Developing a Handbook for Trail Crossing Safety Treatments

What Was the Need?
In Minnesota and throughout the nation, the intersections of paved trails with regular roadways can be dangerous for bicyclists, pedestrians and snowmobilers. These at-grade trail crossings—intersections where the trail does not pass over or under a road—account for more than 50 percent of all bicycle crashes annually and for a significant portion of bicycle and pedestrian fatalities.

To help minimize such accidents, Minnesota traffic engineers use a variety of treatments, such as traffic signs and pavement markings, when designing these crossings. While numerous resources, including the MnDOT Bike-way Facility Design Manual and the Minnesota Manual on Uniform Traffic Control Devices, offer guidance on intersection design, there isn’t a single, up-to-date and comprehensive resource with guidance about safety treatments at roadway-trail crossings. Research was needed to develop a guidance handbook for trail crossing safety treatments in Minnesota.

What Was Our Goal?
The goal of this project was to develop a handbook that synthesizes best practices for trail crossing safety treatments in Minnesota and nationwide to provide traffic engineers and other transportation professionals with a unified source of guidance.

What Did We Do?
Researchers began by holding a workshop with a technical advisory panel and stakeholder group about trail crossing problems in Minnesota. Then they conducted an online survey to gather information from jurisdictions about:

- Problem crossings across Minnesota, including crash data.
- Crossings with recent improvements and before-and-after data for safety impacts.
- Minnesota Department of Public Safety and Minnesota Department of Health accident, crash and injury reports, to be incorporated into evaluations of crossing sites.

Researchers categorized problem trail crossings by type and identified any patterns or consistent problems. Then they conducted a literature review to identify gaps and inconsistencies in Minnesota guidance and laws, and guidance from other regions that might fill in these gaps. Using the results of this comprehensive literature review, researchers developed a decision tree to provide guidance about safety treatment selection for trail crossings based on a crossing’s specific set of conditions.

Analyzing these results, researchers used the decision tree to identify recommended solutions for problem intersections. Then they developed a training presentation and handbook detailing these solutions, including design guidance, diagrams and photos, real-world examples and a matrix of recommended treatments based on road type and condition.
What Did We Learn?

The handbook provides a toolbox of treatments available in the United States for both trails and roadways, including traffic signs and signals, sight distance, refuge areas such as raised islands, pavement markings, traffic calming elements to reduce motorist speed, lighting and curb ramps.

The handbook also contains a discussion of the needs of trail user groups, such as bicyclists, pedestrians, children, the elderly, pedestrians with disabilities, skaters and snowmobilers, based on physical and operating characteristics. Human factors research shows that it is important to consider trail user expectations; ensure design consistency; and design for a range of users with respect to age, ability and mode of travel. For example, key principles for accommodating older users include applying redundancy, enhancing sight distance, preventing visual clutter and increasing the size of pavement markings and signage.

As part of the handbook, researchers developed a unique, decision-tree-based treatment selection methodology, allowing users to rapidly search for and select appropriate alternatives based on different conditions at a particular trail crossing. These conditions include whether a crossing is urban or rural, the number of lanes and speed limit of the crossed roadway, whether the crossed roadway is divided or undivided, and whether the crossing is a midblock or parallel path crossing. Each end node of the decision tree leads to a specific toolbox in table form containing all roadway and trail treatments appropriate to the conditions of the trail crossing. Final treatments for the site can be chosen from the table based on site-specific requirements and engineering judgment.

The training presentation developed by researchers for using the handbook and decision tree was delivered at a workshop attended by MnDOT staff, county traffic engineers and planners.

What’s Next?

MnDOT will continue to encourage MnDOT staff and county traffic engineers to use the handbook and training presentation. Incorporating lessons learned from trail crossing practices nationwide, the handbook developed in this project will help users choose the safest treatment for a crossing given its operational and physical characteristics. By providing a single source of guidance, the handbook will also help improve consistency of treatments statewide so that both trail users and motorists know what to expect when approaching crossings.
