



**Maine Terrestrial Wildlife Crossings Survey Report:**  
***Potential for Retrofitting Transportation Infrastructure to  
Benefit Movement of Terrestrial Wildlife***

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# I. Introduction

Roads and associated traffic act as deterrents or barriers to movement between habitats of many terrestrial wildlife species. When wildlife cross roads, they are at risk of getting killed by vehicles and these collisions can be a safety issue for people too. Mortality from wildlife-vehicle collisions can reduce wildlife populations and for some sensitive species, exacerbate the threat of extinction. Wildlife must move to meet their daily life needs, to breed, and to disperse to new territories. Their ability to move and access necessary habitats will be even more urgent in the future as habitats shift across the landscape due to a changing climate.

Wildlife road crossings are a proven solution to help wildlife safely cross roads and prevent collisions with the traveling public. Identifying which sites are top priorities for building wildlife road crossings is important to best meet the needs of wildlife and use limited funding most effectively. Retrofitting culverts and bridges that are already in place is a cost effective approach for improving wildlife passage under roads. Where there are no dedicated wildlife crossing structures, retrofitting existing road structures can provide opportunities for wildlife to move safely between habitats, and improve permeability for wildlife along road segments. Retrofits can also be used to provide additional opportunities for wildlife to move complementing crossing structures built specifically for wildlife.

During the summer and fall of 2014, Maine Audubon and its partners — the Maine Department of Transportation, Maine Department of Inland Fisheries and Wildlife, and The Nature Conservancy — conducted a pilot project to survey and evaluate existing road crossings for retrofit potential. This project used the “Permeability of Existing Structures for Terrestrial Wildlife: A Passage Assessment System (PAS)” developed for the Washington State Department of Transportation in cooperation with the U.S. Department of Transportation, Federal Highway Administration (*Kintsch and Cramer 2011*).

## Project Goals

The goals of this pilot project were to investigate the following:

- What types of bridges and culverts are prevalent on the landscape in Maine?
- Can existing road crossing structures be retrofitted for wildlife passage?
- Which species groups can benefit from commonly used retrofit solutions?
- What types of retrofit solutions are possible for Maine’s existing bridges and culverts?
- Can this survey method be used to inform opportunities for integrating connectivity for terrestrial wildlife into already planned bridge and culvert replacement projects?
- How well does the PAS methodology work for the northeastern United States, and what, if any, modifications do we need to make for the northeast?

## **Study Areas**

The PAS was applied in two different landscapes in Maine, the northwestern mountains in Franklin and Oxford Counties and the southern Maine forests and wetlands in York County.

The northwestern Maine Mountains is a rural sparsely developed region with few public roads. It is primarily forested with abundant wetlands, streams and rivers. Streams are flashy in areas with steep slopes. Wide ranging species such as moose, white-tailed deer, and bobcat occur in this region. The study routes we selected were identified as potential habitat connectors needed to be maintained to proactively preserve wildlife movement in the Staying Connected Initiative's *Northeast Kingdom Vermont to Western Maine Linkage* ([stayingconnectedinitiative.org/](http://stayingconnectedinitiative.org/)).

The southern Maine area is relatively flat with smaller hills and has a mix of suburban and rural development with greater public road density. It is primarily forested with areas of extensive wetlands. The region was selected for its importance to several threatened and endangered species that are highly susceptible to road mortality as a primary threat. These include blanding's turtle, spotted turtle, and black racer snake. New England cottontails also occur in the study area and their habitat is highly fragmented by roads.

## **Methods**

In June 2014, we held a two-day training by Julia Kintsch on how to use the PAS at Maine Audubon and in the field. Based on our experience in the field, we refined the PAS to incorporate issues we discovered while using the PAS in a part of the country with a high percentage of aquatic road crossings.

We used the PAS to conduct 11 day-long surveys with project partners in teams of 2 from July through October. We took multiple photographs at all survey sites. We entered survey results into a Microsoft Access database.



## II. Summary Findings

### Overview

We inventoried a total of 108 structures along 49.3 miles of 12 road segments, as described in Table 1. Of these, we identified 25 as retrofittable, and 35 as having limited retrofit opportunity. Over half (54%) of the inventoried structures have some retrofit opportunity. The remainder offers no retrofit opportunities and will require replacement to accommodate terrestrial wildlife passage.

**Table 1. Structures Inventoried**

Structure Type	Total
Small Culvert (<5' width x height)	74
Medium Culvert (5' to <8' width x height)	15
Large Culvert (≥ 8' x 8' width x height)	0
Bridge	19

Most of the road segments we inventoried have some opportunity for retrofit, although the degree of opportunity varied among segments (Table 2). We found only one segment (Witch Trot Road) with no retrofit opportunities; however, this is a short road segment where we inventoried only two structures. The longest segment we inventoried was 9.3 miles of Route 26. Of the 29 structures we inventoried, we identified only 8 as having some retrofit opportunity. Other road segments (e.g. Bell Marsh Road, Route 2 and Oakridge Road) have a higher number of retrofit opportunities in proportion to the number of structures inventoried. For a detailed assessment of all retrofit opportunities, see Section IV of this report.

**Table 2. Retrofit potential for inventoried road segments.** Length refers to the length of the road segment; # is the number of structures inventoried in that segment. Retrofit potential at each location was categorized as 'yes', 'yes-limited', or 'no'. Percent retrofittable is the number of structures in a road segment that were identified as having some retrofit opportunity (i.e. either 'yes' or 'yes-limited').

Name	Length (miles)	#	Retrofit – Yes	Retrofit – Yes, Limited	Retrofit – No	% Retrofittable
Bethel-Greenwood-Woodstock: Route 26	9.3	29	2	6	21*	28%
Carrabassett: Route 27	8	10	5	1	4	60%
Gilead: Route 2	8	10	6	2	2	80%
Madrid: Route 4	4.5	15	5	2	8	47%
Sandy River Plt: Route 4	5.3	9	1	4	4	56%
Eliot: Route 236	2.3	5	2	0	3	40%
Kennebunkport: Oakridge Road	1.4	2	0	2	0	100%
South Berwick/Eliot/York: Route 91	2	4	0	2	2	50%

South Berwick: Witch Trot Rd	1.3	2	0	0	2	0%
York: Bell Marsh Road	3	12	3	8	1	92%
York: Mountain Road	2.5	6	0	4	2	67%
York: Scituate Road	1.7	4	1	2	1	75%

*\* The small pipe at location Wood-1 is not considered retrofittable; however Maine-DOT has plans to replace this culvert, providing an opportunity for integrating terrestrial wildlife passage considerations into the design of the replacement culvert.*

## **Retrofit Potential for Each Wildlife Crossings Guild**

Based on survey results, we found that retrofitting will not benefit all species equally. Below is a summary of the Wildlife Crossing Guilds for which retrofitting offers the greatest potential, moderate potential, or minimal potential benefit (Table 3). See Appendix A for complete guild descriptions and the target species associated with each guild.

### *Greatest Potential:*

- Small and medium-bodied Medium-Structure Generalists and Semi-Aquatic Obligates.
  - Due to structure size constraints in a number of cases, only the smaller members of each of these guilds can be accommodated with retrofits. Species that could benefit include a variety of small, adaptive fauna (e.g. raccoon, skunk, weasels, mice), semi-aquatic turtles, and salamanders.

### *Moderate Potential:*

- Larger-bodied Medium-Structure Generalists and Semi-Aquatic Obligates.
  - Larger bridges and culverts that can be retrofit to provide passage for species such as black bear, coyote and bobcat; however, we found fewer of these types of structures than smaller box and pipe culverts.

### *Limited Potential:*

- Large-Structure Generalists and Cover Obligates.
  - Only a few sites offer opportunities for improving passage for large ungulates such as white-tailed deer and moose.
  - It can be challenging to add cover through a structure to render it suitable for members of the Cover Obligates Guild. Where natural vegetated cover is preferred, this may require restoring the natural stream banks and riparian vegetation.
- Conditions Specialists.
  - There are few opportunities for improving passage for species requiring uniquely specialized habitat conditions (e.g. Wood Frog, Northern Leopard Frog) through the inventoried structures; however, the addition of specialized guide fencing could improve passage where existing structures provide natural, damp substrate and access to suitable habitat.

**Table 3. Number of structures with potential retrofit benefits for each Wildlife Crossing Guild, listed by road segment we inventoried.**

<b>Name</b>	<b>Semi-Aquatic Obligates</b>	<b>Medium-Structure Generalists*</b>	<b>Large-Structure Generalists</b>	<b>Cover Obligates</b>	<b>Conditions Specialists</b>
Bethel-Greenwood- Woodstock: Route 26	6	7	0	1	1
Carrabassett: Route 27	6	6	4	0	0
Gilead: Route 2	6	7	3	2	0
Madrid: Route 4	7	6	4	2	3
Sandy River Plt: Route 4	6	5	1	0	0
Eliot: Route 236	2	2	0	0	0
Kennebunkport: Oakridge Road	2	1	0	0	0
South Berwick/ Eliot/York: Route 91	2	1	0	0	0
South Berwick: Witch Trot Road	0	0	0	0	0
York: Bell Marsh Road	0	9	1	0	7
York: Mountain Road	0	4	0	0	0
York: Scituate Road	1	3	0	0	2
	<b>38</b>	<b>51</b>	<b>13</b>	<b>5</b>	<b>13</b>

*\*Includes structures that have retrofit potential only for the small-bodied members of the Medium-Structure Generalists guild.*

Notably, even where a structure may be retrofit, it cannot always be retrofit to provide passage for the full suite of wildlife present. In these cases, the structure will have to be replaced to provide passage for all types of species, although retrofitting may provide temporary passage for some wildlife in the interim. Many small, dry pipes (<2' diameter) may prove functional for salamanders and small mammals — provided that they are not too long. With the addition of limited small animal fencing, these pipes could provide enhanced passage for smaller fauna without creating an additional barrier for larger fauna (see below for more information on species-specific wildlife guide fencing).

## **Aquatic Crossings**

Many of the structures we surveyed have an aquatic component, which may preclude or inhibit passage by terrestrial wildlife. We identified seventy-nine sites, or 72%, as having an aquatic component (i.e. either intermittent or perennial flows).

Culverts and bridges are typically installed to channel ephemeral and permanent water flows under the road without damaging the roadbed itself and are not designed to accommodate terrestrial wildlife passage. Structures with intermittent water flows may be functional for terrestrial wildlife passage

where the timing of wildlife movements does not overlap with spring run-off or seasonal storms. Structures with perennial flows require dry pathways, such as stream banks, through the structure to allow wildlife passage. In some cases, wildlife may be willing to walk through shallow water where no dry pathway is present.

Issues encountered in surveys include:

- Lack of stream banks through the culvert to provide a dry pathway;
- Extensive riprap around structure entrances and along stream banks, which can inhibit wildlife from entering into or traveling through the structure.



Extensive riprap on Route 27,  
Carrabassett Valley © Maine Audubon



No stream bank through structure on Route 27,  
Carrabassett Valley © Maine Audubon

Some culverts and bridges may be retrofit to enhance passage by terrestrial wildlife. In the future we hope that stream crossing replacement projects will consider terrestrial wildlife passage needs during planning and design so terrestrial passage can be integrated with goals of restoring stream geomorphology and reducing stormwater impacts. Designing and constructing road-stream crossings to meet all these needs from the outset offers much higher potential for being cost effective in meeting crossing needs for the full range of wildlife moving through the area.

## Fatal Flaws

Structures with 'fatal flaws' were determined unsuitable for retrofitting for one of three primary reasons:

1. Standing or flowing water was present across the entire width of the structure opening, which prevents access through the structure by terrestrial species. Examples we found in the field included a ponds, wetlands, or streams significantly wider than the structure.
2. Structures that are unsuitable for a dry shelf to be installed either because they are too small or it would not be possible to tie the shelf into the shoreline or stream bank.
3. Small, dark and long pipes that, while dry much of the year, are generally not attractive for animal use. Though some small structures may be used by amphibians, if the pipe is too dry, amphibians may be at risk of desiccation (drying out).

Additional 'fatal flaws' we encountered in the survey included:

- Culverts that jog midway through, preventing a clean line of sight through the culvert;
- Small culverts surrounded by extensive development

### III. Retrofit Solutions

This section discusses retrofit opportunities for common issues identified during the survey. These concepts provide general guidance for improving passage for terrestrial wildlife at locations identified in Section IV. Further site assessments will be required for creating engineering designs of any improvements. Ultimately, determining whether or not to retrofit a given location will depend on several factors:

- What is the condition of the bridge or culvert – is it structurally sound or is it degraded?
- What is the value of the location for the species for which it can be retrofit, and is good quality habitat present on both sides of the structure? Is that habitat likely to remain somewhat intact?
- What is the potential for a retrofit to increase wildlife passage, decrease road mortality, and reduce safety hazards to motorists?
- What is the cost-effectiveness of retrofitting at the location as a temporary or permanent solution for improved wildlife passage?

For each road segment we inventoried, Table 4 summarizes the common types of retrofits we recommend at different structure locations for improving terrestrial wildlife passage. At a given structure location there may be more than one retrofit recommendation (e.g. create a dry pathway and add wildlife guide fencing). Detailed retrofit recommendations for each location are provided in Section IV.

**Table 4. General classes of retrofit opportunities for each road segment we inventoried.** Numbers are the number of structure locations in that road segment where a particular type of retrofit is recommended.

Name	Add Fencing	Create Pathway	Add Shelf	Fix Perched Outlet	Remove Debris	Add Cover	Other
Bethel-Greenwood-Woodstock: Route 26	8	0	4	3	3	0	1
Carrabassett: Route 27	6	5	3	0	0	2	0
Gilead: Route 2	7	5	1	0	0	3	1
Madrid: Route 4	7	2	3	0	1	1	1
Sandy River Plt: Route 4	5	2	3	1	0	0	0
Eliot: Route 236	2	0	1	0	0	0	0
Kennebunkport: Oakridge Road	2	1	0	1	0	0	0
South Berwick/Eliot/York: Route 91	2	0	1	0	0	0	0
South Berwick: Witch Trot Road	0	0	0	0	0	0	0
York: Bell Marsh Road	11	6	1	4	2	0	0
York: Mountain Road	4	0	0	0	1	0	1
York: Scituate Road	3	0	0	0	0	0	1
	<b>58</b>	<b>21</b>	<b>17</b>	<b>9</b>	<b>7</b>	<b>6</b>	<b>5</b>

## Wildlife Guide Fencing (58 sites)

Many of the surveyed bridges and culverts have the potential to function as passages for wildlife with the addition of limited stretches of wildlife fencing designed to guide animals to the structure entrances. The design and length of fencing is species-specific, and must be tailored to the needs of the target species.

We recommend considering the addition of wildlife guide fencing at all potential retrofit sites, and fence designs should address the array of wildlife present at each site. However, while a structure may be retrofit for some types of species, it is possible that it will still be impassible for others. In these situations, wildlife fencing should be designed to funnel the target wildlife towards the structure while not creating an additional barrier for other species that cannot use the structure. Plans for fencing maintenance and abutting landowner access should be part of the project design. Where appropriate think about how structures are in the landscape and how fencing can tie them in as a system rather than isolated crossings.



Eight-foot high large mammal exclusion fencing, CO.  
© I. Kintsch

### Wildlife fencing considerations include:

- Large mammal fencing (e.g. for deer, moose, bear) is typically eight feet high, with four-inch mesh, although a finer mesh may be required to direct bobcat or Canada lynx.
- Smaller fauna, including turtles, frogs, salamanders, snakes and small mammals can be accommodated with shorter fence heights, but require a finer mesh, or in some cases, smooth fence surfaces with an upper lip to prevent animals from climbing over the fence.
- Shorter segments of wildlife guide fencing can be used to direct wildlife to a single crossing opportunity whereas longer stretches of wildlife guide fencing incorporate multiple wildlife crossings.



Large animal fence with fine mesh small animal fence spliced to the bottom.  
© N. Newhouse



Amphibian guide fence approaching culvert entrance in a 'V' pattern, Ontario, CA. © K. Gunson



## Create Pathways (21 sites)

A number of sites could provide improved passage for terrestrial wildlife with the creation of dry, level pathways through a bridge or culvert. For example, at sites with a bridge over a waterway, the banks and support slopes are commonly lined with extensive riprap to protect the bridge footings from scour. However, this riprap is impassible for many species of wildlife. By creating a three-foot wide pathway through the riprap, many of these bridges can be navigated by deer, moose and other species.



Pathway through riprap with gabion wall support, CA. © S. Zahner



Pathway through riprap under bridge, MT. © P. Cramer

Vermont Agency of Transportation has experimented with filling in riprap with grubbing (soil, dirt and other materials from tree, shrub and stump removal) to improve passage conditions for terrestrial wildlife.

## Install a Dry Shelf (17 sites)

A metal shelf or concrete ledge can be installed through a culvert with ramps connecting to the adjacent habitat on either end of the culvert to provide a dry pathway through culverts with water flow. This type of retrofit is limited to culverts that are large enough to accommodate the maximum hydraulic capacity of the waterway without causing the culvert to become blocked by debris.



Raccoon walking on a metal shelf through a drainage culvert, MT. © K. Foresman



Metal shelf with ramps installed in a culvert in MT. © K. Foresman



Stone bench installed through drainage culvert to provide a dry pathway. © R. Reeve

### **Fix Perched Outlets (9 sites)**

Perched outlets can prevent animals, particularly small fauna, including salamanders and turtles, from entering into a culvert that may otherwise provide passage for these species. Some perched culverts can be retrofit by creating a graded slope or ramp leading from the culvert outlet.



Perched outlet at location Mount-4 on Mountain Road. © Maine Audubon

### **Remove Sediment or Debris (7 sites)**

These sites can be rendered more functional for wildlife passage by removing sediment or debris that is blocking access into a culvert or passage through a culvert. Regular maintenance may be required to keep these passages open.

### **Add Cover Elements (6 sites)**

Protective cover is an important feature for a variety of smaller fauna, including those that are prey for larger wildlife and are hesitant to expose themselves through the length of a crossing structure; and amphibians that risk desiccation in a dry, open environment. Cover elements may include vegetation, woody debris or rocks, depending on the target species. Unfortunately, many drainage culverts are not suitable for adding cover as a retrofit: culverts that are too small risk being plugged by cover elements or having them wash away during larger storms.



Soil and branches inside tunnel bottom, British Columbia, CA. ©B. Beasley

### Retrofit Design Resources:

- Wildlife Crossing Structure Handbook: Design and Evaluation in North America. 2011. [Refer to hot sheets] <http://flh.fhwa.dot.gov/innovation/td/wildlife/>
- Ministry of Natural Resources and Forestry Guidelines for Mitigation of Road Impacts on Amphibians and Reptiles in Ontario. 2015. Available from the Ontario Ministry of Natural Resources guidance and resources library for species at risk in 2016 <https://www.ontario.ca/environment-and-energy/species-risk-guides-and-resources>
- Reptile and Amphibian Exclusion Fencing: Best Practices. 2013. [http://files.ontario.ca/environment-and-energy/species-at-risk/mnr\\_sar\\_tx\\_rptl\\_amp\\_fnc\\_en.pdf](http://files.ontario.ca/environment-and-energy/species-at-risk/mnr_sar_tx_rptl_amp_fnc_en.pdf)



## IV. Recommendations: Surveyed Road Segments

### Franklin & Oxford Counties—Routes Surveyed

#### Bethel-Greenwood-Woodstock: Route 26

Segment Description: Starting in Bethel running west-east/south-east through Greenwood to Woodstock ending at Route 232.

Segment Length: 9.3 miles

#### Roadway and Site Description

Two-lane paved road. Surveyors recorded daytime traffic volumes ranging from high (2,000 to <10,000 seasonal average daily traffic (ADT)) to very high ( $\geq 10,000$  seasonal ADT) along the segment. The roadbed is level or raised relative to the surrounding topography through this segment. Vegetation cover consists of forest, meadow and wetland habitats with some residential development.

#### Structures Inventory

Structure ID	Structure Type*	Retrofit Potential	Retrofit Notes**
Beth-1	Bridge	No	<ul style="list-style-type: none"> <li>Fatal flaw: Stream/standing water through entire structure and at both structure entrances. May be functional for some Semi-Aquatic fauna.</li> </ul>
Beth-2	2' to <5' diameter (Ø) round pipe	No	<ul style="list-style-type: none"> <li>Perennial flows with heavy seasonal flows.</li> <li>Seasonally gets blocked with debris at inlet.</li> </ul>
Beth-3	<2' Ø round pipe	No	<ul style="list-style-type: none"> <li>Fatal flaw: small culvert filled with sediment and debris; perched outlet. <b>Recommend replacing</b> undersized culvert rather than retrofitting.</li> </ul>
Beth-4	Box culvert	Yes, limited	<ul style="list-style-type: none"> <li>Perched inlet/outlet stream through entire width of culvert. May be functional for some Semi-Aquatic fauna.</li> <li>Limited clearance (2' to &lt;5' high); investigate whether it would be possible to install a shelf connecting to adjacent habitat on both sides of the structure.</li> <li>Fix perch and enhance with guide fencing.</li> </ul>
Beth-5	2' Ø round pipe	No	<ul style="list-style-type: none"> <li>Old rusted culvert with standing water and perched outlet; pool at outlet.</li> </ul>
Beth-6	Bridge	No	<ul style="list-style-type: none"> <li>Fatal flaw: Stream through bridge obstructing entry (&gt;3' deep). May be functional for some Semi-Aquatic fauna.</li> </ul>
Gree-1	Box culvert	Yes	<ul style="list-style-type: none"> <li>Improve functionality for Medium-Structure Generalists and Semi-Aquatic Obligates (see below for recommendations).</li> </ul>



Photo 8. Typical road profile on Route 26.

Gree-2	2' ø round pipe	No	<ul style="list-style-type: none"> <li>Fatal flaw: Small, collapsed pipe.</li> </ul>
Gree-3	Box culvert	No	<ul style="list-style-type: none"> <li>Fatal flaw: Culvert bends in the middle and has perched outlet.</li> </ul>
Gree-4	Bridge	No	<ul style="list-style-type: none"> <li>Fatal flaw: Concrete, vertical abutments combined with high water velocity and depth renders this structure unsuitable for retrofit.</li> </ul>
Gree-5	2' to <5' ø round pipe	No	<ul style="list-style-type: none"> <li>Small, dark, aquatic culvert.</li> </ul>
Gree-6	18" ø round pipe	No	<ul style="list-style-type: none"> <li>Twin drainage pipes – both are small and long with heavy vegetation and woody debris obscuring entry. Intermittent water flow through culverts; outlet pool.</li> </ul>
Bethel-A	Box culvert	Yes, limited	<ul style="list-style-type: none"> <li>Limited clearance (2' to &lt;5' high); stream through entire structure. May be functional for some Semi-Aquatic fauna.</li> <li>Investigate whether it would be possible to install a shelf connecting to adjacent habitat on both sides of the structure.</li> <li>Could be enhanced with guide fencing.</li> </ul>
Bethel-B	Box culvert (x 2)	Yes, limited	<ul style="list-style-type: none"> <li>Twin culverts with stream through entire structure and at both structure entrances. May be functional for some Semi-Aquatic fauna.</li> <li>Investigate whether it would be possible to install a shelf through one of the boxes, connecting to adjacent habitat on both sides of the structure.</li> <li>Could be enhanced with guide fencing.</li> </ul>
Woodstock-1	18" ø round pipe	Yes, limited	<ul style="list-style-type: none"> <li>Small, concrete drainage pipe situated at base of large headwall, half impounded by sand. No water flow at time of survey.</li> <li>Improve functionality for small fauna (e.g. some Cover Oblivates, Conditions Specialists (specifically salamanders), and Medium Structure Generalists) by cleaning out sediment from culvert and improving drainage at outlet to eliminate pooling.</li> <li>Could be enhanced with guide fencing.</li> </ul>
Woodstock-3	Round pipe	No	<ul style="list-style-type: none"> <li>Small culvert half-filled with standing water.</li> </ul>
Woodstock-4	2' to <5' ø round pipe	No	<ul style="list-style-type: none"> <li>Small culvert in concrete headwall with sediment and &lt;3" water flow through culvert. Pooling at inlet.</li> <li>May have limited functionality for small Semi-Aquatic Oblivates, e.g. some turtles.</li> </ul>
Woodstock-5	2' to <5' ø round pipe	No	<ul style="list-style-type: none"> <li>Concrete pipe culvert with &lt;3' water flow through culvert.</li> <li>May have limited functionality for some Semi-Aquatic Oblivates.</li> </ul>

Woodstock-6	2' to <5'∅ round pipe	Yes	<ul style="list-style-type: none"> <li>Improve functionality for Medium Structure Generalists (see below for recommendations).</li> </ul>
Woodstock-7	2' to <5'∅ round pipe	No	<ul style="list-style-type: none"> <li>Small culvert. Pooling at inlet, which is smaller than outlet, but water doesn't flow through to outlet.</li> </ul>
Woodstock-8	2' to <5'∅ round pipe	No	<ul style="list-style-type: none"> <li>Small, long (100-150') culvert apparently splits into two midway through; wetland on one side and parking lot on the other.</li> </ul>
Wood-1	Box culvert	Replacement opportunity	<ul style="list-style-type: none"> <li>Maine DOT is likely replacing this culvert. Should design for target species, including Wood Turtles &amp; Leopard Frogs and other Semi-Aquatic species.</li> </ul>
Wood-2	Box culvert	No	<ul style="list-style-type: none"> <li>Small, long (100-150') culvert with perennial water flow and outlet pool (&lt;3' deep). Culvert drops midway, 3% grade.</li> </ul>
Wood-3	2' to <5'∅ round pipes	No	<ul style="list-style-type: none"> <li>Twin metal culverts, 100-150' long at base of fill slope with perennial water flows (7" deep at time of survey).</li> <li>Forested wetland with some residential development.</li> <li><b>Recommend replacing</b> with larger culvert with shelf to improve passage for Medium-Structure Generalists and Semi-Aquatic Obligates.</li> </ul>
Wood-4	<2' ∅ round pipe	No	<ul style="list-style-type: none"> <li>Fatal flaw: small, aquatic culvert.</li> </ul>
Wood-5	2' to <5'∅ round pipe	Yes, limited	<ul style="list-style-type: none"> <li>Intermittent water flow through culvert (&lt;3" deep) with pooling at inlet and outlet (6" deep); perched outlet (10").</li> <li>Fix perched outlet to improve functionality for some Semi-Aquatic Obligates.</li> <li>Could be enhanced with guide fencing.</li> </ul>
Wood-6	18" ∅ round pipe	No	<ul style="list-style-type: none"> <li>Fatal flaw: small, aquatic culvert.</li> </ul>
Wood-7	2' to <5'∅ round pipe	No	<ul style="list-style-type: none"> <li>Undersized culvert with sediment buildup.</li> <li><b>Recommend replacing</b> with larger culvert to improve passage for Medium-Structure Generalists and Semi-Aquatic Obligates.</li> </ul>
Wood-8	Box culvert	Yes, limited	<ul style="list-style-type: none"> <li>Improve functionality for Semi-Aquatic Obligates and Medium Structure Generalists (see below for recommendations).</li> </ul>

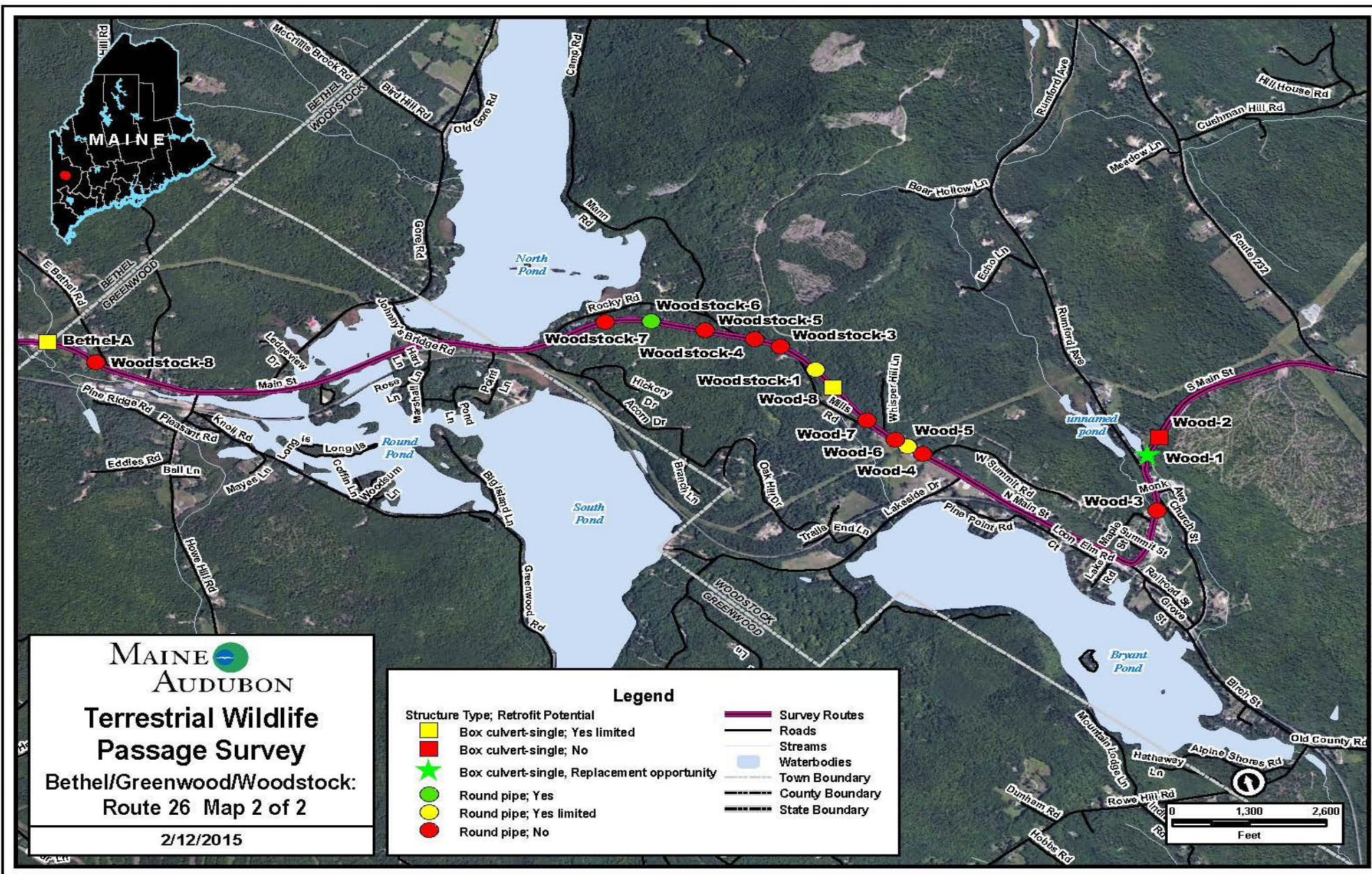
*\*The symbol ∅ is used as an abbreviation for diameter.*

*\*\*Species-specific wildlife fencing should be considered at all retrofit locations, taking into account potential barrier impacts to other species for which the structure is an unsuitable passageway and whose movements the fencing may block. See Section III for discussion of wildlife guide fencing.*

















### Road Segment Summary Findings

Most of the structures in this segment have little retrofit potential. All of the structures we inventoried are aquatic and none span the associated stream banks or provide any sort of dry passage. As such, these structures currently offer only limited passage opportunities for Semi-Aquatic Obligates and Medium-Structure Generalists that are tolerant of some water flow. Some of these structures are large enough and have enough space to be retrofit with the addition of a concrete ledge or metal shelf linking into the adjacent terrestrial habitat to create a dry pathway through the structure. Structures that offer some passage opportunity or are augmented with a shelf should also be augmented with the addition of guide fencing.

RETROFIT PRIORITIES: Bethel-Greenwood-Woodstock, Route 26	
<b>Gree-1</b>	<ul style="list-style-type: none"><li>• Small box culvert (5-8' wide by 2-5' high by &lt;65' long).</li><li>• Perennial stream with low water depth (&lt;3"), stony streambed through structure. Lacks dry pathway.</li><li>• Large culvert drop at outlet (&gt;2' high).</li></ul>
<b>Retrofit Recommendation</b>	<ul style="list-style-type: none"><li>• Retrofitting would require providing access at outlet side by removing drop and restoring stream grade.</li><li>• Install shelf along one side of culvert connecting into adjacent habitat to facilitate passage by species that require dry, level pathway.</li><li>• Install wildlife fencing to guide animals towards bridge.</li></ul>
	
<i>Photo 9. Gree-1: Natural grade, stony streambed at inlet.</i>	<i>Photo 10. Gree-1: Outlet drop.</i>

<b>Woodstock-6</b>	<ul style="list-style-type: none"> <li>• Concrete pipe culvert (2 to &lt;5' diameter by &lt;65' long) with intermittent water flows (low flow at time of survey).</li> <li>• Perched outlet (12" high).</li> <li>• Forest habitat.</li> </ul>
Retrofit Recommendation	<ul style="list-style-type: none"> <li>• Grade outlet perch to improve wildlife access into culvert.</li> <li>• Remove woody debris blocking access to inlet.</li> <li>• Install small animal fencing to guide wildlife towards culvert.</li> </ul>
	
<i>Photo 11. Woodstock-6: Intermittent water flow through pipe. Perched outlet.</i>	<i>Photo 12. Woodstock-6: Inlet located at base of fill slope.</i>
<b>Wood-8</b>	<ul style="list-style-type: none"> <li>• Small, long and dark culvert with perennial, low water flows; large concrete headwall and pooling at inlet.</li> <li>• Extensive sediment deposition at outlet (reduces effective culvert height at outlet); water pools downstream from outlet.</li> <li>• Forested, wetland habitat with adjacent residential development.</li> </ul>
Retrofit Recommendation	<ul style="list-style-type: none"> <li>• Remove sediment from culvert (leaving a small layer of sediment over concrete bottom) and implement sediment controls to prevent further sediment deposition.</li> <li>• Install small animal fencing to guide wildlife to culvert.</li> </ul>
	
<i>Photo 13. Wood-8: Pooling at inlet.</i>	<i>Photo 14. Wood-8: Sediment deposition at outlet.</i>

## Carrabassett Valley: Route 27

Segment Description: Franklin County, from Eustis running south and east to Carrabassett Valley.

Segment Length: 8 miles



Photo 28. Typical road profile on Carrabassett Valley Route 27

### Roadway and Site Description

Two-lane paved highway (where) with high traffic volume (2,000 – <10,000 seasonal ADT). The roadbed is level through much of the segment, though elevated in some places above the surrounding topography. The landscape is primarily forested with some areas of wetlands, residential development and commercial activity.

### Structures Inventory

Structure ID	Structure Type*	Retrofit Potential	Retrofit Notes**
CARRA-1	2' diameter (ø) round pipe (x 2)	No	<ul style="list-style-type: none"> <li>Fatal flaw: Suitable for aquatic passage only.</li> </ul>
CARRA-2	Bridge	No	<ul style="list-style-type: none"> <li>Fatal flaw: Suitable for aquatic passage only.</li> </ul>
CARRA-3	Bridge	Yes	<ul style="list-style-type: none"> <li>Improve functionality for Medium- and Large-Structure Generalists and Semi-Aquatic Obligates (see below for recommendations).</li> </ul>
CARRA-4	2' to <5'ø round pipe	No	<ul style="list-style-type: none"> <li>Perennial stream with &lt;3' deep water flow through structure and adjacent wetlands. Functional for some Semi-Aquatic Obligates.</li> <li>No retrofit potential for other species.</li> </ul>
CARRA-5	5' ø round pipe	No	<ul style="list-style-type: none"> <li>Fatal Flaw: Beaver deceiver prevents culvert access for all species.</li> </ul>
CARRA-6	Bridge	Yes	<ul style="list-style-type: none"> <li>Improve functionality for Medium- and Large-Structure Generalists and Semi-Aquatic Obligates (see below for recommendations).</li> </ul>
CARRA-7	Bridge	Yes, limited	<ul style="list-style-type: none"> <li>Improve functionality for Medium-Structure Generalists and Semi-Aquatic Obligates (see below for recommendations).</li> </ul>
CARRA-8	Bridge	Yes	<ul style="list-style-type: none"> <li>Improve functionality for Medium- and Large-Structure Generalists, Semi-Aquatic Obligates and Cover Obligates (see below for recommendations).</li> </ul>
CARRA-9	Bridge	Yes	<ul style="list-style-type: none"> <li>Improve functionality for Medium- and Large-Structure Generalists and Semi-Aquatic Obligates (see below for recommendations).</li> </ul>
CARRA-10	Box culvert	Yes	<ul style="list-style-type: none"> <li>Improve functionality for Medium-Structure Generalists and Semi-Aquatic Obligates (see below for recommendations).</li> </ul>

\*The symbol ø is used as an abbreviation for diameter.

\*\*Species-specific wildlife fencing should be considered at all retrofit locations, taking into account potential barrier impacts to other species for which the structure is an unsuitable passageway and whose movements the fencing may block. See Section III for discussion of wildlife guide fencing.








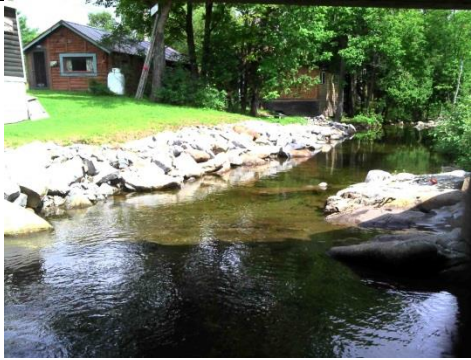








### Road Segment Summary Findings



All of the structures inventoried were constructed at road-stream crossings and were designed primarily to accommodate perennial water flows under the road. Many of the structures, including several bridges, offer an excellent opportunity for retrofitting to improve passage for terrestrial wildlife. Several of the bridges in this segment do not span across the riparian banks and could be improved with the installation of a shelf connecting to the adjacent habitat. Other large span bridges do span across the stream banks, but wildlife passage is largely blocked by riprap on the riparian slopes. In these instances, creating pathways across the riprap slopes above high water to avoid scour of the new pathway, and restoring riparian banks, where possible, would enhance passage for a variety of species. Installing wildlife fencing at each of these sites (and connecting to nearby, passable structures, depending on spacing) would help in guiding animals towards the structures and keeping them out of the right-of-way and off the road surface.

RETROFIT PRIORITIES: Carrabassett Valley Route 27	
<b>CARRA-3</b>	Bridge with concrete vertical abutments over Stratton Brook. Discontinuous dry pathway along south side of structure under low flow conditions. May offer limited functionality for some Large-Structure Generalists willing to get wet feet.
Retrofit Recommendation	Investigate whether it would be possible to build up soil so that there is a continuous dry pathway during low flows. Install a shelf along the south side of the bridge to facilitate passage for Medium-Structure Generalists. Install wildlife fencing to guide animals towards bridge.
	
<i>Photo 29. CARRA-3: Water flow under bridge during low flows. Note partial dry pathway.</i>	<i>Photo 30. CARRA-3: Upstream riparian habitat.</i>

<b>CARRA-6</b>	<ul style="list-style-type: none"> <li>• Bridge over Stoney Brook (<math>\geq 40'</math> wide by 12 to <math>&lt; 20'</math> high by <math>&lt; 65'</math> long).</li> <li>• Rocky streambed may be difficult to traverse for some species. Dry pathway likely obliterated during high water events.</li> </ul>
Retrofit Recommendation	<ul style="list-style-type: none"> <li>• Create raised pathway through length of structure to facilitate passage by species that require dry, level pathway.</li> <li>• Install wildlife fencing to guide animals towards bridge.</li> <li>• Undersized structure unsuitable for Cover Obligates until replaced with larger span bridge and riparian banks restored.</li> </ul>
	
<i>Photo 31. CARRA-6: Rocky stream substrate through entire width and length of structure.</i>	<i>Photo 32. CARRA-6: Shallower water depth on inside bend of stream, but lacks dry, level pathway.</i>
<b>CARRA-7</b>	<ul style="list-style-type: none"> <li>• Bridge spanning perennial stream (20 to <math>&lt; 40'</math> wide by 5 to <math>&lt; 8'</math> high by <math>&lt; 65'</math> long).</li> <li>• Streambed is very rocky and in places, exposed bedrock with deep channel incisions; the structure is not wide enough to span stream banks so there is no dry, level pathway.</li> </ul>
Retrofit Recommendation	<ul style="list-style-type: none"> <li>• Create raised pathway or install a shelf through length of structure to facilitate passage by species that require dry, level pathway.</li> <li>• Could be enhanced with guide fencing.</li> <li>• Undersized structure unsuitable for Cover Obligates until replaced with larger span bridge and riparian banks restored.</li> </ul>
	
<i>Photo 33. CARRA-7: Rocky, boulder streambed with no dry, level pathway through structure.</i>	<i>Photo 34. CARRA-7: Riprap banks and adjacent residences on outlet side.</i>



<b>CARRA-8</b>	<ul style="list-style-type: none"> <li>Bridge (<math>\geq 40'</math> wide by <math>\geq 20'</math> high by <math>&gt; 65'</math> long) with sloped riprap abutments and extensive riprap slopes on both sides of the bridge extending <math>\sim 100'</math> up- and downstream.</li> </ul>
Retrofit Recommendation	<ul style="list-style-type: none"> <li>Create pathways through riprap on both sides of stream.</li> <li>Install wildlife fencing to guide animals towards bridge entrances.</li> </ul>
	
<i>Photo 35. CARRA-8: Extensive riprap slopes on upstream side and through structure.</i>	<i>Photo 36. CARRA-8: Downstream view of rocky streambed and adjacent forest habitat.</i>
<b>CARRA-9</b>	<ul style="list-style-type: none"> <li>Bridge (<math>\geq 40'</math> wide by 12 to <math>&lt; 20'</math> high by <math>&gt; 65'</math> long) with riprap abutments.</li> <li>Parallel pedestrian bridge on upstream side.</li> <li>Currently functional for Semi-Aquatic Obligates and adaptive fauna that are willing to walk through shallow water or navigate across the riprap slopes.</li> </ul>
Retrofit Recommendation	<ul style="list-style-type: none"> <li>Create pathways through riprap on both sides of stream.</li> <li>Install wildlife fencing to guide animals towards bridge entrances.</li> </ul>
	
<i>Photo 37. CARRA-9: Rocky stream and riprap bridge abutments.</i>	<i>Photo 38. CARRA-9: Downstream view of rocky streambed and adjacent forest habitat.</i>

<b>CARRA-10</b>	<ul style="list-style-type: none"> <li>Concrete box culvert (8 to &lt;20' wide by 5 to &lt;8' high by 65 to 100' long). Culvert is slightly wider than stream channel causing flow to spread out through culvert. Water depth at time of assessment was &lt;3' deep. Sand, gravel and woody debris deposits inside culvert.</li> </ul>
Retrofit Recommendation	<ul style="list-style-type: none"> <li>Install a culvert shelf connecting to adjacent habitat to provide dry, level pathway.</li> <li>Install wildlife fencing to guide animals towards culvert entrances.</li> </ul>
	
Photo 39. CARRA-10: Culvert inlet.	Photo 40. CARRA-10: Altered stream geomorphology through culvert.

## Gilead: Route 2

Segment Description: Oxford County – Gilead starting at New Hampshire border, running east towards Bethel to Fleming Road.

Segment Length: 8 miles



Photo 15. Typical road profile on Gilead Route 2.

### Roadway and Site Description

Two-lane paved with moderately high traffic volume (2,000 – 3,000 seasonal ADT) on an average weekday. The roadbed is level or elevated relative to the surrounding topography. Railroad parallels the roadway. This segment runs through forested habitat with wetlands and limited residential development and agricultural fields in some areas.

### Wildlife

Abundant wildlife tracks were observed in and around several structures at the time of the inventory (e.g., deer, fox, moose, raccoon, weasel).

### Structures Inventory

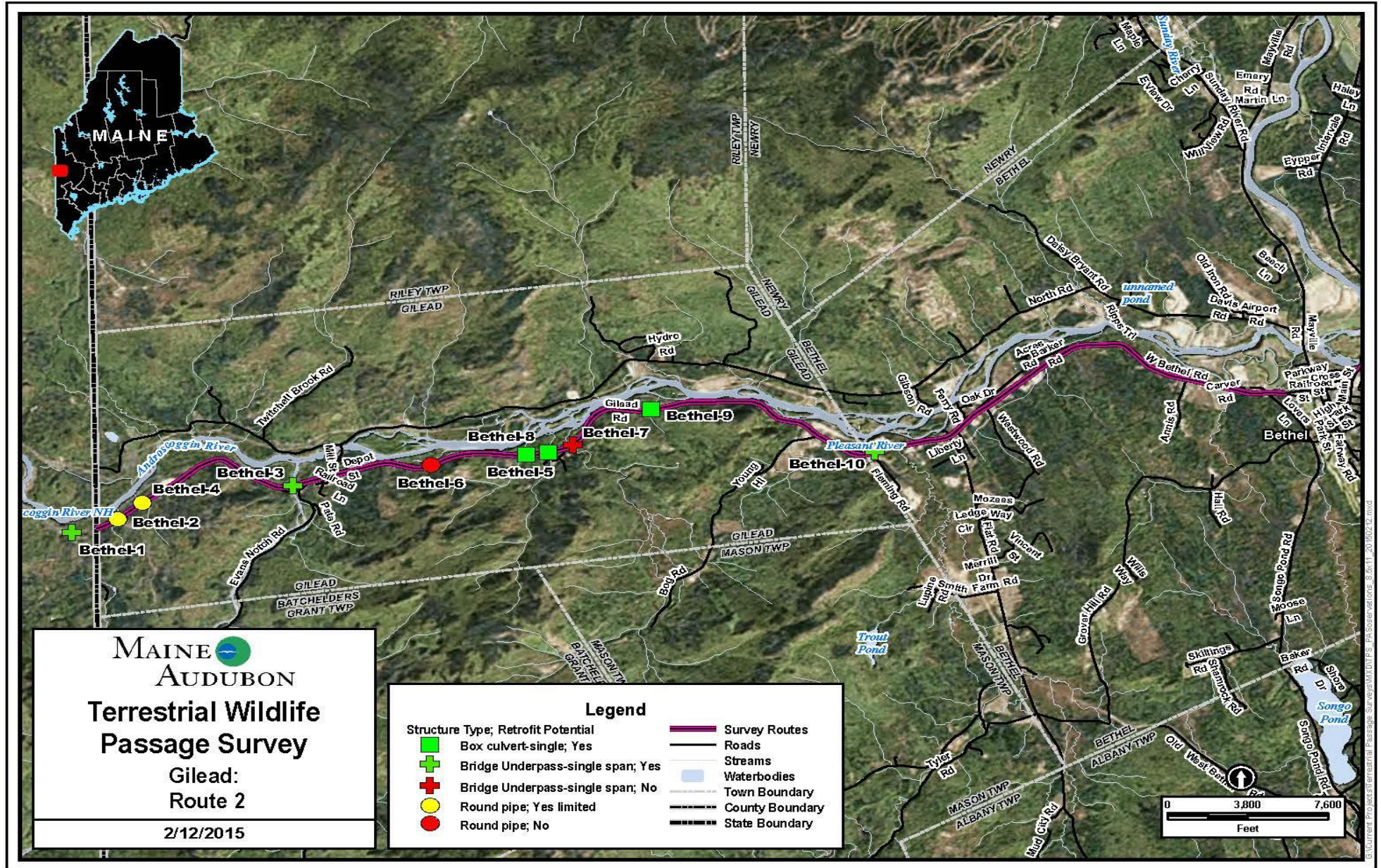
Structure ID	Structure Type*	Retrofit Potential	Retrofit Notes**
Bethel-1 (New Hampshire)	Bridge	Yes	<ul style="list-style-type: none"><li>Improve functionality for Semi-Aquatic Obligates and Medium and Large Structure Generalists (see below for recommendations).</li></ul>
Bethel-2	5 to <8'Ø round pipe	Yes, limited	<ul style="list-style-type: none"><li>188' long culvert with perennial water flow. Offers limited functional for some Semi-Aquatic Obligates and Medium-Structure Generalists.</li><li>Could be enhanced with guide fencing.</li></ul>
Bethel-3	Bridge	Yes	<ul style="list-style-type: none"><li>Improve functionality for Semi-Aquatic Obligates and Medium- and Large-Structure Generalists (see below for recommendations).</li></ul>
Bethel-4	2' to <5'Ø round pipe	Yes, limited	<ul style="list-style-type: none"><li>Small, dark tunnel with perennial flow functional for Semi-Aquatic Obligates.</li><li>Could be enhanced with guide fencing.</li></ul>
Bethel-5	Box culvert	Yes	<ul style="list-style-type: none"><li>Dry, concrete culvert likely functional for some Semi-Aquatic Obligates and Medium-Structure Generalists (see below for recommendations).</li></ul>
Bethel-6	2' to <5'Ø round pipes (x 4)	No	<ul style="list-style-type: none"><li>Four small drainage culverts with extensive riprap at inlet and outlet.</li></ul>
Bethel-7	Bridge	No	<ul style="list-style-type: none"><li>Fatal Flaw: Water pooling on both sides of structure</li></ul>

Bethel-8	Box culvert	Yes	<ul style="list-style-type: none"> <li>• Improve functionality for Medium-Structure Generalists and Cover Obligates (see below for recommendations).</li> </ul>
Bethel-9	Box culvert	Yes	<ul style="list-style-type: none"> <li>• Improve functionality for Medium-Structure Generalists, Semi-Aquatic Obligates and Cover Obligates (see below for recommendations).</li> </ul>
Bethel-10	Bridge	Yes	<ul style="list-style-type: none"> <li>• Improve functionality for Medium- and Large-Structure Generalists, Semi-Aquatic Obligates and Cover Obligates (see below for recommendations).</li> </ul>

*\*The symbol  $\varnothing$  is used as an abbreviation for diameter.*

*\*\*Species-specific wildlife fencing should be considered at all retrofit locations, taking into account potential barrier impacts to other species for which the structure is an unsuitable passageway and whose movements the fencing may block. See Section III for discussion of wildlife guide fencing.*















### Road Segment Summary Findings





Many of the structures inventoried in this segment have good retrofit potential for improving passage for Medium-Structure Generalists and Semi-Aquatic Obligates and, in a few cases, Large-Structure Generalists or Cover Obligates. Several of the large span bridges in this segment could be improved by creating pathways across the riprap slopes and restoring riparian banks, where possible. Installing wildlife fencing at each of these sites (and connecting to nearby, passable structures, depending on spacing) would help in guiding animals towards the structures and keeping them out of the right-of-way and off the road surface.

RETROFIT PRIORITIES: Gilead Route 2	
<b>BETHEL-1</b>	<ul style="list-style-type: none"> <li>• <math>\geq 40'</math> wide by 8 to 12' high by <math>&lt; 65'</math> long bridge with concrete vertical wall abutments spanning a stream <math>&lt; 3'</math> deep at the time of the inventory.</li> <li>• Boulder riprap lining both banks through structure.</li> </ul>
Retrofit Recommendation	<ul style="list-style-type: none"> <li>• Create dry pathway through riprap beneath both the road and railroad bridges.</li> <li>• Install wildlife fencing to guide animals towards bridge entrances.</li> </ul>
	
Photo 16. Bethel-2: Riprap banks.	Photo 17. Bethel-2: Parallel railroad bridge.
<b>BETHEL-3</b>	<ul style="list-style-type: none"> <li>• Large, high Bridge spanning perennial stream; Riprap abutments and rocky streambed.</li> <li>• Abundant wildlife tracks in and around structure (deer, fox, moose, raccoon, weasel).</li> </ul>
Retrofit Recommendation	<ul style="list-style-type: none"> <li>• Add a dry level pathway through the riprap slope on the west side of stream.</li> <li>• Install wildlife fencing to guide animals towards bridge entrances.</li> </ul>
	
Photo 18. Bethel-3: Stream bed beneath span and adjacent railroad bridge.	Photo 19. Bethel-3: Sandy, dry pathway at base of riprap abutments.

## RETROFIT PRIORITIES: Gilead Route 2

<b>BETHEL-5</b>	<ul style="list-style-type: none"> <li>• Medium-sized, long concrete box culvert (5' to 8' wide by 2' to 5' high by 100' to &lt;150' long).</li> <li>• Appears culvert is dry much of the year, investigate hydrology.</li> <li>• Signs of small and medium-sized mammals observed, including possible fox, fisher, and marten tracks.</li> <li>• Second stone box culvert downstream at railroad crossing.</li> </ul>
Retrofit Recommendation	<ul style="list-style-type: none"> <li>• Install sediment-catching baffles.</li> <li>• Install wildlife fencing to guide animals towards culvert entrances.</li> </ul>
	
<i>Photo 20. Bethel-5: View through concrete box culvert in dry conditions.</i>	<i>Photo 21. Bethel-5: Rocky culvert inlet.</i>
<b>BETHEL-8</b>	<ul style="list-style-type: none"> <li>• Concrete dry 4-sided box culvert (5 to &lt;8' wide by 5 to &lt;8' high); likely seasonal storm flows through structure.</li> </ul>
Retrofit Recommendation	<ul style="list-style-type: none"> <li>• Enhance approaches to provide pathway through rocks.</li> <li>• Investigate whether it would be hydrologically acceptable to add cover elements along one side of structure (e.g., down logs and woody debris).</li> <li>• Install wildlife fencing to guide animals towards culvert entrances.</li> </ul>
	
<i>Photo 22. Bethel-8: Rocky approach to culvert inlet, with concrete substrate through structure.</i>	<i>Photo 23. Bethel-8: From outlet looking downstream.</i>



<b>BETHEL-9</b>	<ul style="list-style-type: none"> <li>Concrete box culvert (5 to 8' wide by 2 to 5' high by &lt;65' long) with small perennial stream (low depth); no dry pathway.</li> <li>Perched outlet, shallow pooling.</li> <li>Rocky streambed, riprap surrounding culvert.</li> </ul>
Retrofit Recommendation	<ul style="list-style-type: none"> <li>Create a level pathway through riprap to provide better access into both ends of culvert.</li> <li>Investigate opportunity for installing a dry shelf or ledge through culvert and connecting into adjacent habitat.</li> <li>Install wildlife fencing to guide animals towards culvert entrances.</li> </ul>
	
<i>Photo 24. Bethel-9: Outlet perch, rocky streambed and adjacent riprap.</i>	<i>Photo 25. Bethel-9: Rocky streambed and boulders at Inlet.</i>
<b>BETHEL-10</b>	<ul style="list-style-type: none"> <li>Bridge (&gt;40' wide by &gt;20' high by &lt;65' long) with riprap abutments; No level pathway present through structure.</li> </ul>
Retrofit Recommendation	<ul style="list-style-type: none"> <li>Create pathways through riprap on both sides of stream.</li> <li>Install wildlife fencing to guide animals towards bridge approaches.</li> </ul>
	
<i>Photo 26. Bethel-10: Riprap abutments to water's edge on both sides of stream</i>	<i>Photo 27. Bethel-10: Downstream view.</i>

## Madrid: Route 4

Segment Description: Franklin County, Madrid just south of smalls Falls, southeast to Number 6 Road Phillips.

Segment Length: 4.5 miles

### Roadway and Site Description

Two-lane road with moderate mid-day traffic volume (<2,000 seasonal ADT). The roadbed is level through much of the segment, though in some places it is elevated above the surrounding topography. The surrounding landscape is forest and some residential.

### Wildlife

Surveyors observed moose and frog in this segment.

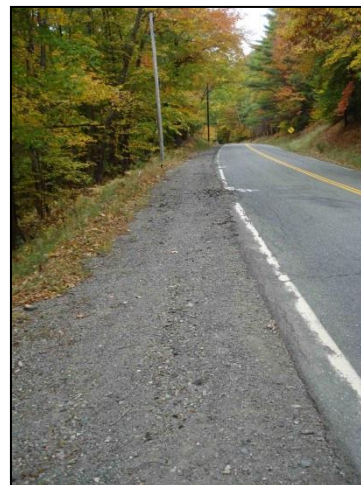


Photo 46. Typical road profile on Madrid Route 2

### Structures Inventory

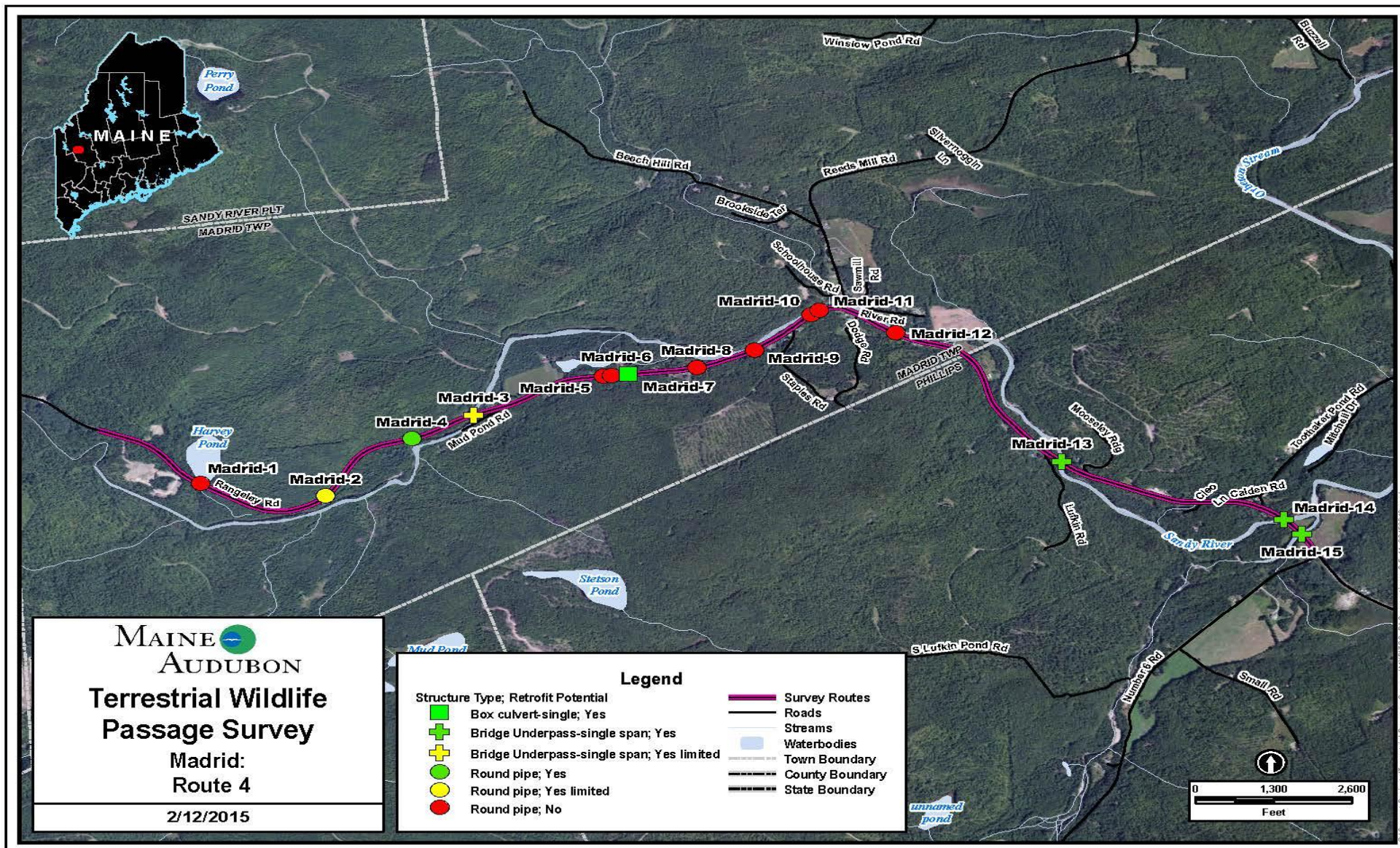
Structure ID	Structure Type*	Retrofit Potential	Retrofit Notes**
Madrid-1	18" diameter (ø) round pipe	No	<ul style="list-style-type: none"><li>• Aquatic culvert with lake at inlet may be functional for some Semi-Aquatic Obligates that are tolerant of enclosed culvert with perennial water flow.</li><li>• Low priority for fencing retrofit.</li></ul>
Madrid-2	<2' ø round pipe	Yes, limited	<ul style="list-style-type: none"><li>• Small, dark tunnel, half-filled with sediment.</li><li>• May have functionality for small adaptive fauna and salamanders.</li><li>• Could enhance by removing sediment and adding guide fencing.</li></ul>
Madrid-3	Bridge	Yes, limited	<ul style="list-style-type: none"><li>• Improve functionality for Medium- and Large-Structure Generalists and Semi-Aquatic Obligates (see below for recommendations).</li></ul>
Madrid-4	<2' ø round pipe	Yes	<ul style="list-style-type: none"><li>• Improve functionality for Cover Obligates and some amphibians (see below for recommendations).</li></ul>
Madrid-5	<2' ø round pipe	No	<ul style="list-style-type: none"><li>• Fatal flaw: Small, aquatic culvert, mostly submerged.</li></ul>
Madrid-6	<2' ø round pipe	No	<ul style="list-style-type: none"><li>• Fatal flaw: Small, dark, water and sediment-filled tunnel.</li></ul>
Madrid-7	Box culvert	Yes	<ul style="list-style-type: none"><li>• Improve functionality for medium-sized Medium-Structure Generalists and Semi-Aquatic Obligates (see below for recommendations).</li></ul>
Madrid-8	2' to <5' ø round pipe	No	<ul style="list-style-type: none"><li>• Small pipe with perennial water flow.</li><li>• May have limited functionality for semi-aquatic turtles.</li></ul>
Madrid-9	<2' ø round pipe	No	<ul style="list-style-type: none"><li>• Fatal flaw: small pipe with drop inlet and perennial water flow.</li></ul>

Madrid-10	<2' ∅ round pipe	No	<ul style="list-style-type: none"> <li>Fatal flaw: small pipe with drop inlet covered by concrete slabs; perched outlet.</li> </ul>
Madrid-11	<2' ∅ round pipe	No	<ul style="list-style-type: none"> <li>Fatal flaw: very small culvert; inlet crushed and outlet perched.</li> </ul>
Madrid-12	2' to <5'∅ round pipe	No	<ul style="list-style-type: none"> <li>Small culvert with perennial water flow; drops into larger river 5' beyond outlet.</li> <li>May have limited functionality for some Semi-Aquatic Obligates and Medium-Structure Generalists.</li> </ul>
Madrid-13	Bridge	Yes	<ul style="list-style-type: none"> <li>Improve functionality for Semi-Aquatic Obligates, Medium- and Large Structure Generalists (see below for recommendations).</li> </ul>
Madrid-14	Bridge	Yes	<ul style="list-style-type: none"> <li>Improve functionality for Semi-Aquatic Obligates, Medium- and Large Structure Generalists (see below for recommendations).</li> </ul>
Madrid-15	Bridge	Yes	<ul style="list-style-type: none"> <li>Improve functionality for Semi-Aquatic Obligates, Medium- and Large Structure Generalists (see below for recommendations).</li> </ul>

*\*The symbol ∅ is used as an abbreviation for diameter.*

*\*\*Species-specific wildlife fencing should be considered at all retrofit locations, taking into account potential barrier impacts to other species for which the structure is an unsuitable passageway and whose movements the fencing may block. See Section III for discussion of wildlife guide fencing.*


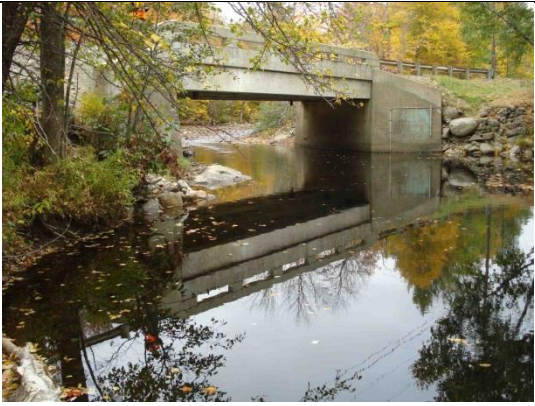












### Road Segment Summary Findings





While there are a number of small aquatic drainage pipes that are wholly unsuitable for terrestrial fauna passage, there are several bridges and one box culvert that could be retrofit to improve opportunities for terrestrial passage. Two of the large span bridges at the southern end of the segment would require creating smooth, level pathways through the riprap slopes. Two other bridges (Madrid-3 and Madrid-13) do not fully span the riparian banks and have only partial, rocky pathways. Improvements at these sites call for installing raised shelves connecting to the adjacent habitat, although ideally, these structures should be replaced with wider spans. Installing wildlife fencing at each of these sites (and connecting to nearby, passable structures, depending on spacing) would help in guiding animals towards the structures and keeping them out of the right-of-way and off the road surface.

RETROFIT PRIORITIES: Madrid Route 4	
<b>Madrid-3</b>	<ul style="list-style-type: none"> <li>• Bridge with vertical, concrete abutments (44' wide by 9' high by &lt;65' long).</li> <li>• Perennial stream &gt;3' deep during average flows; Dry bedrock pathway along one side of structure during average flows.</li> <li>• Undersized structure does not span riparian banks; wide pool at outlet.</li> <li>• Functional only for fauna willing to walk or swim through deep water.</li> </ul>
<b>Retrofit Recommendation</b>	<ul style="list-style-type: none"> <li>• Install shelf through bridge on the side opposite the bedrock pathway, connecting into adjacent habitat on either side of bridge.</li> <li>• Install wildlife fencing to guide animals towards bridge.</li> <li>• Ideally, replace structure with a wider span and restore natural riparian banks.</li> </ul>
	
<i>Photo 47.</i> Madrid-3: Bedrock pathway through structure does not connect to habitat on outlet side.	<i>Photo 48.</i> Madrid-3: Pooling at outlet blocks pathway connection to adjacent habitat.

<b>Madrid-4</b>	<ul style="list-style-type: none"> <li>• Small, metal pipe (&lt;2' diameter by &lt;65' long) with soil/leaf litter substrate through culvert. No water flow, though storm flows are likely.</li> <li>• Likely has functionality for Cover Obligates, including small mammals and salamanders, and possibly, frogs.</li> </ul>
Retrofit Recommendation	<ul style="list-style-type: none"> <li>• Install limited small and medium-sized wildlife fencing to guide animals towards culvert entrances.</li> </ul>
	
<i>Photo 49. Madrid-4: Vegetation and leaf litter at culvert outlet</i>	<i>Photo 50. Madrid-4: Sediment pathway through culvert with leaf litter.</i>
<b>Madrid-7</b>	<ul style="list-style-type: none"> <li>• Concrete box culvert (2' to &lt;5' wide by 2' to &lt;5' high by &lt;65' long with perennial stream and no dry, terrestrial pathway. Perched outlet (4" high).</li> <li>• Instream grade drop immediately in front of culvert inlet may limit some wildlife access into culvert.</li> <li>• Some debris blockage inside culvert.</li> </ul>
Retrofit Recommendation	<ul style="list-style-type: none"> <li>• Install shelf through culvert connecting into adjacent habitat.</li> <li>• Remove debris inside culvert.</li> <li>• Install wildlife fencing to guide animals to culvert.</li> </ul>
	
<i>Photo 51. Madrid-7: Culvert inlet with partial view of grade drop immediately in front of entrance.</i>	<i>Photo 52. Madrid-7: Change in stream geomorphology through culvert. No dry pathway available.</i>



<b>Madrid-13</b>	<ul style="list-style-type: none"> <li>• Bridge with vertical, concrete abutments (<math>\geq 40'</math> wide by 12 to <math>&lt; 20'</math> high by <math>&lt; 65'</math> long).</li> <li>• Perennial stream <math>&gt; 3'</math> deep during average flows; Dry, boulder/rock pathway along one side of structure during average flows.</li> <li>• Functional only for fauna willing to traverse rocky pathway or walk/swim through deep water. Adjacent old stone abutments from bridge may block wildlife access to bridge.</li> <li>• Stony river corridor with adjacent forest habitat.</li> </ul>
Retrofit Recommendation	<ul style="list-style-type: none"> <li>• Remove old stone abutments to enhance wildlife access to Bridge.</li> <li>• Install shelf through bridge on the side opposite the rocky pathway, connecting into adjacent habitat on either side of bridge.</li> <li>• Install wildlife fencing to guide animals to bridge.</li> <li>• Ideally, replace structure with a wider span and restore natural riparian banks to provide natural cover.</li> </ul>
	
<p><i>Photo 53. Madrid-13: View downstream. Note how old abutments from prior bridge adjacent to current bridge reduce access to bridge and effectively lengthen the distance terrestrial wildlife must travel to access adjacent habitat.</i></p>	<p><i>Photo 54. Madrid-13: View upstream, with dry, rocky pathway along one side of bridge (note pathway composed of boulder on downstream side, outside of the view of this image).</i></p>

<b>Madrid-14</b>	<ul style="list-style-type: none"> <li>• Bridge spanning river &lt;3' deep.</li> <li>• Steep, rocky abutments on both sides of river; no dry, level pathways through structure.</li> <li>• Adjacent forest habitat.</li> </ul>
Retrofit Recommendation	<ul style="list-style-type: none"> <li>• Create natural substrate pathway across riprap to connect to adjacent habitat. The steepness of the slopes may require constructing a gabion wall (a cage filled with rocks, sand and soil) or other support structure.</li> <li>• Install wildlife fencing to guide animals to bridge.</li> <li>• Ideally, replace structure with a wider span and restore natural riparian banks to provide natural cover.</li> </ul>
	
<i>Photo 55. Madrid-14: Span bridge with steep, rocky abutments and adjacent forest cover.</i>	<i>Photo 56. Madrid-14: Span bridge with steep, rocky abutments.</i>
<b>Madrid-15</b>	<ul style="list-style-type: none"> <li>• Bridge spanning perennial stream &lt;3' deep.</li> <li>• Steep, rocky abutments on both sides of stream with a more gradual slope and less rocky area along stream banks where wildlife passage is more likely.</li> <li>• Natural riparian banks on either side of bridge; adjacent agricultural fields</li> </ul>
Retrofit Recommendation	<ul style="list-style-type: none"> <li>• Restore riparian banks through structure to provide a natural, non-rocky pathway and natural cover for Cover Obligates and Conditions Specialists.</li> <li>• Install wildlife fencing to guide animals to bridge.</li> </ul>
	
<i>Photo 57. Madrid-15: Span bridge over stream.</i>	<i>Photo 58. Madrid-15: Rocky abutments transition to more natural riparian banks.</i>

## Sandy River PLT: Route 4

**Segment Description:** Franklin County – from Smalls Falls in Township E running north on Route 4 to Pop Dyer Road just after crossing over tip of Long Pond.

**Segment Length:** 5.3 miles

### **Roadway and Site Description**

Two-lane paved highway with moderate daytime traffic volumes (<2,000 seasonal ADT). The roadbed is elevated above the surrounding topography. The landscape is primarily forested with some residential areas.



Photo 62. Typical road profile on Sandy River PLT Route 4.

### **Wildlife**

Surveyors observed moose, green frog and garter snake, as well as bear scat during the assessment.

### **Structures Inventory**

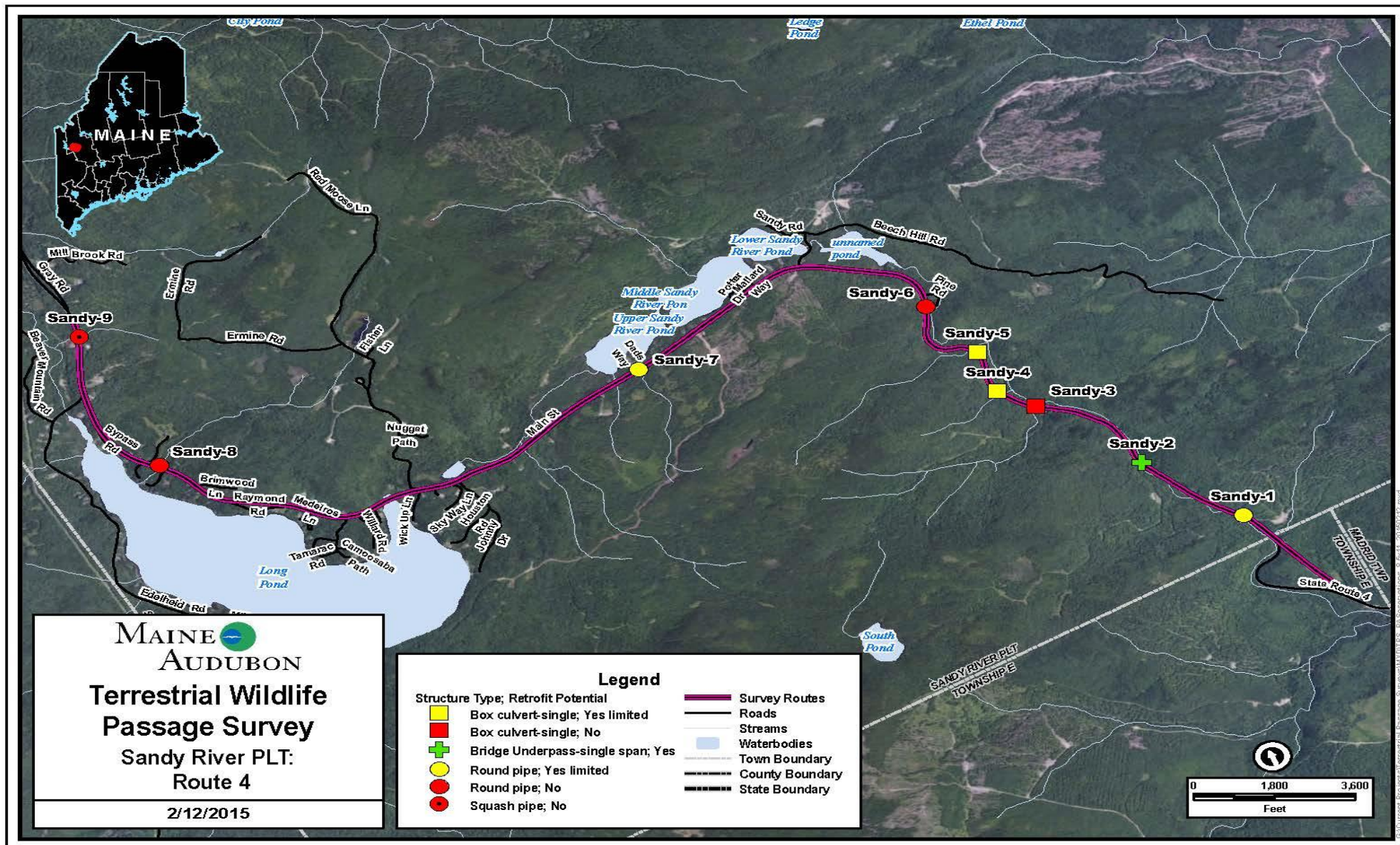
Structure ID	Structure Type*	Retrofit Potential	Retrofit Notes**
Sandy-1	2' to <5' diameter (Ø) round pipe	Yes, limited	<ul style="list-style-type: none"><li>• Smooth, plastic culvert with low water flows. Rocky banks at outlet stabilize channel.</li><li>• Culvert not suitable for shelf, but could install wildlife fencing to guide animals to pipe.</li><li>• Limited functionality for Semi-Aquatic Obligates, such as mink, and Medium-Structure Generalists, such as raccoon.</li></ul>
Sandy-2	Bridge	Yes	<ul style="list-style-type: none"><li>• Improve functionality for Medium- and Large-Structure Generalists and Semi-Aquatic Obligates (see below for recommendations).</li></ul>
Sandy-3	Box culvert	No	<ul style="list-style-type: none"><li>• Water velocity through culvert very high. Not suitable for retrofit.</li></ul>
Sandy-4	Box culvert	Yes, limited	<ul style="list-style-type: none"><li>• Small, long box culvert with extensive riprap at inlet; perennial stream is sheet flow across concrete-bottomed culvert. Perched outlet (8" high).</li><li>• May have limited functionality for mobile Semi-Aquatic Obligates, which could be improved by installing wildlife fencing.</li><li>• Install shelf through culvert and create pathway through riprap at inlet to improve passage for Medium-Structure Generalists.</li><li>• Install small animal fencing.</li></ul>

Sandy-5	Box culvert	Yes, limited	<ul style="list-style-type: none"> <li>• Small box culvert with perennial stream; perched outlet (18" high).</li> <li>• Install shelf through culvert connecting to adjacent habitat to improve passage for Medium-Structure Generalists and Semi-Aquatic Obligates.</li> <li>• Fix perch and install small animal fencing.</li> </ul>
Sandy-6	2' to <5'∅ round pipe	No	<ul style="list-style-type: none"> <li>• Smooth, plastic culvert with perennial stream and riprap (limited at inlet; extensive at outlet) inhibit wildlife access into culvert.</li> <li>• Limited functionality for mobile Semi-Aquatic Obligates and Medium-Structure Generalists.</li> </ul>
Sandy-7	36" ∅ round pipe	Yes, limited	<ul style="list-style-type: none"> <li>• Small tunnel channels stream; shrub wetland habitat on both sides of culvert.</li> <li>• May have limited functionality for small, adaptive Semi-Aquatic Obligates. Could be enhanced with small animal fencing.</li> </ul>
Sandy-8	2' to <5'wide (round) pipe	No	<ul style="list-style-type: none"> <li>• Tall, narrow pipe culvert with perennial stream flow situated in steep stream channel; drops into large pool at outlet. Aquatic culvert is not suitable for terrestrial wildlife passage.</li> </ul>
Sandy 9	2' to <5'∅ (oval) pipe	No	<ul style="list-style-type: none"> <li>• Small, dark tunnel with perennial stream; large outlet drop (36" high) into plunge pool. Inlet partially blocked by boulder.</li> </ul>

*\*The symbol ∅ is used as an abbreviation for diameter.*



*\*\*Species-specific wildlife fencing should be considered at all retrofit locations, taking into account potential barrier impacts to other species for which the structure is an unsuitable passageway and whose movements the fencing may block. See Section III for discussion of wildlife guide fencing.*





### Road Segment Summary Findings

This segment is characterized by hydrologic culverts and bridges, none of which span natural stream banks. Several of the structures in this segment could be retrofit with the installation of animal shelves, and terrestrial passage at several additional locations could be enhanced with the addition of small animal fencing.

RETROFIT PRIORITIES: Sandy River PLT: Route 4	
<b>Sandy-2</b>	<ul style="list-style-type: none"><li>• Single span bridge over Sandy River (20' to &lt;40' wide by 12' to &lt;20' high by 65' to &lt;100' long).</li><li>• Concrete apron at inlet and rocky streambed may be difficult to traverse for some species.</li><li>• Rocky, dry pathway not continuous through structure and likely inundated during high water events.</li><li>• Gabion wing walls on both sides of structure.</li></ul>
Retrofit Recommendation	<ul style="list-style-type: none"><li>• Fully connect rocky pathway to adjacent habitat and supplement with soil substrate to create a level path.</li><li>• Investigate installing a raised shelf on the side opposite the pathway connecting to adjacent habitat.</li><li>• Install wildlife fencing to guide animals towards bridge.</li></ul>
	
<i>Photo 63.</i> Sandy-2: Rocky dry pathway along one side of bridge, but not does not fully connect to adjacent habitat.	<i>Photo 64.</i> Sandy-2: Outlet with gabion wing walls.



## York County—Routes Surveyed

### **Eliot: Route 236/Depot Road**

Segment Description: York County, Route 236 starting at Julie Lane, northwest to Depot Road, then southwest on Depot Road to Route 103.

Segment Length: 2.3 miles



*Photo 41. Typical road profile on Depot Road in Eliot.*

### Roadway and Site Description

Route 236 is a two-lane paved highway with very high traffic volumes ( $\geq 10,000$  seasonal ADT). Depot Road is a two-lane local road with moderate traffic volume ( $< 2,000$  seasonal ADT). The roadbed is raised above the surrounding topography. The landscape is largely forested with some large wetland areas, and some areas of extensive residential and commercial development.

### Wildlife

A variety of wildlife signs were observed during this survey, including frogs and small and medium-sized mammals such as coyote, deer and raccoon.

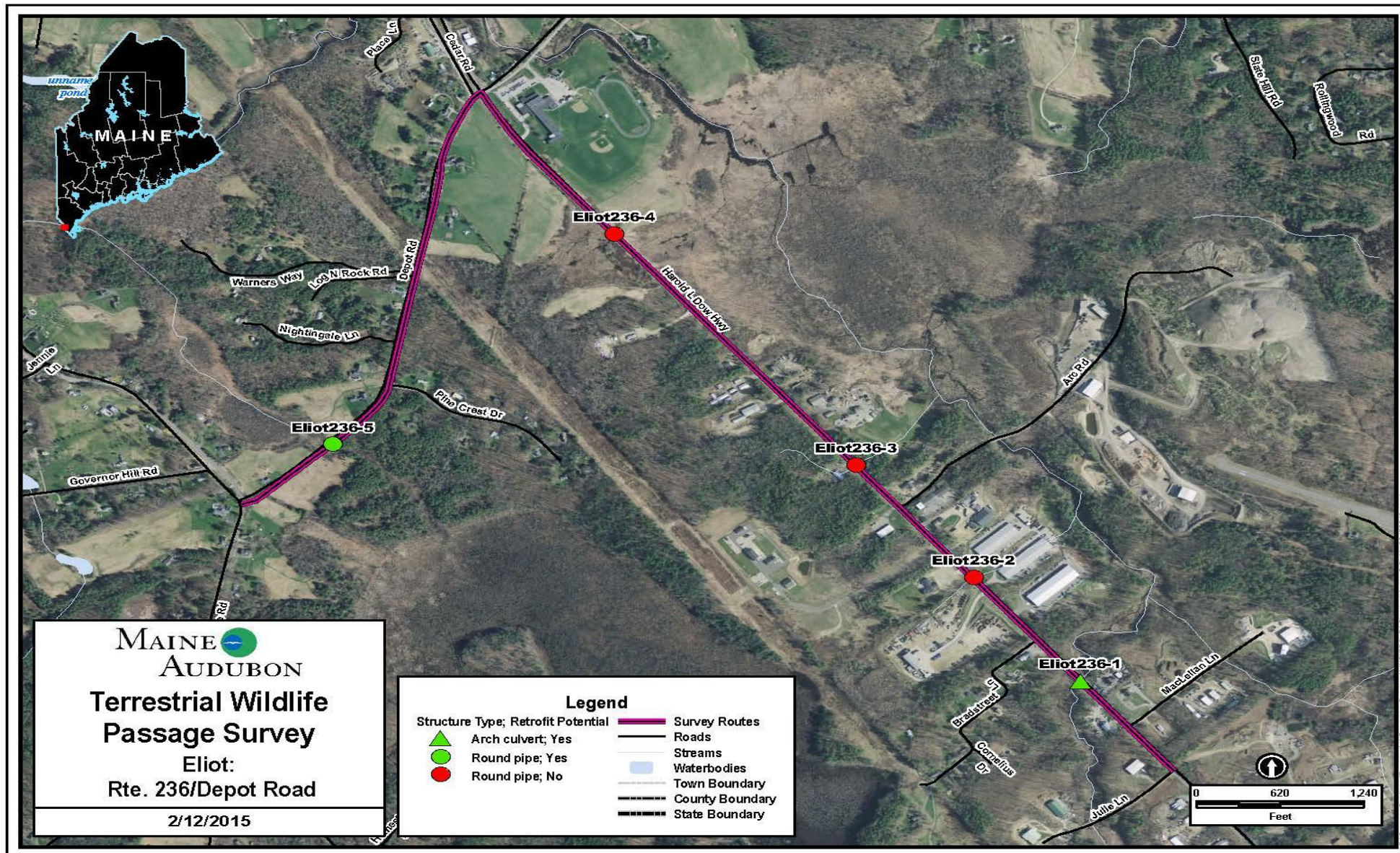
### Structures Inventory

Structure ID	Structure Type*	Retrofit Potential	Retrofit Notes**
Eliot-1	Arch culvert	Yes	<ul style="list-style-type: none"><li>Improve functionality for Medium-Structure Generalists and Semi-Aquatic Obligates (see below for recommendations).</li></ul>
Eliot-2	2' to <5' diameter ( $\phi$ ) round pipe	No	<ul style="list-style-type: none"><li>Fatal flaw: Extensive development in immediate vicinity and small culvert size renders this location unsuitable for retrofit.</li></ul>
Eliot-3	<2' $\phi$ round pipe	No	<ul style="list-style-type: none"><li>Fatal flaw: Very small pipe filled with sediment and standing water. Low priority.</li></ul>
Eliot-4	<2' $\phi$ round pipe	No	<ul style="list-style-type: none"><li>Fatal flaw: Small, collapsed pipe.</li><li>Known location for endangered and threatened turtle and other wildlife mortality. <b>Recommend replacement and fencing.</b></li></ul>
Eliot-5	2' to <5' $\phi$ round pipe	Yes	<ul style="list-style-type: none"><li>Improve functionality for Medium-Structure Generalists and Semi-Aquatic Obligates (see below for recommendations).</li></ul>

\*The symbol  $\phi$  is used as an abbreviation for diameter.

\*\*Species-specific wildlife fencing should be considered at all retrofit locations, taking into account potential barrier impacts to other species for which the structure is an unsuitable passageway and whose movements the fencing may block. See Section III for discussion of wildlife guide fencing.











### Road Segment Summary Findings

This is a short segment with only five small structures inventoried, two of which have retrofit potential for small and medium-sized fauna. Eliot-1 is a tall culvert through which a shelf could be installed to provide a dry pathway. Eliot-5 is functional as is for some adaptive species. Both structures could be enhanced with the addition of guide fencing.

RETROFIT PRIORITIES: Eliot Route 236			
Eliot-1		<ul style="list-style-type: none"><li>Stone arch culvert (8' wide by 7.5' high by 65' long) with perennial stream &lt; 3' deep. Structure is situated in a low fill slope (&lt;20' high).</li><li>Bottomless culvert has natural substrate through structure, but lacks a dry pathway for terrestrial fauna.</li><li>Pooling at outlet (&lt;3' deep).</li><li>Variety of wildlife tracks and scat in immediate vicinity of culvert (e.g., deer, coyote, groundhog, muskrat, raccoon, frog).</li></ul>	
Retrofit Recommendation		<ul style="list-style-type: none"><li>Install shelf along one side of culvert to facilitate passage by species that require dry, level pathway.</li><li>Install wildlife fencing to guide animals towards culvert.</li></ul>	
			
Photo 42. Eliot-1: Wetland vegetation at culvert inlet; Lack of dry pathway through structure.		Photo 43. Eliot-1: Pooling at outlet .	
Eliot-5		<ul style="list-style-type: none"><li>2' to 5' diameter, &lt;65' long plastic culvert.</li><li>Perennial stream runs through culvert; low water depth (&lt;3").</li><li>Outlet slightly perched (2" high).</li></ul>	
Retrofit Recommendation		<ul style="list-style-type: none"><li>Install species-appropriate wildlife fencing to guide animals towards culvert. Culvert has functionality for adaptable small- and medium-sized fauna, including Semi-Aquatic Obligates and Medium-Structure Generalists.</li></ul>	
			
Photo 44. Eliot-5: Tunnel-like view through culvert.		Photo 45. Eliot-5: Thick vegetation cover at both culvert entrances.	

## Kennebunkport: Oakridge Road

Segment Description: York County – starting just south of Cranberry Lane running north to Misery Road just 0.1 mile south of the Biddeford town line.

Segment Length: 1.4 miles

### Roadway and Site Description

Two-lane paved highway with low traffic volume (<700 seasonal ADT). The roadbed through this segment is level or raised relative to the surrounding topography. The landscape through this segment is mostly forested with wetlands and some single house residential development.



Photo 60. Typical road profile on Oakridge Road

### Wildlife

Surveyors observed signs of green frog, raccoon, turtle and fish during the inventory.

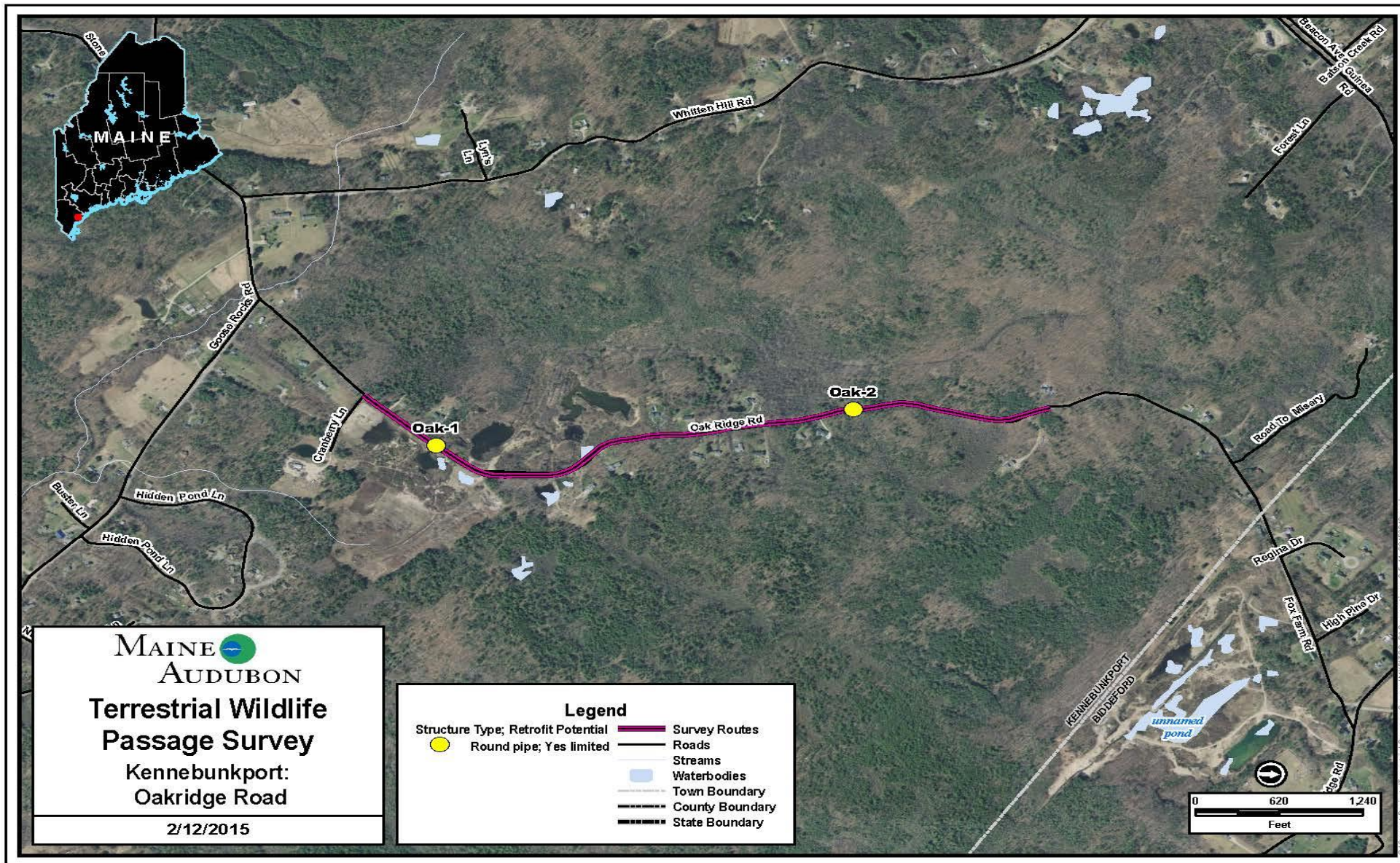
### Structures Inventory

Structure ID	Structure Type*	Retrofit Potential	Retrofit Notes**
Oak Ridge-1	2' diameter (ø) round pipe	Yes, limited	<ul style="list-style-type: none"><li>• Small, long, dark tunnel may have limited functionality for small Semi-Aquatic Obligates and Medium-Structure Generalists, though not suitable for turtles.</li><li>• Pond/wetlands on both sides of structure, though access immediately in front of culvert entrances is dry. Rocky access on outlet side.</li><li>• Could be enhanced by covering rocks at outlet with native soil to create a smooth pathway into culvert and adding small animal fencing to guide wildlife to culvert.</li></ul>
Oak Ridge-2	16" ø round pipes (x2)	Yes, limited	<ul style="list-style-type: none"><li>• Twin drainage pipes with seasonal flows; perched at outlet (5" high) and inlet.</li><li>• Small, dark tunnels limit functionality, but could be improved for small, adaptable Semi-Aquatic Obligates by fixing perch and adding wildlife fencing. Not suitable for turtle passage.</li></ul>

\*The symbol ø is used as an abbreviation for diameter.

\*\*Species-specific wildlife fencing should be considered at all retrofit locations, taking into account potential barrier impacts to other species for which the structure is an unsuitable passageway and whose movements the fencing may block. See Section III for discussion of wildlife guide fencing.





Road Segment Summary Findings

Small pipes could be enhanced by improving access into the culverts, but the size and nature of these structures limits their potential to small, adaptive fauna.



## South Berwick/Eliot/York: Route 91

Segment Description: York County – from Roe Fields Drive in South Berwick southwest to 0.1 mile south of Brixham Road in York.

Segment Length: 2.0 miles

### Roadway and Site Description

Two-lane paved highway with high daytime traffic

volumes (<10,000 seasonal ADT). The roadbed through this segment is level relative to the surrounding topography. The landscape is largely forested with shrub wetlands and some residential development.



Photo 61. Typical road profile on Route 91

### Wildlife

Small fauna observed at the time of the survey include green frog, pickerel frog, garter snake and raccoon.

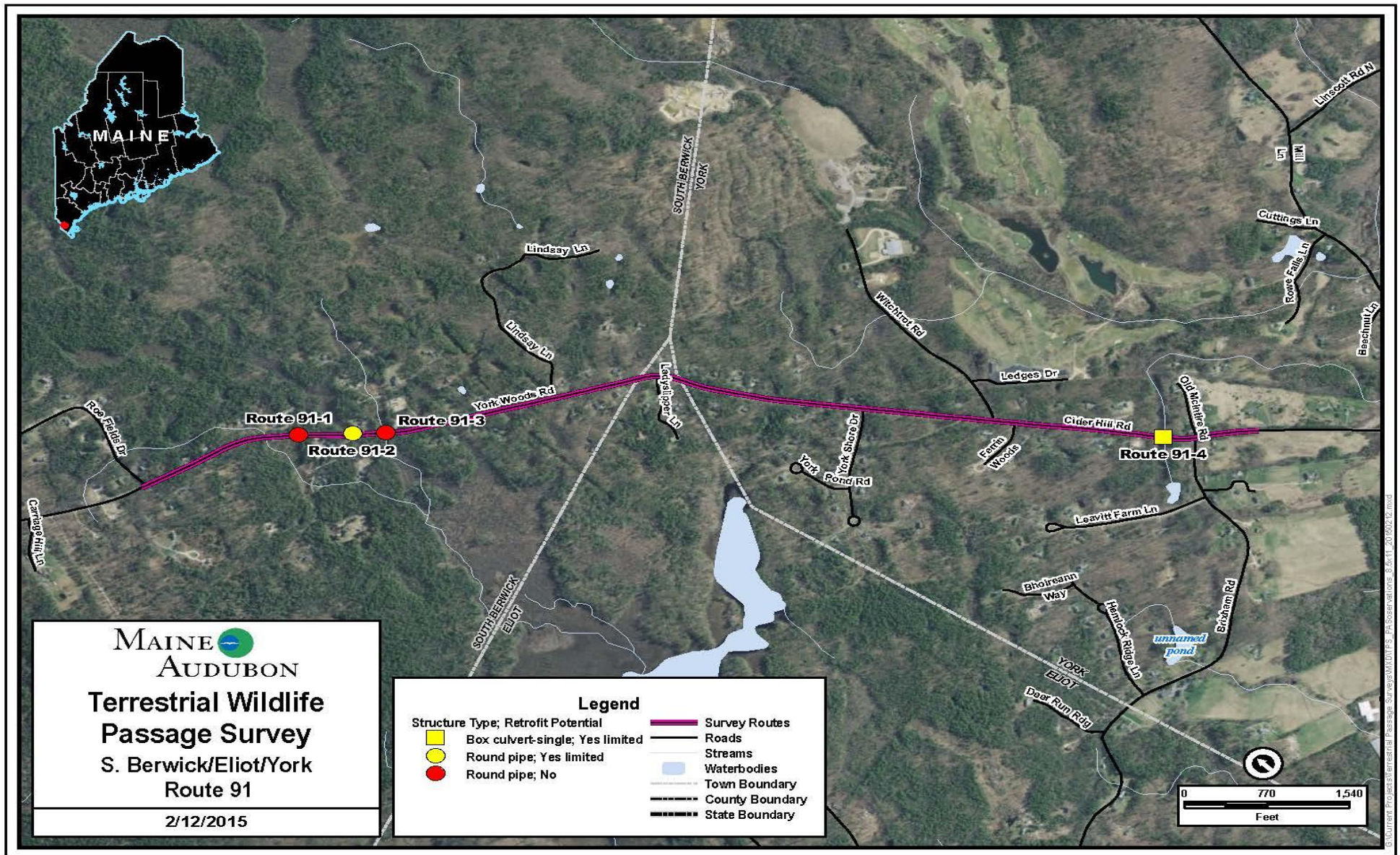
### Structures Inventory

Structure ID	Structure Type*	Retrofit Potential	Retrofit Notes**
Route 91-1	12" diameter (ø) round pipe	No	<ul style="list-style-type: none"><li>• Very small, dark tunnel not suitable for wildlife passage.</li></ul>
Route 91-2	24" ø round pipe	Yes, limited	<ul style="list-style-type: none"><li>• Small tunnel between forested shrub wetlands with intermittent flows. May have limited functionality for some small Semi-Aquatic Obligates. Could be enhanced with small animal fencing.</li></ul>
Route 91-3	16" ø round pipe	No	<ul style="list-style-type: none"><li>• Small, dark tunnel not suitable for wildlife passage.</li></ul>
Route 91-4	Box culvert	Yes, limited	<ul style="list-style-type: none"><li>• Small, deteriorating box culvert (2' to &lt;5' wide &amp; high) with perennial water flow (&lt;3' deep); forested shrub wetland on both sides.</li><li>• Install wildlife fencing to improve functionality for Semi-Aquatic Obligates and Medium-Structure Generalists that are willing to get their feet wet.</li><li>• Investigate whether culvert condition would allow shelf installation.</li></ul>

\*The symbol ø is used as an abbreviation for diameter.

\*\*Species-specific wildlife fencing should be considered at all retrofit locations, taking into account potential barrier impacts to other species for which the structure is an unsuitable passageway and whose movements the fencing may block. See Section III for discussion of wildlife guide fencing.





Road Segment Summary Findings

This segment has limited retrofit opportunities.

## South Berwick: Witch Trot Road

Segment Description: York County – starting 1.3 miles northeast of Route 91 on Witch Trot Road north to Emerys Bridge Road.

Segment Length: 1.3 miles

### Roadway and Site Description

Two-lane paved highway with moderate daytime traffic volumes (<2,000 seasonal ADT). The roadbed through this segment is level relative to the surrounding topography. The landscape is characterized by forest, shrub and wetland habitats.



Photo 68. Typical road profile on Witch Trot Road

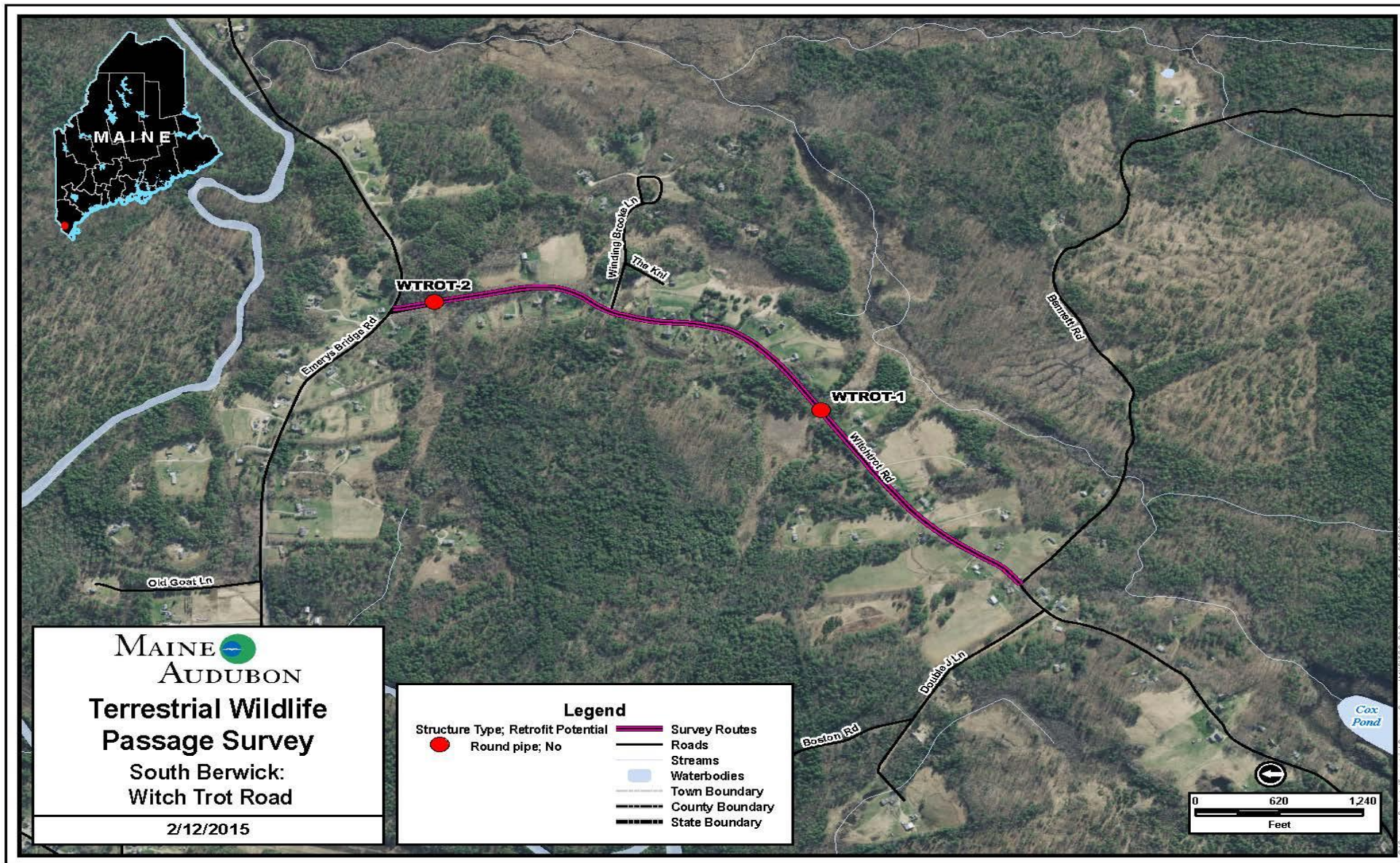
### Structures Inventory

Structure ID	Structure Type*	Retrofit Potential	Retrofit Notes**
WTROT-1	2' to <5'Ø round pipe	No	<ul style="list-style-type: none"><li>Small, dark tunnel with perennial water flow with outlet perch and pooling at both inlet and outlet.</li></ul>
WTROT-2	<2' Ø round pipe	No	<ul style="list-style-type: none"><li>Small, dark tunnel with rocky inlet, pool at outlet. Perched outlet (5" high).</li></ul>

\*The symbol Ø is used as an abbreviation for diameter.

\*\*Species-specific wildlife fencing should be considered at all retrofit locations, taking into account potential barrier impacts to other species for which the structure is an unsuitable passageway and whose movements the fencing may block. See Section III for discussion of wildlife guide fencing.





Road Segment Summary Findings

No retrofit opportunities were identified along this segment.



## York: Bell Marsh Road

Segment Description: Starting from Route 91 in York going north to 0.25 miles from end at Emerys Bridge Road in South Berwick.

Segment Length: 3 miles

### Roadway and Site Description

Two-lane road with low to moderate traffic volume (~500-2,000 seasonal ADT). The road is paved at both the north and south ends of the segment, while the middle section is gravel. The roadbed is level through much of the segment, though in some places it is elevated above the surrounding topography.



Photo 1. Typical road profile on Bell Marsh Road

### Wildlife

Notably, signs of white-tailed deer, small mammals, amphibians and reptiles were apparent throughout the segment. Snapping turtle nesting was observed along the roadsides, including several road-killed hatchlings.

### Structures Inventory

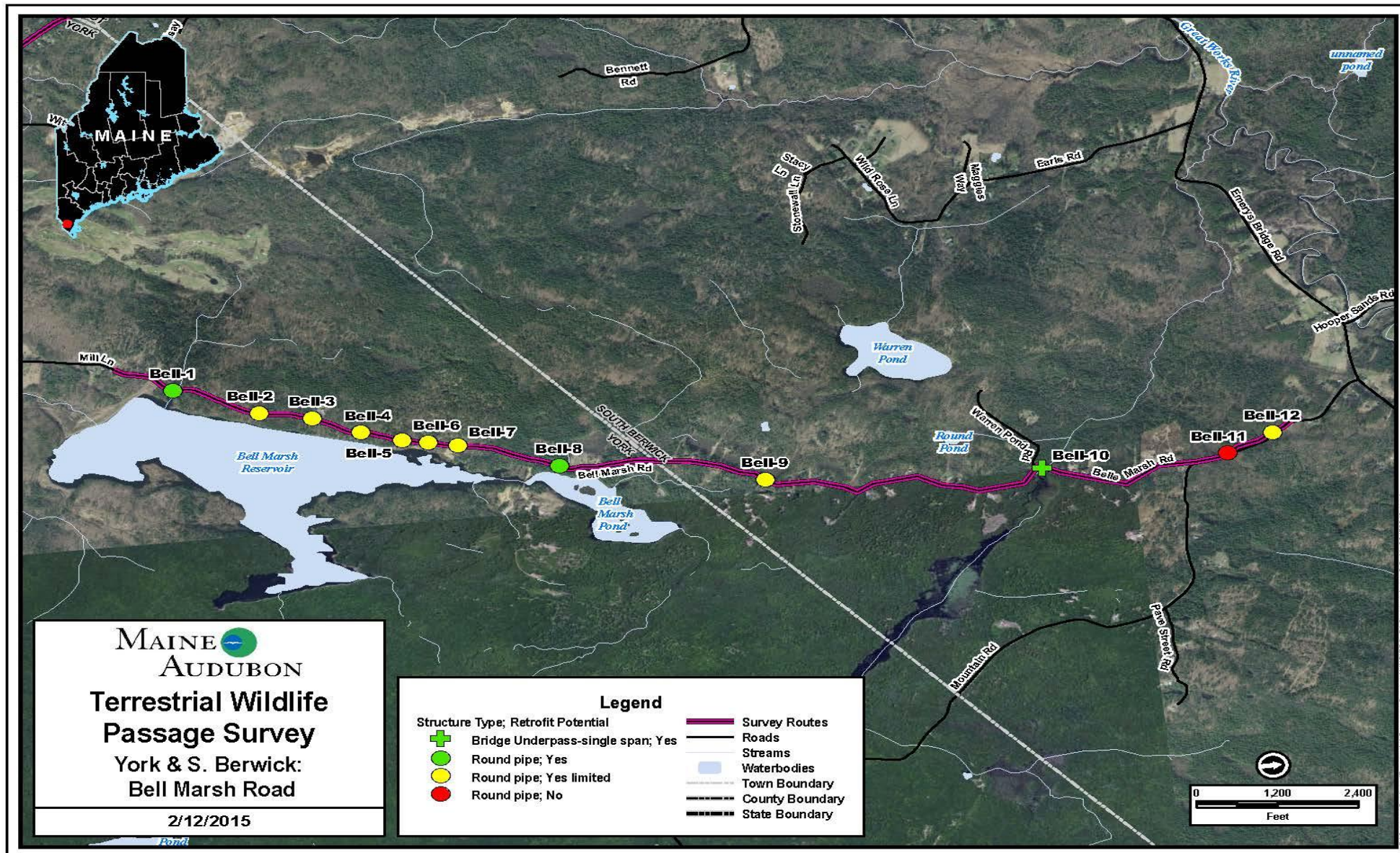
Structure ID	Structure Type*	Retrofit Potential	Retrofit Notes**
Bell-1	30" ø round pipe (x 2)	Yes	<ul style="list-style-type: none"><li>• Improve functionality for adaptive small fauna (see below for recommendations).</li></ul>
Bell-2	18" ø round pipe	Yes, limited	<ul style="list-style-type: none"><li>• Small, dark plastic pipe with limited functionality for adaptive small fauna and salamanders.</li><li>• Could be enhanced with guide fencing.</li></ul>
Bell-3	20" ø round pipe	Yes, limited	<ul style="list-style-type: none"><li>• Small, dark plastic pipe with limited functionality for adaptive small fauna and salamanders.</li><li>• Could be enhanced with guide fencing.</li></ul>
Bell-4	<2' ø round pipe	Yes, limited	<ul style="list-style-type: none"><li>• Small, dark plastic pipe with limited functionality for adaptive small fauna and salamanders.</li><li>• Could be enhanced by creating natural substrate pathways across small rock riprap at outlet and adding guide fencing.</li></ul>



Bell-5	<2' ø round pipe	Yes, limited	<ul style="list-style-type: none"> <li>• Small, dark tunnel with limited functionality for small adaptive fauna and salamanders.</li> <li>• Could be enhanced by removing sediment obscuring both entrances and adding guide fencing.</li> </ul>
Bell-6	2' to <5'ø round pipe	Yes, limited	<ul style="list-style-type: none"> <li>• Improve functionality for adaptive small and medium-sized fauna.</li> <li>• Create natural substrate pathways across riprap at both culvert entrances, and fix perch at outlet.</li> <li>• Add limited guide fencing.</li> </ul>
Bell-7	<2' ø round pipe	Yes, limited	<ul style="list-style-type: none"> <li>• Small, dark tunnel with limited functionality for adaptive small fauna and salamanders.</li> <li>• Could be enhanced by fixing perched outlet, creating natural substrate pathway across riprap at outlet, and adding guide fencing.</li> </ul>
Bell-8	5' ø round pipe	Yes	<ul style="list-style-type: none"> <li>• Improve functionality for small and medium-sized adaptive fauna, including turtles (see below for recommendations).</li> </ul>
Bell-9	16" ø round pipe	Yes, limited	<ul style="list-style-type: none"> <li>• Fix perched outlet to allow salamander passage. Structure very small and dark; not suitable for other species.</li> <li>• Could be enhanced by adding limited salamander guide fencing.</li> </ul>
Bell-10	Single span Bridge	Yes	<ul style="list-style-type: none"> <li>• Improve functionality for small, medium and large-sized adaptive fauna (see below for recommendations).</li> </ul>
Bell-11	< 2' ø round pipe	No	<ul style="list-style-type: none"> <li>• Fatal Flaw: pipe is too small, dark and long.</li> </ul>
Bell-12	< 2' ø round pipe	Yes, limited	<ul style="list-style-type: none"> <li>• Small, dark tunnel with limited functionality for salamanders.</li> <li>• Could be enhanced with guide fencing.</li> </ul>

*\*The symbol ø is used as an abbreviation for diameter.*



*\*\*Species-specific wildlife fencing should be considered at all retrofit locations, taking into account potential barrier impacts to other species for which the structure is an unsuitable passageway and whose movements the fencing may block. See Section III for discussion of wildlife guide fencing.*









### Road Segment Summary Findings

In their current condition, the structures in this road segment have limited functionality for terrestrial wildlife passage. Most of the existing structures in this road segment are small pipes with limited retrofit potential. One structure (Bell-10) is a bridge that is large enough for a variety of wildlife to use. The structure could be retrofit to accommodate larger fauna (e.g., white-tailed deer, coyote and black bear), as well as species with more specialized needs for natural substrate or cover, including amphibians that depend on consistent ambient conditions to avoid desiccation. Two of the pipe culverts have good retrofit potential and, in particular, Bell-8 offers an excellent opportunity to improve passage for small and medium-sized fauna, including turtles.

RETROFIT PRIORITIES: Bell Marsh Road	
<b>BELL-1</b>	<ul style="list-style-type: none"> <li>• Two 30" diameter concrete pipes 63' long at the base of small fill slope; Inlets partially obscured with debris.</li> <li>• Intermittent water flow through structure. Outlet cascades into small rocks; extensive riprap at outlet.</li> <li>• Forest cover at inlet; reservoir ~20' from outlet.</li> </ul>
Retrofit Recommendation	<ul style="list-style-type: none"> <li>• Remove debris at inlets; conduct regular maintenance to prevent future obstructions.</li> <li>• Create natural substrate pathway over rock cascade at outlets, and connect natural substrate pathways across riprap to adjacent habitat.</li> <li>• Install limited fencing to guide animals towards culvert entrances.</li> </ul>
	
<i>Photo 2. Bell-1: Outlets with small rock cascade.</i>	<i>Photo 3. Bell-1: Extensive riprap at outlet; reservoir beyond.</i>



<b>BELL-8</b>	<ul style="list-style-type: none"> <li>• 5' diameter 60' long corrugated plastic pipe.</li> <li>• Some pooling at inlet and outlet; Outlet perched with boulders and rock cascade potentially obscuring entry into culvert for some wildlife.</li> <li>• Intermittent water flow through culvert but appears dry much of the time.</li> </ul>
Retrofit Recommendation	<ul style="list-style-type: none"> <li>• Fix outlet perch and create natural substrate pathway over rock cascade at outlets, and connect natural substrate pathways across riprap to adjacent habitat. Consider installing small mammal shelf.</li> <li>• Install limited small and medium-sized wildlife fencing to guide animals towards culvert entrances.</li> </ul>
	
<i>Photo 4. Bell-8: Inlet side.</i>	<i>Photo 5. Bell-8: Perched outlet and riprap culvert approach.</i>
<b>BELL-10</b>	<ul style="list-style-type: none"> <li>• Single span bridge overpass (20' to 40' wide by 12' to 20' high by 25' long).</li> <li>• Shrubby wetland with beaver dam at inlet, but no pooling immediately in front of structure entrance. Forest cover at outlet.</li> <li>• Water flow through structure, with extensive riprap banks.</li> </ul>
Retrofit Recommendation	<ul style="list-style-type: none"> <li>• Create a level, natural substrate pathway through the boulders leading into the habitat on either side of the structure.</li> <li>• Install wildlife fencing to guide animals towards culvert entrances.</li> </ul>
	
<i>Photo 6. Bell-10: boulder substrate and banks thorough structure.</i>	<i>Photo 7. Bell-10: Beaver dam and wetlands at structure inlet.</i>

## York: Mountain Road

Segment Description: York County – from 0.1 mile east of Mount A Road in York running east to Chase Pond Road

Segment Length: 2.5 miles

### Roadway and Site Description

Two-lane paved highway with moderate traffic volume (<2,000 seasonal ADT). The roadbed through this segment is level or raised relative to the surrounding topography. The landscape includes forest, wetlands, mowed fields and residential development.

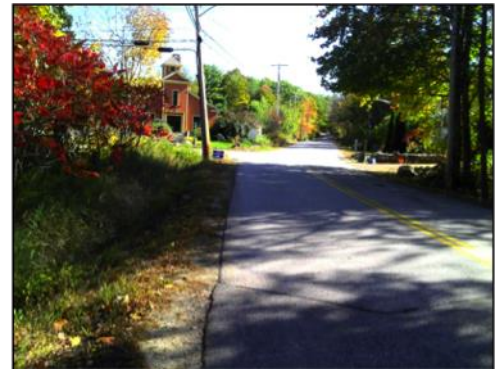


Photo 59. Typical road profile on Mountain Road

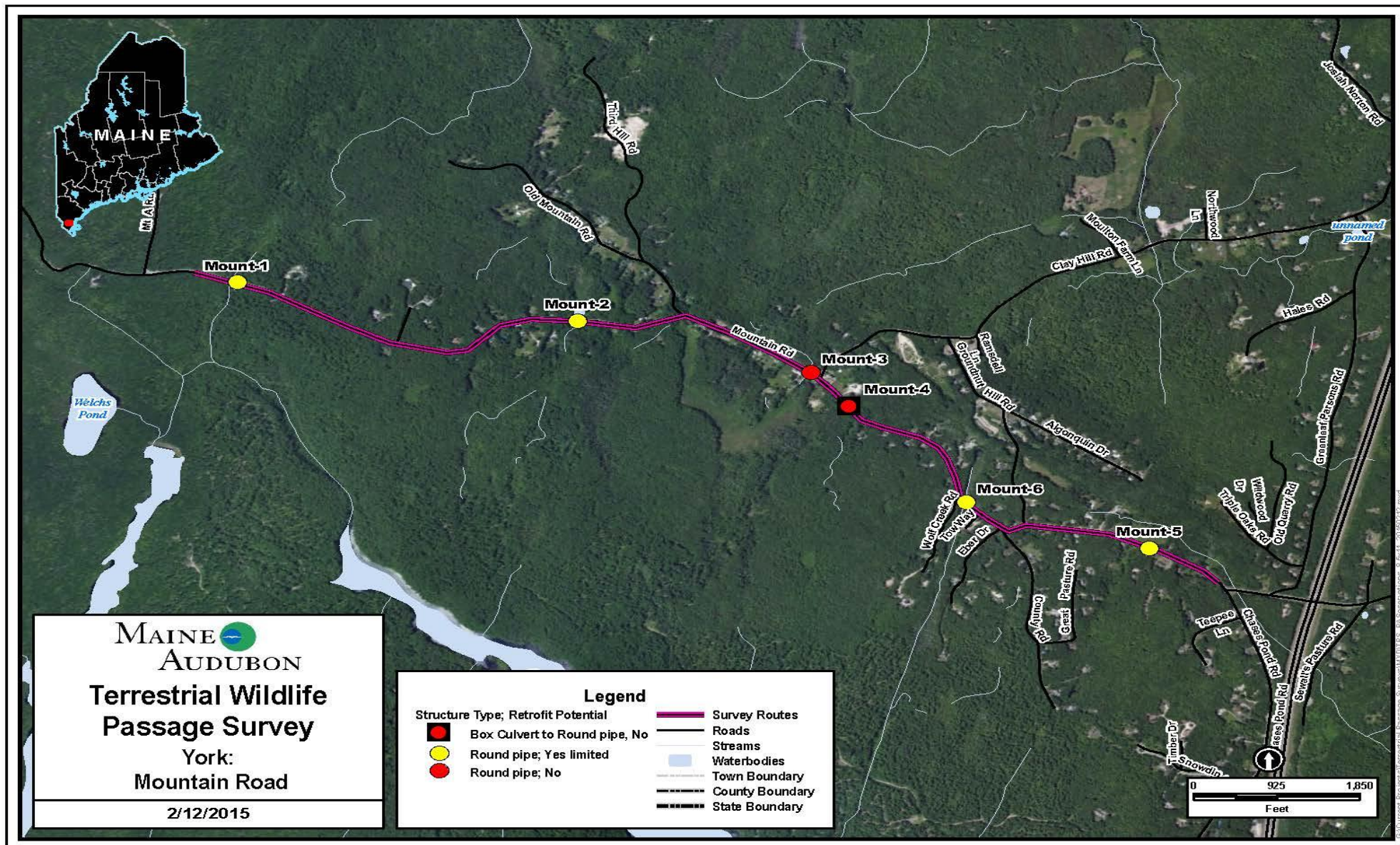
### Structures Inventory

Structure ID	Structure Type*	Retrofit Potential	Retrofit Notes**
Mount-1	2' diameter (ø) round pipe	Yes, limited	<ul style="list-style-type: none"> <li>Small, long, dark tunnel limits functionality, but could be improved for small adaptive fauna by removing the debris and sediment blocking the inlet and inside pipe.</li> <li>Could be enhanced with small animal fencing.</li> </ul>
Mount-2	2' to <5'ø round pipe	Yes, limited	<ul style="list-style-type: none"> <li>Small, dark tunnel with limited functionality for adaptive small fauna.</li> <li>Could be enhanced eliminating inlet pooling to improve access to culvert and with small animal fencing.</li> </ul>
Mount-3	2' to <5'ø round pipes (x3)	No	<ul style="list-style-type: none"> <li>Fatal flaw: fully aquatic drainage pipes; pooling on both sides.</li> </ul>
Mount-4	Box culvert (inlet); round pipe (outlet)	No	<ul style="list-style-type: none"> <li>Structure type changes from box to pipe half-way through; perched outlet. Not functional for wildlife passage or suitable for retrofit.</li> </ul>
Mount-5	2' to <5'ø round pipe	Yes, limited	<ul style="list-style-type: none"> <li>Small culvert with seasonal water flows (dry at time of survey) in a mixed use landscape (natural/human).</li> <li>May have limited functionality for adaptive small fauna, which could be enhanced with the addition of small animal fencing.</li> </ul>
Mount-6	2' to <5'wide oval pipe	Yes, limited	<ul style="list-style-type: none"> <li>Small, dark culvert with seasonal water flows (dry at time of survey) with pond 5' from inlet.</li> <li>May have limited functionality for adaptive small fauna, which could be enhanced with the addition of small animal fencing.</li> </ul>

\*The symbol ø is used as an abbreviation for diameter.

\*\*Species-specific wildlife fencing should be considered at all retrofit locations, taking into account potential barrier impacts to other species for which the structure is an unsuitable passageway and whose movements the fencing may block. See Section III for discussion of wildlife guide fencing.







#### Road Segment Summary Findings

Structures in this segment are small (<5') culverts with seasonal water flows. The current and retrofit potential have limited functionality for small, adaptive fauna. Several of the culverts could be improved by removing debris (Mount-1) or alleviating pooling (Mount-2) that blocks access into the culvert. Each of these sites could be improved with the addition of species appropriate small animal fencing to guide wildlife to these structures.

## York: Scituate Road

Segment Description: York County – from Chase Pond Road running south to Scituate Pond Dam Road.

Segment Length: 1.7 miles

### Roadway and Site Description

Two-lane paved highway with low daytime traffic volumes (<575 seasonal ADT). The roadbed through this segment is level relative to the surrounding topography. The landscape is largely forested with shrub wetlands and some residential development.



Photo 65. Typical road profile on Scituate Road

### Wildlife

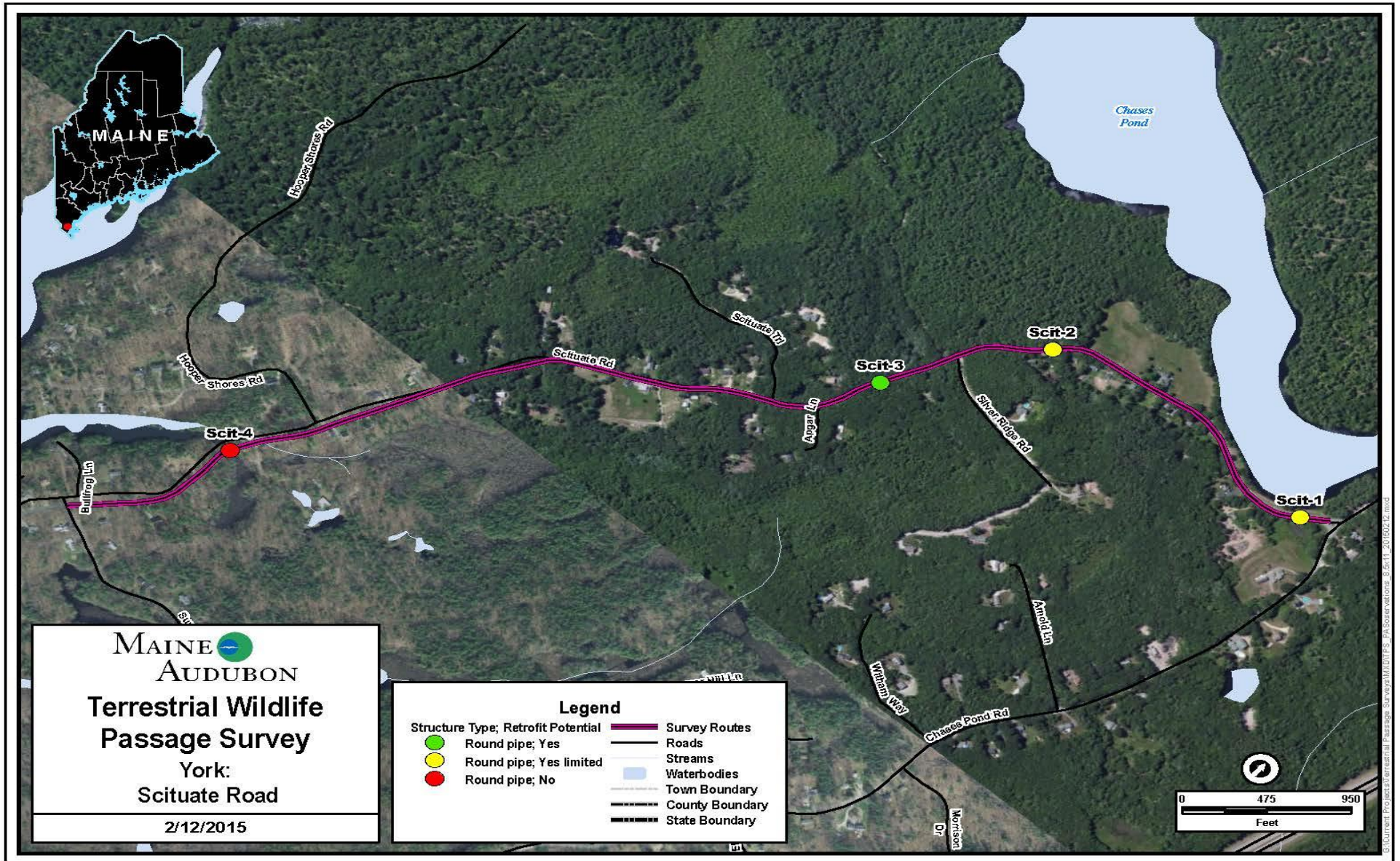
Small fauna observed at the time of the survey include green frog, pickerel frog, garter snake and raccoon.

### Structures Inventory

Structure ID	Structure Type*	Retrofit Potential	Retrofit Notes**
Scit-1	16" diameter (ø) round pipe	Yes, limited	<ul style="list-style-type: none"><li>• Small, dark drainage culvert; plastic substrate, though some sediment buildup at inlet/outlet; limited functionality for adaptive small fauna and salamanders.</li><li>• Enhance with small animal fencing.</li></ul>
Scit-2	<2' ø round pipe	Yes, limited	<ul style="list-style-type: none"><li>• Small, dark drainage culvert; plastic substrate, though some sediment buildup at inlet/outlet; limited functionality for adaptive small fauna and salamanders.</li><li>• Enhance with small animal fencing.</li></ul>
Scit-3	36" ø round pipe	Yes	<ul style="list-style-type: none"><li>• Improve functionality for small Medium-Structure Generalists and Semi-Aquatic Obligates (see below for recommendations).</li></ul>
Scit-4	36" ø round pipe	No	<ul style="list-style-type: none"><li>• Fatal flaw: Aquatic culvert with large pond in front of inlet.</li></ul>

\*The symbol ø is used as an abbreviation for diameter.



\*\*Species-specific wildlife fencing should be considered at all retrofit locations, taking into account potential barrier impacts to other species for which the structure is an unsuitable passageway and whose movements the fencing may block. See Section III for discussion of wildlife guide fencing.





### Road Segment Summary Findings

The structures in this segment are small, dark tunnels with limited retrofit potential, although several of them may be functional for small, adaptive fauna, including salamanders. Small animal fencing would help to guide animals to pass through these structures.

RETROFIT PRIORITIES: York Scituate Road	
Scit-3	<ul style="list-style-type: none"><li>• Round metal pipe (36" diameter by &lt;65' long).</li><li>• Intermittent flows provide drainage. Sand and rocks deposited in culvert provide natural substrate pathway through culvert.</li></ul>
Retrofit Recommendation	<ul style="list-style-type: none"><li>• Add low baffles through culvert to increase sediment deposition through the length of the culvert if feasible.</li><li>• Install wildlife fencing to guide animals to culvert.</li></ul>
	
Photo 66. Scit-3: Inlet.	Photo 67. Scit-3: Sand and rocks deposited in culvert create a natural substrate pathway.

## Appendices

### Appendix A. Target Species and Associated Wildlife Crossing Guilds

Guild classes and descriptions derived from Kintsch, Cramer and Jacobson (in progress...)

WILDLIFE CROSSING GUILD	SPECIES
<b><i>Cover Obligates –</i></b>  Small species that are common prey for larger wildlife, and that use cover to escape from predators.	Black Racer Snake New England Cottontail Snowshoe Hare Spotted Turtle Blanding’s Turtle Small mammals (e.g., gopher, mice, mole, shrew, vole).
<b><i>Semi-Aquatic Obligates –</i></b>  Species that live in or close to fresh water and riparian habitat.	Beaver Mink River Otter Painted Turtle Wood Turtle
<b><i>Medium-Structure Generalists –</i></b>  Small and medium-sized, fauna that tolerate or prefer some enclosure but do not have specific cover requirements.	Black Bear Bobcat Coyote Fisher Fox Marten Raccoon Weasels Striped Skunk Porcupine Woodchuck
<b><i>Large-Structure Generalists –</i></b> Medium and large-sized fauna that are adaptive to a variety of crossing structure types so long as they meet minimum size and openness requirements.	Lynx Moose White-Tailed Deer
<b><i>Conditions Specialists –</i></b> Extremely low mobility species; permeable-skinned species; other habitat specialists; or species with unique movement considerations.	Northern Leopard Frog Wood Frog Spotted & blue-spotted Salamander
<b><i>Arboreal Specialists –</i></b> Species that move primarily through the canopy rather than on the ground surface.	Northern Flying Squirrel

## Appendix B. Passage Assessment System

### PASSAGE ASSESSMENT SYSTEM – UNDIVIDED ROAD

Revised July 2014

Location ID: \_\_\_\_\_

**\*\*For clarifications in using the PAS and responding to individual questions, refer to the accompanying User's Guide\*\***

#### GENERAL

Date:				Start Time (24hr clock):	
Observers:					
Route Name:				Milepost:	
Stream Name (if applicable):					
GPS Northing:				GPS Easting:	
GPS ID #:					
Number of lanes of road: _____				Road direction:      East/West      North/South	
Road type:	Highway	Paved	Gravel	Trail	Railroad
Traffic observation period (15 minute observation period by road segment)					
Vehicles observed:		Low (0-7 cars)	Moderate (8-29 cars)	High (30-139 cars)	Very High (≥ 140 cars)
Note traffic volume conditions at time of evaluation: _____					
Is there parallel infrastructure?	None	Railroad	Recreational path	Frontage road	Other:
Describe how the road is situated relative to the local topography:					
Level or riparian			Sloped: Is the upper slope on the <u>North/West</u> or <u>South/East</u> side?		
Below-grade (i.e., cut slopes)			Raised: Is structure situated at the <u>base</u> of the slope, <u>midway</u> , or <u>near the top</u> ?		
Targets species groups (Wildlife Crossing Guilds) – select all that apply:					
Cover Obligates		Openness Obligates		Semi-Aquatic Obligates	
Habitat Specialists		Arboreals		Aerials	
Medium-Structure Generalists				Large-Structure Generalists	
What is the shape of the structure?	Round Pipe	Squash Pipe	Box Culvert-single	Box Culvert-multiple	Arch Culvert
	Bridge Underpass-single span	Bridge Underpass-multi span	Overpass	Other:	
If Bridge Underpass: (specify if different for North/West and South/East sides of structure)					



## PASSAGE ASSESSMENT SYSTEM – UNDIVIDED ROAD

Revised July 2014

Location ID: \_\_\_\_\_

<b>Are the abutments:</b>	Vertical Walls	Sloped (1:1 = 45°)		Sloped (1:2 = gentle slope)		
<b>What is the material of the abutments?</b>	Soil	Concrete	Concrete/Soil	Riprap	Gabian Wall	Other:

<b>What is the structure material?</b>	Concrete	Metal	Plastic/Fiberglass	Stone	Timber	Other:
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<b>Structure Width class: (at eye level)</b>	< 2 ft	2 to < 5 ft	5 to < 8 ft	8 to < 20 ft	20 to < 40 ft	≥ 40 ft
<b>Structure Height class:</b>	< 2 ft	2 to < 5 ft	5 to < 8 ft	8 to < 12 ft	12 to < 20 ft	≥ 20 ft
<b>Structure Length class:</b>	< 65 ft	65 to < 100 ft	100 to < 150 ft	150 to < 200 ft	≥ 200 ft	

**Briefly describe environmental conditions at the time of the assessment:** (e.g., seasonal conditions, water levels, vegetation growth, snow/ice, etc.)

### PRELIMINARY QUESTIONS (assess Fatal Flaws for target species groups as indicated)

For Openness Obligates, Semi-Aquatic Obligates, and Large Structure Generalists:

Is the structure longer than 300'?	No (continue with PAS)	Yes (STOP, structure not suitable for retrofit)
Can you see through the structure to the other side?	Yes (continue with PAS)	No (STOP, structure not suitable for retrofit)

For all species groups:

Is the culvert slope > 30 degrees AND > 100' long?	No (continue with PAS)	Yes (STOP, structure is not suitable for retrofit)
Is there extensive development in the immediate vicinity?	No (continue with PAS)	Yes (STOP, structure is not suitable for retrofit)
Is there a body of water immediately in front of one or both structure entrances that would make entry inaccessible for the target Guilds?	No (continue with PAS)	Yes (STOP, structure is not suitable for retrofit)

If a Fatal Flaw has been identified, does the site appear suitable for a replacement structure?      Yes      No

Describe:

### WINTER CONDITIONS

In your opinion, are average winter conditions (e.g., snow build up, frozen surfaces) likely to either improve or inhibit passage for the target Guilds?

Not Applicable	Improve	Inhibit	Uncertain
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Explain:

# PASSAGE ASSESSMENT SYSTEM – UNDIVIDED ROAD

Location ID: \_\_\_\_\_

## INLET SIDE: Fencing and Right of Way

How wide is the zone of maintained vegetation along road shoulder?	0'	0-3'	3-6'	6-30'
Is there a shoulder barrier?	No	Yes, above structure only	Yes, extensive	Other:
Select type of fencing adjacent to the <i>right</i> when facing the structure (inlet):	None	Curb	Wall	Chain Link
	Wildlife Fence	Sediment Fence	Wire Strand	Other:
-What is the height of fencing/wall?	≤ 1'	1' to 2'	> 2' to 4'	> 4 to 8'
-What is the mesh size?	None	≤ 6x6"	> 6x6"	
-Is the fence connected to the structure?	Yes, completely	No - small gap (≤ 0.5')	No - large gap (> 0.5')	
-Does the fencing reach all the way to ground level without gaps?	Yes	No		
-What is the condition of the fencing?	Fence in good working order	Some gaps in fence	Vegetation needs to be cleared from fence	
-Minimum distance fence extends from structure:	≤ 10 feet	10-50 feet	50-100 feet	>100 feet
			Miles	End not visible/known
-Are there any breaks in the fence (driveways, intersections) within ½ mile in either direction?	Yes			No
Is the ROW fencing the same as the fencing immediately adjacent to the structure?	Yes	No		
-If no, what is the ROW fencing type?	Wire Strand	Wall	Chain Link	Other:
Select type of fencing adjacent to the <i>left</i> when facing the structure (inlet):	None	Curb	Wall	Chain Link
	Wildlife Fence	Sediment Fence	Wire Strand	Other:
-What is the height of fencing/wall?	≤ 1'	1' to 2'	> 2' to 4'	> 4 to 8'
-What is the mesh size?	None	≤ 6x6"	> 6x6"	
-Is the fence connected to the structure?	Yes, completely	No - small gap (≤ 0.5')	No - large gap (> 0.5')	
-Does the fencing reach all the way to ground level without gaps?	Yes	No		
-What is the condition of the fencing?	Fence in good working order	Some gaps in fence	Vegetation needs to be cleared from fence	
-Minimum distance fence extends from structure:	≤ 10 feet	10-50 feet	50-100 feet	>100 feet
			Miles	End not visible/known
-Are there any breaks in the fence (driveways, intersections) within ½ mile in either direction?	Yes			No
Is the ROW fencing the same as the fencing immediately adjacent to the structure?	Yes	No		
-If no, what is the ROW fencing type?	Wire Strand	Wall	Chain Link	Other:

## FENCING NOTES:

## PASSAGE ASSESSMENT SYSTEM – UNDIVIDED ROAD

Location ID: \_\_\_\_\_

### INLET SIDE: Exterior Conditions

Is there an apron at the inlet?	No	Yes, metal	Yes, concrete
Does the inlet have wing walls?	No	Yes	
Is the immediate entrance blocked?	None	Small rocks/riprap (~ baseball size)	Thick vegetation
	Fence	Large rocks/riprap (> volleyball size)	Other:
	Gate	Boulders (humans would have to climb over)	
Pooling at inlet?	Yes	No	
-If yes, what is the maximum pool depth?	<3"	< 3'	≥ 3'
-If yes, is the pool immediately in front of the inlet wider than the structure?	Yes	No	
Is the structure located in a fill slope?	No	Yes, < 20' high	Yes, ≥ 20' high
-How is the structure situated in the slope?		At the base	Midway on fill slope
			Near the top
Is there vegetation/cover within 25' of the inlet?	No	Yes, partially	Yes, completely
-If yes, select predominant type:	Grasses	Shrubs	Shrubs/Trees
Is there vegetation/cover within 25-50' of the inlet?	No	Yes, partially	Yes, completely
-If yes, select predominant type:	Grasses	Shrubs	Shrubs/Trees
Major land uses within 300' of inlet: (indicate % by 10s)	Forest _____	Meadow/Grassland _____	Wetlands _____
	Agriculture _____	Residential _____	Recreational _____
	Commercial/Industrial _____	Other: _____	

NOTES:



## PASSAGE ASSESSMENT SYSTEM – UNDIVIDED ROAD

Location ID: \_\_\_\_\_

### INSIDE STRUCTURE

Does the inside of the structure appear much darker than the outside lighting?	High Contrast		Low Contrast	
Is there a clear line of sight from one end of the structure(s) to the other?	Clear	Partially Obscured		Completely Obscured
Is there a sky light in structure?	No	Yes		
Is there water flow through structure?	None	Intermittent	Perennial	Uncertain
-What is <i>current</i> water depth in structure?	None	<3"	< 3'	≥ 3'
-Do the current flow conditions appear to be similar to average yearly flow conditions?	Yes	No, appears higher	No, appears lower	
Does there appear to be a dry pathway through the structure during average flows?	Yes	No	Uncertain	
-What is the pathway substrate?	Natural (same as outside)	Concrete/Asphalt	Concrete with sediment baffles	Metal
	Large Rocks (> volleyball)	Small Rocks (~ baseball)	Plastic	Soil
			Other:	
-What is the min. width of the dry pathway within the structure?	≤ 1'	1' to 2'	2' to 4'	4' to 10'
			≥ 10	
-Is there evidence that the dry pathway may be inundated seasonally or during high water events?	No	Yes	Uncertain	
Is there a natural substrate through the length of the structure?	Yes	No		
Is there a natural substrate through the width of the structure?	Yes	No		
Is there vegetative cover and/or woody debris within the structure?	None	Some Logs/Down Trees	Some Grass/Brush	Grasses
				Brush/Bushes/Trees
Are there obstructions inside the structure?	None	Debris	Soil	Man-made Items
				Other:
Is there a road or trail through the structure?	None	Paved Road	Dirt Road	Railroad
				Paved Trail
				Dirt Trail
What does passing traffic sound like at the inlet or outlet of the structure?	Unobtrusive	Low Rumble		Loud and Jarring

NOTES:

# PASSAGE ASSESSMENT SYSTEM – UNDIVIDED ROAD

Location ID: \_\_\_\_\_

## OUTLET SIDE: Fencing and Right of Way

How wide is the zone of maintained vegetation along road shoulder?	0'	0-3'	3-6'	6-30'
Is there a shoulder barrier?	Yes, above structure only	Yes, extensive	No	Type: Guard Rail Jersey Wall Other:
Select type of fencing adjacent to the <i>right</i> when facing the structure (outlet):	None	Curb	Wall	Chain Link
	Wildlife Fence	Sediment Fence	Wire Strand	Other:
-What is the height of fencing/wall?	≤ 1'	1' to 2'	> 2' to 4'	> 4 to 8' > 8'
-What is the mesh size?	None	≤ 6x6"	> 6x6"	
-Is the fence connected to the structure?	Yes, completely	No - small gap (≤ 0.5')	No - large gap (> 0.5')	
-Does the fencing reach all the way to ground level without gaps?	Yes	No		
-What is the condition of the fencing?	Fence in good working order	Some gaps in fence	Vegetation needs to be cleared from fence	
	Some tacking up of fence needed			
-Minimum distance fence extends from structure:				
	≤ 10 feet	10-50 feet	50-100 feet	>100 feet Miles End not visible/known
-Are there any breaks in the fence (driveways, intersections) within ½ mile in either direction?		Yes	No	
Is the ROW fencing the same as the fencing immediately adjacent to the structure?	Yes	No		
-If no, what is the ROW fencing type?	Wire Strand	Wall	Chain Link	Other:
Select type of fencing adjacent to the <i>left</i> when facing the structure:	None	Curb	Wall	Chain Link
	Wildlife Fence	Sediment Fence	Wire Strand	Other:
-What is the height of fencing/wall?	≤ 1'	1' to 2'	> 2' to 4'	> 4 to 8' > 8'
-What is the mesh size?	None	≤ 6x6"	> 6x6"	
-Is the fence connected to the structure?	Yes, completely	No - small gap (≤ 0.5')	No - large gap (> 0.5')	
-Does the fencing reach all the way to ground level without gaps?	Yes	No		
-What is the condition of the fencing?	Fence in good working order	Some gaps in fence	Vegetation needs to be cleared from fence	
	Some tacking up of fence needed			
-Minimum distance fence extends from structure:				
	≤ 10 feet	10-50 feet	50-100 feet	>100 feet Miles End not visible/known
-Are there any breaks in the fence (driveways, intersections) within ½ mile in either direction?		Yes	No	
Is the ROW fencing the same as the fencing immediately adjacent to the structure?	Yes	No		
-If no, what is the ROW fencing type?	Wire Strand	Wall	Chain Link	Other:

FENCING NOTES:

**PASSAGE ASSESSMENT SYSTEM – UNDIVIDED ROAD**

Revised July 2014

Location ID: \_\_\_\_\_

**\*\*For clarifications in using the PAS and responding to individual questions, refer to the accompanying User's Guide\*\*****GENERAL**

<b>Date:</b>				<b>Start Time (24hr clock):</b>			
<b>Observers:</b>							
<b>Route Name:</b>				<b>Milepost:</b>			
<b>Stream Name (if applicable):</b>							
<b>GPS Northing:</b>				<b>GPS Easting:</b>			
<b>GPS ID #:</b>							
<b>Number of lanes of road:</b> _____				<b>Road direction:</b>		East/West	North/South
<b>Road type:</b>	Highway	Paved	Gravel	Trail	Railroad		
<b>Traffic observation period (15 minute observation period by road segment)</b>							
<b>Vehicles observed:</b>		Low (0-7 cars)		Moderate (8-29 cars)		High (30-139 cars)	
						Very High (≥ 140 cars)	
<b>Note traffic volume conditions at time of evaluation:</b> _____							
<b>Is there parallel infrastructure?</b>		None	Railroad	Recreational path	Frontage road	Other:	
<b>Describe how the road is situated relative to the local topography:</b>							
Level or riparian				Sloped: Is the upper slope on the <u>North/West</u> or <u>South/East</u> side?			
Below-grade (i.e., cut slopes)				Raised: Is structure situated at the <u>base</u> of the slope, <u>midway</u> , or <u>near the top</u> ?			
<b>Targets species groups (Wildlife Crossing Guilds) – select all that apply:</b>							
Cover Obligates		Openness Obligates		Semi-Aquatic Obligates			
Habitat Specialists		Arboreals		Aerials			
Medium-Structure Generalists				Large-Structure Generalists			
<b>What is the shape of the structure?</b>		Round Pipe	Squash Pipe	Box Culvert-single	Box Culvert-multiple	Arch Culvert	
		Bridge Underpass-single span	Bridge Underpass-multi span	Overpass	Other:		
<b>If Bridge Underpass:</b> (specify if different for North/West and South/East sides of structure)							



## PASSAGE ASSESSMENT SYSTEM – UNDIVIDED ROAD

Location ID: \_\_\_\_\_

### WILDLIFE CROSSING GUILDS – FIELD RANKINGS

When ranking, consider how changes in seasonal conditions (e.g., water levels, vegetation growth, snow/ice, human activity) may affect passage for each target group. The following are subjective, in-the-field impressions, which may be changed based on new information or analysis of the situation.

A = Guild members could use this passageway as is or with small modifications

C = With modest modification this structure could be a functional passage for members of this Guild.

F = This structure cannot be made functional with a retrofit for members of this Guild.

Rate this structure for each Wildlife Crossing Guild present in the project area:

**Cover Obligates**, i.e., small species that require cover from predators, such as small mammals or terrestrial reptiles:

A C F

**Openness Obligates**, i.e., species that require open structures and excellent visibility, such as elk or pronghorn antelope:

A C F

**Semi-Aquatic Obligates**, i.e., species that require riparian or freshwater habitat, such as beaver, otters and some turtles:

A C F

**Medium-Structure Generalists**, i.e., small and medium-sized fauna that tolerate some enclosure, such as black bears, hares and weasels:

A C F

**Large-Structure Generalists**, i.e., medium and large-sized fauna that are generally adaptive, but require large, more open structures, such as deer, grizzly bears, lynx and mountain lions:

A C F

**Specialists**, i.e., movement specialist species, which require species-specific consideration. May include low-mobility species and amphibians:

A C F

**Arboreals**, i.e., species that move primarily through the tree canopy, such as flying squirrels or monkeys:

A C F

**Aerials**, i.e., species that fly, such as songbirds, raptors, shorebirds and bats:

A C F

Which features could be changed to make the structure more functional for any Wildlife Crossing Guild given and A or C rank?

# **PASSAGE ASSESSMENT SYSTEM – UNDIVIDED ROAD, PHOTO LOG**

Location ID: \_\_\_\_\_

PHOTO ID	PHOTO NAME	NOTES
<p><b>1<sup>st</sup> Picture in Series:</b> Take a photo of the top of the first page of the data sheet, including the Location ID # to indicate the start of a new structure evaluation in the photo roll.</p> <p>Before leaving site, double check photo numbers and the quality of each photo.</p>		
	ROADWAY SITUATION (INLET SIDE)	
	INLET	
	INLET SIDE, LOOKING UPSTREAM	
	INLET SIDE FENCING	
	ROADWAY SITUATION (OUTLET SIDE)	
	OUTLET	
	OUTLET SIDE, LOOKING DOWNSTREAM	
	OUTLET SIDE FENCING	
	INSIDE STRUCTURE	
	OTHER (SPECIFY)	