Wildlife Corridor Protection and Enhancement Plan

2nd Edition, February 2022

ACTION PLAN NO. 5

Central Lake Ontario Conservation Authority


Uxbridge
Scugog
Whitby
Oshawa
Pickering
Clarington
Ajax
Lynde Creek
Bowmanville Creek
Oshawa Creek
Farewell Creek
Soper Creek
Pringle Creek
Harmony Creek
Black Creek
Corbett Creek
Robinson Creek
Darlington Creek
Tooley Creek
Pumphouse
Whitby Shores
Warbler
Cranberry
Heydenshore
McLaughlin Bay
Burk
Osborne
St. Marys
Westside Creek
Bennett Creek
Rickard
Lake Ontario

Executive Summary

Wildlife moving between habitats is not unlike people moving between communities; it's an important part of life. Unfortunately, when these movement pathways intersect, they can result in harm to wildlife or people, or both. Central Lake Ontario Conservation Authority's (CLOCA's) updated *Wildlife Corridor Protection and Enhancement Plan* seeks to resolve this conflict through conscientious land use planning and restoration.

This Plan reviews the current state of the landscape, identifying the wildlife habitats in each of the watersheds and the movement corridors between them, and providing an assessment of their health as represented by the amount of natural cover they contain. It also identifies all of the locations where wildlife corridors meet roads and railways, and offers an updated assessment of the potential for existing culverts and bridges, if present, to function as wildlife passages.

Case studies of wildlife-friendly transportation projects in CLOCA's jurisdiction have been included in this plan to highlight what can be achieved with good inter-agency communication and planning. Recommendations to make roads safer for wildlife are also included, though these are not site-specific, and priority restoration areas are identified in the watershed maps to direct restoration and stewardship actions.

Achieving balance between an efficient transportation system and a healthy, connected wildlife habitat network is possible with intentional planning, and this document, if used as a guidance tool throughout the planning process, will help facilitate such balance.

Table of Contents

List of Figures

List of Tables

Introduction

In 2015, Central Lake Ontario Conservation Authority (CLOCA) developed the first *Wildlife Corridor Protection and Enhancement Plan* — a directive that originated from CLOCA's Watershed Plans to better understand the role of wildlife corridors in the watersheds, maintain overall habitat connectivity, and develop strategies to improve the function of the wildlife habitat network. The first edition of this plan has been a valuable tool in helping land use planners incorporate wildlife movement into development projects; and much of the information contained in that plan remains relevant, however, ecology is an evolving discipline, and our understanding of how wildlife interacts with anthropogenic landscapes, including broad areas of human-created disturbance such as roads, has deepened over the past five years. In addition, some elements of the landscape have changed, as our communities and infrastructure grow and change. Consequently, there is a need for an updated *Wildlife Corridor Protection and Enhancement Plan*, to better reflect current areas of urbanization and human-created disturbance in the CLOCA watershed and offer new insights.

Purpose

Wildlife are important to our ecosystems for numerous reasons, some of which we understand and some of which requires further study. Some wildlife provide us with direct benefits, like maintaining insect and rodent populations, or pollinating flowers and crops, while others form part of the foodchain that supports a diverse community of species. The connections between plants and animals in our ecosystems are very complex, and losing one species or a group of species can have serious impacts to those relationships. In that regard, it remains important for us, as citizens, planners, proponents and designers of development and alteration to the watershed landscape, to maintain or enhance wildlife habitat as critical elements of life-sustaining ecosystems.

One component of ecosystem integrity is habitat connectivity. Many animals rely on more than one habitat as part of their lifecycle, and disconnecting them can be detrimental to their survival. Wood frogs demonstrate this concept, spending their adult lives in forests but breeding and developing as eggs and larva in aquatic habitat. Connectivity is also important for migration or dispersal, when animals move over larger distances in search of new habitats or to find resources, or maintain genetic diversity. Some species do this quickly and navigate across open areas easily, while others are slow and more sensitive to landscapes that don't provide the necessary cover or conditions they require. For the slow and sensitive species, natural corridors between habitats are particularly important.

Climate change is another emerging driver of wildlife movement. As the climate warms, some species may be pressured into migration or dispersal because their current habitats are changing, possibly causing negative impacts like a decrease in food sources, or an increase in invasive species, or more disease. In Durham Region, more frequent and intense storms are likely to cause catastrophic damage to some habitats, forcing animals to relocate (Durham Region, 2014). Across North America, an expected northward shift of all species means that CLOCA's habitats may become refuges for new species (Rempel and Hornseth, 2017). For all of these reasons, we must ensure local watershed habitats remain or are connected to each other, as well as across the region to larger provincial habitat networks.

Planning for Wildlife

This Plan identifies the core and secondary wildlife habitat areas in the watersheds across CLOCA's jurisdiction and connects them via wildlife movement corridors. Collectively, this is called the wildlife habitat network (Figure 1). This network forms a critical part of, and is embedded into, CLOCA's natural heritage system, as identified in the Watershed Plans. Support for the development, implementation, and protection of such a network comes from both provincial and municipal planning activity. In CLOCA's jurisdiction, this is achieved through a natural heritage system integrated into provincial land use plans, such as the *Greenbelt Plan*, the *Durham Region Official Plan*, and local *Official Plans*.

The wildlife habitat network is intended to provide planning authorities with a tool that they can use to inform land use plans and site-specific planning decisions with the objective of managing land and resources in CLOCA's watersheds to support, protect and enhance wildlife needs. Meeting this objective is increasingly important in the face of a rapidly changing climate, a global loss in biodiversity, and our rapidly urbanizing local watersheds. This Plan helps to set limits for development and encourages land use planners to avoid activities that cause fragmentation to the existing network, but also offers guidance on how to mitigate development activities that infringe on those limits. The network is also a useful tool for directing restoration projects that seek to improve habitat connectivity within the watersheds.

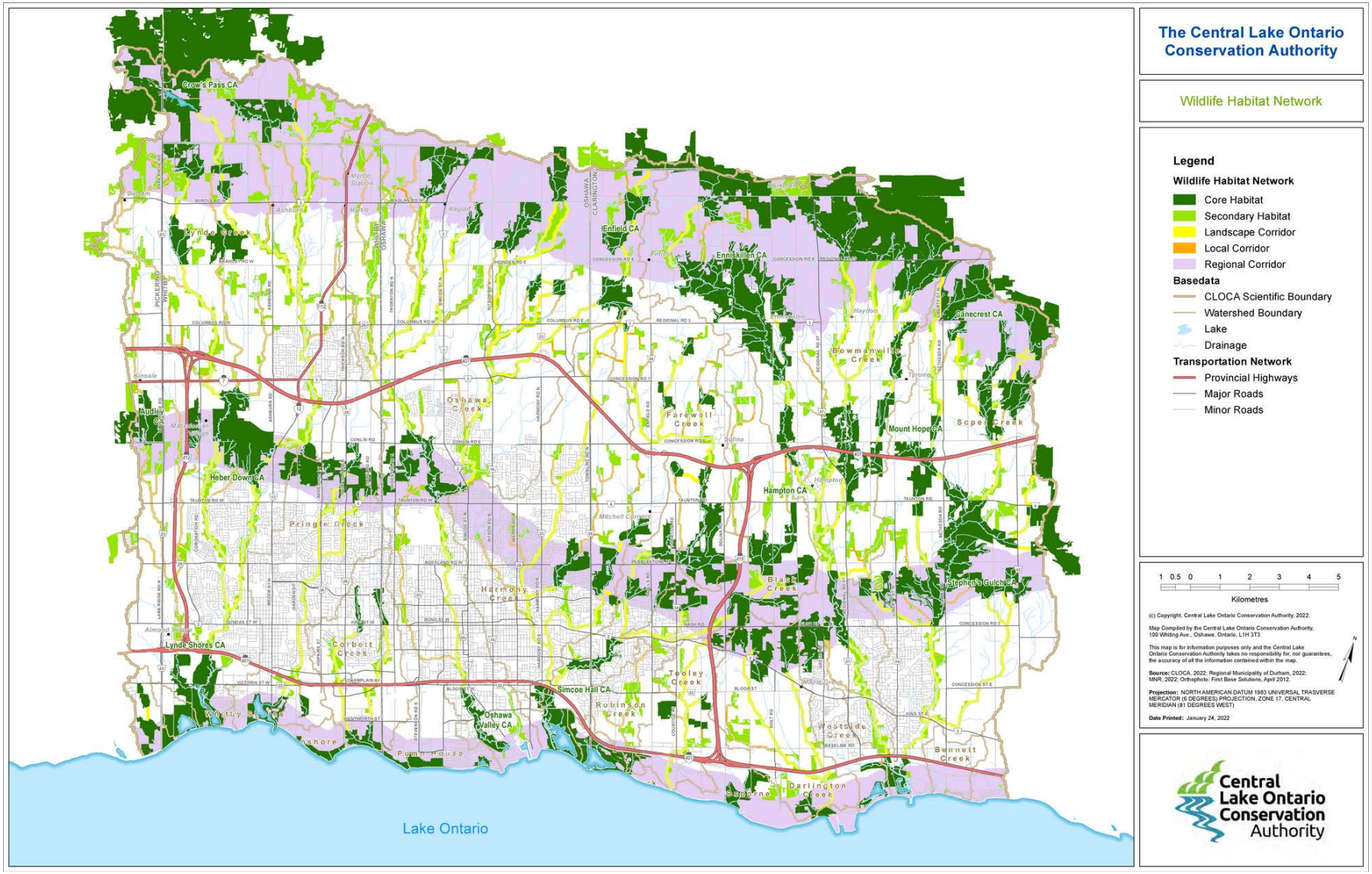
Policy Support for the Wildlife Habitat Network

Provincial Policy 2.1.2 – The diversity and connectivity of natural features in an area, and the long-term ecological function and biodiversity of natural heritage systems, should be maintained, restored or, where possible, improved, recognizing linkages between and among natural heritage features and areas, surface water features and ground water features. (Ministry of Municipal Affairs and Housing, 2020)

Natural Heritage Reference Manual, policy guidance, section 3.1 – A natural heritage system is an ecologically based delineation of nature and natural function – a system of connected or to be connected green and natural areas that provide ecological functions over a longer period of time and enable movement of species. Natural heritage systems encompass or incorporate natural features, functions and linkages (also referred to as "corridors") as component parts within them and across the landscape. They also enable the linking of different landscapes. (Ontario Ministry of Natural Resources, 2010)

Durham Region Official Plan Policy 2.3.2 – The development of a connected and functional natural system comprised of the Greenlands System and additional linkages and corridors, substantiated by appropriate study, as identified in area municipal official plans is encouraged. (Durham Region, 2020)

Figure 1: CLOCA Wildlife Habitat Network



Defining the Wildlife Habitat Network

The wildlife habitat network, as shown in Figure 1, is comprised of core and secondary wildlife habitat areas connected by wildlife movement corridors. The core habitats identified in each watershed are based on evaluations carried out by CLOCA as part of the watershed planning process, and rationales can be found in the existing conditions' reports developed for the Lynde Creek, Oshawa Creek, Black-Harmony-Farewell Creek, and Bowmanville-Soper Creek watersheds. Generally, core habitat designations coincide with significant features such as wetlands and areas of natural and scientific interest, species at risk records, rare or significant habitat types, and large contiguous areas of natural cover like those found in CLOCA's Conservation Area landholdings or in large municipally owned greenspaces. Secondary habitats are important supporting habitat areas within the watersheds, often providing essential in-between habitats.

Three classes of wildlife corridors are identified in the network: regional, landscape, and local. There is some overlap between the classes, and some corridors may function as habitat themselves, but generally, regional corridors connect habitats between the watersheds and across the region, and are defined by the boundaries of the Oak Ridges Moraine, the Lake Iroquois Beach, and the Lake Ontario shoreline (Figure 1). Landscape corridors connect core habitats within the watersheds, and local corridors connect secondary habitats to the network or act as secondary pathways between core habitats.

Guidelines for wildlife movement corridors

To protect existing corridors and set goals for improvement, CLOCA has established corridor size guidelines for each of its corridor classes (Table 1). These guidelines were developed in consideration of documents from other planning agencies (see Appendix A), but recognize a lack of species-specific information and limited capacity in many urban areas for larger corridors. A full rationale for the guidelines is included in Appendix A.

Table 1: Wildlife movement corridor size guidelines

Corridor Class	Guidelines
Regional Corridors	Specific widths are not prescribed but it is recommended that a one-kilometre stretch of brushy or forested habitat be maintained along the Lake Ontario shoreline to positively affect migrant songbirds and insects, and facilitate movement of terrestrial animals. Within the Lake Iroquois Beach and Oak Ridges Moraine corridors, maintain as much natural cover as possible and establish direct, vegetated connections between habitat patches wherever possible.
Landscape Corridors	Should be maintained or restored to no less than 100 metres in width.
Local Corridors	Should be maintained or restored to no less than 60 metres in width.

The size guidelines presented in this Plan are minimum size thresholds and do not prevent any landowner or agency from maintaining larger corridors.

Assessing Barriers to Habitat Connectivity

In CLOCA's watersheds there are two main disruptors to habitat connectivity: transportation infrastructure and lack of natural cover within the corridors. Both result in habitat network fragmentation, reducing habitat connectivity for all wildlife.

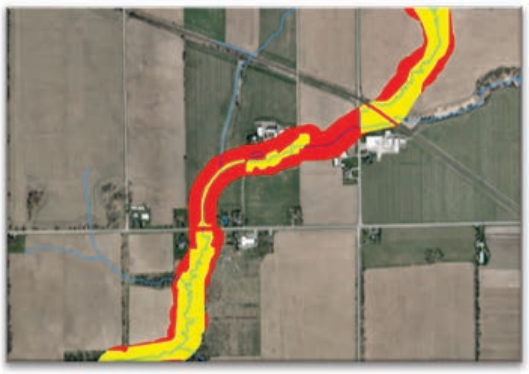
A lack of natural cover between habitat areas is of little consequence to some species, but for others it presents an increased risk of injury or mortality. For the most sensitive species, it may prevent movement entirely, potentially resulting in losses of genetic diversity over time or of entire species in some areas. Roads and railways present a similar lack of natural cover, but they introduce an additional risk from vehicle collisions — one that is significantly greater for animals that don't recognize cars as a threat or that respond to approaching vehicles by standing still (Jacobson, Bliss-Ketchum, de Rivera and Smith, 2016). Because CLOCA's watersheds are home to a diverse suite of animals, this plan strives to create a wildlife habitat network that functions for its most sensitive species, with continuous, naturally vegetated corridors and passable roads.

Corridor Cover

Corridors were originally delineated in 2015 following the method illustrated below. For this plan, the existing cover within the corridors was re-assessed using CLOCA's updated (year??) Ecological Land Classification (ELC) mapping and altered to reflect any changes in vegetation. 'Restored' corridors were also reviewed for this plan in consideration of changes in land use and any stream realignments or removals since 2015. Some corridors were altered or eliminated as a result of this review and these changes are discussed in later sections.

1. Map ELC within corridor to determine the 'existing' corridor.

2. Buffer the creek layer to the recommended width of the corridor (landscape = 100 m and local = 60 m) and refine as needed to determine the 'restored' corridor.



3. The 'existing' and 'restored' corridors can be compared to assess overall corridor fragmentation and prioritize restoration.

Transportation Barriers

Central Lake Ontario Conservation Authority's landscape and local corridor systems largely coincide with the existing creek and valley system; consequently, the majority of road and railway crossings within the network include bridges or culverts that function primarily to pass water and aquatic species, but have the potential to pass semi-aquatic and terrestrial wildlife as well. The system used to assess passage potential in the first edition of this Plan was adapted from guidelines developed for the construction of Highway 407, and was largely based on the opening size of the culvert/bridge, the presence of continuous dry bank within it, and its openness ratio — a function of opening size and culvert length. Passages were then ranked from Excellent (able to pass all wildlife in the jurisdiction) to Very Poor. Since 2015, studies looking at how wildlife behave at certain culverts and bridges have found the relationship between animal use and openness ratio to be weaker than once thought (Gates and Sparks Jr., 2012; Kintsch and Cramer, 2011), and have found other elements, such as bank substrate and steepness, to be more important factors. Furthermore, some connectivity functions, such as enabling dispersal and maintaining gene flow, can be fulfilled by passages that may only accommodate wildlife movement periodically, potentially elevating the value of some openings (Dillon, Boyle, Litzgus and Lesbarreres, 2020).

After reviewing wildlife passage assessment systems from other jurisdictions, in particular the terrestrial assessment guidelines developed by the North Atlantic Aquatic Connectivity Collaborative and Staying Connected Initiative (Fadden and Marx, 2019) and the terrestrial wildlife passage assessment system developed for the Washington State Department of Transportation (Kintsch and Cramer, 2011), the evaluation system for CLOCA's culverts and bridges was revised (Table 2). This new passage assessment system puts more emphasis on the functional features of culverts and bridges that are likely to influence wildlife use, rather than the light levels within it. The new system also moves away from describing existing passages as good or bad, and instead groups them into structural classes with targeted wildlife groups. Of additional note, the previous passage assessment system included evaluating road crossings where no culverts existed; however, in this update, those network breaks are simply identified as having no passage (NP).

Table 2: CLOCA passage assessment system, for evaluating wildlife movement potential across roads

Crossing Structure Category	Criteria	Target Wildlife**
A / A*	• Crossing structure height ≥ 2.4 m • Continuous or seasonally discontinuous (*) dry passage along entire length of structure • No significant barriers to movement present in the structure	Suitable for all targeted wildlife species all of the time or for some periods of time (*).
B / B*	• Crossing structure height ≥ 1.8 m • Continuous or seasonally discontinuous (*) dry passage along entire length of structure • No significant barriers to movement present in the structure	Suitable for all targeted wildlife species, except deer, all of the time or for some periods of time (*). Some structures may still allow deer passage.
C / C*	• Crossing structure height ≥ 0.9 m • Continuous or seasonally discontinuous (*) dry passage along entire length of structure • No significant barriers to movement present in the structure	Suitable for medium and small mammals, and all turtles, snakes, and amphibians all of the time or for some periods of time (*).
D / D*	• Crossing structure height ≥ 0.5 m • Continuous or seasonally discontinuous (*) dry passage along entire length of structure • No significant barriers to movement present in the structure	Suitable for small mammals, some turtles, and all snakes, and amphibians all of the time or for some periods of time (*).
E / E*	• Crossing structure height ≥ 0.5 m • No dry passage present in structure. • No significant barriers to movement present in the structure. • Barriers, if present, may still provide access to some animals within the class (*)	Suitable for aquatic or semi-aquatic mammals, some turtles, and most amphibians. May be periodically suitable for larger wildlife if height is sufficient and flows are very low.
F	• Crossing structure height < 0.5 m • Significant barriers to movement present in the structure	Not suitable for most wildlife most of the time.
X	• Drainage mapped and culvert likely present but cannot be accessed for assessment	Unknown.

Table 2: CLOCA passage assessment system, for evaluating wildlife movement potential across roads - continued

Crossing Structure Category	Criteria	Target Wildlife**
NP	• Any breaks in the wildlife habitat network where there is no existing passage	None.

***Targeted species include white-tailed deer (Classes A and potentially B), coyote (Classes A and B), medium-sized mammals such as eastern cottontail, skunk, fox, and beaver (Classes A, B, and C. Possibly E if mammal is semi-aquatic), small mammals such as mouse, shrew, squirrel, and weasel (Classes A, B, C, and D. Possibly E if mammal is semi-aquatic), reptiles such as turtles (Classes A, B, C, D and E), snakes (Classes A, B, C, D and E if semi-aquatic), and amphibians (Classes A, B, C, D, E).*

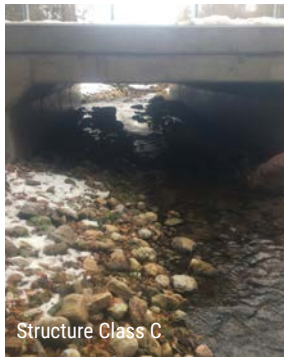
As Table 2 shows, culverts and bridges are grouped initially by structure size, which is a primary use factor for larger animals.The categories are further refined based on functional characteristics, such as the presence of continuous dry passage within the structure (a significant feature for many fully terrestrial species), or the presence of a significant barrier, such as a grate. Structures that are marked with an asterisk meet all of the structural needs of the target species but may not function for those species at certain times (e.g., seasonal flooding or high water levels). Generally, the asterisk denotes the presence of fragmented or temporarily dry passage.


Barrier (perched culvert)


Barrier (grate)


Structure Class A


Structure Class B


Structure Class C


Structure Class D


Structure Class E


Structure Class F

Evaluating Habitat Connectivity

In the first edition of this Plan, priority areas for corridor restoration were identified, but no goals were set for overall cover. As part of the *2020 Watershed Plan Updates*, wildlife corridor cover was included as an attribute of natural cover, representing the amount of habitat connectivity in each of the watersheds and goals were established (Table 3).

Percent cover within each of the corridors is determined by dividing the area of corridor that is classified as being vegetated (from the ELC layer) by the total area of the corridor.The corridor cover results for each watershed are presented in their respective sections within this plan.

While the ideal wildlife habitat network would include passages beneath roads that accommodate all wildlife at all times, this isn't a realistic expectation given financial and physical constraints, so this plan aims to achieve a high level of potential habitat connectivity by setting goals related to the structure categories within the wildlife habitat network, and accepts that there may be some variability in function, as indicated by the asterisks. The wildlife passage goals for each of the habitat types are listed in Table 4 and the results of the passage assessments for each watershed are discussed in the respective watershed sections.

Table 3: Wildlife corridor cover goals

Corridor	Goal
Lake Ontario Shoreline Regional Corridor	By 2060, achieve and maintain a minimum 67% naturally-vegetated wildlife corridor in the Lynde Creek watershed, 30% naturally-vegetated wildlife corridor in the Oshawa Creek watershed, 78% naturally-vegetated wildlife corridor in the Black-Harmony-Farewell Creek watershed, and 58% naturally-vegetated wildlife corridor in the Bowmanville-Soper Creek watershed.
Oak Ridges Moraine and Lake Iroquois Beach Regional Corridors	No percent cover goals were set for the Oak Ridges Moraine or Lake Iroquois Beach regional corridors. The creation of continuous and naturally-vegetated connections between existing patches within these corridors should be considered whenever opportunities arise.
Landscape Corridors	By 2060, achieve and maintain 75% natural cover in the landscape corridor systems in each of the watersheds.
Local Corridors	By 2060, achieve and maintain 75% natural cover in the local corridor systems in each of the watersheds.

Table 4: Wildlife passage goals

Habitat	Goal
Regional Corridors	Many of the roads within the regional corridor system do not have existing openings to facilitate drainage and are therefore classified as NP (Table 2). The potential to install passages or facilitate wildlife movement in some other way, (e.g., exclusionary fencing) should be considered as road improvement projects arise.
Landscape Corridors and Core Habitats	Wildlife passages within the landscape corridor system or between core wildlife habitat areas should meet the criteria of crossing structure categories A/A* or B/B*.
Local Corridors and Secondary Habitats	Wildlife passages within the local corridor system or between secondary wildlife habitat areas should meet the criteria of crossing structure categories A/A*, B/B*, or C/C*.

Highway 407 span bridge, Oshawa Creek, Oshawa, ON

Why *did* the chicken cross the road?

It's a good question, and one that road ecologists have been working hard to answer. It's clear that all wildlife movement is impacted by roads to some extent, but the effects are not uniform across species. In fact, there is a high degree of variability, which makes it difficult in many ways to develop a large-scale plan like this one. Vehicle collisions with wildlife are a visible consequence of roads, but there are numerous other impacts that are less visible or unknown. Here's what we do know:

Animal behaviour is a major predictor of mortality. In a 2016 study by Jacobson, Bliss-Ketchum, de Rivera, and Smith, animals were grouped according to four behaviours: non-responders (don't recognize traffic or don't see it as a threat); pausers (stop when a car approaches); speeders (see cars as a threat and run away), and avoiders (repelled by any traffic). Non-responders, such as insects, some amphibians, turtles, snakes and owls, and pausers, such as skunks, porcupines, and some amphibians and turtles, were at the highest risk of being hit by vehicular traffic.

Wildlife mortality increases with traffic volume, regardless of behaviour. In other words, busier roads are deadlier roads, and it isn't hard to imagine why when you think about your chances of crossing Highway 401 compared to a secluded, gravel road. Even speedy animals can't make it across roads with high traffic volumes (Jacobson, Bliss-Ketchum, de Rivera, & Smith, 2016; Fahrig, Pedlar, Pope, Taylor, & Wegner, 1995).

Mortality isn't the only problem. Wildlife that avoid roads may be safe from vehicle collisions, but from a population perspective, it has a negative impact. For these animals, roads create numerous small, isolated populations, resulting in a lack of genetic diversity over time and vulnerability to local extinction events, such as drought or disease.

Not all animals who get hit on the road are trying to cross the road. Many species are drawn to roads because the roads themselves provide a resource. Female turtles love nesting on the gravel shoulders of roads near wetlands; snakes see the warm asphalt as a perfect basking spot on a cool day; bees and butterflies move between flowers in roadside meadows, and scavengers come looking for turtle eggs, discarded human food waste or leftover roadkill.These natural behaviours create an additional risk of being hit by vehicles.

Watershed Findings and Recommendations

Lynde Creek Watershed

Since 2015, some significant changes have occurred in the watershed, most notably the completion of highways 407 and the 412 connectors to Highway 401. This major infrastructure has increased fragmentation of the wildlife habitat network, as well as the removal or re-alignment of some wildlife corridors. Positive inter-agency partnerships from the beginning of the project led to wildlife movement being considered and incorporated into the highway design, and the new highway series now represent some of the best wildlife passages in the watershed (see Case Study #2). Secondary road realignments, which occurred as part of the construction of the highway series, and upgrades to other roads in the watershed, such as Victoria Street and Highway 7, have also resulted in improvements to some culverts and bridges. Of particular interest is the inclusion of two dedicated terrestrial wildlife passages beneath Highway 412, which not only connects the local habitats in the area but also facilitates east-west movement within the Lake Iroquois Beach regional corridor.

Exclusionary fencing was also included along the length of the highway series, which will improve use of installed passages and help reduce wildlife mortality from vehicle collisions.

Corridor Cover in the Lynde Creek Watershed

Figure 2, which presents the wildlife habitat network for the Lynde Creek watershed, also illustrates existing gaps in vegetation within the landscape and local corridor systems. These gaps appear in red, and they represent potential areas where movement may be impeded for wildlife requiring natural cover. Currently, the landscape corridors in the watershed are relatively well vegetated, with total natural cover in the system exceeding the watershed goal of 75 per cent. The local corridor system has a total of 56 per cent natural cover, so some naturalization or restoration efforts are required. Natural cover in the Lake Ontario Shoreline regional corridor is currently 64 per cent, just under the watershed plan goal of 67 per cent (Table 5).

Table 5: Corridor cover in the Lynde Creek watershed

Corridor Class	Area of Existing Vegetation (ha)	Corridor Area if Restored (ha)	Per Cent Cover	Goal
Lake Ontario Shoreline	73.84	115.37	64%	67%
Landscape Corridors	393.49	489.34	80%	75%
Local Corridors	226.66	402.96	56%	75%

While per cent natural cover is a useful metric for assessing overall corridor health and measuring change over time, it does not reflect the distribution of cover within the systems, which is also an important consideration. Complete breaks in corridor cover need to be minimized as well. The *2015 Action Plan* identified six priority restoration areas in the watershed, all in the landscape corridor system, and the table below provides an update on their status.

Concerted restoration effort in these locations would remove key gaps in the landscape corridor system. No priority restoration sites were previously identified within the local corridor system, but it is clear from Figure 2 and from the cover analysis in Table 5, focused restoration efforts are needed here, particularly within the Kinsale subwatershed.

Table 6: Priority restoration areas in the Lynde Creek watershed

Habitat Type	Approximate Location	Current Status	Recommended Action
Landscape Corridor	South of Lyndebrook and west of Country Lane.	No change in vegetation in this section has occurred since 2015.	Private land stewardship.
Landscape Corridor	North of Taunton, east of Cochrane in Cullen Central Park.	Natural regeneration in the area has occurred and largely reduced this gap.	Maintain current conditions and avoid unnecessary mowing or maintenance within the corridor limits.
Landscape Corridor	Either side of Brock St. between Hwy. 7 and Carnwith Ave.	ELC layer shows a loss of vegetation, particularly on either side of Cassels Rd. E.; however, losses appear minor on aerial photographs.	Private land stewardship and engagement with homeowners to reduce extent of mowing within the corridor.
Landscape Corridor	South of Brawley Rd., east of Lakeridge Rd.	No change in vegetation in this section has occurred since 2015.	Private land stewardship.
Landscape Corridor	South of Myrtle Rd., east of Lakeridge Rd.	No change in vegetation in this section has occurred since 2015.	Private land stewardship.
Landscape Corridor	South at Myrtle Rd., through Royal Ashburn Golf Club.	Some natural regeneration of habitat to the west of the corridor provides some improved movement opportunities; however, little change in vegetation has occurred through the golf course itself.	Encourage private land stewardship but improvements to this gap are unlikely unless a change in landuse occurs at this site.

Movement Barriers in the Lynde Creek Watershed

The culverts and bridges that intersect with the wildlife habitat network in the watershed were reviewed and updated for this plan, and the new passage assessment system (Table 2) was applied. The location of existing passages and the structure class of each is shown in Figure 2 and the results are summarized in Table 7.

In total, 127 breaks in the wildlife habitat network were identified as a result of transportation infrastructure. This is an increase from 115 breaks in 2015 and accounts for the new passages installed at Victoria Street and beneath Highways 407 and 412.

Table 7: Passage assessment results for the Lynde Creek watershed.

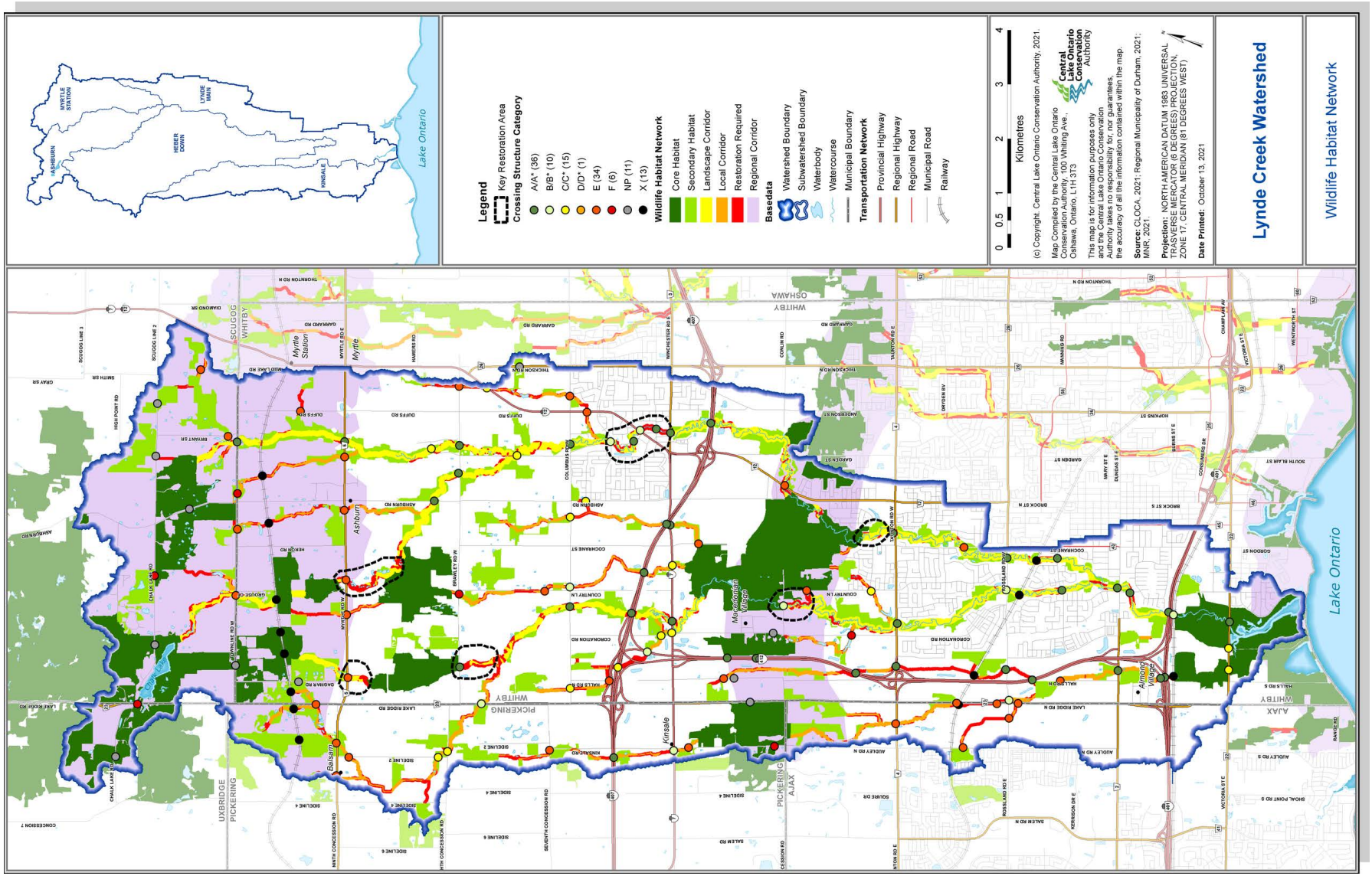
Structure Class	Regional Corridors		Landscape Corridors and Core Habitats		Local Corridors and Secondary Habitats	
	Quantity	Per cent of Total	Quantity	Per cent of Total	Quantity	Per cent of Total
A / A*	2	33%	24	45%	10	15%
B / B*			5	9%	5	7%
C / C*			4	8%	11	16%
D / D*			1	2%		
E / E*			7	13%	27	40%
F	1	17%	2	4%	3	4%
X			6	11%	8	12%
NP	3	50%	4	8%	4	6%
TOTAL	6	5%	53	42%	68	53%

Because the passage assessment methodology has been modified and new goals have been established for this update, it isn't possible to directly compare these results to those in the previous plan; however, some assessment is possible.

In 2015, 38 per cent (18 of 47) of the passages in the landscape corridor system and core habitats were evaluated as meeting the Plan goal of Very Good or Better. An analysis of the 2020 passages using the 2015 assessment method suggests that 53 per cent (28 of 53) would have met that goal, indicating an overall improvement in wildlife movement potential within the landscape corridors and core habitats in the watershed. By comparison, 55 per cent (29 of 53) of these passages meet the new goal of being in structure classes A/A* or B/B* using the new assessment method. This improvement reflects passage upgrades at Victoria Street, Highway 7, and at roads impacted by Highway 412, as well as the addition of new passages beneath Highway 407. It also reflects the assessment of some existing passages that had not been previously evaluated due to access issues.

In 2015, 37 per cent (23 of 62) of passages in the local corridor system and secondary habitats met the goal of being Moderate or Better, and an analysis of the 2020 passages using the 2015 assessment method reveals that 50 per cent (34 of 68) of these passages would have met that goal. This apparent improvement in connectivity is largely due to the replacement of a local corridor in the Lynde Creek Main subwatershed with a more permeable local corridor in the Kinsale subwatershed, which occurred as a result of infrastructure upgrades to the east of Highway 412. The analysis results using the new passage assessment method classify only 38 per cent (26 of 68) of passages in the local corridors and secondary habitats as A/A*, B/B*, or C/C* however, suggesting that there has been less overall improvement in the watershed. This difference reflects the number of passages that had been previously classified as Moderate (reptiles and amphibians) or Moderate (low risk). The new assessment system classifies culverts without dry passage as E/E* and areas without any passage as NP, neither of which meet the new structure class goal for the local corridors/secondary habitats. While there may still be adequate passage for some species at these locations, there is now an increased emphasis on the presence of permanent or periodic dry passage under roads in the evaluation of overall corridor permeability.

Figure 2: Lynde Creek wildlife habitat network, corridor gaps and infrastructure barriers



Case Study #1 – Victoria St. (Whitby, ON)

In 2006, Durham Region initiated a road-widening project for Victoria Street. This busy causeway, which runs through the Lynde Shores Conservation Area, was slated to go from two to four lanes. Road mortality surveys were undertaken by CLOCA to better understand the impact of the current road on local wildlife, and the results were extremely significant: in a single year, over 1,000 animals were found dead along the side of the road. It was determined that 80 per cent were amphibians, but the list included insects, birds, turtles, mammals, and snakes. It was clear that all animals in the Lynde Creek Marsh and surrounding protected areas were at risk, and that this impact would only be worse as traffic volumes increased.

Partners in success. Working with Durham Region and their project consultants, CLOCA helped develop a road design that would meet the Region's transportation needs while also benefitting wildlife. Bridge structures were widened to include dry passages, a dedicated wildlife passage was incorporated, and four-foot exclusionary fencing was installed to prevent wildlife from accessing the road and directing them to the passages. Within the Marsh itself, the road was elevated and set atop a one-metre-high exclusion wall, which replaced traditional fencing. This elevated causeway, the only example of its kind built for wildlife in Ontario, demonstrates the value of partnership and the Region's environmental commitment.

A model for the future. Following the completion of the road-widening project, CLOCA did additional road surveys and the findings were remarkable. In 2019, just under 100 animals were documented. Amphibians made up 14 per cent of the wildlife found, a significant reduction from 2007, and only one adult turtle was recorded. Of particular interest, very few of these observations were made along the elevated section of the road. The bridges and wildlife passage all showed evidence of use as well, especially by mammals. Of course, the new design is not 100 per cent wildlife-friendly, and there are other habitat impacts from noise, light, garbage, and road salt, but it's an excellent example for other infrastructure projects and a promising step toward a more functional wildlife habitat network.

Exclusionary wall to terrestrial passage.

Oshawa Creek Watershed

Since 2015, the most significant changes in the watershed relate to the construction of Highway 407 and the completion of some residential development in the Windfields' subwatershed. Highway 407 impacted three landscape corridors in the wildlife habitat network, but wildlife needs were taken into consideration in this project, which led to the incorporation of large span bridges to provide ample room for wildlife movement. In addition, exclusionary fencing along the length of the Highway will help prevent animals from getting onto the highway, reducing animal collisions and improving driver safety.

Corridor Cover in the Oshawa Creek Watershed

Table 8 contains the corridor cover analysis for the Lake Ontario Shoreline regional corridor, and the landscape and local corridors in the watershed. The *Oshawa Creek Watershed Plan* identifies a 30 per cent natural cover goal for the regional corridor, which is currently estimated to be at 22 per cent. The natural cover goals for the landscape and local corridors is 75 per cent, and the landscape system currently meets this goal, at 76 per cent cover, while the local system falls short at 53 per cent cover. Restoration and stewardship efforts in the watershed should focus on the local corridors, particularly in the southern part of the Goodman Creek subwatershed.

Table 8: Corridor cover in the Oshawa Creek watershed

Corridor Class	Area of Existing Vegetation (ha)	Corridor Area if Restored (ha)	Per Cent Cover	Goal
Lake Ontario Shoreline	60.32	276.52	22%	30%
Landscape Corridors	412.20	539.43	76%	75%
Local Corridors	129.17	244.88	53%	75%

Per cent cover in the corridors is helpful in assessing overall corridor health, but this metric does not describe the distribution of the natural cover, which is also important. Large gaps in cover may represent complete movement barriers for some species and targeting key locations to restore natural cover could result in significant connectivity improvements.

Figure 3 shows the existing cover in the landscape and local corridor systems, as defined by CLOCA's ELC layer, as well as the gaps in cover (red). Five priority restoration areas were identified for the watershed in 2015, and these are revisited in Table 9 below and their statuses updated.

Table 9: Priority restoration areas in the Oshawa Creek watershed

Habitat Type	Approximate Location	Current Status	Recommended Action
Landscape Corridor	Oshawa Creek valley west of Simcoe St., between Olive Ave. and Rossland Rd.	No change in vegetation in this section has occurred since 2015.	Active plantings along creek edge on municipal lands and private land stewardship.
Landscape Corridor	Ritson Rd., south of Winchester Rd.	No change in vegetation in this section has occurred since 2015.	Private land stewardship.
Landscape Corridor	Northeast of Winchester Rd. and Thornton Rd.	No change in vegetation in this section has occurred since 2015.	Private land stewardship.
Landscape Corridor	Simcoe St. between Columbus Rd. and Howden Rd.	No change in vegetation in this section has occurred since 2015.	Private land stewardship.
Landscape Corridor	North of Columbus Rd. between Grandview St. and Townline Rd.	No change in vegetation in this section has occurred since 2015.	Private land stewardship.

Movement Barriers in the Oshawa Creek Watershed

The culverts and bridges that intersect with the wildlife habitat network in the Oshawa Creek watershed were reviewed and updated, and the new passage assessment system (Table 2) was applied. The location of the passages and the structure class of each is presented in Figure 3 and the results are summarized in Table 10 below.

In total, 111 breaks in the wildlife habitat network were identified as a result of transportation infrastructure. This is an increase of one from 2015 and reflects some adjustments to the wildlife habitat network that resulted in the removal or consolidation of some corridors or breaks, as well as the addition of new break from Highway 407 and new subdivision development.

Table 10: Passage assessment results for the Oshawa Creek watershed

Structure Class	Regional Corridors		Landscape Corridors and Core Habitats		Local Corridors and Secondary Habitats	
	Quantity	Per cent of Total	Quantity	Per cent of Total	Quantity	Per cent of Total
A / A*			24	37%		
B / B*			4	6%	8	17%
C / C*			5	8%	9	20%
D / D*			1	2%	2	4%
E / E*			21	32%	16	35%
F			2	3%	2	4%
X			6	9%	5	11%
NP			2	3%	4	9%
TOTAL	0	0%	65	59%	46	41%

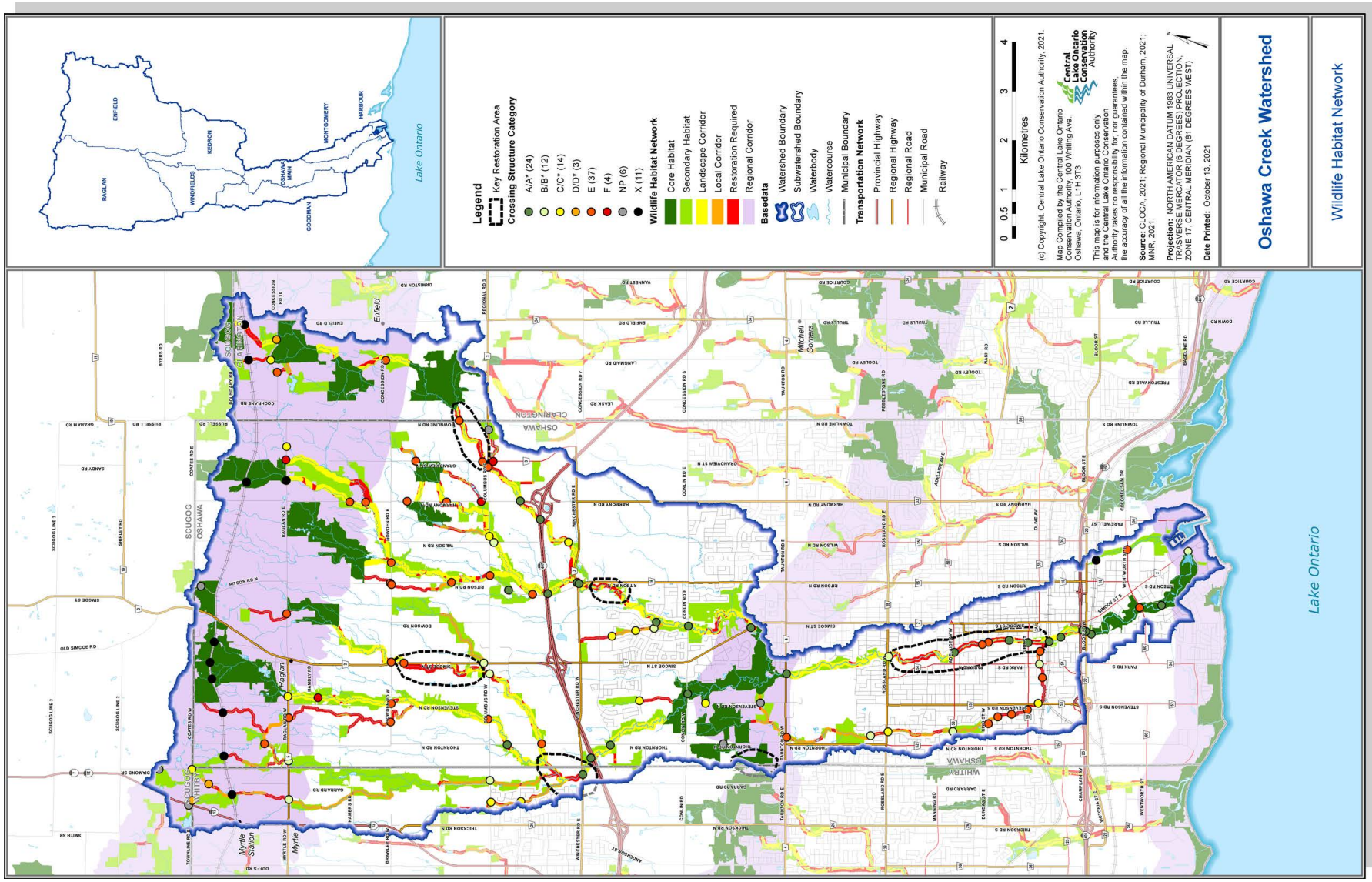
Because the passage assessment methodology was modified for this update, and new goals have been established in the *Oshawa Creek Watershed Plan*, it isn't possible to directly compare the evaluation results in Table 10 with the results in Table 5 of the 2015 Plan, however, the 2015 assessment methodology was applied to new passages in the watershed for this discussion to provide some insight into progress.

In 2015, 29 per cent (19 of 65) of the passages in the landscape corridor system and core habitats were evaluated as meeting the plan goal of Very Good or Better. An analysis of the 2020 passages using the 2015 assessment method suggests that 38% (25 of 65) would have met that goal, indicating an overall improvement in wildlife movement potential within the landscape corridors and core habitats in the watershed. By comparison, 43 per cent (28 of 65) of these passages meet the new goal of being in structure classes A/A* or B/B* using the new assessment method. Generally, this improvement is genuine and reflects the installation of high-quality passages within Highway 407 and passage improvements in roads that were impacted by Highway 407. Some of the overall improvement, however, is attributable to minor changes to the wildlife habitat network and the reclassification of some passages with the new assessment criteria, which do not necessarily represent true improvements in movement potential.

Within the local corridors and secondary habitats, 29 per cent (13 of 45) of passages in 2015 met the goal of being Moderate or Better, and an analysis of the 2020 passages using the 2015 assessment method reveals that 43 per cent (20 of 46) of these passages would have met that goal. By comparison, the new passage assessment method classifies 37 per cent (17 of 46) of passages in the local corridors and secondary habitats as A/A*, B/B*, or C/C*, which is the new goal. This overall improvement in movement potential is actual and can be attributed to the addition of new breaks to the system that included better quality passages, but is also inflated slightly by the removal of some poor scoring passages and a few low-functioning corridors.

Highway 407 Class A example.

Figure 3: Oshawa Creek wildlife habitat network, corridor gaps and infrastructure barriers



Black-Harmony-Farewell Creek Watershed

Highway 407 and its north-south link, Highway 418, have been completed through the watershed, resulting in increased fragmentation of the wildlife habitat network, several new passage installations, and some culvert upgrades due to road realignments. In addition, some changes to the wildlife habitat network have been made to recognize creek alterations and some habitat loss. Despite these changes, successful inter-agency communication led to some positive results for wildlife habitat connectivity (see Case Study 2). Of particular note is the presence of a dedicated terrestrial wildlife passage beneath Highway 418, which maintains connectivity between the local wetland habitats, but also facilitates east-west wildlife movement within the Lake Iroquois Beach regional corridor. Exclusionary fencing was also incorporated into the design to prevent wildlife from accessing the road.

Corridor Cover in the Black-Harmony-Farewell Creek Watershed

In 2015, 20 per cent (12 of 61) of the passages in the landscape corridor system and core habitats were evaluated as meeting the plan goal of Very Good or Better. An analysis of the 2020 passages using the 2015 assessment method suggests that 25 per cent (16 of 63) would have met that goal, indicating a slight improvement in wildlife movement potential within the landscape corridors and core habitats in the watershed.

This improvement is due to the replacement of a poor quality culvert at Enfield Road, north of Concession 6, and the addition of higher-quality passages within Highways 407 and 418. By comparison, 32 per cent (20 of 63) of these passages meet the new goal of being in structure classes A/A* or B/B* using the new assessment method. This includes the previously mentioned culvert improvements, but also reflects the change in criteria in the new assessment method relating to terrestrial passage within the culverts, which led to some previously 'Moderate' passages being reclassified as A* or B / B*.

Figure 4 shows the wildlife habitat network for the watershed. The existing cover in the landscape and local corridors is shown in yellow and orange respectively, while areas within the corridors that are lacking natural cover are shown in red. An analysis of the existing cover in the Lake Ontario Shoreline regional corridor, as well as the landscape and local corridors (Table 11) reveals that both the landscape and local corridor systems need some restoration, though neither system is severely degraded. The regional corridor is generally well vegetated as a result of the presence of Oshawa Second Marsh and its surrounding habitat.

Table 11: Corridor cover in the Harmony-Black-Farewell Creek watershed

Corridor Class	Area of Existing Vegetation (ha)	Corridor Area if Restored (ha)	Per Cent Cover	Goal
Lake Ontario Shoreline	121.68	163.12	75%	78%
Landscape Corridors	304.08	472.70	64%	75%
Local Corridors	106.74	176.84	60%	75%

The existing corridor cover, while relatively good throughout the system, is not necessarily evenly distributed and there are some corridor stretches that have virtually no cover, potentially representing complete movement barriers to some wildlife species. Seven priority restoration areas were identified in 2015 and an update to the status of these is provided in Table 12.

Table 12: Priority restoration areas in the Black-Harmony-Farwell Creek watershed

Habitat Type	Approximate Location	Current Status	Recommended Action
Landscape Corridors (2)	Bloor St. just east of Harmony Rd.	No change in vegetation in this section has occurred since 2015.	Private land stewardship.
Landscape Corridor	Courtice Rd. at Nash Rd.	No change in vegetation in this section has occurred since 2015.	Private land stewardship.
Landscape Corridor	Washington Rd. between Taunton Rd. and Concession Rd. 6.	No change in vegetation in this section has occurred since 2015.	Private land stewardship.
Landscape Corridors (2)	North of Concession Rd. 6, immediately east of Werry Rd. and towards Vannest Rd.	Some natural regeneration has occurred in both corridors since 2015 leading to connectivity improvements.	Corridor connecting to Vannest Rd is no longer a priority for restoration. Continue to maintain a natural corridor along east side of Werry Rd.
Landscape Corridor	Langmaid Rd. south of Regional Rd. 3.	No change in vegetation in this section has occurred since 2015.	Private land stewardship.
Landscape Corridor	Townline Rd. north of Conlin Rd.	No change in vegetation in this section has occurred since 2015.	Private land stewardship.

Within the Lake Iroquois Beach regional corridor, some key gaps between core habitats were also identified as being a priority for restoration in the 2015 document. The absence of creeks between these habitats means that there are few existing corridors and, so, some effort must be made to dedicate tableland areas to serve this function. This can occur via private land stewardship to encourage landowners to restore vegetation or allow naturalization, but should also occur through development planning by earmarking areas for corridor restoration and restricting development of those areas. This is particularly important given the intensification of residential development around Townline Road and north of Courtice. One priority area that has been addressed is between core habitats east and west of Highway 418, where a 300-metre-span bridge was installed to maintain connectivity between the provincially significant wetlands and restoration has been occurring.

Movement Barriers in the Black-Harmony-Farewell Creek Watershed

Figure 4 identifies all the breaks in the wildlife habitat network from transportation infrastructure in the watershed. These were evaluated in 2015 using the passage assessment system in that Plan and have been reviewed and updated to include new passages, reflect changes in the wildlife habitat network, and apply the new passage assessment system (Table 2). The results of the passage assessments are summarized in Table 13 below.

A total of 96 breaks were identified in the network, which is an increase from 2015 when 90 breaks were identified. This increase is consistent with the construction of Highways 407 and 418 through the watershed.

Table 13: Passage assessment results for the Black-Harmony-Farewell Creek watershed

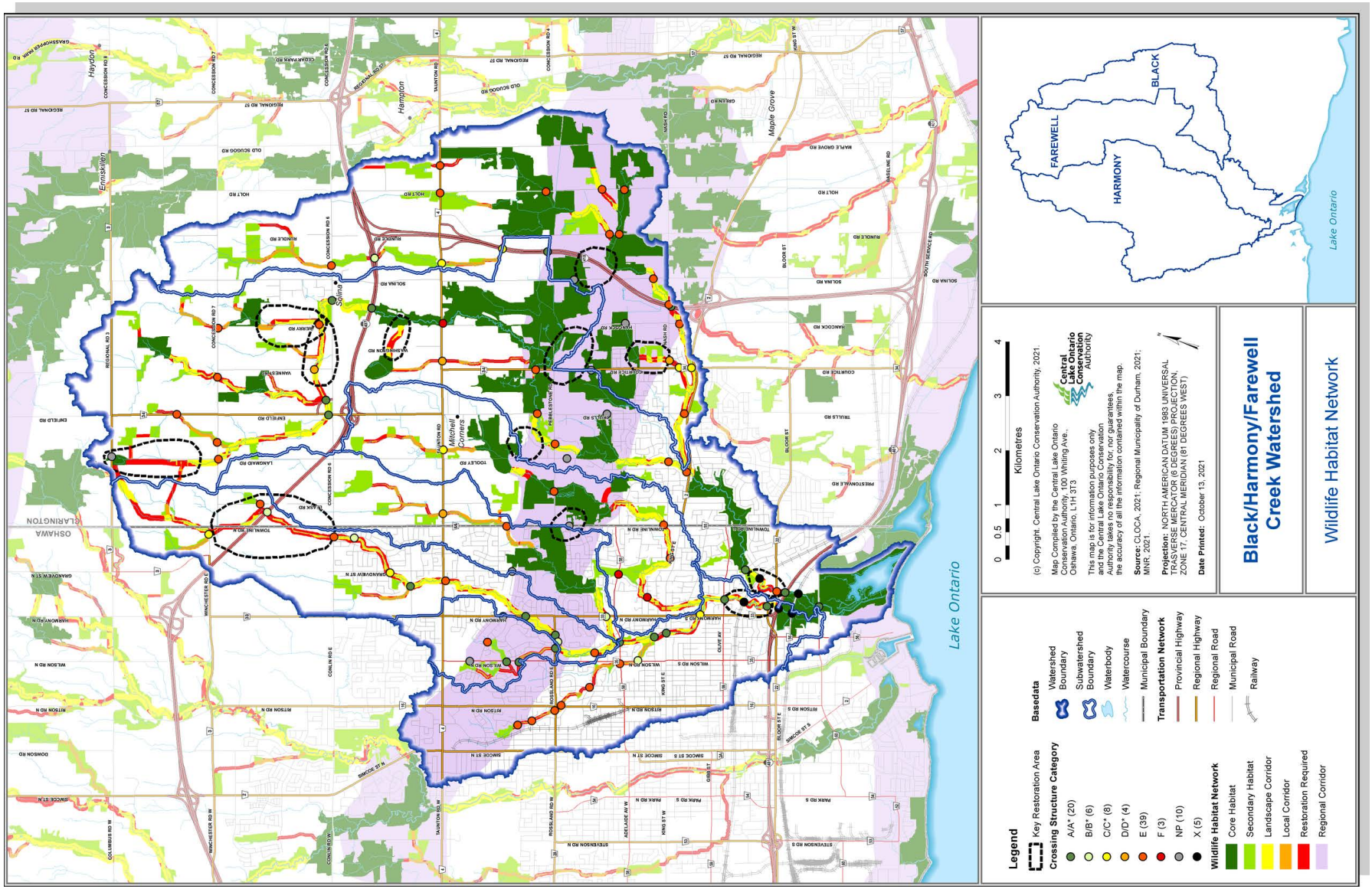
Structure Class	Regional Corridors		Landscape Corridors and Core Habitats		Local Corridors and Secondary Habitats	
	Quantity	Per cent of Total	Quantity	Per cent of Total	Quantity	Per cent of Total
A / A*	1	17%	16	25%	3	11%
B / B*			4	6%	2	7%
C / C*			4	6%	4	15%
D / D*			2	3%	2	7%
E / E*			25	40%	15	56%
F			2	3%	1	4%
X			5	8%		
NP	5	83%	5	8%		
TOTAL	6	7%	63	65%	27	28%

The assessment system used to categorize culverts and bridges in 2015 is different enough from the 2020 assessment system that the results from Table 13 can't be directly compared to those from 2015. In order to gain some insight into progress however, the 2015 criteria was applied to the new culverts and bridges in the watershed for the purposes of discussion.

In 2015, 20 per cent (12 of 61) of the passages in the landscape corridor system and core habitats were evaluated as meeting the plan goal of Very Good or Better. An analysis of the 2020 passages using the 2015 assessment method suggests that 25 per cent (16 of 63) would have met that goal, indicating a slight improvement in wildlife movement potential within the landscape corridors and core habitats in the watershed. This improvement is due to the replacement of a poor quality culvert at Enfield Road, north of Concession 6, and the addition of higher quality passages within Highways 407 and 418. By comparison, 32 per cent (20 of 63) of these passages meet the new goal of being in structure classes A/A* or B/B* using the new assessment method. This includes the previously mentioned culvert improvements but also reflects the change in criteria in the new assessment method relating to terrestrial passage within the culverts, which led to some previously 'Moderate' passages being reclassified as A* or B / B*.

In 2015, 46 per cent (11 of 24) of passages in the local corridor system and secondary habitats met the goal of being Moderate or Better, and an analysis of the 2020 passages using the 2015 assessment method reveals that 52 per cent (14 of 27) of these passages would have met that goal. An analysis of the 2020 passages using the new passage assessment method classifies only 33 per cent (9 of 27) of passages in the local corridors and secondary habitats as A/A*, B/B* or C/C* however. This apparent decline in overall passage function reflects the number of passages that had been previously classified as Moderate (reptiles and amphibians) or Moderate (low risk) but were reclassified as E/E* due to their lack of dry passage. While there may still be adequate passage for some species at these locations, there is now an increased emphasis on the presence of permanent or periodic dry passage under roads in the evaluation of overall corridor permeability.

Figure 4: Black-Harmony-Farewell Creek wildlife habitat network, corridor gaps and infrastructure barriers



Case Study #2 – Highway 407

In 2006, the Ontario Ministry of Transportation initiated the environmental assessment process for a new highway through Durham Region: Highway 407. This east-west route through the middle of Central Lake Ontario Conservation Authority's (CLOCA's) watersheds would include two north-south connector highways: Highway 412 in the Lynde Creek watershed and Highway 418 in the Black-Harmony-Farewell creek watershed, and together they would have a significant impact on habitat connectivity in CLOCA's jurisdiction.

Responsible development. The impact that highways have on wildlife was well known, and these concerns were expressed to the project team. In response, the Ontario Ministry of Transportation included habitat connectivity in their assessment and identified numerous stream crossings that would be enlarged to accommodate natural stream channels, as well as wildlife passage. Other wildlife features were included in the design as well, such as exclusion fencing and jump-outs to help wildlife that did breach the fence to escape, but perhaps the most significant addition was a dedicated wildlife passage within each of the connector highways, as they had fewer valley crossings and acted as barriers to movement within the Lake Iroquois Beach regional wildlife corridor.

Leading by example. The construction of a highway through Durham Region with large, vegetated wildlife passages is encouraging and is a positive example for other transportation planning agencies. The quality of the passages also sets a high construction standard and entrenches the wildlife habitat network into each of the watersheds.

Bowmanville-Soper Creek Watershed

Like the other watersheds, the construction of Highway 407 has been the most significant change since 2015, resulting in increased fragmentation of the wildlife habitat network and introducing new breaks for wildlife to cross. Fortunately, responsible planning and inter-agency collaboration resulted in the inclusion of high functioning wildlife passages in the form of span bridges and exclusionary fencing to keep wildlife off the roads.

Corridor Cover in the Bowmanville-Soper Creek Watershed

The percentage of natural cover in the Lake Ontario Shoreline regional corridor and in the landscape and local corridor systems was calculated and the results are presented in Table 14.

Overall, corridor cover is very good in the watershed, with the landscape corridors exceeding the goal of 75 per cent. Both the local corridors and Lake Ontario Shoreline regional corridor fall slightly below their goals of 75 per cent and 58 per cent cover, respectively, so some restoration or naturalization efforts should be undertaken.

The distribution of natural cover in corridors is also an important connectivity consideration and is not reflected in the per cent cover analysis.

Table 14: Corridor cover in the Bowmanville-Soper Creek watershed

Corridor Class	Area of Existing Vegetation (ha)	Corridor Area if Restored (ha)	Per Cent Cover	Goal
Lake Ontario Shoreline	67.82	145.27	47%	58%
Landscape Corridors	567.97	701.69	81%	75%
Local Corridors	76.95	108.27	71%	75%

Figure 5, which shows the existing cover within the landscape corridors in yellow, the local corridors in orange, and corridor areas without natural vegetation in red, suggests that cover is generally well distributed, though there are some clear gaps, particularly in the Soper Creek watershed. Priority restoration areas for the watershed were identified in 2015 and the status of each is shown in Table 15.

Table 15: Priority restoration areas in the Bowmanville-Soper Creek watershed

Habitat Type	Approximate Location	Current Status	Recommended Action
Landscape Corridors	Concession St between Providence Rd. and Darlington Clarke Townline.	No change in vegetation in this section has occurred since 2015.	Private land stewardship.
Landscape Corridor	Concession Rd. 3 (north and south) between Bragg Rd. and Darlington-Clarke Townline.	No change in vegetation in this section has occurred since 2015.	Private land stewardship.
Landscape Corridor	Darlington-Clarke Townline south of Taunton Rd.	Some natural regeneration has occurred since 2015, but still a significant lack of vegetation.	Private land stewardship.
Landscape Corridors	Mearns Rd. north of Concession Rd. 4.	No change in vegetation in this section has occurred since 2015.	Private land stewardship.
Landscape Corridor	Regional Rd. 57 (Bowmanville Ave.) south of Concession Rd. 6.	No change in vegetation in this section has occurred since 2015.	Private land stewardship.
Landscape Corridor	North of Concession Rd. 7 and east of Liberty St.	No change in vegetation in this section has occurred since 2015.	Private land stewardship.
Landscape Corridor	Acres Rd. north of Concession Rd. 6.	No change in vegetation in this section has occurred since 2015.	Private land stewardship.
Landscape Corridor	Middle Rd. north of Concession Rd 8.	No change in vegetation in this section has occurred since 2015.	Private land stewardship.

Movement Barriers in the Bowmanville-Soper Creek Watershed

Figure 5 shows the location of the breaks in the wildlife habitat network as a result of roads and rail lines. Any culverts and bridges that may act as passages beneath them were reviewed and updated to include new passages. The new passage assessment system (Table 2) was applied and the results are summarized in Table 16 below.

In total, 115 breaks were identified in the wildlife habitat network, which is an increase of seven from 2015 (Table 16). This is due to the completion of Highway 407 through the watershed.

Table 16: Passage assessment results for the Bowmanville-Soper Creek watershed

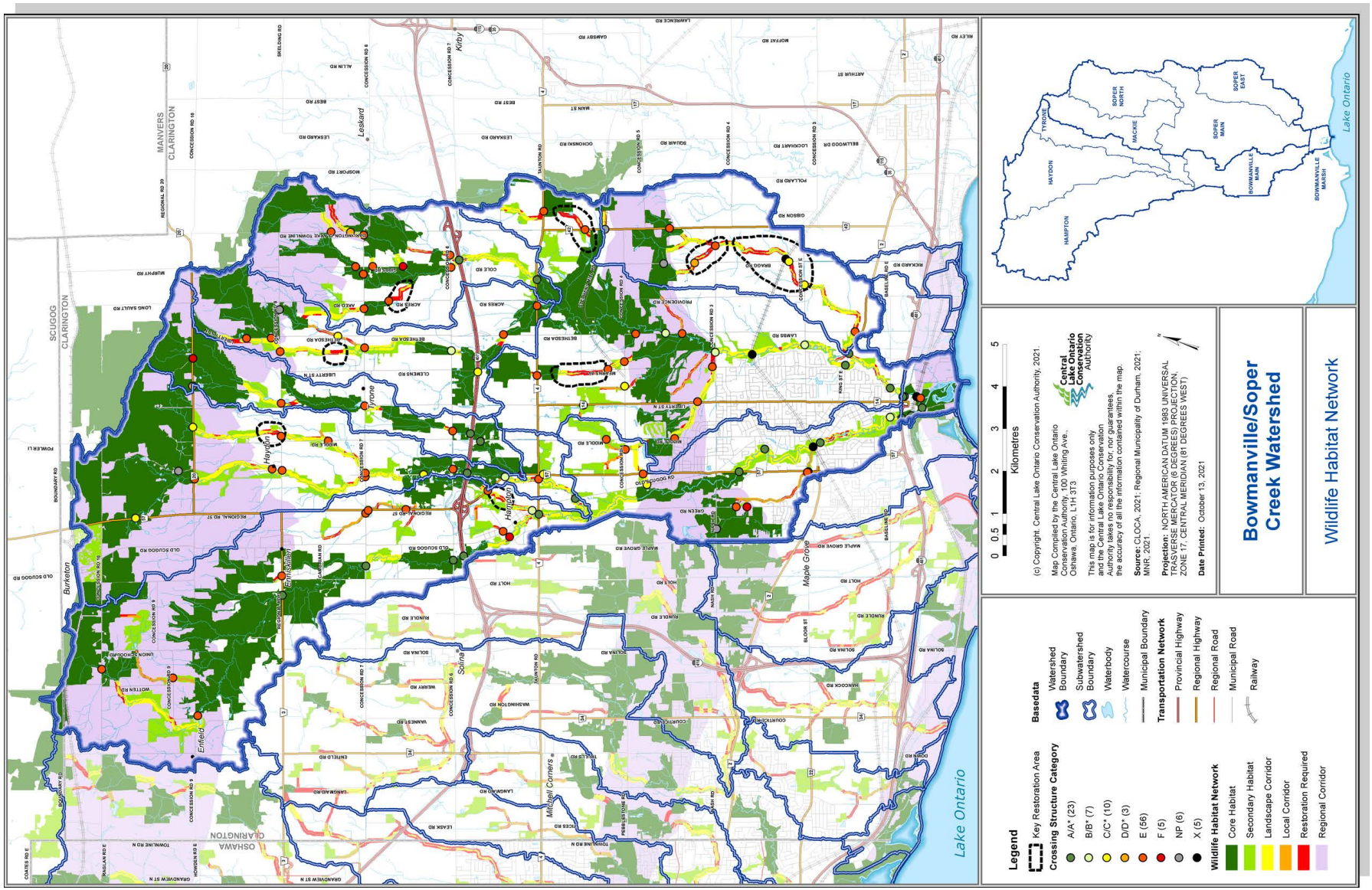
Structure Class	Regional Corridors		Landscape Corridors and Core Habitats		Local Corridors and Secondary Habitats	
	Quantity	Per cent of Total	Quantity	Per cent of Total	Quantity	Per cent of Total
A / A*			23	23%		
B / B*			7	7%		
C / C*			8	8%	2	13%
D / D*			3	3%		
E / E*			45	45%	11	73%
F			4	4%	1	7%
X			5	5%		
NP			5	5%	1	7%
TOTAL	0	0%	100	87%	15	13%

Because the passage assessment methodology has been modified and new goals have been established for this update, it isn't possible to directly compare these results to those in the previous plan, however some evaluation of the two is possible.

In 2015, 24 per cent (22 of 92) of the passages in the landscape corridor system and core habitats were evaluated as meeting the plan goal of Very Good or Better. An analysis of the 2020 passages using the 2015 assessment method suggests that 33 per cent (33 of 100) would have met that goal, indicating an overall improvement in wildlife movement potential within the landscape corridors and core habitats in the watershed. By comparison, 30 per cent (30 of 100) of these passages meet the new goal of being in structure classes A/A* or B/B* using the new assessment method. This improvement directly reflects the installation of highly functional span bridges along the Highway 407 route.

In 2015, 13 per cent (two of 15) of passages in the local corridor system and secondary habitats met the goal of being Moderate or Better and, since there have been no new breaks added to the local corridor system, the number of 2020 passages that would have met the 2015 goal is the same (13 per cent). Applying the new passage assessment method classifies 13 per cent (two of 15) of passages in the local corridors and secondary habitats as A/A*, B/B*, or C/C*.

Figure 5: Bowmanville-Soper Creek wildlife habitat network, corridor gaps and infrastructure barriers



Small Watersheds

There has been little new infrastructure development in the small watersheds since 2015, aside from the completion of Highway 418 through the Robinson-Tooley Creek watershed, and the construction of a few new roads in Whitby and Courtice. Of note for this update is that the *2015 Wildlife Corridor Protection and Enhancement Plan* did not identify the habitat and corridor areas within the Robinson-Tooley Creek watershed, as a separate process had been undertaken by the Municipality of Clarington to delineate the Natural Heritage System. For this plan, CLOCA has applied the same wildlife habitat assessment principles to the Robinson-Tooley Creek watershed as for the other watersheds, and a map of the new wildlife habitat networks is included in Figure 7.

Corridor Cover in the Small Watersheds

An analysis of the corridors in the watershed was completed for this update to establish per cent cover in the landscape and local corridor systems and provide a point of comparison for future updates. Unlike the other watersheds, Watershed Plans for the small watersheds do not exist and, consequently, natural cover goals for the Lake Ontario Shoreline regional corridor and landscape and local corridor systems have not been established. Table 17 presents the results of the natural cover analysis.

Table 17: Corridor cover in the small watersheds

Corridor Class	Watershed	Area of Existing Vegetation (ha)	Corridor Area if Restored (ha)	Per Cent Cover
Landscape Corridors	Corbett Creek	45.41	78.50	58%
	Darlington Creek	47.10	121.42	39%
	Osborne Creek	0.11	0.26	42%
	Pringle Creek	81.76	125.80	65%
	Robinson-Tooley Creek	37.22	71.72	52%
	Warbler and Cranberry Creek	0.46	4.99	9%
	TOTAL	**212.06**	**402.69**	**53%**
Local Corridors	Darlington Creek	12.40	19.13	65%
	Pringle Creek	0.72	3.10	23%
	Robinson-Tooley Creek	12.55	30.33	41%
	TOTAL	**25.67**	**52.56**	**49%**

Only six of the small watersheds have landscape corridors identified within the wildlife habitat network (Figure 6 and Figure 7), and the per cent natural cover within them ranges from nine per cent (Warbler and Cranberry Creeks) to 65 per cent (Pringle Creek). If the natural cover goal from the other watersheds is adopted (75 per cent), then none of the landscape corridors in the small watersheds meets that goal. Similarly, only three of the small watersheds have local corridors identified in them and if the 75 per cent corridor cover goal is also applied, then all of the corridors fall short of meeting the goal. The watershed closest to the 75 per cent goal is Darlington Creek.

The small watersheds largely connect the habitats along the Lake Ontario shoreline with the habitats in the Lake Iroquois Beach. In places where urban development has occurred within the Lake Iroquois Beach regional corridor and east-west movement is disrupted, these small watershed corridors act as the only terrestrial connections. As such, restoring natural cover is important. In 2015, seven key restoration areas were identified to improve habitat connectivity in the small watersheds and Table 18 updates these.

Table 18: Priority restoration areas in the small watersheds

Watershed	Habitat Type	Approximate Location	Current Status	Recommended Action
Pringle Creek	Core Habitat	Several places within the Iroquois Beach regional corridor.	No change in vegetation in this section has occurred since 2015.	Private land stewardship and development protection.
Corbett Creek	Landscape Corridor	Thickson Rd. between Highway 401 and Victoria Rd.	No change in vegetation in this section has occurred since 2015.	Private land stewardship.
Corbett Creek	Landscape Corridor	East and west of Thickson Rd. between Highway 401 and Dundas St.	Some natural regeneration has occurred since 2015, but still a significant lack of vegetation.	Private land stewardship.
Pumphouse Marsh	Regional Corridor	East and west of Thickson Rd. between Highway 401 and Dundas St.	This section of corridor was removed from the wildlife habitat network. No longer a priority.	None.
Darlington Creek	Landscape Corridor	Between Lake Ontario and rail line.	No change in vegetation in this section has occurred since 2015.	Private land stewardship.
Darlington Creek	Landscape Corridor	Maple Grove Rd. between the Iroquois Beach and rail line.	No change in vegetation in this section has occurred since 2015.	Private land stewardship.
Darlington Creek	Landscape Corridor	Holt Rd./Rundle Rd. between Highway 401 and Iroquois Beach.	Some natural regeneration has occurred south of Baseline.	Private land stewardship between Baseline and the Iroquois Beach.
Robinson-Tooley Creek	Landscape Corridor	East and west of Hancock Rd.	New priority area.	Private land stewardship.

Movement Barriers in the Small Watersheds

The culverts and bridges within the wildlife habitat network in the small watersheds were reviewed and updated, and the new passage assessment system (Table 2) was applied. The location of the passages and the structure class of each is presented in Figure 6 and Figure 7, and the results are summarized in Table 19 below.

In total, 102 breaks have been identified in the small watersheds and the breakdowns, in Table 19, are largely unchanged from 2015.

The main differences include one new road in the Corbett Creek watershed, Stellar Drive and two new assessments of existing passages in the Pringle Creek watershed. Table 19 suggests little change in the Robinson-Tooley Creek watershed, however the passage locations have been reconfigured as a result of the delineation of the wildlife habitat network for this update.

Table 19: Passage assessment results for the small watersheds

Watershed	Structure Class	Regional Corridors		Landscape Corridors and Core Habitats		Local Corridors and Secondary Habitats		Total
		Quantity	Per cent of Total	Quantity	Per cent of Total	Quantity	Per cent of Total	
Corbett Creek	A/A*			1	5%			
	B/B*			3	15%			
	C/C*			4	20%			
	E/E*			7	35%			
	F			1	5%			
	X			4	20%			
	Total	**0**		**20**		**0**		**20**
Cranberry Creek	NP			2	100%			
	Total	**0**		**2**		**0**		**2**
Darlington Creek	A/A*			1	5%			
	B/B*			2	11%			
	C/C*			2	11%			
	D/D*			2	11%			
	E/E*			8	42%	3	75%	
	X			2	11%	1	25%	
	NP	1	100%	2	11%			
	Total	**1**		**19**		**4**		**24**

Table 19: Passage assessment results for the small watersheds, cont.

Watershed	Structure Class	Regional Corridors		Landscape Corridors and Core Habitats		Local Corridors and Secondary Habitats		Total
		Quantity	Per cent of Total	Quantity	Per cent of Total	Quantity	Per cent of Total	
Osbourne Creek	X			1	50%			
	NP			1	50%	1	100%	
	Total	**0**		**2**		**1**		**3**
Pringle Creek	A/A*			3	14%			
	B/B*			4	18%			
	C/C*			4	18%			
	E/E*			6	27%			
	F			1	5%			
	X			2	9%	1	100%	
	N/P			2	9%			
	Total	**0**		**22**		**1**		**23**
Robinson-Tooley Creek	A/A*			2	15%			
	B/B*			2	15%	1	7%	
	C/C*			2	15%	5	33%	
	D/D*			1	8%	4	27%	
	E/E*			3	23%	2	13%	
	X			2	15%	3	20%	
	NP			1	8%			
	Total	**0**		**13**		**15**		**28**
Warbler Creek	NP			2	100%			
	Total	**0**		**2**		**0**		**2**
Total		**1**	**1%**	**80**	**78%**	**21**	**21%**	**102**

There are 80 breaks in the landscape corridors and core habitats in total, which is an increase of 15 from 2015 due to the new classification of landscape corridors and core habitats in the Robinson-Tooley Creek watershed. Similarly, the number of breaks in the local corridors and secondary habitat areas has also increased from six to 21. In 2015, 12 per cent (eight of 65) of the passages in the landscape corridors and core habitat areas met the 2015 Plan goal of being classified as Very Good or Better, and the same analysis suggests that 13 per cent (10 of 80) of the 2020 passages would meet that goal. Thirty-three per cent (two of 6) of the breaks in the local corridors and secondary habitats, as identified in 2015, met the plan goal of being classified as Moderate or Better, and in 2020, 19 per cent (four of 21) of the passages would have met the 2015 goal. Using the new passage assessment criteria, 22 per cent (18 of 80) of the passages in the landscape corridors and core habitats meet the new plan goal of being in structure classes A/A* or B/B*. In the local corridors and secondary habitats, 29 per cent (six of 21) of the passages are classified as A/A*, B/B*, or C/C*, which reflects the updated goal. Overall, there has been some improvement to passage function in the small watersheds, which can be attributed to new passages and new passage evaluations since 2015.

Ecopassages, Ontario Parks

Figure 6: Small watersheds (west) wildlife habitat network, corridor gaps and infrastructure barriers

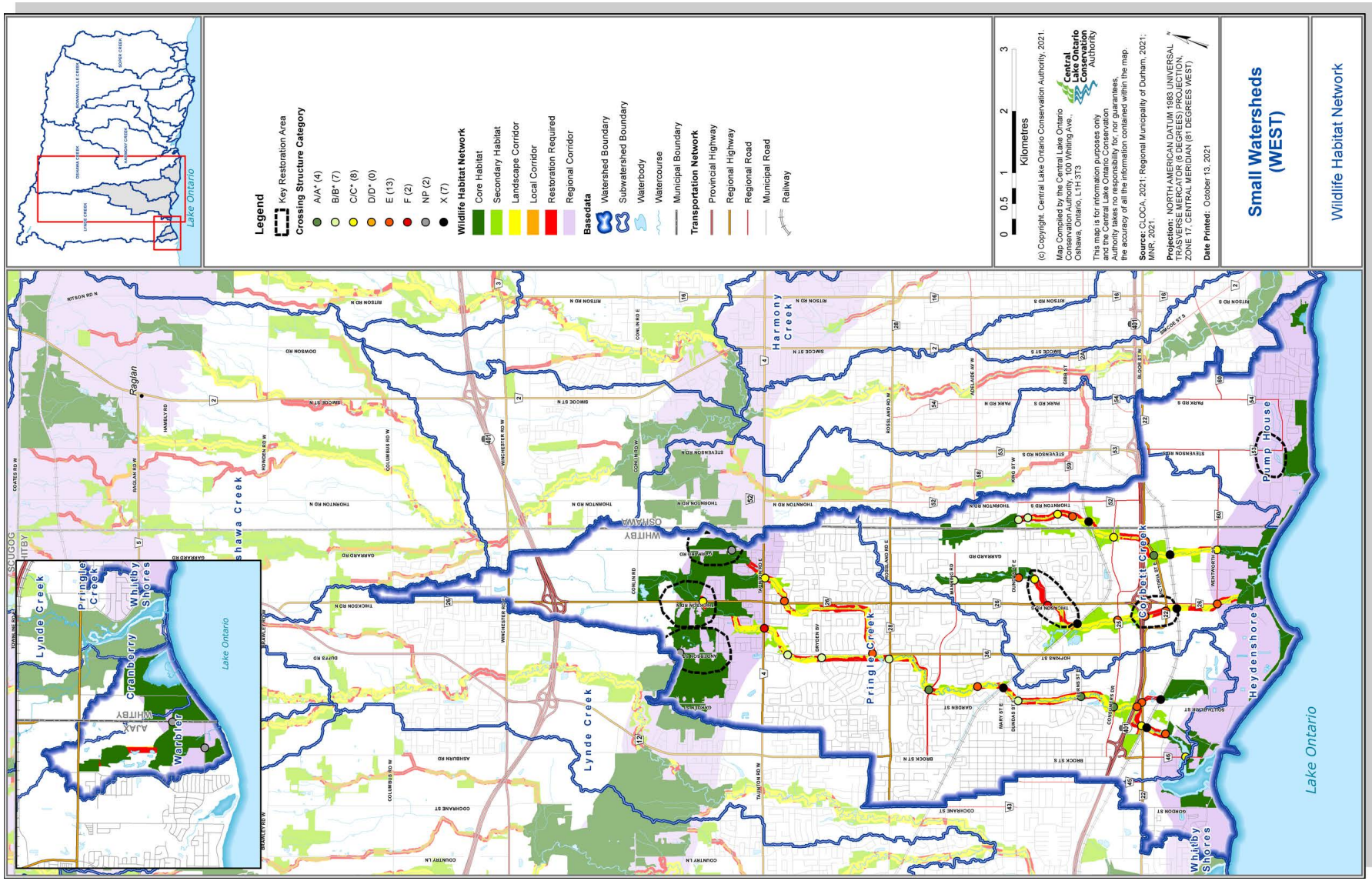
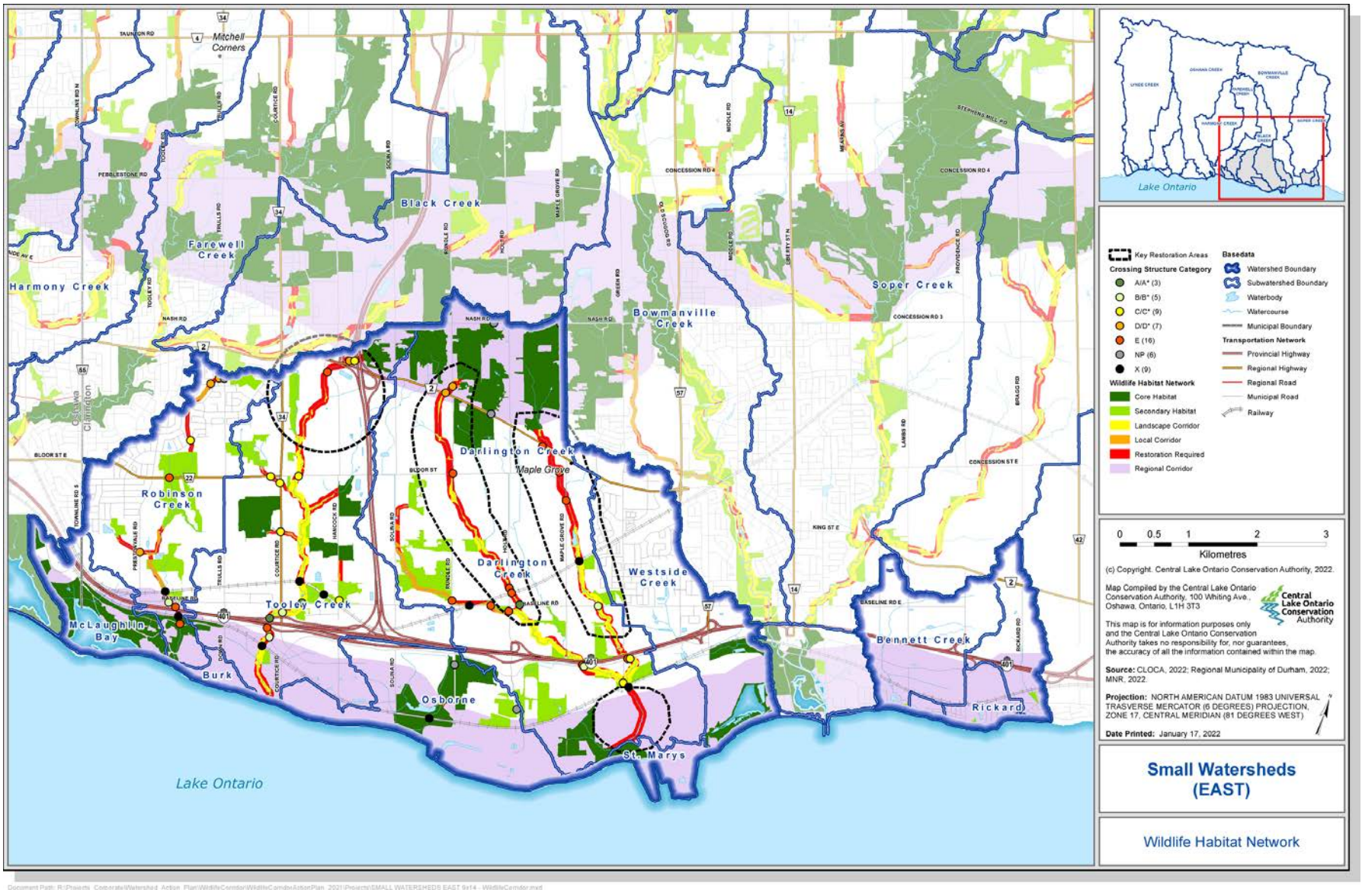


Figure 7: Small watersheds (east) wildlife habitat network, corridor gaps and infrastructure barriers



Infrastructure as Habitat

Although it is never preferable to replace natural habitat with infrastructure, there are some species for whom bridges and culverts provide suitable habitat. With a little planning, it's possible to turn these features into safe wildlife movement conduits, as well as places to nest, roost, or feed. Here are a few examples:

Nesting brids. Barn Swallows, which are listed as Threatened in Ontario, happily build their mud nests under bridges and then forage for flying insects over nearby creeks and fields. Cliff Swallows are also willing bridge dwellers, as are Eastern Phoebes. By designing bridges with built-in ledges or protected crevices, nesting can be encouraged, thereby creating new habitat.

Bat roosts. Bats love dark, dry crevices, and bridges can often provide such conditions, but these conditions could be enhanced to create bat roosting habitat. In Austin, Texas, the Congress Avenue bridge is home to a colony of 1.5 million Mexican free-tailed bats; a feature that has become a major tourist attraction in that city. In the Netherlands, the town of Monster has also installed a bridge that includes bat habitat (https://www.wired.com/2015/10/a-town-called-monster-builds-a-bridge-for-people-and-bats/). There are even pre-fab panels that can be purchased and mounted on existing bridge walls to create bat habitat. Bat Conservation International has a great article on bats and bridges for more information (https://www.batcon.org/article/bats-in-bridges/).

Foraging. If there is any kind of natural habitat around or within a bridge or culvert, then wildlife will use it to hunt for food. Wading birds search through mud banks for insects, mammals use shallow areas to catch invertebrates and fish, and raptors perch on railings to get a better view of their surroundings for hunting purposes.

Barn Swallow nest in bridge.

Protecting and Enhancing Habitat Connectivity

There are two courses of action that we can take to ensure a future landscape with a high-quality wildlife habitat network: protect the natural features that exist and avoid new habitat fragmentation; and undertake restoration activities to close existing gaps, enhance corridor function, and remove barriers. Some of these actions can be achieved through sound policy and conscientious land use planning, while others will require investing in stewardship programs and infrastructure upgrades, as well as a willingness to develop and support creative solutions.

Protecting what we have

Policy

The need to maintain habitat connectivity across all landscape scales is increasingly being recognized. Planning policies at both the provincial and regional scales already support the creation and maintenance of connected natural heritage systems, but there is room for improvement. At the provincial scale, CLOCA has used the contents of the *2015 Wildlife Corridor Protection and Enhancement Plan* to make recommendations to both the province and the Greenbelt Foundation to encourage policies with stronger wildlife habitat protections. Central Lake Ontario Conservation Authority has also helped to implement improved wildlife habitat and connectivity measures at the local scale. The City of Oshawa, for example, recently approved *Official Plan Amendment 179*, which defined a one-kilometrre habitat buffer along the Lake Ontario shoreline and included policies for the protection of this buffer. This action will help the City of Oshawa protect an important regional wildlife corridor in several watersheds within its municipal boundaries, and CLOCA encourages similar actions from its other municipal partners.

Planning and Regulation

Central Lake Ontario Conservation Authority's work is strongly connected to the work of its planning partners through the development review and permitting processes. This allows CLOCA to assist their partners in the effective integration of wildlife connectivity into planning projects. Our role in the review of Environmental Assessments and Environmental Impact Studies enables CLOCA staff to identify impacts to the wildlife habitat network offering advice on how to avoid or mitigate them. It is our primary intention that wildlife habitat needs are easiest to accommodate when they are identified early—before any land use plans have been made. A recent example of progressive and successful wildlife planning occurred in the Oshawa Creek watershed as part of Stantec's Columbus Creek subwatershed study. This study considered all the needs of the community prior to development being approved, and it lays out the future development of the subwatershed in such a way that the existing wildlife habitat network is protected, future road crossings will prioritize wildlife movement, and space is left for restoration of degraded corridors. The inclusion of the wildlife habitat network at the earliest stages of planning was a significant contributor to the success of this study, but effective collaboration was also key. Central Lake Ontario Conservation Authority recognizes the positive working relationships it has with many of the municipal and private-sector agencies. These are important throughout the planning and development process, and we continue our commitment to engaging in open and thoughtful discourse. Our role as the permitting agency for *Ontario Regulation 42/06*, which regulates development and interference in hazard lands and wetlands, further allows CLOCA to advocate for the protection of wildlife habitat and connectivity where these features overlap.

Restoring What Has Been Lost

Stewardship

Significant portions of the wildlife habitat network are on public lands, and municipal partners are encouraged to use this Plan to develop strategies to restore corridor gaps and enhance existing wildlife habitat areas to improve overall quality and function. Restoration can be achieved passively, for example by letting areas naturalize through reduced mowing and maintenance, or actively through planting initiatives. We encourage our partner municipalities to take an active role in strengthening the wildlife habitat networks in their watersheds and we continue to work with interested parties to plan and carry out restoration works.

The remaining portions of the network are on private land, and private land conservation has an important role to play in protecting wildlife habitat and maintaining a connected system. Central Lake Ontario Conservation Authority holds the largest share of private lands, with our Conservation Areas providing much of the core wildlife habitat in the watersheds. These areas are protected for the purpose of conservation, and restoration and enhancement are ongoing, as is strategic land acquisition to further improve habitat quality. The rest of the wildlife habitat network exists on lands owned by watershed residents and businesses. Although the contributions of these landowners may seem less significant individually, collectively their efforts to protect and restore wildlife corridors and habitat is substantial. Actively engaging landowners as partners in the building and maintenance of the wildlife habitat network is an activity that is currently lacking, as there are few resources dedicated to private land stewardship.

While we are currently working to address this gap through the development of more supportive private land stewardship programming, we also encourage our partners to develop policies and strategies that encourage private landowners to be active participants in conservation.

Infrastructure upgrades

Wildlife habitat connectivity has been severely impacted by transportation corridors and opportunities to improve passage for wildlife across these corridors needs to be a prime consideration for transportation planners. Culverts and bridges are readily used by many animals and, if properly designed, can act as effective wildlife passages. As infrastructure in the watersheds is upgraded over time, transportation agencies have the opportunity to replace existing culverts and bridges with larger structures that not only benefit terrestrial wildlife, but also create healthier streams for fish and reduce threats from flooding. New roads and rail lines are generally subject to an Environmental Assessment, and CLOCA, as a partner in the review process, is able to recommend actions to reduce the impacts of roads on wildlife and improve habitat connectivity. Culvert replacements and some other road works carried out by works' departments directly do not necessarily involve CLOCA and, in these instances, opportunities for improvement may be missed if works staff are not aware of how the road relates to the wildlife habitat network in that watershed. To close this gap, CLOCA recommends that a municipal training program be developed to introduce works' staff to the Plan and its maps. This action can be carried out by CLOCA’s infrastructure planner, whose functions include operationalizing and implementing this Plan.

Before-and-After examples

These photos are examples of upgraded culverts in the Lynde Creek watershed. The top row shows what the passages looked like in 2015 and the bottom row shows how they look today. Previously, they all suffered from a lack of dry passage. As the 'after' photos show, these passages are now passable for both aquatic and terrestrial wildlife.

Fencing and signage

Culverts and bridges can facilitate access across roads, but passages alone are not the only solution; exclusionary fencing that directs wildlife toward passages is also a critical component to consider. Fencing is site specific and deciding what to install depends on the wildlife species being targeted, as well as physical factors such as road shoulder width and slope. Transportation planners and works department staff are encouraged to consult with CLOCA to discuss options and develop customized solutions.

Not all roads may need wildlife passages or be able to accommodate them and, in these instances, fencing alone may be the best solution as it prevents wildlife from accessing the road and reduces road mortality (Teixeira, Rytwinski and Fahrig, 2020). As is the case with all projects, understanding the problem prior to initiating works is best, and CLOCA can assist with evaluating mitigation measures if engaged as early on in the process as possible. Not only does early engagement prevent project delays, but it can give CLOCA time to organize or conduct preliminary site investigations for evidence of nesting turtles or wildlife mortality which can influence exclusionary fencing decisions. Additional measures for consideration in areas of concern and where wildlife passage isn't feasible, include wildlife warning signage and traffic calming measures. The effectiveness of signage at reducing wildlife mortality is still unclear, so signs alone should not be viewed as a solution to reducing road impacts. Seasonal signs in conjunction with temporary speed bumps or other speed-reducing tools may be an effective way of dealing with annual events in key hotspots, and CLOCA can assist its partners in identifying these areas. A great resource for practitioners is the *Wildlife Fencing Guide: Amphibians, Reptiles and Small Mammals (2021)* by Animex. This guide is available online at https://wildlifefencing.com/version1.

Evaluating Success

In 2025, CLOCA's watershed plans will be updated, as will this Plan, to review changes in the watershed and assess the impact of those changes, either positive or negative, on the wildlife habitat network. The evaluation metrics identified in this report (corridor cover and passage assessments) will form the basis of future success evaluation.

As part of our commitment to wildlife corridor protection, CLOCA staff will continue to monitor the evolution of road ecology to ensure our planning partners are implementing the most up-to-date practices, and any revelations in the future will continue to be incorporated into the five-year update.

Savings two birds with one stone

Replacing an existing culvert with one that is wider has benefits for more than just wildlife. Here are five reasons why it makes sense to consider upsizing culverts:

Climate change. Projections for Durham Region indicate that we should anticipate an up to 15 per cent increase in period flood magnitude, so providing additional capacity for water today is planning for our future.

Cost savings. Larger culverts usually result in quicker agency approvals and permits, which reduces costly delays. They also generally require less maintenance by public works staff, as they are less prone to blockages from debris such as trees.

Stream health. Larger culverts are often open-bottomed, which allows a watercourse to migrate over time, both horizontally and vertically, without the need for engineering solutions such as instream grade controls. Such controls usually require maintenance during the life of the crossing structure, so there is an additional cost benefit as well.

Fish passage. Fish, too, prefer to pass through a natural channel, and because larger culverts tend to span the bankfull width of a creek, there is no need to model complicated fish passage requirements.

Wildlife passage. Larger culverts are likely to include areas of dry bank, which make them useful for terrestrial wildlife to use as pathways beneath roads, avoiding vehicle collisions and maintaining habitat connectivity in the watersheds

Wildlife Underpass, Route 1, New Brunswick, Atlantic Industries Limited

References

Agard, K., Schneider, K., & Spellman, C. (1993). On the importance of Lake Ontario woody shoreline habitat to neotropical migrant songbirds. Retrieved from https://seagrant.sunysb.edu/elodune/Education/EDU%20PDF/Resources/ontheimportance.pdf

Bontner, D. N., Gauthreaux Jr., S. A., & Donovan, T. M. (2009). Characteristics of Important Stopover Locations for Migrating Birds: Remote Sensing with Radar in the Great Lakes Basin. Conservation Biology, 23(2), 440-448. doi:10.1111/j.1523-1739.2008.01085.x

Dillon, R. M., Boyle, S. P., Litzgus, J. D., & Lesbarreres, D. (2020). Build It and Some Will Use it: A Test of Road Ecopassages for Eastern Gartersnakes. Journal of Herpetology, 54(1), 19-23. doi:10.1670/18-163

Durham Region. (2014). Durham Region's Future Climate (2040-2049). SENES Consultants. Retrieved from Adaptation and Resilience: https://www.durham.ca/en/living-here/resources/Documents/EnvironmentalStability/DurhamsFutureClimateStudy_Executive-Summary.pdf

Durham Region. (2020). Durham Regional Official Plan. Retrieved from https://www.durham.ca/en/doing-business/resources/Documents/PlanningandDevelopment/Official-Plan/2020-Durham-Regional-Official-Plan-Consolidation---Revised-1.pdf

Environment Canada. (2013). How Much Habitat is Enough? 3rd Edition. Toronto, Ontario.: Environment Canada.

Fadden, A., & Marx, L. (2019). NAACC Stream Crossing Instruction Guide for Terrestrial Passage Assessments. University of Massachusetts Amherst: North Atlantic Aquatic Connectivity Collaborative (NAACC). Retrieved from https://streamcontinuity.org/sites/streamcontinuity.org/files/pdf-doc-ppt/NAACC_terrestrial%20passage%20user%20guide%20July%202019.pdf

Fahrig, L., Pedlar, J. H., Pope, S. E., Taylor, P. D., & Wegner, J. F. (1995). Effect of road traffic on amphibian density. Biological Conservation, 73(3), 177-182. doi:10.1016/0006-3207(94)00102-V

Gates, J. E., & Sparks Jr., J. L. (2012). An investigation into the use of road drainage structures by wildlife in Maryland, USA. Human-Wildlife Interactions, 6(2), 311-326.

Jacobson, S. L., Bliss-Ketchum, L. L., de Rivera, C. E., & Smith, W. P. (2016). A behavior-based framework for assessing barrier effects to wildlife from vehicle traffic volume. Ecosphere, 7(4), 1-15. doi:10.1002/ecs2.1345

Kintsch, J., & Cramer, P. C. (2011). Permeability of Existing Structures for Terrestrial Wildlife: A Passage Assessment System. Washington Department of Transportation (WSDOT). Retrieved from https://www.wsdot.wa.gov/research/reports/fullreports/777.1.pdf

References

Ministry of Municipal Affairs and Housing. (2020). Provincial Policy Statement under the Planning Act. Government of Ontario. Retrieved from https://files.ontario.ca/mmah-provincial-policy-statement-2020-accessible-final-en-2020-02-14.pdf

Ontario Ministry of Natural Resources. (2010). Natural Heritage Reference Manual for Natural Heritage Policies of the Provincial Policy Statement, 2005 (Second edition). Queen's Printer for Ontario. Retrieved from https://docs.ontario.ca/documents/3270/natural-heritage-reference-manual-for-natural.pdf

Rempel, R. S., & Hornseth, M. L. (2017). Binational climate change vulnerability asssessment of migratory birds in teh Great Lakes Basins: Tools and impediments. PLOS ONE, 12(2), 1-17. doi:10.1371/journal.pone.0172668

Teixeira, F. Z., Rytwinski, T., & Fahrig, L. (2020). Inference in road ecology research: what we know versus what we think we know. Biology Letters, 16, 1-8. doi:10.1098/rsbl.2020.0140

Appendix A: Rationale for corridor sizes for CLOCA's jurisdiction

Feature	Description	Recommended Size	Rationale	References
Local Corridor	Connects core areas or other natural areas within a subwatershed.	Creek valleys and some upland connections: 60 m wide (minimum)	• E.C. guidelines recommend min 50-100 m widths to support movement. • ORM technical paper 4 recommends min 60 m width on the ORM (or half the width of area separating features (max 240 m). • Fisheries recommends 30 m buffer on streams (most corridors follow watercourses). • NHRM does not differentiate between corridor types but cites Noss (1992) which suggests that the width of corridors shorter than 16 km should be three times measurable edge effects, or 300 m wide. • **Recommend 60 m corridor width to be consistent with fisheries, and accommodate movement of generalist species.**	E.C.(2004) (pg 40) ORM T.P. 4 (pg 5) OMNR (2nd ed., pg 29)
Landscape Corridor	Connects core areas across multiple subwatersheds or across the watershed.	Larger creek valleys and some upland connections: 100 m wide (minimum)	• E.C. guidelines recommend minimum 50-100 m widths to support movement. • E.C. guidelines also recommend 75-175 m to support breeding birds. • Wider corridors are more effective. • NHRM does not differentiate between corridor types but cites Noss (1992) which suggests that the width of corridors shorter than 16 km should be three times measurable edge effects, or 300 m wide. • **Recommend 100 m width to support generalist movement as well as breeding birds.** • **Bigger size acknowledges the importance of landscape corridors in connecting the shoreline with the ORM and Iroquois Beach Regional Corridors.**	E.C.(2004) (pg 40) OMNR (2nd ed., pg 29)

Appendix A: Rationale for corridor sizes for CLOCA's jurisdiction

Feature	Description	Recommended Size	Rationale	References
Regional Corridor	Connects core habitats across watersheds.	Lake Ontario (1 km wide).	• OMNR recommends corridor width of up to 5 km from Lake Ontario shoreline. • NCC recommends 1 km corridor width from shoreline. • Recommend 1 km corridor width for Lake Ontario to be consistent with OMNR and NCC recommendations.	Significant Wildlife Habitat Decision support system (index #25). Agard, Schneider, & Spellman (1993) pg. 9 Bontner, Gauthreaux Jr., & Donovan (2009) E.C.(2004) (pg 40) ORM T.P. 4 (pg 5) OMNR (2nd ed., pg 29)
		Iroquois Shoreline (300 m connections between habitat patches preferred. Min 100 m is acceptable when 300 m cannot be achieved).	• No published information specific to Iroquois Shoreline. • E.C. guidelines recommend minimum 50-100 m widths to support movement. • E.C. guidelines also recommend 75-175 m to support breeding birds. • Wider corridors are more effective. • NHRM does not differentiate between corridor types but cites Noss (1992) which suggests that the width of corridors shorter than 16 km should be three times measurable edge effects, or 300 m wide. • **Recommend 300 m corridor width for Lake Iroquois Shoreline to recognize importance of regional movement. This corridor is defined by a physiographic region therefore it is preferred that as much of the shoreline as possible be in natural cover/habitat (consistent with goals of g.w. recharge protection and fisheries). Where pinch points in cover occur, 100 m width is acceptable (consistent with landscape corridor widths).**	
		Oak Ridges Moraine (as large as possible but legal width defined in ORMCP T.P 4).	• ORM technical paper 4 recommends min 60 m width on the ORM (or half the width of area separating features (max 240 m). • **At provincial scale ORM is a corridor, therefore goal should be to keep as much of ORM as possible in natural cover.At watershed scale, ORMCP guidelines in T.P 4 should be followed.**	

ORM = Oak Ridges Moraine
NHRM = Natural Heritage Reference Manual
NCC = Nature Conservancy Canada
OMNR = Ontario Ministry of Natural Resources

Wildlife Corridor Protection and Enhancement Plan
2nd Edition, February 2022

ADMIN OFFICE

100 Whiting Avenue,
Oshawa, ON L1H 3T3

WEBSITE

WWW.CLOCA.COM

CONTACT

905.579.0411
info@cloca.com