REFERENCE

Huijser, M.P., P. McGowen, A.P. Clevenger, and R. Ament. *Wildlife Vehicle Collision Reduction Study: Best Practices Manual: Report to Congress*. Federal Highway Administration, U.S. Department of Transportation, 2008.

INTRODUCTION

The document referenced above (the *Best Practices Manual*) outlines and describes best practices related to the implementation or consideration of WVC mitigation measures when the regional (or statewide) transportation system, corridors, and specific sites are the evaluative focus. In addition, the document provides specific best practices and guidance for mitigation measures focused on threatened and endangered species and the monitoring and evaluation of WVC mitigation. The potential funding for WVC mitigation programs is also discussed and a general checklist for implementing a WVC reduction program provided (the reader should refer to the documented referenced for a description of these). This summary includes a brief description of its content that is relevant to WVC mitigation measures for large animals and safety improvement. The overall organization of the report is noted in Figure 1. The report begins by addressing best practices at the regional scale (at the bottom of Figure 1) and moves up to more site-specific best practices and monitoring and evaluation (at the top of Figure 1). Each of the subjects noted in Figure 1 is considered a "step" in the implementation of a complete WVC mitigation program. They do not, however, necessarily need to be followed in the order in which they are stacked in Figure 1.

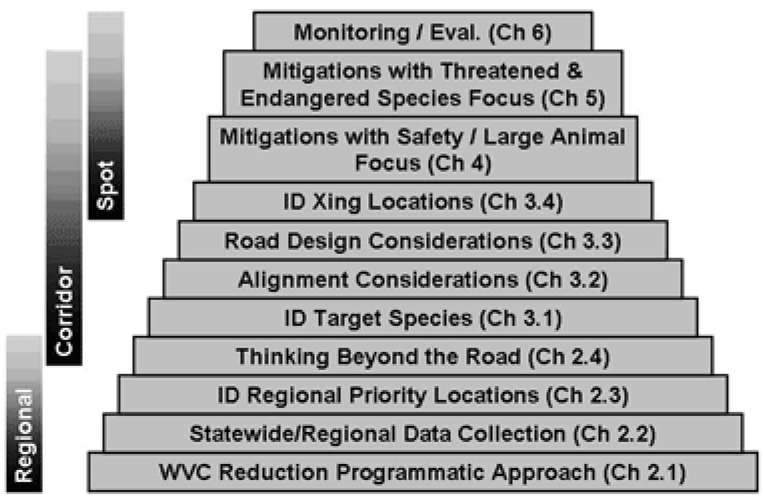

Figure 1. Report format. (inserted from referenced report)

STATE AND REGIONAL WVC REDUCTION BEST PRACTICES

The *Best Practices Manual* begins with a discussion of the steps needed to implement a statewide/regional WVC reduction program. The importance of data collection at these "scales" (i.e., statewide and regional) is emphasized and some methods of obtaining data are reviewed. The authors of the *Best Practices Manual* note that WVCs are substantially under-reported when police crash reports are used, but a more detailed discussion of this subject is available in *NCHRP Synthesis 370* (linked and summarized on the www.deercrash.com website). The need to collect landscape and environmental or habitat data was also discussed. The second step proposed for the implementation of a statewide/regional WVC reduction program involving the application of collected data to identify roadways with high animal mortality concerns and/or significant animal habitat linkage zones. The use of, among other things, carcass and/or crash data, prioritized linkage-zone maps, GIS-based landscape and movement models, and local knowledge were suggested for WVC hotspot and/or habitat linkage identification. These tools or approaches and their specific functions, along with specific real-world examples, are briefly discussed in the report. The third step for implementing a WVC reduction program at the statewide/regional scale suggested that a program should not only address WVCs along specific roadways but also along roadways and railways system-wide in the adjacent landscape. The report authors insisted that WVC reduction programs should consider the broader landscape instead of particular linear road segments. It was emphasized that this kind of effort would require the cooperation and participation of multiple public agencies.

Overall, suggestions for statewide or regional planning of WVC reduction mitigation included prioritizing habitat linkage zones during the transportation planning process, reviewing roadway reconstruction projects that cross WVC hotspots or habitat linkage zones, including WVC mitigation in roadway reconstruction projects to save money, and the development of innovative funding sources (which is discussed in more detail in the referenced report).

CORRIDOR-LEVEL WVC REDUCTION BEST PRACTICES

The second portion of the *Best Practices Manual* includes steps or best practices for successfully implementing a WVC reduction program for road corridors. The first step in the development of this type of program is to determine the home range area, dispersal movements, and migratory patterns of the species being targeted for roadway impact mitigation. The second step in this process is the consideration of road alignment choices and their potential impact on WVCs. The *Best Practices Manual* provides examples and discusses models that can assess ecological impacts of road alignment choices (e.g., Variables for Assessing Reasonable Mitigation in New Transportation and Metroquest). Resources that describe the context sensitive roadway design (including alignment choices) process are also referenced. The third step or component of a WVC reduction program for corridors focuses on roadway design components (with a focus on two-lane rural/suburban roadways and low- to medium-volume highways). The *Best Practices Manual* includes suggestions related the design of side slopes, culverts and bridges, roadside ditches, drainage systems, roadside vegetation, and median barriers that might help reduce (or at least not increase) WVCs. The authors suggest that certain roadway design characteristics could be implemented along a corridor to mitigate WVCs in general but that hotspots might necessitate more intensive mitigation methods. The fourth consideration when considering the reduction of WVCs along a roadway corridor is the identification and prioritization of wildlife crossing patterns. The methodologies proposed in the *Best Practices Manual* to accomplish this task are similar to those previously described for the statewide/regional WVC reduction program. However, because the area of consideration is more focused (e.g., a corridor) it's possible to collect and use more specific data (e.g., roadside surveys for tracks, local expert knowledge, and identification of specific landscape characteristics such as waterways or forest cover). Finally, the last consideration proposed for the reduction of WVCs when planning a corridor was the identification and proposal of wildlife crossing (i.e., over- and underpasses, etc.) spacing. It was noted that sometimes the permeability of roadways is purposefully reduced and that sometimes crossings are needed. Methods for estimating the desirable spacing of crossings are provided based on a target species home range.

SITE-SPECIFIC WVC REDUCTION

The last portion of the *Best Practices Manual* describes the design and implementation of mitigation strategies at spot locations along a roadway. The report authors categorized best practices for the mitigation of large animal WVCs based on what they believed the research indicated about their effectiveness (i.e., how much they reduce WVCs). These effectiveness levels can be found in the *Wildlife Vehicle Collision Reduction Study: Report to Congress* (summarized separately on this website) for 47 WVC mitigation measures. Those measures (or combination of measures) with one or more research projects indicating a WVC reduction of 80 percent or more (along with a positive estimated benefit-cost comparison) were considered "best practices." These mitigation measures included wildlife fencing (along with associated methods that allow wildlife crossing), underpasses, overpasses, multiple underpasses, multiple overpasses, and animal detection systems. However, the researchers included deer population culling and roadside vegetation management as best practices because deer population culling may be the only alternative under certain conditions (e.g., suburban settings), and roadside vegetation management may be integrated with existing right-of-way management. Examples of all these mitigation measures are extensively described in the document. Figures, illustrations and photographs of existing and conceptual implementation and planning for them are provided. In addition, technical specifications, implementation considerations, cost estimates, and maintenance issues related to each WVC reduction measure are described. Similar information is provided for mitigation related to 21 threatened and endangered species (for which WVCs are a threat to survival). Overall, the authors acknowledge that the identification of what is a best practice (i.e., their impact on WVCs and their cost effectiveness) might change with more research and implementation.

MONITORING WVC MITIGATION IMPACTS

The last section of the *Best Practices Manual* includes a discussion of methods to monitor and evaluate the safety and wildlife movement impacts of WVC mitigation methods. Common errors in the evaluation of data to complete these tasks are also noted. For example, the researchers state that three to five years of crash data are usually necessary to compare the potential impact of WVC mitigation on safety (based on crash data). However, some common mistakes include doing a simple comparison of mean crash frequencies and not considering other factors that might impact this data other than the implementation of the mitigation measure (e.g., traffic volume, data collection changes, etc.). The authors suggest that improved data comparison evaluations would also improve the robustness of WVC reduction monitoring and the research or evaluation results of mitigation measure impacts. Improvements to habitat connectivity and wildlife movement assessments, after mitigation measure implementation, are also suggested (e.g., The use of tracking beds, ink beds, cameras, infrared beam counters, GPS collars and radio telemetry, and other wildlife tracking devices).

DVCIR CENTER FINDINGS

There is some valuable information in this *Best Practices Manual* that can be used to guide the incorporation of WVC mitigation into the entire roadway development process (i.e., from statewide planning to site specific improvements). The manual provides methods and suggestions related to the consideration of WVCs during statewide and/or regional transportation system planning and when new roadway corridor alignments are being compared. In addition, some adjustments to typical "reconstruction" roadway design decisions (e.g., sideslopes) are noted. Overall, however, the mitigation measure information that is provided in the manual should be applied/adjusted, as appropriate, on a case by case basis. It should be noted that the choice of "best practices" in the manual is based a review of the research on WVC mitigation measure effectiveness. The current state-of-knowledge is limited in this subject area (i.e., based on a small number of studies) and list of "best practices" could increase or decrease as more information is gathered. The authors acknowledge this in the document. The implementation of any other WVC mitigation measures (i.e., those not included in this manual) would simply require an evaluation component. In other words, they might be considered pilot applications. More detail about the WVC mitigation measure research that was used in this manual is provided on this website and in the original *Wildlife Vehicle Collision Reduction Study: Report to Congress* (which was summarized separately for this toolbox update, see www.deercrash.com). In addition, the benefit-cost information provided in this manual is based on the same research and should be completed on a case-by-case basis. It can be supplemented with the content of several other summaries done as part of this toolbox update. Overall, the information provided in this document is a good starting point for an agency considering the implementation of a WVC mitigation measure.