Chapter 4. Guidance for CHANJ Cores and Corridors

- Road Mitigation Practices -

Skip to Best Practices for Wildlife Passage Systems

PRIORITIZING CONSERVATION ACTIONS

The Cores, Corridors, and Road Segments depicted in the CHANJ Mapping are meant to highlight the most advantageous places to implement conservation actions for wildlife connectivity, as they represent New Jersey's most contiguous remaining habitat areas and the best opportunities to keep those areas functionally linked. But when viewing this mapping from a broad, even statewide scale, tackling the connectivity challenge can seem very daunting. With resources being limited, it is important to prioritize our actions to have the greatest positive impact.

One approach is to prioritize areas based on high Biological Value and Opportunity or Need. Figure 4.1 offers scenarios from the CHANJ Mapping where conservation action – **Habitat Protection**, **Habitat Restoration and Management**, or **Road Mitigation** – would be most beneficial to terrestrial wildlife connectivity based on criteria of Biological Value and Opportunity or Need. The **CHANJ Web Viewer** provides supplemental mapping layers, detailed in the About section, to inform decision making as well. Revisit Chapter 2 of the full **Guidance Document** for details on how the mapping was developed.

Conservation Action Guidance for Roads

Biological Value	Opportunity or Need
Mitigate road barriers when… Priority terrestrial wildlife, such as Federal or State listed species or Species of Greatest Conservation Need (see Appendix B of NJ's **Wildlife Action Plan**) are documented along or in close proximity to a CHANJ Road Segment. Look for a completed CHANJ Road Segment Report and/or adjacent habitat intersections with NJDEP **Landscape Project** mapping.	*Mitigate road barriers when…* A road transect is mapped as a CHANJ Road Segment, indicating it is within Core or Corridor habitat and is not adjacent to urbanization. The darkest black Road Segments represent the most severe barriers to wildlife movement, with high traffic volumes (>10,000/day), and are therefore among the highest priorities for mitigation. Look for a completed CHANJ Road Segment Report for more information, or if one does not exist, assess the location for opportunity and need.
Mitigate road barriers when… A diversity and/or abundance of wildlife have been documented crossing or attempting to cross at the CHANJ Road Segment. Look for a completed CHANJ Road Segment Report for these details.	*Mitigate road barriers when…* Habitat is protected and managed on both sides of the barrier. It is better to invest in a wildlife passage system where adjacent lands are likely to remain wildlife-friendly, and the risk of conversion or development is low. Check the CHANJ Road Segment's proximity to Terrestrial Wildlife Habitat Preserved Land (a **CHANJ Web Viewer** layer).
	*Mitigate road barriers when…* A high number of wildlife-vehicle collisions have been reported along a CHANJ Road Segment. Look for a completed CHANJ Road Segment Report for these details.
	Mitigate road barriers when… The CHANJ Road Segment intersects with a transportation plan, such as the **NJDOT Statewide Transportation Improvement Program** or a municipal plan, or a regulatory nexus mitigation opportunity (e.g., Flood Hazard Area Control Act, Freshwater Wetlands Protection Act).

Figure 4.1. Guidance for prioritizing areas for conservation action. Implementers can take strategic action for habitat connectivity by prioritizing CHANJ-mapped areas of high *Biological Value* and *Opportunity or Need* that fall within the region of interest or jurisdiction. (Adapted from **CorridorDesign**, accessed 11/2017)

TAKING CONSERVATION ACTION

*The three types of conservation actions – **Habitat Protection**, **Habitat Management and Restoration**, and **Road Mitigation** – are not only important on their own; they are critically intertwined in the effort to secure and improve functional habitat connectivity. A wildlife tunnel will not function well if the land on one side is not protected and gets converted into a parking lot, just as a large protected area may become an "island" if it's surrounded by unsuitable land uses or bisected by a high-traffic roadway, preventing wildlife from getting from one side to the other. Indeed, taking effective action for wildlife connectivity requires a great deal of thought and collaboration.*

Once the opportunities for conservation action have been evaluated and priorities set, the next step is to find the resources to protect, restore, and/or manage those habitats or facilitate movement across roads that we've identified as important to New Jersey's landscape connectivity. Fortunately, New Jersey has a large and well-established network of land trusts and stewardship organizations ready to guide and assist with land acquisition and management. Some of these potential partners are listed in the **Habitat Protection, Restoration, and Management section** of Chapter 4 of the full **Guidance Document**. The road mitigation network is currently far smaller, but a few resources to guide and/or fund road mitigation projects are listed near the end of this chapter.

To further coordinate proactive, collaborative conservation amongst implementers, we are developing CHANJ Action Teams for the northern, central, and southern regions of New Jersey. The CHANJ Action Teams are a network of partners from the land use, conservation and transportation fields who can be alerted to important opportunities for land acquisition, habitat restoration, and other conservation actions as they come up. See Chapter 5 for more information on the CHANJ Action Teams framework.

CONSERVATION ACTION: ROAD MITIGATION

A critical step in restoring wildlife connectivity is facilitating the movement of animals across roads. Installation of crossing structures with wildlife fencing (Figure 4.2) is an effective means of reducing wildlife vehicle collisions and allowing safe movement across road barriers, thus maintaining connectivity. These wildlife passage systems can be in the form of new structures and fencing or retrofits to existing culverts or bridges. While road mitigation measures are still unfamiliar to many resource managers and planners, it is well known within the road ecology community that mitigation measures (structures and fencing) that are designed properly, implemented in the correct locations, and well-maintained are very effective at providing safe passage across roadways and reducing road mortality for a variety of animals, from large mammals to small amphibians. These measures also help to safeguard drivers from the property damage and personal injury that can result from wildlife collisions.

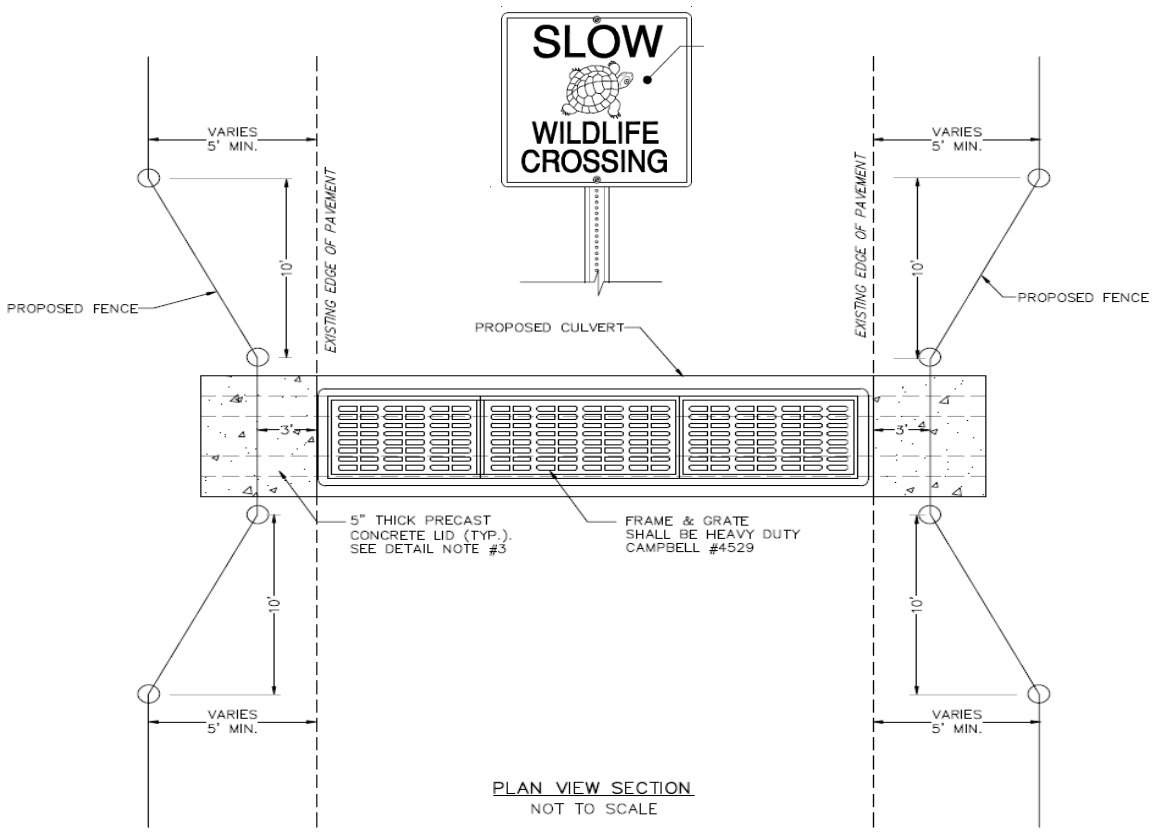


Figure 4.2. An example schematic of a grated-top crossing structure, showing tie-in with fencing.

As road mitigation projects become more commonplace, it is important to monitor and evaluate their effectiveness at achieving our conservation goals to justify the use of limited available resources, to adaptively manage projects, and to improve road mitigation techniques over time.

CHANJ incorporates several tools to assist in planning, monitoring, and tracking road mitigation projects. The tools are described in Table 4.I, along with where you can find them.

Table 4.I. Tools to inform and track road mitigation projects in New Jersey.

Road Mitigation Tools		
Tool	**Description**	**Where to Find It**
CHANJ mapping layers	Consists of habitat Cores, Corridors, and Road Segments. The Road Segments identify areas where Cores and Corridors are intersected by road barriers of varying severity. These serve as starting points for targeting road/wildlife mitigation efforts.	CHANJ Web Viewer; Tools of CHANJ webpage
Road Segment Reports	Describes what is known about a Road Segment based on a variety of monitoring approaches conducted at that location (e.g., GIS analyses, roadkill surveys, camera monitoring, culvert assessment, genetic analyses) and provides recommendations on the design of a wildlife passage system.	Report Outline – Appendix I of the Guidance Document
Culvert Inventory	The NJ portion of the regional (13-state) North Atlantic Aquatic Connectivity Collaborative (NAACC) database identifies road/stream crossing structures across the state. For those that have been surveyed following NAACC protocols, the Culvert Inventory displays results and a wildlife passability rating (from "No" barrier to "Severe" barrier).	CHANJ Web Viewer; Available as its own NJDEP NAACC Web App; Tools of CHANJ webpage;
Best Practices for Wildlife Passage Systems	Guidelines for designing effective crossing structures and guide fencing for terrestrial wildlife, small to large.	Next in this Chapter; By clicking any Road Segment in the CHANJ Web Viewer;
Road Wildlife Mitigation Projects Database	A central repository for information on permitted and constructed wildlife passage systems across the state. Can be used to help inform future projects.	CHANJ Web Viewer

BEST PRACTICES FOR WILDLIFE PASSAGE SYSTEMS

These best practices are a short guide to designing effective wildlife passage systems for terrestrial wildlife species of various mobility guilds. Table 4.II lists the species belonging to each of the mobility guilds referenced throughout the guide. Wildlife passage systems might include under-road tunnels or overpasses, with guide walls or fencing to funnel movement. Fencing plays a critical function in intercepting animals as they approach the roadway and directing them to the crossing structure. Wildlife passage systems do not always need to be new structures. In many cases, existing bridges, culverts, and underpasses can be modified to accommodate the needs of wildlife.

Please note that construction of new crossing structures, or the replacement, modification or rehabilitation of existing structures, may require permits or approvals from agencies with local, State, or Federal jurisdiction. For information on potential State jurisdiction under the Flood Hazard Area Control Act Rules (NJAC 7:13) or the Freshwater Wetlands Protection Act Rules (NJAC 7:7A), contact the NJ DEP Division of Land Use Regulation at (609) 777-0454.

Table 4.II. Species belonging to low mobility, moderate mobility, high mobility, and high openness guilds.

Low Mobility Terrestrial Wildlife					
Mammals		**Reptiles**		**Amphibians**	
Allegheny Woodrat * (E)	Water Shrew *	Bog Turtle * (E)	Red-bellied Snake	Allegheny Mountain Dusky Salamander *	Green Frog
Eastern Chipmunk	White-footed Mouse	Common Five-lined Skink *	Rough Greensnake *	American Bullfrog	Jefferson Salamander * (SC)
Eastern Mole	Woodland Jumping Mouse *	Common Gartersnake	Smooth Earthsnake *	American Toad	Marbled Salamander * (SC)
Hairy-tailed Mole *	Woodland Vole	Dekay's Brownsnake *	Smooth Greensnake *	Atlantic Coast Leopard Frog *	New Jersey Chorus Frog *
Least Shrew *		Eastern Box Turtle * (SC)	Spotted Turtle * (SC)	Blue-spotted Salamander * (E)	Northern Dusky Salamander *
Long-tailed Shrew *		Eastern Fence Lizard *	Wood Turtle * (T)	Carpenter Frog * (SC)	Northern Red Salamander *
Masked Shrew		Eastern Mud Turtle *		Cope's Gray Treefrog * (E)	Northern Slimy Salamander *
Meadow Jumping Mouse *		Eastern Musk Turtle		Eastern Cricket Frog *	Northern Spring Salamander *
Meadow Vole		Eastern Painted Turtle *		Eastern Long-tailed Salamander * (T)	Northern Two-lined Salamander *
Pygmy Shrew *		Eastern Ribbonsnake *		Eastern Mud Salamander * (T)	Pickerel Frog
Short-tailed-shrew		Eastern Wormsnake *		Eastern Red-backed Salamander	Pine Barrens Treefrog * (T)
Smoky Shrew *		Little Brown Skink *		Eastern Spadefoot *	Red-spotted Newt
Southern Bog Lemming *		Northern Diamond-backed Terrapin *		Eastern Tiger Salamander * (E)	Southern Leopard Frog *
Southern Red-backed Vole		Northern Ring-necked Snake *		Four-toed Salamander *	Spotted Salamander *
Star-nosed Mole *		Northern Scarletsnake *		Fowler's Toad * (SC)	Spring Peeper
Tuckahoe Masked Shrew *		Queensnake * (E)		Gray Treefrog	Wood Frog

(Continued on next page) E – State Endangered; T – State Threatened; SC – State Special Concern; * – NJ Species of Greatest Conservation Need (SGCN; from New Jersey's Wildlife Action Plan)

Moderate Mobility Terrestrial Wildlife			High Mobility Terrestrial Wildlife	High Openness Fauna
Birds	**Mammals**	**Reptiles**	**Mammals**	**Mammals**
American Bittern * (E)	American Beaver	Eastern Hog-nosed Snake *	Black Bear	White-tailed Deer
American Black Duck *	Common Raccoon	Eastern Kingsnake * (SC)	Bobcat * (E)	
American Woodcock *	Eastern Cottontail	Eastern Milksnake	Common Gray Fox	**Insects**
Black Rail * (E)	Eastern Gray Squirrel	Eastern Ratsnake *	Coyote	Frosted Elfin * (T)
Clapper Rail *	Ermine	Northern Black Racer *	Fisher *	Georgia Satyr * (SC)
King Rail *	Long-tailed Weasel	Northern Copperhead * (SC)	Northern River Otter	Northern Metalmark * (SC)
Least Bittern * (SC)	Marsh Rice Rat *	Northern Pinesnake * (T)	Red Fox	Silver-bordered Fritillary * (T)
Northern Bobwhite *	Mink	Northern Red-bellied Cooter *		
Ruffed Grouse *	Muskrat	Northern Watersnake		
Virginia Rail *	Northern Flying Squirrel *	Red Cornsnake * (E)		
Whip-poor-will * (SC)	Porcupine	Snapping Turtle		
Wild Turkey	Red Squirrel	Timber Rattlesnake * (E)		
	Southern Flying Squirrel			
	Striped Skunk			
	Virginia Opossum			
	Woodchuck			

(Continued from previous page) E – State Endangered; T – State Threatened; SC – State Special Concern; * – NJ Species of Greatest Conservation Need (SGCN; from New Jersey's Wildlife Action Plan)

Table 4.III. Wildlife passage system structure specifications recommended for different species mobility guilds.

Wildlife Passage System: Structure Specifications													
SPECIES GUILD	STRUCTURE TYPE*	SUBSTRATE	SPAN (if conveying water)	WIDTH (internal)		HEIGHT (internal)		LENGTH		SPACING of STRUCTURES		GRATED TOP (openings along road surface for climate)	
				recommended	*min*	*recom'd*	*min*	*recom'd*	*max*	*recom'd*	*max*	*recom'd*	*min*
Low mobility	Open bottom bridge / culvert	Leave natural	1.2x bankfull width at both ends, minimum	2'	18"	2'	1'	≤ 40'	125'	120'	200'	Entire length	At ends
	Box, circular, or elliptical culvert	Backfill with >6" natural substrate											
Moderate mobility	Open bottom bridge / culvert	Leave natural	1.2x bankfull width at both ends, minimum	4'	3'	4'	3'	≤ 40'	125'	500'	1,000'	Entire length	At ends
	Box, circular, or elliptical culvert	Backfill with >6" natural substrate											
High mobility	Open bottom bridge / culvert	Leave natural	1.2x bankfull width at both ends, minimum	8’	6’	8’	6’	≤ 40'	125'	500’	1 mile	-	-
	Box, circular, or elliptical culvert	Backfill with >6" natural substrate											
High Openness Fauna	Open bottom bridge / culvert	Leave natural	1.2x bankfull width at both ends, minimum	20’	10’	10’	8’	≤ 40'	125'	0.5 miles	1 mile	-	-
	Box, circular, or elliptical culvert	Backfill with >6" natural substrate											
NOTES:	• Tunnel should be perpendicular to road, situated at base of slope below road grade, completely level or minimum grading (3%) • Design for the needs of all species utilizing the area; multiple structures of different types and sizes may be preferable, and in general, the bigger the better. • Maximize continuity of native vegetation, natural material (e.g., rocks, logs), and soils adjacent to and within structure • * Overpasses are effective across all species guilds, especially when designs include natural substrate, continuous vegetation cover, a diversity of microhabitats, and separation from human use areas.												

Table 4.IV. Wildlife passage system specifications for shelves and dry pathways recommended for different species mobility guilds.

Wildlife Passage System: Shelf / Dry Pathway Specs					
SPECIES GUILD	**WIDTH** of shelf / dry pathway (Structure width specs still apply)		**CLEARANCE** from pathway surface to ceiling		**SHELF / PATHWAY MATERIAL and PLACEMENT** (Applies to all species guilds)
	recommended	*minimum*	*recommended*	*minimum*	
Low mobility	2′	18″	2′	1′	• No exposed gabion baskets or rip-rap should be used for shelf or dry pathway, as these materials are difficult or dangerous for many types of wildlife to traverse; • If the structure conveys water, a shelf or dry pathway should be available on both sides inside the structure; • Pathway should be above the high water line of 2-year storms; • A transition ramp or extended pathway should connect the shelf or dry pathway to the landscape around it at both ends of the structure, mimicking surrounding substrate and vegetation.
Moderate mobility	4′	3′	4′	3′	
High mobility	4′	3′	5′	4′	
High Openness Fauna - deer	4′	3′	10′	8′	

Table 4.V. Wildlife passage system fencing and guide wall specifications recommended for different species mobility guilds.

<table>
<tr><th colspan="4">Wildlife Passage System: Fencing and Guide Wall Specs</th></tr>
<tr><th>SPECIES GUILD</th><th>FENCE HEIGHT</th><th>MATERIAL</th><th>ORIENTATION
(Applies to all species guilds)</th></tr>
<tr><td>Low mobility</td><td>≥ 1.5'</td><td>Solid/opaque material that is smooth and non-grippable to climbing animals (e.g., firm plastic, concrete, treated wood)</td><td rowspan="5">• Fencing should be angled 25-45 degrees from the road to create a funnel effect toward the crossing structure
• No gaps should exist between the fencing and passage structure, as animals may slip through
• Fencing should be buried 6-12" into the ground to prevent animals from burrowing under
• Top of fencing should have an overhang or "lip" up to 12” long on the side facing the habitat, to prevent breaching by climbing animals (particularly important for reptiles and amphibians and some mammals)
• Consider all species likely to utilize the passage structure when choosing the fence material and design
• Regular maintenance is critical for identifying problems and making timely repairs</td></tr>
<tr><td rowspan="2">Moderate mobility</td><td rowspan="2">3-6'</td><td><u>For Reptiles/Amphibians</u>:

Solid/opaque material that is smooth and non-grippable to climbing animals (e.g., firm plastic, concrete, treated wood)</td></tr>
<tr><td><u>For All Other Species</u>:

See-through materials are acceptable and may include fine wire mesh, hardware cloth, welded-wire fence, etc. (max 1" x 1" mesh size)</td></tr>
<tr><td>High mobility</td><td>6’</td><td>Fencing should have max mesh openings of 2” x 4”, and bottom 4 ft. should be a smooth, non-grippable surfaces such as fine wire mesh or flashing for climbing animals.</td></tr>
<tr><td>High Openness Fauna - deer</td><td>8-9’</td><td>Woven metal wire fence with 6” x 6” mesh size</td></tr>
</table>

Structure Type and Materials

A. In stream/wetland/riparian environments:
    1. Open-bottom structures that preserve natural ground substrate and hydrology are preferred. When feasible, the structure should span a minimum of 1.2 times the bankfull width to allow dry passage on both sides of watercourse. *(Bankfull width is the distance between a stream or water body's top-of-banks at normal full water level.)*
    2. Four-sided box culverts and circular or elliptical culverts should be backfilled with native substrate (>6 inches deep) while still meeting minimum internal height recommendations (Table 4.III). Ensure that the substrate will remain stable against velocities of the stream.
B. In upland environments:
    1. Open-bottom structures are preferred to maintain continuity of the natural substrate.
    2. Four-sided box culverts and circular or elliptical culverts should be backfilled with native substrate (>6 inches deep) when possible, while still meeting minimum internal height recommendations (Table 4.III).

Placement

C. Install the structure perpendicular to the road it crosses to allow for a clear line-of-sight through the structure. The shorter the structure length, the better for wildlife movement.
D. Tunnels should be designed to conform to local topography and should be situated at the base of the slope below the road grade.
E. Install the structure parallel with the stream flow through it, when applicable.

F. The structure should be installed completely level or with minimal grading (up to 3%), both at the entrances and throughout the tunnel.

G. On divided highways, structures should be continuous across all lanes, below-grade, and should not open up in the central median unless barrier fencing is in place to guide animals into the structures and to prevent animals from entering the highway.

Considering Species' Needs

For Low to Moderate Mobility Species:

H. Reptiles and Amphibians: A grated top or similar design is preferable, allowing natural light to enter the structure from above and helping to keep soil moisture, humidity and temperature consistent with ambient conditions. If a grated top option is not feasible for the entire length, consider grating at the structure's ends beyond the edge of roadway.

I. Small, low mobility species often need cover when moving through an open area in order to maintain body climate and/or to feel secure from predators. Their cover requirements can be met by placing, for example, PVC tubes of varying diameters and/or woody debris inside the structure, along the sides, spanning the entire length of the structure. Also ensure that cover is available outside the structure for continuity with surrounding habitats.

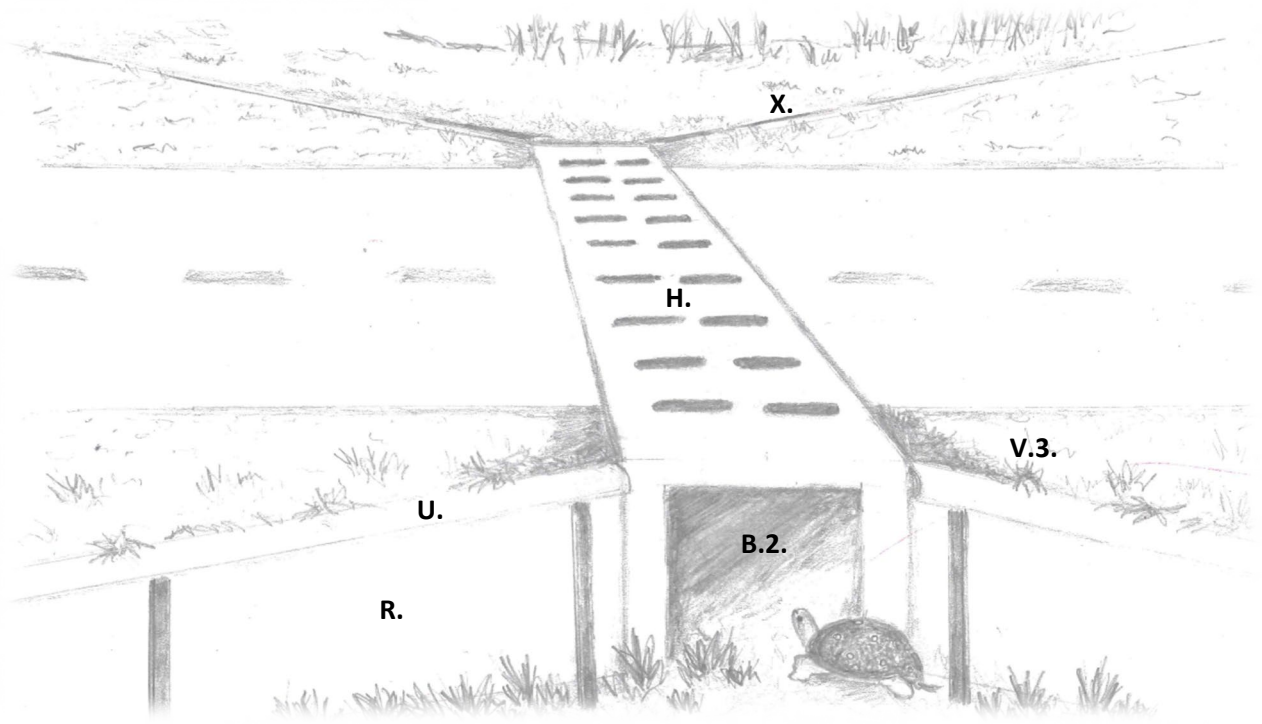


Figure 4.2. Sketch of a wildlife passage system appropriate for the low mobility species guild. This example uses a four-sided box culvert back-filled with natural substrate (described in B.2.) with a grated top (H.) and angled guide fencing (R.) with overhang (U.), on both sides of the road (X.). The back side (road side) of the fence is level with the earth (V.3.), allowing animals to escape the road.

For Moderate to High Mobility Species:

J. Semi-aquatic species such as river otters, muskrats, and beavers may not use structures unless aquatic habitat is present or nearby. Maintain riparian vegetation throughout the structure to encourage use by these species.

For ALL Species:

K. Having closely-spaced crossing structures representing a diversity of structure types and sizes creates safe passage opportunities for a variety of species guilds.

L. Minimize the intensity of noise and light coming from the road.

M. Maximize continuity of native vegetation, natural material (e.g., rocks, logs), and soils adjacent to and within the structure. Avoid importation of soils from outside the project area.

N. Riprap is difficult or even dangerous for many animal species to traverse and should not be placed in front of or on the slopes adjacent to a passageway. If riprap is required, then it should be buried, back-filled with topsoil, and planted with native vegetation; there should be no exposed

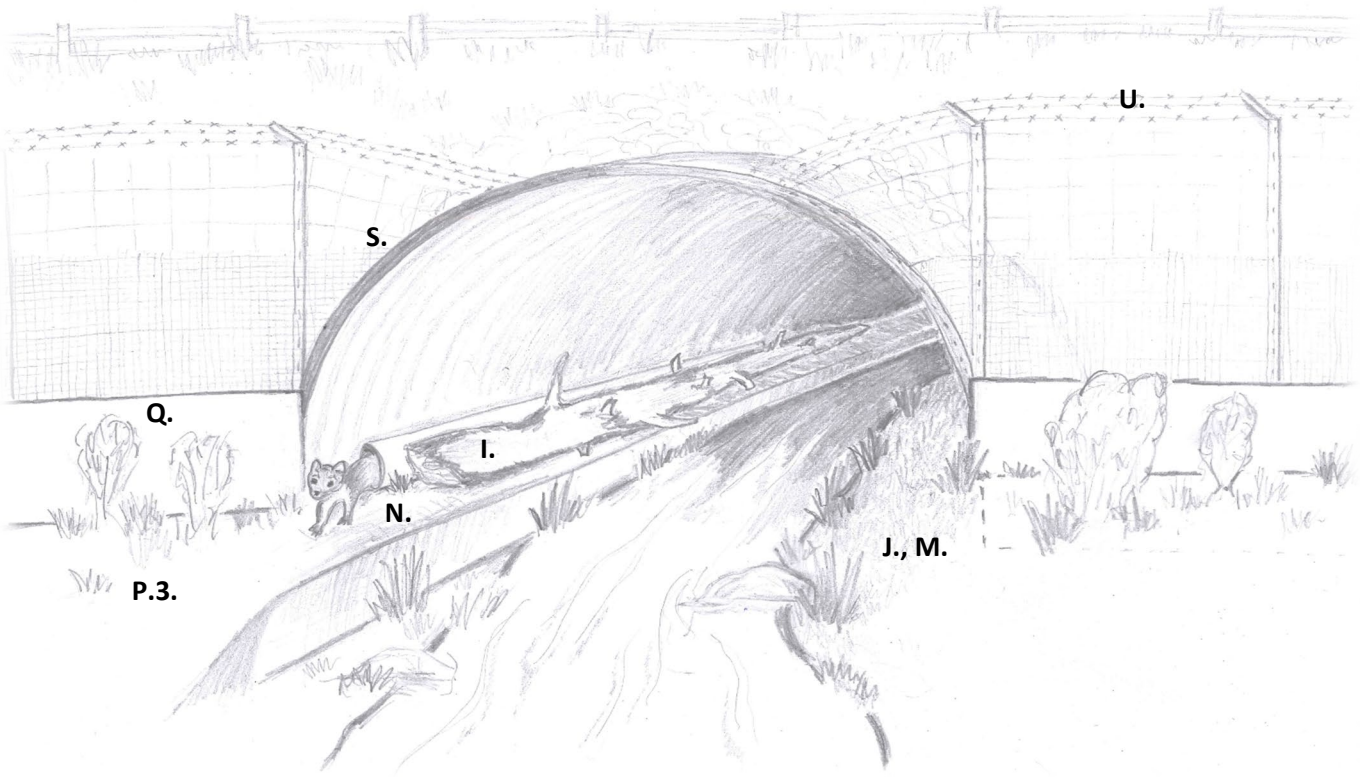
gabion baskets or mattresses. In situations with high stream velocity, an aggregate, sediment-choked riprap can be used to create a smooth surface while maintaining stability in accordance with FHA Rules, including N.J.A.C 7:13-12.7 (f)4.

O. Design drainage features such that runoff from the roadway and from flooding does not cause dry passageways within the structure to become submerged by standing or flowing water.

P. Structures that need to accommodate flowing water should maintain or replicate the stream's natural channel conditions as specified in the FHA Rules including N.J.A.C. 7:13-11.1 (b):

1. To facilitate passage by both aquatic and terrestrial species, the structure should be wide enough to provide dry passage with dry ground or an elevated shelf that is above the high water line of a 2-year storm. This can be accomplished by ensuring that the crossing structure width is at least 1.2 times that of the stream at normal full water level (1.2x bankfull width) on both ends of the structure. Width and height specifications for structures and dry passages are given in Tables 4.III and 4.IV, respectively.
2. The surface of the dry passageway should be set at or just above the vegetation line, which generally marks the 2-yr flood elevation. The intent of the dry passageway along a watercourse is to mimic a streamside wildlife trail (not a cliff!).
3. Dry passageways should be connected to traversable habitat on both sides of the road to allow for seamless animal movement. They may include a gently sloping ramp to transition from the passageway to the surrounding landscape.
4. Stream velocities and depths under a variety of flow conditions should replicate the stream's natural channel conditions and meet FHA Rules including N.J.A.C. 7:13-11.1(b).
5. Water flow should not be constricted within the structure and should not result in hydrologic drops or jumps upstream of, within, or immediately downstream of the structure. Refer to FHA Rules including N.J.A.C. 7:13-12.7(d)1 or (e)1 as appropriate.
6. The structure should provide continuity of stream bed materials, both in type and texture, allowing for similar passage conditions for animals that are sensitive to substrate.

Figure 4.3. Sketch of a stream culvert with a shelf on one side and natural dry pathway on the other to facilitate terrestrial wildlife passage (described in P.1.). This example includes a shelf with natural substrate and vegetation (no exposed riprap or gabion baskets; N.), woody cover and a PVC tunnel for small animals (I.), and a smooth transition between the shelf and adjacent habitats (P.3.). Both the shelf and dry pathway have natural vegetation throughout the structure for continuity (J., M.). The guide fencing is tiered for animals of all mobility guilds (Q.), includes an overhang to prevent climbing (U.), and attaches flush with the crossing structure entrance (S.).



Fencing and Guide Walls

Q. Fencing/guide walls should be designed based on all species likely to utilize the passage structure.

R. Fencing/guide walls should angle out from each end of the crossing structure at approximately 25-45 degrees to help funnel animals towards the structure.

S. Fencing/guide walls should attach flush with the crossing structure entrance, with no gaps that small animals might slip through. Avoid any surface irregularities that might impede or distract animals moving toward the entrance.

T. Fencing/guide walls should be buried 6-12 inches into the ground to prevent animals from digging under it or gaps from being created by erosion.

U. The top of fence should have a 6-12-inch overhang or "lip" to prevent breaching by climbing animals. This is particularly important for reptiles and amphibians and some mammals. The overhang should face the habitat side (angled away from the roadway).

1. Eliminate or maintain vegetation and materials that would allow animals to climb over the fence and onto the roadway.

V. The design should allow animals that do enter the roadway to safely escape it.
    1. Natural objects such as brush or woody debris (for climbing species), or ramps can be placed on the roadway side of the fence to allow escape.
    2. Backfilling with soil or adding textured materials to the road side of the fence gives animals the ability to climb over and escape from the road.
    3. The top of the guiding wall/fence can be installed level with ground on the road side, while still meeting minimum fence height recommendations (Table 4.V) on the habitat side.
    4. Earthen ramps or jump-outs can be employed for high mobility species and deer. They need to be of an appropriate height to allow animals to jump down and outside the roadway, but not back up and into the roadway. Also the non-road side should be non-grippable material to prevent animals from climbing up onto the roadway.

W. Fence ends should angle away from the road, orienting wildlife toward the natural habitat and away from the road.

X. Fencing should extend on both sides of the structure, along the entire length of suitable, traversable habitat. Fencing should extend to equal lengths on both sides of the road, as conditions allow.

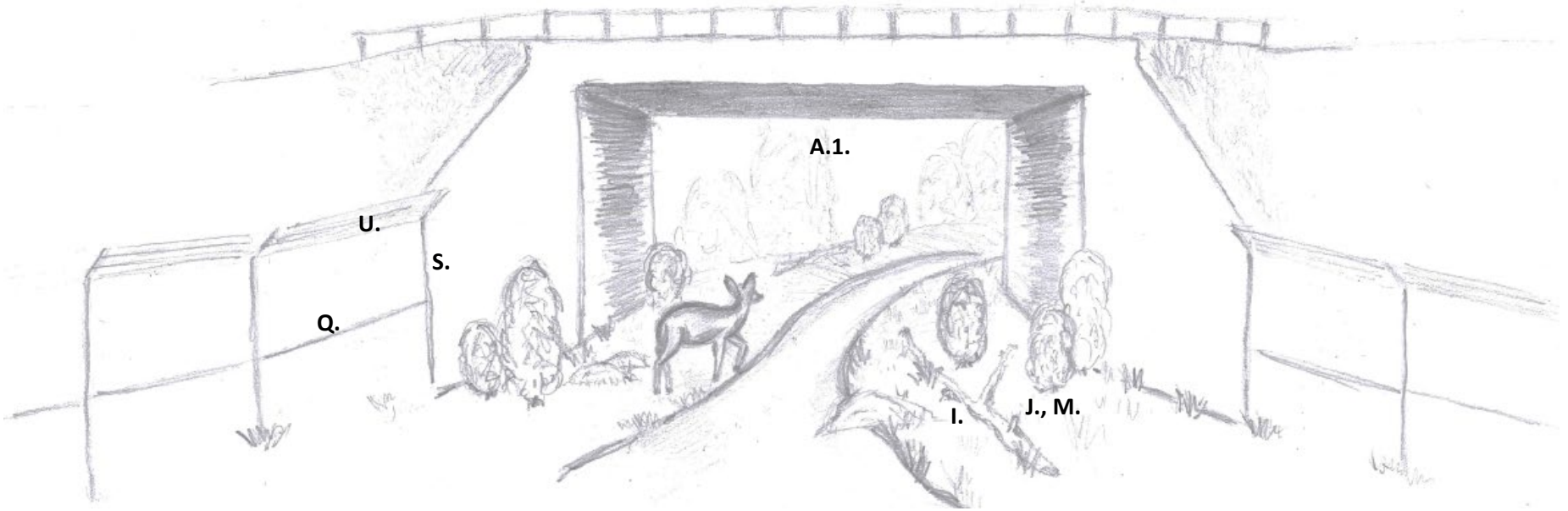


Figure 4.4. Sketch of a stream overpass suitable for all species mobility guilds, including the High Openness Fauna which are less apt to travel through confined spaces. The open-bottom structure spans at least 1.2 times the bankfull width to preserve natural stream and riparian conditions and to provide dry passage on both sides of watercourse (A.1.). The dry pathways have natural vegetation, logs, and rocks throughout the structure for continuity with adjacent habitat (J., M.) and cover for small animals (I.). The guide fencing could be tiered for animals of all mobility guilds (Q.); it includes an overhang to prevent climbing (U.) and attaches flush with the crossing structure entrance (S.)

MAINTENANCE

Wildlife passage systems should be thoroughly inspected and maintained on a routine basis to ensure good function. Maintenance should be done at least once per year, and perhaps more often depending on the intensity of use and the forces acting on the system (e.g., if vulnerable to tree fall, scouring, vandalism, etc.). The maintenance schedule may also vary based on the phenology of animals using the system, such as in preparation for early spring amphibian migrations or turtle nesting season. Crossing structures should be checked for obstacles, foreign matter, overgrown vegetation, or other issues within or near the structure that might affect wildlife use. Fencing should be checked for any damage, vandalism, gaps or breaches, fallen trees, or overgrown vegetation affecting its function. Make repairs and address any issues in a timely manner, prior to the target animals' seasonal movements or peak activity period, as applicable.

MONITORING

It is important to evaluate a passage system's effectiveness at allowing wildlife to move safely across the roadway. Monitoring should be seen as an integral part of road mitigation projects, and include an evaluation of both wildlife usage of the passage system as well as the amount of roadkill occurring at the location and adjacent areas before and after construction. These metrics tell us whether the project is achieving our conservation goals as planned, or if adaptive management is needed to make them more effective. Monitoring also helps us to justify investing in similar projects elsewhere and to improve road mitigation techniques over time.


Hundred Year Films

Monitoring protocols are always fairly specific to the site and situation, but certain methods have been developed and adapted over years of field-testing by various researchers and should be considered. Motion-triggered cameras (a.k.a. camera traps) are continually more dependable as technologies improve, with simpler field deployment, better image quality, increased file storage capacity, and better ability to capture a variety of species – including small, ectothermic, and nocturnal types. Cameras are particularly useful for monitoring animal usage of tunnels and other discrete structures. Well-thought roadkill survey protocols have also been developed to investigate the need for and the effectiveness of road mitigations for wildlife. Refer to the Appendix of the full **Guidance Document** for camera and roadkill survey protocols, among others.

ADDITIONAL GUIDANCE (DOs AND DON'Ts)

In addition to the main road mitigation tools and resources described earlier in this Chapter, Table 4.VI offers a short list of guidance to help minimize impacts to wildlife during everyday transportation planning. Many of these items are easy to implement; they simply need to become part of the lexicon, and eventually, the standard practice.

Table 4.VI. Guidance to minimize wildlife impacts in basic, broad-scale transportation planning.

Do	Do NOT
CURBING	
✓**Gently sloped or Cape Cod Curbing** • Allows small animals such as amphibians and turtles to easily and safely escape the roadway • Where sloped curbing is not convenient, provide escape slopes for small animals	✕ **Traditional Vertical Curbing** • Small animals cannot climb over, causing them to travel parallel to curb or into the roadway • Leads animals to fall directly into side box outlets
STORM DRAINS	
✓**Seasonal adaptation for storm drains** • In early spring during amphibian migration season, a wire mesh can be placed under grate to catch animals that fall in, if storm drain would otherwise be a trap (must check daily)	✕ **Storm drains with side box outlets** • Pose a trap to small animals that fall inside
NOISE BARRIERS	
✓**Noise barriers with openings at the bottom** • Openings allow wildlife to escape roadways • Recommended size of openings is 8”H x 18”W • Noise barriers in combination with wildlife crossing structures are ideal when habitat is present on both sides of the road	✕ **Noise barriers or walls without openings** • Trap animals on the road or prevent them from reaching habitat on the other side
BARRIER WALLS	
✓**Barriers of non-transparent materials or markings** • Opaque, non-transparent walls (such as concrete or wood) are less apt to have bird or bat strikes • Add markings or vertical striping <6” apart on transparent walls for visibility • Leave openings at the base of barriers for wildlife passage (see “NOISE BARRIERS”)	✕ **Barriers with clear or transparent walls** • Pose a collision risk to birds and bats, which frequently fly into them, causing injury or death
EROSION CONTROL FENCING	
✓**Biodegradable erosion control products** • Jute, sisal and coir fiber are examples of 100% biodegradable erosion control materials • Netting should be a loose weave to reduce wildlife entanglement	✕ **Plastic erosion netting** • Netting is an entanglement hazard for wildlife • These products require UV-light to degrade and do not break down properly in shaded forests

ADDITIONAL ROAD MITIGATION RESOURCES

The following are a couple of additional resources to guide and/or fund road mitigation projects for wildlife in our region:

The Roads and Wildlife Portal

The Roads and Wildlife Portal, a collaborative effort of the Staying Connected Initiative and Ontario Road Ecology Group, is a dynamic, interactive website to share information about road mitigation projects, guidance, designs, and studies related to maintaining and restoring connected habitats for fish and wildlife across eastern Canada and the northeastern United States.

Federal Highway Administration – Transportation Alternatives

The U.S. Department of Transportation's Federal Highway Administration reserves a set-aside of Surface Transportation Block Grant (STBG) program funding for "transportation alternatives," which can include environmental mitigation related to stormwater and habitat connectivity.

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