have not been damaged due to vehicular hits or other factors.
Pavement	**Definition**
Pavement Potholes	A bowl-shaped hole of various sizes in the pavement surface. The surface may have broken into small pieces due to cracking or localized disintegration and the material removed by traffic.
Rutting	A surface depression of pavement in the wheel paths. Ruts may be more noticeable after a rainfall when wheel paths are full of water.
Shoulders	**Definition**
Pavement Drop Off to Shoulder	Occurs whenever there is a decrease in elevation between the traffic lane and the shoulder. It may be due to consolidation, displacement or settlement of underlying material.
Shoulder Drop Off to Ground	An elevation difference between the improved shoulder and adjacent ground at the outside edge of the shoulder. It could be due to consolidation of material, erosion, run off or other factors.
High Shoulder	The opposite of pavement drop-off to shoulder. Frost heave, swelling soils or other factors can cause it. High shoulder creates ponding of water on pavement.
Shoulder Potholes	A bowl-shaped hole or depression in the shoulder surface. The surface may have broken into small pieces due to the cracking or localized disintegration and the material removed by traffic.
Drainage	**Definition**
Drainage	Drainage structures like pipes and culverts that are free of any degree of obstruction and are in good working order. Drainage structures obstructed more than 25% fail.
Ditches	Ditches on the side of the road with water flow not obstructed by dirt, rock, debris, or other items or by structural damage.
Curbs and Gutters	Curbs and gutters with water flow not obstructed by blockage or damage.
Traffic	**Definition**
Striping Reflectivity	Yellow and white; measures night reflectivity of striping that provides positive guidance to motorists.
Guide Sign Faces	Includes route markers (cardinal directions, route numbers, arrows), distance/destination signs, and directions signs. (Green, brown or blue backgrounds). The standard is no visible defects that detract from effectiveness under nighttime conditions.
Guide Sign Assemblies	Guide signs mounted according to specifications including: not leaning more than 22.5 degrees in either direction, no bolts or rivets missing, not turned more than 45 degrees from the line of sight, etc.

Regulatory and Warning Sign Faces	No visible defects that detract from sign face effectiveness under nighttime conditions. Includes red and white backgrounds (STOP, WRONG WAY, DO NOT ENTER, speed limit, etc.) and yellow backgrounds (STOP AHEAD, curve warning signs, chevrons, etc.)
Regulatory and Warning Sign Assemblies	Warning and regulatory signs mounted according to specifications, including: not leaning more than 22.5 degrees in any direction, no bolts or rivets missing, not turned more than 45 degrees from the line of sight, etc.

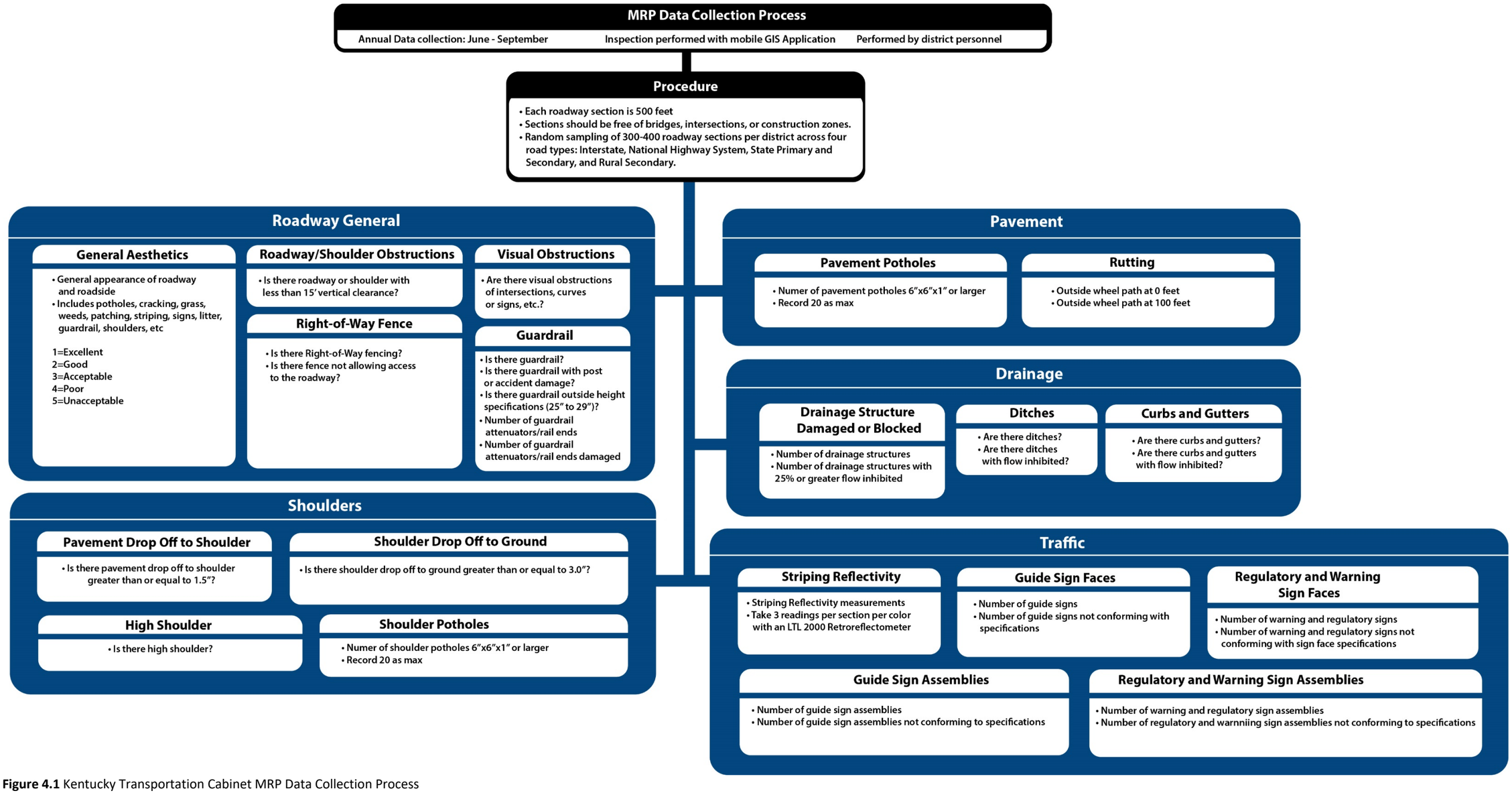


Figure 4.1 Kentucky Transportation Cabinet MRP Data Collection Process

We gathered data from MRP reports issued between 1999 and 2020. Figure 4.2 plots the scores for all roads against the target score of 80. Figure 4.3 and Table 4.2 break down scores by roadway type. Over the 22-year period, scores have gradually improved. Interstates improved by over 11 points, the National Highway System by 15 points, and the State Primary and Secondary by 7 points. By 2020 all road types (except for Rural Secondary, which scored a 78.2) met or exceeded the target score. Rural Secondary scores eclipsed 80 in 2015, 2016, and 2018, a significant increase over the score of 69.9 logged in 1999. The score for all roads has exceeded 80 since 2011, with some variability.

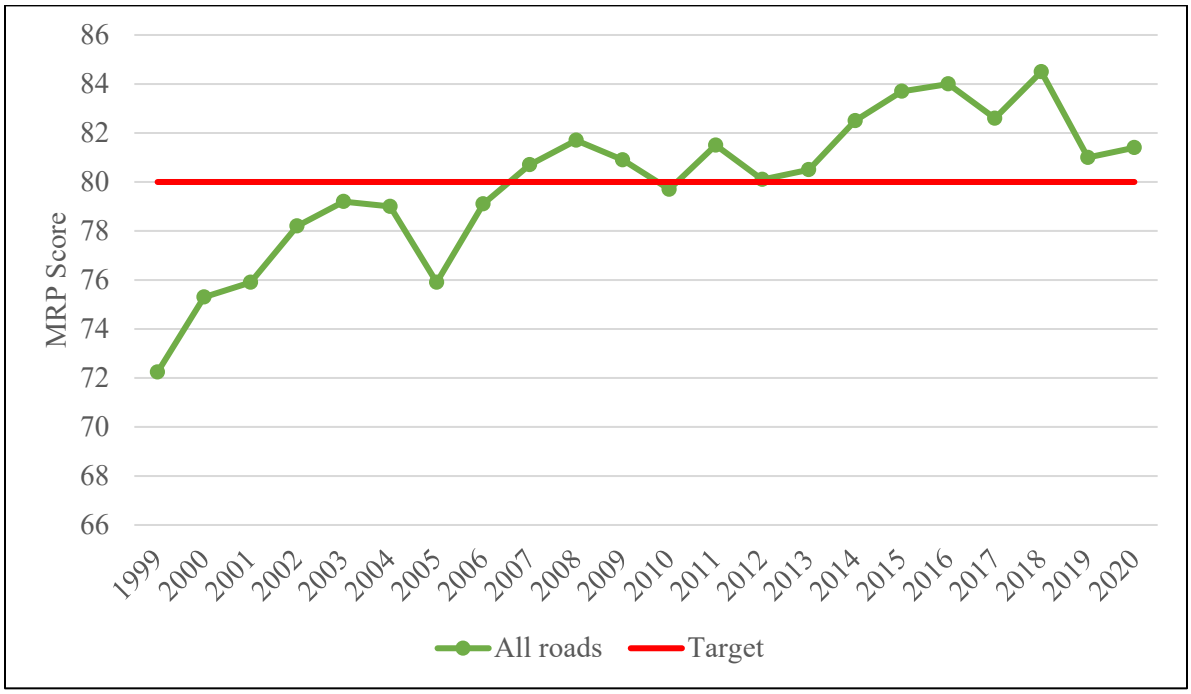


Figure 4.2 Kentucky Statewide MRP Score — All Roads (1999-2020)

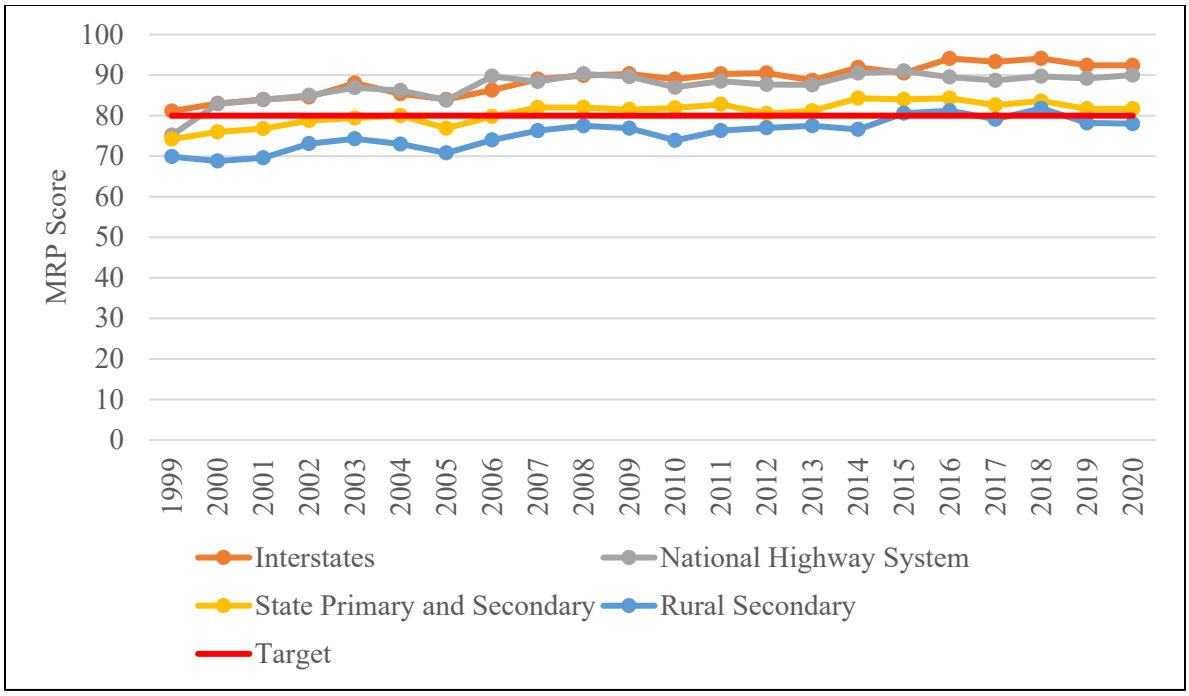


Figure 4.3 Kentucky Statewide MRP Scores — By Road Type (1999-2020)

Table 4.2 Kentucky Statewide MRP Scores (1999-2020)

Year	Interstates	National Highway System	State Primary and Secondary	Rural Secondary	All roads
1999	81.12	75.18	74.21	69.9	**72.24**
2000	83	82.9	76	68.8	**75.3**
2001	84	83.9	76.8	69.6	**75.9**
2002	84.6	85	78.8	73.1	**78.2**
2003	88	86.9	79.4	74.3	**79.2**
2004	85.4	86.2	80	73	**79**
2005	84	83.8	76.9	70.8	**75.9**
2006	86.3	89.7	79.8	74	**79.1**
2007	89	88.4	82	76.3	**80.7**
2008	89.9	90.3	82	77.5	**81.7**
2009	90.3	89.6	81.5	76.9	**80.9**
2010	89	87	81.9	73.9	**79.7**
2011	90.3	88.5	82.8	76.3	**81.5**
2012	90.5	87.7	80.5	77	**80.1**
2013	88.7	87.6	81.2	77.5	**80.5**
2014	91.9	90.5	84.3	76.6	**82.5**
2015	90.5	91	84	80.6	**83.7**
2016	94.1	89.5	84.3	81.2	**84**
2017	93.3	88.7	82.6	79.1	**82.6**
2018	94.1	89.7	83.6	81.8	**84.5**
2019	92.4	89.2	81.7	78.2	**81**
2020	92.4	90	81.7	78	**81.4**

Appendix A contains data for each category listed in Table 4.2, including graphs and accompanying tables detailing scores over the study period. In some cases, data were not collected for certain road types or changes were made that apparently led to missing data.

4.1 MRP Survey

The Cabinet's maintenance employees took part in a survey to register their perceptions of the MRP. Respondents were asked to assess whether each component in the MRP is useful and relevant. Appendix B includes the full survey and complete results are in Appendix C. In this section we highlight a few interesting findings and summarize the perspectives of Central Office personnel who oversee the MRP. Several questions asked about the random sampling approach used by the MRP and whether it is representative of roads across districts. Thirty-six percent of respondents said the current approach is not representative of the roads in their district, and 23 percent said it does not provide adequate representation across road types. Several respondents suggested how to improve the sampling process:

- Increase length of a sample from 500 feet to 1,000 or 1,500 feet. Or sample more than one 500-foot section per route.
- Multiple sections may appear on the same route. It may be worth considering sampling more individual routes rather than multiple samples along the same route.
- There appears to be oversampling of routes such as Interstates and the National Highway System. In areas that lack these routes, consider sampling other routes as well.
- Keep random samples but allow some engineer discretion to add samples that are more representative of the average road conditions in the district.

KYTC Central Office personnel further contextualized these responses and provided their own insights:

- Sections are 0.1-mile long (528 feet) and taken from a random section selection in the OMS database. If we were to change section length, it might limit how much will be comparable between years of data.
- Because of random sampling, in some years there are more sections in one a county than in another. Or more of one road classification in a county than other road classifications (e.g., more NHS than RS).
- Sampling is as follows: 60 sections (minimum) of Interstates; 110 sections (minimum) of National Highway System; 110 (minimum) of State Primary and State Secondary routes; and 110 (minimum) of Rural Secondary routes. Districts without Interstates do not have additional sections of other road types and districts that only have Interstate sections in one or two counties will still have 60 sections on the Interstate to provide a larger sample set for grading (another reason that the samples are only 0.1 mile in length).

With respect to the app used for MRP data entry, 100 percent of respondents indicated that it performs as expected and meets district needs. Respondents also rated MRP components and evaluated whether existing data collection is useful (Figure 4.4). Sixty-two percent indicated that *Right-of-Way Fence* is not a useful data component. Other data components with low ratings include *General Aesthetics* and *Regulatory/Warning Sign Assemblies*, with 27 percent saying they are not useful. Thirty-one percent of respondents said that *Striping Reflectivity (White)*, *Striping Reflectivity (Yellow)*, *Guide Sign Faces*, and *Guide Sign Assemblies* are not useful. All respondents said the following components are useful: *Roadway/Shoulder Vertical Obstructions*, *Visual Obstructions*, *Pavement Potholes*, *Pavement Drop Off to Shoulders*, and *Shoulder Drop Off*. Some comments submitted on components rated as not useful include the following:

- *Right-of-Way Fence* is often not visible and is not maintained or repaired.
- *General Aesthetics* are subjective and not a focus with budget issues.
- *Guardrail and End Treatments* are usually repaired by contract or Master Agreement
- *Reflectivity* requires special equipment and may take extra time; *Striping* is contracted and would not be addressed until the road is restriped.

From management's perspective, district maintenance funds are allocated to addresses right-of way fencing and rutting. So, while reexamining the inclusion of those components could be in order, documenting their condition may nonetheless be necessary. Right-of-way fences, while often difficult to locate, are present on any divided highway. Determining whether one is present and if it is broken is a simple evaluation process. Inspection of striping is not required in certain cases where training, equipment, or safety is a concern. Management grasps that aesthetic judgments are subjective, although the *Field Guide* provides some guidance. Finally, drainage features require simply scanning for a cross drainpipe in the section evaluated.

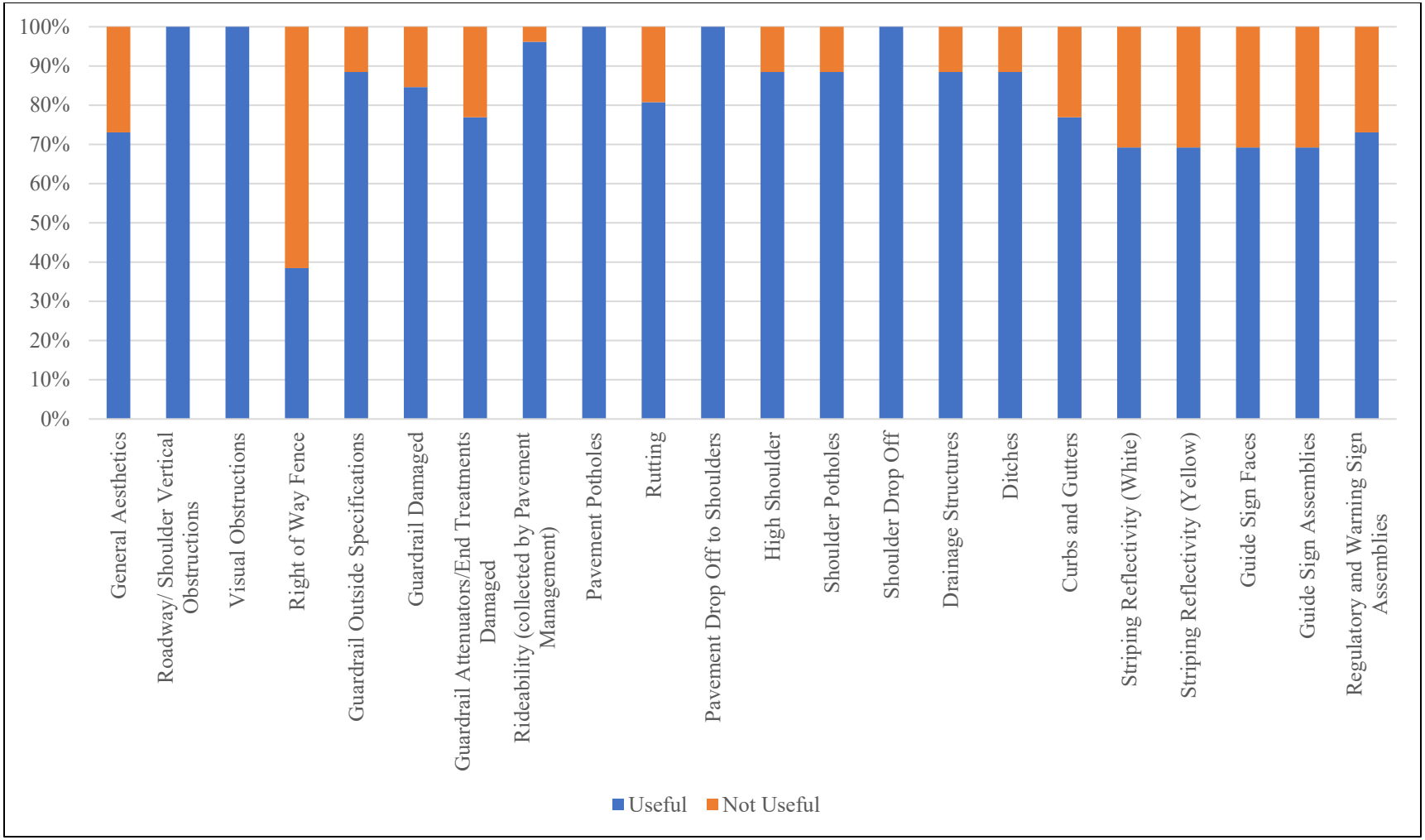


Figure 4.4 Kentucky Transportation Cabinet MRP Survey of Data Components

MRP data are used to generate annual reports and biannual county-level reports. To determine whether the data and reports support decision-making, we asked respondents which reports are useful in this regard and if county-specific reports are helpful. Respondents noted the following benefits:

- Improve distribution and more data availability to help focus on improvements and budget decisions.
- County-level reports are useful and provide feedback on deficiencies and how funding is being allocated.
- MRP reports and the categories provide general focus areas where improvement may be needed.

KYTC management understands that many stakeholders may not read reports or know how to leverage data. This problem can be remedied by improving the use the data in the decision-making process. The county supplement is used mostly by Central Office staff and helps establish budgets for Rural Secondary roads.

Questions also inquired about what facets of the MRP do or do not work well and potential improvements that could be made. Respondents documented the following benefits:

- Provides a snapshot of conditions and information about problems to address. It is a good, structured way to gather condition data.
- App makes data collection much easier.
- Helps identify issues that may otherwise go unnoticed.

The following comments capture areas that could be improved:

- Provide N/A options (in the app) when a feature is not present and auto-fill options when N/A is selected. For example, guardrail — if there is no guardrail the remaining guardrail fields are auto-filled with N/A).
- In the past having funding tied to MRP skewed results, now there is not much incentive; need to find the right balance to ensure consistent reporting.
- Circulate the results more widely across KYTC Division of Maintenance.
- Consider adding bank failures/slides.
- Train those that enter the data.

KYTC Central Office have requested the app be updated to allow for auto-population of fields if they are not relevant to the evaluation. For example, if guardrail is not present a *No* answer results in the remaining guardrail fields being assigned N/A. Implementation of this update will streamline the evaluation process. KYTC may wish to explore adding other components to the MRP, but those components should be well represented throughout the state and reviewers need to be appropriately trained in their evaluation.

Chapter 5 Conclusion

KYTC's Division of Maintenance manages numerous assets throughout Kentucky. While maintenance challenges — from budgets to manpower — are ubiquitous, ongoing efforts like MRP provide much-needed insights into asset performance. Through data collection on roadways, pavements, shoulders, drainage, and traffic, MRP provides an expansive view of asset conditions statewide. Insights generated through the program help decision makers target areas for improvement, thus preserving assets in good condition and bolstering mobility. For this project, our team re-examined the MRP by comparing it to asset management and performance management initiatives at other STAs, reviewing current items on which data are collected, documenting asset performance over the 1999-2020 period, and surveying Division of Maintenance staff on the program's implementation.

Our literature review pinpointed surprisingly few examples of researchers analyzing maintenance rating programs. But researchers have devised numerous models to predict asset conditions under different scenarios. These could be useful for identifying future needs and planning. Other STAs measure performance in categories similar to those adopted by KYTC — drainage, roadside, pavement, bridges, traffic, and other special facilities. Three methods are used to score asset condition — pass/fail, level of service, or a hybrid framework. While approaches vary between agencies, maintenance quality assurance programs are widely used to establish targets for asset performance and make decisions about resource allocation. Based on our look at STA maintenance rating strategies, we believe MRP compares favorably to the most robust state-level maintenance quality assurance programs.

Because KYTC strives to continuously improve all facets of its operation, the agency can use the results of this study — particularly the survey results — to enhance MRP. Cabinet stakeholders generally agreed on the value of MRP for identifying challenges and that the data entry app meets district-level needs. Several updates have been requested by app users, including a feature that auto-populates fields if they are not relevant to an evaluation.

More widely disseminating MRP results and increasing their use among maintenance staff — especially at the district level — can yield significant dividends and focus activity planning on improving key areas. Bolstering the distribution and availability of MRP data could be undertaken as a Cabinet-wide push to emphasize greater use of the program. Given the time constraints and staffing pressures facing the Division of Maintenance, additional funding and/or staffing could let supervisors and others take advantage of MRP data more regularly to plan maintenance activities and therefore improve outcomes.

Some respondents voiced concerns that MRP's sampling approach produces results that are not representative of all road types. However, management which oversees the MRP observed that altering the selection process could inhibit efforts to make sound year-to-year data comparisons and that while some roads appear oversampled, this is merely a result of random sampling.

With respect to MRP data components, the *Right-of-Way Fence* was rated least useful. Other components garnering low ratings included *General Aesthetics* and *Regulatory/Warning Sign Assemblies*. Because aesthetic judgments are unavoidably subjective, KYTC could benefit by providing additional/clarifying guidance for collecting data related to appearance. Even though making observations of right-of-way fences is difficult along some corridors, because they are present on divided highways, and due to funding being allocated for their inspection, they should continue to be evaluated. Survey respondents were unanimous in their endorsements of these components: *Roadway/ Shoulder Vertical Obstructions*, *Visual Obstructions*, *Pavement Potholes*, *Pavement Drop Off to Shoulders*, and *Shoulder Drop Off*. These components generate valuable information and data on them should continue to be collected and remain a point of emphasis for decision makers.

Continuing existing training efforts for personnel who collect MRP data, along with users of the end data, will prove enormously beneficial. Training can focus on data collection practices and tips for operating in the field, which has been done in the past. This will help to maintain consistency between districts and staff. The Cabinet's MRP quality assurance process requires that Central Office personnel re-inspect 10 percent of segments in each district to compare data quality and identify areas where training may be needed. Information gathered during the quality

assurance process, or even expanding it, will strengthen the overall MRP process, help refine training protocols, and mitigate challenges related to data consistency.

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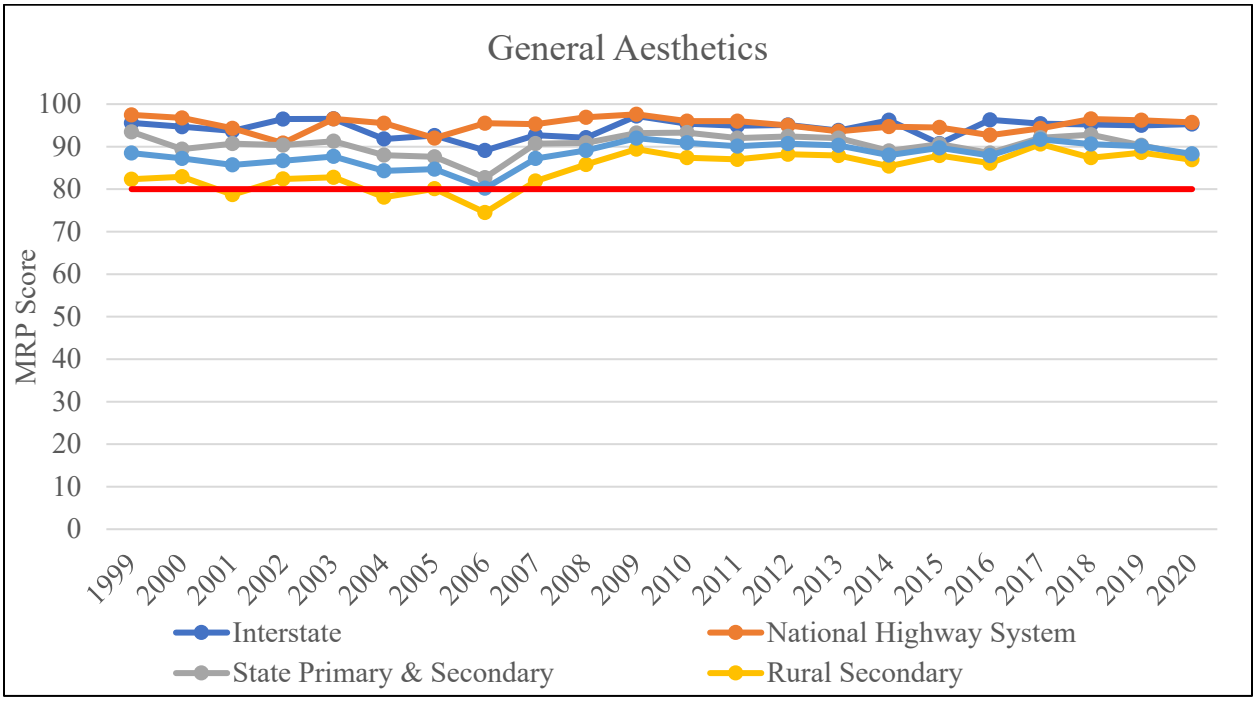
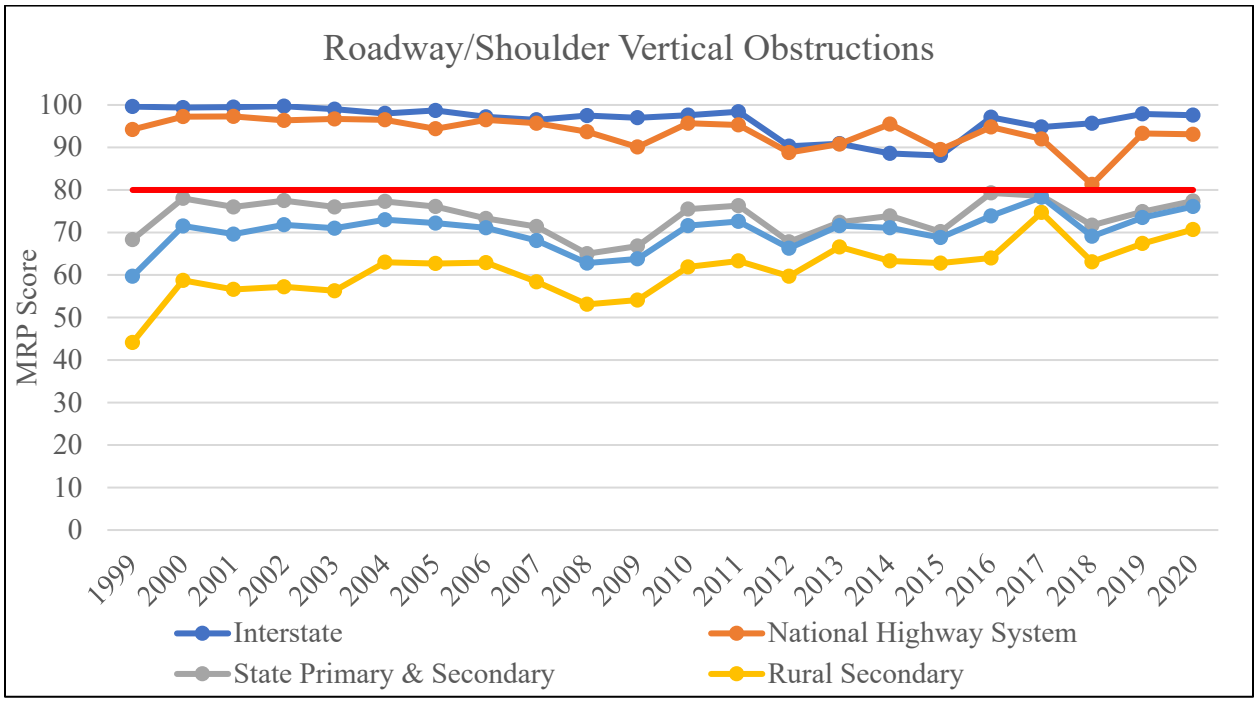
Appendix A MRP Performance Trends By Category

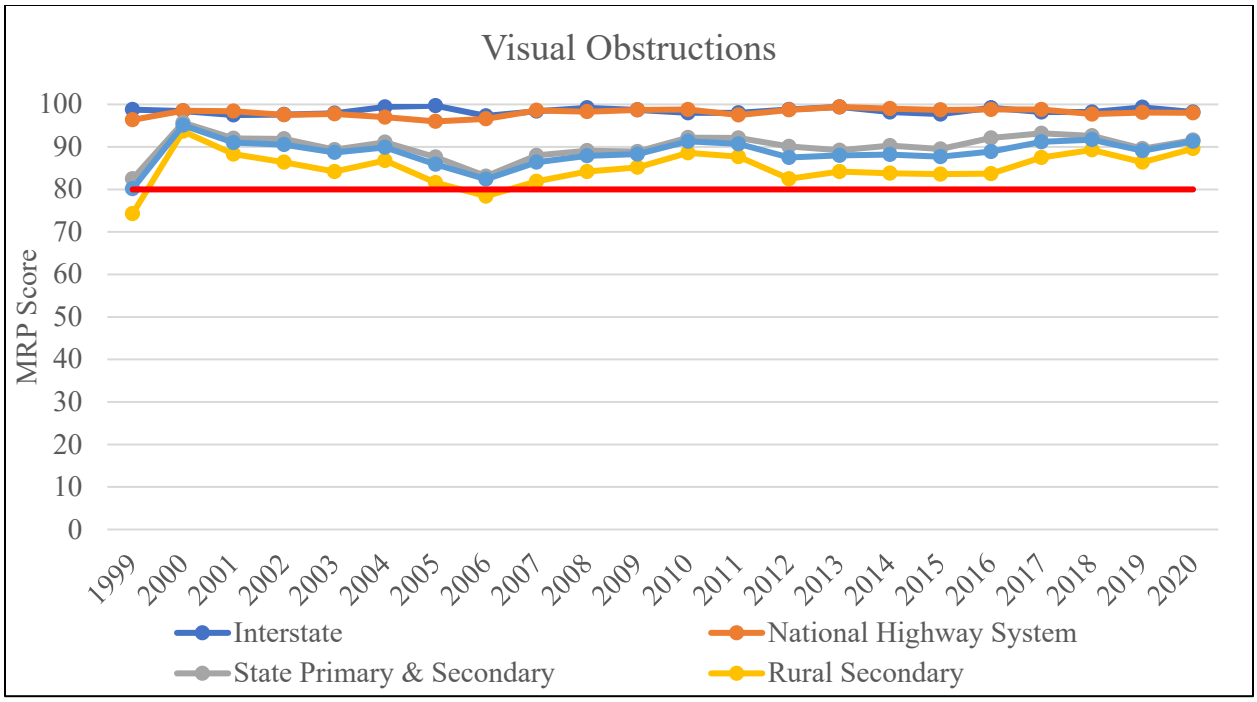
Roadway General



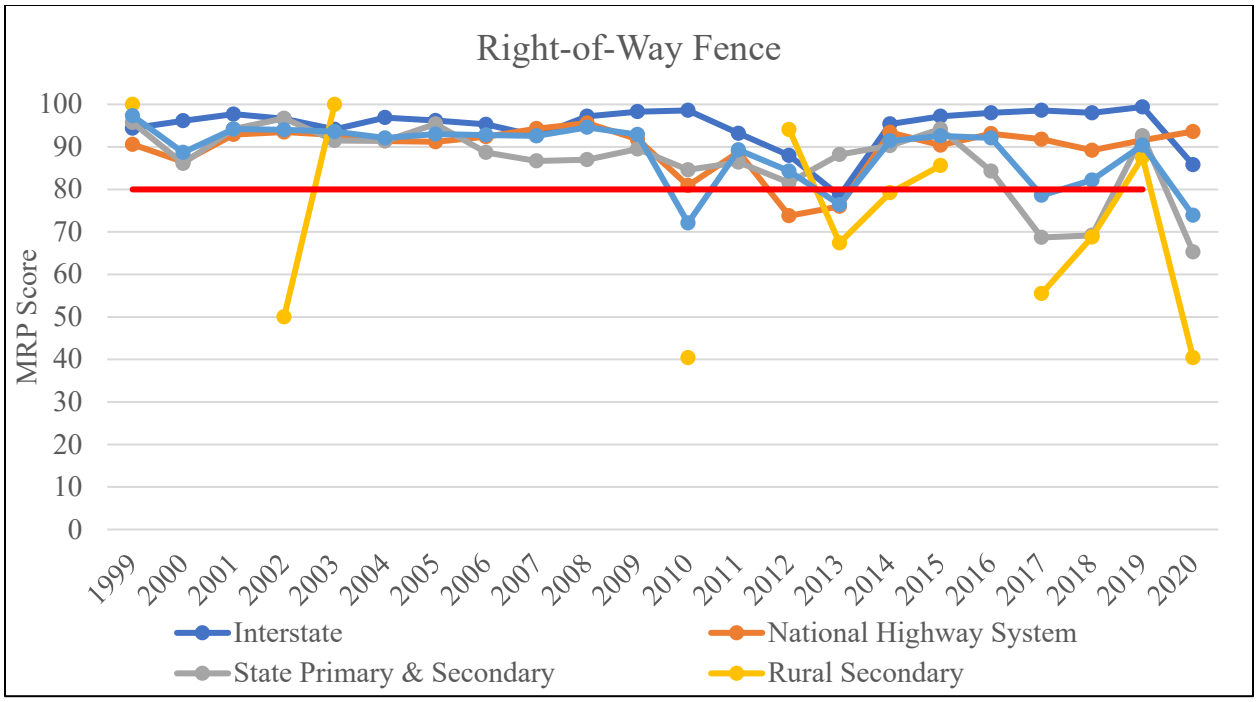
General Aesthetics					
	Interstate	National Highway System	State Primary & Secondary	Rural Secondary	All Roads
1999	95.58	97.46	93.48	82.33	88.48
2000	94.67	96.75	89.4	82.91	87.23
2001	93.7	94.3	90.7	78.7	85.7
2002	96.5	90.8	90.3	82.4	86.67
2003	96.5	96.5	91.3	82.8	87.7
2004	91.8	95.5	88	78.1	84.3
2005	92.6	92	87.6	80.1	84.7
2006	89.1	95.5	82.7	74.5	80.2
2007	92.7	95.3	90.7	81.9	87.2
2008	92.1	96.9	90.9	85.8	89.1
2009	97.2	97.6	93.2	89.4	92
2010	95.4	96	93.3	87.4	90.9
2011	94.9	96	92	87	90.1
2012	95.1	95	92.4	88.2	90.7
2013	93.8	93.6	92	87.9	90.3
2014	96.2	94.7	89	85.4	88
2015	90.7	94.5	90.6	87.9	89.7
2016	96.3	92.7	88.5	86.1	87.9
2017	95.4	94.3	92.1	90.6	91.7
2018	95.2	96.5	92.8	87.4	90.6
2019	95	96.2	90.3	88.6	90.1
2020	95.3	95.7	88	86.9	88.3



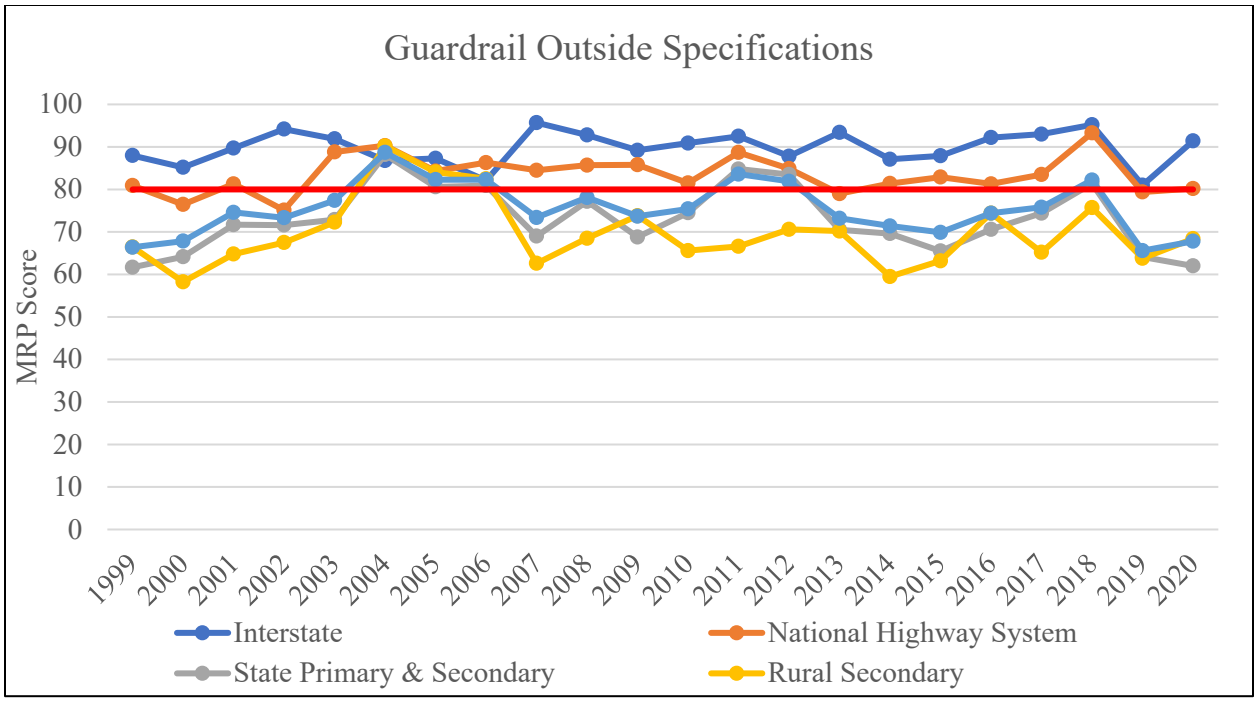
Roadway/Shoulder Vertical Obstructions (Vertical Clearance)					
	Interstate	National Highway System	State Primary & Secondary	Rural Secondary	All Roads
1999	99.62	94.23	68.32	44.13	59.71
2000	99.38	97.26	78.02	58.73	71.52
2001	99.5	97.3	76	56.6	69.6
2002	99.7	96.4	77.5	57.2	71.81
2003	99	96.7	76	56.3	71
2004	98	96.5	77.3	63	73
2005	98.7	94.4	76.1	62.7	72.2
2006	97.2	96.5	73.3	62.9	71.1
2007	96.5	95.7	71.4	58.4	68.1
2008	97.5	93.7	65	53.1	62.8
2009	97	90.1	66.8	54.1	63.8
2010	97.6	95.7	75.5	61.9	71.6
2011	98.4	95.3	76.3	63.3	72.6
2012	90.3	88.8	67.8	59.7	66.3
2013	90.9	90.8	72.4	66.6	71.6
2014	88.6	95.5	73.9	63.3	71.1
2015	88.1	89.5	70.2	62.8	68.8
2016	97.1	94.8	79.3	64	73.9
2017	94.8	92	78.6	74.7	78.3
2018	95.7	81.3	71.7	63.1	69.1
2019	97.9	93.3	74.9	67.4	73.5
2020	97.6	93.1	77.4	70.7	76.1



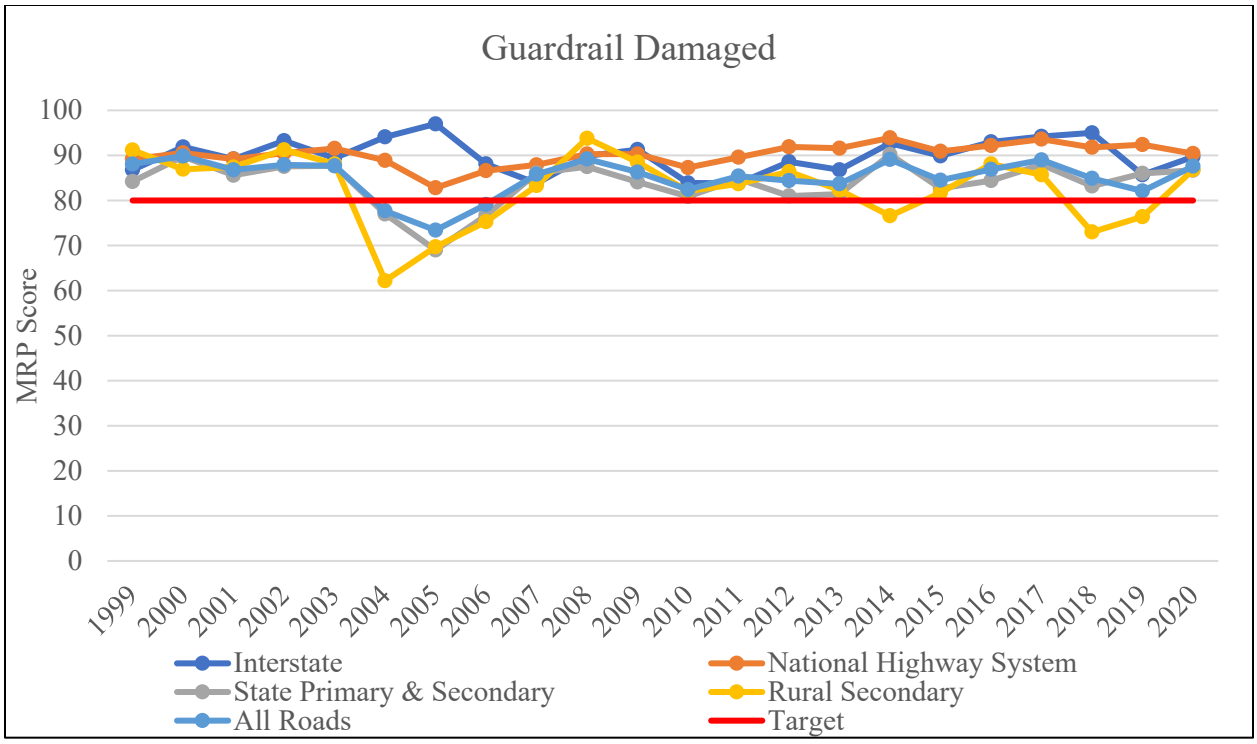
Visual Obstructions					
	Interstate	National Highway System	State Primary & Secondary	Rural Secondary	All Roads
1999	98.78	96.37	82.51	74.28	80.17
2000	98.44	98.5	95.7	93.67	95.09
2001	97.5	98.4	92	88.3	91
2002	97.6	97.5	91.9	86.4	90.53
2003	97.9	97.8	89.4	84.2	88.7
2004	99.4	97	91.1	86.8	89.9
2005	99.7	96	87.6	81.6	85.9
2006	97.3	96.6	83.1	78.4	82.4
2007	98.4	98.6	88	81.9	86.4
2008	99.2	98.3	89.1	84.2	87.9
2009	98.7	98.7	88.9	85.2	88.3
2010	98	98.8	92.2	88.6	91.3
2011	98	97.5	92.1	87.7	90.7
2012	98.8	98.7	90.1	82.5	87.5
2013	99.4	99.4	89.2	84.2	88
2014	98.2	99	90.3	83.8	88.2
2015	97.7	98.7	89.5	83.6	87.7
2016	99.2	98.8	92.1	83.7	88.9
2017	98.2	98.8	93.2	87.5	91.2
2018	98.2	97.7	92.6	89.3	91.7
2019	99.3	98.1	89.6	86.4	89.1
2020	98.2	98	91.6	89.6	91.3



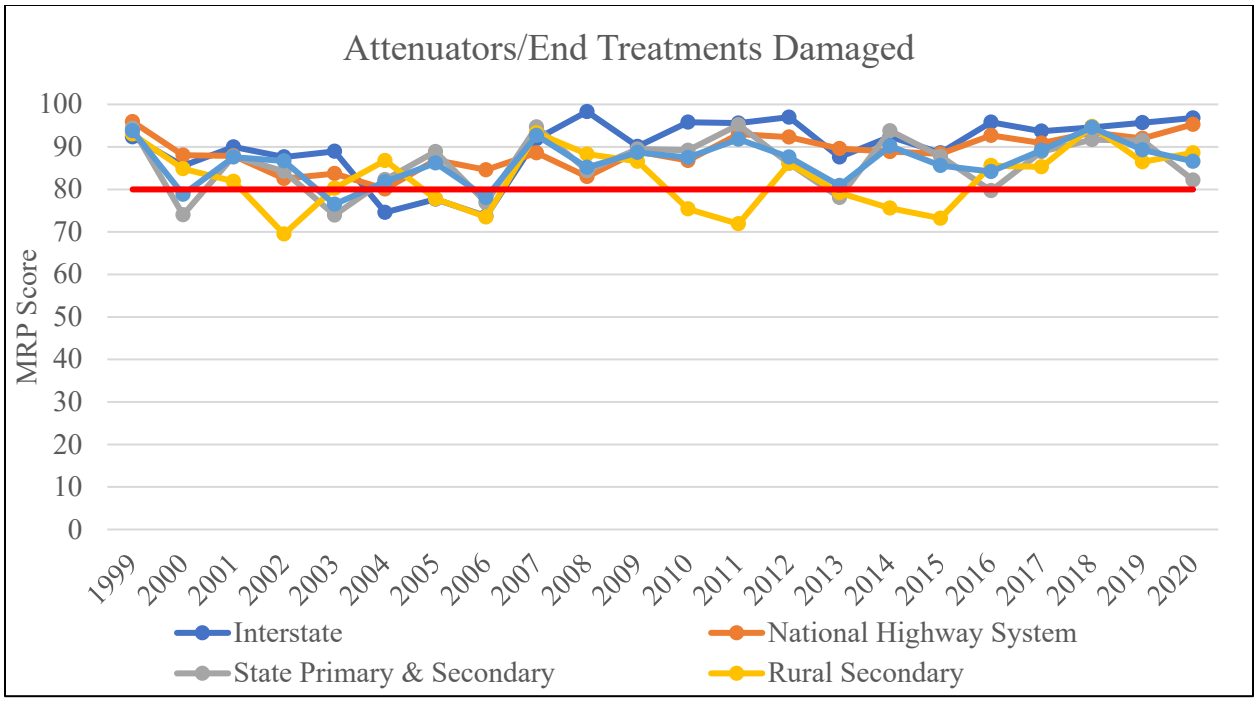
Right-of-Way Fence					
	Interstate	National Highway System	State Primary & Secondary	Rural Secondary	All Roads
1999	94.4	90.6	82.51	100	97.34
2000	96.14	86.51	95.7	—	88.7
2001	97.7	92.9	92	—	94.2
2002	96.6	93.5	91.9	50	94.02
2003	94.1	92.8	89.4	100	93.6
2004	96.9	91.4	91.1	—	92.1
2005	96.2	91.2	87.6	—	93
2006	95.3	92.4	83.1	—	92.8
2007	92.6	94.3	88	—	92.6
2008	97.2	95.6	89.1	—	94.6
2009	98.3	91.8	88.9	—	92.9
2010	98.6	80.9	92.2	40.4	72.1
2011	93.2	88.8	92.1	—	89.3
2012	88	73.8	90.1	94.1	84.3
2013	78.5	76	89.2	67.4	76.4
2014	95.4	93.4	90.3	79.2	91.4
2015	97.2	90.4	89.5	85.6	92.6
2016	98	93.1	92.1	—	92.1
2017	98.6	91.8	93.2	55.5	78.6
2018	98	89.2	92.6	68.8	82.2
2019	99.4	91.6	89.6	87.6	90.4
2020	85.8	93.6	65.3	40.4	73.9



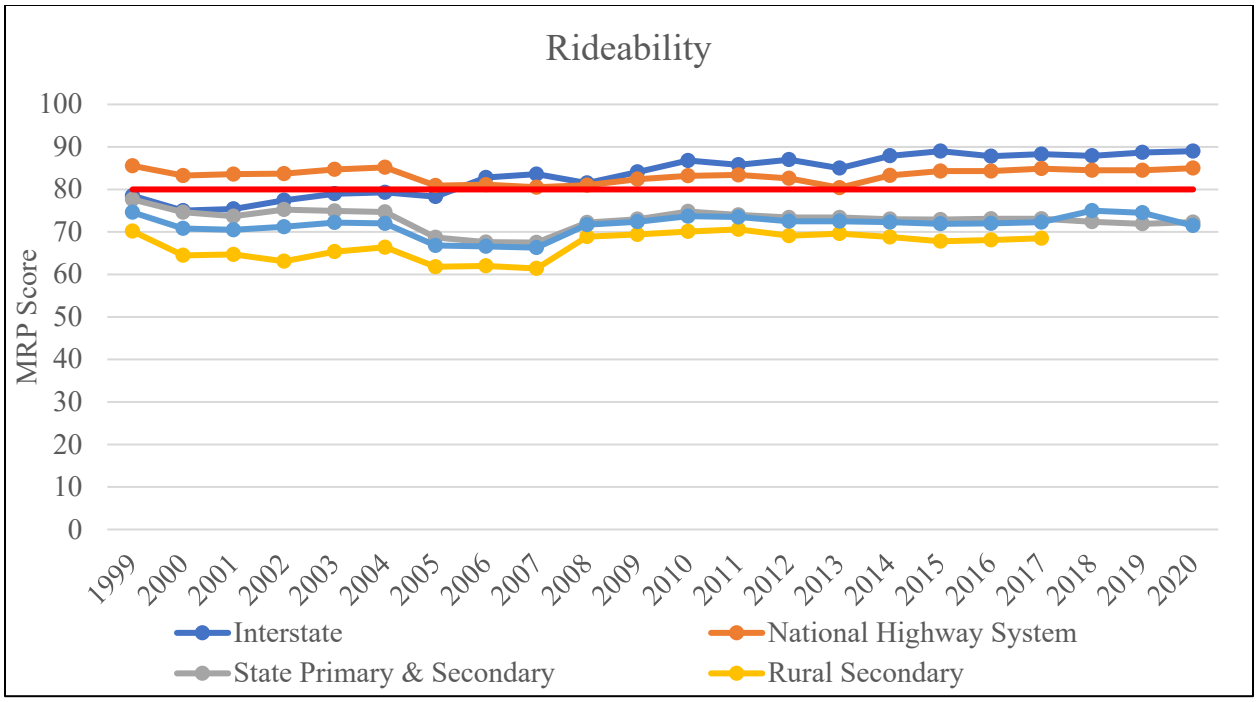
Guardrail Outside Specifications					
	Interstate	National Highway System	State Primary & Secondary	Rural Secondary	All Roads
1999	87.97	80.9	61.69	66.46	66.4
2000	85.19	76.46	64.15	58.25	67.84
2001	89.7	81.3	71.7	64.8	74.6
2002	94.2	75.1	71.6	67.5	73.34
2003	91.9	88.8	72.9	72.3	77.4
2004	86.8	90.3	88.2	90.2	88.7
2005	87.3	84.3	80.6	84.1	82.3
2006	82.1	86.3	80.9	82.5	823.
2007	95.7	84.5	69	62.6	73.4
2008	92.8	85.7	77.2	68.5	78.1
2009	89.2	85.8	68.8	73.8	73.7
2010	90.9	81.5	74.5	65.6	75.4
2011	92.5	88.7	84.8	66.6	83.6
2012	87.8	84.9	83.5	70.6	81.9
2013	93.4	79	70.5	70.2	73.2
2014	87.1	81.4	69.6	59.5	71.4
2015	87.9	82.9	65.5	63.2	69.9
2016	92.2	81.3	70.6	74.4	74.4
2017	93	83.5	74.4	65.2	75.8
2018	95.2	93.3	81.4	75.7	82.2
2019	81	79.4	64.1	63.8	65.6
2020	91.4	80.2	62	68.4	67.8



Guardrail Damaged					
	Interstate	National Highway System	State Primary & Secondary	Rural Secondary	All Roads
1999	86.78	89.2	84.21	91.19	88.09
2000	91.89	90.55	89.75	86.92	89.85
2001	89.2	89.2	85.6	87.4	86.8
2002	93.3	90.5	87.5	91.3	87.93
2003	89.4	91.5	87.7	88.1	87.7
2004	94.1	88.9	77	62.2	77.7
2005	97	82.8	69	69.7	73.4
2006	88.1	86.6	76.7	75.3	79.1
2007	83.8	87.9	86.1	83.3	85.8
2008	89.9	90.3	87.5	93.8	89.2
2009	91.3	90.3	84.1	88.5	86.3
2010	83.9	87.3	80.9	82.1	82.4
2011	83.8	89.6	84.8	83.7	85.4
2012	88.6	91.9	81	86.4	84.4
2013	86.8	91.6	81.4	82.3	83.7
2014	92.7	93.9	90.2	76.6	89.1
2015	89.9	90.9	82.7	81.7	84.5
2016	93	92.2	84.4	88.1	86.9
2017	94.2	93.6	88	85.7	89
2018	95	91.8	83.2	73	84.9
2019	85.7	92.4	86	76.4	82.1
2020	89.7	90.4	86.7	86.8	87.6

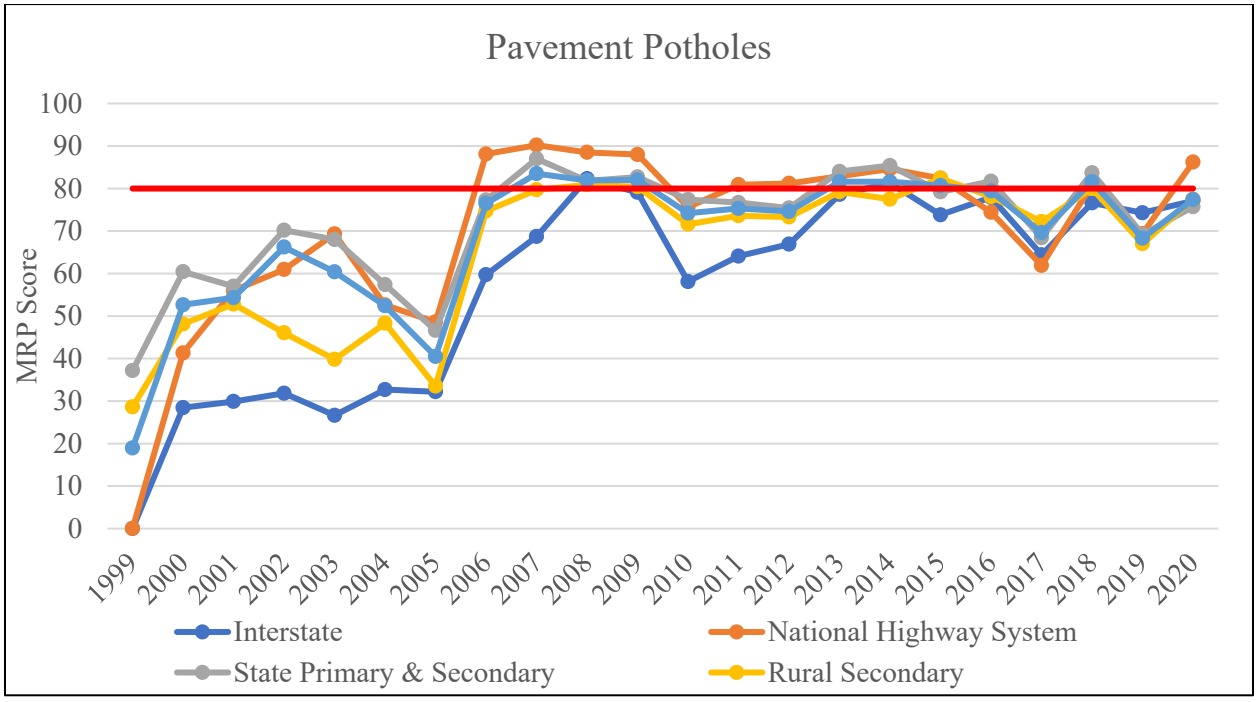


Attenuators/End Treatments Damaged					
	Interstate	National Highway System	State Primary & Secondary	Rural Secondary	All Roads
1999	92.35	95.93	94.38	93.03	93.8
2000	85.57	88.05	74.02	84.86	78.83
2001	90	87.9	87.8	81.9	87.6
2002	87.6	82.6	84.2	69.5	86.7
2003	89	83.7	74	80.3	76.5
2004	74.6	80.1	82.3	86.8	81.8
2005	77.7	86.9	88.9	77.8	86.2
2006	73.7	84.6	76.9	73.5	78.1
2007	91.9	88.6	94.7	93.3	92.7
2008	98.3	83	84.4	88.3	85.2
2009	90.1	88.9	89.5	86.6	88.7
2010	95.8	86.8	89.2	75.4	87.5
2011	95.6	93	95.2	71.9	91.8
2012	97	92.3	86.1	86.1	87.6
2013	87.6	89.6	78.1	79.2	80.9
2014	92.4	88.9	93.8	75.6	90.2
2015	88.6	88.4	87.8	73.2	85.6
2016	95.8	92.7	79.7	85.6	84.2
2017	93.7	90.9	88.9	85.3	89.2
2018	94.6	93.4	91.7	94.8	94.6
2019	95.7	92	91.5	86.5	89.3
2020	96.8	95.3	82.2	88.6	86.6

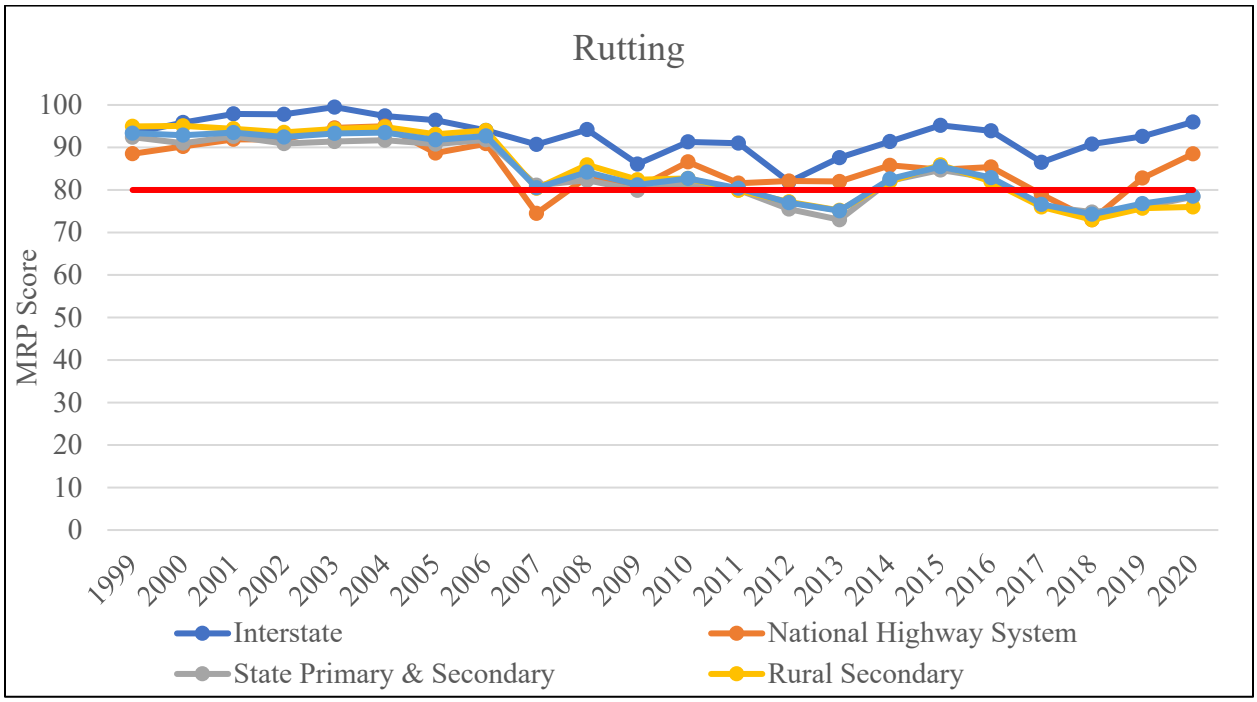


Rideability					
	Interstate	National Highway System	State Primary & Secondary	Rural Secondary	All Roads
1999	78.52	85.55	77.64	70.18	74.62
2000	75.02	83.25	74.63	64.49	70.81
2001	75.4	83.6	73.7	64.7	70.5
2002	77.4	83.7	75.3	63.1	71.21
2003	79	84.7	74.9	65.4	72.2
2004	79.3	85.2	74.7	66.4	72
2005	78.3	80.9	68.7	61.8	66.8
2006	82.8	81.1	67.6	62	66.6
2007	83.6	80.5	67.5	61.4	66.3
2008	81.5	81	72.2	68.9	71.7
2009	84.1	82.4	73	69.4	72.4
2010	86.8	83.2	74.8	70.1	73.7
2011	85.8	83.4	74	70.6	73.5
2012	87	82.6	73.4	69.1	72.5
2013	85	80.4	73.4	69.6	72.5
2014	87.9	83.3	73	68.8	72.3
2015	89	84.3	72.9	67.8	71.9
2016	87.8	84.3	73.1	68.1	72
2017	88.3	84.9	73.1	68.5	72.3
2018	87.9	84.5	72.4	—	75
2019	88.7	84.5	71.9	—	74.5
2020	89	85	72.3	—	71.5

Pavement

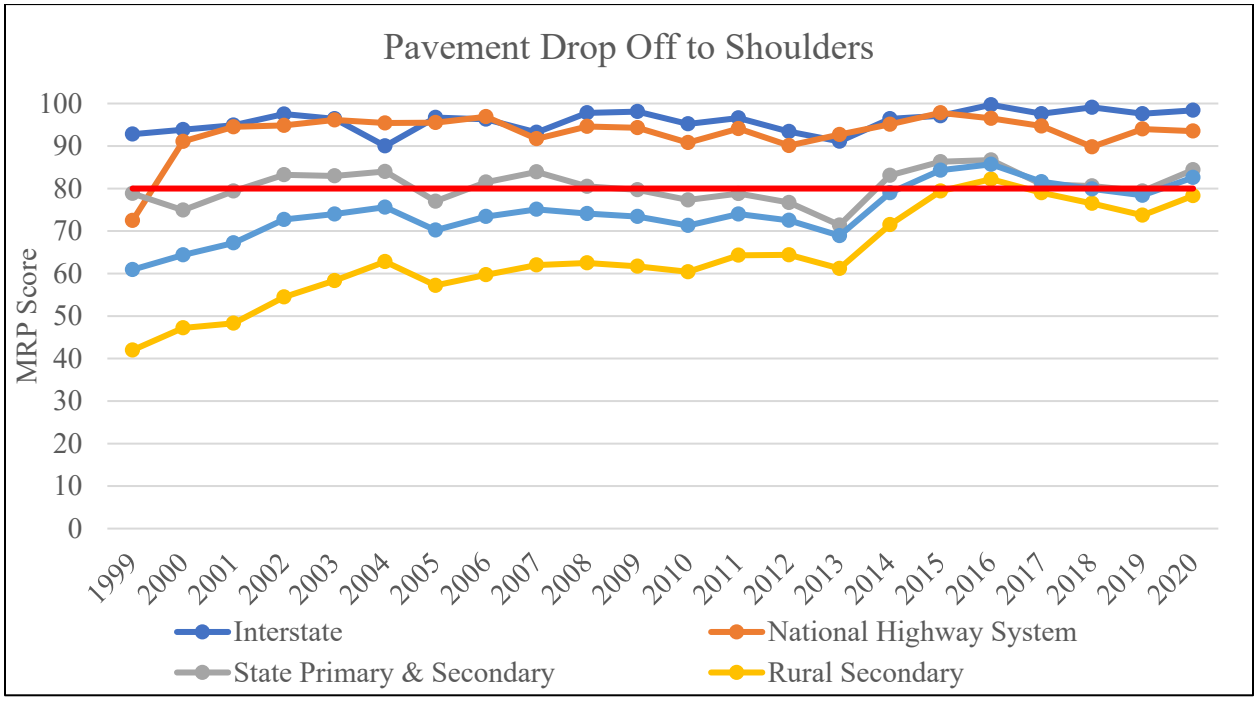


Pavement Potholes					
	Interstate	National Highway System	State Primary & Secondary	Rural Secondary	All Roads
1999	0	0	37.18	28.61	18.95
2000	28.44	41.31	60.42	48.13	52.64
2001	29.9	56	57	52.8	54.3
2002	31.8	61	70.2	46	66.22
2003	26.6	69.3	68	39.8	60.4
2004	32.7	52.6	57.4	48.3	52.4
2005	32.2	48.6	46.6	33.5	40.5
2006	59.7	88.1	77.3	74.7	76.5
2007	68.7	90.2	87	79.7	83.5
2008	82.3	88.5	81.8	80.9	81.9
2009	79.1	88	82.7	80.4	82
2010	58.1	75.6	77.4	71.6	74.2
2011	64.1	80.9	76.7	73.6	75.3
2012	66.9	81.2	75.4	73.3	74.6
2013	78.6	82.9	84	79.2	81.6
2014	81.3	84.6	85.4	77.5	81.6
2015	73.8	82.4	79.2	82.4	80.7
2016	77.9	74.4	81.7	78.1	79.4
2017	64.4	61.9	68.4	72.2	69.6
2018	76.6	80.9	83.7	80	81.6
2019	74.3	69.4	69.2	67	68.3
2020	77.1	86.2	75.7	77.5	77.4

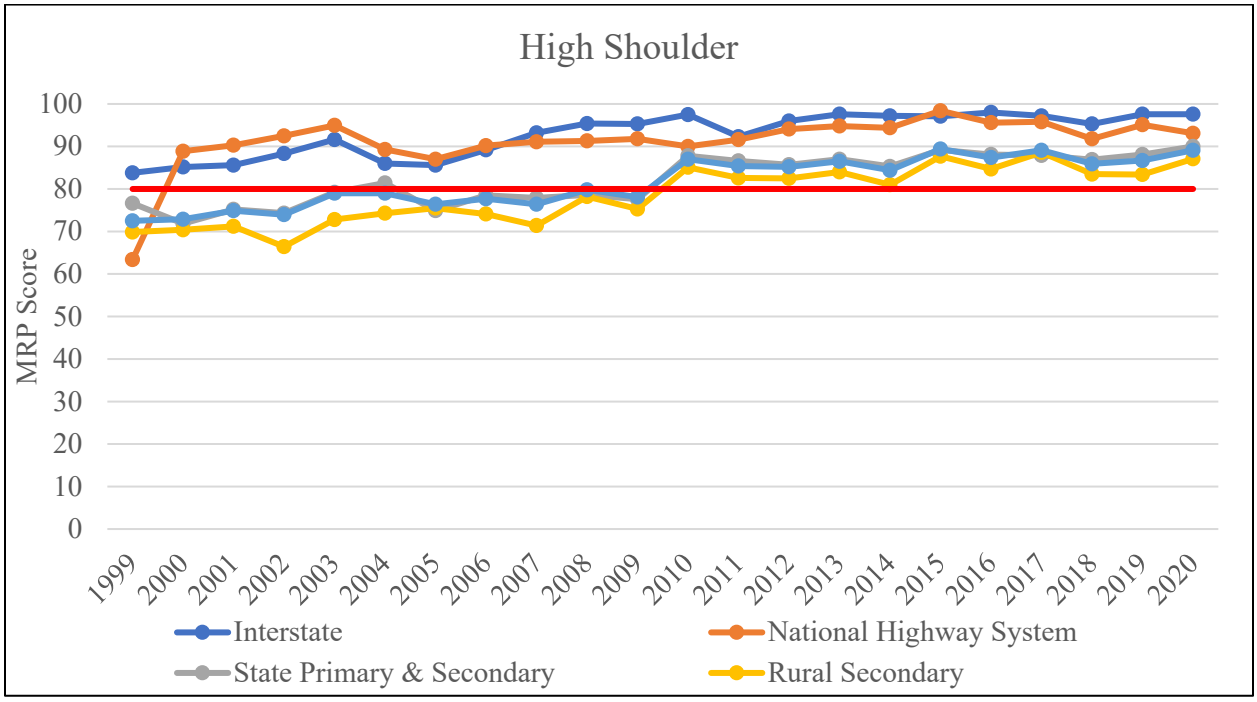


Rutting					
	Interstate	National Highway System	State Primary & Secondary	Rural Secondary	All Roads
1999	93.36	88.53	92.41	94.96	93.36
2000	95.87	90.23	91.01	95.08	92.89
2001	97.9	91.9	92.6	94.4	93.5
2002	97.8	91.9	90.9	93.6	92.45
2003	99.5	94.6	91.4	94.3	93.3
2004	97.4	95	91.7	94.8	93.5
2005	96.4	88.7	90.8	93.1	91.8
2006	94	90.9	91.8	94	92.7
2007	90.7	74.5	81.1	80.4	80.5
2008	94.2	83	82.3	85.9	84.2
2009	86.1	80.5	79.9	82.4	81.2
2010	91.3	86.6	81.5	82.7	82.7
2011	91	81.6	80	79.9	80.4
2012	81.9	82.1	75.5	77.2	77
2013	87.6	82	73	75.2	75.1
2014	91.4	85.8	82.2	82	82.6
2015	95.2	84.8	84.7	85.9	85.5
2016	93.9	85.4	82.8	82	82.9
2017	86.5	78.9	76.2	76	76.6
2018	90.8	73	74.8	73	74.3
2019	92.6	82.8	76	75.7	76.8
2020	96	88.5	78.4	76	78.5

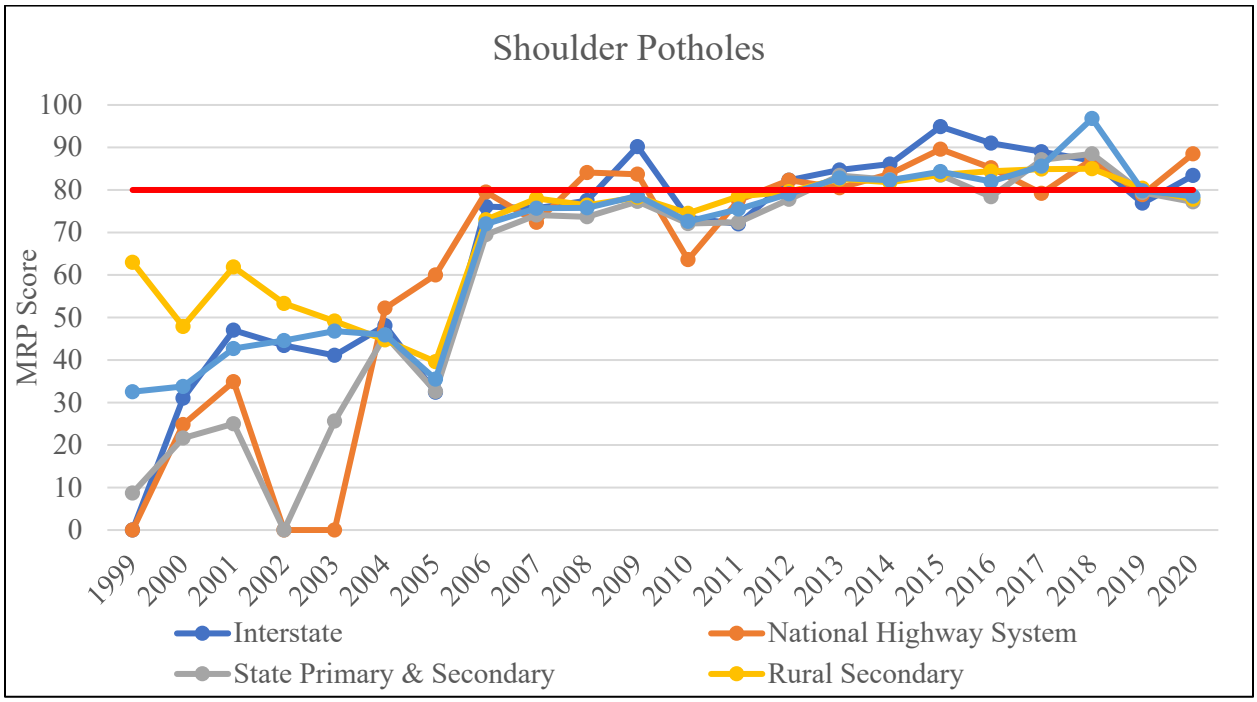
Shoulders



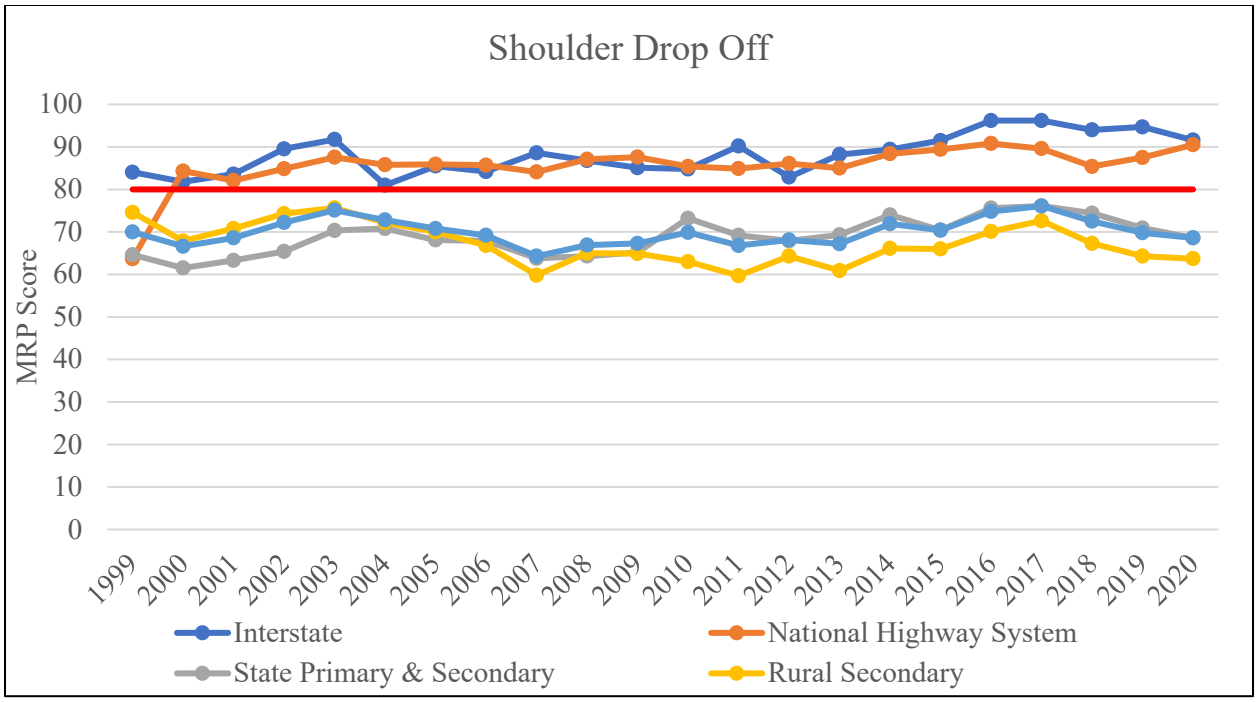
Pavement Drop Off to Shoulders					
	Interstate	National Highway System	State Primary & Secondary	Rural Secondary	All Roads
1999	92.8	72.49	78.82	41.98	60.91
2000	93.84	91.08	74.91	47.21	64.38
2001	94.9	94.5	79.4	48.3	67.2
2002	97.5	94.8	83.2	54.5	72.72
2003	96.4	96.1	83	58.3	74
2004	90	95.4	84	62.8	75.6
2005	96.7	95.5	77	57.2	70.2
2006	96.3	96.9	81.5	59.7	73.4
2007	93.2	91.7	83.9	62	75.1
2008	97.8	94.6	80.5	62.5	74.1
2009	98.1	94.3	79.7	61.7	73.4
2010	95.2	90.8	77.3	60.4	71.3
2011	96.6	94.1	78.8	64.3	74
2012	93.4	90.1	76.7	64.4	72.5
2013	91.1	92.7	71.4	61.2	68.9
2014	96.4	95.1	83.1	71.5	79
2015	97.1	97.8	86.3	79.4	84.3
2016	99.7	96.5	86.7	82.2	85.7
2017	97.6	94.7	81	79	81.6
2018	99.1	89.8	80.6	76.5	79.9
2019	97.6	94	79.4	73.7	78.4
2020	98.4	93.5	84.4	78.3	82.6



High Shoulder					
	Interstate	National Highway System	State Primary & Secondary	Rural Secondary	All Roads
1999	83.8	63.39	76.63	69.87	72.51
2000	85.17	88.87	71.86	70.4	72.88
2001	85.6	90.3	75.2	71.2	74.9
2002	88.3	92.5	74.3	66.4	73.96
2003	91.6	95	79.2	72.8	79
2004	86	89.3	81.4	74.3	79
2005	85.6	87	74.9	75.5	76.4
2006	89.2	90.2	78.5	74.1	77.7
2007	93.2	91.1	77.9	71.4	76.4
2008	95.4	91.3	78.6	78.2	79.8
2009	95.3	91.8	77.6	75.3	78.1
2010	97.5	90	87.8	85.1	87
2011	92.3	91.6	86.6	82.6	85.4
2012	96	94.1	85.7	82.5	85.2
2013	97.6	94.8	87	84	86.5
2014	97.2	94.4	85.3	81	84.4
2015	97.1	98.4	89.2	87.7	89.4
2016	98	95.6	88.1	84.7	87.4
2017	97.2	95.8	87.9	88.6	89.1
2018	95.3	91.8	86.9	83.5	85.9
2019	97.6	95.1	88.1	83.4	86.7
2020	97.6	93.1	90	87.1	89.1

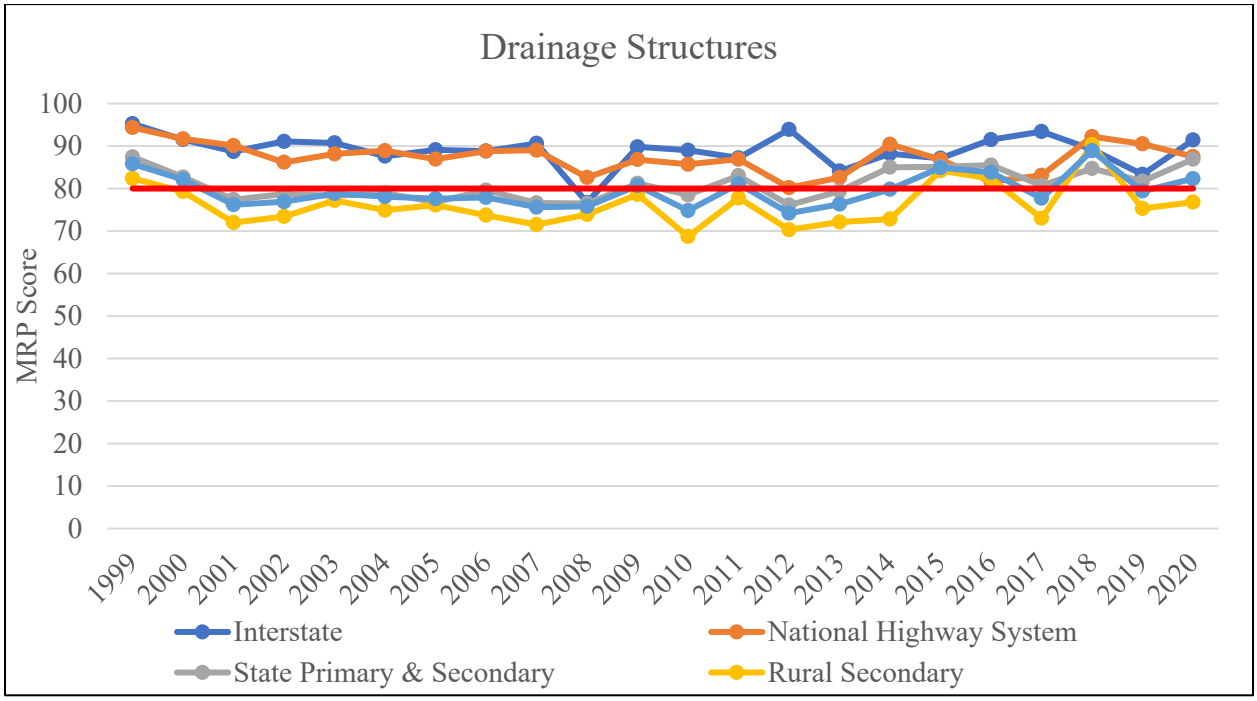


Shoulder Potholes					
	Interstate	National Highway System	State Primary & Secondary	Rural Secondary	All Roads
1999	0	0	8.71	62.98	32.54
2000	31	24.79	21.63	47.88	33.77
2001	47	34.9	25	61.9	42.7
2002	43.4	0	0	53.3	44.58
2003	41.1	0	25.6	49.2	46.8
2004	48.1	52.2	45.8	44.7	45.9
2005	32.4	60	32.6	39.6	35.5
2006	76.1	79.5	69.5	73	72
2007	75.7	72.4	74.1	78	75.7
2008	77.5	84.1	73.7	76.4	75.8
2009	90.2	83.7	77.3	78.3	78.6
2010	73.5	63.6	72.1	74.5	72.6
2011	72	77.6	72.4	78.5	75.5
2012	82.3	82.3	77.8	79.6	79.1
2013	84.7	80.5	83.4	82.6	82.8
2014	86.1	83.8	82.4	81.8	82.3
2015	94.9	89.6	83.5	83.6	84.3
2016	91	85.2	78.4	84.4	82
2017	89	79.2	87.1	84.9	85.6
2018	86.9	87.2	88.5	85	96.8
2019	76.9	78.9	79.4	80.4	79.8
2020	83.4	88.5	77.2	77.8	78.5

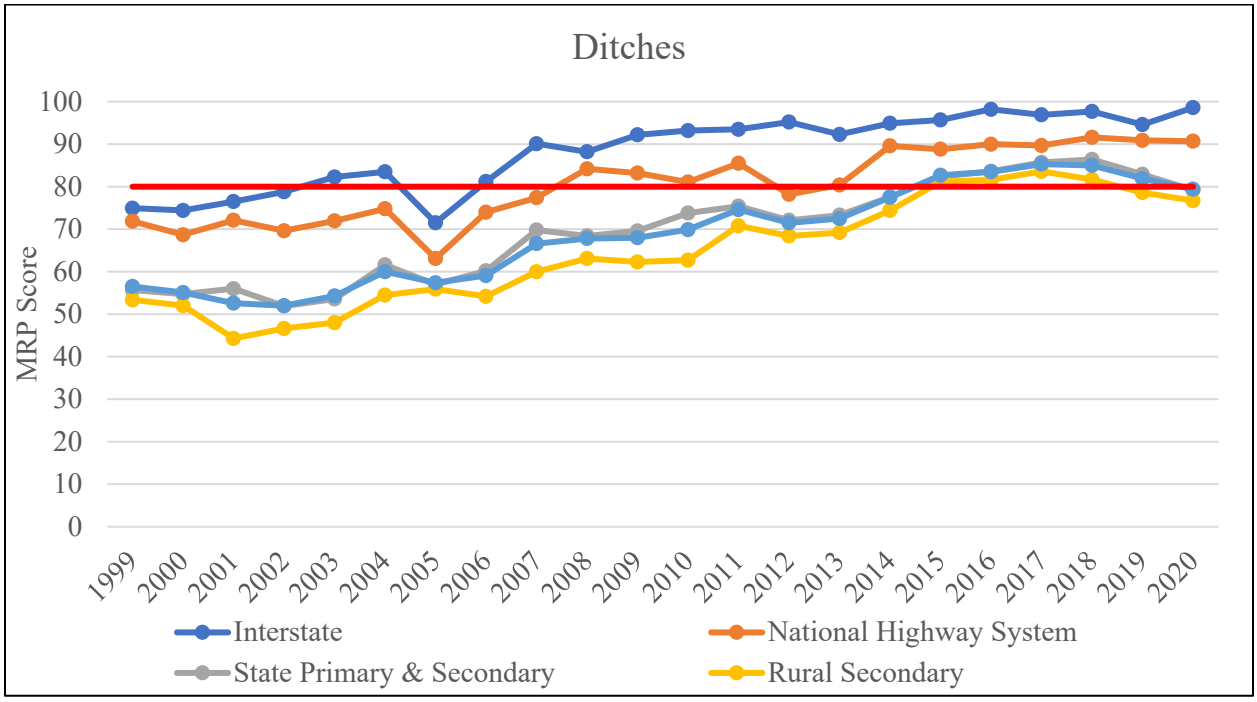


Shoulder Drop Off					
	Interstate	National Highway System	State Primary & Secondary	Rural Secondary	All Roads
1999	84.04	63.66	64.62	74.59	69.98
2000	81.81	84.3	61.51	67.86	66.62
2001	83.6	82.1	63.3	70.8	68.6
2002	89.5	84.9	65.4	74.3	72.2
2003	91.7	87.6	70.4	75.6	75.1
2004	81	85.8	70.8	72.2	72.8
2005	85.5	85.9	68.1	70	70.8
2006	84.2	85.7	67.9	66.8	69.2
2007	88.6	84.1	63.8	59.8	64.3
2008	86.8	87.1	64.3	65	66.9
2009	85.1	87.6	65.2	64.9	67.3
2010	84.8	85.4	73.2	63	69.9
2011	90.2	84.9	69.2	59.7	66.8
2012	82.9	86.1	67.9	64.3	68.1
2013	88.2	85	69.3	60.9	67.2
2014	89.4	88.4	74	66.1	71.9
2015	91.5	89.4	70.4	66	70.4
2016	96.2	90.8	75.6	70.1	74.8
2017	96.2	89.6	76.1	72.6	76.1
2018	94	85.4	74.4	67.3	72.5
2019	94.7	87.5	70.9	64.3	69.8
2020	91.6	90.5	68.6	63.7	68.6

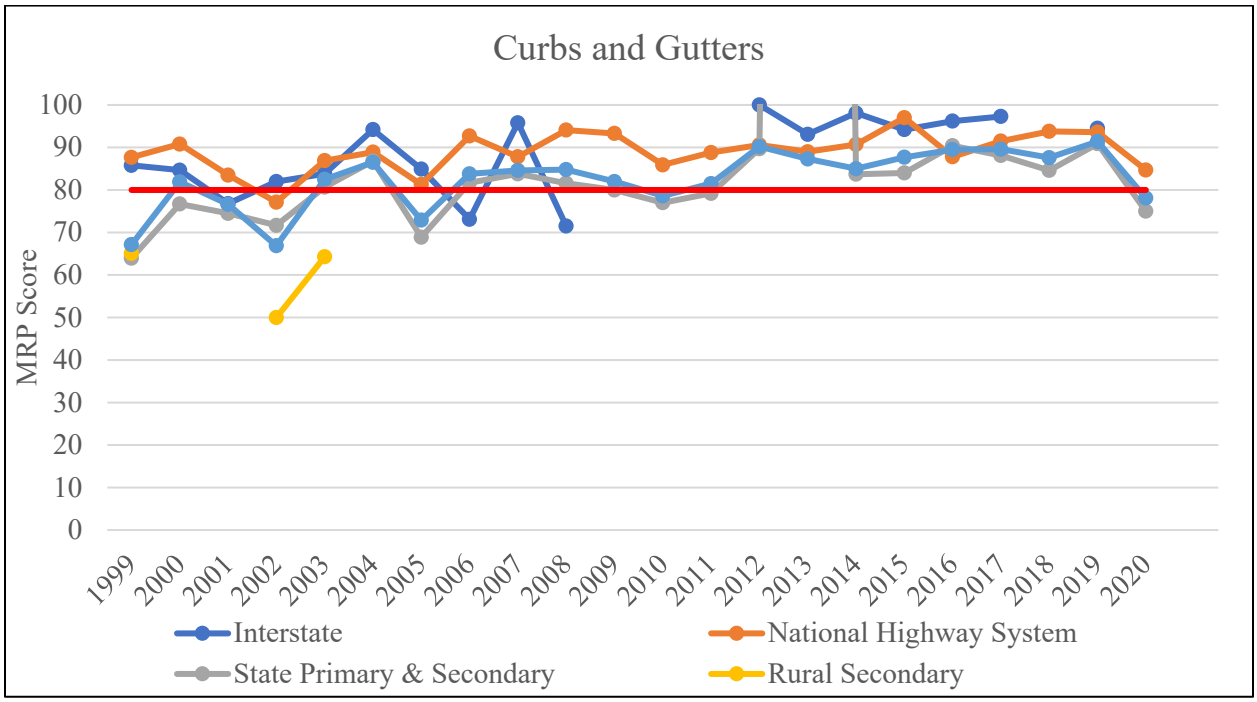
Drainage



Drainage Structures					
	Interstate	National Highway System	State Primary & Secondary	Rural Secondary	All Roads
1999	95.23	94.34	87.43	82.38	85.8
2000	91.51	91.68	82.68	79.27	82.08
2001	88.7	90.1	77.4	72	76.2
2002	91.1	86.2	78.7	73.4	76.89
2003	90.7	88.1	78.3	77.2	78.8
2004	87.6	88.9	78.9	74.9	78.1
2005	89.1	86.9	76.8	76.1	77.6
2006	88.8	88.8	79.6	73.7	77.9
2007	90.6	89	76.6	71.5	75.6
2008	76.7	82.6	76.5	73.9	75.8
2009	89.8	86.8	81.2	78.6	80.7
2010	89	85.7	78.5	68.7	74.8
2011	87.2	86.9	83	77.8	81.1
2012	93.9	80.2	76.1	70.3	74.2
2013	84.1	82.6	79.4	72.1	76.3
2014	88.2	90.4	85	72.8	79.8
2015	87.1	86.8	85.1	84.2	84.9
2016	91.5	81.6	85.5	82.3	83.8
2017	93.4	83.1	80.7	73	77.7
2018	89.2	92.2	84.7	90.3	88.9
2019	83.3	90.5	81.7	75.3	79.4
2020	91.4	87.5	86.9	76.8	82.3

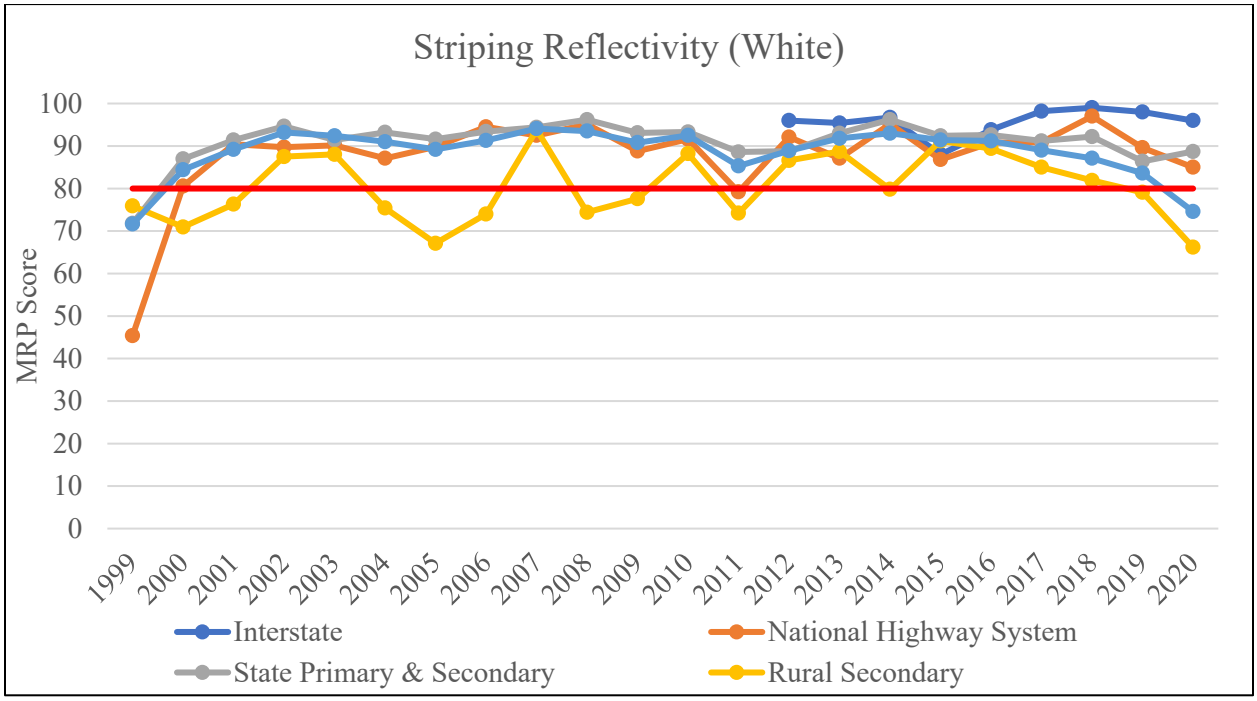


Ditches					
	Interstate	National Highway System	State Primary & Secondary	Rural Secondary	All Roads
1999	74.94	71.87	55.68	53.37	56.51
2000	74.42	68.69	54.73	52.01	55.1
2001	76.5	72.1	56	44.3	52.6
2002	78.8	69.6	51.9	46.6	52.01
2003	82.3	71.9	53.6	48	54.3
2004	83.5	74.8	61.6	54.5	60
2005	71.5	63.1	57	55.9	57.4
2006	81.2	74	60.2	54.2	59.1
2007	90.1	77.4	69.8	60	66.6
2008	88.2	84.2	68.4	63.1	67.8
2009	92.2	83.2	69.6	62.3	68
2010	93.2	81.1	73.8	62.7	69.9
2011	93.5	85.5	75.4	70.8	74.6
2012	95.2	78.2	72.1	68.4	71.5
2013	92.3	80.4	73.3	69.2	72.5
2014	94.9	89.6	77.6	74.4	77.5
2015	95.7	88.8	82.4	81.2	82.7
2016	98.2	90	83.6	81.6	83.5
2017	96.9	89.7	85.7	83.6	85.3
2018	97.7	91.6	86.4	81.7	85
2019	94.6	90.9	82.9	78.6	81.9
2020	98.6	90.7	79.2	76.7	79.4

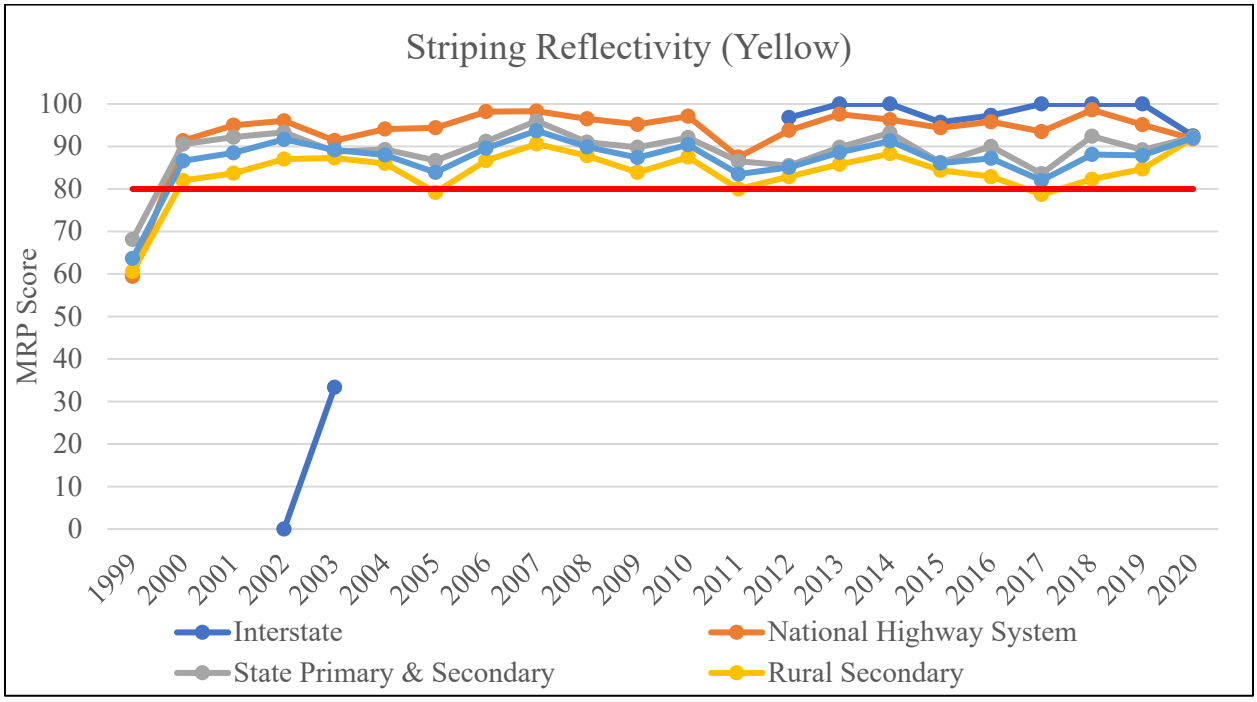


Curbs and Gutters					
	Interstate	National Highway System	State Primary & Secondary	Rural Secondary	All Roads
1999	85.8	87.67	63.97	65.1	67.15
2000	84.66	90.8	76.7	—	81.9
2001	76.8	83.5	74.5	—	76.6
2002	82	77.1	71.7	50	66.87
2003	83.8	86.9	80.7	64.3	82.5
2004	94.2	88.9	86.8	—	86.5
2005	84.9	81.3	68.9	—	72.9
2006	73.1	92.7	81.7	—	83.8
2007	95.8	87.8	83.8	—	84.6
2008	71.5	94.1	81.6	—	84.8
2009	—	93.3	80	—	82
2010	—	85.9	77	—	78.6
2011	—	88.8	79.2	—	81.5
2012	100	90.6	89.7	—	90.2
2013	93.1	89	86.5	—	87.3
2014	98.1	90.7	83.7	—	85
2015	94.2	97	84	—	87.7
2016	96.2	87.8	90.4	—	89.5
2017	97.3	91.5	88.1	—	89.6
2018	—	93.8	84.6	—	87.6
2019	94.5	93.6	90.9	—	91.4
2020	—	84.7	75	—	78.1

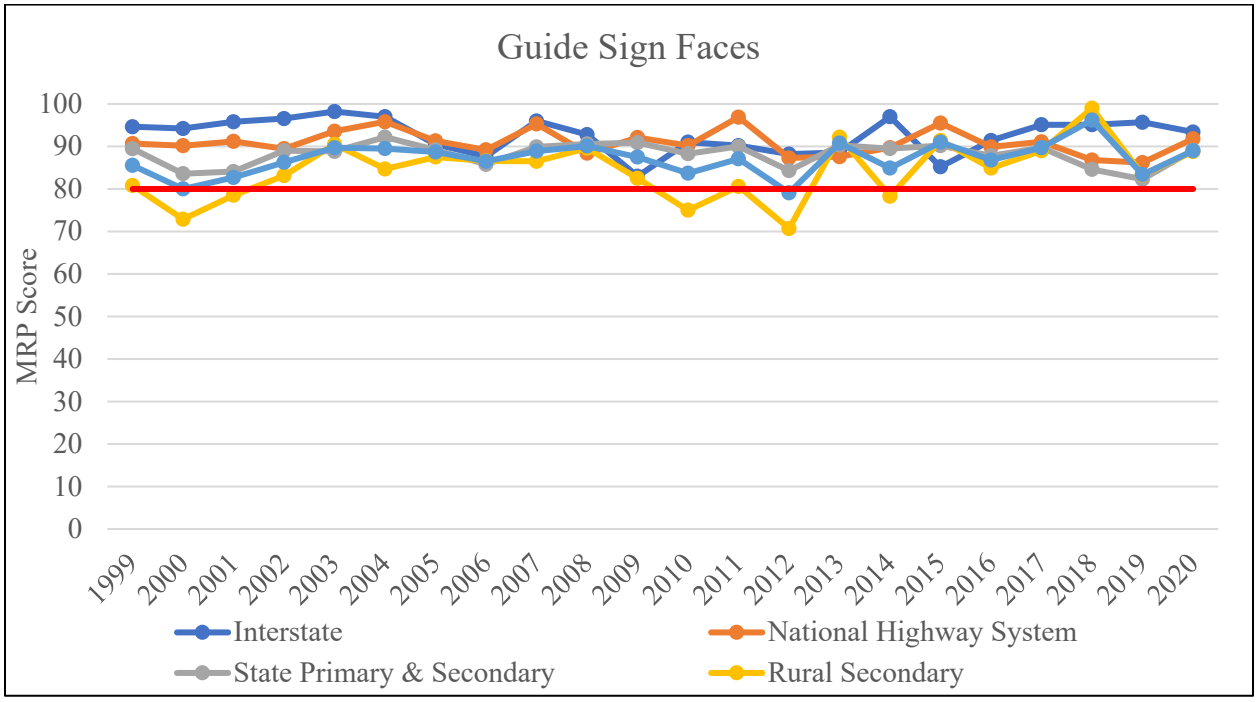
Traffic



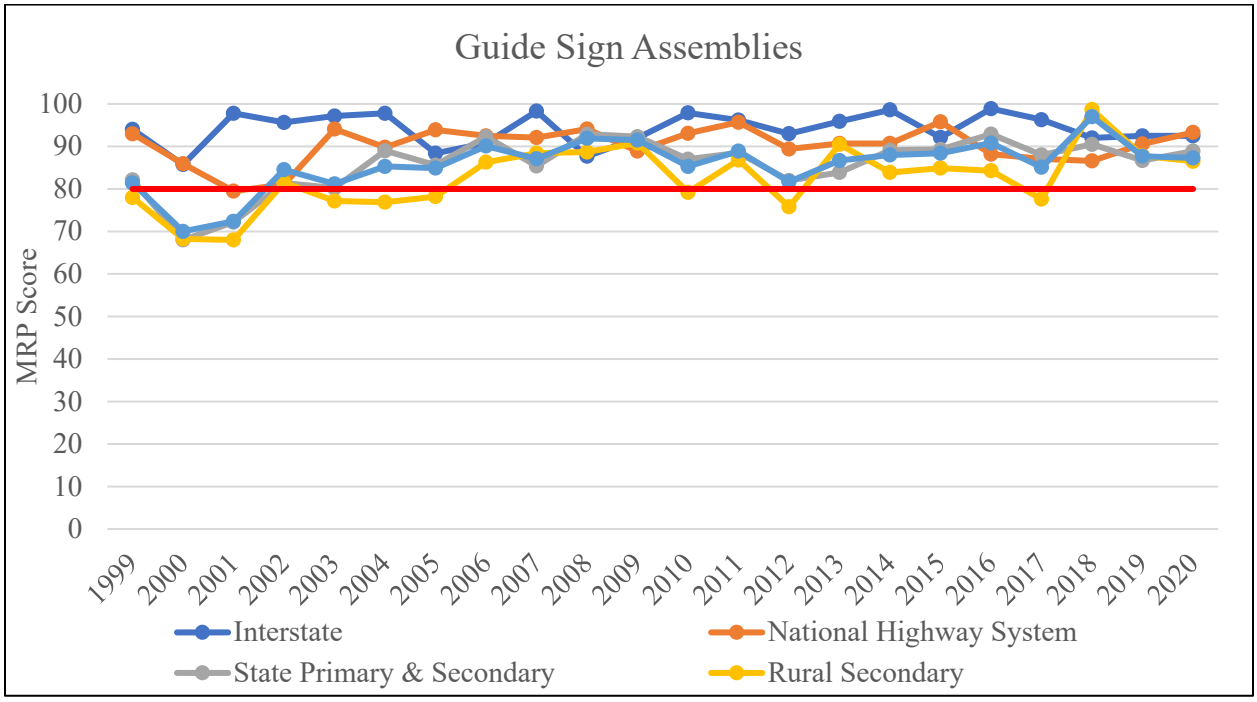
White Stripe Reflectivity					
	Interstate	National Highway System	State Primary & Secondary	Rural Secondary	All Roads
1999	—	45.39	71.81	75.9	71.65
2000	—	80.56	86.95	70.94	84.39
2001	—	90.4	91.4	76.3	89.2
2002	—	89.7	94.6	87.5	93.19
2003	—	90.2	91.4	88	92.4
2004	—	87.1	93.2	75.4	91
2005	—	89.8	91.6	67.1	89.2
2006	—	94.5	93.4	74	91.3
2007	—	92.5	94.4	93.8	94.1
2008	—	95.1	96.2	74.4	93.5
2009	—	88.8	93.1	77.6	90.8
2010	—	91.6	93.3	88.2	92.5
2011	—	79.2	88.6	74.2	85.3
2012	96	92.1	88.8	86.6	88.9
2013	95.4	87.1	93	88.7	91.8
2014	96.7	95.2	96.2	79.8	93
2015	88	86.8	92.4	91.2	91.4
2016	93.8	90.8	92.6	89.4	91.2
2017	98.2	90.9	91.2	85	89
2018	99	97	92.2	81.9	87.1
2019	98	89.6	86.4	79.1	83.6
2020	96	85	88.7	66.2	74.6



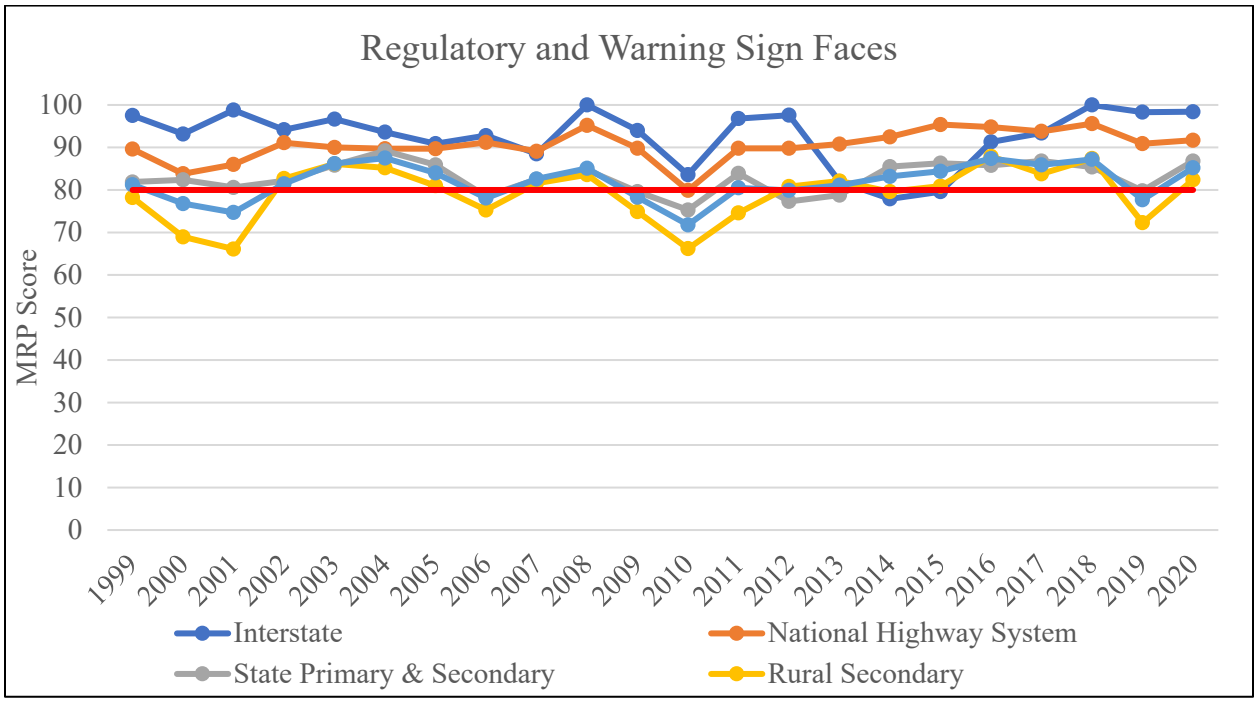
Yellow Stripe Reflectivity					
	Interstate	National Highway System	State Primary & Secondary	Rural Secondary	All Roads
1999	—	59.45	68.13	60.55	63.65
2000	—	91.36	90.55	82	86.63
2001	—	95	92.2	83.7	88.5
2002	0	96	93.3	87	91.66
2003	33.3	91.4	88.8	87.3	89.2
2004	—	94.1	89.3	86	88
2005	—	94.4	86.7	79.2	83.9
2006	—	98.2	91.2	86.7	89.6
2007	—	98.3	96	90.6	93.7
2008	—	96.5	91	87.8	89.9
2009	—	95.2	89.8	83.9	87.4
2010	—	97.1	92.1	87.5	90.4
2011	—	87.5	86.5	80	83.5
2012	96.8	93.8	85.5	82.9	85.1
2013	100	97.6	89.8	85.8	88.6
2014	100	96.3	93.2	88.3	91.3
2015	95.7	94.4	86.2	84.4	86.1
2016	97.3	95.8	90	82.9	87.2
2017	100	93.5	83.6	78.7	82
2018	100	98.6	92.4	82.3	88.1
2019	100	95.1	89.2	84.7	87.9
2020	92.5	91.8	92.2	92	92



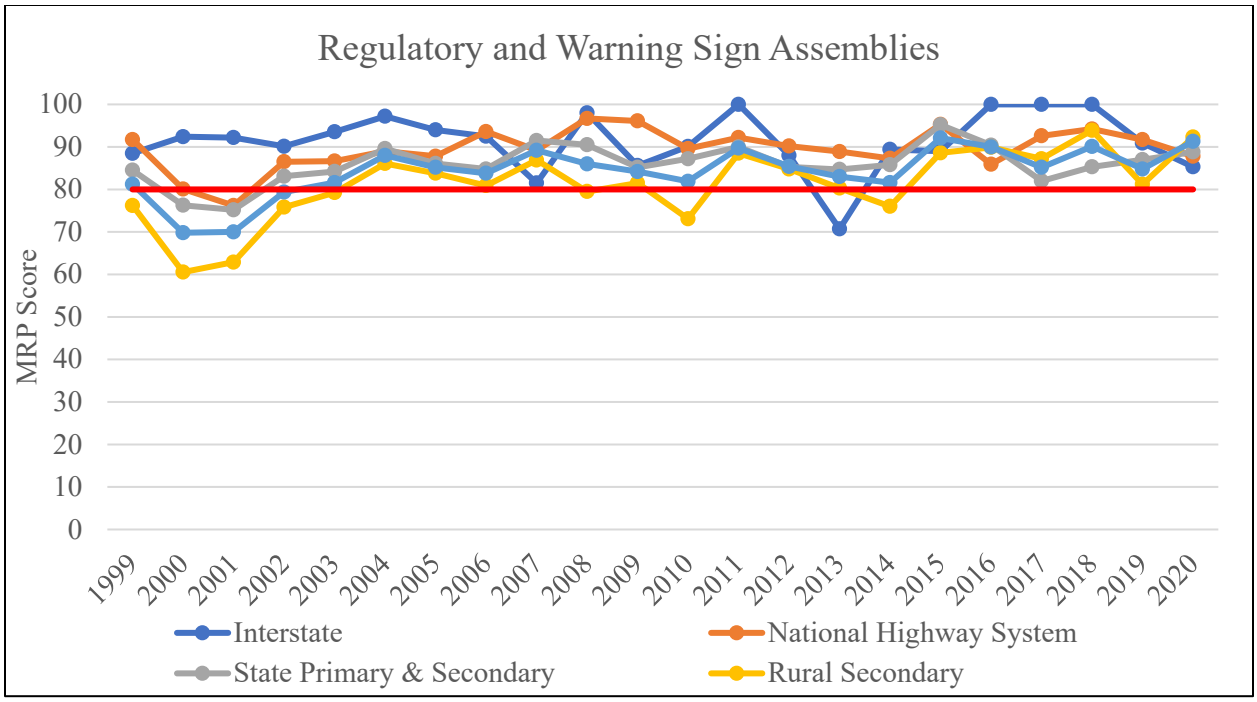
Guide Sign Faces					
	Interstate	National Highway System	State Primary & Secondary	Rural Secondary	All Roads
1999	94.63	90.68	89.48	80.8	85.54
2000	94.23	90.18	83.59	72.88	80.02
2001	95.8	91.2	84.1	78.5	82.7
2002	96.6	89.5	89	83.1	86.27
2003	98.2	93.6	88.8	90.5	89.7
2004	97	95.8	92.2	84.7	89.5
2005	90.5	91.3	89.2	87.5	88.7
2006	87.7	89.2	85.8	86.6	86.5
2007	96	95.3	89.9	86.5	88.9
2008	92.8	88.4	90.6	89.6	90.1
2009	83	92.1	90.9	82.5	87.5
2010	91	90.2	88.3	75	83.7
2011	90.2	96.9	90	80.6	87.1
2012	88.2	87.3	84.3	70.7	79.1
2013	88.6	87.6	90.3	92.2	90.8
2014	97	89.7	89.5	78.3	84.9
2015	85.2	95.5	90.2	91.4	91
2016	91.4	89.9	87.8	84.9	86.8
2017	95.1	91.1	89.7	89	89.7
2018	95.1	86.8	84.6	99	96.2
2019	95.7	86.2	82.3	83.3	83.4
2020	93.4	91.8	89.1	88.8	89



Guide Sign Assemblies					
	Interstate	National Highway System	State Primary & Secondary	Rural Secondary	All Roads
1999	94.01	92.99	82.13	78.01	81.4
2000	85.73	85.92	68	68.25	70.03
2001	97.8	79.5	72.2	68	72.4
2002	95.7	81.1	81.4	81.5	84.53
2003	97.2	94.1	80.2	77.2	81.2
2004	97.8	89.8	89	76.9	85.3
2005	88.4	93.9	85.6	78.2	84.9
2006	90.8	92.5	92.3	86.3	90.1
2007	98.3	92.1	85.4	88.4	87.1
2008	87.7	94.1	92.9	88.7	91.9
2009	92	88.9	92.3	90.8	91.5
2010	97.9	93.1	87	79.2	85.3
2011	96.2	95.7	88.5	86.8	88.9
2012	93	89.4	82	75.8	81.7
2013	95.9	90.7	83.9	90.5	86.7
2014	98.6	90.7	89.1	83.9	88
2015	92.1	95.8	89.3	84.9	88.4
2016	98.9	88.2	92.9	84.3	90.8
2017	96.3	87.1	88	77.6	85.1
2018	92	86.6	90.5	98.7	97
2019	92.5	90.6	86.7	87.8	87.7
2020	92.5	93.3	88.9	86.5	87.3



Regulatory and Warning Sign Faces					
	Interstate	National Highway System	State Primary & Secondary	Rural Secondary	All Roads
1999	97.52	89.61	81.87	78.2	81.22
2000	93.17	83.82	82.39	68.96	76.8
2001	98.8	86	80.6	66.1	74.7
2002	94.2	91.1	82.2	82.7	81.46
2003	96.7	90	85.8	86.2	86.2
2004	93.6	89.7	89.2	85.2	87.5
2005	90.9	89.7	85.9	81	84
2006	92.8	91.2	78.5	75.3	78.1
2007	88.5	89.1	82.5	81.6	82.6
2008	100	95.2	84.7	83.6	85.1
2009	94	89.8	79.6	74.9	78.3
2010	83.6	79.9	75.3	66.2	71.8
2011	86.8	89.8	83.9	74.6	80.5
2012	97.6	89.8	77.3	80.8	79.9
2013	82	90.8	78.8	82.1	81.1
2014	77.9	92.5	85.5	79.6	83.2
2015	79.6	95.4	86.3	80.9	84.4
2016	91.3	94.8	85.8	87.9	87.4
2017	93.4	93.8	86.8	83.8	85.9
2018	100	95.6	85.4	87.4	87.2
2019	98.3	90.9	79.8	72.3	77.7
2020	98.4	91.7	86.8	82.4	85.2



Regulatory and Warning Sign Assemblies					
	Interstate	National Highway System	State Primary & Secondary	Rural Secondary	All Roads
1999	88.49	91.73	84.52	76.22	81.23
2000	92.4	80.09	76.27	60.54	69.81
2001	92.2	76.2	75.2	62.9	70
2002	90.1	86.5	83.1	75.8	79.37
2003	93.5	86.7	84.2	79.2	81.6
2004	97.2	89	89.6	86.1	88
2005	94	87.8	86.1	83.8	85.2
2006	92.5	93.6	84.8	80.9	83.8
2007	81.5	89.2	91.5	86.9	89.2
2008	98	96.7	90.5	79.5	86
2009	85.6	96.1	85.2	81.5	84.2
2010	90.1	89.6	87.2	73.1	81.9
2011	100	92.2	90	88.5	89.7
2012	88	90.2	85.3	84.8	85.4
2013	70.7	88.9	84.7	80.3	83
2014	89.4	87.3	85.8	76	81.6
2015	89	95.3	95.2	88.6	92.1
2016	100	85.9	90.4	89.9	90
2017	100	92.6	82	87.2	85.2
2018	100	94.2	85.3	93.9	90.1
2019	90.9	91.7	87	81.2	84.8
2020	85.3	87.8	88.8	92.3	91.3

Appendix B MRP Survey Questions

Q1 Who collects the MRP data in your office? (select all that apply)

- ○ Engineer in Training
- ○ Highway Technician
- ○ Highway Technician Superintendent
- ○ Transportation Engineer Supervisor
- ○ Transportation Engineer Technologist
- ○ PD&P Branch Manager
- ○ Seasonal Temporary Employee
- ○ Other

Q2 If you answered other please list that position here:

_____

Q3 Current procedure calls for random sampling of 300-400 segments of 500 feet each in each district across four road types: Interstates, National Highway System, State Primary and Secondary, and Rural Secondary. **Have you found this sampling approach to be representative of the roads in your district?**

- ○ Yes
- ○ No

Q4 If you answered no, how should sampling be adjusted to be more representative of the roads in your district?

_____

Q5 **Is the current sampling procedure providing adequate representation across the four road types in your district**: Interstates, National Highway System, State Primary and Secondary, and Rural Secondary? (for those that are applicable)

- ○ Yes
- ○ No

Q6 Does the app meet the needs of your District?

- ○ Yes
- ○ No

Q7 Please explain why.

_____

Q8 For the existing MRP data that is collected, please answer whether each component is **relevant and useful or not useful.**	Useful	Not Useful
General Aesthetics	○	○
Roadway/Shoulder Vertical Obstructions	○	○
Visual Obstructions	○	○
Right of Way Fence	○	○
Guardrail Outside Specifications	○	○
Guardrail Damaged	○	○
Guardrail Attenuators/End Treatments Damaged	○	○
Rideability (collected by Pavement Management)	○	○
Pavement Potholes	○	○
Rutting	○	○
Pavement Drop Off to Shoulders	○	○

High Shoulder	○	○
Shoulder Potholes	○	○
Shoulder Drop Off	○	○
Drainage Structures	○	○
Ditches	○	○
Curbs and Gutters	○	○
Striping Reflectivity (White)	○	○
Striping Reflectivity (Yellow)	○	○
Guide Sign Faces	○	○
Guide Sign Assemblies	○	○
Regulatory and Warning Sign Assemblies	○	○

Q9 For those you answered not useful, please explain why below.

_____

Q10 What MRP reports (annual report) are useful for District decision making? What about county-specific reporting from the survey?

_____

Q11 Use this space to share any other thoughts about what ***works well*** with MRP.

_____

Q12 Use this space to share any other thoughts about what ***does not work well*** with MRP and ***how it could be improved*** (i.e. what should be looked at, what would be useful to collect data on).

_____

Q13 Name (optional)

_____

Q14 Email (optional)

_____

Q15 Phone (optional)

_____

Q16 District

- ○ 1
- ○ 2
- ○ 3
- ○ 4
- ○ 5
- ○ 6
- ○ 7
- ○ 8
- ○ 9
- ○ 10
- ○ 11
- ○ 12

Q17 What is your position?

- ○ Engineer in Training
- ○ Highway Technician
- ○ Highway Technician Superintendent
- ○ Transportation Engineer Supervisor

- ○ Transportation Engineer Technologist
- ○ PD&P Branch Manager
- ○ Seasonal Temporary Employee
- ○ Other

Q18 If you answered "Other", please list your position here:

_____

Appendix C MRP Survey Results

Q1 - Who collects the MRP data in your office? (select all that apply)

Answer	%	Count
Engineer in Training	23.81%	15
Highway Technician	9.52%	6
Highway Technician Superintendent	3.17%	2
Transportation Engineer Supervisor	22.22%	14
Transportation Engineer Technologist	20.63%	13
PD&P Branch Manager	3.17%	2
Seasonal Temporary Employee	17.46%	11
Other	0.00%	0
Total	100%	63

Q2 - If you answered other please list that position here:
No responses

Q3 - Current procedure calls for random sampling of 300-400 segments of 500 feet each in each district across four road types: Interstates, National Highway System, State Primary and Secondary, and Rural Secondary. Have you found this sampling approach to be representative of the roads in your district?

Answer	%	Count
Yes	63.64%	21
No	36.36%	12
Total	100%	33

Q4 - If you answered no, how should sampling be adjusted to be more representative of the roads in your district?

I answered no but I'm not really sure how to adjust them.
Two options. Option 1 increase the length from 500 feet to 1000 or 1500 feet. Option 2, sample more than one 500 feet section per route. Example, sample two 500 feet sections 1 mile apart.
Sometimes we will have (10+) sections for a particular route in a county. We may want to consider having at least (1) segment for every road in the county. Or the same number of sections for RS and MP routes within the county.
A range on a road to put the 500-foot section may better represent the entire road.
Majority of our counties do not have interstates/parkways nor NHS routes so more of the other types should be focused on.
For my section a majority of the samples are on the AA highway which represents on a small portion of the roads in my section.
Excessive sampling is present in the interstate and parkway segments. Those projects typically have longer lengths and one sample yields a statistical larger roadway segment. MP and RS route sample types need to be increased to capture the widely varying pavement qualities.
Not sure, but it seems like the random samples are rarely in the location of the worst pavement. Maybe keep the random samples, but have the ability to add in a number of segments that the engineer feels is more "representative" of the condition of the average.
There are many repetitive samples on the higher class routes (interstates and major routes).

Q5 - Is the current sampling procedure providing adequate representation across the four road types in your district: Interstates, National Highway System, State Primary and Secondary, and Rural Secondary? (for those that are applicable)

Answer	%	Count
Yes	76.67%	23
No	23.33%	7
Total	100%	30

Q6 - Does the app meet the needs of your District?

Answer	%	Count
Yes	100.00%	30
No	0.00%	0
Total	100%	30

Q7 - Please explain why.

500 feet is adequate. Although it may miss some problems that are out of the section it isn't possible to survey the entire road.
Very easy to use if you have adequate wifi or cell service a bit more complex if you do not it helps to be familiar with the county you are working in if not some of the sections are very hard to find with no cell service.
The answers to these questions are from a section office's maintenance viewpoint. For instance, on general aesthetics: The biggest issue we have is mowing, but we have contracted mowers so they take care of it. If we have issues that we keep getting called about then we will go take care of it, but most of the things we get called about aesthetically do not show up on the MRP routes chosen. Good diversity of routes is typically shown, but our problem spots are typically known prior to any of the MRP routes being given to us.
ROW fence is being taken down in many areas by Permit. Rutting is not a widespread problem on our roads in the district. Striping reflectivity readings are not used for budgeting needs; more need for striping than budget allows.
The roadways selected have been a wide variety of types and show what is needed.
There is usually a variety of different road types. One thing I run into is it seems to have stopped separating 4 lane divided highways into NB and SB sometimes. It meets the needs just fine, I'm glad it is an iPad app and it shows where you are, makes it easier to find the area.
These components are useful to the department in a way to let us know the condition of the roads that may not be traveled by us or a fellow employee frequently.
I don't know. Been years since I have performed a MRP.
Multiple segments for a particular route, while other routes are not sampled.
of all segments observed, they all have had ditches
The representation of sections of roadways throughout the district seems to be consistent. However, there seems to be an abundance of sections on the interstates. Most of the sections are in close proximity to each other and receive a lot of similar results. Maybe it would be possible to spread those out more and use the extra sections to rate more areas in our rural areas?
The sampling works better on Interstate and Parkway, but on the Rural Secondary it is lacking.
The app is way better than the Trimble Junos we once had. It actually helps locate sections and guides you through the questions.
There is no program for maintaining the R/W fence and its usefulness is primarily for denoting property lines. General aesthetics is very subjective to the evaluator and therefore is not a reliable quality to measure.
All of the data collected during the MRP is useful and helps make sure that the roads are in a good, safe condition.
Not sure what this question is an antecedent to.

Guardrail damage not necessary because it is usually repaired within the District. If damage is noted, then should be forwarded to District Guardrail Personnel.
In my district, particularly Jefferson County, the sampling locations this year seem to be heavy on Dixie Highway (US 31W) and Gene Snyder (KY 841). Bullitt and Oldham Counties seem to have a better spread of interstate to rural secondary road sections. The app is good. I would like to see it modified where if the user clicks No for "Is there guardrail?", the remaining guardrail questions would auto populate with either a 0 or no. I think that would save time at each location.
We commented several times that the sections preselected were the best sections on a roadway. We would pass over many very poor sections only to have to rate the best-looking section of the roadway.
The signs and guardrail rarely have damage and if so, we fix it very quickly. Not many curb and gutter in our district and again if there were blockage it would be addressed in an adequate amount of time.
The app seems adequate
Damaged Guardrail is something that should be checked regularly and has no impact on the MRP.
Drainage Structures are not needed in my opinion. You don't need to know how many are in a 500-foot section.
T e sign assemblies are not needed since these should be checked regularly.

Q8 - For the existing MRP data that is collected, please answer whether each component is relevant and useful or not useful.

Question	Useful		Not Useful		
General Aesthetics	73.08%	19	26.92%	7	26
Roadway/Shoulder Vertical Obstructions	100.00%	26	0.00%	0	26
Visual Obstructions	100.00%	26	0.00%	0	26
Right of Way Fence	38.46%	10	61.54%	16	26
Guardrail Outside Specifications	88.46%	23	11.54%	3	26
Guardrail Damaged	84.62%	22	15.38%	4	26
Guardrail Attenuators/End Treatments Damaged	76.92%	20	23.08%	6	26
Rideability (collected by Pavement Management)	96.15%	25	3.85%	1	26
Pavement Potholes	100.00%	26	0.00%	0	26
Rutting	80.77%	21	19.23%	5	26
Pavement Drop Off to Shoulders	100.00%	26	0.00%	0	26
High Shoulder	88.46%	23	11.54%	3	26
Shoulder Potholes	88.46%	23	11.54%	3	26
Shoulder Drop Off	100.00%	26	0.00%	0	26
Drainage Structures	88.46%	23	11.54%	3	26
Ditches	88.46%	23	11.54%	3	26
Curbs and Gutters	76.92%	20	23.08%	6	26
Striping Reflectivity (White)	69.23%	18	30.77%	8	26
Striping Reflectivity (Yellow)	69.23%	18	30.77%	8	26
Guide Sign Faces	69.23%	18	30.77%	8	26
Guide Sign Assemblies	69.23%	18	30.77%	8	26
Regulatory and Warning Sign Assemblies	73.08%	19	26.92%	7	26

Q9 - For those you answered not useful, please explain why below.

Most roads are contracted to stripe once a year and reflectivity is measured after the operation by the onsite inspector. regardless of how poorly it test during MRP's I have never seen a road restriped because of it and I

have been doing this for many years. It’s also quite dangerous. I feel that the rest of the questions answered can be corrected by the Maintenance barn for that county but striping cannot. I don't personally have a problem doing the striping test but feel it is not useful on my end. Thanks
We do not have the training nor equipment to take the white and yellow paint readings.
Unnecessary data to determine pavement condition.
Right of way fence. In May, locations on our (4) lanes. The fence is not viable from the road.
of all segments observed, they've all had ditches
Drainage Structure normally can't be seen from the roadway which would involve more in-depth investigation.
I don't have many of the items that were listed in my section.
Aesthetics are too subjective to measure because it is based on the perception of the evaluator. R/W fence first isn't present in most routes, and secondly is not maintained.
Guardrail not really useful because if it is damaged it is usually repaired on District Guardrail contract.
Guardrail and end treatments are usually repaired by master agreement quickly and not included on construction projects. Rutting in the wheel path would be a better representation than rutting outside the wheel path. In addition, sign of distress such as cracking would also be a good indicator.
General aesthetics is not something we can focus on with the constant budget crunch. Other items marked not useful are generally items we cannot fix with our FE budget.
Right of way fence is never maintained or repaired. There is rarely any rutting and doesn't get repaired or resurfaced due to these criteria.
the guardrail and signs are generally repaired quickly, and we don't have many to report in this area and the same with right of way fence. maybe have a drop down in the comments section to choose from with these items that we could check there is an issue but not in a required section that doesn't allow us to proceed without checking.
Right of way fencing isn’t used but on restricted /semi restricted roadways and majority of the time is off the sides of a fill or up a cut. They are typically grown over by vegetation. Thus, hard to tell condition and even if need repaired won’t be a priority to repair unless evidence of access violation is present. Reflectivity has to be measured with special meter that only a couple people in the district has ability or cert to use. So to get it slows the process. If Reflectivity is poor striping will not be corrected until long line contracts are performed anyway, so knowing it only prioritizes the route that most likely would have been done no matter the results.

Q10 - What MRP reports (annual report) are useful for District decision making?

What about county-specific reporting from the survey?

As stated above in the striping portion I feel that it is all Useful except striping testing. As the Branch II Maintenance Engineer anything I run across that needs to be corrected other than just normal day to day maintenance is reported to County Foreman, Section Supervisor or my Branch Manager.
I believe its vitally important we grade/rate all our roads so me may disperse the maintenance money accordingly
All the reports are useful. There are some that are more useful than others for example the right of way fencing is less useful than say the 3.0 inch drop off from pavement to shoulder. In the counties that I report in (Lawrence and Johnson) in district 12 some roads don't have right of way fencing but just about every road has the drop off or high shoulder. These reports do show the deficiency that are in our county's.
Who has time to read the reports.
Don't recall seeing the reports the past few years.
as far as section office, we don't use them
In the times that we get to see these reports, we use them to apply the needed resources to try to remedy these issues in the areas. There isnâ€™t really any follow up to how districts are trying to fix these issues.
Back in the day the MRP Result was presented in a appendix that when the Maintenance Engineers, before reorg, could use to focus their foreman towards improving based on average conditions. The last few years I havenâ€™t

seen a report. It's like Frankfort got what they wanted and didn't disseminate anything to the county level. That said county specific reports would be useful to help focus projects to what is needed most.
It is used to see what we are deficient with in each county so we can plan our work.
I have never seen any of the MRPs at my level. I believe District wide and county reports would be helpful to determine need in my section.
The reports break down where significant improvements should be made and what counties are spending their money on.
Level of service report
The categories of the MRP provide a general area to improve on, and a tangible measure of improvement.
It is nice to look at but don't really know what the individual that took data was looking at. At one time we have one person from each section that collected data. An employee from one county may score rutting as 3, the rutting may be the same and another inspector may show it as a 2, so it really depends on who enters the data. I think it would be best to have one person to enter the data from each District.
I don't see those reports so I'm not able to answer this question
County specific probably will not matter. The district knows where the roadways are located. Rutting in the wheel path, cracking, base failures, potholes, are all information is more useful.
Graph report showing largest areas of concern.
The reports are looked at, but we are so far behind we cannot address most of what they contain. MP resurfacing is decided by C.O.
County specific would definitely be beneficial.

Q11 - Use this space to share any other thoughts about what works well with MRP.

I feel that it helps see a lot of things in a county that may go unnoticed due to lack of time from focusing on certain jobs or complaints not only for the County Foreman but for me as well.
Does give us a snapshot of the roadway conditions. Seams to work.
getting out on the roads seeing things you may overlook otherwise.
The App for the IPAD is a big help.
It lets the state know where we stand on average different aspects of our roadways. Example if it shows ditches are impeded we can start ditching projects across a county to help improve them.
Helps to educate what problems we have,
The statistical sampling model works well to give a snap shot of conditions
It allows us to see what sections of roads may have been overlooked and need maintenance and what roads could use maintenance more often due to level of service.
Give you an ideal of how you stack up against other districts, but again the data is only as good as the inspector entering.
The app for the iPad works very well, when there is a signal.
I like having the app so much easier that the paper report and helpful for GPS usage.
The data collection works well. It is good to get out and see roadways and see some problem areas that might be overlooked.
think the MRP can be valuable data to everyone down to county superintendents if the sections are representative of the county's road sections. The reports can show areas of need for each county or District.
The map format is easy to use. The MRP provides a well structured way for general road condition data to be collected from around the district.

Q12 - Use this space to share any other thoughts about what does not work well with MRP and how it could be improved (i.e., what should be looked at, what would be useful to collect data on).

It would be helpful if some of the questions would be automatically filled. For example, if there is no Guardrail in the section and you answer no you still have to fill the rest of the questions about the Guardrail even if there is none.
I only have a one issue with the process, if you don't have any guardrail. drainage structures or signs on a sections there should be a NA choice instead of answering several questions that do not apply, for example I find confusing and time consuming answering yes or no to guardrail damage when no guardrail exist.
I would like to see a skip button for the lack of better words for the questions that do not apply to the section of road that is being rated. For example, if a section does not have guardrail be able to skip those questions and still be able to submit the rating.
pretty good as it is
One of the only thoughts that I have is dealing with the app. If we could get it to where the app would auto-fill answers that are only valid if a previous question is answered a specific way (i.e., guardrail). If there is no guardrail, then all of the other questions are also a no This would make the entry of data go more smoothly and efficiently.
Sometimes using the application at the beginning with uploading the new sections is difficult. I would assume this is something that should automatically happen.
MRP in the past was used as a means to provide funding justification for districts needing improvement in a certain area. Unfortunately, some districts knew this and skewed their field findings to get funding this way. Which made in unfair to those that did it truthfully. Now that there isn't funding associated with it there isn't an incentive for districts to put in an effort to do the field work unless they see the information itself as incentive. You get some doing it poorly or not at all now. You can see this due to the number of districts that have not or are late reporting.
Better segment selection is needed to represent the roads in my section.
The problem is that personnel believe that funding is tied to the evaluation. Therefore, they permit that to skew the results based on their understanding of how the funding formula is modified by items. Some look at the program to see where additional money is needed so they rate items to need improvement. Some believe that if they are not performing well at current funding levels, that budgetary cuts will follow and rate their roadways as performing well. I personally believe you should incentivize the change you want to achieve, but it would require an honest evaluation.
The app could be more streamlined so that each segment does not take such a long time to enter. Also, there should be some kind of control to prevent segments from being butted up against one another to provide more random samples.
The only things I could think to add would be base failures or road displacements due to developing embankment slides. However, I think this information could be captured in the comments section and may not warrant the user to check a box at each location.
Suggest setting up the app to allow it to store information until a signal is found and allow it to upload automatically at that time. There were situations where I had to find a signal and reenter the information.
it is useful measurement in looking where we need to focus. When it asked if there is guardrail and the answer is no we shouldn't have to answer the series of other questions in order to save and the same with the signs.
Need to modify how the results are generated and who has access to them. I rarely see the results from this. Either I didn't know where to look for this information or it wasn't sent to me. It would be good to send to the Branch Managers and distribute from there or have a site where it can be referenced at any time.
I think it is a good indicator of what we need to look at but really if we have shoulder drop-offs throughout the district we don't have the means or number of employees needed to correct, so really while the data may be good to look at it really don't fix the problems. Need to extensively train those that enter the data.

Q13, Q14, and Q15 are not reported to preserve anonymity.

Q16 - District

Answer	%	Count
1	5.00%	1
2	15.00%	3
3	10.00%	2
4	10.00%	2
5	10.00%	2
6	5.00%	1
7	5.00%	1
8	0.00%	0
9	10.00%	2
10	0.00%	0
11	15.00%	3
12	15.00%	3
Total	100%	20

Q17 - What is your position?

Answer	%	Count
Engineer in Training	15.00%	3
Highway Technician	0.00%	0
Highway Technician Superintendent	0.00%	0
Transportation Engineer Supervisor	45.00%	9
Transportation Engineer Technologist	20.00%	4
PD&P Branch Manager	15.00%	3
Seasonal Temporary Employee	0.00%	0
Other	5.00%	1
Total	100%	20

Q18 - If you answered "Other", please list your position here:
No responses