

Research Digest

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Item 1

Accommodating Oversize / Overweight Vehicles at Roundabouts: Final Report

KANSAS STATE UNIVERSITY TRANSPORTATION CENTER

KSU-10-1 • 2013

"...Roundabouts can offer several advantages over signalized and stop-controlled intersection alternatives, including better overall safety performance, lower delays, shorter queues, better management of speed, and opportunities for community enhancement features. However, potential use of roundabouts with all their benefits may be greatly diminished if they cannot accommodate oversize/overweight vehicles (OSOW). Accommodating OSOW at roundabouts is the central issue and the need for this research. Note that the acronym OSOW has been used in this report as a universal term, generally understood to mean a permitted vehicle. OSOWs impact pavement structure, roadway geometrics, and traffic operations. These issues are discussed in the report. OSOWs are a reality for American industry and often critical for certain industries. A better understanding and sharing of current practices is essential for states that permit such movement, and the industry which must rely on state highways and a permit to deliver large loads. Thus, the main objectives of this report are to compile current practice and research by various states and countries related to the effects OSOW have on roundabout location, design, and accommodation. Second, the research will attempt to fill in information gaps with respect to roundabout design and operations for this class of vehicles. A literature review uncovered no published reports on OSOW accommodation per se; however, much information on the advantages of having designated truck and OSOW networks is analyzed and reported. The authors make an argument that states should consider conducting a study to develop a freight network, which includes segments where OSOW need to be accommodated, in accordance with state and federal commerce laws and policies and the state's economy. The study should include determining all motor vehicles whose size and turning movements are critical to developing routes on which all segments will accommodate these vehicle. To obtain information on the state-of-the-art of OSOW accommodation, the authors turned to personal contacts, unpublished material, case studies and surveys. Examples of accommodating OSOW in general, and various turning movements, found in the literature, surveys, and personal contacts are provided in the report as examples of ideas and concepts that could be considered, and possibly adapted to the needs of a specific site. Several examples from England, France, and Germany, and other countries, were also found and are presented. Also, cutting edge research and a state's recent policy on accommodating low, ground clearance vehicles that could "hang up" are presented. Four surveys were developed, executed and analyzed: a general survey on permitted vehicles to the 50 states; a second survey to the 50 states on specific roundabout issues, a survey to regional managers of the Specialized Carriers and Rigging Association (SC&RA), and a survey developed and conducted in partnership with the American Transportation Research Institute (ATRI) and sent to their membership. The complete analysis and some actual answers are contained in the report and its appendices..."

This report is available for free download (7.6 MB):

<http://idmweb.ksdot.org/PublicLib/publicDoc.asp?ID=003826789>

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Item 2

Alternatives to the Public Funding and Operation of Colorado's Rest Areas

COLORADO DEPARTMENT OF TRANSPORTATION. DTD APPLIED RESEARCH AND INNOVATION BRANCH
2013-03 • 2013

Due to budget challenges, Colorado is looking for alternative funding sources for the operation and maintenance of its interstate safety rest areas (SRAs). Federal Code 23 U.S.C. § 111 prohibits commercial “establishments for serving motor vehicle users on any highway which has been, or is hereafter, designated as a highway . . . on the Interstate System” . . . “unless the establishment is owned by a state and existed in its location prior to January 1, 1960.” Based on this law, the majority of SRAs in the U.S. have been developed to provide motorists with access to restrooms, picnic tables, and vending machines, but no other commercial services. In FY 2012, the cost of operating and maintaining twenty-seven rest areas in Colorado was just above \$3.5 million. In addition, planned and emergency projects in 2012 cost CDOT an additional \$251,233 for a total cost of approximately \$3.75 million in 2012. Although CDOT’s cost of operating rest areas is lower than some states, the maintenance budget has not grown fast enough to finance their operation and maintenance. The closure of five SRAs in 2012 has been estimated to save the department \$300,000 annually. CDOT also closed two SRAs in 2009 for financial and other reasons.

This report is available for free download (118 KB):

<http://www.coloradodot.info/programs/research/pdfs/2013/restareas.pdf>

Item 3

Application of Bluetooth Technology to Rural Freeway Speed Data Collection

UNIVERSITY OF AKRON
2012-16 • 2012

Bluetooth data collection devices are an innovative technique for measuring travel times and speeds on roadway segments. This project developed a system capable of recording Bluetooth MAC addresses with a timestamp and determining the space mean speed of vehicles between multiple nodes. Battery powered and solar powered nodes are developed for the project. Various deployments of the nodes are utilized to determine the ideal placements and distances. The nodes are utilized in determining capacity of work zones by using travel speeds and times as surrogate measures of congestion. Nodes are also used to detect incidents based on increased Bluetooth device hit counts. Recommendations for node spacing are made for rural and urban areas.

This report is available for free download (6.1 MB):

http://www.dot.state.oh.us/Divisions/Planning/SPR/Research/reportsandplans/Reports/2012/Traffic/134567_FR.pdf

Item 4

Concrete Pavement Noise: I-90 Spokane, I-90 Easton, I-5 Federal Way, I-82 Sunnyside, and I-5 Northgate

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION. MATERIALS LABORATORY
WA-RD 814.1 • 2013

On-Board Sound Intensity (OBSI) measurements are reported for various concrete pavement textures including transverse and longitudinal tining, carpet drag, conventional diamond grinding and Next Generation Concrete Surface. The noise levels increased on most of the textures to levels in the 104 to 108 dBA range. The cause of the increased noise levels was attributed to the wear on the pavements from studded tires.

This report is available for free download (1.3 MB):

<http://www.wsdot.wa.gov/research/reports/fullreports/814.1.pdf>

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Item 5

Construction Cost Forecast Model : Model Documentation and Technical Notes

DYE MANAGEMENT GROUP

2013-06 • 2013

Construction cost indices are generally estimated with Laspeyres, Paasche, or Fisher indices that allow changes in the quantities of construction bid items, as well as changes in price to change the cost indices of those items. These cost indices, while useful in forecasting the near-term costs of construction contracts for projects that have been designed and are about to be let, are not good indicators of price inflation in highway construction. This report contains the documentation and supporting technical notes for a statistical model that estimates changes in the price components of the Colorado Construction Cost Index. The model contains two specifications. In the first, the composite construction index is a function of the producer prices of inputs: oil, concrete, steel, labor and equipment. In the second, the composite construction index is a function of the price of oil, wages and nationwide demand for construction services.

This report is available for free download (1.1 MB):

<http://www.coloradodot.info/programs/research/pdfs/2013/costs.pdf/view>

Item 6

Developing a Network-Level Structural Capacity Index for Structural Evaluation of Pavements

VIRGINIA CENTER FOR TRANSPORTATION INNOVATION AND RESEARCH (VCTIR)

2013-R-09 • 2013

The objective of this project was to develop a structural index for use in network-level pavement evaluation to facilitate the inclusion of the pavement's structural condition in pavement management applications. The primary goal of network-level pavement management is to provide the best service to the users for the available, often limited, resources. Pavement condition can be described in terms of functional and structural condition. The current widespread practice of network-level pavement evaluation is to consider only the functional pavement condition. This practice results in suggested treatments that are often under-designed or over-designed when considered in more detail at the project level. The disagreement can be reduced by considering the structural capacity of the pavements as part of a network-level decision process. This study developed a flexible pavement structural index to use for network-level pavement applications. Available pavement condition data were used to conduct a sensitivity analysis of the index, and example applications were tested.

This report is available for free download (1.4 MB):

<http://vtrc.net/reports/13-R9.pdf>

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Item 7

Development of a Freight Benefit/Cost Methodology for Project Planning

WASHINGTON STATE TRANSPORTATION CENTER (TRAC)

WA-RD 815.1 • 2013

Future reauthorizations of the federal transportation bill will require a comprehensive and quantitative analysis of the freight benefits of proposed freight system projects. To prioritize public investments in freight systems and to insure consideration of the contribution of freight to the overall system performance, states and regions need an improved method to analyze freight benefits associated with proposed highway and truck intermodal improvements that would lead to enhanced trade and sustainable economic growth, improved safety and environmental quality, and goods delivery in Washington State. This project develops a process to address this need by building on previous and ongoing research by some project team members with the goal of developing an agency-friendly, data-supported framework to prioritize public investments for freight systems in Washington and Oregon. The project integrates two ongoing WSDOT funded efforts: one to create methods to calculate the value of truck and truck-intermodal infrastructure projects and the other to collect truck probe data from commercial GPS devices to create a statewide Freight Performance Measures (FPM) program. This integration informs the development of a framework that allows public agencies to quantify freight investment benefits in specific areas such as major freight corridors and across borders.

This report is available for free download (1.3 MB):

<http://www.wsdot.wa.gov/research/reports/fullreports/815.1.pdf>

Item 8

Development of performance assessment guidelines for Virginia's work zone transportation management plans

VIRGINIA CENTER FOR TRANSPORTATION INNOVATION AND RESEARCH (VCTIR)

2013-R-06 • 2012

As America's roadways are becoming more congested and in need of maintenance and repair, management of traffic through work zones is a major issue for state departments of transportation. To assist states with this challenge, in 2004, the Federal Highway Administration (FHWA) published its "Final Rule on Work Zone Safety and Mobility," which mandated that state DOTs develop transportation management plans (TMPs) for all federally funded roadway construction projects. The Virginia Department of Transportation (VDOT) now requires TMPs for all projects, regardless of funding source. Part of federal and Virginia TMP requirements are to monitor and assess traffic impacts, including a post-construction evaluation of the TMP. Currently, TMPs are not being assessed following individual construction projects, and VDOT does not yet have a formally established process to assess TMP performance throughout its districts and regions. The purpose of this project was to develop a set of guidelines to assist VDOT's work zone personnel and contractors with evaluating TMP performance. The research methodology examines existing literature on work zone evaluation strategies. Thirty state DOTs, as well as personnel within VDOT, were surveyed to explore TMP assessment practices. Finally, two work zone case studies from within the Commonwealth of Virginia were examined. The results of this research effort were used to develop Guidelines for TMP Performance Assessment, with aid and review from a VDOT Performance Assessment Task Group. While these new requirements may add up-front costs to project engineering, VDOT will benefit by having a methodology in place to identify and measure successful strategies to manage safety and mobility impacts from work zones.

This report is available for free download (998 KB):

http://www.virginiadot.org/vtrc/main/online_reports/pdf/13-r6.pdf

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Item 9

Economic impact of closing low-volume rural bridges

KANSAS DEPARTMENT OF TRANSPORTATION

KS-2013-1 • 2013

"As the infrastructure in Kansas ages, bridges can become structurally deficient or functionally obsolete. The Kansas Department of Transportation (KDOT) defines a bridge as structurally deficient if an inspector determines the bridge deck, superstructure, substructure, culverts and retaining walls are not able to support today's federal legal loads (KDOT, 2008). A bridge that is defined as functionally obsolete consists of design characteristics, which could include narrow width, inadequate clearance beneath, condition of the structure, or deficient approaching roadway alignment (KDOT, 2008). Limited research has been performed that specifically investigates advantages and/or disadvantages of closing a bridge on a rural low volume road. The objective of this research project was to determine a cost comparison of replacing and/or repairing a rural low volume structurally deficient bridge, versus closing the same bridge and finding the change in vehicle operating cost based on the proposed driver detour." --Background

This report is available for free download (1 MB):

<http://idmweb.ksdot.org/PublicLib/publicDoc.asp?ID=003826219>

Item 10

Evaluation of the installation and initial condition of Rosphalt overlays on bridge decks

VIRGINIA CENTER FOR TRANSPORTATION INNOVATION AND RESEARCH (VCTIR)

2013-R-05 • 2013

Protection systems are placed on bridge decks to retard the intrusion of chlorides and moisture that can eventually cause corrosion deterioration. The Virginia Department of Transportation typically uses hydraulic cement concrete (HCC) overlays of latex-modified concrete (LMC); LMC with very early hardening cement (LMC-VE); and silica fume concrete (SFC) and epoxy overlays for deck protection. Occasionally, a conventional asphalt overlay and waterproof membrane system is used. Rosphalt is an asphalt that is considered to be impermeable and has been used on decks without placement of a membrane. The purpose of this research was to evaluate the construction, initial condition, and cost of the Rosphalt overlays placed on two bridges in Virginia: (1) the northbound lanes of I-85 over Route 629 and the eastbound and westbound lanes of Span 22 of the Norris Bridge on State Route 3 over the Rappahannock River. As a comparison to Rosphalt, a conventional asphalt overlay and waterproof membrane system was placed on the adjacent bridge on the southbound lanes of I-85 over Route 629. Emphasis was placed on comparing the wearing and protection systems with respect to speed and ease of construction (including lane closure time), initial condition as indicated by physical properties, protection and skid resistance, and cost. An objective was also to compare these asphalt protection systems to HCC overlays of LMC-VE, LMC, and SFC and epoxy overlays.

This report is available for free download:

<http://vtrc.viriniadot.org/PubDetails.aspx?PubNo=13-R5>

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Item 11

A Framework for Monitoring the Performance of Travel Demand Management and Vehicle Miles Traveled (VMT) Reduction Activities

WASHINGTON STATE TRANSPORTATION CENTER (TRAC)

WA-RD 806.1 • 2013

This report presents a framework to support performance monitoring for demand management related to VMT (vehicle miles traveled) reduction. The framework consists of performance monitoring measures and a system for their collection and dissemination. The report also provides the context within which the framework would exist, and describes how it will support a wide variety of other statewide and regional needs, thus providing additional incentive for its adoption. The intent of the framework is to not only meet the requirements of Washington state's Legislature to reduce VMT per capita (RCW 47.01.440), but to do so in a way that provides WSDOT and its partner agencies with information that supports planning and programming. The report also provides an excellent framework for developing and reporting congestion-related performance measures in support of MAP-21.

This report is available for free download (1.6 MB):

<http://www.wsdot.wa.gov/research/reports/fullreports/806.1.pdf>

Item 12

Implementation of Sustainability in Bridge Design, Construction and Maintenance

MICHIGAN STATE UNIVERSITY, SCHOOL OF PLANNING, DESIGN AND CONSTRUCTION

RC-1586 Final • 2012

The focus of this research is to develop a framework for more sustainable design and construction processes for new bridges, and sustainable maintenance practices for existing bridges. The framework includes a green rating system for bridges. The green rating system is divided into three sections, which are design, construction and maintenance. The three sections are further divided into various criteria. For each criterion the description, intent, and requirements have been established. The requirements were established after reviewing various industry standards. The Delphi survey was conducted at MDOT divisions to assign point values to sections and the criteria. The results of the Delphi survey and scorecard of the rating system are shown in the relevant appendix and/or sections. The certification levels for the rating system are established to categorize sustainable bridges. A bridge can be categorized as Non-Green, Certified, Green, Total Green, and Evergreen, depending on the total score obtained by the project. LCA and LCCA guidelines are also developed to support the sustainability of bridge projects. LCA guidelines include the steps to calculate GHG emissions in a bridge project. It was made an inventory of construction materials and equipment that can be used in bridge projects, and found their emission factors in literature, historical databases, or by using computer tools. Certain products emit less GHG compared to conventional products. Recycled materials such as fly ash, blast furnace slag cement, high performance concrete, and steel produce much less emissions than traditional materials. Sustainable products are listed along with their emission factors and can be used to calculate GHG emissions. LCCA guidelines include steps to calculate the life cycle cost of bridges.

This report is available for free download (3.9 MB):

http://www.michigan.gov/documents/mdot/RC-1586_413209_7.pdf

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Item 13

Mobility and Reliability Performance Measurement

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION (NCDOT)

2011-07 • 2013

This project grew out of the fact that mobility was identified early on as one of the key performance focus areas of NCDOT's strategic transformation effort. The Transformation Management Team (TMT) established a TMT Mobility Workstream Team in 2007. This team began working on a mobility implementation plan in early 2008, completed the report in May 2008, and presented final recommendations to the Strategic Management Committee (SMC) in November 2008. The team recommended that NCDOT measure mobility of highway and other modes, naming the enabling tasks as 1) defining the performance measures, 2) assessing baseline performance, and 3) setting performance targets. The research presented in this final report included tasks designed to contribute to each of these enabling tasks. Key findings and conclusions are presented regarding data accuracy, signal system data availability and quality, route travel time estimation and performance metric calculation, estimation of volume and volume-based metrics in the absence of direct volume observation, temporal specification of the mobility performance metric analysis period, and mobility metric uses beyond operational monitoring and management. Primary deliverables were a robust and validated algorithm for estimating route travel times from segment travel times, a decision framework and accompany models for estimating volume, VMT, and system delay in the absence of direct volume observation, and a preliminary framework for project lifecycle mobility value estimation.

This report is available for free download (6.1 MB):

<http://www.ncdot.org/doh/preconstruct/tpb/research/download/2011-07finalreport.pdf>

Item 14

Planning for active traffic management in Virginia: international best practices and implementation strategies

VIRGINIA CENTER FOR TRANSPORTATION INNOVATION AND RESEARCH (VCTIR)

2013-R-01 • 2012

Active Traffic Management (ATM) applications, such as variable speed limits, queue warning systems, and dynamic ramp metering, have been shown to offer mobility and safety benefits. Yet because they differ from conventional capacity investments in terms of cost, service life, and operating requirements, how to incorporate them into the planning process is not clear. To facilitate such incorporation, this study developed guidelines for considering ATM deployments. The guidelines consist of four sets. The first set identifies required infrastructure and operational conditions, such as sensor placement and queuing behavior, to apply a particular ATM technique at a given site. The second set presents sketch planning analysis methods to estimate the operational and safety benefits of applying the particular technique at the site; these may be refined with the third set concerning a more detailed (and accurate) simulation analysis. The fourth set concerns continued monitoring of an ATM deployment at a given site. Also provided is a framework for incorporating ATM concepts into the regional planning process. The framework is illustrated with a hypothetical case study of variable speed limits implemented on I-66 in Virginia.

This report is available for free download (681 KB):

http://www.virginiadot.org/vtrc/main/online_reports/pdf/13-r1.pdf

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Item 15

Plug-in Electric Vehicle Action Tool

CENTER FOR CLIMATE ENERGY AND SOLUTIONS (C2ES)

WA-RD 801.1 • 2013

To share information and best practices on PEV [Plug-in Electric Vehicle] deployment and define the role of state DOTs, the Washington State Department of Transportation initiated a Federal Highways Administration transportation pooled fund study, TPF-5(250) on strategies and best practices to support PEV and charging infrastructure commercialization. Representatives from seven other state transportation departments (Arizona, California, Georgia, North Carolina, Ohio, Oregon, and Wisconsin), Federal Highways Administration, and various other local and states entities (Siskiyou County, Oregon Governor's Office, City of Raleigh, and California Energy Commission) participated in two workshops in Berkeley, CA and Raleigh, NC in March and June 2012, respectively. The Plug-in Electric Vehicle Action Tool is the synthesis of the workshops as well as previous research conducted by the Center for Climate and Energy Solutions (C2ES). The purpose of the Action Tool is to help state DOTs determine their goals for PEV deployment and to chart out a path for reaching those goals. The Action Tool is also a resource for learning about PEVs and best practices from other state agencies. Although state DOTs are the primary audience, many of the suggested actions and resources in the tool are applicable to other public entities such as local governments and other state agencies.

This report is available for free download (991 KB):

<http://www.wsdot.wa.gov/research/reports/fullreports/801.1.pdf>

Item 16

Review and Revision of Overload Permit Classification: Final Report

MICHIGAN DEPARTMENT OF TRANSPORTATION (MI DOT)

RC-1589 Final • 2013

The Michigan Department of Transportation (MDOT) allows trucks that exceed their legal loads to cross bridges if they apply and are approved for a permit. More than 30,000 permits have been processed each year since 2002, providing a vital service to Michigan's economy. However, the permitting system must be robust enough to ensure that the safety of the motoring public is maintained by accounting for overload vehicles without unduly restricting commerce. Currently, structures are placed into Overload Class by checking all service limit states as identified by the 2005 MDOT Bridge Analysis Guide (BAG) with 2009 Interim Updates and the 2010 American Association of State Highway and Transportation Officials (AASHTO) Manual for Bridge Evaluation (MBE) with interims. Vehicles are placed into the Overload Class by comparing the maximum moments of the vehicle for span lengths between 15-ft to 160-ft to the moments produced by the 20 standard overload configurations provided by the BAG. Structures that do not pass an overload class would be marked as restricted and require a specific analysis, increasing the turn-around time for the client and the analysis cost incurred by MDOT. The current software used for the analysis of the structures is a simplified solution that was developed well over 20 years ago when more robust solutions were not feasible. With the capability of modern computing and the availability of bridge software solutions, this research project looks at solutions for updating the bridge analysis as well as the overall overload permit classification process.

This report is available for free download (4.4 MB):

http://www.michigan.gov/documents/mdot/MDOT-ORBP-RC-1589-ReviewOverloadClass-ONLINE_412641_7.pdf

Research Digest

Item 17

Skewed Highway Bridges

WAYNE STATE UNIVERSITY. CENTER FOR ADVANCED BRIDGE ENGINEERING

RC-1541 Final • 2013

Many highway bridges are skewed and their behavior and corresponding design analysis need to be furthered to fully accomplish design objectives. This project used physical-test and detailed finite element analysis to better understand the behavior of typical skewed highway bridges in Michigan and to thereby develop design guidelines and tools to better assist in routine design of these structures.

It is found herein that the AASHTO LRFD Bridge Design Specifications' distribution-factor analysis method is generally acceptable but overestimates the design moment for the typical Michigan skewed bridge spans analyzed herein and sometimes underestimates the design shear. Accordingly, a modification factor for possible shear underestimation based on detailed finite element analysis is recommended for routine design. Furthermore, the AASHTO specified temperature load effect is found to be relatively significant, compared with live load effect and should receive adequate attention in design. On the other hand the influence of warping and torsion effects in the analyzed typical Michigan skewed bridges is found to be small and negligible for the considered cases of span length, beam spacing, and skew angle. Based on these findings, the AASHTO distribution-factor analysis method is recommended to be used beyond the MDOT current policy of 30-degree skew angle limit for refined analysis, provided that the recommended modification factor C is applied and if the structure type, span length, beam spacing, and skew angle are within the ranges of the analyzed spans covered in this report.

An analytical solution for skewed thick plate modeling the concrete bridge deck is also developed in this research project, which can be furthered into an analytical solution for the bridge superstructure. When implemented in a software program, the analytical solution will serve routine design better than the distribution factor method and the finite element analysis method, without a constraint to the skew angle or a requirement for complex input such as

This report is available for free download (5.2 MB):

http://www.michigan.gov/documents/mdot/RC-1541_430318_7.pdf

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Item 18

Tolerable strains for hot mix asphalt overlays over concrete pavements: Final report

KANSAS DEPARTMENT OF TRANSPORTATION (KDOT)

KU-2008-03 • 2013

Due to change of temperature and/or moisture, freezing-thaw cycles, loss of subgrade support by erosion, and traffic loading, concrete pavements can develop different types of distresses during service life. Hot mix asphalt (HMA) overlays are commonly used to improve the serviceability of damaged concrete pavements. The most challenging issue for HMA overlays over concrete pavements is the development of reflection cracks through the overlays at the locations of joints and existing cracks on concrete pavements. Even though different techniques have been used to overcome this issue, they often do not yield satisfactory results and performance. Cracking of HMA overlays results from intolerable tensile strain and/or shear movement developed in the overlays due to the movement of concrete pavements. Limited studies have been conducted so far to determine the tolerable tensile strain and shear deformation of HMA overlays on concrete pavements. If the strain and shear deformation the HMA can endure are known, the methods that will limit or prevent that strain and deformation can be sought. This research experimentally determined the tolerable tensile strain and the relative shear movement of the HMA overlays. Direct shear tests and semi-circular bend tests of HMA specimens and HMA overlay loading tests under static and cyclic loading on gapped concrete blocks were conducted in this research. HMA materials from two Kansas Department of Transportation (KDOT) projects, namely 089 C-4318-01 (Mix 1) and 56-29 KA-1087-01 (Mix 2), were used in the laboratory study...

This report is available for free download (4.1 MB):

<http://idmweb.ksdot.org/PublicLib/publicDoc.asp?ID=003825281>

Item 19

WSDOT Pavement Preservation Guide for Local Agencies: An assessment of the outreach and implementation needs for WSDOT Local Programs to improve pavement preservation within the State

PAVIA SYSTEMS, INC.

WA-RD 800.1 • 2012

This report was intended to address two key objectives: (1) identify usage and implementation gaps found in local agency asset management practices due to decreased resources and develop guidance for local agencies on recommended practices and tools to effectively manage their roadway assets, and (2) identify knowledge gaps across WSDOT [Washington State Department of Transportation] and local agencies with respect to pavement preservation and pavement maintenance practices and provide WSDOT a recommendation on how to address training and outreach needs for increased pavement preservation and maintenance demands statewide.

This report is available for free download (1.68 MB):

<http://www.wsdot.wa.gov/research/reports/fullreports/800.1.pdf>