Riparian Vegetation Mapping

in Thames Centre, Middlesex County

2008

Prepared for:

Middlesex Stewardship Council

Prepared by:

Upper Thames River Conservation Authority

Prepared for:

Middlesex Stewardship Council
c/o Ontario Ministry of Natural Resources
615 John Street North
Aylmer, Ontario N5H 2S8
Ph: 519-773-4785 Fax: 519-773-9014
Website: www.ontariostewardship.org/middlesex
Email: cale.selby@ontario.ca

Published by:

Upper Thames River Conservation Authority
1424 Clarke Road, London, Ontario N5V 5B9
Ph: (519) 451-2800 Fax: (519) 451-1188
Website: www.thamesriver.on.ca
Email: info@thamesriver.on.ca

Authors:

Cathy Quinlan, Terrestrial Biologist
Chris Harrington, Coordinator, Planning and Research Unit
Tracey Haycock, GIS Technician
Terry Chapman, GIS Specialist

Executive Summary

The Upper Thames River Conservation Authority (UTRCA) in partnership with the Middlesex Stewardship Council (MSC), mapped riparian vegetation in Thames Centre, Middlesex County in 2007-2008. The work was seen as a pilot project, with the possibility of completing the mapping in the remainder of the county at a future time.

Natural vegetation growing alongside streams and rivers is called riparian vegetation or a vegetated buffer. The vegetation can include meadow, shrubland, and woodland. Riparian vegetation is very important from a water quality and habitat point of view as it protects the banks from erosion, absorbs pollutants in runoff, shades the water and provides habitat for terrestrial and aquatic species.

Currently, land use maps show woodlands and forests but not grassy areas, meadows or open shrub/ treed areas. Thus, important riparian vegetation is not mapped or measured. Detailed maps showing the extent of riparian buffers will assist the MSC, UTRCA and other interested groups and agencies in targeting areas in need of protection and rehabilitation, in cooperation with landowners.

GIS (Geographic Information System) technology was used for this project. A digital vector layer of riparian meadows was created based on coloured 2006 orthoimagery (May 2006, so some leaf cover is evident). Other layers used to help with interpretation include: elevation contours, drain classification, woodlands, wetlands, and municipal boundaries.

Four vegetation categories were established and mapped: meadow, pasture, lawn, and human influence lands. Woodlands make up the fifth category, but this habitat is already mapped on the SOLRIS (Southern Ontario Land Resource Information System) layer.

Tools in ESRI's ArcMap software were used to draw polygons around each vegetation type. The exercise is largely that of orthoimagery interpretation (e.g. air photo interpretation) using visual clues (colour, texture, landscape features) and contour lines to determine vegetation types along the watercourses. Windshield surveys were conducted at several locations to double-check areas that were ambiguous.

Prior to running statistics on the percentage riparian cover within defined buffer widths, the width of the water and valley needed to be accounted for. Watercourses are presented as a single blue line on the digital mapping layer, not the full width of the water or the slope up to top-of-bank. The riparian buffer does not include the watercourse or the associated slope, but starts at the top of bank, where defined. Average valley widths were assigned to each stream order: stream orders 1 and 2 = 10 m; stream orders 3 and 4 = 30 m; stream orders 5 and 6 = 50 m. Only the meadow and woodland vegetation captured between the valley limit and the 30 m buffer limit is counted as riparian vegetation.

Findings: There are about 571 km of open watercourse in Thames Centre. Overall, 43% of the riparian zone is in some form of permanent vegetation including woodland, meadow, pasture or other. Environment Canada recommends 75% of stream length be vegetated (e.g. with a 30-m buffer). Woodland makes up the largest portion (59%) of riparian vegetation types. Meadows comprise the second largest area (31%), while pastures (9%) and human influenced lands (1%) make up the remainder.

Previous efforts to measure riparian cover could focus only on woodlands as it was the only vegetation layer available. Thus, by mapping meadows, pastures and other permanent vegetation communities, significant additional riparian cover is documented. In the past, riparian cover would have been reported as 25% (e.g. woodland only), but now we can report 43% riparian cover is actually present.

Table of Contents

List of Figures

List of Tables

List of Maps

Riparian Vegetation Mapping

1.0 Project Background

In the fall of 2007, the Upper Thames River Conservation Authority (UTRCA) submitted a proposal to the Middlesex Stewardship Council (MSC) to partner on a project that would involve mapping riparian vegetation in the Municipality of Thames Centre. Both the UTRCA and MSC were interested in obtaining more detailed information about the amount of vegetated buffers along open rivers, creeks and drains in Middlesex County. This project was scoped to focus on Thames Centre as a pilot. The MSC agreed to share the costs of the work with the UTRCA (see Appendix 1).

2.0 Riparian Vegetation – Definitions and Function

Natural vegetation growing alongside streams and rivers is called riparian vegetation or a vegetated buffer. The vegetation can include meadow, shrubland, and woodland.

Floodplain meadows are composed primarily of grasses (native and non-native), wildflowers such as asters, goldenrod and sunflowers, and a scattering of shrubs and trees. Meadows are very common along waterways because flooding and ice scour often prevent trees from gaining a long-term foothold. As well, some meadows have grown up from retired pastures and agricultural fields, which become meadows as grasses and flowers take hold.

Shrublands are composed of such water-tolerant species as Gray and Red Osier Dogwood, Ninebark, hawthorns and willows. Floodplain woodlands are dominated by species such as willow, ash, Sycamore, Manitoba Maple and others.

Riparian vegetation is very important from a water quality and habitat point of view. Riparian vegetation protects the banks from erosion, absorbs pollutants in runoff, shades the water and provides habitat for terrestrial and aquatic species. Vegetated river corridors provide a link between woodlots and other habitats. Wildlife travel along rivers and seeds are transported on wildlife and in the water to new locations.

Environment Canada (2004) recommends 75% of stream length be naturally vegetated (e.g. up to a 30 metre width).

3.0 Need for Mapping

Land use maps interpreted from air photos show woodlands/ forests but not grassy areas, meadows or open shrub/ treed areas. SOLRIS (Southern Ontario Land Resource Information System) is the most up-to-date habitat mapping. Under SOLRIS, wooded wetlands (e.g. swamps, bogs) were identified using air photo interpretation and separated from the woodland layer. The work on this continues; however, areas that are neither woodland nor wetland are left unidentified. Meadows and open-canopy wooded areas are not discernible on small scale maps and must be mapped using air photo interpretation at a large scale. Thus, important riparian vegetation has not been mapped or measured due to cost and time constraints.

In 2006, the UTRCA mapped riparian meadows in Oxford County for the *Oxford County Natural Heritage Study*. The UTRCA developed its own methodology to do this mapping exercise using black

and white digital air photos (2000 orthoimagery). Working in Middlesex County is a natural expansion of this work. The municipality of Thames Centre was chosen as the focus of this Pilot Project because it lies primarily within the Upper Thames River watershed so all mapping is readily available to the UTRCA (see Figure 1).

Improving stream health and creating wildlife corridors are important components of a healthy natural heritage system and thus important to the MSC. Detailed maps showing the extent of riparian buffers will assist the MSC, UTRCA and other interested groups and agencies target areas in need of protection and rehabilitation. Landowners have shown an interest in completing riparian projects, especially if grants are available. These maps will help coordinators put their energies and dollars into sites that have the potential to make the biggest impact.

4.0 Thames Centre Description

The Municipality of Thames Centre is located in eastern Middlesex County, abutting the City of London and Middlesex Centre (Figure 1). It is flanked by Perth County to the north, Oxford County to the east and Elgin County to the south. The majority of the municipality is drained by the Thames River system and its tributaries with a small portion (10%) of land in the Kettle Creek watershed (see Figure 2 and Appendix 2). Map 6 shows the names of the watercourses.

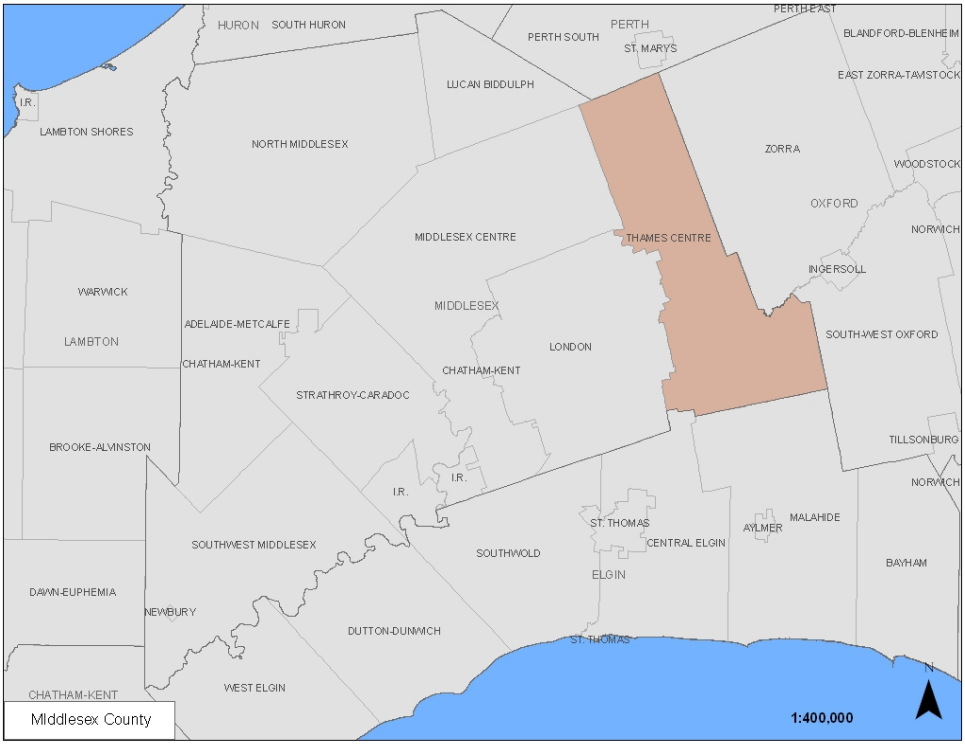


Figure 1. Thames Centre within Middlesex County

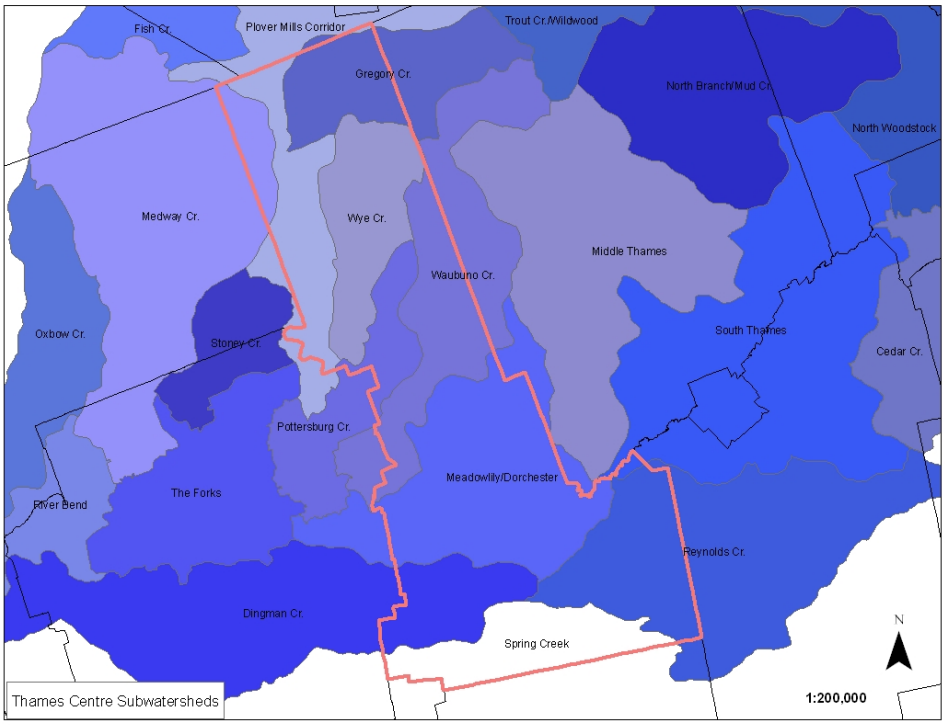


Figure 2. Subwatersheds within Thames Centre
Blue and purple areas are in the Thames River watershed; white area is in the Kettle Creek watershed.

5.0 Methodology

5.1 Mapping Layers

GIS (Geographic Information System) technology was used for this project. A digital vector layer of riparian meadows was created based on coloured 2006 orthoimagery. This orthoimagery of the Thames watershed area was captured in late spring (May 2006) so some leaf cover is evident. Other layers used to help with interpretation include: elevation contours, drain classification, woodlands, wetlands and municipal boundaries. References for these layers are provided. The SOLRIS (Southern Ontario Landuse Resources System) mapping layer from MNR was used to identify woodlands and some wetlands.

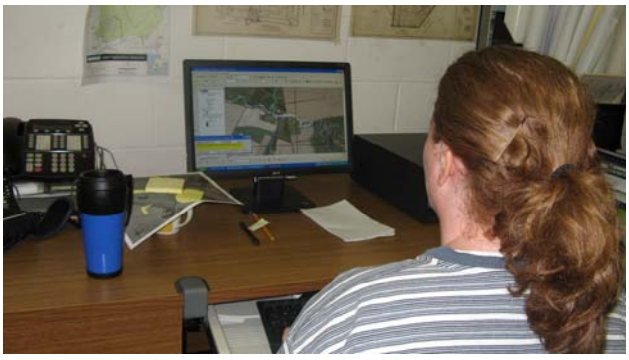
5.2 Riparian Categories

Table 1 outlines the four vegetation categories established to group the types of vegetation communities commonly found along the open watercourses of Thames Centre (meadow, pasture, lawn, human influence). Woodlands make up the fifth category, but this habitat is already mapped on the SOLRIS layer.

Table 1. Vegetation Categories within the Riparian Zone

Vegetation Category		Definition	Appearance on air photo
1	Meadow	- Grassland or grassland with some wildflowers, trees/shrubs adjacent to or within the floodplain of an open watercourse. - Includes lands newly planted into trees where the herbaceous layer still dominates - Includes tree-lined strips of land along a watercourse that are only one tree deep and thus will never be mapped as woodland/forest in SOLRIS	- Granular with some texture compared with crop fields non-uniform in height - Scattering of trees and shrubs, often willows (wide canopy) - Often a sharp contrast between adjacent farm fields and this more wild grassland
2	Pasture	- Short grassland used as grazing pasture for livestock - Pastures are a mix of cool season grasses and clovers planted by the farmer and not “wild” or “natural” meadows	- Can be similar to floodplain meadow, but often appears much shorter and more uniform in texture - Can often see trails leading from barns or to salt licks through the pasture and/or machinery or hay bales
3	Lawn	- Lawns of sod grass planted near houses or businesses and manicured to a short height includes golf courses	- Short and green - Uniform height - Associated with homes/businesses
4	Human Influence	- Meadow-type habitats that are still used by humans. Examples: gravel pits, dirt bike courses, archery clubs, hydro corridors, etc.	- Similar to meadows but irregular features such as ruts and trails dispersed
5	Woodland	- Already mapped (SOLRIS)	- Already mapped (SOLRIS)

5.3 GIS Mapping and Field Checking



Tools in ESRI’s ArcMap software were used to draw polygons around each vegetation type. The exercise is largely that of orthoimagery interpretation (e.g. air photo interpretation) using visual clues (colour, texture, landscape features) and contour lines to determine vegetation types along the watercourses. The GIS Technician and Terrestrial Biologist worked together to complete the mapping. The GIS Technician created the riparian layer and the Biologist reviewed the results.

Field verification was conducted by the GIS Technician and Terrestrial Biologist. Windshield surveys were conducted at several locations to double-check areas that were ambiguous in terms of orthoimagery interpretation. This improved overall confidence in terms of mapping product.

5.4 Valley Width and Stream Order

Prior to running statistics on the percentage riparian cover within defined buffer widths, the width of the water and valley needed to be accounted for. Watercourses are presented as a single blue line on the digital mapping layer, not the full width of the water or the slope up to top-of-bank.

It is the intent of this project to measure riparian vegetation cover from the top-of-bank outwards. The riparian buffer does not include the watercourse or the associated slope, but starts at the top of bank, where defined. Thus, some adjustments had to be made to account for the actual width of the watercourse and bank/slope.

Average valley widths were assigned to each stream order (see Table 2). The values for water width are based on averages taken from actual in-field measurements collected by UTRCA staff when undertaking the Municipal Drain Classification System work (2000 to 2005). The water width was measured in May, June and October, so reflects a wide range of conditions. Valley width was based on a few measurements taken from orthoimagery, and then averaged.

Table 2. Average Stream and Valley Width in the Upper Thames Watershed

Stream Order	Average Width of Water (m)	Average Valley Width * (m)
1	2.0	10
2	2.5	10
3	5.3	30
4	8.5	30
5	28.5	50
6	48.4	50

* Valley width is top-of-bank to top-of-bank

For example, when measuring the amount of vegetation cover within a 30-metre buffer of a 4th order stream, start at the blue river line, add 15 m (half of 30 m) to each side, then add the 30 m buffer for a total of 45 m on each side and a grand total of 90 m for the entire swath. Figure 3 illustrates how this would look for a section of Waubuno Creek. Only the meadow and woodland vegetation captured between the valley limit and the 30-m buffer limit is counted as riparian vegetation.

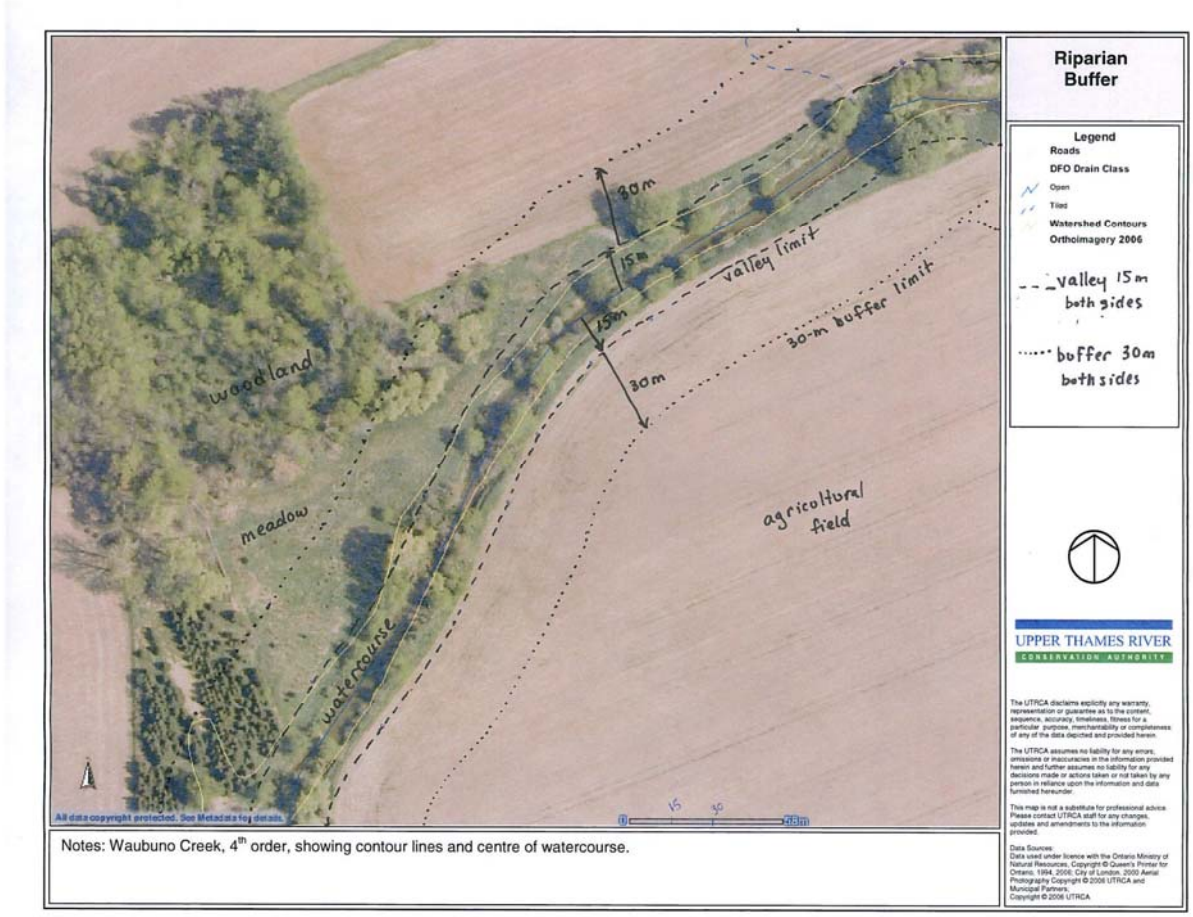
Appendix 3 illustrates how stream order is assigned. Stream order (Strahler method) is a simple hydrology algorithm used to define stream size based on a hierarchy of its tributaries. In the Thames, the streams range from 1st order at the headwaters to 7th order below the Forks in London.

Figure 3. Illustration of Valley and Buffer Set-backs for a 4th Order Stream

Left: The eastern portion of the creek is straight and narrow with almost no riparian vegetation cover except what grows on the sloped bank. The western portion of the creek passes through a small meadow and woodlot community that provides riparian cover on the north side.

Right: This same creek is zoomed in to show the meadow and woodland area. Only the woodland marked in green hatchmarks would have been picked up in past riparian mapping projects.

Bottom: The same creek showing where the valley width limit and 30-m buffer limit would fall.



Notes: Waubuno Creek, 4th order, showing contour lines and centre of watercourse.

6.0 Results

6.1 Stream Length

There are about 571 km of open watercourse in Thames Centre. The riparian vegetation, where present, was mapped along each watercourse. Table 3 summarizes the lengths of stream by stream order. First order streams comprise the majority of open watercourses (45%).

Table 3. Stream Length versus Stream Order

Stream Order	Length (km)	% of Total Length
1	256	45%
2	127	22%
3	75	13%
4	76	13%
5	2	<1%
6	36	6%
Total	**571**	**100%**

6.2 Maps and Digital Data

The results of the mapping exercise are presented in four maps (Maps 1-4) at a scale of 1:50,000. The maps are colour-coded to differentiate the various vegetation types (e.g. woodland, meadow, pasture). The woodland layer was obtained from SOLRIS, and all other vegetation types were mapped by the UTRCA. Map 5 shows the entire municipality at a scale of 1:105,000. Map 6 shows the names of the watercourses in the municipality and adjacent areas.

The maps (pdf), digital data (shape files) showing riparian habitats mapped as polygons and applicable metadata are available from the UTRCA.

6.3 Statistical Summary

Overall, 43% of the riparian zone is in some form of permanent vegetation including woodland, meadow, pasture or other. Tables 4a and 4b show the details.

Environment Canada recommends 75% of stream length be vegetated (e.g. with a 30-m buffer). From a mapping standpoint, it is difficult to calculate the linear length of watercourse that is flanked on both sides by at least 30 metres of continuous vegetation. Our results provide a proxy measurement; that is, the percentage of the 30-m buffer zone that is occupied by permanent vegetation. Assuming both figures say roughly the same thing, 43% of Thames Centre stream length is vegetated, compared to the ideal of 75% as recommended by Environment Canada. Thus, the municipality falls short, but is within reach.

Table 4a. Percentage of the 30 m Riparian Buffer Zone Vegetated and Non-vegetated

Land Cover	Area (ha)	Percent of Total Buffer Area
Vegetated (Woodland, Meadow, Pasture, etc.)	1562	43%
Non vegetated (Cropland, Urban)	2071	57%
Total Buffer Area	**3633**	**100%**

Table 4b. Details of Riparian Vegetation Cover Types

Vegetation Community Type	Area (ha)	Percent of Riparian Vegetation Cover (1562 ha)
Woodland	913	59%
Meadow	489	31%
Pasture	141	9%
Human Influenced Vegetation (e.g. vegetated gravel pits, lawns, hydro corridors, golf courses)	18	1%
Total	**1562**	**100%**

Woodland makes up the largest portion (59%) of riparian vegetation types. Meadows make up the second largest area (31%). Pastures (9%) and Human Influenced Lands (1%) make up the remainder.

Previous efforts to measure riparian cover could focus only on woodlands as it was the only vegetation layer available. Thus, by mapping meadows, pastures and other permanent vegetation communities, significant additional riparian cover is documented. In the past, riparian cover would have been reported as 25% (i.e. woodland only), but now we can report 43% riparian cover is actually present.

Table 5 presents the percent cover by stream order. As expected, the small, first order streams (mostly agricultural drains) have less riparian vegetation cover than the larger, higher order watercourses. On average, only 33% riparian cover exists on first order streams. The percent cover goes up with each successive order to 77% for sixth order watercourses. The fifth order stream is somewhat misleading as it includes a very short stretch of the South Thames River and only one side of the river is within Thames Centre. This trend is expected as the larger watercourses have a larger floodplain (area that floods in spring), keeping development and agriculture well back from the banks. Thus, the North and South Thames Rivers have riparian cover close to or exceeding the Environment Canada target of 75%.

Table 5. Percent Riparian Vegetation Cover by Stream Order

Stream Order	30 m Buffer Area (ha)	Vegetation Area (ha)	Percent Cover
1	1801	592	33%
2	760	297	39%
3	448	243	54%
4	423	270	64%
5	11	11	95%
6	216	166	77%
Average	**3658**	**1581**	**43%**

Additional information is presented in Appendix 4, showing vegetation cover for both 10 and 20 m buffer widths in addition to the 30 m buffer width. In summary, 49% of the 10-m buffer is vegetated versus 46% of the 20-m buffer. This result is expected as land closest to the river is most likely to flood and be unproductive and thus is left in a natural state.

7.0 Stewardship Recommendations

Based on the findings above, it is recommended that stewardship efforts be focused on the smaller watercourses as they currently lack sufficient riparian vegetation cover. The larger rivers are well-vegetated, but even these areas can benefit from additional protection if landowners are willing.

Meadows are a natural and appropriate vegetation type along watercourses. The planting of meadows (grasses and flowers) is a valid alternative to tree planting, especially where there is frequent flooding and ice scour. In some cases, planting is not needed. Agricultural fields, left idle or fallow, will soon be colonized by grasses, wildflowers and woody plants. However, in this case, weedy or non-native species may colonize first, so planting native species is preferred.

8.0 Cost to Map the Remainder of Middlesex County

Thames Centre is one of seven municipalities in Middlesex County and occupies approximately 18% of the area (see Appendix 5). Assuming the work load would be similar in similar-sized municipalities, the cost to carry out the riparian vegetation mapping in the entire county is approximately six times the current budget of $5,000, or $30,000 (see Appendix 6). Cost-sharing may make this affordable.

9.0 Summary

This mapping project illustrates the benefit of mapping non-woodland vegetation cover along streams and rivers. Floodplain meadows, pastures and other lands add a significant percentage to our estimation of riparian cover. This project clarified many technical aspects of the work from vegetation community descriptions to valley width and statistical summaries. Very little work of this nature has been done before so it provides an excellent background and how-to guide for continuing the work.

References

Environment Canada. 2004. *How Much Habitat is Enough? Second Edition. A Framework for Guiding Habitat Rehabilitation in Great Lakes Areas of Concern*. www.on.ec.gc.ca/wildlife/publications-e.html.

Federal Interagency Stream Restoration Working Group. 1998. *In Stream Corridor Restoration: Principles, Processes and Practices* (10/98).

References for Digital Layers Used

- 2006 Orthoimagery (First Base Solutions)
- Woodland layer (Upper Thames River Conservation Authority updated from OBM 2000 and SOLRIS)
- Wetland layer (Ministry of Natural Resources)
- Elevation Contour layer (Ontario Base Mapping / Ministry of Natural Resources)
- Watercourse layer (UTRCA based on 2006 Orthoimagery)
- Municipal Boundary layer (Land Information Ontario)

Appendices

Appendix 1. Proposed Budget for Pilot Project
Appendix 2. Watersheds of Thames Centre
Appendix 3. Stream Order
Appendix 4. Percent of the Buffer Zone in Various Vegetation Types in 3 Buffer Widths
Appendix 5. Conservation Authorities in Middlesex County
Appendix 6. Budget to Map Riparian Vegetation in Middlesex County

Appendix 1. Proposed Budget for Pilot Project

Item	Description	Total Cost	UTRCA Share	MSC Share
Staff Time	100 hours (60 hours GIS Technician + 20 hrs GIS Specialist + 20 hrs Terrestrial Biologist). Includes wages, benefits and overhead.	$4700	$2350	$2350
Expenses	UTRCA field vehicle, mapping and supplies	$300	$150	$150
Total		**$5000**	**$2500**	**$2500**

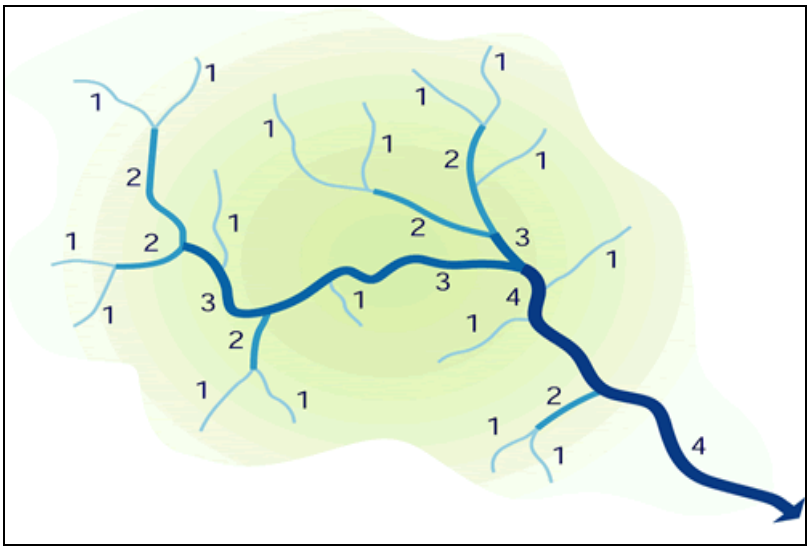
Appendix 2. Watersheds of Thames Centre

Creek/Watershed	Area (sq km)
South Thames / Dorchester	102
Wye Creek	56
Reynolds Creek	53
Waubuno	46
North Thames / Plover Mills	42
Gregory Creek	32
Dingman Creek	31
Pottersburg Creek	18
Medway Creek	12
South Thames	2
Spring Creek (Catfish Creek)	46
Total	**440**

All watersheds are within the Thames River basin, except Spring Creek which is part of the Kettle Creek basin. Areas are approximate.

Appendix 3. Stream Order

(Federal Interagency Stream Restoration Working Group, 1998)

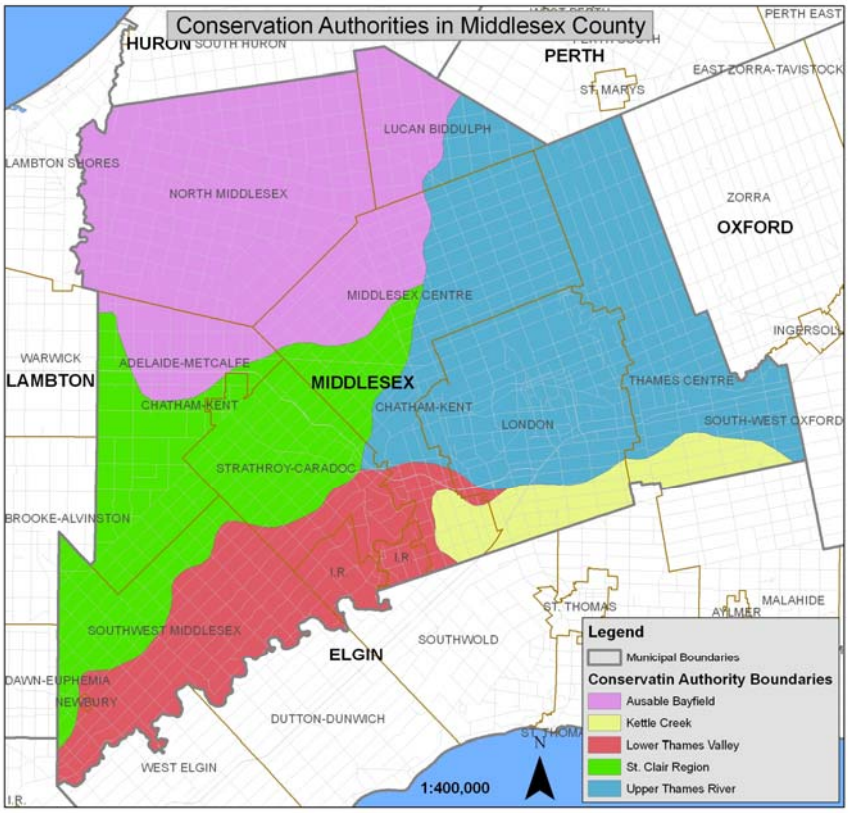


Appendix 4. Percent of the Buffer Zone in Various Vegetation Types in 3 Buffer Widths

Vegetation Communities	10 m Buffer		20 m Buffer		30 m Buffer	
	Area (ha)	% of Total	Area (ha)	% of Total	Area (ha)	% of Total
Woodland (Woodlands and wooded Wetlands)	319	27 %	623	26%	913	25%
Meadow (Floodplain Meadow, Meadow)	217	18%	367	15%	489	14%
Pasture (Pasture or Floodplain Meadow/Pasture)	50	4%	97	4%	141	4 %
Human Influenced Land, Lawn (Gravel Pits, Lawn, Hydro Corridors, Golf Courses)	6	<1%	12	<1%	18	<1%
Total of All Vegetation Communities	**592**	**49%**	**1099**	**46%**	**1562**	**43%**

Note: The buffer widths are not cumulative. Each buffer width starts at the edge of the valley limit and extends outward from there. The 30-m buffer extends exactly 30 m from the valley limit. See Figure 2.

Appendix 5. Conservation Authorities in Middlesex County



Appendix 6. Budget to Map Riparian Vegetation in Middlesex County

Municipality	Approx. Size (sq km)	Area by Conservation Authority	Approx. Cost
Thames Centre	440	90% UTRCA 10% KCCA	$5000
Middlesex Centre	450	50% UTRCA 25% SCRCA 25% ABCA	$5000
Lucan Biddulph	130	40% UTRCA 60% ABCA	$2000
North Middlesex	420	100% ABCA	$5000
Strathroy Caradoc	300	15% UTRCA 40% SCRCA 45% LTVCA	$4000
Adelaide Metcalfe	340	70% SCRCA 30% ABCA	$4500
Southwest Middlesex	350	50% SCRCA 50% LTVCA	$4500
Total Middlesex County	**2430**		**$30,000**

UTRCA = Upper Thames River Conservation Authority
KCCA = Kettle Creek Conservation Authority
SCRCA = St. Clair Region Conservation Authority
ABCA = Ausable Bayfield Conservation Authority
LTVCA = Lower Thames Valley Conservation Authority

Maps