Watershed Monitoring and Reporting
PROGRESS REPORT

Watershed Monitoring and Reporting Section
Restoration Services Divison

2014

Toronto and Region Conservation
for The Living City

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1 Introduction

The mission of the WM&R is to improve the health and sustainability of the Toronto region's watersheds through the long-term collection, analysis and dissemination of scientifically defensible data which are used to guide decision making.

Through the collection of scientific data, TRCA's Watershed Monitoring & Reporting (WM&R) Section tracks and reports on changes in the health of our regional watersheds over time. Monitoring involves collecting ecological data at sites across our watersheds, at various points in time over many years. In the business of monitoring, the true impacts of our work are measured long-term. Five to ten years of data is required at minimum to be able to effectively report on long-term trends in the key program service areas we support in TRCA's Building the Living City: 10-Year Strategic Plan 2014-2023 (TRCA 2012):

- Regional Biodiversity
- Water Risk Management

The ability of WM&R to track and report on long-term changes to these elements at local, watershed, and regional scales is vital to the success of an organization that is responsible for watershed planning, management and reporting in the greater Toronto region. To achieve our mission, WM&R coordinates with various agencies, groups and individuals involved in monitoring activities. This knowledge can then be shared with others and applied to areas outside of TRCA's jurisdiction, accelerating innovation and fostering new partnerships with agencies, regional and local municipalities, community groups, businesses and other stakeholders.

From a long-term perspective, we know that key sections reported on in the Conservation Ontario and The Living City reports cards are derived from our team's datasets. We know that a key outcome of the monitoring we do is to help guide where, when and why restoration activities occur throughout our regional watersheds. We know that measuring and reporting on the state and health of our watersheds through our various annual and 10 year summary reports, have greatly contributed to TRCA's knowledge base from which sound management decisions, policy and planning are based.

But how do we measure the performance of watershed monitoring activities in the short term, particularly when they are designed to be an on-going assessment of ecosystem health and condition over the long-term?

This annual report is designed to answer this question by providing an overview of the 2014 monitoring activities and results produced by the WM&R Section. The report identifies the types of data available along with project highlights from both the Regional Watershed Monitoring Program (RWMP) (**see Section 2**) and special projects underway.

In 2014 alone, WM&R collected **more than 17 million** data records from **1508** monitoring sites using more than **275** fixed monitoring instruments. This includes **long-term** sites that are part

of the Regional Watershed Monitoring Program (**see Section 2**) and sites that have been sampled as part of a specific project (**see Section 3**). The data collected was compiled into **21** TRCA reports, were the product of **20** unique partnerships and were made available to others through more than **200** data sharing opportunities. The latter number alone is one example of how the long-term data collected by TRCA (and with the support of our funding partners) has value beyond the purpose for which we collected it, and will for many years in the future.

Of the data records collected in 2014, more than **105,000** of them were directly related to a record of biodiversity – the observation or characterization of a plant, animal, bird, fish or insect! Tracking the status of aquatic and terrestrial habitats and the vegetation and wildlife communities they support is an important step towards understanding how successful we are at protecting and managing these ecosystems. For example, large thriving populations of Muskflower *(Mimulus moschatus*) were discovered for the first time in the organic swamp and marsh communities at Glen Haffy Conservation Area. This plant, a member of the figwort family, was thought to be extirpated (local extinction) from the GTA due to its sensitivity to hydrological changes and disturbances such as invasive species.

We hope that by reading more about the discovery of the Muskflower and other monitoring program highlights you will gain an appreciation for why monitoring matters in the short and long-term. The collected data and its reporting not only contributes to measuring the performance of management decisions, but also contributes to facilitating a region-wide approach to sustainability while telling the story of the Toronto region and its ecosystem health. A detailed list of the various data reports and other products that have been developed by WM&R staff are provided in Section 4. Since the work undertaken by WM&R staff is multi-faceted, a staff directory with contact information is also provided in Section 4. Tables in Appendices A and B provide a summary of the sampling effort undertaken by WM&R staff during 2014 and maps at the end of Section 2 and Section 3 identify sampling locations.

2 Regional Watershed Monitoring Program

The Regional Watershed Monitoring Program (RWMP) is a science based, long-term monitoring initiative developed by the TRCA. Its purpose is to collect aquatic and terrestrial ecosystem data at the watershed and sub-watershed scale, and across the region as a whole. The program provides the data and information that informs the key planning and reporting mechanisms of the TRCA. Since its inception in 2001, the program has enhanced the planning and coordination of monitoring activities, helped standardize protocols, and has filled several key data gaps that were identified. It also facilitates the communication of data availability and data sharing both internally and with external agencies.

The scope of the RWMP focuses on key components of the terrestrial and aquatic ecosystems, including:

- ***Terrestrial Habitat and Species*** - staff and trained volunteers monitor flora and fauna species and biological communities through biological inventories and fixed plot surveys,
- ***Aquatic Habitat and Species*** - including aquatic insects, fish populations, algae, stream temperature and the physical shape of the stream,
- ***Stream Water Quality*** - assesses a variety of water chemistry variables/parameters such as nutrients, metals, and bacteria,
- ***Stream Water Quantity*** - stream gauges and in-stream measurements monitor changes in the water levels of the region's watercourses,
- ***Groundwater Quantity and Quality*** - assessed at a series of wells throughout the region, and
- ***Climate & Hydrology***- assesses the contribution of rain and snow to the hydrology of the region.

The data collected are shared with partner municipalities and other agencies, and is used for planning, implementation and reporting purposes. Partnerships with academic institutions facilitate achievement of common research objectives as well as data sharing in support of academic study. All elements of the program are designed to provide data sets that allow for interpretation at the watershed and regional scales. In certain circumstances, data can be assessed at the site scale and used as a "flag" to identify potential issues or direct additional assessment. Where restoration and recovery plans are implemented, future monitoring will track the progress of such enhancement initiatives.

All program elements are strongly focused on the collection of scientific data. When possible, community outreach and education are incorporated. This is accomplished through the involvement of trained volunteers (e.g. Terrestrial Volunteer Monitoring Program), through partnerships with community groups and other non-governmental organizations, and through special events that demonstrate to or involve the community.

2.0 Terrestrial Habitat and Species

Staff Lead: Sue Hayes

Support Staff: Natasha Gonsalves, Gavin Miller, Paul Prior, Derek Tune

Seasonal Staff: John Barker, Lyndsay Cartwright, Maria Ciancio, Richard Dickinson, Brian Ford, Jessica Frigault, Mike King, Nadine Price, Rivka Shachak, Chana Steinberg, Alisa Samuelson

Funding: City of Toronto, Durham Region, Parks Canada, Peel Region, York Region, Toronto Remedial Action Plan, Town of Richmond Hill

Figure 1. TRCA field staff collecting terrestrial monitoring data at a fixed wetland plot. The long-term monitoring plots have been measuring how species and vegetation communities are responding over time to impacts, both positive and negative, from the surrounding landscape.

Background and Significance:

The Terrestrial Natural Heritage (TNH) component of the RWMP was established in 2000 and builds on data collected during the previous 15 years under the Environmentally Significant Areas work. The core focus of the TNH program has been systematic inventories of habitats and species throughout TRCA's nine watersheds (TRCA 2007a). In 2008, TRCA also implemented terrestrial monitoring (**Figure 1**) at a number of fixed plots throughout our region. This new component of the program will identify trends in species and vegetation communities that are occurring over time.

Collecting terrestrial data is key to: advancing the goals of TRCA's *Terrestrial Natural Heritage System Strategy* (TRCA 2007b); developing and testing of terrestrial ecosystem modelling; updating the annual ranking of regional wildlife and vegetation communities of conservation concern; informing conservation, recovery and site restoration planning activities across our region; guiding planning activities across watersheds, conservation lands, and remedial action sites (RAP); and providing scientific information to partner municipalities and agencies.

2014 Program Highlights

- ✓ Sixteen biological inventory sites that covered approximately 1805 hectares were inventoried for vegetation communities as well as flora and fauna species (***See Regional Maps***). In addition, breeding bird surveys were updated at 3 sites (480 hectares) and flora surveys at 1 site (435 hectares) . As part of the regional fixed plot monitoring program, data were collected across TRCA's jurisdiction at 24 vegetation, 29 bird, and 25 red-backed salamander forest plots; 23 vegetation, 24 bird, and 24 amphibian wetland plots; and 20 bird meadow plots (***See Regional Maps***).

- ✓ A breeding pair of Barred Owls (*Strix varia*) (**Figure 2**) were observed in an urban area within the Town of Stouffville. In the past, this species has only been found in the large forested tracts located in the northeast and northwest sections of TRCA's jurisdiction. In the United States, trends show that this owl is nesting more in urban developments; meaning it may become more commonplace within TRCA's jurisdiction.

Figure 2. The Barred Owl is a species of Regional Conservation Concern (ranked L2) as it requires large undisturbed areas for nesting.

- ✓ Palgrave Conservation Area in Caledon was resurveyed in 2014 (last surveyed in 2004) and an expanding population of nodding trillium (*Trillium cernuum*) was documented. This is the only known location of this Species of Regional Conservation Concern in the TRCA region, characteristically found in high-quality cool moist mixed forests.

- ✓ Early coral-root (*Corallorhiza trifida*) was found at Palgrave and Cold Creek Conservation Area in 2014. This rare orchid, a Species of Regional Conservation Concern (ranked L1), has been found in only two other locations in TRCA's jurisdiction.

- ✓ Sheathed sedge (*Carex vaginata*) was found by botanists at Cold Creek Conservation Area in a large conifer swamp. This is the first record for this boreal sedge in TRCA's jurisdiction.

- ✓ Large thriving populations of Muskflower *(Mimulus moschatus*) were discovered in the organic swamp and marsh communities at Glen Haffy Conservation Area. This plant, a member of the figwort family, was thought to be extirpated (local extinction) from the GTA due to its sensitivity to hydrological changes and disturbances such as invasive species.

2.1 Terrestrial Volunteer Monitoring Program

Staff Lead: Theresa McKenzie

Support Staff: Team of Volunteers

Funding: City of Toronto, Durham Region, Peel Region, York Region

Figure 3. TVMP Volunteer observing target plant species.

Background and Significance:

The Terrestrial Volunteer Monitoring Program (TVMP), in operation since 2002, uses trained volunteers to survey 56 fixed sites (10 hectares in size) distributed throughout the region (***See Regional Maps***). Volunteers (**Figure 3**) collect data on the presence of a set of 50 native amphibian, mammal, bird, plant and lichen indicator species (TRCA 2008b). Effective 2009, they also conduct 2 surveys each year to determine the extent of invasion of each site by 8 invasive exotic plants (TRCA 2008b). Data are analyzed by TRCA to report on the condition of the terrestrial ecosystem and major habitats of the region, document differences between land-use zones, and to monitor change over time. These results contribute to the on-going implementation of TRCA's *Terrestrial Natural Heritage Strategy* (TRCA 2007b).

2014 Program Highlights

- ✓ In 2014, a total of 403 survey visits were completed across 54 sites by 126 volunteers (volunteers work in pairs).

- ✓ A 2014 TVMP review was conducted and recommendations made; no changes were identified with respect to monitoring methods or protocols, only program logistics.

- ✓ A focus in 2014 was to communicate the results of the *Terrestrial Biodiversity in the Toronto Region 2003 - 2012* report published in December 2013 (TRCA 2013). The report was distributed widely and presentations made to TRCA staff in Planning and Development, Engineering Services, Planning Ecology and Stewardship sections, as well as the Etobicoke-Mimico Watersheds Coalition and the Humber Watershed Alliance. TRCA Web pages and watershed e-newsletters communicated the monitoring results to a wider public audience.

- ✓ A Latornell conference presentation *Terrestrial Biodiversity in the Toronto Region* (TRCA 2014) highlighted the monitoring and data analyses methods applied in the TVMP; the purpose was to inform the wider scientific community about its practical application of the TRCA Species of Conservation Concern (SOCC) scores to monitoring data (**Figure 4**).

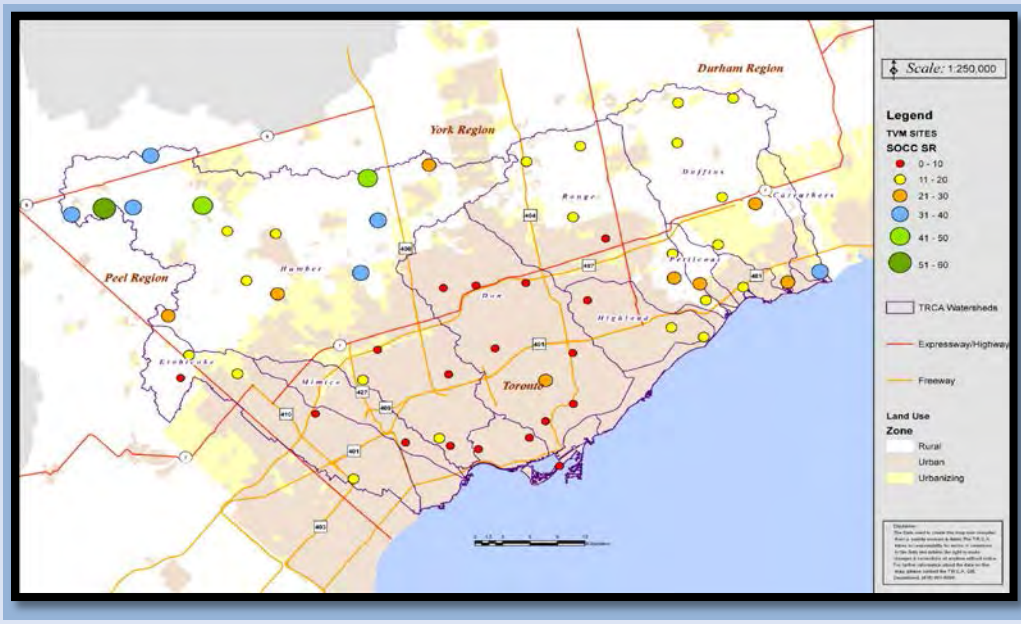


Figure 4. Variation in SOCC species richness scores across the region. High scores in the northwest are related to higher natural cover, greater frequency of wetlands interspersed with forests, and possible increased habitat diversity resulting from the diverse topography of the Oak Ridges Moraine.

2.2 Fish Community Monitoring

Staff Lead: Jeff Vandenberg

Support Staff: Samantha Everson, Mark Szonda

Seasonal Staff: Emma Brookfield, Kyle Chalmers, Samantha Delargy, Danielle Dellandrea, Taylor Ivanovich, Dean Lamming, Christopher Ng, Paula Reynolds, Jet Taylor, Tracey Ubbens

Funding: City of Toronto, Durham Region, Peel Region, York Region, Toronto Remedial Action Plan

Figure 5. TRCA field technicians taking fish measurements. Captured fish are separated by species and measured for total length and weight, then released.

Background and Significance:

The aquatic habitat and fish community monitoring component of the RWMP includes sampling fish communities (**Figure 5**) and physical habitat characteristics at regional sites. Fish communities are a combination of different fish species living and interacting with each other at a specific location and/or time (Strus 1994). Fish are excellent indicators of stream health because they: are easy to collect and identify, live for several years, are sensitive to changes in their environment, differ in their tolerance to amount and types of pollution, and are sensitive to forms of pollution that chemical tests may miss. Approximately 50 sites are monitored annually on a three year rotation. Standardized sampling methods outlined in the Ontario Streams Assessment Protocol (OSAP) are used to allow for the comparison of the fish community within the physical habitat sampled, both geographically and over time across the region (Stanfield 2013).

2014 Program Highlights

- ✓ In 2014, a total of 47 RWMP sites (***see Regional Maps***) were sampled in the Don, Highland, Mimico, Petticoat and Frenchman's Bay watersheds. This is the fifth time that these sites have been monitored since RWMP's inception in 2001.

- ✓ A total of 3410 fish were sampled (captured, weighed and measured) in 2014 (**Figure 6**). A total of 27 species were found.

- ✓ Lake Chub (*Couesius plumbeus*) was found near the mouth of Highland Creek for the first time. These fish are a common Lake species and travel upstream to spawn.

Figure 6. Brown Bullhead being measured for length before being released.

- ✓ Chinook Salmon (*Oncorhynchus tshawytscha*) was captured in the Don River watershed for the first time since RWMP sampling began. Chinook Salmon are common lake fish that travel upstream in the fall to spawn, so it was unusual to find one in mid-summer.

- ✓ Invasive Round Gobies (*Neogobius melanostomus*) were captured at four sites. One site each in the Don River and Mimico Creek, and two sites in Highland Creek. The two Highland sites represent the first range expansion into this watershed. Round Gobies have been captured at the other two sites previously but to date no further range expansion is evident in these watersheds. These fish were preserved and samples were sent to McMaster University for analyses.

2.3 Fluvial Geomorphology

Staff Lead: Nelson Amaral

Funding: City of Toronto, Durham Region, Peel Region, York Region, Toronto Remedial Action Plan

Figure 7. Geomorphology work includes collecting cross sectional data, where the stream is measured from bank to bank and perpendicular to flow. Cross section monitoring identifies how physical characteristics of a stream change over time.

Background and Significance:

Fluvial geomorphology measures the physical characteristics of stream channels in order to understand how the natural setting and human land use in a watershed determine the shape of watercourses. The adjustment of watercourses to changes in the environment may take thousands of years (e.g. in response to de-glaciation) but may occur in less than a decade, as is frequently the case with direct human activity i.e. urban development. Understanding how these processes, both natural and human, operating at different time scales, alter the width, depth, and platform of a channel is critical for identifying areas in a river system that may be prone to erosion, flooding, or other problems. Regional, municipal and academic partners use the data to assess stream channel adjustment and assist with design and construction of erosion controls and other capital infrastructure projects.

A total of 150 fluvial geomorphology sites were established throughout the 9 watersheds in the TRCA jurisdiction between 2001 and 2003 as part of the RWMP, with approximately 50 sites monitored every year on rotation. Detailed geomorphic data are collected at each site in order to quantify and characterize the channel dimensions along with various bed and bank properties. Monitoring efforts include: re-evaluating channel stability through stability indexes, re-measuring channel dimensions along an established "control" cross-section (**Figure 7**), reassessing particle size distribution, and re-measuring bed chains and erosion pins in streambeds and banks. A decade of data has now been collected for each of TRCA's9 watersheds. Analyses to compare the data collected over the past decade is underway to show any large-scale changes in the stream channels on the watershed scale.

2014 Program Highlights

- ✓ In 2014, no RWMP geomorphic stations were sampled. A summary report detailing the findings of the fluvial geomorphology monitoring program to date (2000 to 2013) will be published in 2015. An assessment of future fluvial geomorphology monitoring activities will be determined based on the findings presented in this comprehensive data summary report, as well as availability of funding and future monitoring goals.

- ✓ In 2014, 28 stations were sampled as part of 6 special projects. Of these 28 stations, 22 were newly established stations (**see *2014 Special Projects Map***).

- ✓ The data collected from 2000-2012, which represents complete sample years, were consolidated and verified to allow for the calculation of metrics that characterize the physical stream characteristics at the geomorphic monitoring stations; including 28,360 particle measurements, 23,888 depth measurements, 600 cross-sectional area surveys, 2,468 erosion pin measurements. This information should facilitate the identification of large-scale changes in the stream channels at the subwatershed and watershed scale. For example, **Figure 8** displays the geomorphic data collected at station GTPC-6 located in the centre of the Petticoat Creek watershed, approximately 6.5 km from Lake Ontario. The data collected since 2001 will be analyzed to identify the processes acting upon this station and watershed.

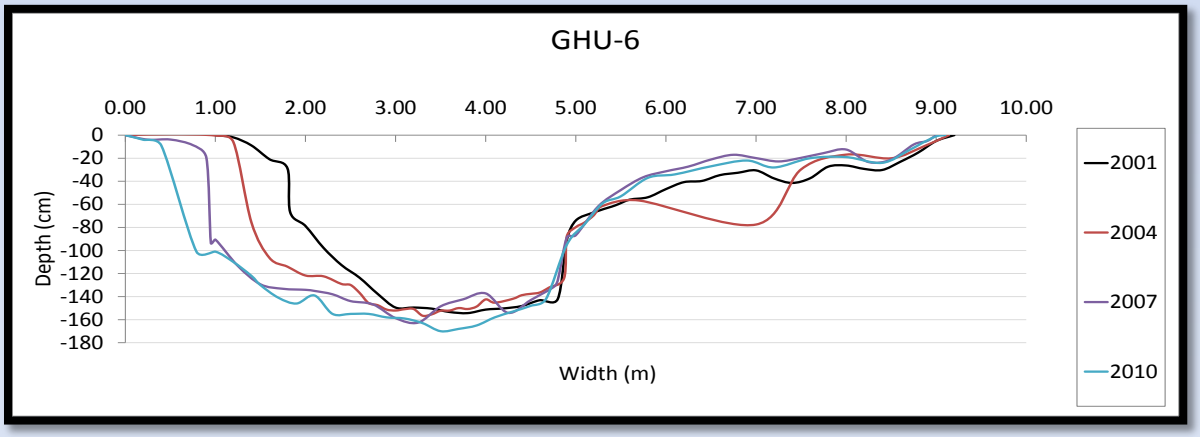


Figure 8. Cross-sectional profile of site GHU-6 in Petticoat Creek.

2.4 Surface Water Quality

Staff Lead: Ray Biastoch

Support Staff: Angela Wallace, Samantha Everson, Mark Szonda

Funding: City of Toronto, Durham Region, Peel Region, York Region, Toronto Remedial Action Plan, Ontario Ministry of the Environment and Climate Change

Figure 9. Collecting monthly water quality samples.

Background and Significance:

Across TRCA's watersheds, non-point sources of pollution such as stormwater runoff from impervious surfaces are the main contributors to water quality impairment. In addition, nutrient runoff from agricultural land, salting roads in winter, discharging wastewater from industries and sewage treatment plants can also affect water quality. Since 2002, TRCA has been monitoring water quality (**Figure 9**) at a number of sites across the jurisdiction. Surface water quality monitoring involves the measure of stream water chemistry, including metals, nutrients and bacteria (e.g. *E. coli*). This includes a partnership with the Ontario Ministry of the Environment and Climate Change (OMOECC) whereby TRCA collects samples at 13 sites for the Provincial Water Quality Monitoring Network (PWQMN). In addition to the PWQMN sites, TRCA collects samples at 30 Regional Watershed Monitoring Program sites (plus special projects) in order to enhance our knowledge of water quality throughout the jurisdiction.

Surface water quality data are used to help understand the impacts of land-use (e.g. agriculture, urban) on the water quality of local watercourses, which ultimately flow into Lake Ontario. Long-term data are needed to characterize water quality conditions in the jurisdiction as well as individual watersheds, and also to show trends over time. This information is used to help make informed decisions about managing and protecting our valuable water resources.

2014 Program Highlights

- ✓ Surface water quality samples were collected monthly at 46 sites. The 46 sites (***see Regional Maps***) were comprised of 13 PWQMN sites, 30 RWMP sites and 3 special project sites (Seaton/Duffins Heights development lands).

- ✓ In November 2014, the biennual inter-laboratory comparison sampling was performed and duplicate water samples were delivered to five laboratories for analyses. The 2015 inter-laboratory report will examine similarities between lab results as well as support management decisions of laboratory selection.

- ✓ The *2013 Surface Water Quality Summary Report* was completed in the spring of 2014. Included for the first time in this annual report was an analyses of five years of data for each water quality parameter, characterizing long-term conditions at each site. Data analyses showed that the sites experiencing the highest levels of metals, nutrients and bacteria were situated in very urbanized areas closer to Lake Ontario. For example, **Figure 10** shows how monthly chloride samples from 2009 to 2013 demonstrated higher levels in winter months largely due to the application of de-icing road salts. Despite the fact that road salts are not applied in spring and summer months, levels of chloride can remain sufficiently high such that it is toxic to aquatic life; chloride molecules that persist in nearby ditches and aquifers can enter watercourses following large rain events.

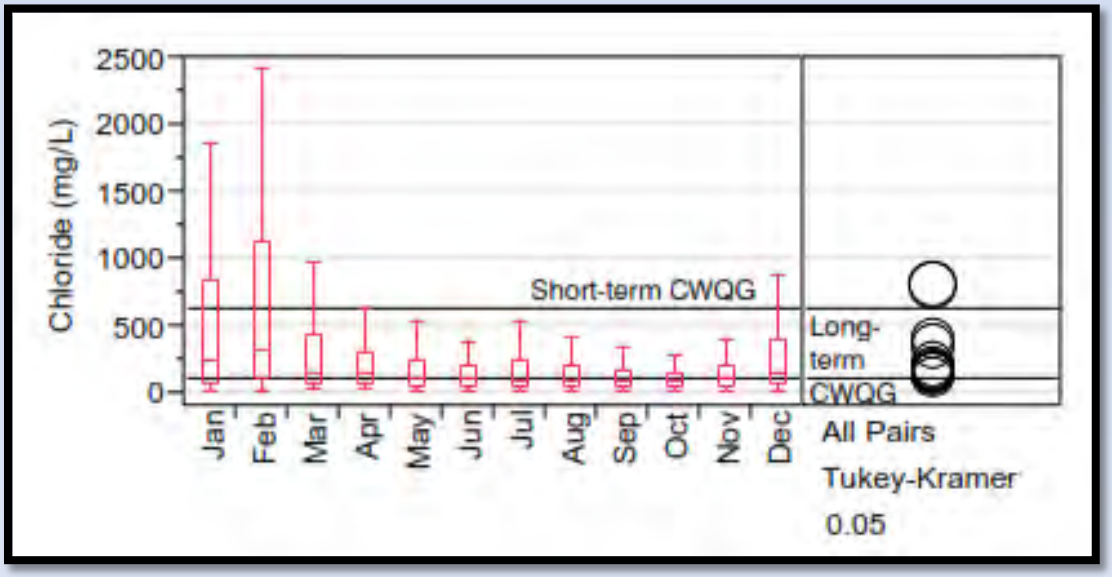


Figure 10. Monthly chloride (mg/L) levels demonstrate higher levels in winter months due to the application of de-icing road salts. Throughout the warmer months, chloride levels can surpass short-term 'toxic to aquatic life' thresholds outlined by the Canadian Water Quality Guidelines as a result of rain washing persisting chloride molecules into watercourses from adjoining ditches and aquifers.

2.5 Water Temperature Monitoring

Staff Lead: Angela Wallace, Mark Szonda

Support Staff: Samantha Everson

Funding: City of Toronto, Durham Region, Peel Region, York Region, Toronto Remedial Action Plan

Figure 11. Installing a year-round temperature logger in a watercourse.

Background and Significance:

Water temperature data are collected as part of the aquatic monitoring component of TRCA's RWMP using seasonal and year-round temperature loggers (**Figure 11**). Since aquatic organisms are highly dependent on the temperature of the water they inhabit, much of the diversity of aquatic organisms within a stream can be associated with water temperature. Tracking water temperature can also help indicate the influence of groundwater on the watercourse. For example, coldwater streams are of particular importance since certain fish species such as Brook Trout (*Salvelinus fontinalis*) rely on groundwater upwellings for spawning. In addition, the data collected by the RWMP may be able to show long-term changes in water temperature over time caused by land-use changes (e.g. urbanization) or climate change.

2014 Program Highlights

- ✓ A total of 87 water temperature loggers were active for 2014: 36 seasonal loggers (approximately April-October) and 51 year-round loggers (***see Regional Maps***).

- ✓ Water temperature data are being moved to the Aquarius software database to help organize and analyze this enormous dataset (more than 2 million data points!).

- ✓ Year-round temperature loggers have now been installed at several locations in all of TRCA's nine watersheds.

- ✓ Additional year round (**Figure 12**) and seasonal loggers were installed at the Seaton development lands in Pickering in order to collect baseline data before development begins in 2015.

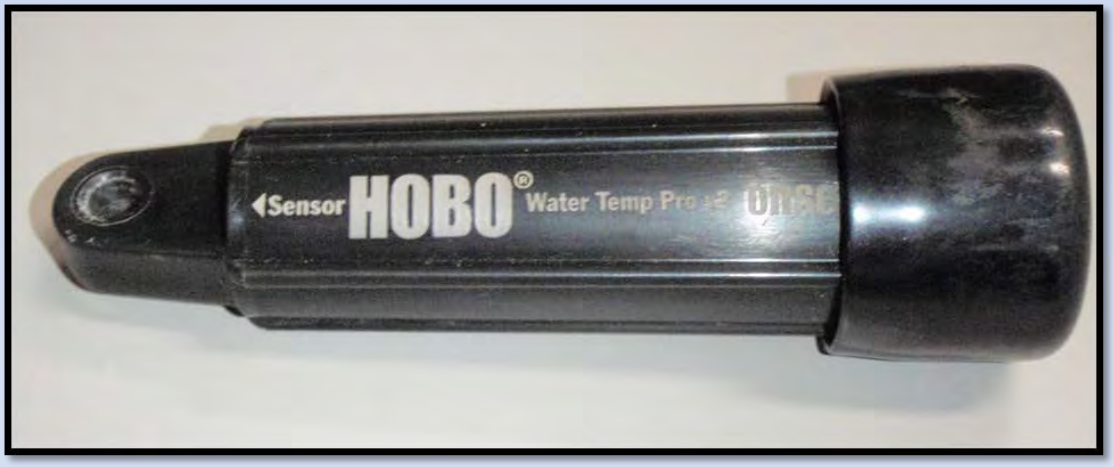


Figure 12. A year-round temperature logger installed at the Seaton development lands site.

2.6 Benthic Macroinvertebrates

Staff Lead: Jessica Fang

Support Staff: Angela Wallace, Samantha Everson, Jeff Vandenberg

Seasonal Staff: Emma Brookfield, Kyle Chalmers, Samantha Delargy, Danielle Dellandrea, Taylor Ivanovich, Dean Lamming, Christopher Ng, Paula Reynolds, Ryan Scott, Jet Taylor, Tracey Ubbens

Funding: City of Toronto, Durham Region, Peel Region, York Region, Toronto Remedial Action Plan

Figure 13. Field technicians collecting benthic macroinvertebrates in Duffins Creek.

Background and Significance:

There are a wide variety of animals without backbones which inhabit the substrate and sediment of watercourses for at least portion of their lives. Those visible without the use of a microscope such as aquatic worms, juvenile insects, snails, etc. are referred to as benthic macroinvertebrates (BMI). Organisms in this diverse group have different ecological requirements and different sensitivities to disturbances in their environment; some may be tolerant and others may be intolerant of disturbances, environmental change, and poor water quality. BMI tend to be sedentary with short life cycles and therefore reflect the environmental conditions at that particular location. Additionally, the relatively high abundance of BMI and the low cost of equipment to collect make them ideal organisms for biomonitoring purposes.

TRCA's BMI monitoring program (**Figure 13**) started in 2001 and has been used to track changes in aquatic biota and water quality across the region for over 10 years. BMI monitoring is conducted yearly at approximately 150 sites across the TRCA jurisdiction as well as at a number of additional sites for special projects.

2014 Program Highlights

- ✓ A total of 141 RWMP sites were sampled (**see *Regional Maps***); 434 samples were processed and more than 50,000 macroinvertebrates were identified.

- ✓ The TRCA is a provincial leader in identifying BMI (**Figure 14**) to the Lowest Practical Level (LPL), with its staff being certified in genus level identification by the Society for Freshwater Science (SFS). It is expected that the ecological information provided by LPL identification will improve analyses and reporting due to the increased ability to detect and track changes in its watersheds.

Figure 14. Staff biologists identifying benthic macroinvertebrates to the Lowest Practical Level.

- ✓ An uncommon Empidoid fly larva was collected in Duffins Creek in June 2014, during RWMP's benthic macroinvertebrate survey. Empidoid flies consist of two major families of flies: Dolichopodidae (long-legged flies) and Empididae (dagger flies and balloon flies). This larva is rare and morphologically unique; however it could not be identified with available publications and references. One specimen (two were collected) was donated to Dr. Bradley J. Sinclair to be deposited in The Canadian National Collection of Insects, Arachnids and Nematodes in Ottawa for future reference. Dr. Bradley J. Sinclair specializes in world fauna and classification of predaceous empidoid flies.

- ✓ All benthic macroinvertebrate data are now stored in the BMI database, which is a Microsoft Access database. The latest BMI data can now be searched and queried on this database.

2.7 West Nile Virus Vector Monitoring

Staff Lead: Jessica Fang

Support Staff: Danielle Dellandrea

Funding: City of Toronto, Durham Region, Peel Region, York Region

Figure 15. West Nile virus technician sampling for larval mosquitoes (L) and identifying mature larvae in the lab (R).

Background and Significance:

West Nile virus (WNV) primarily exists between birds and bird-biting mosquitoes. The virus transmits to humans through the bite of a mosquito which become infected by feeding on the birds carrying the virus. Humans are considered dead-end hosts, meaning we can be infected by the virus but do not spread it. For people who become infected, the majority will have no symptoms or only mild flu-like symptoms. Severe cases of WNV, including the development of meningitis and encephalitis, are extremely rare but can be fatal. In Canada, human WNV case numbers fluctuate from year to year driven by complex environmental and biological factors. In 2014, a total of 19 human cases were reported from 3 provinces (Ontario with 10 cases, Quebec with 5 cases, and 4 cases in Manitoba). In the Greater Toronto Area (GTA), 3 human WNV cases were reported in the City of Toronto (Public Health Ontario 2014).

Due to TRCA's role in managing various aquatic habitats and at the request of TRCA's Regional Public Health partners, a WNV Surveillance and Monitoring Program (**Figure 15**) was launched in 2003. The core objectives of the WNV Monitoring and Surveillance Program are to: assess the abundance of mosquito larvae, collaborate with the Regional Public Health Units, investigate standing water complaints associated with TRCA properties, educate the public about WNV risks, and take proactive management steps to reduce risk of WNV transmission when warranted.

2014 Program Highlights

- ✓ In 2014, monitoring began on June 3 and ended on August 21. A total of 45 sites were monitored across TRCA's jurisdiction, including 39 wetlands and 6 stormwater management ponds (SWMPs) (**see Regional Maps**).

- ✓ A total of 6956 mosquito larvae were collected from the routine monitoring sites in 2014, including 6538 larvae from 39 wetlands and 418 larvae from the 6 SWMPs.

- ✓ Thirteen mosquito species were identified including six WNV vector species and seven non-vector species. The most widespread species was *Culex territans*, a non-vector species. The major WNV vector *Culex pipiens* was the primary species found in SWMPs.

- ✓ Risk assessment resulted in the identification of eight WNV vector mosquito larvae hot spots, with larvicide treatments applied as needed. These included:

    - o Grenadier Pond in High Park,
    - o Topham Pond in Eglinton Flats,
    - o Goldfish Pond in Tommy Thompson Park,
    - o Albion Hills Conservation Area Wetland,
    - o Unnamed wetland in Vaughan,
    - o L'Amoreaux Park North Pond,
    - o Granger Wetland, and
    - o Colonel Sam Smith Pond.

- ✓ The data collected in 2014 were used to generate the *Annual Report: West Nile Virus Vector Mosquito Larval Monitoring and Surveillance – 2014*.

2.8 Groundwater Quality and Quantity

Staff Lead: Jeff Vandenberg

Support Staff: Don Ford, Andrew Taylor, Jehan Zeb

Funding: Ontario Ministry of the Environment and Climate Change, Toronto and Region Conservation

Figure 16. TRCA and Ontario Ministry of Environment and Climate Change (OMOECC) installing a pilot satellite groundwater telemetry system at Mono Mills.

Background and Significance:

Approximately three million residents in Ontario rely on groundwater from municipal and private wells as their primary source of drinking water. Many communities are dependent on groundwater supplies to maintain existing domestic, commercial, industrial, agricultural and institutional operations. Overdrawing and contamination activities are elevating the stress placed on this vital resource.

The Provincial Groundwater Monitoring Network (PGMN) was established in April 2000 to assess current groundwater conditions and provide an early warning system for changes in water levels and water quality. The Provincial Groundwater Monitoring Network (PGMN) is a partnership program between the OMOECC and all 36 Ontario conservation authorities, including 10 municipalities (in areas not covered by a conservation authority). The role of OMOE in the network is to set policy direction, develop strategic objectives and maintain the Provincial Groundwater Monitoring Information System (PGMIS) program database, The mandate of the TRCA under the PGMN partnership is to maintain the digital telemetry systems, collect water level data and arrange for chemical analyses of water quality samples at dedicated wells.

2014 Program Highlights

- ✓ The regular maintenance of wells and instrumentation, including manual level checks, continued at 19 well sites in 2014 (***see Regional Maps***).

- ✓ In 2014, a total of 16 groundwater wells were sampled for water quality in the fall. An annual report on groundwater quality will be produced later in 2015 by TRCA's Geoenvironmental Section.

- ✓ Two groundwater wells were lost from the network at the end of 2014. Development is taking place around where two of our wells are located near Taunton Road in Ajax and these wells were removed. Discussions are taking place to identify if these wells could be replaced in the network.

- ✓ All of TRCA's logger data are now updated on the OMOECC Provincial Groundwater Monitoring Information System database to fall 2014. Updates will be on-going.

- ✓ The technology used in the Provincial Groundwater Monitoring Network telemetry system has become obsolete. All digital telemetry systems have been removed from the wells. The OMOECC is currently exploring options to convert to a satellite telemetry system. One site in Mono Mills had the new equipment installed in 2014 (**Figure 16**). More wells will be converted over to the new system as funding becomes available. It is expected this will take a number of years.

2.9 Water Quantity: Stream Flow, Precipitation and Snow Course

Staff Lead: Leland Wilbur

Support Staff: Matt Derro, Greg Dillane, Jamie Duncan, Calvin Hitch, Bill Kerr, Rita Lucero, Craig Mitchell

Funding: City of Toronto, Durham Region, Peel Region, York Region, Toronto Remedial Action Plan

Figure 17. TRCA real time stream and precipitation gauges. Knightswood stream gauge is shown on the left and the new Brock West Landfill 4 season rain gauge is on the right.

Background and Significance:

One of the indicators monitored under TRCA's RWMP is water quantity which includes stream flow, precipitation, and snowpack accumulation.

Stream flow data has been collected in TRCA's jurisdiction for over 50 years and was originally implemented by the federal government to meet its international obligations related to the Great Lakes. Today, the TRCA has 36 stream gauges (**Figure 17**) as part of both the RWMP and Flood Management Services (FMS). Watercourse flow and level information is collected by TRCA stream gauges every 15 minutes. Each station is maintained monthly and flow measurements are taken throughout the year in order to develop a level-flow relationship (stage-discharge curve). Each curve is either verified or generated depending on the hydraulic conditions. Of the 36 stream gauges, 16 of them are part of the TRCA Real Time Flood Warning Network (**Figure 18**), where 4 are used to observe dam reservoir storage. Typically, stream flow data are used for stormwater management, water budget models, flood infrastructure operations, flood forecasting and warning, water quality studies, and impairment models in watercourses and Lake Ontario.

Figure 18. (L to R) TRCA real-time flood warning website (www.trcagauging.ca) and real-time stream gauge.

Generally used in context with stream flow, precipitation data are collected to document storm events, annual discharges, and for flood forecasting. The data are regularly found in road and sewer design details, water balance and flood models, water quality/quantity studies, calibrating/confirming Intensity Duration Frequency curves, and emergency bulletins. In Toronto and the surrounding area there are over 100 rain gauges (**Figure 19**) which are owned and operated by all levels of government, educational institutions, and the private sector; of that total, the TRCA has 34 gauges. Stations in this network were strategically located in order to provide maximum coverage of TRCA's jurisdiction and all of its watersheds. Originally conceptualized for the TRCA's FMS program and ambient monitoring initiatives, it has evolved into a regional database regularly utilized by numerous public and private organizations.

Figure 19. Various TRCA precipitation gauges. The four season gauge at Stouffville Dam is shown on the left, Heart Lake rain gauge is shown undergoing calibration in the centre and Bruce's Mill is shown on the right.

Unlike the stream and precipitation networks, which are fully automated, the TRCA manually monitors snowpack accumulation (**Figure 20**) at ten locations in order to determine the condition of its watersheds prior to the spring thaw. The stations were selected to provide a jurisdictional assessment of snow characteristics including: snow depth, water equivalent, snow density, snow crust, and underlying soil attributes (e.g. frozen). The TRCA uses the MNR's snow course sampling protocols (OMNRF 1985), where each snow course is visited twice a month during the winter season (approx. the 1st and 15th day). The data are submitted to the

Ministry of Natural Resources (MNR) and TRCA flood duty officers bi-weekly in order to assess the snow melt flood threat in our watersheds. Information has been collected at several stations since the late 1970s with one station having records as far back as 1957.

Figure 20. Snowcourse sampling kit (left) and data collection (right).

2014 Program Highlights

- ✓ The Streamflow network operated as normal during 2014. A number of sites required significant field work after the ice storm in December 2013 (**Figure 21**). The ice storm took down a large number of branches and trees. At a number of sites, these fell across channels and were caught in the stream, which required them to be cleaned out and removed.

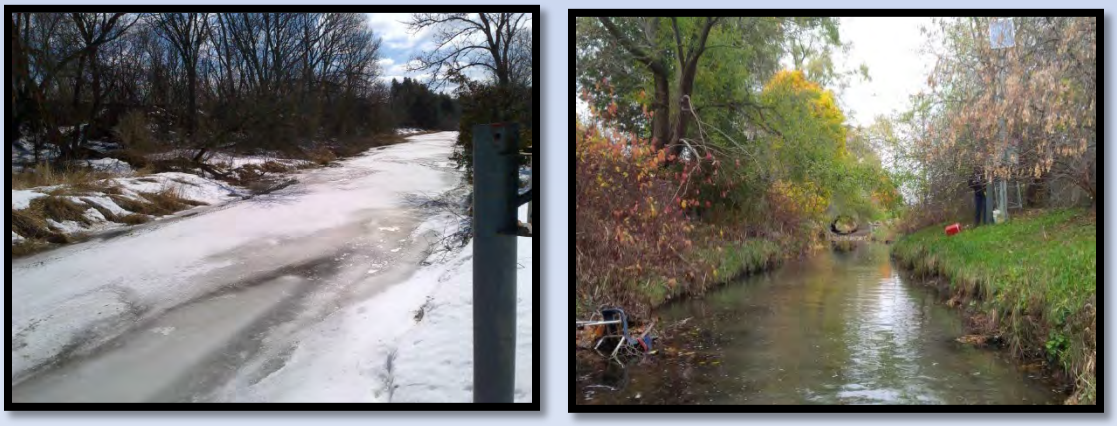


Figure 21. West Duffins stream gauge with ice over is shown on the left and Krosno Creek real time gauge is shown on the right.

- ✓ Streamflow network rating curves were able to use a number of Lowflow Program discharge measurements to further develop the low end of rating curves and prevent staff from duplicating efforts.

- ✓ Discharge measurements were taken at every site to verify existing rating curves and create new ones where needed. Equipment upgrades over the last few years have allowed staff to create rating curves very quickly and at higher flows than previously recorded. This has led to more accurate discharge data in higher flow regimes as well as discharge values higher than the Hydrometrics group has been able to produce in the past.

- ✓ During 2014, TRCA precipitation network underwent a number of equipment upgrades to include a new real time four season rain gauge at Brock West Landfill. This upgrade has helped to improved the coverage of the real time precipitation network while also providing four season data collection where previously only three season data was available.

- ✓ Streamflow, precipitation and meterological data all underwent rigourous quality control checks, including correction for calibration, data drift and data gap filling. This has produced some of the highest quality data created by the Hydrometrics group. Additionally, data grading has been included as part of the quality control process which gives end users a better understanding of the quality of the dataset produced.

- ✓ Snowcourse sampling over Winter 2014 operated as normal. Over the course of the winter, snow accumulations quickly reached the highest amounts in almost a decade. Additionally, the snow stuck around later into the spring than it had in the previous ten years, as seen in **Figure 22.**

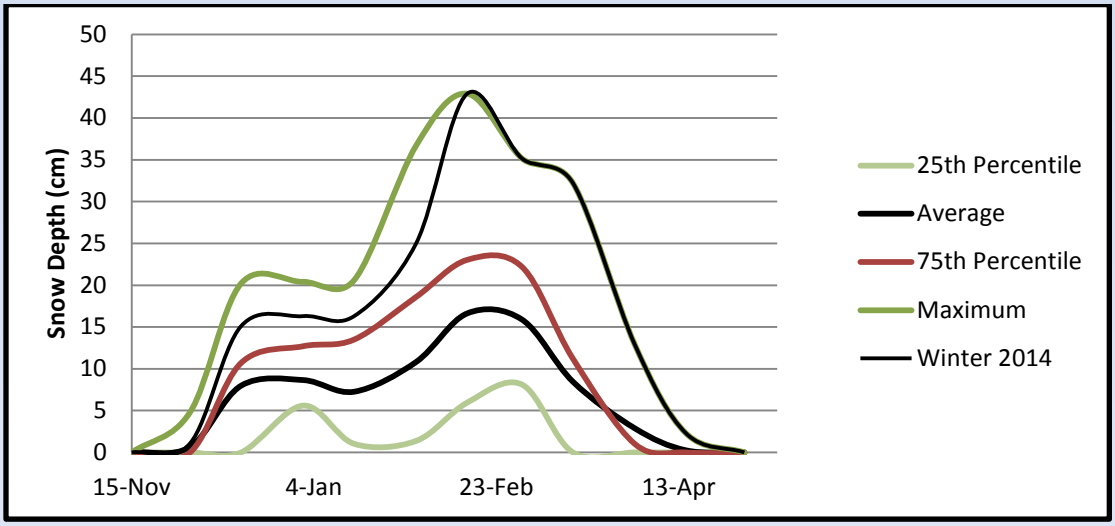


Figure 22. While the Winter 2014 started out relatively normal, a particularly snowy February contributed to a 10 year maximum snowfall on average around the GTA. Not only was there much more snow than normal, it also took longer than normal to melt as we had the latest snow on the ground in 10 years as well.

2.10 Water Quantity - Baseflow

Staff Lead: Leland Wilbur, Greg Dillane

Support Staff: Matt Derro, Jamie Duncan, Calvin Hitch, Rita Lucero

Funding: City of Toronto, Durham Region, Peel Region, York Region, Toronto Remedial Action Plan

Figure 23. Baseflow measurements were conducted from June to September 2014.

Background and Significance:

Baseflow conditions represent the lowest stream flows that typically occur in a watercourse. Baseflow is usually supplied primarily by groundwater discharge occurring along the stream corridor and / or the gradual release of water from wetlands. The term low flow refers to the amount of stream flow that is sustained in a watercourse during extended periods of dry weather. In our watersheds, low flow conditions occur in the drier summer season between late May and September.

The TRCA Low Flow Monitoring Program was established in 2000 to conduct ongoing jurisdictional monitoring of low flows during the drier summer season. This program makes important contributions to the overall data collected by our RWMP. It consists of more than 1100 individual monitoring stations, with summer monthly monitoring occurring at an average of 68 stations per year. These 68 stations are called indicator stations and are usually located at the outflow of each major sub-watershed. The other monitoring stations are distributed within each watershed and are measured systematically every 5 to 7 years in order to obtain provide a higher resolution of ground and surface water interactions.

The main purpose of TRCA's Low Flow Program is to develop data that allows for a better understanding of the interconnections between the groundwater and surface water systems in our watersheds. The program also helps to establish contacts and relationships with water users as a basis for promoting awareness of overdrawing and contamination issues. The long-term goal of the TRCA Low Flow Program is to guide the management and protection of baseflow levels to protect aquatic life and sustainable human use of surface water.

2014 Program Highlights

- ✓ A total of 59 transect measurements were conducted across all watersheds during the 2014 field season. The intention of the 2014 fieldwork season was to include all of the indicator stations plus additional monitoring sites in the Etobicoke and Mimico watersheds. Due to a significant number of rainy days throughout the field season, only the indicator stations were completed. The baseflow measurements were collected from June to mid-September (**Figure 23**).

- ✓ During 2014, fieldwork was modified to accommodate the increase in precipitation. Due to high levels of rain occurring throughout the summer months, roughly 80% of the fieldwork sampling days scheduled were not completed; the Lowflow sampling criteria was not met. By the end of August, drier weather had arrived and a majority of the samples were collected throughout September.

- ✓ While the GTA did see a number of localised high intensity rain events, the majority of rainfall was low intensity and the accumulated rainfall was close to average. Despite this, the baseflow samples collected were generally higher than the long term average at indicator stations. Only Frenchman's Bay and Petticoat Creek had lower than average flows while the rest of the watersheds observed between 100% and 190% of average flows. This increase in baseflows is likely due to higher groundwater levels that received large amounts of surface water during precipitations events

2.11 Meteorological Monitoring

Staff Lead: Greg Dillane, Leland Wilbur

Support Staff: Greg Dillane, Jamie Duncan, Calvin Hitch, Bill Kerr, Rita Lucero, Craig Mitchell

Funding: City of Toronto, Durham Region, Peel Region, York Region

Figure 24. (L to R) Knightswood Road in Toronto before and during the June 25th 2014 storm, which dropped between 60-70 mm of rainfall in two hours on North and East York.

Background and Significance:

The TRCA identified Climate Change as an important issue related to its watershed management mandate in the mid-1990s. While it is well known that urbanization has an impact on natural systems, the additional stress of climate change can further modify our natural systems and create new or increased challenges to the TRCA's management objectives (Haley 2006). For example, early attempts to deal with increased volumes of water in waterways were centered on stormwater management by reducing peak flow to match pre-development conditions. While this practice is now commonplace, urban infrastructure falls short of dealing with extreme weather (**Figure 24**) such as rainfall greater than a 100 year storm (Haley 2006).

Conservation Authorities provide their clients with effective direction and input around mitigation and adaptive management of local ecosystems under the challenges that climate change can create (Haley 2006). Numerous TRCA programs (e.g. RWMP and FMS) and partners continue to rely on our data collection services and monitoring expertise to give them as much information regarding their watersheds as possible; ultimately leading to the development of the TRCA's meteorological (MET) network.

Construction of the MET network began in the spring of 2006 with the acquisition of two MET stations from Natural Resources Canada and one from Guelph University. Since that time, partnerships with both Guelph and York Universities have surfaced where they are investigating evapotranspiration (ET) respectively. Currently, the TRCA has six MET stations consisting of a variety of sensory devices and eight air temperature stations. Monitored parameters include: rainfall, wind direction and speed, air and soil temperature, relative humidity, solar radiation, snow depth, barometric pressure, soil moisture, evaporation, ET and leaf wetness. Similar to our water quantity monitoring, the MET network is designed for remote operations and long-term deployment (>15 years).

2014 Program Highlights

- ✓ All MET stations continued to operate normally in 2014. Upgrades to the network were performed at Transport Canada and Glen Haffy stations (**Figure 25**). Sensors and loggers were upgraded to maintain consistency with the rest of the stations as well as produce higher quality data going forward.

Figure 25. TRCA MET stations at Transport Canada (Claremont) and Glen Haffy.

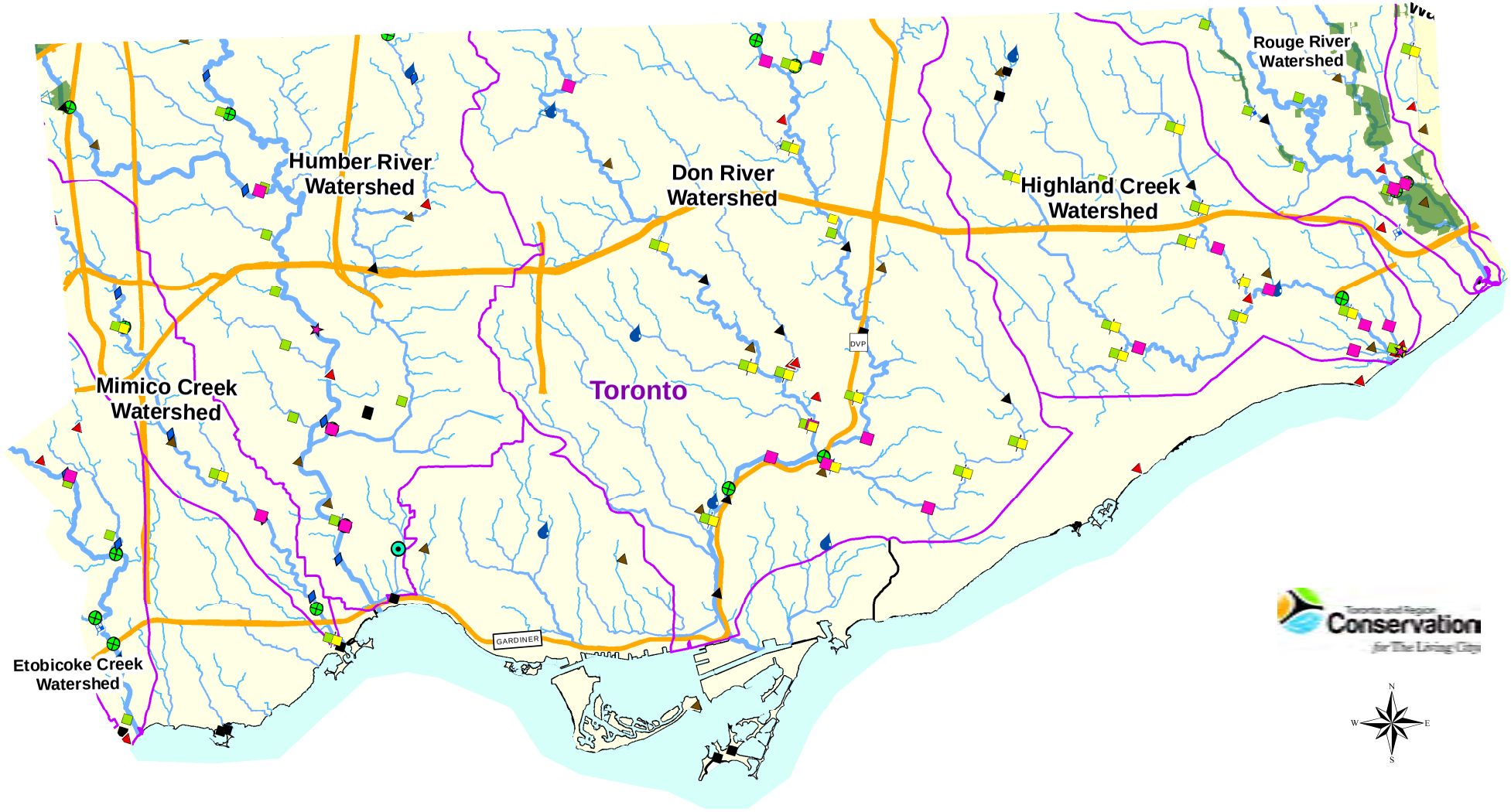
- ✓ The meteorological stations at Transport Canada and Glen Haffy were replaced with Onset loggers and sensors. The sensors replacement was completed to remove older equipment from the field, allow for easier diagnostics as well as utilize the same software and QAQC procedures as the precipitation network.

- ✓ The air temperature monitoring for TRCA's aquatic biology program continued in 2014. Since 2005, eight air temperature stations were deployed with the intent to correlate air temperature fluctuations with tributary water temperatures.

- ✓ Since the adoption of time series data correction software in 2013, meteorological monitoring data has undergone rigorous quality control for every record of data and for every parameter.

Toronto & Region Conservation Authority

2014 City of Toronto Monitoring Locations



Legend

- Air Temperature Loggers
- Aquatic Species & Habitat
- Baseflow Stations
- Benthic Macroinvertebrates
- Climate Monitoring
- Fluvial Geomorphology
- Groundwater Quality
- Groundwater Wells
- Precipitation Gauges
- Snow Gauges
- Stream Gauges
- Stream Water Quality
- Terrestrial Fixed Plots
- Terrestrial Inventories
- Terrestrial Volunteer Program
- Water Temperature (Seasonal)
- Water Temperature (Year Round)
- West Nile Virus Monitoring
- Highway
- Watercourse
- Watershed Boundary

Date: 4/1/2015

Created by: T.R.C.A. Information Services/ Information Technologies

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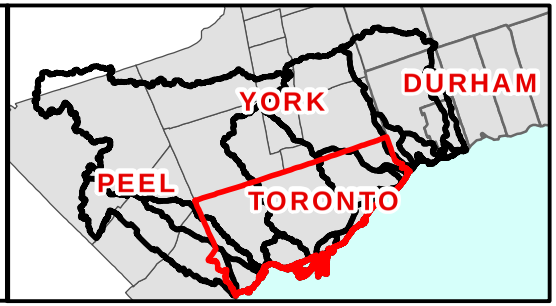
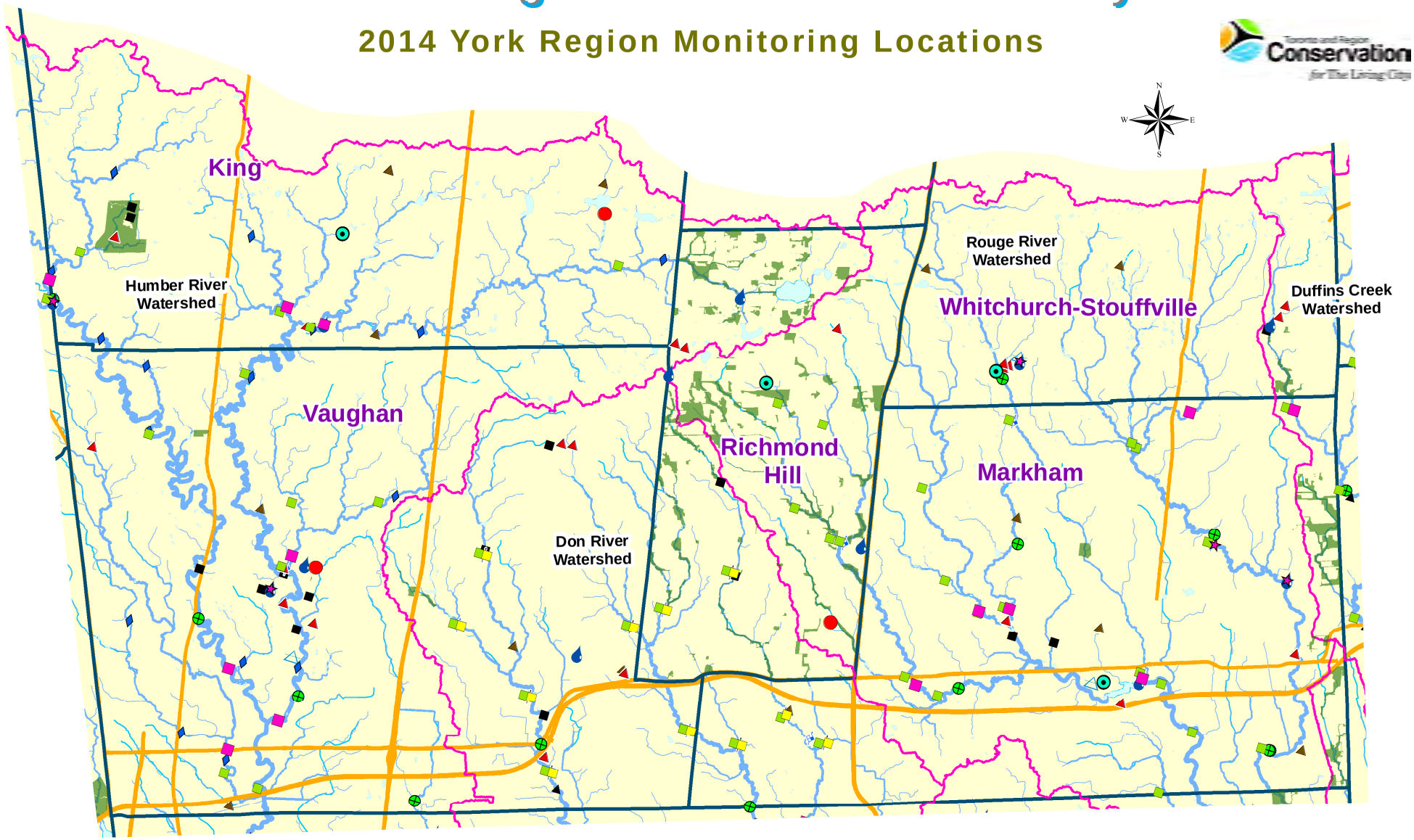


Toronto & Region Conservation Authority

2014 York Region Monitoring Locations



Legend

- Air Temperature Loggers
- Aquatic Species & Habitat
- Baseflow Stations
- Benthic Macroinvertebrates
- Climate Stations
- Fluvial Geomorphology
- Groundwater Quality
- Groundwater Wells
- Precipitation Gauges
- Snow Gauges
- Stream Gauges
- Stream Water Quality
- Terrestrial Fixed Plots
- Terrestrial Inventories
- Terrestrial Volunteer Program
- West Nile Virus
- Water Temperature (Seasonal)
- Water Temperature (Year Round)
- Municipal Boundary
- Highway
- Waterbodies
- Watercourse
- Watershed Boundary

Date: 4/2/2015

Created by: T.R.C.A. Information Services/ Information Technologies

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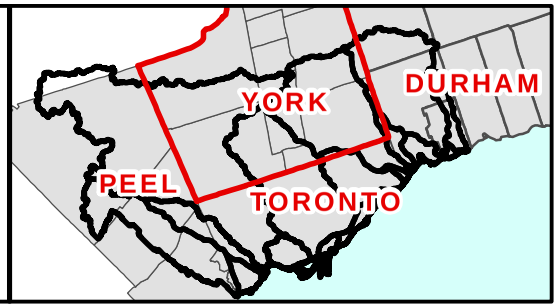

Toronto & Region Conservation Authority

2014 Peel Region Monitoring Locations

Toronto and Region Conservation for The Living City

Legend

- Air Temperature Loggers
- Aquatic Species & Habitat
- Baseflow Stations
- Benthic Macroinvertebrates
- Climate Stations
- Fluvial Geomorphology
- Groundwater Quality
- Groundwater Wells
- Precipitation Gauges
- Snow Gauges
- Stream Gauges
- Stream Water Quality
- Terrestrial Fixed Plots
- Terrestrial Inventories
- Terrestrial Volunteer Program
- Water Temperature (Seasonal)
- Water Temperature (Year Round)
- West Nile Virus
- Municipal Boundary
- Highway
- Waterbodies
- Watercourse
- Watershed Boundary

Date: 4/1/2015

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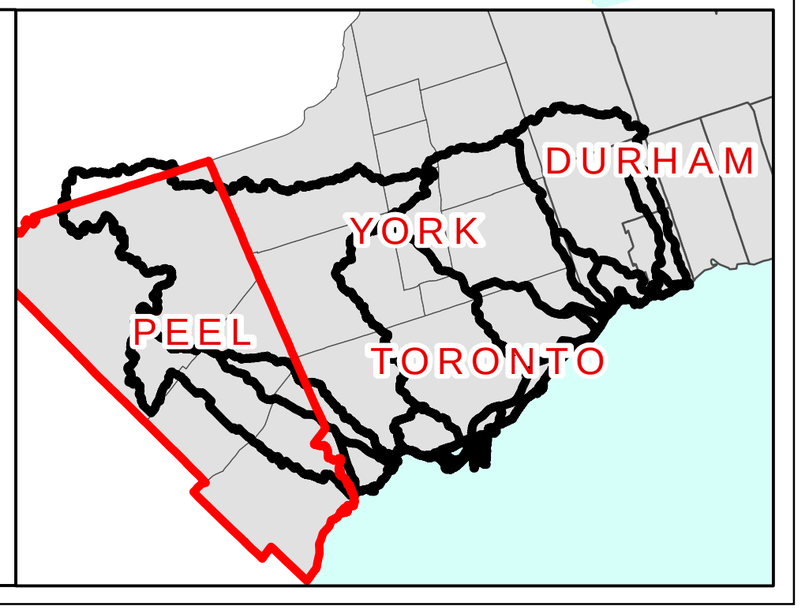

Toronto & Region Conservation Authority

2014 Durham Region Monitoring Locations

Toronto and Region Conservation for The Living City

N W E S

Legend

- Air Temperature Loggers
- Aquatic Species & Habitat
- Baseflow Stations
- Benthic Macroinvertebrates
- Climate Stations
- Fluvial Geomorphology
- Groundwater Quality
- Groundwater Wells
- Precipitation Gauges
- Snow Gauges
- Stream Gauges
- Stream Water Quality
- Terrestrial Fixed Plots
- Terrestrial Inventories
- Terrestrial Volunteer Program
- Water Temperature (Seasonal)
- Water Temperature (Year Round)
- West Nile Virus
- Municipal Boundary
- Highway
- Watercourse
- Waterbodies
- Watershed Boundary

Date: 4/1/2015

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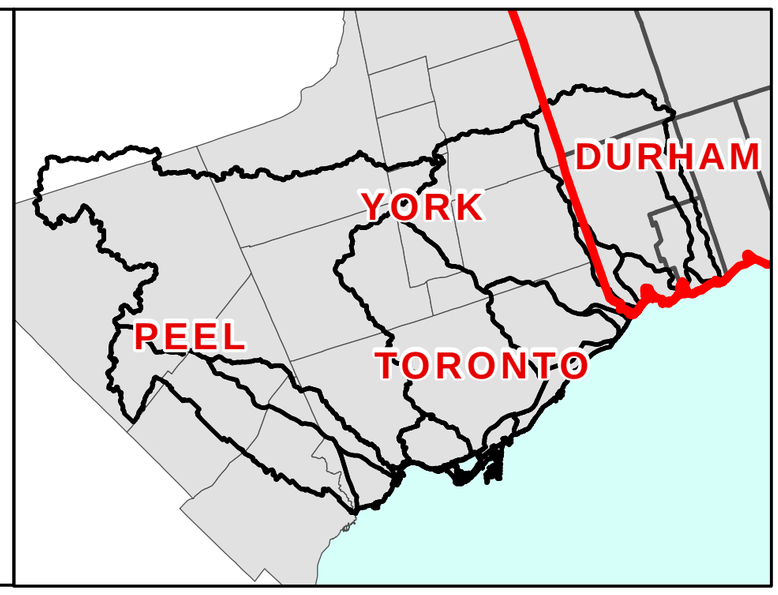

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3 Special Projects

In addition to the RWMP, numerous special projects are undertaken annually by TRCA. These projects employ staff from various sections and divisions within the TRCA in order to address research questions related to restoration and mitigation techniques and to provide valuable baseline information on watershed condition. These projects are often centered around localized issues and are often shorter in duration and narrower in focus compared to the RWMP. Where possible the monitoring for these special projects follows the same sampling methodology and protocols as the RWMP. This consistency in methodology increases efficiency and provides continuity in the data, allowing the data to be easily compared to RWMP monitoring sites. Both data sets are often relied upon for hypothesis testing and trend analyses at various geographical scales. The following sections give a brief overview of each of the special projects that the WM&R section was involved in during 2014. A map outlining monitoring locations of the various described special projects is located at the end of this Section.

3.1 Natural Channel Design

Staff Lead: Dean Young

Support Staff: Nelson Amaral, Samantha Everson, Natasha Gonsalves, Sue Hayes, Gavin Miller, Paul Prior, Mark Szonda, Derek Tune, Jeff Vandenberg

Seasonal Staff: John Barker, Brian Ford, Jessica Frigault, Greg Gapski, Mike King, Liz Petrov, Alisa Samuelson

Funding: City of Toronto, Peel Region, York Region

Figure 26. TRCA field staff collecting a geomorphic sample for natural channel design monitoring.

Background and Significance:

Reconstruction of stream channels to restore, rehabilitate or enhance its geomorphic and ecological functions is becoming an increasingly common management approach in urban areas both in Canada and internationally. The intent of the natural channel design (NCD) approach is to replicate the channel form that would naturally occur given the hydrologic and sediment conditions of the upstream drainage area. This approach also tries to re-establish in-stream and riparian habitats that exhibit healthy ecological functions, populated by diverse and productive aquatic and terrestrial communities. Natural channel designs incorporate the characteristics of natural rivers and streams including meandering plan form, bed forms, channel bed and banks constructed of natural materials, bioengineering techniques and native vegetation plantings. Considering the complexity of channel forming processes and the

inherent uncertainty associated with approaches to natural channel design, projects are largely experimental with long-term outcomes subject to considerable uncertainty. Due to the large uncertainty in predicting river response to design intervention, the need for an adaptive approach to natural channel management and design is acknowledged and advocated in Ontario. There is little evidence broadly available regarding the short and long-term effectiveness of natural channel designs, making it difficult to evaluate and improve current practices.

To address the general lack of systematic evaluations of the effectiveness of NCD projects in Ontario, the Toronto and Region Conservation Authority (TRCA) initiated a program to monitor and evaluate completed projects in the Greater Toronto Area watersheds in 2005. The first project undertaken as part of the Natural Channel Design Monitoring Program involved identifying a suite of monitoring parameters and data collection methods / frequencies suitable for evaluating if the original design objectives of NCD projects are being met. The monitoring protocol *Evaluating the Effectiveness of Natural Channel Design Projects: A Protocol for Monitoring Natural Channel Design Projects* (TRCA 2009a), was developed based on an extensive literature review and input from experienced practitioners of natural channel design and watershed monitoring (TRCA 2009b).

The second project of the Natural Channel Design Monitoring Program, initiated in 2005 and continuing to 2014, involves monitoring and evaluating a number of completed NCD projects in the TRCA jurisdiction (**Figure 26**). The project scope includes periodic monitoring and evaluation of 30 NCD project sites over a 10 year time period from 2005 to 2014 (**see *2014 Special Projects Map***). Each project is examined at a midway point, in case adjustments to the study design or monitoring protocols being applied are needed. Monitoring parameters assessed include: geomorphic characteristics (cross-sections, longitudinal profiles, bank and substrate, erosion pins), engineered elements (e.g. functioning of riffles, pools, vanes, bioengineering, mitigation of fish barriers), aquatic habitat and communities (fish and benthic invertebrates), riparian vegetation communities (ELC vegetation type and regional species of concern inventories, including invasive species), and amphibian and breeding bird surveys.

2014 Program Highlights

- ✓ Three additional Natural Channel Design sites were added to the monitoring program in 2014 (NCD 32, 33, and 34), which involved setting up and assessing the geomorphology monitoring locations, conducting an ELC inventory of vegetation communities, breeding bird and amphibian surveys, as well as sampling of fish and benthic communities.

- ✓ TRCA staff returned to the Morningside Creek Natural Channel Design site to repeat geomorphic survey work to locate cross-section monuments and erosion pins originally installed in 2003, and repeat surveys and sampling. This allows for comparison of 2014 data with the original survey and sampling data. Such data sets are valuable as they allow: (1) analyses of changes to the cross sectional profiles and (2) show the magnitude of various erosion processes acting upon the channel, which affect channel stability and ultimately influence stream sediment composition and habitat.

- ✓ Sampling of fish and benthic communities and characterization of aquatic habitat was repeated at six NCD project sites in 2014. Information from 2014 will be examined together with that from 2012 and 2013 and compared to results of sampling done between 2006 and 2008 to examine if: (1) changes have taken place in aquatic habitat and communities, and (2) if the sites continue to show signs of improvement over the 5 to 10 year or 5 to 15 year post-construction timeframes.

- ✓ In 2014, five NCD sites were re-surveyed for breeding fauna (breeding birds and amphibians) and four sites were re-surveyed for both fauna and vegetation communities. Information will be compared to that from previous surveys done between 2007 and 2009 to examine how terrestrial communities are evolving over time and what types of species are utilizing the habitats created. In addition, two recently constructed Natural Channel Design sites were surveyed for breeding fauna and vegetation communities for the first time.

- ✓ 2014 marks the final year for collection of data at the original 10 Natural Channel Design sites where monitoring began in 2005. Reporting on findings from the 10 years of monitoring will be completed in 2015.

3.2 Caledon East

Staff Lead: Don Ford, Sharon Lingertat, Jan Moryk, Christine Tu-Parker

Support Staff: Ray Biastoch, Jessica Fang, Mark Szonda

Funding: Region of Peel

Figure 27. Preparing 2014 turbidity samples gathered from Boyce's Creek, Caledon East.

Background and Significance:

With population growth expanding within Caledon East, the Region of Peel completed a Class Environmental Assessment (EA) in November 2007. The EA assessed the impacts to natural water features posed by increased draws from existing water supply wells. One of the EA recommendations was for the Region of Peel and TRCA to coordinate the monitoring activities outlined in the Region of Peel's *Natural Heritage Monitoring Program (NHMP)* (TRCA 2008a) on an annual basis. The *Natural Heritage Monitoring Program (NHMP)* was developed by TRCA in 2008 for the Region of Peel's *Environmental Management Plan (EMP) for the Caledon East Existing Water Supply System*. The monitoring activities currently underway include:

- biological monitoring of the fish community, including trout spawning activity,
- stream turbidity, flow, sediment particle size distribution in Boyce's Creek, and
- biological monitoring of the benthic macroinvertebrate ('aquatic insects') community in Boyce's Creek.

2014 Program Highlights

- ✓ In addition to the NHMP, 2014 marked the second year of a three year water quality monitoring initiative in Boyce's Creek in response to periodic sediment releases that began in 2010. The Region of Peel has implemented long term mitigation and management efforts intended to prevent future silt releases. Water quality monitoring (**Figure 27**) is in place to track stream recovery post-siltation and is anticipated to continue for at least one more year. Once sediment conditions return to pre-existing conditions, water quality monitoring activities will be discontinued. For more detail on this initiative and some preliminary results please refer to the *2013 or 2014 Caledon East Technical Brief.*
- ✓ Every August since 2007, fish communities are monitored in the two creeks that flow though Caledon, Centreville Creek and Boyce's Creek. 2014 marked the lowest ever recorded abundance for Brook Trout juveniles in both creeks, continuing the steady decline in abundance observed since 2009/10. In Boyce's Creek specifically, increasing Brook Trout size coupled with decreasing abundance (**Figure 28**) is signifying that only the largest fish are able to occupy this stressed reach. The multiple silt releases are considered the main cause of recent impacts to Brook Trout size and abundance.

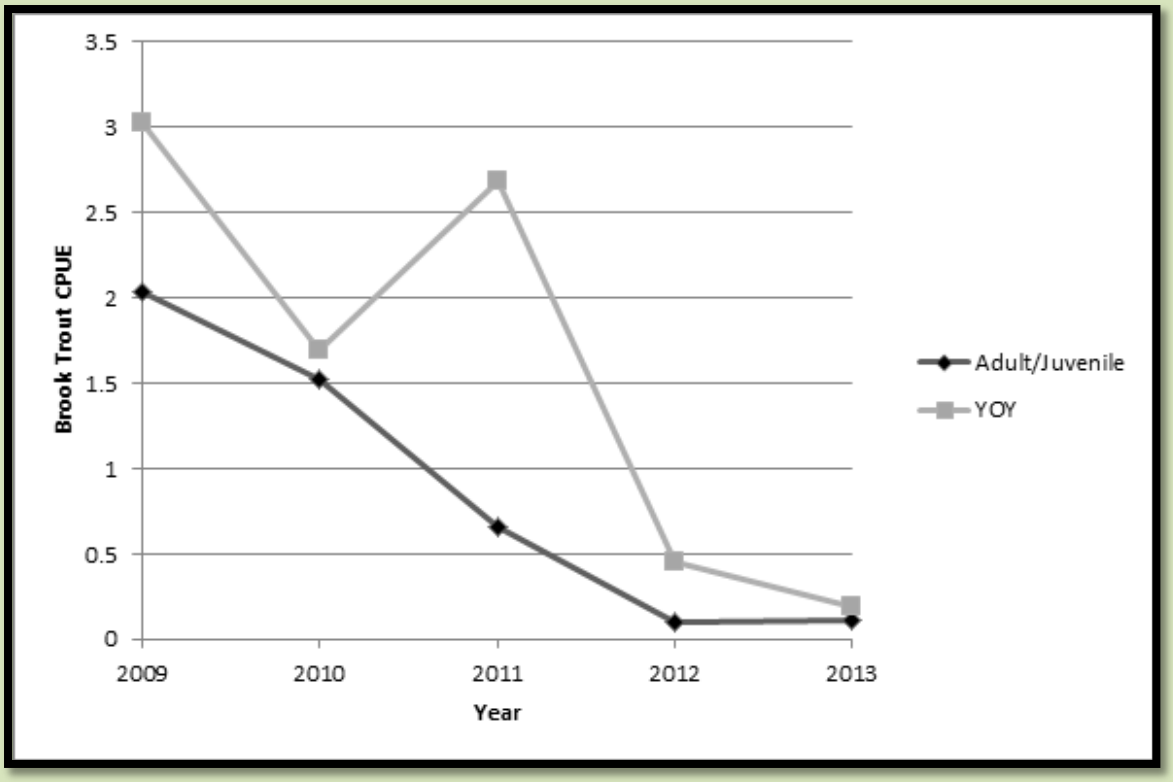


Figure 28. Boyce's Creek Brook Trout Catch Per Unit Effort (CPUE) line graph showing abundance.

- ✓ Since 2007, annual fall spawning surveys have been completed in the two creeks that flow through Caledon, Centreville Creek and Boyce's Creek. The purpose of these surveys is to quantify the amount of Brook Trout spawning redds; a hollow in sand or gravel on a river bed, scooped out as a spawning place by fish. Between October 7th and October 29th 2014, 36 redds were identified in Boyce's Creek, indicating the occurrence of spawning. No redds were observed in Centreville Creek in 2014.

- ✓ The *2014 Caledon East Technical Brief* is scheduled to be completed in Summer 2015. The report synthesizes and interprets stream flow, temperature, and turbidity, groundwater levels, and biological data (both fish and benthic macroinvertebrates), as it relates to the impacts of increased groundwater draws on the health of local aquatic habitat and species. In addition to the annual NHMP monitoring activities listed here, this report also discusses the water quality data in context of the silt releases, which have been occurring since December 2011. Included in the Brief is a discussion surrounding the large amount of silt that has built up behind a sediment fence in the wetland adjacent to Boyce's Creek and to property 16399 Airport Road. The silt behind the sediment fence is approximately one meter deep, bypassing the sediment fence and flowing into Boyce's Creek (**Figure 29**) during precipitation events.

Figure 29. Silt from Boyce's Creek accumulating at the junction between Boyce's Creek and Centreville Creek.

3.3 Nobleton Phosphorus Offset

Staff Lead: Nelson Amaral

Support Staff: Mark Szonda

Funding: York Region

Figure 30. Measuring stream flow in Nobleton.

Background and Significance:

Local creeks in Nobleton showed a combination of high phosphorus, ammonia, nitrate and *E. coli* counts, consistent with failing septic systems. A new water pollution control plant (WPCP) was built to service the Village of Nobleton in York Region and began treating water in June 2012 (Township of King 2012a). The new plant is expected to reduce contaminant load (e.g. phosphorus, *E. coli*) to local waterways as the leaky septic systems are no longer in use. At the end of December 2014, there were 307 connections to the new sewer system with approximately 294 septic systems completely decommissioned. This is approximately 42% of the total number of septic systems to be decommissioned (Saleem Khowaja, Township of King, *pers. comm.).* Decommissioning of all septic tanks is scheduled to be completed by the end of 2015.

TRCA, on behalf of York Region, has been conducting a surface water monitoring program (**Figure 30)** since 2009 to track the contaminant levels in local waterways before, during, and after the septic tank decommissioning in order to measure its effectiveness. TRCA has completed the surface water quality monitoring from 2009 to 2014, and will continue monitoring during the final decommissioning phase in 2015. The intention is to monitor water quality for one year after all the septic systems have been removed.

2014 Program Highlights

- ✓ Baseline sampling (prior to septic tank decommissioning) indicated that phosphorous, ammonia and bacteria were all elevated in the streams downstream of the older residential area of Nobleton.

- ✓ Seven water quality samples as well as flow measurements were collected (**Figure 31**) in 2014 as part of the decommissioning phase (**see *2014 Special Projects Map***). The water quality parameters measured were: total phosphorus, total ammonia, E. coli, TSS, pH, conductivity, water temperature, and dissolved oxygen. Data analyses and reporting will be completed in spring 2015.

Figure 31. Flow meter and surface water quality collection bottles used to collect stream water chemistry parameters.

3.4 South-central Ontario Reference Conditions / Biocriteria Project

Staff Lead: Angela Wallace

Support Staff: Jessica Fang, Samantha Delargy

Funding: Regional Watershed Monitoring Program (RWMP)

Figure 32. RWMP field staff collecting benthic macroinvertebrate samples for the Biocriteria project.

Background and Significance:

In 2011, the Reference Conditions / Biocriteria Project's was initiated by the Ontario Ministry of the Environment and Climate Change (OMOECC) to help describe the normal range of biological condition for streams in the different ecoregions of southern Ontario. Currently there is very little information to date about what constitutes a "normal" benthic macroinvertebrate (aquatic bugs that inhabit stream bottoms) community for southern Ontario. Once this is done, biocriteria (pass-fail guidelines) can be developed for indices that define a "normal" benthic macroinvertebrate community. The OMOECC and various Conservation Authorities are participating in the collection of benthic macroinvertebrate (**Figure 32**) and water quality samples across south-central Ontario. The collaborative study hopes to collect almost 500 samples over a 5 year period. Priorities for project partners in 2014 include sampling as many new sites as possible, entering the data into a database and generating interim biocriteria by combining similar ecoregions.

2014 Program Highlights

- ✓ Benthic macroinvertebrate and water quality samples were collected from three sites in 2014 (**see *2014 Special Projects Map***); four other sites were visited but they were unsampleable.

- ✓ TRCA has visited 75 sites from 2011-2014. During this time, the collaborative team has collected over 250 samples (**Figure 33**) throughout south-central Ontario.

- ✓ Separate sampling in southeastern Ontario, which began in 2010, was completed in 2014. Data analyses for south-eastern Ontario will begin in 2015 by the OMOECC and will include:
  - o evaluating stressor responses,
  - o evaluating biomonitoring indices, and
  - o setting biocriteria for biomonitoring indices that are sensitive to stressors common in the study regions.

- ✓ Preliminary data analyses for the south-central Ontario dataset will start in 2015 to complement and compare with the results of the south-east monitoring program.

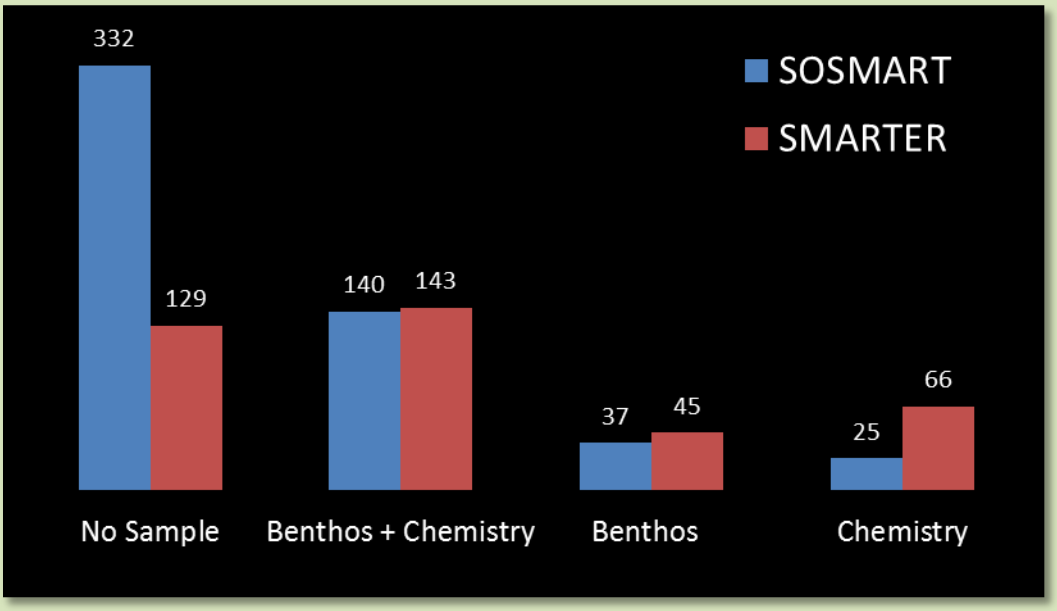


Figure 33. Biocriteria samples collected as of December 2013 (does not include 2014 samples). SOSMART is the Southern Ontario Stream Monitoring and Research Team and SMARTER is the Eastern Region Stream Monitoring and Research Team.

3.5 Remedial Action Plan Aesthetics Monitoring

Staff Lead: Ray Biastoch

Support Staff: Mark Szonda

Summer Staff: Samantha Delargy, Danielle Dellandrea, Paula Reynolds

Funding: Environment Canada, Ontario Ministry of the Environment and Climate Change, Toronto and Region Remedial Action Plan

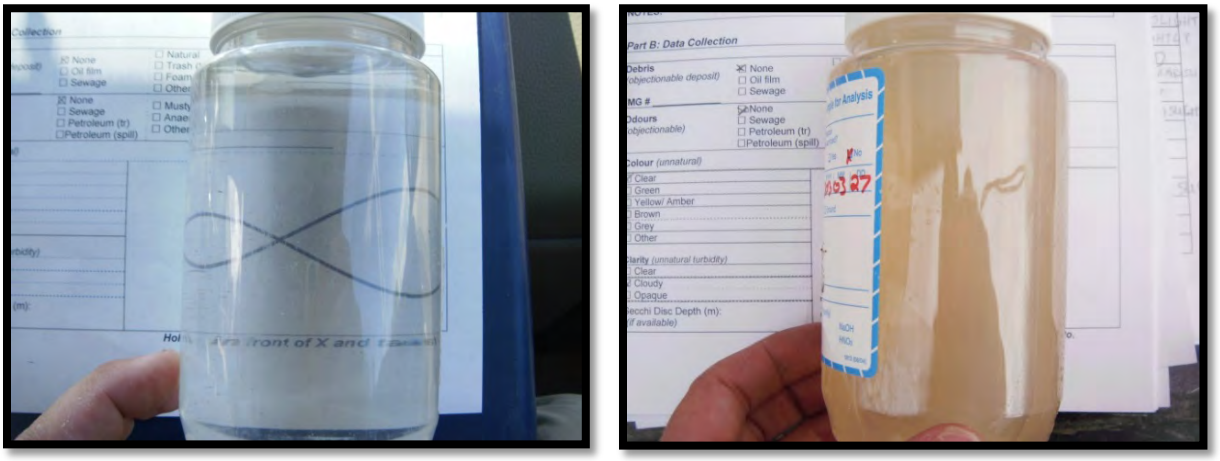


Figure 34. (L to R) Field staff examining stream water for aesthetic categories 'Colour' and 'Clarity' of water.

Background and Significance:

Toronto and Region is one of 43 areas in the Great Lakes identified as an Area of Concern (AOC). The status of an AOC is determined by assessing the state of the region's environmental conditions against 14 different 'Beneficial Use Impairments' (BUIs), with aesthetics (primarily debris and turbidity) being one of them. The monitoring of aesthetic sites involves assessing the presence, absence, or degree of non-natural debris, water turbidity, and odour. Each site is assessed for water colour, water clarity (**Figure 34**), water odour, and debris by trained staff using a standardized protocol (Heidtke and Tauriainen 1996). 2014 was the third and final year for data collection.

2014 Program Highlights

- ✓ In 2014, 738 aesthetic records were collected at 220 sites in 6 watersheds across TRCA's jurisdiction (**see *2014 Special Projects Map***). The 2014 aesthetic records collected are being entered into the RAP Aesthetics database for analyses and interpretation.

- ✓ Findings of the 2013 RAP Aesthetic Technical Report (published in 2014) include:

  - ➢ Approximately 85% of sites had no debris, no odour, and clear water colour.

  - ➢ Only six sites were considered below the minimum acceptable conditions.

  - ➢ Precipitation was found to have significant impact on aesthetics. For example, sites with lower amounts of precipitation on the day of sampling had better Aesthetics Quality Index (AQI) scores.

  - ➢ Sites closer to roads exhibited poorer aesthetics than those located farther away.

  - ➢ Sites which were sampled multiple times in 2013 demonstrated improved aesthetic conditions from April to December.

  - ➢ High precipitation and fast stream currents reduced water clarity.

3.6 Ontario Power Generation

Staff Lead: Sue Hayes

Support Staff: Natasha Gonsalves, Paul Prior

Seasonal Staff: Maria Ciancio, Jessica Frigault, Rivka Shachak

Funding: Ontario Power Generation

Figure 35. Ontario Power Generation wetland bird monitoring station.

Background and Significance:

In 2009 TRCA biologists were contracted by Ontario Power Generation (OPG) to establish a local monitoring project on their land in the vicinity of the Pickering power plant, to the east of Frenchman's Bay (**Figure 35**). Several terrestrial fixed plots were established on the designated study area following TRCA's *Long-Term Monitoring Project (LTMP) protocols* for forest, wetland and meadow habitat types (TRCA 2011a to 2011g). The purpose of these study plots is to detect changes and trends in the flora and fauna communities over time. Standardized scientific data collection protocols enable us to assess the response of the terrestrial ecosystem to various landscape changes. For example, the effects of increased natural cover through reforestation or the increased use of the natural area due to urbanization can be quantitatively documented. The assessment of changes in these natural systems can be used to better guide management actions on site with the aim of improving overall biodiversity.

2014 Program Highlights

- ✓ In 2014, TRCA Terrestrial Biologists collected the sixth year of data at ten long-term monitoring stations (**see *2014 Special Projects Map***) on Ontario Power Generation lands.

- ✓ A summary report discussing all five years of data was completed, highlights of the results include:

  - ➢ Although the forests are fragmented and isolated, the tree crowns are relatively healthy and are below the threshold for concern.

  - ➢ The two woodlots showed marginal declines in floristic quality, due to increases in non-native invasive species such as garlic mustard and dog-strangling vine. Floristic quality is a measure of site quality based on the number and overall sensitivity of the plant species found there. For example, floristic quality increases with the number of native species found, and with the sensitivity of those species.

  - ➢ Three species of frog / toad have been recorded at OPG over the past five years (American Toad, Northern Leopard Frog, and Green Frog) but have only been heard in very low numbers (**Figure 36**).

Figure 36. The northern leopard frog is a Species of Conservation Concern (ranked L3) due to its nomadic nature which results in it being especially susceptible to road-kill as individuals forage and disperse across the landscape. Similarly, since the species spends a large amount of time foraging away from aquatic environments, it is often preyed upon by free-ranging cats and dogs.

3.7 Natural Feature Water Balance Monitoring Study

Staff Lead: Sue Hayes

Support Staff: Natasha Gonsalves, Gavin Miller, Paul Prior, Derek Tune

Seasonal Staff: Maria Ciancio, Jessica Frigault, Nadine Price, Rivka Shachak

Funding: Great Lakes Sustainability Fund, Peel Region, Toronto Remedial Action Plan (RAP), York Region

Figure 37. Vegetation transects, delineated by white PVC poles, were monitored in Baif Wetland, Richmond Hill.

Background and Significance:

Natural features, such as wetlands, woodlands, and watercourses are important components of our regional watersheds, and their hydrology is often negatively affected by urban development. For example, the hydrology of a wetland can dramatically change if the flow of stormwater is either directed towards or away from it, following the installation of stormwater drainage systems to support new development. The wetland may either become too wet or too dry to provide conditions for the wildlife and vegetation it supports. Negative impacts to the hydrology of natural features can also occur in the catchment area upstream where there is not adequate consideration for stormwater management and its effects downstream.

The purpose of this monitoring project is to gain a better understanding of how sensitive wetlands, woodlands and watercourses are to changes in hydrology caused by urbanization. Hydrological and ecological conditions at fixed sites (**see *2014 Special Projects Map***) are monitored on a long-term basis to examine baseline conditions before and after development. This information helps both TRCA and Credit Valley Conservation assess and address the hydrologic impacts of urban development on natural features when reviewing development proposals, as well as establish defensible water management criteria for their protection. This

data also assists with future land-use planning and impact assessment, and may possibly influence ecological restoration initiatives and the evaluation of overall watershed health.

2014 Program Highlights

- ✓ Four vegetation transects, four amphibian stations and three bird stations were monitored at Baif Wetland in Richmond Hill (**Figure 37**). Two pied-billed grebe (**Figure 38**) territories were observed with at least one pair successfully producing young. This is a bird that requires large wetlands with open water areas in addition to wetland shrubs and vegetation for shelter.

Figure 38. Pied-billed grebe is a Regional Species of Conservation Concern (ranked L3) because of its requirement for large undisturbed wetlands with open water along emergent vegetation for nesting.

- ✓ Three vegetation transects, three amphibian stations and one bird station were monitored at two additional wetlands on Seaton development lands in Durham Region.

- ✓ Two wetland transects and one amphibian station were monitored at Mayfield West in in the Town of Caledon.

3.8 Rusty Crayfish Monitoring Study

Staff Lead: Jessica Fang

Support Staff: Samantha Everson

Seasonal Staff: Emma Brookfield, Kyle Chalmers, Samantha Delargy, Danielle Dellandrea, Taylor Ivanovich, Dean Lamming, Christopher Ng, Ryan Scott, Jet Taylor, Tracey Ubbens

Funding: Regional Watershed Monitoring Program (TRCA)

Figure 39. (L to R) Rusty Crayfish (*Orconectes rusticus*).

Background and Significance:

The Rusty Crayfish (*Orconectes rusticus*) (**Figure 39**)**,** is an invasive species that outcompetes native crayfish species. Thus, native crayfish are not expected to buffer the range expansion of this large and aggressive invader, which is present in southern and western Ontario (Phillips *et al.* 2009). Originally from the northeastern United States, Rusty Crayfish has expanded its range presumably due its bait bucket releases (Phillips *et al.* 2009). Once established, it can reduce the benthic macroinvertebrate community, macrophyte biomass, as well alter aquatic habitats.

Rusty Crayfish was first collected by TRCA staff in 1983 in Duffins Creek. However, there is limited historic data available. In 2012, RWMP initiated the Rusty Crayfish Monitoring Project in conjunction with the fish community monitoring. Electrofishing crews collected and preserved the Rusty Crayfish, whereas captured native crayfish species were recorded and released. The objective of this project is to examine the health conditions of the Rusty Crayfish, including

abundance, sex ratio, hybridization, length-weight relationship (condition factor), and the correlation to a variety of habitat characteristics.

The collection of this data will fill in data gaps regarding the current distribution and abundance of the Rusty Crayfish within the TRCA jurisdiction. Analyses are expected to reveal Rusty Crayfish's habitat preference, overall health of the populations, and the hybridization between the Rusty Crayfish and the Northern Clearwater Crayfish (*Orconectes propinquus)*. This project is an important first step in assessing if and how to prevent the Rusty Crayfish from spreading into other streams and watersheds.

2014 Program Highlights

- ✓ In 2014, 34 sites in the Don River watershed, 14 sites in the Highland Creek watershed and 5 sites in the Mimico Creek watershed were sampled (**see *2014 Special Projects Map)***. Only one Rusty Crayfish was found in the Don River. This data suggests that the Rusty Crayfish is not well established in these watersheds.

- ✓ Sampling in previous years showed that the Rusty Crayfish had become the dominant crayfish species in the Rouge River and Duffins Creek watersheds. The Rusty Crayfish does not appear to be well established in the Humber River or Etobicoke River watersheds, with only one Rusty Crayfish captured in Etobicoke Creek in 2013.

- ✓ Sampling for this three-year project has now concluded and results will be discussed in a short note and will be submitted to The Canadian Field Naturalists journal in 2015.

3.9 Mayfield West Comprehensive Adaptive Management Plan

Staff Lead: Angela Wallace (Aquatic), Sue Hayes (Terrestrial)

Support Staff: Samantha Everson, Natasha Gonsalves, Mark Szonda, Derek Tune

Seasonal Staff: Maria Ciancio, Greg Gapski, Mike King, Liz Petrov, Alisa Samuelson, and Rivka Shachak

Funding: Town of Caledon

Figure 40. Narrow-leaved spring beauty (L) and wild turkey (R) are two examples of Species of Conservation Concern (ranked L3) that are found on Mayfield West development lands.

Background and Significance:

The Mayfield West (Phase 1) development is part of the planned community of Mayfield located between Hurontario Street and Dixie Road, north of the Highway 410 extension in the Town of Caledon. Mayfield West has been designated as a "Rural Service Centre" and is the product of a substantial and comprehensive planning process. A Comprehensive Adaptive Management Plan (CAMP) was prepared by a consultant on behalf of the Town of Caledon. The goal of the CAMP was to design a long-term environmental monitoring program that would measure the performance and adherence to the Town's environmental management policies as well as to help provide guidance for future developments. TRCA was contracted by the Town of Caledon to conduct all the monitoring activities related to the CAMP. Ecological monitoring began in 2013 and activities are expected to continue for at least 10 more years. Aquatic monitoring includes stream flow, water chemistry, fish and benthic invertebrate habitat and communities, and fluvial geomorphology. Terrestrial monitoring includes amphibians, breeding birds and vegetation in forest, wetland and meadow habitats (**Figure 40**).

2014 Program Highlights

- ✓ Six water quality samples (three wet, three dry) were collected at seven sites in the Mayfield study area (**see *2014 Special Projects Map)***. .

- ✓ The first year of water quality monitoring data (**Figure 41**), from the automated continuous water quality sonde were downloaded and analyzed.

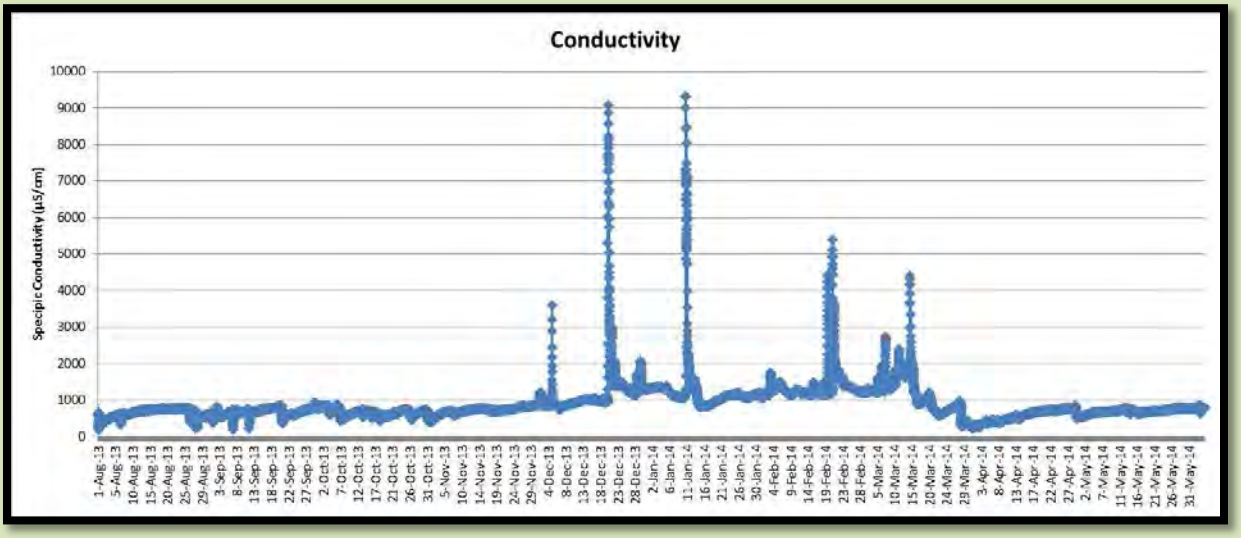


Figure 41. Example of continuous conductivity monitoring data collected by in-stream water quality probe. There were large spikes in conductivity during the winter months. These spikes are associated with snowfall and are caused by road salt (direct or indirect) entering the stream.

- ✓ Data from the six pressure transducers were downloaded and rating curves were developed to monitor stream flow (discharge) in the Etobicoke Creek and the Humber River.

- ✓ Benthic macroinvertebrates (aquatic bugs that inhabit stream bottoms) were sampled at seven sites (five in Etobicoke Creek, two in Humber River).

- ✓ In Mayfield forest and wetland communities a total of 19 long-term monitoring plots were monitored for a second year; vegetation (5 forest and 3 wetland plots), birds (4 forest and 1 wetland plot), salamanders (1 forest plot), and frogs (5 wetland plots).

3.10 Copper Creek Golf Course Monitoring

Staff Lead: Sue Hayes (Terrestrial), Angela Wallace (Aquatic)

Support Staff: Samantha Everson, Natasha Gonsalves, Gavin Miller, Paul Prior, Mark Szonda, Derek Tune

Seasonal Staff: Rivka Shachak

Funding: Copper Creek Golf Course

Figure 42. Aerial view of Copper Creek Golf Course, bordered by Highway 27 to the west and Humber River to the east.

Background and Significance:

The Copper Creek Golf Course (CCGC) (**Figure 42**) located near Kleinburg, Ontario, was opened to the public in late 2002. TRCA, along with various consulting firms, have been conducting monitoring to:

(1) measure any changes in vegetation and wildlife communities due to the golf course's intrusion into a previously forested natural area, and

(2) assess any changes to water quality and quantity in the East Humber River resulting from the initial golf course development and its on-going operation.

2014 Program Highlights

- ✓ The final two (total four) water quality samples were collected in 2014 (**see *2014 Special Projects Map)***. Water quality samples were analyzed for pesticides and nutrients commonly used at the golf course:
  - ➢ In most cases, the concentration of nutrients in the Humber River was similar and sometimes lower downstream of the golf course compared to the upstream reference location. This suggests that the golf course is not grossly contributing to the nutrient concentrations in the Humber River.
  - ➢ Samples were analyzed for a suite of 138 different pesticides. At least one pesticide was detected in the golf course runoff on each sampling date but no pesticides were detected in the Humber River. This suggests that even though small amounts of pesticides are running off the golf course, they are not impacting the Humber River.
  - ➢ Results from the aquatic and terrestrial monitoring will be incorporated into a single report in 2015.
- ✓ No terrestrial monitoring was conducted in 2014.

3.11 Seaton Development Lands Monitoring

Staff Lead: Sue Hayes (Terrestrial), Angela Wallace (Aquatic)

Support Staff: Natasha Gonsalves, Gavin Miller, Paul Prior, Mark Szonda

Seasonal Staff: John Barker, Maria Ciancio, Jessica Frigault, Greg Gapski, Liz Petrov, Rivka Shachak

Figure 43. The Redside Dace (*Clinostomus elongates*), a provincially endangered minnow species, is an example of a sensitive aquatic species that currently resides within the Seaton development lands boundary.

Background and Significance:

The Seaton development lands refer to a large parcel of land (1200 ha) in Pickering, Ontario which is slated for urban development. The Central Pickering Development Plan (CPDP; OMMAH 2006) outlines the blueprint for an urban community with up to 70,000 people and 35,000 jobs, along with a designated agricultural area on the west side of Duffins Creek. The urban development portion of the Seaton Community will incorporate advanced sustainability techniques such as low impact design (LID) to help mitigate the impacts of urbanization to the natural environment.

The Seaton development lands is unique because 53% of the community has been zoned as a Natural Heritage System. The Ontario Ministry of Natural Resources and Forestry in cooperation with the Toronto and Region Conservation Authority (TRCA) identified the NHS for the Seaton Lands area, which includes all wetlands, significant woodlands, streams and watercourses, and the Lake Iroquois shoreline. The aquatic system is home to important fish species; the provincially endangered Redside Dace (**Figure 43**); and Brook Trout, which have a very limited population in the Toronto region.

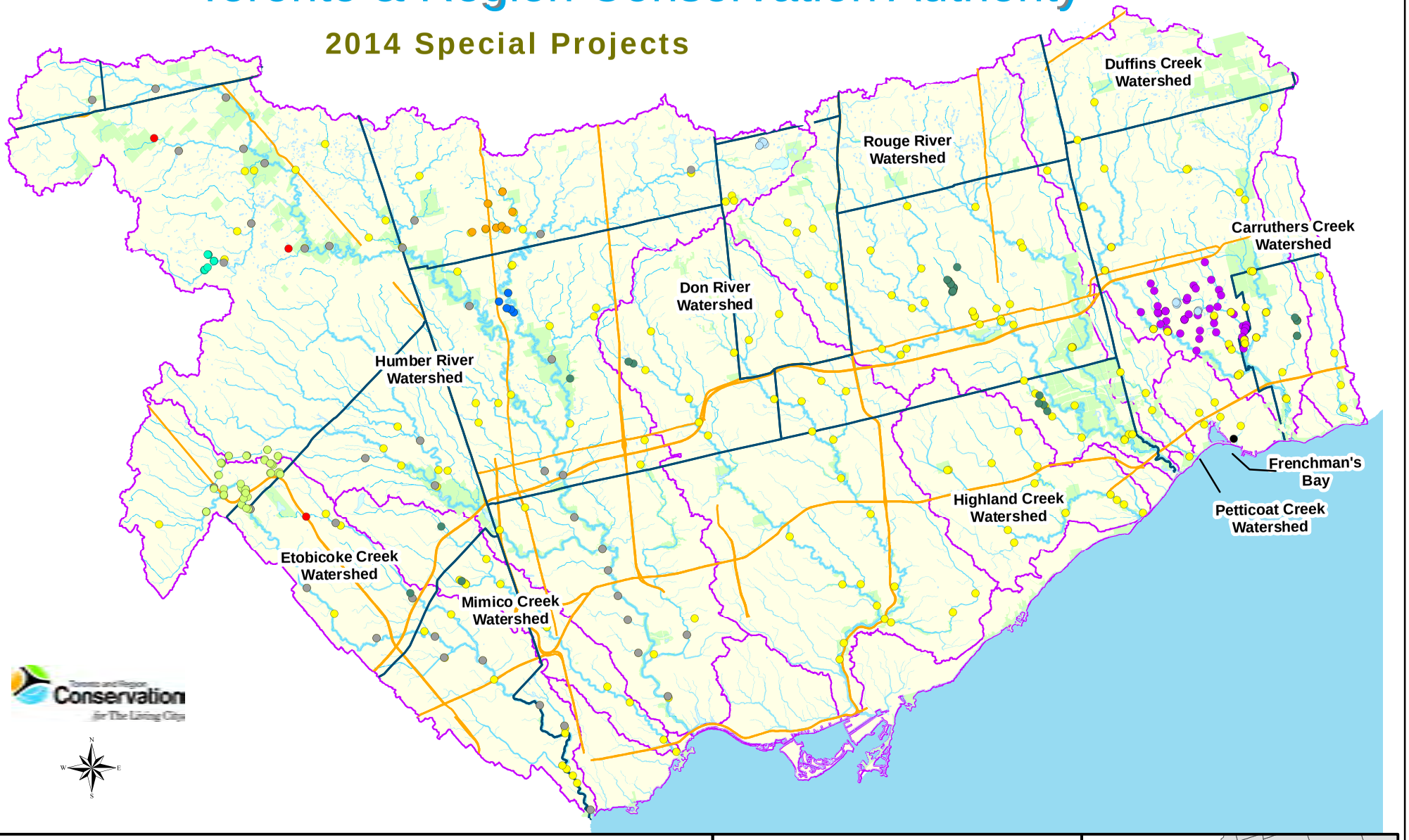
Due to the size and scale of this development, its sustainability aspects and the sensitivity of the nearby ecosystems, the TRCA initiated a large-scale monitoring program to evaluate the natural heritage of Seaton development lands. TRCA will be monitoring both the aquatic and terrestrial ecosystem (pre, during, and post development) to determine if the sustainability practices and the large NHS are sufficient to protect the ecological integrity of the sensitive natural heritage features within the project boundaries. It is expected that a number of additional monitoring activities will be added in the next few years to support research and monitoring questions. Results from this monitoring program are expected to largely influence future planning decisions at the Seaton Lands and in other parts of TRCA's watersheds.

2014 Program Highlights

- ✓ Ten new aquatic and nine new terrestrial monitoring sites (**see *2014 Special Projects Map)*** were established on the Seaton development lands in 2014 to track the baseline health of the wetlands, significant woodlands, streams and watercourses pre-construction, including:
    - o Six vegetation (four forest and two wetland) and three bird (two forest and one wetland) long-term monitoring plots were set up and monitored.
    - o Ten aquatic fish and habitat sampling sites, according to the Ontario Stream Assessment Protocol.
- ✓ Three water quality stations near the southern border of the Seaton development lands were monitored monthly, with an additional three wet weather samples collected in 2014.
- ✓ Four conductivity loggers were installed on Seaton lands. Conductivity values can be used to estimate chloride concentrations, which are expected to increase with the use of road salt in the new urban area.
- ✓ Twenty year-round temperature monitoring stations are currently in place. Additional water temperature stations will be installed as part of LID specific testing in 2015.
- ✓ Fifteen fish community sites were visited; only 13 sites were monitored due to dry conditions at 2 sites. No Redside Dace, a provincially endangered minnow species, was found as part of the 2014 sampling. Redd surveys (Brook Trout spawning locations) were completed in fall 2014. These coldwater fish are important indicator species of water quality conditions because they rely on groundwater upwellings for spawning.
- ✓ Benthic macroinvertebrates (BMI), aquatic bugs that inhabit stream bottoms, were collected from 24 sites and will be identified in 2015.
- ✓ New fluvial geomorphology equipment were installed and 10 sites were monitored in 2014. Fluvial geomorphology measures the physical characteristics of the stream channels to help explain the structural changes that may occur in response to alterations in watershed conditions.

Toronto & Region Conservation Authority

2014 Special Projects



Legend

- Caledon East
- Copper Creek Golf Course
- Mayfield West Monitoring
- Natural Channel Design
- Natural Feature Water Balance Study
- Seaton Development Lands
- Nobleton Phosphorous Offset
- Ontario Power Generation
- Remedial Action Plan Aesthetics
- Rusty Crayfish Study
- SC Ontario Reference Conditions/Biocriteria
- Municipal Boundary
- Highway
- Waterbodies
- Watercourse
- TRCA Property
- Watershed Boundary

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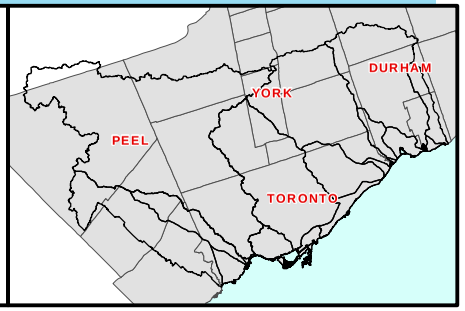

4 Staff Contributions

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Tracy Ubbens
Jehan Zeb

4.1 Training and Workshops

TRCA's Restoration Services Division is committed to the belief that both the transfer of knowledge and continuous education are critical elements to effective management of our environmental resources. In addition to attending various training sessions, staff in the Watershed Monitoring and Reporting Section conducted several workshops for both internal and external participants.

4.1.1 Conducted by TRCA Staff

- The Aquatic Insects inventory at the Humber Bioblitz 2014 was guided on May 23-25, 2014 at the Kortright Centre for Conservation with a total of 36 participants. (Jessica Fang)
- Class 2 Backpack Crew Leader Electrofishing Certification Course was conducted on May 22, 2014 at Boyd Office with a total of 22 participants, internal and external. (Jeff Vandenberg)
- Mosquito Larvae Identification Workshops were conducted on May 13 and 15, 2014 at Earth Rangers Centre for Durham Region and Halton Region Public Health Units respectively. A separate session was offered to the City of Hamilton Public Health Unit on May 16, 2014. A total of 20 participants attended all three sessions. (Jessica Fang)
- Ontario Stream Assessment Protocol Certification Course was conducted on June 10-14, 2014 at Durham College, Oshawa with a total of 23 participants. (Jeff Vandenberg)
- Ontario Stream Assessment Protocol Certification Course was conducted on June 10-14, 2014 at Thunder Bay with a total of 14 participants. (Jeff Vandenberg)
- Ontario Stream Assessment Protocol Fish Identification Workshop was conducted on May 31 and June 1, 2014 at Durham College, Oshawa with a total of 18 participants. (Scott Jarvie, Jeff Vandenberg)

- Ontario Stream Assessment Protocol Benthic Invertebrate ID Workshop was conducted on May 31 and June 1, 2014 at Durham College, Oshawa with a total of 12 participants. (Jeff Vandenberg, Jessica Fang)
- Ontario Stream Assessment Protocol Internal Training Session was offered to 7 staff participants from May 20 to 23rd. (Jeff Vandenberg, Jessica Fang)
- Terrestrial Volunteer Monitoring Seasonal Training was conducted in 14 sessions covering 4 seasons with a total of 140 attendees. (Theresa McKenzie)
- Water Safety Training Course (Internal) was conducted on May 27, 2014 in collaboration with Restoration and Monitoring Section staff. (Jeff Vandenberg)

4.1.2 Attended by TRCA Staff

- A.D. Latornell Conservation Symposium, Conservation Ontario; November 2014. (Nelson Amaral, Jessica Fang, Theresa McKenzie)
- ArcGIS Desktop Training Level 2, York Region; April 2014. (Natasha Gonsalves)
- Financial Management 101, TRCA; October 2014. (Derek Tune)
- Introduction to ArcGIS Desktop Training, York Region. March 2014. (Paul Prior, Derek Tune)
- Joint Aquatic Sciences Meeting, Portland, Oregon; May 2014. (Angela Wallace)
- Microsoft Excel Level 1, Peel Region; March 2014. (Derek Tune, Paul Prior)
- Microsoft Excel Levels 2 & 3, Peel Region; March 2014. (Derek Tune)
- Road Ecology: A National Agenda for Canada, Ontario Road Ecology Group; November 2014. (Paul Prior and Sue Hayes).
- Road Ecology: Tools for Defining Strategic Linkages in EA Planning. TRCA. March 2014. (Derek Tune, Paul Prior, Sue Hayes)
- Symposium on Urbanization and Stream Ecology, Portland, Oregon; May 2014. (Angela Wallace)
- Provincial Flood Forecasting and Warning Workshop, Black Creek Pioneer Village; September 2014. (Craig Mitchell, Leland Wilbur, Greg Dillane, Rita Lucero, Jamie Duncan)
- Canadian Dam Association Annual Workshop, Banff, Alberta; October 2014. (Craig Mitchell, Leland Wilbur)
- Swift Water Rescue Technician – Level 1, Madawaska Kanu Centre, Barry's Bay, Ontario; August 2014. (Greg Dillane, Matt Derro, Leland Wilbur)
- Sontek Products Training (RiverSurveyor, HydroSurveyor, FlowTracker), Albion Hills Conservation Area; July 2014. (Matt Derro, Craig Mitchell, Greg Dillane, Leland Wilbur)

4.2 Professional Activities

Watershed Monitoring and Reporting Section staff annually participates in a variety of professional activities such as presenting at conferences and contributing to numerous committees. In addition numerous reports or journal articles are completed based on data collected under RWMP or through special projects.

4.2.1 Presentations

- A.D. Latornell Conservation Symposium. *Terrestrial Biodiversity in the Toronto Region.* November 2014. (Theresa McKenzie)
- International Association Great Lakes Research (IAGLR*). An Assessment of Rusty Crayfish Populations in the Greater Toronto Area*. May 2014. (Jessica Fang)
- Symposium on Urbanization and Stream Ecology. Poster: *Diagnosis Stream Sickness: A Closer Look at the Urban Stream Syndrome in Toronto, Ontario, Canada*. May 2014. (Angela Wallace)
- International Association of Great Lakes Research (IAGLR). *Spatial and Temporal Trends in Toronto and Region Conservation Benthic Macroinvertebrate Communities from 2001-2012*. May 2014. (Ray Biastoch)
- Conservation Ontario Benthic Workshop, Ministry of Natural Resources. *Introduction to the Mann-Kendall Temporal Trend Test*. March 2014. (Ray Biastoch)

4.2.2 Reports and Publications

- 2013 Bathurst Glen: Pond Water Quality Assessment
- 2013 Caledon East Technical Brief
- 2013 Mayfield CAMP
- 2013 Nobleton Phosphorus Offset
- 2013 RAP Aesthetic Study: Technical Report
- 2013 Regional Watershed Monitoring Program Progress Report
- 2013 Water Quality Summary
- 2013 West Nile Virus Larval Mosquito Monitoring Program Annual Report
- 2014 Copper Creek Golf Course: Summary of Post Construction Monitoring
- 2014 Fish Collection Records Report
- 2014 Mayfield West Study Area: Terrestrial Biological Inventory and Monitoring Report
- 2014 Ontario Power Generation - Terrestrial Long-term Monitoring Project (Year 5)
- 2014 Rank and Score Updates – Vegetation Communities
- 2014 Terrestrial Biological Inventory and Assessments
  - Altona Forest
  - Mimico Waterfront Linear Park.
  - Humber Bay Park.
  - Port Union Waterfront Park Study Area.
  - Colonel Sam Smith Park Study Area.
- 2014 The Gore Road (Patterson Side Road to Highway 9): Baseline Monitoring Results
- 2014 Water Balance Study Sites: Baif and Seaton (Natural Heritage Monitoring Program – Terrestrial Component Preliminary Findings)
- Effects of Ponds on RWMP BMI Sites in the Upper Rouge Watershed from 2000 to 2006.

4.3 Committees

Watershed Monitoring and Reporting Section staff participated on the following committees:

- Database Working Group – Toronto and Region Conservation (Scott Jarvie, Angela Wallace, Sue Hayes, Ray Biastoch)
- Durham Region West Nile Virus Response Committee (Jessica Fang)
- Environment Canada's Meteorological and Environmental Monitoring "Network of Networks" Initiative (Jamie Duncan, Leland Wilbur)
- Jefferson Salamander Implementation Team – Ontario Ministry of Natural Resources and Forestry (Sue Hayes)
- Ontario Ministry of Natural Resources and Forestry Ecological Land Classification Update Technical Team (Gavin Miller)
- Provincial Groundwater Monitoring Network Central Working Group (Jeff Vandenberg)
- Southern Ontario Conservation Authorities Terrestrial Monitoring Network – Toronto & Region Conservation, Conservation Halton, Credit Valley Conservation, Central Lake Ontario Conservation (Theresa McKenzie & Sue Hayes)
- Southern Ontario Stream Monitoring and Research Team (SOSMART) (Scott Jarvie, Angela Wallace)
- York Region West Nile Virus Liaison Committee (Jessica Fang)

5 References

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Appendix A

2014 WM&R Monitoring Activities by Watershed

	Etobicoke	Mimico	Humber	Don	Highland	Rouge	Petticoat	Duffins	Carruthers	Other[1]	Total
Fish Species & Aquatic Habitat	0	5	0	23	11	0	4	0	0	4	47
Benthic Macroinvertebrates	14	5	35	23	11	25	4	21	3	4	145
West Nile Virus Monitoring	4	2	13	5	1	8	1	9	1	1	45
Surface Water Quality	8	2	11	5	1	7	1	9	1	1	46
Baseflow	4	3	6	8	6	7	2	8	3	4	59
Stream Flow	4	1	7	9	1	2	1	8	1	2	36
Precipitation	4	0	11	5	2	5	1	6	0	1	35
Snow	1	0	3	1	0	2	0	3	0	0	10
Groundwater Quality & Quantity	2	0	9	0	0	3	0	6	0	0	20
Terrestrial Natural Heritage[2]	174	25	1140	200	0	1000	81	100	0	0	2720
Terrestrial Natural Heritage Fixed Plots	20	3	62	20	5	17	6	30	2	4	169
Terrestrial Volunteer Monitoring	5	1	18	8	3	7	1	7	0	4	54
Meteorological (Climate Monitoring)[3]	1	0	6	0	0	3	0	4	0	0	14
Water Temperature	3	5	6	23	11	6	4	4	2	4	68

[1]Other minor watersheds including tributaries of Frenchman's Bay and Toronto Waterfront

[2]Italicized numbers are the number of hectares monitored

[3] Includes both meteorological stations and "stand alone" air temperature stations

Appendix B

2014 WM&R Monitoring Activities by Region

	Durham	Peel	Toronto	York	Other[1]	Total
Fish Species & Aquatic Habitat	8	2	26	11	0	47
Benthic Invertebrates	30	27	47	39	2	145
West Nile Virus Monitoring	12	7	13	13	0	45
Surface Water Quality	12	8	13	13	0	46
Baseflow	16	9	21	13	0	59
Stream Flow	11	9	11	5	0	36
Precipitation	7	9	7	12	0	35
Snow	3	3	1	3	0	10
Groundwater	6	7	1	6	0	20
Terrestrial Natural Heritage[2]	70	460	460	1730	0	2720
Terrestrial Natural Heritage Fixed Plots	32	56	31	50	0	169
Terrestrial Volunteer Monitoring	9	12	19	13	1	54
Meteorological (Climate Monitoring)[3]	4	2	1	7	0	14
Water Temperature	13	7	33	15	0	68

[1]Dufferin/Simcoe

[2]Italicized numbers are the number of hectares monitored

[3] Includes both meteorological stations and "stand alone" air temperature stations

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