RESEARCH & DEVELOPMENT

Coordinating Road Safety Reviews with Bicycle and Pedestrian Project Prioritization:

Final Report on Development and Implementation of a Guide for North Carolina Agencies

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Coordinating Road Safety Reviews with Bicycle and Pedestrian Project Prioritization

Final Report on Development and Implementation of a Guide for North Carolina Agencies

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16. Abstract

Concerted, well-coordinated, and performance-driven efforts are needed by state and local agencies to achieve North Carolina's strategic safety goals since pedestrians and bicyclists continue to experience a high injury and fatality rate in traffic crashes.

This report summarizes the development of the *North Carolina Pedestrian and Bicycle Road Safety Assessment Guide*, for use by North Carolina agencies to improve the safety project development process. The Guide aims to foster an inter-agency collaborative and data driven approach to identify pedestrian and bicycle safety problems, diagnose problems through road safety assessments (RSAs), identify potential countermeasures, and document the results in RSA reports. The RSA report can be used as a detailed plan for longer-range safety project development and to identify more immediate safety improvements such as signal timing changes, re-channelization, or enhanced enforcement. There are challenges for local and regional agencies and NCDOT to implement this approach primarily resulting from limited resources and staffing levels across all of these agencies, but through incorporation of these activities into regular work processes, it may be feasible to streamline and sustain such activities to enhance safety in NC communities.

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EXECUTIVE SUMMARY

North Carolina continues to experience a high number of pedestrian and bicyclist fatalities and injuries, with 196 pedestrians and 23 bicyclists killed in 2015 alone. Many more received serious or disabling-type injuries. Communities across North Carolina are increasingly interested in creating safer networks for pedestrians and bicyclists and effectively address safety issues. Addressing critical safety needs can reduce the toll on families and communities from fatal and serious crashes. At the same time, improvements can reduce safety barriers to walking and biking, and improve the livability and economic and social vitality of towns and cities.

A data-driven and robust safety assessment process is essential for identifying and prioritizing safety needs and projects to most cost-effectively apply scarce resources. The main goal of this project was to develop a sound, data-driven, collaborative, but adaptable pedestrian or bicycle road safety assessment process to improve safety project development and prioritization. Local and regional agencies are encouraged to use the guidance and process in collaboration with NCDOT and other partners to better identify safety needs, match potential countermeasures to needs, and develop improved safety project plans and project proposals. This report provides an overview of the tasks and processes used to develop the guide, which serves as the main project deliverable.

The process aims to enhance safety practices by the following means:

- To facilitate local agencies to use data to identify and prioritize pedestrian and bicycle safety problem locations;
- To help agencies investigate those problems through road safety assessments;
- To help agencies document safety issues and potential solutions that may be used to develop and prioritize safety improvement projects.

This project was accomplished through the following tasks:

- Performed a literature and resource review to identify and incorporate best practices in safety analysis and road safety audits/assessments. This step also involved identifying North Carolina data sources and Guidebooks that should be incorporated.
- Developed an initial process Guidebook. This draft was reviewed by the research panel.
- Worked with NCDOT and crash data analysis to identify a list of candidate pilot cities.
- Interviewed staff from eight candidate cities to learn more about their current practices, and using criteria of geographic distribution, size, and need for assistance, as well as interest of the local agencies, we identified three smaller to moderate sized towns to work with.
- Documented lessons learned from the pilot tests.

- Interviewed MPO, RPO and NCDOT Safety Office staffs to gain additional insights into how to feasibly incorporate the RSA process into regular practices.
- Presented the process at a statewide conference (NC Bike/Walk Summit) attended by all the relevant types of stakeholders / target audience for the Guidebook.
- Revised the Guidebook to incorporate the lessons learned, tips, and insights from the pilot tests and interviews.

We summarize key findings from the pilot testing (task 4) and other tasks in this report. This report also provides suggestions for implementation of the Guide.

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INTRODUCTION

Bicyclists and pedestrians who are involved in collisions with motor vehicles are more likely to be killed or injured than motorists or vehicle passengers. North Carolina continues to experience a high number and proportion of pedestrian and bicyclist fatalities and injuries, with 196 pedestrians and 23 bicyclists killed in 2015 alone. Many more received serious or disabling-type injuries. Communities across North Carolina are increasingly interested in creating safer networks for pedestrians and bicyclists and effectively addressing safety issues so that all people have the opportunity to get home safely no matter what mode of travel they use. Addressing critical safety needs can reduce the toll on families and communities from fatal and serious injuries. At the same time, improvements can reduce safety barriers to walking and biking, and improve the livability and economic and social vitality of towns and cities.

Besides the direct costs of injuries and fatalities, safety concerns are often a barrier to walking, biking, and accessing transit. This serious impediment may prevent the State's residents, including those with disabilities or who lack car access, from traveling to work, school, and other destinations by these modes. Safety barriers may also prevent the State's residents from getting the health and life-style benefits available from active modes of transportation, resulting in even greater health care, social, and other costs to residents. Communities of all sizes and State policy-makers, through the North Carolina Complete Streets policy, and other efforts, are recognizing the role of pedestrian and bicycle infrastructure for economic benefits and to improve equality of opportunity.

Need for the Project

The State's draft Strategic Highway Safety Plan (NC-SHSP) goals are to reduce pedestrian and bicyclist fatalities and serious injuries by more than half by 2030 (2014, draft plan). Concerted, well-coordinated, and performance-driven efforts are needed by both State and local agencies to achieve these goals. Although too numerous, crashes that result in severe injuries and fatalities to pedestrians and bicyclists are often widely dispersed. How do communities identify and prioritize the most important safety problems and develop safety projects to address those needs?

In addition to the lack of detail needed to describe project safety needs in depth, local transportation plans may not reflect the needs of all stakeholders. These plans may not represent safety needs for those for whom participation in transportation planning processes may be limited, nor those who are currently not walking or biking much due to safety barriers, but would like the opportunity to. Therefore, areas with significant safety problems and access needs may be overlooked. There is significant potential to improve the identification and prioritization of safety concerns using a systematic data analysis and diagnosis approach.

While crash analysis is an important component of understanding the problem, it is only a first step to prioritize safety needs and potential projects. On-site review and additional diagnosis is essential to understand the safety issues present (*Highway Safety Manual*, 2010, recommended practice), and what solutions are most appropriate and feasible to meet the needs of all users in the context of the street type and land use (*NC Complete Streets Design Guide*, 2012). Pedestrians and bicyclists also have very specific characteristics and needs that may require specialized knowledge and multiple perspectives among road safety practitioners. Investigation of the interactions of pedestrians and bicyclists with motor vehicles within the built environment is an important aspect of developing a complete street. By using multi-disciplinary road safety teams and local knowledge to assess locations through road safety assessments or audits (RSAs), there is a better chance of recognizing how the road environment and operating conditions affect pedestrians and bicyclists as well as motorists so that the right types of countermeasures can be identified. With this improved knowledge, there is a greater likelihood of identifying the most effective and appropriate treatments that fit the land uses and purposes of the street or highway. Data analysis in combination with RSAs should result in better understanding of conditions affecting the safety and interactions of road users, and therefore enhance the development of projects that meet all users' needs as well as possible. Such a process can also improve efficiency from project development to implementation, hopefully reducing the need for additional future re-designs or retrofit treatments.

Project Objectives

The goal of this project is to improve pedestrian and bicycle safety in all sizes of communities across the State. To accomplish this goal, the objective of this project was to develop a sound, data-driven, but adaptable, safety assessment process that can be used by local and regional agencies to prioritize pedestrian and bicycle safety improvements in collaboration with NCDOT and other partners.

This report summarizes the research and activities completed to develop the RSA process and guidebook. The data and resources, process, tips for success, and examples of steps in the process were turned into a Guidebook, the *North Carolina Pedestrian and Bicycle Road Safety Assessment Guide* which serves as the main deliverable for this project. The process aims to enhance safety practices by the following means:

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- Documented lessons learned from the pilot tests.
- Interviewed MPO, RPO and NCDOT Safety Office staffs to gain additional insights into how to feasibly incorporate the RSA process into regular practices.
- Presented the process at a statewide conference (NC Bike/Walk Summit) attended by all the relevant types of stakeholders / target audience for the Guidebook.
- Revised the Guidebook to incorporate the lessons learned, tips, and insights from the pilot tests and interviews.

LITERATURE REVIEW

As the literature used is well-documented in the guidebook, we will not repeat that information in this report. We identified relevant guidance resources to use to develop the draft guide, as well as North Carolina-specific data and resources. The guidebook references existing FHWA guides for performing pedestrian and bicycle road safety audits, additional resources, risk and safety data analysis guides, and examples–from within the State as much as possible–along with countermeasures resources. In addition, we identified primary and secondary data sources for North Carolina agencies to use.

SUMMARY OF RESEARCH PROCESS WITH KEY FINDINGS

Task 1 – Convene Kickoff Meeting, Finalize Work Plan, and Administer Project

During the kick-off meeting with NCDOT, the research panel encouraged the team to develop the initial Guide, to pilot test the Guide, and emphasized that local pilot jurisdictions should try to implement the process themselves, with only guidance and limited technical assistance from the research team. The initial process was also conceived as very robust and thorough, and aimed to provide a well-documented plan for improvements, with RSA reports ideally certified by a qualified engineer.

Task 2 – Develop Problem Screening and Ranking Processes

This task was combined with task 3.

Task 3 – Develop a State-approved RSA Process and Resources or Toolkit

We ultimately combined Tasks 2 and 3 since they were intertwined. We developed and submitted a draft Guide that covered data analysis and screening, diagnosis, and the RSA process. We determined that advanced screening methods were not likely to be used at the present time, and focused instead on facilitating GIS-based spatial analyses, and using exposure and risk principles (or exposure data as available) to help prioritize corridors or other location types for RSAs.

The draft Guide followed recommendations of the Research Panel at the kick off meeting, and best practice Guides from FHWA on performing RSAs. The draft Guide was reviewed and discussed at an interim meeting. Carrie Simpson provided a summary of the NCDOT safety office process from a recent RSA, which is more in-depth than the qualitative FHWA process, for comparison. The results were very similar to our draft process. Other comments touched on the need for user-friendly design and formatting; and perhaps a need for a short summary or Executive version of the process Guide. The draft Guide covers up to development of the RSA report as this tends to be the scope of other RSA guides.

We developed a "Quick Start" Summary of the Guide, and made some revisions to the initial draft Guide before it was tested; but saved the bulk of revising the Guide until after the pilot testing.

After review of the revised Guide near the end of the project, the importance of the further steps of project development, implementation and evaluation were raised. We added some information about the importance of following through with these activities, but were limited at this stage of the project. In addition, none of the pilot communities had gone through all of these steps, so there is an opportunity for a follow-up project to document the project development processes, successes and lessons. This could be a valuable addition to future North Carolina guidance.

We revised the final guidebook following the pilot testing, and panel review, and the final draft guidebook was professionally designed.

Task 4 – Pilot Test the RSA Process

Identification of Pilot Communities and Interviews

We analyzed data to identify cities with high frequencies and/or higher than average pedestrian or bicycle crash rates per population. We also coordinated with NCDOT's Director of the Division of Bicycle and Pedestrian Transportation to identify an initial list of eight candidate cities. We conducted structured interviews with all eight cities.

The project team conducted these interviews to develop a better understanding of the current state of the practice with respect to network screening, prioritization, and road safety audits for developing pedestrian and bicycle safety projects. Interviews focused on the questions below:

1) Have you submitted pedestrian or bicycle safety projects to NCDOT for funding, and were those projects successful in receiving funds?
2) How do you typically identify locations for pedestrian or bicycle safety projects?
3) How often do you use road safety audits or field reviews to better understand safety problems for pedestrians and bicyclists?

We also asked the cities if they would be interested in participating in the forthcoming process to pilot test the network screening, prioritization, and RSA guide. All expressed interest in the process; however some expressed concerns about, primarily, staff time commitment.

Key findings from Interviews

We learned through these interviews that most of the larger cities analyze crashes and do some type of network screening and field review on a regular basis. Winston-Salem performs formal RSAs, as one category of investigation. Fayetteville had experienced RSAs in partnership with NCDOT. The larger cities often had several levels of field investigation of high crash locations, and Charlotte, for example, runs two types of screenings for pedestrian and bicycle safety problems:

1) Regularly identifies areas with concentration of crashes based on three years of data and runs screenings each two years searching for 'chronic' problems, crash patterns, including alcohol-related.
2) Reviews requests for crosswalks or crossing improvements at uncontrolled locations. For this screening, which is more risk-based, the City uses several criteria or combinations of criteria to help determine if risk warrants more in-depth review. These include the area type and density of the land uses, if the location is within a ped overlay area, or whether the location is near a transit station. If the location does not meet any of those criteria, then it must meet criteria based on traffic volumes and speeds, and be more than 600 feet from a controlled crossing opportunity. A minimum pedestrian crossing volume threshold may also qualify a location for review, as well as if the location is near a greenway.

We included some of these examples as short case examples within the Guide. The analysis processes and screening being conducted varied in complexity. Despite the somewhat more sophisticated approaches for screening being used by some of the larger cities, these cities typically fund infrastructure improvements at sites that demonstrate need with local funds, and had not submitted such projects to NCDOT. Neither had the smaller towns. All of the municipalities expressed interest in more help from the State in identifying appropriate pedestrian and bicycle safety projects that might qualify for State funding.

Moderate sized cities also tended to do at least some analysis and field work, perhaps in conjunction with NCDOT. In general, there seemed to be a less clear process and also uncertainty about State-funded safety projects and what criteria could lead to winning a pedestrian- or bicycle-focused safety project. There was discussion about network plans from the local staffs, and there also seemed to be some confusion about spot safety or HSIP (Highway Safety Improvement Program) types of projects.

We also explored some of the issues of RSA feasibility–including the use of outside, independent audit teams. Most of the agencies mentioned that identifying 'independent' outside team members, as desired in an RSA, could be an issue (cost and/or traveling across regions etc. to exchange services), and they would like to learn to perform their own investigations, at least within a region. The respondents felt having regional exchanges could also help them better understand safety needs in their own communities, since the communities would have similarities. Therefore, one suggestion made by a local jurisdiction was to share resources or teams within a COG.

Another finding was that smaller jurisdictions appeared to have most need of this guidance, and we worked again with the DOT Pedestrian and Bicycle Division staff to select Lenoir, High Point, and Fayetteville to participate as pilot communities.

Pilot Process and Findings

In going through the initially-developed process with these three local agencies (one started and got to the focus location identification, but was unable to complete the process), the following ***key challenges*** were identified through the pilot tests:

- Local agencies conveyed that they are very constrained in terms of personnel, and some felt they lack the skillset needed to adequately analyze safety data or had a steep learning curve. Although we provided guidance, data resources, examples, and offered consulting assistance, it was challenging for some local agencies to take on a meaningful analysis and interpretation of crash data on their own, beyond conducting some basic GIS-based visual assessments. Staff turn-over, leave, and many other disruptions may impact the ability of a smaller- to medium-sized jurisdictions, to institutionalize new practices, even if able to initially spend the time and develop skills needed to perform these tasks.
- Small towns and rural regions may have ***limited resources or staff*** to carry out not only the analyses, but also the organizational and reporting aspects of the RSA process including identifying qualified RSA teams, and/or identifying potentially appropriate countermeasures for problems identified. It may be most feasible for local jurisdictions to partner with state partners, such as NCDOT regional safety and division engineers, or to hire consultants, to perform the RSAs.
- There may also be some capacity at metropolitan and rural regional organizations to assist with some tasks such as data analysis.

- There is also a problem, as mentioned in the introduction, with ***relatively small numbers of widely-dispersed pedestrian/bicycle crashes***, to use only crashes to identify priority locations. It is difficult to draw inferences about problem types and crash patterns from limited numbers of pedestrian and bicycle crashes when these may be widely dispersed and have a variety of particular circumstances, even if these may be severe. This is especially the case once agencies zero in on a particular location or corridor. Agencies need to have an understanding of conflict types and crash risks including demand owing to area type, transit, and population characteristics, to supplement information from crash reports. Understanding crash types that occur at similar locations across the network may also help with identifying potential improvements.
- Involvement of more expert, independent auditors is needed as per recommendations in the Guide. These skills develop with practice, especially regarding pedestrian and bicycle safety needs and issues, with which many people lack much prior experience. While many treatments and designs that improve safety for pedestrians and bicyclists also tend to improve safety for all road users (e.g. road diets, turn phase restrictions, access management, lighting enhancements, speed enforcement, etc.), the same cannot necessarily be said of treatments that are used primarily to improve safety for motorists (wider clear zones, median barriers, etc.). Again, the use of consultants may be an option. Consideration could be given to potential funding sources for professionally-performed, consultant-led RSAs.

Other lessons learned

- Agencies were able to use visual assessments of spatially represented crash data, in combination with maps of land use and census data. This method seems useful to smaller jurisdictions to help prioritize locations that may be at most risk of future crashes. However, more complex analysis skills, especially in smaller jurisdictions may be limited. To some extent, the 'softness' of analyses are also limited by the numbers of crashes, particularly for smaller jurisdictions, as mentioned above.
- ***Hold a pre-RSA briefing***. Only one of the pilot communities held a pre-assessment meeting, and this clearly helped the process by providing an overview of the corridor, the land use and population context, and the crash issues (albeit limited) and fully engaging NCDOT and the other partners in the RSA process. NCDOT Safety Office partners in this case subsequently provided additional data analysis and followed-up with RSA inputs and the team had good engagement and discussion of issues during the RSA.
- ***A post-assessment debriefing or meeting also seems important*** to ensure that all relevant data and inputs are compiled from the assessment team. (This was not done by the pilots, and seemed to create additional challenges in coordinating to complete the reports.) This would also be a key issue to establishing the next steps to coordinate among local, regional and NCDOT partners for project development and evaluation.

- ***Document discussions.*** There seems to have also been a failure to document observations from all members of the team during the RSAs. The explanations seem to vary for the two different pilots. Nevertheless, for both RSAs, follow-up was made more challenging by the lack of initial documentation and post-assessment briefing.

Tips for Success learned in developing the process guidance

- ***Engagement of partner agencies to assist with data analysis is beneficial***. NCDOT and transit agencies both provided assistance in data analysis, in one case, following the field audit.
- There are ***multiple sources of data that can be used for analyses***, and these are described in the Guidebook. The NC Pedestrian and Bicycle Crash data available from the crash map site (https://ncdot.maps.arcgis.com/home/item.html?id=b4fcdc266d054a1ca075b60715f88aef) can be used to identify clusters and crash density areas, crash type, time of day, light conditions, alcohol-related, and other patterns across a network, or along specific corridors or intersections. These data can also be spatially linked to other data types (land use, census, transit, and roadway) for further analysis. However, these geo-coded data are not as up-to-date as TEAAS data due to a time lag needed for ensuring complete crash years and acquiring, coding, and compiling the data.

  Traffic Engineering Accident Analysis System (TEAAS data, see https://connect.ncdot.gov/resources/safety/Pages/TEAAS-Crash-Data-System.aspx) can be used to identify the most recent crashes; to analyze all types of crashes, including pedestrian and bicycle crashes, for a priority location (strip analysis or intersection analysis); and to obtain crash report IDs needed to acquire detailed crash reports. Using both data sources together, along with other data types (land use, transit, census, pedestrian and bicycle counts), will provide the most complete understanding of an area's crash history and estimation of continuing safety concerns.
- The RSAs seemed to ***encourage collaboration*** between the local staff and NCDOT staff to try to solve safety problems for the identified location, and have potential to lead to better future collaboration and engagement.
- It may be helpful if the local agency staff have some ***prior knowledge of participating in or leading field reviews*** or walkability assessments. There tended to be variation in engagement and contributions during the RSAs, which may reflect comfort with the process, the skills and knowledge of the participants, RSA leadership, or other issues such as familiarity with pedestrian and bicycle user characteristics and safety issues.
- There may be a need to provide additional training for performing pedestrian and bicycle RSAs.

- ***Include local policy-makers in the process.*** It was suggested by one of the local pilot practitioners that it may also be valuable to strengthen the recommendations regarding the importance of observations from various perspectives to include local elected officials, as opposed to the NCDOT-recommended process to include professionals in the RSA. This would enable local decision-makers to contribute their understanding of the community goals and vision for the road, learn from the professional members of the team, and help strengthen opportunities for mutual understanding and collaboration. We included in the Guide, recommendations to gather public and other groups' input prior to the RSAs, to consider holding meetings and potentially conduct RSAs during regular, local policy board meetings such as TAC or BPAC meetings. However, we did not explicitly recommend that policy-makers participate in the RSAs, since as conceived, the process was intended to involve qualified, professional transportation safety experts from different fields of practice.
- ***Conduct more frequent, smaller, informal field assessments.*** All except one of an initial list of eight towns and cities were interested in pilot-testing the process, especially if it could lead to State-funded safety projects. Most of the moderate to larger cities also conduct some types of field reviews, but usually of a more limited scale and time investment, in collaboration with NCDOT partners. There were some concerns about the involvement and time required for performing more in-depth, formal safety audits. The same concern was mentioned later by MPO staff.

Following pilot testing, and in consultation with the research panel chair, it was recommended that the project team should revise the Guidebook to address the following needs:

- Provide compelling reasons and benefits for using the Guide and implementing an RSA process in today's time-constrained world;
- Encourage a more collaborative approach between local agencies and NCDOT;
- Address the limited capacity of local jurisdictions (especially smaller jurisdictions) and highlight examples of ways to streamline the process, enhance collaboration across agency types, and incorporate other implementation ideas.

We therefore held additional discussions with both NCDOT research panel members, and practitioners at MPOs and RPOs (where resources remain fairly limited) to find out how these partner agencies might support the process and learn other tips on how the process might be implemented. Finally, we presented at the NC Bike/Walk Summit to a diverse group of stakeholders and received some additional suggestions.

We tried to address the above three issues in revising the Guide, and incorporated the (somewhat) limited examples and number of ideas on facilitating this process that emerged from interviews and pilot testing. The main ideas were:

- Provide suggestions to seek help from the State DOT Safety Office, MPO or RPO regional staffs for data analysis and other steps in performing RSAs such as collecting traffic and

pedestrian and bicycle counts. Some MPOs, especially, already provide data analysis support and help link up communities with NCDOT for field investigations. This may be more challenging for smaller MPOs and RPOs to take on. The NCDOT safety office offered some assistance in analysis and help with collecting user volume data.

- Include consultants in the list of those qualified to perform RSAs.
- Focus on at least a length of corridor if conducting a full-fledged RSA.
- Provide tips for streamlining or incorporating these processes into regular activities and meetings including internal or inter-agency meetings, and meetings such as Transportation Advisory Commission and Bike Pedestrian Advisory Board meetings, in which relevant stakeholders are already engaged.
- Relax some of the strictures regarding reporting. Spreadsheets and other 'short formats' may be used to document the essential analyses, RSA findings and recommendations.
- It is not required to have an engineer to 'certify' the RSA report.
- Perform more frequent, targeted field inspections at locations identified as having crash problems or other safety concerns (through complaints of speeding, failure to yield, etc.). This requires being familiar with risk principals and optimal pedestrian and bicycle treatments with documented safety effectiveness.
- The RSAs can lead to lower cost and sometimes locally-implemented spot safety improvements such as changes in signal timing or enforcement that may enhance pedestrian and bicycle safety. Lower-effort field investigations can also be used on a more frequent basis.

We have attempted to highlight these suggestions in the final, draft Guidebook.

In addition, the project team tried to highlight the conceptual benefits of the process. As more examples emerge over time of communities that have successfully used the process and implemented pedestrian or bicycle safety projects, these examples can be used in outreach and promotion efforts.

Besides seeking input on how to make the process workable, we initiated outreach at the NC Bike/Walk Summit to engage those present and encourage attendees to act and to implement this process.

Task 5 – Conduct Outreach and Training

We reached out to several MPOs and RPOs and presented and discussed the draft Guidebook to these agencies. They in turn, provided suggestions for how to make the process more 'implementable.

We also presented on the RSA process during a workshop at the statewide NC Bike Walk Summit on November 3-4, 2017 in Wilmington, NC. The presentation was well-received, and

participants, including some non-traditional road safety stakeholders (such as public-health agencies) seemed to have a keen interest in following up.

Finally, we provide recommendations for additional implementation steps in the I Implementation and Technology Transfer Plan below.

Task 6 – Prepare Final Guidebook and Summary Final Report

The Guide was revised again following all of these activities and the research panel review, and incorporated new examples, ideas for seeking help or collaboration, additional resources, and tips for success. The Guide was then designed to enhance user appeal.

RECOMMENDATIONS FOR FUTURE EFFORTS

Small and more rural agencies face severe limitations to data analysis and problem identification. Smaller agencies also have fewer crashes for understanding safety needs, yet may face disproportionate (to the amounts of walking or biking etc.) severe and fatal injuries, especially when divided by regional highways. Such highways can act as barriers to walking and biking, and consequently limit the crashes that occur. In addition to enhancing crash-based approaches, these agencies may need assistance with risk-based approaches to screen their networks. NCDOT could consider research to determine if risk based screening tools are plausible and productive for different types of jurisdictions across the state.

IMPLEMENTATION AND TECHNOLOGY TRANSFER

The research products include a Guidebook and two example RSAs from pilot communities as well as a PowerPoint presentation. Suggestions for implementation include the following:

Recommendation	Agency Lead
Post the Guidebook and RSAs case examples on the North Carolina DOT Complete Streets website, and include in upcoming Complete Streets training courses. The Complete Streets website - http://www.completestreetsnc.org/ will be updated in a pending NCDOT project by HSRC to provide additional trainings across the State.	UNC-HSRC
Disseminate the Guide to all NCDOT divisions and encourage regional and district engineers to share the Guide with their local and regional partners (MPOs and RPOS) and discuss opportunities for implementing the process, division of labor, etc.	NCDOT

Recommendation	Agency Lead
Consider presenting on the Guide at additional Statewide conferences or webinars. The final close-out presentation (provided with final deliverables) can be adapted for further presentations.	NCDOT (possibly Bicycle and Pedestrian Division or Safety Office)
Include non-traditional partners in outreach. The public health community, for example, was present at the NC Bike/Walk Conference and seems prepared to act on this guidance and should be included in further outreach and Complete Streets activities.	All UNC-HSRC can include multiple groups in Complete Streets training and other projects in the state.
Provide technical assistance. Become familiar with the guidance, resources and process, and collaborate with local agencies to help implement the process through to project development. This may include data analysis, staffing for RSAs, and other types of assistance and collaboration.	NCDOT Safety Office, regions and divisions; MPOs and RPOs could also assist in this effort
Consider providing training to engineering, planning, law enforcement, and other types of practitioners (injury prevention/public health workers) to perform pedestrian and bicycle-focused RSAs.	○ Could involve further contractor-led projects. ○ Could be as simple as engaging local practitioners and officials in planned RSA activities.
Encourage agencies (including NCDOT) to use NC's pedestrian and bicycle crash geo-database, as well as TEAAS data, when assisting local agencies with analyses. The crash types available in the ped/bike crash database enable identification of common crash types and patterns both across the network and on specific corridors.	NCDOT
NCDOT could consider additional research to determine if risk based screening tools are plausible and productive. Pedestrian and bicycle crashes are prone to year-to-year migration, and smaller jurisdictions may also have fewer crashes for understanding safety problems and patterns amenable to treatment.	NCDOT and/or Contractor-led project in collaboration with NCDOT and local agencies (for data).
Consider developing an NC pedestrian and bicycle countermeasures resource. The focus of this project was to develop the essential problem identification and diagnosis	Contractor-led project in collaboration with NCDOT and local agencies

Recommendation	Agency Lead
process. There may be a need to develop a North Carolina-focused countermeasures resource that can be used along with the RSA Guide to identify countermeasures appropriate to different location types.	
Consider developing case examples of successful projects that emerge from RSA processes to disseminate to statewide DOT and local partners.	Either DOT or potentially Contractor-led project in collaboration with NCDOT and local agencies
Consider opportunities (potentially safety planning grants) to support conduct of RSAs.	NCDOT

CITED REFERENCES

Highway Safety Manual 1st ed. (2010). American Association of State Highway Transportation Officials.

North Carolina Department of Transportation, Complete Streets Planning and Design Guidelines. [Online]. Available at: http://www.completestreetsnc.org/