Implementing Connectivity Science into Action in Transportation Planning: Examples from Ontario & Quebec

FOR: Canadian Maritimes Ecological Connectivity Forum – April 24 2019

Session Outline (~100 minutes)

- Dave Ireland, Conservation Council of New Brunswick
- Mandy Karch, Ontario Road Ecology Group
- Kari Gunson, Wildlife on Roads
- Jochen Jaegar, Concordia University
- Discussion

CCNB

The genesis of a road ecology movement in Ontario and Quebec

FOR: Canadian Maritimes Ecological Connectivity Forum – April 24 2019

TALK OUTLINE (20 minutes)

- Three stories over two decades
  - 2000-2005: salamanders & science
  - 2006-2011: building the collaboration, finding a champion
  - 2012-2019: Resolution 40-3, from land to water

CCNB

Dave Ireland
@davehireland

Effect of Road Traffic on Two Amphibian Species of Differing Vagility

LAURIE W. CARR AND LENORE FAHRIG


Joe Crowley

Recovery Strategy for the Massasauga (*Sistrurus catenatus*) in Canada

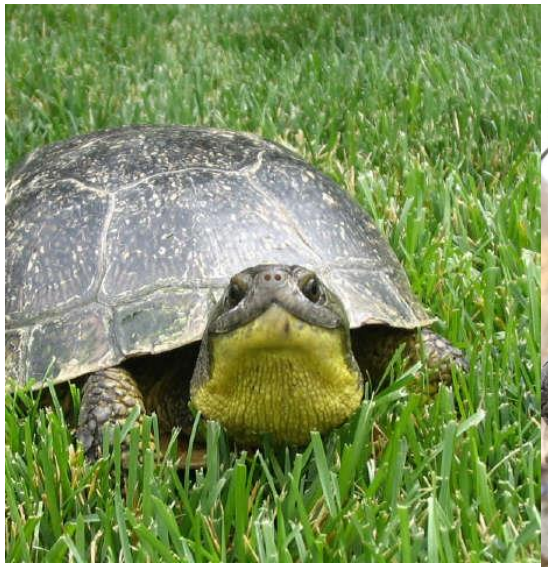
Table 2. Threats to Massasauga Recovery

Threat	Level of Concern	Extent	Occurrence	Frequency	Severity	Causal Certainty
Habitat loss and degradation						
Development - roads	High	Widespread	Current	Continuous	High	High
Development - other than roads (e.g. housing, golf courses, agriculture)	High	Widespread	Historic and Current	Continuous	High	High

Conservation, education and research programmes

RAYMOND

2006 2019



Roads & Ecopassages Forum

Connecting landscapes, people and wildlife.

© M.Aresco

© A. Clevenger

© S. Zahner

© S. Rosa

toronto ZOO


Canada


Ontario


Parks Canada
Parcs Canada


TORONTO AND REGION
Conservation
for The Living City


Ontario
Nature


Central
Lake Ontario
Conservation


Brock
University


Concordia
UNIVERSITY


Carleton
UNIVERSITY


toronto
ZOO


Rouge Park


ecokare
international

Conservation, education and research programmes

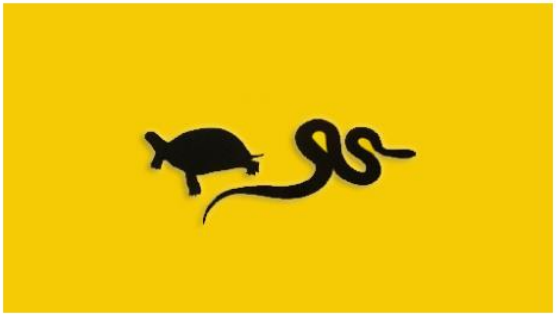
Celebrating 10 years!
2009 - 2019

A Guide to Road Ecology in Ontario

Major Road In Burlington To Be Closed For Salamander Migration

by Damian Ali on March 11, 2019
in Burlington, News

IN THE NEWS



Wildlife crossing signs

2016 | 0 Comments

Huron Stewardship Council presented Central Huron council with a proposal to erect wildlife crossing signs on two roads in the municipality where turtles and other reptiles are being killed in high numbers. The goal of [...]

Wildlife crossings pave the way for biodiversity

2016 | 0 Comments

The first dedicated wildlife bridge gets built over Oracle Road in the Sonoran Desert to help protect one of Arizona's most threatened wildlife linkages. Volunteers were invited to plant and prepare Pima County's first vegetated [...]

Monkton Conservation Commission

2016 | 0 Comments

Monkton Conservation Commission and partners install new wildlife crossing culverts in Monkton, Vermont to facilitate safe amphibian crossings. Rendering above is of a culvert for salamanders, with side wings. Read More

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The genesis of a road ecology movement in Ontario and Quebec

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  - **2012-2019: from land to water in Atlantic Canada**

CCNB

Dave Ireland
@davehireland


ROYAL ONTARIO MUSEUM
#iamascientist

EVC Environmental Visual Communication

ROM BIODIVERSITY

Fleming College

Jacqueline Waters – EVC grad 2013


NIGHT
LIVE

"This was an opportunity for us, born of tragedy, to make something more of her life"

– *Mark Engstrom,* deputy director of collections and research

MINGAN ISLAND CETACEAN STUDY

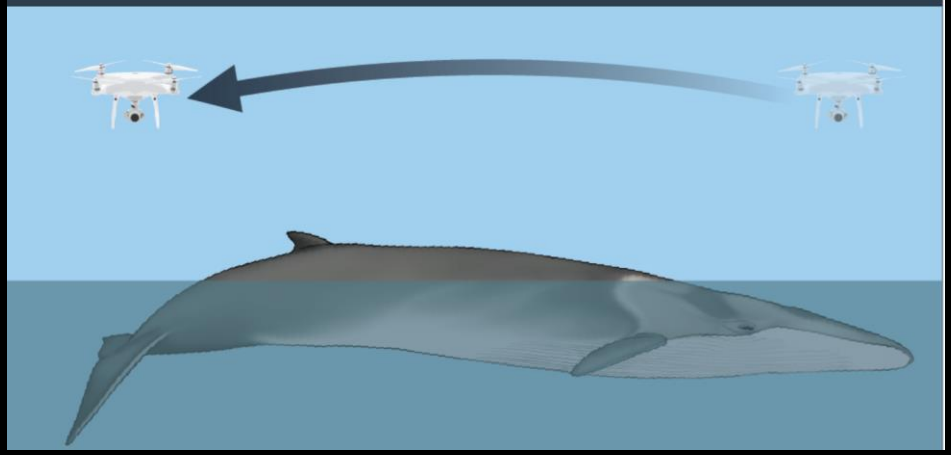
STATION DE RECHERCHE DES ÎLES MINGAN

Vincent Luk – EVC Grad 2014

THE SCAR STUDY

Entanglement rates of fin whales
in the northern Gulf of St. Lawrence

DRONES AS A RESEARCH TOOL

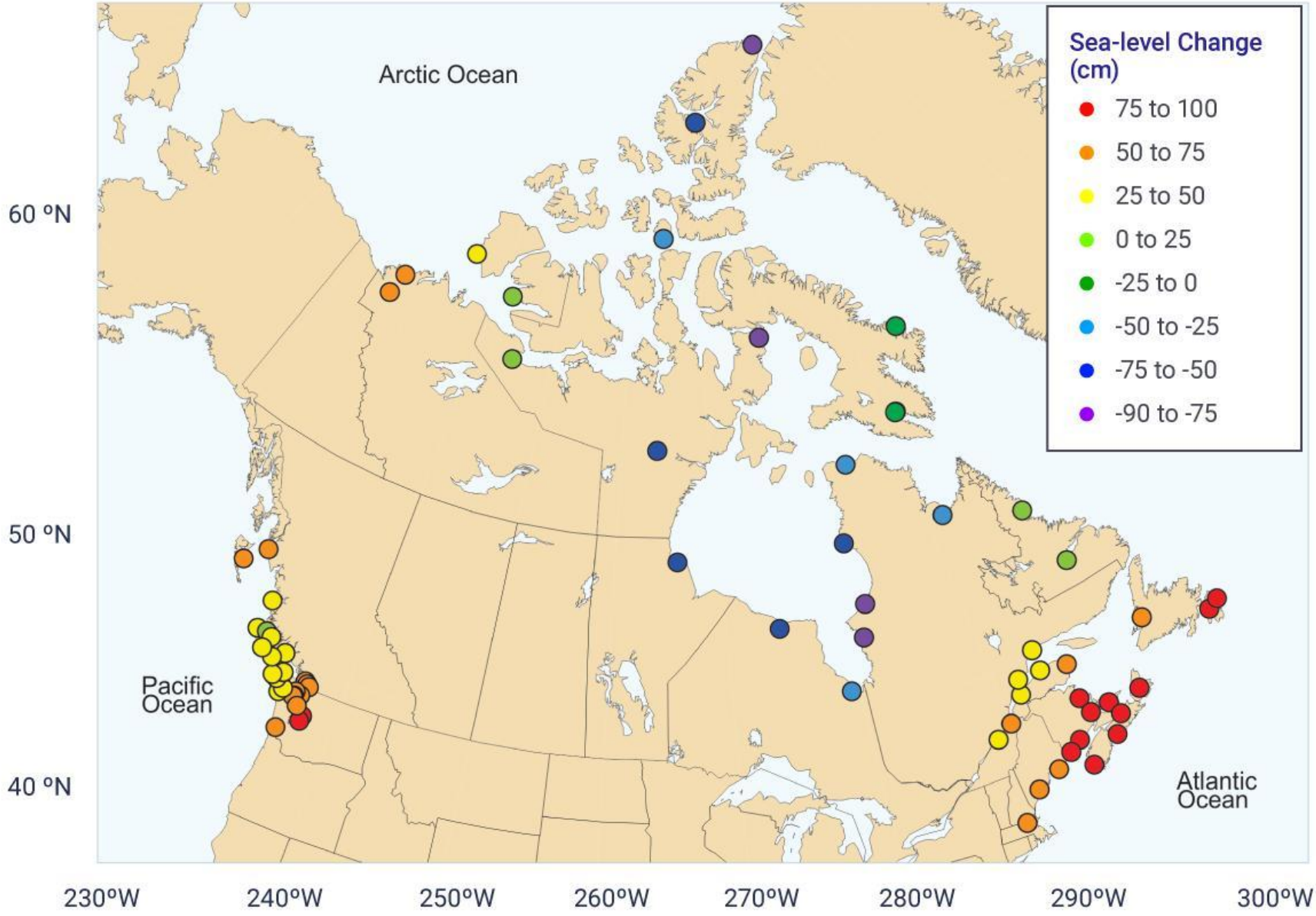


Conservation Council *of* New Brunswick
Conseil de conservation *du* Nouveau-Brunswick

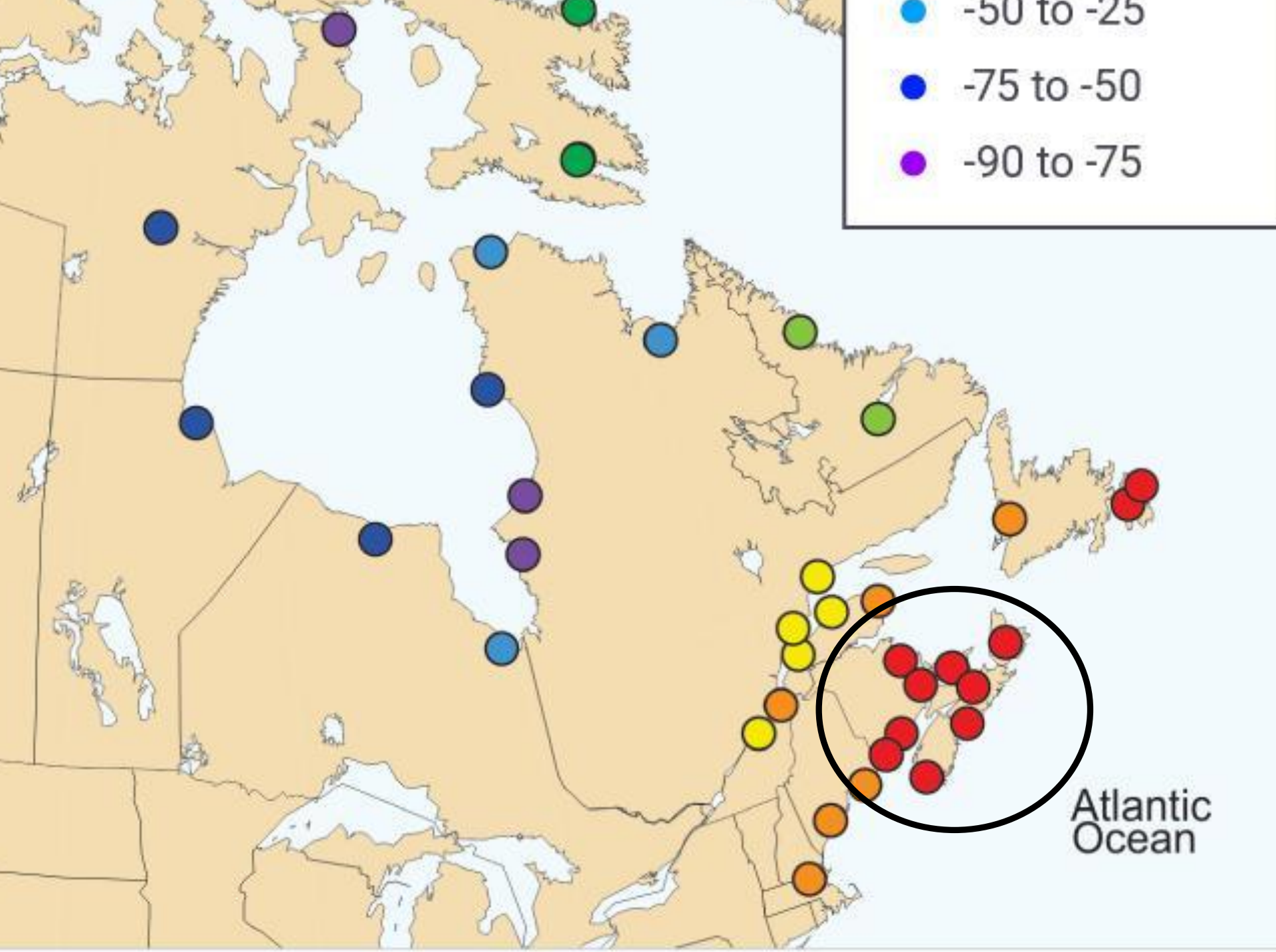
Celebrating our 50th anniversary

Marine conservation programme

Climate change and Atlantic Canada



Canada's Changing Climate Report, April 2019 ® Natural Resources Canada


-50 to -25
-75 to -50
-90 to -75
Atlantic Ocean

Dr. Vanessa Pirotta, Macquarie University, Australia

VIDEO CLIP FROM VANESSA PIROTTA

Implementing Connectivity Science into Action in Transportation Planning: Examples from Ontario & Quebec

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CCNB

How can we mitigate the negative effects of roads on ecological connectivity? Investigating the options

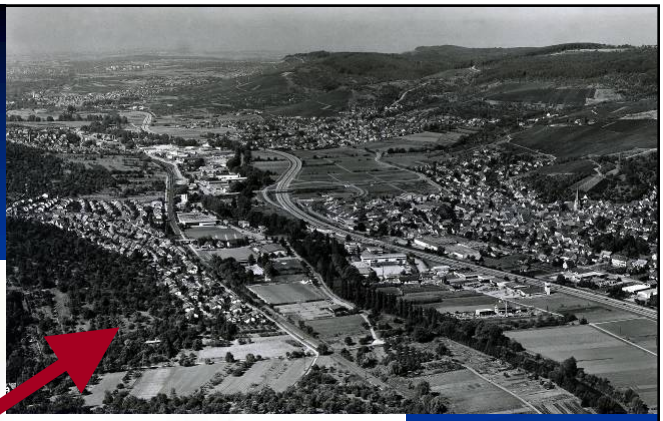
Dr. Jochen Jaeger

Concordia University, Montréal (QC)
Department of Geography, Planning and Environment

Canadian Maritimes Ecological Connectivity Forum, Dalhousie University
Halifax (NS), 24-25 April 2019

0

Landscapes are changing very fast
Increase of roads and urban sprawl



1989

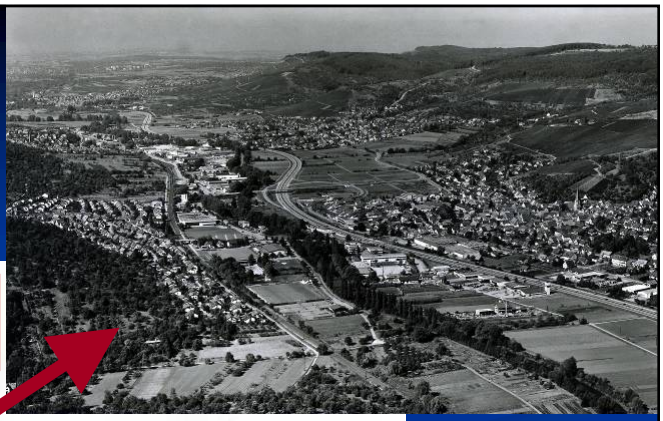
Brugger (1992)

1956

Landscapes are changing very fast

Increase of roads and urban sprawl

What does this mean for landscape connectivity?



1989

- More animals killed on roads (incased road mortality)
- Loss of habitat
- Reduced connectivity

Brugger (1992)

1956

Planned new roads worldwide:

The total length of additional roads worldwide by 2050 compared to 2010:
> 25 million kilometers

= more than **600 times** around the planet
(Dulac 2013; Laurence *et al.* 2014)

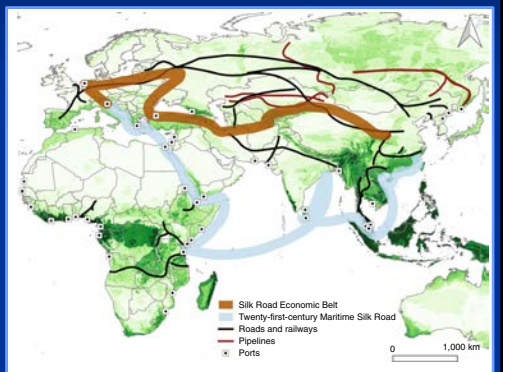


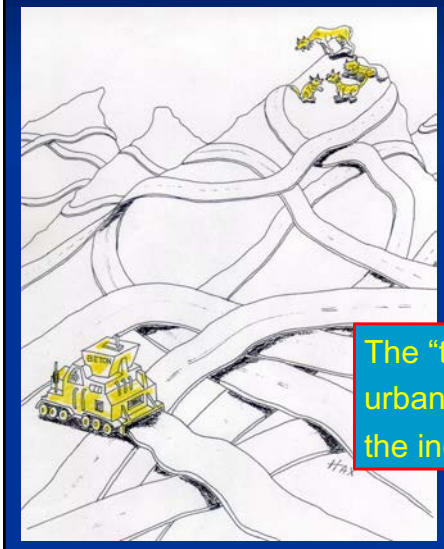
Fig. 1 | **Main trade corridors (Silk Road Economic Belt and twenty-first-century Maritime Silk Road) from and to China and some of the most important infrastructure and ports built or planned with Chinese investment in the BRI.** Environmental value is shown in green (darker green corresponding to more value), integrating data on terrestrial biodiversity, key habitats, wilderness and environmental services[5]. Infrastructure mapping is based on infographics from the Mercator Institute for China Studies (MERICS).

Ascensao et al. (2018)

e.g., Belt-and-Road (BRI) Initiative by China and more than 60 other countries (since 2013)

"Global Infrastructure Tsunami"

Laurance (2018)



What to expect for the coming years:

- strong reduction in roadless areas,
- severe reduction in connectivity,
- massive increase in road mortality,
- great loss of wildlife habitats.

The "tsunami" of new roads (and urban sprawl) will greatly accelerate the incipient 6th mass extinction.

4

In fact, Canada...

…is world champion in terms of amount of roads per capita!

Forman et al. (2003)

Locations in Quebec

Autoroute 85
Route 138
Route 175

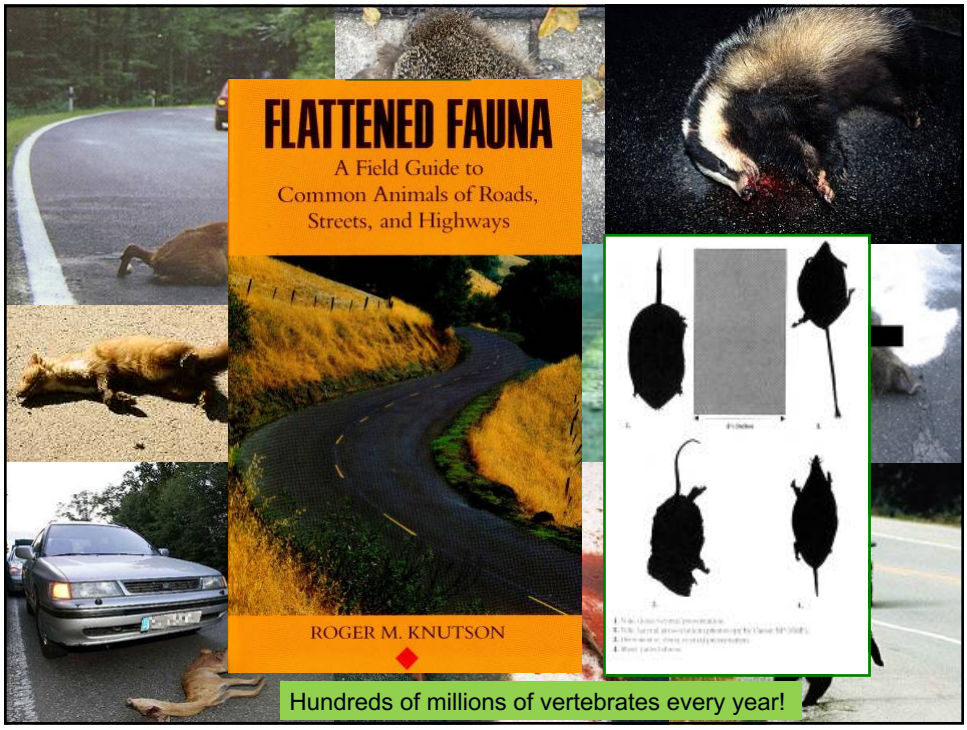
Autoroute 73

Autoroute 10
Route 245

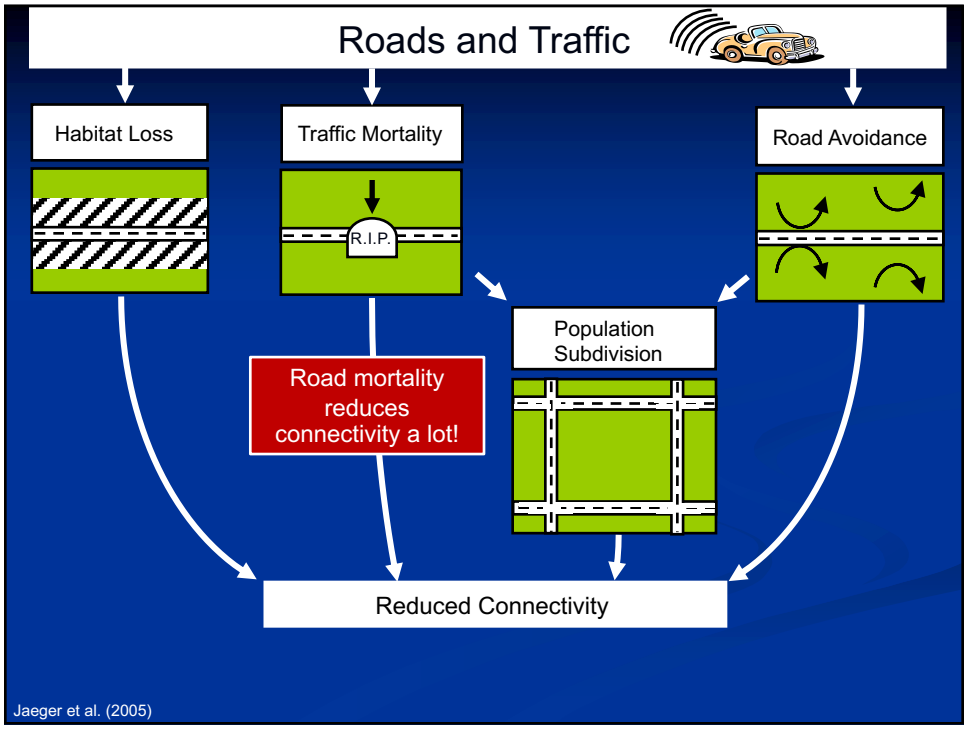
6

Encounters with wildlife

Canadian Street Gang


FLATTENED FAUNA
A Field Guide to
Common Animals of Roads,
Streets, and Highways
ROGER M. KNUTSON
Hundreds of millions of vertebrates every year!


© H. Corneliussen



Jaeger et al. (2005)

Biological Conservation 144 (2011) 3143–3148

Contents lists available at SciVerse ScienceDirect

Biological Conservation

journal homepage: www.elsevier.com/locate/biocon

Short communication

Relative effects of road mortality and decreased connectivity on population genetic diversity

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Geomatics and Landscape Ecology Research Laboratory, Department of Biology, Carleton University, 1125 Colonel By Drive, Ottawa, ON, Canada K1S 5B6

ARTICLE INFO

Article history:
Received 18 May 2011

ABSTRACT

Roads can have two important effects on populations that impact genetic variation: reduced gene flow and reduced abundance. Reduced gene flow ("barrier effects") due to road avoidance behavior or road

- Effect of **road mortality** on genetic diversity is **stronger** than the barrier effect in most cases.
- Increasing movement across roads will generally not compensate for genetic variation lost due to road mortality.
- The genetic effects of road mortality should be more often considered when prioritizing road-mitigation measures.

Jackson & Fahrig (2011)

1. Introduction

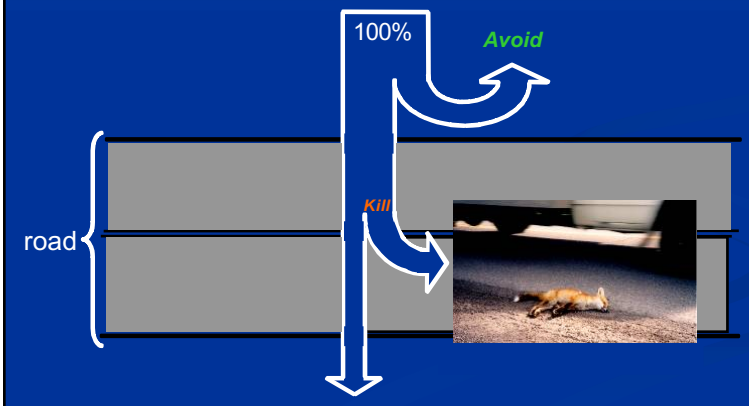
One of the fundamental goals of conservation biology is to preserve genetic diversity (Avise, 1996; Schonewald-Cox et al., 1983). Consequently, when evaluating the influence of roads and traffic on patterns of population genetic variation, genetic diversity is one of the parameters we are most interested in tracking. The impact of roads on population connectivity and abundance are of concern to conservation geneticists largely because they are thought

leading to lower effective population sizes. This heightens the power of genetic drift to erode genetic diversity within populations (Wright, 1931). Road avoidance thus results in a "barrier effect" that is expected to decrease diversity within populations while increasing divergence between populations.

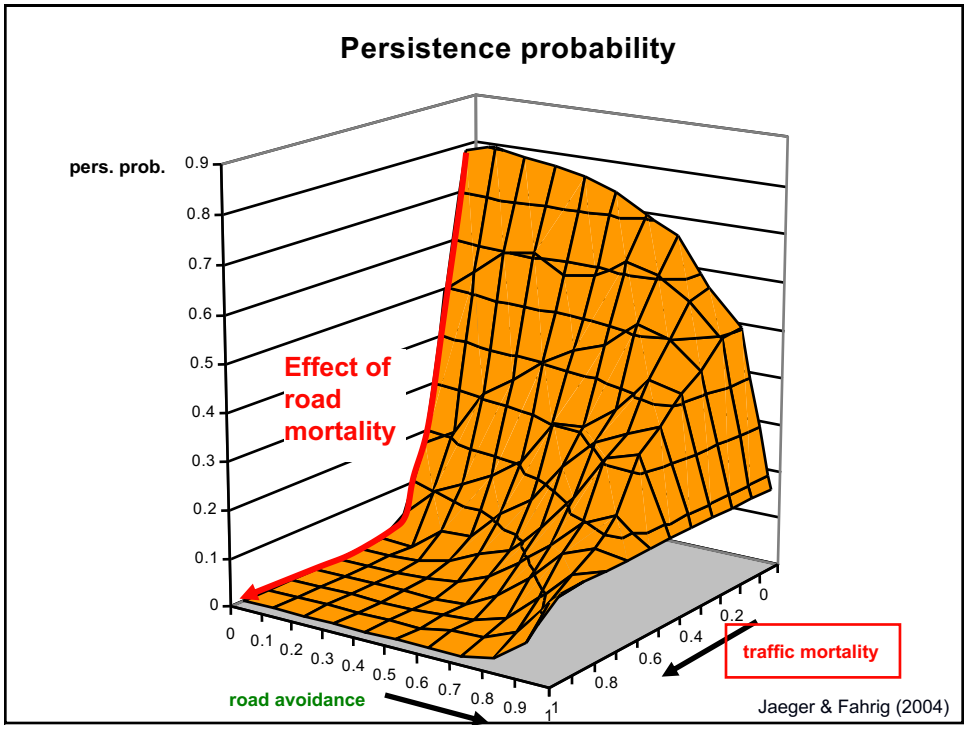
Mortality on roads due to collision of individuals with on-coming vehicles has been well-documented in many animal species (reviewed in Forman et al., 2003). Mortality can depress population abundance if sufficiently high relative to background mortality

What is more important for **population persistence**: Road mortality or the barrier effect alone (without mortality)?

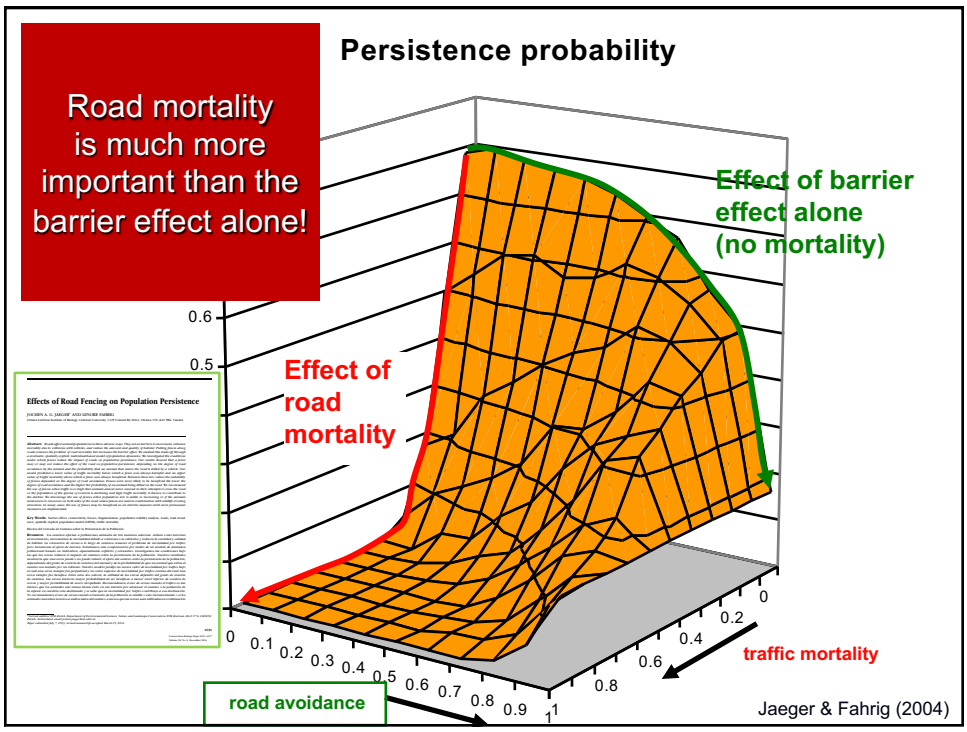
road avoidance = animals don't try to cross (*Avoid*)
traffic mortality = percent of animals killed on the road (*Kill*)

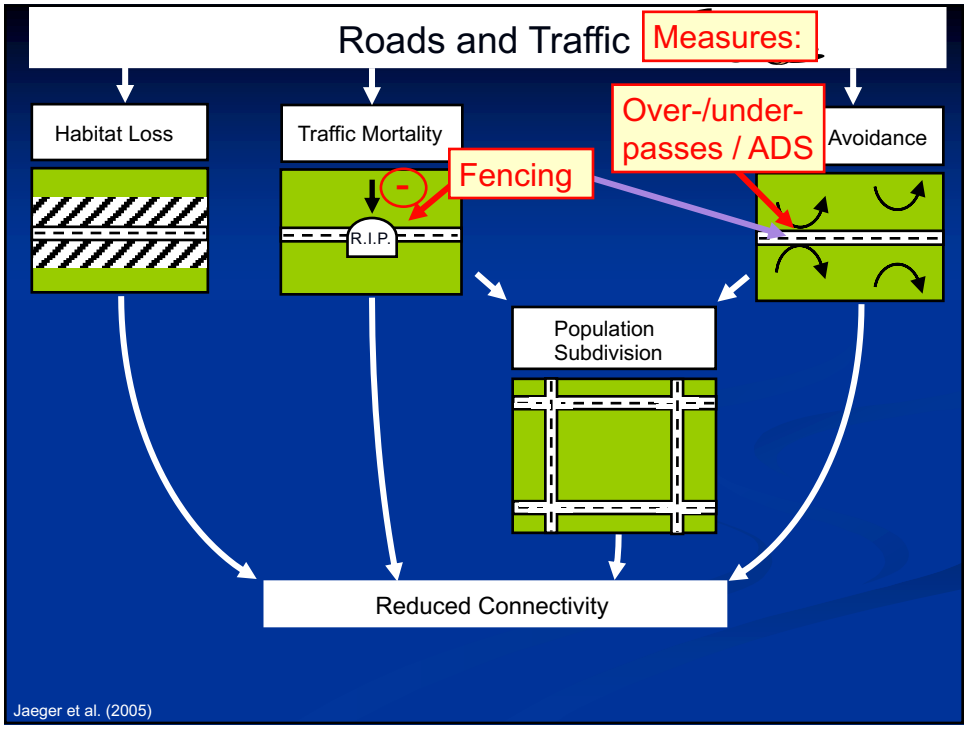


Jaeger & Fahrig (2004)

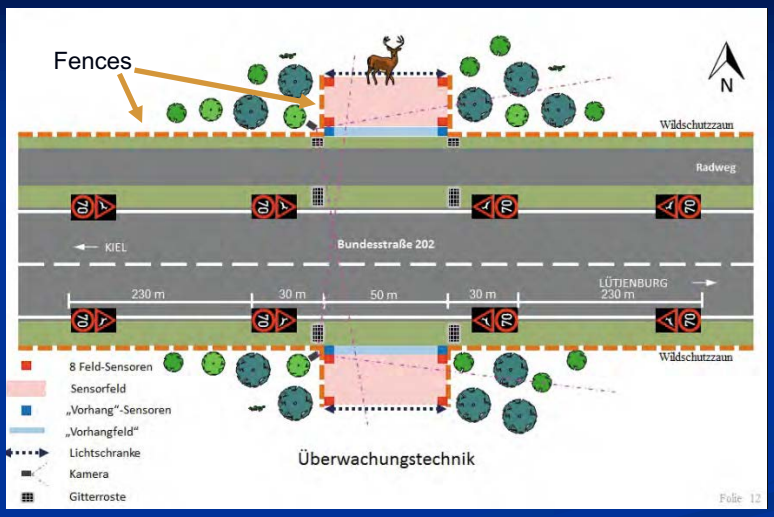


Jaeger & Fahrig (2004)


Road mortality is much more important than the barrier effect alone!
Persistence probability
Effect of barrier effect alone (no mortality)
Effect of road mortality
0.6
0.5
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
road avoidance
0
0.2
0.4
0.6
0.8
traffic mortality
Jaeger & Fahrig (2004)


Roads and Traffic
Measures:
Habitat Loss
Traffic Mortality
Avoidance
Over-/under-passes / ADS
Fencing
R.I.P.
Population Subdivision
Reduced Connectivity
Jaeger et al. (2005)

Animal Detection System (ADS)



Example from Schleswig-Holstein (Germany) along highway B 202

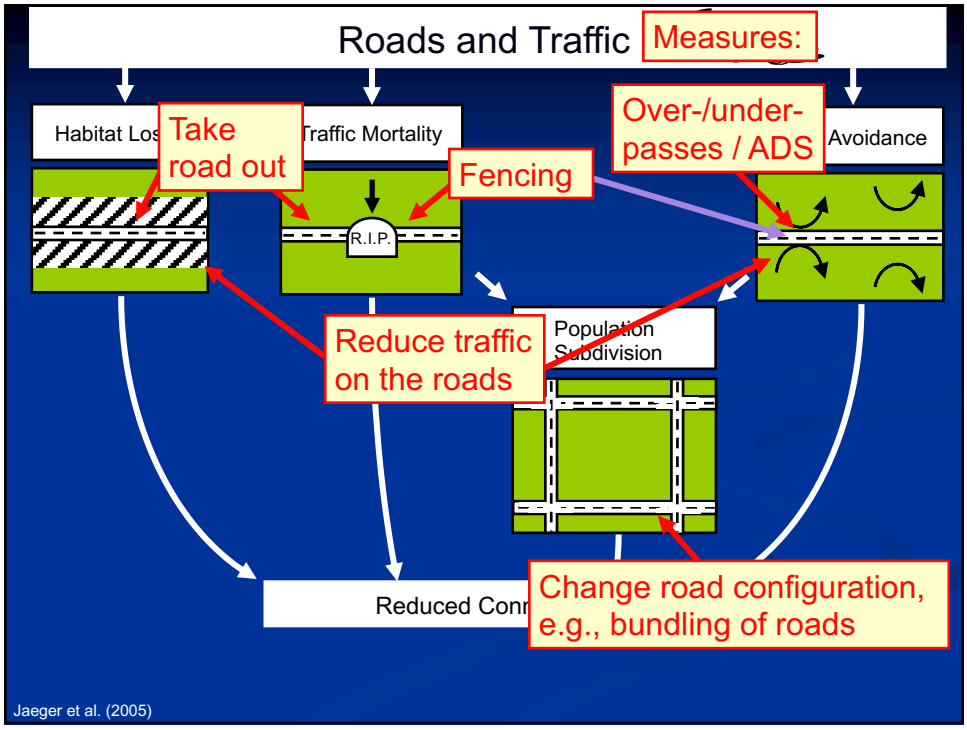
Trothe and Herzog (2014)

16

Photo: J. Jaeger

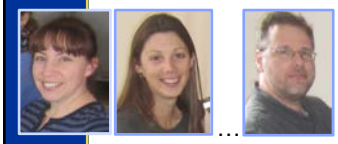
17


Photos: J. Jaeger
18


Roads and Traffic
Measures:
Habitat Los
Traffic Mortality
Avoidance
Take road out
Fencing
Over-/under-passes / ADS
R.I.P.
Reduce traffic on the roads
Population Subdivision
Reduced Conn
Change road configuration, e.g., bundling of roads
Jaeger et al. (2005)

How to reduce road mortality?

- Wildlife fencing is by far the most effective measure.
- Crossing structures alone do not reduce road mortality. Fences must be included.
- Reflectors and warning signs do not reduce road mortality.



PLOS ONE

Rytwinski et al. (2016)

RESEARCH ARTICLE

How Effective Is Road Mitigation at Reducing Road-Kill? A Meta-Analysis

Trina Rytwinski[1]*, Kylie Soanes[2¤], Jochen A. G. Jaeger[3], Lenore Fahrig[1], C. Scott Findlay[4], Jeff Houlahan[5], Rodney van der Ree[2], Edgar A van der Grift[6]

1 Geomatics and Landscape Ecology Research Laboratory, Department of Biology, Carleton University, Ontario, Canada, **2** Australian Research Centre for Urban Ecology, Royal Botanic Gardens Victoria, C/- School of BioSciences, University of Melbourne, 3010, Victoria, Australia, **3** Department of Geography, Planning and Environment, Concordia University Montreal, 1455 Montreal, Quebec, Canada, **4** Institute of the Environment & Ottawa-Carleton Institute of Biology, Ottawa, Ontario, Canada, **5** Department of Biology, University of New Brunswick at Saint John, Saint John, 550, New Brunswick, Canada, **6** Alterra, Wageningen University and Research Centre, Wageningen, The Netherlands

¤ Current address: Clean Air and Urban Landscapes Hub, National Environmental Science Programme, School of Ecosystem and Forest Science, University of Melbourne, Victoria, Australia
* trytwinski@hotmail.com

CrossMark
click for updates

Research in our lab (some examples)

Road Ecology

Urban Sprawl

Connectivity

Scale:
single roads
or single cities

regions

countries

Europe

planet

Research in our lab (some examples)

Road Ecology


Highway 175 Québec-Saguenay

K. Bélanger-Smith, J. Plante, J. Gaitan et al., Ariel Spanowicz + Fernanda Teixeira (subm.): Mortality reduction graphs

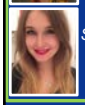
Highway A10 Montréal-Sherbrooke

Daniella LoScerbo (subm.)

Michelle Anderson (2018)

Kendra Warnock (in progress)

Benjamin Brunen (in progress)



Steffy Velosa (in progress)

Landscape fragmentation in Switzerland *Jaeger et al. (2007, 2008)*

Landscape fragmentation in Europe

Jaeger et al. (2011), Aurora Torres et al. (2016)

Connectivity

Ecological Corridor Algonquin-Adirondacks (A2A)

Laura Roch (2015)

Ecological Corridor Adirondacks-Laurentides

Jonathan Cole (in progress)

Urban Sprawl

Montréal + Québec 1951 - 2011

Nagmeh Nazarnia et al. (2016)

Connectivity in cities, in Montréal

Megan Deslauriers et al. (2018)

Canada 1971 - 2011

Mehrdokht Pourali (in progress)

Consideration of connectivity in EIA

Charla Patterson (in progress)

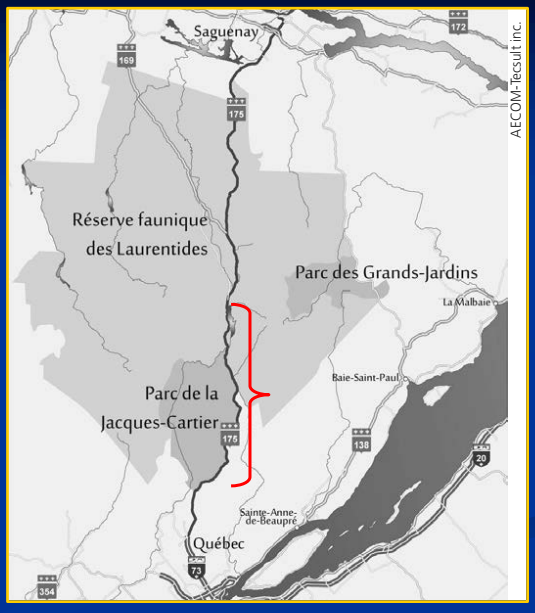
Consideration of road mortality in EIA

Mitra Pourali (2019)

Route 175

Wildlife passages and fences along route 175 between Quebec City and Saguenay: *How well do they work?*

Photo: J. Jaeger



Research on large fauna 2004-2011

Journal of Zoology

ZSL

Journal of Zoology. Print ISSN 0952-8369

Avoidance of roads by large herbivores and its relation to disturbance intensity

M. Leblond[1], C. Dussault[2] & J. -P. Ouellet[1]

1 Département de Biologie, Chimie & Géographie, Université du Québec à Rimouski, Rimouski, QC, Canada
2 Service de la faune terrestre et de l'avifaune, Ministère des Ressources naturelles et de la Faune du Québec, Québec, QC, Canada

Research Article

Moose Movement Rates Along Highways and Crossing Probability Models

CHRISTIAN DUSSAULT,[1] *Direction de la recherche sur la faune, Ministère des Ressources naturelles et de la Faune du Québec, 880 chemin Sainte-Foy, Québec, PQ G1S 4X4, Canada and Département de biologie, Université du Québec à Rimouski, 300 allée des Ursulines, Rimouski, PQ G5L 3A1, Canada*

JEAN-PIERRE OUELLET, *Département de biologie, Centre d'études nordiques, Université du Québec à Rimouski, 300 allée des Ursulines, Rimouski, PQ G5L 3A1, Canada*

CATHERINE LAURIAN, *Département de biologie, Centre d'études nordiques, Université du Québec à Rimouski, 300 allée des Ursulines, Rimouski, PQ G5L 3A1, Canada*

RÉHAUME COURTOIS, *Direction du développement de la faune, Ministère des Ressources naturelles et de la Faune du Québec, 880 chemin Sainte-Foy, Québec, PQ G1S 4X4, Canada*

MARIUS POULIN, *Direction générale de Québec et de l'est du Québec, Ministère des Transports du Québec, 5353 boulevard des Gradins, Québec, PQ G2K 1M1, Canada*

LAURIER BRETON, *Direction de la recherche sur la faune, Ministère des Ressources naturelles et de la Faune du Québec, 880 chemin Sainte-Foy, Québec, PQ G1S 4X4, Canada*

ABSTRACT We developed and validated a density-adjusted spatial model to predict moose (*Alces alces*) highway-crossing probability and to assess if the model could be used as an index of moose-vehicle collision risk. We installed Global Positioning System telemetry collars on 47 moose in the north of the Laurentides Wildlife Reserve, Québec, for 2–36 months. We recorded only 84 highway crossings in spring (1 crossing per 2-hr steps) and 122 crossings in summer (0.18% of 68,237 2-hr steps), despite a high sampling effort and having captured animals near highways. Moose movement rates during movement steps crossing a highway were on average 3 times higher than during the steps following highway crossing. Paths used by moose when crossing a highway were characterized by a high proportion of

Abstract

Avoidance of roads has been demonstrated for many animal species, but little is known about the relationship between anthropogenic disturbance levels and the degree of avoidance by animals. We investigated the hypothesis that the strength of road-avoidance behaviour increases with the intensity of the disturbance for a large, disturbance-sensitive herbivore: the forest-dwelling caribou *Rangifer tarandus caribou*. We assessed the behaviour of 53 global positioning system-collared caribou monitored during the gradual modification of a highway over a 7-year

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Grosman, P. D., J. A. G. Jaeger, P. M. Biron, C. Dussault, and J.-P. Ouellet. 2009. Reducing moose–vehicle collisions through salt pool removal and displacement: an agent-based modeling approach. *Ecology and Society* **14(2)**: 17. [online] URL: http://www.ecologyandsociety.org/vol14/iss2/art17/

E&S

Research, part of a Special Feature on Effects of Roads and Traffic on Wildlife Populations and Landscape Function

Reducing Moose–Vehicle Collisions through Salt Pool Removal and Displacement: an Agent-Based Modeling Approach

Paul D. Grosman[1], *Jochen A. G. Jaeger*[1], *Pascale M. Biron*[1], *Christian Dussault*[2], *and Jean-Pierre Ouellet*[1]

2002, more than 200 moose–vehicle collisions occurred each year in
he Laurentides Wildlife Reserve. One cause is the presence of roadside
ads in the spring and summer. Using the computer simulation technique
dy investigated whether salt pool removal and displacement, i.e., a
to 1500 m away from the road shoulder, would reduce the number of
oad crossings were used as a proxy measure. A GPS telemetry data set
00 locations of 47 moose over 2 yr in the Laurentides Wildlife Reserve
e model. Twelve moose were selected from this data set and programmed
in the study area. Five parameters with an additional application of
ine moose movement between forest polygons. These included food
on from predators and thermal stress; proximity to salt pools; proximity
nificant reduction in road crossings when either all or two thirds of the
ith and/or without salt pool displacement. With 100% salt pool removal,
thout compensatory salt pools than with them (18%). When two thirds
he reduction was the same with and without compensatory salt pools
ollisions are not a significant mortality factor for the moose population
e, in areas with higher road densities, hunting pressure, and/or predator
ce between a stable and a declining population, and salt pool removal
on plan to halt population declines. This model can be used, with
ory of salt pool locations and the addition of a road avoidance behavior,
ation measures intended to reduce moose–vehicle collisions

PROJETS ENTOURANT LA ROUTE 175

Impacts de clôtures métalliques et de passages fauniques sur la sécurité routière et le déplacement des orignaux le long de la route 175 au Québec

Mélanie Bouffard, Yves Leblanc, Yves Bédard et Donald Martel

Résumé

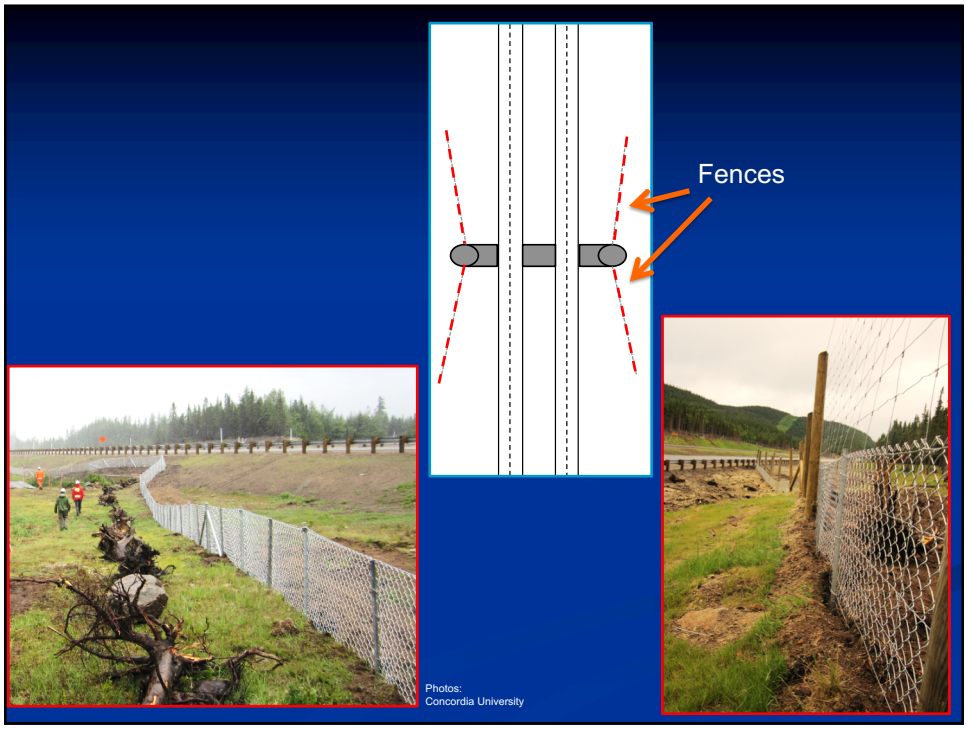
Les collisions de véhicules avec les orignaux, un phénomène qui représente une préoccupation majeure pour la sécurité routière, sont en augmentation depuis plusieurs années au Québec. Par exemple, plus de 50 collisions ont été répertoriées annuellement sur la route 175, un tronçon routier en réfection qui traverse la réserve faunique des Laurentides et qui est récemment passé de 2 à 4 voies. À échéance, 67 km de cette route auront été clôturés pour réduire les collisions impliquant l'orignal. Nos travaux visaient à documenter les impacts des clôtures métalliques hautes (2,4 m) et des structures connexes

4 types of passages for medium-sized and small fauna

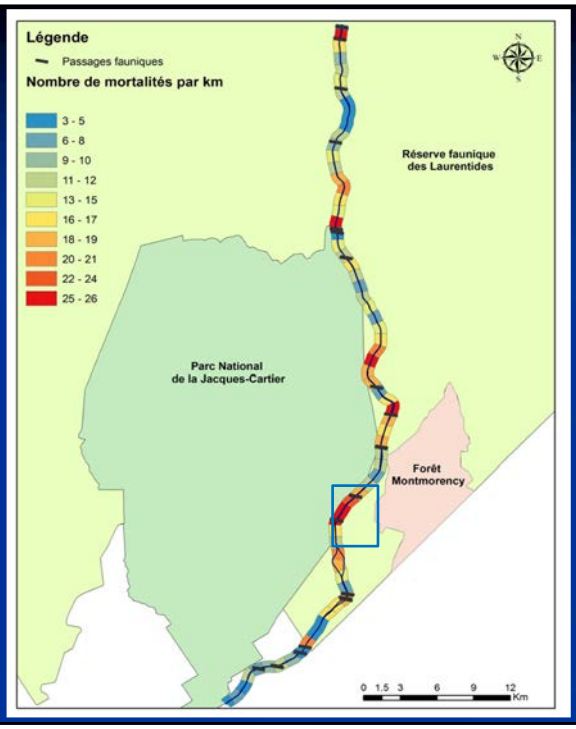
Photos: Concordia University

Figure 2. Quatre types de passages fauniques conçus pour les mammifères de petite et de moyenne taille le long de la route 175 : (a) ponceau sec (PS) ou tuyau circulaire (n = 6); (b) ponceau avec tablette de bois installée en porte-à-faux (PTBois) (n = 4); (c) ponceau avec pied sec de type tablette de béton (PTBét) (n = 7); (d) ponceau avec banquette de béton (PBBét) (n = 1).

Research project: 3 MSc students and 1 research associate


Fences
Photos:
Concordia University


(1) Road mortality
(2) Cameras: passage use
Photos:
Concordia University
MSc theses of Katrina Bélanger-Smith and Judith Plante
MSc theses of K. Bélanger-Smith and A. Martinig



Documented road mortality along HWY 175

4 summers of surveys (June - September 2012-2015)

Mortality surveys:
Katrina Béanger-Smith and Judith Plante

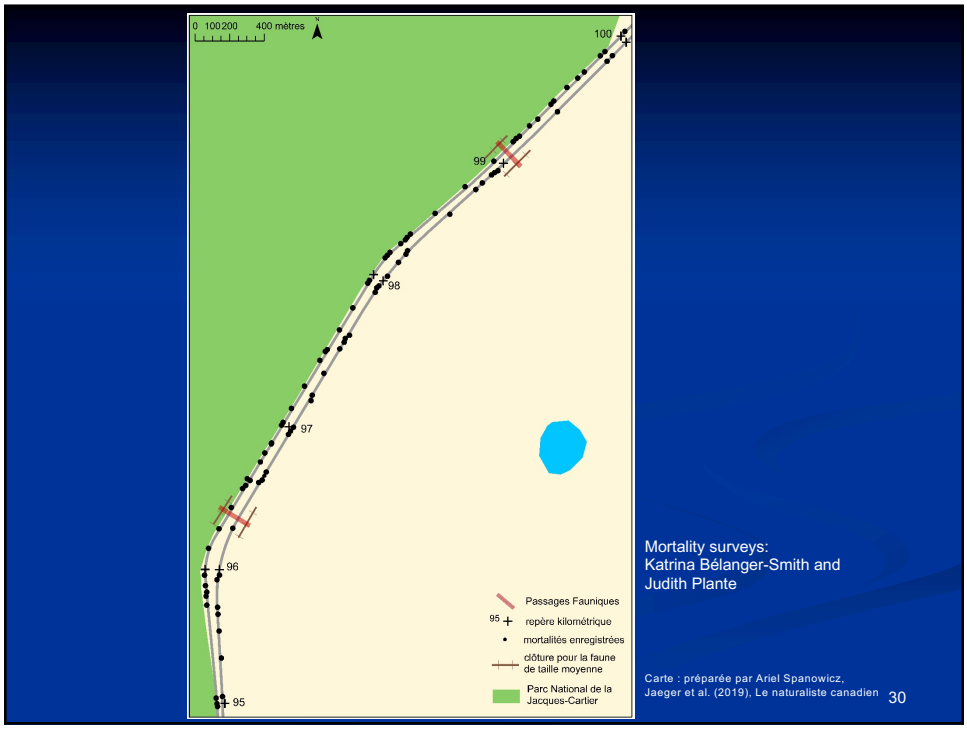
Carte : préparée par Judith Plante, Plante et al. (2019)

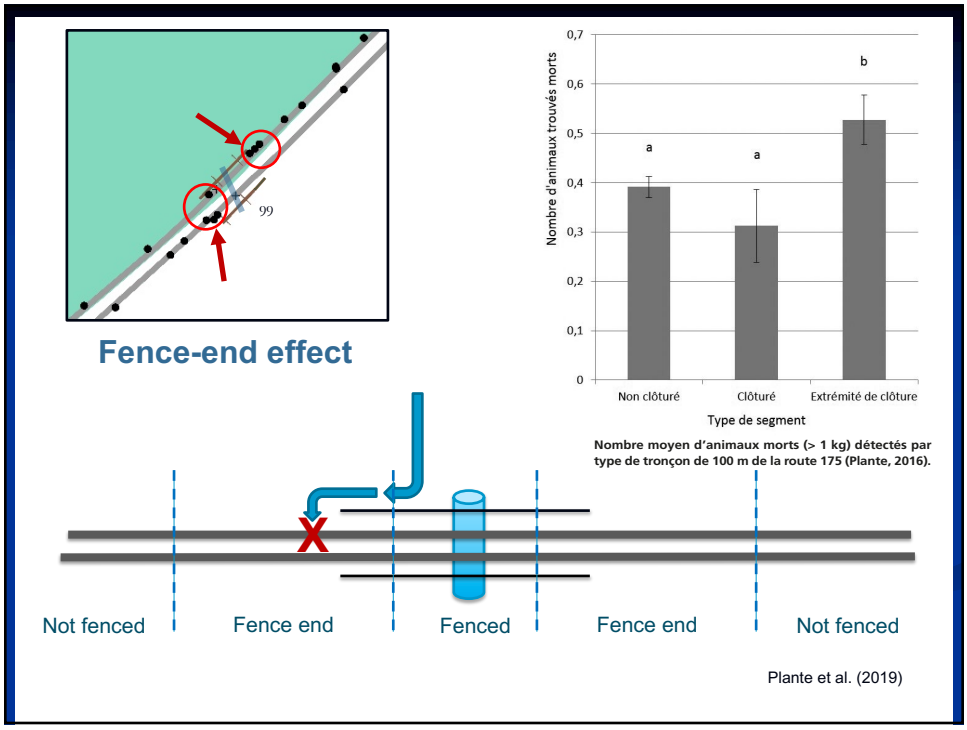
Tableau 1. Nombre total d'animaux morts détectés sur la route 175 pendant les mois d'été de 2012 à 2015, par espèce et par année – suivi de la mortalité routière animale par Bélanger-Smith (2015) et Plante (2016).

	2012	2013	2014	2015	Total
Nombre de relevés	90	81	72	63	306
Espèce :					
Porc-épic d'Amérique (*Erethizon dorsatum*)	94	112	81	87	374
Petit mammifère non identifié	40	15	27	20	102
Mammifère non identifié	18	23	16	10	67
Renard roux (*Vulpes vulpes*)	19	15	12	6	52
Marmotte commune (*Marmota monax*)	8	9	19	11	47
Souris (espèce indéterminée)	40	3	2	1	46
Moufette rayée (*Mephitis mephitis*)	14	18	4	6	42
Lièvre d'Amérique (*Lepus americanus*)	16	10	9	6	41
Campagnols et campagnols-lemmings (*Arvicolinae*)	27	1	2	3	33
Musaraigne (*Sorex* sp.)	19	3	6	3	31
Écureuil roux d'Amérique (*Tamiasciurus hudsonicus*)	9	3	2	5	19
Raton laveur (*Procyon lotor*)	9	1	2	0	12
Souris sauteuse (*Zapus hudsonius*/*Napaeozapus insignis*)	5	2	0	2	9
Castor du Canada (*Castor canadensis*)	1	5	0	2	8
Belette ou hermine (*Mustela* sp.)	1	2	0	0	3
Lynx du Canada (*Lynx canadensis*)	0	0	1	1	2
Grand polatouche (*Glaucomys sabrinus*)	2	0	0	0	2
Martre d'Amérique (*Martes americana*)	0	0	0	1	1
Vison d'Amérique (*Neovison vison*)	1	0	0	0	1
Condylure étoilé (*Condylura cristata*)	0	0	0	1	1
Loup gris (*Canis lupus*)	0	0	0	0	0
Loutre de rivière (*Lontra canadensis*)	0	0	0	0	0
Pékan (*Martes pennanti*)	0	0	0	0	0
Rat musqué commun (*Ondatra zibethicus*)	0	0	0	0	0
Total	**323**	**222**	**183**	**165**	**893**

Jaeger et al. (2019)

29


0 100 200 400 mètres
100
99
98
97
96
95
Passages Fauniques
repère kilométrique
mortalités enregistrées
clôture pour la faune de taille moyenne
Parc National de la Jacques-Cartier
Mortality surveys:
Katrina Bélanger-Smith and Judith Plante
Carte : préparée par Ariel Spanowicz,
Jaeger et al. (2019), Le naturaliste canadien
30


99
Fence-end effect
Nombre d'animaux trouvés morts
0,7
0,6
0,5
0,4
0,3
0,2
0,1
0
a
a
b
Non clôturé
Clôturé
Extrémité de clôture
Type de segment
Nombre moyen d'animaux morts (> 1 kg) détectés par type de tronçon de 100 m de la route 175 (Plante, 2016).
Not fenced
Fence end
Fenced
Fence end
Not fenced
Plante et al. (2019)

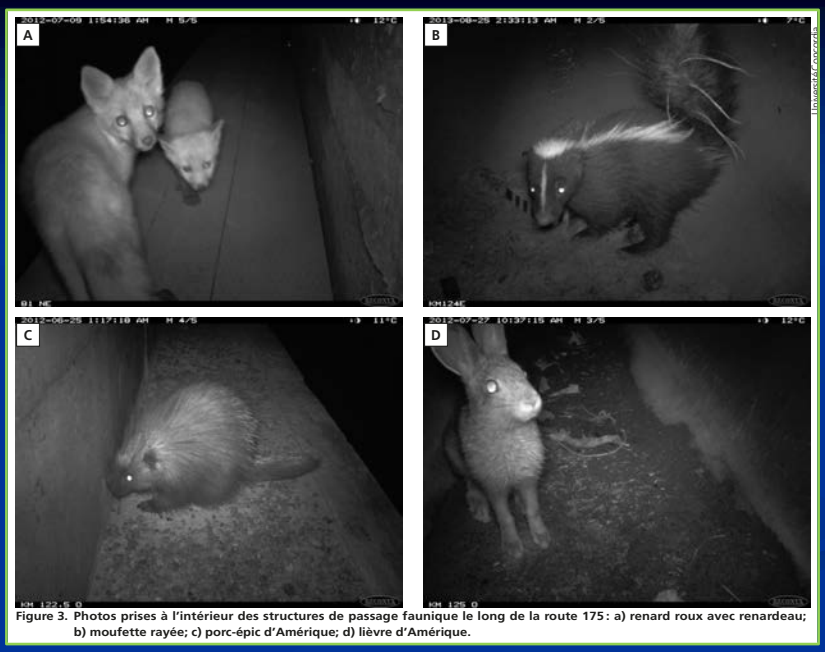


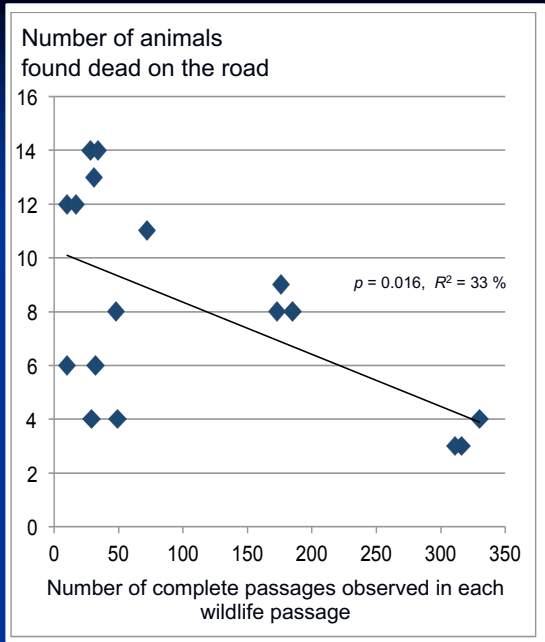
Figure 3. Photos prises à l'intérieur des structures de passage faunique le long de la route 175 : a) renard roux avec renardeau; b) moufette rayée; c) porc-épic d'Amérique; d) lièvre d'Amérique.

32

A strong negative relationship!

between the frequency of use of the wildlife passages and road mortality at the fence ends and within the fenced sections

for all mammal spcies combined (small and medium-sized)



Jaeger et al. (2019)

Photo d'une martre d'Amérique utilisant un ponceau de drainage ordinaire le long de la route 381 (à deux voies). Le collier émetteur est visible sur le cou de l'animal.

Jaeger et al. (2019)

Perhaps all we need is fencing?

34

8 News Bulletins about our research along HWY 175 in Quebec

- Available on website: http://gpe.concordia.ca/ -> Jaeger -> Publications

SUIVI DE L'UTILISATION ET DE L'EFFICACITÉ DES PASSAGES À FAUNE LE LONG DE LA ROUTE 175 POUR LES PETITS ET MOYENS MAMMIFÈRES
Projet R709.1

Rapport Final

Jochen A.G. Jaeger[1], Katrina Bélanger-Smith[2], Jorge Gaitan[1], Judith Plante[1], Jeff Bowman[3], Anthony P. Clevenger[4]

[1]Université Concordia, Département de géographie, urbanisme et environnement
[2]Université Concordia, Département de biologie
[3]Ontario Ministry of Natural Resources and Forestry & Université Trent
[4]Université d'État du Montana, Western Transportation Institute (WTI-MSU)

Comité directeur:
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[5]Ministère des Transports, de la Mobilité durable et de l'Électrification des transports du Québec
[6]Ministère des Forêts, de la Faune et des Parcs du Québec
[7]Université Laval, Centre d'étude de la forêt
[8]AECOM Consultants Inc., Directeur de projet, Études environnementales

Réalisé pour le compte du ministère des Transports, de la Mobilité durable et de l'Électrification des transports du Québec
Chargé de projet: M. Lafrance

Octobre 2017

Journal of Environmental Management

Research article

How do landscape context and fences influence roadkill locations of small and medium-sized mammals?

Judith Plante[a], Jochen A.G. Jaeger[a,b,*], André Desrochers[c]

ROUTES ET PETITE ET MOYENNE FAUNE

Clôtures et passages fauniques pour les petits et moyens mammifères le long de la route 175 au Québec: quelle est leur efficacité ?

Jochen A.G. Jaeger, Ariel G. Spanowicz, Jeff Bowman et Anthony P. Clevenger

Journal of Applied Ecology

Factors influencing the discovery and use of wildlife passages for small fauna

April Robin Martinig* and Katrina Bélanger-Smith

Data in Brief

Road mortality locations of small and medium-sized mammals along a partly-fenced highway in Quebec, Canada, 2012–2015

Judith Plante[a], Katrina Bélanger-Smith[b], Ariel G. Spanowicz[a], Anthony P. Clevenger[c], Jochen A.G. Jaeger[a,d,e]

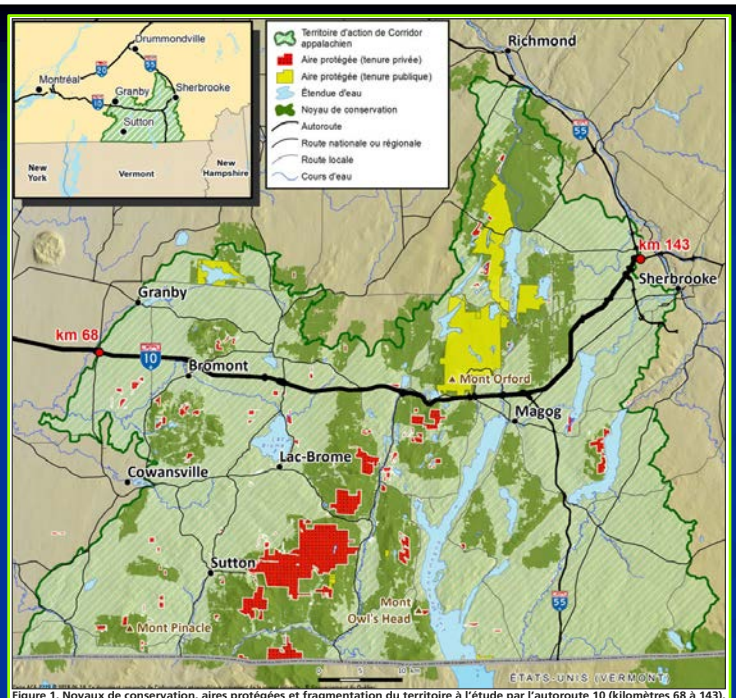


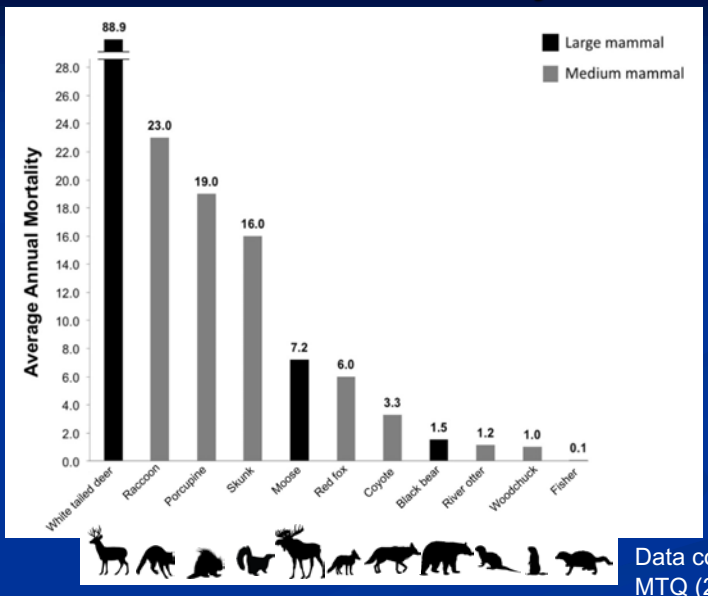
Figure 1. Noyaux de conservation, aires protégées et fragmentation du territoire à l'étude par l'autoroute 10 (kilomètres 68 à 143).

A 10
(Estrie &
Montérégie Est)

Daguet et Lelièvre (2019), Appalachian Corridor

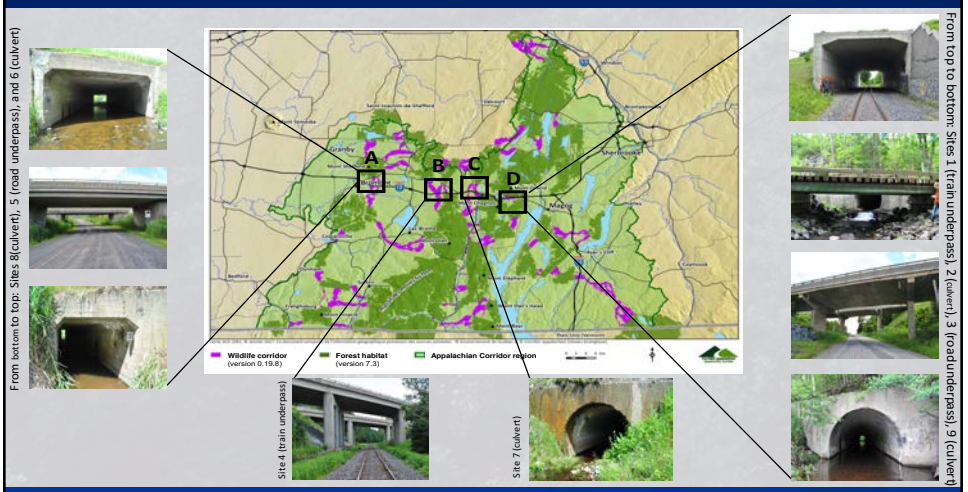
38

Road mortality



Data collected by MTQ (2005-2016).

39



LoScerbo et al. (subm.)

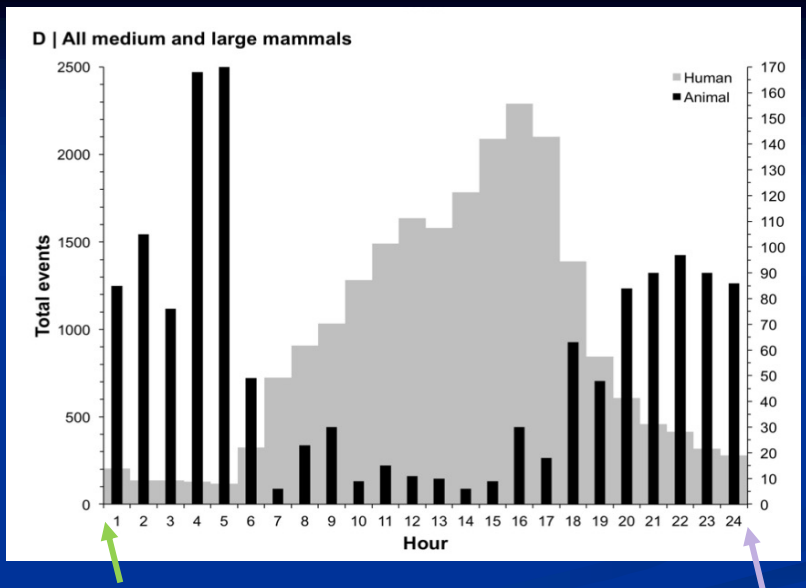
LoScerbo et al. (subm.)

TABLE 3. Total numbers of individuals detected at each existing underpass for each species of medium and large mammals (confirmed events + unknowns). A confirmed event is an instance where an animal was detected at the structure and either crossed through the structure (full crossing) or avoided the structure (aversion); the number of events for which an animal was detected at a structure, but the outcome is not known (unknowns) is given after the + sign. The number in brackets represents the percentage of full crossings per confirmed events by mammals. Daily human activity is the average calculated from the total days observed at each site and includes trains, automobiles and other road vehicles, ATVs (including snowmobiles), pedestrians, cyclists, equestrian riders, as well as the research crew while visiting sites for maintenance

	Species	Total number of medium and large mammals detected at existing underpasses								
		Train underpass		Road underpass		Culvert				
		1	4	3	5	2	6	7	8	9
AU	*Odocoileus virginianus* (White-tailed deer)	54 (78%) + 4	85 (92%) + 6	1 (0%) + 0	14 (79%) + 12	39 (0%) + 0	78 (12%) + 5	1 (0%) + 0	17 (0%) + 2	2 (0%) + 0
AHMF	*Canis latrans* (Coyote)	2 (100%) + 0	1 (100%) + 0	-	4 (100%) + 0	-	-	-	-	-
AHMF	*Lynx rufus* (Bobcat)	2 (100%) + 0	20 (100%) + 0	-	1 (100%) + 0	-	-	-	-	-
AHMF	*Ursus americanus* (Black bear)	-	-	-	-	1 (100%) + 0	-	-	-	-
MMMF	*Marmota sp.* (Woodchuck)	4 (100%) + 0	5 (100%) + 0	-	-	1 (100%) + 0	-	-	-	-
MMMF	*Neovison vison* (Mink)	-	-	-	-	26 (4%)** + 1	-	2 (100%) + 0	0 (0%) + 1	-
MMMF	*Pekania pennanti* (Fisher)	1* (0%) + 0	-	-	-	-	-	-	-	-
MMMF	*Procyon lotor* (Raccoon)	5 (100%) + 0	21 (95%) + 0	-	553 (99.8%) + 33	41 (100%) + 0	196 (90%) + 56	10 (100%) + 0	4 (100%) + 0	18 (0%) + 6
MMMF	*Vulpes vulpes* (Red fox)	31 (97%) + 1	2 (100%) + 0	-	2 (100%) + 0	-	-	3 (100%) + 0	-	1 (0%) + 0
MMMF	*Ondatra zibethicus* (Muskrat)	-	-	-	-	-	-	1 (100%) + 0	-	-
	Unknown medium sized mammal	1 (100%) + 0	-	-	-	1 (0%) + 0	-	-	-	-
	All mammals	**100 (87%) + 5**	**134 (94%) + 6**	**1 (0%) + 0**	**574 (99%) + 45**	**109 (40%) + 1**	**274 (68%) + 61**	**17 (94%) + 0**	**21 (19%) + 3**	**21 (0%) + 6**
	Daily human activity	5.1	3.4	196.1	29.2	0.1	1.5	0.3	2.3	0.2
	Total days observed	223	216	101†	216	315	308	46§	46§	39§

* The fisher observed at site 1 was visually observed at the site, less than 10 m from the underpass.

LoScerbo et al. (subm.)



Total hourly human (grey bars, left axis) and mammal activity (black bars, right axis), pooled for all sites (*n* = 9).

LoScerbo et al. (subm.)

43

Can passages be shared by humans and wildlife? How human use of existing underpasses affects the tendency of mammals to cross beneath a high-traffic highway

Running title: Can passages by shared?

Daniella LoScerbo,[1] Caroline Daguet,[2] Jochen A.G. Jaeger[3,4,*]

https://doi.org/10.22621/cfn.vxxxix.xxxx

Article

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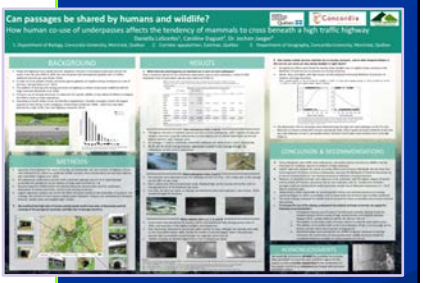
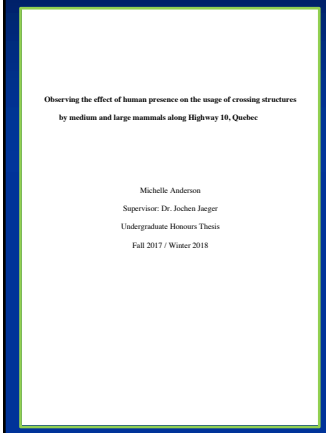
* Corresponding author: Dr. Jochen A.G. Jaeger: Concordia University Montreal, Department of Geography, Planning and Environment, 1455 de Maisonneuve Blvd. West, Suite H1255, Montréal, QC, H3G 1M8, Canada, jochen.jaeger@concordia.ca, phone: +1 (514) 848 2424 ext. 5481

LoScerbo et al., manuscript submitted to *Canadian Field Naturalist*



44

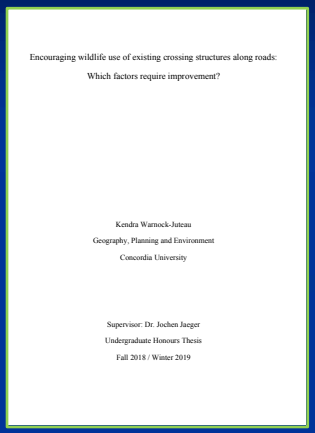
Related papers:



Observing the effect of human presence on the usage of crossing structures by medium and large mammals along Highway 10, Quebec

Michelle Anderson
Supervisor: Dr. Jochen Jaeger
Undergraduate Honours Thesis
Fall 2017 / Winter 2018

Honours thesis by Michelle Anderson (June 2018)

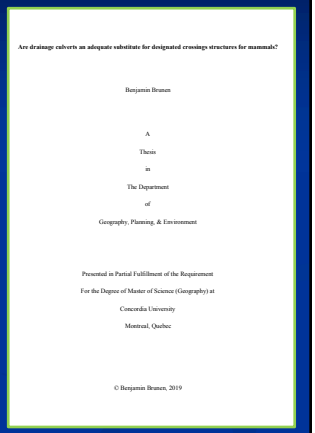


Encouraging wildlife use of existing crossing structures along roads:
Which factors require improvement?

Kendra Warnock-Juteau
Geography, Planning and Environment
Concordia University

Supervisor: Dr. Jochen Jaeger
Undergraduate Honours Thesis
Fall 2018 / Winter 2019

Honours thesis by Kendra Warnock (May 2019)



Are drainage culverts an adequate substitute for designated crossings structures for mammals?

Benjamin Brunen

A
Thesis
in
The Department
of
Geography, Planning, & Environment

Presented in Partial Fulfillment of the Requirement
For the Degree of Master of Science (Geography) at
Concordia University
Montreal, Quebec

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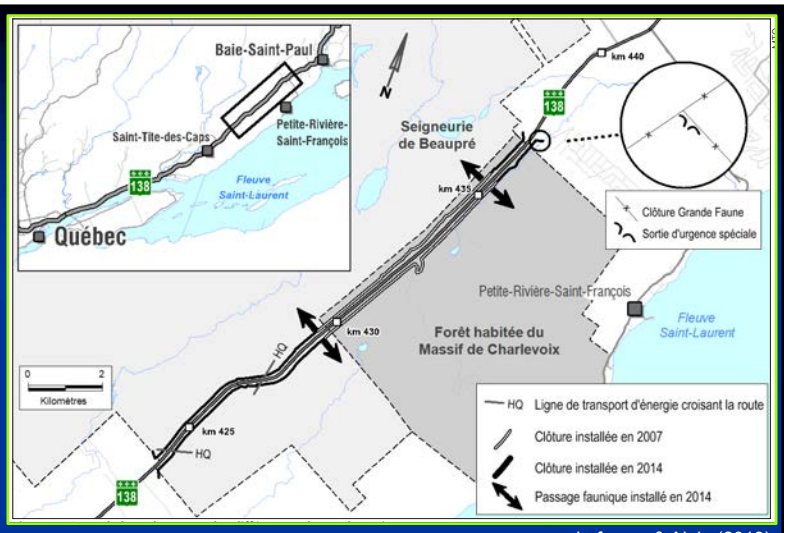
MSc thesis by Benjamin Brunen (May 2019)

45


Rytwinski et al. (2015)
Box 1
Seven key questions road planners commonly have about crossing structures and fencing.
Questions road planners have about mitigation structures:
Question 1
Does a given crossing structure work? What type and size (width, height and length) of crossing structures should we use?
Question 2
How many crossing structures should we build?
Question 3
Is it more effective to install a small number of large-sized crossing structures or a large number of small-sized crossing structures?
Question 4
How much barrier fencing is needed for a given length of road?
Question 5
Do we need funnel fencing to lead animals to crossing structures, and how long does such fencing have to be?
Question 6
How should we manage/manipulate the environment in the area around the crossing structures and fencing?
Question 7
Where should we place crossing structures and barrier fencing?


Predicting when animal populations are at risk from roads: an interactive model of road avoidance behavior
Evaluating the effectiveness of road mitigation measures
Assessing large-scale wildlife responses to human infrastructure development
The Rauischholzhausen Agenda for Road Ecology

Route 138



Lafrance & Alain (2019)

Fences installed in 2007 (phase 1) for moose: 6.3 km

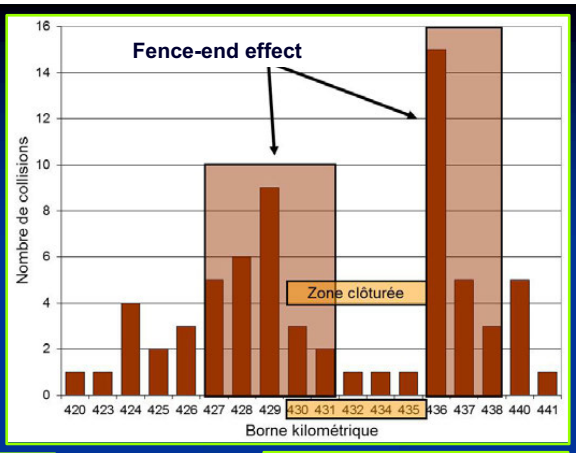
Fence-end effect: new hotspots at the fence ends

Extension of the fence, modification of fence ends, 2 large underpasses.

48

Route 138

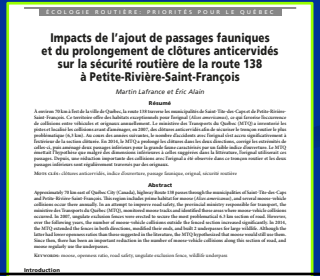
Moose-vehicle collisions



Lafrance & Alain (2019)

Large underpass at km 436

Lafrance & Alain (2019)



ÉCOLOGIE ROUTIÈRE : PRIORITÉS POUR LE QUÉBEC

Impacts de l'ajout de passages fauniques et du prolongement de clôtures anticervidés sur la sécurité routière de la route 138 à Petite-Rivière-Saint-François

Martin Lafrance et Éric Alain

Résumé

Abstract

Introduction

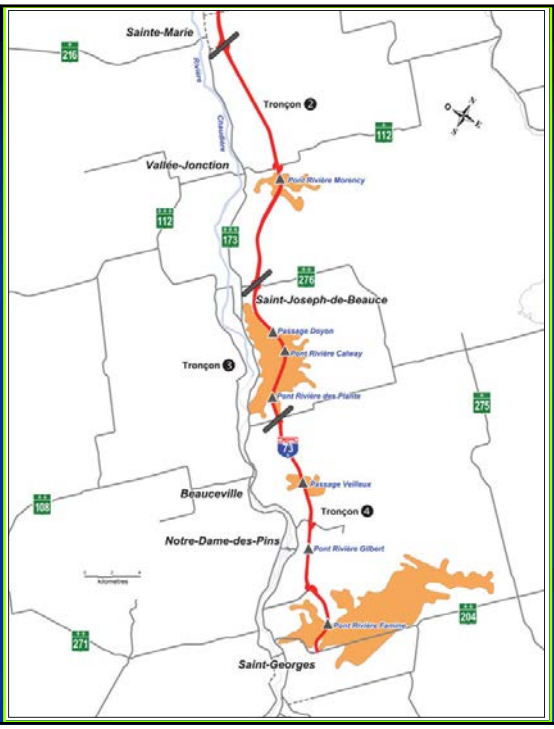
A 73

Road construction, 50 km long

Wintering habitat used by white-tailed deer (*orange*)

High fences, jump-outs, wildlife crossings (*triangles*) (2004-2016)

Vallée et al. (2019)



A 73

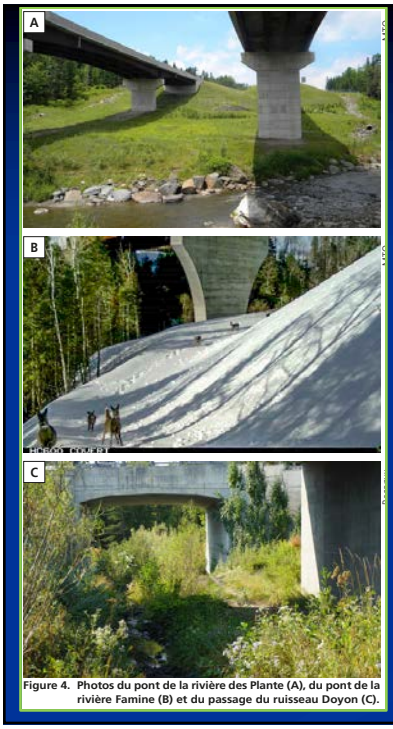


Figure 4. Photos du pont de la rivière des Plante (A), du pont de la rivière Famine (B) et du passage du ruisseau Doyon (C).

Vallée et al. (2019)

LES ROUTES ET LA GRANDE FAUNE

Conception et construction des aménagements relatifs aux cerfs de Virginie le long de l'autoroute Robert-Cliche (A-73) au Québec

Pierre-Michel Vallée, Jacques Bélanger et Jacques Fortin

Résumé

Des mesures d'atténuation des impacts et d'intégration à l'habitat hivernal du cerf de Virginie (*Odocoileus virginianus*) ont été appliquées à un projet autoroutier de plus de 50 km dans la région de la Chaudière-Appalaches, au Québec. Des clôtures hautes, des rampes de fuite ou sauteurs, des passages fauniques et d'autres mesures ont été conçus et construits en plusieurs séquences sur une période de 12 ans, soit de 2004 à 2016. Outre la description des aménagements et des enjeux propres à chacun, l'article expose différents problèmes rencontrés ainsi que l'évolution qu'ils ont induite dans la conception et la mise en place des aménagements. Des suggestions sont énoncées à l'intention des concepteurs de projets routiers incluant de telles mesures. Elles soulignent notamment l'importance de déterminer leur emplacement sur la base d'observations faites sur le terrain, avant et pendant la réalisation des travaux, et celle d'émettre des directives précises dans les documents contractuels et lors de la surveillance de chantier, afin de favoriser le maintien de la végétation aux abords des aménagements.

Mots clés: aire d'hivernage, clôture à cervidés, passage faunique, rampe de fuite, route

Abstract

During the construction of a 50 km-long section of highway in the Chaudière-Appalaches region of Québec (Canada), measures were taken to minimize the impact of the project on, and to facilitate its integration within, wintering habitat used by white-tailed deer. High fences and jump-outs, as well as safe wildlife crossings and other mitigation measures were designed and constructed, in several stages, over the 12-year period from 2004 to 2016. This article provides a description of the different systems used and the inherent challenges of each. Emphasis is placed on the various problems encountered and the alterations that were made with regards to their design and installation to overcome those. Suggestions are proposed for the designers of infrastructure projects seeking to implement similar measures, including the importance of determining the best location based on field observations made before and during the construction phase, and of issuing clear directives in all contracts and site surveillance documents, to ensure the protection of surrounding vegetation cover.

Keywords: deer fences, highway, jump-out, wildlife crossings, wintering area

Introduction

Les aires de confinement hivernal du cerf de Virginie (*Odocoileus virginianus*), ou ravages, sont des habitats essentiels qui doivent être protégés au sens du Règlement sur les habitats fauniques[1]. Lorsqu'il est inévitable d'y construire une infrastructure routière, différentes mesures de gestion peuvent être appliquées à la fois pour atténuer les effets sur les cerfs et leur habitat et pour réduire les risques d'accidents impliquant ces animaux.

Le propos de cet article est de partager l'expérience acquise par les auteurs depuis près de 20 ans, au fil de la conception, de la construction et du suivi de 4 tronçons d'une même autoroute aménagés au milieu de plusieurs habitats d'hiver du cerf de Virginie.

Contextes géographique et historique

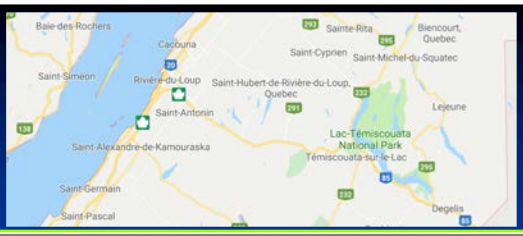
L'autoroute Robert-Cliche (A-73) prend son origine immédiatement au sud de la ville de Québec, sur le territoire de la ville de Lévis, dans la région administrative de la Chaudière-Appalaches. À partir du croisement de l'autoroute Transcanadienne (A-20/Jean-Lesage), en direction de la frontière avec l'État du Maine au sud-est, elle permet de relier les principales villes de la région de la Beauce, soit : Sainte-Marie, Beauceville et, depuis 2016, Saint-Georges. Il est important de noter que l'A-73 et ses aménagements s'insèrent dans un milieu agroforestier de tenure privée.

L'autoroute à 2 chaussées de 2 voies chacune sur 88 km de longueur a été construite par le ministère des Transports (ci-après le Ministère), en plusieurs étapes depuis les années 1970. C'est particulièrement aux prolongements 3 et 4 (construits de 2004 à 2007 et de 2010 à 2016, respectivement) au sud de Saint-Joseph-de-Beauce, ainsi qu'au récent doublement

1. Le Règlement sur les habitats fauniques (chapitre C-61.1, r. 18) découle des articles 128.1, 128.6 et 128.18 de la Loi sur la conservation et la mise en valeur de la faune (chapitre C-61.1).

Pierre-Michel Vallée et Jacques Fortin sont respectivement biologiste et technicien de la faune à la Direction générale de la Chaudière-Appalaches du ministère des Transports (MTQ).
pierre-michel.vallee@transports.gouv.qc.ca
Jacques Bélanger est biologiste, retraité du MTQ.

Autoroute 85

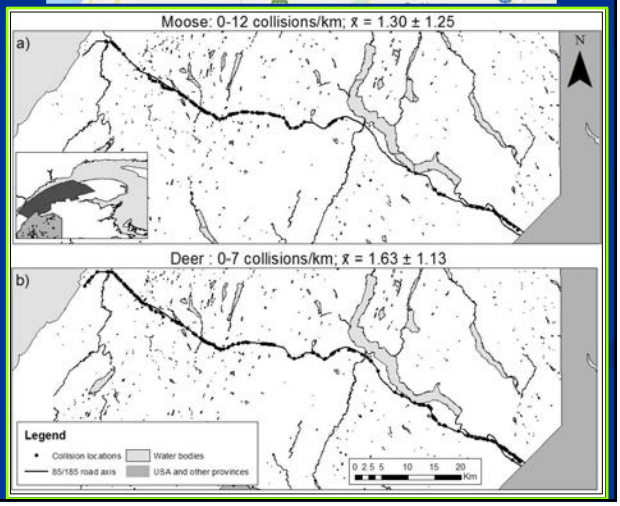


Locations of collisions with moose

and

white-tailed deer

(1990-2015)



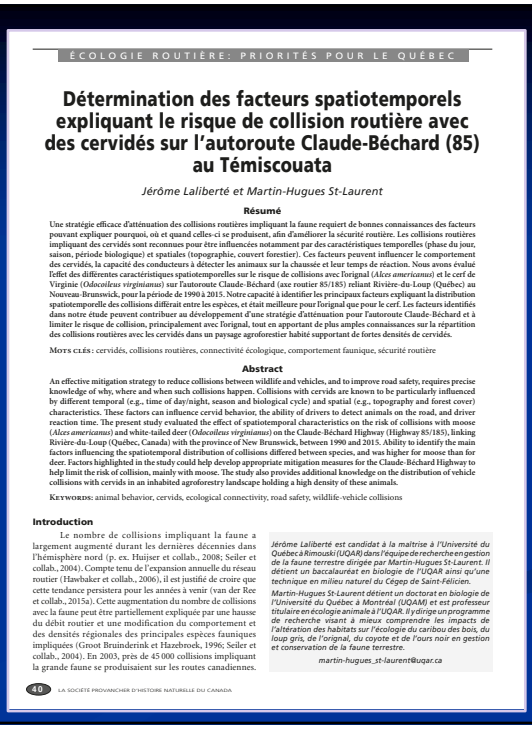
Laliberte & St-Laurent (2019)

Autoroute 85

Risk of collisions with moose and white-tailed deer (1990-2015),
as affected by:
- Sinuosity
- Rain
- Distance to habitat patch
- Elevation
- Slope
- Forest cover
- Wetlands
- Distance to salt pool

etc.

Laliberte & St-Laurent (2019)



ÉCOLOGIE ROUTIÈRE: PRIORITÉS POUR LE QUÉBEC

Détermination des facteurs spatiotemporels expliquant le risque de collision routière avec des cervidés sur l'autoroute Claude-Béchard (85) au Témiscouata

Jérôme Laliberté et Martin-Hugues St-Laurent

Résumé

Une stratégie efficace d'atténuation des collisions routières impliquant la faune requiert de bonnes connaissances des facteurs pouvant expliquer pourquoi, où et quand celles-ci se produisent, afin d'améliorer la sécurité routière. Les collisions routières impliquant des cervidés sont reconnues pour être influencées notamment par des caractéristiques temporelles (phase du jour, saison, période biologique) et spatiales (topographie, couvert forestier). Ces facteurs peuvent influencer le comportement des cervidés, la capacité des conducteurs à détecter les animaux sur la chaussée et leur temps de réaction. Nous avons évalué l'effet des différentes caractéristiques spatiotemporelles sur le risque de collisions avec l'orignal (*Alces americanus*) et le cerf de Virginie (*Odocoileus virginianus*) sur l'autoroute Claude-Béchard (axe routier 85/185) reliant Rivière-du-Loup (Québec) au Nouveau-Brunswick, pour la période de 1990 à 2015. Notre capacité à identifier les principaux facteurs expliquant la distribution spatiotemporelle des collisions différait entre les espèces, et était meilleure pour l'orignal que pour le cerf. Les facteurs identifiés dans notre étude peuvent contribuer au développement d'une stratégie d'atténuation pour l'autoroute Claude-Béchard et à limiter le risque de collision, principalement avec l'orignal, tout en apportant de plus amples connaissances sur la répartition des collisions routières avec les cervidés dans un paysage agroforestier habité supportant de fortes densités de cervidés.

Mots clés : cervidés, collisions routières, connectivité écologique, comportement faunique, sécurité routière

Abstract

An effective mitigation strategy to reduce collisions between wildlife and vehicles, and to improve road safety, requires precise knowledge of why, where and when such collisions happen. Collisions with cervids are known to be particularly influenced by different temporal (e.g., time of day/night, season and biological cycle) and spatial (e.g., topography and forest cover) characteristics. These factors can influence cervid behavior, the ability of drivers to detect animals on the road, and driver reaction time. The present study evaluated the effect of spatiotemporal characteristics on the risk of collisions with moose (*Alces americanus*) and white-tailed deer (*Odocoileus virginianus*) on the Claude-Béchard Highway (Highway 85/185), linking Rivière-du-Loup (Quebec, Canada) with the province of New Brunswick, between 1990 and 2015. Ability to identify the main factors influencing the spatiotemporal distribution of collisions differed between species, and was higher for moose than for deer. Factors highlighted in the study could help develop appropriate mitigation measures for the Claude-Béchard Highway to help limit the risk of collision, mainly with moose. The study also provides additional knowledge on the distribution of vehicle collisions with cervids in an inhabited agroforestry landscape holding a high density of these animals.

Keywords: animal behavior, cervids, ecological connectivity, road safety, wildlife-vehicle collisions

Introduction

Le nombre de collisions impliquant la faune a largement augmenté durant les dernières décennies dans l'hémisphère nord (p. ex. Huijser et collab., 2008; Seiler et collab., 2004). Compte tenu de l'expansion annuelle du réseau routier (Hawbaker et collab., 2006), il est justifié de croire que cette tendance persistera pour les années à venir (van der Ree et collab., 2015a). Cette augmentation du nombre de collisions avec la faune peut être partiellement expliquée par une hausse du débit routier et une modification du comportement et des densités régionales des principales espèces fauniques impliquées (Groot Bruinderink et Hazebroek, 1996; Seiler et collab., 2004). En 2003, près de 45 000 collisions impliquant la grande faune se produisaient sur les routes canadiennes.

Jérôme Laliberté est candidat à la maîtrise à l'Université du Québec à Rimouski (UQAR) dans l'équipe de recherche en gestion de la faune terrestre dirigée par Martin-Hugues St-Laurent. Il détient un baccalauréat en biologie de l'UQAR ainsi qu'une technique en milieu naturel du Cégep de Saint-Félicien.

Martin-Hugues St-Laurent détient un doctorat en biologie de l'Université du Québec à Montréal (UQAM) et est professeur titulaire en écologie animale à l'UQAR. Il dirige un programme de recherche visant à mieux comprendre les impacts de l'altération des habitats sur l'écologie du caribou des bois, du loup gris, de l'orignal, du coyote et de l'ours noir en gestion et conservation de la faune terrestre.

martin-hugues_st-laurent@uqar.ca

40 LA SOCIÉTÉ PROVANCHER D'HISTOIRE NATURELLE DU CANADA

Autoroute 85

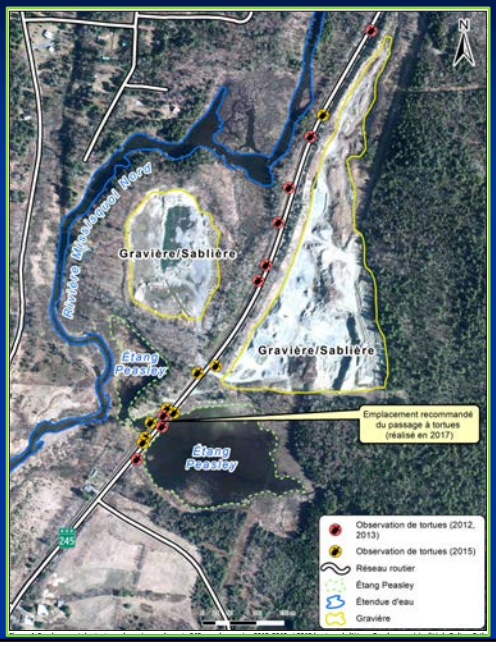
Risk of collisions with moose and white-tailed deer (1990-2015),
as affected by:
- Sinuosity
- Rain
- Distance to habitat patch
- Elevation
- Slope
- Forest cover
- Wetlands
- Distance to salt pool

etc.

Construction of 8 underpasses for large mammals (dear, moose, bear) and 14 wildlife passages for small and medium-sized mammals is planned on a **40 km stretch along the TransCanada Highway (85)** being upgraded from 2 to 4 lanes.
Funding is also planned for future monitoring.

54

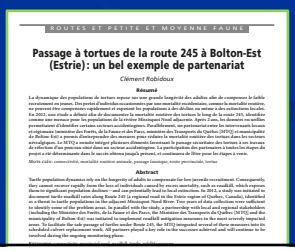
Route 245



Turtle mortality 2012-2014
- Roadkill mitigation measures
- MTQ: scheduled culvert replacement work
- Partnerships with local and regional stakeholders

Figure 2. Photographies du passage à tortues de la route 245 à Bolton-Est : a) ponceau préfabriqué en béton; b) tunnel préfabriqué en béton polymère; c) clôture de déviation et échappatoire.

Robidoux (2019)


ROUTES ET PETITE ET MOYENNE FAUNE

Passage à tortues de la route 245 à Bolton-Est (Estrie) : un bel exemple de partenariat

Clément Robidoux

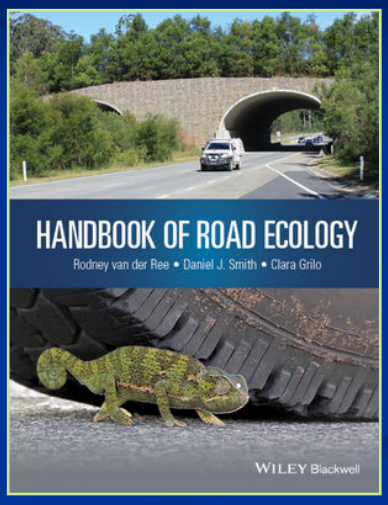
Résumé

Abstract

- Road Ecology is "the sleeping giant of conservation biology"
  (Forman 2002)

Recommended reading:

- Rodney van der Ree, Daniel J. Smith, Clara Grilo (eds.) (2015): **Handbook of Road Ecology: An international practitioner's guide**.
  - 63 chapters
  - 100 authors from 25 countries
  - Case studies from many countries



56

- Special issue on Road Ecology in the journal *Ecology & Society*:
  www.ecologyandsociety.org/

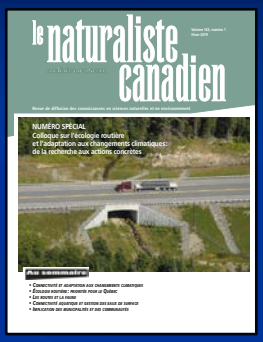
- First Road Ecology Conference in Quebec was on 24-27 May 2011:
  "Routes et faune terrestre : de la science aux solutions"
  www.ugar.ca/routes-faune-terrestre/
  -> Special issue in ***Le naturaliste canadien*** (2012):

www.gpe.concordia.ca/about/facultystaff/jjaeger.php
www.fragmentation.de
http://www.glel.carleton.ca

Thank you so much!

- All members of our lab
- Many colleagues, for ex.,
  - Lenore Fahrig
  - Christian Schwick
  - Tomas Soukup
  - Anthony Clevenger
  - Jeff Bowman
  - André Desrochers
  - Felix Kienast
  - and many others
- For funding:
  - MTMDET / MTQ
  - German Research Foundation (DFG)
  - Swiss Federal Office for the Environment (FOEN)
  - European Space Agency
  - and many others

Any Questions?



Second conference about road ecology in Québec (2017): "L'écologie routière et l'adaptation aux changements climatiques : de la recherche aux actions concrètes"

-> Special issue in ***Le naturaliste canadien***, Hiver 2019, vol. 143(1).

Road Ecology: Process to Progress

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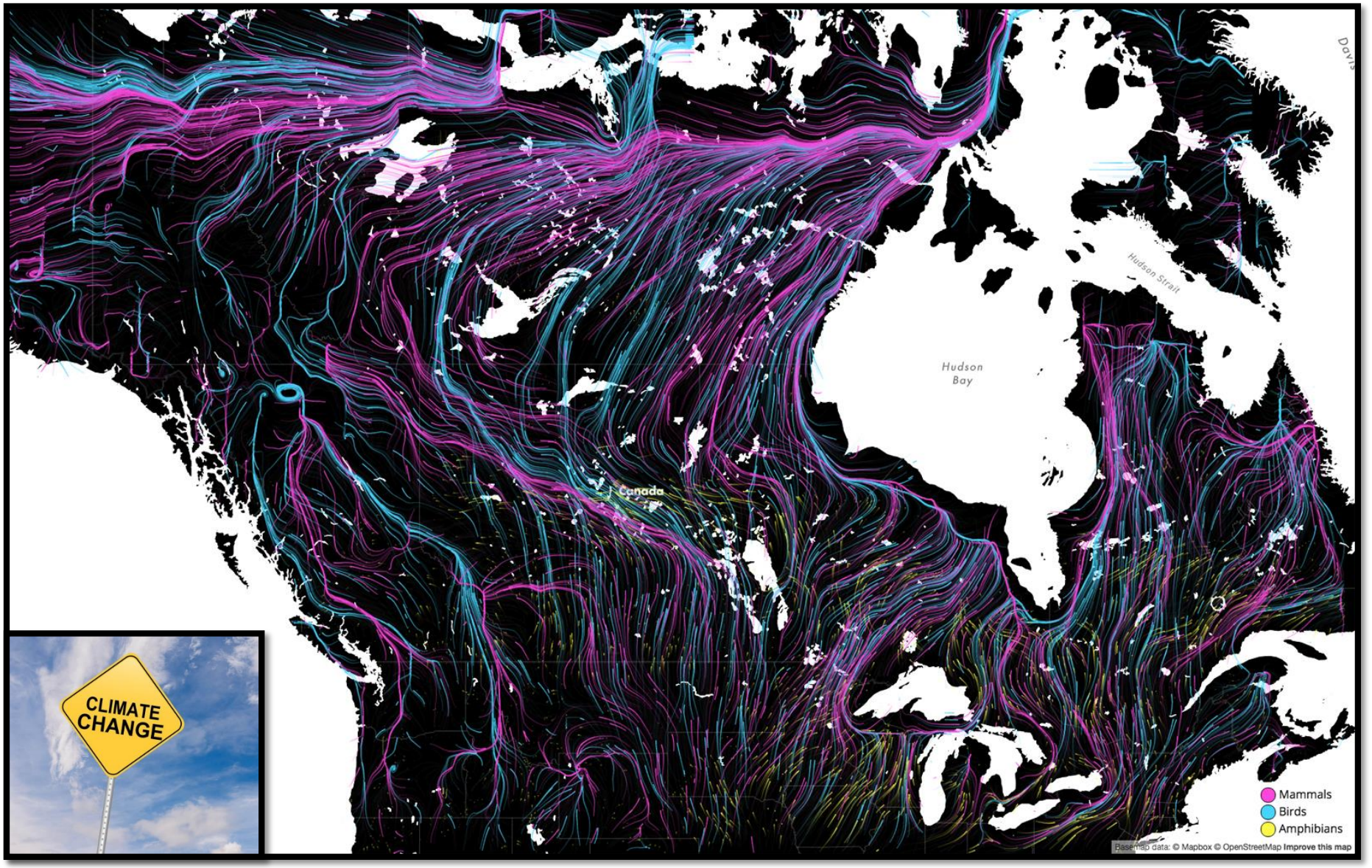
Ontario Road Ecology Group

Ontario Road Ecology Group

Global Trend: Wildlife Corridors

- 2010 – Australia, 1st transcontinental wildlife corridor.
- 2016 – The Nature Conservancy: Protecting wilderness corridors will be essential to preserving biodiversity. As climate change disrupts habitats, species will migrate and will have to navigate through human settlement areas.
- 2016 – Resolution 40-3: Ecological Connectivity, Adaptation to Climate Change, Biodiversity Conservation
- 2017 – International Union for Conservation of Nature (IUCN) World Commission on Protected Areas (WCPA)
  - Links landscapes, reducing fragmentation and enabling migratory flows essential to a functioning and resilient system.



The Nature Conservancy

Ontario Road Ecology Group

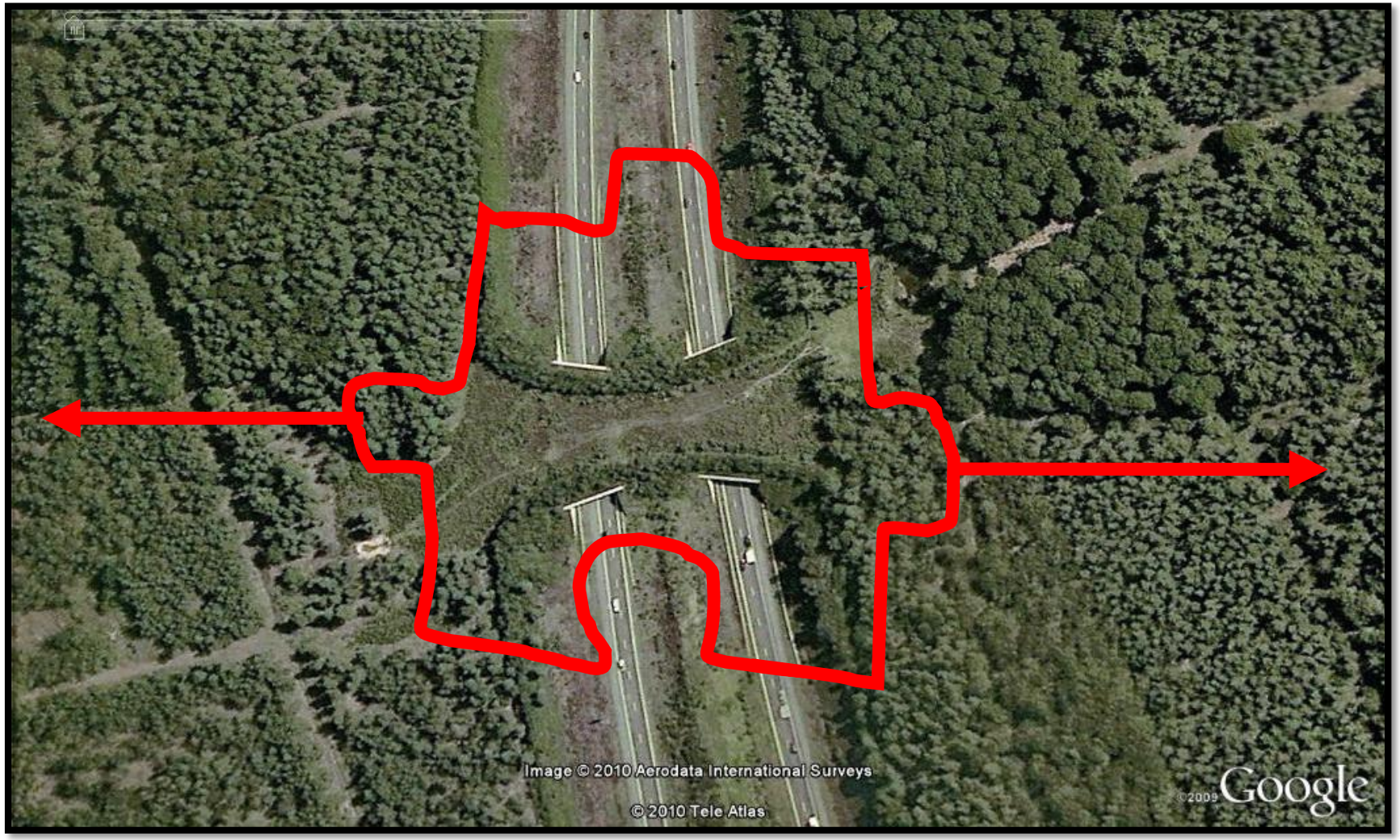


Image © 2010 Acrodata International Surveys
© 2010 Tele Atlas
©2009 Google

CENTER for LARGE LANDSCAPE CONSERVATION

Corridors & Crossings

Protecting wildlife movement across landscapes and making roads safer for people and animals.

Policy & Law

Integrating large landscape connectivity by promoting wildlife corridor and crossing policy at international, federal, state, and local levels.

Two Countries One Forest | Deux Pays Une Forêt

A2A Algonquin to Adirondacks Collaborative

Yellowstone to Yukon Conservation Initiative

Corridor appalachien
Appalachian Corridor

CONNECTIVITY CONSERVATION Specialist Group

STAYING CONNECTED Northern Appalachians

CONSERVATION CORRIDOR

Ontario Road Ecology Group

Ontario

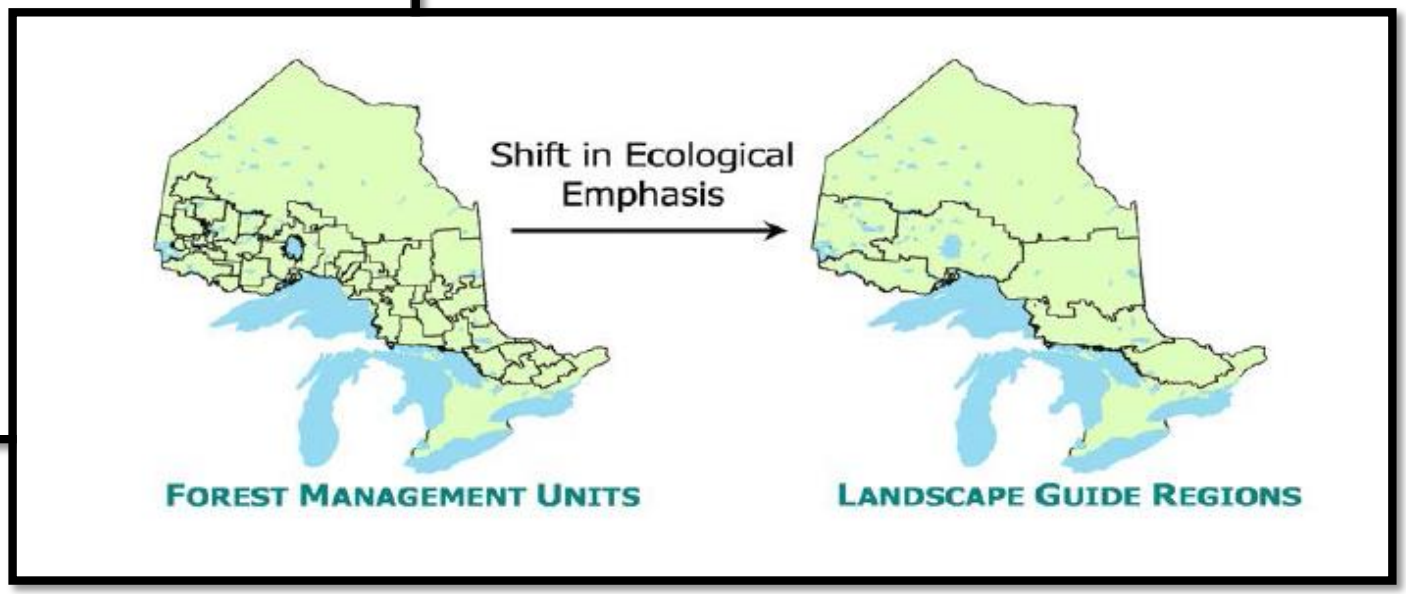
Taking a Broader Landscape Approach

A Policy Framework for Modernizing Ontario's Approach to Natural Resource Management

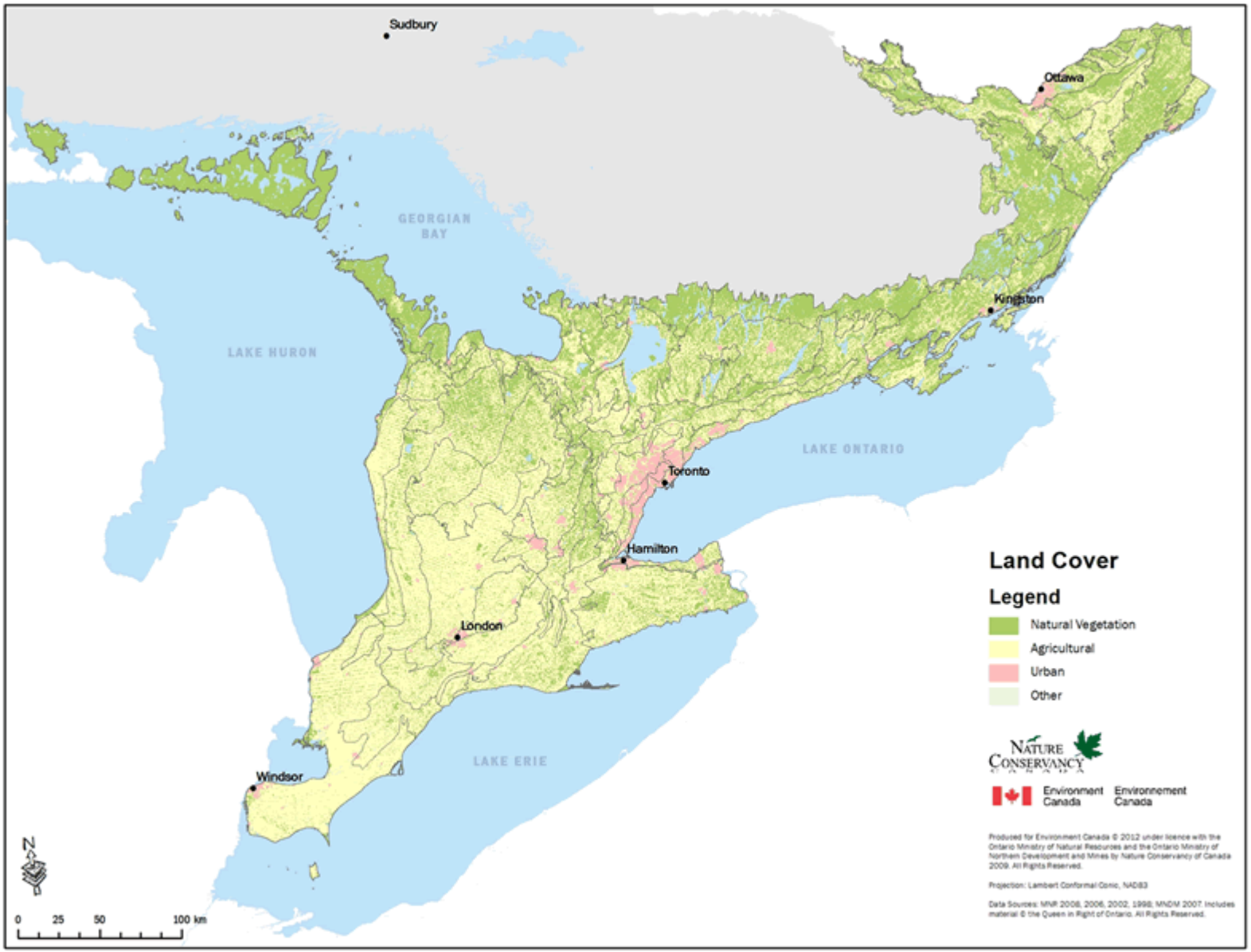
Spring 2013

Ontario Ministry of Natural Resources

Conserve biodiversity through ecosystem or landscape-based management.



Ontario Road Ecology Group



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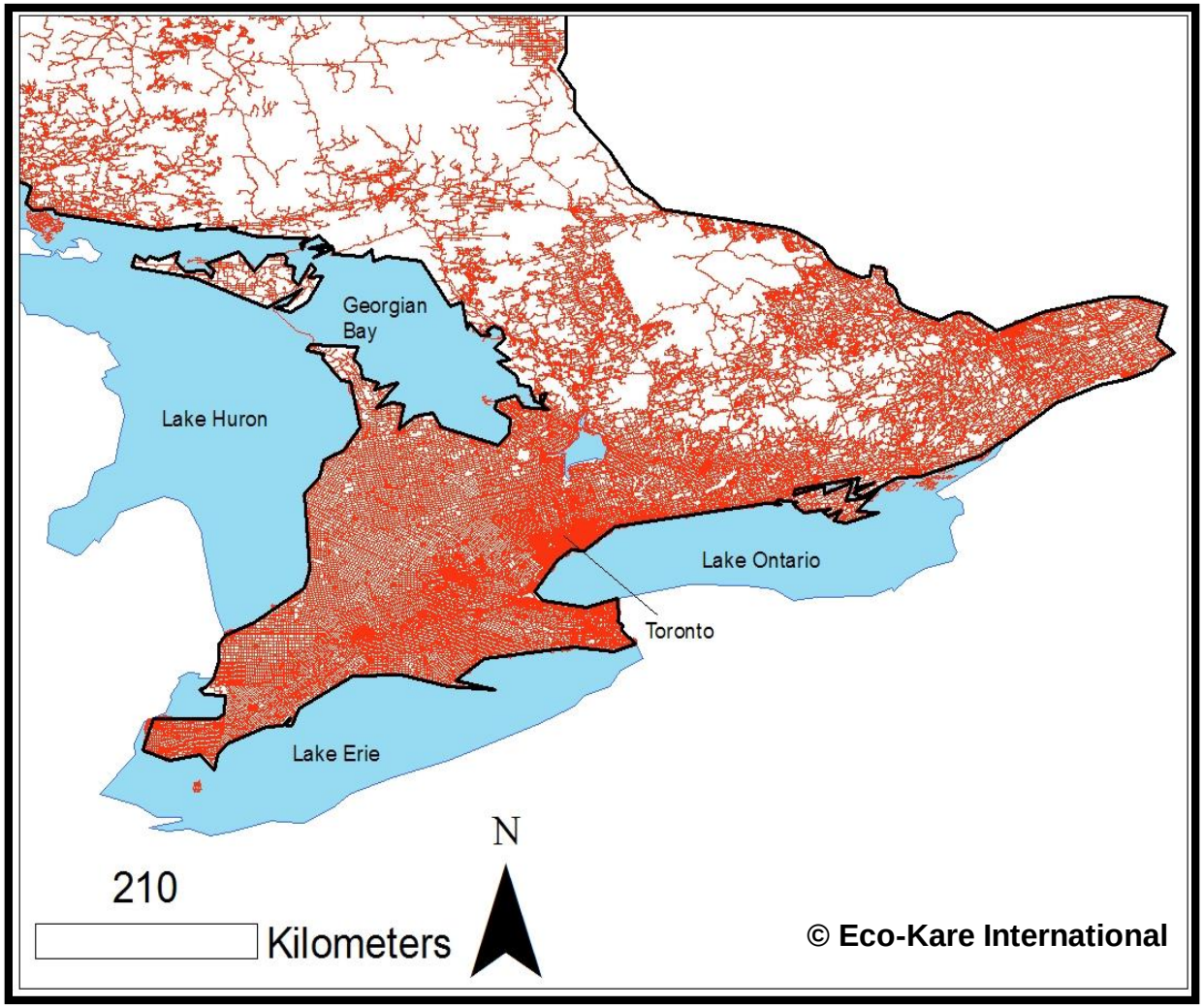
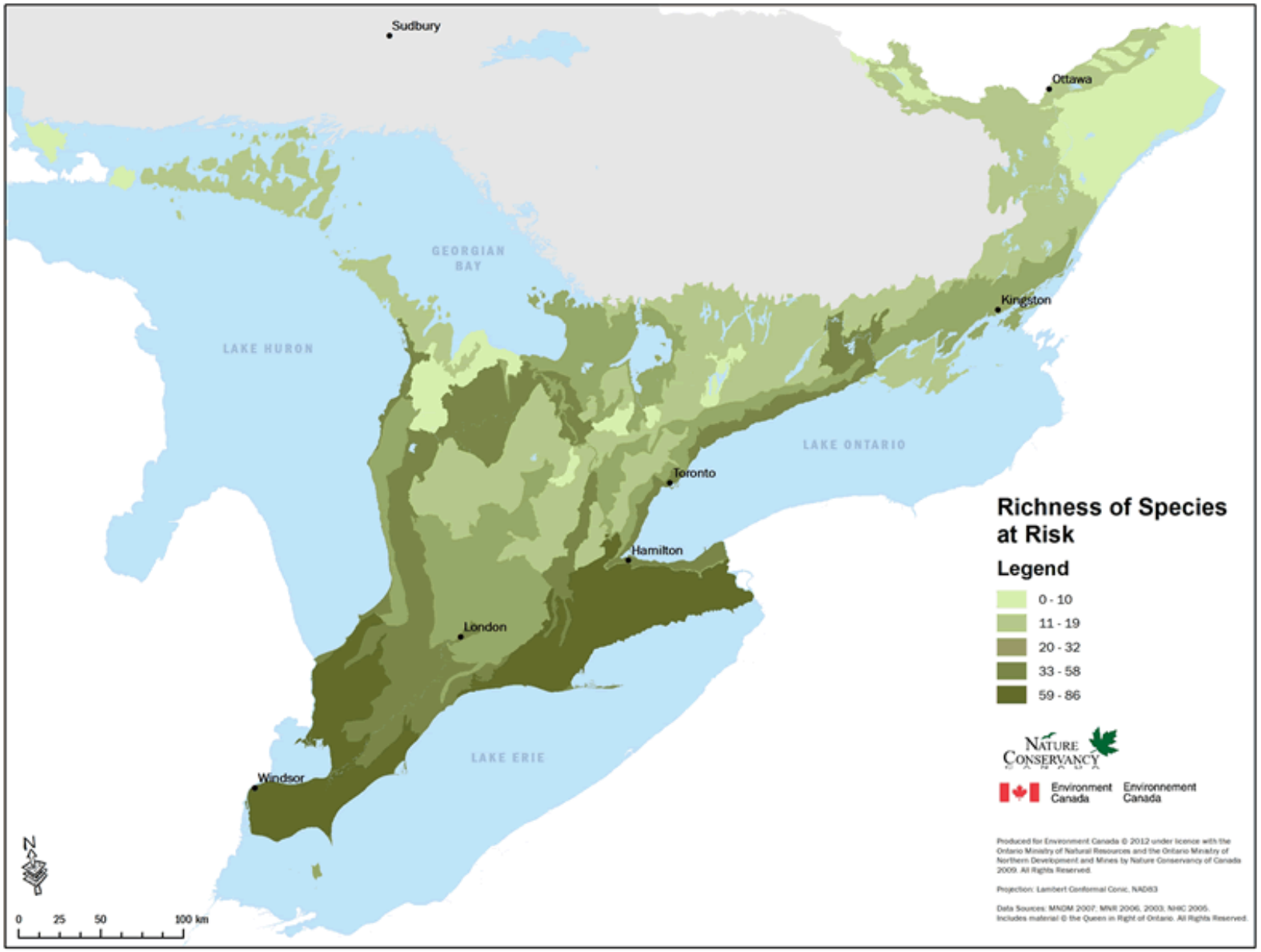
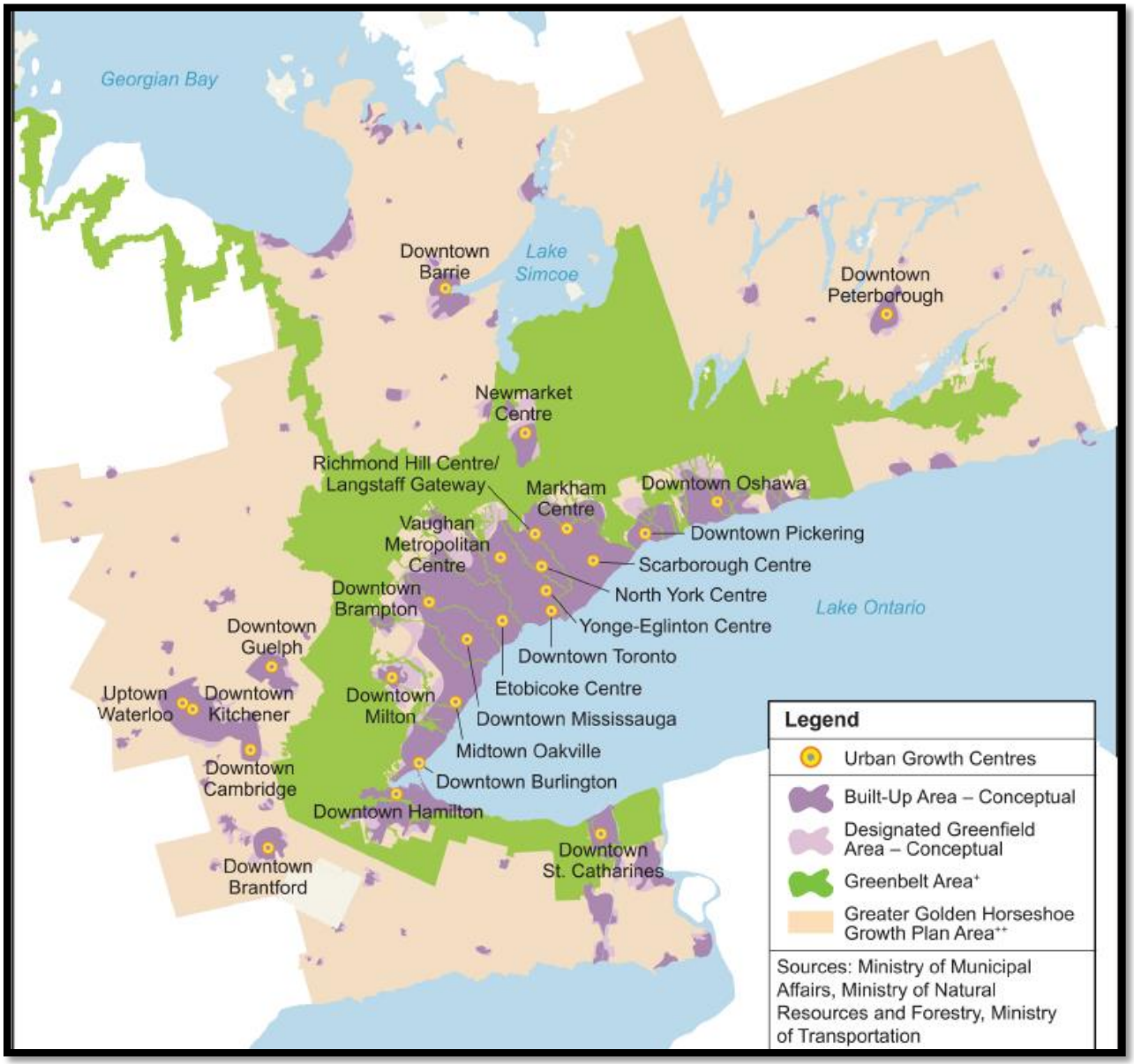
Southern Ontario Road Network

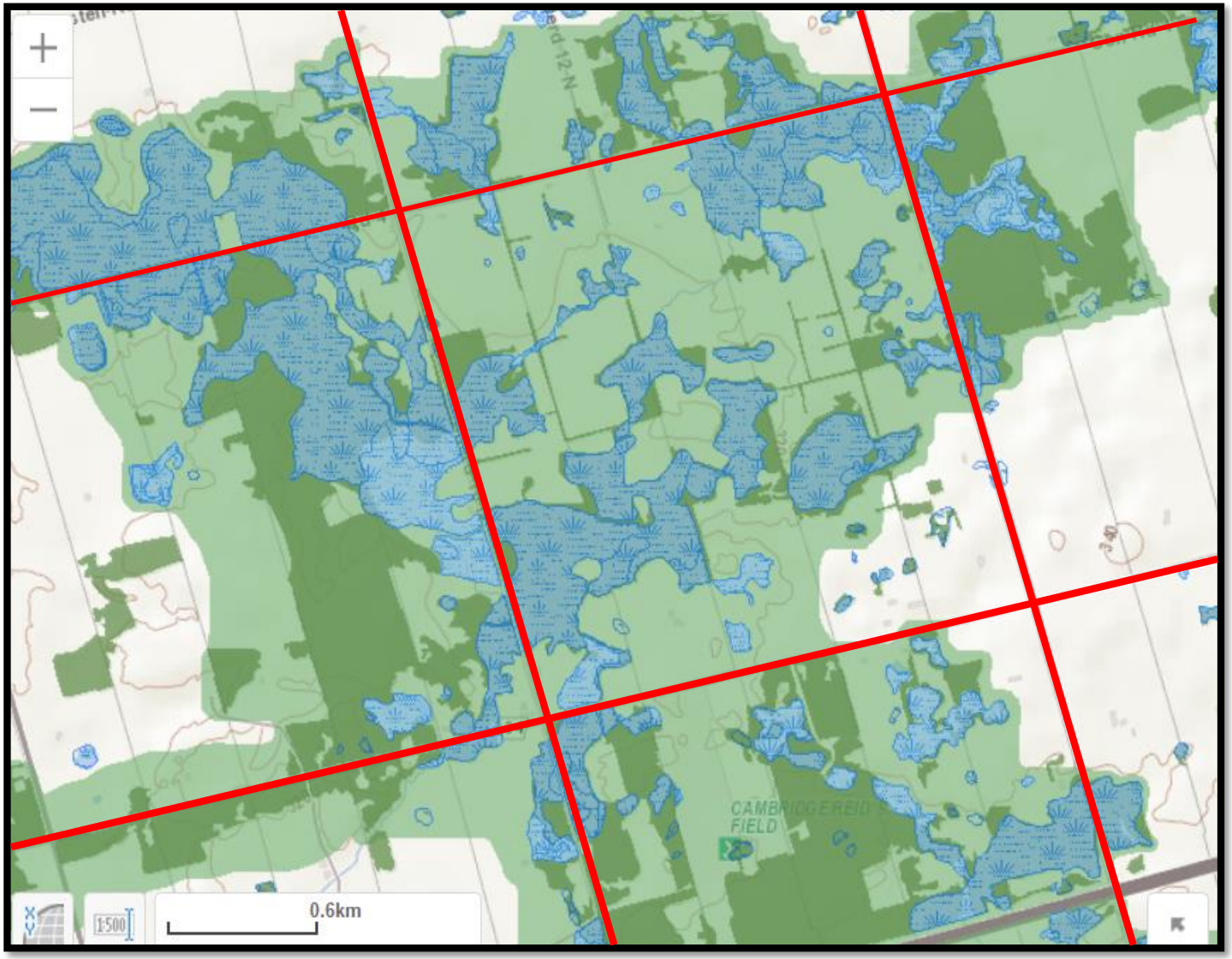


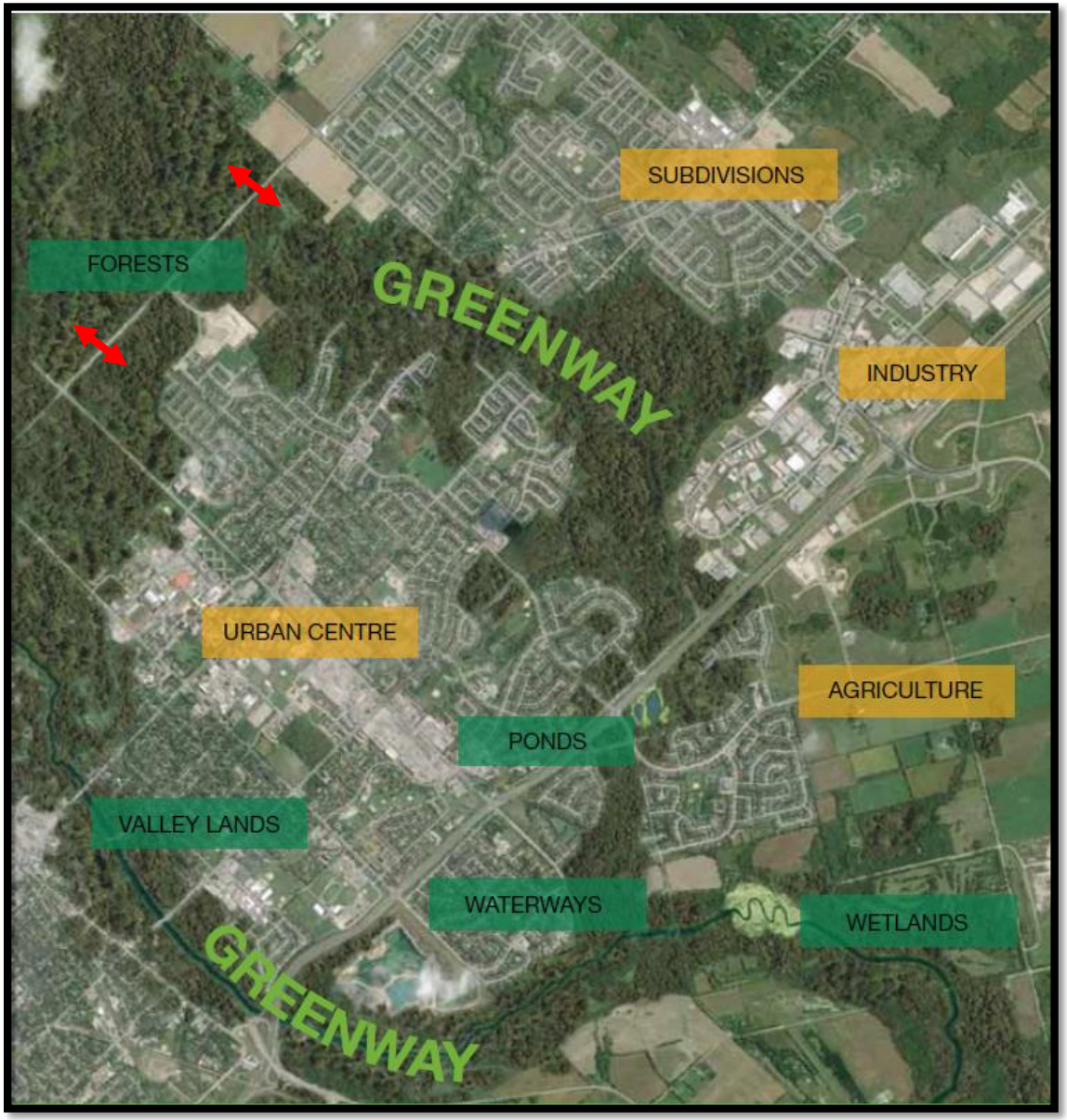


Ontario Road Ecology Group


Georgian Bay
Lake Simcoe
Lake Ontario
Downtown Barrie
Downtown Peterborough
Newmarket Centre
Richmond Hill Centre/ Langstaff Gateway
Markham Centre
Downtown Oshawa
Vaughan Metropolitan Centre
Downtown Pickering
Scarborough Centre
North York Centre
Downtown Brampton
Yonge-Eglinton Centre
Downtown Guelph
Downtown Toronto
Etobicoke Centre
Uptown Waterloo
Downtown Kitchener
Downtown Milton
Downtown Mississauga
Midtown Oakville
Downtown Cambridge
Downtown Burlington
Downtown Hamilton
Downtown St. Catharines
Downtown Brantford
Legend
Urban Growth Centres
Built-Up Area – Conceptual
Designated Greenfield Area – Conceptual
Greenbelt Area+
Greater Golden Horseshoe Growth Plan Area++
Sources: Ministry of Municipal Affairs, Ministry of Natural Resources and Forestry, Ministry of Transportation

Ontario Road Ecology Group


0.6km
1:500



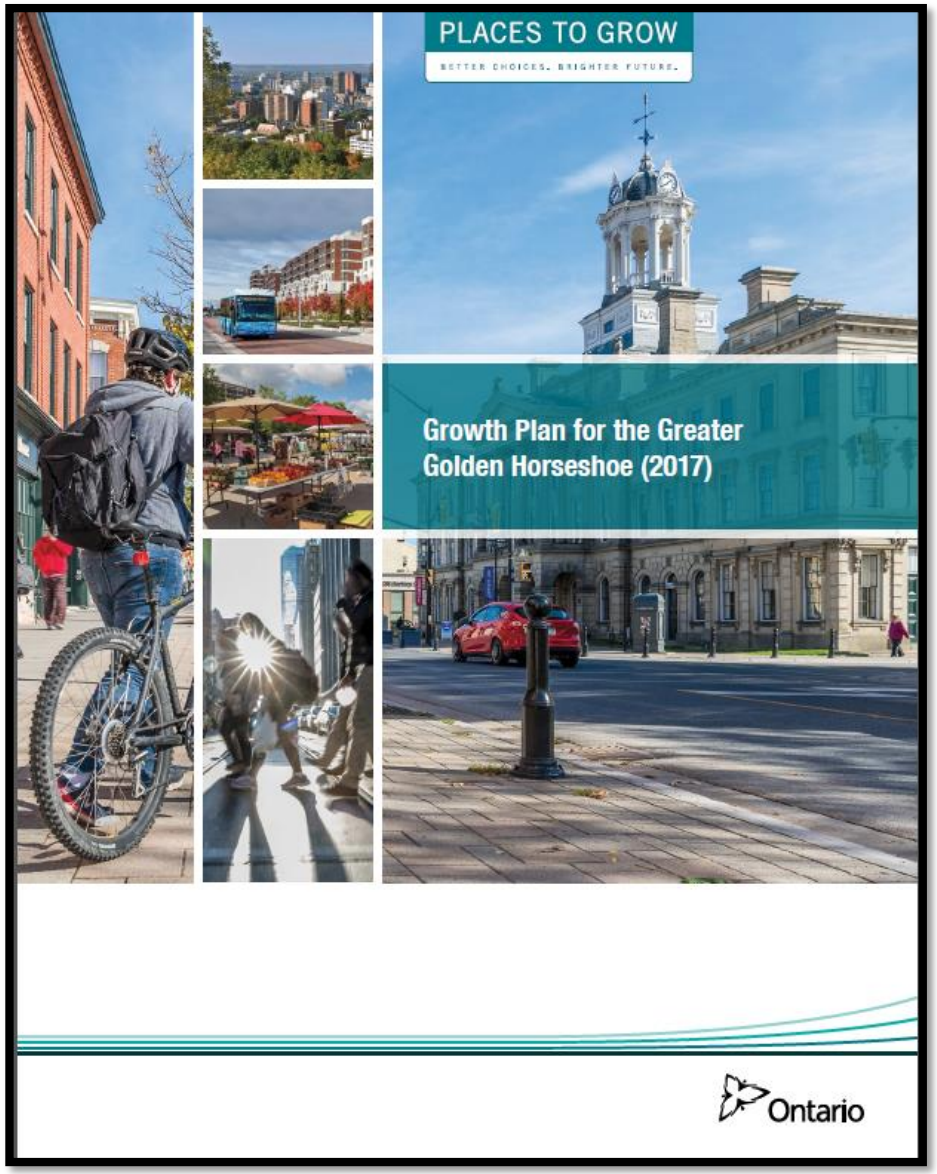
Connectivity elements are extremely important to maintain biodiversity. Keeping Nature in Our Future, 2014

Provincial Policy Statement, Natural Heritage Reference Manual: Section 3.4.6.2

Linear infrastructure (e.g. roads) crossings should be kept to a minimum and incorporate suitable design and mitigation measures (e.g. provide appropriate wildlife crossings) to maintain linkages between and among natural heritage features.

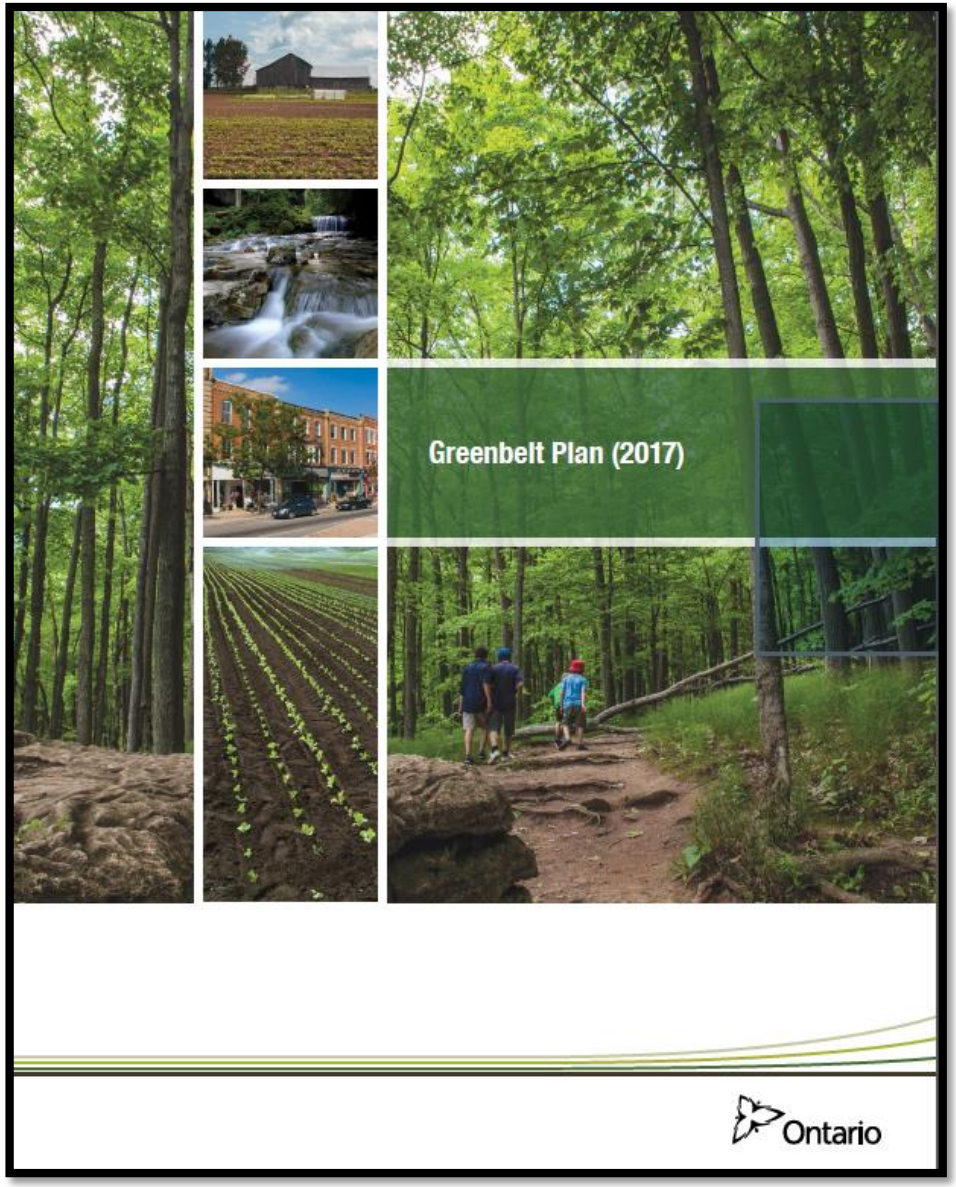
Table C-1 (*continued from previous page*)

DEVELOPMENT ACTIVITY	POTENTIAL PHYSICAL IMPACTS	POTENTIAL IMPACTS ON FUNCTIONS AND FEATURES	SOME POSSIBLE MITIGATION MEASURES
CONSTRUCTION			
2. Roads – water crossings	• obstruction of lateral flows in wetlands	• significant alterations in wetland vegetation communities; potential change of wetland type; changes in wildlife populations	• install adequate culverts and gravel base to maintain flow of surfacewater and shallow groundwater
	• interruption of linkage along a watercourse	• increased roadkill as animals cross roads to follow a watercourse	• identify wildlife use of linkage and size passage under road accordingly (information on cryptic species that use linkage will probably not be obtainable, so knowledge of wildlife most likely to be present must be used)
	• attraction of nesting turtles and other wildlife to roadsides and roads	• roadkill	• build roadside wings to keep turtles off roads; build underpasses with funnel fencing to direct turtles and other wildlife; develop alternative egg-laying sites
	• pollutants from roads	• introduction of heavy metals, oils and grease from vehicles • increased levels of salt from de-icing	• collect and treat road runoff in stormwater management facilities • use vegetated swales to capture pollutants
	• barriers to wildlife movement	• interrupted wildlife movement along watercourse	• extend bridges beyond watercourse shorelines to allow wildlife passage



The Province will map a *Natural Heritage System* for the *GGH* to support a comprehensive, integrated, and long-term approach to planning for the protection of the region's natural heritage and biodiversity.

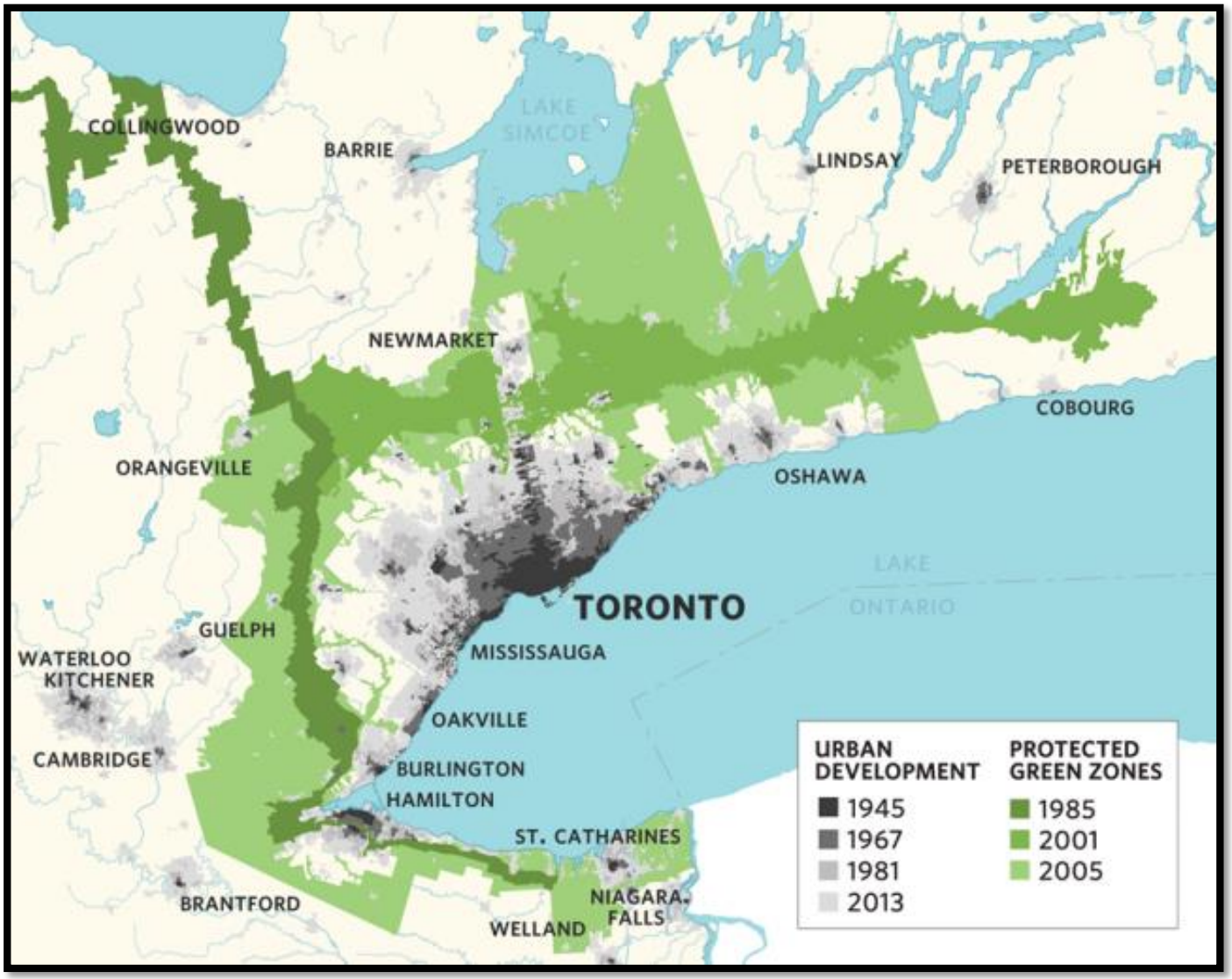
Directs municipalities to apply appropriate policies to maintain, restore, or enhance the diversity and connectivity of the system.

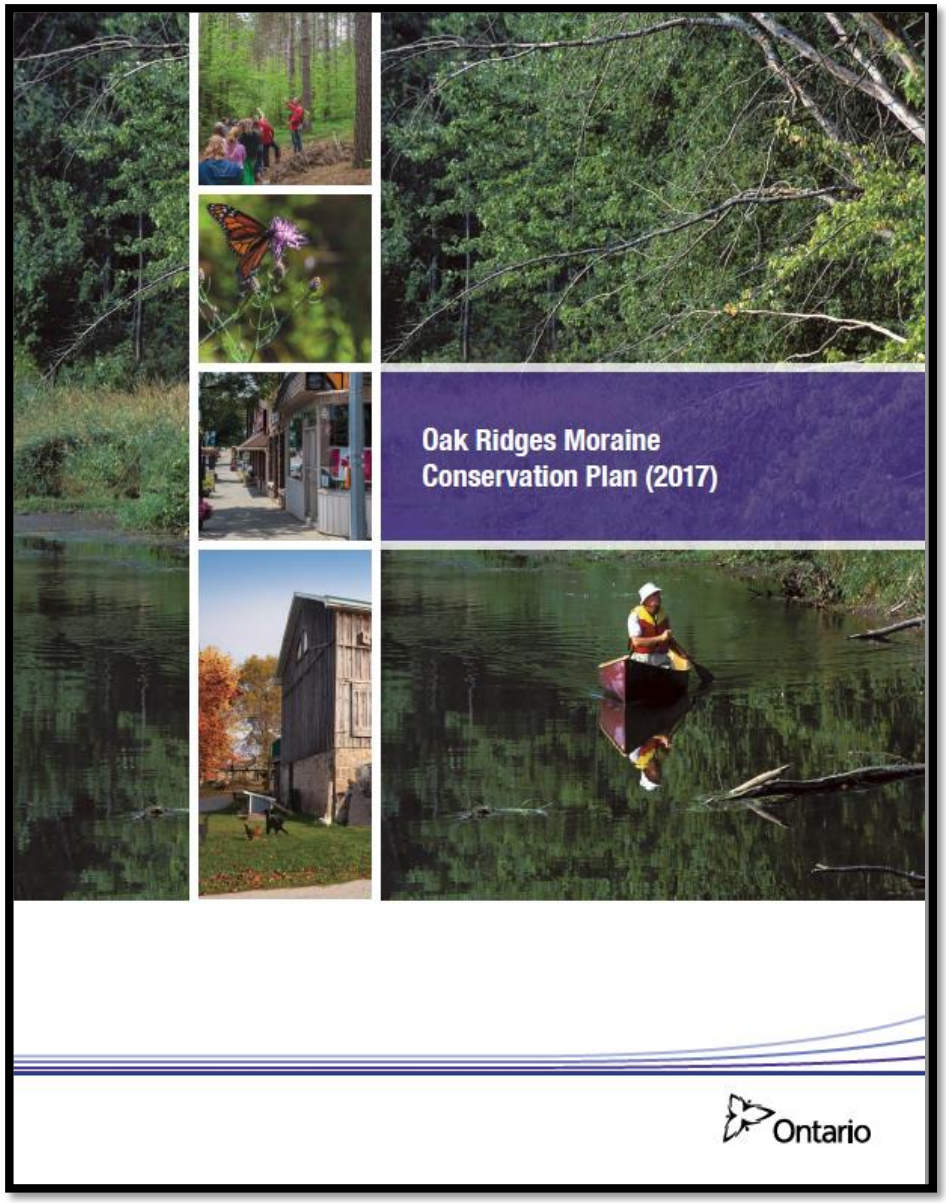


Connectivity will be maintained or, where possible, enhanced for the movement of native plants and animals across the landscape.

Greenbelt

2 Million acres of protected environmentally sensitive areas and farmlands.





Supporting Connectivity

Every application for development or site alteration shall identify planning, design and construction practices that ensure that no buildings or other site alterations impede any hydrological functions or the movement of plants and animals among key natural heritage features, key hydrologic features, and adjacent land within Natural Core Areas and Natural Linkage Areas.

Projects will allow for wildlife movement.

Additional Ontario Acts

- **Fish and Wildlife Conservation Act**
  - Specially Protected Species – aims to preserve wildlife
- **Conservation Authorities Act**
  - Balance human, environmental, and economic needs
- **Lake Simcoe Protection Act**
  - Connectivity to allow for the movement of plants and animals
- **Niagara Escarpment Planning and Development Act**
  - Maintain a continuous natural environment and ensure development is compatible with the natural environment

Ontario

Ontario Road Ecology Group

Ontario

Endangered Species Act, 2007

***Purpose*:** Protection and recovery of Species at Risk and their habitat.

Ontario Road Ecology Group

ESA Implementation

Road improvement activities with the protection of reptiles and amphibians and benefits provided through the installation of fencing and improved passage.

Ontario

WILDLIFE HABITAT AWARENESS SIGN

Report #: 2012-03	February 6, 2012

Ontario Road Ecology Group

CAUTION

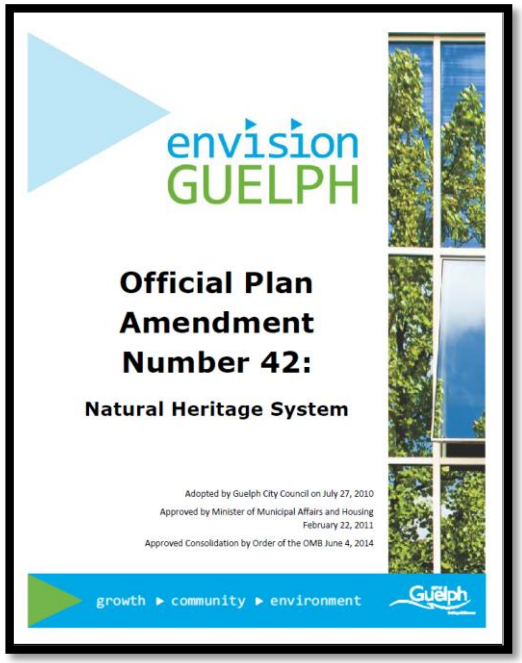
CONVENTION

CONSERVATION

Ontario

Ontario Road Ecology Group

City of Guelph Official Plan



Recommended Natural Heritage Action Plan, 2018

Section 6A.4: Wildlife Crossing Locations

The City will implement species-appropriate mitigation measures to minimize the impacts to wildlife and property damage.

Ontario's land use planning system gives municipalities the major role in planning decisions.

Transportation Budget 2019-2028

Ten Year Capital Budget & Forecast

Roseville Rd Turtle Crossing

Previous Unspent Approvals: $50,000

2019 New Request: $150,000

2020: $50,000

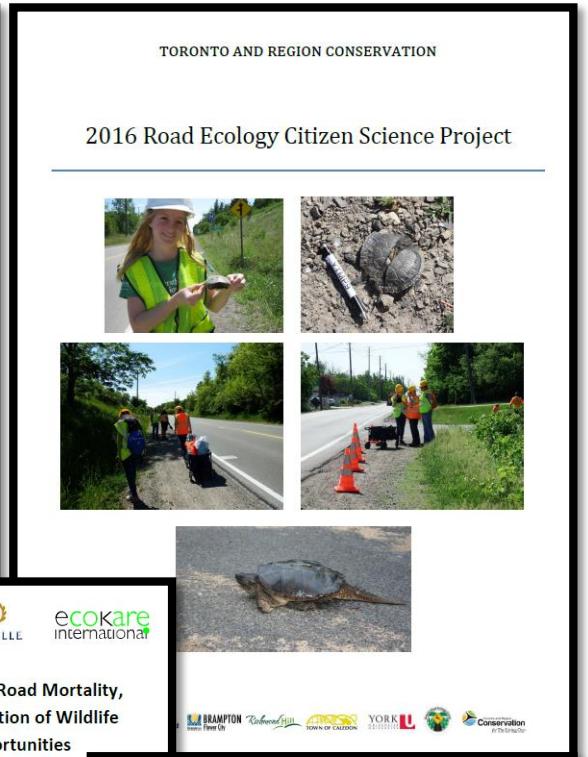
Total = $250,000

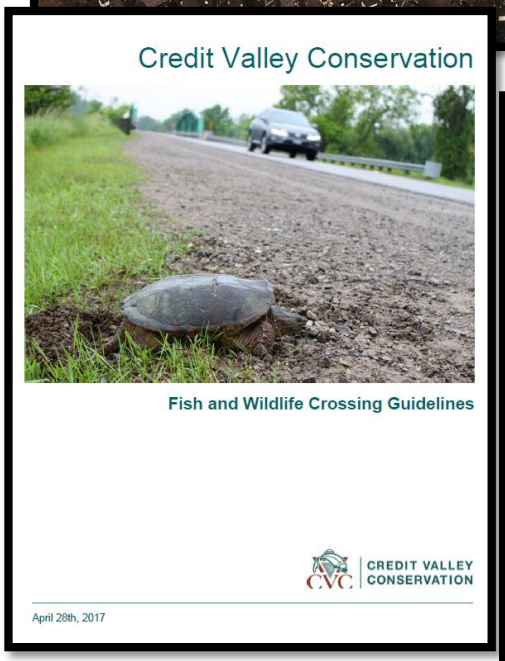
Recommendation (Sept. 2018)

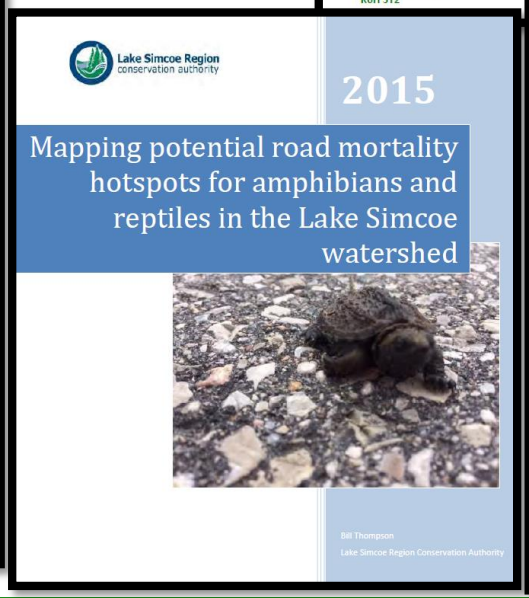
That Regional Council approve the installation of two wildlife tunnels and directional fencing to address the two highest priority turtle crossing locations along Roseville Road at Barrie's Lake.

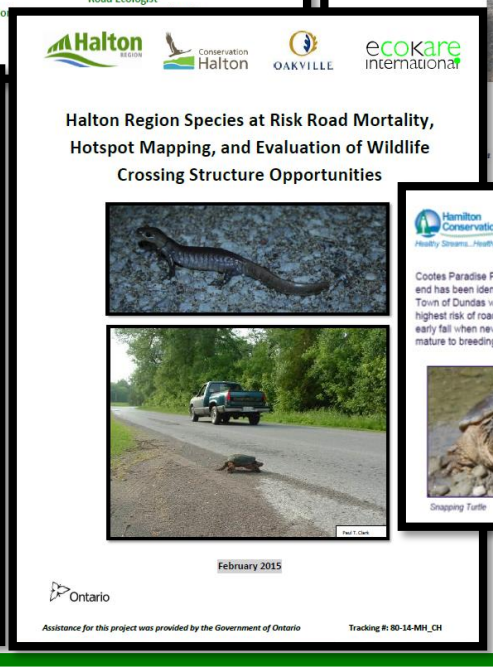
Region of Waterloo

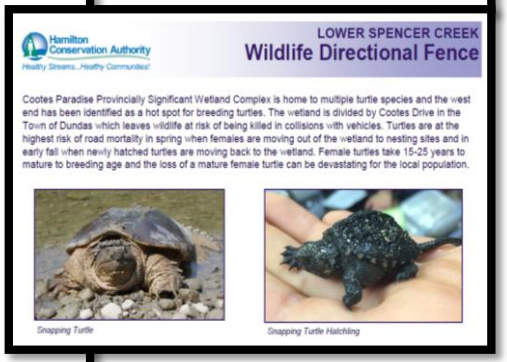
Ontario Road Ecology Group







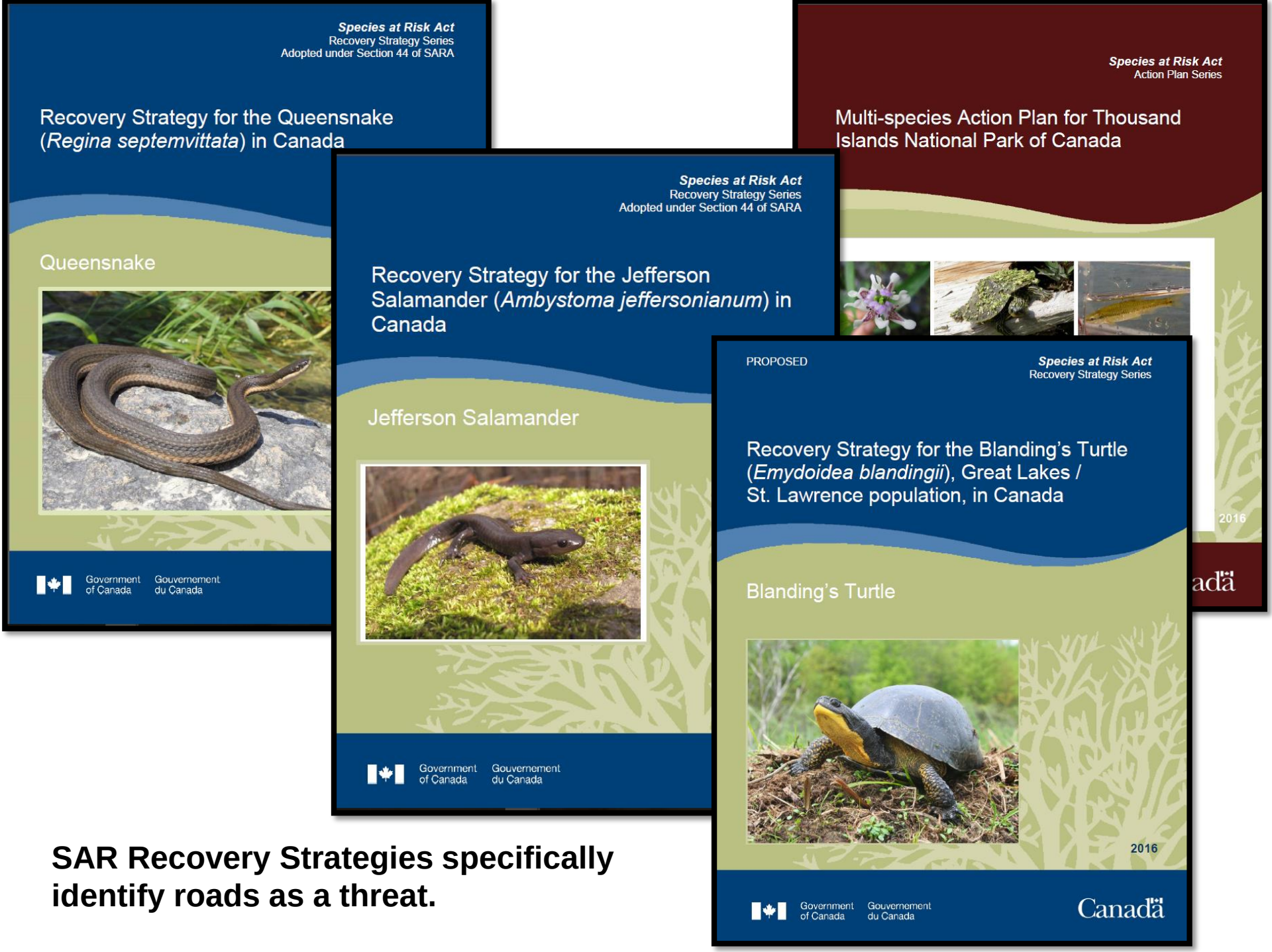




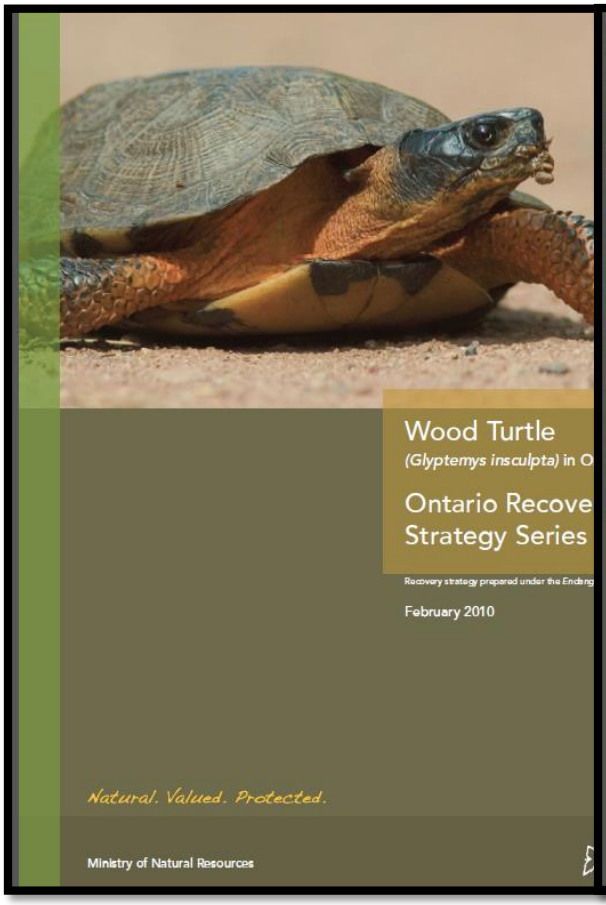
Conservation ONTARIO
Natural Champions

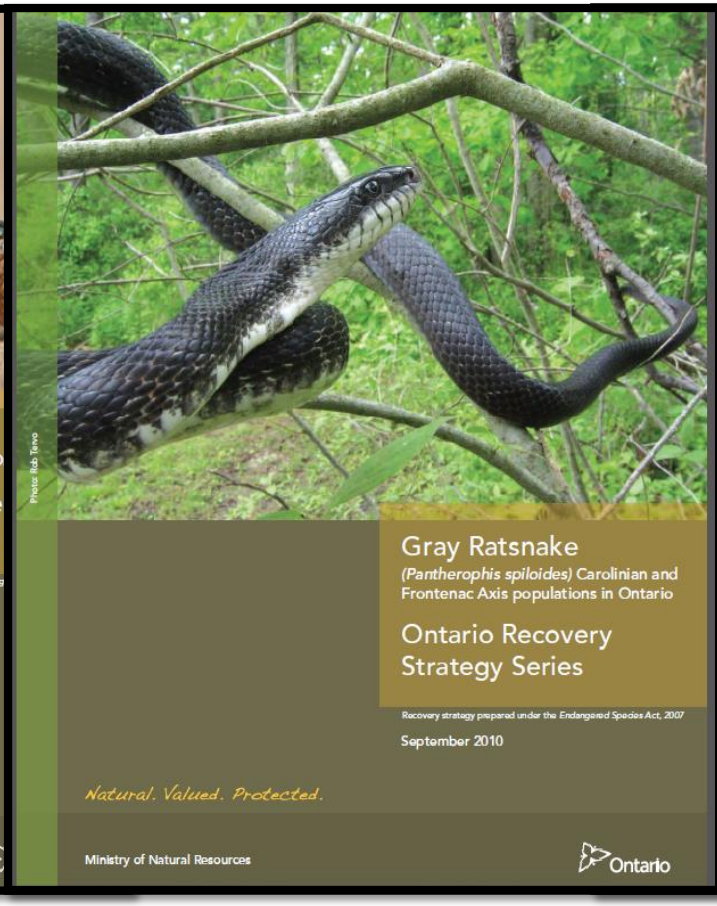
Local, community-based natural resource management agency.

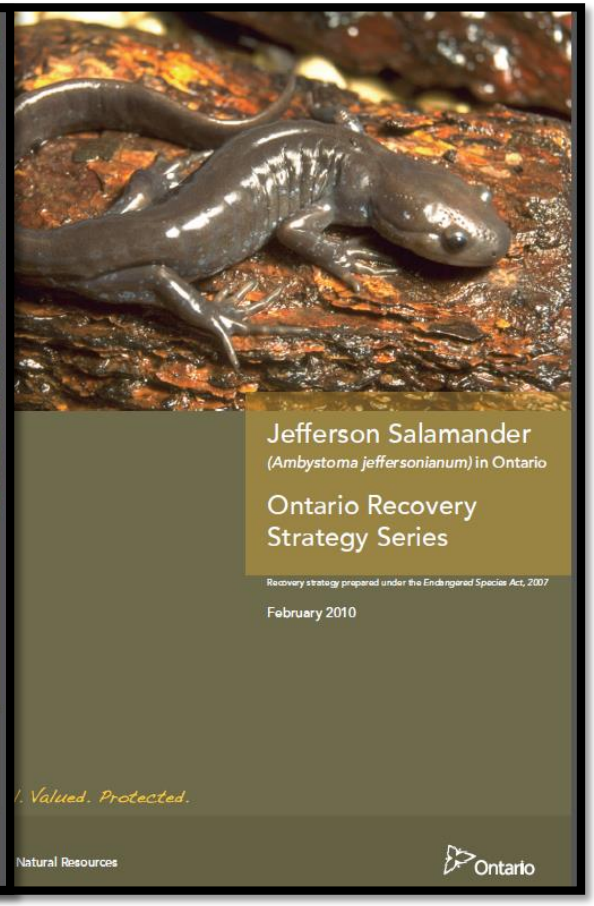
Ontario Road Ecology Group



SAR Recovery Strategies specifically identify roads as a threat.







Ontario

Ontario Road Ecology Group

Best Practices Guide to Natural Heritage Systems Planning

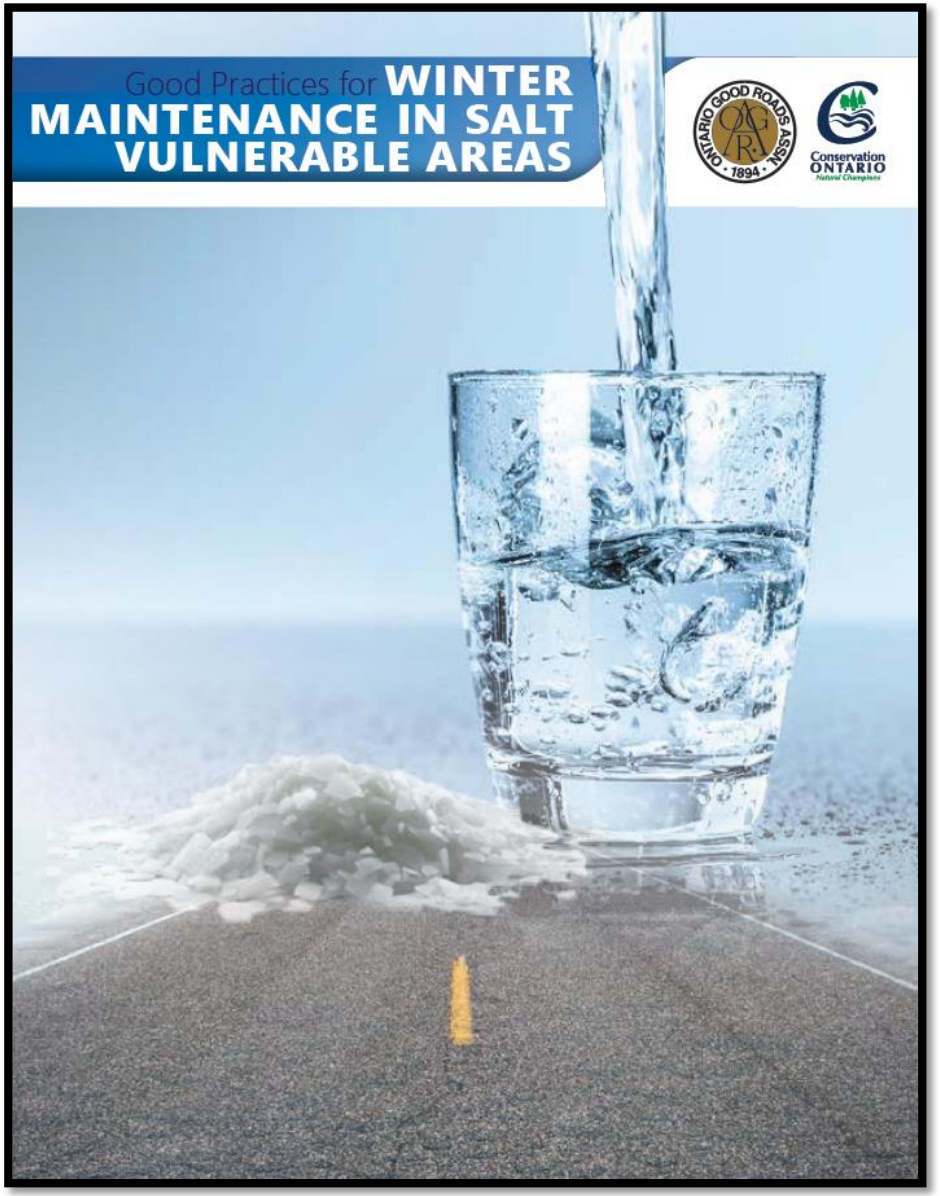
Ontario Nature

Ontario Nature's Greenway Guide Series

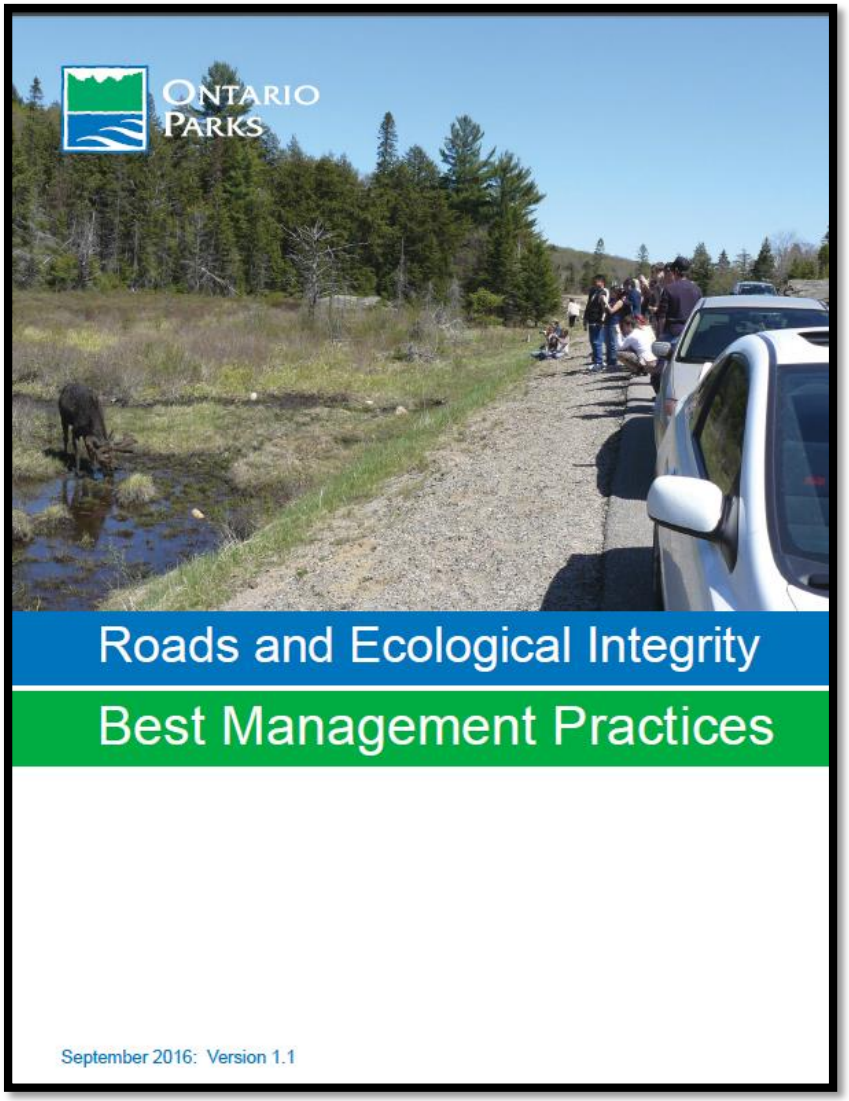
Good Practices for **WINTER MAINTENANCE IN SALT VULNERABLE AREAS**

Ontario Good Roads Assn. 1894

Conservation Ontario Natural Champions



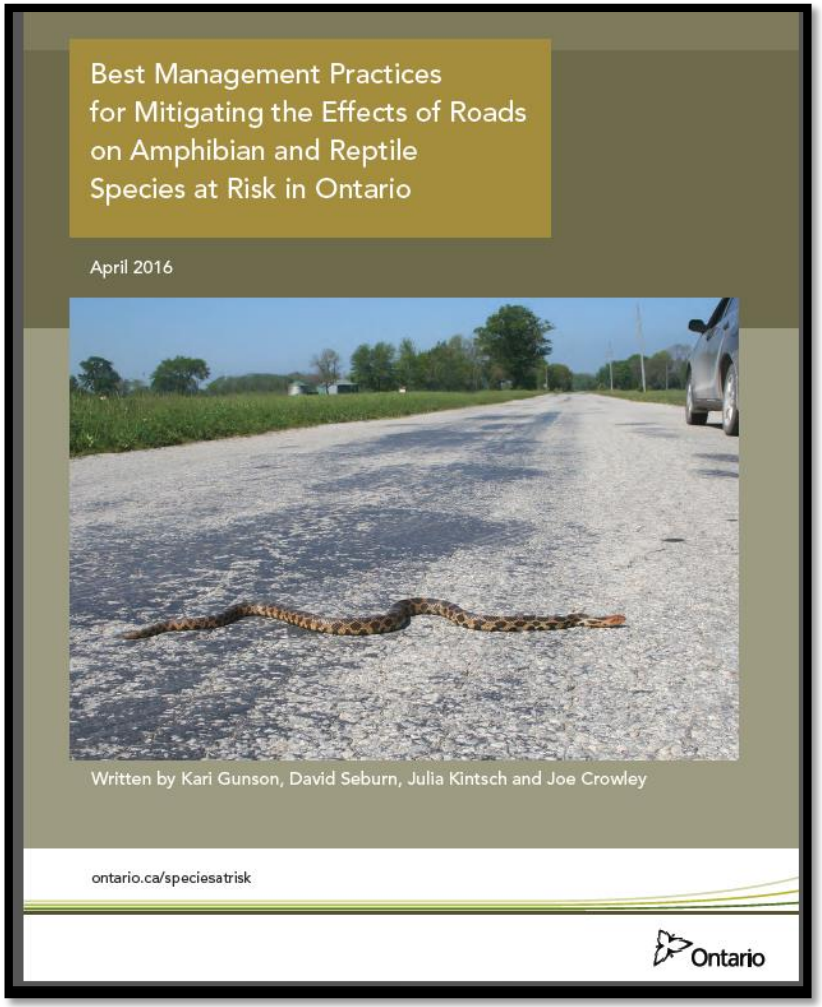
Ontario Road Ecology Group

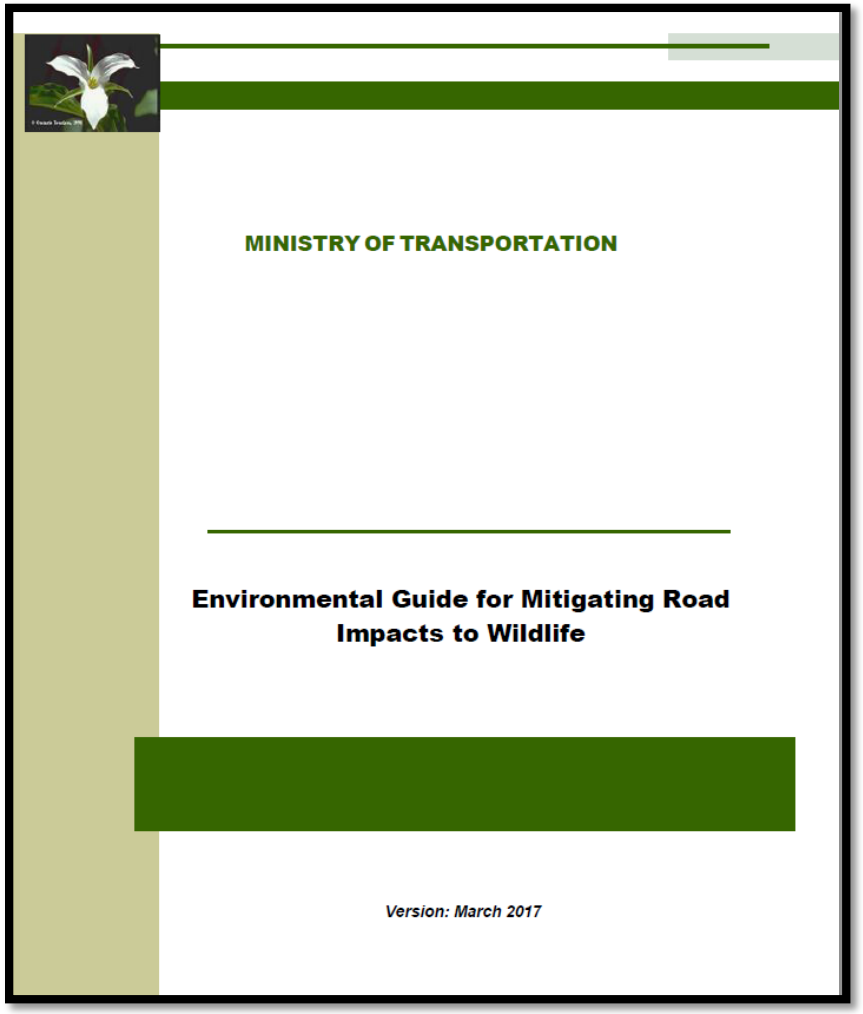


Roads & Wildlife Portal

www.roadsandwildlife.org

Ontario Road Ecology Group





*Dynamic documents. We are always learning and improving.

Ontario

Ontario Road Ecology Group

MTO Best Management Practices for Species at Risk Protection During Maintenance Activities

Document type: Best Management Practices Manual

Prepared for: Maintenance Service Providers
Issued by: Ministry of Transportation, Policy and Planning Division, Transportation Planning Branch - Environmental Policy Office

January 2017

Cette publication hautement spécialisée, MTO Best Management Practices for Species at Risk Protection During Maintenance Activities, n'est disponible qu'en anglais conformément au Règlement 671/92, selon lequel il n'est pas obligatoire de la traduire en vertu de la *Loi sur les services en français*. Pour obtenir des renseignements en français, veuillez communiquer par courriel avec Nicole.Forbes@ontario.ca au ministère des Transports.

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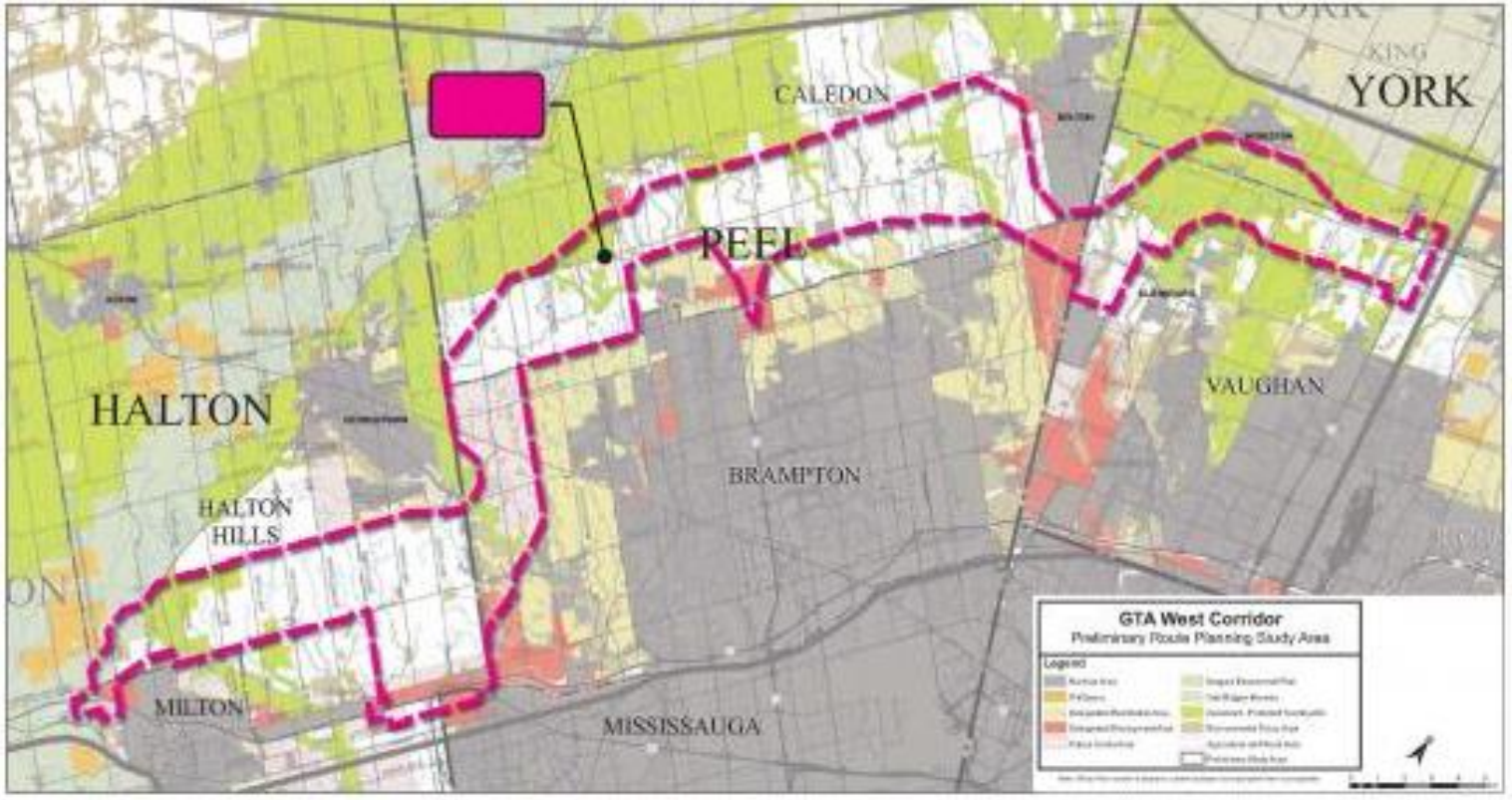
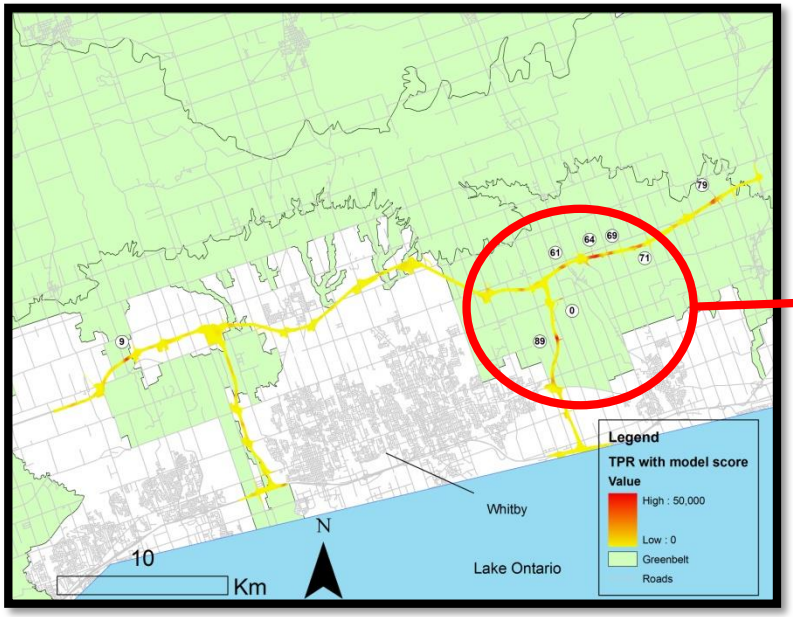
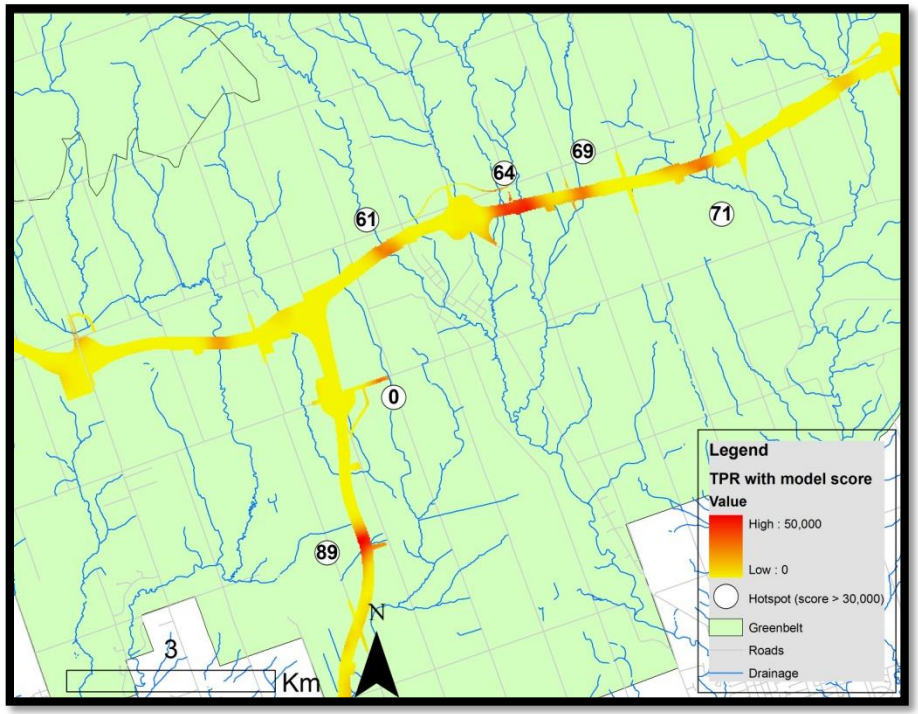
Route Alignment

- Technically Preferred Route



GIS Analysis - Hotspots

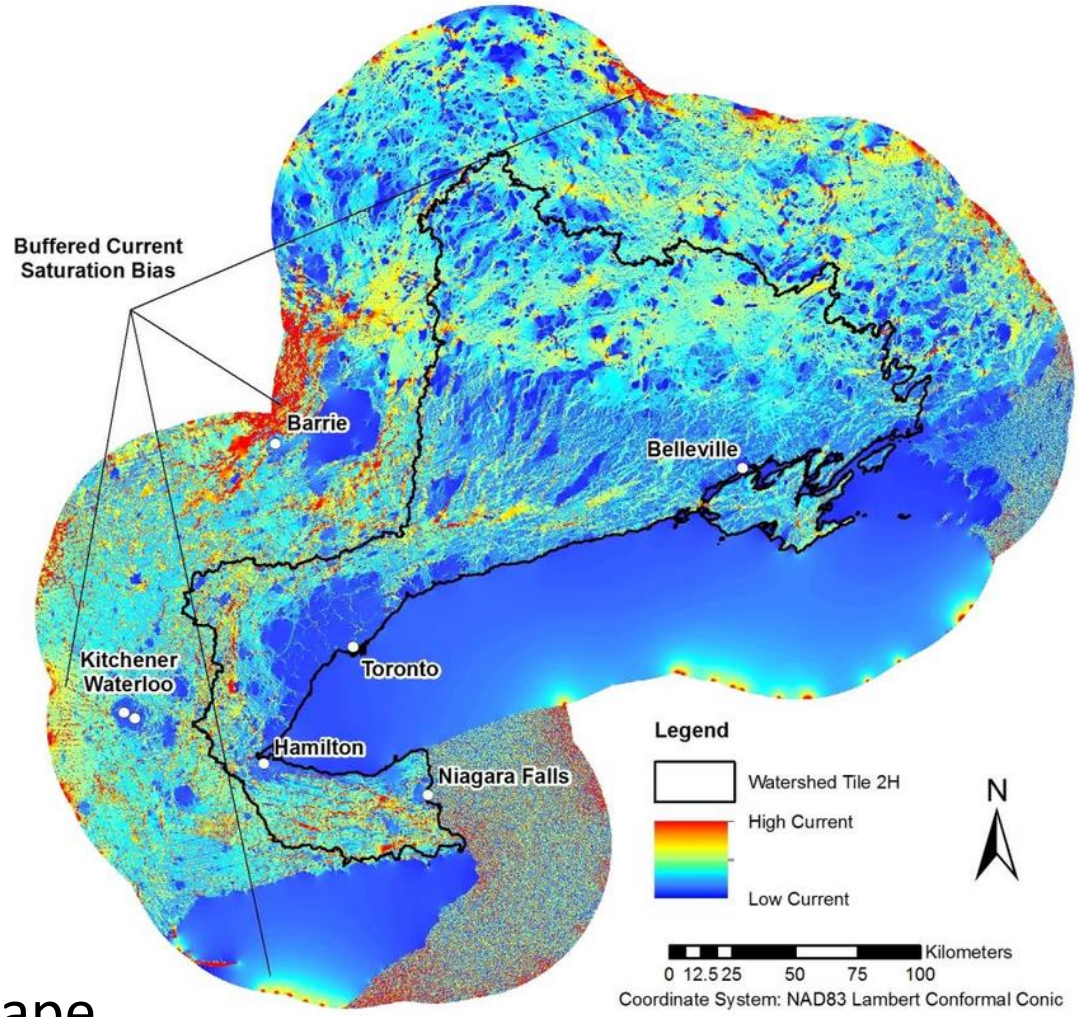




ecokare international

Ontario Road Ecology Group

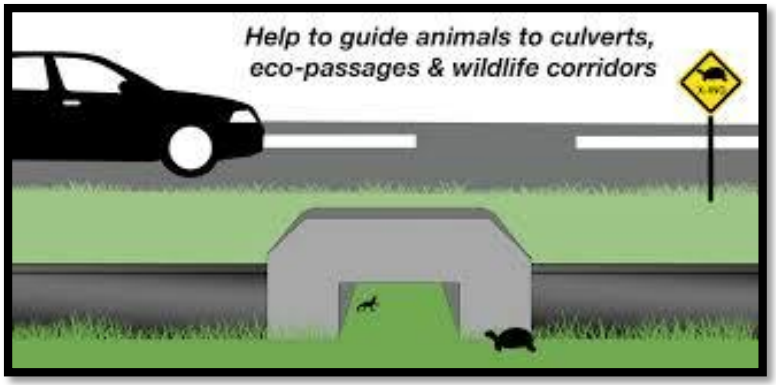
Modelling Landscape Permeability for Wildlife Movement



Circuitscape

Bowman and Cordes, 2015

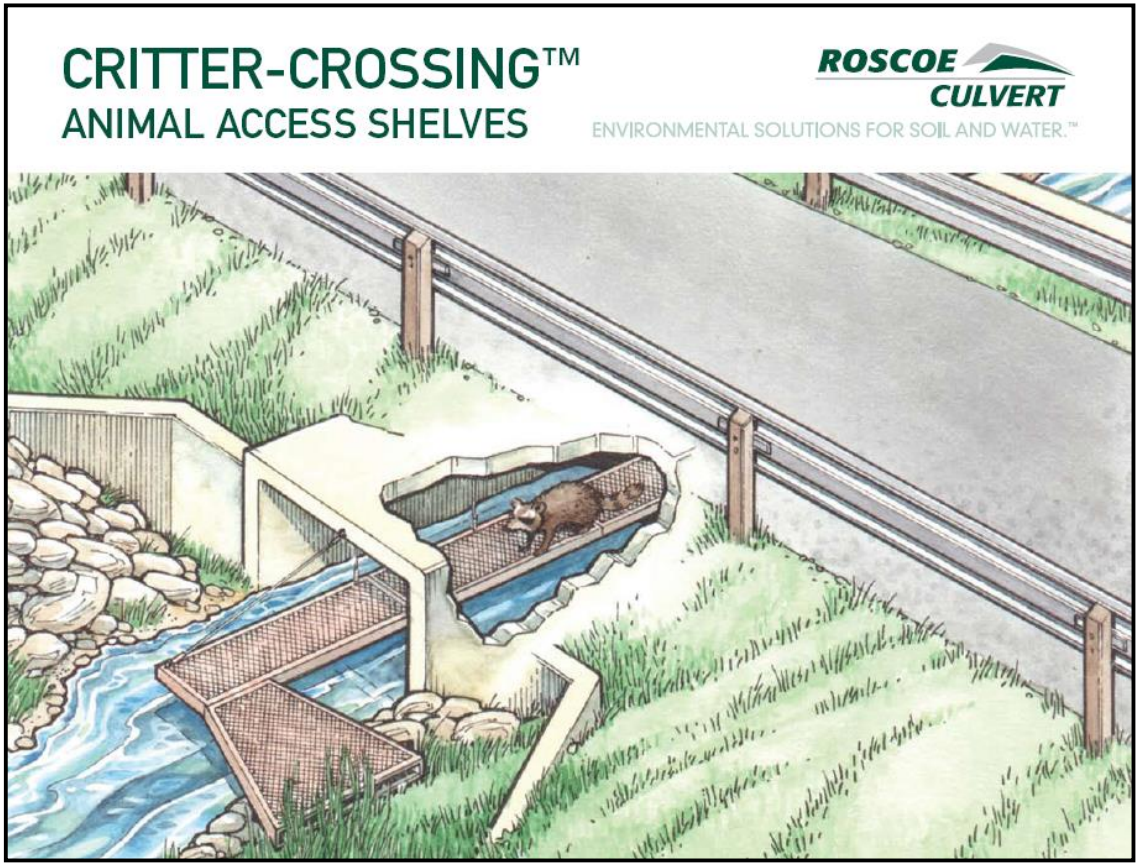
Wildlife Crossings & Fencing



Ontario Road Ecology Group

Passage Design

- Approach
- Aspect Ratio
- Line of Sight
- Light
- Moisture
- Bottom substrate
- Hydrology



Road Closures

*Collect Data

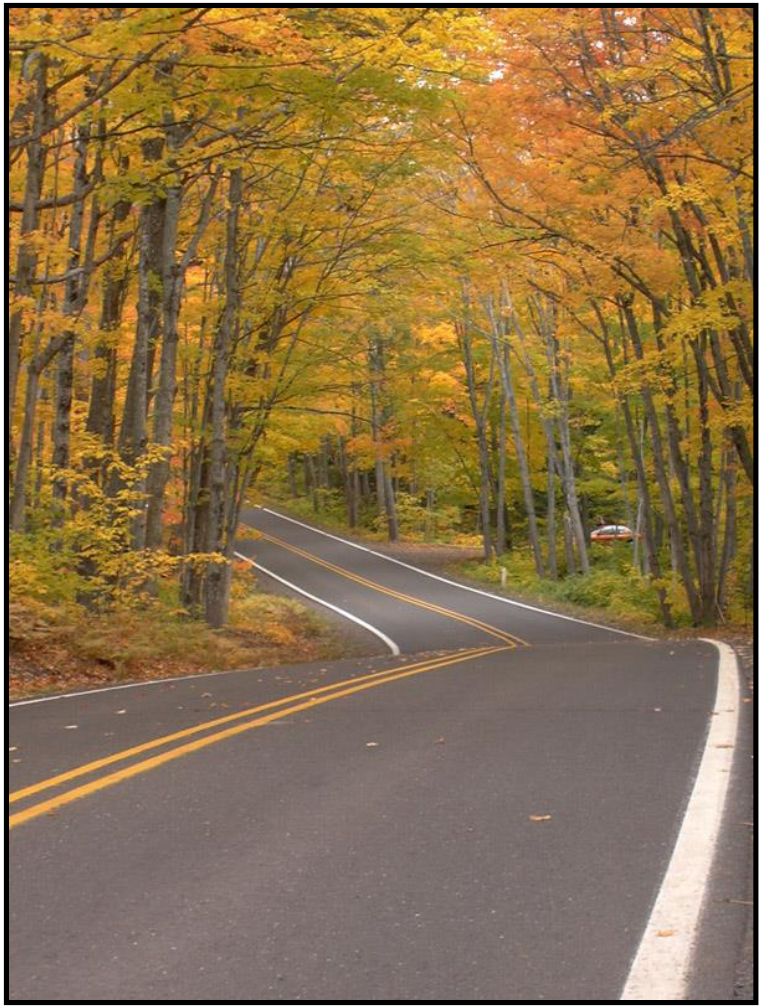
"The reaction was positive towards the road closure last year and shows how the community will support steps to protect the local environment," City of Burlington.

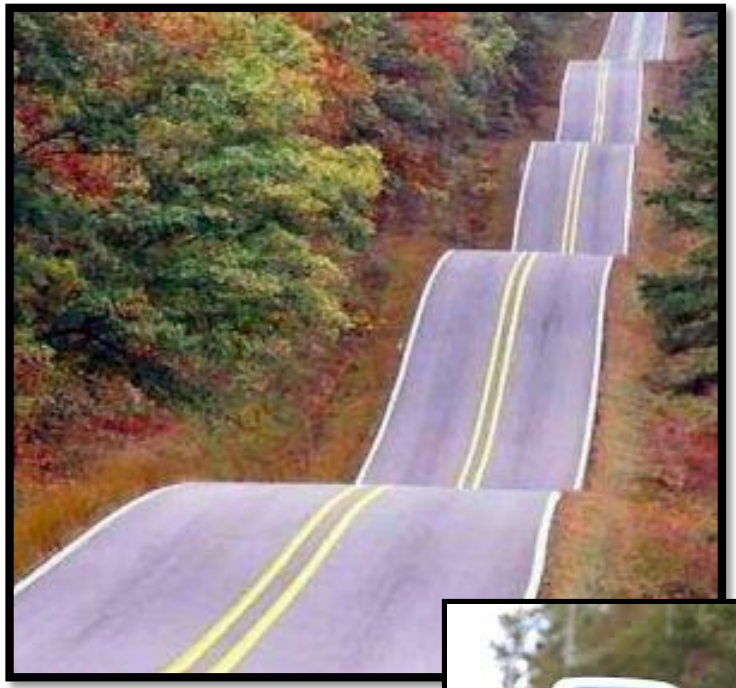
CITY OF Burlington

KITCHENER

Ontario Road Ecology Group

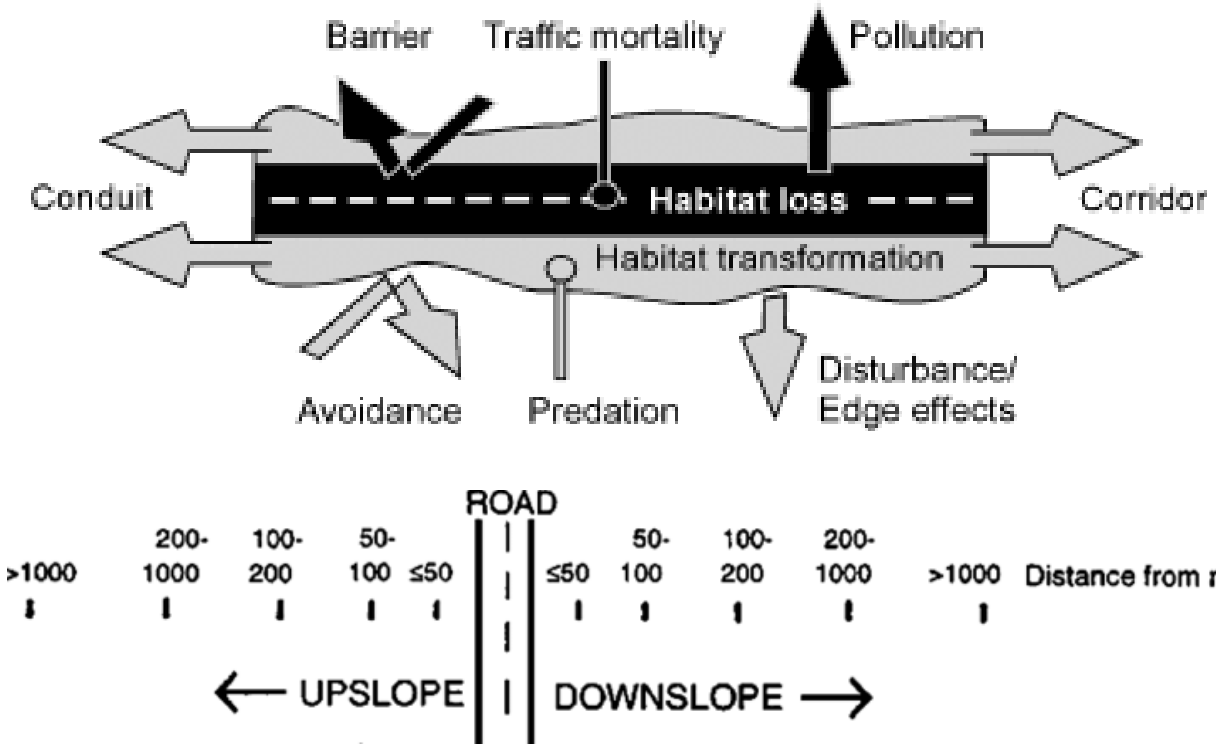
Road Design





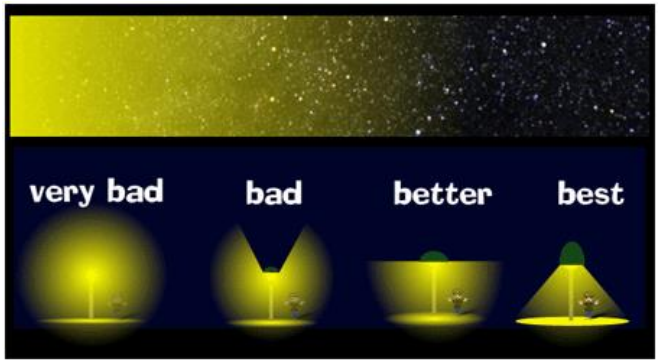
Mountable Curbs

Ecological Road Effect Zone

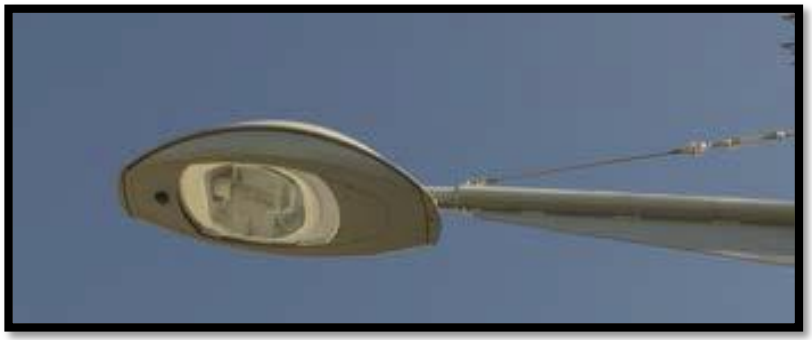


Seiler 2001, adapted from Van der Zande *et al*. 1980 and Forman and Alexander 1998

Light Mitigation



- Full cutoff street lighting
  - Especially important in residential neighbourhoods where light at night may impact human health.
- Dimming, motion detection, colour, etc.



Full Cutoff Street Light

TORONTO

Ontario Road Ecology Group

Vegetation Management/Grading

- Blade height (Mow to a min. of 20 cm)
- Schedule

Timing of Work Window – Mowing, Brush Control, Tree and Shrub Maintenance		
Species / Region	Ground, Tree, and Shrub-Nesting Birds	Turtles, Snakes, and Lizards
West	September 16 – May 14	July 11 – April 14
Central	September 16 – May 14	July 11 – April 30
East	September 16 – May 14	July 11 – April 30
Northwest	August 2 – May 14	No protected species.
Northeast	August 2 – May 14	July 11 – April 30

Ontario

Ontario Road Ecology Group

Kingston Public Works alters road work schedule to reduce impact on turtle nests

- Started regular road maintenance grading earlier to get it done in sensitive areas before the start of nesting season, which goes from mid-May into September.
- To further minimize impacts, Public Works is training staff to identify nesting areas.
- "We can then mitigate our impact as much as possible but also preserve public safety."

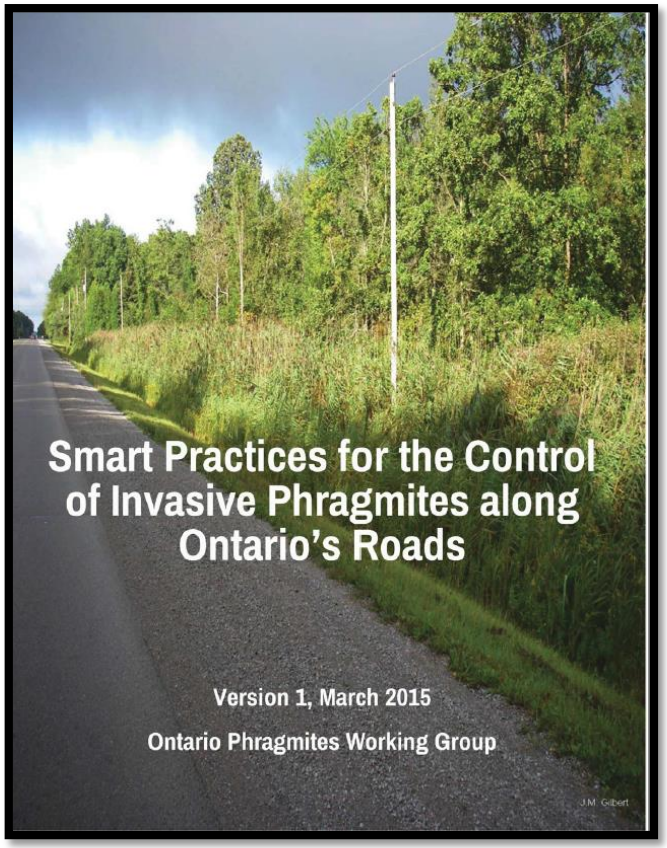
Bill Linnen, Director, Public Works

KINGSTON

Ontario Road Ecology Group

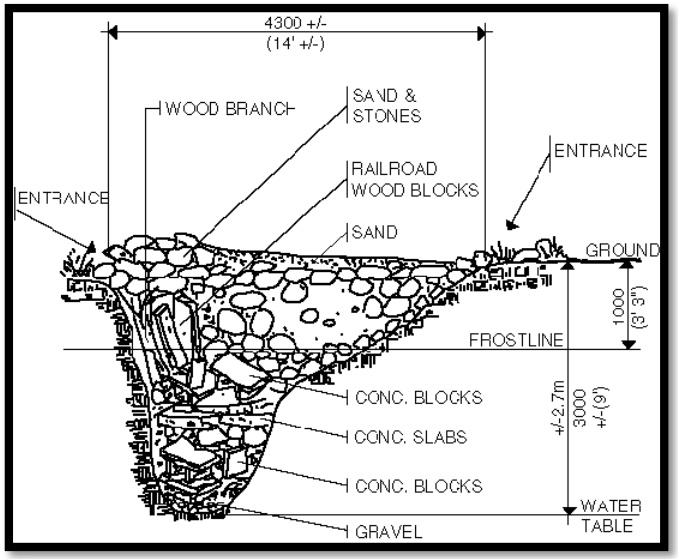
Construction Methods

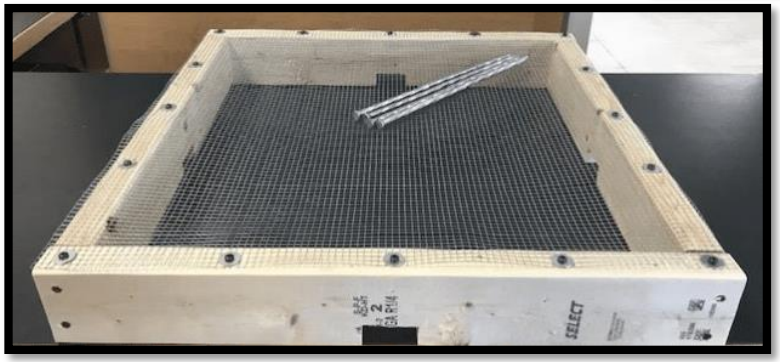
- Minimize spread of invasive species
  - *Phragmites australis* control



Herbicide/Insecticide/Ice Control

Habitat Creation/Protection



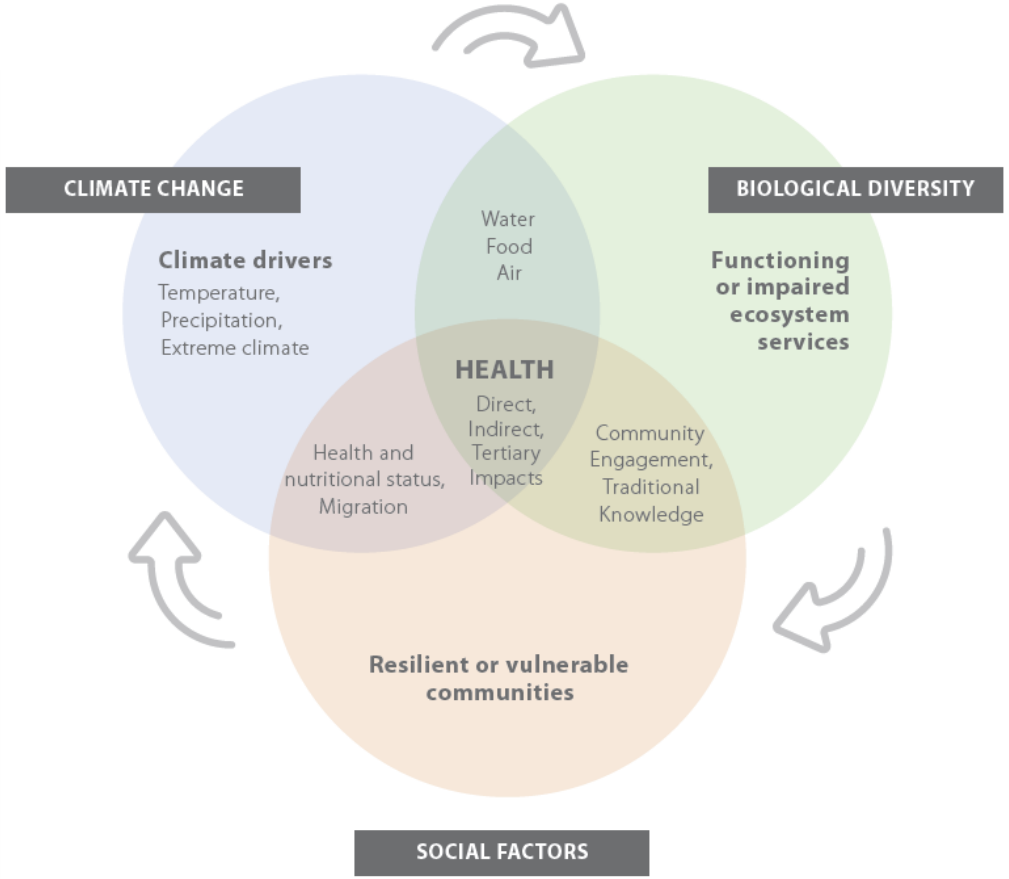


Ontario Road Ecology Group

Monitor

Maintenance

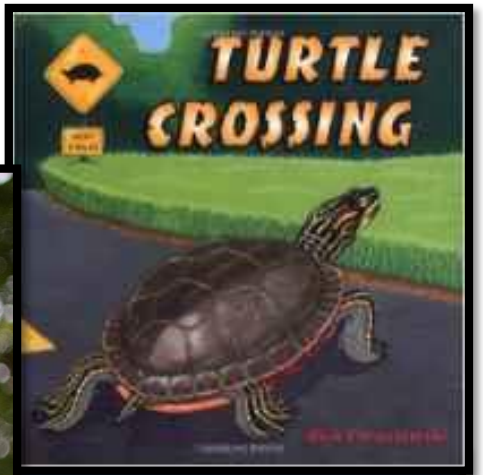
- Once mitigation is installed, budget for monitoring and maintenance of the infrastructure within the road right of way.
  - Fencing – repairs, maintain vegetation
  - Culverts – clean out, approach

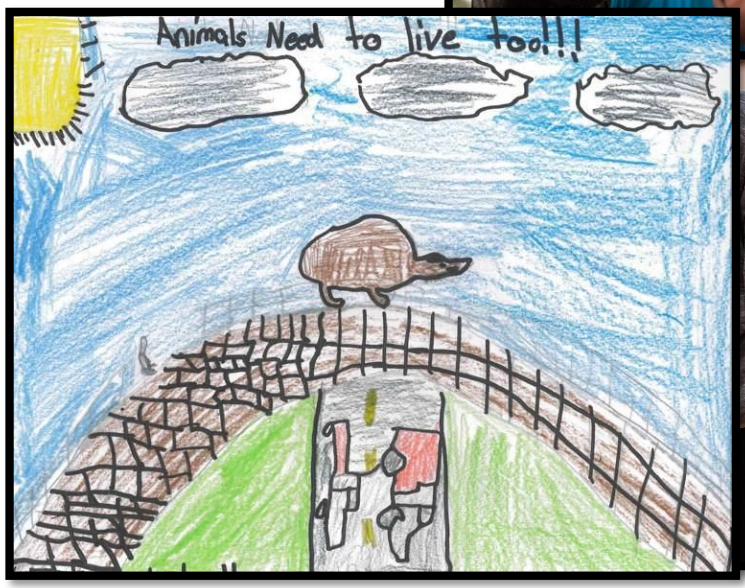


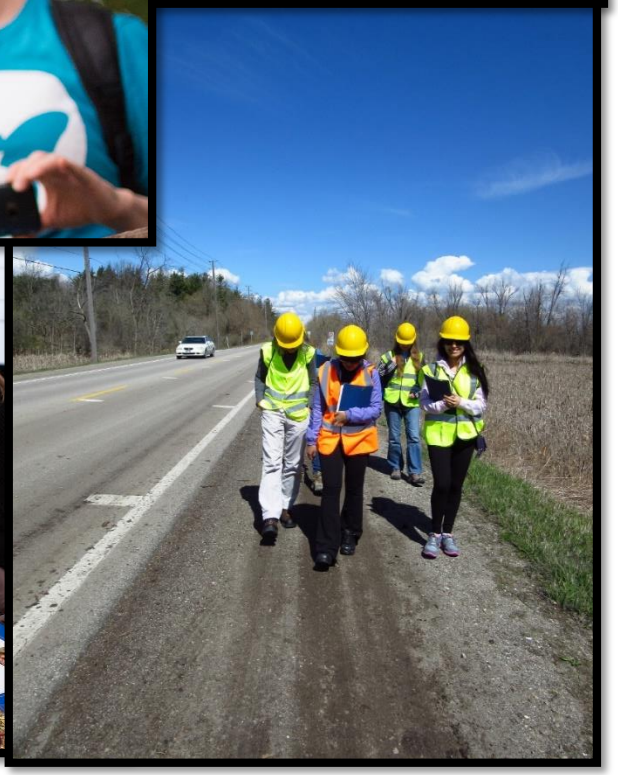
Putting health at the Centre:
Climate change, biological diversity and social factors influencing the health and wellbeing of current and future generations.
(WHO, 2016)

Community Engagement

- Educate
- Empower
- Stewardship







The Public CARES!

Citizen Science

- Collect Data
- Road Ecology Ambassadors
- Motivate Municipal Action

Toronto and Region Conservation for The Living City

BRAMPTON Flower City
brampton.ca

Ontario Road Ecology Group

10th Year Review of ESA

These changes propose to gut the cornerstones of the law that made species recovery and survival possible.

This move is regressive and dangerous.

Condemn these changes in the **strongest** possible terms, and call for the Government to reconsider immediately.

Ontario Nature

DAVID SUZUKI FOUNDATION
One nature.

environmental defence


Ecopassage


2015-06-15 4:28:36 PM M 2/2
32°C


A


ANS

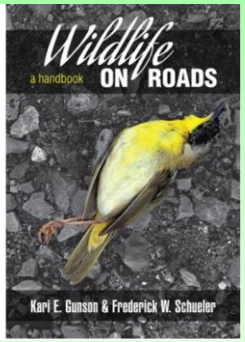
ontarioroadecologygroup@gmail.com

Thank you

Road-Connectivity Planning in S. Ontario

Presented by: Kari E. Gunson
24-April-2019

CANADIAN MARITIMES
ECOLOGICAL
CONNECTIVITY
FORUM



www.eco-kare.com

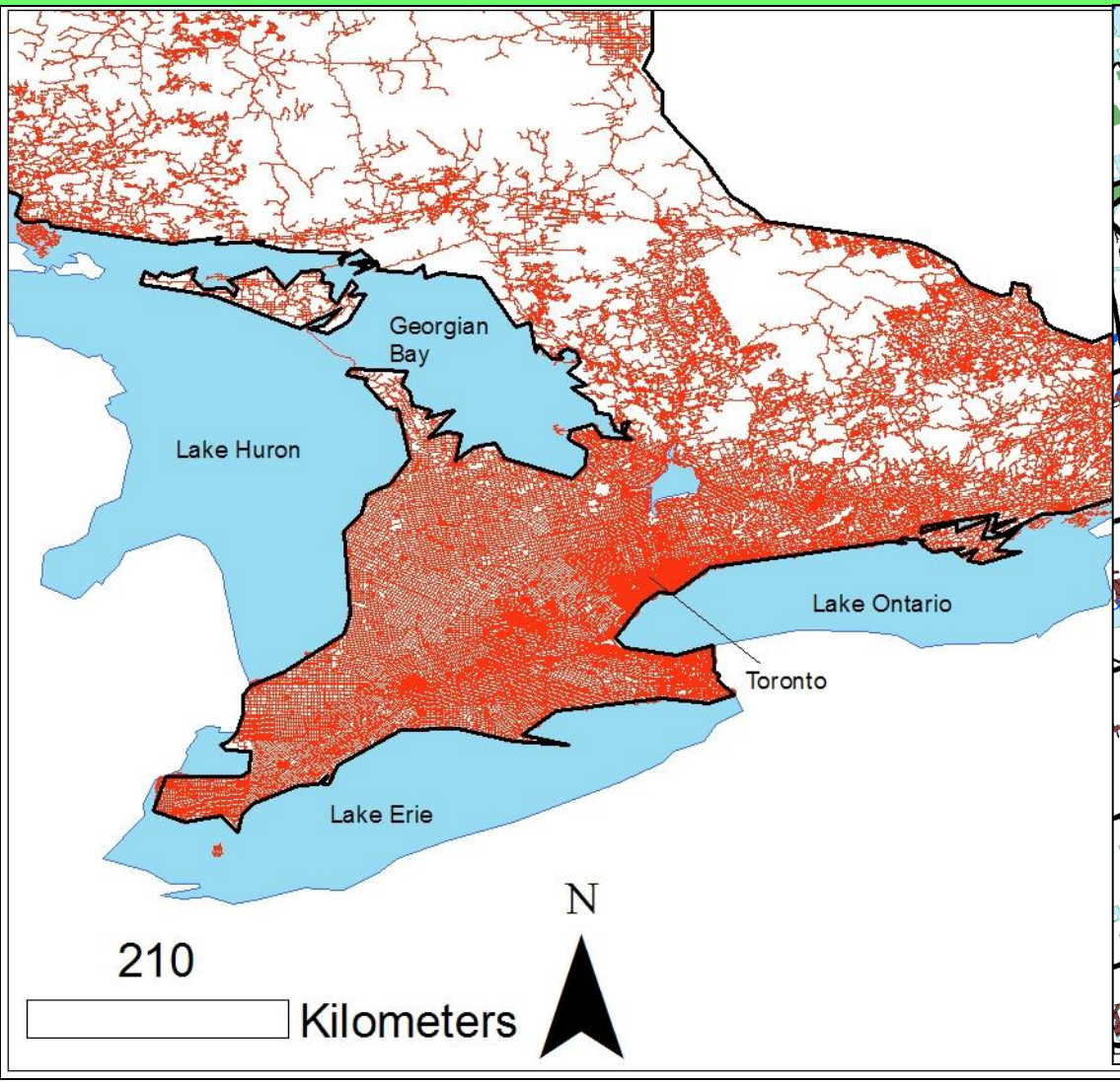

Kenny Reulland

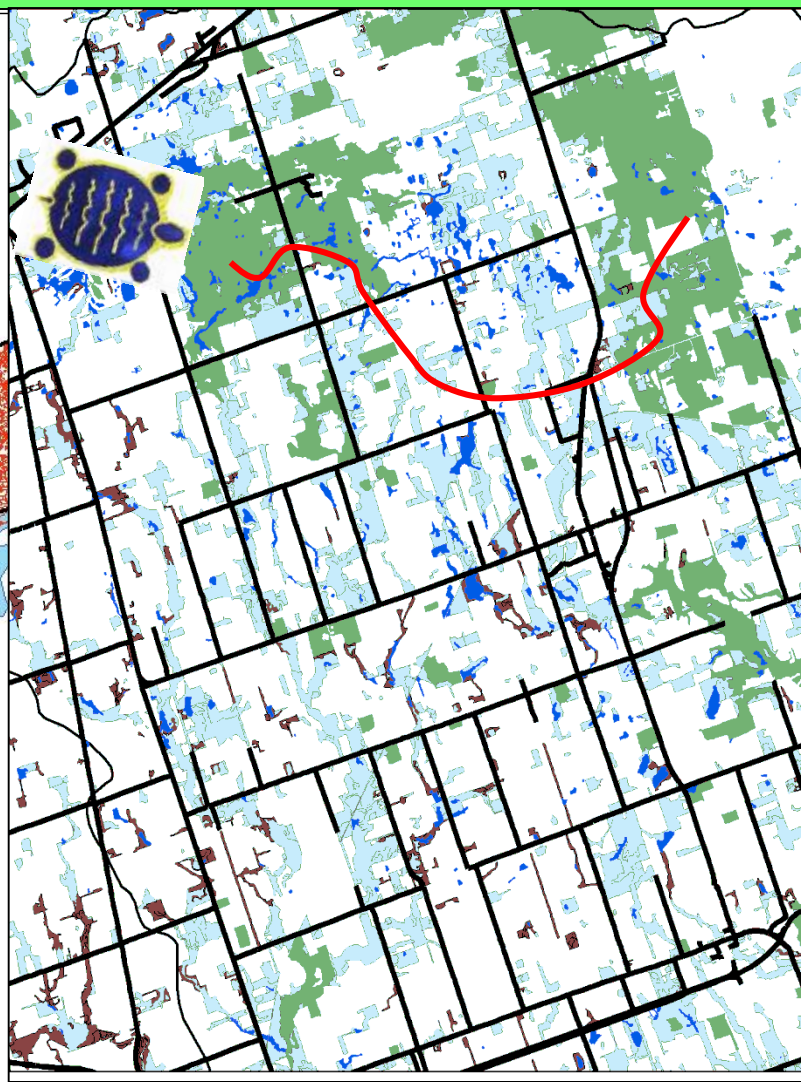

Mandy Karch


Don Scallen

Outline

- Southern Ontario
  - Many roads, jurisdictions, and biodiversity
  - Focus on reptiles and amphibians for this presentation = puts scale into perspective
- Integrating connectivity into transportation planning
  - Timeline
  - Methodology
  - Guideline documents
- Where and what
  - Mitigation strategies



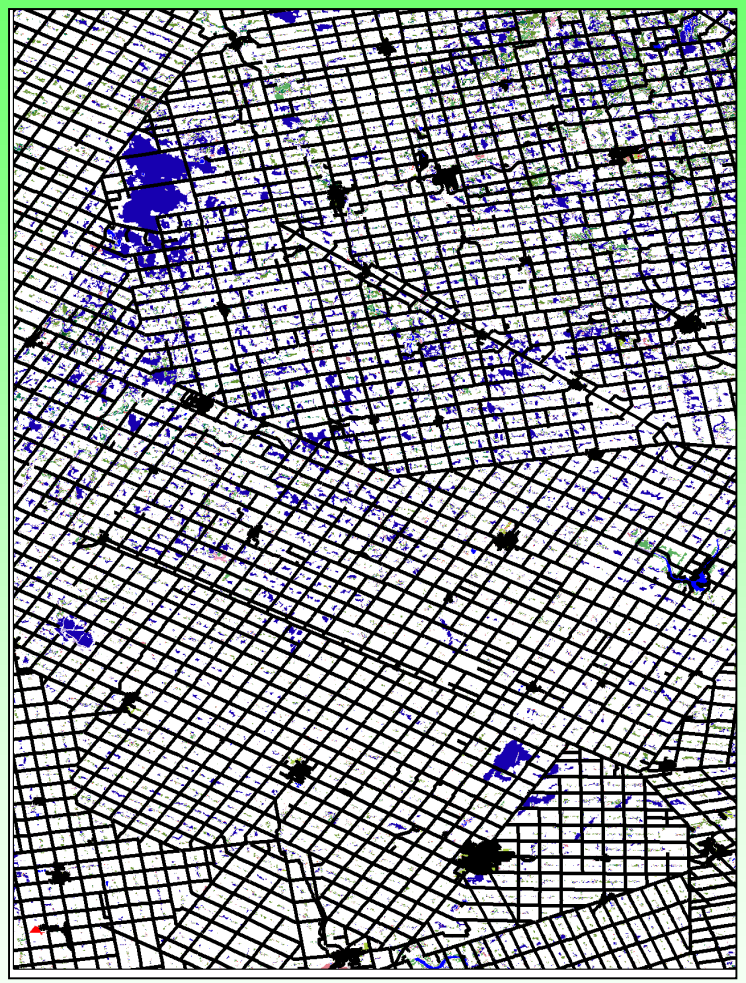


Southern Ontario harbours the largest species diversity and road density in Canada….

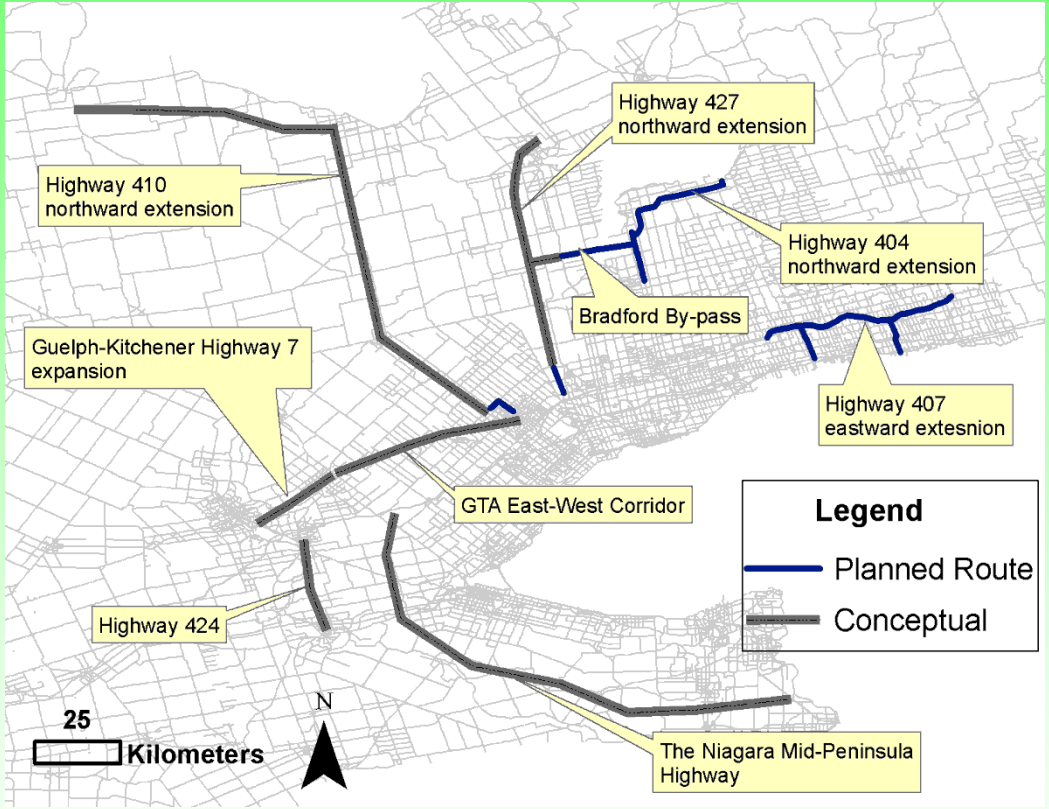
Turtle Distribution (10 x 10 km grid cells, data source Ontario Herpetofaunal Atlas-2010)

Snake Distribution (10 x 10 km grid cells, data source Ontario Herpetofaunal Atlas-2010)

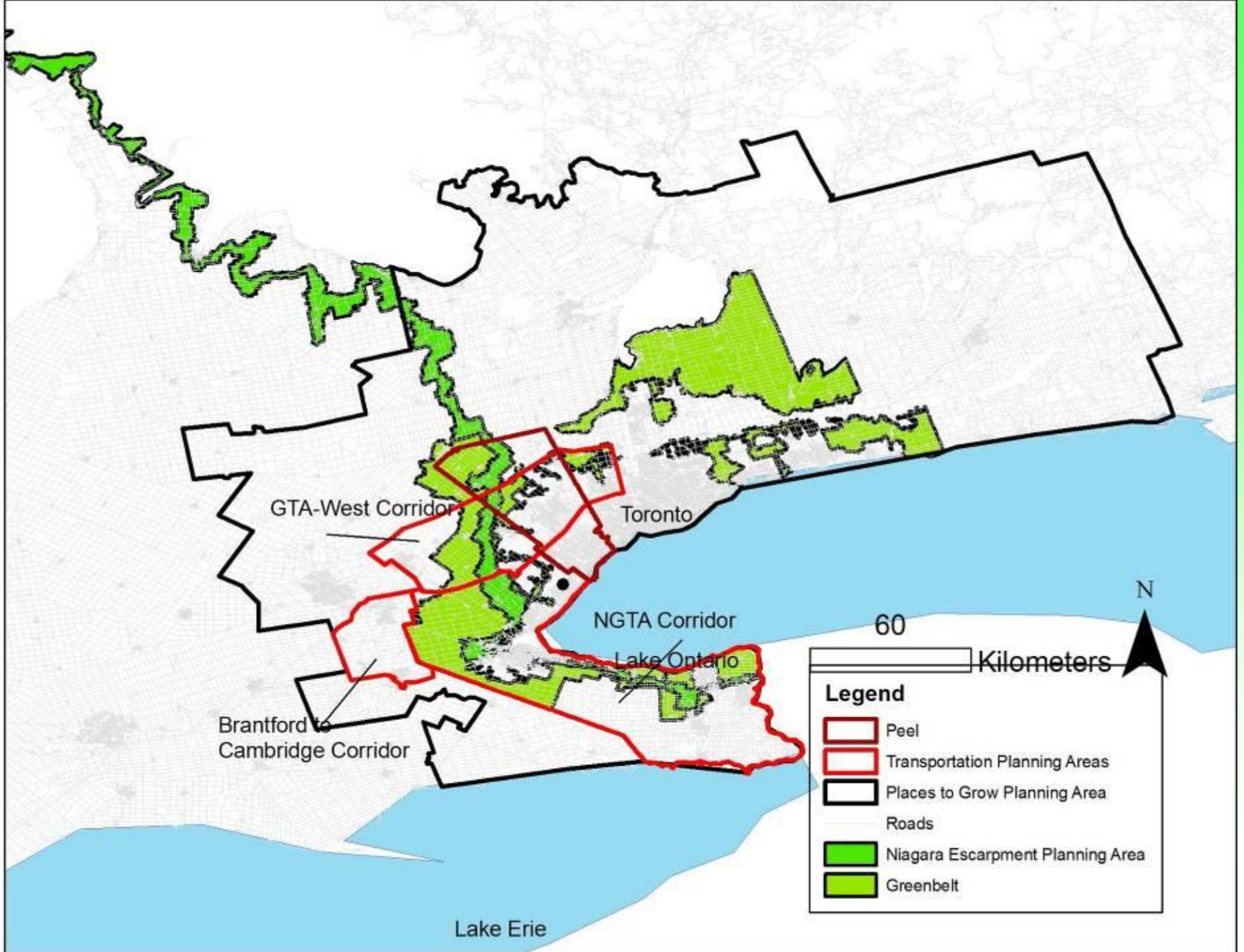
Amphibian and Skink Distribution (10 x 10 km grid cells data source Ontario Herpetofaunal Atlas-2010)



Municipal Roads



Planned Super Highways……


GTA-West Corridor
Toronto
NGTA Corridor
Lake Ontario
Brantford to
Cambridge Corridor
Lake Erie
N
60
Kilometers
Legend
Peel
Transportation Planning Areas
Places to Grow Planning Area
Roads
Niagara Escarpment Planning Area
Greenbelt

2008 – Ontario Road Ecology Group development of a predictive model for wetland-forest animals across all roa

NORTH-WESTERN JOURNAL OF ZOOLOGY 8 (2): 409-413 ©NwjZ, Oradea, Romania, 2012
Article No.: 121401 http://biozoojournals.3x.ro/nwjz/index.html

IENE 2010 International Conference on Ecology and Transportation
"Improving Connections in a Changing Environment"
September 27 - October 1, Velence, Hungary

A tool to prioritize high-risk road mortality locations for wetland-forest herpetofauna in southern Ontario, Canada

Kari E. GUNSON[1,*], Dave IRELAND[2] and Fred SCHUELER[3]

1. Corresponding author: Eco-Kare International, 644 Bethune Street, Peterborough, Ontario,

2009 – Eco-Kare International

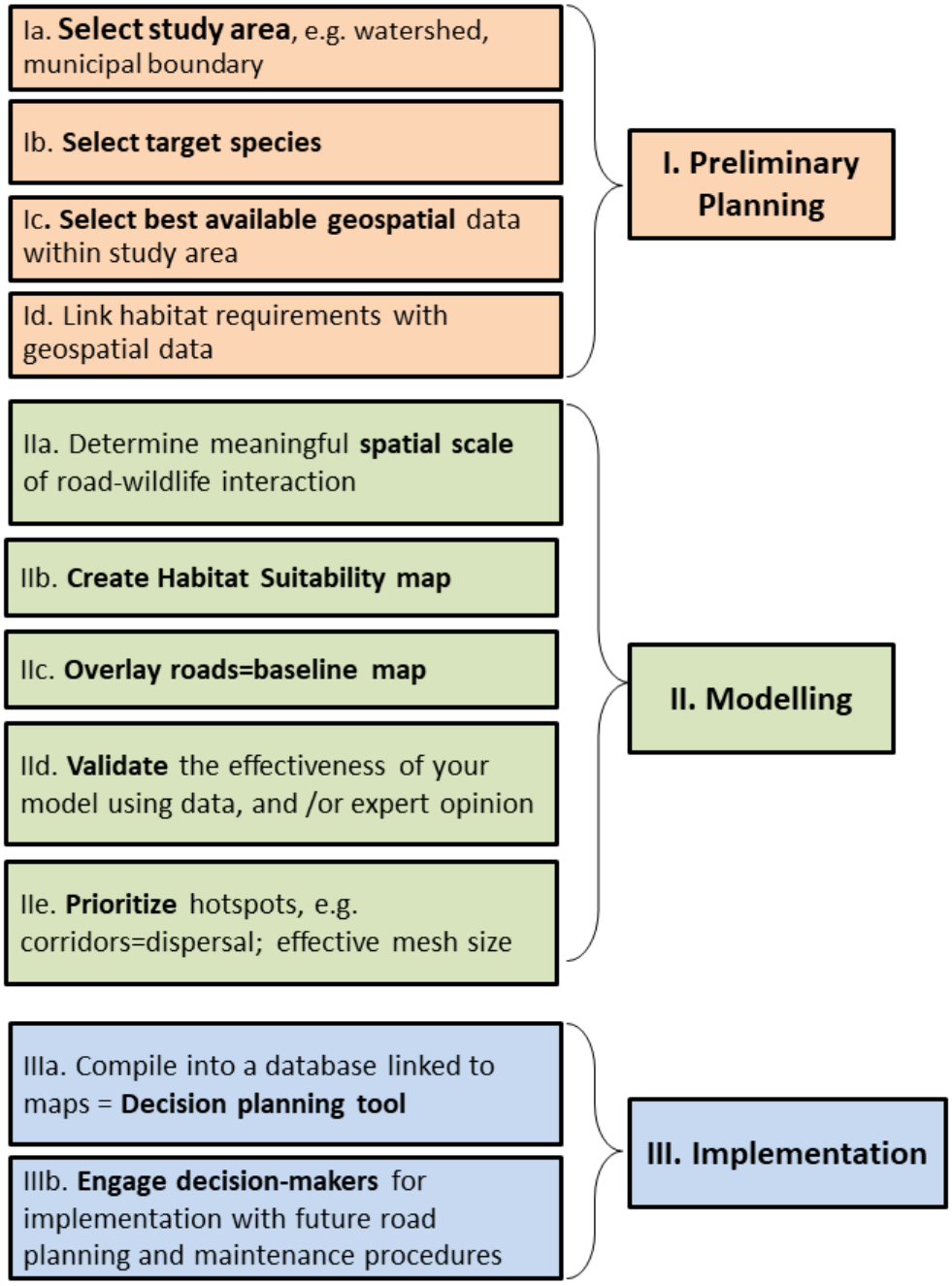
2010-2014 – MTO Road Ecology Strategy: provincial scale

2010-2014 – MNRF academic and research collaboration: using circuitscape

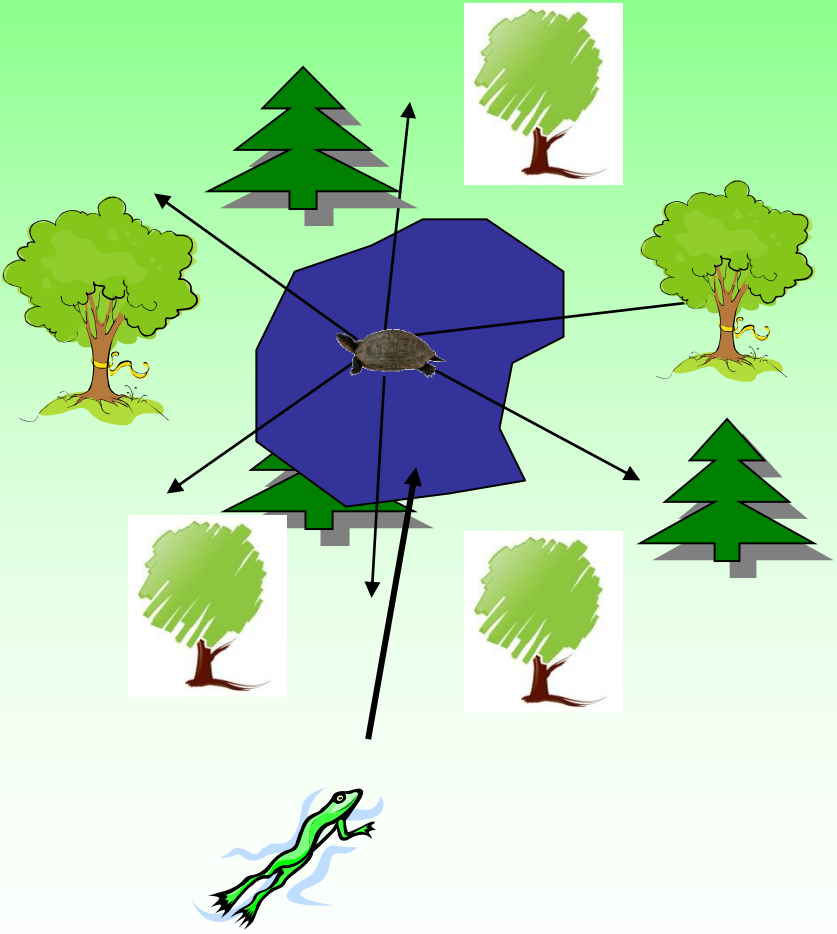
2013 – Oakville Road Ecology Strategy

2015 – Conservation Authority planning: watershed scale, e.g., TRCA, CLOCA, Halton, Raisin, Lake Simcoe, Credit Valley

2019 – Grand River, Norfolk County integrate all methods from above


Ia. Select study area, e.g. watershed, municipal boundary
Ib. Select target species
Ic. Select best available geospatial data within study area
Id. Link habitat requirements with geospatial data
I. Preliminary Planning
IIa. Determine meaningful spatial scale of road-wildlife interaction
IIb. Create Habitat Suitability map
IIc. Overlay roads=baseline map
IId. Validate the effectiveness of your model using data, and /or expert opinion
IIe. Prioritize hotspots, e.g. corridors=dispersal; effective mesh size
II. Modelling
IIIa. Compile into a database linked to maps = Decision planning tool
IIIb. Engage decision-makers for implementation with future road planning and maintenance procedures
III. Implementation

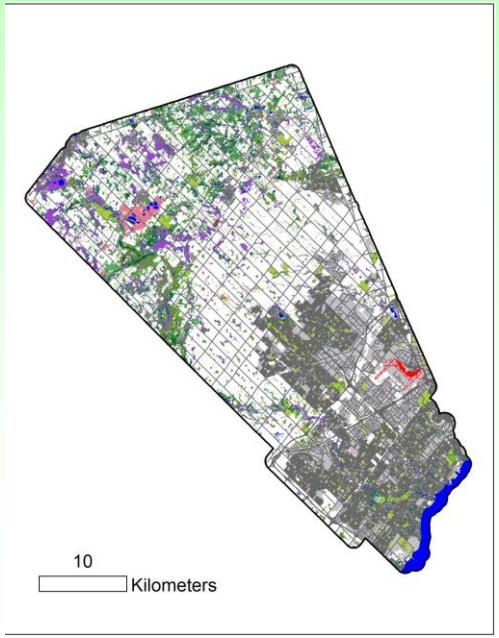
I. Preliminary planning

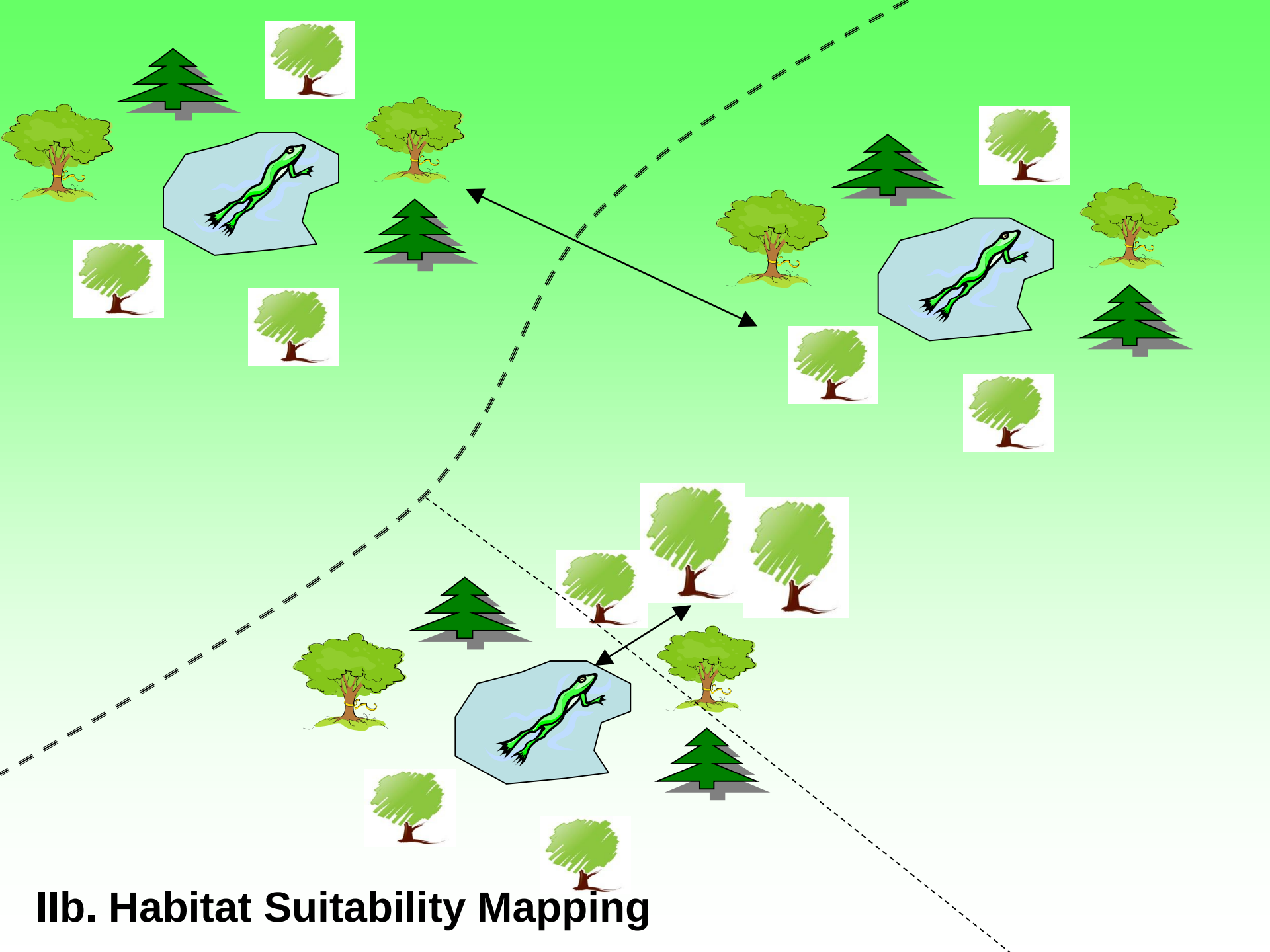


- Species at risk-
  e.g. blanding's turtle OR common species – e.g. Spring peepers, wood frogs

- Wetlands and forests are easily identified geospatially

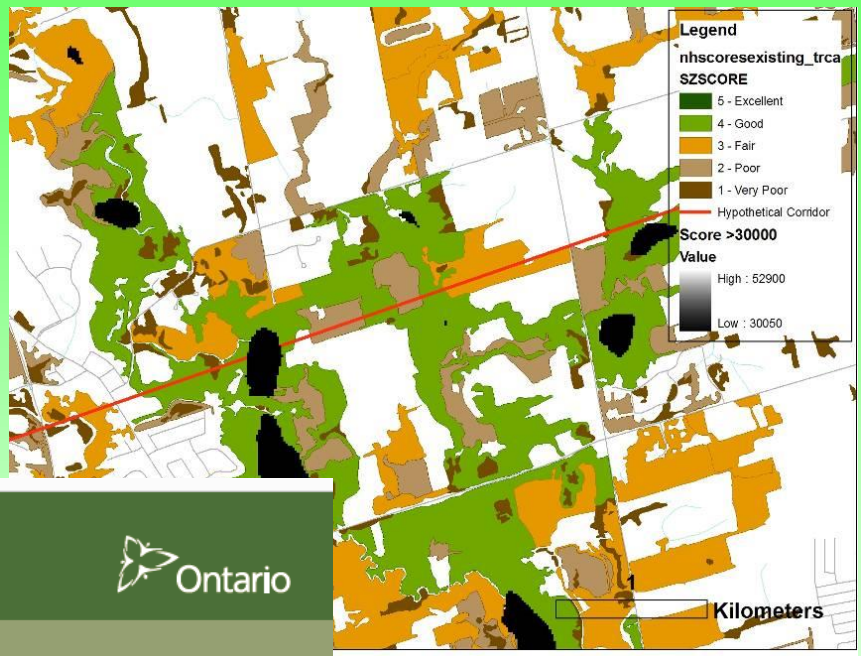
- Region of peel, e.g. municipal or Watershed scale





IIb. Habitat Suitability Mapping

IIc. Overlay other models, mapping



Ontario

Natural Heritage Reference Manual

for Natural Heritage Policies of the Provincial Policy Statement, 2005

Working Draft for Environmental Registry
May 21, 2009

Second Edition

Methods in Ecology and Evolution

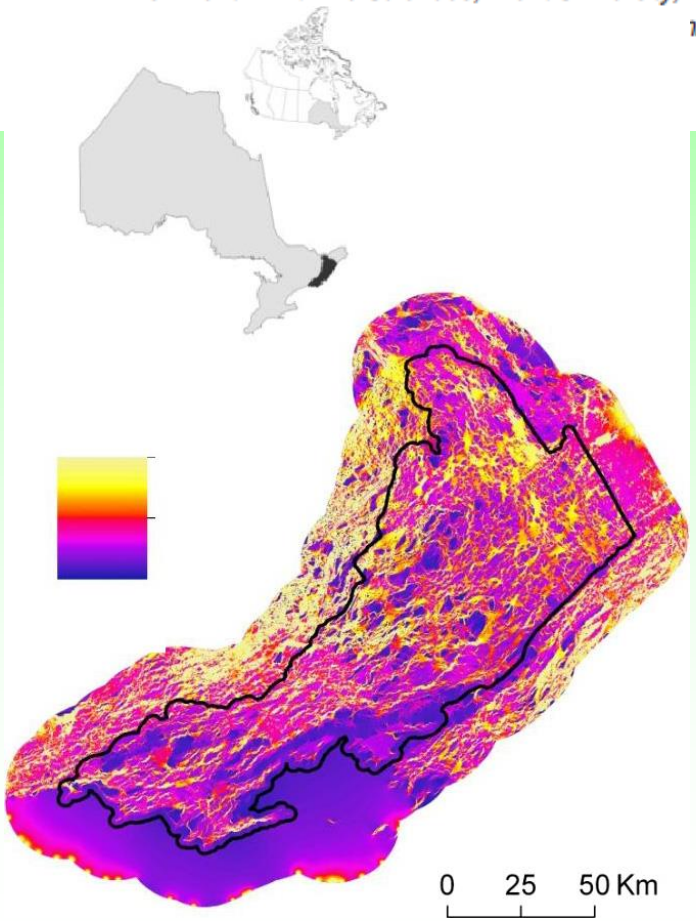
British Ecological Society

Methods in Ecology and Evolution 2014, 5, 626–633 doi: 10.1111/2041-210X.12197

Landscape connectivity for wildlife: development and validation of multispecies linkage maps

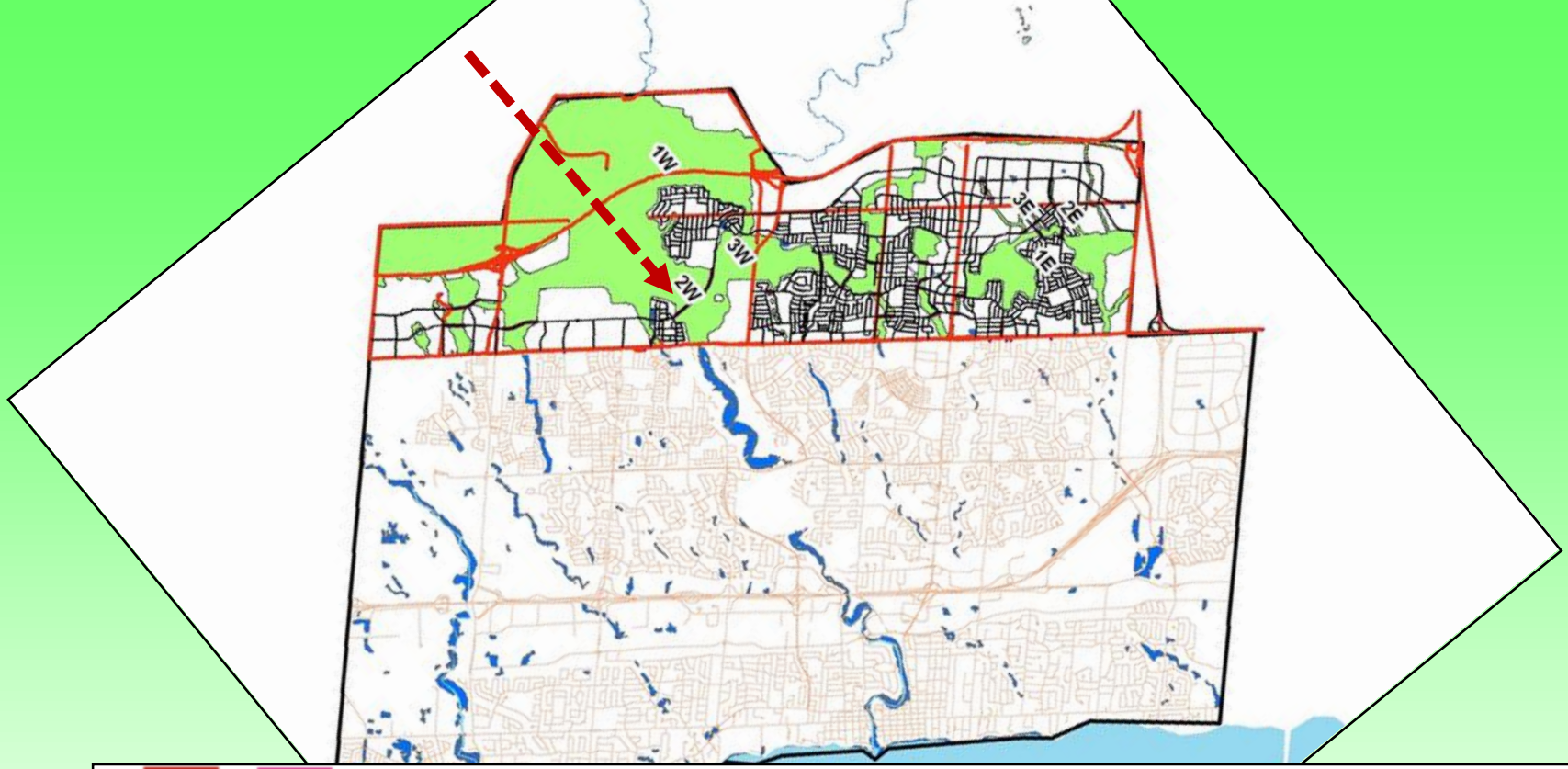
Erin L. Koen[1]*, Jeff Bowman[2], Carrie Sadowski[2] and Aaron A. Walpole[2]

[1]*Environmental and Life Sciences, Trent University, 1600 West Bank Drive, Peterborough, Ontario K9J 7B8, Canada; and*
istry of Natural Resources, 2140 East Bank Drive, Peterborough, Ontario

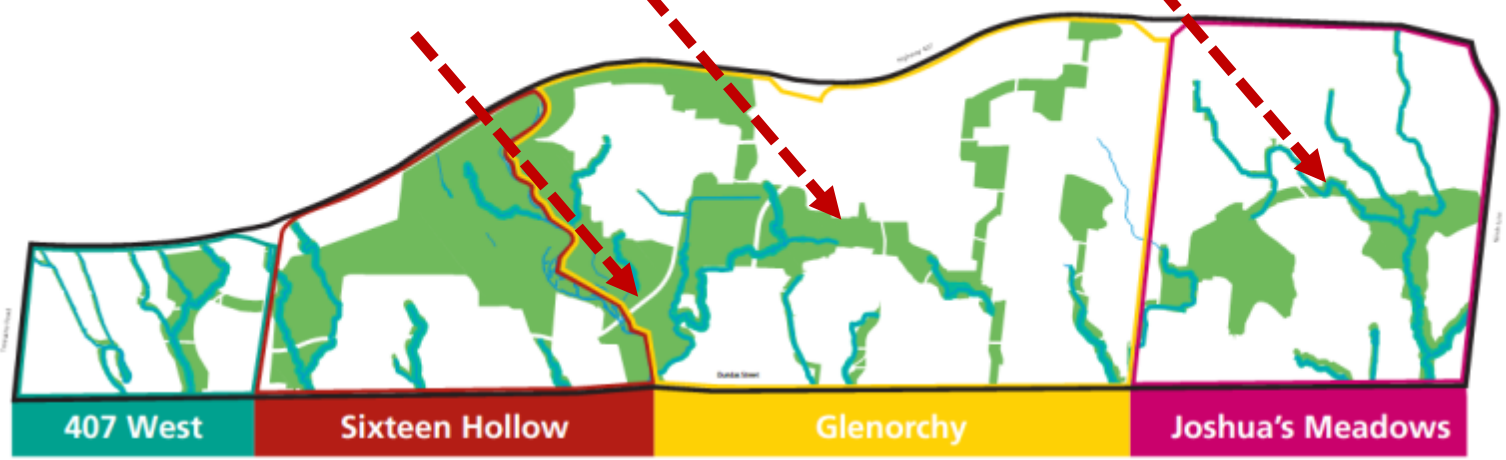


amphibians and reptiles were more likely to cross roads in areas of high current density =yellow areas

Currently expanding on these methods in the Grand River watershed



The New Communities of Oakville



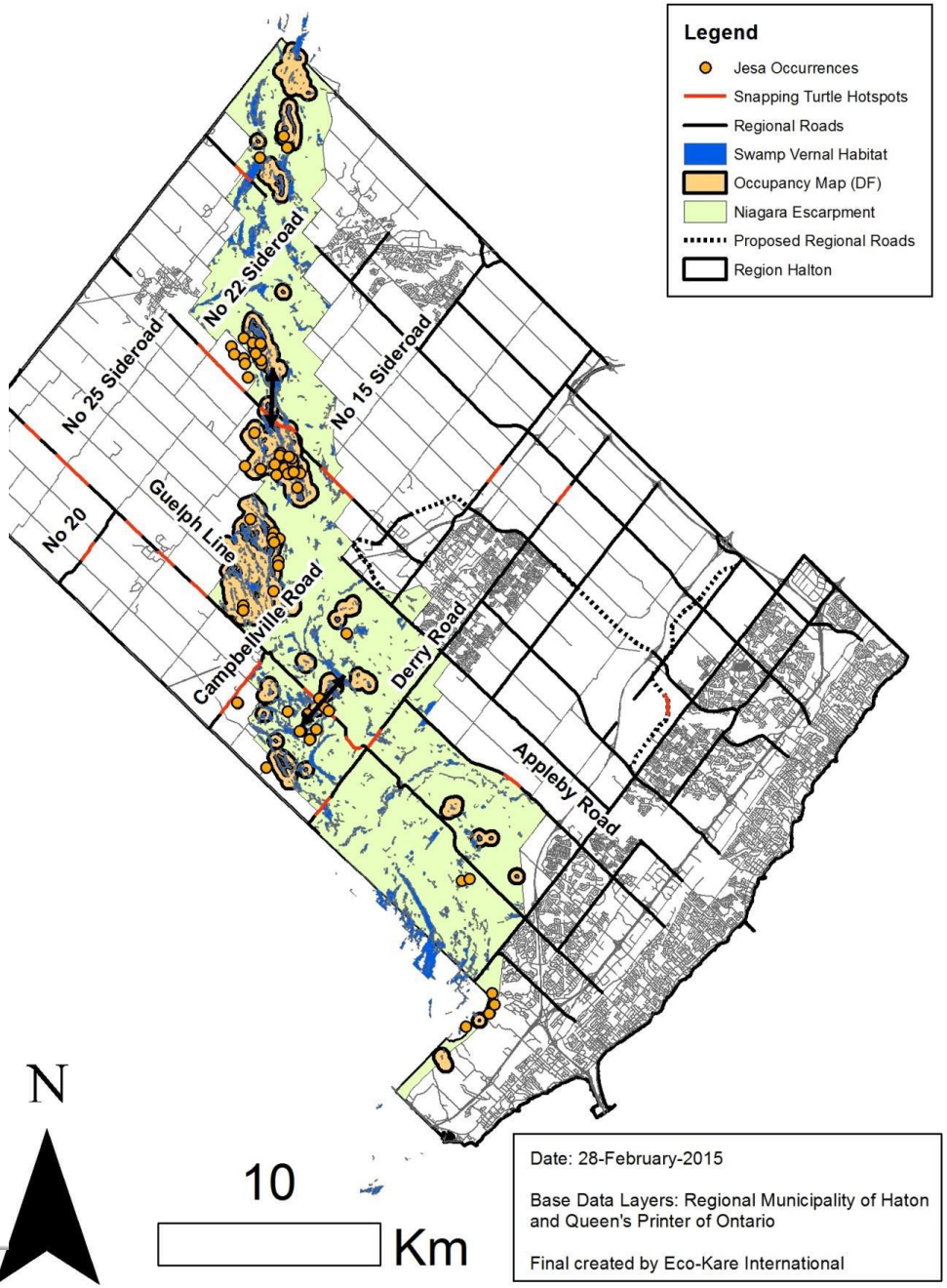
Halton Region Species at Risk Road Mortality, Hotspot Mapping, and Evaluation of Wildlife Crossing Structure Opportunities

February 2015

Ontario

Assistance for this project was provided by the Government of Ontario

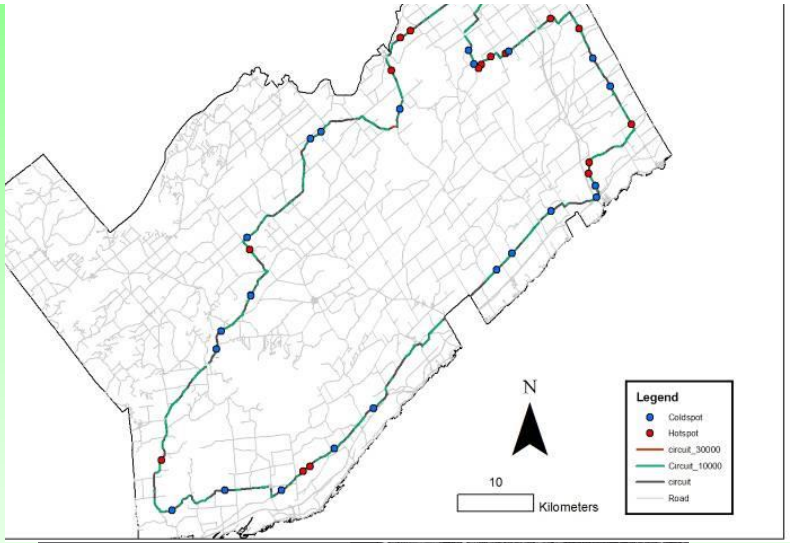
Tracking #: 80-14-MH_CH

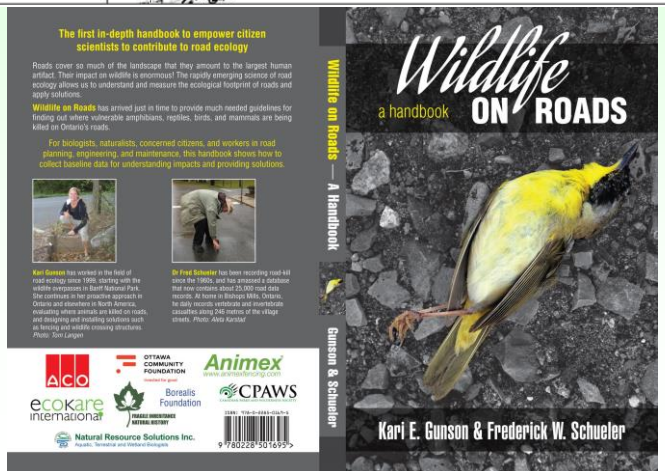


Validation

The Road Ecology Circuit in Leeds & Grenville

Frederick W. Schueler[1] and Kari E. Gunson[2]





Wildlife on Road Data Collection

Citizen scientists

Researchers

Students

Maintenance contractors

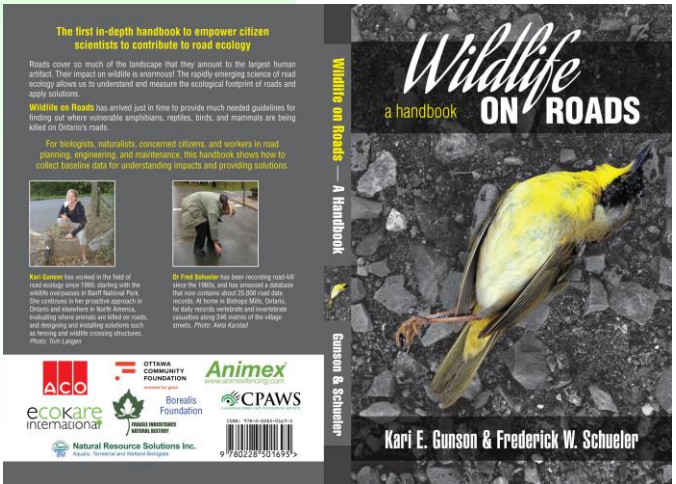
Awareness campaigns, press releases

Data collection (App or on-line form)

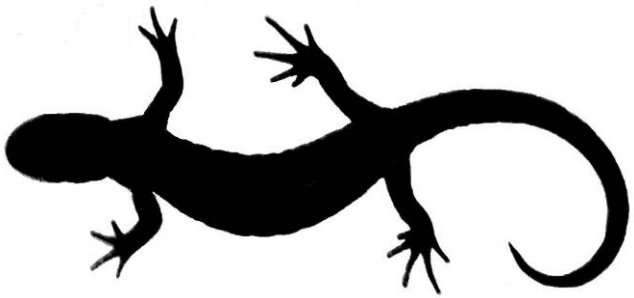
Partners and funders

Data management
On-line maps

Research summaries



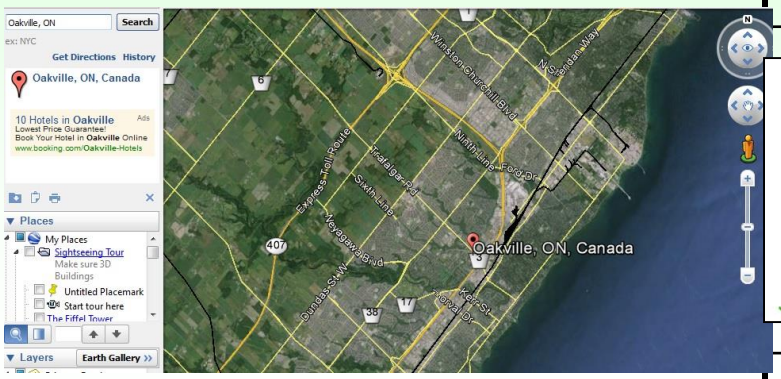
Adopt-A-Crossing

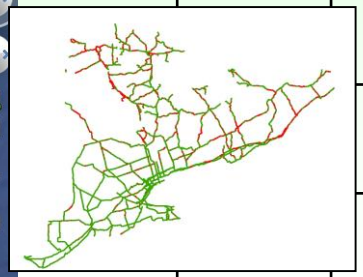


Good Start But:

- Implementation and involvement of stakeholders

Road	In NHS	Habitat Score	Circuit Density	Verified	Mitigation Strategy





What type of mitigation strategy?

-Decreased traffic volume, i.e. traffic calming

-Maintain road as gravel

-Signage plus speed bumps

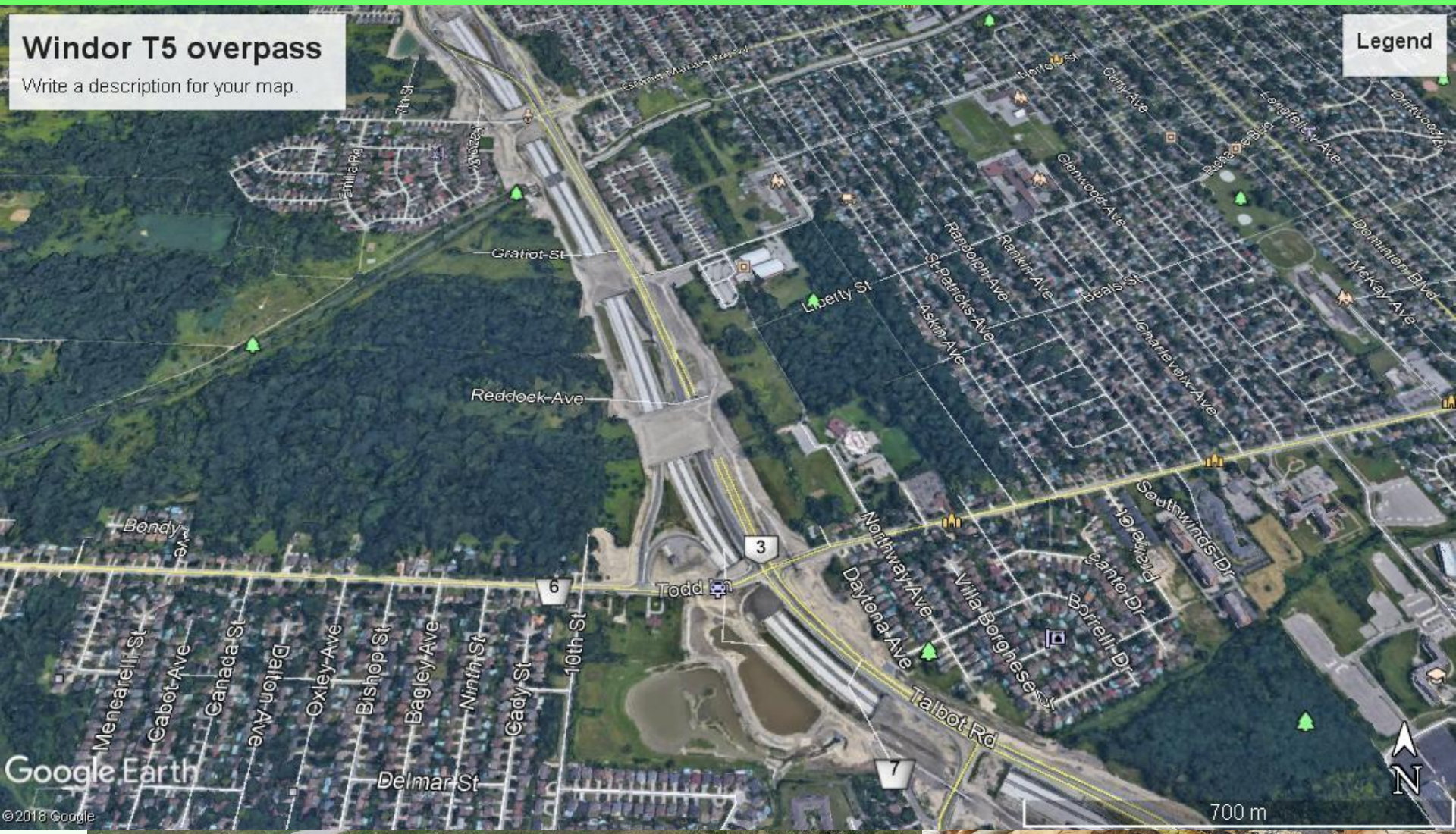
-Several underpasses with fencing

+

=

Crossing Structure-Underpass

Fencing Design-All types


Windor T5 overpass
Write a description for your map.
Legend
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Randolph Ave
St Patricks Ave
Rankin Ave
Askin Ave
Glenwood Ave
Charlevoix Ave
Dominion Blvd
McKay Ave
Bondy Ave
Todd
Northway Ave
Daytona Ave
Villa Borghese
Borrelli Dr
Santo Dr
Southwinds Dr
Talbot Rd
Mencarelli St
Cabot Ave
Canada St
Balon Ave
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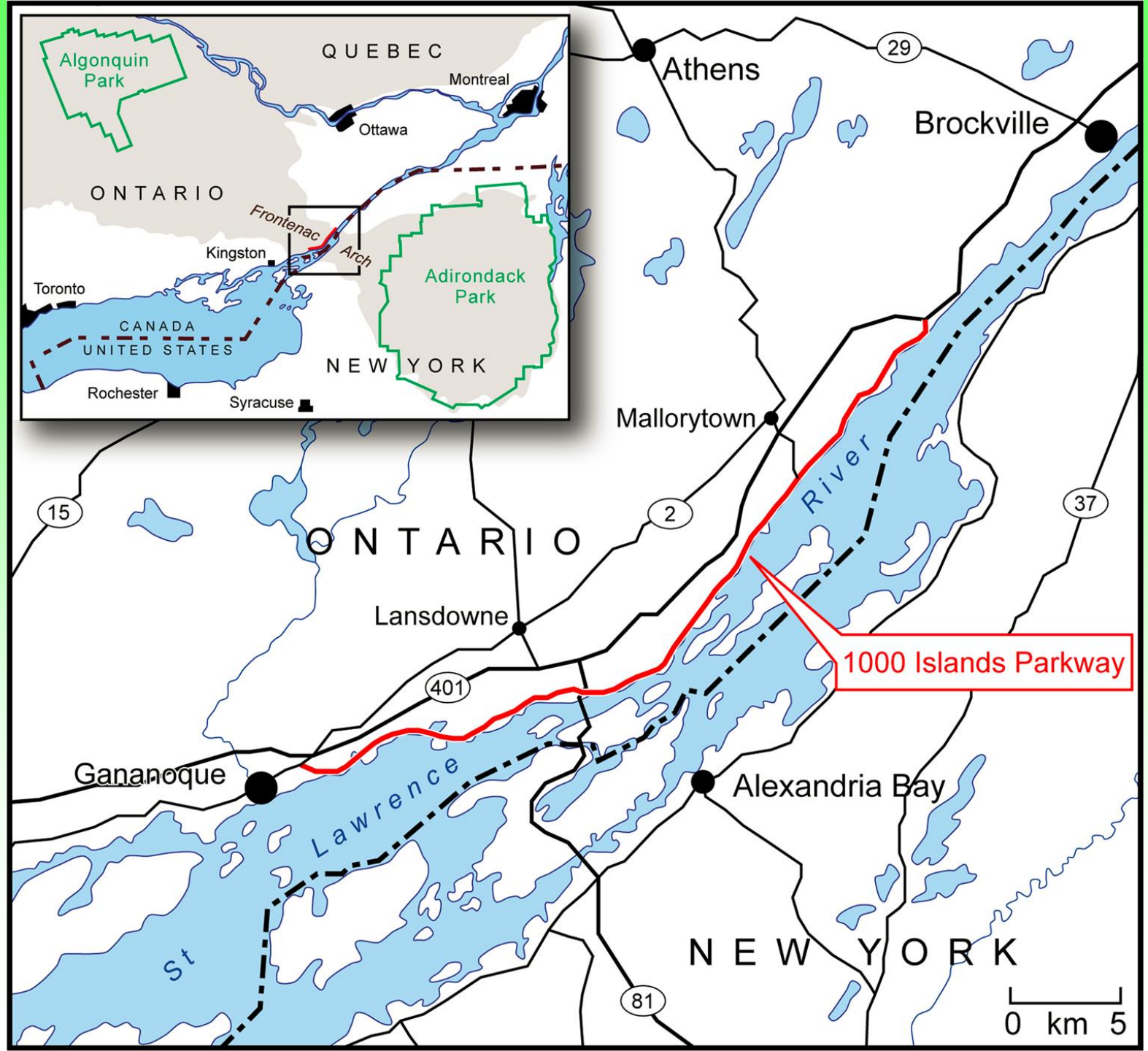
Algonquin Park
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Kingston
Toronto
CANADA
UNITED STATES
Adirondack Park
NEW YORK
Rochester
Syracuse
Athens
29
Brockville
Mallorytown
River
37
15
2
ONTARIO
Lansdowne
1000 Islands Parkway
401
Gananoque
Alexandria Bay
St Lawrence
NEW YORK
81
0 km 5

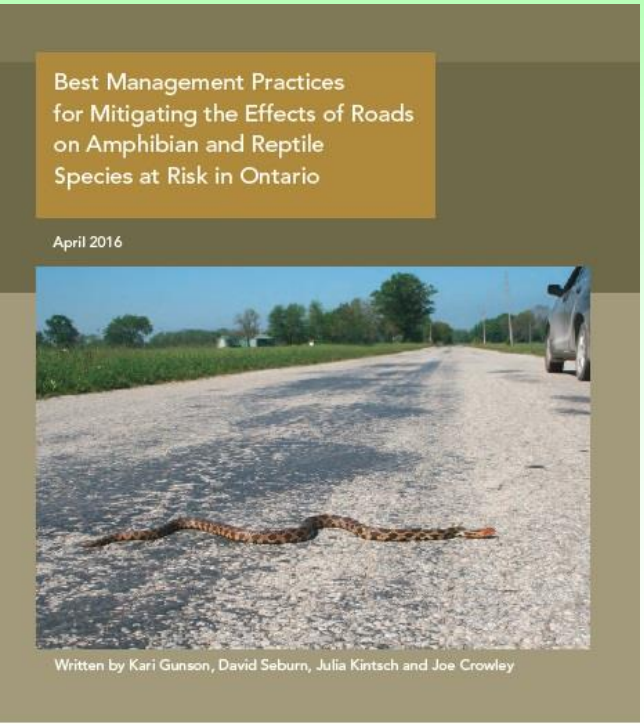
Guideline documents

TABLE 1: CLOCA DECISION MATRIX FOR EVALUATING WILDLIFE MOVEMENT POTENTIAL ACROSS ROADS[2]

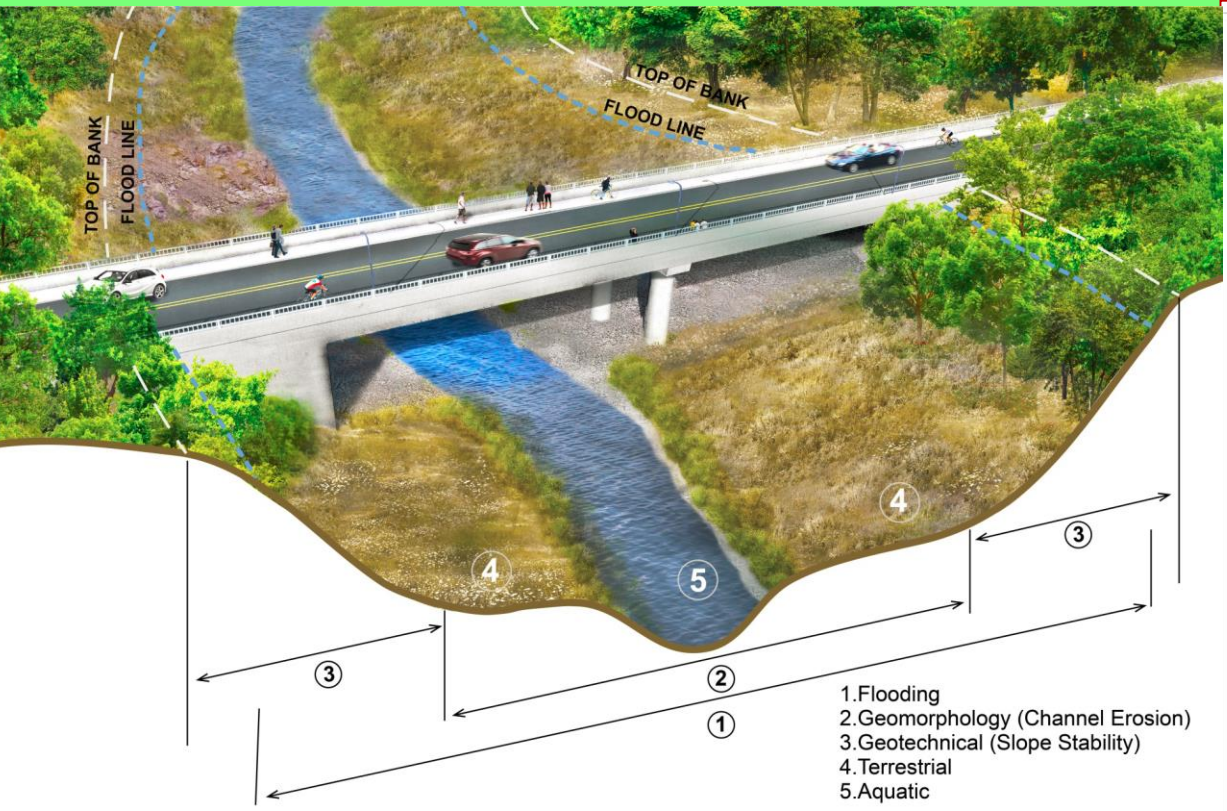
CRITERIA	VALUE
• Culvert height ≥ 3.0 m • OR ≥ 0.6 m • Terrain is present along entire length of culvert/bridge	**EXCELLENT** *(suitable for all wildlife)*
• Culvert height ≥ 1.0 m • OR ≥ 0.25 • Terrain is present along entire length of culvert/bridge	**VERY GOOD** *(suitable for small mammals and reptiles)*
• Culvert height ≥ 1.0 m • OR ≥ 0.1 • Terrain is present along entire length of culvert/bridge	**MODERATE** *(suitable for small mammals only)*
• Culvert height ≥ 0.5 m • OR ≥ 0.25 • Terrain may or may not be present	**MODERATE** *(suitable for reptiles and amphibians only)*
• Any breaks in the habitat network that do not meet the above 4 criteria, but where the barrier is a gravel road with a traffic volume < 3 cars/5 min	**MODERATE** *(low risk of mortality from cars)*
• Any breaks in the habitat network where a culvert exists, but does not meet the criteria in first 5 categories	**POOR** *(not suitable for most wildlife)*
• Any breaks in the habitat network that do not meet the criteria in any of the categories listed above and where there is no culvert	**VERY POOR** *(mobile wildlife at highest risk of being hit on road)*
• Break location inaccessible	**UNKNOWN**

Best Management Practices

- Ontario Ministry of Natural Resources and Forestry 2016
  - Amphibians and reptiles
    - » Gunson, K.E., Seburn, D., Kintsch, J., and Crowley, J 2016. Best management practices for mitigating the effects of roads on amphibian and reptile species at risk in Ontario. Submitted to the Ministry of Natural Resources and Forestry. Queen's Printer for Ontario. 112 pp (also available in French).



Available for download online at
https://eco-kare.com/news/

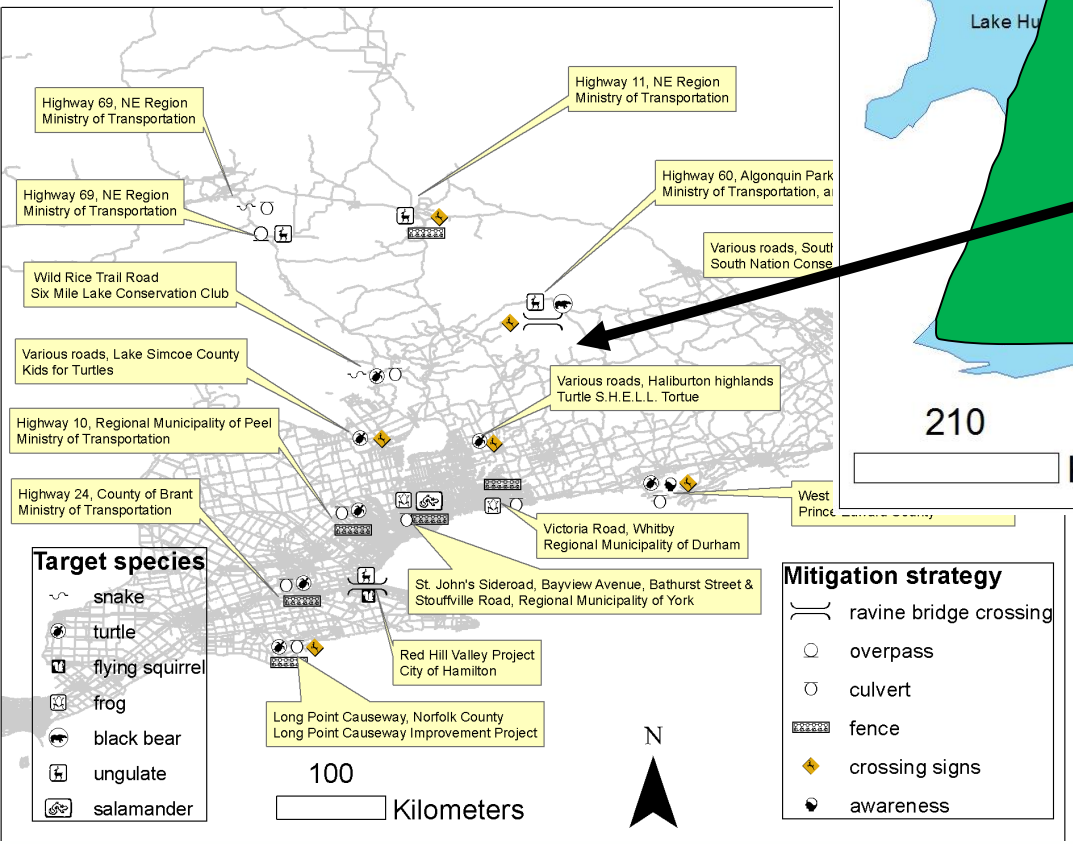


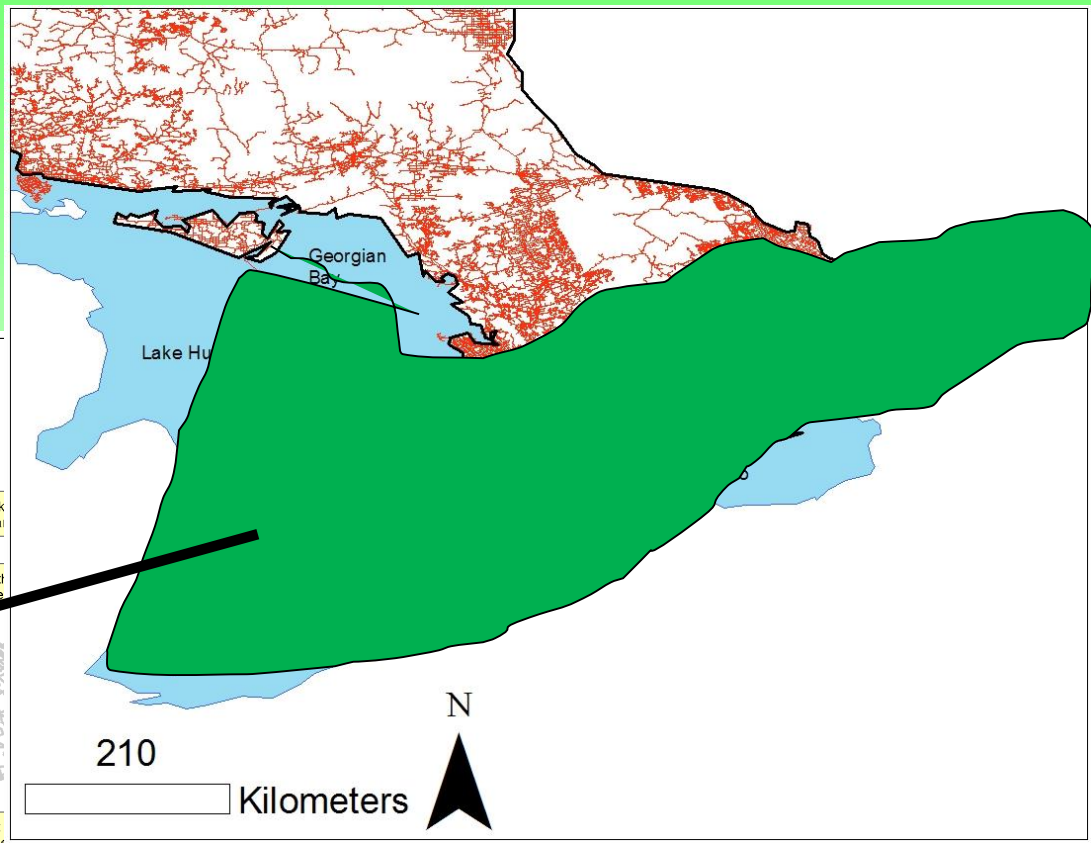
Crossings Guideline for Valley and Stream Corridors

September 2015

Toronto and Region Conservation
for The Living City®

Towards a co-ordinated connectivity strategy for southern Ontario……





Thank-you!