malaria plague

yellow fever

west nile virus

tularemia

eastern equine encephalitis

lyme disease

chikungunya zika virus

dengue fever

Vector-borne Disease Control Program

DURHAM REGION
HEALTH DEPARTMENT
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2018 Annual Report & 2019 Prevention Plan

Vector-Borne Disease Control Program 2018 Annual Report and 2019 Prevention Plan

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Vector-Borne Disease Control Program 2018 Annual Report

Executive Summary

This report details the Durham Region Health Department's (DRHD) Vector-borne Disease Control Program activities for 2018 and outlines the proposed activities for 2019.

The goal of the Vector-borne Disease Control Program is to provide an effective response to the presence of West Nile virus (WNV), Eastern Equine Encephalitis (EEE), Lyme disease (LD), and other vector-borne diseases of public health significance within Durham Region. Its objectives are as follows:

- to limit the impact of vector-borne diseases on human health
- to reduce the availability of larval mosquito and tick development sites
- to educate the public about personal protective measures against mosquitoes and ticks
- to provide accurate and timely information on vector-borne diseases to health professionals, the public, and the media
- to employ the principles of Integrated Vector Management (IVM) to reduce the risk that vectors of disease may pose to humans

Background

In response to the health threat posed by the 2001-2002 outbreak of WNV in Ontario, the Ontario Ministry of Health and Long-Term Care (MOHLTC) mandated that all public health units (PHUs) in the province develop and implement a WNV control program to "prepare for, prevent, or mitigate the risk, if possible, of contracting West Nile virus illness". The DRDH responded by implementing its first West Nile Virus Control Program in 2001.

A local Durham Region West Nile Virus Response Committee (DRWNVRC) was created under the authority of Regional Council to coordinate WNV response activities

in Durham Region. The DRWNVRC was comprised of regional, municipal, conservation authority, and provincial representatives. The committee received technical advice from the MOHLTC and Public Health Ontario (PHO), as well as the Ontario Ministries of Agriculture, Food and Rural Affairs (OMAFRA), Environment, Conservation and Parks (MOECP), and Natural Resources and Forestry (MNRF).

In accordance with the requirements of the provincial *West Nile Virus Preparedness and Prevention Plan* the DRWNVRC developed a *Durham Region West Nile Virus Response Plan* that outlines the coordinated actions to be taken to protect the life and health of the citizens of Durham Region in response to the threat of WNV. The Response Plan applies to Durham Region Health and Works Departments as well as all 8 Durham Region municipalities.

In 2003, the DRWNVRC also created a *Durham Region West Nile Virus Vector Control Plan* which provided details of the specific measures to be implemented to reduce the number of WNV vector mosquitoes in Durham Region and thereby reduce the risk of exposure for Durham Region residents.

Both the *Durham Region West Nile Virus Response Plan* and the *Durham Region West Nile Virus Vector Control Plan* were designed to be working documents and, as such, they have been updated to reflect the emergence of new vectors and vector-borne disease agents within the Region.

Over the past number of years, in response to the threat of EEE, the establishment of blacklegged tick populations within the Region, and the increasing incidence of LD amongst Durham Region residents, DRHD has expanded its surveillance and control activities beyond the scope of the original WNV Response and Control Plans.

Currently, in addition to its WNV surveillance activities, DRHD annually monitors EEE activity as well as conducting passive and active tick surveillance and human LD case surveillance. This change in the scope of activities has resulted in the DRWNVRC being renamed the Durham Region Vector-Borne Disease Response Committee (DRVBDRC), the Response Plan evolving to become the *Durham Region Vector-borne Disease Response Plan*, and the Control Plan evolving to become the *Durham Region Vector Control Plan*.

The Durham Region Vector-borne Disease Control Program, detailed within the *Durham Region Vector Control Plan*, currently consists of 5 major components:

1. Vector Surveillance
    a. Adult mosquito surveillance
    b. Larval mosquito surveillance
    c. Tick surveillance
2. Vector Control
    a. Monitoring and treatment of catch basins (roadside, regional, residential)

   b. Monitoring and treatment of standing water sites (SWMPs, ditches, field pools, etc.)
   c. Remediation / posting of identified Lyme disease “risk areas”
3. Human Case Surveillance
4. Complaint Response
5. Vector-borne Disease Communication / Public Education

While vector and human case surveillance activities have generally been conducted by DRHD staff, WNV control activities are conducted by a licensed pest control operator (PCO). During 2018, the PCO was the Canadian Centre for Mosquito Management (CCMM).

Vector-borne Disease Control Program - Introduction

Adult Mosquito Surveillance

Adult mosquito surveillance (trapping and testing) for WNV was first implemented in late 2002 and has been undertaken every year since. Surveillance begins mid-June and continues until mid to late September, depending on climate conditions. Traps are set up at predetermined locations throughout the Region. The locations are determined using the following criteria: site security, historical data (e.g., previous positive surveillance results), proximity to human populations, ease of access, and geographical distribution. Adult mosquitoes are trapped one day each week during the trapping period, and the captures are sent to an accredited laboratory where they are enumerated, identified by species, and tested for WNV.

Historically, in addition to conducting adult mosquito surveillance for WNV, DRHD has subjected any adult *Culiseta melanura* species captures to testing for the EEE virus (EEEV) since the virus is known to be maintained in a cycle between *C. melanura* mosquitoes and birds. However, in 2011, in response to an increase in EEEV activity in the United States, the MOHLTC asked PHUs to modify their adult mosquito surveillance protocols to include any species that may act as vectors/bridge vectors for the transmission of EEEV to humans. Accordingly, DRHD implemented modified surveillance protocols from 2011 to 2013. Subsequently, in 2014, after finding no EEEV-positive mosquito pools during any of those years, DRHD, in consultation with PHO, reverted to traditional surveillance protocols.

During the 2013 WNV season, DRHD participated in a working group, overseen by PHO. The working group developed a guidance document designed to assist PHUs to determine their need to institute adult mosquito control measures during any WNV season. The document, *Guide for Public Health Units: Considerations for Adult Mosquito Control*, was developed in response to Ontario experiencing, in 2012, the

second highest number of WNV human cases and positive mosquito pools since the virus was first identified in Ontario in 2002.

To date, based on the relatively low number of WNV-positive mosquito pools and human cases identified annually within the Region, DRHD has not considered instituting adulticide activities.

Larval Mosquito Surveillance and Control

Larval mosquito surveillance generally begins each year in early May. The larval mosquito component of the Vector Control Plan consists of weekly monitoring of surface water sites on public property in relation to the potential for these sites to support larval mosquito development.

A roadside catch basin monitoring and larviciding program has also been active since 2003. Historically, **3** rounds of catch basin larviciding have been conducted in Durham Region by a licensed PCO, with the first treatment round beginning in early-to-mid June, and subsequent treatment rounds occurring in July and August. A 21-day residual period is maintained after each round of treatment.

Catch basins on selected Durham Region properties, including long-term care homes, child care centres, and Regional housing, are larvicided once per season using a methoprene briquette formulation which provides an extended residual effect.

Catch basins located on residential properties are also larvicided based on requests from the public and a risk assessment.

Tick Surveillance

In relation to the growing concerns about LD, DRHD conducts both passive and active tick surveillance. Ticks submitted by the public (passive surveillance) are sent to the Public Health Ontario Laboratory (PHOL) for identification. Once identified, all blacklegged tick specimens are sent to the National Microbiology Laboratory (NML) to be analyzed for the presence of *B. burgdorferi* and other pathogens these ticks can carry.

DRHD uses the information gained from passive surveillance to determine areas where active surveillance should be conducted. Once tick populations become established in specific geographic areas, DRHD works with property owners to provide LD information, to conduct active tick surveillance, to determine if properties can be remediated to reduce the risk of human contact with ticks, and/or to provide signage warning the public that ticks may be present and providing precautions to avoid tick exposures. DRHD also provides the information to PHO so that the Ontario Lyme Disease Map can be updated annually.

Human Case Surveillance

Human case surveillance, for WNV, EEE, LD, and the other vector-borne diseases of concern, is conducted by DRHD staff. The number of human cases of each disease, reported to DRHD by healthcare providers, is entered into the integrated Public Health Information System (iPHIS) data base and transmitted to the MOHLTC.

The accumulated WNV case surveillance data is used to assist DRHD to determine areas where additional vector surveillance and control activities (e.g., standing water site surveillance, adult mosquito trapping, mosquito larviciding) may have to be implemented.

DRHD uses the LD case surveillance data to determine where additional active tick surveillance may be required and where further signage and public education about ticks and LD may be necessary.

Complaint Response

DRHD investigates complaints regarding stagnant water, on regional and municipal land, in accordance with divisional policies and procedures. In consultation and cooperation with local municipalities, DRHD also investigates complaints regarding privately-owned (commercial and residential) standing water sites. These sites are individually assessed to determine the need for treatment and or remediation. This assessment includes dipping for the presence of mosquito larvae. If mosquito larvae which may be vectors of WNV are observed to be present, a Section 13 Order, pursuant to the *Health Protection and Promotion Act* (HPPA), is issued to the owner(s) of the private property, requiring remediation of the mosquito development site. Where remediation is not possible, other vector control activities, such as the application of larvicide, may be implemented.

Communication / Public Education

Originally, Durham Region's WNV communication plan was developed with an aim to increasing community awareness of WNV and the personal precautions that can be taken to prevent transmission. The communication plan provided standing water prevention and personal protection information through a variety of means including the Durham Region website (durham.ca), social media, local media (i.e., TV, radio, newsletters and newspapers), billboard and poster advertisements (i.e., shopping malls, arenas), and community events (e.g., health and safety fairs).

A communication plan for LD was first developed in 2010. Since then, the Durham Region website has been updated to include information about endemic areas for LD in Ontario, disease transmission, and personal protective measures to avoid tick bites.

In 2015 a weekly summary report on vector-borne disease activities was developed and this is now distributed to community stakeholders throughout each WNV/LD season.

WNV and LD presentations are provided to community groups upon request, and various health promotion items have been produced and utilized at community events and health fairs including an interactive LD game. Various community groups have been

targeted for distribution of the LD information including: Durham Region elementary schools, Darlington Provincial Park, golf courses, horticultural societies, garden centres, riding stables and doctor's offices. As well, a number of WNV and LD articles have been developed and distributed via various Regional and other agency newsletters.

In 2018 a LD infographic was developed and distributed to local healthcare providers and veterinarians. The infographic provides a 5-year retrospective view of tick and LD activity within Durham Region.

The WNV communication plan has been evaluated regularly since 2002 using the Rapid Risk Factor Surveillance System (RRFSS) WNV modules. Since 2011, RRFSS has also been used to survey Durham Region residents regarding their awareness of LD and their use of personal protective measures to reduce exposures to ticks.

Vector-borne Disease Control Program - Highlights

- WNV activity in mosquitoes, equines, and humans has been very low since the inception of WNV surveillance and control activities in Durham Region.
- Durham Region has experienced just **28** confirmed or probable human WNV cases between 2002 and 2018. There were **5** confirmed human cases of WNV reported in 2018.
- No local cases of equine WNV were reported in 2018. **One** case was reported and investigated in 2017. This was an unvaccinated horse that was rescued and brought into the Region in 2017.
- Few equine cases of EEE have been reported in Durham Region and, to date, only 1 locally-acquired human case has ever been reported by PHO/MOHLTC in Ontario.[α]
- The establishment of the DRWNVRC (now DRVBDRC) has served to streamline stakeholder communications and coordinate public education and vector control measures within the Region.
- DRHD has established a successful partnership with municipal by-law departments for the investigation of stagnant water complaints on private property. As per the agreement between DRHD and local municipal by-law enforcement officers, outlined in the Notice of Required Action (distributed annually to municipalities), municipal staff are the first to respond to investigate stagnant water complaints on private property. Where compliance is not achieved within 48 hours, complaints are forwarded to DRHD for follow-up action.
- During 2018 DRHD staff responded to **26** new complaints regarding standing water on private property. Between 2003 and the fall of 2018, a total of **618** stagnant water complaints on private property were investigated. This number

does not include complaints that were investigated by municipal by-law enforcement staff and where compliance was achieved without further action by DRHD.

- In most instances, property owners have complied promptly with DRHD requests to remediate sources of standing water (e.g., pool, pond, bird bath, land depression). In instances where compliance was not immediately achieved, a Section 13 Order was issued.
- During the 2018 WNV season, **8** new Section 13, standing water Orders were issued; **5** Orders to residential property owners requiring them to eliminate mosquito breeding sites in standing water on their properties (swimming pools, ornamental ponds, etc.), and **3** Orders to our licensed PCO to larvicide standing water sites on private properties when owners failed to address mosquito breeding concerns. Since 2003, a total of **114** Orders have been issued.
- While most properties are promptly remediated once an Order is issued, a total of **37** charges to property owners for “fail to comply with an Order of a PHI” or “fail to comply with a Probation Order” have been laid between 2003 and 2018. For 2018, DRHD laid **2** such charges and obtained **2** convictions against a property owner.
- In 2018 DRHD produced a LD infographic which has been distributed to healthcare providers and veterinarians in the Region.
- Active surveillance for blacklegged ticks has been conducted in various wooded or grassy locations within Durham Region since 2010. No ticks were found until the fall of 2013 when 19 blacklegged ticks were found in south Whitby. Since then blacklegged ticks have been found in a number of wooded or grassy locations across Durham Region.
- Active tick surveillance (“tick dragging”) activities resulted in blacklegged ticks, positive for *Borrelia burgdorferi*, being discovered in the Rouge National Urban Park, Pickering in the fall of 2014. Further active surveillance has resulted in the Rouge National Urban Park being designated a “risk area” for LD by PHO.
- In the fall of 2016, DRHD staff provided tick signs for posting at the entrances to the Lynde Shores Conservation Area (Whitby), and the Rouge National Urban Park (Pickering), where populations of blacklegged ticks were known to have become established. Since then, signs warning the public of the presence of blacklegged ticks and the precautions to be taken to avoid exposures have also been posted at other risk sites, including all entrances to the Durham Forest (Uxbridge).
- There were **0** reported cases of plague, tularemia, or yellow fever in Durham Region in 2018.

Vector-borne Disease Control Program - Demands

- There has been a steady increase in the program workload associated with population growth and the ongoing construction of new surface water sites and catch basins within the Region.
- DRHD continues to liaise with municipal works and maintenance department personnel to address issues around maintenance and remediation of municipally and privately-owned storm water management ponds (SWMPs). Although there are guidelines and best practices for the maintenance and design of SWMPs, it is not clear who enforces or oversees adherence to the relevant guidelines.
- While remediation of surface water sites that are larval mosquito development sites is always the preferred option, the financial reality is that these sites may take many years to be remediated. Furthermore, it is not feasible to remediate all surface water sites that are larval mosquito development sites. In such instances, ongoing larvicide treatments are the default option.
- DRHD is continuing to investigate more efficient means to effect remediation of derelict pools, ornamental ponds and/or other water features on private properties where the property has been abandoned by the property owner(s). In these instances, tracking the responsible property owners (i.e., individuals, financial institutions, property management firms, etc.) to enforce remediation of the standing water, can often involve considerable time and staff resources.
- Since not all local municipalities have by-laws that address standing water on private property (e.g., derelict swimming pools, ponds, etc.) it has been necessary to establish a partnership with all 8 local municipal by-law departments whereby they conduct the initial investigation of stagnant water complaints on private property but refer outstanding issues to DRHD staff when the issue cannot be resolved within 48 hours. Complaint investigations and legal activities consume a considerable amount of DRHD staff resources and time.
- The program workload has also increased in relation to substantial increases in the number of ticks submitted by the public and/or healthcare providers for identification and testing (e.g. passive tick surveillance). In 2018, **125** ticks were submitted to DRHD versus 176 in 2017 and 83 in 2016.
- The data obtained via passive tick surveillance indicates that there is an increasing need for DRHD staff to conduct active tick surveillance to confirm “Lyme disease risk areas” where blacklegged tick populations have become established.
- The number of laboratory and healthcare provider reports of suspect human cases of LD and WNV has increased dramatically in the past 5years. In 2018 there were **29** confirmed and **8** probable cases of LD reported as compared to 40 confirmed and 8 probable cases in 2017 and 16 confirmed and 8 probable cases reported in 2016.

- The identification of confirmed and probable human cases of WNV and LD is often problematic due to:
    - Challenges interpreting laboratory results. In particular, false negative or inconclusive blood test results for LD are common based on timing and the nature of the infection / infective agent.
    - Incomplete information from patients and healthcare providers regarding mosquito and tick exposure histories, symptoms, diagnosis, and treatment.

  DRHD consults with healthcare providers and patients to attempt to obtain the most accurate and up to date information regarding each patient's potential exposure to disease and their symptoms / diagnosis.
- DRHD staff work diligently to provide timely and accurate information relating to expanding LD risk areas, LD symptoms, and protective measures to prevent tick bites to healthcare providers and the public.
- The current Lyme assays (EIA and Western Blot) used by the Public Health Ontario Laboratory (PHOL) do not test for the European strains of LD (*Borrelia garinii* and *Borrelia afzelii).* Because testing for European strains must be specifically requested it is difficult to identify these cases and it is important to investigate and determine whether patients have visited or resided in Europe and been potentially exposed to a tick(s) while there. In most years a small number of the total reported cases of LD in Durham Region are confirmed to be associated with the European strains of the bacteria.

Vector-borne Disease Control Program Results (2014-2018)

West Nile Virus (WNV)

Overview

WNV is maintained in nature in a transmission cycle that occurs between mosquitoes and birds. Mosquitoes become infected when they feed on the blood of a bird infected with the virus and they can then pass the virus on to other birds. The virus can be transmitted to humans and other mammals by mosquitoes that choose to feed on both birds and mammals. These mosquitoes are known as “bridge vectors”. Humans and other mammals (e.g., horses) are only incidental or “dead end” hosts and are generally incapable of transmitting the virus further. In rare instances, WNV has been transmitted within the human population through blood transfusions, organ or tissue transplants, and via breast milk.

WNV is endemic in many areas of the world including Africa, Europe, the Middle East, West Asia, South America, and throughout North America.

Currently, of the over **60** species of mosquitoes identified in Ontario, only **13** are known to be WNV vectors.

Most people infected with WNV will not develop any symptoms. When symptoms do develop, they appear within 3-15 days following the bite of an infected mosquito. They can range from mild fever, headache, and flu-like illness to severe neuro-invasive disease (meningitis, encephalitis or poliomyelitis) with rapid onset of symptoms including severe headache, high fever, stiff neck, muscle weakness, convulsions, paralysis, or coma. Severe WNV symptoms are more likely to occur in the elderly, the very young, and those with suppressed immune systems. There is no specific treatment for WNV once symptoms develop, and victims can only be provided with supportive care. In rare cases, WNV can result in death. However, most people do recover fully over time.

There is no human vaccine for WNV, so preventative measures are based on vector control and the use of personal precautions against mosquitoes.

Equine Surveillance

In 2018 in Ontario, **11** equine cases of WNV were reported by OMAFRA. None of the cases occurred within Durham Region. This is a significant decrease from the 21 equine WNV cases reported in Ontario in 2017.

Adult Mosquito Surveillance

Currently, the order of preference for testing of adult mosquitoes is as follows:

1. *Culex pipiens/restuans*
2. *Culex salinarius*

3. *Ochlerotatus japonicus*
4. *Culex tarsalis*
5. *Aedes vexans vexans/Aedes vexans nipponi*
6. *Ochlerotatus triseriatus*
7. *Anopheles punctipennis*
8. *Ochlerotatus trivittatus*
9. *Anopheles walkeri*
10. *Ochlerotatus stimulans*
11. *Anopheles quadrimaculatus*
12. *Ochlerotatus Canadensis*

During the 2018 WNV season, DRHD's adult mosquito surveillance consisted of a network of up to **15** trap sites distributed over **7** of the 8 local municipalities. A total of **196** traps were set over a **15-week period** extending from CDC week 23 (w/o June 9) to week 37 (w/o September 15).

A total of **8,199** adult mosquitoes were captured during the 2018 season. This is less than the total mosquitoes captured in any of the 2014 to 2017 seasons.

Coquillettidia perturbans was the most dominant mosquito species captured in Durham Region in 2018, representing **51%** of total captures. While *Cq. perturbans* is not considered to be an efficient WNV vector, it is thought that it may still play a role in WNV transmission to humans due to its relative abundance and aggressive nature.

The second most prevalent mosquito species group captured in Durham Region was *Culex pipiens/restuans,* representing **19%** of total captures. This species group is of particular concern since both *C. pipiens* and *C. restuans* are known to be efficient vectors of WNV in Ontario.

The third most prevalent species captured was *Aedes vexans* at **14%** species abundance. *A. vexans* is a WNV bridge vector, known to bite both birds and humans.

Species abundance numbers for the *Culex pipiens/restuans* group have remained relatively stable over the past few years, ranging from 15% in 2015 to 20% in 2016.

A total of **357** pools of mosquitoes were tested in 2018 using RT-PCR. **Seven** of the 357 pools tested positive for WNV. The 7 WNV-positive mosquito pools were all identified as *Culex pipiens/restuans* mosquitoes. In comparison, 10 WNV-positive mosquito pools were identified in each of 2017 and 2016, and 0 in both 2015 and 2014.

Table 1: Summary of Adult Mosquito Trapping - Durham Region (2014-2018)

Year	# of Traps Set	# of Mosquitoes Captured	# Viral Pools Tested for WNV	# of WNV-positive Pools Identified	% *Culex pipiens / restuans* : % Bridge Vectors
2018	**196**	**8,199**	**357**	**7**	**19% : 30%**
2017	174	13,426	455	10	17% : 50%
2016	199	9,347	374	10	20% : 67%
2015	175	20,092	440	0	15% : 79%
2014	136	14,495	357	0	9% : unknown

Larval Mosquito Surveillance

Currently a total of **415** standing water (SW) sites, including SWMPs, field or woodland pools, ditches, and other such areas, have been identified in Durham Region. Every year, these SW sites are monitored by WNV students or staff on a weekly basis, from the beginning of May to the end of September. The number of standing water sites in Durham Region has increased in each of the past 5 surveillance years. When high counts of larval mosquitoes are observed, SW sites are treated with larvicide, by the Region's licensed PCO, until 0 larvae are found for 3 consecutive weeks.

In 2018 WNV students and PCO staff conducted a total of **4,402** SW site inspections resulting in **1,044** larvicide treatments in instances where live mosquito larvae or pupae were found.

Note: SW site monitoring and treatment results are summarized in Table 4 below.

Human Case Surveillance

- In 2018 there were **5** confirmed human cases of WNV reported in Durham Region. In contrast, 3 confirmed cases were reported in 2017 and 1 confirmed and 1 probable case was reported in each of 2016 and 2015.
- The Public Health Agency of Canada (PHAC) has reported **126** clinical human cases of WNV for Ontario in 2018*. This is a decrease from the 158 cases reported in 2017, but a significant increase from the 46 cases reported in 2016, 33 cases in 2015, 10 cases in 2014, and 53 cases in 2013.
- For Canada, PHAC has reported **367** clinical human cases of WNV in 2018*. This is an increase from the 200 cases reported in 2017; the 104 cases reported in 2016; 80 cases reported in 2015; and 21 cases reported in 2014.
- In the United States, the US Centers for Disease Control and Prevention (CDC) reported **2,544** human cases of WNV in 2018, including **137** deaths≠. For 2017 there were 2,097 cases; in 2016 2,149 cases; in 2015 2,175 cases; and in 2014 2,205 human WNV cases reported.

Note:

** As of December 15, 2018, for Ontario and Canada statistics, link:* *https://www.canada.ca/en/public-health/services/diseases/west-nile-virus/surveillance-west-nile-virus/west-nile-virus-weekly-surveillance-monitoring.html*

≠ As of January 8, 2019, for USA statistics, link: https://www.cdc.gov/westnile/statsmaps/preliminarymapsdata2018/disease-cases-state-2018.html

Table 2: Summary of Reported Confirmed and Probable Human Cases of WNV - Durham Region (2014-2018)

Year	# of Reported Confirmed Human WNV Cases	# of Reported Probable Human WNV Cases
2018	**5**	**0**
2017	3	0
2016	1	1
2015	1	1
2014	0	0

Vector Control Measures:

Monitoring and Treatment of Roadside Catch Basins

Pre-treatment surveillance of **65** roadside catch basins commenced mid-May 2018 and then roadside catch basin treatments were initiated on May 28 (CDC week 21) in response to an increase in the numbers of *Culex* larvae found.

Product used: Altosid (methoprene) pellets which are designed to release effective levels of methoprene insect growth regulator for up to 30 days under typical environmental conditions.

Three rounds of roadside catch basin larviciding treatments were conducted in 2018, with the first round of treatment commencing May 28, 2018, and the third round ending August 6, 2018. A 21-day residual period was incorporated after each treatment round.

During 2018, the total number of roadside catch basins treated was **164,354** (more than 54,750 catch basins during each round of treatment).

Larvicide treatments occurred in all 8 Durham Region municipalities: Pickering, Ajax, Whitby, Oshawa, Clarington, Scugog, Uxbridge, and Brock.

Monitoring and Treatment of Backyard Catch Basins and Catch Basins located on Regional Property

Selected catch basins, located on regionally-owned properties (including long-term care homes, child care centres, and regional housing), received larvicide treatments.

Backyard catch basins (i.e., municipally-owned catch basins located on private, residential properties) were treated upon request by the property owner and were based on a risk assessment.

A total of **390** regionally-owned catch basins were treated in 2018. In addition, **100** backyard catch basins were treated. These treatments were scheduled to coincide, where possible, with the first round of roadside catch basin larviciding.

Product used: Altosid (methoprene*)* briquettes, designed to release effective levels of methoprene insect growth regulator over a period up to 150 days in mosquito breeding sites.

Table 3: Summary of Catch Basin Treatments - Durham Region (2014-2018)

Year	# of Roadside Catch Basins Larvicided	# of Backyard and Regionally-Owned Catch Basins Larvicided
2018	**164,354**	**490**
2017	159,306	472
2016	154,743	482
2015	161,799	392
2014	161,595	386

Monitoring and Treatment of Standing Water Sites

DRHD routinely monitors chronic SW sites including municipally-owned SWMPs, ditches, field pools, etc. As noted above, under the heading Larval Mosquito Surveillance, DRHD and licensed PCO field staff combined to conduct a total of **4,402** SW site inspections during the 2018 WNV season, resulting in **1,044** larvicide applications. The product used was Vectobac (*Bacillus thuringiensis israelensis* or Bti)

Treatment of SW sites with Bti is dependent upon a risk assessment that takes into account the number and type (species) of larvae found, the time of year, the potential

for timely site remediation, and WNV surveillance data obtained from Durham Region and other PHU jurisdictions.

Risk thresholds are as follows:

- For SWMPs ≥30 larvae in ≤10 dips to prompt an initial larviciding treatment. Thereafter, larviciding is initiated if any mosquito larvae are present;
- For derelict pools and ornamental ponds, > 0 larvae based on close proximity to human population and relative ease of remediation; and
- For ditches, field pools, etc. the potential for timely site remediation and risk assessment criteria are assessed.

Table 4: Summary of Standing Water Site Treatments - Durham Region (2014-2018)

Year	# of Standing Water Sites Routinely Monitored	Total # of Site Visits	# of Standing Water Sites Requiring Treatment	% of Standing Water Sites Requiring Treatment	# of Treatment Events
2018	**415**	**4,402**	**208**	**50%**	**1,044**
2017	405	3,999	227	56%	966
2016	401	3,365	155	39%	684
2015	395	4,282	185	47%	625
2014	384	3,936	163	42%	852

Standing Water Complaint Investigations and Resulting Legal Action

DRHD responds to public complaints regarding SW on private properties such as privately-owned swimming pools, ornamental ponds, ditches, field pools, etc. A total of **26** new standing water complaints were registered in 2018.

As a result of the complaint investigations, **8** new SW Orders were issued, 5 to property owners and 3 to our licensed PCO. The Orders required remediation or treatment of the complaint sites. In instances where property owners do not comply promptly with an Order to remediate or treat a SW site where mosquitoes are observed to be breeding, legal action is initiated. In 2018, 2 charges were laid against 1 property owner for failure to comply with an Order of a PHI in respect to a chronic SW concern. The property owner was subsequently convicted on both counts and was fined a total of $5,000.

Table 5: Summary of Standing Water Complaint Investigations and Resulting Legal Action - Durham Region (2014-2018)

Year	# of Complaint Investigations	# of Standing Water Orders Issued	# of Charges Laid (Fail to Comply with an Order)	# of Convictions Registered
2018	**26**	**8**	**2**	**2**
2017	28	13	4	4
2016	10	8	1	1
2015	29	9	0	0
2014	34	4	4	4

Eastern Equine Encephalitis (EEE)

Overview

Like WNV, the EEE virus (EEEV) is spread by the bite of infected mosquitoes. EEEV is maintained in nature in a cycle between *Culiseta melanura* mosquitoes and avian (bird) hosts in freshwater, hardwood swamps. The United States Department of Agriculture (USDA) reports that EEEV has been isolated from at least 27 different mosquito species in the USA.

While *Cs. melanura* is the primary vector for EEEV it is not an important vector with regards to transmission of EEEV to humans because it feeds almost exclusively on birds. Rather, “bridge vectors” (i.e., mosquitoes that feed on both birds and mammals), and in particular some *Aedes*, *Coquillettidia,* and *Culex* species, are responsible for transmission of EEEV to humans.

EEEV can cause serious infection in horses with case fatality rates ranging from 50-90% in symptomatic animals. Equine cases of EEE have been reported throughout North America, particularly in Eastern Canada, in a number of US states, and in Mexico. Fortunately, an EEEV vaccine is available for horses. Emus and ostriches are also highly susceptible to EEEV infection.

While most humans infected with EEEV will remain asymptomatic, serious infections, involving encephalitis (inflammation of the lining of the brain) may occur. Severe symptoms can include sudden onset of headache, high fever, chills, and vomiting, followed by disorientation, seizures, and coma. Human case fatality rates range from 30-70%, and survivors often suffer long-term neurological effects.

Adult Mosquito Surveillance

In response to an increase in EEEV activity in mosquitoes, birds, horses, and humans in several US states and the Province of Quebec between 2008 and 2010, the MOHLTC asked PHUs to conduct increased surveillance for EEEV and they introduced a new order of preference for viral testing of adult mosquitoes in 2011. DRHD implemented the requested viral testing preferences in 2011, 2012, and 2013.

No EEEV-positive mosquitoes were identified in Durham Region during any of the 2011, 2012, or 2013 surveillance seasons and, despite increased surveillance, only 1 EEEV-positive mosquito pool was identified in Ontario within that period (a single positive pool of *Coquillettidia perturbans* in Eastern Ontario in 2013) [š]. As a result, enhanced surveillance for EEEV was discontinued in Durham in 2014.
One *Culiseta melanura* mosquito was identified from all of the 196 adult mosquito traps set in Durham in 2018. There were **0** EEEV-positive mosquito pools identified.

For Ontario, PHO reported **0** EEEV-positive mosquito pools [+]

[§] Source: *Public Health Ontario, Eastern Equine Encephalitis Virus - History and Enhanced Surveillance in Ontario, 2014,* link: https://www.publichealthontario.ca/en/eRepository/Eastern_Equine_Encephalitis_Virus_Report_2014.pdf

Equine Surveillance

No cases of equine EEE were reported in Durham Region between 2009 and 2018.

OMAFRA reported **13** cases of equine neurological disease in 2018. In comparison, there were 2 equine cases in 2017, 0 cases in 2016, 5 in 2015 and 24 in 2014 [¥].

In the USA, for 2018, the USDA reported **97** equine cases of EEE [∞]. US equine EEE case statistics are of concern in Ontario because some of the equine cases reported in recent years have occurred in bordering states such as Michigan and New York.

[¥] Source: *Ontario Ministry of Agriculture, Food, and Rural Affairs - Equine Neurological Disease Surveillance 2017.* Data last updated October 30, 2017, link: http://www.omafra.gov.on.ca/english/livestock/horses/facts/nhd_surv2017.htm

[∞] Source: *United States Department of Agriculture, Animal and Plant Health Inspection Service (APHIS) - 2017 Equine Case Reports of Eastern Equine Encephalitis.* Data last updated December 11, 2018, link: https://www.aphis.usda.gov/animal_health/downloads/animal_diseases/2018-eee-report.pdf

Table 6: Summary of Equine Cases of EEE - Durham Region, Ontario and USA (2014-2018)

Year	# Equine Cases Reported in Durham Region (OMAFRA - as of 10/30/2018)	# Equine Cases Reported in Ontario (OMAFRA - as of 10/30/2018)	# Equine Cases Reported in the USA (USDA - as of 01/08/2019)
2018	**0**	**13**	**122**
2017	0	2	86
2016	0	0	116
2015	0	5	70
2014	0	24	136

Human Case Surveillance

2018

No human cases of EEE were reported in Durham Region

No human cases of EEE were reported in Ontario in 2018 [+] and only 1 locally-acquired human case has ever been reported by PHO/MOHLTC in Ontario.[α]

In the USA, in 2017, the CDC reported **5** human cases of EEE. At the time this report was printed no statistics for 2018 were available [≡].

[+] Source: *Public Health Ontario, West Nile Virus Surveillance - Other Arboviruses and Mosquito Species of Interest.* Data last updated October 30, 2018, link: https://www.publichealthontario.ca/en/DataAndAnalytics/Pages/WNV.aspx

[α] *Source: Public Health Ontario, Vector-borne Diseases 2017 Summary Report, link: https://www.publichealthontario.ca/en/eRepository/Vector-Borne-Diseases-Summary-Report-2017.pdf*

[≡] *Source: Centers for Disease Control and Prevention (CDC) - Eastern Equine Encephalitis, Epidemiology and Geographic Distribution.* https://www.cdc.gov/easternequineencephalitis/tech/epi.html

Lyme Disease

Overview

LD is an infection caused by a spirochete of the genus *Borrelia*. Worldwide, there are several species of *Borrelia* that can cause disease. However, to date in Ontario, the only species of concern is *Borrelia burgdorferi.* The infection is transmitted to humans via the bite of an infected tick. In Ontario, *Ixodes scapularis* (the blacklegged tick / deer tick) is the primary vector of LD.

LD is the most common vector-borne disease in North America, and, in 2010, it became a nationally reportable disease in Canada. PHAC has stated that there is a low risk of encountering ticks infected with the LD agent in most of Canada although the risk has been steadily increasing in eastern and central Canada. The risk for exposure to the disease is highest in regions where the ticks that transmit LD are known to be established. However, surveillance data indicates that small numbers of blacklegged ticks can be introduced into widely separated areas of Canada by migratory birds, posing some risk that individuals in other areas may also be exposed to infected ticks.

Passive Tick Surveillance

DRHD accepts tick specimens, submitted by members of the public or healthcare providers, that have been found and/or feeding on human hosts. These specimens are sent for identification by the PHOL. If they are identified as *Ixodes scapularis* (“blacklegged”/“deer”) ticks, they are then forwarded to the National Microbiology Laboratory (NML) in Winnipeg to determine if they are carrying *Borrelia burgdorferi,* the bacterium that causes Lyme disease.

The number of ticks submitted annually to DRHD has increased steadily from 2014 to 2018.

In 2018, **125** tick specimens were submitted to DRHD for identification and potential testing. **100** of the 125 specimens were identified as blacklegged ticks, while the other specimens were identified as follows: **16** *Dermacentor variabilis* (“dog tick”); **4** *Ixodes cookei* (“woodchuck / groundhog tick”); **2** *Amblyomma americanum* (“Lone Star tick”) or other *Amblyomma species*; and **3** “other” tick species.

75 of the 100 blacklegged ticks identified were reported to have been acquired locally in Durham Region. The other 25 were acquired from various geographic areas outside Durham Region.

20 of the 100 blacklegged ticks identified were found to be positive for *Borrelia burgdorferi*, the agent responsible for LD. Of the 20 positive ticks, **8** were reported to have likely been acquired within Durham Region. The other 12 were reported to have been acquired elsewhere.

The number of tick specimens submitted annually to DRHD, for identification and potential testing, has increased four-fold since 2014 (i.e., from 35 to 125 specimens).

Table 7: Passive Tick Surveillance Results - Durham Region (2014-2018)
All Ticks

Year	# Ticks Submitted	# Blacklegged Ticks Identified	# of Other Tick Species Identified
2018	**125**	**100**	**16 Dog tick (*Dermacentor variabilis*)** **4 Woodchuck tick (*Ixodes cookei*)** **2 Lone star tick (*Amblyomma americanum*)** **3 Other tick species**
2017	176	117	42 Dog tick (*Dermacentor variabilis*) 7 Woodchuck tick (*Ixodes cookei*) 3 Lone star tick (*Amblyomma americanum*) 3 Brown dog tick (*Rhipicephalus sanguineus)* 4 Other tick species
2016	83	57	13 Dog tick (*Dermacentor variabilis*) 2 Woodchuck tick (*Ixodes cookei*) 1 Lone star tick (*Amblyomma americanum*) 1 Other tick species
2015	84	60	17 Dog tick (*Dermacentor variabilis*) 5 Woodchuck tick (*Ixodes cookei*) 2 Lone star tick (*Amblyomma americanum*) 0 Other tick species
2014	35	18	12 Dog tick (Dermacentor variabilis) 3 Woodchuck tick (*Ixodes cookei*) 1 Other tick species

Note: In Table 8 below, B.b stands for *Borrelia burgdorferi* bacteria

Table 8: Passive Tick Surveillance Results - Durham Region (2014-2018) Blacklegged Ticks

Year	# of Blacklegged Ticks Identified	# and % of B.b-positive Blacklegged Ticks Acquired Within Durham	# and % of B.b-positive Blacklegged Ticks Acquired Outside Durham
2018	**100**	**8 (8.0%)**	**12 (12.0%)**
2017	117	12 (10.3%)	9 (7.7%)
2016	57	1 (1.7%)	3 (12.3%)
2015	60	2 (3.3%)	3 (5.0%)
2014	18	0 (0.0%)	2 (11.1%)

Active Tick Surveillance

Active surveillance for blacklegged ticks ("tick dragging") has been conducted, in likely tick habitats within Durham Region, since 2010. No ticks were found during active surveillance activities until the fall of 2013 when 19 blacklegged ticks were found in south Whitby.

In the fall of 2014, 7 blacklegged ticks were found during active tick surveillance at 3 different sites as follows: 1 tick at Lynde Shores Conservation Area in south Whitby, 4 ticks in the Rouge National Urban Park in south Pickering, and 2 ticks on the Seaton Hiking Trail in north Pickering. Three of the 4 blacklegged ticks found in the Rouge National Urban Park subsequently tested positive for *B. burgdorferi*. This was the first time that any blacklegged ticks, found within Durham Region, tested positive for the bacteria that causes LD.

These findings resulted in a joint media release being issued by DRHD, Toronto Public Health, and York Region Community and Health Services, warning the public to take precautions against ticks when spending time outdoors in and around wooded areas. In addition, an updated *FAX About Lyme Disease* was distributed to all Durham Region healthcare providers advising them to consider LD as a possible diagnosis for patients with related symptoms and/or whose lifestyle and travel histories may have resulted in them being exposed to ticks.

More LD-positive ticks were found in Durham Region between 2015 and 2018 and each year the number of established tick populations appears to be increasing within the Region.

Active surveillance sites are determined based on information obtained from passive surveillance (i.e. sites where the public has indicated they had exposure to blacklegged ticks).

In 2018, tick dragging was conducted at **7** different sites during the spring and/or fall. In total, **7** blacklegged ticks were found at **3** different sites: Camp Samac in north Oshawa, Seaton Hiking Trail, in Whitevale, and Greenwood Conservation Area, in north Ajax. All **7** ticks tested negative *for B. burgdorferi*.

PHO defines "estimated LD risk areas" ***** as locations where blacklegged ticks have been identified or are known to occur and where humans have the potential to come into contact with infected ticks.

In the fall of 2016, signage was posted at the entrances to the Lynde Shores Conservation Area and the Rouge National Urban Park, warning the public that blacklegged tick populations have become established in these areas.

In the fall of 2017 signage was provided to the Lake Simcoe Region Conservation Authority in relation to public concerns about the number of ticks being found on the various trails throughout the Durham Forest, Uxbridge. Further signage will be provided as new "estimated Lyme disease risk areas" are identified within Durham Region.

** Source: Ontario Agency for Health Protection and Promotion (Public Health Ontario). Technical Report: Update on Lyme disease Prevention and Control, Second Edition, Toronto, ON: Queen's Printer for Ontario; 2016, link: http://www.publichealthontario.ca/en/eRepository/Technical_report_update_on_Lyme_disease_prevention_and_control.pdf*

Note: In Table 9 below, B.b stands for *Borrelia burgdorferi* bacteria

Table 9: Active Tick Surveillance Results - Durham Region (2014-2018)

Year	# Sites Where Blacklegged Ticks Were Found	# of Ticks Found	# of Blacklegged Ticks Identified	# of LD-positive Blacklegged Ticks Identified	Sites Where B.b-positive Blacklegged Ticks Were Found
2018	**3**	**7**	**7**	**0**	**N/A**
2017	5	21	21	6	1 - Greenwood CA, Ajax 5 - Rouge National Urban Park, Pickering
2016	3	8	8	0	N/A
2015	2	12	12	4	Rouge National Urban Park, Pickering

Year	# Sites Where Blacklegged Ticks Were Found	# of Ticks Found	# of Blacklegged Ticks Identified	# of LD-positive Blacklegged Ticks Identified	Sites Where B.b-positive Blacklegged Ticks Were Found
2014	3	7	7	3	Rouge National Urban Park, Pickering

Human Case Surveillance

LD became a reportable disease in Ontario in 1988 and a nationally notifiable disease in 2010. Because of this, DRHD routinely conducts human LD case investigations whenever laboratory testing, ordered by healthcare providers, is received and if results indicate that a patient has had a positive reaction to one or both tiers of LD testing. Confirmed and probable cases of LD are defined based on the patient's history of residence in or visit to a LD risk area plus a combination of clinical and laboratory evidence.

While the risk of contracting LD within Durham Region is currently low, the potential for infection is likely to increase subject to deer, small rodent, and bird migration patterns across the north shore of Lake Ontario. In addition, changing climatic conditions are likely to contribute to an expansion of the distribution of ticks that carry LD.

In 2010, in an effort to increase public awareness about the risk of LD, DRHD developed a communication plan that included the provision of LD information on the Durham Region website and the development of an LD brochure and "Banner Bug" display. Since then, the annual communication campaign has expanded to include a variety of social media platforms, digital advertising in medical offices and malls, signage at golf courses and restaurants, and web-based ads via various media outlets.

In 2018 a LD and tick infographic was developed and distributed to both health care providers and veterinarians.

DRHD has observed a dramatic increase in the number of LD test results received from the PHOL between 2014 and 2018, reflecting the steadily increasing concerns, amongst both the public and health professionals, regarding tick exposures and LD.

The PHOL performs tests for antibodies to *B. burgdorferi* using a two-tier test method as recommended by the Canadian Public Health Laboratory Network. Initially, specimens are tested for total antibodies using a *Borrelia* (Lyme) IgM/IgG ELISA. A specimen that is either reactive or indeterminate by ELISA will be further tested for IgM and IgG specific antibodies using a western blot (WB) assay.

In all instances where patients react to either the ELISA or both the ELISA and WB testing, the PHOL forwards the test results to the local PHU as per the requirements under the HPPA.

DRHD investigates all “reactive” test results to attempt to determine if individuals represent a “confirmed” or “probable” case of LD based on prescribed MOHLTC definitions.

In 2018, there were **29** confirmed and **8** probable human cases of LD identified in Durham Region (as of 15 January, 2019), as compared to 40 confirmed and 8 probable human cases identified in 2017.

In total, **18** of the confirmed and probable cases reported that their tick exposures most likely occurred within Durham Region.

One of the 29 confirmed LD cases was positive for *Borrelia afzelii,* one of two European strains of *Borrelia* that are known to cause LD.

Table 10: Summary of Reported Confirmed and Probable Human Cases of Lyme Disease - Durham Region (2014-2018)

Year	# of Confirmed Human LD Cases Reported (as of 01/15/2019)	# of Probable Human LD Cases Reported (as of 01/15/2019)
2018	**29**	**8**
2017	40	8
2016	16	8
2015	11	4
2014	9	3

Other Vector-Borne Diseases of Concern

Malaria

Overview

Malaria is an acute, flu-like illness caused by one of four species of parasite of the genus *Plasmodium*: *Plasmodium falciparum, Plasmodium vivax, Plasmodium ovale,* and *Plasmodium malariae.*

Malaria is most commonly transmitted to humans through the bite of an infected female *Anopheles* mosquito. When an *Anopheles* mosquito ingests blood from a malaria-infected person, malaria parasites develop in the mosquito and migrate into the mosquito's salivary glands. When the infected mosquito bites another human, malaria can be transmitted to that individual. In rare instances the malaria parasite can also be transmitted by transfusion with infected blood, by shared needle use, or by a mother to her unborn child.

Symptoms of malaria include fever and flu-like symptoms such as headache, nausea, vomiting, muscle pain or spasms, chills, and malaise. Acute infection can cause enlargement of the spleen and make the liver tender.

The severity of the illness varies depending on which species of the malaria parasite is responsible for the infection. Of the 4 parasite species, *P. falciparum* is responsible for the most serious illness, including seizures, coma, kidney failure, and respiratory failure, which can lead to death.

If identified early and treated appropriately, almost all malaria cases can be completely cured. However, even short delays in diagnosis can make treatment more difficult and less successful.

Malaria is endemic (i.e., constantly occurring) in most of Sub-Saharan Africa and New Guinea; in large areas of South Asia, Southeast Asia, Oceania, Haiti, Central and South America; and in parts of Mexico, the Dominican Republic, North Africa, and the Middle East.

Measures to prevent malaria infection include personal precautions to avoid mosquito bites, and the use of effective anti-malarial medications. No vaccine is available.

According to PHAC, Canada sees, on average, 488 reported cases of malaria each year in persons travelling to endemic areas.

Currently, in Ontario, malaria is not considered to be a “Disease of Public Health Significance” and it is therefore not reportable to local medical officers of health or the MOHLTC. Consequently, no new data is available for Durham in 2018.

Human Case Surveillance

Table 11: Summary of Human Cases of Malaria - Durham Region (2014-2018)

Year	# of Cases in Durham Region	# Cases with Travel or Residence in an Endemic Country as a Known Risk Factor	Responsible Organism
2018	**N/A**	**N/A**	**N/A**
2017	4	4	3 - *P. faciparum* / 1 - *P. vivax*
2016	6	6	4 - *P. falciparum* / 1 - *P. vivax* / 1 - *P. ovale*
2015	6	5	5 - *P. falciparum* / 1 - unspecified
2014	9	3	2 - *P. falciparum* / 3 - *P. vivax* / 4 - unspecified
2013	12	10	6 - *P. falciparum* / 6 - *P. vivax*

Plague

Overview

Plague is an infectious disease caused by the bacteria *Yersinia pestis.* It can affect both animals and humans. Plague is transmitted between animals and humans by the bite of infected fleas, direct contact with infected rodents, inhalation, and rarely, ingestion of infective materials. While there have been many outbreaks of plague in human history, outbreaks are rare today.

There are three different types of illness that the plague infection can cause. They are bubonic, pneumonic, and septicemic plague. All forms of plague begin with flu-like symptoms including fever, chills, muscle pain, weakness, and headache. Symptoms can also include nausea, vomiting, diarrhea, and abdominal pain.

Bubonic plague is the most common form of the plague. Infection results from the bite of an infected flea that has fed on an infected rodent, such as a rat. Bubonic plague infection affects the lymph nodes, causing swelling and pain.

Pneumonic plague is the least common but most deadly form of plague. It can be spread through airborne droplets released through coughs or sneezes or contact with infected body fluids. It can also be spread through contact with clothing, or bed linens that have been contaminated with infected body fluids.

Septicemic plague can result from either bubonic or pneumonic plague.

Rapid diagnosis and treatment of plague is essential to reduce complications and fatality. Effective treatment methods enable almost all patients to be cured if diagnosed in time. Several antibiotics can effectively treat plague along with supportive therapy. While there is a vaccine to protect people who are at high risk of exposure to the disease, the vaccine is not available for general public use.

Because plague is usually transmitted from animals to humans via rodents or their fleas, in areas where plague is established in wildlife populations, people should avoid contact with the habitats where infected rodents or fleas might reside.

Human Case Surveillance

No human cases of plague were reported in Durham Region in 2018

Human cases of plague are very rare in Canada. The last reported case occurred in 1939.

Tularemia

Overview

Tularemia is an infection that is caused by the bacteria *Francisella tularensis.* It is endemic throughout North America, and many parts of Europe as well as the Soviet Union, China, and Japan.

The reservoirs for tularemia in North America include rodents, rabbits, muskrats, and beavers. The organism can also be carried by various hard ticks. Tularemia can be spread from animals to humans, although this is not common. Human infection usually results from direct contact with infected live animals, animal hides, or uncooked meat, but may also occur as a result of a tick bite, or inhalation of contaminated dust from animal environments (e.g., cages, barns, etc.).

The clinical signs of tularemia infection in animals are not always obvious, and will vary depending on the susceptibility of the animal species to the bacteria, the virulence of the bacteria, and the source of the infection

There are two types of tularemia: Type A and Type B. Type A tularemia usually causes more serious illness in people.

The onset of disease in humans is usually sudden, with cases experiencing flu-like symptoms including: high fever, chills, general body aches, headache, and nausea. An ulcer often develops on the skin or mouth at the site of introduction of the organism, and there may be swelling and pain in the lymph glands.

Symptoms of infection vary according to the means by which the *F. tularensis* bacterium is introduced into the body. Ingestion of the organism can produce pharyngitis, abdominal pain, diarrhea, and vomiting, while inhalation can result in pneumonia, and

introduction into the eyes can result in painful and productive conjunctivitis. Symptoms usually appear three to five days after exposure to the bacteria but can take up to 14 days to appear.

While both types of tularemia can usually be successfully treated with antibiotics, in rare cases tularemia can be fatal.

Human Case Surveillance

No human cases of tularemia were reported in Durham Region in 2018. Tularemia is very rarely reported in Ontario. According to the MOHLTC, 2 human cases were reported between 2014 and 2018; 1 in 2015 and 1 in 2017.

Yellow Fever

Overview

Yellow fever is caused by a virus that is transmitted to humans by the bite of an infected mosquito. Yellow fever derives its name from the yellowing of the skin and eyes (jaundice) that occurs when the virus attacks the liver.

The primary vector of yellow fever virus is *Aedes aegypti* but other *Aedes* species in Africa and the *Haemagogus* species in South America also play a role in transmission. Non-human primates (e.g., monkeys, great apes) can also be infected with the yellow fever virus, and these animals serve as a reservoir for the virus in rural and jungle areas.

Yellow fever is endemic (always present) in many tropical areas of South America and Africa. Canadians travelling to endemic areas may be at risk of contracting the virus.

Symptoms of yellow fever usually take 3-6 days to appear in infected individuals, and may include sudden onset of fever, headache, joint pain, loss of appetite, abdominal pain, vomiting, and dehydration. Most patients recover after this stage. However, in severe cases, the disease can lead to shock, internal bleeding, jaundice (yellowing of the skin and eyes), and organ failure. This occurs in about 15% of patients.

The case-fatality rate for those who develop severe yellow fever disease is 20-50%. Once symptoms develop there is no specific treatment, and the only option is supportive care.

A yellow fever vaccine is available to prevent infection. First time recipients of the vaccine must be vaccinated at least 10 days before travelling to endemic areas for the vaccine to be effective. In addition to vaccination, personal protective measures against mosquitoes are recommended for persons travelling to endemic regions.

PHAC indicates that mosquito control has played a major role in preventing transmission of yellow fever in North America and Europe.

Currently, in Ontario, yellow fever is not considered to be a “Disease of Public Health Significance” and it is therefore not reportable to local medical officers of health or the MOHLTC. Consequently, no new data is available for Durham for 2018.

Human Case Surveillance

One case of yellow fever was reported in Durham Region In 2014. This case was reported to have been related to travel to Guyana. No cases were reported in Ontario from 2015 to 2017 and no data is available for 2018 since yellow fever is no longer considered a disease of public health significance in Ontario.

Zika Virus

Overview

Zika virus was first identified in humans in 1952 in the Zika forest of Uganda. Since then, outbreaks of disease have been recorded in Africa, Asia, the Americas and the Pacific.

Zika virus is generally transmitted to humans via the bite of an infected mosquito. The vectors of Zika virus are *Aedes* mosquitoes (i.e., *Ae. aegypti* and *Ae. albopictus*). These mosquitoes also transmit the dengue and chikungunya viruses.

In addition to the primary means of transmission, it is now known that the Zika virus can be transmitted sexually from one partner to another via semen or vaginal fluids and that a pregnant woman infected with Zika virus can transmit the virus to her fetus during pregnancy or at the time of birth resulting in the potential for severe birth defects. Zika can also potentially be transmitted via blood transfusions, and via laboratory and healthcare setting exposures.

Most people infected with Zika virus experience mild symptoms including: fever, rash, joint pain, conjunctivitis, muscle pain, and headache. Some have no symptoms. However, during a large outbreak of Zika virus that was identified in Brazil in the spring of 2015, researchers identified an association between Zika virus infection and Guillain-Barré syndrome. In addition, it was found that Zika virus infection during pregnancy can cause microcephaly and other severe birth defects. Microcephaly is a condition in which a baby has a head size much smaller compared to other babies of the same age and sex. Head size is an important measure of a child’s brain growth. Researchers are still attempting to determine the full range of potential health problems Zika virus may cause.

There is no vaccine for Zika virus so the best way to prevent Zika virus transmission is to protect against mosquito bites using appropriate clothing, insect repellents, and barriers such as window screens and mosquito netting. Sexual transmission can be prevented with condom use or abstinence from sex after potential exposures to the virus.

Currently the risk of acquiring Zika virus within Canada is extremely low as it is thought that the Canadian climate is not conducive to the survival of and proliferation of *Aedes aegypti* and *Aedes albopictus* mosquitoes. However, PHAC is planning to enhance mosquito surveillance within Canada in future to allow for the detection of species that could transmit the virus.

Zika virus is not currently listed as a "Disease of Public Health Significance" in Ontario. Therefore, no data is available regarding human cases within Durham.

Human Case Surveillance

As of August 31, 2018, 569 travel-related cases and 4 sexually transmitted cases have been reported in Canada since cases started being detected in October 2015. A total of 45 cases have been reported amongst pregnant women in Canada [≠]

[≠] *Source: Public Health Agency of Canada (PHAC), Surveillance of Zika, link: https://www.canada.ca/en/public-health/services/diseases/zika-virus/surveillance-zika-virus.html#_Has_Zika_virus*

Health Promotion and Public Communications

Table 12: 2018 West Nile Virus and Lyme Disease Communications Campaign - Durham Region

Messaging	Media Type	# of items
“Protect Yourself Against Lyme Disease” web ads	Parentsource.ca – centre page ad (400 x 370 pixels) digital – Sept. x 4 weeks	1 digital ad – 20,000 impressions
“Protect Yourself Against Lyme Disease” digital ads	Medical wait room digital LCD screen ads in Brooklin and Uxbridge; May x 4 weeks	:30 second digital ad x 2 locations – 10,420 impressions
“Protect Yourself Against Lyme Disease” web ads	Metroland Media Group (durhamregion.com) Leaderboard and Big Box – Sept. x 4 weeks	1 ad – 111,111 impressions
“Protect Yourself Against Lyme Disease” digital ads	Lakeridge digital ads in Oshawa, Bowmanville and Ajax ; May x 4 weeks	:20 second digital ad x 3 locations – 120,018
“Protect Yourself Against Lyme Disease” cross platform digital ads	Cross platform ads (mobile, desktop) on The Weather Network; Durham Region - May x 4 weeks	120,833 impressions
“Protect Yourself Against West Nile Virus” digital ads	Lakeridge digital ads in Oshawa, Bowmanville and Ajax; August x 4 weeks	:20 second digital ad x 3 locations – 120,018
“Protect Yourself Against West Nile Virus” Virus digital ads	Medical wait room digital LCD screen ads in Brooklin and Uxbridge; August x 4 weeks	:30 second digital ad x 2 locations – 10,420 impressions

West Nile Virus cross platform digital ads	Cross platform ads (mobile, desktop) on The Weather Network; Durham Region – July x 4 weeks	120,833 impressions
“Protect Yourself Against Lyme Disease”/“Protect Yourself Against West Nile Virus” mall ads	Pickering Town Centre 6 digital food court screens – May 7 x 4 weeks	1 digital ad on 6 screens – 1,850,904 impressions
Lyme Disease/West Nile Virus bathroom posters	New Ad Media Classic 13”x17” bathroom stall posters and digital posters from; Various restaurants throughout Durham Region Medical Clinics (Walmart) June x 4 weeks + Sept. x 4 weeks	44 posters – 62,400 impressions

Pesticide Notification	**“Metroland” Newspapers (1/4 pg. b&w ads – April 26)** Brock Citizen Oshawa/Whitby/Clarington This Week Pickering/Ajax News Advertiser Port Perry Star Uxbridge Times Journal **“Independent” Newspapers (1/4 pg. b&w ads)** Brooklin Town Crier – April 27 Durham Citizen – April 24 Orono Weekly Times – April 25 Oshawa Express – April 25 Scugog Standard – April 27 Uxbridge Cosmos – April 26	8 Metroland ads - 211,556 Impressions 6 ads – Brooklin Town Crier – 8000 impressions; Durham Citizen – N/A; Orono Weekly Times – 4500 impressions; Oshawa Express – N/A impressions; Scugog Standard – 15,000 impressions Uxbridge Cosmos – N/A

Lyme Disease Trackable Impressions – 1,307,834

West Nile Virus Trackable Impressions – 1,207,923

Pesticide Notification Trackable Impressions – 239,056

Total Trackable Impressions – 2,754,813

Note: “An impression (also referred to as a view or ad view) refers to the point at which an advertisement or document is viewed by the audience. It is typically an estimate of the number of people an advertisement or document is reaching, and may be calculated differently depending on the vendor’s estimates”

Response to Public Inquiries – Environmental Help Line

Between 2014 and 2018 the total number of public inquiries regarding vector-borne diseases increased steadily. This has largely been due to increasing public concerns around ticks and LD. **The number of inquiries related to ticks and LD has risen significantly from 14 in 2014 to 136 in 2018**.

Table 13: Environmental Help Line Inquiries, Vector-Borne Diseases - Durham Region (2014-2018)

Year	# Telephone Calls Received Per Topic			
	# WNV/Stagnant Water Inquiries	# LD/Tick Inquiries	# Other VBD Inquiries (e.g. Zika Virus)	Total - All Inquiries
2018	**30**	**136**	**3**	**169**
2017	67	82	4	163
2016	39	69	7	115
2015	53	56	1	110
2014	102	14	1	117

Program Evaluation Durham Region - Rapid Risk Factor Surveillance System (RRFSS) Results

The RRFSS is an ongoing telephone survey of adults aged 18 years and older, conducted by the Institute for Social Research at York University, on behalf of DRHD and other participating Ontario PHUs. Since 2001, a sample of at least 100 Durham Region residents has been surveyed on a monthly basis regarding knowledge, attitudes and risk behaviours of importance to public health. Questions related to WNV were included in the Durham Region RRFSS survey from 2002 to 2005, and in 2008, 2010, 2012, 2014, 2016, and 2018. In 2011, new modules were added to RRFSS to measure awareness and perceived risk of LD and the use of personal protective measures. The LD questions were included in the Durham Region RRFSS survey in 2011, 2012, 2013, 2015, and 2017. Beginning in 2016, both landline and cell phone numbers were used to survey adults living in Durham Region. The RRFSS results provide data for evaluation of DRHD initiatives to increase public awareness and encourage behaviours that reduce the risk of contracting WNV and LD.

Data Notes:

95% Confidence Interval (CI): Percentages are expressed in the form of the point estimate ± the 95% CI around the estimate. The true or actual percentage falls within the range of values, 95 out of 100 times. A wide CI reflects a large amount of variability or imprecision. Usually, CIs are narrower when a large number of residents are surveyed. In bar charts, the 95% CI is represented by an error bar (I) at the top of each bar.

Significant Difference refers to a difference between two estimated percentages that is not likely due to chance. If the 95% confidence intervals of two estimates do not overlap, there is considered to be a significant difference between the estimates.

Household Weights are applied when calculating the estimates to adjust for the unequal probability of respondent selection based on the number of adults in the household.

West Nile Virus (WNV)

During the summer of 2018 (May-August), over 625 Durham Region adults aged 18 and older were surveyed on their awareness of WNV and use of personal and household protective measures to reduce exposure to mosquitoes and mosquito bites.

WNV Awareness

In 2018, **96%** (±2%) of adults in Durham Region had heard of WNV and **78%** (±4%) knew that WNV is passed on to people by mosquitoes. In 2016, when these questions were last asked, 97% (±2%) had heard of WNV and 83% (±4%) knew that mosquitoes

were the means of transmission. This slight decrease since 2016 does not represent a significant change in awareness.

WNV Personal Protective Behaviours - Use of Clothing & DEET

2018

During the summer of 2018, **31%** (±4%) of Durham Region adults reported covering up with long sleeves, pants, and socks all or most of the time to protect themselves from being bitten by mosquitoes and **12%** (±3%) of residents used a DEET-based insect repellant all or most of the time.

Main Reasons for Not Covering Up More Often (among residents who did not cover-up all or most of the time), Durham Region, May - August 2018

Table 14: Reasons for Not Covering Up More Often

Response	Rate
Not Enough Mosquitoes Out	44% (±6%)
Not Worried About Being Bitten by Mosquitoes	18% (±5%)
Didn't Go Where Mosquitoes Are	13% (±4%)
Too Hot to Cover Up	18% (±4%)
Other Reasons	7%* (±3%)

**Interpret with caution due to high variability*

Main Reason for Not Using DEET More Often (among residents who did not use DEET all or most of the time), Durham Region, May - August 2018

Table 15: Reasons for Not Using DEET

Response	Rate
Not Enough Mosquitoes Out	43% (±5%)
Not Worried About Being Bitten by Mosquitoes	15% (±4%)
Didn't Go Where Mosquitoes Are	13% (±3%)
Don't Like Using Chemicals Like DEET	21% (±4%)
Other Reasons	9%* (±3%)

**Interpret with caution due to high variability*

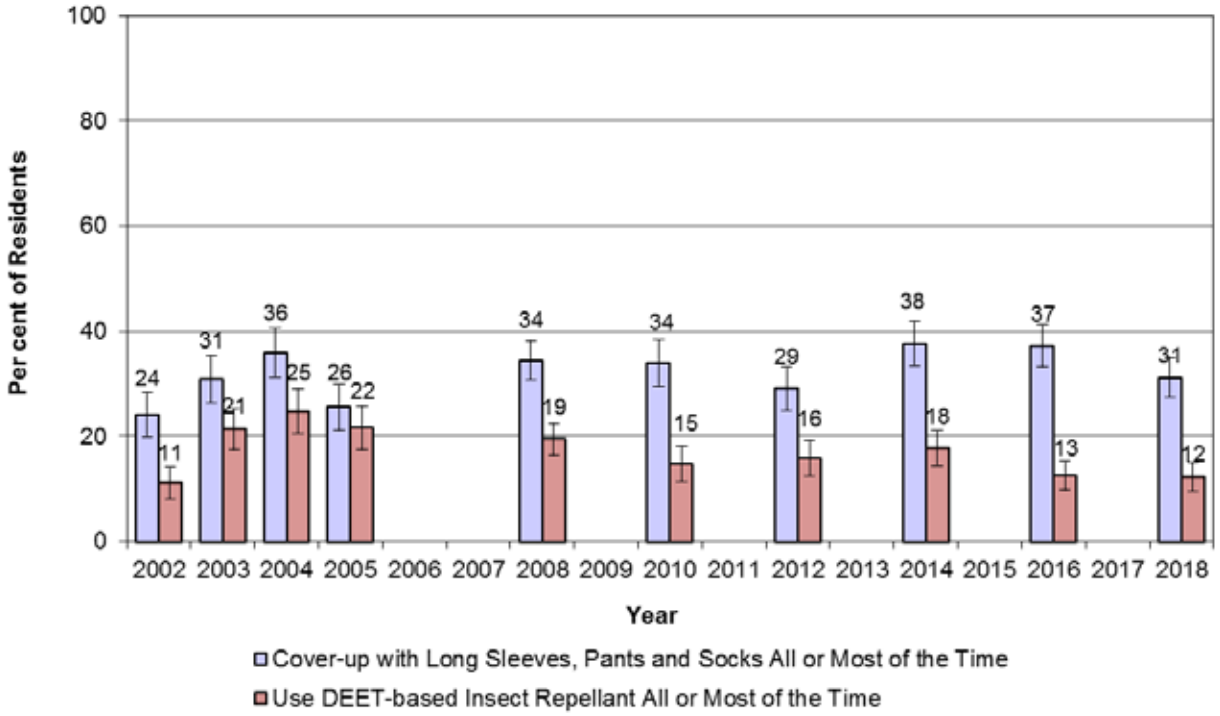
Trend 2002 - 2018

The percentage of residents who cover-up with long sleeves, pants, and socks all or most of the time to protect themselves from being bitten by mosquitoes was lower in

2018 (**31%** ±4%) compared to 2016 (37% ±5%). There have been regular annual fluctuations over the more than ten years of data collection, such as the significant increase between 2012 (29% ±4%) to 2014 (38% ±4%).

Use of DEET-based insect repellant increased from 11% (±3%) in 2002 to a peak of 25% (±4%) in 2004. From 2008 onwards, it has since declined; ranging between 12% and 19%.

Graph 1: WNV Personal Protective Behaviours, Adults (18+), Durham Region, 2002-2018



WNV Household Protective Behaviours - Removal of Standing Water & Use of Window/Door Screens

2018

During the summer of 2018, **88%** (±3%) of Durham Region households did not have containers outside where water collected and stayed for more than 7 days: 72% (±4%) did not have containers that collected water and 16% (±3%) reported having containers where water could collect but was not allowed to stay for more than 7 days at a time. Only 12% (±3%) of households reported having containers where water collected and stayed for more than 7 days.

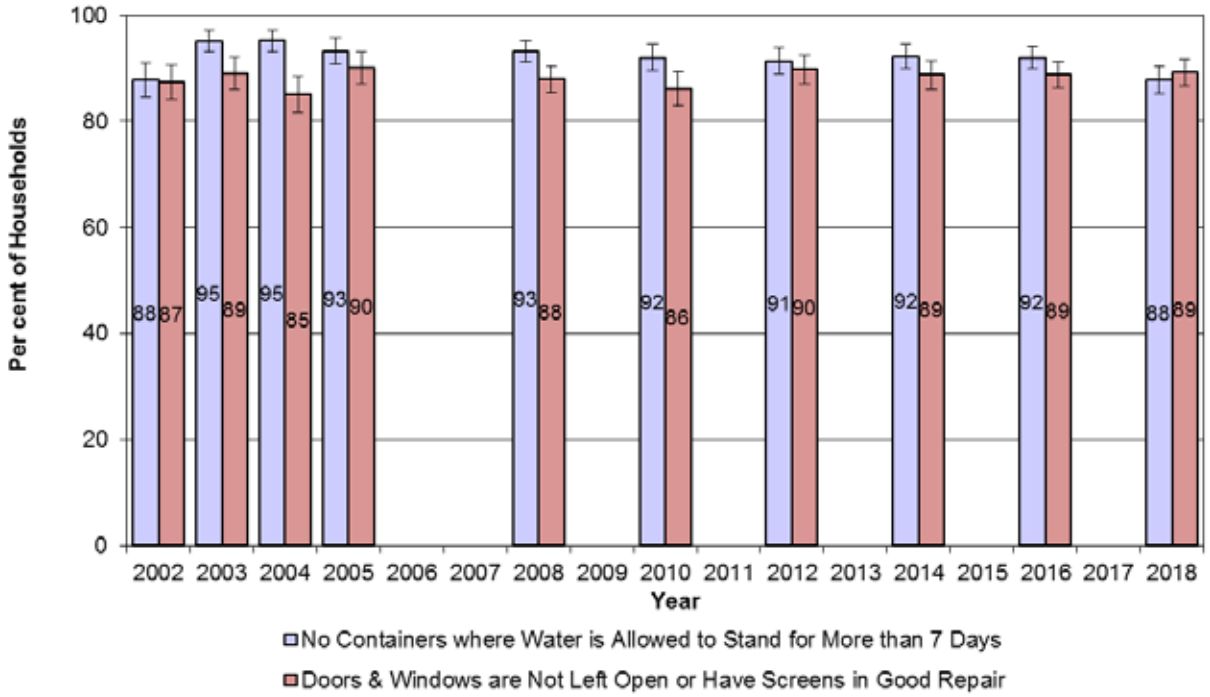
Most households (**89%** ±2%) had all door and window screens in good repair or did not leave doors and windows open: 65% (±4%) reported having screens with no holes or tears and 24% (±4%) did not leave doors and windows open. Ten per cent (11% ±2%) of households had screens in need of repair or had windows and doors without screens.

Trend 2002 - 2018

The percentage of households with no containers outside where water is allowed to collect and stand for more than 7 days increased significantly from 88% (±3%) in 2002 to 95% (±2%) in 2003 and 2004 and has since remained relatively steady ranging from about 88% to 93% of households.

The percentage of households with screens in good repair or where doors and windows are not left open has remained relatively steady since 2002 ranging from about 85% to 90% of households.

Graph 2: WNV Household Protective Behaviours, Durham Region, 2002-2018



Lyme Disease (LD)

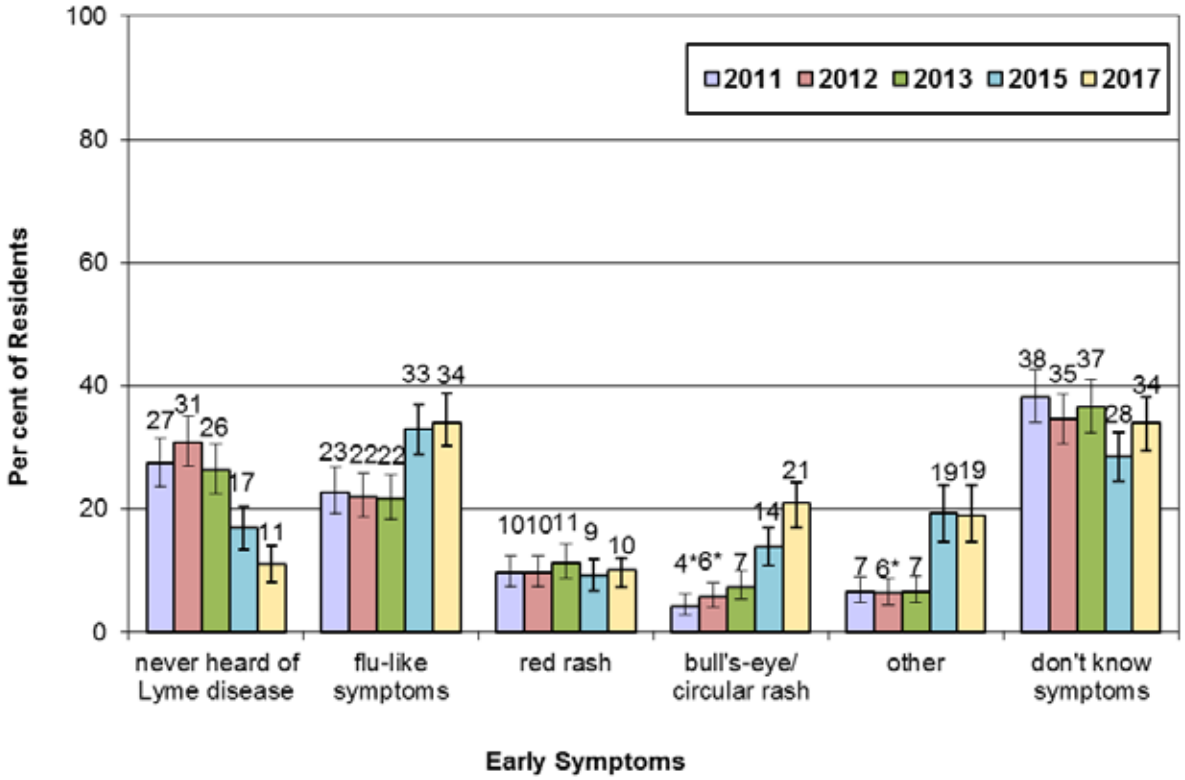
During 2011, 2012, 2013, 2015 and 2017, approximately 600 Durham Region adults were surveyed each fall regarding their awareness and perceived risk of LD and their use of personal protective measures during the past summer to reduce exposure to ticks.

LD Awareness

In 2017, **88%** (±4%) of adults in Durham Region had heard of LD and more than half (62% ±5%) knew that people get LD from ticks. These results are similar to the 2015 rates, where 83% (±4%) had heard of LD and 58% (±4%) knew that LD is transmitted through ticks. Awareness of the early symptoms of LD varied: 34% (±4%) mentioned general flu-like symptoms including fatigue, fever or chills, muscle or joint pain, or swollen lymph nodes, 10% (±3%) mentioned a red rash and **21%** (±4%) specifically

described a circular “bull’s-eye” rash. The number of residents who were able to identify a bull’s eye rash as a symptom has significantly increased from 2015 compared to 2017.

Graph 3: Awareness of Early Symptoms of LD, Adults (18+), Durham Region, 2011-2013, 2015, 2017



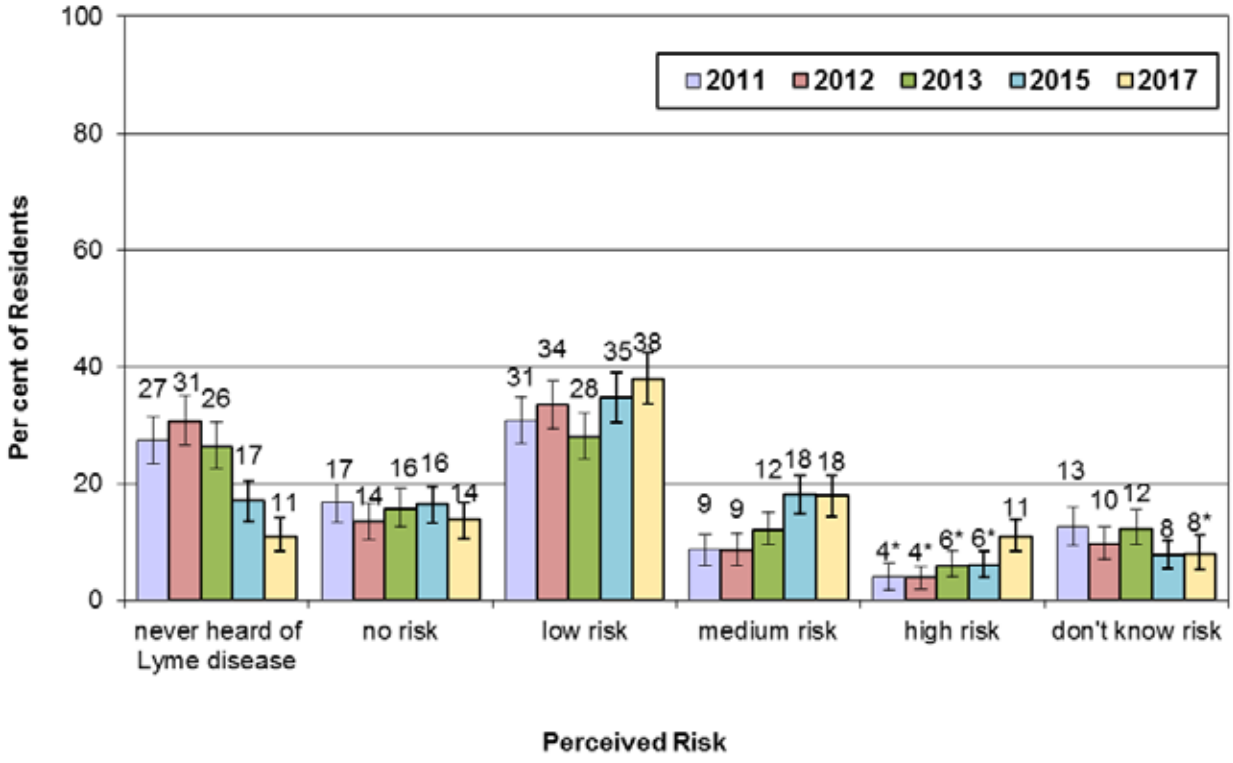
**Interpret with caution due to high variability.*

Among those who had heard of LD, **47%** (±4%) indicated that they would remove a tick attached to their skin by pulling it out with tweezers or some other tool. This did not change significantly from previous years. Using tweezers is the method recommended for safe tick removal. **Thirteen** per cent (13% ±3%) indicated that they would go to a hospital, clinic, doctor, or other healthcare provider. Other methods mentioned by respondents were applying heat, salt or alcohol (10% ± 3%) or pulling, brushing or flicking with your hand (18% ±4%). These methods are not recommended. About half of residents (52% ±5%) knew that ticks could be sent for Lyme disease testing.

LD Perceived Risk

Most Durham Region residents did not consider themselves to be at much risk of contracting LD during the fall of 2017. Those who had never heard of LD (**11%** ±3%) would not be aware of any risk and a further **52%** (±4%) considered themselves at low or no risk of getting LD. Another **29%** (±3%) felt they were at medium or high risk and **8%** (±3%) could not identify their level of risk. The rate which residents felt they were at high risk of getting LD increasing significantly in 2017 compared to 2015.

Graph 4: Perceived Risk of Getting Lyme Disease, Adults 18+, Durham Region, 2011-2013, 2015, 2017



**Interpret with caution due to high variability.*

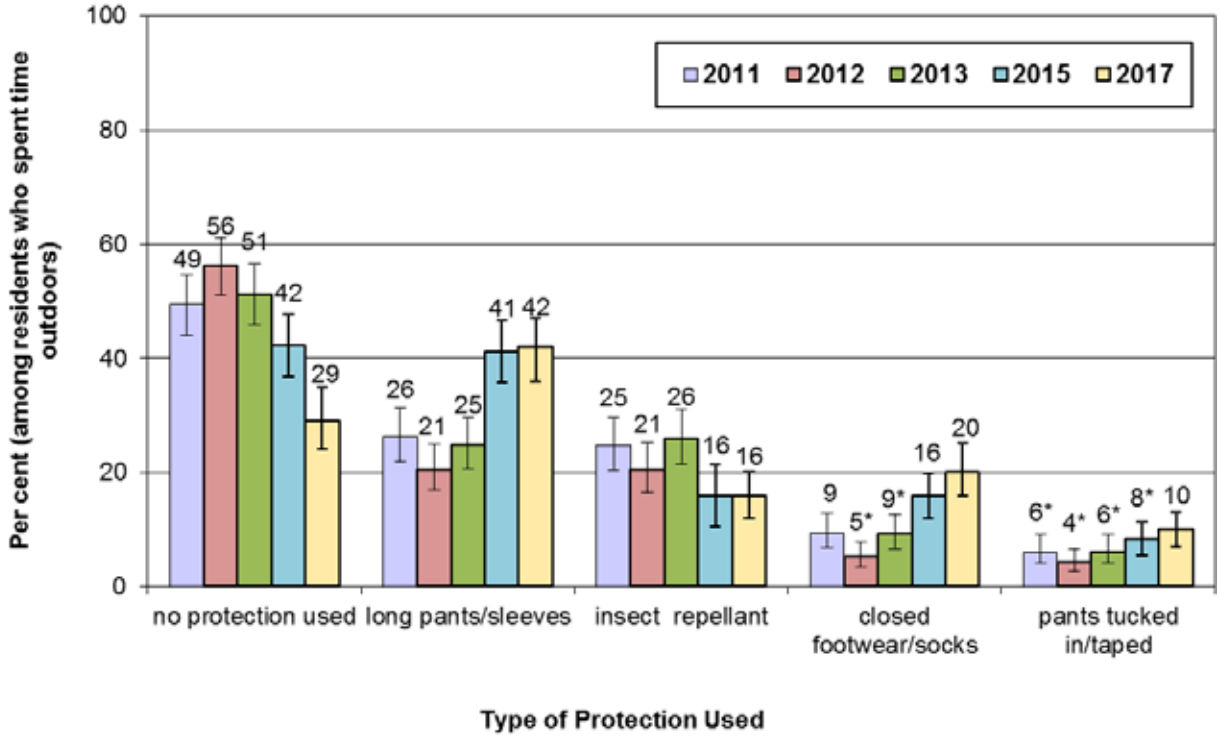
LD Personal Protective Behaviours

During the fall of 2017, almost two thirds (**65%** ±5%) Durham Region adults aged 18 and over spent time outdoors in grassy fields or wooded areas. Among these residents, **42%** (±5%) protected themselves every time or most of the time, 16% (±4%) protected themselves only some of the time and 42% (±6%) rarely or never took steps to protect themselves from tick bites while in these areas. This pattern was not significantly different from previous years.

The most common methods of tick protection used were wearing long pants and sleeves (**52%** ±6%) and/or wearing closed footwear and/or socks (**20%** ±4%). Using insect repellant was mentioned by **16%** (±4%) of residents, and only **5%*** (±3%) specifically mentioned using DEET. **Ten per cent** (10% ±3%) said they tucked in or taped the bottom of their pants. The number of Durham residents who wore long pants and sleeves when spending time outdoors in grassy fields or wooded areas has significantly increased since 2015.

After being outside, only **30%** (±5%) checked themselves for ticks every time or most of the time, **14%** (±4%) checked themselves some of the time, and over half (**56%** ±5%) rarely or never checked themselves. There has been a significant decrease in the rate for which residents use no protection when spending time outdoors in grassy fields or wooded areas.

Graph 5: Type of Tick Protection Used by Adults (18+) who Spent Time Outdoors in Grassy Fields or Wooded Areas, Durham Region, 2011-2013, 2015, 2017



**Interpret with caution due to high variability.*

Overall Summary / Conclusions

West Nile Virus

Surveillance activities have revealed that WNV has been present in one or more of the adult mosquito, wildlife, or human populations, within Durham Region, since 2002.

Each year since 2002, in order to control the spread of WNV, the DRHD has instituted a Vector Control Plan which includes control measures such as adult mosquito surveillance, larval mosquito surveillance, the monitoring of human health effects / complaints, as well as a public awareness campaign focusing on source reduction, and personal protective measures.

For several years, the Vector Control Plan included an active avian (dead bird) surveillance component. However, this surveillance was discontinued in Durham Region in 2009, resulting in no birds being collected and submitted for testing by the DRHD since that time. General public inquiries and atypical avian fatalities are still referred to the Canadian Cooperative Wildlife Health Centre (CCWHC) for its follow-up, which may include bird pick-up and testing.

No equine cases of WNV were reported in Durham Region in 2018, but OMAFRA reported **11** cases of equine WNV in Ontario (OMAFRA website last updated October 30, 2018).

Every year, beginning 2003, DRHD has contracted a licensed PCO, and licensed laboratory, to assist in the delivery of the Vector Control Program. For the 2018 season, CCMM was tasked with providing larvicide treatments to control Durham's larval mosquito population, while Entomogen Inc. was tasked with laboratory identification and testing of adult mosquitoes.

With regard to larval mosquito surveillance, DRHD and CCMM field staff combined to conduct a total of **4,402** inspections at identified standing water sites (including SWMPs, ditches, field pools, etc.) throughout Durham Region. These inspections resulted in **1,044** larvicide applications to standing sites where live mosquito larvae were identified. Both the total number of inspections and the number of larvicide applications were higher in 2018 than in any of the previous 4 years.

Adult mosquito surveillance (trapping) was conducted in Durham Region between CDC weeks 23 (w/o June 12, 2017) and 37 (w/o September 18, 2017). The surveillance program consisted of a network of up to **15** trapping stations distributed over **7** of 8 local municipalities. Over the 15-week capture period a total of **196** traps were set, and **28** different mosquito species or species groups were identified. Of the 28 species, **10** are representative of WNV vector or bridge vector species.

A total of **8,199** adult mosquitoes were captured during the 2018 season. This is lower than the number captured during any of the 2014 to 2017 seasons.

WNV vectors, primarily *Culex pipiens/restuans,* represented **19%** of total adult mosquito captures in Durham Region in 2018. Bridge vectors represented **30%** of total captures and non-vector species made up the remaining 51% of captures. At 14% of total captures, *Aedes vexans* was the predominant bridge vector species captured. *Coquillettidia perturbans* (a non-vector) was the dominant adult mosquito species captured in 2018, at 44% of all captures.

A "degree-day" analysis was conducted for the 2018 season, by Entomogen Inc., from weather data collected at the Environment and Climate Change Canada, Oshawa Water Pollution Control Plant station. Based on an accumulated degree day model, used by PHO, Entomogen has indicated that the rate at which WNV replicates within adult female *Culex pipiens/restuans* depends on the ambient temperatures. Below an average daily temperature of 18.3°C WNV does not appear to incubate in the mosquito. A total of 380 accumulated degree days would have been required for 50% of infected *Culex pipiens/restuans* mosquitoes to have tested positive for WNV. Since the 380 accumulated degree day threshold was attained as of CDC week 37, and in all there were 419.1 accumulated degree days in Durham during the 2018 WNV season, Entomogen concluded that there were "sufficient heat units for amplification of the virus in *Culex spp. m*osquitoes".[^]

In 2018, a total of **357** pools of captured mosquitoes were tested for the presence of WNV using the RT-PCR method. Of the 357 pools tested, **7** were positive for WNV. *Culex pipiens/restuans* mosquitoes were responsible for all 7 of the WNV-positive pools.

Durham Region had **5** confirmed human cases of WNV reported in 2018. This is the highest number of cases reported any year from 2014 to 2018.

As of December 15, 2018, for the 2018 WNV season, PHAC reported **126** clinical human cases of WNV in Ontario and **367** clinical cases for all of Canada.[ɣ] The case numbers seen in 2018 and 2017, for both Ontario and Canada, were more than double the numbers seen in the previous 3 years.

In the USA, as of January 8, 2019, a total of 2,544 cases of human WNV, including 137 deaths, were reported by the CDC. Of these, 1,594 (63%) were classified as neuro-invasive disease (such as meningitis, encephalitis, or acute flaccid paralysis) and 950 (37%) were classified as non-neuro-invasive disease.[+] There have been over 2,000 cases of WNV reported in the USA in each of the past 5 years.

[^]*Source: Entomogen Inc., West Nile Virus Mosquito Surveillance Report and Notes on Eastern Equine Encephalitis Virus Mosquito Testing, 2018-The Regional Municipality of Durham*

[ɣ]*Source: Public Health Agency of Canada (PHAC), Surveillance of West Nile Virus, link:*

https://www.canada.ca/en/public-health/services/diseases/west-nile-virus/surveillance-west-nile-virus/west-nile-virus-weekly-surveillance-monitoring.html

[+]*Source: Centers for Disease Control and Prevention, West Nile Virus Disease Cases and Presumptive Viremic Blood Donors by State-United States, 2018 (as of January 8, 2019), link: https://www.cdc.gov/westnile/statsmaps/preliminarymapsdata2018/disease-cases-state-2018.html*

Eastern Equine Encephalitis

Culiseta melanura mosquitoes are the primary vectors of EEEV in Ontario. **One** pool of *C. melanura* mosquitoes was collected during the 2018 trapping season. However, that pool tested negative for EEEV. No EEEV-positive mosquito pools were identified in Durham Region between 2014 and 2017.

No equine cases of EEE were reported in Durham Region during 2018, but as of October 30, 2018 OMAFRA reported **13** equine cases in Ontario. In comparison, 2 equine cases were reported in Ontario in 2017, 0 in 2016, 5 in 2015, and 24 in 2014.[≠]

In 2018, **107** equine cases of EEE were reported in the USA. In comparison, 81 equine cases were reported in 2017, 118 cases in 2016, 70 cases in 2015, and 136 cases in 2014.[∞]

No human cases of EEE were reported in Durham Region in 2018 and, to date, only 1 locally-acquired human case has ever been reported by PHO/MOHLTC in Ontario.[α]

As of the date of this report, no data was available with regard to human cases of EEE in the USA in 2018. The CDC reported 5 human cases in 2017, 7 cases (with 3 fatalities) in 2016, 6 in 2015, and 8 in 2014.[¥]

[≠] *Source: Ontario Ministry of Agriculture, Food and Rural Affairs, Equine Neurological Disease Surveillance 2018, Cases of Equine Neurological Disease in Ontario - 2018, last updated October 30, 2018, link: http://www.omafra.gov.on.ca/english/livestock/horses/facts/nhd_surv2018.htm*

[∞] *Source: United States Department of Agriculture, Animal and Plant Health Inspection Service (APHIS), 2018 Equine Case Reports of Eastern Equine Encephalitis reported to the ArboNET reporting system as of December 11, 2018, link: https://www.aphis.usda.gov/animal_health/downloads/animal_diseases/2018-eee-report.pdf*

[α] *Source: Ontario Agency for Health Protection and Promotion (Public Health Ontario).Vector-Borne Diseases 2017 Summary Report. Toronto, ON: Queen's Printer for Ontario; 2017, link: https://www.publichealthontario.ca/en/eRepository/Vector-Borne-Diseases-Summary-Report-2017.pdf*

[¥] Source: United States Centers for Disease Control and Prevention (CDC), Eastern Equine Encephalitis - Epidemiology and Geographic Distribution, link: https://www.cdc.gov/easternequineencephalitis/tech/epi.html#casesbystate

Lyme Disease

In 2010, the MOHLTC and PHUs initiated a campaign to increase public awareness of LD in response to an increase in the number of established populations of blacklegged ticks in the southern part of the province.

For the past number of years, the number of ticks submitted to DRHD for identification and potential testing for LD (passive surveillance), has been steadily increasing. Tick specimens, removed from human hosts, may be submitted either by the public or by their healthcare providers. In 2018, a total of **125** tick specimens were submitted. This is less than the 176 ticks submitted in 2017 but substantially more than the number of ticks submitted in each of 2016 (83), 2015 (84), and 2014 (35).

One Hundred (100) of the **125** ticks submitted in 2018 (**80%**) were confirmed to be blacklegged ticks (*Ixodes scapularis*). **Seventy-four** (**74**) of the 100 blacklegged ticks submitted (74%) were reported to have likely been acquired within Durham Region.

To date, **20** of the total 100 blacklegged ticks identified (**20%**) have tested positive for *Borrelia burgdorferi* with **8** of the **20** positive ticks likely acquired within Durham Region.

Of note, **2** of the 100 blacklegged ticks submitted tested positive for *Anaplasma phagocytophilum*, the organism that causes Anaplasmosis. **One** of these 2 ticks was reported to have likely been acquired in Durham Region.

DRHD has been conducting active tick surveillance (tick dragging) since 2010. For the first time, in the fall of 2013, blacklegged ticks were found in Whitby. Subsequently, in 2014 and 2015, blacklegged ticks, positive for *B. burgdorferi*, were collected during active surveillance in the Rouge National Urban Park in Pickering resulting in the park being designated a LD risk area.

In 2017, 1 *B. burgdorferi*-positive blacklegged tick was found during active surveillance at Greenwood CA. However, in 2018 no ticks from this site, found during active surveillance, tested positive.

The human case surveillance data for Durham Region indicates that there were **29** confirmed and **8** probable human cases of LD reported in Durham Region in 2018. These results are lower than the 40 confirmed and 8 probable cases reported in 2017, but they represent a significant increase over the 16 confirmed and 8 probable cases reported in 2016. Confirmed and probable LD cases are defined within the MOHLTC *Infectious Diseases Protocol*.[q]

[q] *Source: Ontario Ministry of Health and Long-term Care Infectious Diseases Protocol, Appendix B: Provincial Case Definitions for Reportable Diseases, Disease: Lyme Disease, Revised March 2017, link:* *http://www.health.gov.on.ca/en/pro/programs/publichealth/oph_standards/docs/lyme_disease_cd.pdf*

Eighteen of the total 37 (confirmed and probable) cases of LD reported they were most likely exposed to a tick within Durham Region ("locally acquired"). Another 17 confirmed and probable cases reported travel to or residence in an endemic/risk area, outside of Durham Region, as a risk factor for LD exposure. For the final 2 cases, no information on exposure location was available.

Currently, the risk of acquiring LD within Durham Region remains low. However, as a result of the recent passive and active tick surveillance findings, active surveillance activities will continue to be enhanced in likely tick habitats in 2019 and steps will be taken to increase public (particularly elementary school-aged children) and healthcare provider knowledge about LD and personal precautions to avoid tick exposures.

Other Vector-borne Diseases of Concern

Historically, human cases of malaria, plague, tularemia and yellow fever have been rare in Durham Region. Due to malaria no longer being considered a "disease of public health significance" there was no data available as to the number of cases reported in 2018. However, there were **4** confirmed cases of malaria reported in Durham Region in 2017, 6 cases reported in each of the 2016 and 2015, and 9 cases reported in 2014. In all cases where exposure details were available, travel to or residence in an endemic area was listed as a risk factor for exposure.

There were **0** cases of tularemia reported in Durham Region in 2018 and there have been **no** cases of plague reported anywhere in Canada since 1939.

Yellow fever is not required to be reported to the MOHLTC as a "disease of public health significance" at this time ad no data is available as to the number of cases in Ontario in 2018.

DRHD received only 3 inquiries regarding Zika virus during 2018. However, a number of inquiries about Zika virus were received during both 2017 and 2016. Information about Zika virus transmission, personal precautions to avoid transmission, and viral testing is provided on the Durham Region website. Zika virus is not required to be reported to the MOHLTC as a "disease of public health significance" at this time.

2019 Vector-borne Disease Prevention Plan

DRHD plans to:

- Maintain a passive surveillance program for blacklegged ticks (*Ixodes scapularis*) and other tick species of increasing concern in terms of expanding migration patterns and climate change.
- Continue to expand the active surveillance program for blacklegged and other tick species based on passive surveillance patterns and specimen results.
- Maintain effective human surveillance programs for WNV, EEE, LD, plague, and tularemia and respond to concerns regarding other emerging vector-borne diseases that may threaten human health as required.
- Maintain an effective vector surveillance (adult and larval mosquito) program for WNV and EEEV.
- Where possible, investigate reports of equine cases of WNV and EEE.
- Maintain an effective control program for WNV vector populations (i.e., *Culex pipiens/restuans*) in municipal and private catch basins, and in open water sites such as SWMPs, sewage lagoons, and ditches, beginning May/June, and continuing through to the end of September.
- Maintain an effective control program for *Aedes vexans* and other bridge vector species via monitoring of and, where necessary, larviciding of ditches, temporary pools, etc., from early May through to the end of September.
- Maintain effective and timely communications with municipal representatives to promote the upkeep and/or remediation of standing water sites on municipal properties.
- Maintain a 48-hour response to public complaints regarding potential mosquito breeding sites on public and private property (i.e., derelict swimming pools, ornamental ponds, backyard catch basins, and other areas of standing water).
- Enhance partnerships with local municipal by-law departments in respect to the investigation of stagnant water complaints.
- Maintain an effective and comprehensive public communication campaign designed to educate the community regarding WNV and the need for source reduction, vector control, and personal protective measures against mosquitoes. In the absence of a vaccine or cure for infections caused by WNV, the cycle of transmission must be interrupted to prevent outbreaks. The promotion of personal protective measures through public education is an important step in combatting both WNV and EEE.
- Continue to develop an effective and comprehensive public communication campaign designed to educate healthcare providers and the community regarding LD and the need for personal protective measures against ticks.

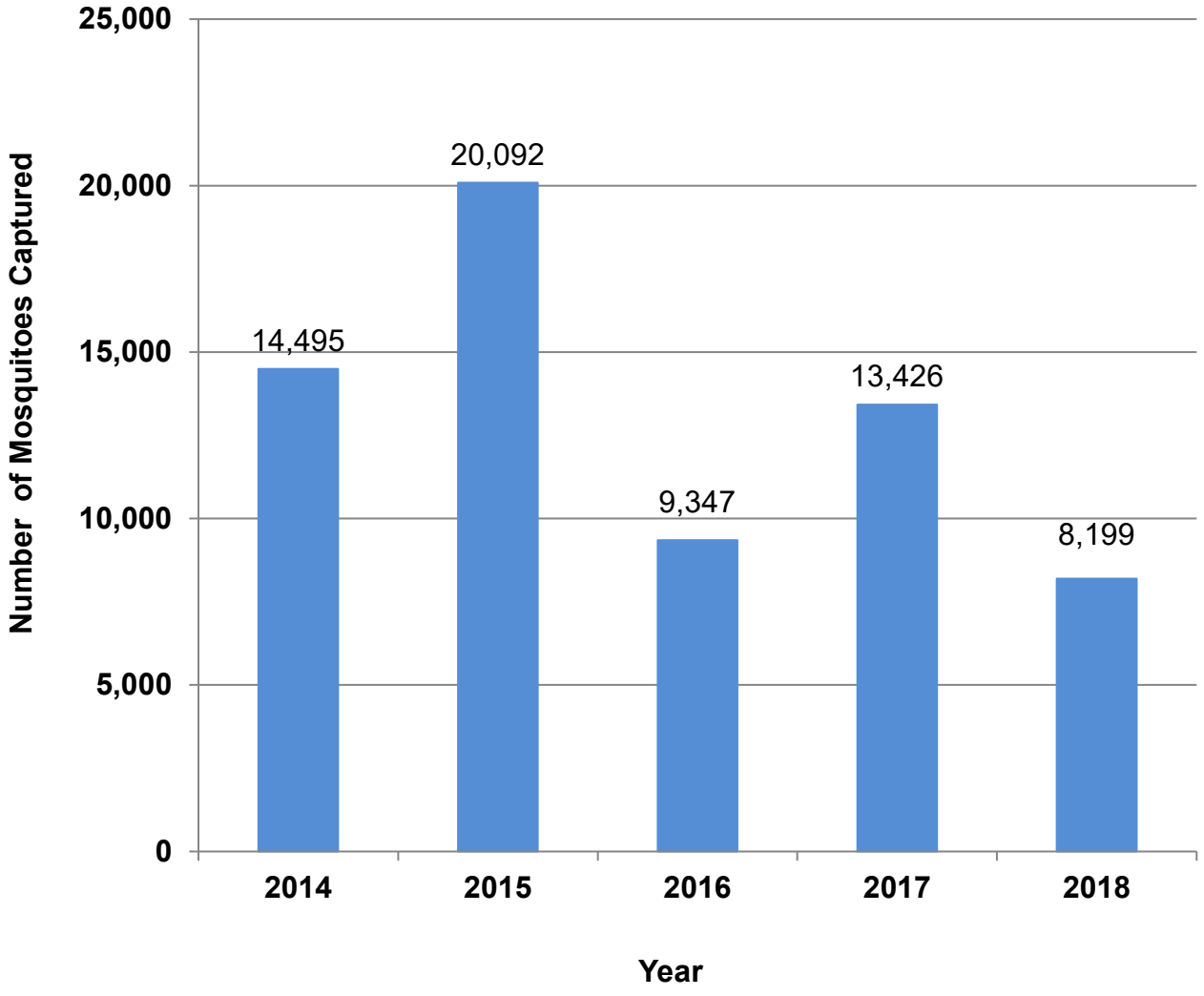
- Develop a curriculum-based tick and LD education program for elementary school children.
- Produce a 5-year retrospective WNV infographic to be distributed to local healthcare providers and veterinarians.
- Continue to develop a communication campaign designed to educate healthcare providers and the public regarding Zika virus, focusing on the need for personal protective measures against mosquitoes when travelling and the need to prevent sexual transmission of the virus to women who are pregnant or who may be planning a pregnancy.
- Continue to use and improve the RRFSS survey module to measure WNV personal and household protective behaviours.
- Continue to use and improve the RRFSS survey module to measure public awareness about ticks and LD.

Appendix A

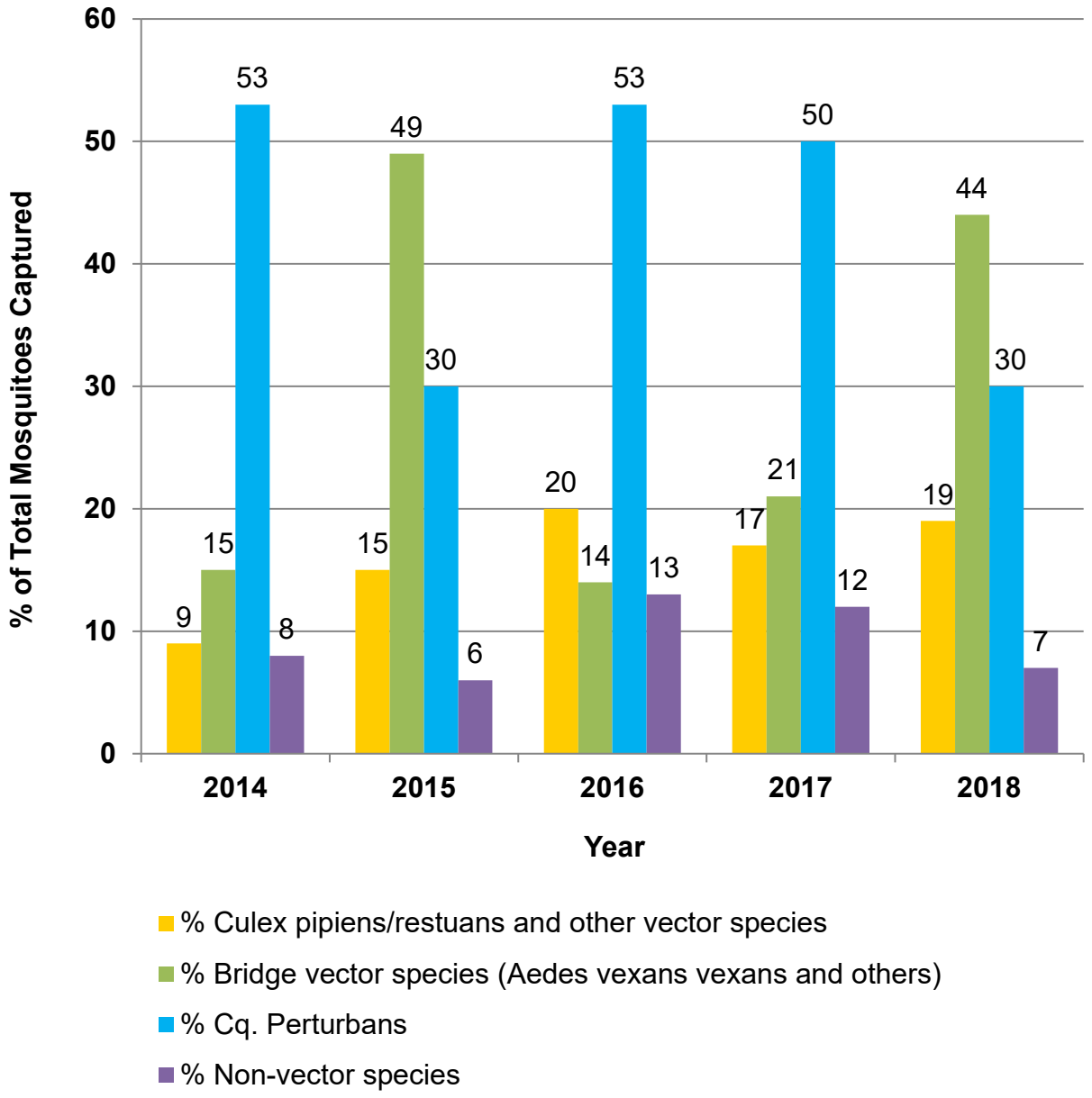
Graphs of West Nile Virus, Eastern Equine Encephalitis, and Lyme Disease / Tick Surveillance Results (2014 - 2018)

West Nile Virus

Graph 6: Number of Adult Mosquitoes Captured Per Year - Durham Region (2014-2018)

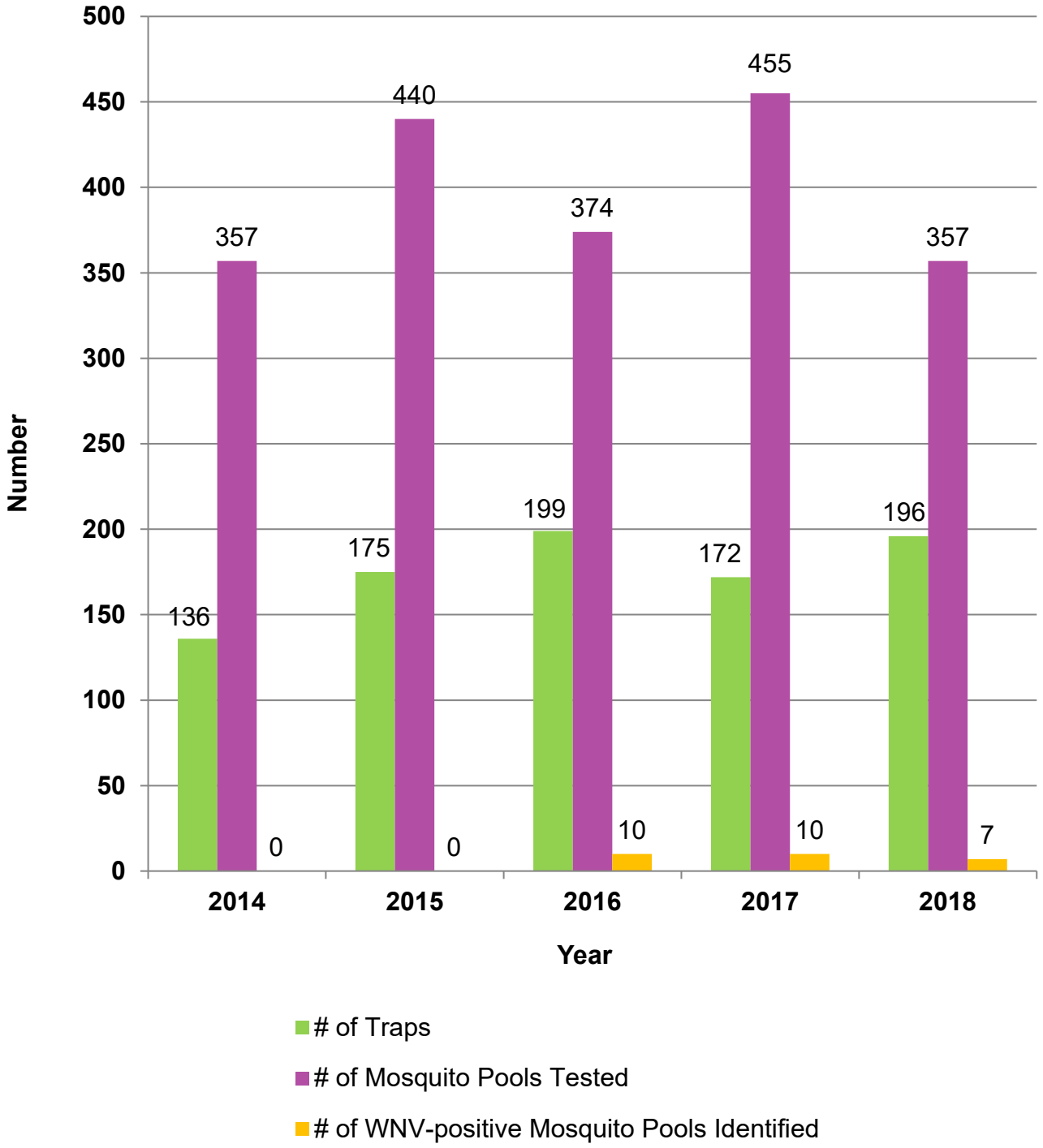


Graph 7: Mosquito Species Distribution - Durham Region (2014-2018)
(% based on adult mosquito captures)

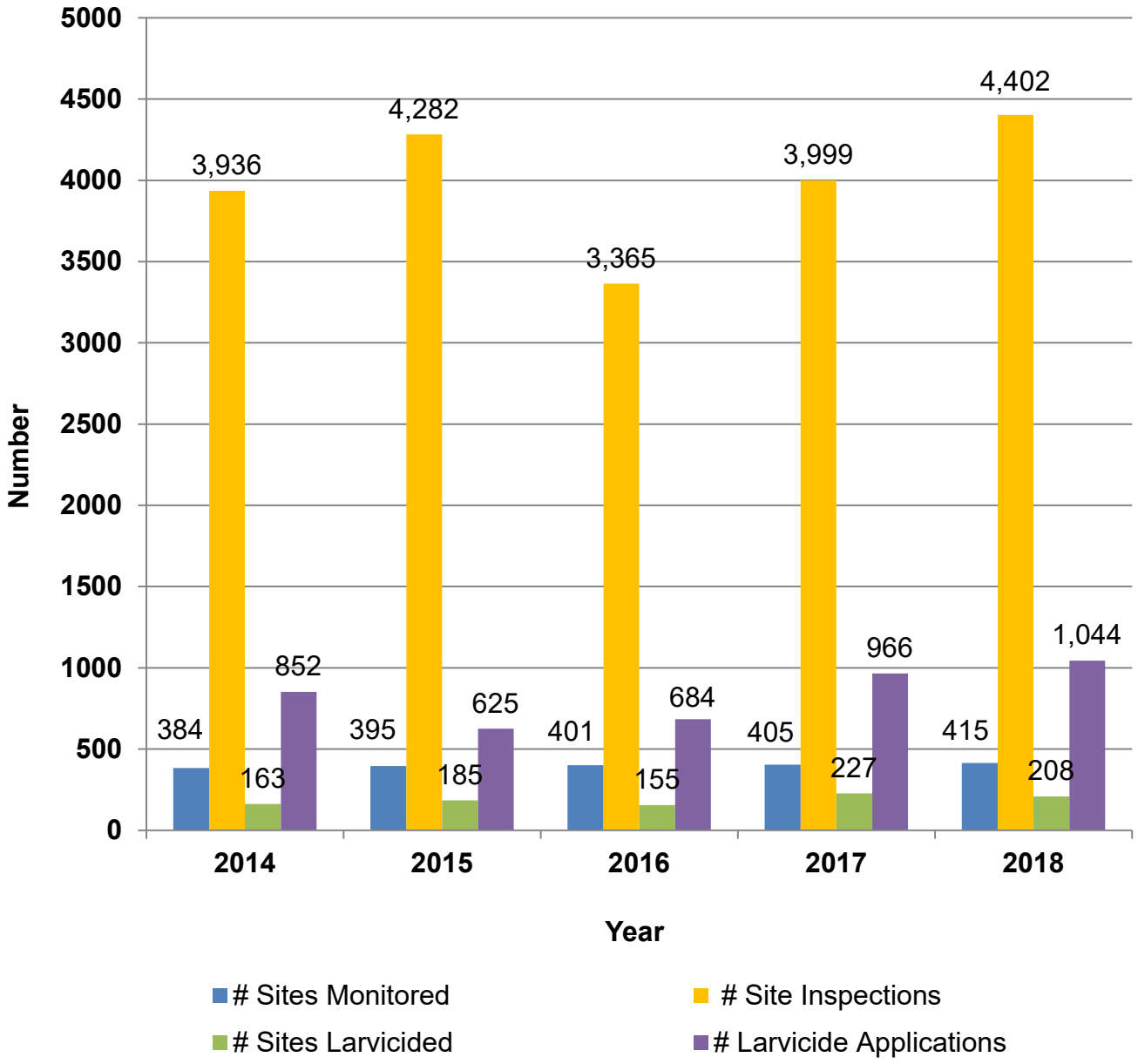


Note: While Cq. perturbans is not considered to be an efficient WNV vector or bridge vector, it is thought that it may still play a role in WNV transmission to humans due to its relative abundance and aggressive nature.

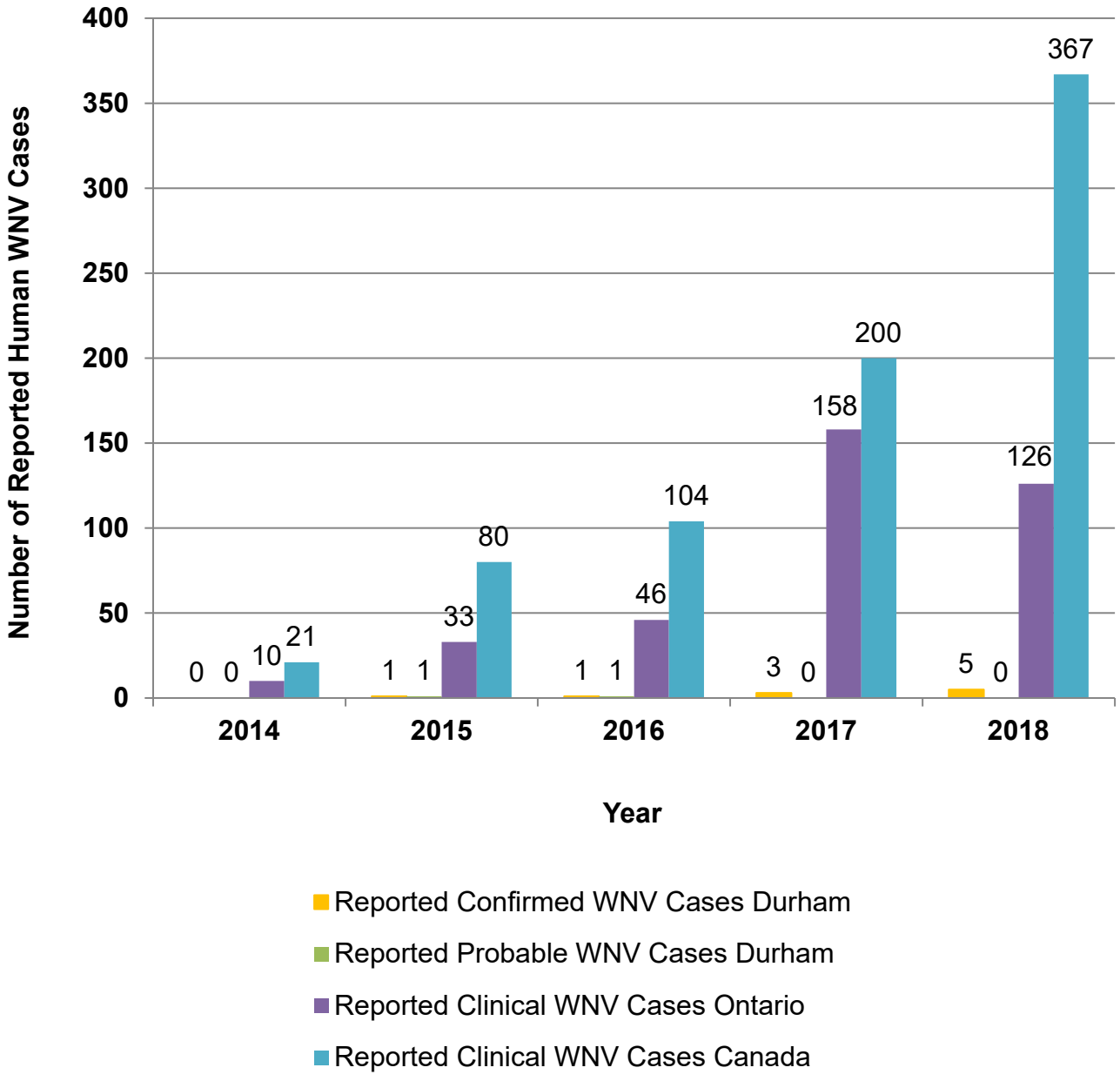
Graph 8: Results of Adult Mosquito Trapping - Durham Region (2014-2018)



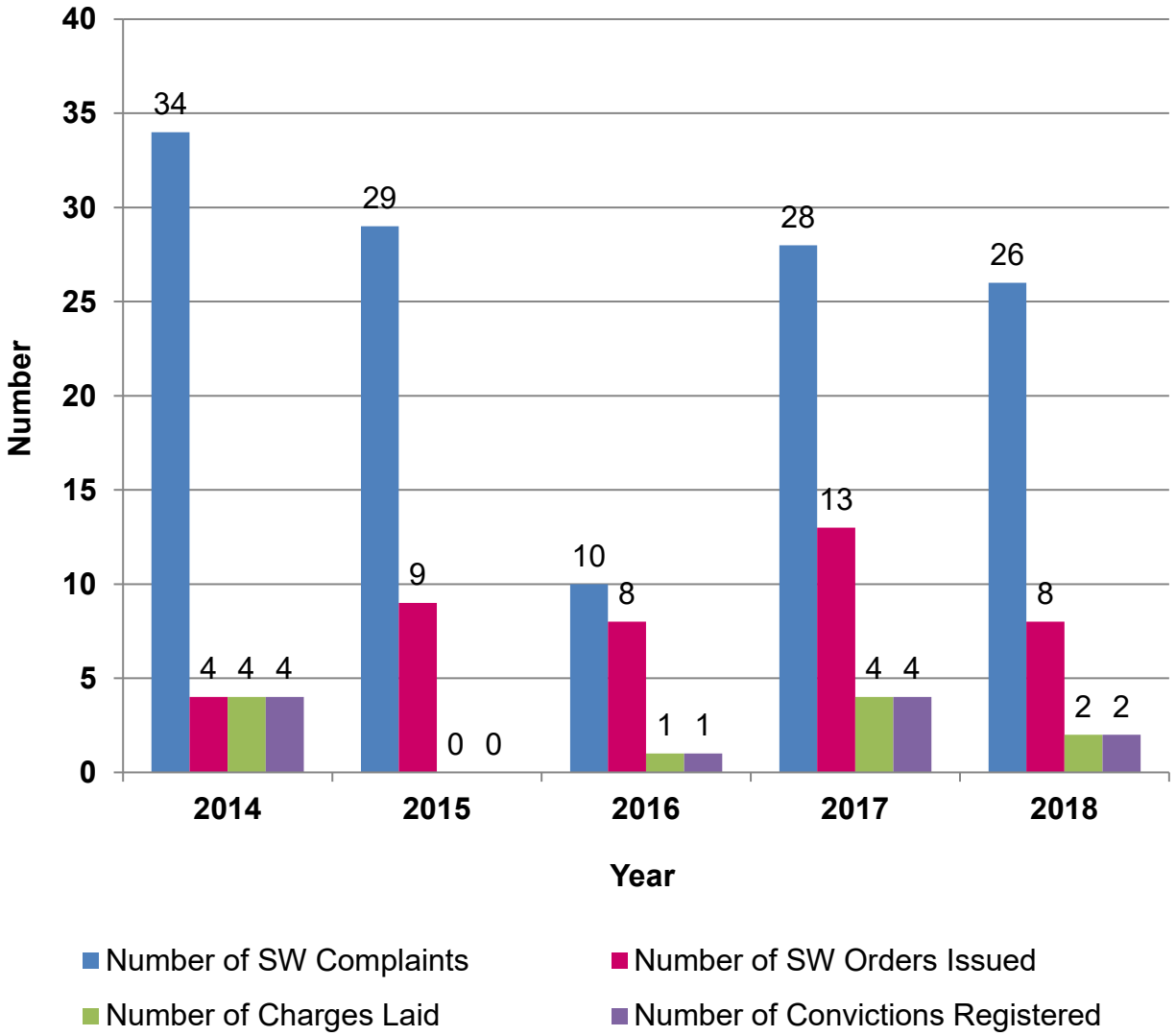
Graph 9: Results for Standing Water Site Surveillance - Durham Region (2014-2018)



Graph 10: Reported Human WNV Cases - Durham Region, Ontario, Canada (2014-2018)

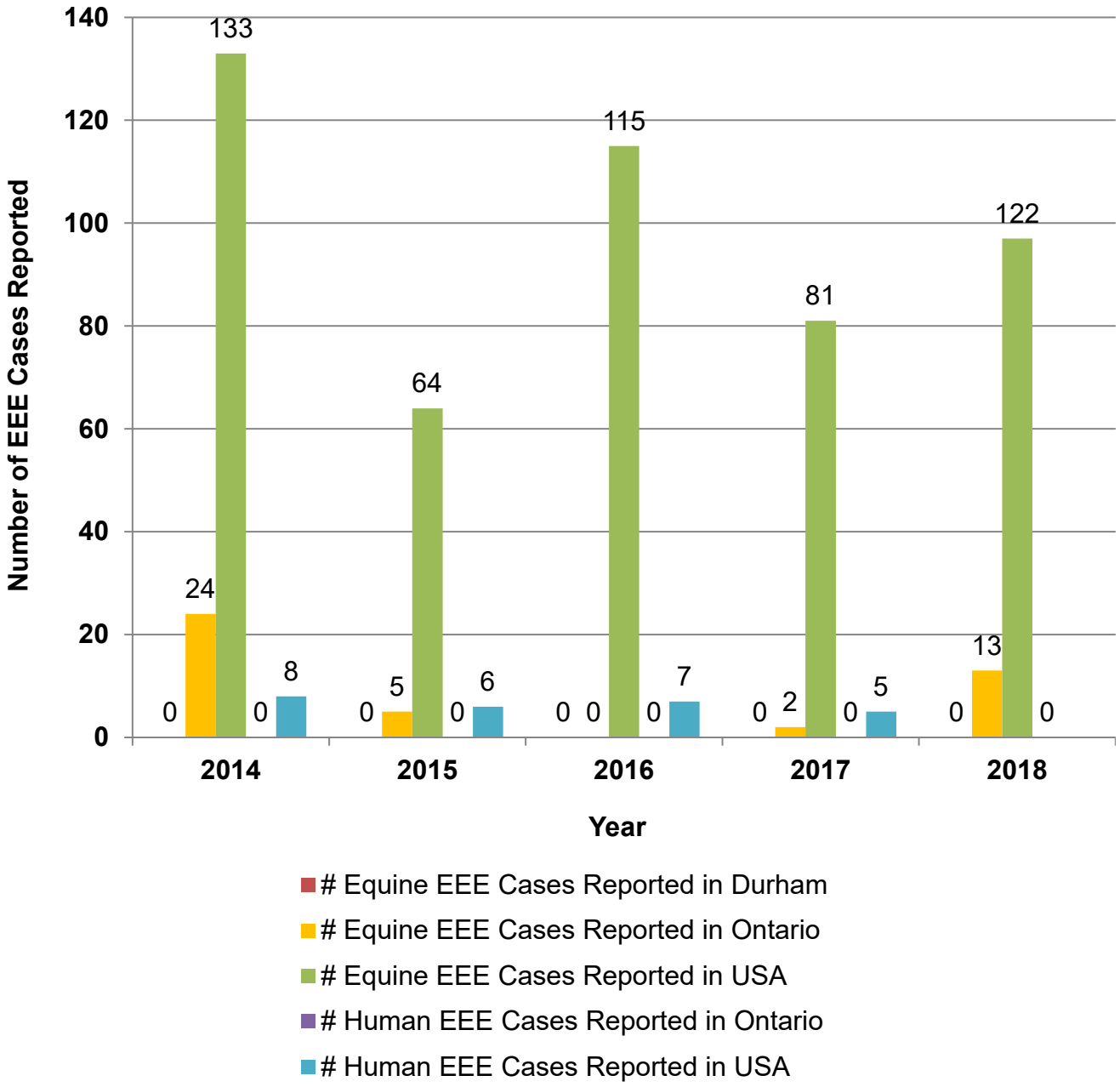


Graph 11: Standing Water Complaint Investigations and Resulting Legal Action - Durham Region (2014-2018)



Eastern Equine Encephalitis

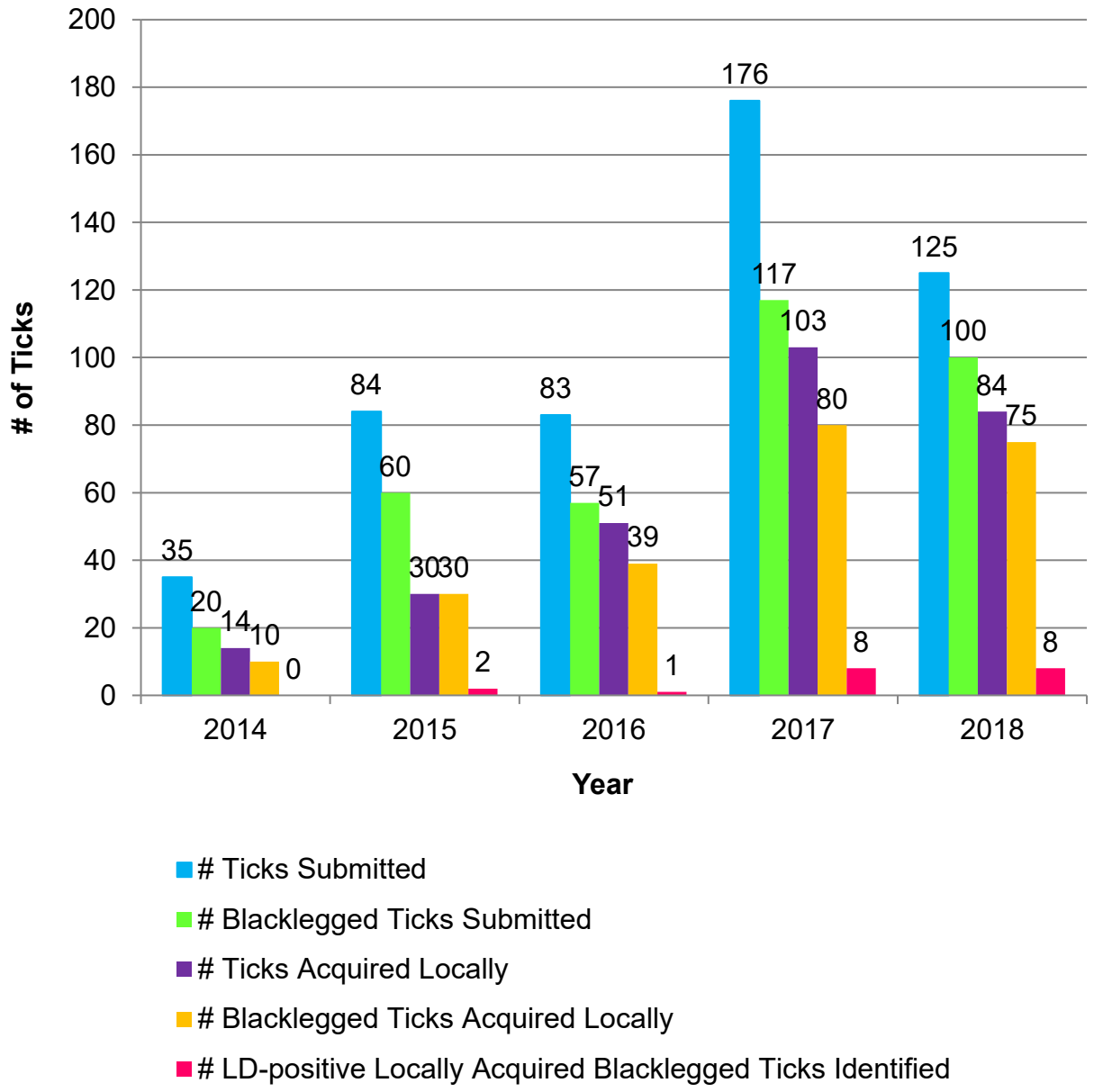
Graph 12: Eastern Equine Encephalitis Surveillance Results - Durham Region, Ontario, USA (2014-2018)



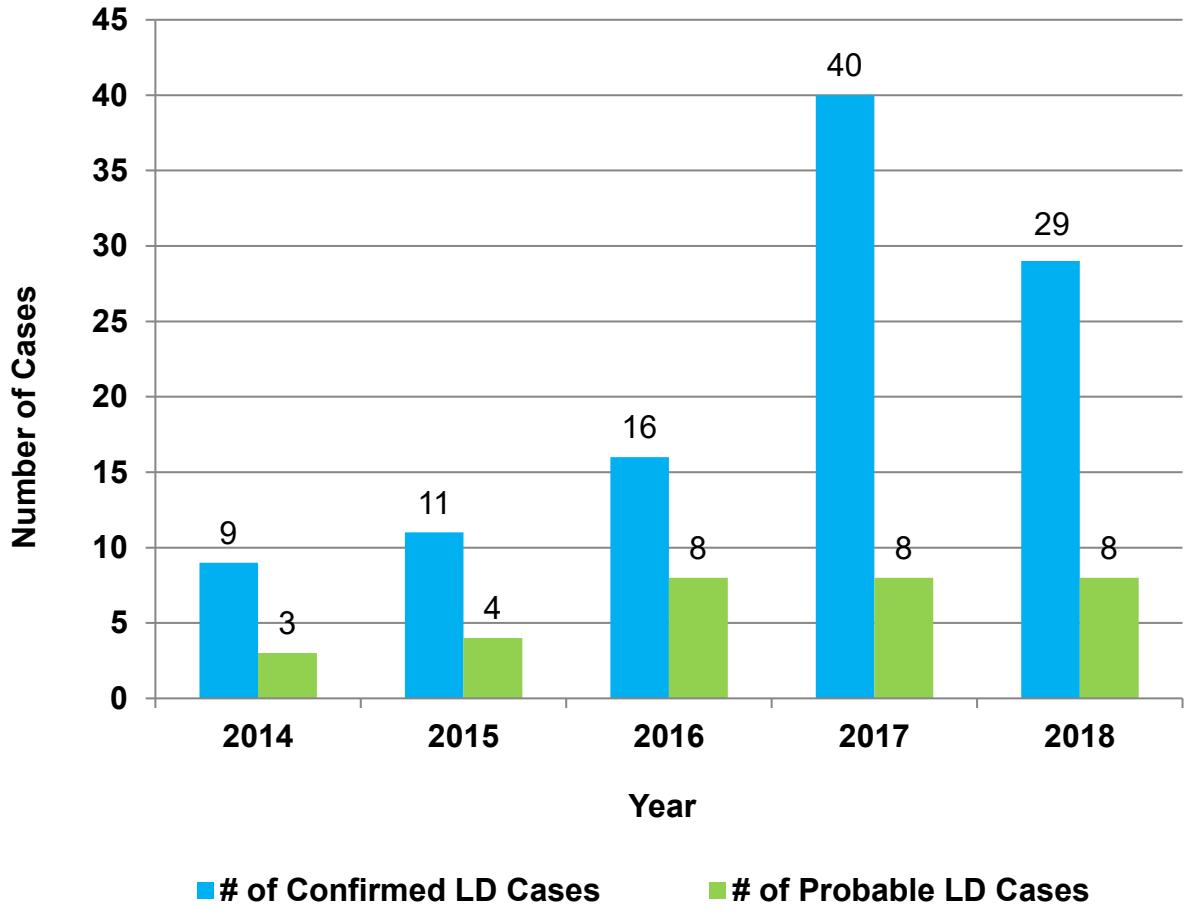
Note: The # of human EEE cases in USA for 2018 was not reported as of January 10, 2019

Lyme Disease / Ticks

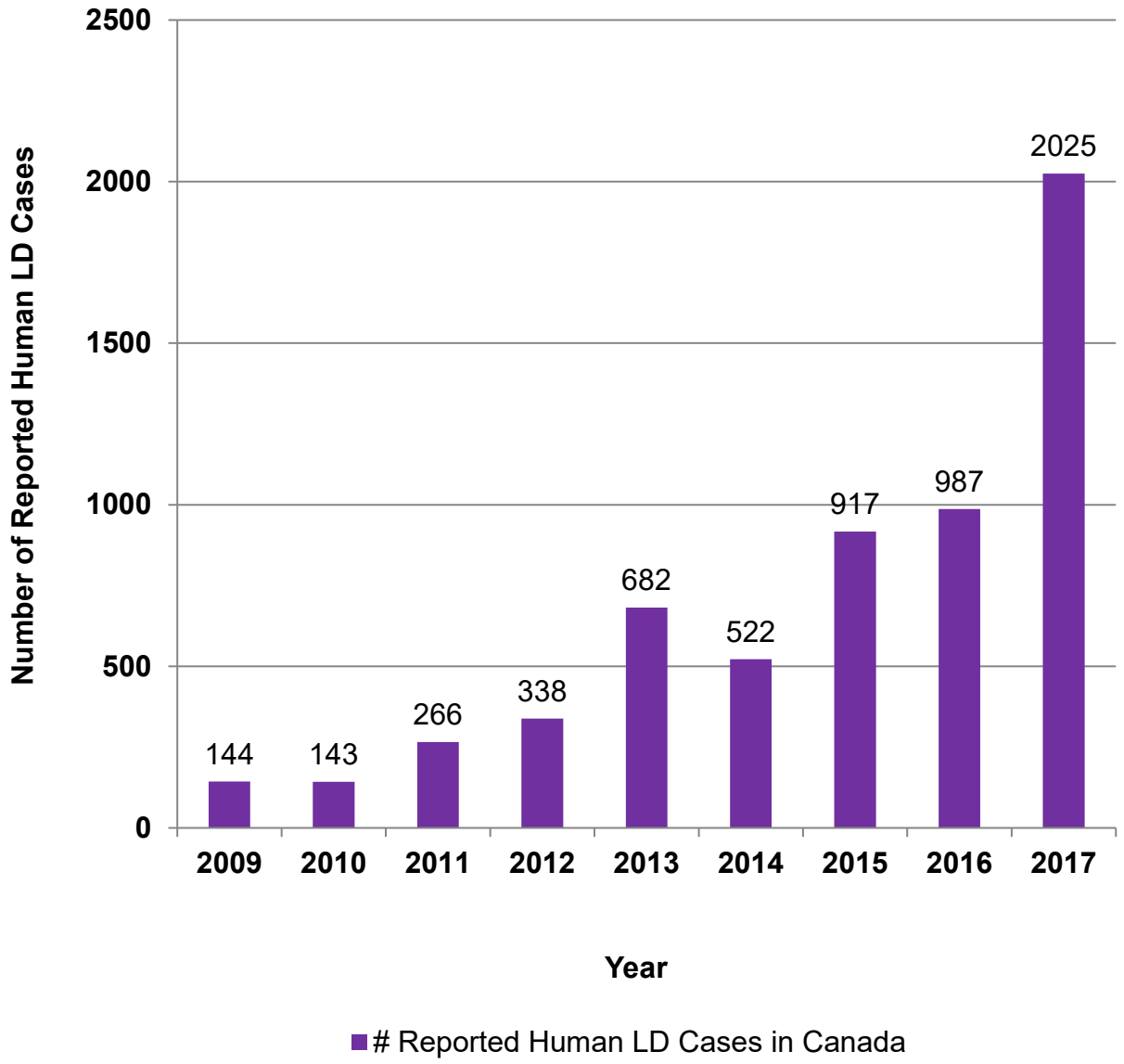
Graph 13: Results of Passive Tick Surveillance - Durham Region (2014-2018)



Graph 15: Reported Human Cases of LD - Durham Region (2014-2018)



Graph 15: Reported Human Cases of LD - Canada (2009 - 2017)



No 2018 data was available as of the date this report was printed.

Source: Public Health Agency of Canada, Surveillance of Lyme Disease, link: https://www.canada.ca/en/public-health/services/diseases/lyme-disease/surveillance-lyme-disease.html

DURHAM REGION

HEALTH DEPARTMENT

March 2019

Environmental Help Line
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