Appendix A

Natural Heritage System Identification Criteria

Includes the following:

- Criteria for Identifying the Proposed Additions to the Natural Heritage System
- Criteria for Identification of the “No Development or Site Alteration Areas”

Appendix A

Natural Heritage System Identification Criteria

1. Criteria for Identifying the Proposed Additions to the Natural Heritage System

The following features will be identified as **proposed** additions to the Innisfil Creek Subwatershed Natural Heritage System. (The selection of these areas meet the requirements for identifying “significant areas” outlined in the Provincial Policy Statement (PPS) and the Natural Heritage Reference Manual)

- Woodlands greater than 4.0 ha (Innisfil Creek Subwatershed has approximately 14% forest cover)

- Significant valley lands and stream corridors (including seepage, discharge and headwater areas)

2. Criteria for Identification of the “No Development or Site Alteration Areas”

The subwatershed plan identifies the following areas as requiring the most restrictive policy protection in municipal planning documents. Some of these no development areas are protected by the Oak Ridges Moraine Conservation Plan, others such as “other wetlands” go beyond the minimum protection requirements of the PPS.

- All wetlands
- 30 metres on either side of a natural water course
- Key Natural Heritage Features and Hydrologically Sensitive Features of the Oak Ridges Moraine
- Significant Natural Heritage features off the moraine that are contiguous to and part of the same “Key Features” on the ORM and are also identified by the province.
- Other Natural Heritage Features that are the most significant within the Subwatershed (Identified by the Town of New Tecumseth’s and Essa Townships Natural Heritage Strategy). ***Please note that these features will only be added to the mapping when approved by the respective municipal councils.***

APPENDIX B

Innisfil Creek Subwatershed Stream Health Report

Includes the following:

1. Water Chemistry & Pollutant Loads
2. Biological Stream Health Assessments
3. Thermal Regimes
4. Bacteriological Surveys
5. Conclusions and Discussion

APPENDIX B

Innisfil Creek Subwatershed
Stream Health Report

PLEASE NOTE: The purpose of this appendix is to provide technical support for stream health management recommendations listed in the Innisfil Creek Subwatershed Plan

This section provides detailed information related to water chemistry, pollutant loadings, biomonitoring and thermal analyses with a discussion of the analytical assumptions made. Planning implications are described in Section B.4.

B.1. Water Chemistry & Pollutant Loads

This section documents results from water chemistry sampling in the Innisfil Creek subwatershed.

The water chemistry component of the Innisfil Creek Subwatershed Study had two purposes:

1. To enable prediction of the annual total phosphorus (TP) load to the Nottawasaga River and partition that load according to contributions from Innisfil Creek and its contributing catchments (Bailey Creek, Beeton Creek, Penville Creek).
2. To determine the frequency of MOE Provincial Water Quality Objective (PWQO) exceedences and hence characterize Innisfil Creek and its major tributaries as either Policy 1 or Policy 2 receivers in relation to major metals, nutrients and ions.

B.1.1. Methodology

Six stations were designated to collect and analyze water chemistry data and flow measurements within the subwatershed (Figure B.1):

- Innisfil Creek @ Sideroad 10 (Station 1)
- Bailey Creek @ Sideroad 10 (Station 2)
- Beeton Creek @ 10th Line (Station 3)
- Beeton/Bailey Creek @ 11th Line (Station 4)
- Innisfil Creek @ Sideroad 15 (Station 5)
- Penville Creek @ 11th Line (Station 6)

Figure B.1: Water quality/flow monitoring stations. Innisfil Creek Subwatershed Study.

These stations were chosen to identify flow and water quality contribution from major tributary systems within the study area and, ultimately to derive nutrient loading estimates from various catchments within the subwatershed.

Water quality samples ("grab samples") and flow measurements were collected at regular intervals during the ice-free period in 2002 and 2003 (Table B.1). All samples were packed in ice and delivered via courier to the Ministry of the Environment lab in Rexdale immediately following collection. Analytes for each sample included: alkalinity, calcium, conductivity, hardness, dissolved solids, total solids, chloride, suspended solids, pH, magnesium, nitrite, ammonia N, total nitrogen, nitrate and nitrite, phosphate and TP.

Table B.1: Water quality sample and flow measurement collection samples. Innisfil Creek Subwatershed Study. 2002-2003.

Date	Flow Conditions	Water Quality Sampling	Flow Measurements
May 6, 2002	Spring	Yes	Yes
June 3, 2002	Spring	Yes	Yes
July 4, 2002	Baseflow	Yes	Yes
August 15, 2002	Baseflow	Yes	Yes
September 10, 2002	Baseflow	Yes	Yes
October 22, 2002	Storm Event	Yes	Yes
December 4, 2002	Unknown	Yes	No
May 5, 2003	Spring	Yes	No
June 24, 2003	Spring	Yes	Yes
July 22, 2003	Baseflow	Yes	Yes
August 13, 2003	Storm Event	Yes	Yes
September 10, 2003	Baseflow	Yes	Yes
October 16, 2003	Storm Event	Yes	Yes

B.1.2. Analytical Assumptions

When completing the analyses detailed in sections B.1.3 and B.1.4, a number of assumptions were made as follows:

- Predictions of flow averaged, TP loads for the ice free period used instantaneous phosphorus concentrations from nine of the sample runs carried out between April and December, coupled with the average flow for the ice-free period (as calculated by the arithmetic mean of nine instantaneous flow measurements for each site). This approximation of average flow included three spring flow samples, three summer baseflow samples and three summer/fall storm events. Two flow events were not included as a result of mass balance flow analyses which indicated possible erroneous results associated with difficulties in measurement of low summer baseflow
- To determine the relative contribution of TP loads from Innisfil (upstream of Penville confluence), Bailey, Beeton and Penville Creeks, instantaneous loads at the downstream stations of each system were compared.
- NH3+ concentrations were derived from MOE lab reports for total ammonia N combined with pH and instream temperature measurements. The relationship used to estimate free ammonia is given in Figure B.2

$[NH_3^+]$=(Total $[NH_3^+$ & $NH_4^+]$)/(1+10^[(0.0902-pH) + (2730/(273.2 + Temp))])
Where:
$[NH_3^+]$ is the free ammonia concentration in mg/l
$[NH_3^+$ & $NH_4^+]$ is the total ammonia N value reported by the lab in mg/l
Temp is the temperature in Celcius degrees

Figure B.2: Calculation equation for free ammonia

B.1.3. Phosphorus Loads and Nutrient Assimilation

Solute loads are defined as the mass of a given analyte carried past a given point in the channel per unit time and are usually reported in units such as mg/s or kg/year.

Our prediction of TP loading from the Innsifil Creek subwatershed to the Nottawasaga River is 10.15 kg/d based on the analysis of nine flow and water quality sampling events near the downstream termini of the Bailey Creek, Beeton Creek and Penville Creek systems as well as Innisfil Creek upstream of the Penville Creek confluence. Extrapolating, the average annual TP loading from the subwatershed to the Nottawasaga River is 3704.62 kg/y. It should be noted that this is a rough approximation of loadings based on extrapolations of means from limited instantaneous sampling conducted in support of this study.

The total ice-free period contributions to subwatershed TP loadings by catchment are approximately 48.53% from Innisfil Creek, 18.5% from Bailey Creek, 19.1% from Beeton Creek and 13.86% from Penville Creek, as shown in Figure B.3. Standardizing loads in each catchment yields predictions of mean ice-free loads as 11.59 kg/y/km^2 for Innisfil Creek, 5.68 kg/y/km^2 for Bailey Creek, 9.16 kg/y/km^2 for Beeton Creek and 8.01 kg/y/km^2 for Pennville Creek.

Contributions to TP loading varies during the year. Flow and water quality sampling were broken down into three event types for analyses: spring flow, summer baseflow and summer/fall storm events. The results of this analysis are presented in tables B.2 and B.3.

Innisfil Creek is the dominant contributor to TP loadings during spring flow conditions (62.02% of all loadings) and represents the largest contributor to loadings during summer/fall storm events (48.6% of all loadings). However, during baseflow conditions, Beeton Creek (71.19) becomes the dominant contributor to phosphorus loadings within the subwatershed. This major shift is associated with significant changes in catchment flow contributions during baseflow periods. Beeton Creek contributes approximately 73.39% of all subwatershed flows during baseflow periods as compared spring and summer/fall storm flow contribution (24.06% and 30.43%, respectively). This significant change is associated with constant baseflow inputs from the Tottenham Wastewater Treatment Plant during a period when baseflows in other catchments have declined and surface water taking for irrigation is at a maximum. Statistical analysis (ANOVA) did not indicate a significant relationship between TP concentrations and flow type.

Table B.2: Percentage contribution to total phosphorus loadings by event type.

Catchment	Spring Flow	Summer Baseflow	Summer/Fall Storm	Mean (based on total loading)
Innisfil Creek*	62.02%	13.85%	46.80%	51.67%
Bailey Creek	11.09	10.08	20.92	17.12
Beeton Creek	17.90	71.19	21.26	18.47
Penville Creek	8.99	4.88	11.01	12.72
	100.0	100.0	99.99	99.98

* upstream of Penville Creek confluence

Table B.3: Percentage contribution to flows by event type.

Catchment	Spring Flow	Summer Baseflow	Summer/Fall Storm	Mean
Innisfil Creek*	38.53%	10.41%	24.82%	36.80%
Bailey Creek	23.38	11.28	35.05	26.82
Beeton Creek	24.06	73.39	30.43	23.69
Penville Creek	14.04	4.91	9.70	12.69
	100.01	99.99	100.0	100.01
Total Flow (m^3/s)	7.839	.704	2.672	

* upstream of Penville Creek confluence

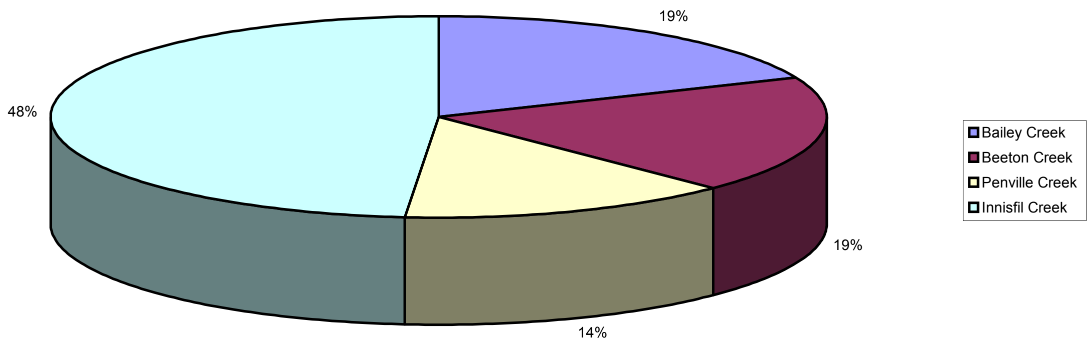


Figure B.3: Proportional total phosphorus load contributions to Innisfil Creek from the upper Innisfil Creek, Bailey Creek, Beeton Creek and Penville Creek drainages (based on mean discharge and total P concentrations).

The Provincial Water Quality Objective (PWQO) for total phosphorus in surface waters is 0.03 mg/l. Analysis of sampling station data and phosphorus exceedances is presented in Table B.4.

Table B.4: Analysis of total phosphorus concentrations at Innisfil Creek Subwatershed sampling stations.

Sampling Station	Total Samples	Total Exceedances (>0.03 mg/l)	Mean (mg/l)
Bailey Creek @ 10	13	7 (53.8%)	.0195
Beeton Creek @ 10	13	12 (92.3%)	.039
Beeton/Bailey @ 11	11	10 (90.9%)	.054
Penville Creek @11	13	10 (76.9%)	.061
Innisfil Creek @ 15	13	12 (92.3%)	.085
Innisfil Creek @ 10	13	13 (100%)	.052

TP exceedances were observed in more than 90% of samples at four of the six sampling stations. The Bailey Creek station was the only sampling site where exceedences were observed in roughly half of all samples. Similarly, it was the only sampling station where the mean TP concentration was less than the PWQO. Statistical analysis (ANOVA) indicates that total phosphorus concentrations at the Bailey Creek station are significantly less than all other sampling stations in the subwatershed. No statistically significant relationship was observed between the other stations.

There are MOE regulatory implications associated with phosphorus. The downstream portions of Innisfil Creek and its contributing tributaries must be considered “Policy 2” receivers since, even at base flow, TP frequently exceeds the PWQO at all water quality monitoring sites. Regulatory implications include:

- All reasonable measures shall be taken such that water quality meets PWQO.
- Where new or expanded discharges are proposed, no further degradation will be permitted and all practical measures shall be undertaken to upgrade water quality.

In order to meet regulatory objectives, more detailed TP sampling and modelling are required to determine phosphorus sources and a suitable remedial strategy for the Innisfil Creek subwatershed.

B.1.4. Spatial Trends in Water Chemistry

Summary statistics for each sampled parameter over the 2002 and 2003 sampling seasons are provided in Table B.5.

Table B.5: Mean analyte concentrations (unweighted arithmetic means and standard deviation) at each of the six sampling stations within the Innisfil Creek subwatershed during the 2002 and 2003 sampling seasons. Units are mg/l, µS/cm (conductivity), mg/l as $CaCO_3$ (alkalinity) or none (pH).

Parameter		Bailey Creek @ Sideroad 10	Beeton Creek @ 10th Line	Beeton-Bailey @ 11th Line	Penville Creek @ 11th Line	Innisfil Creek @ Sideroad 15	Innisfil Creek @ Sideroad 10
Chloride	mean s	33.75 3.4648	47.95 6.1518	41.1 1.4142	77.2 18.9505	73.7 15.9806	58.05 9.1217
Calcium	mean s	89.75 15.9099	76.5 9.4752	80.6 11.8794	76.4 6.5054	90.4 10.1823	87.55 12.7986
Magnesium	mean s	13.25 0.495	14.85 0.0707	14.45 .3536	15.9 1.2728	15.05 0.0707	14.6 0
Hardness	mean s	279 42.4264	252 24.0416	261 31.11	256 11.3137	288 25.4558	278.5 31.8198
Suspended Solids	mean s	4.95 2.8991	14.6 1.9799	25.05 0.2121	10.1 3.677	36.4 9.051	29.65 15.7685
Total Solids	mean s	375 41.0122	393.5 3.5355	396.5 14.8492	465.5 30.4056	492 31.1127	452 11.3137
Dissolved Solids	mean s	370.5 38.891	379 1.4142	371.5 14.8492	455.5 27.5772	455.5 21.9203	422.5 4.9497
Conductivity	mean s	570 59.397	583 2.8284	571 22.6274	701 41.0122	700.5 34.6482	650 7.0711
PH	mean s	8.2 0.0283	8.255 0.0071	8.225 0.0212	8.245 0.0071	8.245 0.0636	8.23 0.0283
Alkalinity	mean s	224.5 33.234	212.5 33.234	214 28.2842	227 29.6985	229.5 19.0919	225.5 26.163
Ammonium	mean s	0.0205 0.0247	0.039 0.0297	0.0315 0.0375	0.0155 0.0007	0.015 0.0099	0.0085 0.0007
Nitrite	mean s	0.0115 0.0106	0.0185 0.0064	0.056 0.0636	0.017 0.0085	0.019 0	0.017 0.00141
Nitrate/ Nitrite	mean s	0.9455 0.8408	1.24 0.1273	1.1125 0.4914	2.1895 2.419	1.85 1.1031	1.555 0.8697
Phosphate	mean s	0.0029 0.002	0.0039 0.002	0.0054 0.0013	0.0049 0.0054	0.0062 0.0059	0.0049 0.0033
Total P	mean s	0.0195 0.005	0.039 0.0099	0.054 0.0028	0.0385 0.0318	0.0585 0.0375	0.052 0.0283
Total N	mean s	0.62 0.0849	0.63 0.0424	0.685 0.1344	0.595 0.1344	0.845 0.0636	0.69 0.0707

Spatial variance in Innisfil Creek's mean analyte concentrations (grouped as "high range", "mid-range" and "low range" parameters) are shown in figures B.4-B.6.

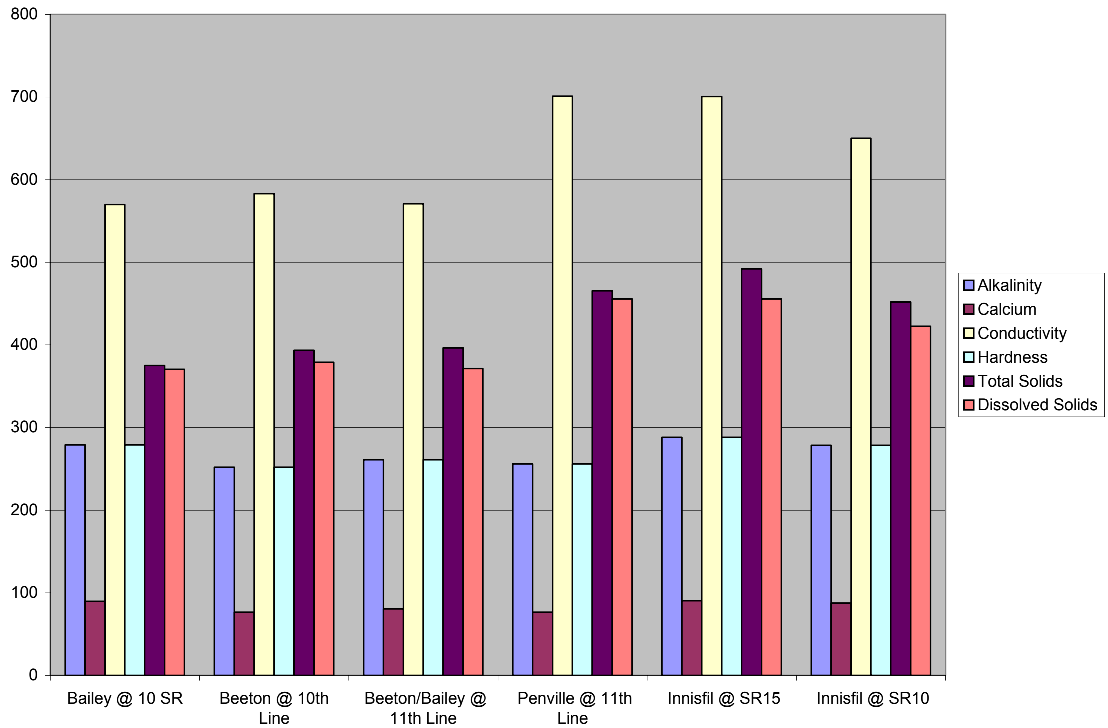


Figure B.4: High range analyte spatial trend analysis (means). Y-axis units are in mg/l, µS/cm (conductivity), and "mg/l as $CaCO_3$" (alkalinity)

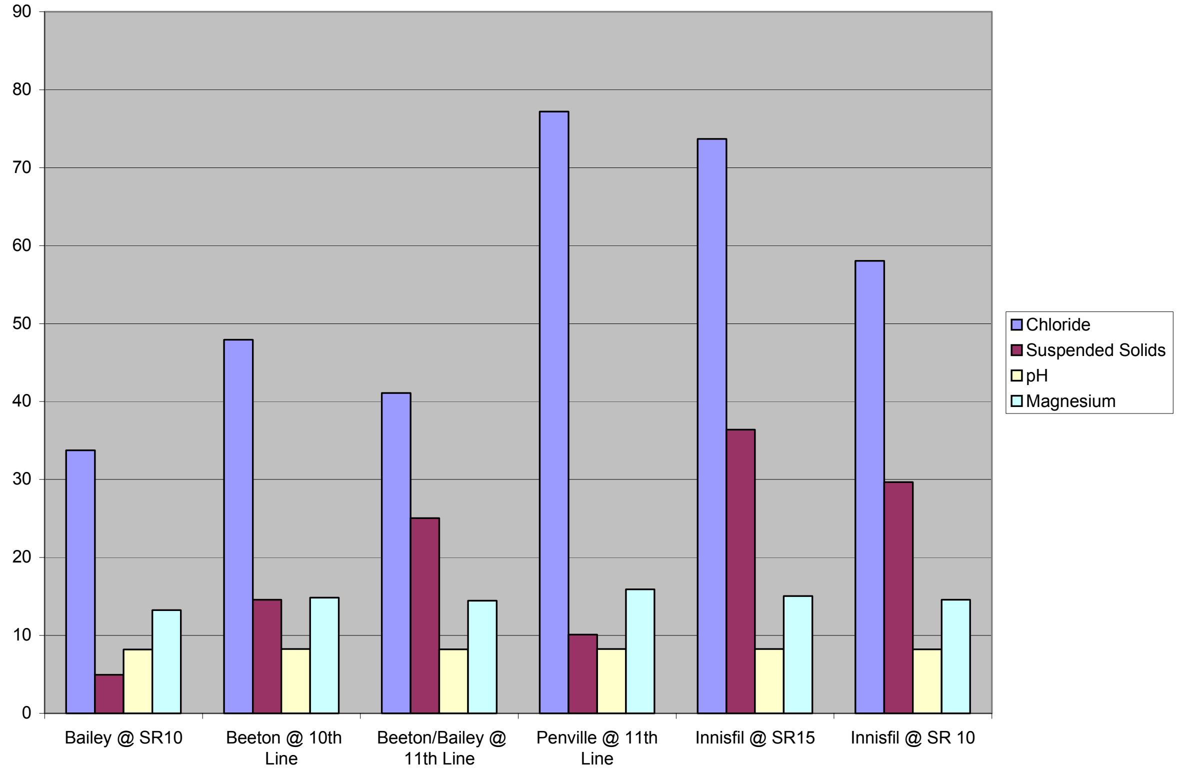


Figure B.5: Mid-range analyte spatial trend analysis (means). Y-axis units are in mg/l or are dimensionless (pH).

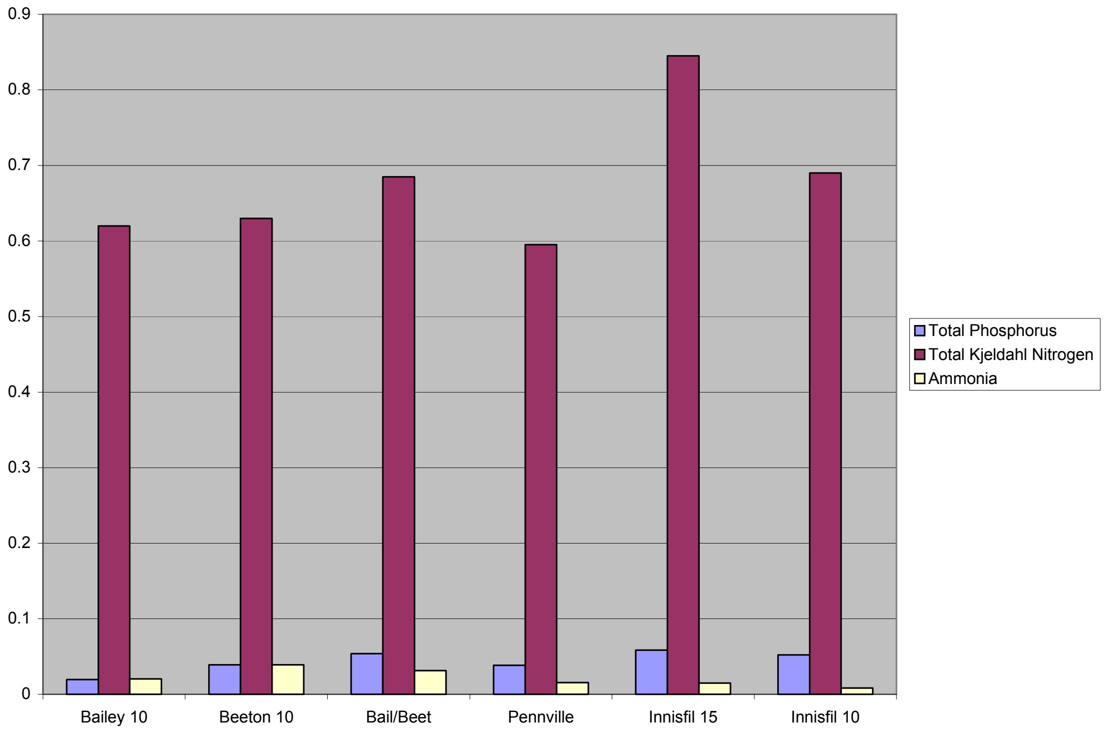


Figure B.6: Low range analyte spatial trend analysis. Trend lines reflect seasonal arithmetic means in analyte concentrations +/- 1 standard deviation. Y-axis units are in mg/l.

B.1.5. PWQO exceedences

Table B.6: Incidence of PWQO exceedences at water quality stations within the Innsifil Creek subwatershed as a percentage of all samples collected during the 2002 and 2003 sampling seasons.

Sampling Station	Total P (>0.03 mg/l)	Free Ammonia (0.02 mg/l)	Total Kjeldahl Nitrogen (0.5 mg/l)
Bailey Creek @ 10	53.8%	0%	92.3%
Beeton Creek @ 10	92.3	7.7	92.3
Beeton/Bailey @ 11	90.9	0	100
Penville Creek @11	76.9	0	100
Innisfil Creek @ 15	92.3	0	100
Innisfil Creek @ 10	100	0	100

Sampling results indicate that nutrients are the key water quality analytes of concern within the Innisfil Creek subwatershed. Although there are no formal MOE objectives for total phosphorus and total Kjeldahl nitrogen, the MOE notes that concentrations referenced in Table B.2 should not be exceeded. Exceedences of total phosphorus and total Kjeldahl nitrogen are widespread throughout the subwatershed.

Free ammonia is positively correlated with water temperature and negatively correlated with pH. This analyte can be a significant toxicant to aquatic biota at low concentrations. Within the Innisfil Creek subwatershed, only one exceedence of the PWQO was observed (Beeton Creek). Statistical analysis (ANOVA) confirmed that ammonia concentrations within Beeton Creek were significantly higher than concentrations at all other sampling stations. Inputs of ammonia associated with the Tottenham Wastewater Treatment Plant are likely associated with this finding.

CATCHMENT SUMMARY

The following conclusions can be reached based on analyses of water quality sampling data. Water quality impairments (excessive nutrients) are associated with all tributaries of Innisfil Creek; however, discharge from Bailey Creek has the highest quality of the four main catchments that discharge into Innisfil Creek. Total phosphorus concentrations in Bailey Creek are significantly lower than concentrations in downstream portions of Beeton Creek, Penville Creek and Innisfil Creek (upstream of Penville Creek). Statistical analysis (ANOVA) also indicates that chloride concentrations in Bailey Creek are significantly lower than in the other watercourses. Conductivity and total solids in Bailey Creek are also significantly lower than in Penville and Innisfil Creek.

Beeton Creek has significantly lower concentrations of total phosphorus and chlorides than Innisfil Creek. Conductivity is also significantly lower than Innisfil Creek. A weak pattern suggests that water quality is better in Beeton Creek in comparison to Penville Creek; however, this pattern is not statistically significant. Beeton Creek has significantly higher levels of free ammonia than the other watercourses discharging to Innisfil Creek that may occasionally stress aquatic biota, particularly during periods of elevated instream temperatures during the summer months. These higher concentrations are likely associated with discharge of effluent from the Tottenham Wastewater Treatment Plant.

Penville Creek and Innisfil Creek are similarly impaired and have the highest concentrations of nutrients and total solids within the subwatershed. Statistical analysis indicates that ammonia concentrations in Penville Creek are significantly higher than those in Innisfil Creek; however, free ammonia concentrations in both systems are well below PWQO.

B.2. Biological Stream Health Assessments

Biological monitoring was borne out of the concept that the biotic community at a site is a useful indicator of site habitat and water quality. Benthic (bottom dwelling) invertebrates are particularly useful indicators since they are diverse, relatively abundant and easy to sample and exhibit a wide range of tolerances to environmental conditions. Furthermore, they are relatively immobile and are subject to the full range of water quality conditions within a watercourse reach. Poor water quality conditions that may be missed by conventional water quality sampling that is typically restricted to random, instantaneous measurements will be reflected within the benthic community. Benthos biomonitoring has been used in many studies to:

- Establish baseline water quality conditions prior to development or other land use change (various community indicators and analytical approaches can then be used to detect changes over time to habitat and water quality)
- Provide early warning of potential impacts to fisheries
- Diagnose the magnitude, range of effect and cause of impairments to the aquatic system

B.2.1. Methodology

Benthic invertebrate assessments were undertaken at 25 different sites within the subwatershed between 1996 and 2002.

The rationale for locating sampling sites as indicated above was based upon:

- Proximity to likely growth centres
- Nodes marking likely transitions in physiographic potential or human impact
- Existing or proposed Healthy Water Program project sites
- Integration with existing/proposed sampling locations collecting other types of data (e.g. flow, water chemistry, etc)
- Suitability as long-term reference sites

Benthic invertebrate samples at riverine sites were collected using the NVCA reference site protocol. Quantitative collections were obtained using a T-sampler or A-frame net with 600 μm mesh. Quantitative collections were made by sampling all types of aquatic habitats present at a site in order to generate a representative taxa list. Invertebrates were sorted "live" and subsequently preserved in Ethanol to permit enumeration, identified to "lowest practical level" and archived for future reference.

B.2.2. Definition

Stream health, as indicated by BioMAP indices, is a measure of how closely a stream's habitat, water quality and living community match its historical and physiographic potential. We are able to evaluate a site's potential by comparing it to "pristine" or "minimally impacted" streams (reference sites) that share similar physiological and historic attributes such as soil types, substrate, gradient, temperature and groundwater flows. "Impaired" reaches are those where sample communities diverge markedly from expectations based on physiographic potential. Reaches are considered "unimpaired" if their biological community agrees with our expectation based on physiography and minimally impacted reference sites. Stream reaches are considered "below potential" if there is some divergence from our expectation but the community retains elements of its historical biota.

B.2.3. Results

Benthic invertebrate data summaries of Innisfil Creek and its tributaries, as sampled between 1996-2002, are shown in Table B.7.

Table B.7: Benthic invertebrate data for Biomonitoring Sites within the Innisfil Creek Subwatershed

No.	Station Identifier	Date	WQIq	WQId	Substrate	Status
1	Beeton Creek @ Concession 10 New Tecumseth	25/10/1996	2.5	6.33	Sand	Impaired
1	Beeton Creek @ Concession 10 New Tecumseth	23/05/1997	2.79	4.84	Sand	Impaired
1	Beeton Creek @ Concession 10 New Tecumseth	30/10/1997	2.79	6.94	Sand	Impaired
2	Beeton Creek @ Concession 11 New Tecumseth	24/05/1998	2.63	5.96	sand	Impaired
3	Beeton Creek @ Concession 2 New Tecumseth	11/05/1998	3.28	16.94	sand, gravel, woody debris	Unimpaired
4	Beeton Creek @ Concession 4 New Tecumseth	11/05/1998	3	9.15	gravel, sand, silt	Impaired
5	Beeton Creek @ Concession 6 New Tecumseth	23/05/1997	2.82	6.57	sand	Impaired
5	Beeton Creek @ Concession 6 New Tecumseth	19/10/2001	3	11.62	gravel/sand/cobble	Impaired
6	Beeton Creek Tributary @ 4th Line - just East of Tottenham	19/10/2001	3	4.08	gravel, cobble, sand, silt	Impaired
7	Bethesda Creek - Innisfil Creek Trib. @ 5th sdrd (N of 3rd line)	18/10/2001	3.5	21.43	cobble/gravel	Unimpaired
8	Cookstown Creek - 13th Line New Tecumseth	10/11/2000	2.75	5.55	Sand	Impaired
9	Cookstown Creek - 5th sdrd - W of Innisfil/Essa Townline	19/10/2001	3.14	10.96	gravel/sand/boulders	Impaired
10	Cooney Property - Beeton Creek @ Cty rd 10	24/05/2001	3	8.59	sand/gravel	Below potential
11	Jebb Property - Upper Innisfil Creek	17/10/2002	2	3.9	Clay, silt	Impaired
12	Innisfil Creek @ Highway 27	29/05/1997	2.79	5.67	sand/gravel	Impaired
12	Innisfil Creek @ Highway 27	18/10/1998	2.32	11.61	sand/silt	Impaired
13	Innisfil Creek @ Sideroad 10 New Tecumseth	16/06/1997	2.8	4.15	sand/silt	Impaired
13	Innisfil Creek @ Sideroad 10 New Tecumseth	17/10/1997	2.8	2.63	sand/silt	Impaired
13	Innisfil Creek @ Sideroad 10 New Tecumseth	22/05/1998	2.79	5.28	sand, silt	Impaired
13	Innisfil Creek @ Sideroad 10 New Tecumseth	29/10/1998	2.79	5.96	sand, silt	Impaired
13	Innisfil Creek @ Sideroad 10 New Tecumseth	11/05/1999	2.77	4.13	Sand, silt	Impaired
13	Innisfil Creek @ Sideroad 10 New Tecumseth	01/11/1999	2	2.56	Sand, silt	Impaired
13	Innisfil Creek @ Sideroad 10 New Tecumseth	16/05/2000	1.5	2.15	Sand, silt	Impaired
13	Innisfil Creek @ Sideroad 10 New Tecumseth	16/10/2000	3	8.81	Sand, silt	Impaired
13	Innisfil Creek @ Sideroad 10 New Tecumseth	22/05/2001	3	6.55	Sand, silt	Impaired
13	Innisfil Creek @ Sideroad 10 New Tecumseth	25/10/2001	3	3.98	Sand, silt	Impaired
13	Innisfil Creek @ Sideroad 10 New Tecumseth	25/10/2002	3	9.34	Sand, silt	Impaired
14	Innisfil Creek Tributary - 5/6 Sideroad BWG	10/11/2000	2	3.22	Sand/Silt	Impaired
15	Innisfil Creek Tributary @ 10 sdrd/ 5th Line	18/10/2001	3.8	24.49	cobble,gravel	Unimpaired
16	Innisfil Creek Tributary @ 13th Line - West of 5th sdrd, BWG	19/10/2001	3	14.4	gravel, silt, some sand	Below potential
17	Innisfil Creek Trib. @ 5th Line Innisfil - (East of 10th sdrd)	18/10/2001	2	1.98	sand	Impaired
18	New Tech Sewage Site #1 - approx. 300m d/s of sewage outlet	23/05/2002	3	9.72	Sand, gravel	Below potential
18	New Tech Sewage Site #1 - approx. 300m d/s of sewage outlet	24/10/2002	2.83	7.37	Sand, gravel	Below potential
19	New Tech Sewage Site #2 - approx. 150m d/s of sewage outlet	23/05/2002	3.25	7.57	Sand, gravel	Below potential
19	New Tech Sewage Site #2 - approx. 150m d/s of sewage outlet	24/10/2002	2.86	6.73	Sand, gravel	Below potential
20	New Tech Sewage Site #3 - approx. 70m u/s of sewage outlet	23/05/2002	3	10.51	Sand, gravel	Below potential
20	New Tech Sewage Site #3 - approx. 70m u/s of sewage outlet	24/10/2002	3	8.39	Sand, gravel	Below potential
21	Nottawasaga River @ Concession 13 New Tecumseth	16/06/1997	3.11	11.5	sand, gravel, cobble	Below potential
21	Nottawasaga River @ Concession 13 New Tecumseth	09/10/1997	3.11	16.13	sand, gravel, cobble	Below potential
21	Nottawasaga River @ Concession 13 New Tecumseth	22/05/1998	3.15	12.59	sand, gravel, cobble	Below potential
21	Nottawasaga River @ Concession 13 New Tecumseth	29/10/1998	3.15	16.14	sand, gravel, cobble	Below potential
21	Nottawasaga River @ Concession 13 New Tecumseth	11/05/1999	3.18	8.86	gravel, cobble, boulder, sand	Below potential
21	Nottawasaga River @ Concession 13 New Tecumseth	01/11/1999	3.2	10.23	gravel, cobble, boulder, sand	Below potential
21	Nottawasaga River @ Concession 13 New Tecumseth	16/05/2000	3	9.81	Sand, gravel	Unimpaired
21	Nottawasaga River @ Concession 13 New Tecumseth	16/10/2000	3.13	16.84	Sand, gravel	Unimpaired
21	Nottawasaga River @ Concession 13 New Tecumseth	22/05/2001	3	8.97	gravel, cobble, boulder, sand	Below potential
21	Nottawasaga River @ Concession 13 New Tecumseth	25/10/2001	3.13	15.7	gravel, cobble, boulder, sand	Unimpaired

22	Nottawasaga River @ Concession 14 New Tecumseth	09/06/1997	2.63	7.67	sand	Impaired
22	Nottawasaga River @ Concession 14 New Tecumseth	07/10/1997	2.63	2.77	sand	Impaired
22	Nottawasaga River @ Concession 14 New Tecumseth	19/05/1998	2.56	4.09	sand, gravel	Impaired
22	Nottawasaga River @ Concession 14 New Tecumseth	27/10/1998	2.56	3.43	sand, gravel	Impaired
22	Nottawasaga River @ Concession 14 New Tecumseth	18/05/1999	2.9	4.19	sand, silt, gravel	Impaired
22	Nottawasaga River @ Concession 14 New Tecumseth	19/10/1999	2.36	2.76	sand, silt, gravel	Impaired
22	Nottawasaga River @ Concession 14 New Tecumseth	16/05/2000	3.33	2.1	Sand, silt, coarse gravel	Impaired
22	Nottawasaga River @ Concession 14 New Tecumseth	16/10/2000	3	10.6	Sand, silt, coarse gravel	Impaired
22	Nottawasaga River @ Concession 14 New Tecumseth	13/11/2001	3.2	4.36	sand, silt	Impaired
23	Nottawasaga River @ Simcoe Road 10	16/06/1997	3.06	10.88	sand, gravel	Below potential
23	Nottawasaga River @ Simcoe Road 10	17/10/1997	3.06	15.75	sand, gravel	Below potential
23	Nottawasaga River @ Simcoe Road 10	24/05/1998	3.07	11.31	sand, gravel	Below potential
23	Nottawasaga River @ Simcoe Road 10	29/10/1998	3.07	12.57	sand, gravel	Below potential
23	Nottawasaga River @ Simcoe Road 10	11/05/1999	3.29	8.9	Gravel	Below potential
23	Nottawasaga River @ Simcoe Road 10	01/11/1999	3.1	10.8	Gravel	Below potential
23	Nottawasaga River @ Simcoe Road 10	16/05/2000	3.2	13.99	Fine gravel, sand	Unimpaired
23	Nottawasaga River @ Simcoe Road 10	16/10/2000	3.14	13.95	Fine gravel, sand	Unimpaired
23	Nottawasaga River @ Simcoe Road 10	22/05/2001	3.17	14.02	Fine gravel, sand	Unimpaired
23	Nottawasaga River @ Simcoe Road 10	25/10/2001	3.14	14.21	gravel, sand	Unimpaired
23	Nottawasaga River @ Simcoe Road 10	25/10/2002	3	15.29	gravel, sand	Unimpaired
24	Penville Creek @ Concession 10 New Tecumseth	18/10/1996	2.4	4.21	sand	Impaired
24	Penville Creek @ Concession 10 New Tecumseth	23/05/1997	2.2	3.53	sand, silt	Impaired
25	Penville Creek @ Concession 6 New Tecumseth	03/06/1999	2.82	6.46	gravel, silt/clay	Impaired

No. – Station Number as Shown on Stream Health Classification Map.
Station Identifier – General Location of Biomonitoring Site.
Date – Sampling Date.
WQId – Water Quality Index (quantitative) - The overall quantitative BioMAP rating for the site. This is a representation of the numbers (density) of invertebrates at the site. Though rating is primarily based on the potential of a site, a general guideline when examining WQId ratings is: 25 or more = Excellent, 20-24 = Very Good, 15-29 = Good, 10-14 is below average, less than 9 = poor.
WQIq – Water Quality Index (qualitative) – The overall qualitative BioMAP rating for the site. This is a representation of the species diversity found in the sample. Though rating is primarily based on the potential of a site, a general guideline when examining WQIq ratings is: 4 = Excellent, 3.5 – 3.9 = Very Good, 2.5 – 3.4 = Good, less than 2.4 is poor.
Substrate – The representative substrate at the biomonitoring site. The type of substrate plays a key role in the biological potential of a site. A sand or clay substrate *may* indicates a channelized or dredged site and is considered poor habitat for a diverse aquatic ecosystem.
Status – The overall status designated to a site after a complete bioassessment.

B.2.6. Stream Health Classification

Figure B.7 provides a stream health classification scheme based on a synthesis of all bioassessment data collected.

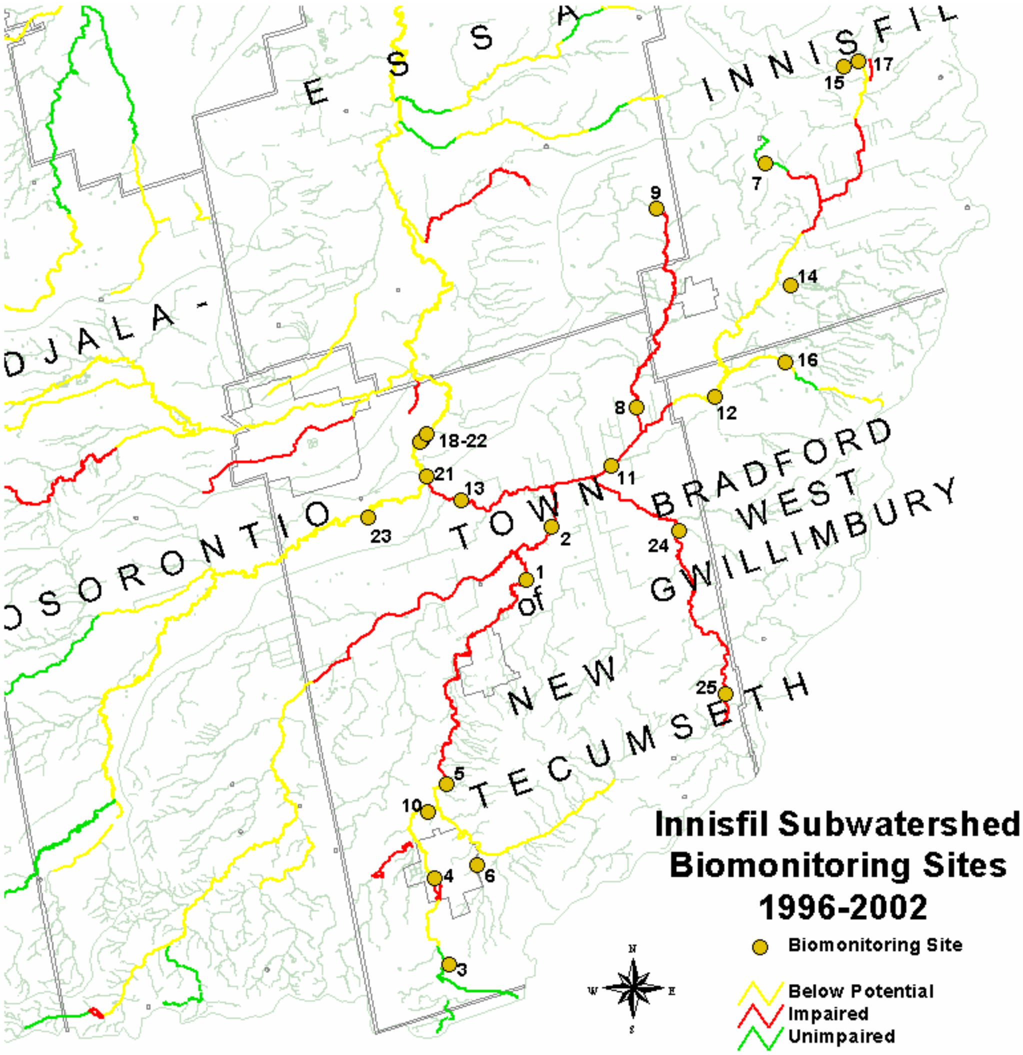


Figure B.7: Biological stream health classification showing reaches designated as "Impaired", "Unimpaired" and "Below Potential" based on benthic invertebrate assessments. Unclassified stream reaches are shown in grey.

Innisfil Creek is considered unimpaired only in its headwaters near Bethesda and downstream of Pinkerton. East of Highway 400, stream reaches considered below potential are present in the Pinkerton area and in the area northwest of Churchill. West of Highway 400, the main branch of Innisfil Creek is classified as below potential downstream to its confluence with Cookstown Creek. Sections of the main branch east of Highway 400, Cookstown Creek, and the main branch downstream of Cookstown Creek are all considered impaired.

Bailey Creek is considered unimpaired from its headwaters near Connor and Cedarville downstream to Keenansville. Reaches from Keenansville downstream past Loretto are considered below potential while reaches extending from this point downstream to the confluence with Beeton Creek are considered impaired.

The headwater reaches of Beeton Creek near Black Horse and Tecumseth Pines are considered unimpaired. Downstream of the headwaters to Tottenham, Beeton Creek is below potential. From Tottenham downstream to its confluence with Bailey Creek, Beeton Creek is considered to be an impaired system.

The assessed portion of Penville Creek, downstream of 6th Line, is considered to be impaired.

B.3. Thermal Regimes

B.3.1 Methodology

An intensive study of spatial variation in thermal regime at the reach level was completed in the Innisfil Creek subwatershed during summer 2002 and 2003. Dataloggers were installed at a number of locations (as shown in figures B.8 and B.9 and described in tables B.8 and B.9) during the months of July and August. Water temperatures were recorded every half hour. Less formal temperatures "runs" were conducted in the Bailey Creek, Beeton Creek, Penville Creek and Innisfil catchments between 1998 and 2004 to supplement datalogger monitoring.

Thermal classifications were assigned according to Stoneman and Jones' (1996) protocol. In the case of temperature logger data, datapoints collected during the critical 16:00 to 17:00 period were extracted and screened for air temperature and precipitation effects to permit classification (weather data from the nearest Environment Canada Station was used for this purpose). In the case of volunteer spot temperature data, thermometers were calibrated to 0^{o}C and 100^{o}C prior to the sampling season.

Figure B.8: Temperature datalogger sampling locations, Beeton Creek (left) and Innisfil Creek (right), summer 2002.

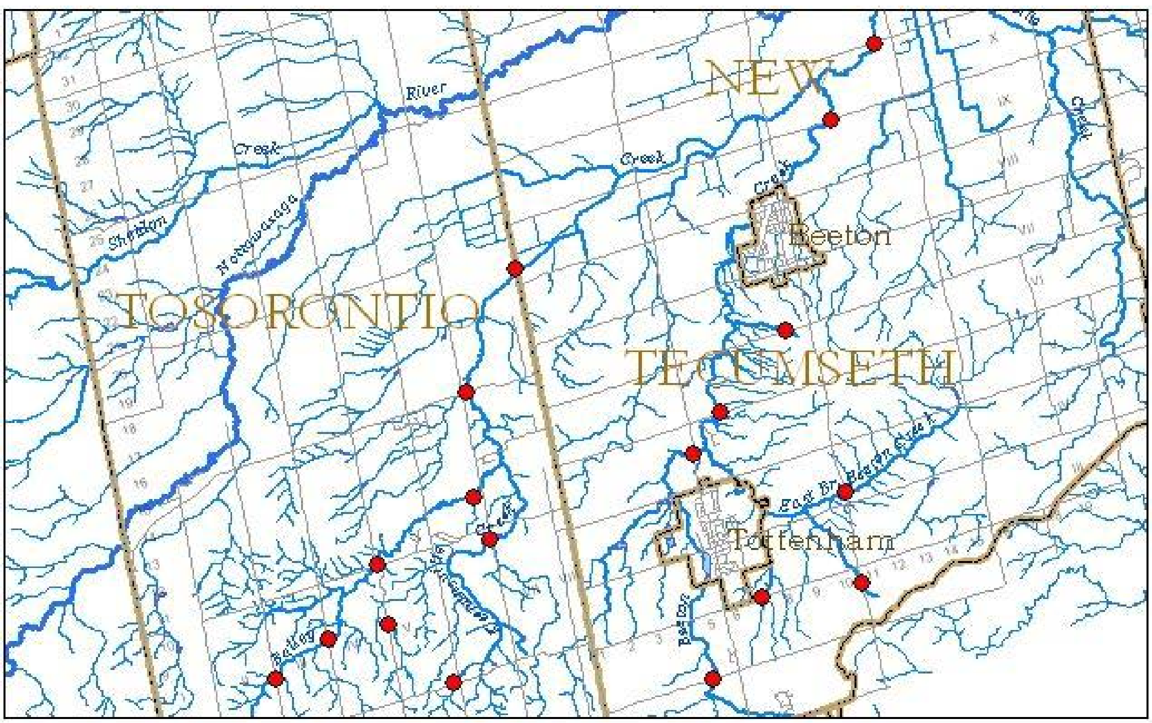


Figure B.9: Temperature datalogger sampling locations, Bailey Creek and Beeton Creek, summer 2003.

Table B.8: Thermal Classification based on continuous datalogger records from summer 2002

Site	Thermal Classification
Beeton Creek, East Branch @ Sideroad 10	Warm
Beeton Creek, East Branch @ 5th Line	Warm
Beeton Creek @ 6th Line	Warm
Beeton Creek, West Branch @ Simcoe Road 10	Warm
Beeton Creek, West Branch @ 4th Line	Cool
Bethesda Creek (Innisfil trib.) @ Conc. 3	Cool
Innisfil Creek @ Conc. 3	Unknown (lost)
Innisfil Creek @ 4th Line	Warm
Innisfil Creek @ 5th Line (east)	Cold
Innisfil Creek @ 5th Line (west)	Cool

Table B.9: Thermal classification based on continuous datalogger records from summer 2003

Site	Thermal Classification
Bailey Creek @ Sideroad 5 west of Hwy. 50 (Adj.-Tos.)	Cold
Bailey Creek @ 3rd Line north of Sideroad 5 (Adj.-Tos.)	Cool
Bailey Creek @ 4th Line south of Sideroad 10 (Adj.-Tos.)	Cool
Bailey Creek @ 5th Line north of Sideroad 5 (Adj.-Tos.)	Cool/cold
Bailey Creek @ Sideroad 10 and 5th Line (Adj.-Tos.)	Warm
Bailey Creek @ 7th Line south of Sideroad 10 (Adj.-Tos.)	Warm/cool
Bailey Creek @ 7th Line north of Sideroad 10 (Adj.-Tos.)	Cool/warm
Bailey Creek @ County Road 1 east of 7th Line (Adj.-Tos.)	Warm
Bailey Creek @ Townline north of 9th Line (AT/New Tec.)	Warm
Beeton Creek @ 6th Line east of County Rd. 10 (New Tec.)	Warm
Beeton Creek @ County Rd. 10 south of 6th Line	Cool/warm
Beeton Creek (East Branch) @ Sideroad 10 north of 4th Line	Cool/warm
Beeton Creek (tributary) @ 3rd Line east of Tottenham Road	Cool
Beeton Creek @ 2nd Line west of Tottenham Road	Cool
Beeton Creek (tributary) @ Sideroad 10 south of 3rd Line	Cool
Beeton Creek (tributary) @ 7th Line west of 10th Sideroad	Cold
Beeton Creek @ 10th Line	Warm
Bailey/Beeton Creek @ 11th Line (New Tec.)	Warm

B.3.2. Water Temperature Results

The results of datalogger and spot temperature analyses are shown on Map B 10 **(Please see the accompanying Acrobat document Map B.10- Instream Temperature Regimes**). It is important to note that, in most situations, there is a gradual transition from coolwater to warmwater thermal regimes. Localized areas of groundwater discharge, where present, can provide refugia for coldwater biota (i.e. salmonids) even in warmwater reaches.

Beeton Creek is characterized by a coolwater thermal regime downstream to 4^{th} Line with a transition to a warmwater regime occurring between the outlet of the Tottenham Reservoir and 6^{th} Line. Small tributaries emanating from the Oak Ridges Moraine and the upland area south of Beeton are fed by groundwater discharge and support coldwater/coolwater temperature regimes which, in turn, moderate temperature regimes in the main branch. The middle and upstream portions of the east branch of Beeton Creek support a transitional coolwater/warmwater temperature regime.

The headwaters of Innisfil Creek (5^{th} Line station, Bethesda tributary and middle reaches of Cookstown Creek) are characterized by coolwater thermal regimes but rapidly grade to warmwater thermal regimes through downstream agricultural reaches. Localized areas of groundwater discharge appear to provide small areas of refugia within warmwater reaches of Innisfil Creek downstream to Highway 400.

Within Bailey Creek, coolwater regimes extend downstream to 5^{th} Line (Adjala-Tosorontio) with a transitional zone extending downstream to 7^{th} Line. Small tributaries of Bailey Creek, emanating from the Oak Ridges Moraine, are fed by groundwater discharge and support coldwater/coolwater temperature regimes which, in turn, moderate temperature regimes in the main branch. A warmwater temperature regime extends on Bailey Creek from 7^{th} Line downstream to its confluence with Beeton Creek.

The headwaters of Penville Creek and its upstream tributaries support coolwater habitat. Downstream of its headwaters, lack of riparian cover contributes to warmwater habitat conditions which persist downstream to its confluence with Innisfil Creek.

B.4. Bacteriological Surveys

In contrast to water quality methods that are used as indicators of stream health, bacteriological sampling is used to provide an indicator of human health risks associated with recreational or consumptive water use.

B.4.1 Methodology

Bacteriological samples were collected using a grab sampling technique during NVCA sampling undertaken from July to September from 1994 to 1998 **(Please see the accompanying Acrobat document Map B.11- Bacteriological Sample Sites)**. Samples were analyzed at the MOE lab in Rexdale. Results of bacteriological sampling are provided in Table B.10

Stream Name	Road Crossing	Date	*E. coli* (geometric mean)
Bailey Creek	Sideroad 10	Aug-Sept/96	483
Bailey Creek	Weber Farm	Jun-Jul/94	537
Bailey Creek	Weber Farm	Jul-Aug94	246
Beeton Creek	6th Line	Jun-Jul/94	544
Beeton Creek	6th Line	Jul-Aug/94	559
Beeton Creek	6th Line	Aug-Sept/94	215
Beeton Creek	2nd Line	Jun-Jul/94	46
Beeton Creek	2nd Line	Jul-Aug94	47
Beeton Creek	2nd Line	Aug-Sept/98	477
Beeton Creek	3rd Line	Jun-Jul/94	95
Beeton C reek	3rd Line	Jul-Aug/94	83
Beeton Creek	Upstream of Tott. reservoir	Jun-Jul/94	155
Beeton Creek	10/11 Sideroad	Jun-Jul94	283
Beeton Creek	10th Line	Aug-Sept/96	418
Beeton Creek	11th Line	Jul-Aug/97	190
Beeton Creek	Simcoe Road 14	Aug-Sept/8	182
Innisfil Creek	12th Line	Jun-Jul/94	1112
Innisfil Creek	12th Line	Jul-Aug/94	863
Innisfil Creek	12th Line	Aug-Sept/94	639
Innisfil Creek	Sideroad 10	Aug-Sept/96	455
Innisfil Creek	Sideroad 10	Jul-Aug/97	294
Innisfil Creek	Sideroad 20	Aug-Sept/96	492
Penville Creek	11th Line	Aug-Sept/96	1176
Penville Creek	11th Line	Jul-Aug/97	802

Table B.10 Bacteriological data collected from 1994 to 1998.

Based on the geometric mean of five samples taken over a 30 day period, the concentration of *E. coli* should not exceed 100 organisms per 100 ml of water used for recreational purposes (MOE, 1994). The 1994-1998 sampling results indicate that bacterial pollution is highly likely at the sampled locations within the Innisfil Creek subwatershed. With the exception of samples collected in the headwaters of Beeton Creek (2nd and 3rd Line stations), all samples collected at the Bailey Creek, Beeton Creek, Innisfil Creek and Penville Creek stations exceeded the MOE objective.

B.5. Conclusions and Discussion

General Stream Health Trends

The headwaters of Bailey Creek and Beeton Creek arise from the Oak Ridges Moraine whereas the headwaters of Innisfil Creek and, to a lesser extent, Penville Creek arise within moderately steep terrain associated with the Simcoe Uplands and Peterborough Drumlin Field. Discharge through well-drained loams associated with these physiographic features combined with relatively extensive riparian cover supports healthy aquatic habitat in most of the headwater reaches of these systems (with the exception of Penville Creek). Reach-appropriate benthic assemblages are found in these areas. Thermal regimes are indicative of cool and coldwater habitat conditions which are confirmed by the presence of resident brook trout and juvenile rainbow trout (where unobstructed access to these habitats is present). Although salmonids have not been identified in Penville Creek, the presence of mottled sculpin in the upstream reaches of the watercourse indicates that potential salmonid habitat may be present, though stream health is considered impaired at this time.

As these watercourses leave the rugged terrain of their headwater areas, they enter relatively flat landscapes associated with the Schomberg Clay Plain and Simcoe Lowlands. Groundwater discharge is relatively weak through these physiographic features and riparian land use is dominated by agricultural activities including drain maintenance. Summer instream temperatures rise precipitously through this area, quickly rising above levels suitable for salmonid production. Nutrient loadings from urban and agricultural resources, combined with drain maintenance and loss of significant riparian cover, result in impaired/below potential stream health which extends downstream through Innisfil Creek and its tributary systems to the subwatershed's confluence with the Nottawasaga River.

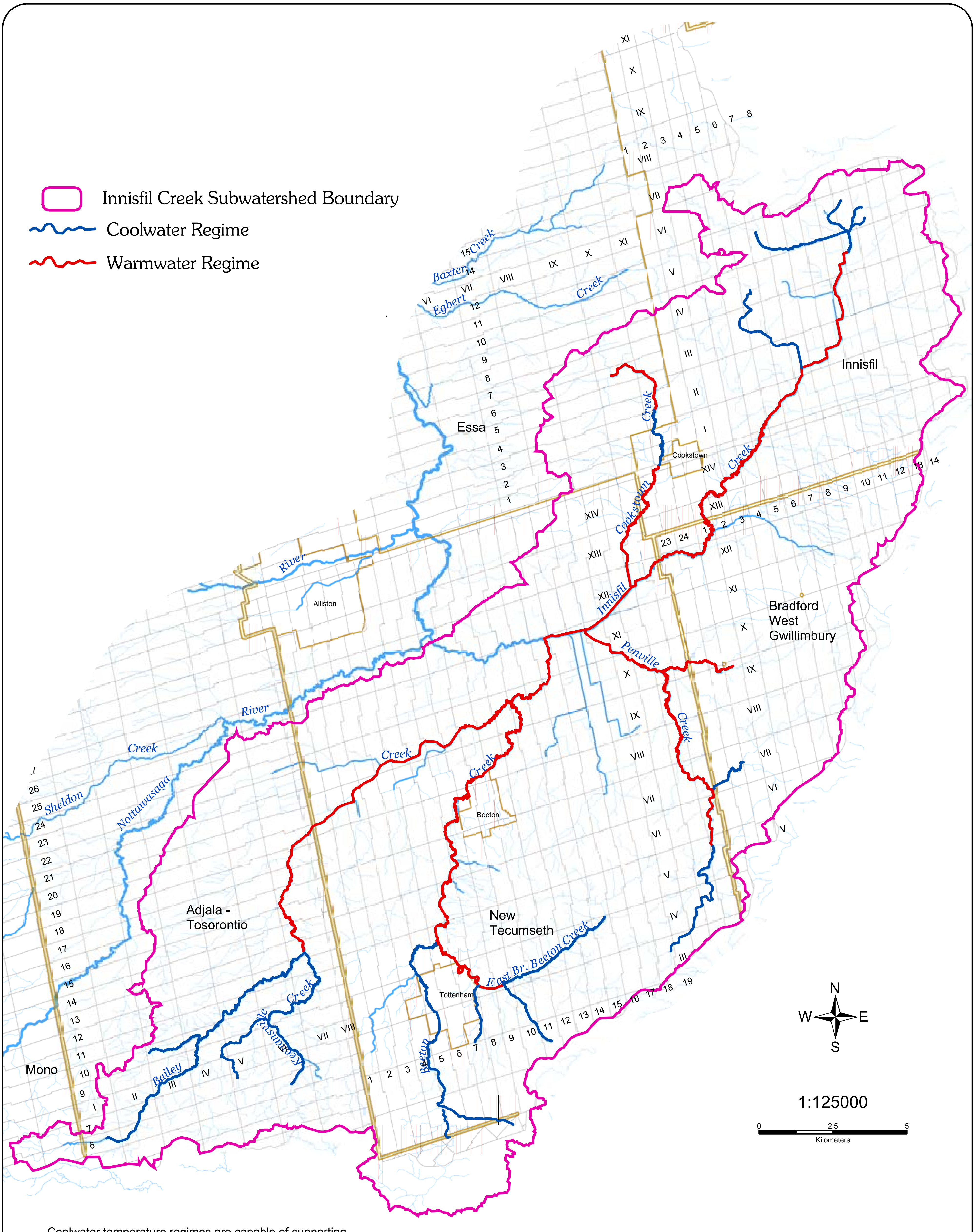
Phosphorus is a key analyte of concern within the Innisfil Creek subwatershed with TP concentrations generally exceeding PWQOs in the downstream portions of the major catchments under both baseflow and storm conditions. Although standard bacteriological monitoring protocols were not used during *E. coli* surveys in the mid 1990s, sample results indicate that *E. coli* contamination is likely present in poses a risk to human health through recreational and consumptive uses.

Summer baseflow in the downstream section of Innisfil Creek is strongly supported by discharge from Beeton Creek which contributes approximately 73% of all subwatershed flows during these baseflow periods. This significant baseflow is associated with inputs from the Tottenham Wastewater Treatment Plant during a period when baseflows in other catchments have declined and surface water taking for irrigation is at a maximum. Loss of baseflow associated with possible decommissioning of the Tottenham Wastewater Treatment Plant would have significant impacts on baseflow in Beeton Creek and the downstream section of Innisfil Creek which could have significant impacts on agricultural water users in these areas.

Innisfil Creek Subwatershed Study

Instream Temperature Regimes

Map B.10



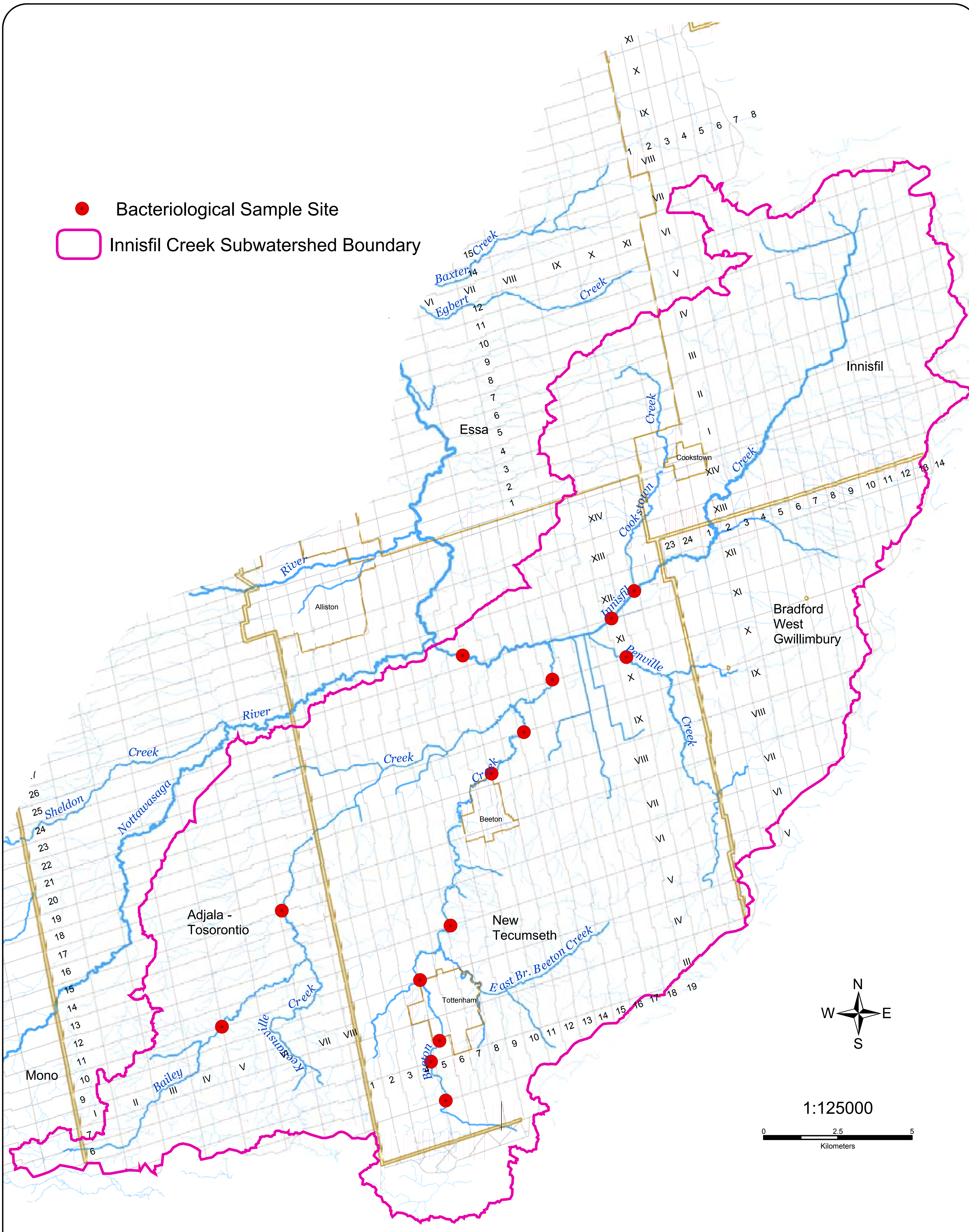
Coolwater temperature regimes are capable of supporting coldwater fish species such as trout and sculpin whereas warmwater temperature regimes support fish species that are more tolerant of elevated stream temperatures during the summer months. There are often broad transition areas between these regimes and coldwater fish species can be found in upstream portions of the warmwater reaches, particularly where small pockets of cool groundwater discharge provide refuge during the summer months.

T.DesRoches
Universal Transverse Mercator
Zone 17 North
North American Datum 1983
September, 2004
Temp_Regime.mxd

Innisfil Creek
Subwatershed Study

Bacteriolgical Sampling Sites

Map B.11

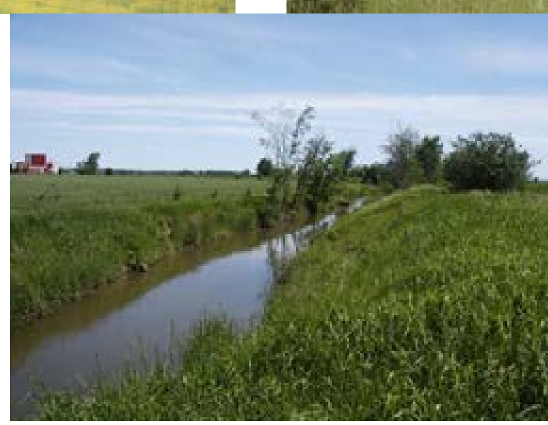


T.DesRoches
Universal Transverse Mercator
Zone 17 North
North American Datum 1983
September, 2004
Temp_Regime.mxd

Appendix C

Beeton Creek
Stream Health Report 2004





June 2004
(Revised April 2005)

Created by: *Nottawasaga Valley Conservation Authority*
Created For: New *Tecumseth Streams Committee*

Table of Contents

List of Figures

1.0 Introduction

Beeton Creek was once documented as a cool water stream providing habitat for native cold water fish species. Over many decades of misuse, land alteration and streamside vegetation removal the health of the stream and its surrounding environment has significantly depleted and will likely require time and assistance in order to re-establish itself to its natural stream health potential. The water quality of Beeton Creek has been a concern for many years and it has been repeatedly documented as an 'Impaired River System' that requires extensive rehabilitation in order to reverse these impacts.

This report summaries the physical conditions surrounding Beeton Creek, documents the current health status along the stream and also documents the restoration projects that have been completed along Beeton Creek by various partners and community groups. In addition, this report includes generalized recommendations, created while reviewing the data and information on Beeton Creek, which could be applied throughout the entire system to improve the health of the stream and increase the available data on the current stream health conditions.

This river system is just one of the many river systems that has been impacted by both urban and rural development. It is proposed that this report will assist in generating both interest and funding support in order to completely restore the degraded watercourse by re-establishing healthy stream waters as well as healthy stream corridors along Beeton Creek.

2.0 Background

The Nottawasaga River is approximately 122 km in length and drains an immediate *catchment area* of approximately 3,361 km^{2}. The catchment area is divided up into smaller drainage basins centred around the larger tributaries of the river. These smaller drainage basins are referred to as 'sub*watersheds*' and contribute to the overall stream health of the system.

Beeton Creek lies within the Innisfil Creek Subwatershed and contributes a catchment area of approximately 88 km^2. The headwaters of Beeton Creek originate within the Oak Ridges Moraine formation. Beeton Creek flows north from the Moraine through the urban communities of Tottenham and Beeton and continues throughout the municipality of New Tecumseth where it converges with Bailey Creek in the 10th Concession. Together, these waters flow north and drain into Innisfil Creek within the 12th Concession of New Tecumseth (*Figure 1*).

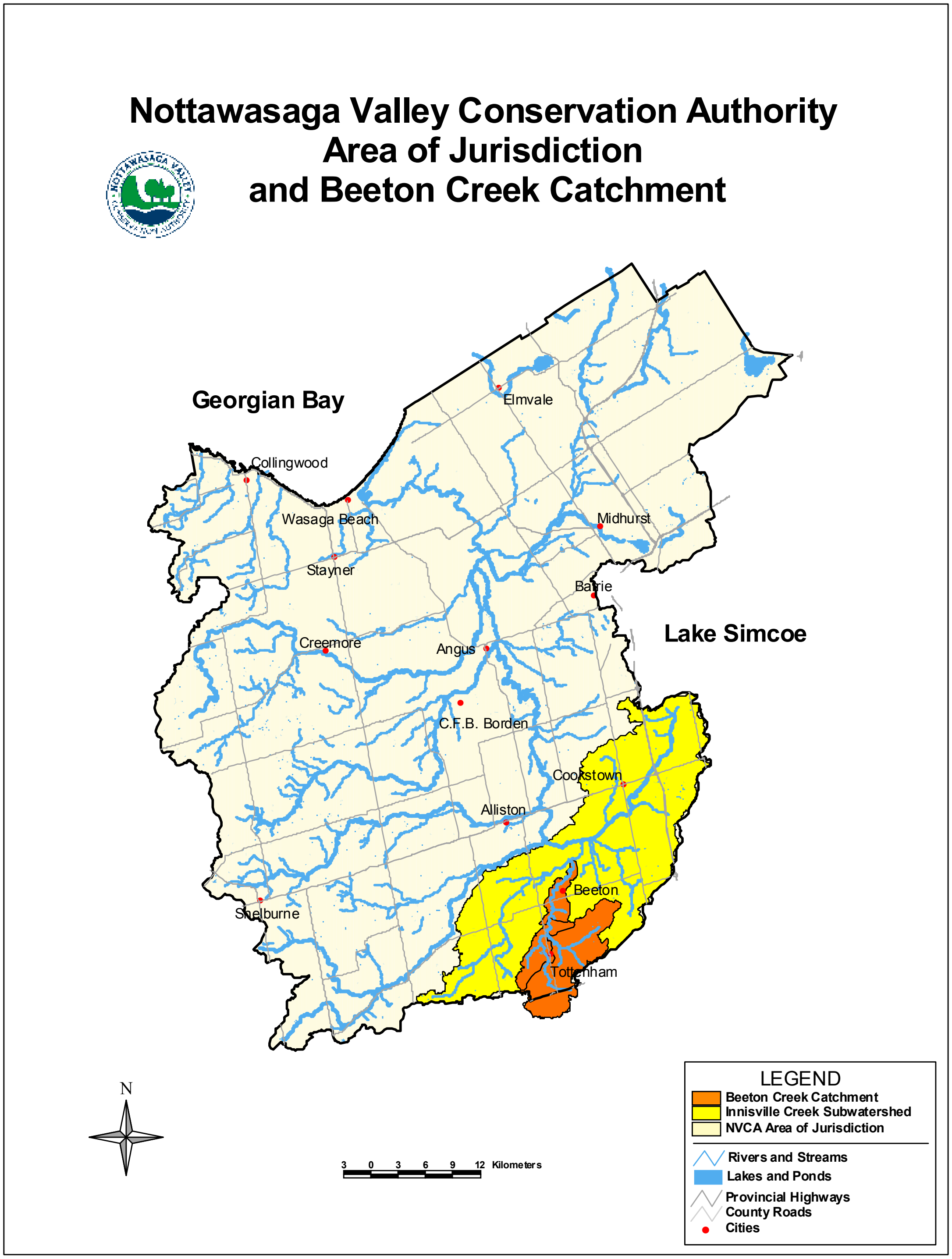


Figure 1: Nottawasaga Valley Conservation Authority area of jurisdiction highlighting the Innisfil Creek Subwatershed and the Beeton Creek study area respectively.

The municipality of New Tecumseth has felt a lot of stress from agricultural practices due to its abundance of flat, well-drained soil regions. Respectively, the majority (63.3%) of the landuse is made up by agricultural land (*Figure 2*).

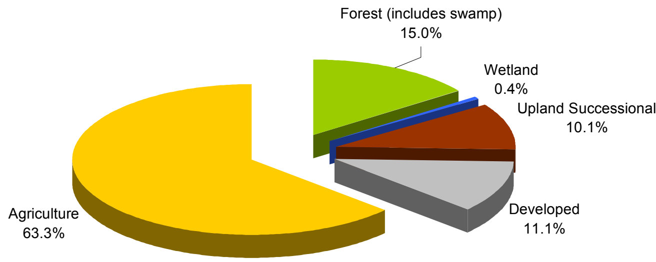


Figure 2: Landuse practices within the Township of New Tecumseth. (Source: *New Tecumseth Natural Heritage Strategy*)

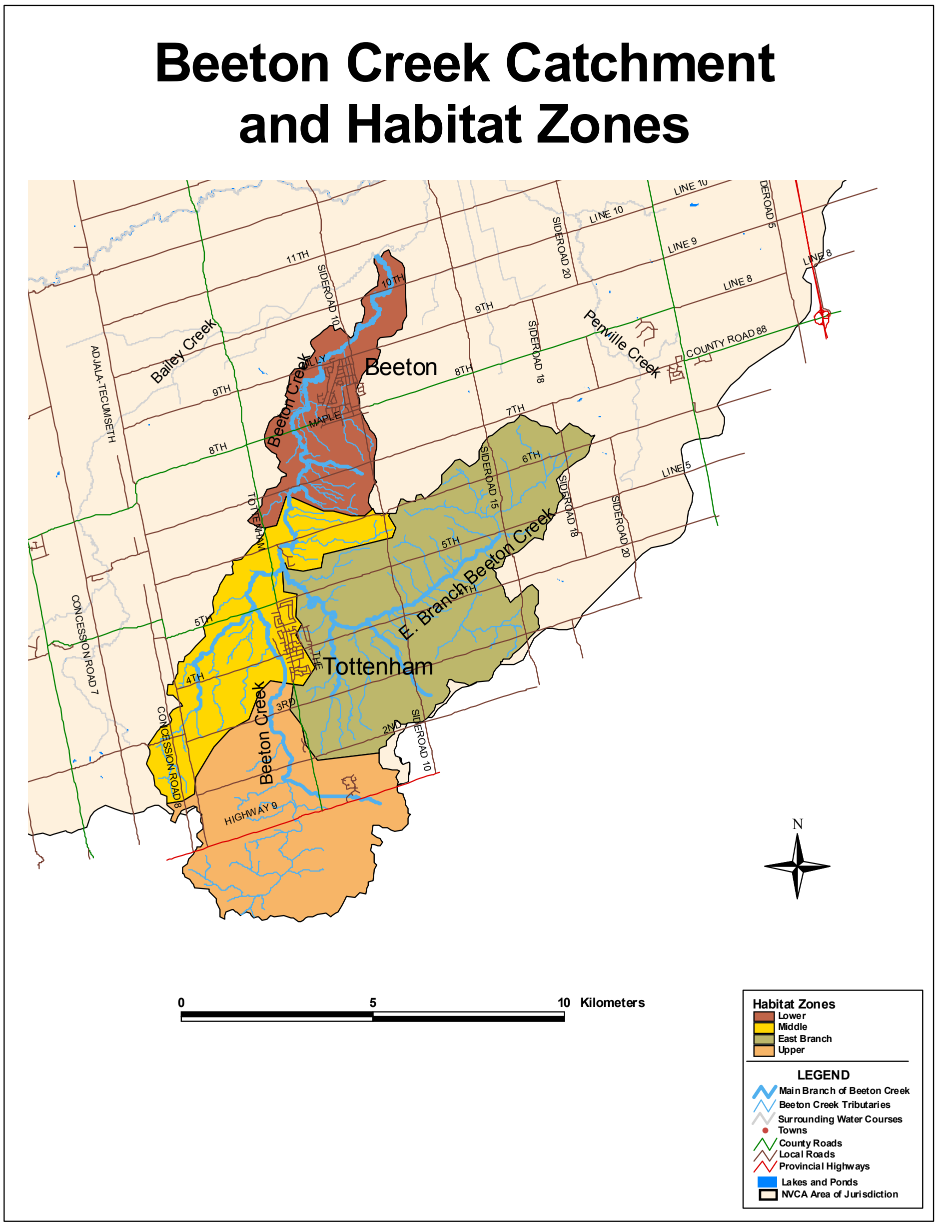
Intensive agricultural demands have lead to high levels of deforestation and stripping of essential *riparian* vegetation along the stream corridors. This lack of mature *riparian* vegetation has enabled the stream channel to widen its meander bends significantly lengthening the stream without any corresponding increase in gradient. Erosive stretches have developed extreme meander forms where the stream "doubles back" on itself and cuts through stream banks, isolating "*oxbows*" etc. As a result of this phenomenon the gradient or slope of the stream has decreased resulting in sandier, siltier stream bottoms. In general, flat streams are characterized by silty or sandy bottoms while steeper streams exhibit gravely or rock bottoms.

These slower moving waters are susceptible to phosphorous accumulation and without having the ability to sustain an oxygenated environment for essential phosphorous interceptors such as invertebrates and larger predatory fish the levels of concentration remain a concern. Groundwater inputs can also be devoid of oxygen due to microbial decomposition as it passes through the soil, therefore areas with higher levels of groundwater discharge that may be cooler in temperature may not be suitable for oxygen dependent organisms.

Groundwater interactions play an important role along the Beeton Creek drainage area. Significant areas of groundwater recharge, infiltrating precipitation into lower groundwater aquifers, lie within the Oak Ridges Moraine as well as along the Simcoe Uplands located downstream towards the lower stream reach of Beeton Creek. Groundwater discharge areas are associated with the stream corridors throughout the township, particularly where these corridors cut into the landscape and intersect shallow aquifers especially located around the town of Beeton. Discharge areas are also associated with large expanses of low-lying lands within the Simcoe Lowlands. Groundwater discharge and recharge maps of the Town of New Tecumseth can be located in Appendices.

Irrigation along Beeton Creek has been rather intensive over the years especially during drought conditions. Back in 1966 only 7 permits were issued to withdrawal water along Beeton Creek for crop irrigation and only 4 of those successfully pumped water. However, it was also documented that the stream-water withdrawals from Beeton Creek were rather large and resulted in insufficient flows for downstream users. Currently, the permits to take water have been issued to a significantly larger number of landowners with no structured compliance monitoring. Recently, landowners within the Innisfil Creek drainage basin have observed dried up stream channels during periods of drought, due to excessive, uncontrolled stream water pumping for large agricultural fields.

Provincial Water Quality sampling for the Ministry of the Environment performed on the Nottawasaga River Watershed in 2002-2003 deemed Beeton Creek as a dominant contributor of phosphorus loadings within the Innisfil Creek subwatershed. Sampling results indicated that 'nutrients' were the key water quality issues of concern within the Innisfil Creek subwatershed. Beeton Creek had significantly higher Ammonia concentrations and significantly lower concentrations of total phosphorus and chlorides than the main Innisfil Creek. Beeton Creek also had significantly higher levels of free ammonia which may be stressing the aquatic biota, particularly during periods of elevated instream temperatures. The Tottenham and Beeton Sewage Treatment Plants may be negatively contributing higher levels of phosphorous into the stream especially during incidences of high flows when the plants are unable to discharge their effluent at appropriate rates potentially releasing improperly treated wastewaters into the stream.



<u>Figure 3</u> : Beeton Creek watershed divided up into its respective Planning Zones.

The Beeton Creek Watershed can be divided up into 4 distinct 'Planning Zones' based on their landuse practices, associated stream health impacts and local topographic formations and deposits. These four zones include the Upper River, Middle River, Lower River and East Branch River Planning Zones (*Figure 3*).

This report will use these Zoning divides in order to describe stream features, determine current stream health status and document restoration projects and activities that have occurred within each zone.

A list of resources used for this report in order to compile the general stream information and stream health information can be found in detail at the end of this report within the Appendices.

3.0 Stream Information

The information found within this section of the report was compiled using Quaternary Geology Information to determine the various types of geological land characteristics (*See Appendices for Geology Map*), the Beeton Creek Habitat Assessment 1998 Assessment Plan to gather stream morphology and local ecology information as well as with previously recorded watershed health documents provided by the NVCA. This section gives an over-all impression of the local land morphology within each zone.

3.1 Upper River Planning Zone

The headwaters of Beeton Creek originate within the Oak Ridges Moraine. The Oak Ridges Moraine is a prominent geological landform with its sands and gravels absorbing rain and snow, delivering water to aquifers deep below the ground providing fresh, clean waters to the local rivers.

Figure 4: Representative photograph of Beeton Creek within its Upper River Planning Zone taken within the 2nd Concession of New Tecumseth at approximately 1000 feet.

Abundant groundwater discharge and forest cover associated with the Oak Ridges Moraine, maintains year-round flows, cold summer temperatures and high oxygen concentrations along the headwaters of Beeton Creek. Historical data from a Nottawasaga Valley Conservation Report (1964) documented this section of Beeton Creek as having permanent cold waters with the presence of book trout populations as far north as the Tottenham Reservoir located within the Tottenham Conservation Area.

The stream flows through relatively dense forest cover as it flows north towards the village of Tottenham (*Figure 4*). Just south of the 3rd Concession of New Tecumseth the stream begins showing visible changes in stream morphology as it begins flowing through agricultural land and continues on until it flows through a large marsh-like area immediately before reaching the Tottenham Reservoir.

3.2 Middle River Planning Zone

The upstream stretch of Beeton Creek within this zone flows through the Tottenham Conservation Area (*Figure 5*).

<u>Figure 5</u>: Representative photograph of Beeton Creek within the Middle River Planning Zone. Photograph illustrates the Tottenham Reservoir and the surrounding rural environment within the 3rd and 4th Concession of New Tecumseth taken at approximately 1000 ft.

Within the Tottenham Conservation Area there is an approximate 1 Km^2 reservoir online with Beeton Creek. This reservoir plays a key role in stream health both downstream and immediately upstream of the reservoir. The impoundment is currently operating as a 'Bottom- draw' structure, discharging cooler waters from the bottom of the reservoir. The reservoir provides recreational opportunities including fishing, boating and swimming for local residents.

Recent assessments document the conditions of the reservoir as somewhat degraded due to the deposition over time of materials transported by Beeton Creek. The upstream end of the impoundment is shallow and has been filling in from sediment deposition. Accumulation of nutrients in the pond environment has lead to the development of suspended algae blooms during the warmer months of the year. These suspended algae blooms create murky or "turbid" water conditions where visibility into the reservoir is limited to several inches. Accumulation of bacteria from Beeton Creek into the Tottenham pond may also be contributing to the degradation of water quality as warm stagnant, nutrient-rich environment are conducive to bacterial blooms. The swimming area at the Tottenham Reservoir has occasionally been closed due to high bacteria counts.

Downstream of the reservoir lies the outlet for the Tottenham Sewage Treatment Plant (STP). The STP may be contributing higher levels of nutrients within stream, but may also act as a key player in maintaining baseflows during low flow conditions.

The stream channel flows through the Village of Tottenham becoming more narrow in width and lower in stream bank height. The banks become less stable and show more impacts from erosion. The stream waters begin to show signs of turbidity due to the excess in sediment loading. The stream corridor becomes less prominent of forest cover with only small ‘patches’ of forested areas quite distinctively dispersed amongst open reaches. Riparian buffer strips along the stream channel become narrower and less prevalent as the creek flows further downstream.

Another key role in the stream health of this reach is a failed flood and ice control structure located within the 5th Concession. The flood and ice control structure located on this property was designed to reduce the stress of ice impact on a road crossing bridge downstream in order to minimize the probability of bridge failure. The design was either not accurate or the structure was not maintained properly because it is now not functioning and has created a large online pond that has connected itself to its neighbouring off-line pond causing water to flow through the existing berm. This structure is blocking the migration of fish and may be contributing to the warming of instream temperatures.

This stream reach has been labelled as a target zone for stream/riparian habitat restoration

3.3 Lower River Planning Zone

As Beeton Creek flows off its rugged terrain in its headwaters, it enters a relatively flat landscape associated with the Schomberg Clay Plain and Simcoe Lowlands. The creek flows north of the 6th Line of New Tecumseth into areas with very little riparian forest cover and very little riparian vegetation permitting increased levels of nutrient runoff. Riparian land use is dominated by intensive agricultural activities, including pastured and cropped lands (*Figure 6*).

Coldwater tributaries flowing off of the Peterborough Drumlin Field also flow into this stream reach and have been documented as cool water contributors into Beeton Creek. This area provides significant amounts of groundwater recharge to the area and the cooler stream temperatures may be providing refuge for temperature sensitive fish and invertebrates during high temperature stress periods. These smaller tributaries provide permanent flow even during low flow conditions.

The stream banks of the main Beeton Creek become deeply incised and are highly erosive attributing to continuous scouring action releasing large amounts of sediment loadings downstream. Numerous hairpin loops along this reach are also contributing to high erosion and slumping stress. Some of these stretches have had cattle access and are still demonstrating impairments. Slumping, bank erosion and undercutting along the banks of Beeton Creek from extensive agricultural practices have been documented in literature dating back to the 1960's in Ministry of Natural Resources Reports.

Figure 6: Representative photograph of Beeton Creek within the Lower River Planning Zone. Photograph documents the heavy agricultural landuse along with the very minimal riparian vegetation along the stream channel located within the 8th Concession of New Tecumseth. Photograph taken at approximately 1000 ft.

The vegetation along the stream banks of this reach consists of grasses, dogwoods, willows and other shrub species with limited habitat diversity. This stream segment has been documented as a target zone for stream/riparian habitat restoration.

3.4 East Branch River Planning Zone

The headwaters the East Branch of Beeton Creek originate out of coarse-grained lacustrine and pond deposits yielding sufficient quantities of water to most domestic wells. Further downstream, the landscape is scattered with rolling drumlins that are visible throughout this area. The creek flows southwest along Concession 4 of New Tecumseth where it breaks and heads northwest flowing into the main Beeton Creek (*Figure 7*). The East Branch contributes a catchment area of approximately 34 km^2 (40% of the total Beeton Creek catchment).

The East Branch lies within well-laminated soils contributing to the consistently warmer water temperatures within this stream reach. There is no significant groundwater discharge areas within this zone that would contribute to the cooling of instream temperatures.

There are moderate levels of forest cover along this reach of stream that are segmented amongst long stretches of open corridors.

Figure 7: Representative photograph of Beeton Creek along the East Branch River Planning Zone. Photograph documents the agricultural landuse along with the moderate levels of riparian vegetation along the stream channel within the 4th Concession of New Tecumseth. Photograph taken at approximately 1000 ft.

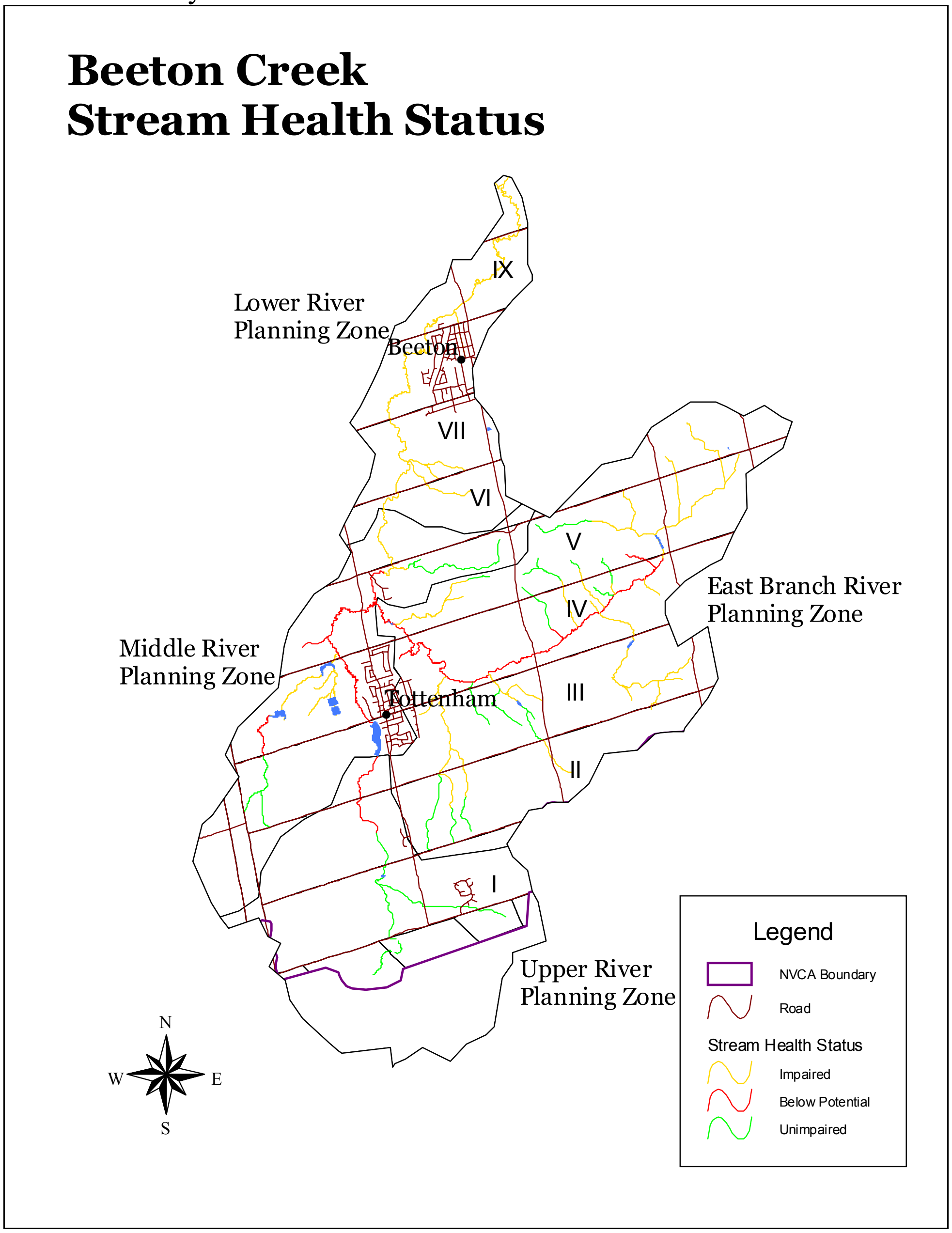
4.0 Stream Health Status

This section of the report documents the current health status within each zone of Beeton Creek. The NVCA monitors stream health through a program called the Watershed Ecosystem Health Monitoring Program (WEHMP) that documents trends in watershed health and provides watershed health data and science-based analysis to aid in planning future watershed management strategies. Information presented within this section will include 'Biological Conditions' and 'Physical Conditions' of each Zone summarizing both the biological and physical monitoring data respectively.

By definition, human activities (land use, pollution, etc.) are the main factors shaping habitat, water quality, and the aquatic communities at *impaired* sites, while natural processes are the major influence on *unimpaired* streams and their inhabitants. In general, unimpaired streams support a diverse, robust community. They have the ability to assimilate wastes, provide recreational opportunities, contribute to the ecology of the watershed, and are an important source of bio-diversity.

Biological monitoring data is used to classify stream reaches into distinct health statuses using both fish and benthic *invertebrates* as indicator species. A streams health status can be deemed ' *Unimpaired*', '*Below Potential'* and '*Impaired*' depending the stream conditions. Detailed definitions of these terms can be found within the Glossary. *Figure 6* illustrates the most recent documented stream health within the Beeton Creek watershed. A summary table of all of the documented Biological Monitoring stations can be found within the Appendices.

Physical monitoring data will also be presented in this section including temperature data that has been collected through both spot sampling and continuous data-logger recordings. Spot temperature "runs" were performed on various occasions during warm summer days to supplement the datalogger information and to assist in deeming the stream thermal stability.



<u>Figure 8</u> : The current stream health status of Beeton Creek created using existing biological monitoring information collected by the Nottawasaga Valley Conservation Authority. Stream health data as of the 2003 season.

4.1 Upper River Planning Zone

Physical Conditions

Based on various temperature datalogger analyses, the headwaters of Beeton Creek are characterized by a coolwater thermal regime up until the 4th Line of New Tecumseth where it crosses over to a warmwater thermal regime downstream. This coolwater instream thermal regime of Beeton Creek is indicative of coolwater habitat for aquatic species.

Biological Conditions

There has only been one recorded Biological Monitoring survey done within the headwater zone of Beeton Creek back in 1998. The sample was collected along the 2nd Concession of New Tecumseth and documented the presence of sensitive cool water invertebrate species. These results assisted in deeming this reach of Beeton Creek as 'Unimpaired'. There has been no further biological monitoring within this headwater region due to its already documented healthy stream status.

Fisheries data dates back to the Nottawasaga Valley Conservation Report 1964 documenting the presence of coldwater species including Brook Trout and Sculpin, both very sensitive aquatic species, within this stream reach. Recent observations of Brook Trout have also been recorded as far north along Beeton Creek into the 4th Concession of New Tecumseth immediately downstream of Tottenham Reservoir. These fish give good indication that the waters within the headwater planning zone are cool and relatively capable of supporting sensitive coldwater aquatic species.

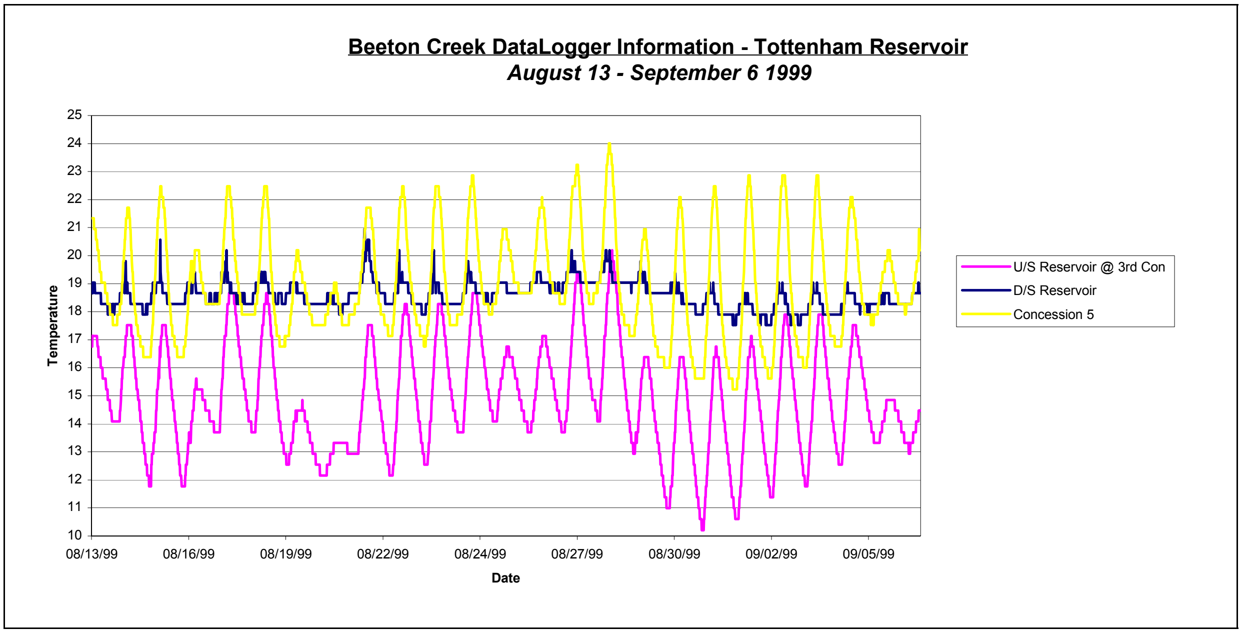
4.2 Middle River Planning Zone

Physical Conditions

Downstream of the Village of Tottenham, Beeton Creek converts to a warmwater thermal regime extending downstream to the confluence with Bailey Creek.

Datalogger information collected during the summers of 1999 and 2002 show warming trends as the river flows from the 3rd Concession, through the Tottenham Reservoir and up to the 6th Concession (*Figure 9*).

The bottom-draw dam structure releases relatively consistent cooler temperatures downstream, however, those temperatures show dramatic increases as near as the 5th Concession, approximately 1.5 km downstream from the reservoir outfall. Random spot temperature runs within this stream reach also illustrate warmer waters as the creek flows north.



<u>Figure 9:</u> Temperature logger data recorded between August 13 and September 6 1999. Datalogger stations were located upstream, immediately downstream and a concession downstream from the Tottenham Reservoir documenting 'warming trends' as the creek flows downstream.

Biological Conditions

Invertebrate sampling has been performed at various locations throughout this zone between the 4th Concession, downstream of the Tottenham Reservoir, to the stream crossing at the 6th Concession. The data collected has deemed the stream reach immediately downstream of the reservoir until just south of the 6th Line as 'Below Potential'. These results indicate that the stream is demonstrating slight impairment supporting both a community of tolerant invertebrate taxa as well as sensitive taxa more susceptible to impairments.

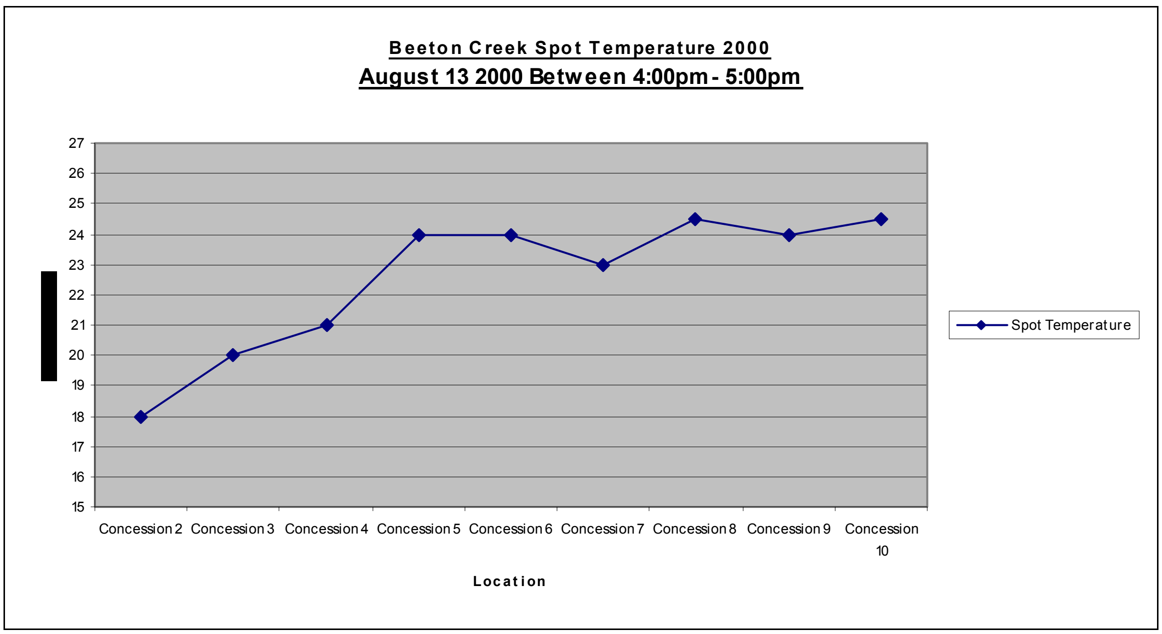
The Tottenham Reservoir plays a major role in the fisheries distribution within the Middle River Planning Zone. The Reservoir impoundment acts as a barrier to fish migration impeding the movement of juvenile fish downstream and, as it is currently acting as a bottom draw operation, with no distinct upstream fish passage. Fish are able to move downstream out of the Reservoir but are unable to return into the pond. This is shown through fish sampling documenting warm water predators that are found in the reservoir, including Yellow Perch and Large Mouth Bass, immediately downstream of the Reservoir. Fisheries data have documented the presence of brook trout upstream and immediately downstream of the Tottenham Reservoir however as the waters flow downstream they quickly warm up and are no longer able to support coldwater species. Migratory Rainbow Trout (Steelhead) have been observed up to the base of the dam structure which may be positively acting as a barrier preventing stressful competition for resources between Rainbow and Brook Trout.

Downstream of the Reservoir, the Creek shows visible signs of warmwater fisheries continuing until the confluence of Bailey Creek. Qualitative fish samplings have documented various warmwater benthic feeders including white suckers and carp along with warm water minnows including creek chub and dace species within this reach however there has been no records of warm water sport fish species.

4.3 Lower River Planning Zone

Physical Conditions

Beeton Creek arises to a warmwater thermal regime and continues to maintain warm temperatures until it reaches the confluence of Bailey Creek within the 10th Concession of New Tecumseth (*Figure 10*). Temperature logger data show consistent warm water temperature stress during peak warming periods with slight overnight cooling. The lack of significant riparian forest cover enables the stream to be exposed to direct sunlight for longer periods of time. Instream temperatures rise precipitously through this area, quickly rising above levels suitable for salmonid production.



<u>Figure 10:</u> Temperature survey 'run' taken on August 13 2000 documenting stream temperatures (in Celsius) between the 2nd and 10 Concession of New Tecumseth. This data illustrates the increase in thermal temperatures as the stream flows north.

Biological Conditions

Downstream of the 6th Concession the stream reach is documented as sandy, highly erosive, with stripped riparian vegetation. The characterizing taxa within this lower stretch of Beeton Creek are 'Chronomus', very tolerant invertebrates that can tolerate oxygen deficient environments. Sampling records for this region between 1996 and 2002 show consistent stream impairment deeming this stream reach as 'Impaired'. This area is very agriculturally developed, dominated by sandy sediments with riparian habitat dominated by grasses, pastures and cropped fields. There are even stream stretches that are channelized most likely for irrigation purposes.

Nutrient loadings from urban and agricultural resources, combined with drain maintenance and loss of significant riparian cover, result in impaired stream health extending downstream to the subwatershed's confluence with the Nottawasaga River.

This stream reach of Beeton Creek supports a warm water fish community. Fisheries data document smaller minnow species along with larger warm water benthic feeders such as white suckers and carp throughout this reach. The sandy substrates along with warmer stream temperatures do not provide ideal spawning areas for migratory coldwater fish, however, there have been observations of migratory rainbow trout within this stream reach with no documentation of successful spawning.

4.4 East Branch Planning Zone

Physical Conditions

Several tributaries of the east branch of Beeton Creek exhibit coolwater characteristics; however, the East Branch itself supports a warmwater thermal regime. Spot temperature runs along the east tributaries of the East Branch, along Sideroad 10, were done in 2002 documenting them as potential warm water contributors of the main branch.

Biological Conditions

The overall stream health of the East Branch of Beeton Creek has been identified as 'Below Potential' through the Biological Monitoring Protocol. Invertebrate samplings have documented segments of the East Branch as 'Impaired' and some of the tributaries as 'Unimpaired' documenting the presence of cool water indicator species.

Fish sampling was last performed on the East Branch in 2002, sampling various locations and a few of the tributaries. Data from these samples indicate the presence of warm water benthic feeders and predatory species including creek chub, yellow perch and pumpkin seeds. However, there has also been documentation of sculpin species in a few of the East Branch tributaries indicating cooler stream temperatures.

5.0 Stream Restoration

The Nottawasaga Valley Conservation Authority along with the strong support and assistance of The New Tecumseth Streams Committee have been exploring the stream health of Beeton Creek and have been working towards improving the water quality throughout the municipality of New Tecumseth using a phase approach for stream rehabilitating. Detailed information on the New Tecumseth Streams Committee, their involvement with environmental enhancement projects and partnerships that have contributed their time and effort towards environmental projects can be located in the Appendices.

For this report, information was gathered from restoration projects and environmental enhancement activities that have been documented within the Beeton Creek watershed. Enhancement work that has been recorded for the area around Beeton Creek includes Tree Planting, Stream Restoration and Habitat Improvements. Funding support for these projects have been contributed by local community groups and landowners with additional financial assistance through:

- Nottawasaga Valley Conservation Authority
- New Tecumseth Streams Committee
- Ontario Ministry of Agriculture and Food (OMAF)
- Honda of Canada Mfg. (Honda)
- Dufferin South Simcoe Land Stewardship Network (MNR)
- Community Fish and Wildlife Incentive Program (CFWIP) (MNR Grant)

Project information was complied using NTSC documents and NVCA documentation and are listed below briefly summarizing the work that was completed. Please note that with each project site, the landowners have played an important role in providing access and funding for these projects. As well, the partnerships that have been involved with these projects are acknowledged within the Appendices under the New Tecumseth Streams Committee information. Not all projects were as extensive and there may be smaller projects unaccounted for. Note that this information was compiled using NTSC documents along with the NVCA documentation.

5.1 Upper River Planning Zone

There have been no large stream restoration projects performed within the headwater planning zone of Beeton Creek. There have, however, been tree planting initiatives both along the stream corridor as well as within the interior of the concessions.

5.2 Middle River Planning Zone

Since 1998, there have been 6 larger restoration locations along Beeton Creek within the Middle River Planning Zone. The project locations can be located in *Figure 11* and are summarized below.

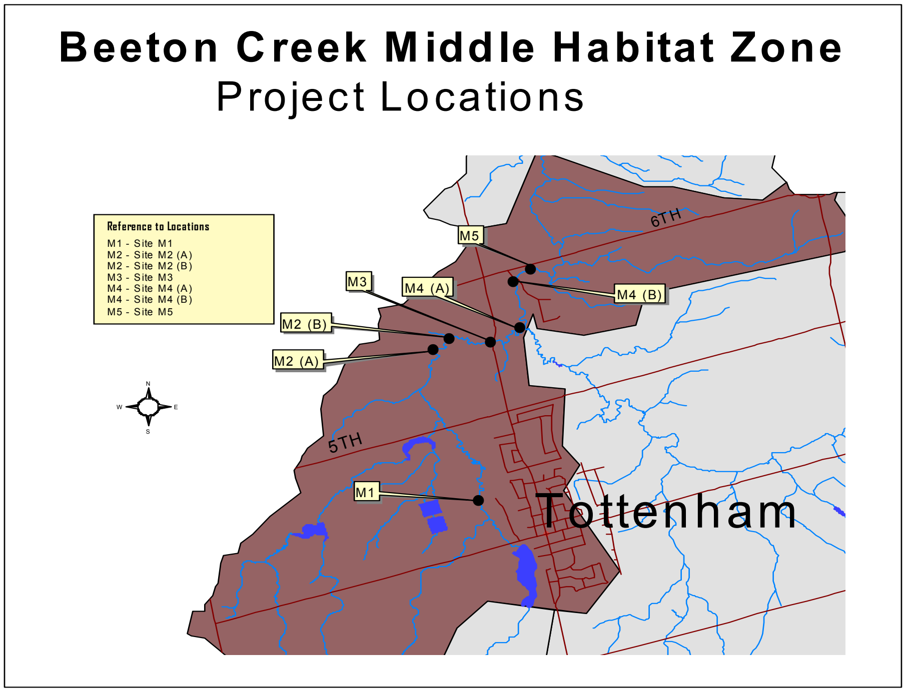


Figure 11: Environmental enhancement project locations located within the Middle River Planning Zone along Beeton Creek.

5.2.1 Site M1 (*Concession 4 Lot 5)*

Summary of Works:

The stream reach along this property was the recipient for a supplemental riparian tree planting in 1999 in credit to the work done beforehand by the Arbour Committee. The Arbour Committee had previously coordinated a large tree plant with volunteer groups planting trees along the valley walls, the stream channel and along the old stream paths where the stream once followed. The New Tecumseth Streams Committee continued this tree plant by infilling the valley with 500 seedlings of white cedar, white spruce and white pine that were planted closer to the streams edge *(Figure 12).* The survival of these trees has been very good and the valley is developing into a nice riparian buffer region for the creek.

<u>Figure 11 :</u> Site M1. Photographs were taken late spring 2004 after approximately 4 years of growth. (Left) Photograph taken along the berm of the valley documenting the in filled valley floor. (Right) Photograph documents the riparian tree planting along the stream channel.

5.2.2 <u>Site M2</u> *(Concession 5 Lot 5 (S))*

Summary of Works:

This restoration site included two distinct reaches of Beeton Creek; section A which flows through active pasture land and section B which flows through retired pasture land (*Appendix 9*). Stream habitat restoration work was completed at site M2 through three tree planting projects implemented between 2001-2003. Livestock exclusion fencing was completed in section A in 2002.

This site has been used as a practicing agricultural area for many years and still is today. Row-cropping and cattle pasturing have lead to the removal of riparian vegetation and degradation of stream habitat quality. Riparian tree planting was implemented at this site in order to improve stream health, water quality and fish/wildlife habitat. The objectives of these projects were to reduce bank/upland erosion, decrease sediment/nutrient loading to the stream, improve the diversity and health of vegetation alongside to the stream and to decrease summer stream temperatures.

On April of 2001, approximately 35 students from the Prince of Wales Elementary School in Barrie participated in a volunteer tree plant. This tree plant was coordinated by the NTSC and the NVCA incorporated the planting of 500 white pine seedlings adjacent to 400m of meandering stream (section B). One row of trees was planted on each side of the stream through section B.

In the spring of 2002, the NTSC/NVCA planted an additional 2,250 seedlings (white cedar, white spruce, norway spruce, black walnut) adjacent to section B, through a professional hand planting project. These seedlings were planted in several rows extending back from the stream up to 30 meters (*Appendix 8*). Also in the spring of 2002, livestock exclusion fencing was implemented along the stream in section A adjacent to 45 acres of pasture land. This fencing project was coordinated by the landowner with technical and financial support provided by the NVCA. A windmill was installed to pump water into an open storage bin and provide as an alternate source of drinking water for the cattle. A bridge was also established over the stream as a livestock crossing within the pasture.

The livestock exclusion fencing project completed in 2002, set the stage for a future riparian tree planting project in section A. In the spring of 2003, the NTSC/NVCA planted 800 seedlings (white cedar, white spruce and red osier dogwood) within the exclusion fencing adjacent to section A of Beeton Creek. An additional 1,200 seedlings (white cedar, white spruce, white pine, black walnut and red oak) were planted adjacent to section B.

As of the end of 2004, 4750 seedlings have been planted at site M2, including; 850 White pine, 1000 White spruce, 1800 White cedar, 650 Black walnut, 250 Norway spruce, 150 Red osier dogwood and 50 Red oak. The survivorship rate for the three tree plantings was approximately 70% based on audits preformed by the NVCA Forestry Program as of the end of 2004. Funding for the projects completed at this site was provided by landowners, the NTSC and the NVCA's Healthy Waters Grant Incentive Program.

Figure 12: Cattle exclusion fencing along Beeton Creek on site M2. (Left) 'Before' photograph illustrates the effects of trampling along the stream channel. (Right) 'After' photograph illustrates the electric cattle fence along with the healthier, non-impacted buffer region.

5.2.3 Site M3 (*Concession 5 Lot 5)*

Summary of Works:

This location was observed as a good candidate for riparian tree planting because of the open land adjacent to the stream. Volunteer tree planting was done on site M3 during 2000, planting small tree seedlings and shrub species along the stream on both the north and south sides *(Figure 14).* The trees at this site have had to compete with the growth of the dense grasses and in most areas have not been very successful. This site may be a good candidate to readdress and infill with more trees. A reassessment as to the proper trees for the site conditions should be performed as well as more controlled planting measures to control the growth of the surrounding grasses.

Figure 13 : Photograph illustrates the property that was planted with spruce and white pine seedlings. Notice the intense competition with native grasses within this region that seem to out compete the growth of the trees.

5.2.4 Site M4 *(Concession 5 Lot 6 (N)*

Summary of Works:

This location was also a candidate site for riparian tree planting as it was once agricultural land that was cleared many years before. Volunteer tree planting days were held on this property in 2000, 2001and 2003, planting various amounts of tree seedlings along the riparian zone of Beeton Creek that flows through site M4 (*Figure 15*).

Figure 14 : Tree planting site located within site M4. Notice the small tree seedlings starting to show growth above the heavy grasses

Site M4 Flood and Ice Control Structure

The Flood and Ice Control Structure that is located on this property was designed to reduce the stress of ice impact on a road crossing bridge in order to reduce the probability of bridge failure. This ice control structure has not been working properly for the past few years and is currently acting as a barrier to fish migration along Beeton Creek (*Figure 16*). There has been extensive investigation into this structure by the NTSC, NVCA, and Town of New Tecumseth. The NTSC has expressed continued interest in this structure and are willing to assist in the repair/improvement of this structure in order to see the waters flow more freely through this stream reach and to see the structure operate as originally designed.

<u>Figure 15:</u> Photograph illustrating the failed ice control structure located on site M4 on Concession 5 of New Tecumseth. (Left) Newly created on-line pond upstream of the ice control structure. (Left) The culverts that have failed; notice water flowing through the berm rather then through the culverts.

5.2.5 <u>Site M5</u> *(Concession 5 Lot 6)*

Summary of Works:

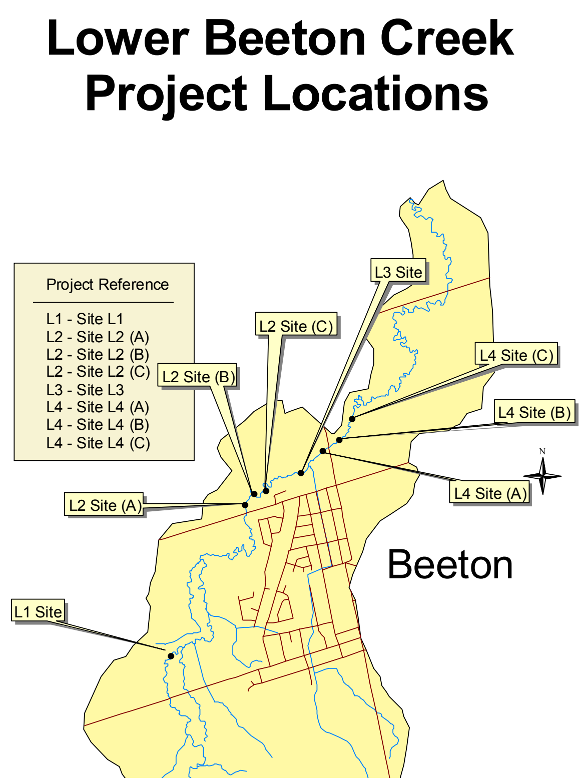
This location was a candidate site for bank stabilization due to noticeably higher levels of bank erosion and slumping along a sharp stream bend. In 1996, NVCA staff planted 550 white cedar, 500 white spruce, 800 white pine, 600 silver maple, 300 hemlock, 400 red pine, 500 larch and 400 red osier dogwood. The New Tecumseth Arbour Committee covered the costs for this planting. Tree revetments were installed along the outer banks of Beeton Creek on site M5 during a volunteer workday in the fall of 1999. Large cedar tree revetments were instilled along the toe of the eroding bank in order to help stabilize the bank and minimize the erosion impacts. Live willow stakes were also planted along the bank to aid in minimizing the erosion intensity (*Figure 17*). The intensity of the stream flow at this bend did not allow sediment to accumulate within the tree revetments and scouring has occurred behind the revetments as a result of this.

The banks are still showing low levels of slumping, however the tree revetments are providing instream fish habitat.

Figure 16 : Site M5. Photographs were taken late spring 2004 along the restoration site. (Left) Photograph documents the tree planting along the bank. (Right) Photograph illustrates the bank stabilization practice that was implemented. Notice the downstream section accumlating sedimentation while the upstream end not as successful due to the force of the stream.

5.3 Lower River Planning Zone

There have been 4 main project locations along the stream corridor within the Lower River Planning Zone. The project locations can be located in *Figure 18* and are summarized below.



<u>Figure 17 :</u> Lower River Planning Zone restoration project locations.

5.3.1 <u>Site L1</u> *(Concession 8 Lots 8&9)*

Summary of Works:

A large portion of Beeton Creek runs through an open agricultural field within the L1 site. Four tree-planting projects were undertaken at this site starting in 2000 until 2004. This agriculture field is now idle land, which was once used for cattle pasturing.

The use of this land as a pervious cattle pasture has led to the great disturbance and reduction of stream habitat quality along the stream reach on site L1. The goals of these projects were to improve stream health, water quality and fish/wildlife habitat. The objectives of these projects were to reduce bank/upland erosion, decrease sediment/nutrient loading to the stream, improve the diversity and health of vegetation alongside to the stream and to decrease summer stream temperatures.

On April of 2000, the NVCA completed a hand and machine plant of 7000 seedlings (white cedar, white spruce, white pine) on adjacent sides of the stream. A second tree planting was undertaken in April of 2001 by the NVCA. This machine planting comprised of 6700 seedlings (white cedar, white spruce, white pine and tamarack) over a 9 acre area. In the spring of 2002, the third planting was completed by the NVCA. This was the hand planting of 2000 seedlings (white cedar and white spruce). In the spring of 2004 there was a fourth planting on the north and south side of the stream. The north side of the stream encompasses 4.8 acres of vacant land that was machine planted. This was the planting of 3425 seedlings (white cedar, white spruce, and bur oak). The south side of the stream was planted by hand. This was the planting of 650 seedlings (white cedar, white spruce and tamarack) on a 1.5 acre area of vacant land.

In 2004 to date, 19,775 seedlings have been planted on site L1, alongside the Beeton Creek. In total there are; 7200 white cedar, 8100 white spruce, 3700 white pine, 750 tamarack and 25 bur oak. In general, the survivorship rate for the three tree plantings is 75%, which was calculated through an audit performed by the NVCA Forestry Management. These projects were completed through the cooperation, technical and financial support of the New Tecumseth Priority Planting Program, the NVCA, the Lake Simcoe Conservation Authority and the landowner.

<u>Figure 18 -</u> Photograph taken during Spring 2004 after a 3425 machine plant was performed within this idle agricultural field. Previous plantings have also taken place within this agricultural field.

Small tree seedlings have also been planted along the stream channel by the landowner and volunteers to create an enhanced riparian buffer region along the stream

5.3.2 <u>Site L2</u> *(Concession 9 Lots 9 and 10 (S))*

Summary of Work:

In 2001, the section of Beeton Creek that flows through the north end of site L2 was noted as a high priority site for river restoration. It was also labelled as a candidate for a 'Demonstration site' due to its accessibility and location within the community of Beeton.

Figure 19 - Location of project site completed in Summer 2002. Photograph was taken late spring 2004 documenting vegetation growth along the outer stream banks as well as vegetation growth within the implemented tree revetments. Arrow points to old tree revetments along stream edge.

The stream within this stretch flows through a lot of tight hairpin turns and the lack of significant riparian vegetation and bank stability have resulted in a lot of bank slumping and intense erosion releasing excess sediment into the stream. There are houses located just south of the stream that lie within the floodplain and have been susceptible to flooding over the years. Work was performed on various banks within this river stretch over the past few years.

In 2001 and 2002, volunteer work days along with NVCA staffing and heavy machinery operation stabilized a few banks by grading back the steep slopes installing tree revetments and planting shrubs and live willow stakes (*Figure 25*).

In 2003, two large projects were undertaken through both the NVCA and the NTSC. A floodplain was created at the upstream end of the park which included heavy machinery grading, placement of erosion control blankets and the planting of live willow stakes performed by both NVCA staff and volunteer work days. Sediment moving down the stream can now be captured in the newly vegetated floodplain, removing sediment from the watercourse. Phosphorus captured in floodplains would be assimilated by uptake into terrestrial plants rather than fertilizing growth of suspended green algae in the watercourse. Also in 2003, 800 white cedar and 200 red osier dogwood were hand planted through the cooperation of the NVCA, the New Tecumseth Streams Committee and volunteers.


<u>Figure 20 -</u> Channel stabilization project at the downstream end of site L2. (Left) Before the project was initiated during fall 2003. (Right) Late spring 2004 documenting the growth of live willow stakes and the survival of the large spruce trees. Arrows point to restored bank.

Downstream from this location, another bank was identified as having very steep slopes and was eroding towards the direction of the residential houses. Heavy machinery assisted in the grading of the slopes, along with local volunteers putting down erosion control blankets and planting live willow stakes and shrubs along the new bank. Rock rip-rap and large spruce trees were also placed along the banks to prevent the stream channel from encroaching further towards the properties on the south side**.**

In 2004, both locations were seeded with grasses in order to further stabilize the stream banks and further tree planting occurred. This area has received a lot of tree plantings of small tree species, shrub species on both the north and south sides of the creek through organized volunteer planting days. Future plans to further stabilize the stream reach throughout this site are currently being examined.

Figure 21 - Floodplain creation upstream end of Beeton Creek at site L2. (Left) 'Before' photograph taken prior construction. (Right) 'After' photograph taken during late spring 2004. (Bottom) Floodplain construction viewed from downstream end taken late spring 2004. Arrow points to new floodplain area.

5.3.3 Site L3 (*Concession 9 Lot 10)*

Summary of Works:

The NTSC and the NVCA worked together with the Roman Catholic School in creating stream restoration projects along the stretch of Beeton Creek that flows behind the school property on site L3. The stream banks were showing high stress from erosion and had no prominent riparian vegetation cover along the stream banks.

Figure 22 - Photograph taken during the late spring of 2004 after work was completed. Photograph illustrates the graded slope as well as the anchored tree revetments that have successfully filled with sediment are now growing vegetation. Arrow points to new bank.

Starting in 2000, machinery grading was done along the bank in order to lessen the steepness of the bank slopes. The graded banks were then laid with sod mats to prevent soil erosion and were further planted with small seedlings during various volunteer workdays. Tree revetments were also placed along the outer bank of the stream in order to further stabilize the bank and assist in dispersing the flow impacts. Approximately 38m of the stream was stabilized and planted and was completed by the end of 2002 (*Figure 24*).

5.3.4 Site L4 (Co*ncession 9 Lots 10 &11 (S))*

Summary of Works:

Over the past 5 years there have been a lot of changes to the stream channel and stream morphology along Beeton Creek at site L4 on both the east and west sides of the 10^{th} Sideroad. Steep banks, high erosion activity and little to no vegetative buffer zone due to heavily farmed and pastured lands made this property a good candidate for continued restoration activities.

Many long hours of hard labour have been banked on this site performing rehabilitation work using tree revetments, various grading methods, tree planting and seed planting in order to stabilize banks, improve the floodplain areas and create a significant riparian buffer zone. In 1996, the NVCA planted 500 white cedar, 1000 white pine, 10500 red pine and 500 nannyberry. Various volunteer tree planting days have also planted large tree stock, small tree seedlings and live willow stakes along the banks of the stream along the L4 site.

At the upstream portion of site L4 (*Figure 18- Site A*) the buffer region along the stream channel was widened and planted with shrubs and trees in order to increase the riparian zone and provide shade during high sun (*Figure 24*). The agricultural fields on either side of the stream were actively cultivated very close to the streams edge. A floodplain was also created along the inside of a meander bend.

<u>Figure 23</u> : Upstream restoration project site. (Left) Before photograph taken 1997 illustrating the lack of vegetation along the stream channel. (Right) After photograph taken 2004 illustrating the stream side vegetation and the planted trees.

At the middle stream portion along site L4 (*Figure 18 – Site B*) work was done in order to lessen the impacts caused during high water levels by creating a more stabilized flood plain. Tree revetments using coniferous tree stocks were instilled along outer banks at various locations to assist in stabilizing the banks from erosion due to high instream flow stress (*Figure 25*). Various stream banks where graded using heavy machinery in order to lessen the steepness of the bank slope as well as to create a larger floodplain region to minimize impacts during high flow (*Figure 26*). These areas were seeded and planted with trees in order to maintain bank stabilization while providing future riparian vegetation.

<u>Figure 24:</u> Photographs illustrate the benefits of instream restoration projects. These photographs were taken before and after restoration work immediately downstream of the 10th Sideroad at site L4 within the 8th Concession of New Tecumseth. (Left) Before photograph taken in 1997. (Right) After photograph taken late spring 2004.

Figure 25: Smaller projects undertaken during 2002-2003. Floodplain was created on the inside stream bank. (Left) Before photograph taken in 1997/98. Arrow points to old streambank. (Right) After photograph taken late spring 2004. Arrow points to new floodplain.

At the furthest downstream project area along site L4 (*Figure 18- Site C*) a rather steep and eroding bank was machine graded to a lesser slope and the base was stabilized using tree revetments to secure the toe. The slope was then planted with grasses in order to minimize erosion (*Figure 27*).

Figure 26 : Restoration photographs taken during late spring 2004. (Left) Bank stabilization project along the outside bank at Site C. (Right) An additional bank stabilization project located within Site B.

5.4 East Branch Planning Zone

There have been no documented stream restoration projects within the East Branch Beeton Creek Planning Zone.

6.0 Recommendations

The following recommendations have been compiled after assessing the current stream health status of Beeton Creek. These suggestions are simply guidelines on what actions could be taken in order to better the health of Beeton Creek as well as to assist in maintaining the overall stream health of the stream.

6.1 Biological monitoring

Integrate the new Ontario Benthos Biomonitoring Network (OBBN) into the Beeton Creek Watershed to collect consistent invertebrate data throughout the system. Instilling and maintaining this monitoring protocol could generate a stream health database that could be used to produce annual summary reports on the health of Beeton Creek. For example, one could monitor on-going health trends of the stream especially around specific restoration sites in order to determine the improving stream conditions caused by restoration activities.

6.2 Temperature Monitoring

Temperature monitoring gives a good representation of the various thermal transition zones along a watercourse. By tracking temperature readings during high temperature stress periods, one can determine how the stream is recovering. Temperatures Data loggers are ideal for showing overnight recovery trends by recording 24 hours of temperature readings over a set period of time. Monitoring on-going temperature trends can be ideal for locations that have received restoration work including large tree plants and stream channel realignment that show long term improvements.

6.3 Fisheries monitoring

By monitoring the populations of fish within the stream and tracking their status one can determine whether instream work has provided any more significant habitat for fish species along Beeton Creek. Also, monitoring the fish populations can better assist in determining how to improve their specific habitats. Currently, there is very minimal information on the specific fish populations within Beeton Creek and a lot of the records are through observations rather then through sampling practices. Creating an efficient fish database for Beeton Creek may assist in determining the direction of stream improvements that should be under seen that would benefit the current and/or potential fish populations.

6.4 Tree Planting/ Tree Planting Assessments

Review the natural heritage mapping performed in New Tecumseth to review the current status of wooded areas and forested stream reaches. Try to reconnect forested areas in order to provide habitat for wildlife and to re-establish corridors along the entire Beeton Creek watercourse.

Re-assess the success of previous tree planting sites that were done at least 3-5 years ago. Some of the volunteer planting sites have had lower survival rates due to the increased levels of competition with the grasses and heavy thatch. Small tree seedlings are easily out competed by the intense growth of grass during late spring.

Site visits to some of the volunteer tree planting sites have shown low survivorship of trees that were planted. These sites could be re-assessed as to why the tree species may not have survived and new planting strategies could be developed in order to better suite these areas. Soil conditions, drainage and species competition are just a few of the factors that need to be considered when developing planting plans and determining the best practices to ensure higher survival rates for example, following up a tree plant with a controlled spray of herbicide to decrease the growth of grass during the initial stages of tree growth may increase survival rates.

These tree planting sites have been well documented as good candidates, therefore infilling them with new tree stocks may be worth investing in order to successfully forest the stream corridor.

Continuing to locate new locations for both large scale and small scale tree plants is always a good environmental project.

6.5 Riparian Vegetation

Continue planting idle lands along the stream channel especially in the Middle and Headwater Zones where the channel itself is more stabilized. Intensive riparian planting will assist in stabilizing the stream bank from enhanced erosion and will hopefully assist in providing long term stream cooling by decreasing the streams exposure time to intensive solar heating. Streamside vegetation reduces both sediment and nutrient transport especially along an area impacted by agricultural practices.

6.6 Agricultural Involvement

Continue to locate and approach landowners along Beeton Creek to create, enhance and widen the buffer regions along Beeton Creek. Encourage landowners to take advantage of available grants and funding opportunities to better the environment within their properties.

Also, ensuring that all cattle are excluded from directly accessing the stream including alternative watering sources and proper cattle crossing bridges. Properties were documented as having potential cattle access during the Beeton Creek Stream Study in 1997/98 within the 5^{th}, 7^{th}, and 9^{th} Concession of New Tecumseth along the east sides of the stream. These sites may still be allowing cattle access into the stream. Following up with the landowners of these locations to ensure that the cattle are restricted and that a buffer zone is recreated along these reaches to restore the banks would be a good community outreach project. Beeton Creek should no longer be directly impacted by agricultural activities but will still be suffering from indirect impacts from cropped land, irrigation, agricultural run-off and lack of riparian zones.

Project sites, such as the Cooney Property are good reference sites that show the success of excluding cattle from the stream and recreating a vegetative buffer region along the stream channel. Use these sites to encourage other farmers to become actively involved in environmental enhancement and implement the best management practices along the stream corridor.

6.7 Flood and Ice Control Structure

The old Ice Control structure located within the 5th Concession of New Tecumseth is now acting as a barrier to fish migration due to its inability to pass significant volumes of water through the structure. The water has pooled up behind the structure and has connected to the existing off-line pond creating a significant online pond. The stress of water has altered its course and is now seeping though the berm and smaller amounts are passing through the structure. This large standing body of water is creating aquatic habitat but is also creating a large surface for solar warming. However, due to the seepage through the berm, the water being released in not coming directly from the surface and is acting similar to a 'bottom-draw' control structure. This structure needs to be fixed and either redesigned or properly re-established in order to handle the appropriate amounts of water to allow the stream channel to re-establish itself to its original form. Continued support by all parties involved is required.

6.8 Stream Channel Enhancement

Continue investigating project sites that would benefit from stream channel enhancement activities including stabilizing eroding banks and grading back steep banks to lesser slopes. The Lower Planning Zone where the stream channel is more deeply incised and the banks are unstable as well as the Middle Planning Zone are two large stream stretches that have lengthened in overall stream length due to the migrating meander bends. These meander bends continue to migrate and increase in length due to the lack of significant stream side vegetation, including larger shrubs and trees. Shortening Beeton Creek by developing more moderate meanders will increase the gradient of the stream and increase the potential for the development of gravelly and rocky stream bottoms and riffles. Rocky riffles provide diverse habitats for stream invertebrates that remove excess phosphorus from the water column and reduce the phosphorus available to support growths of suspended green algae. Reducing suspended algae growth can significantly improve water clarity and conditions for sight-feeding species.

6.9 Instream Habitat Structures

Installing instream habitat structures such as woody debris that would assist in providing short term shade relief in areas that have minimal vegetative cover could assist in providing increased levels of fish habitat along Beeton Creek. These structures would need to be further developed and researched as to where they would be beneficial and where they would be the most stable before any plans to implement them are developed. Existing tree revetments that have been installed along restoration sites in order to assist in bank stabilization are acting as instream habitat.

An example of artificial instream habitat structures are 'Digger Logs' that mimic large organic debris and are embedded at the change in gradient from a riffle/run to a flat or pool. These digger logs create a scoured, rocky pool immediately downstream of the structure and provides potential spawning grounds for fish species especially immediately upstream of the structure that is usually supported by a 2:1 sloped cobble/small boulder rock bed. They prevent flooding, minimizes ice damage and allows fish passage. They are usually placed at ¼ of the bank height and placed across the stream on a 30 degree angle from the perpendicular (*Rutherford, R.J. et al, 1994*). This is just one example of a practice that could be implemented along Beeton Creek but further research and assessment of the stream would be required in order to implement the best instream habitat structures for the existing fish populations.

6.10 Tottenham Reservoir

The Tottenham Reservoir is a man-made reservoir that is intensely used by the local community for recreational purposes as well as provides ideal habitat for pond organisms. Levels of concern have been arising regarding the health status of the reservoir. Large levels of phosphorous accumulation and noticeably increasing levels of algae blooms have been documented by local residents over the past few summers and the concern lies with the long term accumulation of bacteria and phosphorous as well as its potential warming affects on the downstream creek.

There is currently an interest group known as the Tottenham Conservation Committee that has taken action into looking into how to monitor and collect data in order to better document the health status of the pond. This Conservation Committee have been working with the New Tecumseth Streams Committee and the Nottawasaga Valley Conservation Authority and have already had a limnologist visit the reservoir and give feed back on what the conditions were.

It is recommended that there be continued interest into monitoring the health status and determine how the health of the reservoir is impacting the surrounding environment. Monitoring data would assist in determining what future actions should be implemented in order to achieve the best management practices for the reservoir. It is crucial to fully understand the processes that are occurring within the reservoir environment before any conclusions can be made.

6.11 Environmental Funding Support

Generate funding to maintain monitoring practices along Beeton Creek including temperature, fish, invertebrate and chemical tests in order to maintain an up to date health status and to locate problem and problem prone areas. Funding could also be used to plan and implement environmental enhancement projects. Community action groups such as the New Tecumseth Streams Committee should continue to apply for these types of funding in order to receive funding to assist in conducting stream enhancement projects by working with organizations like the Nottawasaga Valley Conservation Authority. The Ontario Trillium Foundation (www.trilliumfoundation.org) is just one of the many government programs that provides funding to support environmental enhancement projects. The Ministry of Natural Resources (MNR) also provides financial help, expertise, equipment and materials for volunteer projects that improve fish and wildlife as well as improve opportunities for outdoor recreation through a grant program called CFWIP (Community Fisheries and Wildlife Incentive Program). Some of their funded programs include habitat restoration and streambank fencing. Continue to apply for and receive funding to enhance the environmental status surrounding Beeton Creek.

6.12 Landowner/Community Involvement

Maintain and increase the involvement of the local landowners and community members that are within the Beeton Creek watershed. Providing the community residents with 'Stream reports' that document the overall stream health status along with the projects that have been undertaken may encourage more community members to become involved in the enhancement of Beeton Creek. Also, providing more information about on-going projects and proposed environmental enhancement plans may entice community members to become for environmentally concise and may become more involved with the environmental restoration.

6.13 Tottenham Sewage Treatment Plant

Streams are limited as to the levels of phosphorous loadings they can handle due to their size and flow rate and therefore their ability to assimilate phosphorous efficiently. Beeton Creek has been documented as being too 'small' to assimilate the excess levels of phosphorous currently being released by the Tottenham Sewage Treatment Plant. The plant is operating at it top capacity and because of this, the town of Tottenham is unable to further develop and increase its population size. There have been plans developed to redirect sewage from the Tottenham area up to the Alliston Plant where the larger Nottawasaga River is more capable of handling increased discharges of phosphorous.

Suggestions would be to maintain communication with the Town of New Tecumseth in determining whether or not the plant is merging with the Alliston Sewage treatment plant and determine what the time line is if this has already been determined. Knowing whether the treatment plant will remain active for the next few years could determine whether it is beneficial to initiate environmental enhancement plans. Short term environmental enhancement projects around the plant and outfall stations may assist in the infiltration and filtering of the treated sewage effluent. Developing long-term goals to restore the site to its natural form when the plant is no longer in operation may also be a project to consider looking into further.

6.14 Northwood Park Stream Enhancement Site

This project site has one more proposed restoration action involving the re-alignment of the existing stream channel to recreate a shorter, more stabilized stream reach that would generate more concentrated flows through the newly established stream reach. This newly constructed stream reach could produce riffle habitats can provide critical spawning and food producing habitats for various fish species. The presence of predator fish can not only provide a viable resource for sport fishing but also plays a role in storing phosphorus and further improving water quality.

Proposed plans have been developed to work with a credited hydro-geomorphologist in order to perform a study that would incorporate designs to re-align the stream channel and determine opportunities for riffle construction and appropriate riffle specifications. The construction of riffles could also be used to establish well-defined pool habitats, which are currently limiting in Beeton Creek. Upon completion of this design, plans would be developed in order to fund the proposed design plans that would complete the restoration projects at this location.

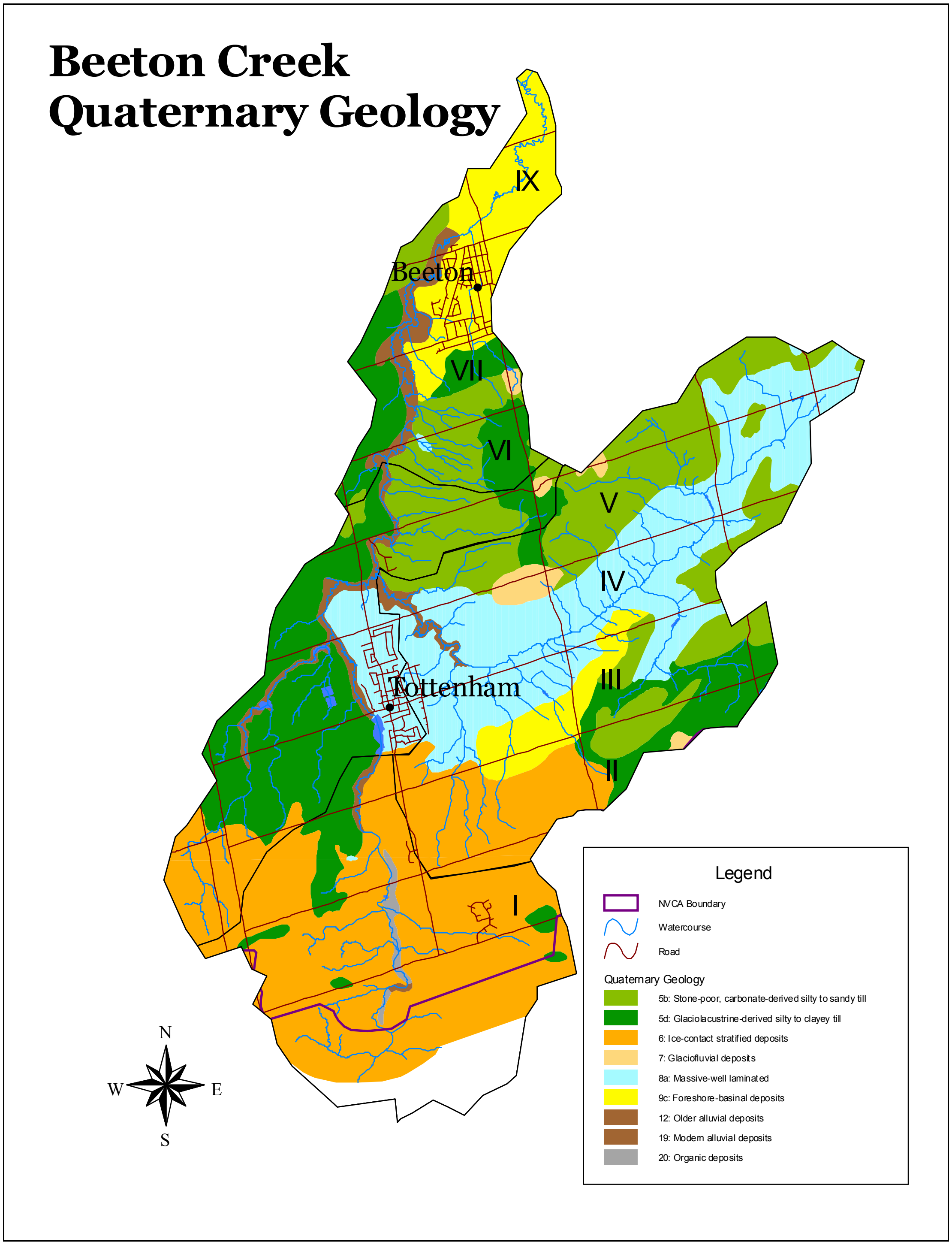
6.15 East Branch Beeton Creek

Currently there have been no restoration projects documented within or along the East Branch of Beeton Creek. This tributary of Beeton Creek has been classified as 'Below Potential' and further examination into how to improve this tributary may assist in improving the overall health of Beeton Creek. Further studies to determine how the stream morphology and surrounding stream conditions of this tributary interact may assist in developing strategies to restore the stream conditions. The habitat survey completed on Beeton Creek in 1998 evaluated the stream habitat along the main Beeton Creek but did not include exploration along the East Branch. The East Branch is not necessarily negatively impacting Beeton Creek but examination into how it is interacting with the main branch may determine the appropriate future direction for the stream.

Appendices

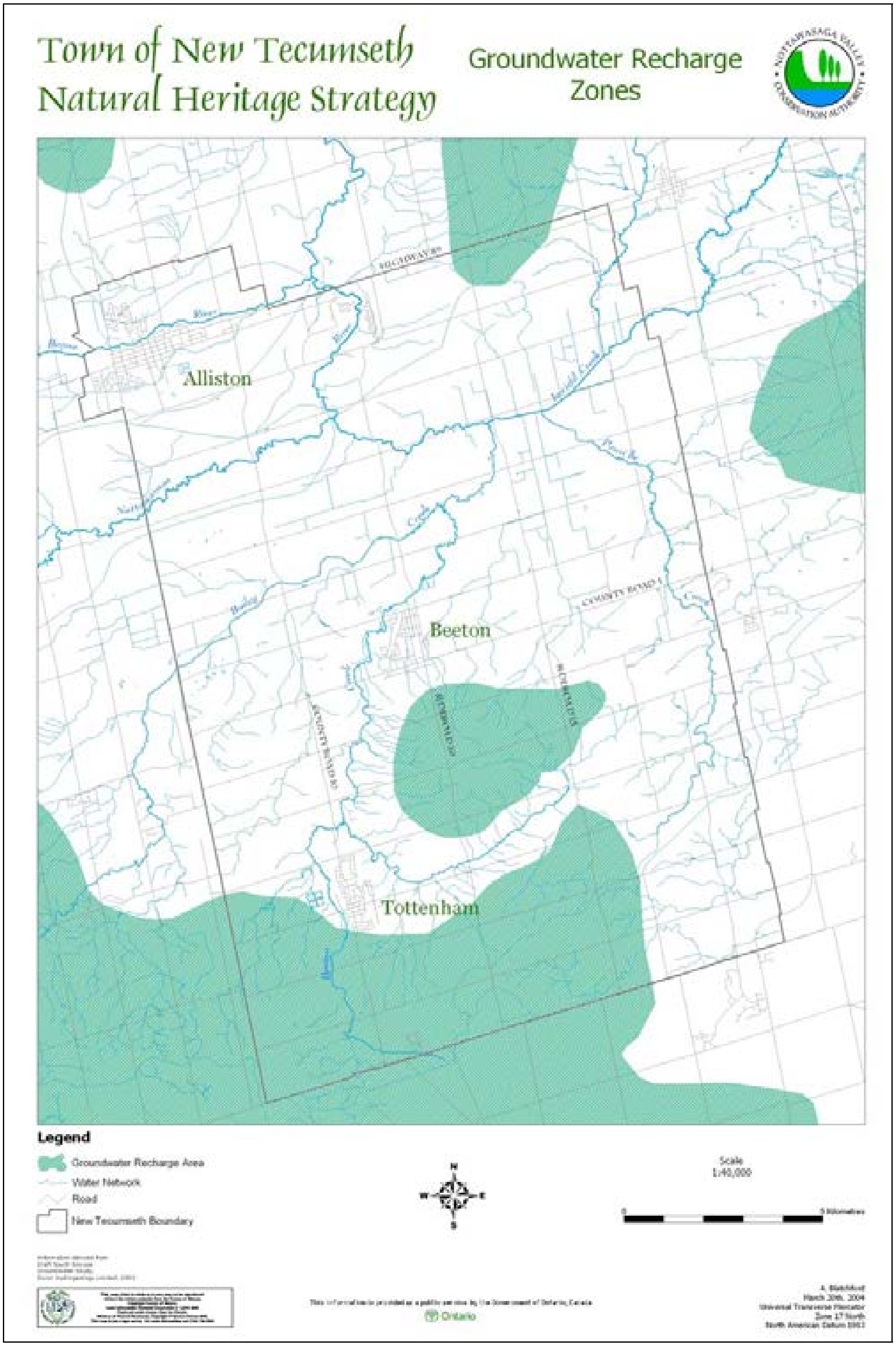
1. Quaternary Geology of Beeton Creek Watershed
2. Groundwater Recharge Zones located within the Town of New Tecumseth
3. Groundwater Discharge Zones located within in the Town of New Tecumseth
4. Biological Monitoring Sampling Locations Summary Table for Beeton Creek
5. Map of the Biological Monitoring Sampling Locations
6. New Tecumseth Streams Committee Information
7. Summary Statistics of Stream Rehabilitation Projects
8. Projects Listed by Year
9. Resources Used

Appendix 1 Quaternary Geology of Beeton Creek



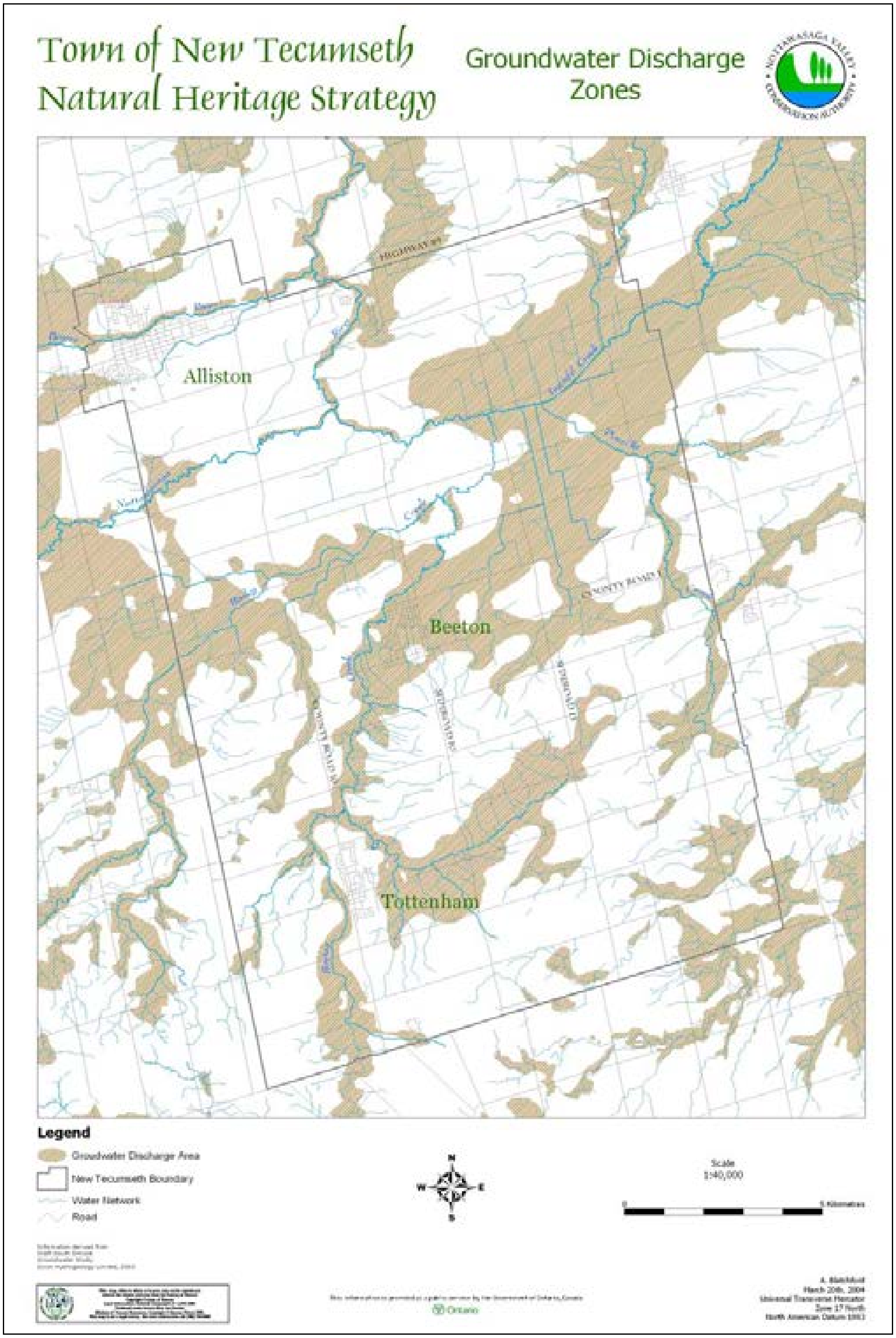
Source: New Tecumseth Natural Heritage Strategy Draft

Appendix 2 Groundwater Recharge Zones located in the Town of New Tecumseth



Source: New Tecumseth Natural Heritage Strategy Draft

Appendix 3 Groundwater Discharge Zones located in the Town of New Tecumseth



Source: New Tecumseth Natural Heritage Strategy

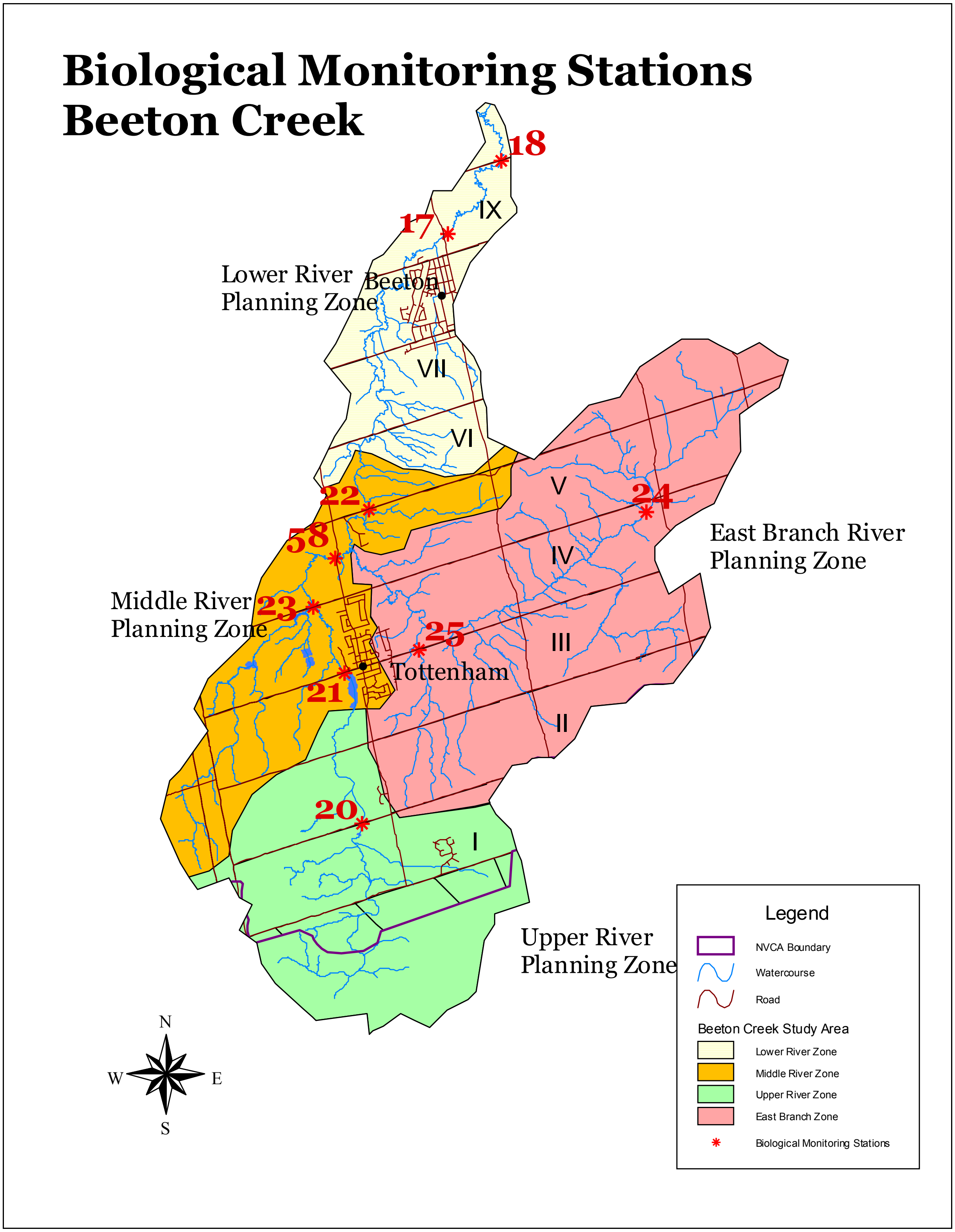
Appendix 4 Biological Monitoring Sampling Locations Summary Table for Beeton Creek

Beeton Creek - Biological Monitoring Summary 1996-2001

Sampling Site	Station Identifier (Report)	Sampling Date (M/D/Y)	WQIq	WQId	Status	Stream Health Constraints or Impairment Factors	Characterizing taxa	Substrate	Riparian Habitat	Adjacent Land Use	Number of Sensitive Taxa
19	Concession 11 New Tecumseth	5/24/98	2.63	5.96	Impaired	stripped riparian vegetation, erosion	Saetheria	sand	grasses	agriculture	0
18	Concession 10 New Tecumseth	10/25/96	2.5		Impaired	highly erosive, stripped riparian vegetation		sand	pasture	agriculture	
18	Concession 10 New Tecumseth	5/23/97	2.79	4.84	Impaired	Highly erosive, striped riparian vegetation	Chironomus	sand	cropped	agriculture	0
18	Concession 10 New Tecumseth	10/30/97	2.79	6.94	Impaired	Highly erosive, stripped riparian vegetation	Chironomus	sand	cropped	agriculture	0
17	Concession 9 New Tecumseth [@ Sideroad 10](Lequelenec Property)	5/31/01	2.57	8.02	Impaired	erosion, minimal riparian zone, no cover	Chironomids, Baetidae, S. crenata	silt/sand/clay	grasses	agriculture/grazing land	
22	Concession 6 New Tecumseth	5/23/97	2.82	6.57	Impaired	Channelized		sand	old field	rural residential	
22	Concession 6 New Tecumseth	10/19/01	3	11.62	Impaired		Optioservus, Cheumatopsyche, Hydropsyche sp.	gravel/sand/cobble	old field	rural residential	
23	Concession 5 New Tecumseth	5/11/98	3.13	10.43	Below potential		Worms, Hydropsychids, Chironomus, Baetis tricaudat	gravel, sand, silt	forested	commercial, industrial, residential	1
58	Concession 5 New Tecumseth County Road 10 (Cooney Property)	5/24/01	3	8.59	Below potential	sand/gravel			grasses/meadow		
21	Concession 4 New Tecumseth	5/11/98	3	9.15	Impaired	below Tottenham Reservoir	Hydropsychidae, worms	gravel, sand, silt	park land	commercial, park land	0
20	Concession 2 New Tecumseth	5/11/98	3.28	16.94	Unimpaired	below on-line pond	Gammarus pseudolimnaeus	sand, gravel, abundant woody debris	forested	residential	2
24	East Branch @ Concession 5 New Tecumseth	6/03/99	2.88	6.71	Impaired	below small impoundment, municipal drain, pastured	Chironomus, worms, Simuliidae	gravel	grasses	agiculture	
25	Tributary (E. Branch) @ 4th Line	10/19/01	3	4.08	Below potential		Chironominae	gravel, cobble, sand, silt	grasses, lawns	residential	

Source : Nottawasaga Valley Conservation Authority Biological monitoring database.

Appendix 5 Map of the Biological Monitoring Sampling Locations



Source: Nottawasaga Valley Conservation Authority

Appendix 6 New Tecumseth Streams Committee Information

New Tecumseth Streams Committee

The New Tecumseth Streams Committee (NTSC) is a volunteer organization developed in 1997 and is made up of local residents, community group, industry and government representatives with strong support from the Town of New Tecumseth, Honda Manufacturing of Canada Ltd., and the Nottawasaga Valley Conservation Authority (NVCA). Goals include improving the health of local rivers and streams by enhancing water quality, fish and wildlife habitats and the environmental attributes of local waterways and corridors, and optimizing the benefits to local communities resulting from the presence of healthy streams and rivers. The Streams Committee is highly involved in identifying environmental impacts, planning remedial works, securing funding for remedial works, and incorporating and coordinating various groups and local community members in these environmental enhancement projects.

Rivers and streams flowing through the Town of New Tecumseth are the Nottawasaga and Boyne Rivers, and the Bailey, Beeton, Innisfil, Penville and Spring Creeks. Restoration and clean-up projects have been undertaken on the Boyne and Nottawasaga Rivers, and the Beeton and Spring Creeks. The priority focus is on the Beeton Creek which lies completely within the Town borders and has been identified as highly impaired by the NVCA. Some of the issues affecting all local streams include:

- Impacts related to developing urban communities such as Alliston, Tottenham and Beeton and potential resulting water quality and habitat impairments.
- Impacts related to rural land usage such as those potentially associated with agricultural operations (both crop and livestock) and in particular habitat and water quality issues related to historic riparian vegetation losses immediately adjacent to streams and drainage channels.
- Impacts on fisheries and water temperatures through existing on-line structures and from expanding transportation, infrastructure service corridors contacting streams
- Impacts associated with storm/melt peak flows as it relates to the lack of local stream ability to mitigate negative impacts.

The NTSC applies for funding and works closely with the Nottawasaga Valley Conservation Authority for project detail in order to secure funding to cover the costs of supplies, labour and project implementation. Over the years, the NTSC has received funding from CFWIP (MNR grant), Healthy Waters (NVCA grant), The Town of New Tecumseth, Honda Mfg. of Canada Ltd., and other Environmental Enhancement Funds along with landowner donations and individual contributions. Some of the projects are implemented through Community Work Party Days involving activities such as tree planting, bank stabilization through tree revetment installation, live willow staking and riverside clean-up.

Partnerships, community support and involvement are crucial in riverside restoration. Over the years, the NTSC has formed many partnerships and enjoyed community support through volunteer, monetary and in-kind contributions. Some of the Partnerships are listed below:

- Alliston & District Chamber of Commerce
- Alliston Lions Club
- Alliston Rotary Club
- Arbor Committee
- Baxter Lab Green Tree
- Banting Memorial Secondary School
- Beeton Beavers, Cubs and Scouts
- Beeton Rotary Club
- Dufferin South Simcoe Land Stewardship Network (MNR)
- Honda of Canada Mfg.
- Landowners
- Local Newspapers
- New Tecumseth Economic Development Corp.
- Nottawasaga Steeleheaders
- NVCA
- Rich Hill United Church
- Simcoe County Roman Catholic School Board
- Somerville Nurseries
- St. Thomas Aquinas Secondary School
- The Hillcrest Pentecostal Church
- Tottenham Beaver, Cubs and Scouts
- Tottenham Chamber of Commerce
- Tottenham Legion
- Town of New Tecumseth

Appendix 7.1 Project Summary Statistics for Site M1

Project	Item	Supplier	Cost (including taxes)
1 – Volunteer Tree Plant 1999	Tree Seedlings: 500 white cedar, white spruce and white pine	Nottawasaga Valley Conservation Authority	$170.00 (~$0.34 each)
	Brush Blanket	Nottawasaga Valley Conservation Authority	$500.00 ($1.00 each)
	Volunteer Contributions	Nottawasaga Valley Conservation Authority	$500.00 (at $10.00/hour) – In-kind
		Total Project Value	**$1170.00**

Appendix 7.2 Project Summary Statistics for Site M2 Projects

Project	Item	Supplier	Cost (including taxes)
1 - Volunteer Tree Plant – Thurs. April, 26 2001 (in section B)	Transportation of 35 students with portable toilet	Prince of Wales Elementary School and Al Toilets	$300.00
	Tree Seedlings: 500 white pine	Nottawasaga Valley Conservation Authority (Invoice #3634)	$185.00 (500 at $0.37 each)
	Volunteer contributions (37 volunteers contributed 6 hours in the field)	Prince of Wales Elementary School and	$2,220 (at $10.00/hour) – In-kind
	Herbicide Application	Nottawasaga Valley Conservation Authority	$128.00
		Total Project Value	**$2,878.00**
2 - Professional Tree Plant in 2002 (in section B)	Trees Seedlings: 1000 white cedar, 500 white spruce, 500 black walnut, 250 norway spruce	Nottawasaga Valley Conservation Authority	$2,233.63 (planting and herbicide included) -See Appendix 7.2A – Planting Plan
		Total Project Value	**$2,233.63**
3 - Exclusion Fencing in 2002	Fencing materials	Landowner and Nottawasaga Valley Conservation Authority	$2,045.00
	Windmill with water pump	Trillium Windmills Inc. (Invoice #4530)	$1,209.64
	Bridge	Landowner – In-kind	$1,190.00
	Labor (landowner contributed 80 hours)	Landowner – In-kind	$1,400.00 (at $17.50/hour)- In-kind
		Total Project Value	**$5,844.64**
4 - Professional Tree Plant 2003 (in section A and	Tree Seedlings: 800 white cedar, 500 white spruce, 350 white pine, 150 black walnut,	Nottawasaga Valley Conservation Authority	$2,610.50 (planting and herbicide included) -See Appendix 7.2B – Planting Plan

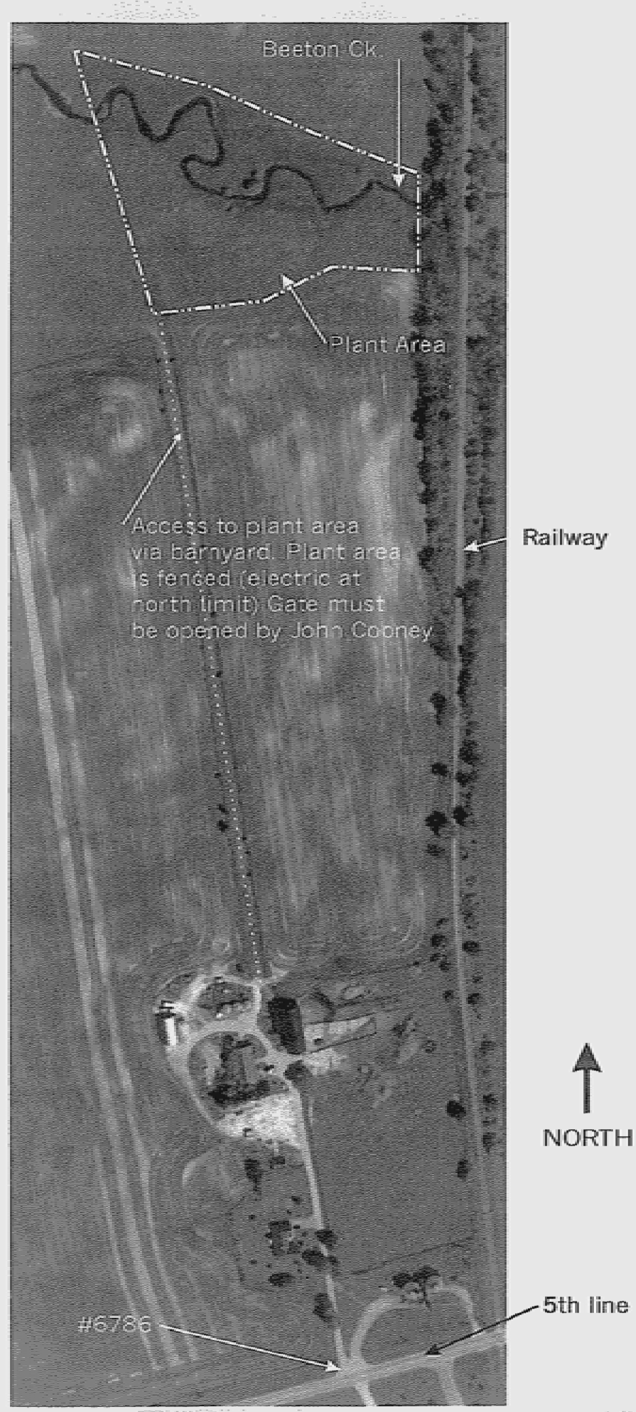
B)	150 red osier dogwood, 50 red oak		
		Total Project Value	**$2,610.50**
		Total Project Value for all four projects	**$13,521.77**

Appendix 7.2A Site M2 Planting Plant in 2002

NVCA Spring 2002 Tree Planting Program - John Cooney Site Plan South part lot 5, conc. 5 New Tecumseth

Plant trees 6' x 6'. Intermix species in rows that run east - west. Stay 6' from trees planted last year, fences and any existing mature trees. Plant Cw in low, wet sections, and adjacent to the creek.

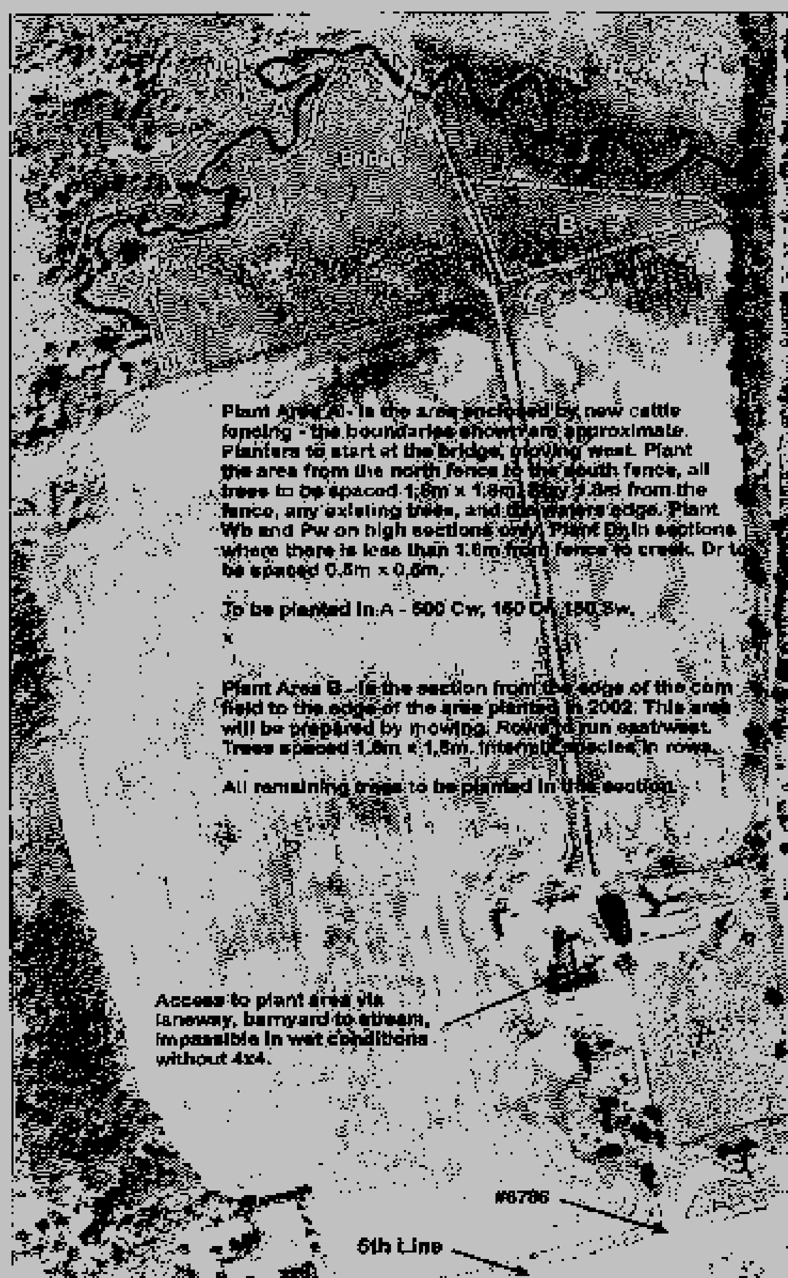
Start on North side of the stream, moving south across the plant area till out of trees.



Source: Nottawasaga Valley Conservation Authority

Appendix 7.2B Site M2 Planting Plan in 2003

NVCA Spring 2003 Tree Planting Program
John Cooney Site Plan
South part lot 5, conc. 5, Town of New Tecumseth



Source: Nottawasaga Valley Conservation Authority

Appendix 7.3 Project Summary Statistics for Site M3

Project	Item	Supplier	Cost (including taxes)
1 – Volunteer Tree Plant in 2000	Tree Seedlings: 20 red pine, 20 white pine, 10 white spruce	Nottawasaga Valley Conservation Authority	$ 44.28
	Volunteer Contributions	New Tecumseth Streams Committee	$750.00 (at $10.00/hour) – In-kind
		Total Project Value	**$794.28**

Appendix 7.4 Project Summary Statistics for Site M4

Project	Item	Supplier	Cost (including taxes)
1 – Volunteer Tree Plant in 2000	Tree Seedlings: 100 white spruce, 200 white pine, 200 red pine	Nottawasaga Valley Conservation Authority	$347.75
	Brush Blanket	Steelheaders	$100.00 ($1.00 each)
	Volunteer Contributions	New Tecumseth Streams Committee	$750.00 (at $10.00/hour) – In-kind
		Total Project Value	**$1197.75**
2 – Volunteer Tree Plant – Sat. May 12, 2001	Tree Seedlings 300 and 15 shrubs, 10 cedar, 8 large stock trees	Nottawasaga Valley Conservation Authority	$1140.00
	Brush Blanket	Nottawasaga Valley Conservation Authority	$207.00 (.69 each)
	Volunteer Contributions	New Tecumseth Streams Committee	$750.00 (at $10.00/hour) – In-kind
		Total Project Value	**$2097.00**
3 – Volunteer Tree Plant – Sat. May 3, 2003	Tree Seedlings: 800 white cedar, 200 red osier dogwood	Nottawasaga Valley Conservation Authority	$844.25 (each $1.10)
	Bush Blankets	Nottawasaga Valley Conservation Authority	$345.00 (.69 each)
	Weed Mat Staples	Nottawasaga Valley Conservation Authority	$180.00 (.06 each)
	Volunteer Contributions	New Tecumseth Streams Committee	$750.00 (at $10.00/hour) – In-kind
		Total Project Value	**$2119.25**
		Total Project Value for all three projects	**$5411.00**

Appendix 7.5 – Project Summary Statistics for Site M5

Project	Item	Supplier	Cost (including taxes)
1 – Professional Tree Plant in 1996	Tree Seedlings: 550 white cedar, 500 white spruce, 800 white pine, 600 silver maple, 300 hemlock, 400 red pine, 500 larch, 400 red osier dogwood	New Tecumseth Arbour Committee	$3281.65 (planting and herbicide included)
		Total Project Value	**$3218.65**
2 – Bank Stabilization in 1999	Tree revetments (large cedars), 200 live willow stakes, aircraft cable, t-bars		$1400.00
	Volunteer Contributions		$750.00 (at $10.00/hour) – In-kind
		Total Project Value	**$2150.00**
		Total Project Value for both projects	**$5368.65**

Appendix 7.6 Project Summary Statistics for Site L1 Projects

Project	Item	Supplier	Cost (including taxes)
1 - Professional Tree Plant in 2000	Tree Seedlings: 1000 white spruce, 1000 white cedar, 1000 white pine	Nottawasaga Valley Conservation Authority	$5,422.25 (planting and herbicide included)
		Total Project Value	**$5,422.25**
2 - Professional Tree Plant in 2001	Tree Seedlings: 1200 white pine, 2500 white spruce, 500 tamarack, 2500 red osier dogwood	Nottawasaga Valley Conservation Authority	$5,745.90 (planting and herbicide included)
		Total Project Value	**$5,745.90**
3 - Professional Tree Plant in 2002	Tree Seedlings: 1500 white spruce, 500 white cedar	Nottawasaga Valley Conservation Authority	$1,899.25 (planting and herbicide included)
		Total Project Value	**$1,899.25**
4 - Professional Tree Plant in 2004	Tree Seedlings: 1400 white cedar, 2800 white spruce, 700 tamarack, 20 bur oak	Nottawasaga Valley Conservation Authority	$5863.60 (planting and herbicide included)
		Total Project Value	**$5,863.60**
		Total Project Value for all four projects	**$18,931.00**

Appendix 7.7 – Project Summary Statistics for Site L2

Project	Item	Supplier	Cost (including taxes)
1 – Stream Bank Stabilization 2001	X-Mas Trees for Revetments (50)	From Lequelenec Donation at N.V.C.A.	$1500.00
	9’ Trees (30)	Supplement from Sommervilles	$200.00
	Livestakes		$57.50 (50 at $1.00/stake)
	Shrubs		$172.50 (10 shrubs at $15.00/shrub)
	Erosion Control Blankets		$648.60 (6 rolls at $94.00/roll)
	Staples for Blankets		$73.60 (1 box at $64.00/box)
	Cables		$207.00 (3 rolls at $60.00/roll)
	T-bars		$207.00 (30 bars at $6.00/bar)
	Crew Supervisor	Nottawasaga Valley Conservation Authority	$449.40 (28 hours at $15.00/hour)
	Work Crew	Nottawasaga Valley Conservation Authority	$1168.44 (3 workers for 28 hours at $13.00/hour)
	Rock rip-rap		$579.60 (24 tonnes at $21.00/tonne)
	NVCA Summer Staff	Nottawasaga Valley Conservation Authority	$2268.00
	NVCA Crew Mileage	Nottawasaga Valley Conservation Authority	$144.00
	Full Size Excavator	New Tecumseth Streams Committee	$1035.00 (10 hours at $90.00/hour)
	Float for Excavator		$207.00 (2 hours at $90.00/hour)
	Volunteer Contributions		$600.00
		Total Project Value	**$9517.64**
2 – Volunteer Clean-up	Field Crew Supervisor	Nottawasaga Valley Conservation Authority	$315.00 (at $15.00/hour)
	3 Person Field Crew	Nottawasaga Valley Conservation Authority	$819.00 (at $13.00/hour)
	3 Days of Mileage	Nottawasaga Valley Conservation Authority	$84.00 (250km at $0.35/km)
	NVCA Hours	Nottawasaga Valley Conservation Authority	$715.50 (at $27.00/hour)
		Total Project Value	**$1933.50**
3 – Volunteer Tree	Live Willow Stakes		$230.00 (100 at $2.00 each)

Plant 2002 (west side) – Sat. May 4			
	Larger Stock		$862.50 (25 trees at $30.00 each)
	Shrubs		$575.00 (50 shrubs at $10.00 each)
	Volunteer Contributions		$750.00 (at $10.00/hour)
		Total Project Value	**$2417.50**
4 – Bank Stabilization 2002 (85m)	High hoe for 3 days		$3300.00
	Rock rip rap		$3000.00 (100metric tones)
	Grass seed and application		$300.00
	Erosion and Sediment Control Material	Terrafix Geosynthetics Inc.	$5852.11
	Project Set-up and Management	Nottawasaga Valley Conservation Authority	$900.00 (30 hours at $30.00/hour)
	2 person work crew	Nottawasaga Valley Conservation Authority	$1246.70 (182 hours at $6.85/hour)
	Mileage	Nottawasaga Valley Conservation Authority	$175.00 (50km roundtrip for 10 days at $0.35/km)
		Total Project Value	**$14773.81**
5 – Volunteer Tree Plant 2003	Tree Seedling: 800 white cedar, 200 red osier dogwood, 10 large spruce, large stock (east side – 30m)		$1423.10
	Brush Blanket		$604.95
	Volunteer Contributions		$900.00
		Total Project Value	**$2928.05**
6 – Bank Stabilization (Floodplain Creation/Bank Stabilization) 2003	Tree Revetments		$1700.00 (170 trees at $10.00 each)
	Cables		$552.00 (8 rolls at $60.00 each)
	T-Bars		$1368.50 (170 bars at $7.00 each)
	Live Willow Stakes		$460.00 (200 at $2.00/each)
	Erosion Control Blanket		$648.60 (6 rolls at $94.00/eaci)
	Filter Fabric		$4280.00
	High-hoe		$9416.00
	Trucking for Fill		$4494.00

	Rock rip rap		$4280.00
	Grass Seed		$535.00
	Professional Service	Nottawasaga Valley Conservation Authority	$2478.00 (88.5 hours at $28.00/hour)
	Professional Service	Nottawasaga Valley Conservation Authority	$901.00 (26 hours at $35.00/hour)
	Project Site Coordinator	Nottawasaga Valley Conservation Authority	$4378.28 (at $30.00/hour)
	Volunteer Contributions		$1050.00
		Total Project Value	**$35491.38**
7 – Volunteer Tree Plant – Sat. May 1, 2004	Live Willow Stakes	Nottawasaga Valley Conservation Authority	$600.00 ($2.00 each)
	Volunteer Contributions	New Tecumseth Streams Committee	$1200.00 (at $10.00/hour) – In-kind
		Total Project Value	**$1800.00**
8 – Stream Habitat Restoration 2004	Excavation, trucking and rock rip-rap	Rumball Excavation and Haulage (Invoice #9358)	$6249.74
	Biologist(s) mileage	Nottawasaga Valley Conservation Authority (Invoice #4513)	$1453.50
	Coconut fibre Erosion Control Mat and Staples	Nottawasaga Valley Conservation Authority	$500.00 – In-kind
		Total Project Value	**$8203.24**
		Total Project Value for all eight Projects	**$77065.00**

Appendix 7.8 Project Summary Statistics for Site L3 Projects

Project	**Item**	**Supplier**	**Cost (including taxes)**
1 – Stream Bank Stabilization in 2000 – 40m	Tree revetments		$800.00 (80 at $10.00 each)
	Sod mats, grading		$1120.00
	Cables		$276.00 (4 rolls at $60.00 each)
	T-bars		$644.00 (80 bars at $7.00 each)
	Excavator		$1000.00 (10 hours at $100.00/hour)
	Trucking Fill		$600.00 (8 hours at $75.00/hour)

	Coordination	Nottawasaga Valley Conservation Authority	$480.00 (16 hours at $30.00/hour)
	Volunteer Contributions		$800.00
		Total Project Value	**$5720.00**
2 – Volunteer Tree Plant – Wed. May 1, 2002	Tree Seedlings: 3000 white pine, white spruce, white birch	Nottawasaga Valley Conservation Authority	$2407.50
	Mileage	Nottawasaga Valley Conservation Authority	$28.70 (82 km at $0.35/km)
		Total Project Value	**$2436.20**
		Total Project Value for both projects	**$8156.20**

Appendix 7.9 Project Summary Statistics for Site L4 Projects

Project	**Item**	**Supplier**	**Cost (including taxes)**
1 – Professional Tree Plant in 1996	Tree Seedling: 500 white cedar, 1000 white pine, 10500 red pine, 500 nannyberry		$4234.48 (planting and herbicide included)
		Total Project Value	**$4234.48**
2 – Volunteer Tree Plant in 1999	Tree Seedlings: 600 white spruce, white pine		$200.10
	Coordinator	Nottawasaga Valley Conservation Authority	$88.00 (at $11.00/hour)
	Mileage for coordinator	Nottawasaga Valley Conservation Authority	$27.00 (90km at $0.30/km)
	Volunteer Contributions		$180.00 (at $10.00/hour) – In-kind
		Total Project Value	**$597.30**
3 – Bioengineering in 1999	Permit		$75.00
	Site Visits	Nottawasaga Valley Conservation Authority	$144.45 (3 hours at $45.00/hour)
	Project Design	Nottawasaga Valley Conservation Authority	$144.45 (3 hours at $45.00/hour)
	Costing		$144.45 (3 hours at $45.00/hour)
	Labour of collecting and installing Live Willow Stakes		428.00 (10 hours at $20.00/hour)
	Rock rip-rap		$607.20 ($24 tonnes $22.00/tonne)
	Geotextile		$500.00
	Christmas Trees		$200.00

	Cable Clamps		$100.00
	High Hoe		$621.00 (6 hours at $90.00/hour)
	Float for Excavator		$172.50 (2 hours at $75.00/hour)
	Pickup Truck Mileage		$72.00 (80 km at $0.30/km)
		Project Total	**$3209.05**
4 – Re-vegetation and Bioengineering in 2000	Live willow stakes		$200.00
	Project Design	Nottawasaga Valley Conservation Authority	$210.00 (at $30.00/hour)
	Permit Acquisition	Nottawasaga Valley Conservation Authority	$210.00 (at $30.00/hour)
	Project Management	Nottawasaga Valley Conservation Authority	$210.00 (at $30.00/hour)
	Field Supervisor (6 days)	Nottawasaga Valley Conservation Authority	$630.00 (at $12.00/hour)
	Field Crew (2 persons, 6 days)	Nottawasaga Valley Conservation Authority	$1092.00 (at 13.00/hour)
	Metal t-bars	Nottawasaga Valley Conservation Authority	$207.00 ($6.00 each)
	Aircraft cables (2 rolls)	Nottawasaga Valley Conservation Authority	$138.00 ($60.00 each)
	Cable crimps (2 bags)	Nottawasaga Valley Conservation Authority	$59.80 ($26.00 each)
	Miscellaneous (bug repellent, patch kit)	Nottawasaga Valley Conservation Authority	$100.00
	Pickup truck (NVCA)	Nottawasaga Valley Conservation Authority	$147.00 (70km at $0.35/km)
		Project Total	**$5003.80**
5 – Volunteer Tree Plant- Sat. May 4, 2000	Tree Seedlings: 300 white pine, 300 spruce		$217.35
	Large Stock		$900.00 (30 Spruce at $30.00/each)
	Volunteer Contributions		$750.00 (at $10.00/hour)
		Total Project Value	**$1867.35**
6 – Bioengineering in 2001	200 live willow stakes	New Tecumseth Streams Committee/Dufferin-South Simcoe Land Stewardship Network	$460.00 (200 at $2.00/each)
	100 tonnes of rock rip rap	New Tecumseth Streams Committee/Dufferin-South Simcoe Land Stewardship Network	$3000.00
	High hoe operator	New Tecumseth Streams Committee/Dufferin-	$2000.00 (20 hours at $100.00/hour)

		South Simcoe Land Stewardship Network	
	Cable and t-bars	New Tecumseth Streams Committee/Dufferin-South Simcoe Land Stewardship Network	$345.00
	Tree Revetments		$300.00 (30 trees at $10.00/each)
		Total Project Value	**$ 3000.00**
7 – Volunteer Tree Plant in 2001	Tree Seedlings: 250 white pine, 50 white spruce, 10 shrubs, 7 cedars, 28 large stock trees		$1685.25
	Brush Blankets		$214.00
	Volunteer Contributions		$900.00 (at $10.00/hour)
		Total Project Value	**$2799.25**
		Total Project Value for all seven Projects	**$20711.00**

Appendix 8 Projects Listed by Year

Date	**Year**	**Proponent**	**Location**
Saturday May 10th	1997		Riverdale Park
Spring 1998			
Spring 1999			
Saturday May 6th	2000	New Tecumseth Streams Committee	Lequelenec
Thursday April 26th	2001	Prince of Wales Public School	Cooney
Saturday May 12th	2001	New Tecumseth Streams Committee	Vinneau
Wednesday May 1st	2002	School Group	Roman Catholic School
Saturday May 4th	2002	New Tecumseth Streams Committee	Northwood Park
Saturday May 3rd	2003	New Tecumseth Streams Committee	Vinneau
Saturday May 1st	2004	New Tecumseth Streams Committee	Northwood Park

Appendix 9 Resources Used

Resources Used

- Innisfil Creek Watershed 2003 Report (Draft)
  NVCA Documentation

- Allan, David J. *Stream Ecology Structure and Function of Running Waters*. Kluwer Academic Publishers. The Netherlands, 1995.

- Beeton Creek 1998 Habitat Assessment and Rehabilitation Plan for 1999 prepared for the New Tecumseth Streams Committee and various other NVCA and NTSC documented restoration projects, databases and stream health reports.

- New Tecumseth Natural Heritage Strategy (Draft)
  NVCA Documentation
- Rutherford, R.J., MacInnis, C., MacLean Sean. *Restoration of Spawning and Juvenile Rearing Areas for Atlantic Salmon (Salmo Salar) And Brook Trout (Salvelinus Fontinalis).* Chapter 22. Natural Channel Design: Perspectives and Practice. 1994

- U.Sibul and A.V. Choo-Yihng, Water Resources Report 3 : Water Resources of the Upper Nottawasaga River Drainage Basin. Ontario Water Resources Commission. 1971. Toronto, Ontario.

- Nottawasaga Valley Watershed Management Plan 1996-2015, *Nottawasaga Valley Conservation Authority Documentation*

Glossary

Below Potential – Not functioning up to healthy standards; shows signs of disturbance.

Catchment Area - The area drained by a river or body of water. Also called *catchment basin.*

Impaired - Diminished, damaged, or weakened; functioning poorly or incompetently.

Invertebrate - An animal, such as an insect or mollusk, that lacks a backbone or spinal column.

Ox-Bow - A U-shaped bend in a river and/or the land within such a bend of a river.

Riparian - Of, on, or relating to the banks of a natural course of water

Unimpaired – Healthy, not disturbed; functioning efficiently.

Watershed - A ridge of high land dividing two areas that are drained by different river systems. Also called *water parting*. The region draining into a river, river system, or other body of water.