Central Lake Ontario Conservation

2009

Terrestrial Watershed Monitoring Report


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What we do on the land is mirrored in the water

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EXECUTIVE SUMMARY

2009 saw the successful implementation of the Terrestrial Watershed Monitoring Program. Plots were established throughout the Bowmanville/Soper Watershed, situated within CA and municipal landholdings. Baseline data was collected for three major system types; Forests, Wetlands and Non-Forested systems.

Data collected was related to Tree Health, Ground Vegetation, Regeneration and species richness. This information will be utilized to support various CLOCA projects including prioritizing invasive species practices among other initiatives.

Three special projects were implemented that will provide information on the success of stewardship projects, trail placement and hydrological changes at wetlands.

Monitoring within the Bowmanville/Soper Watershed will occur again in 2011.

1.0 INTRODUCTION

The Terrestrial Watershed Monitoring Program was developed to help determine and monitor the trends of the ecological integrity of terrestrial natural areas within the Central Lake Ontario Conservation Authority's jurisdiction. CLOCA has used the Parks Canada Agency's Panel (1998) definition of Ecological Integrity, "an ecosystem has integrity when it is deemed characteristic for its natural region, including the composition and abundance of native species and biological communities, rates of change and supporting processes. In plain language, ecosystems have integrity when they have their native components (plants, animals and other organisms) and processes (such as growth and reproduction) intact." From this definition ecological indicators are used to help determine if the vegetation communities being studied are in decline and how the systems are changing over the long-term. From the Park's Canada definition for ecological integrity, it was determined that the following ecological indicators will be measured:

- Ground vegetation
- Non-native invasive species
- Biodiversity
- Tree health
- and regeneration of saplings.

The ecological indicators will be monitored in selected community types that occur throughout CLOCA's watersheds. The following vegetation communities were selected using Ecological Land Classification (ELC) communities and are grouped as; forested systems; non-forested systems (thickets, meadows) and non-coastal wetland systems (ELC classification of wetlands restricted to Swamps). These major systems can be monitored to site level, watershed level and jurisdictional level and are comparable across the landscape.

The Terrestrial Watershed Monitoring Program was implemented for the first time in 2009 within the Bowmanville/Soper Watershed. Being the first year of implementation, monitoring plots were established in Conservation Areas, and on municipal landholdings. A total of 18 plots were established, 5 non-forested plots, 5 wetland plots and 8 forest plots. These plots were dispersed throughout the three main physiographic regions in CLOCA's jurisdiction. Prior to the development of the Terrestrial Watershed Monitoring Program, a few special monitoring projects were initiated. Two special projects were continued from previous years, and one special project was just started in 2009. In 2007 a project was started at Crow's Pass Conservation Area to observe the spread of Dog Strangling Vine (*Cynanchum rossicum*) and monitor to see if the creation of a new trail facilitates its spread. The other continued special project is monitoring the success rate of tree planting initiatives CLOCA takes part in, and is also a criterion of the Trees Ontario Foundation. The third special project, just recently implemented is to observe the water levels and ground vegetation at Heber Down Provincially Significant Wetland, within Heber Down Conservation Area.

2.0 TERRESTRIAL WATERSHED MONITORING

There are a variety of ELC community series where the above stated ecological indicators will be monitored. All of the communities to be studied are grouped within three systems, Forested Systems, Non-Forested Systems and Non-Coastal Wetlands. **Error! Reference source not found.** shows the ELC community series classifications that are included within each of the three main systems being monitored.

Table 1: ELC Classification with corresponding system

Ecosystem Type	ELC Community Series Included
Forested Systems	Cultural Woodlots (CUW), Cultural Plantations (CUP), Deciduous Forests (FOD), Mixed Forests (FOM), Coniferous Forests (FOC)
Non-Coastal Wetland Systems	Deciduous Swamp (SWD), Mixed Swamp (SWM), Coniferous Swamp (SWC)
Non-Forested Systems	Cultural Thicket (CUT), Cultural Meadow (CUM)

The ecological indicators, ground vegetation, non-native invasive species, biodiversity, tree health and regeneration, will be monitored within each of the major systems. The ecosystem type and corresponding ecological indicators monitored within it are outlined in **Error! Reference source not found.**.

Table 2: Ecological indicators by system

Ecosystem Type	Ecological Indicator
Forested Systems	Tree Health; Regeneration; Ground Vegetation; Biodiversity
Non-Forested Systems	Ground Vegetation; Biodiversity
Non-Coastal Wetland Systems	Tree Health; Regeneration; Ground Vegetation; Biodiversity

In 2009 the Terrestrial Watershed Monitoring program was implemented within the Bowmanville/Soper Watershed (

Figure **1**). This watershed is contained solely within the Municipality of Clarington, and covers an area of approximately 166km^2. The headwaters of the Bowmanville/Soper watershed are situated within the Oak Ridges Moraine. The resulting tributaries travel south through the old glacial Lake Iroquois Beach towards the Lake Iroquois Lacustrine Plain, draining into Lake Ontario through the Bowmanville Coastal Wetland Complex.

Approximately 36% of the Bowmanville/Soper watershed is naturally vegetated, which equates to 60km^2 of the Bowmanville/Soper watershed landscape. **Error! Reference source not found.** summarizes the representation of vegetative communities within the watershed. Forested systems account for 19% of the watersheds cover, while non-forested systems and non-coastal wetlands account for 9% and 7% cover respectively. The remaining 1% of the total watershed cover consists of submergent, emergent, and floating shallow marshes, meadow marshes and cultural savannahs. These are not included in this monitoring protocol as they cover a very small portion of CLOCA's overall landscape and many of the marshes are monitored through the Durham Region Costal Wetland Monitoring Program (DRCWMP).

Table 3: Natural Cover by ELC community class

Monitoring System	ELC Classification	Cover (ha)	Cover as % of total natural area in watershed	% Cover as total land area in watershed
Forested System	FOD, FOC, FOM, CUP, CUW	31.93	53%	19%
Non-Forested System	CUT, CUM	14.45	24%	9%
Non-Coastal Wetlands	SWM, SWD, SWC	12.13	20%	7%
Not included in	MAM, MAS, SAS,	1.49	3%	1%

monitoring program	SAM, SAF			
Total			**100%**	**36%**

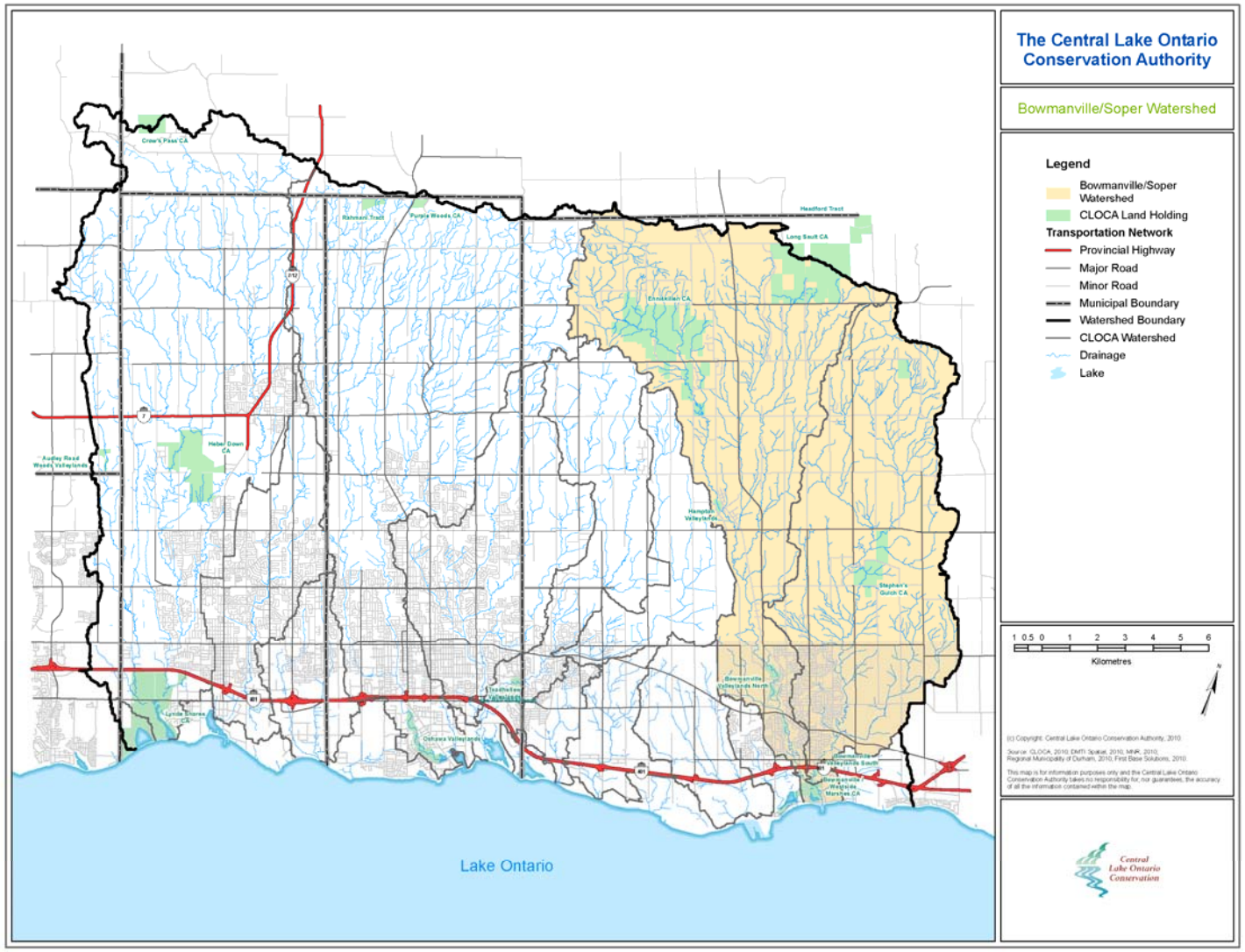

Figure 1: Bowmanville/Soper Watershed

2.1 FORESTED SYSTEMS

Forests account for 53% of the Bowmanville/Soper watershed's natural land cover, just under half of that area (25%) is dominated by mixed forests (FOM), while coniferous (FOC) and deciduous (FOD) forests account for 11% and 7% natural land cover respectively. Many of these areas are home to a variety of animal species, and it is vital to ensure the integrity of their habitat is maintained. For this reason, tree health, regeneration, ground vegetation and invasive species were observed.

Forest monitoring plots were established at eight locations within the Bowmanville/Soper watershed in 2009. Seven of them were 20x20m plots, and the eighth plot was a 10x10m plot, since it was located in a plantation and has a greater concentration and number of trees. Together, all the plots cover a total area of 2900m^2. All of them were established on conservation area lands. As previously mentioned, forest plots were located along all three physiographic regions within CLOCA's watershed, where possible. Fortunately, within the Bowmanville/Soper watershed, CLOCA owns land within all three regions, making it feasible to accomplish this goal. As **Error! Reference source not found.** shows, forest plots were established, from south to north, within Bowmanville Westside CA; Bowmanville Valley; Stephen's Gulch CA; Enniskillen CA; Cane Property; and Long Sault CA.

2.1.1 Tree Health

Tree size and disturbance history can help in understanding how the forest structure is changing, and when regularly monitored, can often help identify both short-term and long-term stresses on the system. These short-term stresses may include extreme weather, insect defoliation and many other factors. While long-term stresses may be more difficult to isolate and can result from surrounding land use changes, recreational uses, climate change, and an array of other factors.

The now retired Canadian Forest Service (Sajan, 2006) states that average annual mortality rates of 1% to 3% are considered normal, but a red flag should be raised at 5% mortality rates. This threshold will be used when monitoring and analyzing data, while recommendations to management practices will be made if mortality rates exceed this rate. To utilize this threshold, a baseline must be established to measure off of and be compared against. At all eight sites, tree health was assessed by observing the species, dbh (diameter at breast height), tree status (alive/dead), stem defects, and crown vigor (amount of defoliation). **Error! Reference source not found.** shows the percent mortality at each site, keeping in mind that the data represented in the table below is meant to act as baseline data and the recommended threshold will not be applied to this year's data.

Table 4: Forested Plots Tree Health Summary

Site Name	Site #	Mortality of Trees (%)	Evidence of Emerald Ash Borer
Bowmanville Valley CA	BVCAF01	26%	None
Cane Property	CPF01	0%	None
Enniskillen CA	ECAF01	19%	None
Long Sault CA	LSCAF01	8%	None
Stephen's Gulch	SGF01	27%	None
Stephen's Gulch	SGF02	3%	None
Bowmanville Westside CA	BWMF01	5%	None
Bowmanville Westside CA	BWMF02	0%	None
Overall		**15%**	**None**

Recently, Emerald Ash Borer (EAB) has been discovered within Pickering, because of this, CLOCA staff inspected potential trees thoroughly. While there were no clear signs of EAB present at any of the sites, site SGF01 had a White Ash (*Fraxinus Americana)* that had experienced severe crown dieback greater than 50% of the branch and twigs within the crown, however upon further inspection there were no signs of EAB. Evidence of EAB will appear in the form of epicormic branching (shoots appearing on the boles); bark deformities and discolorations or D shaped bore holes (Lyons, *et al.*, 2007).

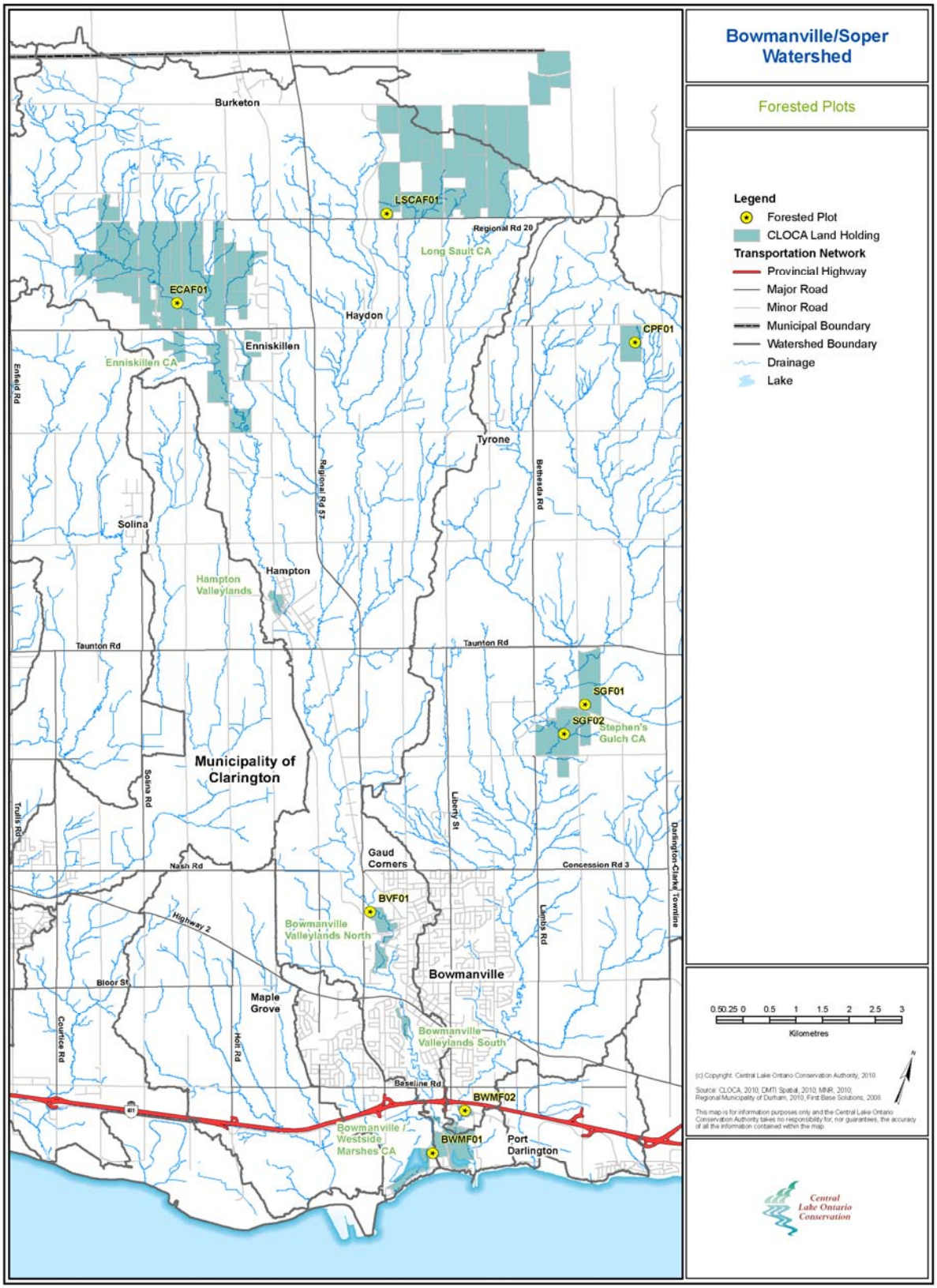

Figure 2: Bowmanville/Soper Forested Plot locations

Aside from site SGF01, two other sites also had trees experiencing severe dieback (greater than 50% branch and twig mortality within the crown); SGF02 and BWMF02. At site SGF01 there were two Trembling Aspen (*Populus tremuloides*) that had greater than 50% dieback. Trembling Aspen are known as pioneer trees, and tend to be among the first to dominate a site that is regenerating. Intermediate species, such as Black Cherry (*Prunus serotina*) and White Pine (*Pinus strobes*) were present at the site, as well as more climax species such as young Eastern White Cedar (*Thuja occidentalis*) and Ironwood (*Ostrya virginiana*). The presence of these species suggests the decline in crown vigor for the two Trembling Aspen's is simply due to natural transitions within the forest. Monitoring will occur again at these sites in 2011.

Table 5: Forest Plot Tree Species Composition by Site

Site Name	Species Richness	Native	Non-Native	% Non-Native
BVF01	2	2	0	0%
BWMF01	6	6	0	0%
BWMF02	2	0	2	100%
CPF01	2	1	1	50%
ECAF01	3	3	0	0%
LSCAF01	2	2	0	0%
SGF01	3	2	1	33%
SGF02	8	7	1	13%

Table 6: Forested Plot Tree Species by Importance Value

Tree Species		Importance Value
Latin Name	Common Name	
Thuja occidentalis	White Cedar	85.04
*Pinus sylvestris**	Scot's Pine	35.07
Pinus resinosa	Red Pine	26.00
Populus tremuloides	Trembling Aspen	24.15
*Acer negundo**	Manitoba Maple	19.30
Tsuga canadensis	Hemlock	14.27
Betula papyrifera	White Birch	13.86
Betula allegheniensis	Yellow Birch	11.30
Picea glauca	White Spruce	10.67
Ostrya virginiana	Ironwood	9.54
Fraxinus americana	White Ash	9.07
Prunus serotina	Black Cherry	8.72
Crastaegus spp	Hawthorn	7.73
Pinus strobus	White Pine	7.67
Fraxinus pennsylvanica	Green Ash	4.88
Juglans nigra	Black Walnut	4.34
Fagus grandifolia	American Beech	4.27
Prunus virginiana	Chocke Cherry	4.13

*indicates non-native species

Error! Reference source not found. shows the species composition and the percent of non-native species by site number. Half of the sites do not appear to have any non-native tree species, while the remaining 4 sites range from 13% to 100% non-native species. Table 6 shows the tree species found in all eight sites according to importance value. Importance value is "an index made up of Relative Density, Relative Dominance and Relative Frequency that profiles the structural role of a species in a stand." (Roberts-Pichette, *et al.*, 1999). Density relates to the number of individual species in a unit area; Dominance refers to an area a species occupies in a stand within a unit area; and frequency refers to the distribution of a species throughout the stand, the percentage of quadrats a species occurs in (Roberts-Pichette, *et al.*, 1999). **Error! Reference source not found.** is arranged according to descending Importance Values, and the only two non-native species present within the plots rank amongst the top five for importance value. Importance values are highly dependent on the number of individual trees observed, the higher the quantity per species, the higher the importance value. This shows that Scots

Pine (*Pinus sylvestris*) and Manitoba Maple (*Acer negundo*) are amongst the most abundant tree species within the eight Forested sites. Tree health will be observed every five years as the plots are monitored.

2.1.2 Regeneration

Monitoring the regeneration of saplings is another important feature used to understand the structure and observe the succession of the forest.

Monitoring plots are established in conjunction with the 20mx20m Forest Plots. The regeneration sub-plots consist of five 2mx2m plots for each 20mx20m Forest plot. While observing regeneration at each site, species and sapling height is recorded. All tree species and heights will be recorded for saplings within 16cm and 200cm in height that lie within the subplot boundaries; specimens less than 16cm will not be recorded as the success rate is too unpredictable and may not survive the growing season. **Error! Reference source not found.** shows the overall species observed at each site.

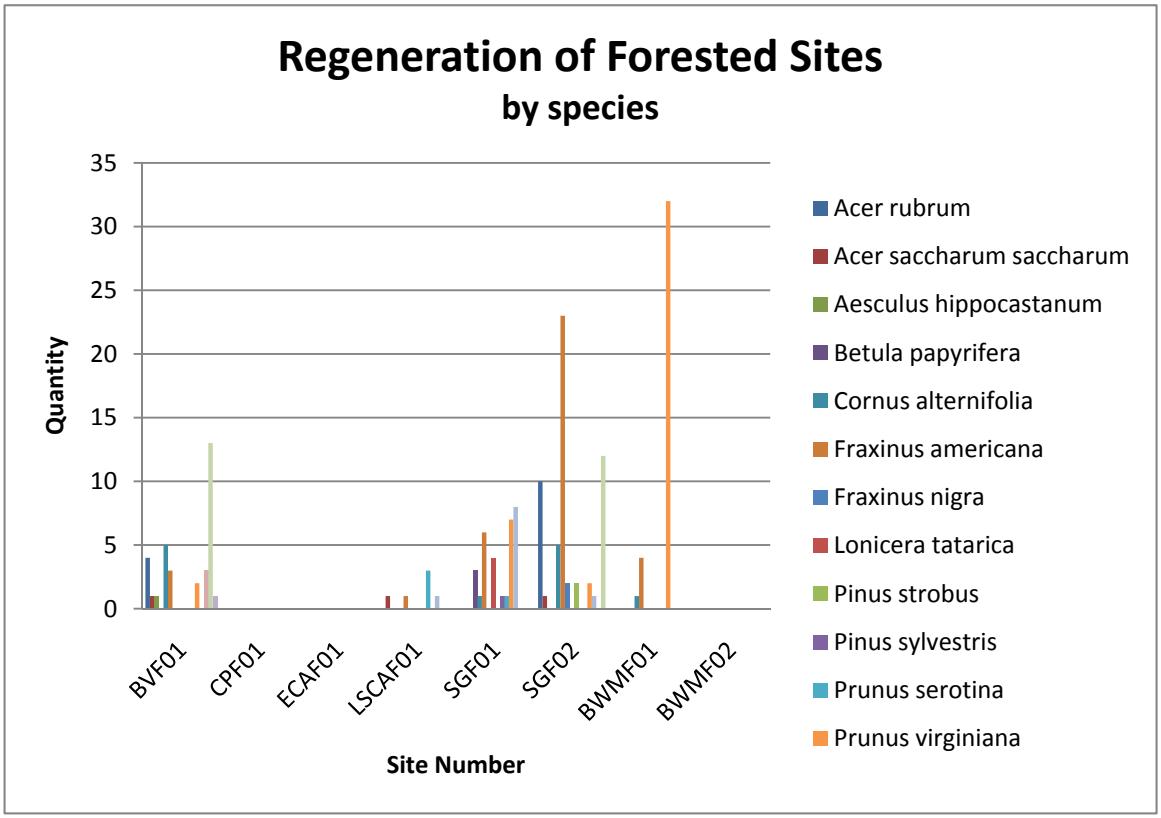

Figure 3: Regeneration of Forested Sites by Species

While three sites (CPF01, ECAF01 and BWMF02) did not have any regenerating seedlings large enough to include in the survey, the remaining five sites had a wide variety of regenerating species. Chokecherry (*Prunus virginiana*), White Ash (*Fraxinus Americana*), and Eastern White Cedar (*Thuja occidentalis*) were the most abundant regenerating saplings throughout the five sites. Five of the sixteen recorded species are non-native, while only three of them are considered invasive; Tartarian Honeysuckle (*Lonicera tatarica*), Scots Pine (*Pinus sylvestris*), and European Buckthorn (*Rhamnus cathartica*). They should continue to be monitored as they are very aggressive plant species, as will be discussed below. Many of the saplings observed are still quite small and are vulnerable to many environmental factors.

Table 7: Regeneration by height classification for Forested Plots

Tree Species	Seedling Height Classes (cm)						Total by Species
	16-35	36-55	56-75	76-95	96-200	>200cm	
Acer rubrum	12	1				1	14
Acer saccharum saccharum	1	1		1			3
*Aesculus hippocastanum**			1				1
Betula papyrifera		3					3
Cornus alternifolia	9	1		2			12
Fraxinus Americana	27	6	2	1		1	37
Fraxinus nigra	1				1		2
*Lonicera tatarica**				2	2		4
Pinus strobes	1	1					2
*Pinus sylvestris**					1		1
Prunus serotina			1			3	4
Prunus virginiana	11	4	6	4	8	10	43
*Rhamnus cathartica**	8	2					10
*Sorbus aucuparia**	3						3
Thuja occidentalis	9	7	4	3		2	25
Tilia Americana				1			1
Total by height class	**82**	**26**	**14**	**14**	**12**	**17**	**165**

*non-native species

Error! Reference source not found. shows the height category by species, the majority of regenerating saplings observed fall within the 16 to 35cm category. Species within the first category are still quite vulnerable, and are the most frequently observed, however as the height category increases the frequency of sapling observations decreases. White Ash (*Fraxinus americana*) has the second highest regenerating rate, next to Chockecheery (*Prunus virginiana*), observing these sites over the next few years will be vital as the threat of EAB continues to spread.

2.1.3 Ground Vegetation/Invasive Species

Monitoring ground vegetation within a forested system can provide information regarding rate of germination, growth and development of seedlings, and the quality of habitat. Ground vegetation is defined as all herbaceous material and ground layer vegetation, including lichens, mosses, fungi and small trailing and rosette plants. It also encompasses woody stemmed material that is less then 1m in height. Ground vegetation can vary depending on many factors, including forest canopy cover, soil substrate, moisture variation and time of the year.

At each of the forested 20mx20m plots ground vegetation was monitored within 1mx1m subplots. **Error! Reference source not found.** provides a summary of the species composition for each site, and breaks it up between native, non-native and overall species richness. Total species richness ranges between 5 species to 20 species. This may be a result of the type of site as CPF01 has a total of 5 species, four of which are non-native, and is a Spruce Plantation (CUP). BWMF02 also contained a high range of non-native species, as well as a high number of non-native trees. This site has been ELC classified as an FOD, and is situated just south of highway 401 and directly north of an auto repair wrecking yard. There are also paths that run through this woodlot that could potentially bring in a greater number of non-native species.

Table 8: Ground Vegetation data for Forested Plots

Site Name	Site Number	Total Species Richness	Native Species Richness	Non-native species richness	% Non-native Species
Bowmanville Westside CA	BWMF01	11	9	2	18%
Bowmanville Westside CA	BWMF02	11	4	7	64%
Stephen's Gulch CA	SGF01	20	12	8	40%
Stephen's Gulch CA	SGF02	16	14	2	13%
Long Sault CA	LSCAF01	12	8	4	33%
Enniskillen CA	ECAF01	9	8	1	11%
Cane Property	CPF01	5	1	4	80%
Bowmanville Valley	BVF01	16	14	2	13%
Overall		64	48	16	25%

A majority of native species were found at all the forested sites, with 25% non-native species overall. Some non-native species may not pose a threat; however, many have the ability to transform entire eco-systems, choking out native plants and altering suitable habitats used by native wildlife. A total of 16 non-native species were found throughout all 8 sites, **Error! Reference source not found.** shows the non-native species list and their ranking of invasiveness according to the Central Lake Ontario Conservation Invasive Species List (CLOCA, 2010-01MP) as adapted from Urban Forest Associates Inc. (2004).

Table 9: Non-Native Species list for Forested Plots

Latin Name	Common Name	Rank	Latin Name	Common Name	Rank
Alliaria petiolata	Garlic Mustard	1	*Impatiens glandulifera*	Himalayan Balsam	1
Arctium minus	Common Burdock	-	*Lonicera tatarica*	Tartarian Honeysuckle	1
Cerastium pumilum	Mouse-eared Chickweed	-	*Medicago lupulina*	Black Medick	4
Cynanchum rossicum	Pale-Swallow wort	1	*Melilotus alba*	White Sweet Clover	2
Epipactis helleborine	Helleborine	4	*Solanum dulcamara*	Bittersweet Nightshade	3
Geum urbanum	Garden Avens	1	*Taraxacum officinale*	Common Dandelion	-
Glechoma hederacea	Ground Ivy	4	*Urtica dioica*	European Nettle	3
Hesperis matronalis	Dame's Rocket	1	*Vicia cracca*	Crown Vetch	2

The rankings for invasiveness are adapted from the Urban Forest Associates Inc (2004) list of Invasive Exotic Species Rankings for Southern Ontario, and range from 1 to 5. **Error! Reference source not found.** explains the criteria for each ranking.

Table 10: CLOCA's Invasive Species Ranking Criteria (as adapted by Urban Forest Associates, Inc., 2004)

Category Rank	Category Criteria
1	This category contains aggressive invasive exotic species that can alter or dominate sites and exclude native species. These organisms are a threat to natural areas, as they disperse widely, through transport by animals and/or natural means (water, wind, etc). These species are top priority, however control may be difficult.
2	Species that are highly invasive but tend to only dominate certain niches or do not spread rapidly from major concentrations. They spread by vegetative means or by seeds that drop close to the parent. They may persist in dense populations for long periods. Control where necessary and limit their spread to other areas.

3	Moderately invasive species, but can become locally dominant when the proper conditions exist. Control where necessary and limit their spread to other areas.
4	Species that do not pose a serious threat to natural areas unless they are competing directly with more desirable vegetation. These plants are sometimes substituted for native plants, but may not reproduce aggressively once established.
5	Some of these species have the potential to become invasive exotics in Ontario. They can reproduce aggressively on occasion but have not been shown to be a serious threat to natural areas in Ontario. Some are very similar to indigenous species and could simply have been overlooked.

Six of the thirteen non-native species are ranked as "… aggressive invasive exotic species that can alter and dominate sites and exclude native species. These organisms are a threat to natural areas, as they disperse widely, through transport by animals and natural means (water, wind, etc.) …" (CLOCA, 2010-01MP). Five of these six non-native species are on CLOCA's top terrestrial invasive species list and are becoming increasingly dominant throughout the landscape. Management of these species can be very difficult and arduous as they require a long-term commitment (at least five years) to control them. CLOCA's internal Invasive Species Working Group will be working towards prioritizing CA lands for potential invasive species management and promoting the awareness of invasive species.

2.2 Non-forested Systems

Non-forested systems, which include cultural meadows (CUM) and cultural thickets (CUT) account for 24% of the total natural cover of the Bowmanville/Soper watershed, or 9% of the entire watershed. As mentioned before, five non-forested plots were established in 2009 throughout the Bowmanville/Soper watershed. Four were placed within Conservation Area lands, Bowmanville Westside Marsh CA, Stephen's Gulch CA, Enniskillen CA and Long Sault CA; and one plot was installed on Municipality of Clarington lands located near Mearns Avenue and Sprucewood Crescent (Figure 4). Each site has six 1mx1m monitoring plots established and were observed twice during the field season, once in early June and once again in late August.

Error! Reference source not found. below shows the overall species composition for the five sites. A total of 41 different species were found distributed throughout the five sites, and just over 60% of those were non-native species. Almost all of the sites, except for Stephen's Gulch CA had more non-native species than they did native, even Stephen's Gulch was close with 45% non-native species.

Table 11: Ground Vegetation data for Non-Forested Sites

Site Name	Site Number	Total Species Richness	Native Species Richness	Non-Native Species Richness	% Non Native Species
Clarington	CLRNF01	8	3	5	63%
Enniskillen CA	ECANF01	17	8	9	53%
Long Sault CA	LSCANF01	14	3	11	79%
Stephen's Gulch CA	SGNF01	11	6	5	45%
Bowmanville Westside CA	BWMNF01	10	4	6	60%
Overall		**41**	**17**	**24**	**59%**

Even though every site has a high number of non-native species, not all of these species pose a threat to native diversity; many non-native species have become naturalized and live in harmony with the surrounding vegetation. That being said, CLOCA has adapted a list from Urban Forest Associates Inc. (2004) on non-native terrestrial species and their potential invasiveness, **Error! Reference source not**

found. shows all the non-native species present among the five sites observed and their potential invasiveness, according to the categorized criteria.

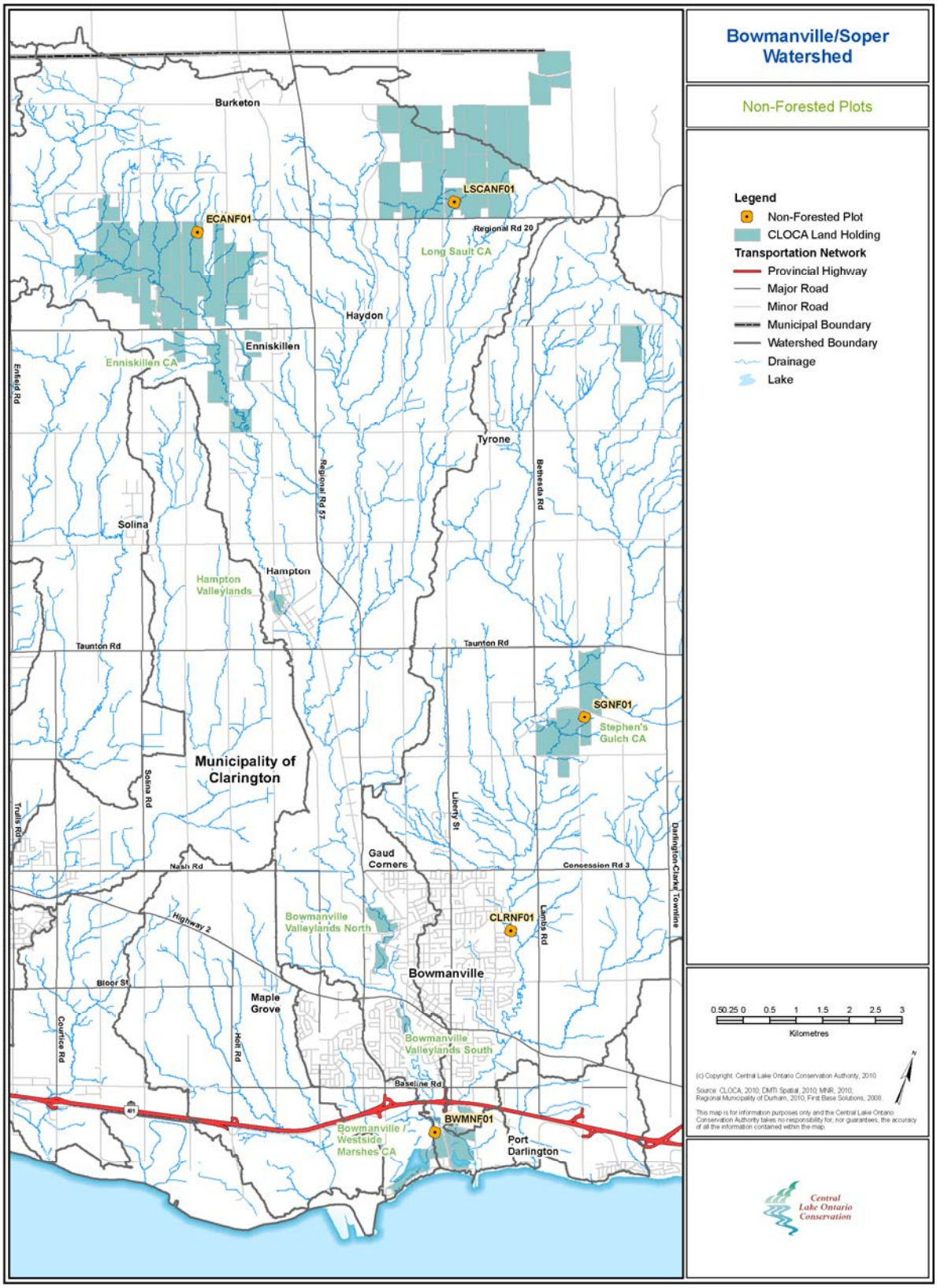

Figure 4: Bowmanville/Soper Non-Forested Plot locations

Table 12: Non-Native Species List for Non-Forested Sites

Latin Name	Common Name	Rank	Latin Name	Common Name	Rank
Achillea millefolium	Yarrow	-	*Medicago sativa*	Alfalfa	4
Chrysanthemum leucanthemum	Ox-eye Daisy	-	Melilotus alba	Sweet White Clover	2
Convolvulus arvensis	Field Bindweed	2	Melilotus officinalis	Sweet Yellow Clover	2
Cynanchum rossicum	Pale-Swallow wort	1	Phleum pretense	Timothy Grass	-
Daucus carota	Queen Anne's lace	-	Potentilla recta	Rough-Fruited Cinquefoil	-
Elaeagnus angustifolia	Russian Olive	1	Taraxacum officinale	Common Dandelion	-
Galium mollugo	White Bedstraw	2	Tragopogon dubius	Goat's Beard	-
Hieracium murorum	Hawkweed	3	Trifolium hybridum	Alsike Clover	-
Hieracium pretense	Hawkweed	3	Trifolium pretense	Red Clover	4
Hypericum perforatum	St. John's Wort	4	Trifolium repens	White Clover	4
Linaria vulgaris	Butter-and-eggs	4	Verbascum thapsus	Common Mullein	-
Lithospermum officinale	European Gromwell	-	Vicia cracca	Crown Vetch	2

While there is a large number of non-native species present, two of them, Pale Swallow wort (*Cynanchum rossicum*) and Russian Olive (*Elaeagnus angustifolia*) are severely invasive, ranking in the first category. These two species are also on CLOCA's top terrestrial invasive species list and management strategies are currently being looked into to control and manage these species. Five of these species are grouped in category 2, and while they may dominate a specific site, their threat, while still high, is not as high as the first group of species. Many of the species listed found in category 2 dominate cultural meadows, and are less commonly found in woodlots.

The remaining species that are grouped within categories 3 and 4 are again predominantly found in Cultural Meadows (CUM); they can become locally dominant within an area without entirely transforming a site. Finding a greater number of non-native species in these sites is not a large surprise, as they are all ELC classified as Cultural Meadows, which Lee, *et al*. (1998) describes as "open communities originating from, or maintained by, anthropogenic or culturally based disturbances (e.g. planting or agriculture, clearing, recreation, soil movement, grazing or mowing); often having a large proportion of introduced species".

Although these sites are clearly dominated by non-native species, they still have the potential to provide adequate habitat for wildlife. In 2008, bird monitoring was conducted within Enniskillen Valley Conservation Area, and in close proximity to site ECANF01. Sixteen bird species were observed within 100m of the site. Evidence of breeding was only probable for three of the species (Clay-coloured Sparrow; Field Sparrow and Red-eyed Vireo), however it was stated that breeding was possible for the 13 remaining bird species (CLOCA, 2009-01MR). For more information regarding Wildlife monitoring the reader is referred to Wildlife Monitoring Annual Report 2008 (CLOCA, 2009-01MR).

2.3 Wetland Systems

Wetlands make up 20% of the natural cover within the Bowmanville/Soper watershed, or 7% of the entire watershed. Wetlands play an integral part in the function and health of a watershed, as they act as natural filters, groundwater recharge sites, and provide habitat for a number of species. The wetlands being monitored as part of this program are non-coastal wetlands, as all of the coastal wetlands within the CLOCA jurisdiction are monitored through the Durham Region Coastal Wetland Monitoring Project (DRCWMP). The wetlands being monitored comprise of the ELC community class treed swamp, which includes Coniferous Swamp (SWC), Deciduous Swamp (SWD) and Mixed Swamps (SWM).

Since the wetland systems being monitored are Treed Swamps, the same monitoring protocols were used as those to assess the ecological integrity of Forested Systems. Five 20mx20m plots were established throughout the watershed (**Error! Reference source not found.**) covering a total area of 2000m^2; three within the Oak Ridges Moraine and two within the Lake Iroquois Beach Shoreline. Due to the lack of CLOCA owned treed wetlands within the Lacustrine Plain, no wetland plots were established in the southern portion of the watershed. From south to north, the plots were established in: Municipality of Clarington Landholdings; Enniskillen CA; and Long Sault CA.

2.3.1 Tree Health

Emerald Ash Borer (EAB) has been discovered within Pickering. CLOCA staff offered further examination of potential trees since there were a few *Fraxinus nigra* at some of the sites, however there was no evidence of EAB. All the trees looked healthy and had full crowns with minimal dieback if any. **Error! Reference source not found.** shows the percent mortality at each site, keeping in mind that the data represented in the table below is meant to act as baseline data and the recommended threshold will not be applied to this year's data; refer to Section 2.1.1 for information regarding the thresholds.

Table 13: Tree Health Summary for Wetland Sites

Site Name	Site #	Mortality of Trees (%)	Evidence of Emerald Ash Borer
Long Sault CA	LSCAW01	16%	None
Enniskillen CA	ECAW01	6%	None
Enniskillen CA	ECAW02	51%	None
Clarington	CLRW01	35%	None
Clarington	CLRW02	0%	None
Overall		**26%**	**None**

The mortality rate amongst the wetland sites is extremely varied, ranging from 0% to 51% mortality. Site ECAW02 has a mortality rate of 51%, and although this is very high, the dominant species at the site were Eastern White Cedar (*Thuja occidentalis*) and White Spruce (*Picea glauca*) the latter of which is often found in upland conditions. CLRW01 also had a relatively high mortality rate of 35%. The dominant species is Manitoba Maple (*Acer negundo*), followed by Eastern White Cedar and Crack Willow (*Salix fragilis*). Manitoba Maple is a non-native maple tree that reproduces vegetatively and prefers lakeshores and stream banks on sites that are seasonally flooded and often colonizes disturbed sites (Farrar, 1995). Crack Willow is a non-native tree from Europe that has weak branches, and can reproduce vegetatively (Farrar, 1995). Crack Willow is ranked in category two on CLOCA's terrestrial invasive species list; while Manitoba Maple is on CLOCA's top terrestrial invasive species list. Both of these two species tend to have weak branches that are liable to break during storms (Farrar, 1995) making them more susceptible to disease and infection. This may explain the high rate of mortality at CLRW01. Also, this site is situated close to public paths and is at the base of a steep valley where yard clippings and garbage are regularly disposed of.

Table 14: Wetland Plot Tree Species Composition

Site Name	Species Richness	Native	Non-Native	% Non-Native
CLRW01	3	1	2	67%
CLRW02	1	0	1	100%
ECAW01	6	5	1	17%
ECAW02	4	4	0	0%
LSCAW01	5	5	0	0%

Table 15: Wetland Plot Tree Species by Importance Values

Tree Species		Importance Value
Latin Name	Common Name	
Thuja occidentalis	White Cedar	125.06
*Salix fragilis**	Crack Willow	33.11
Betula allegheniensis	Yellow Birch	30.08
*Acer nugundo**	Manitoba Maple	26.61
Tsuga Canadensis	Hemlock	26.36
Fraxinus nigra	Black Ash	24.32
Picea glauca	White Spruce	9.61
*Rhamnus cathartica**	European Buckthorn	7.20
Betula papyrifera	White Birch	6.46
Tilia americana	Basswood	5.89
Acer saccharinum	Silver Maple	5.65

*indicates non-native species

Table 14 shows the species composition and the percent of non-native species by site number. Two of the sites do not appear to have any non-native tree species, while the remaining three sites range from 17% to 100% non-native species. Table 15 shows the tree species found in all eight sites according to importance value. Importance value is defined in the Forested Systems Tree Health section. Table 15 is arranged according to descending Importance values. Three non-native tree species are present within the wetland plots; Crack Willow (*Salix fragilis);* Manitoba Maple (*Acer negundo*); and European Buckthorn (*Rhamnus cathartica*). Of these three species, Crack Willow and Manitoba Maple rank amongst the top four for Importance Values. As mentioned previously, Importance Values are highly dependent on the quantity of tree species within the plots. While there appears to be a relatively high number of Crack Willow and Manitoba Maple present, European Buckthorn ranks further down the list. All trees observed and measured must be greater than 10cm dbh; European Buckthorn does not often get larger than 10cm in diameter (Farrar, 2006). Tree health will be observed every five years as the plots are monitored.

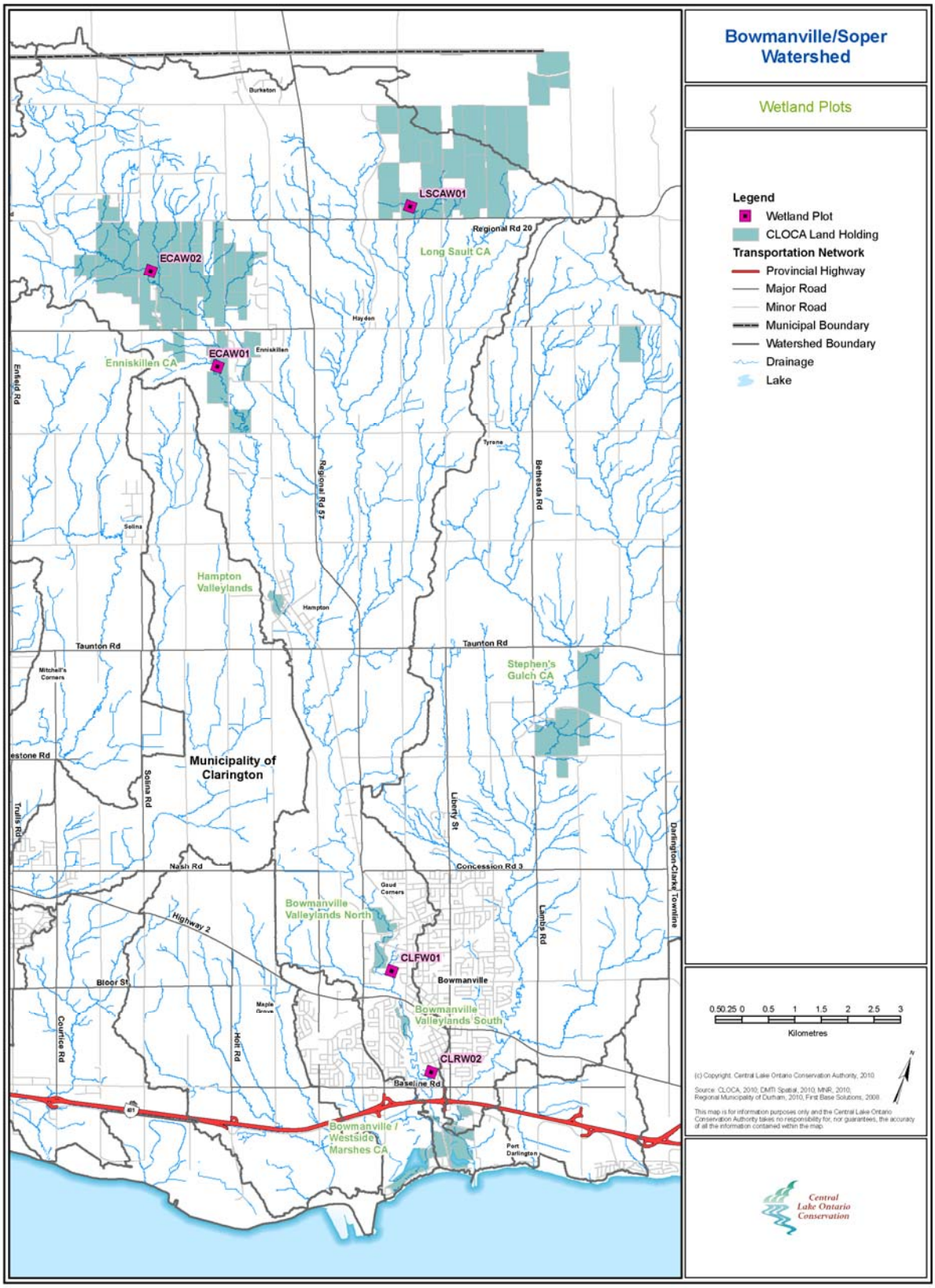

Figure 5: Bowmanville/Soper Wetland Plot Locations

2.3.2 Regeneration

Monitoring plots are established in conjunction with the 20mx20m Wetland Plots, as mentioned in the regeneration section for Forested Plots. **Error! Reference source not found.** shows the species and count observed at each site.

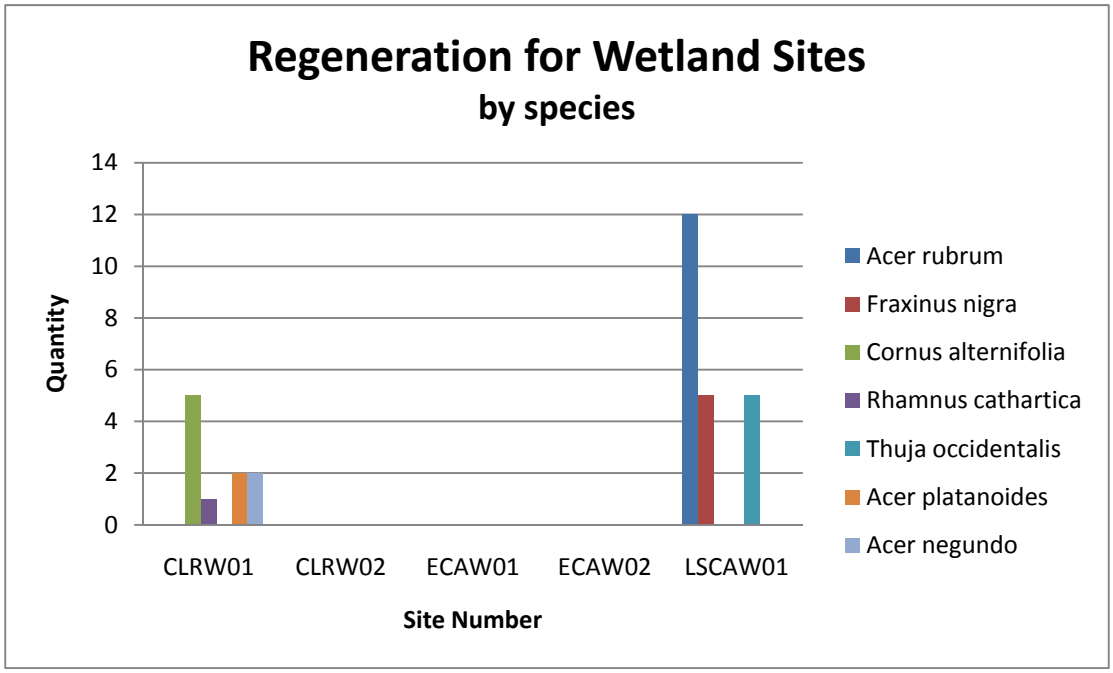

Figure 6: Regeneration of Wetlands Sites by Species

Three of the five sites did not have any regenerating saplings, whereas CLRW01 and LSCAW01 had a relatively high amount of regenerating saplings. At site CLRW02 Manitoba Maple (*Acer negundo*) was the only tree species found within the plot. Manitoba Maple often regenerates through suckers and vegetatively, which could explain why there was no regeneration recorded. For this protocol, only saplings are measured and regenerating branches or suckers are not taken into account. The remaining two sites, ECAW01 and ECAW02, were very saturated and had a high mortality rate. Also, sites that have saplings under 16cm are not recorded, however in subsequent monitoring years, if these specimens are successful they may be accounted for in the next assessment.

Within the two regenerating sites only three non-native species were found to be regenerating, however all three of these species are on CLOCA's top terrestrial invasive species list; European Buckthorn (*Rhamnus cathartica*), Norway Maple (*Acer platanoides*), and Manitoba Maple. **Error! Reference source not found.** shows the height classification and count for all the recorded species present. As seen within the forested sites, saplings within the 16-35cm height classification dominate, and the counts slowly decrease as the height increases. Except for Manitoba Maple, only native species are present within the larger height classes. As mentioned before, the vulnerability of saplings is very high, especially at such a small height class. While the survival rate increases amongst larger saplings, there is still a risk of disease, browsing and other environmental factors.

Table 16: Regeneration by height classification for Wetland Plots

Tree Species	Seedling Height Classes (cm)						
	16-35	36-55	56-75	76-95	96-200	>200cm	Total by Species
*Acer platanoides**	2						2
Cornus alternifolia	3			1	1		5
*Rhamnus cathartica**	1						1
*Acer negundo**		1			1		2
Thuja occidentalis	6		3	1	1		11
Acer rubrum	5		1		3	3	12
Fraxinus nigra	2	2			1		5
Total by height	**19**	**3**	**4**	**2**	**7**	**3**	**38**

*non-native species

2.3.3 Ground Vegetation/invasive species

Monitoring ground vegetation within a wetland system can provide information regarding rate of germination, growth and development of seedlings, and the quality of habitat. As mentioned in the Forested Plots section, ground vegetation is monitored at the 20mx20m plots, in five 1mx1m subplots. **Error! Reference source not found.** provides a summary of the species composition for each site, and breaks it up between native, non-native and overall species richness. Total species richness ranges between five to thirty-three species. Site ECAW01 and LSCAW01 species richness count may have been so low due to the closed canopy of the site, and minimal amounts of natural light exposure to the ground, while ECAW02 had a more open canopy and greater mortality rate, thus allowing a greater amount of light to reach the ground vegetation.

Table 17: Ground Vegetation data for Wetland Plots

Site Name	Site Number	Total Richness	Native Species Richness	Non-native Species Richness	% Non-native Species
Long Sault CA	LSCAW01	7	6	1	14%
Enniskillen CA	ECAW01	5	4	1	20%
Enniskillen CA	ECAW02	33	29	4	12%
Clarington	CLRW01	18	13	5	28%
Clarington	CLRW02	18	11	7	39%
Overall		**62**	**49**	**13**	**21%**

Table 18: Non-Native Species List for Wetland Sites

Latin Name	Common Name	Rank	Latin Name	Common Name	Rank
Alliaria petiolata	Garlic Mustard	1	*Ranunculus acris*	Tall Buttercup	-
Epipactis helleborine	Helleborine	4	*Rumex obtusifolius*	Bitter Dock	-
Geum urbanum	Garden Avens	1	*Solanum dulcamara*	Bittersweet Nightshade	3
Hesperis matronalis	Dame's Rocket	1	*Taraxacum officinale*	Common Dandelion	-
Impatiens glandulifera	Himalayan Balsam	1	*Tussilago farfara*	Coltsfoot	4
Myosotis scirpoides	True Forget-me-not	4	*Urtica dioica*	European Nettle	3
Phalaris arundinacea	Reed Canary Grass	5			

Throughout all five sites there was a total of thirteen non-native species, with a maximum of seven non-native species at one site. **Error! Reference source not found.** shows the list of non-native species and their rank in CLOCA's Terrestrial Invasive Species Plant list. Three of the species are not ranked,

showing that they are naturalized and do not pose a great threat to the local diversity of the area; five of the thirteen rank in categories three, four and five. These plants tend to prefer moist sites, and are common in CLOCA's jurisdiction, and while their spread should be limited, they do not appear to pose a great threat to the surrounding areas. The remaining four non-native species ranked in category one are all highly invasive, three of which are on CLOCA's top Terrestrial Invasive species list; Garlic Mustard (*Alliaria petiolata*), Dame's Rocket (*Hesperis matronalis*), and Himalayan Balsam (*Impatiens glandulifera*). Sites CLRW01 and CLRW02 have the greatest amount of non-native species. Both of these sites are owned by the Municipality of Clarington, and are situated in close proximity to public paths. Even though the remaining three sites (LSCAW01, ECAW01, ECAW02) are located on CA property, there are no direct paths leading to these areas, and they have a much lesser percent of non-native species present. Monitoring of these sites will occur again in 2011.

3.0 SPECIAL PROJECTS

3.1 DOG STRANGLING VINE AT CROW'S PASS CONSERVATION AREA

Observations of Dog-Strangling Vine (*Cynanchum rossicum*) at Crow's Pass Conservation Area were first started in 2007. This project was then continued in 2009. The initial question asked was if the creation of new trails will facilitate the spread of DSV. In July 2007, the Oak Ridges Moraine Trail Association connected two existing trails within the Crow's Pass Conservation Area through the creation of a new trail in a relatively undisturbed patch of deciduous forest. There is a known population of DSV within this Conservation Area, however not within the forest patch where the new trail was created. A series of sweeps were done to confirm that no DSV plants were already in existence within the trail area, and four transects were placed around the new trail, two transects were placed parallel to the trail, 25m away, while the remaining two transects were placed perpendicular to the trail. This was done to ensure DSV was not present in any direction.

The trail was visited twice in 2009, once in the early spring and again in August. During site visits, severity of the populations is recorded. To do this, the ELC ranking for presence and distribution is used, ranging from 0 to 3; zero being absent and 3 is abundant in the presence category, while zero refers to absent and 3 is extensive in the distribution category (CLOCA, 2009-03MM). No DSV was present along the trail and the transects.

Using a Sonin 10300 Multi-Measure Combo Pro – Long Range Indoor/Outdoor Ultrasonic Distance Measuring Tool, the distance was measured from the trail to the last known population of DSV, at the entrance of the forest. The distance calculated was 411.22m.

Discussion:

As previously mentioned, this project was started in 2007. It is difficult to determine if any signs of DSV are directly from trail use or if seeds have been brought in by other means, such as animals, wind dispersal and other environmental contributors. This was the reason for introducing the two additional transects, to observe which direction DSV may be entering the forest by.

While Crow's Pass is open to the public, it is not an overtly advertised conservation area. Due to this, it is unsure the number of patron's visiting this CA, which makes it difficult to assess the spread of DSV and its relation to trail use. Also, while CLOCA staff take adequate precautions to avoid the spread of invasive species, the act of walking the transects could potentially promote the spread of invasive species, specifically DSV. These transects will be observed in the spring and late summer of 2010, and upon further analysis, it will be decided if this program should continue past the field season of 2010.

3.2 TREE PLANTING SURVIVAL ASSESSMENTS

As part of CLOCA's ongoing commitment to forest regeneration, CLOCA participates in yearly initiatives to plant trees on both CLOCA lands and privately owned lands within its jurisdiction. The tree plantings are often done with funding assistance from the Ministry of Natural Resources, Trees Ontario Foundation, Oak Ridges Moraine Foundation, and CLOCA's Clean Water Land Stewardship Program. As part of this yearly tree planting program, monitoring is conducted late in the field season to observe the survival rate of the newly planted trees.

In 2009 five sites were surveyed to assess the survival rate of the tree plantings. The five sites surveyed were Cranberry West Tract, Runnymede, Enniskillen CA Sharp Tract, Bowmanville Westside Marsh CA Tract and the Enniskillen CA Rowsell Tract. According to the Trees Ontario Foundation criteria, a minimum of 2% of the planted population has to be randomly assessed for rate of survival.

Error! Reference source not found. below shows the survival rates of the fives sites surveyed in 2009, and survival rates for subsequent years, where sampling was done.

Table 19: Tree Planting Survival Rates

Planting Site	2009	2008	2007
Cranberry West Tract	88%	-	-
Runnymede Tract*	96%	-	-
Bowmanville Westside Tract	49%	-	43%
Rowsell Tract	68%	-	-
Sharp Tract	83%	78%	-

At certain locations it can be difficult to guarantee that 2% of the population is surveyed, and often is the case the trees surveyed may not be representative of the entire planting, as the trees surveyed are the only existing trees found. Therefore, the table above may not be an adequate representation of the true survival rate of planted trees. Review and suggestions to correct this are discussed section 3.2.6.

3.2.1 Cranberry West Tract

Cranberry West Tract, located south on Halls Road (Figure 7), was planted in 2002, 2003 and 2004. Since planting took place close to 6 years ago, the height of the trees was measured while surveying to observe if they had reached the free-to-grow stage. Six different species of trees were planted; White Spruce, White Pine and White cedar were planted as seedlings, while Black Walnut, Red Oak and Bitternut Hickory were planted as nuts. During the assessments, no specimens of the latter three tree species were found, however a total of 500 were planted. The conifer species were planted as plugs; of these plugs a total of 378 were surveyed, while 19,750 were planted. For this site, the sample size of 2% (395 specimens) was not achieved. **Error! Reference source not found.** shows the overall survey assessment completed in May 2009.

Table 20: Cranberry West Tract Survival Rates

Species	May 2009		
	Alive	Dead	% Survival
White Pine	170	16	91%
White Spruce	131	17	89%
White Cedar	34	11	76%
Total	**335**	**44**	**88%**

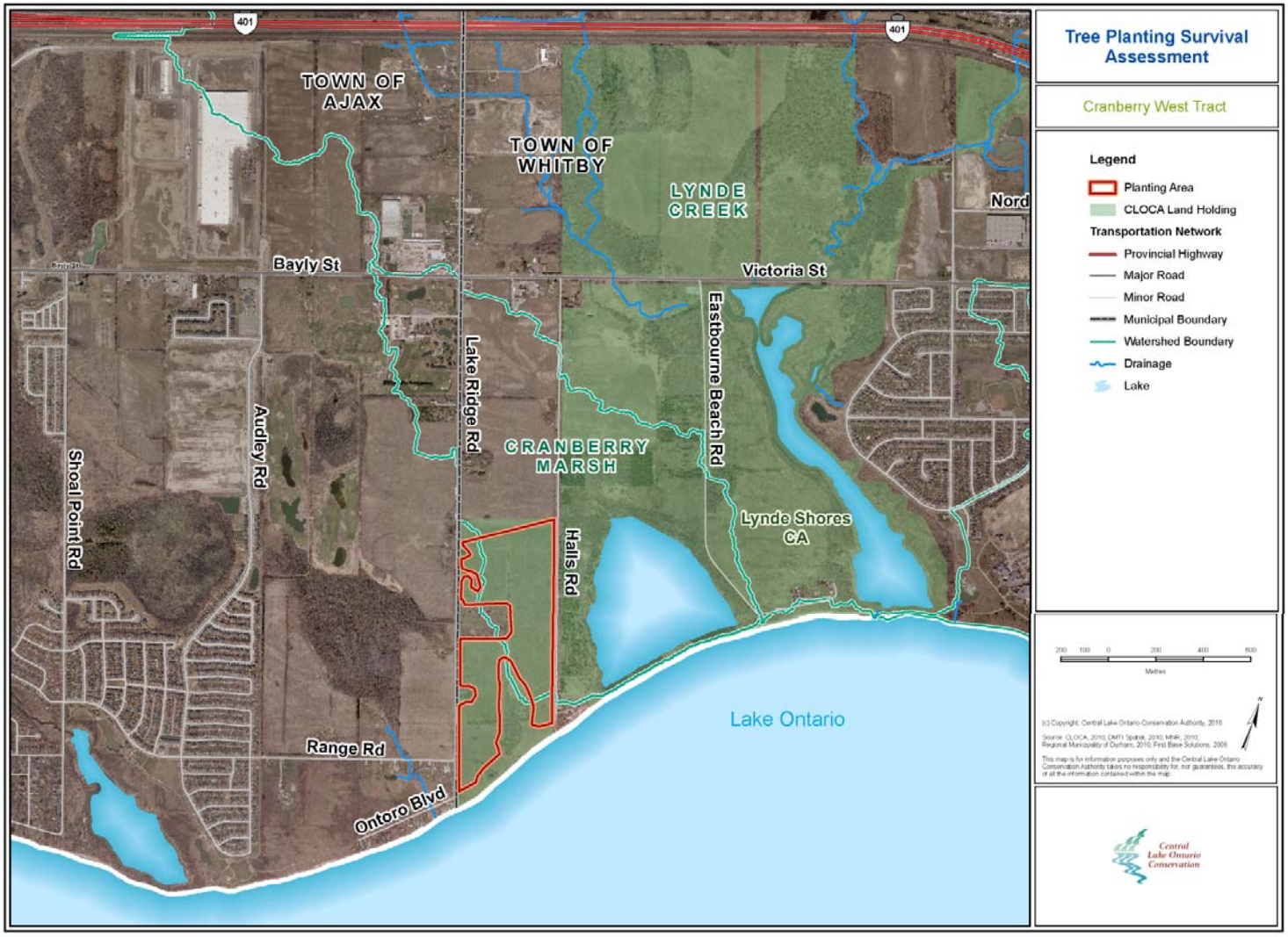

Figure 7: Map of Cranberry West

Error! Reference source not found. shows the number of trees surveyed according to species and height classification. White Pine and White Spruce were the dominant species among the three, and White Pine had some of the tallest specimens. There was minimal, if any browsing evident on the larger trees, however the smaller trees that fell within 16-35cm looked under stress. On the west side of the property, adjacent to a woodlot there were many volunteer *Fraxinus* (Ash) *spp* sprouting. Most of the volunteer Ash were within the first stages of growth, and fell in the first height category.

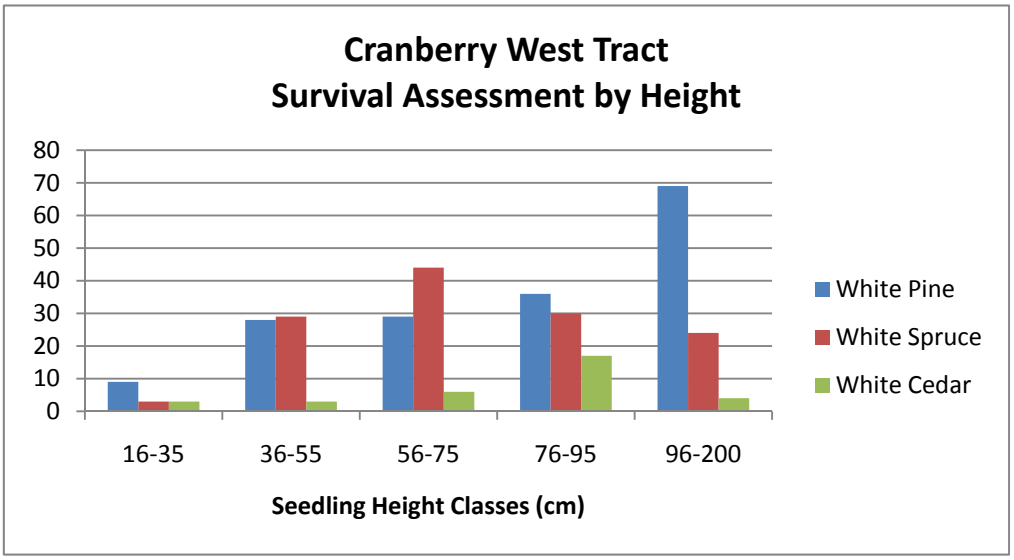

Figure 8: Cranberry West Tract Survival Assessment by height

This site also contains bird nesting boxes as a way to observe its habitat potential. There are 34 nestboxes present at Lyndes Shores that were assessed in March of 2009. Sixteen of the boxes were occupied by House Wren, 3 were occupied by Tree Swallows and one was occupied by a Black-capped Chickadee and an Eastern Bluebird (CLOCA, 2009-01MR).

3.2.2 Runnymede

Runnymede Tract is located directly north of Lynde Shores CA on Victoria Rd (Figure 9). It is situated within an old agricultural field that is dominated by golden rods, mullein and thistles. The Runnymede Tract was planted in 2002 with White Pine, White Spruce and Tamarack. Approximately 22,700 trees were planted at the site; 12,400 - White Pine; 10,000 - White Spruce; 300 – Tamarack. While a tractor and mower had been used to prepare this site, ground vegetation had once again become dominant, prohibiting the growth of the seedlings. The 2% sample, consisting of 454 trees, could not be surveyed unfortunately. Only 46 trees were found to survey, two of which were dead. This would put the survival rate at 96%, however this is not an accurate picture of the site as the sample size could not be achieved. Of the 46 trees found, 30 were White Spruce, 15 were White Pine and a dead Hardwood Maple was found (**Error! Reference source not found.**). The holes in which the dead trees were planted had been completed covered by forbs.

Table 21: Runnymede Tract Survival Assessment

Species	May 2009		
	Alive	Dead	% Survival
White Pine	15	0	100%
White Spruce	29	1	97%

Hardwood Maple	0	1	0%
Total	**44**	**2**	**96%**

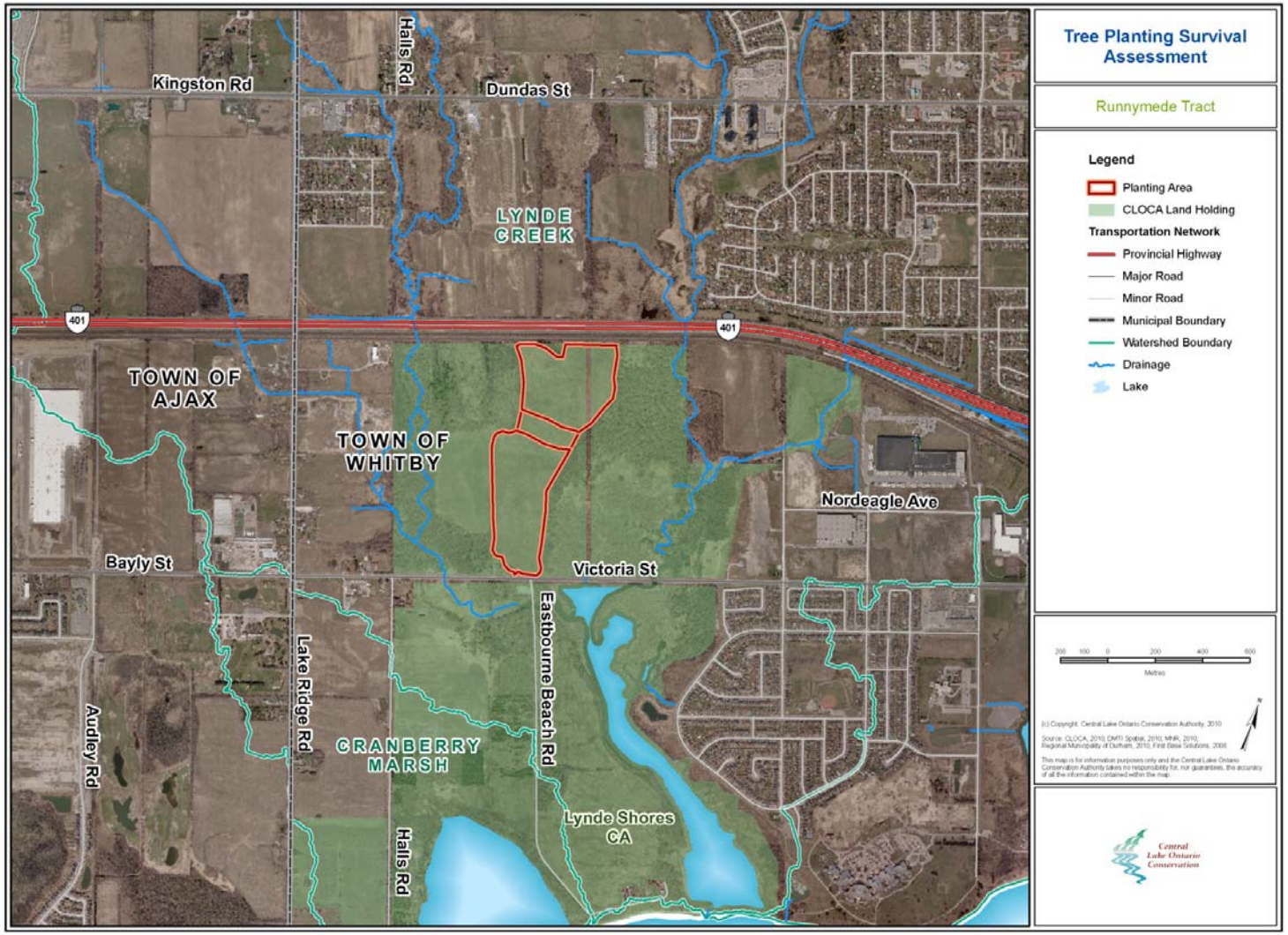

Figure 9: Map of Runnymede Tract

3.2.3 Enniskillen CA Sharp Tract

ECA Sharp Tract is located in the north end of the Enniskillen Valley Conservation Area, just east of Concession 9 (

). It lies between four actively managed agricultural fields, and is just north of a small woodlot. ECA Sharp Tract was planted in April of 2008 in partnership with Trees Ontario Foundation. A total of 3,500 trees were planted, covering an area of approximately 3.2ha. This was divided into three compartments, compartment 1 is located to the far east, compartment two is to the far west, and compartment three is situated in the middle.

Compartment 1

Compartment one consisted of drier soils, and therefore had more upland species planted such as, White Pine (600), White Cedar (500), White Spruce (500), Red Oak (200), Hardwood Maple (200) and Red Maple (400), for a total of 2,400 trees. Hiring the former owner of the land, the site was prepared with a Koola to create the divots in which the trees were planted. Coils were also purchased to put around the seedlings to prevent mammalian herbivory on the newly planted trees. At least 48 trees had to be surveyed to ensure the 2% success rate. A total of 76 seedlings were surveyed, 67 of which were alive and 9 were dead. **Error! Reference source not found.** shows a summary of survival rates by species planted. Tree height was also measured at this site, and heights ranged between 16cm to 55cm, with only three saplings falling into the 56-57cm category. This is to be expected as the trees surveyed were only planted in 2008, and are usually planted as approximately 18-24cm whips.

Table 22: ECA Sharp Tract Compartment 1 Survival Assessment

Species	October 2008			May 2009		
	Alive	Dead	% Survival	Alive	Dead	% Survival
White Pine	22	8	73%	18	0	100%
White Cedar	20	6	77%	16	5	76%
White Spruce	4	4	50%	11	2	85%
Red Oak	0	0	0%	9	1	90%
Hardwood Maple	8	2	80%	4	1	80%
Red Maple	28	0	100%	9	0	100%
Total	**82**	**20**	**80%**	**67**	**9**	**88%**

Compartment 2

Compartment two also consisted of drier soils. There were 6 species of trees planted, White Pine (200), White Cedar (300), White Spruce (300), Red Oak (100), Hardwood Maple (100) and Red Maple (100), for a total of 1,100 trees. Tending was not done on this site, however coils were used to protect the deciduous saplings. A total of 103 trees were surveyed, representing just fewer than 10% of the sample size. At a 9% sample size there was a survival rate of 81%. **Error! Reference source not found.** shows the breakdown of survival according to species. Similar to compartment 1, height classes were taken for each living tree, and the majority of saplings feel between 16-55cm, with 6 trees having a height between 56-75cm, 1 White Pine, 4 Red Oak and 1 Red Maple.

Table 23: ECA Sharp Tract Compartment 2 Survival Assessment

Species	October 2008			May 2009		
	Alive	Dead	% Survival	Alive	Dead	% Survival
White Pine	18	10	64%	21	3	88%
White Cedar	24	7	74%	20	9	69%
White Spruce	27	3	90%	20	2	91%
Red Oak	4	2	67%	13	4	77%
Hardwood Maple	7	4	64%	14	0	100%
Red Maple	8	2	80%	5	2	71%
Total	**88**	**28**	**76%**	**83**	**20**	**81%**

Compartment 3

Compartment's one and two both slope inward toward compartment three and has a slow moving intermittent stream flowing through it, as a result, this site is very moist and requires site appropriate species. Two hundred trees were planted in this 0.8ha compartment, 100 High Bush Cranberry and 100 American Elderberry. This compartment was not surveyed in 2008, and in 2009 only four saplings were found, which does meet the sample size of 2%, however it gives a skewed perspective as to the percent survival. Since only four living saplings were found, it is most likely not accurate to assume the site has a 100% survival rate.

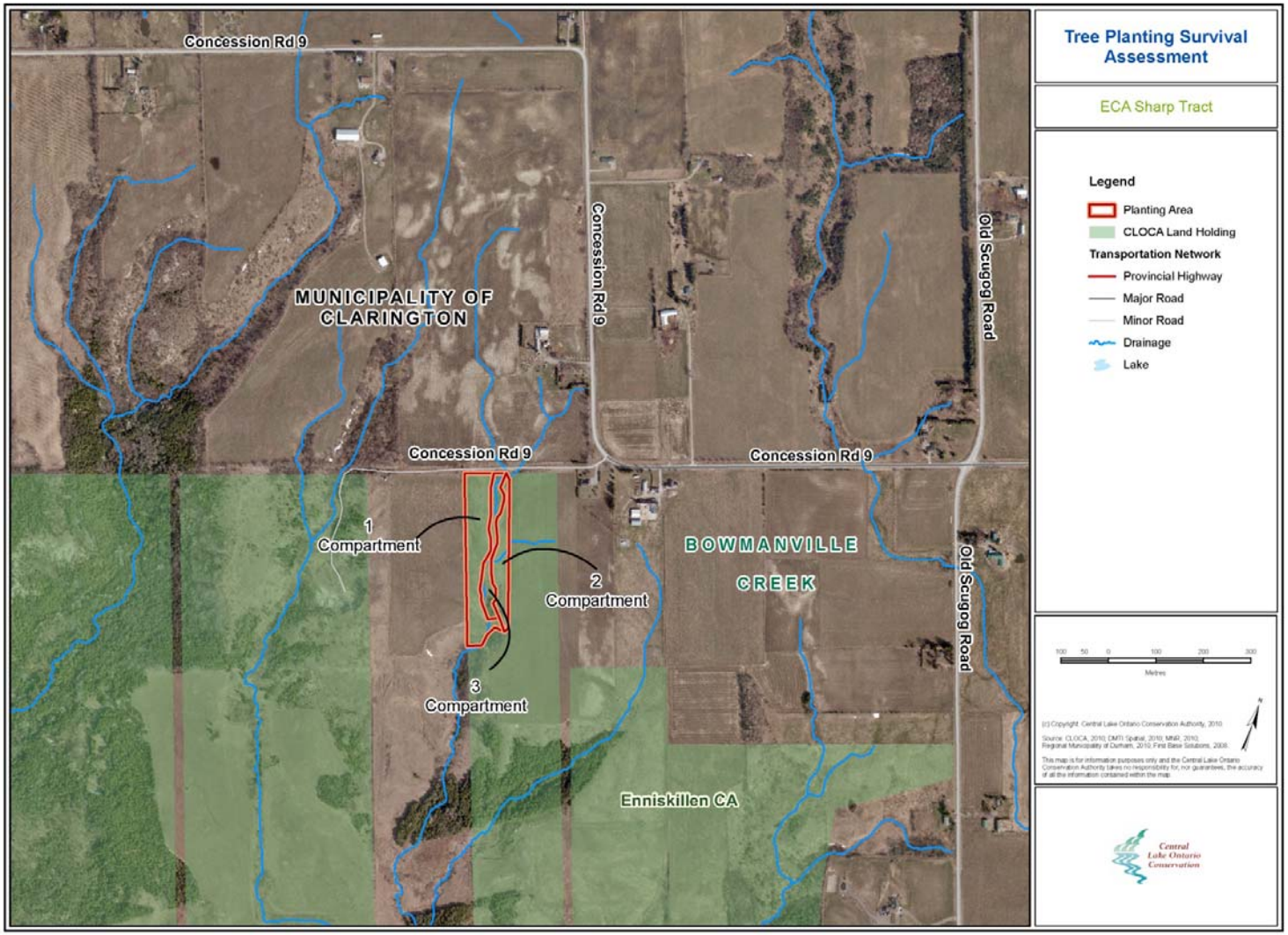

Figure 10: Map of ECA Sharp Tract

3.2.4 Bowmanville Westside Marsh CA Tract

A 1.2ha compartment at Bowmanville Westside Marsh CA was planted in April of 2007 (Figure 11). Approximately 1,525 trees were planted; 500 White Pine; 125 White Cedar; 400 White Spruce; 100 Red Oak; 100 Trembling Aspen; 100 Hard Maple; 200 Red Maple. The site that was planted has been classified through ELC as a Cultural Meadow (CUM), and did not receive any pre-planting treatment. Visual observations have been made by CLOCA staff that mammalian herbivory is a problem at this site. This may explain why the survival rate of the tree plantings was so low; in 2007 a 13% sample size was surveyed and had a 43% survival rate, while in 2009 an 8% sample size was surveyed with a survival rate of 53% (**Error! Reference source not found.**). Many of the trees observed, both living and dead, had evidence of mammalian browsing. Coils had been purchased and placed on the deciduous trees, however this did not appear to stop the browsing. It was also noted that the ground vegetation, consisting of meadow forbs, out grew and competed with many of the saplings. Pre-site treatment and continuous mowing or spraying around the newly planted trees would be recommended. Due to the lack of survival in plantings, this site was re-planted in the spring of 2009 by CLOCA summer staff. It will be reassessed in the spring of 2010.

Table 24: Bowmanville Westside Tract Survival Assessment

	October 2007			April 2009		
Species	Alive	Dead	% Survival	Alive	Dead	% Survival
White Spruce	8	2	80%	0	0	0%
White Pine	24	13	65%	17	4	81%
White Cedar	23	30	43%	14	4	77%
Red Maple	8	34	19%	4	31	11%
Trembling Aspen	13	9	59%	30	4	88%
Hard Maple	10	27	37%	0	7	0%
Red Oak	0	0	0%	0	8	0%
Total	**86**	**115**	**43%**	**65**	**58**	**53%**

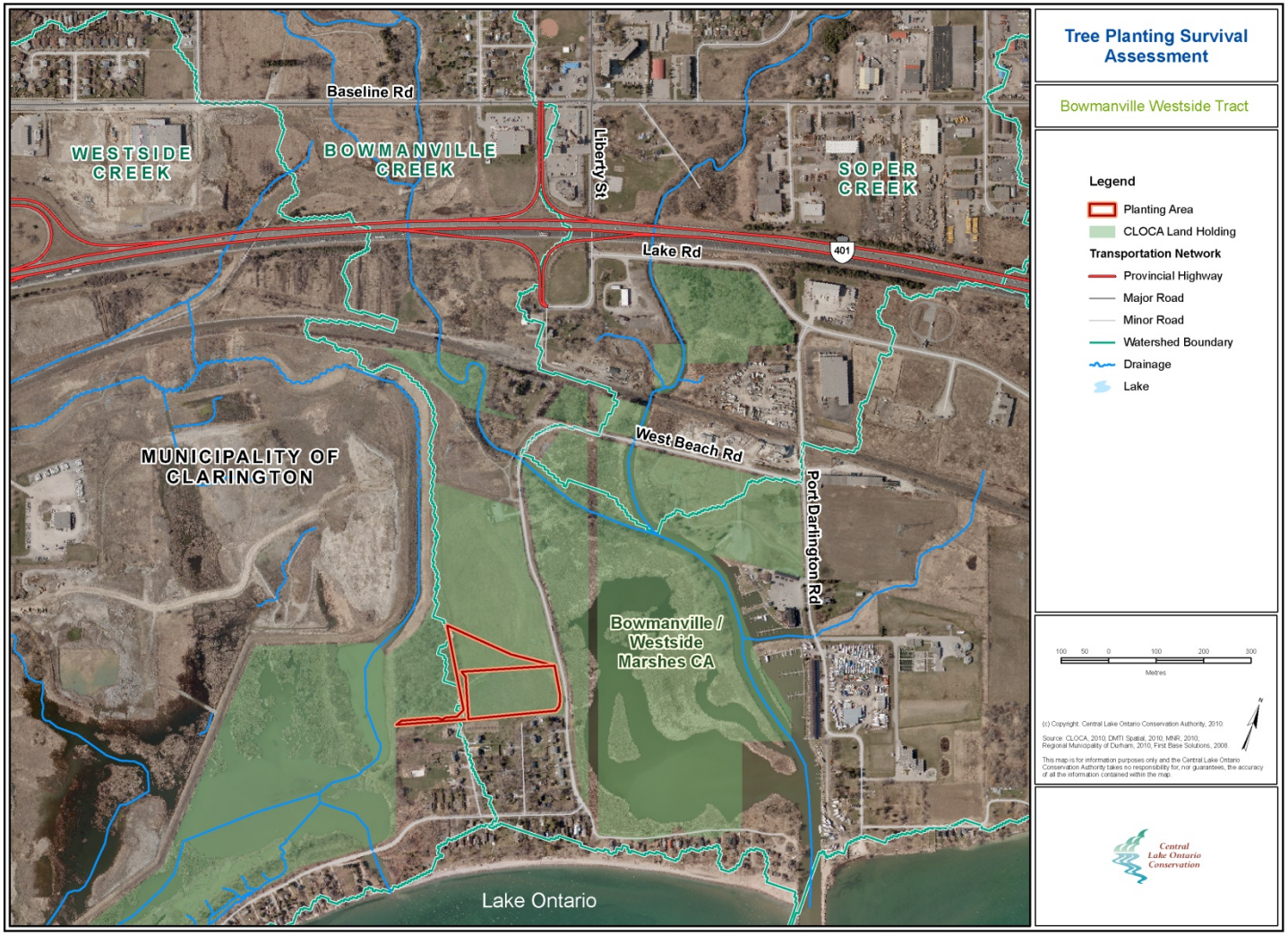

Figure 11: Map of Bowmanville Westside Tract

3.2.5 Rowsell Tract

CLOCA is in the business of educating and promoting tree planting to our watershed residents. Our stewardship program builds from completed projects as examples of future works. As part of this, a demonstration site and restoration plan was developed for Rowsell Tract that was implemented in the fall of 2006 and spring of 2007 (Figure 12). This restoration plan had a series of test plots designed to discern which preparation techniques and species would work best. The information collected and results observed from these plots will be later applied to future planting locations to optimize CLOCA's tree planting efforts and be used for demonstration for future stewardship projects. **Error! Reference source not found.** gives a detailed description of the test plots, the type and quantity of trees planted and the pre and post techniques used.

Table 25: Rowsell Tract Fall Reforestation Treatment Summary

Number	Name	Area	Preparation Technique	Seedlings		Spacing	Post-Planting Technique
				Number	Variety		
1	Richardson Plot	0.5ha	Mowing and Scarifying	50	Sugar Maple	3x3m	None
2	Pridham Plot	0.4ha	Mowing and Scarifying	800	White Spruce	2x2m	None
				100	White Ash		
				100	Sugar Maple		
3	Powell Plot	0.4ha	Mowing and Herbicide Spraying	350	White Spruce	3x3m	None
				50	White Ash		
				50	Sugar Maple		
4	Penwell Plot	0.5ha	Mowing and Herbicide Spraying	200	Red Osier Dogwood	1x3m	None
				200	Silky Dogwood		
				200	Gray Dogwood		
				200	Nannyberry		
				200	Highbush Cranberry		
				100	White Cedar	3x3m	
				100	Tamarack		
				100	Hemlock		
				100	Black Walnut		
				100	Silver Maple		
5	Newell Plot	0.3ha	None	200	White Spruce	3x3m	50 coconut fibre mats, 50 brush blankets, 100 Tassau collars
				25	White Ash		
				25	Sugar Maple		
6	Control Plot	0.2ha	None	175	White Spruce	3x3m	None
				25	White Ash		
				25	Sugar Maple		
	Windbreak	-	None	30	White Spruce	3x3m	
				30	Hybrid Poplar		
				8	White Ash		
				8	Highbush Cranberry		
				8	Sugar Maple		
				8	Nannyberry		

For further information on the site-preparation and details of the project, the reader is referred to ECA Rowsell Tract Fall Reforestation Test Plot (CLOCA, 2006). The sites were surveyed in June of 2007 and again in September 2009. The information gathered for each year and each plot is recorded in the tables below.

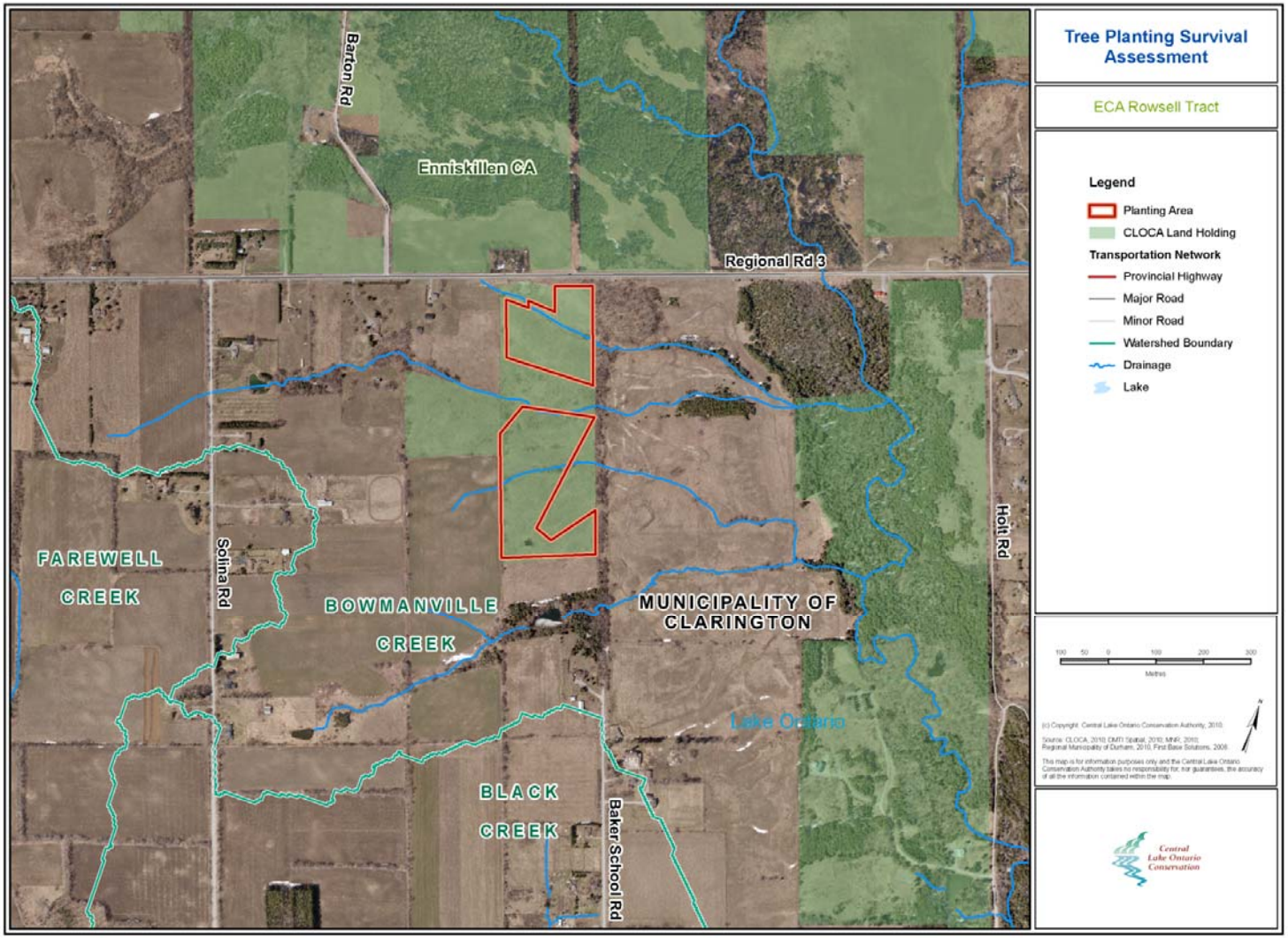

Figure 12: Map of ECA Rowsell Tract

Richardson & Pridham Plots

These two plots were prepared by mowing the area and then using a mechanical scarifier called a Koola. The Koola creates a "pit-and-mound" removing herbaceous groundcover that might compete with the seedlings. As **Error! Reference source not found.** shows, in 2007 there was a 97% success rate among White Spruce and Maple, however no White Ash was observed. In 2009, all the species planted were recorded, however there was a higher mortality rate with an average of 67% survival. While surveying, CLOCA staff observed that the rows were hard to discern, and the lower survival rate may be a result of that.

Table 26: ECA Rowsell Tract Richardson & Pridham Plot Survival Assessment

Species	June 2007			September 2009		
	Alive	Dead	% Survival	Alive	Dead	% Survival
Spruce	57	3	95%	48	18	73%
Maple	40	0	100%	12	4	75%
White Ash				1	5	17%
Unknown				0	3	0%
Total	**97**	**3**	**97%**	**61**	**30**	**67%**

Powell Plot

The Powell plot was mowed and scarified in September and sprayed with Round-Up in October of the planting year. In 2007 Spruce and Maple was observed, with a high survival rate of 88% and 75% respectively (**Error! Reference source not found.**). In 2009 all three planted species were observed, and had an average survival rate of 79%. Again, CLOCA staff had difficultly following the rows while surveying, this was also reported during the planting of the seedlings.

Table 27: ECA Rowsell Tract Powell Plot Survival Assessment

Species	June 2007			September 2009		
	Alive	Dead	% Survival	Alive	Dead	% Survival
Spruce	53	7	88%	10	2	83%
Maple	15	5	75%	11	9	55%
White Ash				21	0	100%
Total	**68**	**12**	**85%**	**42**	**11**	**79%**

Newell Plot

The Newell Plot received no preparation techniques, and was planted directly into the sod and tall grasses. This site did receive post-planting techniques, such as the use of various mat products and spot spraying. **Error! Reference source not found.** shows the success rate by species. In 2007 there was a high success rate of 88% on average, while in 2009 it had decreased dramatically. No living White Spruce was found in Tassau blankets, while the majority of White Spruce found in plastic blankets were dead. No other planted specimens were observed, but it was noted that the rows again were difficult to distinguish. There was also a number of volunteer hard Maples coming in on the east side along the sprayed bands, as well as Apple, Buckthorn and Dog-Strangling Vine.

Table 28: ECA Rowsell Tract Newell Plot Survival Assessment

Species	June 2007			September 2009		
	Alive	Dead	% Survival	Alive	Dead	% Survival
Oak	16	4	80%			
Maple	17	3	85%			
Spruce	37	3	93%			
White Pine	18	2	90%			
White Spruce (Plastic Blankets)				1	12	8%
White Spruce (Tassau				0		0%

Blankets)						
Total	**88**	**12**	**88%**	**1**	**12**	**8%**

Control Plot

The control plot was planted with no preparation treatments, nor any post-planting techniques to act as a comparison against the other planted plots. This site is located adjacent to a hardwood woodlot. The success rate of the control plot was very low, as there was only one tree observed and it was dead. There was a great deal of Dog-Strangling Vine observed along the woodlot edge, and only a few volunteer trees were present.

Discussion

While Penwell was not officially surveyed, many tamarack's and other tree and shrub species were observed. The first three plots seemed to have the greatest success rate, ranging between 65 to 80% survival. These sites all received pre-planting treatments consisting of mechanical preparation or a combination of mechanical preparation and herbicide spraying. In the first survey after planting (2007), Richardson & Pridham sites had a greater success rate than Powell, which received herbicide spraying and mechanical preparation. However, within the 2009 survey, the latter site had a greater survival rate, and also had a much smaller number of trees found dead. It should be noted that there is a large difference between number of trees observed within the 2007 and 2009 surveys, and monitoring should continue to make an accurate assessment as to which treatments are more effective.

Looking at the surveys for the non-treated sites, there is a clear difference as to the survival rate and number of trees observed as compared to the pre-treated sites. Although 2007 surveys show a higher survival rate within non-treated sites, 2009 surveys had a poor outcome. Consistency between survival rates at the treated sites show that pre-treatment, even if it includes just mowing and scarification gives the saplings a greater chance of survival.

3.2.6 Discussion

Reaching the sample size was difficult to accomplish at all the planting sites, as the markings for the planted rows do not always last until the late summer or the following years when the sampling is done. While surveyors are assessing the planted sites, they must assess both living and dead trees to ensure accuracy, however trees that are dead and have been subject to drought or herbivory are not as easy to observe as living trees. It is then difficult to follow the row of planted trees and assess the minimum 2% sample size. Although an average distance of 3m between each tree is strived for, this is not always the case due to factors such as accuracy of the Koola, and accuracy of the tree planters, etc.

The data collected is useful in guiding future planting programs and discerning the best methods for treatment of plantings, as well as mandatory for some funding organizations. However, making the rows more visible may make it more efficient for the planter and the surveyor. Marking the rows with flags at the beginning and end of each row, as well as collecting GPS data on the planted rows may prove to be helpful to the planters and the surveyors. This could be done as a trial at a future planting event.

This being said, the accuracy with the Koola has increased and a common distance between plantings is being sought. Variations among the sample sizes at each site are expected from year to year and efforts to monitor the success rate and methods of surveying will take place to increase the great success of CLOCA's stewardship planting programs.

Due to the risk of spread of EAB, it is also recommended that CLOCA deters from using Ash species in future planting programs. This may presently be the case, as planting assessments for 2008 & 2009 were not done, and will be conducted in the field season of 2010.

3.3 GROUNDWATER LEVELS AT HEBER DOWN CA

Heber Down Conservation Area contains the largest publicly owned Provincially Significant Wetland Complex along the former Lake Iroquois Shoreline. It is approximately 85.3ha, 96% swamp and 4% marsh. All but 2ha of this wetland complex fall within the Conservation Area (Planning Director's Report to the Planning and Development Committee, 2002). Over the past few years, CLOCA staff have made informal observations of water level changes occurring in the wetlands at Heber Down Conservation Area. Due to the nature of wetlands and their dependency on annual precipitation, changes in water levels are an expected occurrence. However, due to the increased development occurring in the Brooklin area and the anticipated future development in the area, monitoring began in the field season of 2009 to observe and document these changes.

From reverse particle tracking, showing the high groundwater discharge areas to significant recharge areas (Earthfx, 2008), and other hydrological computer programs, CLOCA staff determined the location for the wetland vegetative monitoring plots and the piezometers. These monitoring points were established at the major recharge and discharge areas within their vicinity. Four monitoring points were established (

Figure **13**); Transect 1 is located in the southern portion of the conservation area where major discharge has been noted. Transects 2, 3 and 4 are situated on the north east portion of the wetland, following the wetland boundary.

At each of the monitoring points a Solinst Drive-Point 615N Piezometer was installed and surveyed into place by CLOCA's engineering staff. They were installed at varying depths, ranging from 4ft to 5ft. Originally the piezometers were to be installed to a depth as great as 6ft, however due to the underlying geology, it was impossible to drive them in any further than 5ft.

Measurements from the piezometers will be taken on a bi-weekly schedule. This information will be used in conjunction with the vegetative gradient monitoring to observe how the ground water variations are affecting the vegetation and the wetland boundaries.

To monitor the vegetative gradient of the wetland/upland areas, four 50m transects (CVC, 2009) were installed straddling the wetland-upland interface. Along the 50m transects two 1mx1m plots were set up at every 10m point which are 5m away from the 50m transect. Within each of these plots the ground vegetation was mapped, identified and counted. From this data, the FQI (Floristic Quality Index), species richness and wetness index will be assessed. As this is the first year of data collection, all data collected will be used as baseline data.

The vegetation quadrats used are 1mx1m, and are meant to be representative of the entire site. Each transect contains 12 quadrats that are sampled, the individual quadrat samples have been compiled according to transect to illustrate the collected data. Only ground vegetation is included in the data, as it will be more receptive to any environmental changes than trees and shrubs. **Error! Reference source not found.** shows the species composition for each transect, breaking it up by native species, non-native species and percent non-native. Overall, there were 33 different species identified which are distributed through all four monitoring points. The amount of cover at each transect may have been limited since the transects are located in mixed conifer swamps, dominated by Eastern White Cedar (*Thuja occidenatlis*), Blue Beech (*Carpinus caroliniana*), and Black Ash (*Fraxinus nigra*).

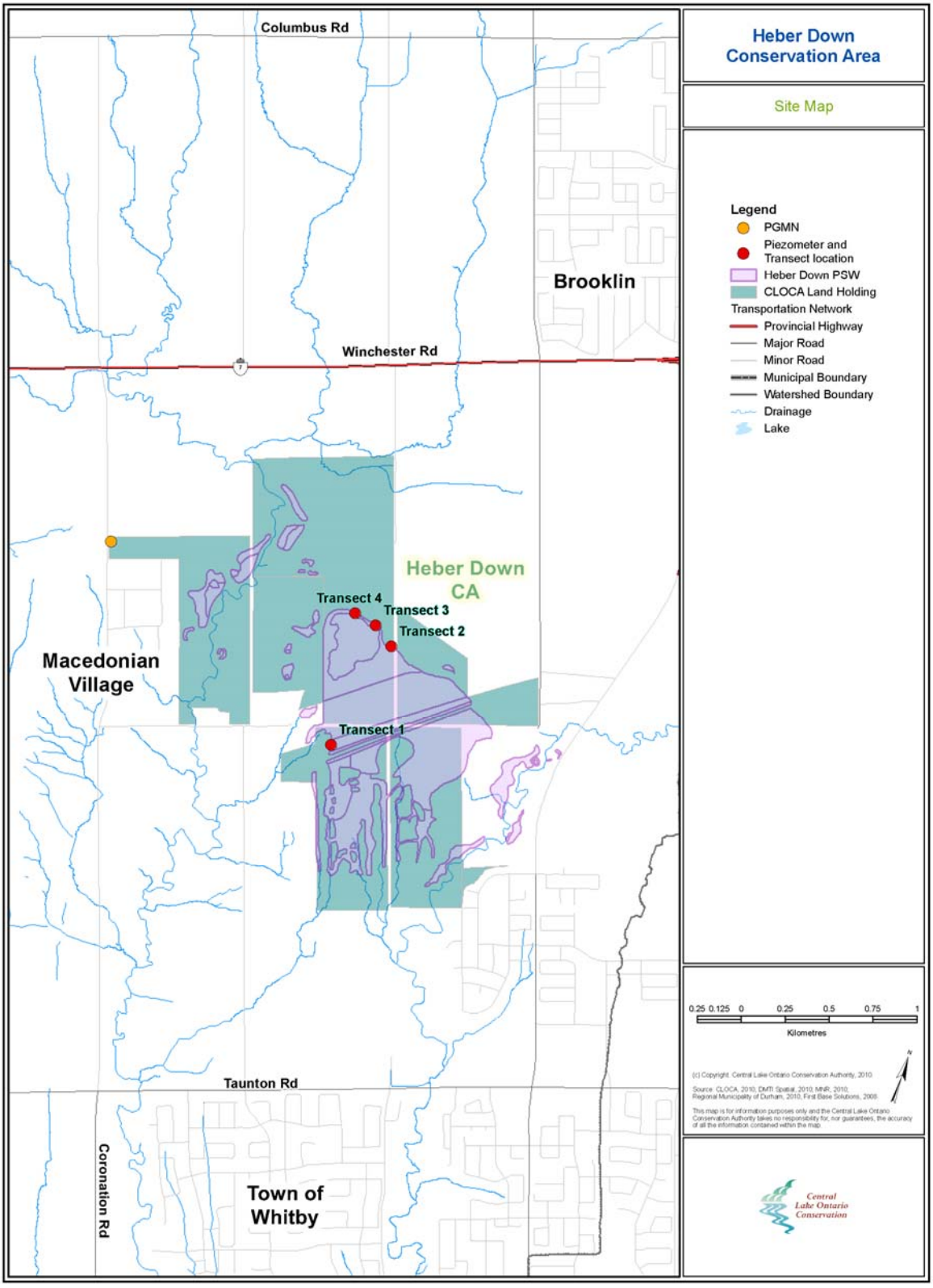

Figure 13: Map of Heber Down CA Study Area

Table 29: Ground Vegetation Data by Transect

Site Number	Total Richness	Native Species Richness	Non-native Species Richness	% Non Native Species
Transect 1	19	16	3	16%
Transect 2	11	9	2	18%
Transect 3	14	13	1	7%
Transect 4	13	12	1	8%
Overall	33	29	4	12%

In all of the transects combined, there was a total of 5 non-native species found, however European Buckthorn (*Rhamnus cathartica*) is not included in the table of the collected data, as it is considered a tree and only herbaceous plants are shown here. The remaining four non-native herbaceous plants observed were Common Buttercup (*Ranunculus acris*), Bittersweet Nightshade (*Solanum dulcamara*), Dog-Strangling-Vine (*Cynanchum rossicum*) and Helleborine (*Epipactis helleborine*). While all five species are non-native, three of them are on CLOCA's Invasive Species list for Terrestrial Plants; European Buckthorn and Dog-Strangling Vine are ranked in category 1 and listed among CLOCA's top terrestrial invaders, while Helleborine is ranked in category 4. Category 1 "contains aggressive invasive exotic species that can alter and dominate sites and exclude native species. These organisms are a threat to natural areas, as they disperse widely, through transport by animals and natural means (water, wind, etc). These species are top priority, however control may be difficult." (CLOCA, 2010-01MP). Category 4 contains "species that do not pose a serious threat to natural areas unless they are competing directly with more desirable vegetation. These plants are sometimes substituted for native plants, but may not reproduce aggressively once established." (CLOCA, 2010-01MP). While these non-native species were present within the quadrats, the total percent cover an individual species covered within one transect was 7%. Expectedly, there seems to be a greater presence of European Buckthorn, and Dog-Strangling Vine near the trail edges, but is starting to creep into the interior of the swamp.

The wetness index categorizes plants based on the probability for them to be found in a wetland or upland area. **Error! Reference source not found.** shows the average wetness for each transect, the maximum wetness value, minimum wetness value and the mode. The maximum wetness value represents the most upland plant within the transect, while the minimum value represents the most wetland plant within the transect. While the wetness index may classify a plant as an obligate wetland plant or obligate upland plant, it may not always be found in those specific areas. Non-native species are perfect examples of that; European Buckthorn, Helleborine and Dog-Strangling Vine receive a +3 (facultative upland), +5 and +5 (obligate upland) respectively, however, while they are more likely to inhabit dryer areas, due to their prolific nature to spread they are still found quite readily in wetland areas.

The mode represents the wetness value that occurs most frequently. **Error! Reference source not found.** shows that transect 1 has a majority of obligate wetland species present ranging from Water Hemlock (*Cicuta maculata*), Marsh Bedstraw (*Galium palustre*), Fowl Manna Grass (*Glyceria striata*) and Bugleweed (*Lycopus uniflorus*). It also contains the highest average wetness value of -1.26. This was somewhat expected as Transect 1 was installed in a major discharge site, and while located in a mixed swamp, it is situated on the north side of a marsh.

Transect 2 has a mode of 0, while according to the wetness index "is equally likely to occur in wetlands or non-wetlands" (Lee et al., 2998), it still has a greater number of species that fall within the negative realm of the wetness index. The remaining transects all have average wetness values that fall in the negative, which shows that they contain a greater number of wetland plants.

Table 30: Wetness index by Transect

Site Number	Mean Wetness index	Maximum Wetness Value	Minimum Wetness Value	Mode Wetness Value
Transect 1	-1.26	5	-5	-5
Transect 2	-0.45	5	-4	0
Transect 3	-1	3	-4	-3
Transect 4	-0.23	5	-5	-3

These values will be observed in subsequent years, along with the water levels to examine if there are any changes.

In November 2009, CLOCA staff went to HDCA to survey the piezometer's into place; measurements were taken at the ground beside the piezometers and at the top of the piezometers. Measurements at the top of the piezometers were taken to ensure accuracy when measuring groundwater levels with the meter tape. **Error! Reference source not found.** below shows the water levels of the four piezometers subtracted from the elevation (m) at the top of each respective piezometer.

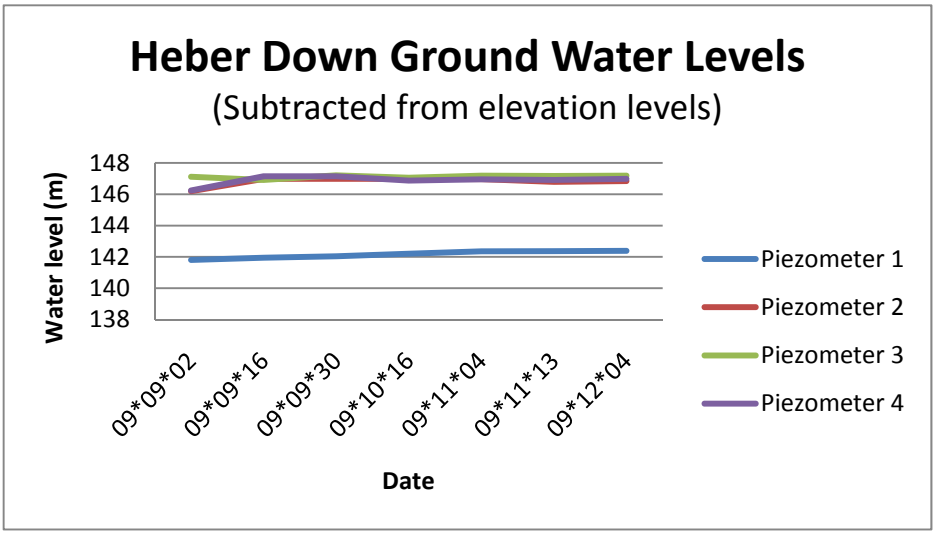

Figure 14: Piezometer groundwater levels

Piezometer 1 is at an elevation of 142.525m, while Piezometer 2, 3, and 4 are at an elevation of 146.988m, 147.288m and 147.149m respectively; thus explaining the varying measurements of ground water levels.

The pizometers are measuring surficial ground water and have been installed to a depth of maximum 6ft because without the use of drills and augers it was impossible to get the piezometers any deeper; and the roots of herbaceous vegetation reach a maximum depth of 2m (~6ft) (Canadell et al, 1996).

These monitoring sites will be observed on a yearly basis, and the values will be compared to see if there is a change in species composition. Range gauges will be introduced in the spring of 2010, to observe the varying precipitation rates over the monitoring term. This information will be included in the analysis when comparing yearly groundwater levels.

4.0 SUMMARY

2009 was the first year the Terrestrial Watershed Monitoring Program was implemented. The field season proved to be a productive and successful period, installing a total of 18 monitoring plots on conservation area and municipal land holdings and collecting valuable baseline data.

This data will be used in conjunction with future existing condition reports for CLOCA's watersheds, CA management plans, and Invasive Species Management planning. As with most long-term monitoring programs, trends are not detectable until enough data has been collected. Monitoring will occur once every five years, following CLOCA's many other monitoring programs.

The special programs will be evaluated individually to determine if they should be continued and when new special projects should be implemented. Presently, the three current special projects will be continued into the 2010 field season.

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