West Nile Virus Vector Mosquito Monitoring Report- 2016

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Acknowledgements

TRCA recognizes the contribution of all our staff who worked diligently on the West Nile Virus Monitoring Program. We would also like to thank our regional public health partners for their support in 2016. This report was prepared by Jessica Fang, Biologist, and reviewed by Scott Jarvie, Associate Director, Environmental Monitoring and Data Management. The West Nile Virus Surveillance and Monitoring Program is a part of TRCA's Regional Watershed Monitoring and Reporting Program. It is funded by the following partners:

City of Toronto

Region of Durham

Region of Peel

Region of York

Toronto Remedial Action Plan

Summary

West Nile virus (WNV) is primarily a bird pathogen that first appeared in Ontario in 2001. Research results suggest that two key mosquito species, *Culex pipiens* and *Culex restuans,* are primarily responsible for spreading the disease to humans in Ontario (Kilpatrick *et al*., 2005; Hamer *et al*., 2009). Mosquito species that are capable of carrying and transmitting WNV are called the vector species. Mosquito population dynamics are influenced by biological and environmental factors, therefore, forecasting an outbreak is challenging. West Nile virus management strategies undertaken collectively by the provincial and regional health agencies in Ontario focus on prevention through education and mosquito control measures. The number of human WNV case fluctuates annually. This year, a total of 46 human cases were reported in Ontario. Within Toronto and Region Conservation Authority's (TRCA's) jurisdiction, 29 human WNV cases were reported (Public Health Ontario, 2016).

The WNV Larval Mosquito Surveillance and Monitoring Program was established in 2003 as a measure of due diligence and at the request of TRCA's regional public health partners. The program has a three-pronged approach, which includes prevention, collaboration with regional public health units, and larval mosquito monitoring. The two objectives of the program are to reduce WNV risk to residents and conservation area visitors, and to protect wetlands. These objectives were achieved by identifying WNV hotspots and taking appropriate intervention measures, through public education, and collaboration with regional public health partners. Wetland habitats are traditionally considered mosquito-friendly habitats. However, monitoring data collected by TRCA since 2003 have shown that wetlands generally do not support large vector mosquito species populations. When a WNV vector mosquito hot spot is detected, appropriate control measures can be taken to eliminate mosquito larvae if warranted.

Larval mosquito monitoring was undertaken in 47 sites across TRCA jurisdiction. In total, 7524 mosquito larvae were collected, of which 6776 larvae were identified, including 6326 larvae from 41 wetlands and 450 larvae from 6 stormwater management ponds (SWMPs). The rest of larvae died prematurely during the rearing process, thus the numbers were not included in risk assessment or analyses. In 2016, higher percentages of vector mosquito species were collected possibly due to the moderate drought condition in Southern Ontario (Paull *et al*., 2017). In wetlands, 71% of mosquito larvae collected were vectors; in SWMPs, vector mosquito represented 84% of larvae collected.

Toronto and Region Conservation Authority continues to liaise with our regional public health partners and researchers in the field. Collaboration with partners is a crucial part of managing WNV on TRCA properties. In total, five sites were identified as hot spots of potential WNV risk. With the assistances from our regional health partners, control measures were taken to reduce the presence of larvae at these sites.

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1. Introduction

This report provides an overview of activities conducted by The Toronto and Region Conservation Authority (TRCA) through its West Nile Virus (WNV) Monitoring Program in 2016. West Nile virus primarily exists between birds and bird-biting mosquitoes. Humans can also be infected through the bite of a mosquito which had fed on infected birds. The majority of people who become infected with WNV will have no symptoms. Severe cases of WNV illness, including the development of meningitis and encephalitis, are extremely rare but can be fatal. To date, no human-to-human transmission of WNV through casual contact has been documented (World Health Organization, 2017).

Not all species of mosquitoes are capable of carrying WNV. Mosquito species that are capable of carrying and transmitting WNV are referred to as the **vector** species. Studies (Kilpatrick *et al*. 2005; Hamer *et al*. 2009) suggested that *Culex pipiens* and *Culex restuans* are primary species that spread the disease into the human populations. Another study (Tiawsirisup *et al*., 2008) also indicated that vector competence of *Aedes vexans*, approaches that of the *Culex* species for carrying WNV, and it may play a significant role in WNV enzootic cycles. Species that do not transmit the virus are called **non-vector** species. There are 67 established mosquito species in Ontario (Giordano *et al*., 2015), of which only 13 species are WNV vectors. Most other mosquito species do not pose serious WNV threats and their larvae are important food sources for fish and other predatory aquatic organisms.

TRCA owns over 17,000 hectares of land, including natural and constructed wetlands, woodland pools, reservoirs, and ponds. These aquatic ecosystems have been considered “mosquito friendly” as a result of the permanent availability of standing water (Knight *et al*. 2003; Gingrich *et al*. 2006; Rey *et al*. 2006). The WNV Surveillance and Monitoring Program was initiated in 2003 as a measure of due diligence, and at the request of TRCA’s regional public health partners (Regions of Peel, York, Durham and the City of Toronto). Selected natural habitats (collectively referred to as “wetlands” in this report) and stormwater management ponds (SWMPs) have been monitored in the summer months for the presence of vector mosquito larvae since the launch of the program. Data collected have been used to identify sites of potential concern or vector mosquito “hot spots”, which may require following-up with appropriate management actions.

The objectives of the WNV Vector Mosquito Larval Monitoring and Surveillance Program are to reduce WNV risk and protect wetlands on TRCA properties through the following three approaches:

- **Education and communication:** to respond to public inquiries on WNV related issues and address standing water complaints.
- **Collaboration with regional public health units:** to participate in WNV advisory committees and share information and data.
- **Routine monitoring:** to identify sites of potential concern through larval mosquito monitoring and take appropriate control measures if deemed necessary.

2. Public Education and Communication

Public education and communication part of the program focused on prevention through increasing public awareness and addressing standing water concerns on TRCA properties.

2.1 Increasing public awareness of West Nile virus

In 2016, TRCA continued to increase public awareness of WNV by:

- Providing information, and making the annual reports available on TRCA website https://trca.ca/conservation/environmental-monitoring/aquatic-habitat-and-species/west-nile-virus/
- Sharing tips on personal protection against mosquito bites with staff and providing the latest TRCA and public health monitoring updates.
- Displaying posters and brochures in TRCA offices and Conservation Areas.

2.2 Standing Water Complaints

Complaints or inquiries regarding standing water or mosquito activities are addressed according to TRCA's Standing Water Complaint Procedure (Appendix A). In 2016, TRCA did not receive any standing water complaints as a moderate to severe drought condition occurred throughout the GTA in the summer.

3. Collaboration

The collaboration efforts with our regional public health partners involved providing training, notification of hot spots and participating in WNV advisory committees. TRCA provided larval mosquito identification training to Durham Region Public Health, Halton Region Public Health, and researchers from York University. Throughout our monitoring season, if a hotspot is identified, the respective public health unit is notified of our findings. Appropriate control measures were taken to eliminate vector mosquito larvae.

Participation in regional West Nile virus advisory committees is an important part of liaising with public health partners. In addition, an Order from the Peel Region Medical Officer has been issued to TRCA annually under the *Health Protection and Promotion Act*, R.S.O. 1990, c. H.7 to facilitate all mosquito reduction activities within the Heart Lake Wetland Complex in Brampton.

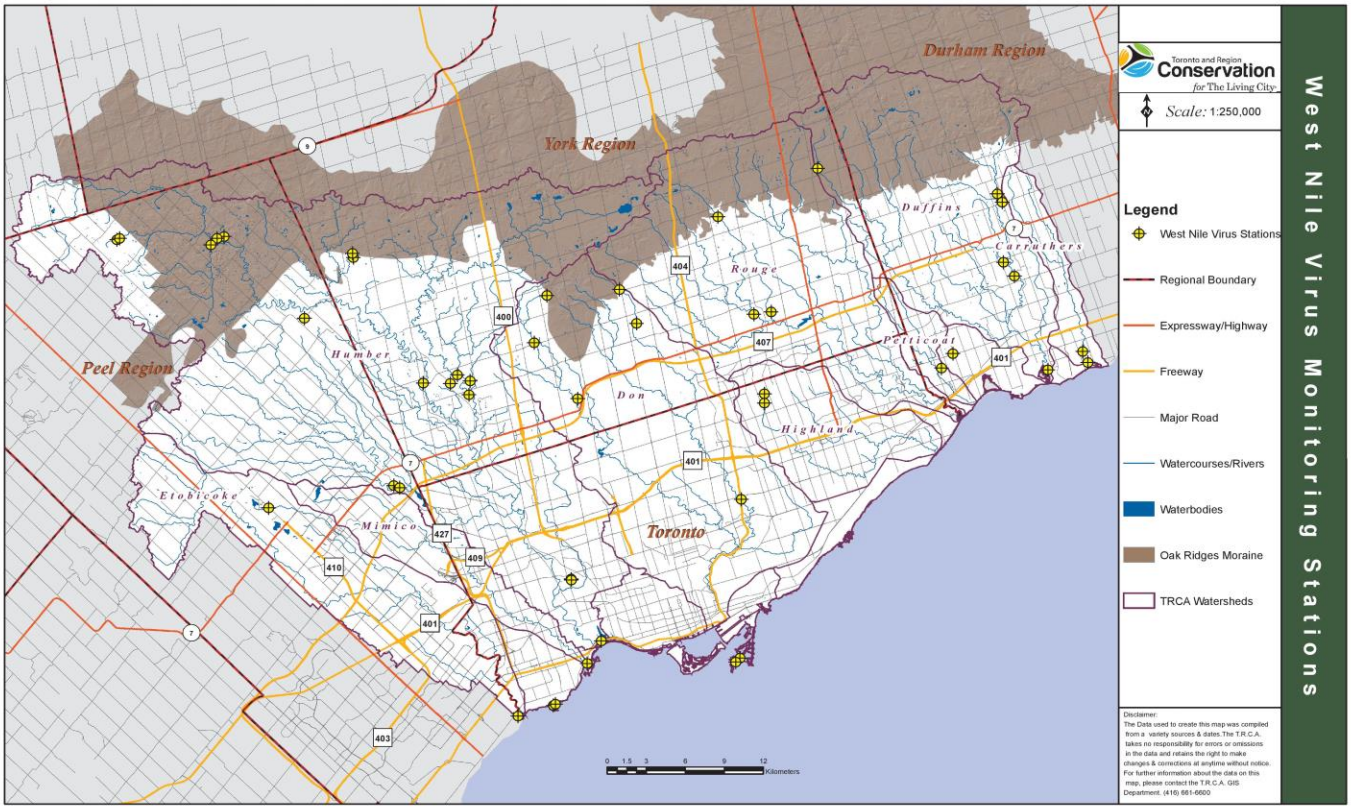
4. Larval Mosquito Monitoring

4.1 Methods

4.1.1 Monitoring Site Locations

The 2016 larval mosquito monitoring program began on June 1, sampling 47 sites across TRCA's jurisdiction: Durham Region, 8 sites; Peel Region: 10 sites; City of Toronto: 12 sites; and York Region: 17 sites (Figure 1).

Figure 1. Location of West Nile virus monitoring stations, 2016



4.1.2 Sampling and Identification of larval mosquitoes

Each monitoring station was sampled five times in approximately two-week intervals from June 1 to August 29. The waterbody at each station was divided into four comparatively equal quadrants, and one sample was taken within each quadrant. Each sample consisted of dipping with a standard mosquito dipper (diameter = 13 cm) 10 times. During sampling, field technician used several dipping techniques to ensure that varies types of potential mosquito habitats were sampled. Samples were not collected during a rain event because raindrops disturb water surface and consequently cause mosquito larvae to disperse (O'Malley, 1995). Collected mosquito larvae were taken back to the lab, enumerated, and reared until they reached maturity (fourth instar

stage). The larvae were then preserved in 70% ethyl alcohol and identified to species under a dissecting microscope using mosquito taxonomic keys (Wood *et al.,* 1979; Darsie and Ward, 2005). Those larvae that died before reaching maturity were not identified.

4.1.3 WNV Risk Assessment

WNV risk ranking was assessed for each site based on the number of vector larvae found in a sample after each site visit, according to the modified Wada's method of ranking (Wada, 1956):

- Sites with no vector larvae were ranked as "***Nil***" risk;
- Sites with <2 vector larvae per 10 dips were ranked as "***Low***" risk;
- Sites with 2 - 30 vector larvae per 10 dips were ranked as "***Moderate***" risk;
- Sites with >31 vector larvae per 10 dips were ranked as "***High***" risk sites.

Risk ranking was applied to each vector species independently, instead of the cumulative number of vector larvae found due to species variation in WNV transmission abilities. Sites with "high" risk ranking or vector hot spots were addressed, the respective regional health unit was informed and if warranted, the sites were treated with larvicide.

Since mosquitoes can only carry WNV after biting an infected bird, mosquito larvae do not feed on blood thus do not carry the virus. When a site is ranked as high-risk, it does not imply that the virus is present and poses immediate threat to the public. The risk ranking simply indicates the presence of vector mosquito species which could potentially spread WNV to human populations after they emerge as adult mosquitoes, not the presence of the virus.

4.2 Results

4.2.1 Mosquito diversity and distribution

In total, 7,524 mosquito larvae representing 10 species were identified from 47 routine monitoring stations. Mosquito larvae that died prematurely were not identified, thus excluded from the analyses and risk assessment in the following sections. The species collected included three non-vector species (*Culex territans, Anopheles earlei*, and *Uranotaenia sapphirina*) and seven WNV vector species (*Aedes vexans*, *Anopheles punctipennis, Anopheles quadrimaculatus, Culex pipiens*, *Culex restuans, Ochlerotatus trivittatus,* and *Coquillettidia perturbans*). Similar to previous years, the most widespread species was *Culex territans* (non-vector) which inhabited 34 of the 47 (72%) monitoring sites. Two key WNV vectors, *Culex pipiens* and *Culex restuans,* were found at 13 and 9 sites respectively. As in previous years, higher mosquito diversity was observed in wetlands compared to SWMPs. This finding may be attributed to the facts that more wetland sites were sampled, and wetlands generally provide more diverse habitats and shelter.

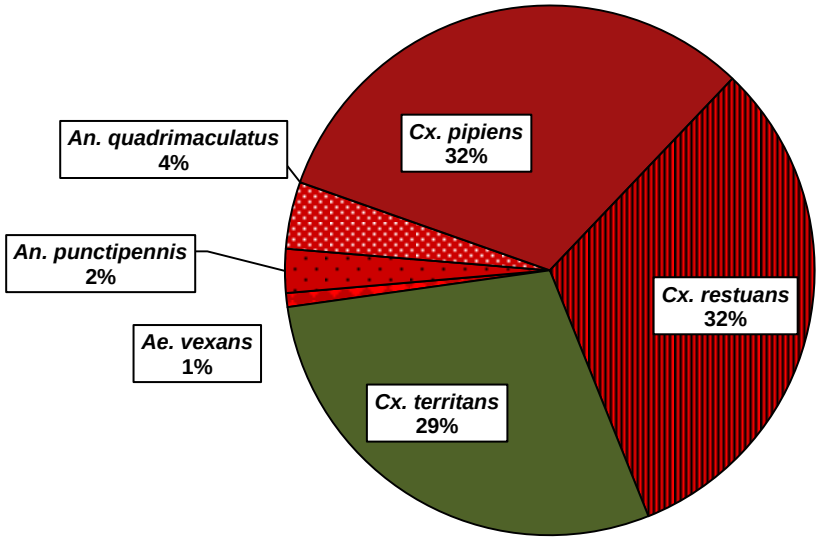
4.2.2 Wetlands

In total, 6326 mosquito larvae of 10 species were identified. Similar to previous years, monitoring results showed that most wetlands (n=37; 90%) posed minimal risk for harbouring WNV vector mosquitoes. The high numbers of vector mosquitoes were collected only from a few isolated hot

spots. The four identified hot spots were: Grenadier Pond in High Park, Woodland Pond, Topham Pond and Keffer Marsh. Because of the high concentration of the vector species presence in these hotspots, the overall dominant mosquitoes in wetlands were *Culex restuans* and *Culex pipiens* (Figure 2). Environmentally friendly larvicide, *Bacillus thuringiensis israelensis* (*Bti*) was used to treat all the hot spots identified. *Bti* is a bacterium found naturally in soils, and since 1982, it has been used successfully worldwide as a biological pest control agent to combat mosquitoes and black flies (Health Canada 2011). Full mosquito monitoring risk assessment results for each monitoring station can be found in Appendix B-1 to B-4.

Figure 2. Mosquito species composition in wetlands in 2016.

(non-vector species are in green and vector species are in red) Note: Other species collectively represented less than 1% of the mosquito collected, therefore excluded from the chart.

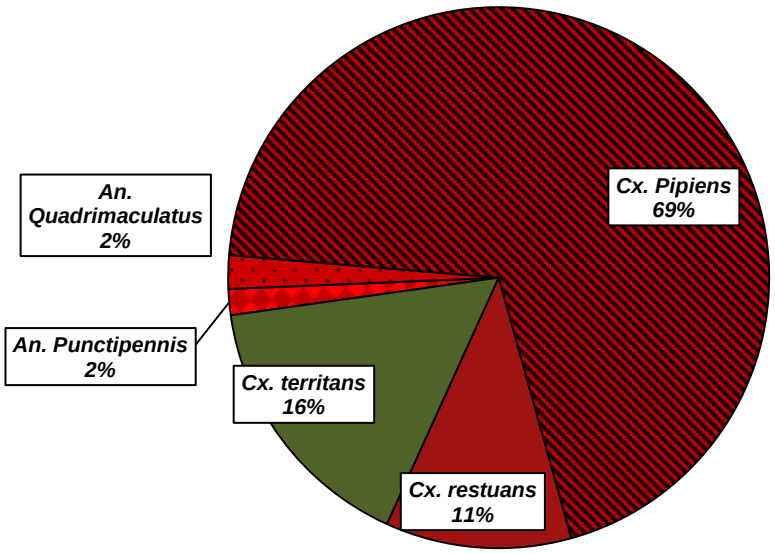


4.2.3 Stormwater Management Ponds

From the six SWMP monitoring sites, 450 mosquito larvae were identified, which consisted of 378 (84%) vector and 72 (16%) non-vector mosquito species larvae. The most abundant mosquito species was *Culex pipiens* (69%) (Figure 3). One hotspot was found in L'Amoreaux Stormwater Management North Pond during the third sampling event and it received larvicide treatment. This site had been identified as a *Culex pipiens* hotspot for several years in the past. In August, to help ensure that the pond is functioning as originally designed, the City of Toronto and TRCA worked together to remove sediment and conduct maintenance in the pond. TRCA will continue to monitor this pond post-maintenance in 2017. Full mosquito monitoring risk assessment results for each monitoring station can be found in Appendix B-1 to B-4.

Figure 3. Mosquito species composition in stormwater management ponds, 2016.

(non-vector species are indicated in green and vector species are indicated in red)



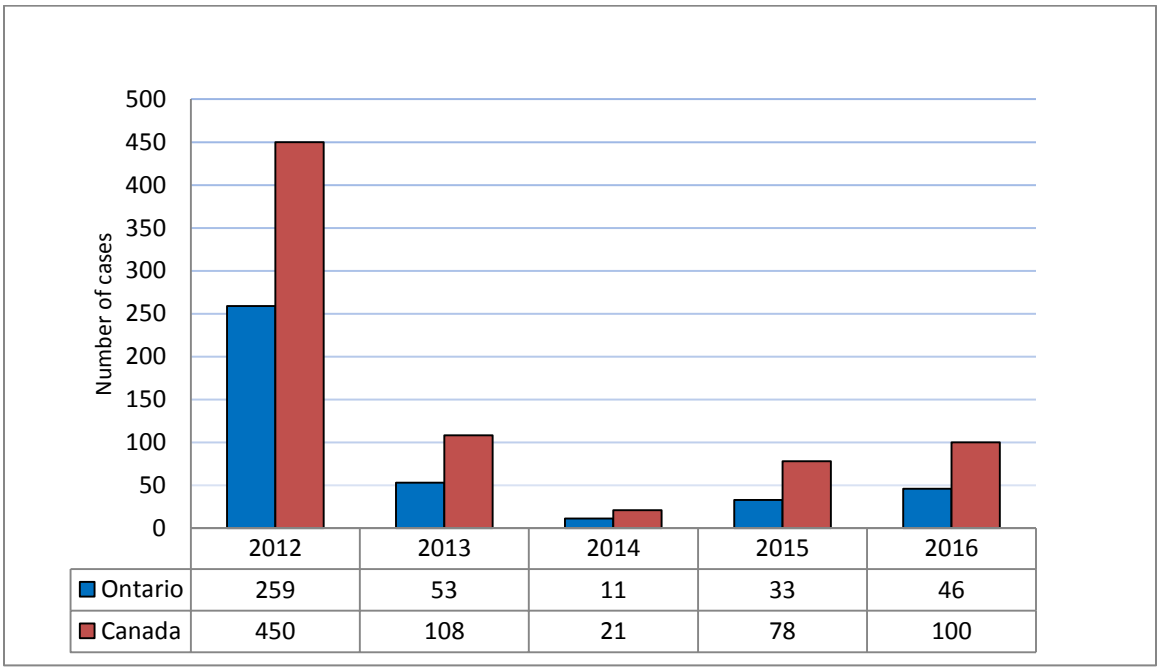
5. West Nile virus in Ontario and in Canada

In Canada, the number of human WNV cases fluctuates annually (Figure 4), driven by various environmental and biological factors. In 2016, a total of 100 human clinical cases have been reported to the Public Health Agency of Canada: Alberta (4), Manitoba (21), Ontario (46), Quebec (27), New Brunswick (1), and Prince Edward Island (1) (Public Health Agency of Canada, 2016).

Ontario's provincial and regional health agencies continued to monitor adult mosquitoes, larval mosquitoes, and human cases as part of the WNV surveillance programs. Adult mosquitoes monitoring is crucial for determining the immediate risk of humans contracting WNV. Larval mosquito surveillance provides information allowing regional public health units to eliminate/reduce mosquito larvae through larvicide application. Human surveillance information is used to alert the health care professionals of an outbreak, and provides clues about who may be at higher risk for serious health effects from WNV. Dead bird surveillance program had been terminated since 2009 in Ontario; however, The Canadian Wildlife Health Cooperative continues to test dead birds for WNV in collaboration with Ontario laboratories and The National Microbiology Laboratory in Winnipeg. In 2016, number of WNV human cases increased to 46 cases from 33 cases in 2015 in Ontario (Figure 4). Most human cases were reported in urban areas in Ontario because of the large numbers of catch basins, which are the preferred development site for the *Culex* mosquito vector species. Public Health Units continued to treat

these catch basins on a regular basis in the summer months (4-5 treatments to be repeated at 3-week intervals). Within TRCA's jurisdiction, 29 human WNV cases were reported in 2016.

Figure 4. Human West Nile virus cases in Ontario and in Canada, 2012 – 2016



	2012	2013	2014	2015	2016
Ontario	259	53	11	33	46
Canada	450	108	21	78	100

6. Conclusions

The results from the 2016 program supported the findings from the previous TRCA studies. Generally, wetlands do not pose threats of WNV transmission. Monitoring results showed that most wetlands (n=37; 90%) posed minimal risk for harbouring WNV vector mosquitoes.

West Nile virus vector hotspots continued to occur; five hot spots were detected and treated with the assistance provide by the City of Toronto Public Health, and York Region Public Health. Collaboration with Regional Public Health units is crucial in managing WNV vector hot spots in a timely manner on TRCA properties. The ability to detect hot spots, and subsequently take appropriate control measures continue to highlight the importance of regular and continuous seasonal monitoring of mosquito abundance.

Compared to 2015, a rise in WNV infection rate in humans was observed in Ontario and in Canada possibly associated with the moderate drought condition we experienced in the summer of 2016. It is difficult to predict the level of WNV activity. However, in general, temperature and precipitation are the major influencing factors.

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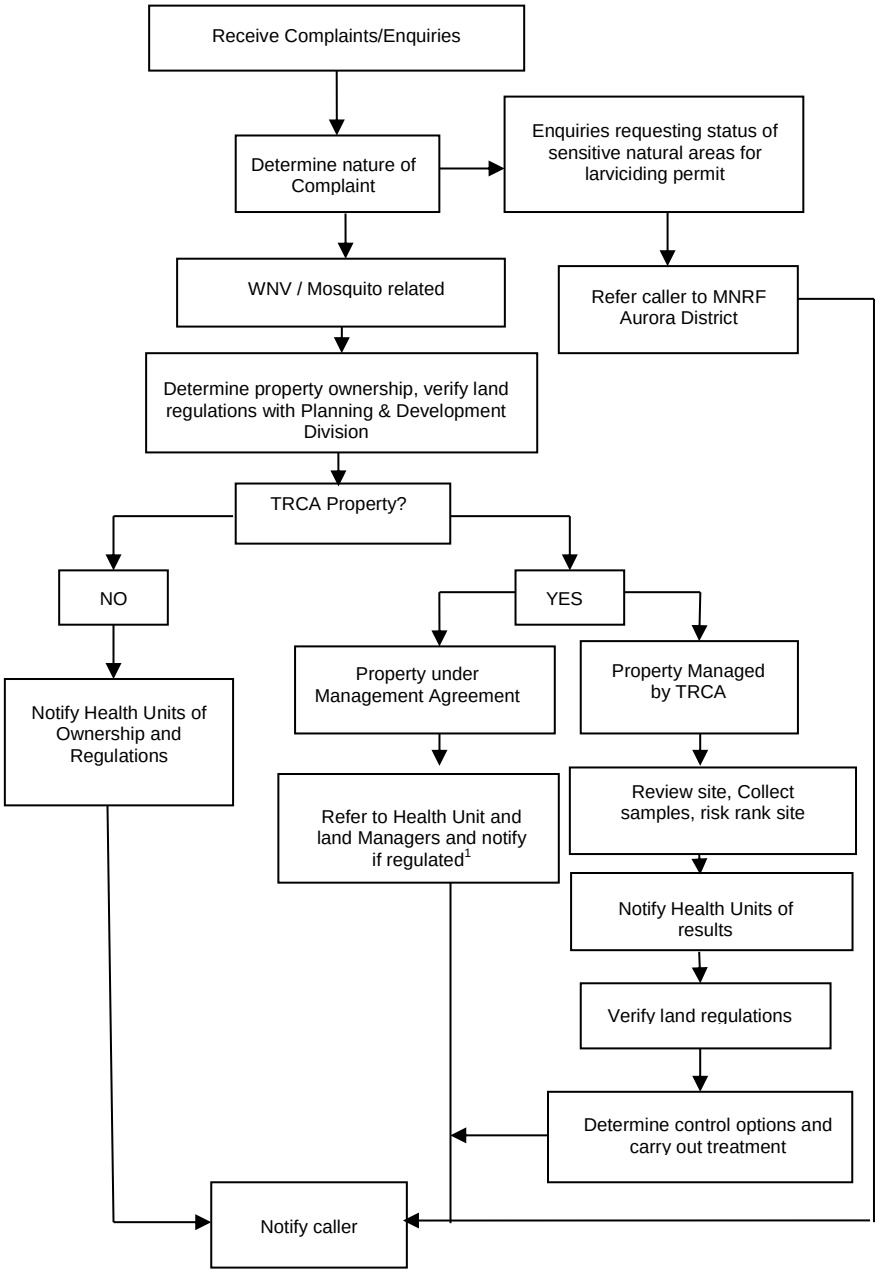
Appendices

Appendix A. TRCA Standing Water Complaint Procedure



Appendix B-1 Monitoring and Risk Assessment Results in Durham Region - 2016

Sites with no vector larvae were ranked as "***Nil***" risk; sites with <2 vector larvae per 10 dips were ranked as "***Low***" risk; sites with 2 - 30 vector larvae per 10 dips were ranked as "***Moderate***" risk; and sites with >31 vector larvae per 10 dips were ranked as "***High***" risk.

Site	Sampling Event	*Ae. vexans*	*An. punctipennis*	*An. quadrimaculatus*	*Cx. pipiens*	*Cx. restuans*	*Oc. trivittatus*
Altona Forest	No Risk						
Carruthers Swamp Complex	1	Nil	Nil	Nil	Nil	Nil	Nil
	2	Nil	Nil	Nil	Nil	Nil	Nil
	3	Nil	Nil	Nil	Nil	Nil	Nil
	4	Nil	Nil	Nil	Nil	Nil	Nil
	5	Moderate	Nil	Nil	Nil	Nil	Moderate
Claremont Wetland-1	1	Nil	Moderate	Nil	Nil	Nil	Nil
	2	Nil	Moderate	Nil	Nil	Nil	Nil
	3	Nil	Low	Nil	Nil	Nil	Nil
	4	Nil	Low	Nil	Nil	Nil	Nil
	5	Nil	Moderate	Low	Moderate	Nil	Nil
Claremont Wetland-2	1	Nil	Nil	Nil	Nil	Nil	Nil
	2	Nil	Nil	Nil	Nil	Nil	Nil
	3	Nil	Nil	Low	Nil	Nil	Nil
	4	Nil	Nil	Nil	Nil	Nil	Nil
	5	Nil	Nil	Moderate	Nil	Nil	Nil
Frenchman's Bay Promenade	1	Nil	Nil	Nil	Nil	Nil	Nil
	2	Nil	Nil	Nil	Nil	Nil	Nil
	3	Nil	Nil	Nil	Nil	Nil	Nil
	4	Nil	Nil	Low	Nil	Nil	Nil
	5	Nil	Nil	Nil	Nil	Nil	Nil
Greenwood Marsh	No Risk						
Greenwood Pond	1	Nil	Nil	Nil	Nil	Nil	Nil
	2	Nil	Low	Nil	Nil	Nil	Nil
	3	Nil	Nil	Nil	Nil	Nil	Nil
	4	Nil	Moderate	Low	Moderate	Nil	Nil
	5	Low	Nil	Nil	Nil	Nil	Nil
Lower Duffins	1	Nil	Nil	Nil	Nil	Nil	Nil
	2	Nil	Nil	Nil	Nil	Nil	Nil
	3	Nil	Nil	Nil	Nil	Nil	Nil
	4	Nil	Low	Nil	Nil	Nil	Nil
	5	Nil	Low	Low	Nil	Nil	Nil

Appendix B-2 Monitoring and Risk Assessment Results in Peel Region - 2016

Sites with no vector larvae were ranked as "***Nil***" risk; sites with <2 vector larvae per 10 dips were ranked as "***Low***" risk; sites with 2 - 30 vector larvae per 10 dips were ranked as "***Moderate***" risk; and sites with >31 vector larvae per 10 dips were ranked as "***High***" risk.

Site	Sampling Event	*Ae. vexans*	*An. punctipennis*	*An. quadrimaculatus*	*Cx. pipiens*	*Cx. restuans*	*Oc. trivittatus*
Albion Hills Pond-1	No Risk						
Albion Hills Pond-2	No Risk						
Albion Hills Pond-4	No Risk						
Claireville Wetland-1	No Risk						
Claireville Wetland-2	No Risk						
Glen Haffy Trout Pond-1	1	Nil	Low	Nil	Nil	Nil	Nil
	2	Nil	Moderate	Low	Nil	Nil	Nil
	3	Nil	Moderate	Low	Nil	Nil	Nil
	4	Nil	Moderate	Low	Nil	Nil	Nil
	5	Nil	Moderate	Low	Nil	Nil	Nil
Glen Haffy Trout Pond-2	1	Nil	Moderate	Low	Nil	Nil	Nil
	2	Nil	Low	Low	Nil	Nil	Nil
	3	Nil	Nil	Nil	Nil	Nil	Nil
	4	Nil	Nil	Nil	Nil	Nil	Nil
	5	Nil	Low	Moderate	Nil	Nil	Nil
Heart Lake	No Risk						
Marie Curtis	No Risk						
SWMP-174	1	Nil	Nil	Nil	Nil	Nil	Nil
	2	Nil	Low	Nil	Nil	Nil	Nil
	3	Nil	Low	Nil	Nil	Nil	Nil
	4	Nil	Nil	Low	Nil	Nil	Nil
	5	Nil	Nil	Nil	Nil	Nil	Nil

Appendix B-3 Monitoring and Risk Assessment Results in Toronto - 2016

Sites with no vector larvae were ranked as "***Nil***" risk; sites with <2 vector larvae per 10 dips were ranked as "***Low***" risk; sites with 2 - 30 vector larvae per 10 dips were ranked as "***Moderate***" risk; and sites with >31 vector larvae per 10 dips were ranked as "***High***" risk.

Site	Sampling Event	*Ae. vexans*	*An. punctipennis*	*An. quadrimaculatus*	*Cx. pipiens*	*Cx. restuans*	*Oc. trivittatus*
Col. Samuel Smith Main Pond	No Risk						
Col. Samuel Smith Mini Pond	No Risk						
High Park Grenadier Pond	1	Nil	Nil	Nil	Low	Moderate	Nil
	2	Nil	Nil	Nil	High	High	Nil
	3	Nil	Nil	Nil	High	Moderate	Nil
	4	Nil	Nil	Low	Moderate	Moderate	Nil
	5	Nil	Nil	Nil	Moderate	Moderate	Nil
L'Amoreaux North Pond	1	Nil	Nil	Nil	Low	Nil	Nil
	2	Nil	Nil	Nil	Low	Nil	Nil
	3	Nil	Nil	Nil	High	Moderate	Nil
	4	Under Construction					
	5	Under Construction					
L'Amoreaux South Pond	No Risk						
Milne Hollow	No Risk						
Mimico Amphibian Pond	No Risk						
Topham Pond	1	Nil	Nil	Nil	Nil	Nil	Nil
	2	Nil	Nil	Nil	High	Moderate	Nil
	3	Nil	Nil	Nil	Nil	Nil	Nil
	4	Nil	Nil	Nil	Nil	Nil	Nil
	5	Nil	Nil	Nil	Moderate	Nil	Nil
TTP Goldfish Pond	1	Nil	Nil	Nil	Nil	Nil	Nil
	2	Nil	Nil	Nil	Nil	Low	Nil
	3	Nil	Nil	Nil	Nil	Nil	Nil
	4	Nil	Low	Moderate	Nil	Nil	Nil
	5	Nil	Low	Moderate	Nil	Nil	Nil
TTP Tri-Pond	No Risk						
Woodland Pond	1	Nil	Nil	Nil	Low	Nil	Nil
	2	Nil	Nil	Nil	High	Nil	Nil
	3	Nil	Nil	Nil	Moderate	Nil	Nil
	4	Nil	Nil	Nil	Moderate	Nil	Nil
	5	Nil	Nil	Nil	Moderate	Nil	Nil
Brickworks Pond 1	1	Nil	Nil	Nil	Nil	Nil	Nil
	2	Nil	Nil	Nil	Nil	Nil	Nil
	3	Nil	Nil	Nil	Nil	Nil	Nil
	4	Nil	Nil	Nil	Moderate	Moderate	Nil
	5	Nil	Nil	Nil	Nil	Nil	Nil

Appendix B-4 Monitoring and Risk Assessment Results in York Region - 2016

Sites with no vector larvae were ranked as "***Nil***" risk; sites with <2 vector larvae per 10 dips were ranked as "***Low***" risk; sites with 2 - 30 vector larvae per 10 dips were ranked as "***Moderate***" risk; and sites with >31 vector larvae per 10 dips were ranked as "***High***" risk.

Site	Sampling Event	*Ae. vexans*	*An. punctipennis*	*An. quadrimaculatus*	*Cx. pipiens*	*Cx. restuans*	*Oc. trivittatus*
Boyd Conservation Area	1	Nil	Nil	Nil	Nil	Nil	Nil
	2	Nil	Nil	Nil	Low	Nil	Nil
	3	Nil	Nil	Nil	Nil	Nil	Nil
	4	Nil	Nil	Nil	Nil	Nil	Nil
	5	Nil	Low	Nil	Nil	Nil	Nil
Bruce's Mill	1	Nil	Nil	Nil	Nil	Nil	Nil
	2	Nil	Low	Low	Nil	Nil	Nil
	3	Nil	Nil	Moderate	Nil	Nil	Nil
	4	Nil	Nil	Nil	Nil	Nil	Nil
	5	Nil	Low	Low	Nil	Nil	Nil
Cold Creek Pond	No Risk						
Cold Creek Wetland	No Risk						
Earth Rangers	1	Nil	Nil	Nil	Nil	Nil	Nil
	2	Nil	Nil	Nil	Nil	Nil	Nil
	3	Nil	Nil	Moderate	Nil	Nil	Nil
	4	Nil	Low	Nil	Nil	Nil	Nil
	5	Nil	Low	Moderate	Nil	Nil	Nil
Granger Wetland South	1	Nil	Nil	Nil	Nil	Nil	Nil
	2	Nil	Nil	Nil	Nil	Nil	Nil
	3	Nil	Moderate	Moderate	Nil	Nil	Nil
	4	Nil	Moderate	Nil	Nil	Nil	Nil
	5	Nil	Nil	Nil	Nil	Nil	Nil
Granger Wetland North	1	Nil	Nil	Nil	Nil	Nil	Nil
	2	Nil	Nil	Moderate	Nil	Nil	Nil
	3	Nil	Nil	Low	Nil	Nil	Nil
	4	Nil	Moderate	Moderate	Nil	Nil	Nil
	5	Nil	Moderate	Moderate	Nil	Nil	Nil
Keffer Marsh	1	Nil	Nil	Low	Nil	Nil	Nil
	2	Nil	Nil	Low	Nil	Nil	Nil
	3	Nil	Low	Low	High	Nil	Nil
	4	Nil	Nil	Nil	High	Moderate	Nil
	5	Nil	Nil	Nil	Mode rate	Moderate	Nil
	5	Nil	Nil	Nil	Nil	Nil	Nil
Killian Lamar	No Risk						
Kortright Centre Marsh	1	Nil	Nil	Nil	Nil	Nil	Nil
	2	Nil	Nil	Low	Nil	Nil	Nil
	3	Nil	Nil	Nil	Nil	Nil	Nil
	4	Nil	Nil	Nil	Nil	Nil	Nil
	5	Nil	Nil	Nil	Nil	Nil	Nil

Appendix B-4 Monitoring and Risk Assessment Results in York Region – 2016 (Continued)
Sites with no vector larvae were ranked as "***Nil***" risk; sites with <2 vector larvae per 10 dips were ranked as "***Low***" risk; sites with 2 - 30 vector larvae per 10 dips were ranked as "***Moderate***" risk; and sites with >31 vector larvae per 10 dips were ranked as "***High***" risk.

Site	Sampling Event	*Ae. vexans*	*An. punctipennis*	*An. quadrimaculatus*	*Cx. pipiens*	*Cx. restuans*	*Oc. trivittatus*
Stouffville Reservoir	1	Nil	Nil	Nil	Nil	Nil	Nil
	2	Nil	Nil	Nil	Nil	Nil	Nil
	3	Nil	Nil	Nil	Nil	Nil	Nil
	4	Nil	Nil	Nil	Low	Nil	Nil
	5	Nil	Nil	Low	Nil	Nil	Nil
Toogood Pond	No Risk						
un-named wetland - Vaughan	No Risk - Dry						
Un-named Wetland 1	No Risk						
un-named Wetland 2	1	Moderate	Nil	Nil	Nil	Nil	Nil
	2	Nil	Nil	Nil	Nil	Nil	Nil
	3	Nil	Nil	Nil	Nil	Nil	Nil
	4	Nil	Nil	Nil	Nil	Nil	Nil
	5	Nil	Nil	Nil	Low	Nil	Nil
SWMP-88.2	1	Nil	Nil	Nil	Nil	Nil	Nil
	2	Nil	Nil	Nil	Nil	Nil	Nil
	3	Nil	Nil	Nil	Moderate	Low	Nil
	4	Nil	Nil	Nil	Nil	Nil	Nil
	5	Nil	Nil	Nil	Nil	Nil	Nil
SWMP-139	No Risk						