

Roadway Safety Data Program



WISCONSIN INFORMATION SYSTEM LOCAL ROADS

STATE AND LOCAL DATA INTEGRATION

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ACRONYMS

AADT	Annual average daily traffic
AASHTO	American Association of State Highway and Transportation Officials
CMAT	Crash-Mapping Automation Tool
DOT	Department of Transportation
FDE	Fundamental Data Elements
FHWA	Federal Highway Administration
GIS	Geographic information system
GPS	Global positioning system
GTA	General Transportation Aid
HPMS	Highway Performance Monitoring System
HSIP	Highway Safety Improvement Program
HSIS	Highway Safety Information System
HSM	Highway Safety Manual
LIDAR	Light detection and ranging
MAP-21	Moving Ahead for Progress in the 21st Century
MIRE	Model Inventory of Roadway Elements
MIS	Management Information System
MPO	Metropolitan Planning Organization
NCHRP	National Cooperative Highway Research Program
NHS	National Highway System
OIT	Office of Information Technology
PASER	Pavement Surface Evaluation and Rating
RPC	Regional Planning Commission
RSDP	Roadway Safety Data Program
STN	State Trunk Network
TMS	Traffic Monitoring System
WisDOT	Wisconsin Department of Transportation
WISLR	Wisconsin Information System for Local Roads
XML	Extensible Markup Language

EXECUTIVE SUMMARY

Quality data are the foundation for making important decisions regarding the design, operation, and safety of roadways. While crash data have been a consistent element of highway safety analysis, in recent years there has been an increased focus on the combination of crash, roadway and traffic data to make more precise and prioritized safety decisions. The application of advanced highway safety analysis processes and tools requires a comprehensive inventory of roadway safety data combined with crash data to better identify and understand problems, prioritize locations for treatment, apply appropriate countermeasures, and evaluate the effectiveness of the those countermeasures. Comprehensive roadway safety data include information on roadway and roadside features, traffic operations, traffic volumes, and crashes.

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INTRODUCTION

This case study presents the Wisconsin Information System for Local Roads (WISLR) project for safety and asset management. WISLR is an example of integrating State and local road data in a spatial framework that differs from the one already in place for State-maintained roads. The integration of spatial information uses an “on/at/towards” location referencing system for local road and crash information along with a translation from the linear reference system (LRS) that applies to State-maintained routes (route and milepoint). The result is an all-public-roads database using a single LRS and basemap. Local agencies collect and own the data, but the centralized system is available to all authorized users. The case study also examines how Wisconsin plans to use WISLR to meet Federal requirements and how the system has improved Wisconsin Department of Transportation’s (WisDOT) ability to locate crashes accurately.

BACKGROUND

Wisconsin has certified 102,000 centerline miles of roadway open to the public. The State manages 10,000 of those miles—more than 1,900 local entities (72 counties, 1,851 cities/towns/villages, plus other organizations including MPOs, RPCs, etc.) manage the remaining roads. For more than 40 years, Wisconsin State Law (SS86: 302) requires local agencies to report public roadway mileage to WisDOT for the purposes of allocating State General Transportation Aid (GTA) funds—currently about \$440 million annually. Before WISLR, WisDOT maintained more than 1,900 separate maps representing the jurisdictions of local units of government (counties, cities, villages, towns). These maps covered more than 90,000 centerline miles of public roads in the State—roughly 90 percent of the total miles. WisDOT entered the roadway attribute information into a mainframe database accessible only to select WisDOT staff. Local agencies received paper copies of local road certification data, e.g., maps and certification mileage listing by route names. WisDOT was also required to inventory every county on a 10-year cycle.

WisDOT partnered with local governments to determine the frequency with which they inventoried local roadways. The results identified a duplication of data being inventoried between WisDOT and local governments. Additionally, local agencies inventoried roads within their jurisdiction more frequently than WisDOT. This finding was one of the reasons the Department asked the Legislature to move inventorying responsibility to local governments.

In the 1990s, the WisDOT Secretary established the Local Roads and Streets Council (LRSC) charged with providing advice on issues related to local roads and streets. The Council

recommended updates to the existing local road inventory system to address shared data responsibilities and roadway attribute data tied to location. The LRSC recommendations aimed to promote data sharing, improve access, and reduce duplication of effort. The new system was the WISLR.

The first, original objective of the WISLR project was to give local roadway government officials the tools and responsibility to update their own inventory of public roadway mileage. This fulfills WisDOT's responsibility for local roadway certification and GTA funding allocation with a more efficient process relying on local agencies to supply the basic physical roadway attribute data. The Stage I implementation of WISLR provided that functionality.

Beginning in 2003, the objectives for WISLR have expanded to include pavement management and, most recently, safety management. The tools and data sources in WISLR now support these additional functions.

SYSTEM DESCRIPTION AND USE

As of the date of this case study, WISLR supports the following functions and uses:

Mileage certification and allocation of General Transportation Aid (GTA) funds:

This is the core functionality of WISLR and the only portion required to meet a State legislative mandate. WisDOT uses a formula set in law to determine the amount of GTA funding each local agency will receive. The State Legislature has changed the formula over time as emphasis moves along a continuum from cost-based to mileage-based funding criteria. WISLR provides the sole basis for determining centerline miles under the jurisdiction of each agency. Local agencies with access to the WISLR website can view physical and administrative local road attribute data statewide in tabular form or represented in a GIS layer across all jurisdictions. These agencies can update physical roadway attribute information for roads in their jurisdiction. To obtain update authority, local officials must complete a computer-based training about the on/at/towards linear referencing method used by WISLR. Administrative roadway attributes and mileage data can be updated by WisDOT staff only. Mileage changes are updated by WisDOT based on legal documentation provided by locals. Mileage data is used in the GTA` formula to determine a local agency's aid payment.

Pavement analysis:

The pavement analysis (PA) module of WISLR supports local agencies using the Pavement Surface Evaluation and Rating (PASER) windshield survey methodology developed at the

University of Wisconsin-Madison Transportation Information Center (TIC). This subsystem includes a pavement rating entry screen and a pavement needs analysis budgeting tool programmed to optimize overall pavement condition in a jurisdiction. Users can alter the optimization method and model as well as the costs and expected effectiveness of each treatment, the calculations in the budgeting tool require ratings in the PASER methodology (a ten-point scale applies to asphalt roads; a four-point scale applies to gravel and dirt roads). Users may use the rating data entry function with any other numeric point-based rating scheme.

The pavement module's budgeting calculations require calibration to make the tool applicable to other rating schemes other than PASER. In Wisconsin, most of the local agencies are using PASER and the number of users of the PA module continues to grow each year—currently there are more than 2,400 active users. The tool defaults to a model that ensures the best average roadway condition at the least cost. The goal is to maintain all pavement at a level that can be treated and maintained with lower cost solutions and put off major reconstruction for as long as possible. This does result in some roadways that are already in poor condition not being fixed at their earliest possible date, but rather when the local agency can afford the major expense of reconstruction. This strategy differs from a “worst first” approach that would spend most of the maintenance and reconstruction budget on the roads that are in the poorest condition—letting those in moderately good condition deteriorate before receiving any treatment. The PA budget module also supports “what if” analysis by allowing users to change the number of dollars spent each year and the assumptions about which treatments match which levels of severity. Users can also manually change the treatment applied to individual locations. The budgeting module provides predicted pavement condition ratings for the next five years based on the user-selected parameters and the starting pavement conditions entered by users. The analysis also produces confidence level ratings—based in part on the age of the pavement ratings supplied to the module and the percentage of the system with pavement ratings.

Safety:

The University of Wisconsin-Madison, Traffic Operations and Safety (TOPS) lab supports safety analysis in the WisTransPortal with GIS mapping capabilities and shared use of geolocated roadway inventory traffic volume, and crash data. Two efforts bring crash data into the system: (1) WisDOT's manual efforts to code locations for all crashes on the State Trunk Network (STN), and (2) the Crash-Mapping Automation Tool (CMAT), which locates crashes on local roads. The South Dakota State University (SDSU) developed CMAT under contract to WisDOT. The CMAT project developed a link-network “cross-walk” capability that enabled the transfer of mapped highway crashes from the State Trunk Network to WISLR. The GIS “cross-walk” mechanism that was developed for highway crash locations was designed and

serves as a generalized tool to move business data between the State Trunk and WISLR linear referencing systems. WISLR serves as the GIS platform for CMAT. The CMAT algorithms convert local roadway crash location information (on street, nearest cross street, distance, and offset) to identify the WISLR location based on the on/at/towards LRS in WISLR. Street names from the crash report data parse automatically into four components (directional prefix, road name, road type, and directional suffix). Figure 1 shows an example of how the name parsing works in WISLR.

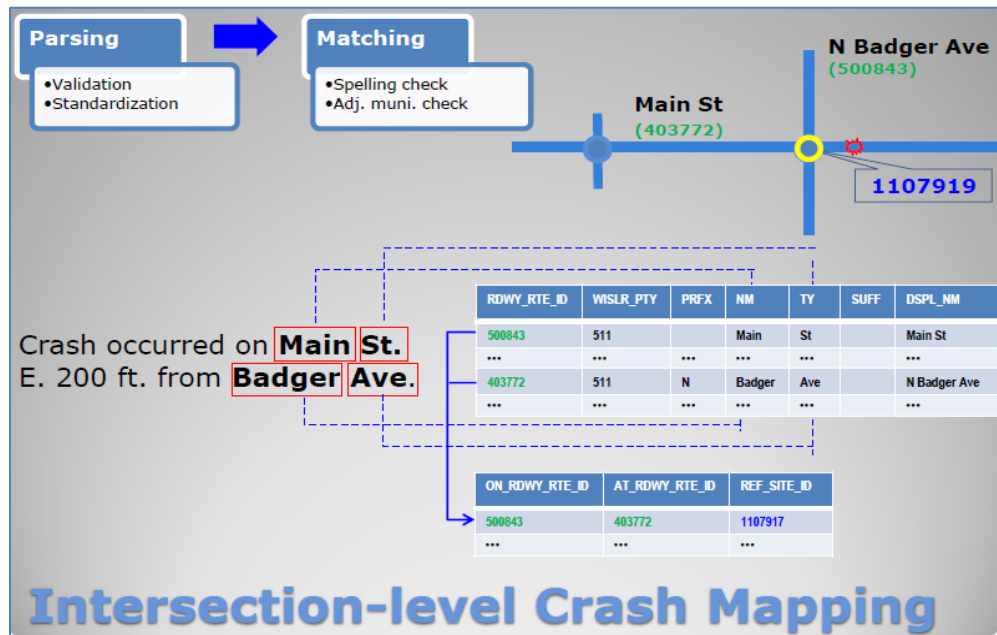


Figure 1: Street Name Parsing in the WISLR Crash Mapping Automation Tool

The system handles alias street names with a look-up table. For local roads, this results in a high degree of location coding success (90 percent successful pinning to a location), with somewhat lower successful matching for STN locations. Accuracy of the mapped locations is also high—a random sample and manual review found that 85 percent of mappable local crashes were mapped correctly, 12 percent were not mapped at all, and the remaining crashes were mapped incorrectly (3 percent). WISLR displays traffic count data for State, county, and collector roadway sites collected by the DOT. This information is made available in tabular form and GIS. The traffic count AADT layer is refreshed annually.

The WISLR GIS layer is selected by the CMAT project to display State and Non-State crashes on a single network. With the majority of crashes occurring on local roads, providing a map with both State and Non-State crashes enables more comprehensive safety analysis.

DATA INTEGRATION

WisDOT has identified WISLR as their answer to the FHWA requirement to develop an all-public-roads linear reference system and base map. The intent is that WISLR will be the database used to support statewide network screening analysis. Because there are two LRSs maintained in Wisconsin (one for the STN and one that was intended for local roads but includes the STN), WisDOT needed a method of crosswalking between the more robust STN database and the minimal inventory and linear representation of the STN in WISLR. Having accomplished this for the CMAT crash mapping project, WisDOT is now able to consider use of the crosswalk for other purposes, including carrying over roadway inventory details on the STN into WISLR. It is clear, however, that WisDOT will continue to conduct analyses (including safety analyses) using its own internal systems. WISLR will support statewide network screening analyses, but WisDOT has additional data and analytic resources that will be used for the STN.

Data integration relies on a mix of contractor support including university-based researchers from the UW TOPS Lab, University of Alabama, and SDSU, and WisDOT data entry and management plus local data input.

There are local entities that are not using WISLR for their local data management. These include some large municipal agencies that have their own systems. WisDOT and its university-based research partners are looking at ways to integrate extracts from these other data systems. This is the source of some of the WisDOT manual data entry in the WISLR management operation and is limited to the focus on certified centerline mileage.

DATA MANAGEMENT PRACTICES

The Transportation Research Board's NCHRP Report 666: Target-Setting Methods and Data Management to Support Performance-Based Resource Allocation by Transportation Agencies defined the concepts of data management, data governance, and data stewardship. Briefly, Data Management is the set of practices related to collecting, storing, and preparing data for use (e.g., in safety decisionmaking). Data Governance is the set of standards and practices applied to any data resource to control the quality of the data. Data Stewardship refers to ownership responsibility and control over data including authority for its collection, storage, integration, and use. Regarding data management, the design philosophy behind WISLR is that the local agencies own their own data—they collect it, manage it, and use it. WISDOT sets the quality standards and enters administrative roadway inventory updates for the majority of local agencies. WISDOT also uploads crash data into WISLR based on records in the statewide

database. All other WISLR data are collected, entered, and managed by the local agencies or their designated partners (e.g., the MPO).

RESOURCES

WISLR development is in its third stage. In the first stage (late 1990s - 2002) WisDOT allocated funding for WISLR (source of original funding is not known). Stage 1 deployment included the critical functions required in order for WisDOT and the local agencies to comply with mileage reporting requirements under State law. WisDOT does not have a figure for the original funding amount. The WISLR's go-live date was 2002.

Stage 2 (completed in 2005) resulted in the development of the Pavement Management Analysis system—a tool that incorporates pavement condition ratings and budget analysis used by local agencies to plan maintenance and reconstruction operations. WisDOT used State Planning Research (SPR) funds to pay for the efforts in Stage 2.

Stage 3 (started in 2004 and ongoing) is the enhancement of WISLR to add a safety analysis capability and is intended to meet FHWA requirements for an all-public-roads basemap and linear referencing system. WisDOT continues to use SPR funds to pay for ongoing enhancements.

The data management and analysis efforts supported by WISLR are staffed as follows:

- One statewide Local Road Coordinator with primary responsibility for the statewide roadway data attributes and network.
- Three GeoEditors responsible for location control changes and data quality of the statewide local road network.
- Equivalent of two to three Field Data Collector positions responsible to collect and verify mileage and roadway attributes for new roads; also perform a one percent “smart and random” validation.
- Three Limited Term Employees (part-time seasonal workers).
- University-based contractor support for system enhancements.

In addition, the efforts are supported by local staffing (local/county/MPO/RPC) that collect, report, and enter data.

KEY OUTCOMES AND LESSONS LEARNED

WISLR delivers the following key outcomes and products for local agencies and WisDOT:

- Consistent statewide local roadway data.
- Cost savings through reduced redundancy.
- Expanded local use of WISLR as WisDOT added new modules and capabilities.
- Improved efficiency of safety analysis including all public roads.

The lessons learned from the WISLR effort are that the success of the program is due to (A) the local agencies having a sense of ownership over the data and the system, and (B) WisDOT's continued investment in the expansion of the system. The philosophy behind WISLR's development has always been to ensure that the local agencies controlled the contents and features of the system. The original purpose of WISLR was to serve as an aid to mandatory recertification of centerline mileage by the local agencies. While State law requires the recertification of centerline mileage, agencies can use any method or software product to accomplish the recertification. Today, compliance is above 90 percent. The vast majority of local agencies use WISLR for data mining and decision-making. The online WISLR user numbers continue to increase each year.

WISLR saves the local agencies money in that they avoid the cost of developing and maintaining software and mapping systems to manage roadways in their jurisdiction. These savings are likely to be more important for the smaller, less well funded local agencies; however, it is clear that WISLR has reduced duplication of efforts by local agencies as well as having a standardized and simplified job of recertification by WisDOT.

WISLR also succeeds because of the continuous expansion of the system's capabilities. The Pavement Management module—consisting of both a pavement rating system and a condition projection and budgeting tool—implements the widely used PASER windshield pavement condition rating method. Most of the local agencies use these ratings and WISLR gives them a convenient way to store and access the data. The budgeting tool helps local agencies by providing a way to optimize their pavement improvement spending to achieve the highest 5-year projected pavement conditions. The addition of the safety module in WISLR helps local agencies incorporate safety into their roadway decision-making process.

SUMMARY

This case study indicates that developing a statewide local road system is a long-term effort. It began with a targeted area, which was to facilitate local agencies' annual reporting of centerline miles of roadway to WisDOT for the purpose of funding allocation. The legal requirement, funding implications, and that the software is freely available, all combined to encourage local agencies to adopt WISLR. As the local user base grew and new needs were identified, WISDOT added analytic tools to better support the work of local agencies. By showing the commitment of the State to local agencies and the capability of the system, more and more local agencies are using WISLR.

SOURCES

To complete this case study, the project team conducted on site interviews and follow-up conversations via email and telephone with WisDOT; university-based contractors from South Dakota State University (SDSU), University of Alabama, and University of Wisconsin (UW); and local representatives from the City of Franklin, the Wisconsin Towns Association, and the East Central Regional Planning Commission.

The project team consulted the following resources, individuals, and agencies in developing this Case Study:

- Wisconsin's submissions to the FHWA Office of Safety project, State Safety Data Capabilities Assessment—used with permission from the State and FHWA.
- NCHRP Synthesis 458: Roadway Safety Data Interoperability between Local and State Agencies, http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_syn_458.pdf.
- NCHRP Report 666: Target-Setting Methods and Data Management to Support Performance-Based Resource Allocation by Transportation Agencies (Section I: Chapter 4, page I-58), http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_666.pdf.
- Federal, State and local personnel and university-based contractors interviewed: WisDOT: Susie Forde, Kelly Schieldt, Joseph Nestler, Mary Forlenza, Rebecca Szymkowski, Scott Janowiak
- City of Franklin: Ron Romies, Paul Rotzenberg, Wisconsin Towns Association: Richard Stadelman
- East Central RPC: Nick Musson
- South Dakota State University: Xiao Qin

- University of Alabama: Andrew Graettinger
- University of Wisconsin, Traffic Operations and Safety (TOPS) Lab: Steven Parker
- FHWA Division Office: David Jolicoeur
- 2013 Traffic Records Forum Presentation: The Evolution of Wisconsin Local Roads System to Support Safety Data Driven Decision-Making. Susie Forde. Available at: <http://www.atsip.org/forum2013/program/sessions/sl5.html>.
- 2013 Presentation to WisDOT Executives: Wisconsin Statewide Crash Mapping and Analysis. Susie Forde, Xiao Qin, Andrew Graettinger, Steven Parker.

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