

City of Stratford: Natural Heritage Inventory (June 2004)

Prepared by the Upper Thames River Conservation Authority

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## Executive Summary

The Stratford Natural Heritage Study (June 2004) includes a description of the natural heritage resources of the City of Stratford and provides discussion and recommendations. The study covers both terrestrial and aquatic natural heritage resources. The study involved the compilation of existing information and the collection of some new information to assist with characterizing the natural heritage system of Stratford. While the study focuses on the expanded urban boundary of Stratford, the interaction of natural heritage features and functions with surrounding areas is also discussed.

The terrestrial natural heritage component of the study focuses on the amount and quality of natural woodland cover in the City of Stratford. For the purposes of the study, natural woodland is considered to be remnant woodland patches that exhibit natural habitat characteristics and recently planted areas that are being encouraged to regenerate into natural woodland cover. The study found that there is 2.3 % existing natural woodland cover and 0.3 % of re-naturalized woodland for a total of 2.6 % natural woodland cover. While a total natural woodland cover of 2.6 % considered on its own appears to be low when compared to the woodland cover for rural areas in the region (11 % for the Avon River watershed) and to recommended targets of 25 - 30 % cover that are commonly cited in landscape ecology literature, this number must be balanced against the following factors:

- The study identified 0.3 % of Stratford as being manicured woodlands. The addition of these areas brings the total to 2.9 %.
- The report identifies a number of areas in the City that are being managed with a more natural approach and as time passes, these areas will increase the natural cover of the City of Stratford. No coverage area was assigned for these sites.
- The study did not attempt to assess the percent of cover or the health of individual trees in the City. It is recognized that there is a significant amount of tree cover that is provided by individual trees and groupings of trees on City parkland, boulevards and privately owned land. These “individual” trees will generally provide a complimentary function to the natural heritage system in addition to their important air quality improvement, shading and aesthetic contributions.
- The amount of natural woodland cover in the City of Stratford must be balanced with the role that Stratford plays as a designated urban growth centre for the region.

The aquatic natural heritage component of the study consists of a compilation of existing information. The study provides a summary of benthic invertebrate monitoring data, fish sampling data, fish habitat assessments and long term water quality monitoring. All of this information assists with characterizing the aquatic ecosystem health of the Avon River and its tributaries. This information summary provides a benchmark for future comparison and can support ongoing watershed planning and implementation for the Avon watershed.

The report includes discussion and recommendations on the terrestrial and aquatic natural heritage resources of the City of Stratford. Strategies for protecting and enhancing natural heritage resources are discussed and specific recommendations are included.

## **1.0 Introduction**

The Upper Thames River Conservation Authority (UTRCA) submitted a proposal to the City of Stratford in July of 2002 to undertake a Natural Heritage Inventory for the City. The City accepted the proposal and the UTRCA proceeded with background information collection and field work. The study area includes all lands that will be within the corporate boundary of the City of Stratford at the end of the phased annexation (January 1, 2007).

The project scope involves the assembly of existing natural heritage information and the collection of new information to provide a summary of the natural heritage resources of the City. The study includes terrestrial natural heritage (natural and “naturalized” woodlands and riparian areas) and aquatic natural heritage. The terrestrial findings incorporate the results from recent studies with new information that was collected in the fall of 2002. The terrestrial natural heritage work was limited to those woodlands and riparian areas that exhibited natural woodland characteristics. Landowner permission was obtained for sites where new information was collected. This report includes discussion of the terrestrial findings, recommendations and a discussion on implementation options. The aquatic information provided in this report is a summary of field inventory and monitoring data.

## **2.0 City of Stratford - Landscape Context**

The Provincial Policy Statement (PPS, 1997) provides municipalities with a framework to guide land use planning decisions. Section 2.3 of the PPS addresses Natural Heritage and identifies the components of a natural heritage system as being:

- wetlands
- endangered and threatened species and their habitat
- fish and their habitat
- woodlands
- valley lands, and
- wildlife habitat

The natural heritage that remains on the southern Ontario landscape is largely contained within the remaining woodland patches, open water wetlands, watercourses and vegetated riparian buffers. For this reason, natural heritage inventories generally focus on the remaining natural woodland patches and aquatic habitat.

The City of Stratford is located within the Avon River Watershed. Information on the forest conditions, surface water quality and watershed features is summarized in the Avon River Watershed Report Card (2001). This report card is included with this report as Appendix 1. Highlights are as follows:

- the Avon watershed area is 169 sq. km. The post annexation area of Stratford will be 26.48 sq. km (2648 Ha).
- it is estimated that 76 % of the land use in the Avon watershed is agriculture with 14 % urban and 11 % woodland
- 54 % of the woodlots in the Avon watershed are very small (< 4 Ha)

- 19 % of the woodlots are small (4-10 Ha)
- 14 % are mid-sized (10-30 Ha)
- 3 % are large (30-40 Ha)
- 10 % are very large (>40 Ha)
- The Gads Hill South Swamp and the Stratford Wetland Complex are two large natural areas that are found within the catchment.
- The water quality in the Avon River watershed has improved since the 1970's. The improvement is attributed to many factors including improvements in sewage treatment technology and infrastructure and the implementation of rural best management practices such as those promoted by the Avon Conservation Club. Despite these improvements, water quality in the Avon is still generally poor.

The woodland and aquatic natural heritage areas that remain in the City of Stratford consist of:

- remnant woodland patches that are associated with golf courses and City owned open space lands
- remnant woodland patches that are found in residential neighbourhoods or that are associated with large industrial parcels
- remnant woodland patches that are surrounded by agricultural uses, particularly in the areas that are being annexed into the City
- areas that have been planted in native species and encouraged to naturalize
- larger watercourses and associated flood plain areas such as the Avon River and Court Drain
- small watercourses and open municipal drains with their associated riparian zones

Natural woodlands are defined as both remnant woodland patches that have not been manicured into parklands and areas that have been replanted and left to naturalize. It is noted that while the City of Stratford has a relatively small amount of natural woodland area, the City does have a significant tree cover that is comprised of individual trees or groupings of trees. The understorey of these areas is typically manicured and as a result, no significant habitat function is provided. While it is accepted that this “individual” tree cover will generally provide a complimentary function to the natural heritage system, the individual trees and groupings of trees have not been included in this natural heritage inventory. It is also noted that Stratford is an urban growth centre and that this must be considered when identifying future woodland cover targets or when comparing existing natural woodland cover for the City of Stratford to the surrounding rural areas.

### **3.0 Natural Heritage - Woodlands**

#### **3.1 Woodlands Sampling Methodology**

##### 3.1.1 Preliminary Site Reconnaissance

April 2000 air photography and 1:2,000 and 1:10,000 Ontario Base Mapping (OBM) was reviewed to identify candidate woodland and riparian areas for investigation. Candidate woodlands include all forested areas in the City of Stratford. Figure 1 is a map showing all of the woodland cover for the City of Stratford. The total area of all woodlands is approximately 76.7 ha. With a post annexation area of 2648 ha, the maximum woodland coverage for the City of Stratford is 2.9 %.

A preliminary field investigation was undertaken on August 19, 2002 to determine which woodland patches exhibited natural vegetation features and habitat function and which woodland patches were being anthropogenically managed (*i.e.* understorey mowed, planting of showy non-natives, *etc.*). The preliminary field investigation involved viewing all of the woodland patches in Figure 1 from road allowances. Based on this reconnaissance, all anthropogenically managed patches were removed from the list to be inventoried. The area of the patches removed was 7.6 ha which equates to 0.3 % of the total area. This leaves 69.1 ha of natural and naturalized woodland cover for the City of Stratford, which equates to 2.6 % of the post annexation land area (Figure 2).

Of the 69.1 ha of natural woodland cover, approximately 11.4 ha have been planted by the City of Stratford or the UTRCA and left to naturalize (Figure 3). These woodland patches have features and functions that are more similar to natural woodlands than manicured parks. For this reason, these “naturalized” woodland patches are included as part of the overall woodland cover for the City of Stratford. Detailed planting records were available for these sites and this information is included in this report.

### 3.1.2 Landowner Contact

City of Stratford staff provided landowner information for the patches identified for detailed field investigation. A sample of the letter mailed to the landowners is included as Appendix 2. Follow up phone calls were made as necessary to secure permission to access the identified sites. Permission was granted for all but two of the woodland areas identified for inventory. Landowners will be provided with a summary of the findings for their woodland area once the final study is delivered to the City of Stratford.

### 3.1.3 Detailed Site Inspections

To determine the ecological significance of each woodland in relation to its surrounding region, woodlands were evaluated based on their size and position within the surrounding landscape. These measures are based on principals of landscape fragmentation. In addition, a qualitative assessment of their composition was conducted in the fall of 2002. Ontario’s Ecological Land Classification (ELC) scheme (Lee *et al.* 1998) was used to classify the woodlands to the ecosite level (*i.e.* green level of the ELC) where possible. Ecosite boundaries are distinguished by vegetation cover types and are recognizable on air photos. The ELC scheme is designed to help standardize the categorization of natural areas throughout the province by assigning sites to specific ecological community types depending upon the composition of their dominant tree species, soil types, hydrology and understorey vegetation. Important riparian vegetation was similarly assessed in the City of Stratford Court Drain Subwatershed Study (Aquafor Beech 2002) and in the biological survey of the TJ Dolan riparian area conducted by the UTRCA (2001). Both study results are summarized in this report.

Sampling conditions and procedures in this study are comparable to those used in the City of Stratford Court Drain Subwatershed Study (Aquafor Beech 2002). The methodology is consistent with the full ELC process (Lee *et al.* 1998). Each woodlot was surveyed on foot and a description of the top four species by presence for each vegetation layer (canopy, sub-canopy, shrub and herbaceous), as well as descriptions of the physiography, estimates of intensity and extent of disturbance, descriptions of the soil profile and evaluation of ecological community features, was recorded. No formal quantitative analysis of the vegetation was performed during this survey and no sampling quadrats or measured transects were taken. Prism sweeps, used to determine basal area (or tree density by species and size), were recorded at least once in each community.

A detailed assessment of the ground cover vegetation was not possible at the time of the survey (late autumn) since frost events would have caused most of the ground vegetation to die back. Further, the ability to detect significant avian, reptile and amphibian diversity is reduced at this time since most of these species have stopped calling and breeding, having either migrated south or begun their quiescent period. Instead, wildlife species were noted opportunistically during the vegetative surveys and significant breeding areas for birds, amphibians and reptiles were presumed but not confirmed in this study.

### **3.2 Woodlands Results**

The City of Stratford lies within the Great Lakes - St. Lawrence forest region, which includes a mixture of deciduous species and some representatives of Carolinian and Boreal species. In general, the City of Stratford has few remaining natural heritage vegetation patches within the corporate boundary. However, this is typical of most of the municipalities in southern Ontario. The natural heritage that remains on the southern Ontario landscape is largely contained within the remaining woodland patches, wetland areas too wet to drain, riparian lands adjacent to watercourses that could not be altered as municipal drains and some plantations, either deciduous orchards or coniferous (red pine, Scotch pine, etc.). Although all communities found in the City of Stratford are common and typical within the regional landscape, it is evident from the cultural use of some of these woodland areas that they are important “natural areas” within the City of Stratford. As well, the woodlands, plantations and riparian features are utilized by a number of mammals, birds, amphibians, snakes and other reptiles which are common near urban settings.

Based on the preliminary field investigation, natural and “naturalized” woodlands cover approximately 69.1 ha and range in size from 0.11 ha to 5.95 ha. Fifteen of these woodlands were surveyed in this study. The rest of the woodlands were surveyed in the City of Stratford Court Drain Subwatershed Study (Aquafor Beech 2002), in the biological survey of the TJ Dolan riparian area conducted by the UTRCA (2001) or were planted by UTRCA and City staff.

The majority of woodland patches are small and they are scattered within the agricultural and urban landscape and as a result, many do not exhibit a full range of ecological functions. The majority of woodlands are surrounded by either intensively used agricultural lands, roads and / or urbanization with no forested corridors or linkages between them.

Figure 2 shows the patches that were identified for detailed field study, the “naturalized” sites planted by the UTRCA and the City and the riparian areas of TJ Dolan and the Court Drain. Approximately 4.5 ha of the inventoried woodlands are deciduous swamp (wetland) forests, and consist primarily of silver maple, willow, cottonwood, ash and elm. The lowland forest patches appear to be no older than mid-aged, although there are some remnant larger (i.e. >50 cm dbh) and older (i.e.> 100 year) trees still remaining near the centres of some of the woodlands.

Approximately 10.5 ha of the inventoried woodlands are upland deciduous forest communities. The upland woodlands are young and generally consist of mixed polewood and small hardwoods dominated by soft (silver) maple, ash and elm in their interior with the forest edge dominated by species such as black cherry, hawthorn, trembling aspen, beech and occasionally sugar maple, oak, hickory and hop hornbeam. The edges of these woodlands are moderately to heavily disturbed by selective cutting and wind blow down. Human trails, and garbage are prevalent.

Approximately 2 ha of the inventoried woodlands are young to mid-aged conifer plantations and 2 ha are young to mid-aged mixed plantations. Conifer plantations are either polewood pine or polewood pine and spruce. Mixed plantations consist primarily of polewood spruce and ash.

Two woodland patches had riparian forest communities. The riparian areas occurred along streams as long, linear strips of varying width and are mid-aged, with some larger (*i.e.* >50 cm dbh) and older (> 100 year) willows along the stream banks. The riparian vegetation along the middle and lower Court Drain (R1) are typically limited to the flood plain and valley wall and extend 5 - 10 m from the stream on either side (Aquafor Beech 2002 report). The communities in the lower reach have less disturbance than those in the middle reach. The typical community consists of willow, white ash, American beech, white elm. There are a number of very large willows interspersed along the middle and lower reaches. In the lower Court Drain just upstream of Kelly's Lane (R2), the riparian area is wider, up to 25 m on each side of the stream and there is an old orchard and red pine plantation adjacent to the riparian zone on the east side of the creek. The removal of vegetation along the Court Drain through the golf course has reduced the habitat value of this riparian area and has the potential to reduce other riparian functions that may include bank stabilization and stream shading. In the TJ Dolan area, the riparian area is very wide, approximately 150 m on each side of the stream. There are 22 different vegetation communities found within this corridor, with willow, poplar and maple found along the length of the river.

Figure 3 shows the sites planted by the UTRCA and /or City of Stratford. These areas have been planted with native tree, shrub and /or herbaceous species and left to naturalize (*i.e.* no mowing). By planting these areas with native species, the intent is to establish native plant communities that will be able to out compete the suite of non-native plants that have adapted to establishing on disturbed and abandoned sites. Table 1 provides information on these planting sites.

Figure 3 also identifies a number of sites that are being managed by the City of Stratford with a more natural approach. While these areas continue to be managed with limited mowing, over the course of time, they will provide more natural heritage function. Some areas for potential regeneration have also been identified on Figure 3. The size of these areas has not been calculated and included in the percent coverage calculations.

**Table 1** Community forestry planting projects in the City of Stratford (refer to Figure 3).

Site	Primary Partners	Species Planted	Comments
TJ Dolan	Stratford's Civic Beautification and Environmental Awareness Committee, City of Stratford, UTRCA	Silver maple, green ash, red maple, staghorn sumac, white ash, black walnut, elderberry, nannyberry, chokecherry, bitternut hickory, shagbark hickory, bur oak, basswood, kentucky coffee, grey dogwood	Over 5000 shrubs and trees have been planted. Most of the available area has been planted.
Cooper Standard	Stratford's Civic Beautification and Environmental Awareness Committee, Cooper Standard, City of Stratford, UTRCA	Fragrant sumac, red osier dogwood, staghorn sumac, sugar maple, red maple, basswood, chokecherry, bur oak, green ash, red oak, serviceberry, silky dogwood, elderberry, american plum, white ash	3 butterfly meadows, a constructed wetland and a mix of 1350 native shrubs and trees
Stratford Education and Recreation Centre (SERC)	Northwestern Secondary School, St Michaels Secondary School, City of Stratford, UTRCA	Arrowwood, chokecherry, highbush cranberry, red oak, staghorn sumac, service berry, elderberry, american plum, red osier dogwood, aquatic plants	330 native shrubs and trees planted and 240 aquatic plants installed
Stratford Watershed Excellence Centre (SWEC)	Stratford's Civic Beautification and Environmental Awareness Committee, Ontario Clean Water Agency, City of Stratford, UTRCA	Highbush cranberry, american plum, green ash, pasture rose, red oak, red osier dogwood, serviceberry, silky dogwood, white ash, red maple	225 native trees and shrubs planted, 1400 native wildflower and grass plugs and possible 225 more shrubs and trees to be planted

### 3.3 Woodlands Analysis

The woodlands results of this study can be used to provide context for site specific Environmental Impact Statements (EIS's) that may be required for proposed land use changes adjacent to, or within, these natural heritage features. Although many of the remaining woodland patches do not contain natural features or functions of provincial or regional significance that would constrain development, local woodlands in urban areas provide a number of important benefits, including the opportunity for

a local “woodland” experience. These benefits may reduce development pressure which, in turn, may have a significant impact on the larger woodlands where the preservation of ecological functions are more important. Recognizing that urban areas tend to have limited woodland cover, it is recommended that ecological, socio-economic and aesthetic values be considered when planning for development in order that woodlands remain for recreational purposes as well as for natural heritage functions.

Table 2 highlights some of the important features and functions of the woodlands surveyed. The presence of a diversity of community types and conservative species, as well as habitat features such as tree cavities, a reliable source of water and aquatic features, a variety of topographic forms and linkage opportunities in the surrounding matrix, indicates higher quality woodlands.

**Table 2.** Summary of ecological features and functions for each woodland surveyed. Higher quality woodlands are in bold.

Patch ID #	Size (ha)	Age	Features	Matrix	Topography	Aquatic Features
C	2.5	mid	- 3 communities - large trees (live / dead)	- golf course	rolling ridges	stream
<b>CC</b>	<b>3.4</b>	<b>pioneer / mid</b>	<b>- 2 communities</b> <b>- conservative species</b> <b>- large trees (live / dead)</b>	<b>- golf course</b> <b>- agriculture</b> <b>- old orchard</b>	<b>rolling ridges</b>	<b>vernal pools</b>
<b>CD</b>	<b>1.5</b>	<b>pioneer / young / mature</b>	<b>- 3 communities</b> <b>- conservative species</b> <b>- large trees (live)</b>	<b>- golf course</b> <b>- agriculture</b> <b>- old orchard</b>	<b>flat to hummocky</b>	<b>swamp with vernal pools</b>
D	1.4	mid	- 1 community	- industry - residential	steep ridges	stream and flood plain
G	1.3	young / mid	- 1 community - large trees (live)	- agriculture - parks	flat	drainage ditch
H	2.3	mid	- 3 communities - large trees (live)	- industry - agriculture	flat to hummocky	swamp and remnant pool
I	2.3	pioneer / mid	- 3 communities - large trees (live) - link to woodland	- industry - agriculture	flat	swamp with stream
J	0.2	pioneer	- 2 communities - link to woodland	- industry - agriculture	flat	wet meadow with intermittent channel

Patch ID #	Size (ha)	Age	Features	Matrix	Topography	Aquatic Features
K	0.5	young	- 1 community	- residential - agriculture	flat	drainage channel
L	0.3	young	- 1 community	- residential - agriculture	flat	no aquatic features
M	1.4	mid	- 1 community - conservative species	- agriculture	flat	swamp
N	1.5	mid	- 2 communities - conservative species - large trees (live) - link to woodland	- golf course - residential - woodland	undulating	no aquatic features
P	0.7	mid	- 1 community - large trees	- agriculture	flat	swamp
Q	1.2	mid	- 2 communities	- residential	flat	no aquatic features
R	0.4	young	- 2 communities	- residential	flat	no aquatic features
O <i>note 1</i>	1.62		- 1 community	- residential - golf course	flat	deciduous forest
F <i>note 2</i>	1.25	unknown	unknown	- industry	unknown	unknown

*Note 1: Landowner permission was not granted for woodland patch O. This patch was clearly visible from the road allowance and specifics about the patch were identified and included in the study.*

*Note 2: Landowner permission was not granted for woodland patch F and therefore specific information for this site is not available.*

The most promising woodlands in terms of diversity of community types, presence of conservative species, varying topography and habitats, woodland stand maturity and landscape connectivity are woodlands CC, CD, M and N. These woodlands have greater tree species and size diversity than other woodlands and are more closely linked to neighbouring woodlands or riparian zones.

Woodland patches C, G, H, I, J, K, O and P have some of the ecological features and functions present in healthy woodlands. If planted with buffers and protected from further human impacts, there is a good chance that many of these woodlands would return to a more natural or healthy state.

Woodlands D, L, Q and R are the most impacted by human disturbance, with a high number of non-native or edge species. Intense and extensive human disturbance, combined with isolation from other natural features, reduces the chances for wildlife to migrate into them.

Riparian habitats are also very important for a variety of animal species, for human recreation and for aesthetic values. The presence of a diversity of community types and habitat features such as size of the riparian patch, tree cavities and a reliable source of water, make riparian areas attractive locations for breeding birds. The relatively deep (20 - 30 cm) and fast flowing characteristics of the stream create a highly suitable and permanent habitat for frogs, snakes and aquatic insect prey. Small mammal tracks, such as skunk, racoon, chipmunk, squirrel and groundhog, were found along the stream bank in all riparian zones within the City of Stratford.

### **3.4 Woodlands Discussion and Recommendations**

The natural woodlands information in this study is provided to assist the City of Stratford with comprehensive planning for these areas. This study identifies a number patches as being natural woodland and detailed data is provided for all but one of the patches targeted. None of the natural woodland patches assessed in this inventory contains features or woodland functions that would justify identification of the patch as being provincially or regionally significant. While no threatened or endangered species were found in the patches inventoried, it must be noted that the study methodology is not rigorous enough to rule out the possibility that threatened or endangered species may be found in the patches. The requirement for more rigorous site assessment, including the need for more comprehensive three season field inventories, could be a prerequisite for any future development proposals in, or adjacent to, the natural woodlands. If threatened or endangered species were found through more rigorous assessment, the specific site may be considered to take on regional or provincial significance.

While this study concludes that there are likely no Provincially or regionally significant natural woodlands within the expanded boundary of Stratford, this finding does not suggest that the remaining woodlands and riparian areas in Stratford have no significance. Given the low percentage cover of natural woodlands within the City, the maintenance of the remaining natural woodlands and riparian areas for their natural heritage function and local community value is encouraged.

#### 3.4.1 Options for Protection and Enhancement

There are several options available for protecting and enhancing natural woodland areas. The following options are provided for discussion.

Options for protection and enhancing natural woodlands include:

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Regulatory Measures - measures to control an individual's freedom to act for the benefit of the individual, the community or the broader public interest. Two regulatory measures that are applicable in this case are:

- i) the regulation of land use through official plan policy and zoning by-law regulation under the jurisdiction of the Planning Act
- ii) the regulation of tree cutting and site alteration under the Trees Act or the Municipal Act

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Stewardship - providing the tools to landowners and the community to undertake measures which sustain and improve resources

Education - creating a broad awareness of the importance of the resource and actions that can be taken to maintain and restore the resource. Education and stewardship are closely linked.

Incentives - measures that reward good management practices. The incentive can be financial or simply recognition.

Acquisition - outright purchase of land or easements as a means of obtaining management control.

A comprehensive program to achieve the goals identified for natural woodlands in the City of Stratford could involve elements of each of these measures and it may involve strategies which go beyond the ones that are listed. This study does not lay out a comprehensive implementation plan but rather, provides a standard information baseline which can be used as a starting point for the City to consider options for protecting and enhancing natural woodlands.

### 3.4.2 Natural Heritage (Woodlands) Recommendations

Based on the findings of this study, we recommend:

1. That all remaining natural woodlands in the City of Stratford be maintained. It is further recommended that the range of options for protecting and enhancing natural woodlands be assessed and that a comprehensive City plan be developed.
2. That existing natural woodlands that are not currently zoned and designated for development be protected in the official plan and zoning by-law.
3. That the City develop policies for the management of City owned natural woodlands and other natural habitats that are aimed at protecting and enhancing natural features and functions.
4. That the City's policies regarding individual trees and landscaping measures be integrated with the City's natural woodland policies
5. That the City continue to identify potential naturalization sites and take steps to encourage the establishment of new natural woodlands.

## **4.0 Aquatic Natural Heritage**

Aquatic information is included with this report to complete the natural heritage picture of the City of Stratford. Aquatic information is provided in the following four topic areas:

- Benthic Monitoring (Section 4.1)
- Fish Sampling (Section 4.2)
- Fish Habitat (Section 4.3) and
- Long Term Water Quality Monitoring (Section 4.4)

Information on each of the above noted topics is included in the body of this report with detailed data included in the Appendices.

## **4.1 Benthic Sampling**

### 4.1.1 Methodology

Benthic macroinvertebrates (BMIs) are excellent indicators of aquatic habitat at the site sampled and of the water quality being contributed by the upstream catchment. Because BMIs are present at the site for much or all of their lives and have fairly well known sensitivity and tolerance to water quality impairment, the BMIs found at a site provide a long-term indicator of aquatic ecosystem health. For example they can allow detection of water quality or habitat disruption occurring in the period prior to sampling.

Sampling was conducted as a cooperative project with the University of Western Ontario (UWO) using a rapid bioassessment protocol developed by the USA Environmental Protection Agency as modified by Dr. Robert Bailey for local conditions. A timed travelling kick was used to capture BMI samples which were preserved at the site and then analysed at the UWO benthic laboratory. BMI were identified to the Family taxonomic level which allowed calculation of the Family Biotic Index, a weighted average of their individual pollution tolerance indices.

### 4.1.2 Findings

Benthic monitoring sampling site locations are shown on Figure 4. Water quality in Stratford was found to be within the range, but toward the lower extreme, of levels of impairment encountered in the Upper Thames watershed. Although limited sampling has been conducted upstream (sampled in 1997 and 1998 only), a trend towards declining water is evident as the Avon passes through Stratford. Benthic analysis provides a reliable indicator of water quality and general aquatic ecosystem health but does not identify specific sources of water quality impairment. Obvious potential sources include sewage treatment plant discharge, stormwater run-off, and the negative impacts of two impoundments. Elevated water conductivity readings noted during sampling at the downstream Avon site indicate that industrial discharge may also be contributing to the level of impairment and could be further investigated.

Court Drain findings were fairly consistent at the upstream site, but varied considerably at the downstream site indicating a possible response to disturbances within Stratford. The poor quality noted in the two Court Drain tributaries is fairly typical of that found in small, intermittent agricultural drains.

Appendix 4 includes a summary of benthic sampling activities 1997-2003 and specific sampling details on a tributary basis.

## **4.2 Fish Sampling**

### 4.2.1 Methodology

Fish community information is based on data extracted from the Royal Ontario Museum (ROM) fish database (eight samples at five sites), sampling conducted by UTRCA staff (fourteen samples at ten sites) and a joint Ministry of Environment (MOE)/UTRCA sampling venture. Sampling done by the ROM typically involves use of seine nets and back pack electrofishers. Sampling conducted by the UTRCA utilized a backpack electrofisher to temporarily stun, net and identify fish species encountered. All fish were then released unharmed. A boat electrofisher was utilized to sample Victoria Lake in the

fall of 2003. Appropriate specimens were collected for analysis to provide information for MOE's next edition of the "Guide to Eating Ontario Sport Fish".

#### 4.2.2 Findings

The Avon and its tributaries in Stratford support a very diverse fish community (33 species observed) fairly typical of warmwater streams in the Upper Thames watershed area. Species such as white sucker, creek chub, common shiner, bluntnose minnow, johnny darter, and brook stickleback were encountered frequently and are representative of this habitat type. Typical gamefish sampled were rock and smallmouth bass. Atypical species more common in pond and lake habitat included largemouth bass, yellow perch, and golden shiner which appear to be thriving in the impoundments. Other atypical species included stocked rainbow trout, sampled at two locations late in the year, and pearl dace, which are sometimes considered a coldwater indicator. This indicates that one or more coldwater refuges may exist in the Avon system in Stratford. Significant species encountered included the greenside darter which is assigned a Canadian status of "Special Concern" (formerly vulnerable) but is abundant in the Thames River system. Species of wide distribution, but considered rare in the Thames River system are the previously mentioned pearl dace and golden shiner, plus the Iowa darter and rainbow darter. The latter hasn't been found during recent sampling and is likely extirpated from the Avon River and most of the rest of the Thames River watershed, possibly due to the increase in greenside darter numbers.

Appendix 5 is the UTRCA/Royal Ontario Museum Fish Species Summary for Stratford.

### **4.3 Fish Habitat**

#### 4.3.1 Methodology

Habitat parameters such as flow, substrate conditions and thermal regimes were examined primarily through the recently completed Municipal Drain Classification Project. A visual assessment, along with a few simple measurements were completed at road crossings over most watercourses. Thermal regime on suspected coldwater tributaries was completed using an accepted DFO protocol. For selected tributaries, fish sampling (as described in Section 4.2.1) was utilized to establish the presence of fish species.

#### 4.3.2 Findings

In July 2001, fish habitat assessments were completed at 34 sites in Stratford. Five of the 34 sites were sampled for fish species indicators. The data indicates that the Avon River system provides warm water habitat. The Avon River and Court Drain have habitat to support top level predators such as largemouth bass, rock bass and other sunfish species. Other tributaries of the Avon and Court Drain are supporting baitfish which includes minnows (common shiner, creek chub, and white sucker) and darters (johnny, blackside and greenside). Approximately five of the tributaries sampled were found to be intermittent in nature (dry for part of the year). Two of the tributaries visited were closed systems. The Municipal Drain Classification Project information has been provided to the City of Stratford in draft form and as new information is collected, the fish habitat database will be updated.

Appendix 6 is a Draft Municipal Drain Classification Map for the City of Stratford.

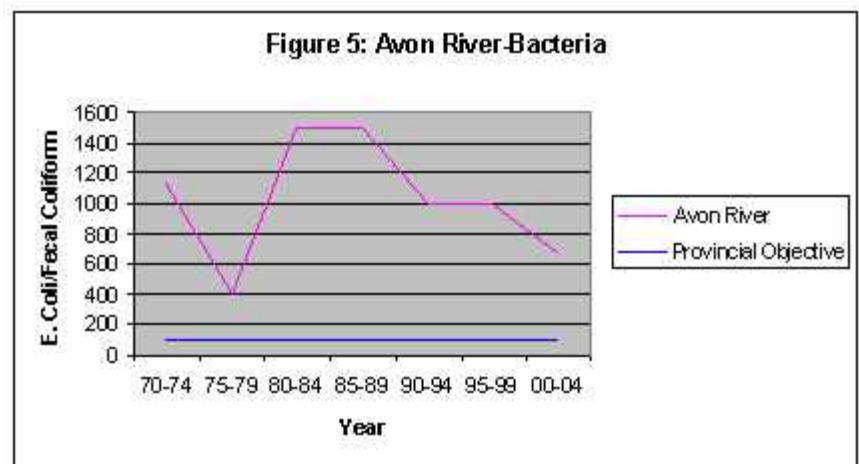
## 4.4 Long Term Water Quality Monitoring

### 4.4.1 Methodology

Since 1967, the Avon River has been monitored for water quality as part of the Provincial Water Quality Monitoring Network (PWQMN) of the Ontario Ministry of the Environment. The monitoring site is located downstream of Stratford at Perth Road 32 (figure 4). The sampling frequency and sample parameters have varied somewhat over the years with changing environmental priorities. Currently samples are taken once a month, eight times per year. A partnership with the Ministry of Health Laboratory and local health units currently provides the bacteria analysis. The long term nature of this data gives a valuable assessment of trends in Avon river water quality over the past 40 years. PWQMN samples are analysed for 37 parameters. The results of 6 key indicator parameters are summarized below. Figures 5 through 12 show the 75<sup>th</sup> percentile for each five-year block of data for the years sampled.

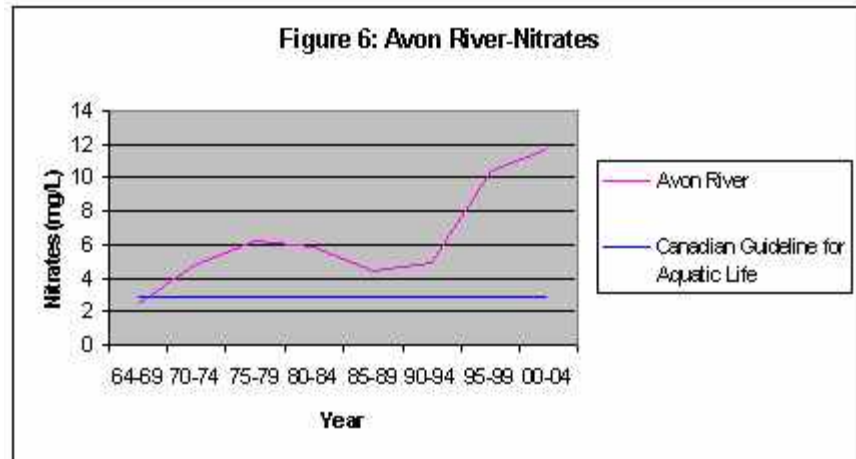
### 4.4.2 Results

#### 4.4.2.1 Bacteria



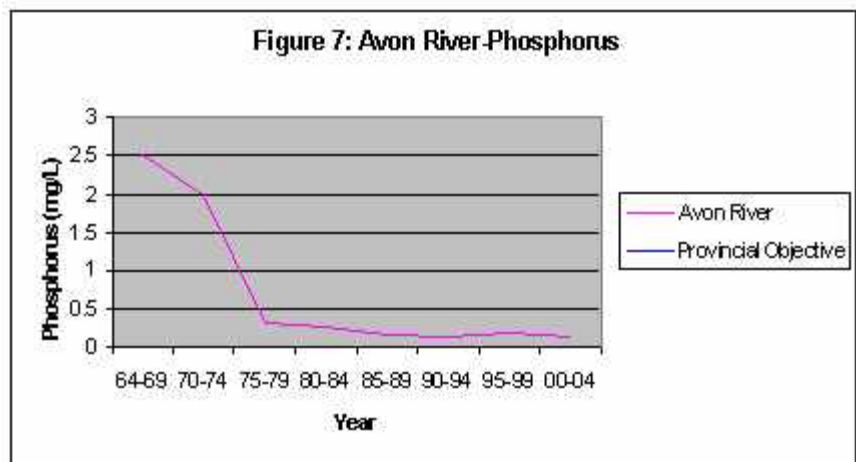
Fecal bacteria levels in the Avon River have shown a significant decline from 1980 to present (figure 5). While bacteria levels have greatly improved, the current levels are consistently well above the provincial objective of 100 *E.coli* per 100 ml sample. These numbers indicate that there continues to be significant sources of human and animal fecal waste entering the Avon River. Potential sources in the watershed include runoff from land applied sewage or livestock waste, faulty private septic systems, inadequate manure storage, and urban stormwater runoff. *E.coli* (the current type of fecal bacteria measured) is an indicator of the presence of pathogenic bacteria in the river.

#### 4.4.2.2 Nitrates



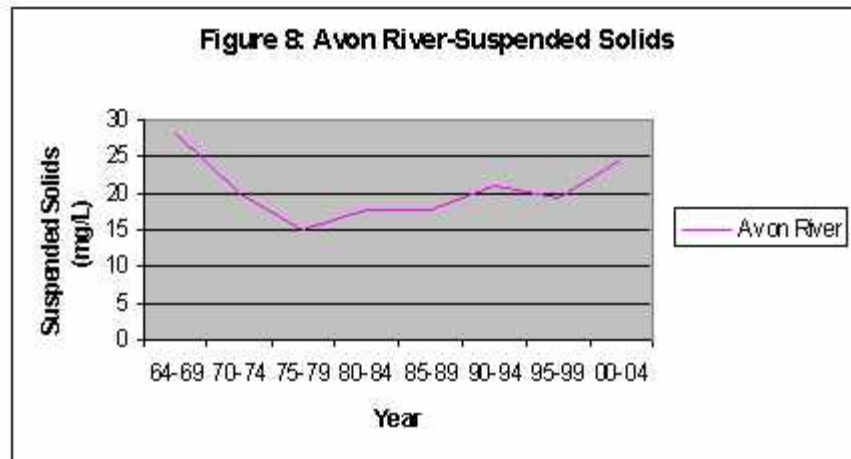
Over the past forty years nitrate levels in the Avon river are showing an increasing trend (figure 6). Since 1970, all nitrate levels are above the Canadian guideline for the protection of aquatic life. Amphibians are particularly affected by nitrates. This increasing trend in nitrates is seen throughout the Upper Thames River watershed and in many parts of the province. Potential sources of nitrate include sewage sludge, industrial wastewater, livestock waste, urban and agricultural pesticide and fertilizer runoff, and atmospheric deposition.

#### 4.4.2.3 Phosphorus



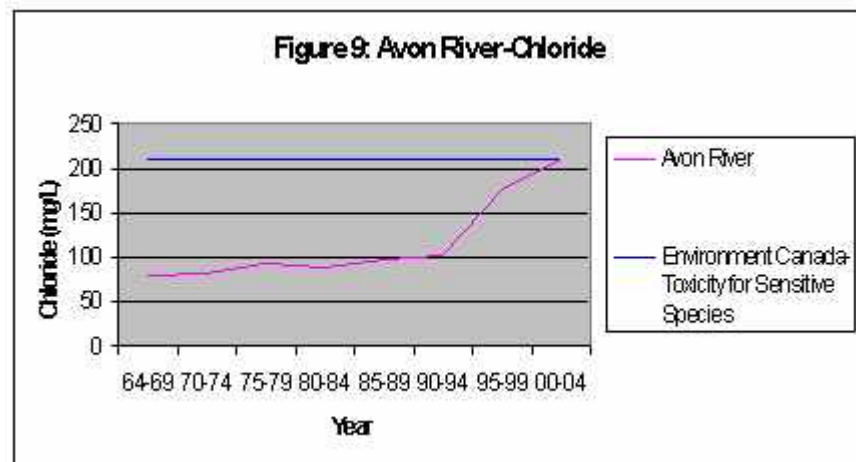
Phosphorus levels in the Avon River show a significant decline through the 1960's and 1970's and continue to show a gradual downward trend (figure 7). Current levels remain well above the provincial guideline of .03 mg/l. This indicates the presence of phosphorus sources within the watershed which can include domestic and industrial effluents (including soaps, cleaning products) and other inputs including pesticides and fertilizers. Phosphorus is used by aquatic plants and algae and excessive levels can lead to algae blooms and oxygen depletion in the river system.

#### 4.4.2.4 Suspended Solids



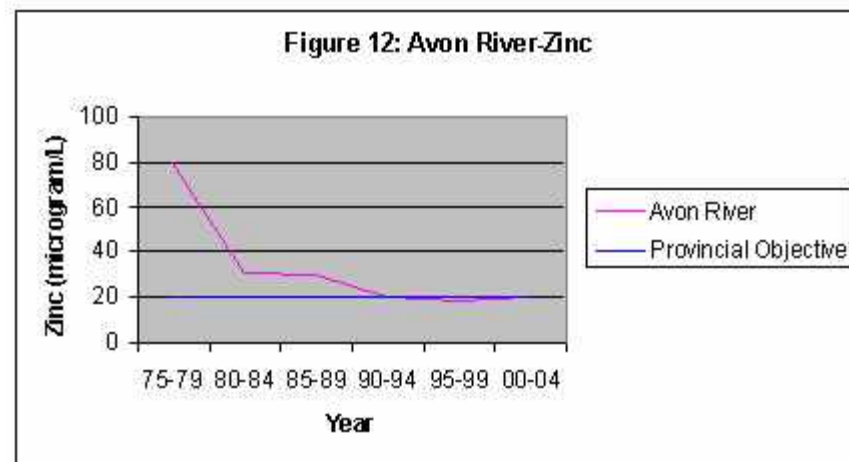
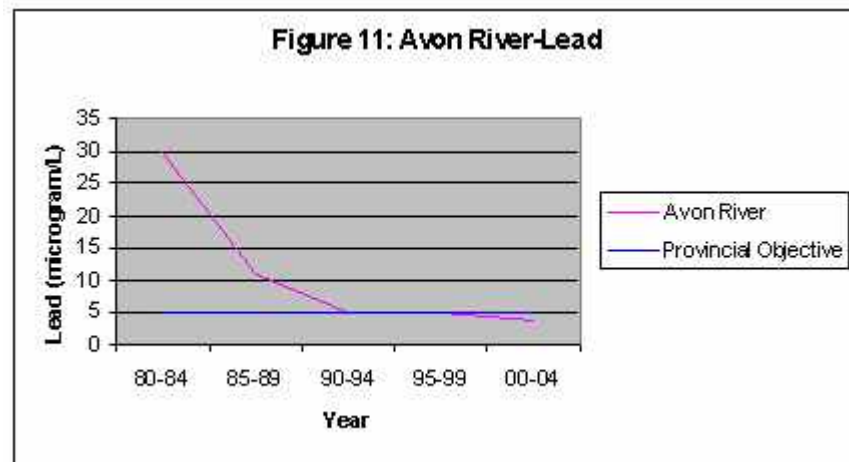
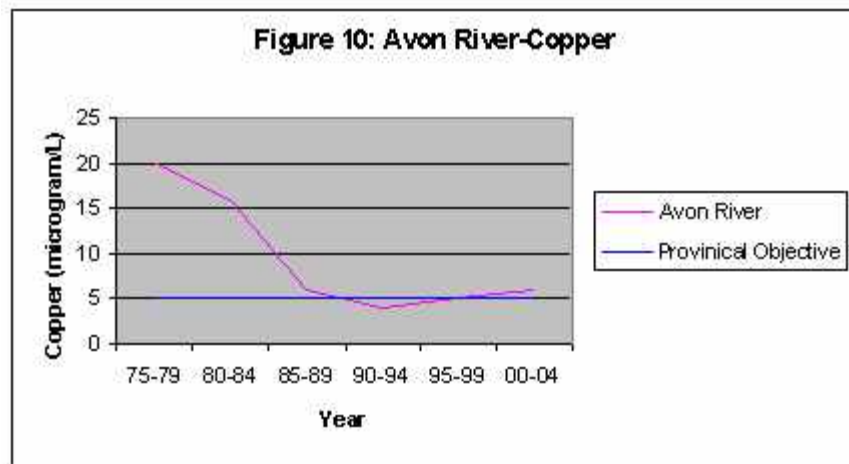
Suspended solids, consisting of silt, clay, and other fine particles, can be significant carriers of pollutants in a river system and can impair the habitat of aquatic life. There was a decline in suspended solids levels in the 1960's and 1970's, but the last 25 years have shown an increasing trend (figure 8). While there are natural levels of suspended solids in a river, soil erosion is the most common source of suspended solids to a watercourse. Sediment loadings from construction sites, agriculture, and industrial wastewater are potential sources.

#### 4.4.2.5 Chloride



Chloride levels have shown a continual increase over 40 years with a significant increase since 1990 (figure 9). Levels in the Avon River are currently at the Environment Canada level of toxicity for sensitive aquatic species. Road salt is a significant source of chloride to rivers. Watercourses in urban areas tend to have the highest chloride contamination.

#### 4.4.2.6 Metals



Metal concentrations (zinc, lead, and copper) in the Avon River are all showing a significant decline over the last 30 years with current values close to the provincial objectives (figures 10 - 12). While remaining close to the provincial objective, copper levels have shown some increase since 1990. Metals are long-lasting in the environment and tend to accumulate in stream bed sediments and can be a cumulative toxin in fish and wildlife. Sources of copper, lead, and zinc can include stormwater/urban runoff, certain pesticides, industrial wastewater, and sewage sludge. of long term monitoring site is shown on Figure 4.

#### **4.5 Aquatic Natural Heritage Discussion and Recommendations**

Although water quality in the Avon River is generally improving, it is still considered to be poor. It is recommended that the City of Stratford continue to support initiatives that are aimed at improving point and non-point source water quality. The ongoing planning and implementation of water quality measures should continue on a watershed basis and involve the City of Stratford and the upstream and downstream municipalities. The planning and implementation needs to continue to focus on private and public landowners in the watershed, including both urban and rural, as key partners in achieving the goal of a healthy watershed ecosystem.

#### **5.0 References**

- Aquafor Beech Limited. 2002. City of Stratford Court Drain Subwatershed Plan Study (Phase 1 to 5) Final Report. 96pp. + Appendices
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