Section 2

PLANNING PROCESS

2.1 Data Analysis and Site Identification

The MPO's wildlife crossing site identification process included a review of existing plans and literature, and GIS analysis. Key sources included coverage of reported crash and safety data, wildlife corridors, transportation structures and locations, land use, and transportation plans.

2.1.1 Review of Existing Plans and Reports

Numerous wildlife crossing plans and reports from North Carolina, and state and federal departments of transportation in the United States were reviewed to help guide best practices and strategies. Below is a short, sample list of plans and reports that were consulted as part of this process. This plan's Reference list can be reviewed for a full list of sources.

- Wildlife Passage Guidance, 2024 (NCDOT and NCWRC)
- Potential Wildlife Crossings for the French Broad River MPO & Land of Sky RPO Planning Areas, 2022 (French Broad River MPO, Land of Sky RPO)
- Prioritizing Wildlife Road Crossings in North Carolina To Reconnect Wildlife Habitat and Improve Road Safety, 2022 (Wildlands Network)
- A Landscape Analysis for Wildlife Habitat Connectivity in Durham County, North Carolina: Covering Watersheds of the Upper Neuse and New Hope Creek, 2023 (Durham County)
- A Landscape Plan for Wildlife Habitat Connectivity in the Eno River and New Hope Creek Watersheds, 2019
- North Carolina Animal Related Crashes: 2020 – 2022 County Rankings and Crash Data Report, 2023 (NCDOT)
- Wildlife Crossing Structure Handbook, Design and Evaluation in North America, 2011 (FHWA)
- Wildlife-Vehicle Collision Reduction Study: Report to Congress, 2008 (FHWA)
- State Transportation Improvement Program (STIP): 2024-2033 (NCDOT)
- Comprehensive Transportation Plan, 2017 (DCHC MPO)
- 2050 Metropolitan Transportation Plan (DCHC MPO)

2.1.2 GIS Analysis

A variety of GIS datasets were gathered and analyzed to help with the site identification process. DCHC MPO's technical approach included the combination of reactive and proactive datasets. The reactive datasets – which included NCDOT's reported WVC data, and the UNC Highway Safety Research Center's (HSRC) current crash rates in the MPO - demonstrate where WVCs have occurred. The proactive datasets – which included identified wildlife cores and corridors identified by the Wildlands Network, the Triangle Connectivity Collaborative's (TCC) Upper Neuse-New Hope Road crossing points and Habitat Patches, HSRC's projected WVC data in the MPO, and NCDOT's structure locations data – demonstrate locations where risk is high even if no recent WVCs have occurred. This proactive approach is to help prevent WVCs from occurring. The following are the datasets that were analyzed and identified the project sites in this plan:

1. **Wildlife-vehicle collision data (NDCOT)**. NCDOT's reported WVC dataset was analyzed to identify the locations of all reported WVCs from 2018 to 2022 within the MPO's planning area. The dataset represents WVCs reported by law enforcement agencies and does not necessarily reflect the actual number of WVCs that have occurred. A map of the

reported WVCs in the MPO's planning area can be found in Appendix F. Each point on this layer does not indicate a single reported crash and some points represent more than one crash event.

2. **Current and projected wildlife-vehicle crash data (UNC HSRC)**. The UNC Highway Safety Research Center (HSRC) developed maps for the MPO using the geometric interval classification method for alternative comprehension of NCDOT's WVC data with green segments indicating very low crash rates and dark red indicating very high crash rates. For the Current Crash Rate layer, the Roadway Characteristics GIS file from NCDOT was used and the rate of crashes that occurred was calculated on segments based on 100 million vehicle miles traveled. A map of the Current Crash Rate in the MPO's planning area can be found in Appendix G. The Projected AWDT (Average Weekday Traffic) Crash Rate layer includes road segments from DCHC MPO's 2050 AWDT where a crash rate could be calculated from the projected AWDT. A map of the Projected Crash Rate in the MPO's planning area can be found in Appendix H.
3. **Wildlife corridor data (Triangle Connectivity Collaborative, Wildlands Network)**. Wildlife crossings must connect and be part of a larger regional wildlife corridor network that does not lead to ecological dead ends. It is understood that not all crashes are reported, but DCHC MPO relied on available reported WVC data to develop an initial list of crossings to target. The movement paths can help identify crossings that were not necessarily identified through the reported WVC data.
    a. *Wildlife habitat cores and wildlife connectivity corridors (Wildlands Network):* Habitat cores are essential areas within a habitat patch that are crucial for the survival of wildlife. Connectivity corridors are areas of habitat that connect critical core habitats allowing for the movement of wildlife. A map of cores and corridors in the MPO's planning area can be found in Appendix I. Additionally, a map of cores and corridors within the eastern seaboard can be found in Appendix J.
    b. *Upper-Neuse New Hope Road Crossing Points (Triangle Connectivy Collaborative):* This dataset – developed by biogeographer and ecologist Julie Tuttle – represents potential wildlife road crossing points and was derived from the Upper Neuse-New Hope (UNNH) Landscape Habitat Connectivity Network, which was developed as part of the Durham County Landscape Connectivity Analysis (Tuttle & Durham County Open Space Program 2023). The analysis focused on the habitat and movement needs of wildlife species that are sensitive to habitat fragmentation ("priority wildlife") and incorporated data on land cover/land use, floodplains, wetlands, water bodies, roads, buildings, and more. The resulting habitat-corridor network represents a prioritized network of forested habitat and movement corridors for priority wildlife in the Upper Neuse and New Hope watersheds. The UNNH Crossing Points dataset includes points where roads identified as barriers were considered "permeable" to wildlife crossing for the connectivity analysis, typically because of stream crossings. Each potential crossing point was assigned a connectivity priority level based on the priority level for any movement corridors intersecting the point. Where available, attributes for roads, NCDOT structures (bridges, culverts, and pipes), traffic volume, and streams were assigned to each potential crossing point.
4. **NCDOT structures dataset**. A review of the locations of existing bridges, culverts, and pipes in both NCDOT's

jurisdiction and DCHC MPO's planning area was conducted. These structures included both National Bridge Inspection Standards (NBIS) and non-NBIS datasets. Bridges, culverts, and pipes provide an opportunity to enhance wildlife connectivity under and through these structures with relatively minor modifications – or retrofits – at a lower cost and on a shorter time frames than constructing new structures. Structures and their locations were also analyzed to determine if they could be part of a corridor of wildlife movement.

5. **Natural land GIS data**. Wildlife crossing sites should be adjacent to land uses that promote wildlife movement, and to prevent ecological dead ends. Considering protected natural lands in the wildlife crossing planning process is important to help ensure that wildlife will have abundant natural habitat to travel along a corridor – from one crossing to the next. Therefore, protected natural lands were an important consideration in this planning process. The Natural Heritage Natural Areas (NHNA) dataset was used to identify sites of special biodiverse significance for terrestrial and aquatic species. The Managed Areas (MAREA) dataset was used to identify areas where natural resource conservation is one of the management goals. Surface waterways data was used to identify streams, rivers, and creeks, that run adjacent to or within these areas.
6. **DCHC MPO Metropolitan Transportation Plan (MTP)**. The MPO's MTP dataset was used to cross reference potential wildlife crossing sites with transportation projects.
7. **DCHC MPO Comprehensive Transportation Plan (CTP)**. The MPO's CTP dataset was used to cross reference potential wildlife crossing sites with transportation projects.
8. **DCHC MPO 2050 Average Weekday Traffic (AWDT).** This dataset is the projected Average Weekday Traffic for 2050, which is based on the amended MPO's 2050 MTP scenario developed from the Triangle Region Model (TRM) Generation 2 (G2). The MPO's 2050 AWDT dataset was also used to develop the projected WVC rate layer.
9. **Annual Average Daily Traffic (AADT)**. The MPO's AADT dataset was used to develop the current WVC rate layer. AADT data is an important consideration in wildlife crossing planning, as most animals who attempt to cross roads will not succeed unharmed. As roads experience increased traffic, the odds of a WVC also increases. Roads with more than 10,000 vehicles per day are considered total barriers to most wildlife, and roads with intermediate traffic volumes are considered a significant source of mortality.[13]
10. **Population and density datasets (US Census Bureau).** The 2020 Urban Area shapefile from the US Census Bureau was used to examine the current urban area within the DCHC MPO boundary. Although the data shows that more reported WVCs occur in rural areas, WVCs do occur within urban areas.

While a variety of GIS datasets are available to help identify key wildlife crossing sites in the MPO's planning area, some additional datasets that could be helpful are not currently available, and some have not been obtained, that could help with this effort. The following list describes these potential datasets:

1. **Wildlife carcass removal data**. Collecting and analyzing wildlife carcass removal data could allow for a more complete picture of the number and variety of wildlife being killed due to vehicular traffic. While some state departments of transportation track carcass removal instances, NCDOT currently does not. The MPO will continue to inquire about this data's availability to NCDOT for its analysis for future iterations of this plan.
2. **Insurance claim data.** Collecting and analyzing insurance claims from animal-vehicle collisions – especially by county and crash location – can help illuminate a more complete understanding of these crash types, wildlife welfare, and economic impacts. The MPO will continue to inquire about the availability of this data.
3. **Local structures datasets.** A review of the locations of existing bridges, culverts, and pipes within the jurisdictional

limits of the MPO's member agencies should be conducted to develop a more complete picture of potential wildlife crossing corridors. Countermeasures for local structures can extend a wildlife crossing corridor and create a larger network. The DCHC MPO will work with local jurisdictions to obtain this data, develop and coordinate project recommendations for future updates to this plan.

2.2 Site Assessments

As potential wildlife crossing sites were identified through data analysis, Triangle Connectivity Collaborative Transportation Workgroup (TCCTW) members and DCHC MPO staff visited each site to conduct a thorough assessment.

Figure 2.2.1: Photograph of site assessment at US 15-501 bridge over Pokeberry Creek. DCHC MPO.

Figure 2.2.2: Photograph of site assessment at US 15-501 bridge over New Hope Creek. DCHCMPO.

The TCCTW partnered with the NCWRC to develop a site assessment form. The site assessment form was used as a guide (Appendix D), which included elements such as analyzing the existing structure (bridge, culvert, etc.), evaluating the site for roadkill, and identifying obstacles for wildlife connectivity. Based on each site's assessment, countermeasures were developed to help improve wildlife connectivity and reduce WVCs.

2.3 Review of Wildlife Crossing Countermeasures

Wildlife crossing mitigation has two main objectives: 1) to connect habitats and wildlife populations and 2) to improve motorist safety by reducing WVCs.[14] There is no one-size-fits-all solution for each wildlife crossing site. While there are many solutions that have proven to be effective at reducing WVCs, each site's existing infrastructure, topography, surrounding land use, property ownership, speed limit, and traffic volume are considerations that must be analyzed to help identify the recommended wildlife crossing countermeasure. While this planning effort has assessed wildlife crossing sites in the DCHC MPO planning area to make recommendations aimed at eliminating fatalities and serious injury crashes as a result of WVCs, each crossing site must be further evaluated in subsequent phases to generate actual costs.

2.3.1 Infrastructure

Several infrastructure countermeasures have proven to reduce WVCs. Countermeasures discussed in this section include fencing, underpasses and overpasses, bridges, culverts, wildlife tunnels, vegetation management, and signage. While not an exhaustive list of infrastructure countermeasures used through the United States, these solutions reflect recommendations put forth in this plan and solutions implemented in North Carolina.

Fencing

One of the most common wildlife crossing countermeasures is fencing. While both transportation infrastructure – such as underpasses, bridges, and culverts – and wildlife fencing are not necessarily an effective solution for safe wildlife passage on their own, several studies have found that the combination of transportation infrastructure with wildlife fencing installed at the crossing site reduces WVCs significantly.[15] However, careful planning of the fence's length and placement is needed to help ensure that it does not completely disrupt and impede wildlife movement, genetic and reproductive functions, and other vital ecological processes.[16]

The height and type of fencing depends on the species being planned for. To deter white-tailed deer from jumping over the barrier, and to discourage small wildlife from climbing over, a ten-foot tall fence is an effective solution. However, when planning for smaller species, mesh size might be the primary consideration to prevent wildlife from traveling through the fence. In addition, fencing should be buried deep enough to prevent wildlife from burrowing underneath.[17] While each crossing site is different and has its own strengths and challenges based on differences in topography, vegetation, and land use, at least one mile of fence on both sides of the crossing and road is common. When identifying placement and length of fencing for large wildlife, installing a fence that is three miles along the crossing and roadway has been shown to garner an 80% reduction in DVCs.[18]

Virginia Department of Transportation (VDOT) has reported that it had success with installing eight-foot-high fencing one mile on both sides of crossing sites with an existing culvert and bridge. Their two-year study found that:

> **"the addition of wildlife fencing to certain existing isolated underpasses can be a highly cost-effective means of increasing driver safety and enhancing habitat connectivity for wildlife."**

VDOT reported that the fencing reduced DVCs by 92%, that the culvert saw a 410% increase in deer passage, and the bridge underpass saw a 71% increase in deer passage. In addition to these safety benefits, VDOT reported that "the benefits from crash reduction exceeded the fencing costs in 1.8 years, and fencing resulted in an average savings of more than $2.3 million per site."[19] The average cost incurred by VDOT per site was $265,409, which included site preparation, traffic control, two miles of fencing, and maintenance.

Wildlife fencing is considered an effective countermeasure when used in tandem with existing structures that have functional passage. Fencing may not be suitable or effective in all cases due to surrounding land use and parcel access, and if the structure/site does not yet have a functional passage in place.

The cost of annual maintenance should be factored into each site estimate that will add wildlife fencing. Having dedicated personnel maintaining the fencing on a regular basis will ensure that the fence was installed properly and is therefore sturdy and in place; has not moved or been broken apart due to the elements, falling trees or the shifting of earth; has not been breached by human activities such as hunting; has not been destroyed by a vehicle collision; or has collected trash. Fencing that is compromised will be ineffective at keeping wildlife – especially white-tailed deer – off the road.[20]

Underpasses and Overpasses

Underpasses and overpasses can be part of an effective solution for wildlife passage and WVC reduction, but countermeasures should be included in the earliest stages of planning to avoid costly remediations once the infrastructure has been built. The likelihood of these structures reducing WVCs and creating safe crossing opportunities is greatly increased when wildlife fencing is incorporated at the site. Working in tandem, wildlife are guided through an overpass and underpass, and off the roadway.[21] In other words, fences keep wildlife off roads, while underpasses and overpasses allow them to cross safely. An underpass sited over lower speed roads could offer wildlife a natural path to the side of the roadway.

Bridges

Bridges that align with wildlife corridors offer an opportunity for wildlife to move safely by traveling under the bridge and thereby staying off the road and reducing the likelihood of a WVC. However, not all bridges and the land beneath them have been planned, engineered, and developed with safe, inviting, and accessible wildlife passage in mind. Existing bridges and the passage beneath them can occasionally be retrofitted to promote wildlife travel, which includes the development of passage benches. When a bridge is set to be replaced, adding length to the new bridge can allow for increased opportunity to incorporate dry passage on both sides under the bridge.

Passage Benches

A passage bench is a gravel-surface path built under a bridge that is along a waterway intended to provide wildlife with continued travel and to reduce the likelihood of wildlife traveling across roadways and into vehicular traffic.[22] This countermeasure is often incorporated into bridge riprap. Riprap is a layer of large stone that protects soil from erosion in areas of high or concentrated water flows. It is especially useful for armoring channel and ditch banks, and protecting the integrity of a bridge abutment and prevent scour.[23] However, since riprap can be a challenge for wildlife to pass over, remediation has been done that repositions riprap along embankments and hills to create a wildlife bench - an example of this is the US 15-501 bridge over New Hope Creek in Durham County (Figure 2.3.3.1). The Old Chapel Hill Road bridge over New Hope Creek (Figure 2.3.1.1) is an example of riprap placement that poses such an obstacle. Wildlife that encounters this obstacle may choose to use the roadway to continue travel, putting the safety of themselves and drivers at risk.

Figure 2.3.1.1 Photograph of site assessment at Old Chapel Hill Road bridge over New Hope Creek. DCHC MPO.

The wildlife crossing along US 70 over the Eno River in Orange County (Figure 2.3.1.2) is an example of a transportation project in the MPO's planning area that eliminated this type of obstacle by repositioning riprap to create a wildlife bench. When this type of mitigation measure is implemented in new projects such

Figure 2.3.1.2: Photograph of US 70 bridge over the Eno River. DCHC MPO.

as a bridge installation or replacement from the start, the cost to position riprap as to not impede wildlife movement is minimal, as is the cost needed for finer material placed over the top of the riprap.

Bridge Lengthening

The length of a bridge influences the openness and space for wildlife passage underneath. A bridge over water should be long enough to allow for dry passage on either side, with the potential for a wildlife bench to be constructed. Due to the high cost of planning, engineering and constructing a bridge, wildlife connectivity should be included in the early stages of the planning process to determine the appropriate length for the facilitation of wildlife movement, and to reduce the likelihood of a costly remediation project.[24] Alternatively, bridges that are slated to be replaced can be candidates for wildlife crossing recommendations, such as lengthening, if the recommendations are shared with NCDOT at the appropriate stage of the planning process. Therefore, communication with NCDOT Divisions as early as possible is key.

An example of a bridge lengthening transportation improvement project in the MPO's planning area is the US 15-501 bridge over New Hope Creek. This project between NCDOT and NCWRC created a bridge that was 160 feet longer than the original and serves as an important wildlife crossing underpass within a riparian corridor connecting Duke Forest and Jordan Lake Game Land.

Culverts and Pipes

Culverts and pipes are structures used as a drainage management solution, as they guide water and sediment flow through a transportation network with minimal impact. While commonly used for the same purpose, the term used (culvert or pipe) often depends on the size of the structure; culverts are large structures, while pipes are smaller. Figure 2.3.1.3 is an example of a bottomless culvert, while Figure 2.3.1.4 is an example of a pipe.

When culverts are being considered in the planning process, " building bigger culverts is better for the entire water system composed of sediment, wood debris, aquatic organisms, and wildlife."[25] Large culverts with high clearance have been shown to be effective for large mammals, such as white-tailed deer, due to their ability to walk-through unobstructed. Smaller culverts can also be an effective solution in instances where small wildlife – such as raccoons, turtles or opossums – are known to migrate across roads.[26]

Figure 2.3.1.3: Bottomless culvert at US 70 over Stony Creek. DCHC MPO.

Figure 2.3.1.4: Pipe at Cole Mill Road at Eno River. DCHC MPO.

Opportunities exist to enhance existing culverts to encourage and provide passage for wildlife. Due to a culvert's purpose of guiding water through a transportation network, water will be present in the structure's bed at any time. Depending on the water's depth, small wildlife may not be able to traverse through without risk. Large rainfall and locations prone to flooding exacerbates this problem. Two solutions can be considered to accommodate wildlife's preference for flat, textured surfaces.

First, corrugated pipe could be installed along the culvert's floor with enough concrete to prevent inhibiting the hydrologic or geomorphic (sediment-moving) function of the culvert.[27] Second, ledges - or dry shelves - could be considered in some cases as a retrofit on one or both sides of the culvert's interior to allow wildlife to traverse safely, above the water. Figure 2.3.1.5 shows an image of a ledge retrofit for a project administered by the New York Department of Transportation and The Nature Conservancy.[28]

Figure 2.3.1.5: Wildlife shelf is installed in a culvert near Boonville, N.Y. Kurt Gardner/The Nature Conservancy via AP.

Wildlife Tunnels

Many wildlife crossing solutions are aimed at reducing the likelihood of large animals traversing roadways due to the significant damage they can inflict in a WVC. While small animals may not necessarily cause vehicle damage or human injury, they greatly outnumber the large wildlife in the MPO's planning area, and their survival is as equally important as their larger counterparts. A solution to be considered for small wildlife passage – such as for turtles and snakes – is a wildlife tunnel.

Figure 2.3.1.6: Wildlife tunnel in western North Carolina. Kevin Hining/NCDOT.

A wildlife tunnel was installed by NCDOT in Ashe County, North Carolina (Figure 2.3.1.6) to accommodate small wildlife passage. Wildlife tunnels can consist of a trench with concrete on both sides and floor, a metal grate on top to allow lighted passage, and fencing that guides wildlife to the tunnel. This project was made possible through a partnership between NCDOT, NCWRC, and local conservation organizations. Funding for materials was provided by the U.S. Fish and Wildlife Service's Partners for Fish & Wildlife habitat restoration program.[29]

Vegetation Management

Vegetation that is both overgrown and not maintained can create a preventable obstacle for wildlife. Managing vegetation at wildlife crossing sites is necessary to promote wildlife movement under or through structures, which can reduce WVCs and can increase the effectiveness of wildlife crossing retrofits or structures that have been implemented. In addition to consistent maintenance, vegetation should be managed responsibly and should consider potential harm to wildlife and the environment. Vegetation should be managed in accordance with the NCDOT Vegetation Management Manual and standard practices.[30]

Signage

Signage indicating wildlife crossing areas can help reduce driver speed and WVCs when used with other strategies such as fencing.[31] Signage options can be broken down into two categories: passive warning signs and flashing beacons.

Passive warning signs (passive traffic control systems) are the least effective of the two signage categories. For example, speed limits are commonly posted on passive signs, but this has been shown to not be an effective speed reduction strategy as drivers tend to drive the speed at which the road was designed, rather than the speed limit that is posted. Wildlife crossings commonly use passive signs as well, though they are not as effective at reducing vehicle travel speed on their own. However, signs could be installed rather inexpensively at sites that have had wildlife crossing solutions implemented to help raise awareness.[32]

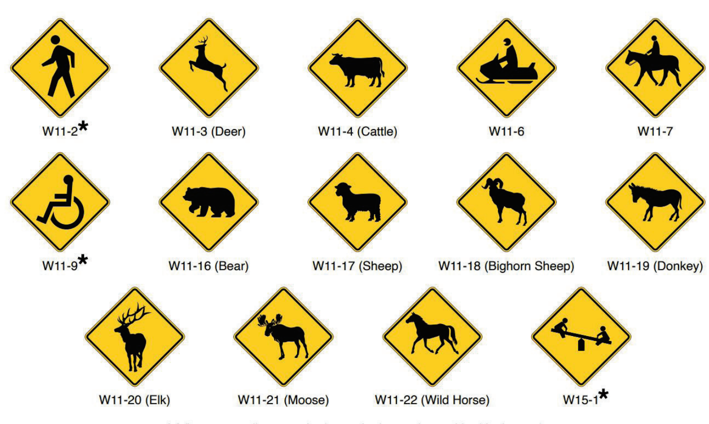

Figure 2.3.1.7: MUTCD Non-Vehicular Warning Signs.

Available wildlife crossing signage is detailed in the Manual on Uniform Traffic Control Devices (MUTCD) (11th edition). The MUTCD does not include a generic "wildlife crossing" sign, but rather ten large wildlife-specific options that are included as part of its non-vehicular warning signs.[33] Sign W11-3 (Deer) is likely the only sign relevant to the DCHC MPO planning area per the NCWRC species list.[34] Figure 2.3.1.7 shows the MUTCD's non-vehicular warning signs.

According to NCDOT's Guidelines for Installing "Deer Crossing" Signs, "this sign can be erected at locations when the investigating traffic engineer determines a site to be a frequent deer crossing and/or an accident location involving deer. Signs normally would not be installed in subdivisions or on unpaved roads due to slow speeds and local traffic. Consideration of the engineering study may include but not limited to: traffic volumes/ approach speeds/ street width/ sight distance/ road geometry, and accident history."[35] The NCDOT Division Traffic Engineer should be contacted when requesting passive warning signage.

Flashing beacons have been proven to be more effective at gaining drivers' attention and reducing vehicular speed. These activated wildlife crossing signs are typically installed during seasonal migration periods and are equipped with flashing lights to attract driver's

Figure 2.3.1.8: Flashing beacon for wildlife crossings in Utah. Adam Small, KSL NewsRadio.

attention. Activated signs can use infrared technology to detect approaching wildlife, which will trigger the flashing lights,[36] or the lights can be set to remain flashing for a set period of time. A study conducted by the Insurance Institute for Highway Safety found that flashing beacon signs reduced speed by 8 mph, and that DVCs were reduced by 70% during migration.[37] The NCDOT Division Traffic Engineer should be contacted when requesting flashing beacons.

2.3.2 Policy

Structures are needed to create the foundation for wildlife crossings in the road network, and policies can work in concert with the infrastructure investments to enhance the effectiveness and safety of the crossing. While there might be little to no financial cost, policy change can be difficult to pass and implement. Policies to promote and advance wildlife crossings countermeasures include consideration of wildlife crossings for each transportation project (such as a "Complete Streets" policy for wildlife), vehicle speed reduction and road design, and public education and awareness campaigns.

Wildlife Crossing Considerations, or Complete Streets for Wildlife

Complete Streets are roadways designed for all travelers, allowing for safe and quality access to highways, transit, bicycle, and pedestrian facilities. In other words, Complete Streets can help create equitable access for all travelers, and all modes of transportation. In August of 2019, the NCDOT Board of Transportation passed a Complete Streets Policy and Implementation Guide to enable the inclusion of Complete Street elements such as sidewalks and bicycle facilities in roadway projects, and the department has been directed to consider Complete Streets elements and incorporate several modes of transportation when building new projects or making improvements to existing infrastructure.

One of the benefits of considering and implementing Complete Streets elements from the start is that it can be more costly to construct these elements as retrofits to already completed projects. This is also the case for wildlife crossing projects. The NCDOT has helped create many effective wildlife crossing projects throughout North Carolina – and within the DCHC MPO planning area – and wildlife crossing considerations should be part of the earliest stages of each transportation planning process to address WVCs proactively at the beginning to avoid costly remediation projects later. Wildlife crossings should be considered during the planning for each transportation project.

Vehicle Speed Reduction and Road Design

Vehicle speed reduction is often cited as a vital step to increased road safety for people, as decreased speeds allow for increased time for drivers to react, and reducing vehicle speed may also decrease the likelihood of WVCs for the same reasons. It is well documented that drivers travel at the speed at which the road was designed rather than the posted speed limit. Many of the roadways that experience high numbers of WVCs have been designed with wide travel lanes, gentle curves, and long sightlines that can create conditions for speeding and distracted driving. In addition, roadways have fragmented habitats for wildlife with various movement abilities and speeds. Therefore, roads designed for lower vehicular speeds and an increased ability to react could help generate fewer WVCs.[38]

Public Education and Awareness Campaigns

Public education and awareness campaigns are a cost-effective way to both inform the public about the potential hazard of WVCs, to promote steps that have been taken to address these hazards, and to share local projects that have incorporated wildlife crossing countermeasures. NCDOT administers a public education and awareness campaign in the Fall to coincide with the documented increase in WVCs resulting from factors like it being darker earlier in the evening and deer mating season. Organizations including the NCWRC, the North Carolina Wildlife Federation, and news agencies, administer awareness campaigns as well. Public education and awareness should continue with increased frequency to help reduce WVCs year-round.

2.3.3 Examples of Wildlife Crossing Projects in the DCHC MPO Planning Area

US 15-501 Bridge over New Hope Creek in Durham County

The bridge on US 15-501 over New Hope Creek in Durham County (Figure 2.3.3.1) is a transportation project in partnership between NCDOT, NCWRC, and others that incorporated wildlife crossing countermeasures. The location of this site was identified as an important wildlife passage – particularly for white-tailed deer – because the natural and riparian areas associated with New Hope Creek create a wildlife corridor between Duke Forest to the north and B. Everett Jordan Lake to the south.[39] Completed in 2007, the bridge span was lengthened by approximately 160 feet. The lengthening created space on both sides of New Hope Creek to develop wildlife benches, which has improved wildlife connectivity and promotes movement underneath the bridge and along this corridor. While fencing is often incorporated as part of wildlife crossing bridge projects, the site's surrounding urban land use prevented fencing from being a viable option due to its relatively short range.[40] Since completion, evidence from camera trap data has shown that the new bridge has increased passage under US 15-501 for a variety of wildlife species.[41] To help ensure this site continues to promote wildlife connectivity under the bridge, land conservation efforts should be explored that include the acquisition of remaining natural lands adjacent to the site.

Figure 2.3.3.1: US 15-501 bridge over New Hope Creek in Durham County, NC. DCHC MPO.

US 70 Bridge over the Eno River in Orange County

The bridge on US 70 over the Eno River, east of Hillsborough in Orange County (Figure 2.3.3.2) is a transportation project in partnership between NCDOT, NCWRC, and others that incorporated wildlife crossing countermeasures. This project was completed in 2022, which lengthened the span to 265 feet (27 feet longer than the original), installed guardrails, and was designed to accommodate the potential for a greenway to be developed underneath. To enhance wildlife connectivity underneath the bridge, a riprap remediation was completed in 2023 that constructed a wildlife passage benches on both sides of the Eno River.

Figure 2.3.3.2: US 70 bridge over Eno River in Orange County, NC. Southeast side. DCHC MPO.

Figure 2.3.3.3: US 70 bridge over Eno River in Orange County, NC. Northwest side. DCHC MPO.

2.4 Core Technical Team

A Core Technical Team (CTT) was formed to help guide the development of DCHC MPO's Wildlife Crossing Plan. The seventeen member CTT was comprised of stakeholders from DCHC MPO's member governments, its NCDOT highway divisions, and environmental and conservation agencies and institutions. The CTT met four times throughout the planning process; April, June, August, and October 2024.

The following stakeholder agencies participated on the CTT:

- Chatham County
- Durham County
- Orange County
- Town of Carrboro
- Town of Chapel Hill
- Town of Hillsborough
- City of Durham
- Durham City-County Planning
- NCDOT Division 5
- NCDOT Division 7
- NCDOT Division 8
- Wildlands Network
- North Carolina Wildlife Resources Commission
- Duke University
- Southern Environmental Law Center
- Triangle Land Conservancy
- DCHC MPO

2.5 Public Engagement Process

The MPO's wildlife crossings planning study included an extensive public engagement process. Throughout the planning process, updates were presented to the MPO's Technical Committee and Policy Board, as well as to organizations such as the Triangle Connectivity Collaborative and the North Carolina Wildlife Connectivity Coalition. A project webpage was created that included the study's background and purpose, updates, and contact information.

Figure 2.5.1 Public engagement event at Chapel Hill Farmers Market in Chapel Hill, NC. DCHC MPO.

The 21-day public engagment period occured between October 1 - 21, 2024. The public engagement activities included:

- Eight public engagement events offered throughout the MPO's planning area in virtual, hybrid, and in-person formats.
- An online survey using ArcGIS Survey123 in both English and Spanish languages. For in-person events, MPO staff utilized iPads to capture survey responses, and paper version of the survey (Appendix M). A total of 129 surveys were received, and the full results can be found in Appendix N.
- A project webpage updated that included all details of the public engagement events, the draft plan for review, the online survey, and a webmap of the project recomendations.
- An awareness campaign that included targeted social media advertisements, and project information distribution by the MPO's partners.

Figure 2.5.2 Public engagement event at Carrboro Farmers Market in Carrboro, NC. DCHC MPO.

The main themes public input indicated are:

- Feedback from people's personal experiences shows that building wildlife crossings is important for keeping both people and animals safe.
- Protecting natural areas for wildlife is a key step in helping animals move around, keeping their habitats safe, and ensuring safe wildlife passage through our transportation network.
- We need to develop infrastructure that supports wildlife crossings, connects wildlife habitats, and allows people to coexist with wildlife.
- Based on survey responses, wildlife-vehicle crashes and roadkill impact human physical and mental health, have contributed to financial losses, and have caused animal suffering and death.

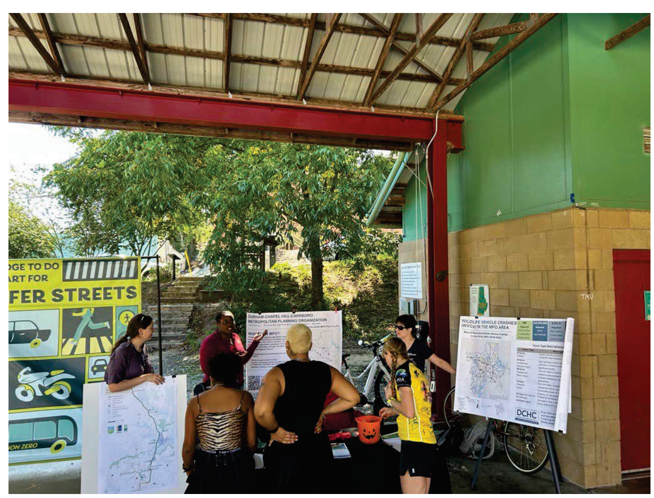

Figure 2.5.3 Public engagement event at Move-a-Bull City event in Durham, NC. DCHC MPO.

2.6 Cost-Benefit Analysis

Conducting a cost-benefit analysis can help inform decision making by comparing the estimated cost of a project with the anticipated benefits. In terms of wildlife crossing projects, a cost-benefit analysis can compare the cost of a countermeasure (i.e. wildlife fencing, passage benches, riprap remediation, wildlife tunnels, etc.) with the variety of costs saved from reducing WVCs (i.e. personal injury, loss of life, medical expenses, vehicle repair, property damage, carcass removal, etc.), including the value to the public of having the animal as part of the ecosystem. The total calculated cost of reducing a WVC – or break-even threshold – can be used to compare the total cost of the project, to understand the length of time it will take to reach the cost benefit.[42]

Estimating Costs

Cost estimation is associated with the construction and maintenance of the proposed infrastructure countermeasure. The estimated monetary benefit is derived from the reduction in the number of WVCs over the infrastructure's lifetime. Table 2.6.1 lists generalized wildlife mitigation cost estimates that were developed by New Mexico DOT and Colorado DOT as part of the New Mexico Wildlife Corridors Action Plan (2022), correspondence with U.S. Fish & Wildlife Service, and correspondence with NCDOT. The cost estimates are meant to compare project costs without requiring further site-specific analysis, which should occur once actual project-specific planning begins.

Estimating Benefits

Benefits of proposed countermeasures can be estimated based on the cost per WVC incident, and how much these costs are expected to be reduced over the life of the countermeasure. While WVC data reported by NCDOT may not identify all WVC crashes that have occurred in an area or site since it is based on law enforcement agency reports alone (as described in Section 1.4) – and a comparison of this data to WVC insurance claims has identified that WVCs are occurring more frequently than what is being reported – it can be used as a starting point. As part of the site identification process for this plan, the MPO used a one-mile buffer around potential crossing sites to identify all WVCs in the area - the total number of WVCs cited for each site could be used to estimate the potential number of WVC reductions.

The NCDOT Transportation Mobility and Safety Division periodically updates costs associated with traffic crashes for cost analyses. Table 2.6.2 displays the monetary values associated with AVCs as published by NCDOT in its 2023 Standardized Crash Cost Estimates for North Carolina[43] report. Elements that go into NCDOT's comprehensive crash cost estimate include medical expenses, emergency services, victim work loss, employer costs, traffic

Table 2.6.1: Wildlife mitigation cost estimates based on NMDOT Wildlife Corridors Action Plan (2022), U.S. Fish & Wildlife Service, and NCDOT.

Structure and Mitigation Type	Cost Estimate	Structure and Mitigation Type	Cost Estimate
14-foot x 14-foot concrete box culvert (CBC) (2-lane) *	$1,430,000	14-foot x 14-foot concrete box culvert (CBC) (4-lane) *	$2,280,000
2-lane pipe arch underpass *	$1,840,000	4-lane pipe arch underpass *	$3,230,000
2-lane underpass bridge *	$1,070,000	4-lane underpass bridge *	$2,520,000
2-lane overpass *	$4,460,000	4-lane overpass with median *	$7,280,000
4-lane overpass without median *	$7,430,000	Wildlife tunnel **	$100,000
Fence per mile *	$100,000	Wildlife Bench Installation and Riprap Placement Retrofit***	$335,000

* NMDOT Wildlife Corridors Action Plan
** U.S. Fish & Wildlife Service
*** NCDOT Cost from Bridge over Eno River on US 70 Bypass project

delay, property damage, and quality of life. Information about crash types can be found in NCDOT's DMV-349 Instructional Manual.[44]

The DCHC MPO developed cost benefits for each project recommendation, which can be found in each project sheet. Each cost benefit was developed by identifying the injury type and number of WVCs within a one-mile buffer of the recommended wildlife crossing site (A Injury, B Injury, Non-Injury Crash, etc.), and then multiplying the number of crash type to its associated cost estimate described in NCDOT's 2023 Standardized Crash Cost Estimates for North Carolina report.

Table 2.6.2: Cost per Crash – Animal Crashes (2023 Standardized Crash Cost Estimates for North Carolina, NCDOT).

Crash Type	**Cost Per Crash – 2023 Dollars**
Fatal Crash	$11,498,000
A Injury Crash	$604,000
B Injury Crash	$187,000
C Injury Crash	$107,000
Property Damage Only Crash	$15,000
Average Crash	$25,000
Injury Crash (F+A+B+C)	$282,000
Non-Fatal Injury Crash (A+B+C)	$154,000
Severe Injury Crash (F+A)	$2,884,000
Moderate Injury Crash (B+C)	$133,000

As part of each project recommendation sheet found in Section 3, both the reported WVCs and associated crash cost estimates, and the likely WVCs and associated crash cost estimates (based on the Virginia DOT Review of Animal-Vehicle Crash Data found in Section 1.4: Reported Wildlife-Vehicle Crash Data of this plan), are included. Table 2.6.3 summarizes the reported and likely WVCs and assocated crash cost estimates for these projects by county. The number of WVCs and crash cost estimates in Table 2.6.3 pertain to only the project sites identified in this plan; they do not pertain to every reported WVC and related crash cost estimate in the MPO's planning area.

Additional costs associated with WVCs that can be factored in to estimate the benefit of a countermeasure – while more difficult to quantify – include animal carcass removal, increases to vehicle insurance, emotional stress on both humans and wildlife, the benefit of wildlife to humans and what loss of wildlife means (ecosystem services), and the hunting value lost of an animal per collision.

Virginia DOT Case Study

To address wildlife-vehicle collisions and the costly toll they inflict, the Virginia DOT identified two sites along Interstate 64 to implement countermeasures. Fencing was installed at a bridge over a creek, and a culvert, which helped guide deer, black bears, foxes, and other wildlife through the crossing instead of on the road. The Virginia DOT reported a 90% decline in roadkill and determined that the fences had paid for themselves within two years.[45]

Table 2.6.3: Reported and Likely Wildlife-Vehicle Crashes and Cost Estimates for Wildlife Crossings Plan Project Recommendations (Animal-Vehicle Crash Data (2018-2022), NCDOT; 2023 Standardized Crash Cost Estimates for North Carolina, NCDOT).

DCHC MPO County	**Reported**		**Likely**	
	WVCs	**Cost Per Crash – 2023 Dollars**	**WVCs**	**Cost Per Crash – 2023 Dollars**
Chatham	56	$1,482,000	467.5	$12,624,000
Durham	141	$4,259,000	1,198.5	$36,200,500
Orange	183	$5,229,000	1,555.5	$44,446,500
Total	**380**	**$10,970,000**	**3,221.5**	**$93,271,000**