# Heart Lake Road Ecology and Turtle Population Study

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# Executive Summary

Turtle Population Study

A turtle population study was conducted in the Heart Lake Conservation Area (HLCA) and designated Provincially Significant Wetland (PSW) complex bordering Heart Lake Road (HLR) in Brampton, Ontario to evaluate population demographics. Two of Ontario's eight native turtle species, the eastern snapping turtle (*Chelydra serpentina*) and midland painted turtle (*Chrysemys picta marginata*) were abundant and confirmed nesting within the study area. The northern map turtle (*Graptemys geographica*) was present but not well established. Non-native red-eared slider turtles (*Trachemys scripta elegans*) were present, presumably due to illegal pet release. Species richness was highest in Heart Lake where all four species were captured.

Turtles were captured in every wetland surveyed but snapping turtles were the only species captured in smaller remnant wetlands. Many factors could be responsible for this anomaly, including but not limited to; poor nesting sites, subsidized predators, lack of food or shelter, pollutants in the water and water turbidity. Age classes were well distributed in larger wetlands including Heart Lake and Sandalwood wetlands but not in smaller isolated remnant wetlands where juvenile snapping and midland painted turtles are noted as missing. Even sex ratios (male: female) were discovered in all wetlands excluding Sandalwood wetlands where there was a significant male skew for midland painted turtles (2.2:1), which may be attributed to adult female road mortality when searching for suitable nest sites. Population size estimates were reported using a Lincoln-Peterson estimator and we estimate that the wetlands and Heart Lake have a meta-population of 456 (+/- 230) midland painted and 199 (+/- 99) snapping turtles. Based on population demographics noted, increasing wetland connectivity through the installation of additional fencing and dedicated wildlife passages is needed to avoid population collapse in fragmented wetlands. Finally, a solution to remove invasive red-eared sliders from the wetland complex is needed to prevent their negative impact on native turtle species.

**Road Mortality Study**

The citizen science Heart Lake Road Ecology Monitoring Program (HLREMP), implemented in 2011, continued in 2018, with a renewed focus on studying the effectiveness of temporary wildlife fencing installed on HLR between Sandalwood Pkwy and Countryside Dr. This year there were 647 observations of wildlife-vehicle collisions (WVCs); 415 frogs/toads, 85 mammals, 58 turtles, 59 birds, 13 snakes and 17 unknowns. A majority of WVCs were concentrated in areas where the temporary fencing segments ended, suggesting that the gaps in temporary fencing permitted some wildlife access to the road. Number of WVCs were compared in areas that were completely covered with fence (temporary or permanent fencing installed on both east and west sides of the road), with the number of WVCs occurring in areas that had no fence coverage or partial fence coverage (fencing installed on only one side of the road). There was a significant decrease in numbers of turtle, snake, and mammal WVCs in areas with complete fence coverage (both permanent and temporary) in comparison to no fence coverage or partial fence coverage areas. This suggests that complete fencing has been effective in reducing the number of WVCs for these taxa, but only when both sides of the road are fenced. No significant difference in number of WVCs for birds and frogs between areas of temporary complete coverage versus areas with no or partial coverage areas, suggesting that these animals found a way around or over the temporary fencing. This result is to be expected for birds as they have the ability to fly over the fence. Leopard frogs have also been observed jumping over wildlife directional fencing to access the road, however we suspect that the

majority of frogs and toads made their way through cracks or hopped around the ends of the temporary fencing. Significant reduction of frog mortality were observed in the area of permanent bench-cut fencing with a maintained strip of vegetation cutback (to prevent climbing), as the area where there is permanent fencing saw very little WVCs for frogs or toads. Effectiveness of the wildlife directional fencing in reducing numbers of WVCs is partially dependent on structural integrity of the fencing. Staff monitoring HLR noticed over 100 different breaches in the temporary fence over the monitoring season and the openings are wide enough to allow small animal's access to the road. Future installation of temporary fencing should ensure that gaps are sealed where animals could bypass, based upon effective properly installed fencing.

A turtle nesting study was also conducted in 2018 to determine the effectiveness of Animex directional fencing in excluding turtles from nesting in gravel areas at road shoulders. A student from York University monitored HLR by searching for nests and wildlife on both road-side and wetland-sides of temporary and permanent fencing areas. Two turtle nests were observed on the road-side and 28 nests were observed on the wetland-side, suggesting that the fence was very effective at preventing nesting in dangerous road-side areas. In addition, artificial nesting beaches were monitored for utilization by turtles for nesting habitat in 2018. A total of six nests were found on turtle nesting beaches. This is in contrast with 2017 results which reported zero nests on the artificial nesting beaches adjacent to HLR. Female turtles typically have high fidelity to nesting habitats and as such, it usually takes a few years for artificial nesting beaches to be utilized by the resident population. All six nests found on turtle nesting beaches were predated (most likely by raccoons or skunks, both species being regularly detected in the underpass cameras), and future efforts will be directed towards improving nest detection and nest protection in 2019.


THE LONG AND WINDING ROAD
Wildlife Mortality Mitigation Along Heart Lake Road
SPRING 2010
MEETING WITH CITIZENS
Citizens contact the TRCA to discuss sightings of dead turtles along HLR.
SUMMER 2010
TRCA MET WITH CITY OF BRAMPTON & ONTARIO ROAD ECOLOGY GROUP
Explain road mortality issue and agree to put out signage.
MARCH 2011
MEDIA STORY
BRAMPTON GUARDIAN: Corpse Counters Needed
MARCH 2011
COMMUNITY PRESENTATION
Town hall type presentation to discuss the issues at HLR.
FEBRUARY 2012
MEDIA STORY
BRAMPTON GUARDIAN: Motorists kill 90 turtles on Heart Lake Road in 25 weeks
SPRING 2012
INITIAL CITIZEN SCIENTIST ROAD ECOLOGY MONITORING REPORT RELEASED
Report submitted to City of Brampton and shared with volunteers, community, and media
MAY 2011
MEDIA STORY
BRAMPTON GUARDIAN: Friends of wetlands
APRIL 2011
MEDIA STORY
BRAMPTON GUARDIAN: Residents wildlife about survey.
MARCH 2011
LAUNCH CITIZEN SCIENCE ROAD ECOLOGY MONITORING PROJECT
Discuss and train volunteers for wildlife road mortality survey. Involving TRCA in partnership with OREG and 40 members of the public.
APRIL 2013
2ND SEASON OF CITIZEN SCIENCE ROAD ECOLOGY MONITORING
TRCA rolls out another season of volunteer monitoring to strengthen data set and maintain and grow community engagement.
JUNE 2013
MEDIA STORY
ROYAL ONTARIO MUSEUM BLOG: Protecting biodiversity from the threats of roads in 25 weeks.
FEBRUARY 2014
DELEGATION TO BRAMPTON ENVIRONMENTAL PLANNING ADVISORY
Update on HLR monitoring project.
SPRING 2014
SECOND CITIZEN SCIENTIST ROAD ECOLOGY MONITORING REPORT RELEASED
Report submitted to City of Brampton and shared with volunteers, community, and media.
SUMMER 2014
TRAFFIC STUDY
Traffic counters installed for one week=Daily traffic 5000-7000 vehicles.
MAY 2015
WILDLIFE CULVERT STUDY
TRCA staff set up and monitored mock culverts in high traffic area.
SPRING 2015
PARTNERSHIP WITH YORK UNIVERSITY
Graduate researcher to explore mitigation best practices.
SPRING 2015
3RD SEASON OF WILDLIFE ROAD MORTALITY MONITORING
Volunteers perform wildlife road mortality surveys.
2015
PARTNERSHIP WITH ANIMEX FENCING
Explored various directional fencing options.
SUMMER 2015
BEST PRACTICES REPORT RELEASED
TRCA provides municipality with specific mitigation options to assist with implementation process.
SUMMER 2015
INSTALLATION OF PRELIMINARY MITIGATION MEASURES
Optical bars and flashing warning road signs installed.
SUMMER 2015
REPORT TO PLANNING INFASTRUCTURE SERVICES
Discuss mitigation of HLR
SPRING 2016
INSTALLATION OF WILDLIFE FENCING & DEDICATED WILDLIFE CULVERT
Directional fencing suitable for herpetofauna and a box culvert are installed at one of the hot spots
SUMMER 2016
4TH SEASON OF WILDLIFE ROAD MORTALITY MONITORING
Volunteers perform wildlife road mortality surveys
APRIL 2017
SCIENTIFIC PAPER PUBLISHED
Link between road mortality and sex ratio in turtles.
JULY 2017
MEDIA STORY
BRAMPTON GUARDIAN: Wildlife dying on Brampton Road that bisects significant wetland.
SUMMER 2017
PUBLIC PRESSURE TO EXTEND MITIGATION
Concerned residents request expedited mitigation response to the continued WVC's along HLR
SEPTEMBER 2017
MEDIA STORY
BRAMPTON GUARDIAN: Matilda Back in Brampton Pond, but Rescuer Fears for Turtle's Safety
WINTER 2017
DISCUSSION FOR FENCING ALONG NEW RESIDENTIAL DEVELOPMENT ON HLR
Mortality mitigation options discussed to help address the increased WVC's resulting from increased traffic
APRIL 2018
INSTALLATION OF SEASONAL WILDLIFE FENCING
Brampton responds to public pressure & installs seasonal fencing along HLR
FUTURE PLANS
INSTALLATION OF PERMANENT FENCING AND ADDITIONAL DEDICATED WILDLIFE CROSSINGS
Adding mitigation measures in the future could decrease wildlife mortality on HLR
FINISH
2010
2012
2014
2016
2018
WVC = Wildlife Vehicle Collision | HLR = Heart Lake Road

# Management Considerations

Based on experiences and outcomes from this report, staff directly involved in the "Heart Lake Road Ecology and Turtle Population Study" have provided the following recommendations for consideration:

## Protective Structures

- Have a TRCA staff member present or available for consultation prior to or during installation of the temporary and or permanent fencing to assist and ensure proper installation.
- Install fencing with a finer attention to detail, ensuring that upper areas are folded over at an appropriate angle to avoid frogs jumping over fencing, gaps are not present in the fencing and if gaps are found.
- A maintenance strategy is put in place to address/repair gaps in fencing and ensure vegetation is kept cut back from fence.
- Extend coverage of fencing to ensure better connectivity and protection and ensure end curls of fencing extend a minimum of 20 metres into the natural areas to minimize access to the road at end points.
- Replace temporary fencing with permanent fencing in combination with a series of dedicated wildlife passages to continue trend of decreasing road mortality in remnant wetlands.
- Extend fencing south of Sandalwood Pkwy due to the number of turtles found, water level fluctuation and proximity to the road at Fenwick Park, Heartview Rd, Presentation Center and Crescent Moon.
- Create a dedicated wildlife passage connecting Sandalwood East and West under a causeway-like structure, should any road improvement be done in the area.
- Implement habitat enhancements such as additional turtle nesting beaches.
- Incorporate features inside wildlife passages to encourage smaller wildlife to access the passage by providing concealment if at risk of predation.

## Community Engagement and Ecotourism

- Design interpretive signage to be placed at the Medicine Wheel Garden (Gitigaan Mashkiki) located within HLCA or docks near Heart Lake educating the public and raising awareness of impacts of roads on wildlife.
- Encourage ecotourism at Heart Lake by providing a boardwalk with educational signage about research being conducted while reducing visitor impact on vegetation and naturally sensitive areas such as turtle nesting sites.
- Educate public on species of concern, pet releases and anti-poaching in an educational pamphlet.
- Train citizen scientists to assist with identifying and caging turtle nests during nesting season to monitor hatchling survivorship and factors influencing hatchling mortality, such as nest predation.
- Engage students from a local school to paint models of turtles to be put on nesting beaches to stimulate use by real turtles, and incorporate during mitigation installation and breeding season.

## Research, Study Design and Ongoing Monitoring

- Research and design more effective turtle nest protectors.
- Determine a plan for managing invasive non-native red-eared slider populations.
- Consider using different types of traps, including seine nets to overcome depth limitations or dip-nets to capture hatchling turtles, to obtain a more accurate population estimate, reduce bias and understand recruitment success.

- Install HALT camera systems in any new dedicated wildlife passage to allow for verification of faunal groups and species using the passage, as well as a general quantification of the amount of movement.
- Initiate a PIT Tag study in combination with an antenna array at the designated wildlife passage to determine specific turtles or numbers of turtles using the wildlife passage.
- Incorporate various concealment micro-habitats in the dedicated wildlife passage to provide protection for herpetofauna from predators.
- Conduct another population study in 10 years at the same wetlands monitored in 2018 in order to get more accurate population numbers and observe population demographic changes.

# 2018 Heart Lake Turtle Population Study at a Glance

Provincially Significant Wetland - Heart Lake Conservation Area, Brampton, Ontario
May to August 2018

OBJECTIVES:

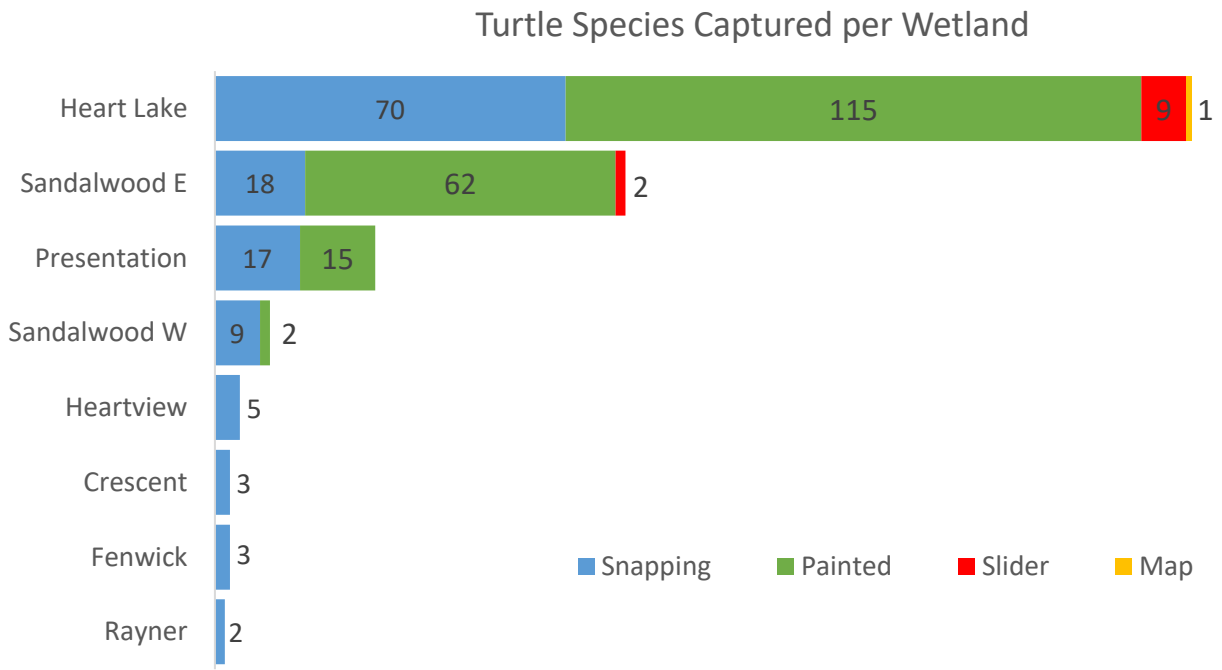
1. Survey the turtle population of the designated Provincially Significant Wetland (PSW) complex bordering Heart Lake Rd and Heart Lake within Heart Lake Conservation Area, to assess health and demographics.
2. Establish baseline data for future road mortality mitigation measures and potential restoration efforts.

RESULTS:

1. Captured and tagged 333 individual turtles at 8 locations including 4 different species.
2. Recaptured 98 individual turtles.

KEY FINDINGS:

1. Turtles observed and/or captured in every sampled wetland, indicating a functional wetland complex = POSITIVE
2. Lack of Midland painted or juvenile snapping turtles in small remnant wetlands= RED FLAG
3. Even sex ratios of snapping turtles in Heart Lake and wetland complex = POSITIVE
4. Even sex ratios of painted turtles in Heart Lake = POSITIVE
5. Male-skewed adult sex ratio (2.1:1) of painted turtles in the bisected Sandalwood wetlands, a known consequence of adult female road mortality = RED FLAG



# 2018 Heart Lake Road Ecology Citizen Science Monitoring Project at a Glance

Provincially Significant Wetland - Heart Lake Conservation Area, Brampton, Ontario
May to October 2018

OBJECTIVES:

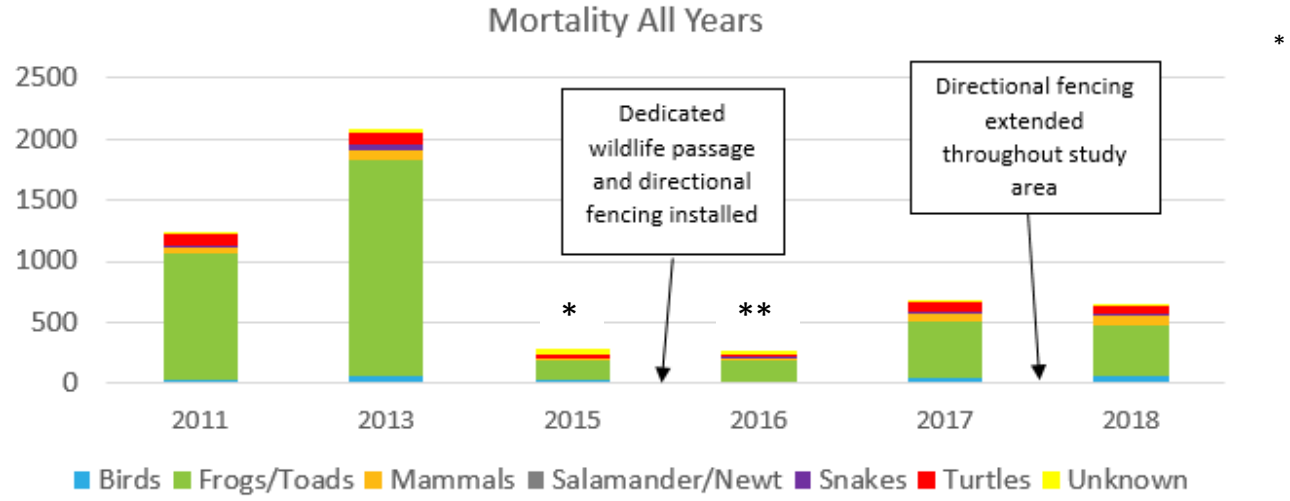
1. Survey wildlife-vehicle collisions (WVCs) along a 1.3 km stretch of Heart Lake Road to add to existing data and assess the effectiveness of mitigation measures.
2. Experiment with new camera technology to ascertain best possible methods to monitor dedicated wildlife passage usage.

RESULTS:

1. In 2018, 647 total WVCs were observed including; 59 birds, 415 frogs/toads, 85 mammals, 13 snakes, 58 turtles, 17 unknowns.
2. Over the study duration (2011, 2013, 2015-2018), 5,189 total WVCs were observed including 4,013 frogs/toads, 378 turtles, 320 mammals, 240 birds, 144 unknowns and 92 snakes.

KEY FINDINGS:

1. Significant decrease in all WVCs in permanent mitigation section = POSITIVE
2. Directional temporary fencing is most effective in mitigating WVCs for turtles, snakes and mammals = POSITIVE
3. Temporary fencing not effective for frogs, birds = RED FLAG
4. WVCs were concentrated near fence ends suggesting curls need to be longer = RED FLAG
5. Permanent fencing had fewer maintenance issues compared to temporary fencing = POSITIVE
6. Fewer WVCs post-mitigation in areas with complete fencing compared to partial/no fence




Monitoring was completed by staff and not citizen scientists in 2015 leading to fewer monitoring hours.

** The summer of 2016 experienced significant drought throughout southern Ontario and numerous wetlands in the HL wetland complex completely dried up.

# 2018 Heart Lake Nesting Study at a Glance

Provincially Significant Wetland - Heart Lake Conservation Area, Brampton, Ontario
June 6 to July 25, 2018

OBJECTIVE:

1. Determine the effectiveness of Animex directional fencing in excluding turtles from nesting on road shoulders.
2. Investigate if the artificial nesting beach has been utilized more by turtles in 2018.

RESULTS:

1. Observed 2 nests on the road-side compared to 28 nests on the wetland-side.
2. Observed 6 nests on the artificial nesting beach and 2 nests in close proximity to beach.

KEY FINDINGS:

1. Significantly more nests were found on the wetland-side of fencing suggesting that Animex directional fencing is effective in excluding most turtles from nesting on the road.
2. Artificial nesting beaches were utilized more by turtles in 2018 however all nests were predated.

# Acknowledgments

We acknowledge that the land on which the work and contributions for this project took place is traditional territory of the Haudenosaunee, Anishinabek, and most recently, the territory of Mississaugas of New Credit First Nation.

Toronto and Region Conservation (TRCA), City of Brampton (CoB) and York University would like to thank the dedicated volunteers and project partners who participated in the Turtle Population Study. Special thanks to volunteers Wouter Schaake Msc. and Alex Désormeaux who assisted with set-up, capture and processing. Also, thank you to the Ontario Turtle Conservation Center (OTTC) for sharing their expertise in handling turtles with staff.

We would also like to thank the dedicated citizen science volunteers, who continue to collect data as part of the ongoing citizen science Heart Lake Road Ecology Monitoring Project at the designated Provincially Significant Wetlands along Heart Lake Road (HLR). This study commenced in 2011 to gain further knowledge on effects of roads on wildlife and fragmented habitat. The continued input of equipment, time, expertise, and valuable feedback from project partners have been critical to this project's ongoing success.

Photographs of staff and volunteers are available in Appendix L.

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# 1.0 Introduction

The wetlands bordering Heart Lake Road (HLR) represent a 53 hectare designated Provincially Significantly Wetland (PSW) complex, scoring in the top 10 out of nearly 1,500 evaluated wetlands in Ontario. There are a variety of amphibians, reptiles, mammals and birds residing within the complex. Most of these species are common, but some are of special concern for local or provincial extirpation. The main bodies of water in the complex are two kettle lakes, Heart Lake and Teapot Lake, the latter of which is one of the only two known meromictic lakes in southern Ontario. The sediment in meromictic lakes is never mixed by water or benthic movements, providing a unique glimpse of historical conditions.

As part of its ongoing citizen science monitoring efforts, Toronto and Region Conservation Authority (TRCA), in partnership with City of Brampton (CoB), Ontario Road Ecology Group (OREG) and York University, have been leading a series of road ecology monitoring studies (2011, 2013, 2015, 2016, 2017, 2018) examining wildlife vehicle collisions (WVCs) along the road. Over the years, citizen scientists have observed high levels of WVCs because HLR bisects the PSW complex. The high number of turtle fatalities observed is especially concerning due to their long maturation time, high juvenile mortality rates, susceptibility of adult females to road fatalities and nest predation (Steen and Gibbs 2004). As of April 2018, the Committee on the Status of Endangered Species in Canada has designated all native Ontario turtles as at-risk populations (COSEWIC 2018).

The findings of the citizen science Heart Lake Road Ecology Monitoring Project (HLREMP) determined the need for ongoing monitoring and turtle population studies (2014, 2015, 2018) to be conducted before and after mitigation measures are applied. Mitigation measures were installed to increase driver awareness of wildlife on the road including an enhanced seasonal, motion activated wildlife crossing sign (Sept 21, 2015) and optical speed bars (September 26, 2015). Additional mitigation was implemented to reduce WVCs, including a designated wildlife passage (April 18-20, 2016) located just south of Countryside Dr with permanent Animex wildlife directional fencing leading to the passage (June 16, 2016). Temporary Animex fencing was installed along both east and west sides of HLR from the permanent fencing south to Sandalwood Pkwy (April 3, 2018). Turtle nesting beaches (May 11-13, 2016) were also installed in the wetlands on either side of the dedicated wildlife passage as alternative nesting grounds to gravel shoulders of the road. Further development between Mayfield Rd. and Countryside Dr. is expected to increase traffic on HLR, potentially increasing wildlife mortality along the roadway.

This report outlines results of the Turtle Population Study (TPS) and HLREMP that took place during 2018. These studies will provide an overview of the current turtle population (species assemblage, age classes and sex ratio) and on-going statistics for WVCs on HLR with mitigation measures in place.

# 2.0 Methods

## 2.1 Study Area Description

The study area for the 2018 TPS includes one lake (Heart Lake) and seven wetlands; Crescent Moon, Presentation Center, Fenwick Park, Heartview Rd., Sandalwood East and West, and Rayner Trail between Bovaird Dr. E. and Mayfield Rd. in Brampton, Ontario (Figure 1). For full site descriptions refer to Appendix A. At the time of this study, HLCA East and West wetlands that were studied in 2015, did not have sufficient water levels to permit trapping and are not included in the study area for 2018.

The study area for the 2018 citizen science HLREMP was a 1.3 km stretch of HLR between Sandalwood Pkwy and Countryside Dr. based on hotspots identified in 2013 (Figure 2).

The study area for the 2018 nesting study is the same 1.3 km stretch of HLR where permanent and temporary Animex directional fencing was installed, including installed nesting beaches at HLR and Countryside Dr.

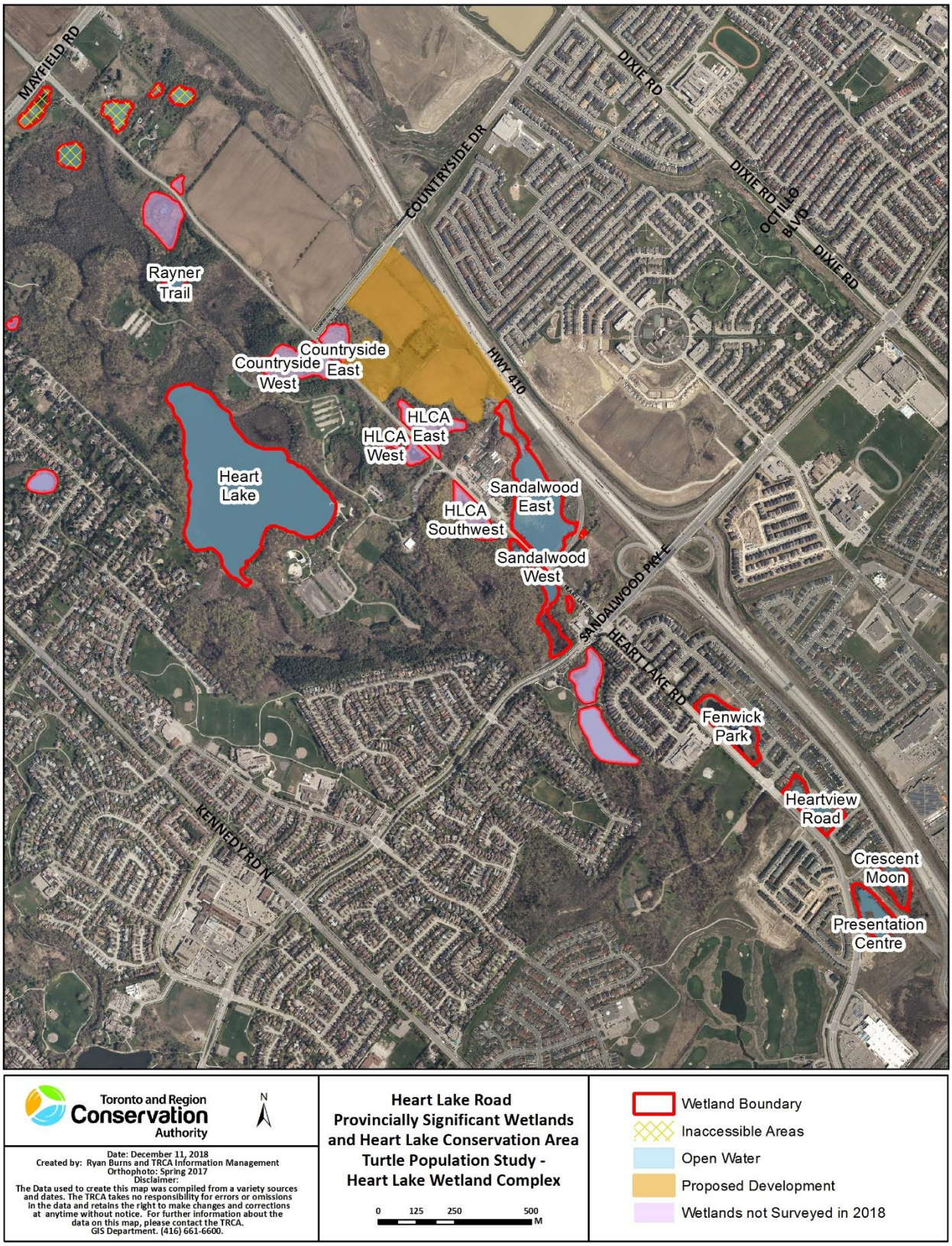
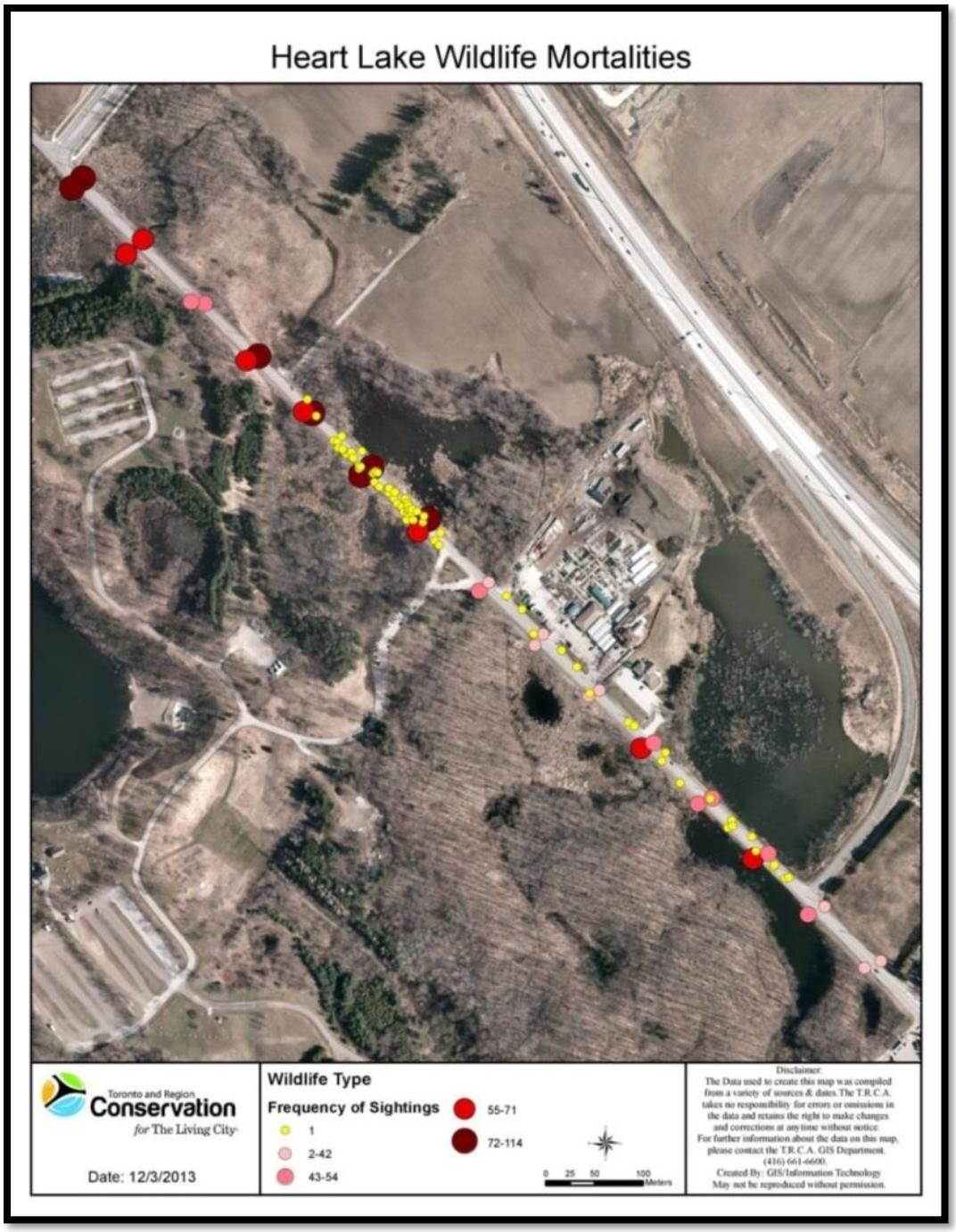



**FIGURE 1. TURTLE POPULATION STUDY AREAS WITHIN THE HEART LAKE PROVINCIALLY SIGNIFICANT WETLANDS.**


Heart Lake Wildlife Mortalities
Toronto and Region Conservation for The Living City
Date: 12/3/2013
Wildlife Type
Frequency of Sightings
1
2-42
43-54
55-71
72-114
0 25 50 100 Meters
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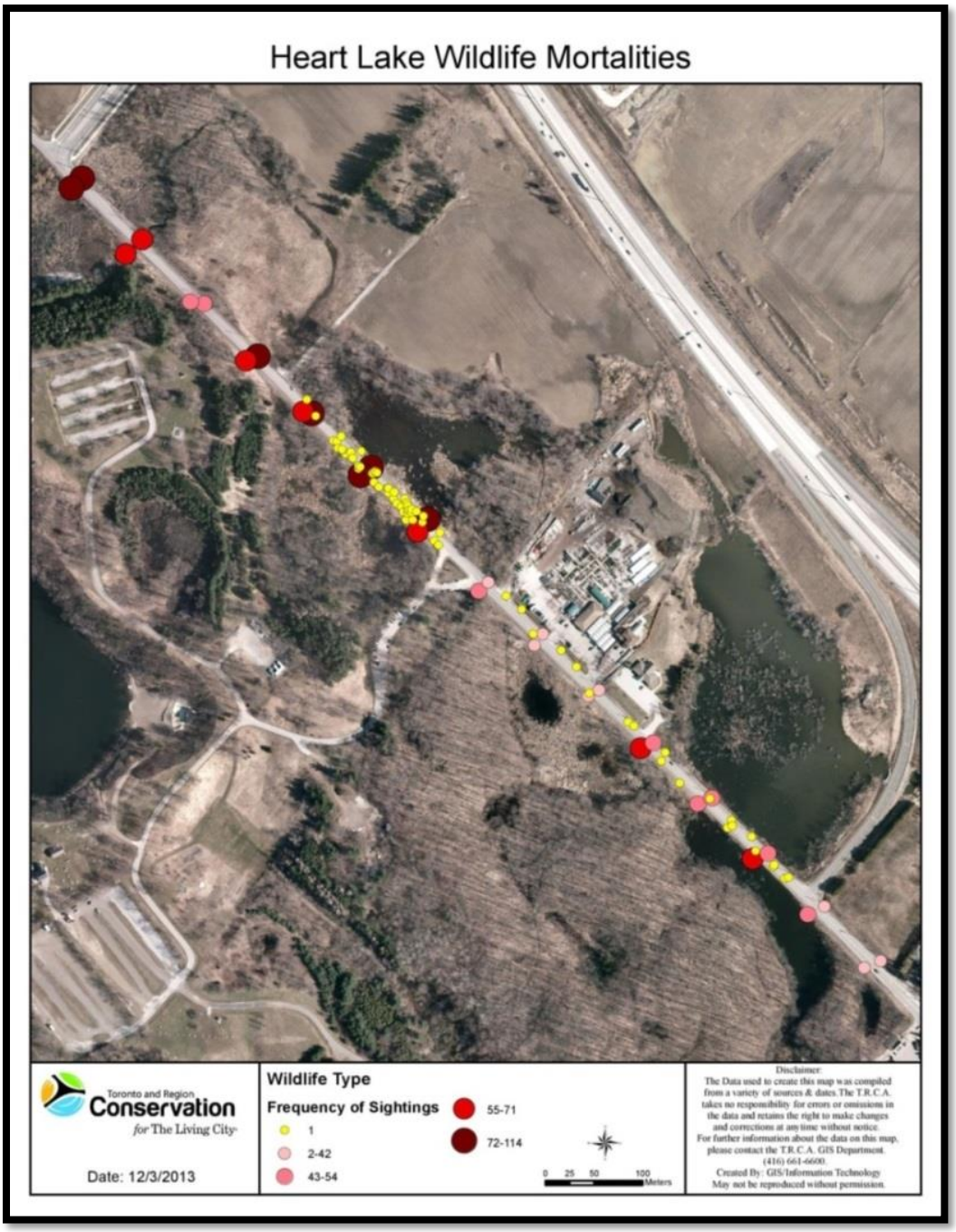
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Toronto and Region Conservation for The Living City
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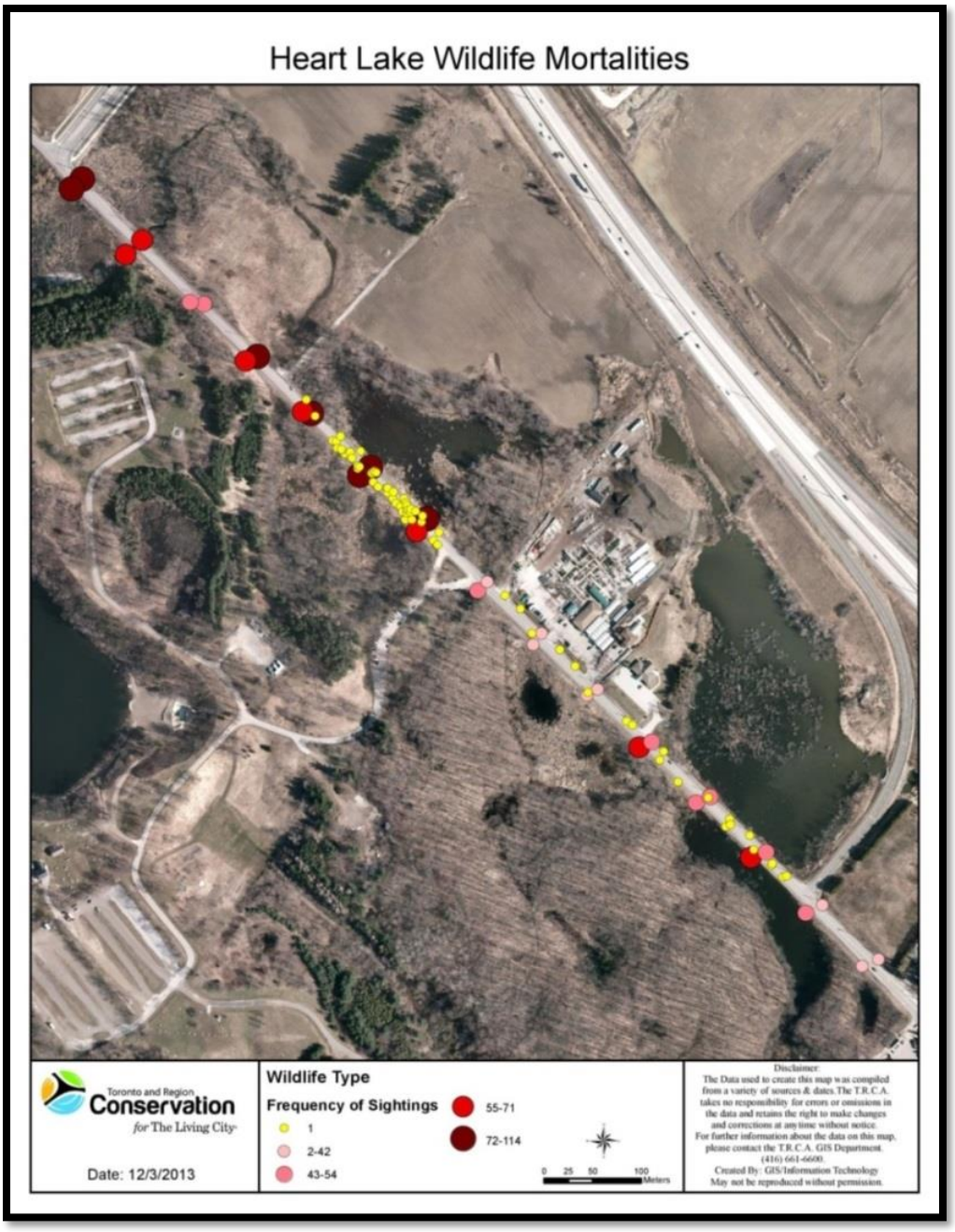
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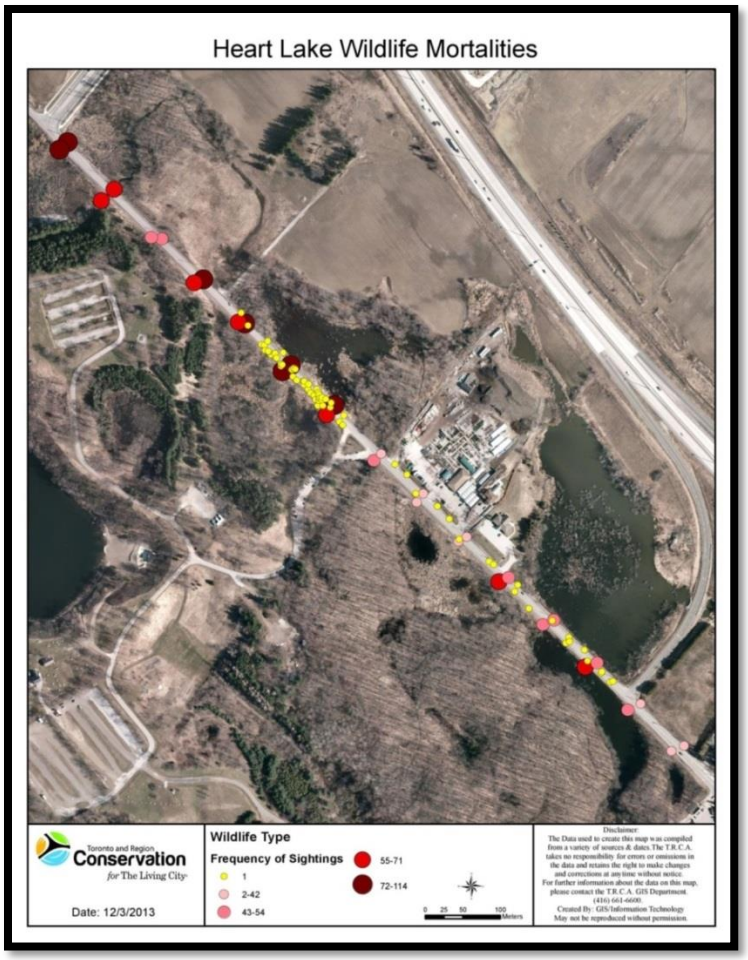


**FIGURE 2. HEART LAKE ROAD ECOLOGY MONITORING STUDY AREA, WITH IDENTIFIED WILDLIFE-VEHICLE COLLISION HOTSPOTS HIGHLIGHTED, 2013.**

## 2.2 Turtle Population Study

**Live Trap Equipment Set-up**

For this study, thirty hoop nets were purchased from Champlin Net Company Jonesville, Louisiana, USA. Trap signs were laminated and attached to each trap with contact information regarding questions about the study (Appendix B). Traps were set in pre-determined locations throughout the study area and moved based on a trapping schedule (Appendix C). Hoop net traps were placed along the perimeter of the wetland or in locations where a portion of the trap remains out of the water to allow animals to emerge for oxygen. Bait was placed in a mesh bag and attached to the inside of the net at the third hoop with a zip tie allowing bait to hang just below water level. The most successful bait were trout from casualties at TRCA's Glen Haffy Trout Hatchery and when trout was unavailable, a mixture of sardines and cat food. At Heart Lake south, a crayfish and garlic scented gel called Liquid Mayhem was rubbed onto the bait bag to attract a map turtle into the net.

Equipment included 30 hoop nets, 60 T-bars, stand-up paddle board (to float equipment and move nets around in the water), row boat, oars, steel toe chest waders, personal floatation devices and boating safety kit (whistle, bailing bucket, throw rope). Equipment was carried or rowed to site and a path was created through vegetation

if necessary. A minimum of 2 staff entered the water in steel toe chest waders and personal flotation devices (PFDs) working as a team to check nets.

Traps were checked daily and when staff were not able to attend the site, all three metal rings of the hoop nets were placed on top of T-bars to deny entry into the traps. No injuries or casualties occurred with this method.

Incidental fish capture (by-catch) of one largemouth bass occurred in Heart Lake north. The fish was unharmed and released from the net. Native species in Heart Lake include largemouth bass, trout and sunfish. Heart Lake is stocked annually with rainbow trout raised at TRCA's Glen Haffy Trout Hatchery during an annual Peel Children's Water Festival in May. Other incidental wildlife observations are reported in Appendix D.

**Protocol of Data Collection**

TRCA secured Ministry of Natural Resources and Forestry (MNRF) Wildlife Scientific Collector's Authorization Permit with approval from Wildlife Animal Care Committee to conduct this study (Appendix E).

This study was carried out in strict accordance of guidelines from the Canadian Council on Animal Care (CCAC). Protocol outlines for the full study was approved by York University Animal Care Committee (Protocol #: B10-32). Appropriate permits were obtained from the Ontario Ministry of Natural Resources (Authorization #: 1089105). No turtles were sacrificed for this research nor did they incur serious injury or death while in traps or during handling.

Upon collection, each turtle captured over the study period was processed according to this protocol. Turtles were weighed and checked for damage which was noted for future reference. Plastron and carapace, length width and depth were measured (Figures 3). The pre-cloacal length was measured from the posterior most point of the plastron to the middle of the vent (cloaca). An additional measurement of the length from the middle of the plastron to the end of the plastron was recorded for snapping turtles as this length is shorter than pre-cloacal length in males. Length of the longest front nail was measured on painted turtles since males have longer nails than females. These characteristics as well as a displaying feature on snapping turtles were used to determine the sex of each turtle. Turtles were also classified into three age categories; hatchling, juvenile and adult.

A wire brush was used to remove algae if present from the carapace before beginning to notch. Notching was completed according to MNRF preferred notching method using an appropriately sized metal filing tool for each turtle (Figure 4). Files created either a triangular or circular notch in the carapace, deep enough to remain noticeable in future but not deep enough to cause bleeding.

Female snapping turtles were checked for eggs before insertion of the tag. Rubbing alcohol was used on a cotton pad to clean and disinfect a small area of skin above the hind leg near the upper edge of the plastron. A passive integrated transponder (PIT tag) was injected into the cleaned area with a BioMark tool and sealed to prevent infection with Newskin liquid bandage (Figure 5). Painted turtles were injected with 9mm tags while slightly larger 12 mm tags were used on snapping turtles. A BioMark wand was used to read the PIT tag's unique code and recorded for each turtle. Rubbing alcohol was also used on a cotton pad to detach and remove leeches which will benefit the turtle.

Equipment was placed in a secure storage area of the HLCA office at the end of each day. All equipment including waders, nets, gloves, bins and stand-up paddle board were disinfected in a mild solution of bleach and water before moving to a new wetland.

For photographs and a description of the species captured in this study and their status as determined by COSEWIC, refer to Appendix F.

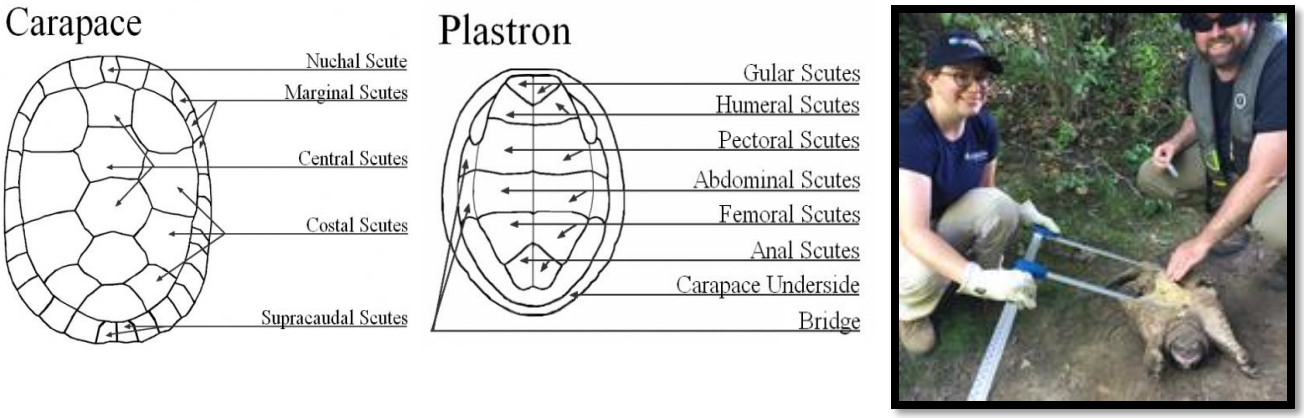


FIGURE 3. SCUTES OF CARAPACE (UNIVERSITY OF MARYLAND 2014), ANATOMY OF PLASTRON (SCIENCERAY 2008), TRCA STAFF MEASURING PLASTRON OF A SNAPPING TURTLE.

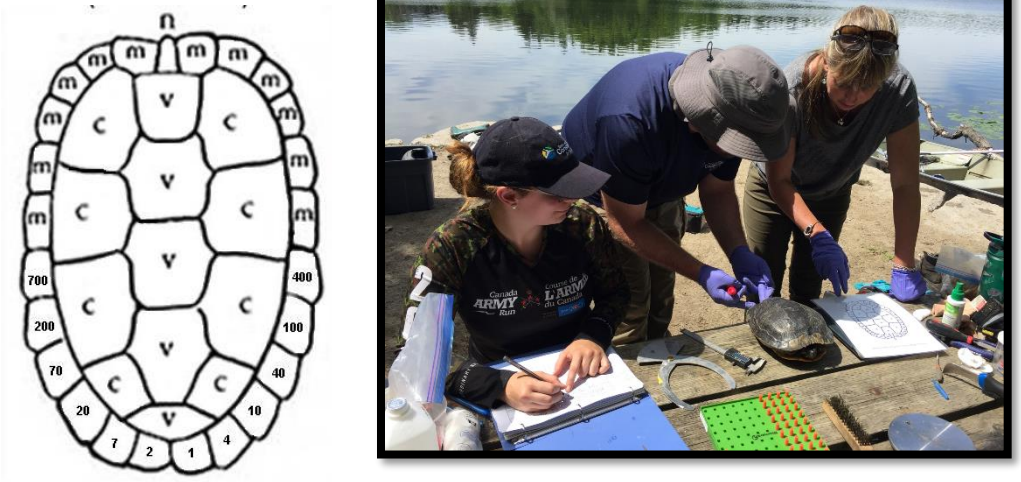

FIGURE 4. MNRF NOTCHING PROTOCOL AND TRCA STAFF NOTCHING THE CARAPACE OF A RED-EARED SLIDER TURTLE.


FIGURE 5. 12MM PASSIVE INTEGRATED TRANSPONDER (PIT) TAG (BIOMARK 2018), NEWSKIN LIQUID BANDAGE AND BIOMARK WAND, TRCA STAFF USING A BIOMARK TOOL TO INJECT A PIT TAG INTO A SNAPPING TURTLE.

**Trapping Bias**

Based on hoop nets used in this study, we did not expect to trap any hatchlings or juveniles. The trap mesh size of hoop nets imposes a lower limit to size of turtles that can be captured. In this study, small turtles of less than 5cm can escape through the mesh. These methods are thus skewed towards capture of adult turtles. It is also possible, and at times observed, that captured turtles escaped the net through the mesh entrance or a hole they created in the mesh before the trap was checked.

**VHF Tracking**

Select gravid (with eggs) female snapping turtles were tagged with a ATS W510 GPS/VHF Integrated transmitter, weighing 65g (weight in air) with dimensions 50mmx40mmx10mm (Figure 6). Transmitters were attached to the posterior portion of the carapace using super glue. Once dry, a layer of Waterweld epoxy putty was used to encase and secure the transmitter to the shell. This method provided a smooth surface to prevent the transmitter from being caught on vegetation or wood debris. The epoxy was coloured using a permanent marker to match the colour of the device more closely with the general colour of the carapace. Transmitters were attached at the original capture site and allowed to dry no longer than within 12 hours of capture. All transmitters except one was removed at the end of the study. The last transmitter will be removed in March of the following year after turtles emerge from hibernation. A GPS unit was also attached to allow researchers to study turtle movements between wetlands.

FIGURE 6. VHF (WHITE) AND GPS UNIT (BLACK) ATTACHED TO THE MIDDLE OF THE CARAPACE OF A SNAPPING TURTLE.

## 2.2 Road Ecology Monitoring

**Wildlife Directional Fencing**

Temporary wildlife directional fencing was installed by City of Brampton on segments of HLR adjacent to wetlands on April 3 to 9, 2018. A total of 957.2 meters of temporary fencing was installed on both sides of HLR between Sandalwood Pkwy and Countryside Dr (Figure 7).

FIGURE 7. TEMPORARY FENCING INSTALLED ALONG HEART LAKE ROAD.

Animex fencing panels (dimensions 3mm x 610mm x 2.5m) were used in the temporary fencing. T-bars were pounded into the ground and used as support posts for fencing panels, which were zip tied to T-bars. Ends of fencing segments were installed so they curved back into the wetland, to encourage wildlife travelling along the fence in search of a way across the road, to return to the wetland upon reaching ends of fencing segments (Figure 8).

FIGURE 8. TEMPORARY WILDLIFE DIRECTIONAL FENCING END CURL.

Metal tags with unique identification numbers were attached to both temporary and permanent fencing at 8-10 meter intervals. These tags were used as markers to better describe and identify locations of WVCs, damaged fencing panels, or other observations if GPS data was unreliable.

Additional maintenance was undertaken in the summer to prevent encroachment from wetland vegetation. TRCA staff used trimmers to cut back encroaching vegetation, which, if long enough, could be used by wildlife to climb over fencing panels. This work was completed in early August.

TRCA staff also spent a day in October walking along the temporary fence, recording the number of damaged fencing panels that would allow wildlife to access the road (Figure 9). These locations were recorded and repairs were made to any minor damages with zip ties. Any instances of major fencing damages were photographed and recorded. The distances of WVCs from fence malfunctions was analyzed in ArcMap using the "Near" function.

FIGURE 9. TEMPORARY WILDLIFE DIRECTIONAL FENCING WITH MINOR DAMAGE.

**Data Collection Protocol**

Data collected for HLREMP has been collected by citizen science volunteers since the project's inception in 2011. Volunteers are trained annually on monitoring protocols and species identification, with an emphasis on wildlife found locally in the HL area. Training also included an on-the-road component, where road safety protocols are explained and demonstrated (Appendix G).

Staff and volunteers adhered to strict safety protocols following guidelines from the Ministry of Transportation. Teams, with two to four people conducted monitoring during daylight hours and only in dry conditions. Monitoring sessions involve walking along the study area on both sides of the road, in the direction of incoming traffic. Traffic spotters continuously monitored road conditions and incoming traffic while data collectors searched the road and shoulder for evidence of WVCs. Upon location of a WVC, safety cones were set up so and were visible to oncoming traffic without impeding traffic flow. Type of observation, number of wildlife affected and species of WVC were recorded using Survey123 Data Application on the citizen scientist's smartphone or tablet (Appendix H). Photos were taken with an object placed adjacent to the WVC as a scale object and appended to the survey (Figure 10). Location data taken from the smartphone or tablet was also attached.

FIGURE 10. WILDLIFE-VEHICLE COLLISION WITH OBJECT FOR SCALE.

Due to the volunteer nature of the citizen science component of this project, the number of monitoring sessions that occurred varied week-to-week. At least one monitoring session occurred each week between April 23 and October 31, 2018. Additional monitoring sessions were also added based on volunteer availability and weather permitting. In 2018, monitoring also occurred on roads within HLCA on a weekly basis between mid-April to the end of October.

In 2018, a Hobbs Active Light Trigger (HALT) coupled with a Bushnell Liveview Passive Infrared (PIR) camera were installed in the middle of the dedicated wildlife passage. Two separate PIR cameras were also installed; one with low glow on the east side and one with no glow on the west side to test the HALT system's performance. To ensure wildlife passed through the laser beam and triggered the HALT camera, a panel of fence was used to narrow the width of the dedicated wildlife passage.

The PIR cameras require animals passing through the tunnel to be approximately 3$^{o}$C warmer than their ambient surroundings to trigger, meaning that only larger mammals that generate enough heat are captured in photographs. The HALT camera system is triggered when the laser beam is broken and allows for a more representative snapshot of reptiles and amphibians using the dedicated wildlife passage.

The HALT system provides an elevated threshold, designed to capture images of amphibians, reptiles, large invertebrates and small mammals. The HALT system has been specifically designed to surpass the detection ability of commonly used passive infrared (PIR) cameras and helps to eliminate other related issues such as high rates of false triggers, back-end image processing and high variability in detection rates among different cameras and study locations (Hobbs and Brehme 2017).

## 2.3 Nesting

A 30-hour turtle nesting study was conducted in 2018 by a student from York University. Thestudent searched for snapping turtles, painted turtles and turtle nests on the wetland-side and road-side of directional wildlife fencing along HLR in 2 hour increments for 15 days between June 6 and 25, 2018. The student used numbered tags and flagging tape to ensure nests were counted only once.

Citizen scientists recorded and flagged turtle nests located on turtle nesting beaches installed on either side of the dedicated wildlife passage in accordance with HLREMP data collection protocols.

## 2.4 Data Analysis

**Turtle Population Study**

For the purpose of data analysis and reporting of the TPS, wetlands were amalgamated into the following groups based on proximity to each other; Crescent Moon/Presentation Center, Fenwick/Heartview Rd, Sandalwood East/West, Heart Lake/Rayner Trail.

A binomial test (success/failure experiment) was used to determine if the sex ratio (male: female) for both snapping and midland painted turtles was unbiased. The resulting probability is significant at a 95% confidence level if the resulting p-value is less than 0.05. Juveniles too young to be sexed are not included in sex ratios calculated.

Population estimates were calculated using the Lincoln-Peterson (LP) method at a 95% confidence level. The LP method had to be modified in order to fit this study, as it is designed to compare one population (total captured and recaptured) to the original population surveyed previously (Krebs 1998). In the formula used to obtain 2018 estimates, the first day of the survey was treated as the original population and consecutive visits were summed together in order to obtain total capture and recapture numbers for the second visit. For example, in estimates for the Sandalwood wetlands, week 1 was treated as visit 1, ignoring recaptures caught, and week 2 is treated as visit 2 including recaptures.

**Road Ecology Monitoring**

After the last day of data collection on October 31, 2018, the Survey123 data was downloaded into ArcMap. Some data points had a high degree of error due to varied GPS units used. As such, some points were moved based on descriptions from citizen scientists. In total 424 WVC records were used out of a total of 481 (88%).

Once all data points were plotted in ArcMap, a kernel density analysis was run to re-evaluate the study area for new WVC hotspots. Kernel density analyses account for multiple observations per GPS point. The search radius used was 75 meters. Five classes were used to best highlight; very low, low, moderate, high and very high concentrations of WVCs.

A t-test at a 95% significance level was conducted to see if the mean number of WVCs (totals and taxa-specific) observed during the post-mitigation period (2016-2018) was significantly lower than WVCs observed during pre-mitigation period (2011, 2013 and 2015).

A second t-test was conducted at a 95% significance level to see if numbers of WVCs observed in areas protected by directional fencing (permanent and temporary) were significantly lower than areas with either partial or non-existent fencing (Figure 11).

WVCs observed within HLCA were not included in the analysis of WVCs on HLR.

**Nesting**

A Z-test was used to analyze the proportion of nests found on the wetland-side compared to the road-side of Animex wildlife directional fencing and is considered significant at a 95% confidence level if the resulting p--value is less than 0.05.

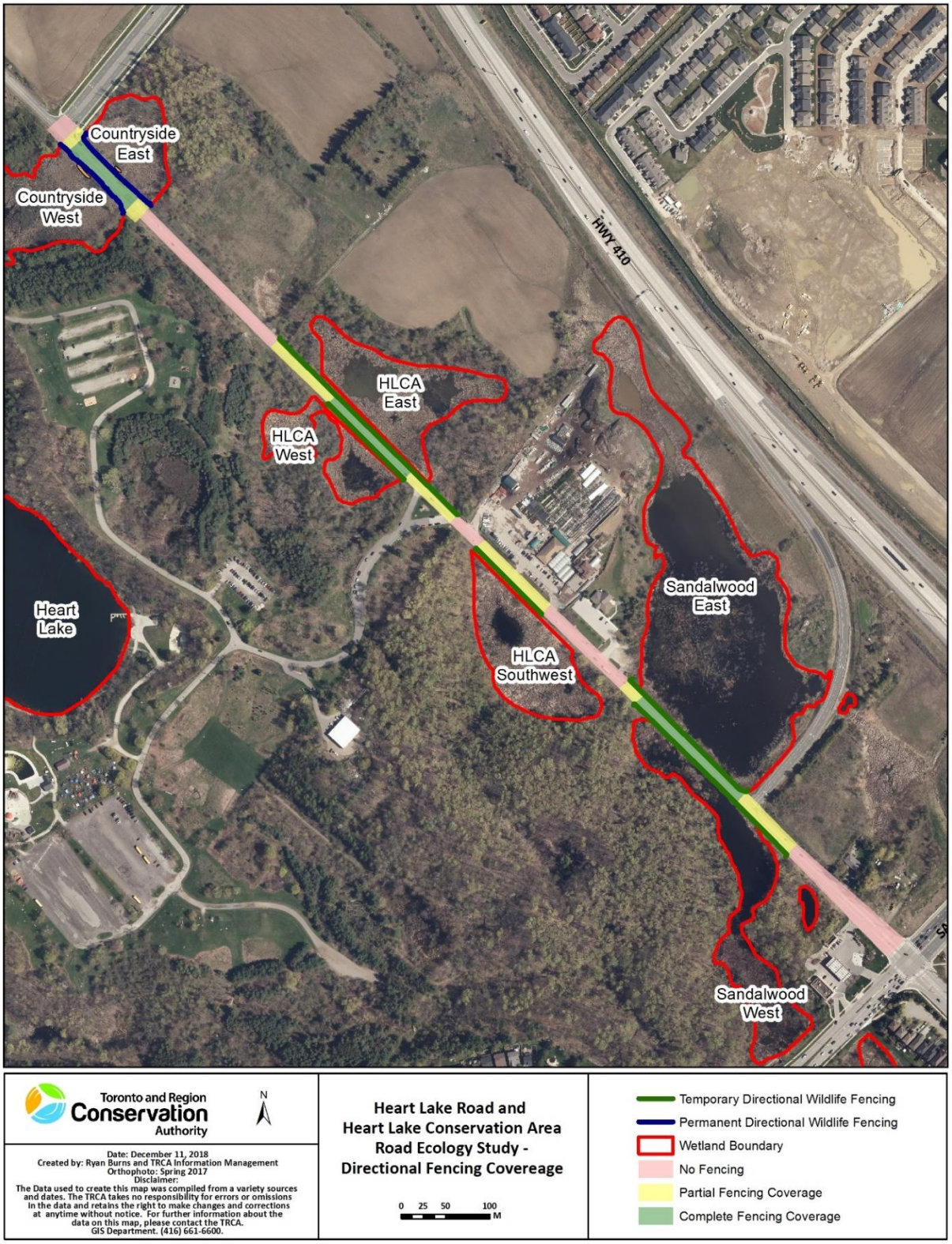


**FIGURE 11. COMPLETE, PARTIAL AND NO FENCE COVERAGE ALONG HEART LAKE ROAD IN 2018.**

# 3.0 Results

## 3.1 Turtle Population

Through the 2018 study, a total of 431 turtles (333 new and 98 recaptured) were trapped, tagged and released over 670 trap-days (catch-per-unit-effort, CPUE, 64.3%). A summary of species, age and sex, of the 333 new turtles (excluding recaptures) captured in each wetland can be seen in Table 1. In the amalgamated wetland groups, Heart Lake was the only wetland that had all 4 species and snapping turtles were present in every wetland surveyed (Figure 12). Notably, a single gravid female map turtle was captured in Heart Lake. A total of 11 invasive red-eared sliders were captured with 7 females and 2 males captured in Heart Lake and 2 females captured in Sandalwood East. Previous TPSs found fewer turtles and had lower catch per unit efforts (Table 2).

Species richness and turtle density were not equally distributed throughout the lake and wetlands. Species richness was highest in Heart Lake where all four species were captured. Juvenile snapping and midland painted turtles were captured in Heart Lake and Sandalwood East but not in Crescent, Rayner, Fenwick, Heartview Rd and Sandalwood West.

Table 1. Summary of species, age and sex of the 333 new turtles captured in each wetland in the Heart Lake Wetland Complex.

| Species | Age and Sex | Heart Lake | Sandalwood East | Sandalwood West | Presentation Center | Crescent Moon | Fenwick Park | Heartview Rd | Rayner Trail | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| Snapping | Adult Male | 35 | 6 | 4 | 8 | 1 | 1 | 2 | 1 | 58 |
| | Adult Female | 31 | 8 | 5 | 6 | 2 | 2 | 3 | 1 | 58 |
| | Juvenile | 4 | 4 | | 3 | | | | | 11 |
| Midland Painted | Adult Male | 48 | 31 | 1 | 4 | | | | | 84 |
| | Adult Female | 56 | 18 | 1 | 9 | | | | | 84 |
| | Juvenile | 11 | 13 | | 2 | | | | | 26 |
| Red-eared Slider | Adult Male | 2 | | | | | | | | 2 |
| | Adult Female | 7 | 2 | | | | | | | 9 |
| Map | Adult Female | 1 | | | | | | | | 1 |
| Total | | 195 | 82 | 11 | 32 | 3 | 3 | 5 | 2 | 333 |

Table 2. Summary of new turtle captures in 2014, 2015 and 2018.

| | Snapping | | | Midland Painted | | | Red-eared Slider | | Map | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Male | Female | Juveniles | Male | Female | Juveniles | Male | Female | Male | Female | Total |
| 2018 | 58 | 58 | 11 | 84 | 84 | 26 | 2 | 9 | 0 | 1 | 333 |
| 2015 | 2 | 4 | 1 | 19 | 5 | 3 | | | | | 34 |
| 2014 | | | | 5 | | 4 | | | | | 9 |

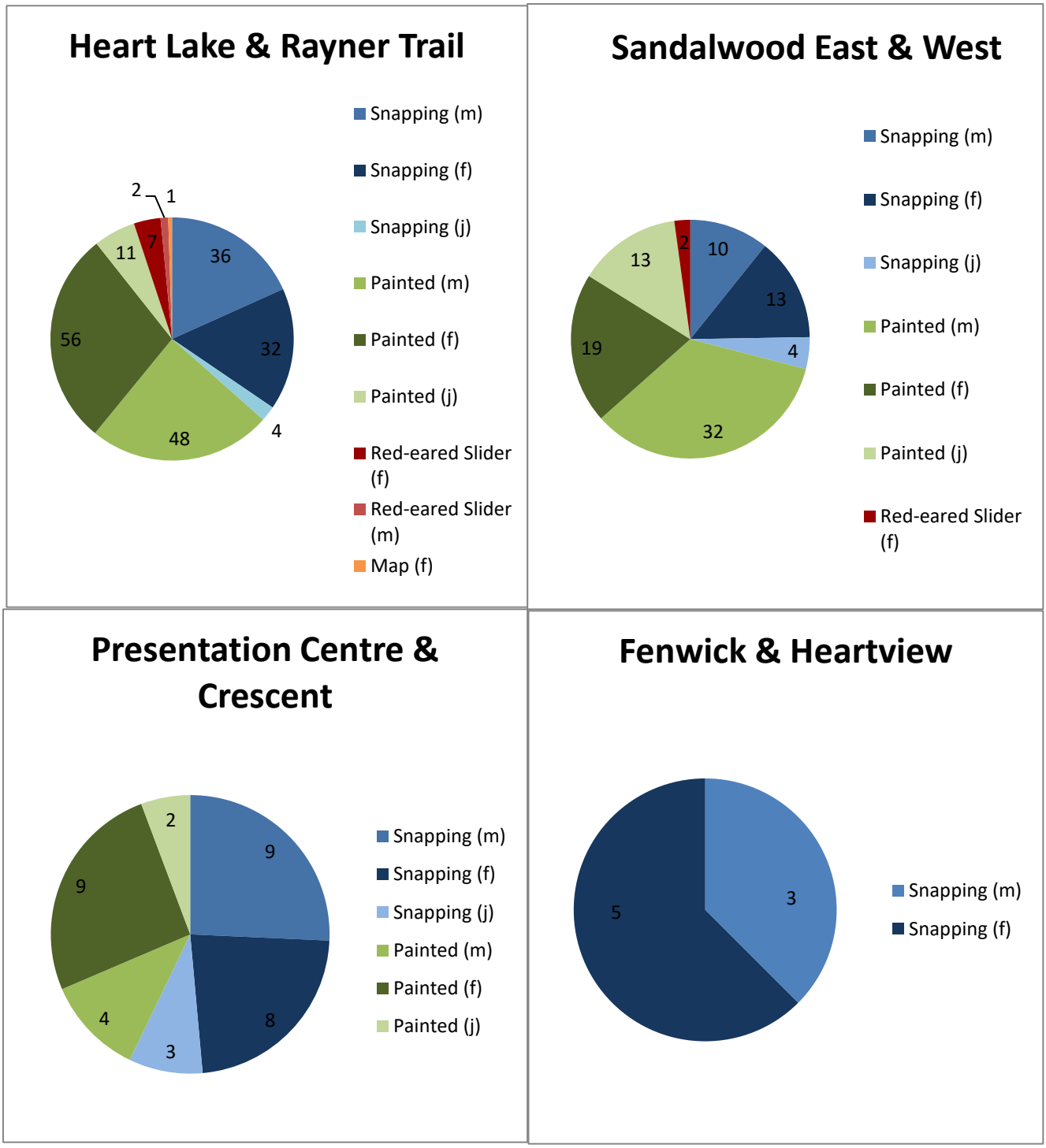


**FIGURE 12. SUMMARY OF THE SPECIES, AGE AND SEX OF THE 333 NEW TURTLES CAPTURED IN EACH WETLAND GROUPING IN THE HEART LAKE COMPLEX *(M=MALE, F=FEMALE, J=JUVENILE)*.**

Catch per unit effort (CPUE) in 2018 was 64.3%. The highest CPUE were in; Heart Lake, Fenwick, Sandalwood East and Presentation Center wetlands (all >40%). Previous turtle population studies found 34 turtles in 2015 over 180 trap-days (CPUE, 24.4%) and 9 turtles in 2014 over 40 trap-days (CPUE, 25.5%) (Table 3).

Table 3. Catch per unit effort for all years of turtle population study.

| Year | Number of Traps Used | Trapping Days | Trapping Effort (trap-days) | Total Captured | Catch per unit Effort |
|---|---|---|---|---|---|
| 2018 | Varied | 42 | 670 | 431 | 64.33% |
| 2015 | 6 | 30 | 180 | 44 | 24.44% |
| 2014 | 8 | 5 | 40 | 9 | 22.50% |

Sex ratios (male: female) in undisturbed turtle populations should be approximately 1:1. Sex ratios did not differ significantly from the expected 1:1 ratio in each wetland grouping except Sandalwood wetlands where a significant male bias in midland painted turtles was recorded (Table 4, 2.2:1, p=0.0150).

Table 4. Capture numbers, sex ratios (male: female) and p-values from the binomial test for adult snapping and midland painted turtles in the wetland groups.

| Wetland Grouping | Snapping Turtle | | | Midland Painted Turtle | | |
|---|---|---|---|---|---|---|
| Heart Lake & Rayner Trail | 36: 32 | 1.35:1 | (p=0.0807) | 48:56 | 0.85:1 | (p=0.0575) |
| Sandalwood Wetlands | 10:13 | 1.25:1 | (p=0.2460) | 31:18 | 2.2:1 | (p=0.0150)** |
| Presentation Center & Crescent Moon | 9:8 | 3:1 | (p=0.1093) | 4:9 | 0.5:1 | (p=0.1208) |
| Heartview Rd & Fenwick Park | 3:5 | 1:1 | (p=0.3750) | N/A | | |

****Significant difference showing more males were present**

Population estimates are reported for each wetland grouping using the Lincoln-Peterson method (Table 5).

Table 5. Population estimates for the Heart Lake wetland groupings using the Lincoln-Peterson population estimator.

| | Population Estimate (Lincoln-Peterson) | | | | Caught | |
|---|---|---|---|---|---|---|
| Wetland | Snapping | CL +/- (95%) | Midland Painted | CL +/- (95%) | Snapping | Midland Painted |
| Crescent Moon/Presentation Center | 46 | 36 | 59 | 70 | 20 | 15 |
| Fenwick/Heartview Rd | 14 | 14 | 0 | 0 | 8 | 0 |
| Sandalwood East/West | 62 | 31 | 220 | 117 | 26 | 64 |
| Heart Lake/Rayner Trail | 90 | 18 | 177 | 43 | 73 | 114 |

Four of the ATS W510 GPS/VHF Integrated transmitter units were recovered out of the six deployed, two trackers had data, the other two did not and two have yet to be recovered. The GPS units collect data when the

animal is above the water, so will only record a location if a turtle is basking or if it is on land. Movement locations were recovered from two trackers in Heart Lake, one for a map turtle and one for a snapping turtle (Figures 13 and 14 respectively). The map turtle was very active and its location was detected in various areas of the lake as well as laying her eggs along the park road in a picnic area. The snapping turtle was only detected leaving the water to nest in the Medicine Wheel garden.

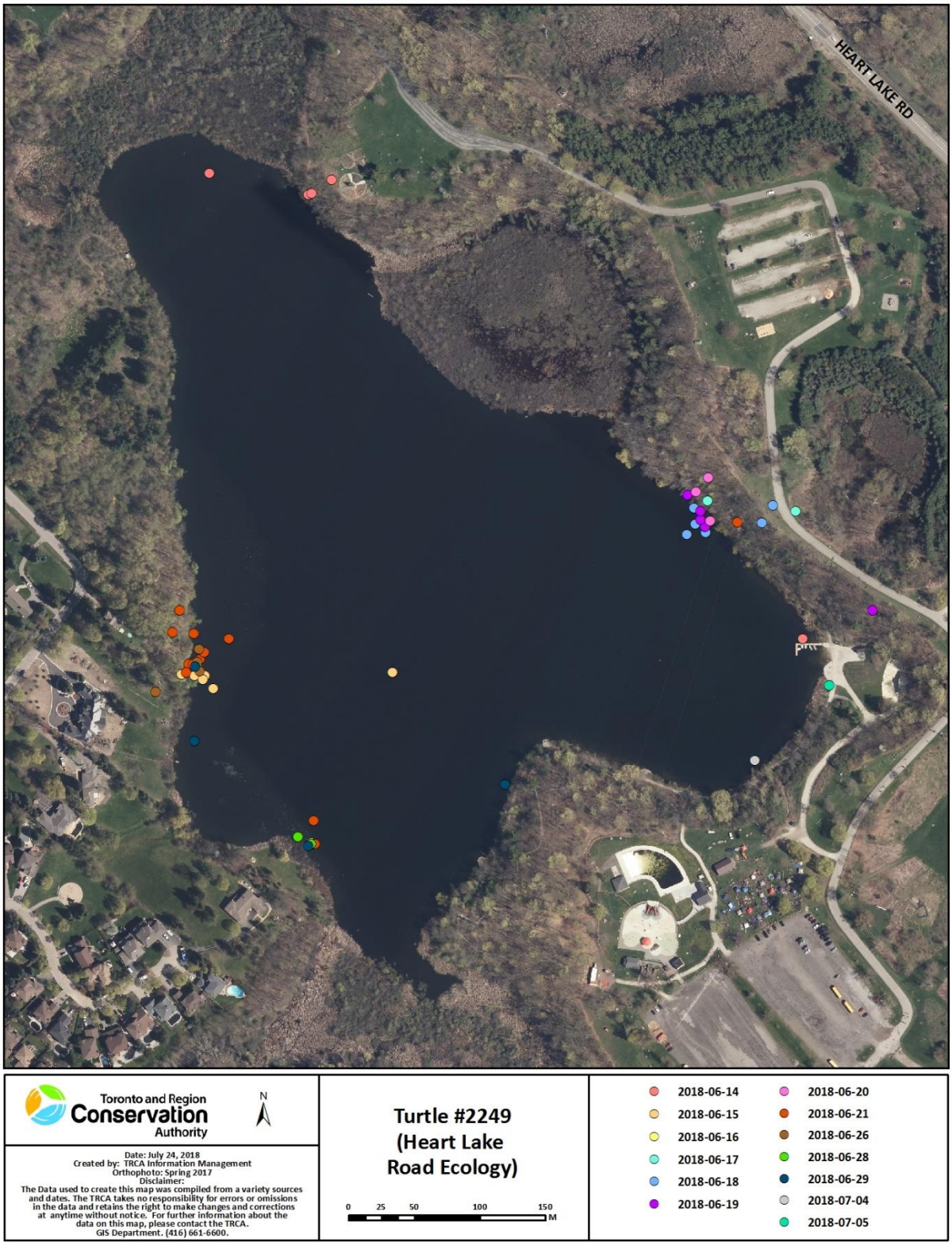


**FIGURE 13. GPS LOCATIONS OF THE NORTHERN MAP TURTLE MOVEMENT IN HEART LAKE.**

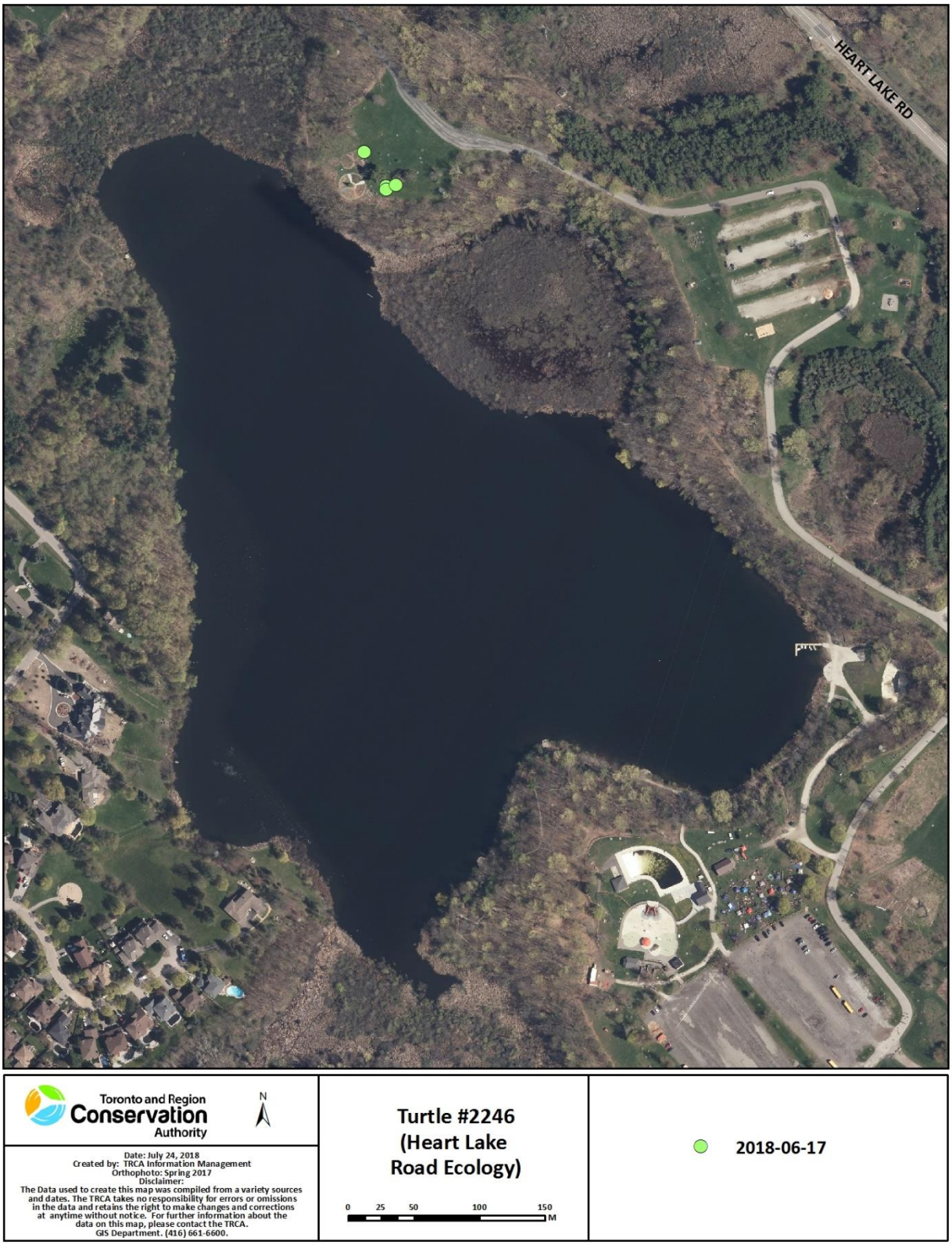


**FIGURE 14. GPS LOCATIONS OF COMMON SNAPPING TURTLE MOVEMENT IN HEART LAKE.**

## 3.2 Road Ecology Monitoring

In 2018, volunteers observed 647 WVCs including 415 frogs/toads, 85 mammals, 58 turtles, 59 birds, 13 snakes and 17 unknowns. Of the 647 WVCs, 39 were observed within HLCA.

Through HLREMP studies (2011, 2013, 2015, 2016, 2017, 2018), citizen scientists have observed a total of 5,189 WVCs, including 4013 frogs/toads, 378 turtles, 320 mammals, 240 birds, 144 unknowns and 92 snakes (Figure 15).

Appendix I contains a full species list found by citizen scientists.

An overview of all road mortality observed throughout the duration of the project, with notable mitigation events highlighted can be found in (Figure 16).

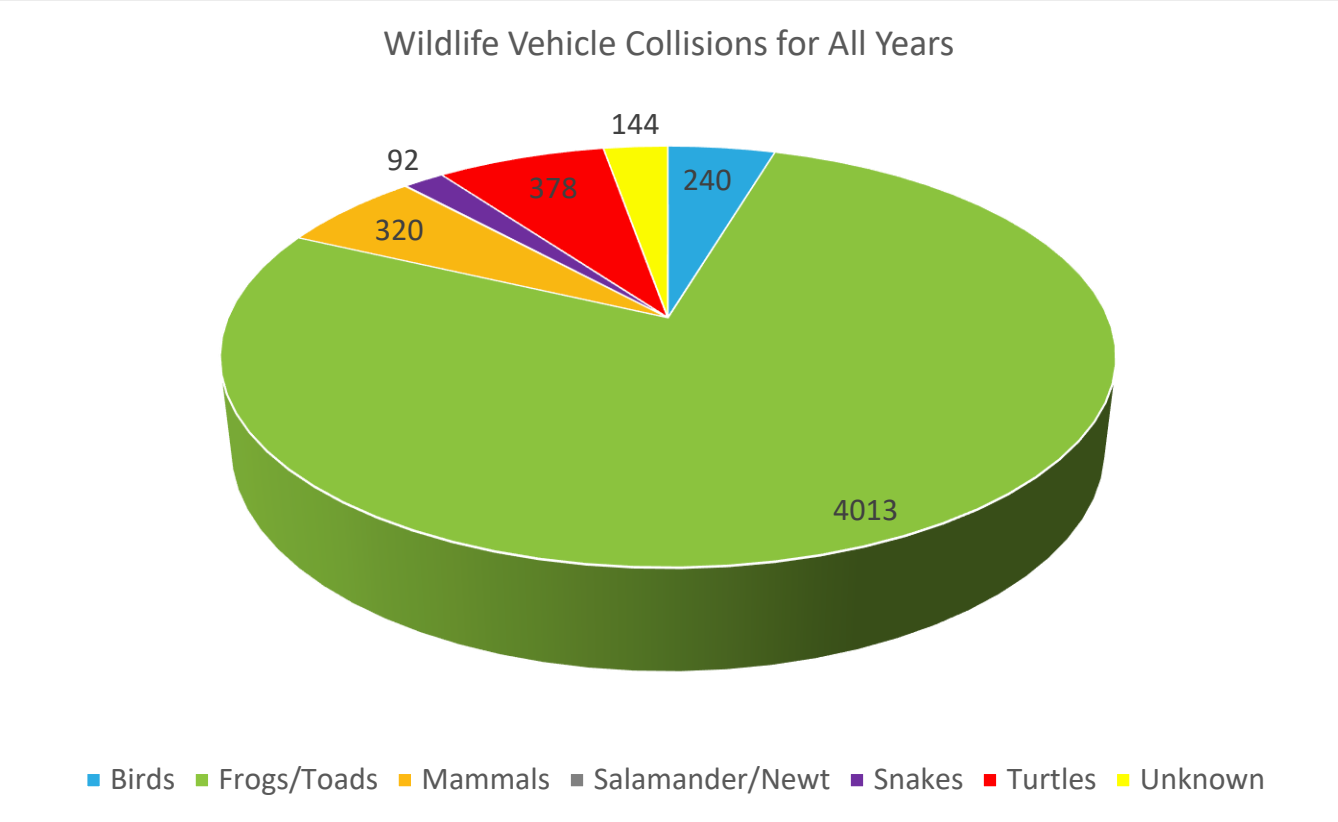


**FIGURE 15. WVCS RECORDED BY CITIZEN SCIENTISTS ALONG HEART LAKE ROAD FROM 2011, 2013, 2015, 2016, 2017 AND 2018.**

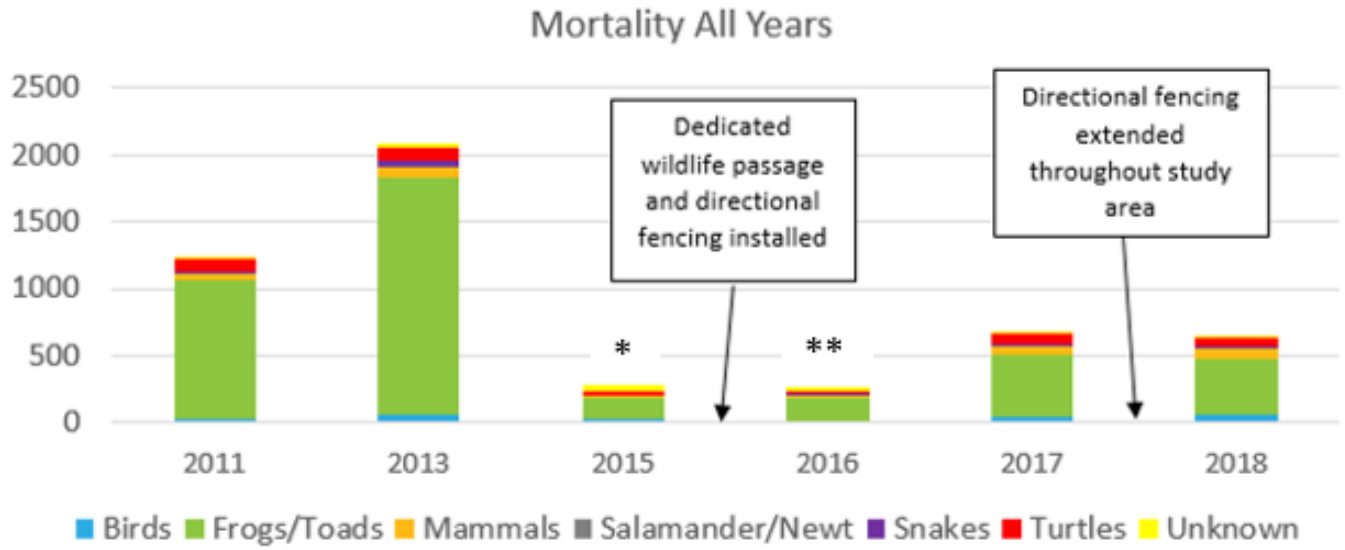


FIGURE 16. WILDLIFE-VEHICLE COLLISIONS ALONG HEART LAKE ROAD DURING ALL YEARS MONITORED.

* Monitoring was completed by staff only (not citizen scientists) in 2015 leading to fewer monitoring hours.
** The summer of 2016 experienced significant drought throughout southern Ontario and numerous wetlands in HL wetland complex became completely devoid of water.

The mitigation efforts, i.e. the fencing and culvert, are designed to restrict road access for herpetofauna including: turtles, amphibians and snakes. The temporary fencing was not designed to mitigate mammals or birds crossing the road.

2018 WVCs are shown in Figures 17-23 hotspots and are concentrated around Sandalwood East and West, and HLCA Southwest wetlands (Figure 17). All WVCs are presented below, regardless of if we expected a change post-mitigation.

**Birds**: birds were unaffected by the directional fencing. The location of the WVCs is reported in Figure 18.

**Amphibians**: Frogs and toads WVCs were spread out along the HLR (Figure 19). WVCs were significantly lower in the permanent fenced area. However, with regards to the temporary fencing, there was no significant difference between the different areas of complete, partial or no temporary fencing. We attribute this finding to the deficiencies in the temporary fencing, notably gaps between sections and the insufficient end-curls of each section.

**Mammals**: Mammal WVCs were concentrated in areas of partial or no fencing (Figure 20). Although not designed for mammals, it appears that WVCs were reduced in areas of complete temporary fencing. This is a welcome result that points to this type of herpetofauna fencing that can also help reduce mammal collisions. These results, combined with the numerous sightings of mammals using the dedicated passage, bode well for the fence/passage combination also helping solve mammal WVC.

**Snakes**: Snakes WVCs were not numerous but were concentrated at the end sections of the fencing (Figure 21), indicating that the fencing seems to mitigate the road mortality and that expanding the end-curls of the fences might prevent snake mortality by further reducing the access to the roads.

**Turtles**: Turtle WVCs were also concentrated at the end sections of the fencing (Figure 22) or in areas of partial or no fencing. These results suggest that permanent and complete temporary fencing were able to significantly reduce the access to the road and lower mortality. Consequently, extending the end-curls or ensuring a complete fence should help reducing future WVCs.

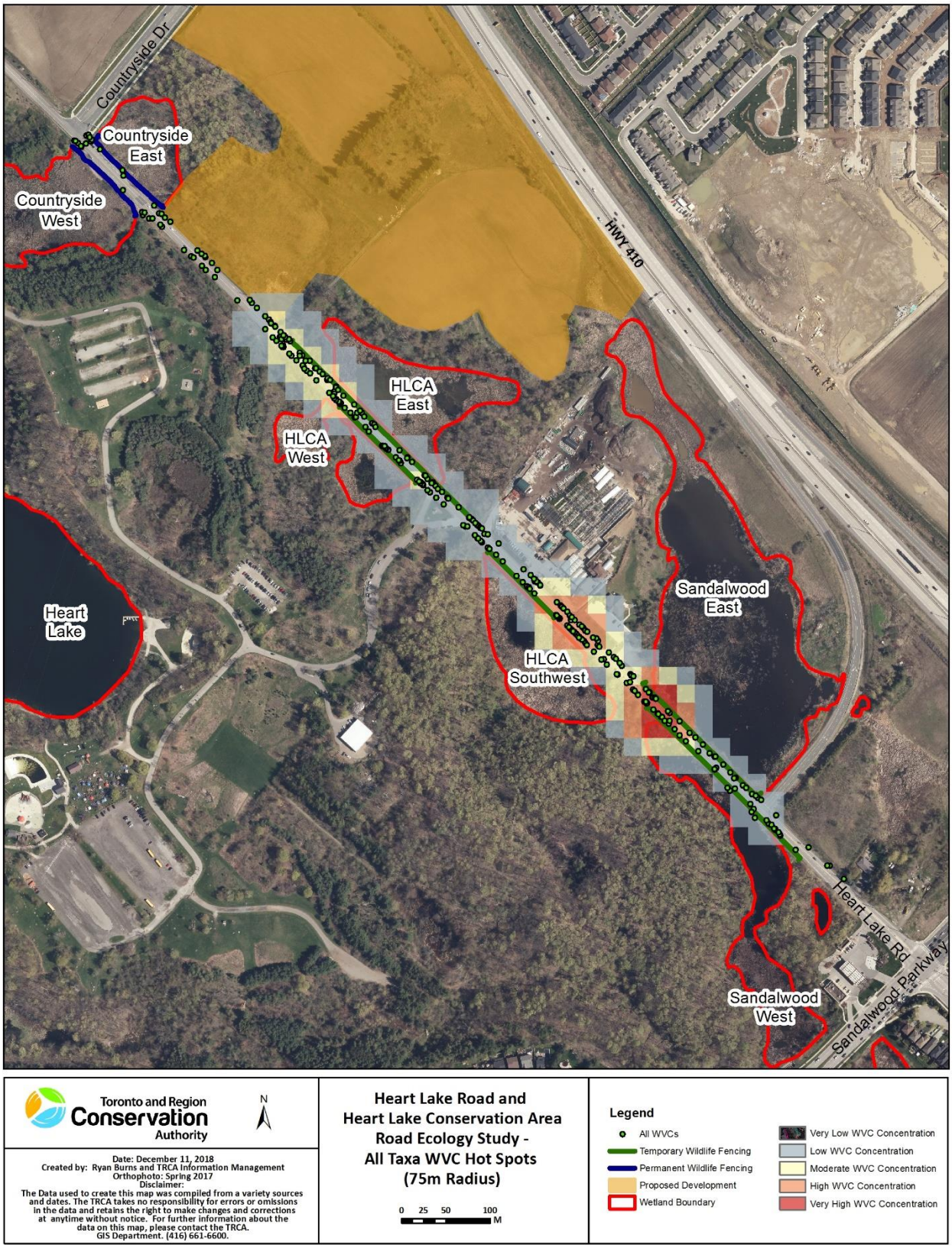


**FIGURE 17. HOT SPOT ANALYSIS OF ALL WILDLIFE-VEHICLE COLLISIONS ALONG HEART LAKE ROAD IN 2018.**

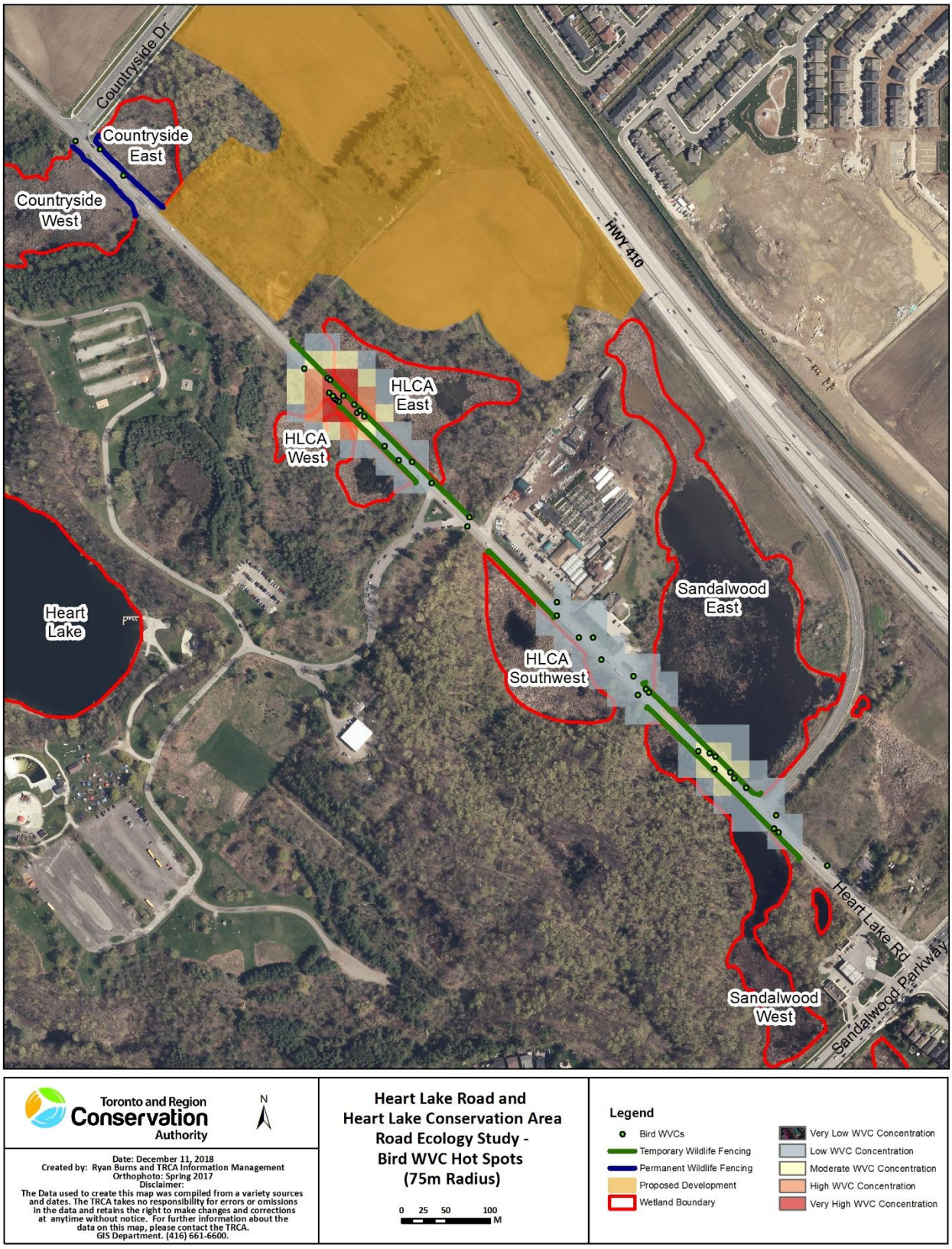


**FIGURE 18. HOT SPOT ANALYSIS OF BIRD WILDLIFE-VEHICLE COLLISIONS ALONG HEART LAKE ROAD IN 2018.**

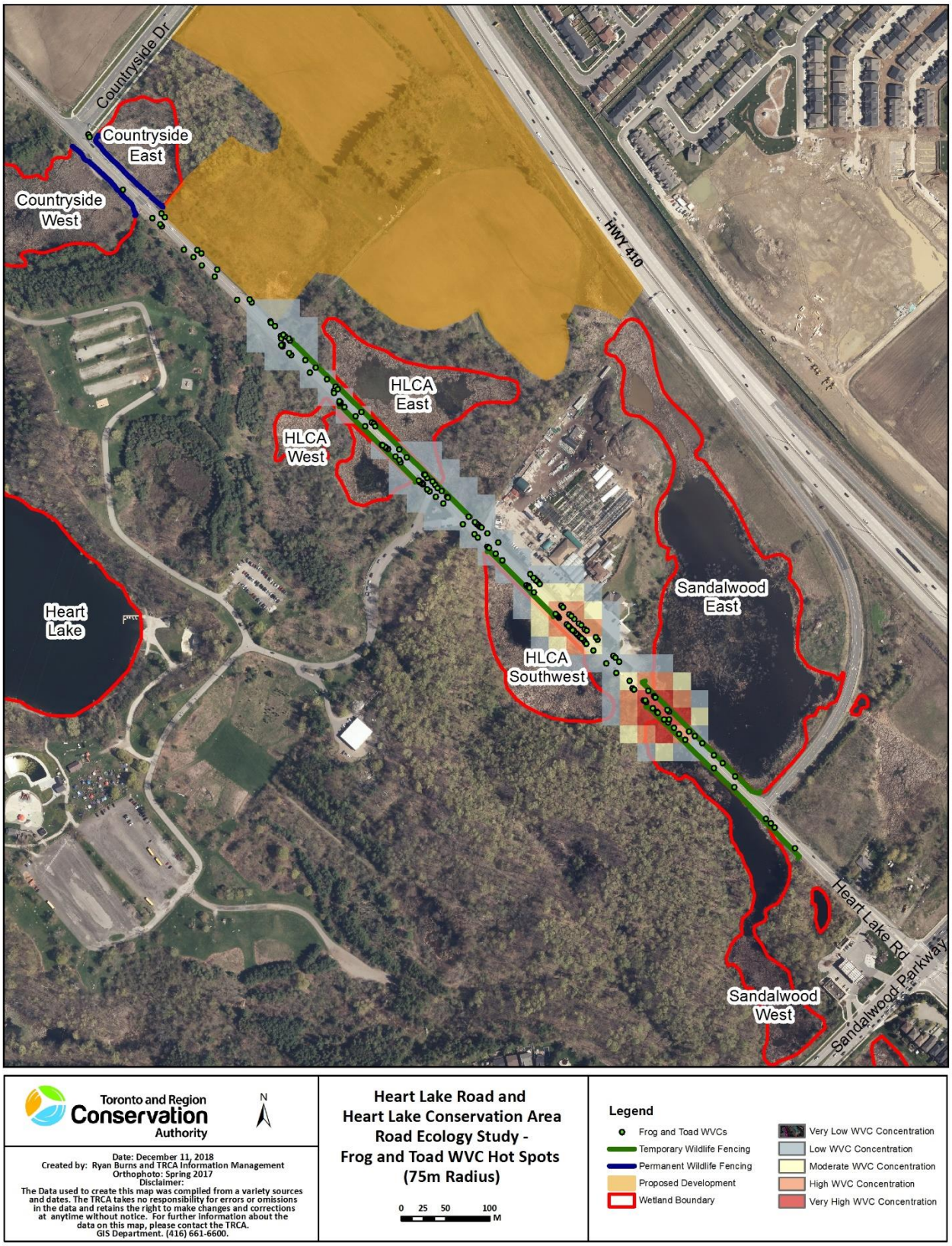


**FIGURE 19. HOT SPOT ANALYSIS OF FROG AND TOAD WILDLIFE-VEHICLE COLLISIONS ALONG HEART LAKE ROAD IN 2018.**

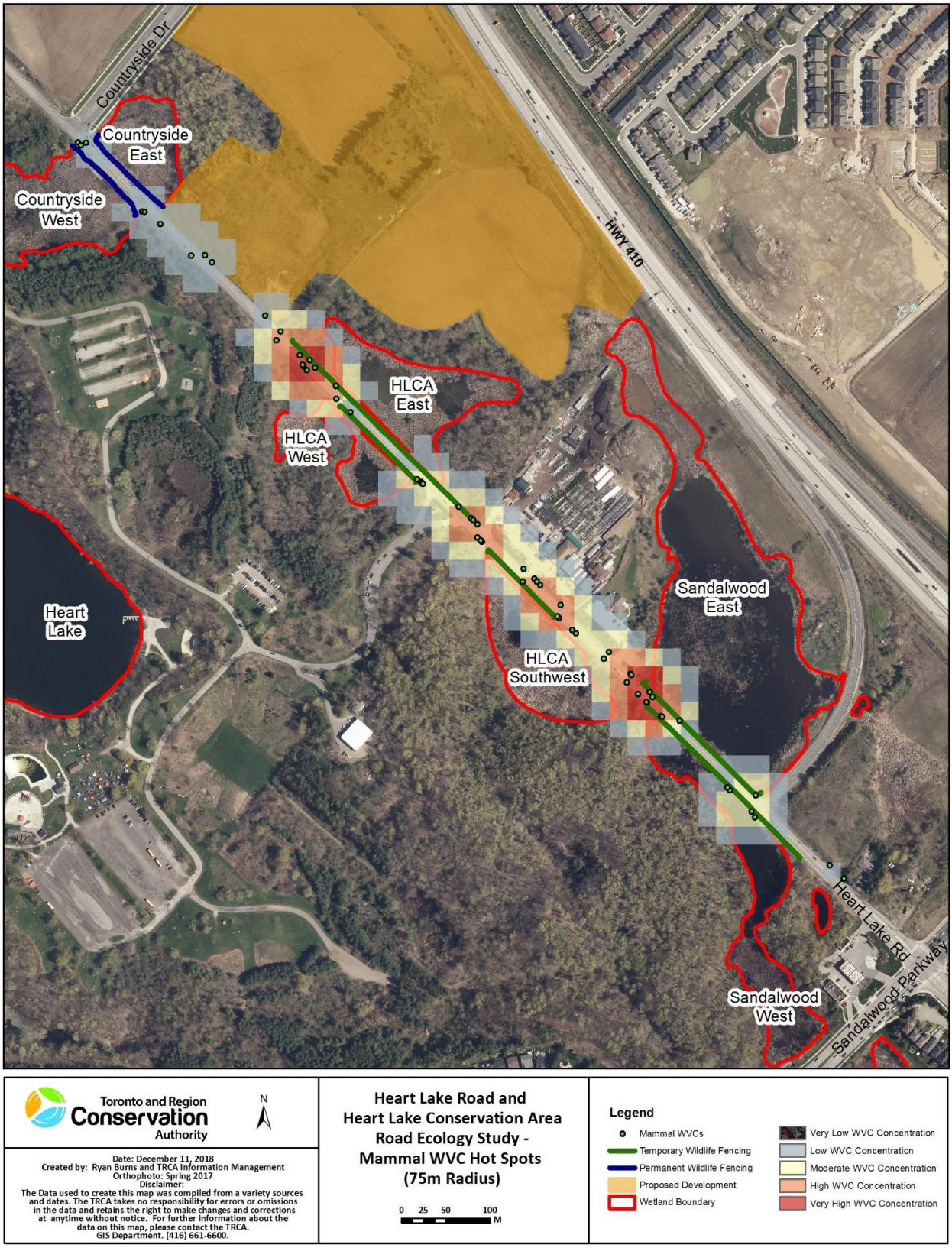


**FIGURE 20. HOT SPOT ANALYSIS OF MAMMAL WILDLIFE-VEHICLE COLLISIONS ALONG HEART LAKE ROAD IN 2018.**

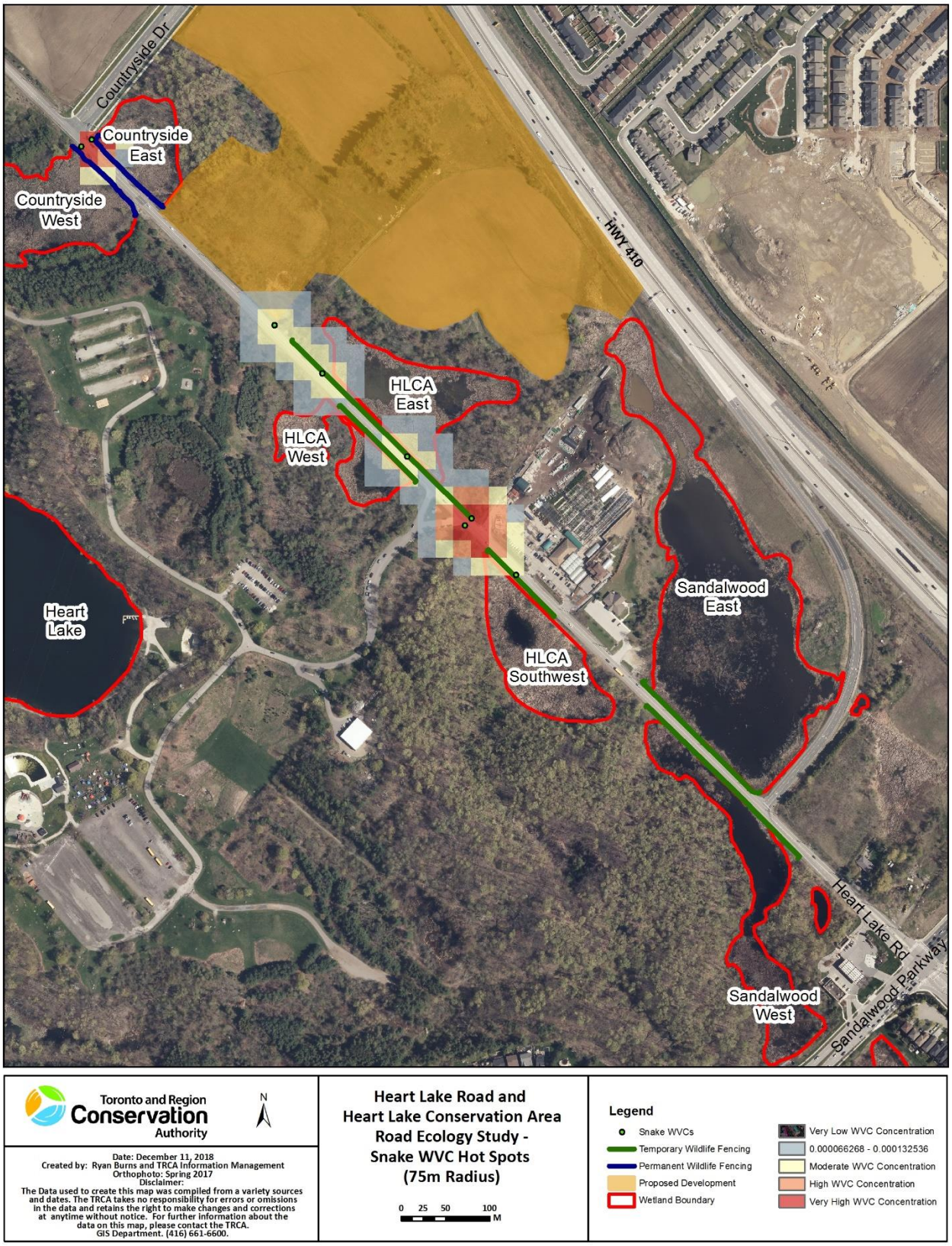


**FIGURE 21. HOT SPOT ANALYSIS OF SNAKE WILDLIFE-VEHICLE COLLISIONS ALONG HEART LAKE ROAD IN 2018.**

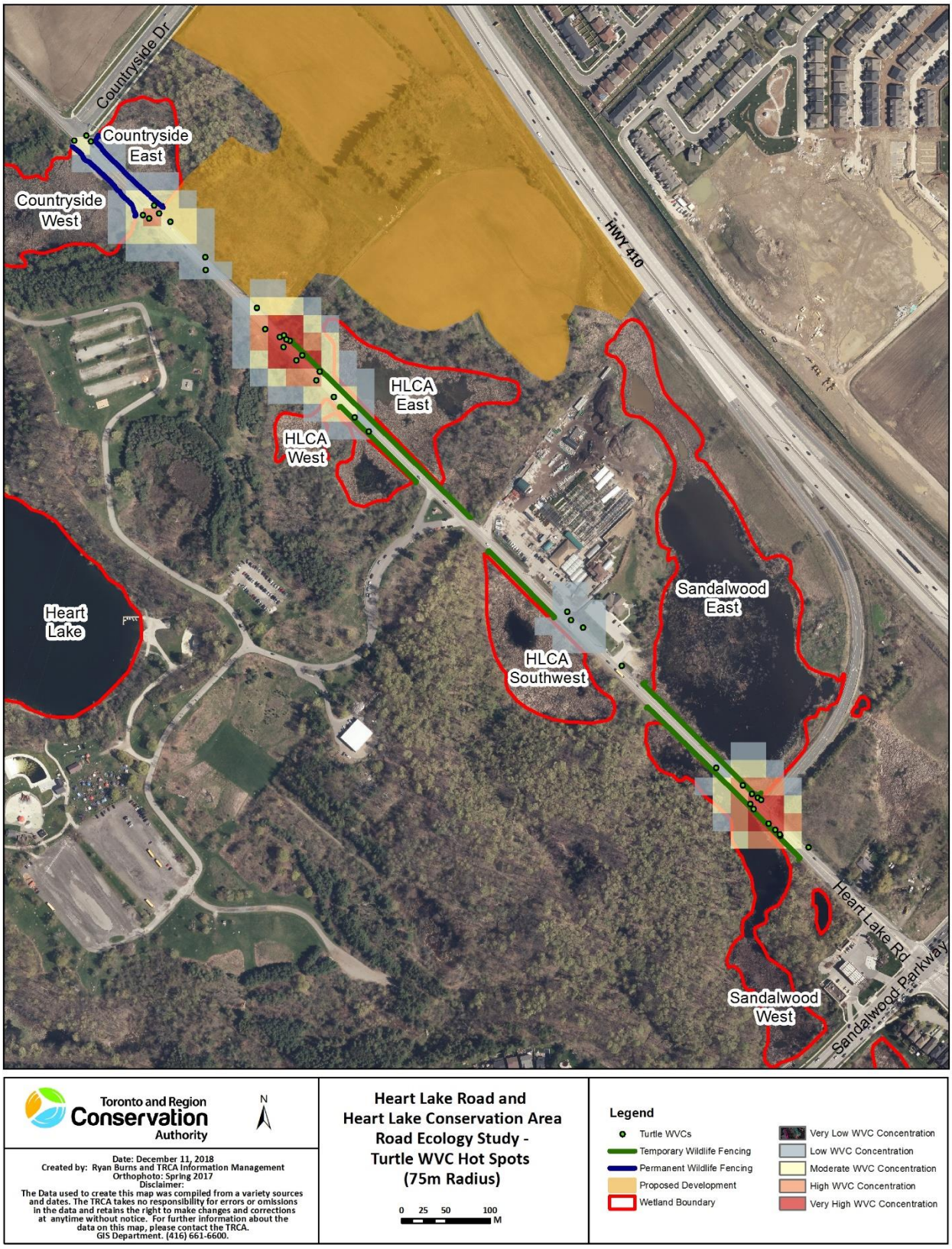


**FIGURE 22. HOT SPOT ANALYSIS OF TURTLE WILDLIFE-VEHICLE COLLISIONS ALONG HEART LAKE ROAD IN 2018.**

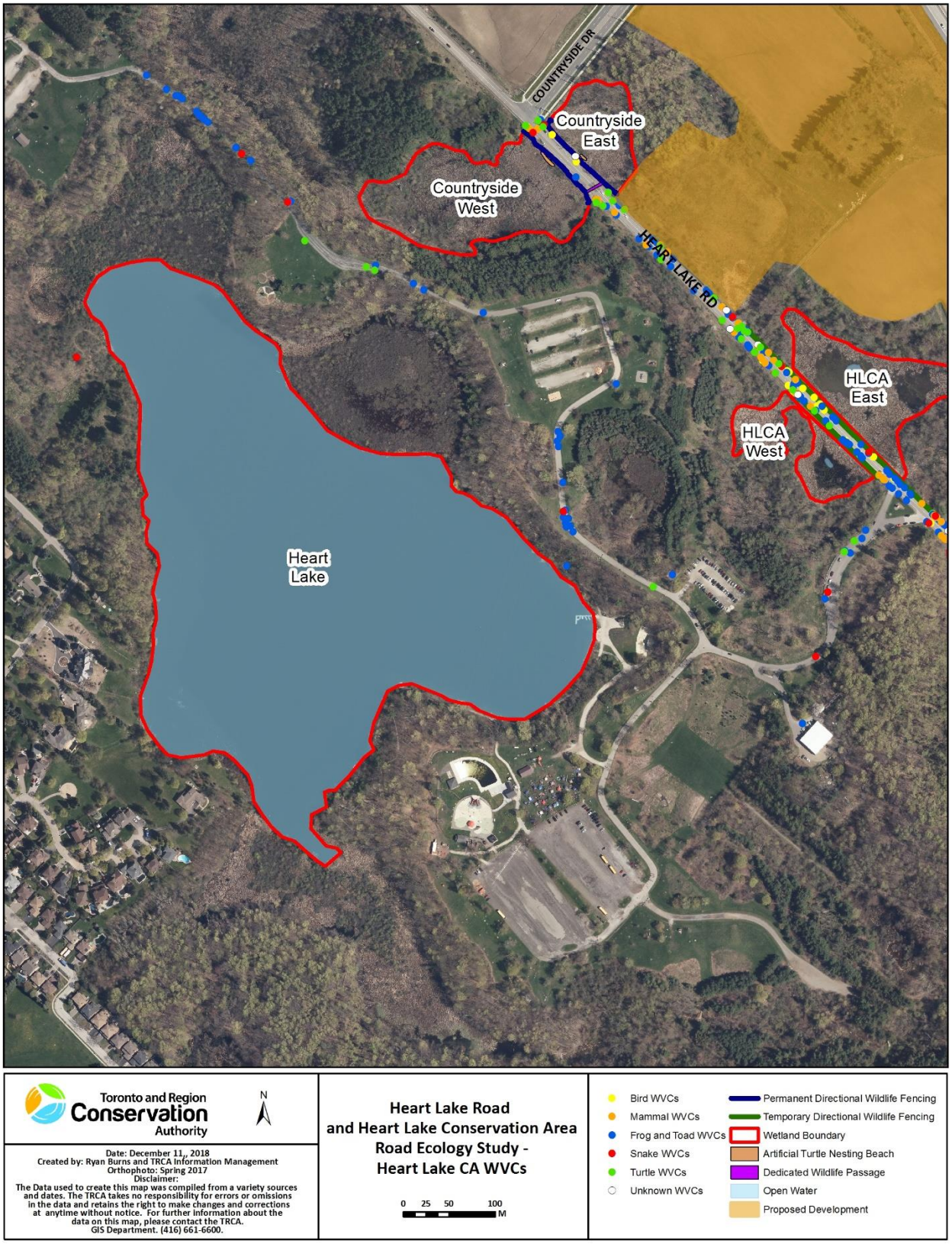


**FIGURE 23. WILDIFE-VEHICLE COLLISIONS WITHIN HEART LAKE CONSERVATION AREA.**

Staff evaluated fencing integrity at the end of the season and found 16 damaged panels (Figure 24), and 108 malfunctions including gaps or breaks found in the temporary fencing that would allow small wildlife to pass through. About 10 malfunctions were found in the permanent fencing. When analyzing distances of WVCs to fence malfunctions, it was found that 78.5% of WVCs occurred within 20 meters of a malfunction (Figure 25).

FIGURE 24. DAMAGE TO TEMPORARY FENCING AND PERMANENT FENCING ALONG HEART LAKE ROAD IN 2018.

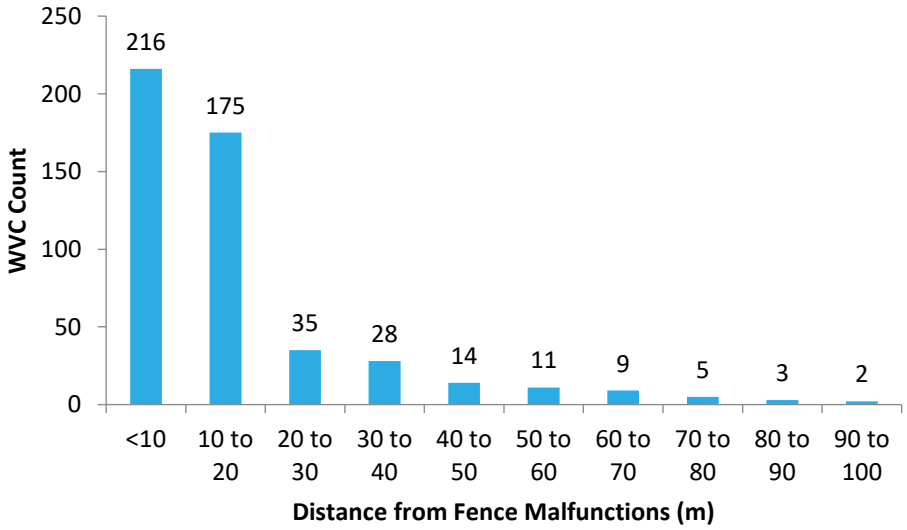


FIGURE 25. DISTANCE OF WILDLIFE-VEHICLE COLLISIONS FROM FENCE MALFUNCTIONS ALONG HEART LAKE ROAD.

The camera with the HALT laser trigger had more total wildlife detections and was able to detect more species compared to the motion-triggered PIR cameras (Table 8). PIR cameras were able to capture photographs of large mammals including skunks, raccoons and a vole. In contrast, the HALT system captured photographs of mammals in addition to small, cold blooded species including a juvenile snapping turtle, frogs and a milk snake (Figure 26). For a list of species detected by each camera refer to Appendix J.

Table 6. Number of species and number of detections by cameras in the dedicated wildlife passage.

| Camera Type | PIR Bushnell Low Glow | PIR Bushnell No Glow | PIR Bushnell Liveview HALT Laser Trigger |
|---|---|---|---|
| Camera Location in Dedicated Wildlife Passage | Eastside | Westside | Center |
| Total # of Species Detected | 10 | 10 | 18 |
| Total # of Detections | 607 | 794 | 2274 |

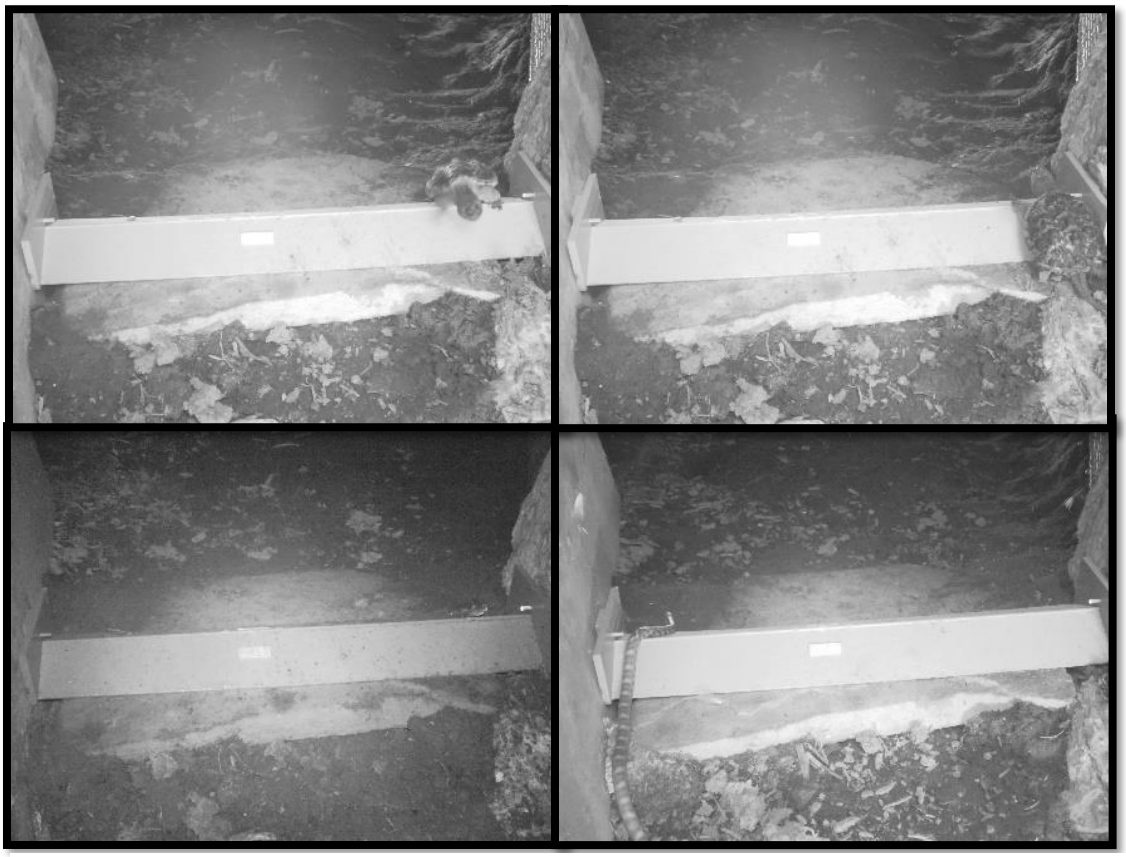

FIGURE 26. 2018 HOBBS ACTIVE LIGHT TRIGGER CAMERA SHOWS IMAGES OF A SNAPPING TURTLE HATCHLING (TOP LEFT AND RIGHT), A FROG (BOTTOM LEFT ) AND A MILK SNAKE (BOTTOM RIGHT).

## 3.3 Nesting

A total of 30 nests were observed along the shoulder of HLR with 28 nests on the wetland-side and two nests on the road-side of fencing (Table 9).

Citizen scientists found six turtle nests (Figure 27) at a nesting beach in the wetland west of the dedicated wildlife passage. All nests showed signs of predation and egg to hatchling survival cannot be confirmed. Another two nests were found near the nesting beach on the shoulder, but in the gravel shoulder on the wetland-side of the fence.

Raw nesting study data showing date and time of observations is available in Appendix K.

Table 7. Results of visual observation turtle nesting study on the wetland-side versus road-side of the fencing.

| Observation | Wetland-side | Road-side | Z-score | p-value |
|---|---|---|---|---|
| Snapping Turtles | 15 | 0 | 5.4772 | 0.00** |
| Painted Turtles | 0 | 2 | -2 | 0.0455 |
| Turtle Nests | 28 | 2 | 6.7132 | 0.00** |

****Significant**

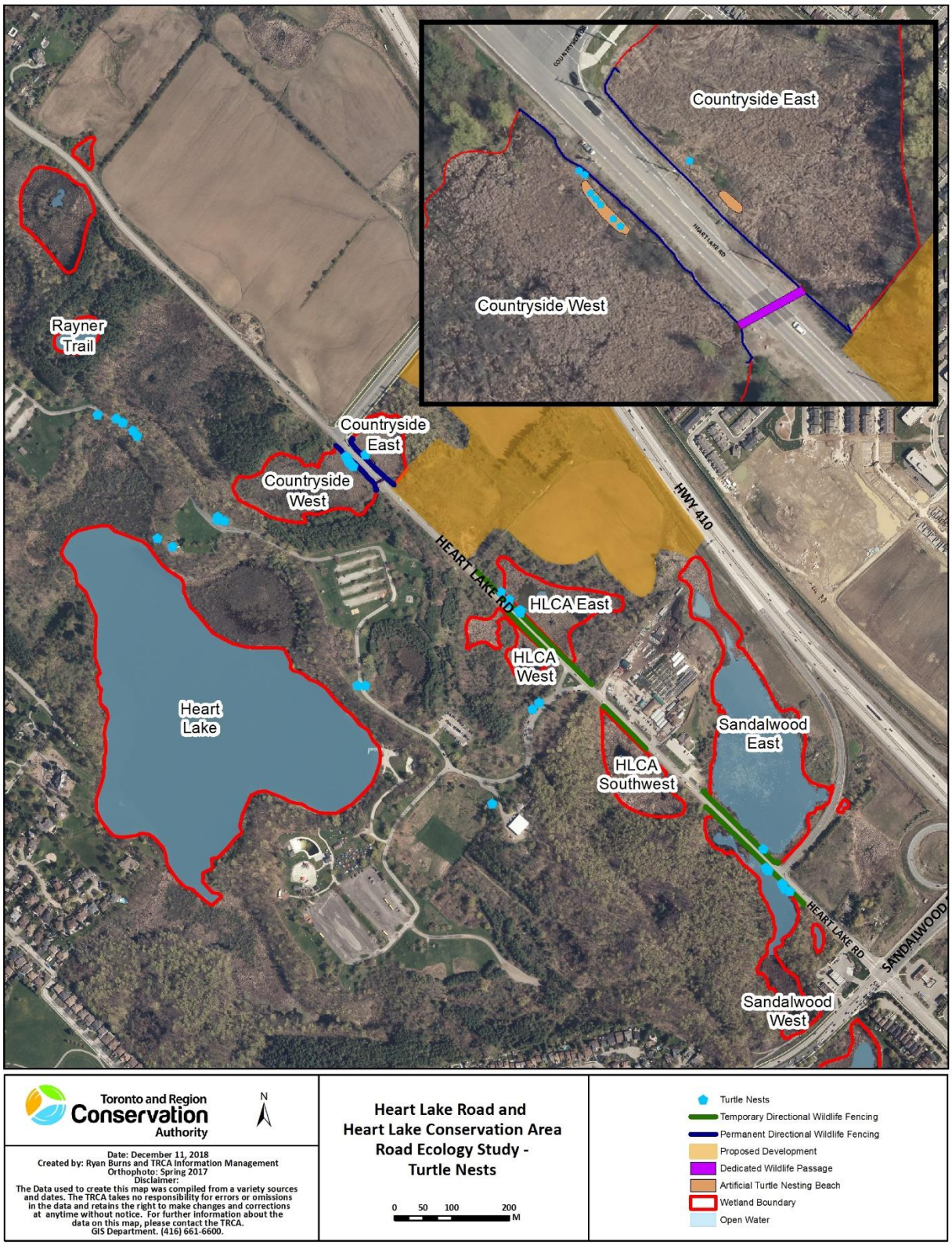


**FIGURE 8. LOCATIONS OF TURTLE NESTS ALONG HLR AND HLCA. THE CALLOUT BOX HIGHLIGHTS THE NESTS AROUND ON THE ARTIFICIAL TURTLE NESTING BEACH, 2018.**

# 4.0 Discussion

## 4.1 Turtle Population Study

Based on number of turtles captured, distribution among age and sex classes, and population estimates, the data suggests that snapping and midland painted turtle populations are robust. Subsequently, only a single map turtle was captured with another being observed, however due to the difficulty in trapping this species, the population is unknown. The presence of red-eared sliders should be of concern as studies have shown that red-eared sliders impact wetland function and compete with native species for food, habitat, basking sites and nesting sites (Lindsay et al. 2013 and Pearson et al 2015).

Species richness was highest in Heart Lake where all four species were captured, which is consistent with amount of habitat available, protection at HLCA being away from high speed roads and availability of presumably safer nesting sites. Juvenile snapping and midland painted turtles were captured in Heart Lake and Sandalwood East but not in Sandalwood West, Fenwick, Heartview, Crescent and Rayner suggesting these wetlands are fragmented, provide minimal resources or nesting habitat and may be subject to seasonal water level fluctuations. Snapping turtles were captured in every wetland suggesting these turtles are successfully moving over land to migrate to new habitat, find new resources and mate.

Notably, sex ratios of males to females were equal in the lake and all wetlands excluding Sandalwood wetlands which were skewed toward males. This suggests that females are being removed from the population in these wetlands possibly due to adult female nesting movements that require movement over HLR leading to differential female mortality (Dupuis-Désormeaux et al. 2017, Gibbs and Steen 2005, Steen et al 2006).

In order to reduce bias in population estimates when catchability is unequal, similar studies suggest using multiple sampling methods (or trap types) and dividing the population by sex for analysis. The population estimator used in this study assumes that there is equal catchability for all individuals in the population, however differential mortality, habitat use, sampling techniques and temperature-dependent sex determination may vary catchability (Koper and Brooks 1998 and Conner et al 2005). Although assumptions of the population estimator were probably violated in this study, controllable bias was minimized wherever possible and it is recommended that similar studies in the future reflect where bias may be present (Koper and Brooks 1998).

Adult density is not a reliable indicator of population size since demographic data for all sexes and age classes is necessary to identify the start of recruitment failure and detect population declines early (Tesche and Hodges 2015).

GPS tracking showed turtles did not move between wetlands suggesting that habitats are fragmented. It is also possible that Heart Lake may be a high quality habitat.

## 4.2 Road Ecology Monitoring

Results of HLREMP show an overall decline in the number of WVCs. Number of observations and metrics used to normalize data to accommodate monitoring effort per year, both show a decline however the decrease was not significant. One taxa that did show a statistically significant decrease between the pre- and post-mitigation time periods were birds. This is an interesting result since mitigation measures are not targeted towards birds. One possible explanation for this could be that fencing deterred waterfowl enough from using the road to move between wetlands. Another possibility is that since citizen scientists clear the road of road kill after each monitoring session, scavenger birds would start scavenging off-road instead of on-road.

From the hotspot analyses conducted, it is evident that concentrations of WVCs for all taxa, occur at ends of fences, or where there is only partial or no fencing. The only hotspot to occur within the completely fenced areas were frogs and toads, likely due to the fact that frogs and toads have the ability to jump over fencing. In addition, Sandalwood wetlands were the only ones with substantial depths of water in 2018. All other wetlands were either partially or completely devoid of water. Bird hotspots located at HLCA wetlands are a curiosity and were not expected. Despite the volume of WVCs seen on HLR, scavenger birds were not found in this particular hotspot.

Overall, date results show that fencing is most effective at significantly reducing the number of WVCs when installed on both sides of the road. Certain taxa such as birds, frogs and toads were not affected by the fence because they can either fly or hop over the fence. Generally, these WVCs were found throughout HLR. Meanwhile, turtle, snake and mammal WVCs were significantly lower within areas were fencing was consistent along the road compared to areas with either partial or no fencing.

Maintaining fence integrity is critical as any structural failure (i.e. holes, gaps, slack walls, overgrown vegetation, etc.), may compromise effectiveness of a mitigation strategy (Baxter-Gilbert et al. 2015). Some case studies have shown that a poorly maintained fence is comparable to no fencing (Markle et al. 2017 and Van der Ree et al. 2007). Given the large number of malfunctions, proper maintenance should be completed to ensure longevity and success of temporary fencing.

The laser-triggered HALT camera system proved to be more effective than motion-triggered PIR cameras in capturing movement of herpetofauna through the dedicated wildlife passage. The HALT camera system was able to detect more species, including cold-blooded species. This system also had more total wildlife detections. Although HALT camera systems outperforms PIR cameras, the number of herpetofauna using the passage is still lower than expected based on amount of WVCs seen on the road.

It is possible that due to significant use of the passage by predator species (i.e. raccoons), prey herpetofauna species may be actively avoiding the dedicated wildlife passage. According to Clevenger and Huijser (2011), small and medium sized mammals and reptiles tend to use passages of a size that allow for movement but may limit movement of larger predators. Clevenger and Huijser recommend meeting cover requirements of smaller fauna by placing cover objects of varying sizes that span the entire length within the passage. Wildlife underpasses targeted towards large mammals have used organic materials (i.e. bushes and other types of vegetation) for cover as well. If continued monitoring of the passage does not result in observations of herpetofauna usage, methods that provide more cover from predator species within the passage should be considered.

## 4.3 Nesting

Most nests were found on the wetland-side compared to the road-side suggesting that fencing is effective at preventing nesting females from accessing the road. However, predation is an important issue for nests found on either side of the fencing. Protecting identified nesting sites using wire-cages is a feasible method (Riley and Litzgus 2013) and practiced by TRCA staff and volunteers with varying degrees of success. Improvements in the design of current wire cages is required to decrease predator ability to circumnavigate materials to affix the cage in place. Sweeping the surface of nesting sites does not effectively hide evidence of their location, and thus does not reduce predation (Geller 2015). Female turtles emit a scent during egg laying which predators easily detect. When observing a new nesting area, a method to assist in removing this scent and deter predators, is to apply water to the nest area, effectively washing away the scent. This scent will dissipate after a short period of time or after a rainfall.

More nesting activity occurred on nesting beaches compared to 2017. This was expected because it often takes a few years for females to located newly installed nesting beaches (Paterson et al. 2013). Both snapping and painted turtles are known to have high nest fidelity, meaning they nest in the same area every year (Rowe et al. 2005). Gravid turtles may choose to nest on constructed mounds as long as they are located in close proximity to their usual nesting site (Buhlmann and Osborn 2011). Due to the amount of predation seen on nests located on nesting beaches, measures to mitigate predation are necessary for nesting beaches to become ideal nesting sites.

# 5.0 Conclusion

In conclusion, snapping and midland painted turtle populations in Heart Lake have substantial population sizes, a wide age class distribution and an even sex ratio similar to reference wetlands. Snapping and midland painted turtle populations in wetland fragments, vary in population size and have limited age class distribution. A male bias was present for midland painted turtles in the Sandalwood East and West wetlands fragmented by the road and is attributable to high adult female mortality on the roadway bisecting these wetlands.

In terms of decreasing WVC rates at HLR, monitoring and mitigation efforts have been successful. Wildlife directional fencing, when installed on both sides of the road, was most effective in mitigating WVCs for turtles, snakes and mammals but not for birds or toads and frogs. WVCs were concentrated near fence ends suggesting the need for longer curls. Proper installation and maintenance of fencing is critical to its effectiveness moving forward.

This year's nesting study has demonstrated the need for a renewed focus on improving population recruitment through nest and hatchling success. Since an increase in activity has been observed at artificial nesting beaches, objectives for 2019 will include a more comprehensive nest monitoring strategy. Citizen scientists will be trained to better detect the presence of nests and wire nest cages will be redesigned to protect nests from predation.

Collaboration with the City of Brampton and citizen scientists continues to positively impact wildlife health, increase awareness of at-risk populations and encourage eco-tourism in Heart Lake Conservation Area. Given growing urbanization in the area and results of traffic studies conducted in 2013, 2016 and 2018, traffic volume and speed of vehicles is expected to increase, adding pressure on resident wildlife populations.

Priorities going forward include additional dedicated wildlife passages and permanent directional fencing.

# 6.0 References

Baxter-Gilbert, J.H., Riley, J.L., Lesbarrères, D. and J.D. Litzgus. 2015. "Mitigating Reptile Road Mortality: Fence Failures Compromise Ecopassage Effectiveness". *PLoS ONE.* 10: e0120537.

Browne, C., and Hecnar, S. 2007. "Species loss and shifting population structure of freshwater turtles despite habitat protection." *Cons. Biol.* 138, p. 421-429.

Buhlmann, K.A. and C.P. Osborn. 2011. "Use of an artificial nesting mound by wood turtles (*Glyptemys insculpta*): a tool for turtle conservation". *Northeastern Naturalist*. 18: 315-334.

Clevenger, A.P. and M.P. Huijser. 2011. "Wildlife Crossing Structure Handbook: Design and Evaluation in North America". Publication Number FHWA-CFL/TD-11-003, US Department of Transportation, Lakewood, CO.

(COSEWIC) 2018. Committee on the Status of Endangered Species in Canada. "Species at Risk Public Registry". Government of Canada. Available from: http://www.registrelepsararegistry.gc.ca/sar/index/default_e.cfm

Dupuis-Désormeaux, M., D'Elia, V., Cook, C., Pearson, J., Adhikari, V. and S. MacDonald. 2017. "Remarkable male bias in a population of midland painted turtles (*Chrysemys picta marginata*) in Ontario, Canada". *Herp. Cons. Biol.* 12, p. 225-232.

Ernst, H., and Lovich, E. 2009. "Turtles of the United States and Canada (2nd Edition)". Baltimore: Hopkins Press.

Geller, G.A. 2015. "A Test of Substrate Sweeping as a Strategy to Reduce Raccoon Predation of Freshwater Turtle Nests, with Insights from Supplemental Artificial Nests". *Chelonian Cons. Biol.* 14: 64-72.

Gibbons, J.W. 1970. "Sex ratios in turtles". *Res. Popul. Ecol.* 12(2), p. 252-254

Gibbs, J. P., and Steen, D. A. (2005). "Trends in sex ratios of turtles in the United States: Implications of road mortality." *Cons. Biol,* 19(2), p. 552-556. doi: 10.1111/j.1523-1739.2005.000155.x

Hobbs, M.T., and Brehme, C.S. (2017). "An improved camera trap for amphibians, reptiles, small mammals, and large invertebrates". *PLoS One,* 12(10):e0185026.

Krebs, C. J. 1998. Ecological Methodology [Online]. Harper and Row, Publishers. New York. Available from: https://www.zoology.ubc.ca/~krebs/downloads/

Lindsay, M., Zhang, Y., Forstner, M., and Hahn, D. 2013. "Effects of the freshwater turtle (*Trachemys scripta elegans*) on ecosystem functioning: an approach in experimental ponds." *Amph. Rep*. 34, p. 75-84.

Markle, C.E., Gillingwater, S.D., Levick, R., Chow-Fraiser, P. 2017. "The true cost of partial fencing: evaluating strategies to reduce reptile road mortality". *Wild. Soc. Bull.* 41, p. 342-350.

Obbard, M.E. and R.J. Brooks. 1980. "Nesting migrations of the snapping turtle (Chelydra-serpentina)". *Herpetologica* 36: 158-162.

Paterson, J.E., Steinberg, B.D. and J.D. Litzgus. 2013. "Not just any old pile of dirt: evaluating the use of artificial nesting mounds as conservation tools for freshwater turtles. *Oryx.* 47: 607-615.

Pearson, S., Avery, H., and Spotila, J. 2015. "Juvenile invasive red-eared slider turtles negatively impact the growth of native turtles: Implications for global freshwater turtle populations." *Biol. Cons.* 186, p. 115-121.

Riley, J.L. and J.D. Litzgus. 2013. "Evaluation of predator-exclusion cages used in turtle conservation: cost analysis and effects on nest environment and proxies of hatchling fitness". *Wildlife Research.* 40: 499-511.

Rowe, J.W., Coval, K.A. and M.R. Dugan. 2005. "Nest placement, nest-site fidelity and nesting movements in midland painted turtles (*Chrysemys picta marginata*) on Beaver Island, Michigan". *Am. Midl. Nat.* 154, p. 383-397.

Steen, D.A., Aresco, M.J., Beilke, S.G., Compton, B.W., Condon, E.P., Dodd, C.K., Forrester, H., Gibbons, J.W., Greene, J.L., Johnson, G., Langen, T.A., Oldham, M.J., Oxier, D.N., Saumure, R.A., Schueler, F.W., Sleenman, J.M., Smith, L.L., Tucker, J.K. and J.P. Gibbs. 2006. "Relative vulnerability of female turtles to road mortality". *Anim. Cons.* 9, p. 269-273.

Steen, D.A., and Gibbs, J.P. 2004. "Effects of roads on the structure of freshwater turtle populations". *Cons. Biol.* 18(4), p. 1143-1148.

Tesche, M., and Hodges, K. 2015. "Unreliable population inferences from common trapping practices for freshwater turtles." *Glob. Ecol. Cons.* 3, p. 802-813.

Van der Ree, R., N. Gulle, K. Holland, E. van der Grift, C. Mata, and F. Suarez. 2007. "Overcoming the barrier effect of roads—how effective are mitigation strategies? An international review of the use and effectiveness of underpasses and overpasses designed to increase the permeability of roads for wildlife". Pages 423–432 in C. L. Nelson and K. P. McDermott, editors. Proceedings of the 2007 International Conference on Ecology and Transportation. Center for Transportation and the Environment, North Carolina State University, Raleigh, USA.

# 7.0 Appendices

## Appendix A – TPS Site Descriptions

**Sandalwood East (3.83 ha, 10% trapped)**

Trapping at Sandalwood East commenced on May 28, 2018 and ended on June 8, 2018 for a total 10-day period (8 trapping days and 2 set-up days) utilizing 30 hoop nets. On May 30, 2018 one trap went missing and was assumed to have collapsed due to severe weather conditions overnight bringing the total down to 29 hoop nets. Nets were placed on top of T-bars to stop trapping on the weekend and re-opened on June 4, 2018. The wetland borders Heart Lake Rd. and a Hwy 410 off-ramp on the south and west borders and is approximately 5 meters from the road. Also bordering the wetland is a church, daycare and garden center. Throughout the wetland there are remnants of a hardwood swamp with many partially or fully submerged logs. There is an abundance of vegetation mostly cattails throughout the wetland.

| Common Name | Scientific Name |
|---|---|
| Cattail | *Typha latifolia* |
| Willow sp. | *Salix sp.* |
| Lesser duckweed | *Lemna minor* |
| Star duckweed | *Lemna trisulca* |
| Tape grass | *Vallisneria Americana* |
| Northern water milfoil | *Myriophyllum sibiricum* |

**Sandalwood West (1.61ha, 45% trapped)**

Trapping at Sandalwood West commenced on June 18, 2018 and ended on June 22, 2018 for a total 5-day period (4 trapping days and 1 set-up day) utilizing 16 hoop nets. Of the 16 nets used, 4 were placed in the small wetland and 12 in the larger wetland. After day two of trapping the 4 nets were moved from the smaller wetland to the larger wetland because nothing was captured. Of the 1.61 ha area 24.7% of the wetland was trapped on the East and south sides. Sandalwood West borders an Esso gas station and car wash on the south side. Approximately 5 meters from HLR. Heart Lake Road bisects Sandalwood East and West resulting in hotspots of road mortality in this area.

| Common Name | Scientific Name |
|---|---|
| Cattail | *Typha latifolia* |
| Crispy pondweed | *Potamogeton crispus* |
| Lesser duckweed | *Lemna minor* |
| Tape grass | *Vallisneria Americana* |
| Eurasian water milfoil | *Myriophyllum spicatum* |


HLCA East
HLCA West
HLCA Southwest
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Toronto and Region Conservation Authority
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Created by: Ryan Burns and TRCA Information Management
Orthophoto: Spring 2017
Disclaimer:
The Data used to create this map was compiled from a variety sources and dates. The TRCA takes no responsibility for errors or omissions in the data and retains the right to make changes and corrections at anytime without notice. For further information about the data on this map, please contact the TRCA.
GIS Department. (416) 661-6600.
Heart Lake Road
Provincially Significant Wetlands
and Heart Lake Conservation Area
Turtle Population Study -
Sandalwood East and West
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Trap Locations
Temporary Directional Wildlife Fencing
Wetland Boundary
Open Water
Proposed Development
Study Area
Wetlands not Surveyed in 2018

**Heart Lake (17.37ha, 60% trapped)**

Trapping at Heart Lake north commenced on June 11, 2018 and ended on July 24, 2018 for a total 4-week period (7 trapping days and 4 set-up days) utilizing 29 hoop nets. On June 12, 2018 an unexpectedly large number of turtles were captured (68) and 2 traps were removed from the wetland bringing the total down to 27 hoop nets. Educational events held in July required addition trapping days with fewer nets at this location.

| Common Name | Scientific Name |
|---|---|
| Cattail | *Typha latifolia* |
| Coontail | *Ceratophyllum demersum* |
| Lesser duckweed | *Lemna minor* |
| Tape grass | *Vallisneria Americana* |
| Eurasian water milfoil | *Myriophyllum spicatum* |
| White pond lily | *Nymphaea odorata* |
| Yellow pond lily | *Nuphar lutea* |
| Floating arrowhead | *Sagittaria cuneata* |

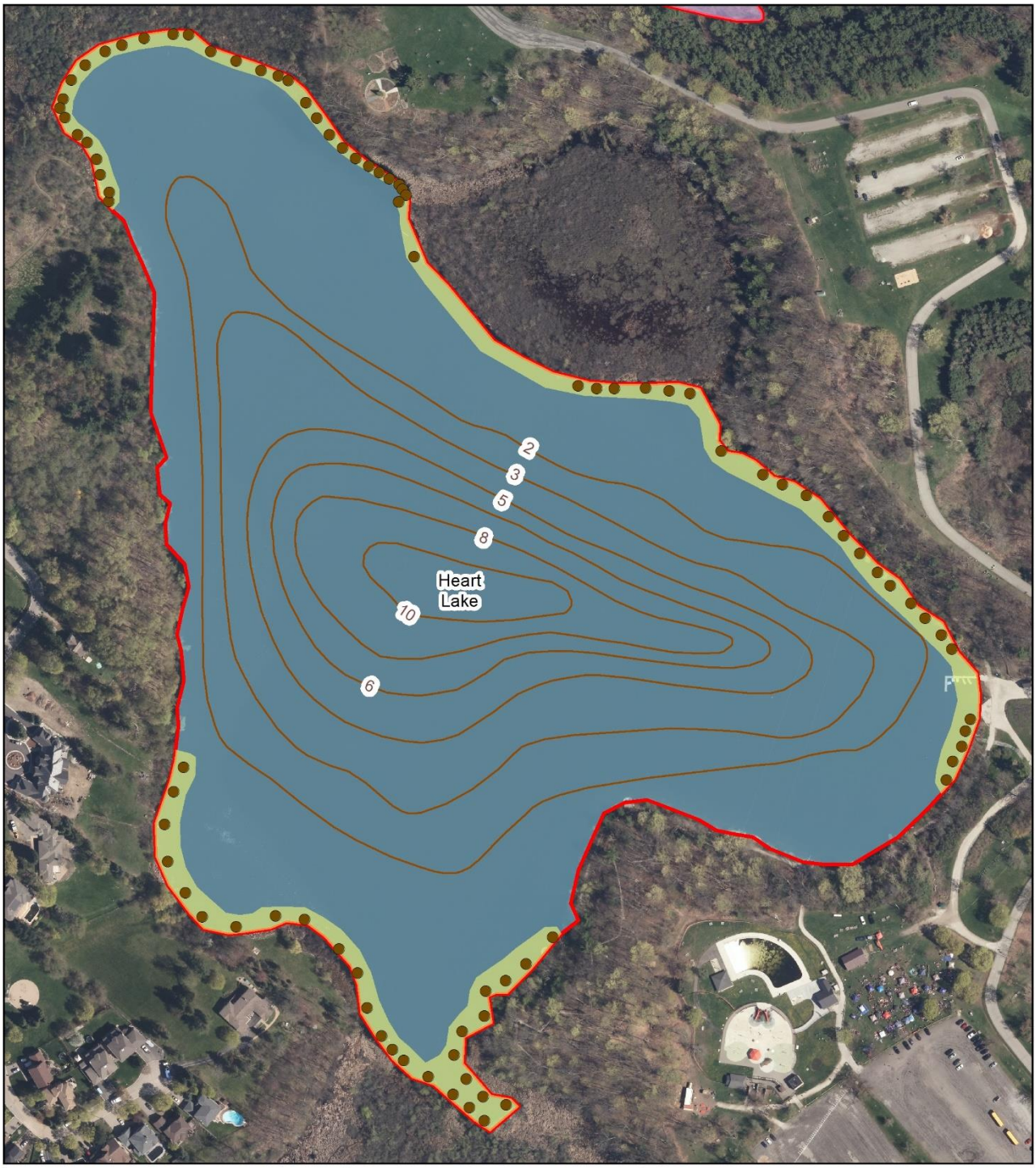
Trapping at Heart Lake south commenced on June 25, 2018 and ended on June 28, 2018 for a total 5-day period (4 trapping days and 1 set-up day) utilizing 29 hoop nets. On June 26, 2018 an unexpectedly large number of turtles were captured and 3 traps were removed from the wetland bringing the total down to 26 hoop nets.

| Common Name | Scientific Name |
|---|---|
| Cattail | *Typha latifolia* |
| Lesser duckweed | *Lemna minor* |
| Tape grass | *Vallisneria Americana* |
| Eurasian water milfoil | *Myriophyllum spicatum* |
| White pond lily | *Nymphaea odorata* |
| Yellow pond lily | *Nuphar lutea* |

Trapping at Heart Lake East commenced on July 3, 2018 and ended on July 6, 2018 for a total 5-day period (4 trapping days and 1 set-up day) utilizing 29 hoop nets. On July 4, 2018 7 traps were removed from the wetland bringing the total down to 22 hoop nets.

| Common Name | Scientific Name |
|---|---|
| Cattail | *Typha latifolia* |
| Coontail | *Ceratophyllum demersum* |
| Crispy pondweed | *Potamogeton crispus* |
| Lesser duckweed | *Lemna minor* |
| Tape grass | *Vallisneria Americana* |
| Eurasian water milfoil | *Myriophyllum spicatum* |
| White pond lily | *Nymphaea odorata* |
| Yellow pond lily | *Nuphar lutea* |
| Sedge sp. | *Cyperaceae* |
| Floating arrowhead | *Sagittaria cuneata* |
| Willow sp. (East) | *Salix sp.* |

The west side of Heart Lake was not accessible due to depth limitations for trapping. The lake is less than 100 meters from the road inside the conservation area (with a speed limit of 30km/hr) and approximately 250 meters from HLR. This kettle lake was formed by retreating glaciers and has a shallow shoreline with several drop-off areas. Features of the lake include multi-use trails, lookout, docks, fishing areas and a ropes course.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Orthophoto: Spring 2017
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GIS Department. (416) 661-6600.
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Provincially Significant Wetlands
and Heart Lake Conservation Area
Turtle Population Study -
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Trap Locations
Bathymetry (m)
Wetland Boundary
Open Water
Study Area
Wetlands not Surveyed in 2018

**Rayner Trail Wetland (0.36ha, 50% trapped)**

Trapping at Rayner Trail wetland commenced on July 22, 2018 and ended on July 25, 2018 for a total 4-day period (3 trapping days and 1 set-up day) utilizing 7 traps. The area surrounding the wetland is heavily wooded and approximately 100 meters from Heart Lake Rd. Within the wetland there are submerged and fallen trees, lily pads, button bush, duckweed.

| Common Name | Scientific Name |
|---|---|
| Buttonbush | *Cephalanthus occidentalis* |
| Red-osier dogwood | *Cornus sericea* |
| Slender pondweed | *Potamogeton pusillus* |
| Cattail | *Typha latifolia* |
| Lesser duckweed | *Lemna minor* |
| Yellow pond lily | *Nuphar lutea* |


HEART LAKE RD
Rayner Trail
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Date: December 11, 2018
Created by: Ryan Burns and TRCA Information Management
Orthophoto: Spring 2017
Disclaimer:
The Data used to create this map was compiled from a variety sources and dates. The TRCA takes no responsibility for errors or omissions in the data and retains the right to make changes and corrections at anytime without notice. For further information about the data on this map, please contact the TRCA.
GIS Department. (416) 661-6600.
Heart Lake Road
Provincially Significant Wetlands and Heart Lake Conservation Area
Turtle Population Study -
Rayner Trail Wetland
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Trap Locations
Wetland Boundary
Open Water
Study Area
Wetlands not Surveyed in 2018

**South of Sandalwood Parkway**

**Fenwick Park (2.12ha, 100% trapped)**

Trapping at Fenwick commenced on July 9, 2018 and ended on July 11, 2018 for a total 3-day period (2 trapping days and 1-set-up day) utilizing 2 traps. Due to the small amount of water within the wetland, we believe 2 traps were effective in sampling the population at this site. Traps were removed after the third day when nothing was captured since the first day. Fenwick is approximately 10 meters from Heart Lake Road and is considered a wetland fragment within a housing subdivision. It is worthy to note that water levels had visibly receded.

| Common Name | Scientific Name |
|---|---|
| Cattail | *Typha latifolia* |
| Reed canary grass | *Phalaris arundinaca* |
| Flowering rush | *Butomus umbellatus* |
| Lesser duckweed | *Lemna minor* |

**Heartview Road Wetland (1.48ha, 50% trapped)**

Trapping at Heartview commenced on July 9, 2018 and ended on July 13, 2018 for a 5-day period (4 trapping days and 1 set-up day) utilizing 5 traps. Heartview is approximately 10 meters from Heart Lake Road and is considered a wetland fragment within a housing subdivisions. It is worthy to note that water levels had visibly receded.

| Common Name | Scientific Name |
|---|---|
| Cattail | *Typha latifolia* |
| Lesser duckweed | *Lemna minor* |
| Flowering rush | *Butomus umbellatus* |
| Tape grass | *Vallisneria Americana* |


Fenwick Park
Heartview Road
HEART LAKE RD
Toronto and Region Conservation Authority
N
Date: December 11, 2018
Created by: Ryan Burns and TRCA Information Management
Orthophoto: Spring 2017
Disclaimer:
The Data used to create this map was compiled from a variety sources and dates. The TRCA takes no responsibility for errors or omissions in the data and retains the right to make changes and corrections at anytime without notice. For further information about the data on this map, please contact the TRCA.
GIS Department. (416) 661-6600.
Heart Lake Road
Provincially Significant Wetlands and Heart Lake Conservation Area
Turtle Population Study -
Fenwick Park and Heartview Road
0 25 50 100
M
Trap Locations
Wetland Boundary
Open Water
Study Area

**Presentation Centre Wetland (1.58ha, 20% trapped)**

Trapping at the Presentation Center commenced on July 11, 2018 and ended on July 19, 2018 for a total 7-day period (5 trapping days and 2 set-up days) utilizing 7 traps. On July 16, 2018 traps from Heartview were moved to the Presentation Center resulting in a total of 12 traps. The wetland borders a field with meadow species.

| Common Name | Scientific Name |
|---|---|
| Cattail | *Typha latifolia* |
| Lesser duckweed | *Lemna minor* |
| Tape grass | *Vallisneria Americana* |
| Large-leaved pondweed | *Potamogeton natans* |
| Willow sp. | *Salix sp.* |

**Crescent Moon Wetland (1.09ha, 100%)**

Trapping at Crescent Moon wetland commenced on July 16, 2018 and ended on July 19, 2018 for a total 5-day period (4 trapping days and 1 set-up day) utilizing 5 traps. The presentation center and crescent moon wetlands are divided to the north/east by a utility road closed to the public however it is worthy to note it is being used as a dumping site. The Presentation Center is approximately 50 meters and Crescent Moon Wetland is approximately 100 meters from HLR.

| Common Name | Scientific Name |
|---|---|
| Cattail | *Typha latifolia* |
| Lesser duckweed | *Lemna minor* |
| Tape grass | *Vallisneria Americana* |


Crescent Moon
Presentation Centre
HEART LAKE RD
Toronto and Region Conservation Authority
N
Date: December 11, 2018
Created by: Ryan Burns and TRCA Information Management
Orthophoto: Spring 2017
Disclaimer:
The Data used to create this map was compiled from a variety sources and dates. The TRCA takes no responsibility for errors or omissions in the data and retains the right to make changes and corrections at anytime without notice. For further information about the data on this map, please contact the TRCA.
GIS Department. (416) 661-6600.
Heart Lake Road
Provincially Significant Wetlands and Heart Lake Conservation Area
Turtle Population Study -
Crescent Moon and
Presentation Centre
0 12.5 25 50
M
Trap Locations
Wetland Boundary
Open Water
Study Area

## Appendix B – TPS Trap Signs

The following trap signs were laminated and attached to each trap.

**PLEASE DO NOT TAMPER WITH THIS LIVE TRAP**
Tampering with this live trap is a Provincial offence
(Chapter 41, para. 13.1 of Fish and Wildlife Conservation Act, 1997).
This trap is being monitored on a regular basis and the trapping is carried out under a live trapping permit (Ministry of Natural Resources- Wildlife Scientific Collector's Authorization #18-322).
Should you wish to receive information about the project, its objectives and methods, please contact:

Mr. Vince D'Elia at the Toronto Regional Conservation Authority,
(416) 661-6600 x5667

# Appendix C – TPS Trapping Schedule

| Date (DDMMYY) | Sandalwood East | Heart Lake North | Sandalwood West | Heart Lake South | Heart Lake East | Fenwick Park | Heartview Road | Presentation Centre | Crescent Moon | Rayner Trail Wetland |
|---|---|---|---|---|---|---|---|---|---|---|
| 28-May-18 | | | | | | | | | | |
| 29-May-18 | 30 | | | | | | | | | |
| 30-May-18 | 29 | | | | | | | | | |
| 31-May-18 | 29 | | | | | | | | | |
| 1-Jun-18 | 29 | | | | | | | | | |
| 4-Jun-18 | | | | | | | | | | |
| 5-Jun-18 | 29 | | | | | | | | | |
| 6-Jun-18 | 29 | | | | | | | | | |
| 7-Jun-18 | 29 | | | | | | | | | |
| 8-Jun-18 | 29 | | | | | | | | | |
| 11-Jun-18 | | | | | | | | | | |
| 12-Jun-18 | | 29 | | | | | | | | |
| 13-Jun-18 | | 27 | | | | | | | | |
| 14-Jun-18 | | 27 | | | | | | | | |
| 18-Jun-18 | | | | | | | | | | |
| 19-Jun-18 | | | 16 | | | | | | | |
| 20-Jun-18 | | | 16 | | | | | | | |
| 21-Jun-18 | | | 16 | | | | | | | |
| 22-Jun-18 | | | 16 | | | | | | | |
| 25-Jun-18 | | | | | | | | | | |
| 26-Jun-18 | | | | 29 | | | | | | |
| 27-Jun-18 | | | | 26 | | | | | | |
| 28-Jun-18 | | | | 26 | | | | | | |
| 3-Jul-18 | | | | | | | | | | |
| 4-Jul-18 | | | | | 29 | | | | | |
| 5-Jul-18 | | | | | 22 | | | | | |
| 6-Jul-18 | | | | | 22 | | | | | |
| 9-Jul-18 | | | | | | | | | | |
| 10-Jul-18 | | | | | | 2 | 5 | | | |
| 11-Jul-18 | | 2 | | | | 2 | 5 | | | |
| 12-Jul-18 | | | | | | | 5 | 7 | | |
| 13-Jul-18 | | | | | | | 5 | 7 | | |
| 16-Jul-18 | | | | | | | | | | |
| 17-Jul-18 | | 4 | | | | | | 12 | 5 | |
| 18-Jul-18 | | | | | | | | 12 | 5 | |
| 19-Jul-18 | | | | | | | | 12 | 5 | |
| 22-Jul-18 | | | | | | | | | | |
| 23-Jul-18 | | 10 | | | | | | | | 7 |
| 24-Jul-18 | | 10 | | | | | | | | 7 |
| 25-Jul-18 | | | | | | | | | | 7 |

Setup only  Check Traps

## Appendix D – TPS Incidental Wildlife Observations

**Heart Lake (North)**

| Common Name | Scientific Name |
|---|---|
| Green frog | *Rana clamitans* |
| Koi | *Cyprinus carpio* |
| Canada goose | *Branta canadensis* |
| Red-winged blackbird | *Agelaius phoeniceus* |
| Great blue heron | *Ardea herodias* |
| Yellow warbler | *Setophaga petechia* |
| Midland painted turtle | *Chrysemys picta* |
| Dragonfly sp. | *Anisoptera sp.* |

**Heart Lake (South)**

| Common Name | Scientific Name |
|---|---|
| Green frog | *Rana clamitans* |
| Canada goose | *Branta canadensis* |
| Red-winged blackbird | *Agelaius phoeniceus* |
| Great blue heron | *Ardea herodias* |
| Midland painted turtle | *Chrysemys picta* |
| Northern map turtle | *Graptemys geographica* |
| Easter grey squirrel | *Sciurus carolinensis* |
| Eastern chipmunk | *Tamias striatus* |
| Dragonfly sp. | *Anisoptera sp.* |

**Heart Lake (East)**

| Common Name | Scientific Name |
|---|---|
| Green frog | *Rana clamitans* |
| Northern leopard frog | *Lithobates pipiens* |
| Canada goose | *Branta canadensis* |
| Red-winged blackbird | *Agelaius phoeniceus* |
| Great blue heron | *Ardea herodias* |
| Canada goose | *Branta canadensis* |
| Midland painted turtle | *Chrysemys picta* |
| Dragonfly sp. | *Anisoptera sp.* |

**Sandalwood East**

| Common Name | Scientific Name |
|---|---|
| Red-winged blackbird | *Agelaius phoeniceus* |
| Canada goose | *Branta canadensis* |
| Red-necked grebe | *Podiceps grisegena* |
| Beaver (activity) | *Castor canadensis* |
| Green frog | *Rana clamitans* |
| Northern leopard frog | *Lithobates pipiens* |
| Mallard | *Anas platyrhynchos* |
| Dragonfly sp. | *Anisoptera sp.* |

**Sandalwood West**

| Common Name | Scientific Name |
|---|---|
| Red-winged blackbird | *Agelaius phoeniceus* |
| White tailed deer | *Odocoileus virginianus* |
| Grebe (red-necked) | *Podiceps grisegena* |
| Mallard | *Anas platyrhynchos* |
| Muskrat | *Ondatra zibethicus* |
| Green frog | *Rana clamitans* |
| Dragonfly sp. | *Anisoptera sp.* |
| Red-tailed hawk | *Buteo jamaicensis* |
| Northern leopard frog | *Lithobates pipiens* |

**Fenwick Park**

| Common Name | Scientific Name |
|---|---|
| American robin | *Turdus migratorius* |
| Red-winged blackbird | *Agelaius phoeniceus* |
| Swallow sp. | *Hirundinidae sp.* |

**Heartview Road**

| Common Name | Scientific Name |
|---|---|
| American robin | *Turdus migratorius* |
| Swallow sp. | *Hirundinidae sp.* |
| Red-winged blackbird | *Agelaius phoeniceus* |
| Mallard | *Anas platyrhynchos* |
| Green frog | *Rana clamitans* |
| Dragonfly sp. | *Anisoptera sp.* |

**Presentation Centre**

| Common Name | Scientific Name |
|---|---|
| Mallard | *Anas platyrhynchos* |
| Killdeer | *Charadrius vociferus* |
| Red-winged blackbird | *Agelaius phoeniceus* |
| Mourning dove | *Zenaida macroura* |
| Green frog | *Rana clamitans* |
| Mute swan | *Cygnus olor* |
| American goldfinch | *Spinis tristus* |
| Red-tailed hawk | *Buteo jamaicensis* |
| Dragonfly sp. | *Anisoptera sp.* |

**Crescent Moon**

| Common Name | Scientific Name |
|---|---|
| Red-winged blackbird | *Agelaius phoeniceus* |
| Green frog | *Rana clamitans* |
| Dragonfly sp. | *Anisoptera sp.* |

**Rayner Trail**

| Common Name | Scientific Name |
|---|---|
| Green frog | *Rana clamitans* |
| Dragonfly sp. | *Anisoptera sp.* |

# Appendix E – TPS Permits

Ontario

Ministry of Natural Resources

Ministère des Richesses naturelles

## Wildlife Scientific Collector's Authorization
## Autorisation pour faire la collecte scientifique d'animaux sauvages

1089105

AU2018-0541

7491147

This authorization is issued under Section 39 of the Fish and Wildlife Conservation Act, 1997 to:
Cette autorisation est délivrée en vertu de l'article 39 de la Loi sur la protection du poisson et de la faune de 1997 à:

Name of Authorization Holder / Nom du titulaire de l'autorisation

Last Name / Nom de famille: Mr. Moro

First Name / Prénom: Danny

Middle Name / Second Prénom:

Name of Business/Organization/Affiliation (if applicable) / Nom de l'entreprise/de l'organisme/de l'affiliation (le cas échéant):

Toronto and Region Conservation

Mailing address of Authorization holder / Adresse postale du titulaire de l'autorisation

Street Name & No./PO Box/RR/Site, No. / N° rue/C.P./R.R./poste rurale: 5 Shoreham Drive

City/Town/Municipality / Ville/village/municipalité: Downsview

Province/State / Province/État: ON

Postal Code/Zip Code / Code postal/Zip: M3N 1S4

This authorization permits the above-named person to:
Cette autorisation permet à la personne nommée ci-haut de:

[X] Capture wildlife of the species and sex, in the numbers, and in the area set out below.
Capturer les espèces d'animaux sauvages selon le nombre et le sexe indiqués ci-dessous dans les lieux indiqués ci-dessous

and/et / or/ou

[ ] Keep game or wildlife or specially protected wildlife in captivity for the purposes of education or science.
Garder des animaux sauvages spécialement protégés et du gibier sauvage en captivité à des fins éducatives et scientifiques

[X] Release the captured wildlife in the area of capture, if the captured wildlife is not to be removed from that area.
Remettre en liberté les animaux sauvages capturés dans la zone de capture et les animaux capturés ne devant pas faire l'objet de cette zone

OR / OU

[ ] Capture and kill wildlife of the species and sex, in the numbers, and in the area set out below.
Capturer et tuer les espèces d'animaux sauvages selon le nombre et le sexe indiqués ci-dessous dans les lieux indiqués ci-dessous

| Species / Espèce | Sex / Sexe | Numbers / Nombre | Location / Endroit |
|---|---|---|---|
| Blanding Turtles | | | as per Schedule A |
| Northern Map Turtle | | | as per Schedule A |
| Common Snapping Turtle | | | as per Schedule A |
| | | | |
| | | | |

Yes/Oui [ ] Additional list attached / Liste additionnelle ci-jointe

Authorization Dates / Dates d'autorisation

Effective Date / Date d'entrée en vigueur (YYYY-MM-DD): 2018-05-01

Expiry Date / Date d'expiration (YYYY-MM-DD): 2019-12-31

Authorization conditions / Conditions de l'autorisation

This authorization is subject to the conditions contained in Schedule A if included / Cette autorisation est assujettie aux conditions de l'annexe A si celle-ci est jointe

Yes/Oui [X] No/Non [ ] Schedule A Included. / Annexe A ci-jointe

Author (print please) / Auteur (en caractères d'imprimerie): Tracey Goodwin

[redacted]

Date of Issue/Date de délivrance (YYYY-MM-DD): 2018-03-28

[redacted]

Date (YYYY-MM-DD): 2018-03-28

FW2558 (04/06)

**Wildlife Scientific Collector's Authorization**
**Schedule A – Authorization conditions**

Authorization No. 1089105
AU2018-0541

This authorization is subject to conditions listed below:

**General:**

1. This authorization is only valid for the person(s), species, number(s), and date(s) indicated. The authorized activities are valid for the following sites(s):

   ☒ Within Colonal Sam Smith Park, East and West Humber Bay Park, Humber Marshes High Park, Toronto Islands, Tommy Thompson Park, Highland Creek Marsh, Rouge Marshes, Frenchman's Bay, Duffins Creek Marsh, Carruthers Marsh and the Heart Lake Wetlands, City of Brampton, Regional Municipality of Durtham and City of Toronto.

2. The authorization holder may be assisted by: Dr. Mark Dupuis-Desmoreaux, Benjamin Shearer, Andrew Ramesbottom, Jennifer Smith, Andrea Chreston, Ryan Stephenson, Luke Hlavenka, Ian Sturdee, Don Johnston and Paul Xamin.

3. A signed copy of the original licence must be carried by the authorized person(s) and be on site at all times.

**Handling and Gear:**

4. Authorized person(s) handling wildlife under the authorization shall be trained in proper wildlife handling procedures by qualified individuals. All wildlife should be handled as little as possible and in a manner that minimizes stress.

5. Authorized person(s) shall collect with the following gear: Hoop Basing, Fyke and Hand nets, bins, hepranized needles, and acoustic transmitters. All traps shall be checked every 12-15 hours.

6. Authorized person(s) shall keep gear regularly maintained and in working order at all times while carrying out the activities permitted under this authorization.

7. Any collection gear left unattended at the designated site(s) shall be clearly marked with the authorization holder's contact information.

Signature of authorization holder

Date

APRIL 11, 2018

Page 1 of 3

**Wildlife Scientific Collector's Authorization**
**Schedule A – Authorization conditions**

Authorization No. 1089105
AU2018-0541

8. Subject to Condition 9 (re: species at risk) and Condition 10 (re: invasive species), all wildlife captured under this authorization shall be released alive:

   ☒ At the capture site

9. Subject to any conditions of any authorization issued under the *Endangered Species Act, 2007*, any person, while acting under the authority of this authorization, shall immediately release at the point of capture, or immediately release outside of the point of capture into an area providing suitable habitat, any species listed on the Species at Risk in Ontario Lists (Ontario Regulation 230/08).

10. Subject to any conditions of any authorization issued under the *Invasive Species Act, 2015*, any person, while acting under the authority of this authorization, shall immediately **euthanize and not return to the water** any species listed as prohibited or restricted under the Prescribed Species Lists (Ontario Regulation 354/16) or any other invasive species. All euthanized specimens shall be disposed of appropriately

**Monitoring and Reporting:**

11. If any injuries or mortalities of wildlife occur as a result activities taking place, the authorization holder shall notify the MNRF Aurora District office within seven (7) business days to scp.aurora@ontario.ca or 905-713-7400.

12. The following mandatory reporting is required and shall be submitted:

    a. A written final report covering the operation under this authorization must be submitted by the authorization holder to the MNRF Aurora District office by January 31st following the authorization expiry date to scp.aurora@ontario.ca. The report shall contain:
        i. a statement outlining the objectives of the operations,
        ii. the methods used,
        iii. the number and species of wildlife caught and their fate, and
        iv. a summary and how results related to the objectives.

Signature of authorization holder

Date

April 11, 2018

Page 2 of 3

**Wildlife Scientific Collector's Authorization**
**Schedule A – Authorization conditions**

Authorization No. 1089105
AU2018-0541

b. Records of any species at risk listed on the Species at Risk in Ontario Lists (Ontario Regulation 230/08) incidentally captured shall be reported within two (2) business days to esa.aurora@ontario.ca

c. Reports of the incidental capture of any species listed as prohibited or restricted under the Prescribed Species Lists (Ontario Regulation 354/16) or any other invasive species, shall be reported within two (2) business days to the Ontario Federation of Anglers and Hunters Invading Species Awareness Program (1-800-563-7711 or **EDDMapS Ontario** at: **https://www.eddmaps.org/**).

Signature of authorization holder

Date

April 11, 2018

Page 3 of 3

## Appendix F –TPS Turtle Biology and Ecology

Ontario has 8 native species of turtle, 3 of which are found within the study area. All of Ontario's turtles are listed as endangered, threatened or of special concern meaning these species could become threatened or endangered because of biological characteristics or perceived threats. Turtles are long-lived, slow to mature and reproduce, and bio-accumulate toxins making them excellent indicators of long-term health of wetland areas. Both males and females will travel long distances on land to nest, search for food and look for mates putting them at risk for WVCs causing injury or fatality. During nesting season females are especially vulnerable because they seek out gravelly or sandy areas to nest (gravel shoulders on roads).

**Common snapping (*Chelydra serpentina*)**

Status: Special Concern

The snapping turtle is Ontario's largest freshwater turtle. Their powerful beak and long claws are used for defense and digging into loose substrate while nesting. Snapping turtles are most aggressive on land because the small size of their plastron leaves them exposed to danger. The edges of the carapace are serrated and the tail has a row of prehistoric like "spikes". Snapping turtles are semi-aquatic species but spend most of their time in shallow waters hidden under soft mud and leaf litter.

**Midland painted (*Chrysemys picta marginata*)**

Status: Special Concern

Midland Painted turtles can be distinguished by the red and black markings on the underside of the carapace that give them their name. They are often seen basking on semi-submerged logs in a range of habitats. As an aquatic species they only travel on land to migrate, look for mates and nest.

**Northern map (*Graptemys geographica*)**

Status: Special Concern

Map turtles can be distinguished by thin yellow lines on a green/brownish carapace and skin that resemble a map. Map turtles prefer large rivers or lakes only leaving the water to migrate or nest. Their diet consists of crustaceans and mollusks.

**Red-eared slider (*Trachemys scripta elegans*)**

Status: Non-native species (invasive)

Native to the Central/South-Central United States, red-eared sliders were introduced to Canada as pets and have become invasive when released into the wild. They inhabit urban and suburban ponds, lakes, rivers and wetlands. They can be distinguished by long red blotches on either side of the head behind the eyes. Red-eared sliders outcompete native turtles for food, basking sites, nesting sites, overwintering sites and can carry disease.

## Appendix G – HLREMP Volunteer Safety Procedures

This package includes the following:

1. Volunteer Letter of Offer
2. Volunteer Intake Form
3. Volunteer Waiver
4. Volunteer Safety Protocol
5. Volunteer Injury Reporting Process
6. Road Ecology Monitoring – Safe Work Procedure
7. Road Ecology Monitoring – Safe Work Procedure (Competency Sign-Off)
8. Competency Checklist (*to be completed by Supervisor at Field Training Session*)

## Volunteer Safety Protocol

All volunteers must:

1. In case of emergency, call 911.

2. In the case of an injury, follow the Volunteer Injury Reporting Process.

3. Attend the mandatory Training Session and one On-the-Road Training Session.

4. Sign “Volunteer Letter of Offer”, “Volunteer Intake Form”, and “Volunteer Waiver” and submit to Project Coordinator.

5. Complete all mandatory AODA and TRCA orientation training modules online.

6. Review and understand the summary of TRCA’s Harassment, Health and Safety, E-Communication Policies and Code of Conduct.

7. Check in with Project Coordinator and Supervisor at the start and end of each shift using an agreed upon method (ie. email, text message).

Marc Dupuis-Desormeaux
[redacted]

Tisha Samara Tan
[redacted]

8. Not conduct surveys in low light, rain, thunder or high winds, where weather conditions inhibit safety while on or near the roads.

9. Do a safe road assessment and follow the procedure to properly place two “Road Works” signs on the side of the roadway prior to the commencement of work. One at either extent of the study site and on the side of the road of oncoming traffic. When the work is done the signs must be dismantled and stored.

10. Work in groups of at least 2 and comply with the roles assigned as outlined in the “Safe Work Procedure”.

11. Adhere to the “Safe Work Procedure” for Volunteer Road Ecology Monitoring.

12. Walk the shoulder of the road, facing on-coming traffic.

13. Wear Personal Protective Equipment that consists of close-toed shoes, Class 2 high visibility safety vest, and Type 1 hard hat. If carrying a backpack, the safety vest is to be worn over the backpack.

14. Park vehicles at designated locations as indicated on site fact sheets.

15. Carry a copy of the Road Occupancy Permit for your site at all times while on site.

16. Only remove wildlife (dead or alive) when there is a sufficient gap in traffic to do so, as volunteers are not authorized to stop or direct traffic.

17. Carry a charged cell phone (minimum 1 per group).

18. Not eat during surveys. Wear nitrile gloves when handling wildlife. Use hand sanitizer at the end of the survey and before eating.

19. Avoid all visual and auditory distractions throughout shift such as wearing ear buds, texting, phone calls, etc.

20. Be prepared for the conditions with:
    a. Sunscreen
    b. Bug spray
    c. Extra clothing layers
    d. Extra drinking water

## Volunteer Injury Reporting Process for the Volunteer:

1. Call 911, if necessary.
2. If possible, treat injuries away from road.
3. Contact Project Coordinator and Supervisor.

   Marc Dupuis-Desormeaux
   [redacted]

   Tisha Samara Tan
   [redacted]
4. Record information as outlined in the Visitor/Volunteer Injury Form in folder. Injury forms will be in the box on site.
5. Take photos of injury and scene.

# Road Ecology Monitoring – Safe Work Procedure

## Background Information

This project involves collecting road/ wildlife interaction data from the roadside. This work necessitates compliance with Ontario Traffic Manuals - Book 7 and municipal requirements for road side works.

## Equipment

All personal protective equipment must be inspected before use, to ensure it is in safe working condition. All equipment must be worn and used as per the manufacturer's recommendations and without modification.

Personal Protective Equipment Requirements:

1. Type 1 hard hat
2. High visibility class 2 safety vest
3. Nitrile gloves
4. Hand sanitizer
5. First aid kit including tick removal kit
6. Working cell phone (minimum 1 per group)
7. 2 'men at work' road signs
8. 4 28" pylons

## Procedure

Volunteers must be given detailed instruction from a properly trained and competent person on all procedures and safe practices. No monitoring will take place without the presence of at least 3 volunteers. Roles and responsibilities shall be designated at the beginning of each shift. At any time volunteers are to communicate any potential hazards or concerns to the volunteer coordinator.

1. Pre-monitoring set-up
    a. Park vehicles at designated parking area identified on site fact sheets.
    b. Observe weather conditions. Refrain from monitoring if there is rain, thunder and/or high winds or where weather conditions inhibit safety while on or near the roads.

    c. Contact volunteer coordinator to indicate that monitoring is about to commence (via text or email).

d. Review all personal protective equipment and ensure that you have all items on the Personal Protective Equipment Requirements list. Inspect all equipment to ensure that it is in good working order

e. Review "Conditions that Affect Traffic Control Requirements" in the site fact sheet for the site being monitored and note any changes to conditions. If conditions have changed record on a new sheet and submit to Project Coordinator. Take special note of Emergency road repair, broken down vehicles, obstructions to traffic flow.

f. Observe site and identify emergency escape route.

g. Identify roles for the shift: Volunteer A, Volunteer B, Volunteer C

| Role | Responsibility |
|---|---|
| A (Spotter and safety set up) | - Observes oncoming traffic in both directions at all times.<br>- Observes oncoming traffic (work side) during removal.<br>- Gives the 'All Clear to A for removal<br>- Communicates potential hazards to team.<br>- Shifts safety set-up as required.<br>- Activates 911 if necessary. |
| B (Data Collection) | - Collects data<br>- Observes for wildlife on roadway<br>- Communicates potential hazards to team |
| C (Support) | - Observes for wildlife on shoulder<br>- Observes oncoming traffic (opposite work side) during removal<br>- Gives the 'All Clear' to A for removal<br>- Assists with data collection at roadside<br>- Communicates potential hazards to team |

2. At work procedure
   a. Set up 'men at work' roadside signs at designated locations identified in site fact sheets (set up will need to be moved once for each monitoring session

b. Walk on shoulder facing on-coming traffic, following the route identified in the site fact sheets.
c. When stopped to record data ensure that you are within a pylon set up as depicted in figure 1 below
d. Volunteer B (Data Collector) to only remove wildlife (dead or alive) when there is a sufficient gap in traffic to do so and when given the 'all clear' by volunteer A (Spotter and safety set up) and volunteer C (support). Volunteers are not authorized to stop or direct traffic.

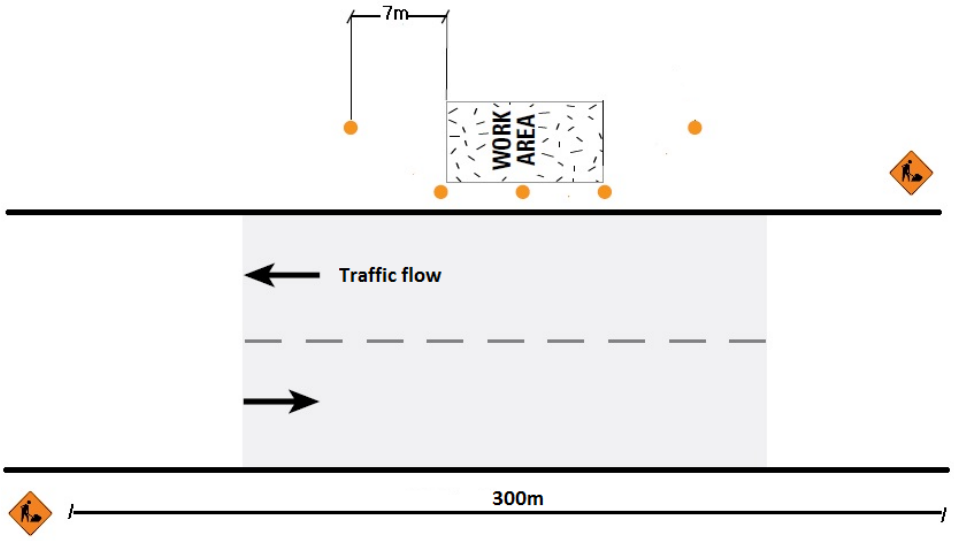


Figure 1: Work Area Set Up

3. Close out procedure
    a. When the work is done the signs must be put back inside the storage box stored onsite. Contact volunteer coordinator to inform that the shift is complete (via text or email).
    b. Upload data at secure wifi location.
    c. Record volunteer hours worked at http://www.trackitforward.com/site/trca

    Important Contact Information:
    Volunteer Coordinator
    [redacted]

4. Volunteer Road Ecology Monitoring Safe Work Procedures - Competency Sign Off

I have reviewed the "Volunteer Road Ecology Monitoring Safe Work Procedures" document and have demonstrated the following tasks to a competent supervisor.

- □ Pre-monitoring Procedure (Assigning roles and responsibilities, setting up signs, etc.)
- □ At Work Procedure (assessing traffic flows, traffic judgement, etc.)
- □ Close-out Procedure (Shift completion)

| Name | Signature | Date |
|---|---|---|
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Competent Supervisor Name: Competent Supervisor Signature:

5. Competency Checklist

*(to be completed by Supervisor at Field Training Session)*
*Competency Checklist* *Volunteer Name:___*

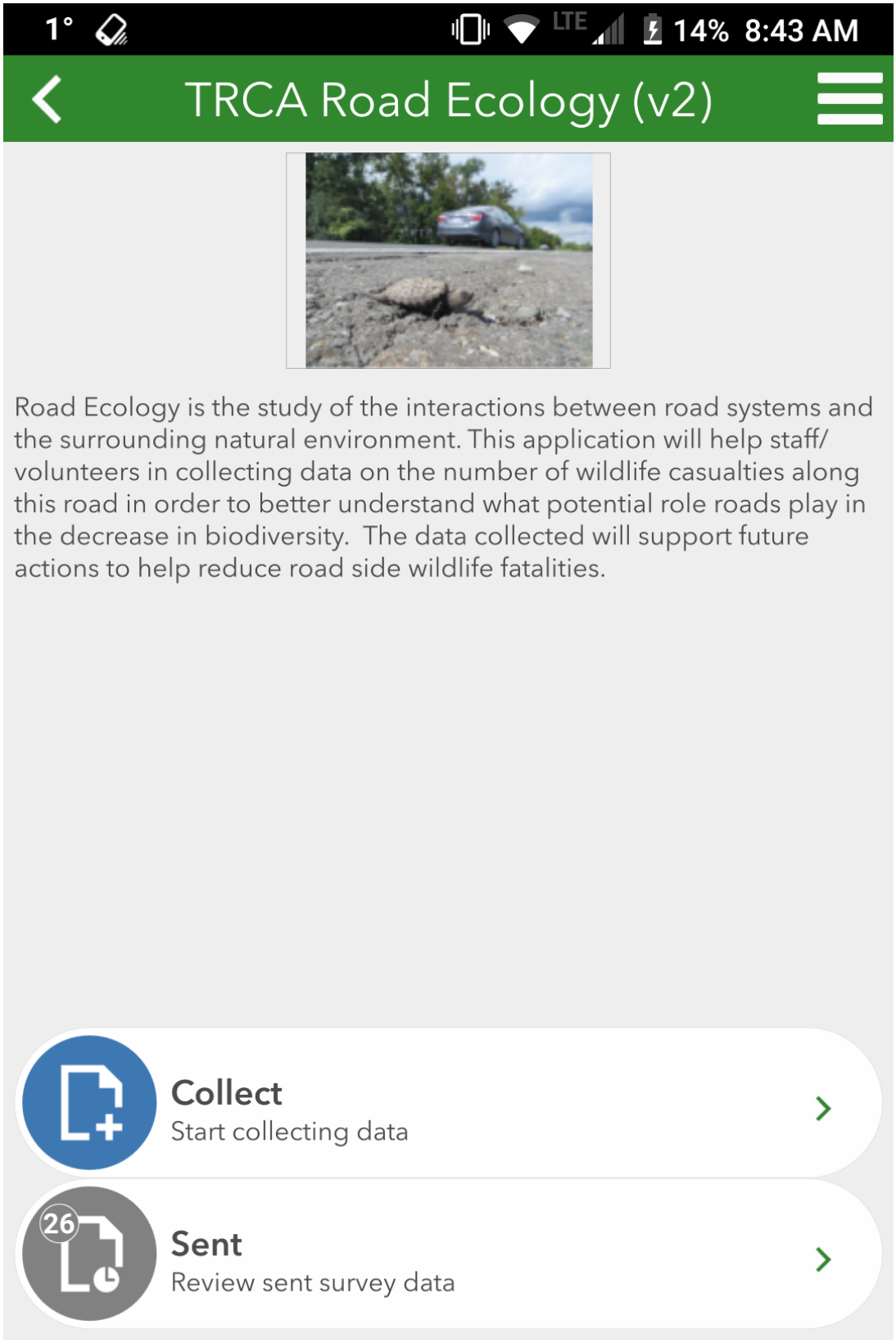
- □ Has gone through Safe Work procedures with supervisor and demonstrates a sound understanding of the outlined principles
- □ Demonstrates knowledge of required PPE
- □ Able to identify hazards during pre-monitoring and at work procedure
- □ Demonstrates knowledge of doing Pre-monitoring Procedure (Assigning roles and responsibilities, setting up signs, etc.)

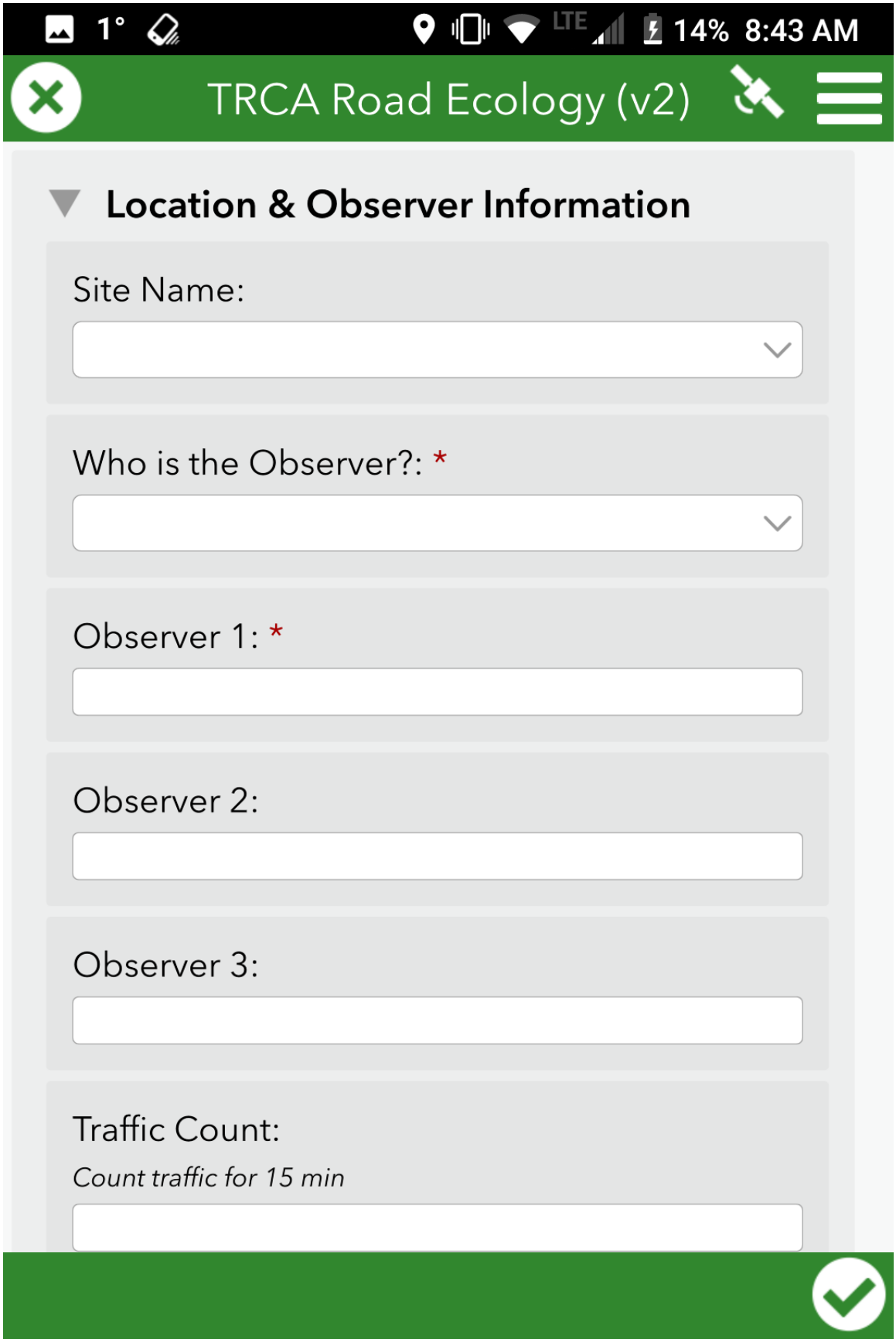
- □ Demonstrates knowledge of doing At Work Procedure (assessing traffic flows, traffic judgement, etc.)

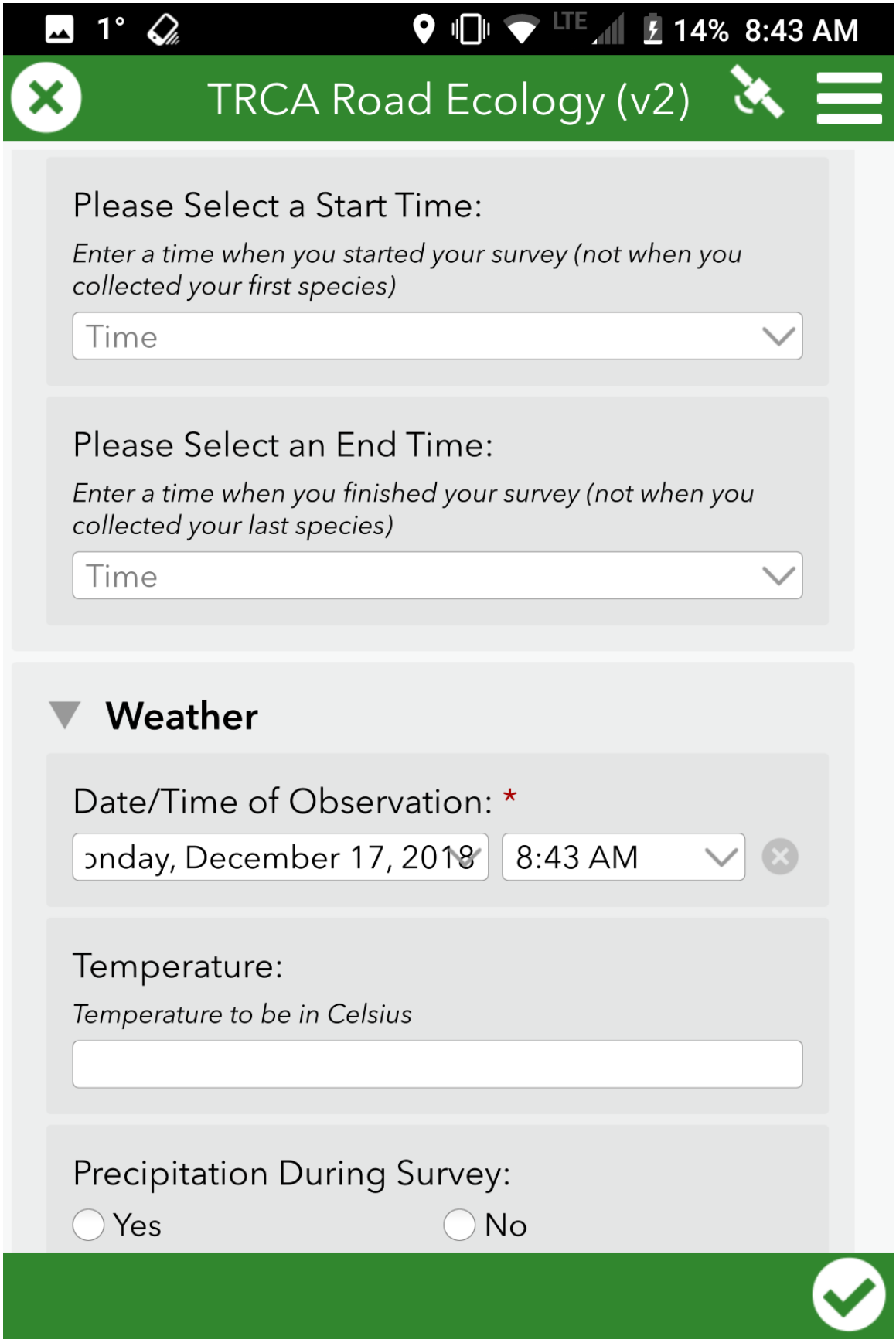
- □ Demonstrates knowledge of doing Close-out Procedure (Shift completion)

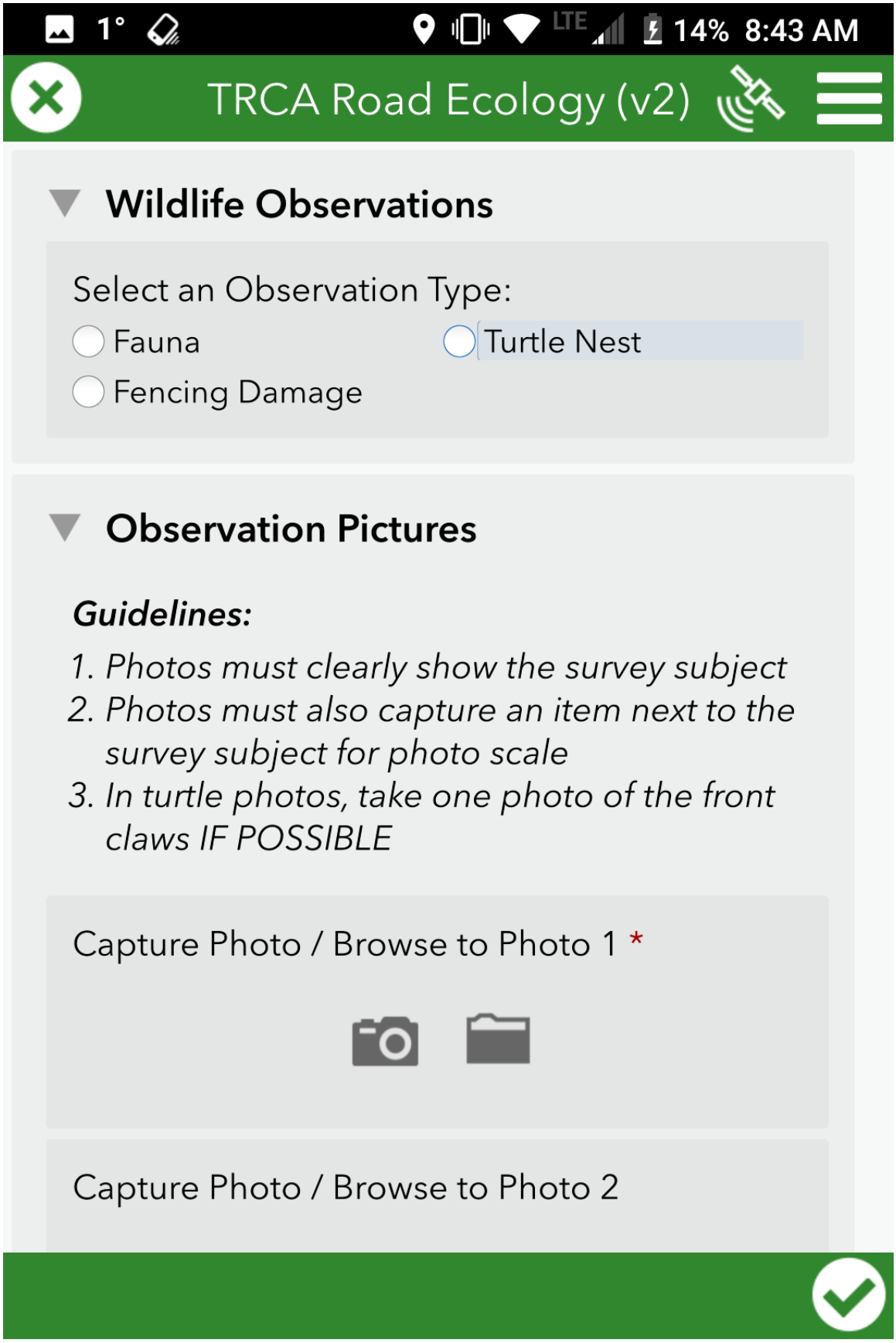
Supervisors Name: _____ Supervisors Signature: _____

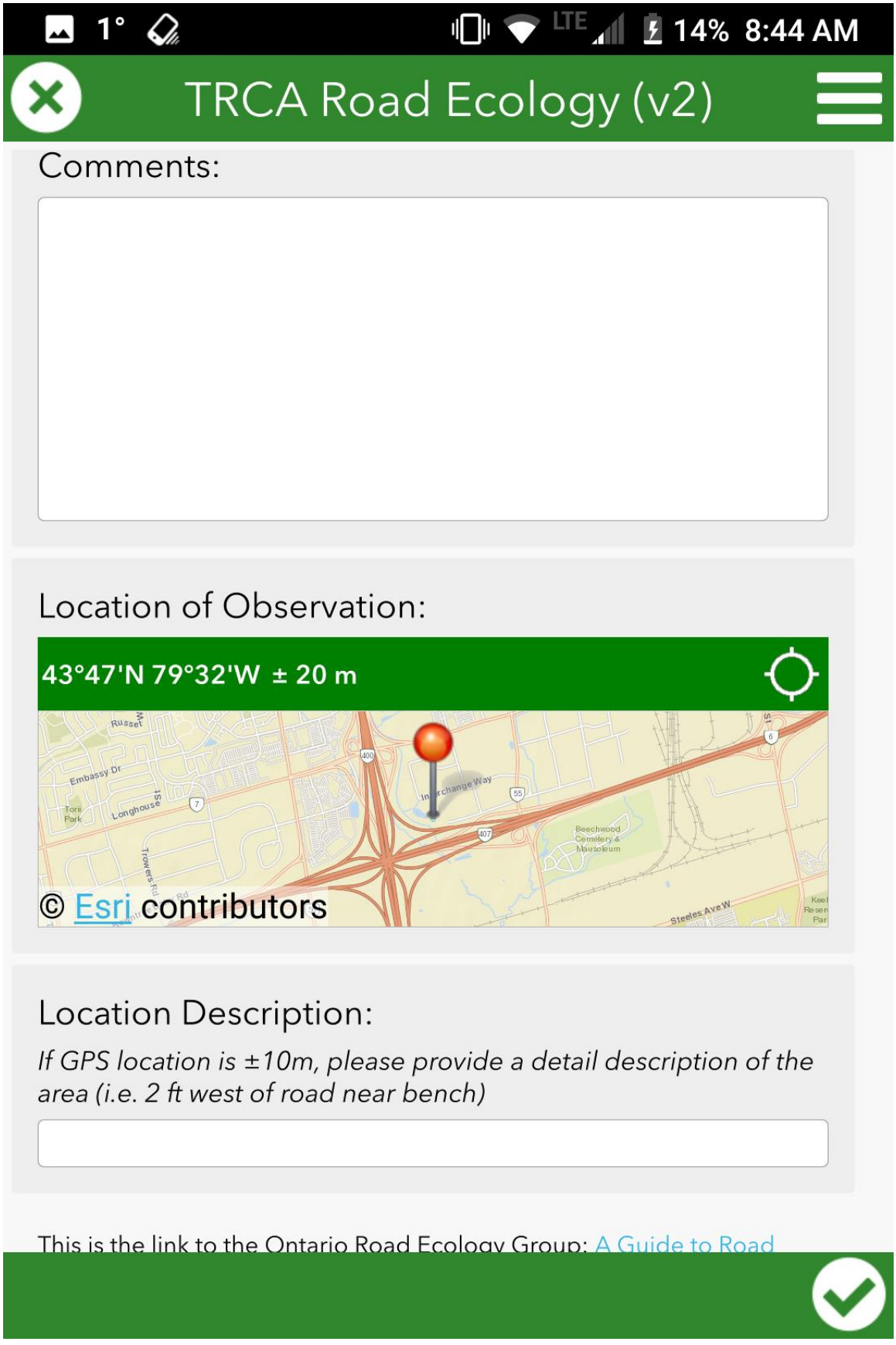
Appendix H - HLREMP Survey 123 App




1°
LTE
14% 8:43 AM
TRCA Road Ecology (v2)
Location & Observer Information
Site Name:
Who is the Observer?: *
Observer 1: *
Observer 2:
Observer 3:
Traffic Count:
Count traffic for 15 min


1°
LTE
14% 8:43 AM
TRCA Road Ecology (v2)
Please Select a Start Time:
Enter a time when you started your survey (not when you collected your first species)
Time
Please Select an End Time:
Enter a time when you finished your survey (not when you collected your last species)
Time
Weather
Date/Time of Observation: *
onday, December 17, 2018
8:43 AM
Temperature:
Temperature to be in Celsius
Precipitation During Survey:
Yes
No


1°
14% 8:43 AM
TRCA Road Ecology (v2)
Wildlife Observations
Select an Observation Type:
Fauna
Turtle Nest
Fencing Damage
Observation Pictures
Guidelines:
1. Photos must clearly show the survey subject
2. Photos must also capture an item next to the survey subject for photo scale
3. In turtle photos, take one photo of the front claws IF POSSIBLE
Capture Photo / Browse to Photo 1 *
Capture Photo / Browse to Photo 2


1°
LTE
14% 8:44 AM
TRCA Road Ecology (v2)
Comments:
Location of Observation:
43°47'N 79°32'W ± 20 m
Embassy Dr
Longhouse St
Interchange Way
Beechwood Cemetery & Mausoleum
Steeles Ave W
© Esri contributors
Location Description:
If GPS location is ±10m, please provide a detail description of the area (i.e. 2 ft west of road near bench)
This is the link to the Ontario Road Ecology Group: A Guide to Road

## Appendix I – HLREMP Species Inventory

| Common Name | Scientific Name |
|---|---|
| Baltimore oriole | *Icterus galbula* |
| American goldfinch | *Spinus tristis* |
| Northern cardinal | *Cardinalis cardinalis* |
| Belted kingfisher | *Megaceryle alcyon* |
| Canadian goose | *Branta canadensis* |
| Red-winged black bird | *Agelaius phoeniceus* |
| American robin | *Turdus migratorius* |
| Leopard frog | *Lithobates sp.* |
| Gray tree frog | *Hyla versicolor* |
| Green frog | *Lithobates clamitans* |
| Wood frog | *Lithobates sylvaticus* |
| Spring peeper | *Pseudacris crucifer* |
| Meadow jumping mouse | *Zapus hudsonius* |
| Deer mouse | *Peromyscus maniculatus* |
| Meadow vole | *Microtus pennsylvanicus* |
| Star-nosed mole | *Condylura cristata* |
| Gray squirrel | *Sciurus carolinensis* |
| Chipmunk | *Tamias sp.* |
| Muskrat | *Ondatra zibethicus* |
| Eastern cottontail | *Sylvilagus floridanus* |
| Raccoon | *Procyon lotor* |
| Virginia opossum | *Didelphis virginiana* |
| Eastern chipmunk | *Tamias striatus* |
| Dekays brown snake | *Storeria dekayi* |
| Eastern garder snake | *Thamnophis sirtalis* |
| Northern red-bellied snake | *Storeria occipitomaculata* |
| Midland painted turtle | *Chrysemys picta marginata* |
| Snapping turtle | *Chelydra serpentina* |
| Northern map turtle | *Graptemys geographica* |

## Appendix J – HLREMP Species Detected by Cameras in the Wildlife Directional Passage

| **Camera Type** | **PIR Bushnell Low Glow** | **PIR Bushnell No Glow** | **PIR Bushnell Liveview HALT Laser Trigger** |
|---|---|---|---|
| **Camera Location in Dedicated Wildlife Passage** | **Eastside** | **Westside** | **Center** |
| **Species Observed** | Raccoon | Raccoon | Raccoon |
| | Deer Mouse | Deer Mouse | Deer Mouse |
| | Eastern Chipmunk | Eastern Chipmunk | Eastern Chipmunk |
| | Eastern Cottontail | Eastern Cottontail | Eastern Cottontail |
| | Grey Squirrel | Grey Squirrel | Grey Squirrel |
| | Mink | Mink | Mink |
| | Red Squirrel | Red Squirrel | Red Squirrel |
| | Striped Skunk | Striped Skunk | Striped Skunk |
| | Virginia opossum | Virginia opossum | Virginia opossum |
| | Vole | Vole | Vole |
| | | | **Ermine*** |
| | | | American Toad |
| | | | **Common Snapping Turtle*** |
| | | | Green Frog |
| | | | **Milksnake*** |
| | | | Muskrat |
| | | | **Northern Leopard Frog*** |
| | | | **Shrew*** |

***species of concern**

## Appendix K – Nesting Study Raw Data

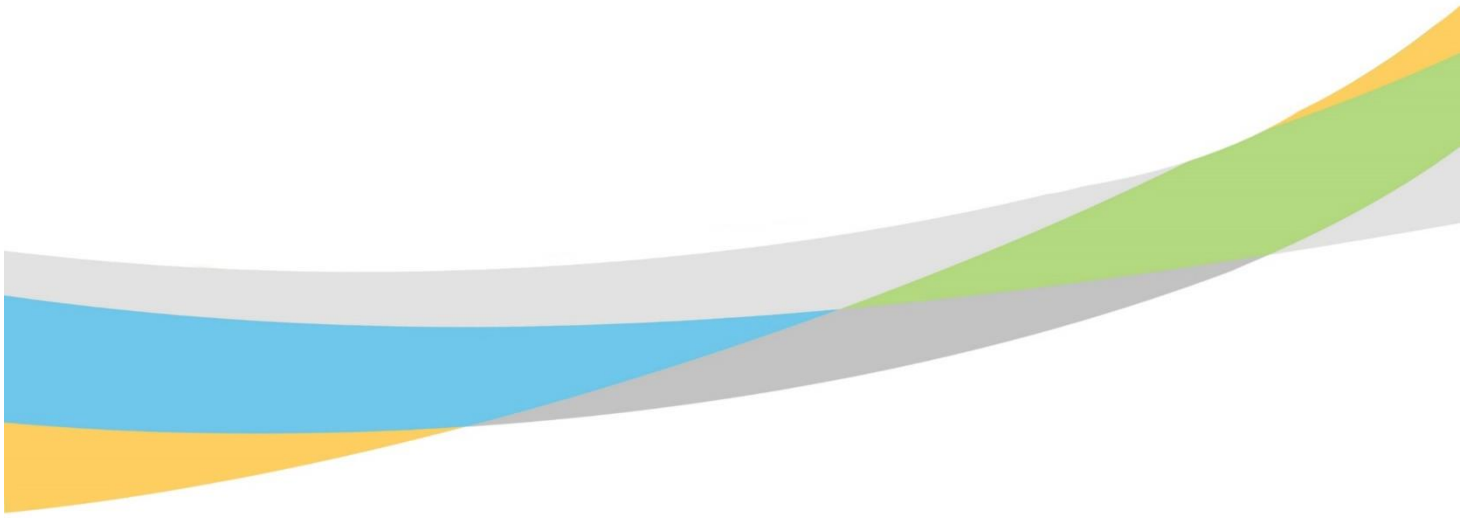
| Sightings Outside Fence/Barrier | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 6/6/18 **(12:20-2:20pm)** | 6/7/18 **(4:00-6:00pm)** | 6/11/18 **(1:55-3:55pm)** | 6/13/18 **(11:40-1:40pm)** | 6/21/18 **(6:30-8:30pm)** | 6/26/18 **(6:15-8:15pm)** | 6/28/18 **(1:00-3:00pm)** | 7/12/18 **(6:00-8:00pm)** | 7/14/18 **(5:35-7:35pm)** | 7/15/18 **(11:15-1:15pm)** | 7/20/18 **(7:50-9:50pm)** | 7/22/18 **(6:05-8:05pm)** | 7/23/18 **(5:50-7:50pm)** | 7/24/18 **(11:00-1:00pm)** | 7/25/18 **(12:10-2:10pm)** |
| Snapping Turtles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Painted Turtles | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Turtle Nests | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | | | | | | | | | | |
| Sightings Inside Fence/Barrier | | | | | | | | | | | | | | | |
| | 6/6/18 **(12:20-2:20pm)** | 6/7/18 **(4:00-6:00pm)** | 6/11/18 **(1:55-3:55pm)** | 6/13/18 **(11:40-1:40pm)** | 6/21/18 **(6:30-8:30pm)** | 6/26/18 **(6:15-8:15pm)** | 6/28/18 **(1:00-3:00pm)** | 7/12/18 **(6:00-8:00pm)** | 7/14/18 **(5:35-7:35pm)** | 7/15/18 **(11:15-1:15pm)** | 7/20/18 **(7:50-9:50pm)** | 7/22/18 **(6:05-8:05pm)** | 7/23/18 **(5:50-7:50pm)** | 7/24/18 **(11:00-1:00pm)** | 7/25/18 **(12:10-2:10pm)** |
| Snapping Turtles | 4 | 0 | 1 | 0 | 9 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Painted Turtles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Turtle Nests | 11 | 0 | 7 | 1 | 6 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |

## Appendix L – TPS and HLREMP Staff and Volunteer Photos









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