SHARON CREEK SUBWATERSHED STUDY

RECOMMENDED SUBWATERSHED PLAN

Prepared by:

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Errata for Dingman Creek - Recommended Subwatershed Plan

The following changes should be noted in Table 12.1:

1. For Aquatic/Stream Restoration, cost is $7.2 m not $0.72 m

2. For All Lands in Important Recharge, area is 1834 ha

3. Add new practice under Conservation and Management Practices:
   Conservation Tillage in Medium Priority Areas, Rank = 3
Attention: TAC Members – Sharon Creek Subwatershed Study

Reference: Recommended Subwatershed Plan

Dear TAC Member:

We are pleased to submit for your review a copy of the Recommended Subwatershed Plan for Sharon Creek. This document complements earlier submissions and will ultimately form part of the Final Report.

In preparing this document, meetings have been held with the public and the Technical Advisory Committee. Furthermore, the consultant teams have met several times in an attempt to standardized the approach.

This document, as noted above, presents the Recommended Plan. Subsequent submissions will include:

i) the Implementation Plan (21 April 1995); and

ii) a Technical Appendix (12 May 1995).

The Technical Appendix will include the technical information, including computer models, targets (or objectives) as well as Fact Sheets for each subcatchment. The Fact Sheet, in turn, will provide insight as to the steps to be undertaken (including type of detail studies) at the Area Plan, Draft Plan or Site Plan stage.

This report will be discussed at the scheduled meeting for Dingman Creek: March 28 1995, at 9:30 a.m., in Committee Room 1, 2nd Floor, City of London.

Yours sincerely,

AQUAFOR BEECH LIMITED

David E. Mautner, M.Sc., P.Eng.
Principal
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   - R. Long, Agricultural Advisory Committee
Chapter 8.0 RECOMMENDED PLAN

8.1 INTRODUCTION

The City of London has embarked upon a comprehensive process which will establish priorities and plans for the City as it moves into the 21st Century. The need for such planning results from legislation approving London's annexation of lands from adjacent municipalities in January 1993. The City is preparing a number of plans including, among others, a new official plan. A study on subwatersheds is one of several studies needed to support the official plan.

The City of London, in partnership with the Upper Thames River Conservation Authority, the Kettle Creek Conservation Authority, and surrounding municipalities therefore began a series of subwatershed studies for the creeks and streams which fall within the new city boundary defined by the recent annexation. The subwatershed studies will identify important natural resources and develop strategies to protect and enhance them through progressive land management practices and land use planning controls. The studies will establish plans for the management of the subwatersheds and will provide one of the inputs to the City's Official Plan review which is being conducted under the Vision '96 program.

Thirteen subwatersheds are under study, including three areas of the Thames Valley. The studies have been undertaken by three teams of consultants, each dealing with specific watersheds. While the characteristics of the subwatersheds have resulted in different emphases and approaches, the process followed by the teams has been similar and can be divided into the following phases:

- Phase I: Background Review
- Phase II: Detailed Studies
- Phase III: Development of Alternative Strategies
- Phase IV: Finalization of Recommended Plan
- Phase V: Development of Implementation Plan
The first phase was completed in 1993 and resulted in a terms of reference for the studies to be completed in Phases II to V. Phase II began in December of 1993 and continued through the summer of 1994. This phase involved data collection, field studies and modelling which allowed the teams to develop an understanding of how each subwatershed functioned and what the major problems and limitations were. Through the course of Phase II, public workshops and meetings were held in order to draw on the local experience and develop goals and objectives for the subwatershed plans.

Phase III began in late summer and involved the development of possible management actions which would address existing problems, prevent future ones, and provide improvements to strengthen the existing ecosystem. Consideration of the latter was necessary because of the damage that has been done by past land use practices. The various management actions were organized into a series of alternative strategies, for the purpose of evaluation. The results of the Phase II studies, the possible management actions, alternative strategies and evaluation criteria were documented in an Interim Report completed October 1994. A summary of the information, including the alternatives and evaluation criteria, was presented to the public through meetings held in November 1994.

Subsequent to the November meetings, evaluations of the different management actions and alternative strategies were conducted by the subwatershed teams. These were submitted to the Technical Advisory Committee for comment. Through the subwatershed teams recommendations, meetings with the TAC and discussions with individual agencies, a series of recommended subwatershed plans has evolved. While the plans differ in some details because of the differences between the subwatersheds, the overall content and recommendations of the plans are similar.

This report presents the Draft Subwatershed Plan for the Sharon Creek Subwatershed. A description of the evaluation criteria and the consultation process used to arrive at the recommended plan is provided, followed by an overall description of the subwatershed plan. This is followed by a graphical and tabular presentation of the plan components.

The Sharon Creek Subwatershed does not have future growth proposed at the present time, and as a result, the recommended plan addresses problems resulting from existing land uses and emphasizes land use management strategies to address them. The
recommended plan, as outlined, provides realistic strategies for the protection/enhancement/restoration of environmental features recognizing that the emphasis on implementation will be on stewardship and non-regulatory mechanisms.

The final steps in the subwatershed planning process will include presentations to the public in April to solicit input on the draft plans and the development of implementation plans to give form to the required management actions. Once these tasks are complete, the plans will be finalized.

8.2 Evaluation Criteria

Different management actions were presented in previous reports. In developing a recommended draft subwatershed plan, the management actions were evaluated against a series of criteria which were common to the subwatershed studies. A listing and a brief description of the evaluation criteria are provided below:

- **Technical Considerations** – each potential management action or option was evaluated to identify technical considerations such as identifying physical limitations for specific options (eg. soil capacity for infiltration), as well as usefulness or effectiveness. The latter limitations were established based on experience in other areas, and did not generally preclude the selection of the option but rather pointed to the need for improvement in program delivery. The feasibility of each alternative strategy was also evaluated.

- **Environmental Benefit** – The overall environmental benefits ascribed to each option were established based on the environmental targets established, on the problems that exist, on the predicted results of implementing the action, and on experience with its application in other areas. It should be recognized that while each action results in specific benefits, it is the cumulative effect of a combination of actions which improves ecological integrity and the results in the largest environmental benefit.

- **Land Requirements/Impacts** – Many of the possible management actions require the use of land which could be used for other purposes. Other management
actions have impacts on the current use of the land (e.g. for agriculture). Each action was therefore evaluated in terms of its land requirements or land use impacts. The emphasis within the City of London (e.g. lands affected by the new Official Plan) was on land requirements (outside of regulated areas) and on impacts on existing land use practices. The emphasis outside the City was on impacts to current land use practices.

- **Cost** – Cost estimates were made and used in the evaluations of options which would involve public or private funding. Costs were not established for lands to be included in a natural heritage system, although the area of these lands (of different types) were documented and used in evaluating the strategies.

- **Agency Acceptance** – The subwatershed plans are being prepared under a partnership involving municipal and provincial agencies, each of which have mandates, regulations and guidelines. Each option was therefore evaluated in terms of the anticipated support and acceptance which could be expected from the different agencies.

- **Public Acceptance** – A public meeting was held in Phase II of the study. The objective of the open house was to obtain public input with respect to:
  
  - the resources that were most highly valued, or used by the public;
  - environmental issues, and relative importance;
  - the perception of the public with respect to the environmental health of Sharon Creek, including recent trends; and
  - study goals and objectives.

The public were asked to respond to a series of questions designed to address public attitudes towards the above concerns. Outlined below is an overview as to some of the key statements by the public:

- the water resources of Sharon Creek are used for recreation, drinking water, well water and agricultural supply;
- predominant recreational uses include bird watching, walking, and fishing;
many parts of the Sharon Creek subwatershed were used for recreational purposes;
• in general, the environmental health of Sharon Creek was perceived to be poor
to good. Everybody felt that the environmental health of the subwatershed was
very important;
• a majority of the people thought that the environmental health had worsened in
the last 10 years; and
• a wide variety of environmental issues were noted, many relating to;
  – the concern with respect to various sources of pollution;
  – loss and disturbance of natural areas.

In addition, each team's Technical Advisory Committee included public representatives who
had participated in the study process since the beginning of Phase II. Based on the input
received from these sources, the potential options were evaluated based on expected public
support and acceptance. The evaluation sought to capture a sense of the general public,
recognizing that landowners will have specific concerns for options which affect their lands.

The evaluation criteria listed above formed the basis for recommending the elements of a
preliminary subwatershed plan. In most cases (excepting physical infeasibility) the
evaluations did not result in discarding a potential action immediately. Rather, the results
of the evaluations were used as input to the consultation process which led to the selection
of the draft subwatershed plans.

8.3 Selection/Description of the Recommended Plan

8.3.1 Selection of Recommended Plan

The recommended plan is described in Sections 8.3 and 8.4 and is illustrated in Figure 8.1
and Table 8.1. The rationale for selecting the recommended plan is provided below.

Technical Feasibility – it is felt that each of the options, as presented, is technically
feasible, and therefore, this criteria does not have considerable influence in selecting a
preferred plan.
Environmental Benefit – the environmental benefit of the recommended plan is considerable, in that an attempt will be made, in the long term, to restore or enhance many of the environmental resources that used to exist within the subwatershed. These include:

- a healthy and functional natural heritage system capable of supporting various species of plants, birds and wildlife, as well as providing key hydrologic/aquatic functions;
- a healthy aquatic ecosystem supporting a migratory and resident warmwater fishery in the lower reach of Sharon Creek (Zone 1) and a tolerant warmwater fishery in the reservoir (Zone 2);
- protection/restoration of the stream, over the long term, such that protection of public/private property is achieved and aquatic/terrestrial targets are met;
- long term reduction of key water quality parameters (total phosphorus, total solids and bacteria) necessary to meet the above objectives;
- protection of existing groundwater supplies which presently are used by rural residents and which support baseflows (from a quantity and quality perspective); and
- protection of the existing levels of flood protection and level of convenience against flooding at crossings.

Land Requirements/Impacts – the recommended plan ensures that lands that are necessary to meet the above noted environmental benefits are set aside (these areas include significant terrestrial features, designated stream setbacks (Zone 1 and 2), etc.) or shifted to more environmentally friendly practices (conservation tillage, livestock access control, etc.). The requirement for additional lands (e.g., non–significant vegetal features) will be determined based on monitoring the plan success and more detailed, impact assessment studies that may be required for resource management planning.

Cost – a majority of the cost required in any of the strategies is related to the construction of structural facilities (e.g. feedlot runoff controls, manure storage facilities). These facilities are required for many of the improvements in water quality. Discussions with both the regulatory agencies and the public suggested that effort should be spent to define funding alternatives, such that the recommended plan, as described, may be implemented.
Agency Acceptance – the recommended plan, as described, is consistent with the preference of a majority of the agencies which participated on the TAC. Considerable discussion was held with the TAC, especially with respect to the selection of a preferred Natural Heritage Strategy.

Public Acceptance – at the public open house (20 September 1994), all participants stated that the environmental health of Sharon Creek was important or very important. This was a primary consideration in selecting the recommended plan. Furthermore, the public's input with respect to which component of the strategy was important was also taken into consideration when selecting the recommended plan.

Components of the plan are presented separately below, for the purposes of clarity and ease of identifying and prioritizing implementation responsibilities for the last stage of the subwatershed planning process. The process of developing the plan, outlined in the Phase II/III documents, was a fully integrated one, which ensured that each action that was developed has considered all the implications to all of the environmental components. The process of subwatershed planning is one of desegregating and then integrating the components of the ecosystem to better understand their function, correct problems and ensure that management actions provide multiple benefits. The following components of the plan are presented:

- Natural Heritage Strategy (Section 8.3.2);
- Aquatic Resources Strategy (Section 8.3.3);
- Flood Prevention Strategy (Section 8.3.4);
- Groundwater Strategy (Section 8.3.5);
- Water Quality Strategy (Section 8.3.6); and
- Stream Morphology/Erosion Strategy (Section 8.3.7).

8.3.2 Natural Heritage System

Sharon Creek occurs near the northern limit of the southern deciduous forest region of Rowe (1972), also referred to as the Carolinian Zone, and falls within site district 7–6 (Hills 1955). It experiences the warmest temperatures in the province and most vegetation communities here are found at the northern limit of their range. A typical forest may contain ten or more
overstorey tree species, however, in the north, sugar maple and american beech often dominate. Typical landform – vegetation features of site district 7–6 include: till plains, moraine ridges, kettle – kame hill complexes, upland forests, spillway (gravels, sands, silts) deposits, river valley systems, swamps and pond/bog complexes.

Historically, the landscape of Middlesex County was about 95% forested, about 90% dominated mostly by sugar maple and american beech with co–dominant species such as oaks, hickories, ash, basswood and white pine, based on the predominance of silty and clayey loams, low lying moraine features and gentle topography. There were, however some other forest types present in wetter, poorly drained soils and cooler micro–climates such as swamps dominated by silver and red maple, elm, willow and tamarack. Some wetter areas and north–facing slopes may have favoured hemlock, yellow birch and ironwood. Open habitats also existed, some of which were quite extensive, including marshes, plains, savannas and tall grasslands. A number of the wetlands were a direct result of the presence of kettle features, created by glacial activity. Finally, a number of cornfields existed which were under active management by native North Americans.

These vegetation communities supported a great diversity of plants and animals, in spite of fairly uniform landscape, not only because of their extensive size and the moderate climate, but probably also because of the biological complexity of the vegetation communities which supported complex food webs and a great diversity of habitat types. Historically, typical representatives of the animal communities present included:

- forest dwelling predators: wolf, black bear, eastern cougar, bobcat/lynx;
- forest interior birds: veery, warblers, wood thrush, vireo, ovenbird;
- forest edge species: fox, blue jay, grouse, grackle, opossum, raccoon;
- area sensitive species: pileated woodpecker, winter wren, red shouldered hawk;
- grassland/savanna dwellers: prairie chicken, wild turkey, upland sandpiper, cowbird, white tail deer, Henslow's sparrow; and
- lake, marsh, wetland dwellers: least bittern, sandhil crane, blue heron, dabbling ducks (eg., mallard)

Many of these habitats, such as savannas and grasslands were maintained by large–scale natural phenomena such as wildfires and flooding, while others, such as the forest
communities were maintained more by small scale effects such as trees toppled by windfalls and also deadfalls.

The existing natural heritage system, as shown in Figure 3.6.1 consists of numerous, isolated, fragmented woodlands scattered throughout the subwatersheds and some well vegetated riparian/valleylands in the lower Sharon Creek near and around the reservoir. These account for only about 10% of the total watershed area, which is now dominated by agriculture (80%) and small communities/rural non-agriculture/transportation corridor (10%) land uses. The woodlands are edge–habitat dominated; mixed–aged, and much younger than historical forests; or, disturbed by past grazing, cutting and colonization by non–native species. Much of the historic habitat diversity is lost because of the decimation of upland vegetation, except in some communities such as the valley areas and some remaining wetlands which historically occupied small portions of the subwatershed. The remaining habitat is dominated by forest edge, wetland and lowland/valley forest types. Habitats characteristic of forest interior, grassland, savanna, area sensitive species and forest predators are very rare. No areas in the subwatersheds have a total area greater than 100 ha and 76% of the vegetation features are less than 16 ha. The creation of the Sharon Reservoir has established a variety of swamp, wetland, marsh and open water habitats which now is the dominant feature in the subwatershed and has in part replaced some of the historic habitats of this nature. Water level fluctuations have reduced the potential diversity of these wetland and open water features. Water quality remains relatively good and sediment loads are moderate, primarily because of the relatively small upstream drainage area.

A small portion of the remaining natural vegetation exists within the 25 ha swamp forest which is a candidate Environmentally Significant Area shown in Figure 8.1, however a large portion of the remaining features are found in the valley and around the reservoir.

The remaining natural habitats are maintained in their current condition by human activities now, rather than by natural phenomena, small or large scale.

The existing natural heritage system has also lost much of its ability to provide the following hydrologic/aquatic functions: water storage and flood retention, recharge/discharge, stream temperature regulation, streambank stabilization, aquatic system food supply. Currently,
woodlands and wetlands are too small to offer significant water storage benefits; only a few woodlands exist in important recharge areas; and, most streams lack riparian cover.

Without a strategy to restore some of the former functions of the current natural heritage system, continued agricultural and forest management practices will continue to degrade existing features. In particular, upland vegetation features are threatened through removal, fragmentation and depletion of the diversity of species and habitats.

Natural Heritage Strategy

The natural heritage strategy for the Sharon Creek Subwatershed builds on the Draft Terrestrial Resource Strategy (DTRS) prepared by Terra (1994) and interpretive and field data compiled by UTRCA and Bowles (1994). The database includes limited data on all 21 patches, based on noninventory techniques and a detailed field inventory of the ESA candidate. This level of vegetation inventory, combined with information on soils, physiography, topography, and drainage patterns, and terrestrial inventories from nearby features in Dodds and Dingman Creeks, is sufficient to provide a planning level strategy, recognizing that additional studies will likely be required at a resource management and site inventory scale. Furthermore, it will be necessary to coordinate the Sharon Creek Natural Heritage Strategy with similar plans in other subwatersheds.

The DTRS noted that the amount of natural habitat in all thirteen subwatersheds is lower than the majority of southern Ontario, and recommended that all natural areas be protected where feasible. In order to increase the extent of natural areas, the DTRS recommended a balanced strategy of retention, restoration and replacement of existing features, and also management of lands adjacent to terrestrial features.

The establishment of a natural heritage system that is representative of the biodiversity of the area, that provides key subwatershed functions, and that is sustainable requires:

- some extensive areas of natural habitat, over 400 ha, to provide natural core areas to support sustainable populations of plants, wildlife and birds, and to serve as core areas that will help to colonize surrounding fragmented areas;
• more areas with interior forest conditions to support the unique assemblage of forest dependant plants, wildlife and birds;
• corridors of continuous vegetation 100 – 200 m wide linking large vegetation areas and "islands" of natural habitat over 35 ha in size;
• greater representation of community types unique to the area such as prairies, savannas, habitat for area sensitive species;
• expanding areas which contain a high diversity of species by virtue of representing a broad cross section of vegetation community types; and,
• protection and restoration of vegetation along watercourses and important recharge/discharge areas where hydrologic/aquatic benefits are optimal.

Wildlife (mammals, birds, reptiles, amphibians, snakes) will make use of those habitats that meet their specific requirements. In addition to specific habitat needs, there must be sufficient habitat to support a sustainable population of animals and corridors that allow animals to move in and out of the area to prevent overcrowding of habitats and to increase genetic diversity. Certain species may never be re-introduced into an area, however the strategy will attempt to establish a broad representation of former wildlife habitats by focusing on representative communities such as forest interior birds, marsh dwellers, some area sensitive species. The goal is to recreate the habitat/community type irrespective of whether the specific "target species" returns.

The key building blocks used to identify the potential natural heritage system are the natural vegetation fragments which represent the remaining biological diversity of the area, and the underlying, physical characteristics of the landscape, which include:

• climate (i.e. solar radiation, precipitation, wind);
• topography and drainage pattern (i.e. slope, aspect, erosion);
• surficial geology/physiography (i.e. moraines, valleys, plains); and
• soils (i.e. texture, moisture content, nutrients).

The interaction of these physical factors, in conjunction with weathering by wind and water, creates a mosaic of habitat features across the landscape which are colonized by different vegetation communities. The diversity in the landscape pattern can be used to reconstruct
a sustainable, diverse natural heritage system by ensuring that there is representation of a broad range of abiotic conditions, as well as representation of remnant vegetation.

Glaciation by the Lake Erie Lobe left Sharon Creek flowing through a gently sloping spillway, shared with Dingman Creek, between two parallel, low lying moraines composed of silts and clays, and predominantly silty clayey loam soils. The topography is flat to gently rolling and the stream valleys are poorly defined upstream of the reservoir, well defined in the lower reaches with coarser soils and rolling topography. Much of the lower creek falls within the Thames floodplain. These features combine to create a relatively uniform landscape within the upper subwatershed. The drainage pattern, reservoir and remnant upland vegetation patches provide the best physical guide for restoring the natural heritage system. The focus of the plan, as shown in Figure 8.1 is to link vegetation features together using this physical "skeleton".

The natural heritage system was developed using the ESA, hydrologically significant vegetation features, reservoir lands and the drainage pattern as the foundation and adding in areas, to provide representative vegetation communities, based on the above priorities. Two categories of areas were identified (Figure 8.1):

Category 1: the ESA, areas within/contiguous with fill lines and adjacent/contiguous with designated streams (Zone 1 and 2), natural features within areas serving important recharge functions; and,

Category 2: all remaining vegetation patches, all areas serving an important recharge function, terrestrial corridors and anti-fragmentation areas

Both Category 1 and 2 features would be identified in the Official Plan schedules; Category 1 would be identified for protection/enhancement/restoration; and Category 2 areas would be subject to more detailed studies, such as scoped EISs, site inventories and resource management plans, to identify the need for further consideration as part of the natural heritage system. The Category 1 areas constitute over 325 ha or about 10% of the subwatershed area. Category 2 lands represent an additional 6% (remaining patches and anti-fragmentation areas) and 24% (remaining recharge lands) of the subwatershed. The areas identified in Category 1 provide a broad diversity of habitats and abiotic features.
representative of much of the biodiversity of the subwatershed. Some areas identified in Category 2, particularly some of the anti-fragmentation areas, may be required to ensure that upland forest and interior forest conditions are represented in the long term.

Key elements of the strategy include protection of Category 1 areas and restoration of the unvegetated lands within the fill lines of Zone 1 streams and setbacks from designated streams (Zone 2). This would restore some large blocks of vegetation to establish interior forest conditions, connect a diverse range of community types and provide streamside vegetation to moderate temperatures and stabilize banks. Protection of woodlands in high recharge will also maintain the recharge characteristics of these lands and offer potential interior forest habitat.

Category 2 areas provide further opportunities to connect vegetation to the valley/drainage features and add significant areas to the core areas to increase the representation of upland habitat to these diverse areas (corridors and anti-fragmentation areas. These opportunities may be accomplished through the retirement of agricultural lands and more environmentally sound forest management practices. The areas in Figure 8.1 shown as anti-fragmentation areas and important recharge areas represent boundaries for further studies not limits for restoration of vegetation.

8.3.3 Aquatic Resources

Fish and benthic invertebrates (dragonflies, stoneflies, crayfish, snails and clams) are most frequently studied as indicators of the overall health of streams. A stream that supports diverse fish and invertebrate communities, generally is a healthy stream. Stream habitats that support aquatic life can be broken into the following components:

- Flow;
- morphology;
- water quality;
- streamside vegetation;
- instream habitats; and
- biological interactions.
A major outcome of implementing the aquatic resources strategy is to restore the stream system to a state of stability. This requires careful consideration of all of the above components.

There are four major factors which have affected the aquatic ecosystem of Sharon Creek:

- the majority of the streams have been altered to improve drainage, by straightening and deepening the stream channels, which has increased runoff flow rates, destroyed natural stream morphology and associated habitats, and reduced baseflows; and

- less than 10% of the reservoir tributary streams have vegetated streambanks consisting of woody species, and as a result, banks are unstable, stream temperatures are high and soil eroded from adjacent lands readily enters the streams.

- nutrients from agricultural runoff reach high levels in reservoir tributaries, because of poor baseflows causing algal blooms and oxygen depletion, which makes habitats unsuitable for fish and other aquatic life.

- the Sharon Creek reservoir, constructed in the late 1960s, has created substantial areas of new habitat and increased the ability of the subwatershed to produce fish. It has also modified the thermal and hydrologic regime of the lower creek.

A total of 27 species of fish occur within Sharon Creek which include both stream resident fish and fish that migrate from the Thames River on a seasonal basis.

The lower Sharon Creek supports the greatest diversity of species and best habitat conditions. The lower creek is considered to support a moderately tolerant warmwater fish community and an unstable warmwater benthic invertebrate community.

The tributaries support a fair to poor quality, warmwater fishery which is limited by lack of flow, poor riparian cover, high sediment loads (see stream morphology), degradation of pool and riffle habitat, high nutrient loads, and extensive stream alterations. The reservoir
supports a moderately tolerant warmwater fish community and provides recreational fishing for crappie and bass.

The intermittent streams, which include most streams in the annexed lands, are poorly defined and sediment laden and do not support a fishery.

Based on the subwatershed characteristics of drainage pattern, topography/gradient, physiography, and flow, three stream Zones were identified which also contained distinctive aquatic communities. The Zones are:

- Zone 1 – Sharon Creek downstream of the reservoir;
- Zone 2 – Sharon Creek Reservoir and the main branch of Sharon Creek; and
- Zone 3 – Tributaries of the main branch and tributaries to the reservoir.

**Aquatic Resources Strategy**

The objective would be to protect the present fish species that occur in Zones 1 and 2, but increase the extent of suitable habitat available for these species. This would include protection of a moderate warmwater fish community (TYPE II/III) (e.g., smallmouth bass, rock bass, hognose sucker, blackside darter) and an unstable warmwater benthic invertebrate community (TYPE III), in Zone 1, a tolerant warmwater fish community (TYPE III/IV) (white sucker, common shiner, creek chub, carp, johnny darter) in Zone 2 and an impaired warmwater benthic invertebrate community (TYPE IV), and improve conditions in Zone 1 to support seasonal migrants (redhorse suckers). The emphasis on aquatic resources within the Zone 3 would be to ensure that land use activities do not diminish the aquatic resources in downstream reaches.

**Key Best Management Practices**

Table 8.1 shows some of the elements of the strategy necessary to protect/enhance/restore aquatic habitats to support the above community targets. These include:

- revegetating streambanks through Zones 1, and 2 for a total stream length of 7 km using natural species to restore bank stability, moderate stream temperatures
and provide some reduction of overland sediment loading to streams. The emphasis should be on use of woody species for Zone 1 reaches, shifting to natural grasses and even hay crops in Zones 2 and 3;

- stream restoration to re-establish stream stability and instream habitats along 2 km of streams in Zones 1 and 2. This would require integrating principles of natural channel design into routine drain maintenance requirements;

- reducing sediment loads from soil erosion in 390 ha of agricultural lands with a high potential to contribute to stream sediment loading.

- eliminating the impacts of livestock access to streams through fencing and installation of appropriate watering facilities and stream crossings

- construction of facilities to control feedlot runoff, manage manure spreading and control milkhouse waste discharges to reduce bacteria and nutrient loads.

8.3.4 Flooding

Flooding of buildings and other structures within the Sharon Creek is not known to be a problem under existing conditions. This is likely the result of several factors, including:

- moderate runoff volumes and peak flow rates that have remained stable, unlike urban watersheds, because of the relatively static, rural land uses;

- few structures, particularly residences, exist near the creek as the area was not a historical concentration point for settlement;

- small headwater tributaries, such as these, typically do not experience the same severity of flooding, in terms of flood levels and flood peak flows, as larger streams because they drain small land areas;
low road densities and large culverts at stream crossing that appear to be oversized relative to the size of the streams, thus minimizing flow constrictions and road flooding.

Therefore, there is little justification from a structural hazard perspective through the subwatershed plan to recommend a strategy for reducing flooding within the Sharon Creek Subwatershed. Further, as substantial urban development is not anticipated to occur in the subwatershed for the foreseeable future, there is little need to define those areas which are currently susceptible to flooding to ensure that future development is located on outside of the flood prone areas. Accordingly the recommended subwatershed plan for Sharon Creek does not contain detailed recommendations to reduce/control flooding.

**Key Best Management Practices**

Detailed floodplain mapping should be prepared on an as needed basis along those watercourses where urban/rural development may occur. Based on the design flows, topography and the width of the existing fill lines, floodlines are expected to be very wide with shallow depths.

8.3.5 **Groundwater**

Within the Sharon Creek subwatershed, the groundwater system is known to consist of four (4) aquifers, including:

- a shallow (0 to 10 m depth), intermediate (15 to 30 m depth) and a deep (30 to 60 metre depth) overburden aquifer; and
- a bedrock aquifer.

These aquifers:

- provide a potable water supply for rural residences; and
- provide baseflows to streams which in turn support aquatic life.
Available information also suggests that groundwater movement in the aquifers is regionally southwards towards Lake Erie, and locally from topographically high areas to topographically low areas.

Much of the surficial soils are silty and clayey loams and the underlying materials are tight silt and clay tills which provide very low recharge rates. The areas of significant recharge (to the aquifers) are generally located in the northern and westerly portions of the subwatershed. These areas are key to protecting both the supply of groundwater for local wells as well as baseflow for aquatic resources. The significant recharge areas also provide a key hydrologic linkage when coupled with terrestrial features which enhance recharge capability. Groundwater discharges to the streams east of the reservoir appear to be insignificant, and hence baseflows in these creeks during the summer months are often zero. There are unconfirmed reports that some groundwater discharge may occur directly to the reservoir, and to the lower reaches of Sharon Creek.

**Key Best Management Practices**

Recommendations developed through the subwatershed planning process will ensure that groundwater resources in the subwatershed can be preserved for the benefit of all. This requires maintaining groundwater quantity and quality.

This can be achieved by:

- protecting woodlands in areas where significant recharge occurs;
- educating the rural community on the impacts of tile drainage; and
- managing land use practices in areas of high recharge to maintain infiltration and reduce risk of contamination

8.3.6 Water Quality

Present water quality conditions reflect the agricultural nature of the subwatershed. Parameters such as total phosphorus (aquatic), total solids (aquatic, aesthetics and stream morphology) and bacteria (recreation, livestock watering) impact existing environmental conditions. Water quality varies throughout the subwatershed. Generally, water quality is
most degraded in the tributaries (which are closest to the non-point sources from agricultural activities) while water quality is best exiting the reservoir due to settling in the reservoir which tends to clarify the water. Water quality does not appear to be the primary limiting factor with respect to the health of the stream-based aquatic system, but may be a concern from the perspective that loading and concentrations to and in the reservoir (e.g., total phosphorus and suspended solids) may limit the long term function of the facility.

About 400 ha of lands (13% of the subwatershed area) represent areas of high priority sediment management in the subwatershed. Nutrient and bacteria loadings have been attributed to the following:

- cropping practices, which contribute to wet weather loadings of suspended sediments and phosphorus to local watercourses;
- inadequate manure storage and feedlot runoff which contribute bacteria and phosphorus during runoff events;
- faulty septic systems and milkhouse waste disposal practices, which contribute bacteria and nutrient loadings continuously; and
- livestock access which contributes to bank erosion, suspended sediment and bacteria loadings on a regular basis.

**Key Best Management Practices**

The long term objective is to reduce concentrations of the suspended solids, total phosphorous and bacteria (Table 8.1). This will improve the relative condition of the streams, the aquatic communities, and aesthetics; and recreational swimming/fishing in the reservoir. This objective can be met through:

- extending the use of conservation tillage practices, particularly in the areas of high sediment delivery which occupy about 400 ha, to lower suspended solids and phosphorous loading from field crops;
- repairing/replacing faulty septic systems and milkhouse waste handling systems;
- revegetating stream banks to help moderate stream temperatures;
- restricting livestock access and improved management of feedlot runoff and manure handling practices through structural works.
8.3.7 Stream Morphology/Erosion

The majority of watercourses upstream of the Sharon Creek Reservoir have been significantly impacted as natural stream morphology has been replaced by constructed municipal drains, and streamside vegetation has been removed. Therefore, there exists little if any natural stream morphology for aquatic communities. Combined with a lack of baseflows in the tributaries, and high sediment loads from neighbouring agricultural areas, aquatic resources in this area are moderately/severely impaired. Undercutting and slumping of creek banks is also common in this area, particularly where grasses provide only a shallow root structure to help bind soils together. Overall, these channels appear to be moderately resistant to scour, and have a greater tendency to erode the creek banks rather than the creek invert.

The lower Sharon Creek, below the reservoir, remains in a predominantly natural state and provides good habitat for both the aquatic and terrestrial communities. These reaches are considered to be the most stable within the system although much of this part of the creek is influenced by a backwater effect from the Thames River.

Without addressing these morphologic instabilities, streambanks will continue to fail as these practices continue resulting in lost land adjacent to the streams, degraded aquatic habitats and continued impairment of water quality to support swimming in the reservoir.

Key Best Management Practices

In order to correct these problems, a watershed wide approach is required. Emphasis should be placed on Zone 1 and 2 streams and selected Zone 3 streams. Measures to be implemented include:

- revegetation of municipal drains to provide a root structure to help stabilize stream banks and reduce undercutting and slumping;
- fencing of creeks/drains to limit livestock access;
- sediment supplies to the creeks be reduced through the use of conservation tillage practices
8.4 The Recommended Plan

8.4.1 Introduction

The recommended subwatershed plan consists of a series of management options, which when applied together will provide a holistic strategy for meeting the Goals and Objectives and the environmental targets. The Plan will protect and enhance the natural resources of the subwatershed and reduce the impacts of existing land uses, while ensuring that future development proceeds in a manner which does not impair the key functions of the physical and biological systems which support watershed integrity. The complex task of providing this protection requires the use of many types of management actions. The recommended actions are grouped under the following headings:

- Designation of Constraint Areas;
- Development Criteria;
- Conservation and Management Practices; and
- Specific Projects and Programs.

Prior to presenting the components of the recommended plan, it should be noted that there is a sub set of Best Management Practices that should also be implemented. This subset of Best Management Practices will not be evaluated since these measures represent environmentally sound, cost effective measures that are rapidly becoming standard practices. All Best Management Practices, and the associated benefits will be presented as part of the Recommended Plan. The sub set of Best Management Practices (see chapter 7 for details) includes:

- site planning – Section 7.3.2;
- source controls – Section 7.3.3;
- public education – Section 7.3.8;
- erosion and sediment controls – Section 7.3.12;
Constraint Areas

The designation of a system of natural areas of biological or physical importance is fundamental to the implementation of a subwatershed plan. These areas are termed "constraint areas" because restrictions are needed on land uses and land use practices, either prohibiting uses or modifying practices in order to preserve the important features and functions of the area. Restrictions placed on uses of these areas perform one or more functions:

- prevents encroachment and direct physical damage to key natural systems;
- enhances two or more natural areas by providing a physical connection between them; and
- prevents land uses and land use practices from occurring at a scale and in a manner which would exceed the capacity of the subwatershed to sustain both human use and natural systems and functions.

Two types of constraint areas are provided for in the Plan. Preservation would be strongly advocated in the following types of areas (Category 1 areas):

- Provincially Significant Areas (ANSIs, wetlands, special status species habitat);
- Candidate ESAs (subject to City adoption as ESAs);
- Lands within the regulatory fill line of Zone 1 streams and contiguous vegetated patches, as appropriate;
- Other designated stream corridors (Zone 2 streams) and contiguous vegetation patches; and
- natural vegetation areas (woodlands and wetlands) in important recharge areas.

Utility crossings and roadways would only be permitted after completion of an Environmental Assessment.

In addition to these areas, a second group of areas (Category 2 areas) would be protected, subject to more detailed studies (e.g. Environmental Impact Study (EIS), site inventory, resource management plan, hydrogeologic study). The detailed studies could result in a reduction of the area to be protected, replacement or other compensation, or an upgrade of
a specific area to a Category 1 status. The types of areas included in the group would include:

- All remaining vegetation patches > 4 ha;
- Non vegetated anti-fragmentation Zones which cluster existing patches;
- Terrestrial corridors and buffers outside of the regulated riparian Zone; and
- Significant Recharge/Discharge areas.

The protection of these areas would be achieved through their designation in the City's Official Plan, with its attendant policies.

**Development Criteria**

This group of management options refers to the requirements and standards that new urban developments will be expected to meet, as a condition of development approval. In general, the cost of these options is borne by the proponent (and therefore ultimately the purchaser). The options seek to mitigate the impacts of land use change and in some cases to improve upon the degraded conditions which have resulted from historic land use practices.

Examples of the management options under this category include various stormwater controls (for flood protection, erosion prevention, water quality treatment, and flow augmentation), infiltration requirements (where applicable) and additional studies (eg. extension of flood line mapping). In general, where specified in the Plan, these controls are a requirement for development to proceed and specific design criteria are provided.

In addition to these specific requirements, this category may include management options which are not mandatory but which may be in the best interests of both the proponent and the natural environment. Such options may include replacement and restoration of a degraded stream corridor or creation of a stable channel which will avoid future erosion problems.

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1 This category is included here primarily for completeness and consistency with other subwatershed plans, recognizing that future development within the annexed lands is not proposed. These measures should be addressed for any development occurring within the subwatershed.
Conservation and Management Practices

Conservation and management practices provide a means of preventing or mitigating the impacts of certain land uses or practices at source. This category of management option seeks to prevent problems from occurring or reduces the impacts from existing land use practices.

There are many sound environmental management practices which are generally applicable to rural and agricultural environments. Recycling programs, household hazardous waste collection, pesticide/fertilizer management, public education and many other such programs are all important to an agricultural community. These programs address the general needs of the community however, and are not specific to a particular subwatershed and so they are not discussed in detail in the Plan. Conservation and management programs which have a direct applicability to the subwatersheds include:

- Flood and fill lines and flood policy;
- Agricultural Practices (conservation tillage, stream buffers, livestock access, etc.);
- Septic System Control Practices;
- Erosion and Sediment Control (during construction);
- Use of Deicing Chemicals; and
- Public Awareness Programs.

Many of the conservation and management options involve both agency assistance and cooperation and participation by landowners. The relative success of many conservation and management programs is dependent upon agency resources (staff to promote the program) and the level of financial assistance available to the landowner (if available at all).

Specific Projects and Programs

Specific projects and programs are recommended as part of the subwatershed plans in order to correct existing problems which have occurred as a result of historic land use practices. Specific projects are targeted at individual stream reaches or flood damage centres. Examples of projects include reconstruction of a natural, stable channel in an area.
experiencing severe ongoing erosion problems, or protective bermsing to prevent potential flood damage. Programs are more general in their application than projects and may include streambank revegetation or stream habitat rehabilitation along fairly long reaches of watercourse.

Projects and programs are normally publicly funded, whether through municipal or conservation authority resources, or through provincial grants to public organizations. As such, their implementation is dependent upon approvals of budgets.

8.4.2 Recommended Plan Components

The recommended plan attempts to bring back several of the environment features that existed previously. Key objectives include restoration of a diverse warmwater fishery in the lower reaches of Sharon Creek (Zone 1); creation (or restoration) of a natural heritage system representative of the area's biodiversity, removal of existing limiting stream functions (e.g., excess sediment supply) and reduction of water quality constituents to achieve objectives which are consistent with the stream morphology, terrestrial and aquatic levels, as well as aesthetic and recreational levels. A key requirement is also the protection of downstream resources in Sharon Reservoir which requires sediment and bacterial loading reductions.

The additional measures required to meet this ecologic level are outlined below and illustrated in Figure 8.1 and Table 8.1. Note that the tables show the total areas within each category, not just the areas outside the fill lines. Since agricultural land uses are not restricted from within fill lines, this calculation was considered to be more representative of impacts on agricultural land uses.

Development Criteria

Construction erosion control, construction inspection and erosion monitoring are environmentally sound, cost–effective measures that will be required for all construction activities associated with projects in the subwatershed such as road construction, farm buildings and structures, etc.
Conservation and Management Practices

For the agricultural areas, measures which will reduce solids (sediment), phosphorous and bacterial loadings will be required, as will general measures to protect the stability of local streams. Measures which are required include livestock access control, implementing tillage practices in high sediment loading areas, management of manure spreading, control of milkhouse waste and upgrading of faulty septic systems.

Highest priority is placed on agricultural measures to reduce sediment loads, i.e., livestock access control and conservation tillage; stabilization of stream and stream banks, i.e. revegetating banks and modifying drain maintenance practices; and, reducing nutrient loads, i.e. manure and milkhouse waste storage. Structural measures correct faulty septic systems to reduce nutrient and bacteria loading are considered to be the second highest priority at this time.

Specific Projects and Programs

Measures to enhance the aquatic resources would include riparian habitat enhancement of 7 km of Zone 1 and 2 streams in order to lower stream temperature as well as stream restoration works of 2 km of these same streams to improve pool/riffle habitat, substrate material composition and in-stream cover. Restoration works should proceed from the downstream end of each Zone and move upstream in order to place the effort on streams in the best condition first. These measures would also address key stream morphology programs to restore stream reaches to a dynamically stable state.

Constraint Areas

Within the City of London, Protection/Restoration/Enhancement of Category 1 constraint areas will require maintaining 325 ha (10% of the watershed area) in natural vegetation and restoration of extensive areas within fill lines and setbacks from designated streams.

Restoration of unvegetated areas within the fill lines of Zone 1 streams is important in order to connect existing vegetation features associated with the valleys in these Zones. A resource management plan needs to be developed to identify communities to be restored,
along term revegetation and vegetation management strategy, and an implementation plan. Approximately 39 ha of lands require vegetation/management. Costs are included within the costs for riparian vegetation plantings.

For category 2 constraint areas, 42 ha of remaining vegetation and 137 ha of anti-fragmentation areas have been identified for further investigation at a more detailed planning stage to assess the relative merits of adding portions of these areas to the Category 1 areas. An additional 735 ha of non-vegetated lands in high recharge also fall into this category. Studies of these areas may include scope EISs, site inventories, resource management plans and hydrogeological investigations. Many of these areas represent potential recreational opportunities particularly on the reservoir lands and lower creek reaches and may also be evaluated from a cultural heritage perspective.

The areas of high recharge have been identified in order to indicate that agricultural uses on these lands should carefully address the need for protection of the quality and quantity of groundwater through management of fertilizer/pesticide application, manure spreading, etc. These areas should also be identified in the Official Plan so that implications of non-agricultural land uses will be addressed.

In conclusion, of the 3,050 ha of land within the subwatersheds, 325 ha or 10% would be included within Category 1 constraint areas. Category 2 areas comprise an additional 179 ha or 6% of the total tablelands (excluding non-vegetated high recharge areas). Total costs excluding land costs and farm implement costs are in the order of $ 1.86 million.
<table>
<thead>
<tr>
<th>Practices</th>
<th>Technical Consideration</th>
<th>Environmental Benefit</th>
<th>Land Requirements/Impacts</th>
<th>Cost (millions)</th>
<th>Agency Acceptance</th>
<th>Public Acceptance</th>
<th>Ranking</th>
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<td>· Stream Morphology</td>
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<td>· Baseflow Augmentation</td>
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<td>20 mm of roof runoff on permeable soils</td>
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<td>- Erosion Control During Construction</td>
<td>- Inspection required to ensure effectiveness</td>
<td>NA</td>
<td>NA</td>
<td>High</td>
<td>High</td>
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<td></td>
<td>- minimizes construction impacts on stream morphology as aquatic resources</td>
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<tr>
<td>- Construction Inspection</td>
<td>- ensure that management practices are constructed as per specification.</td>
<td>NA</td>
<td>NA</td>
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<td>- Erosion Monitoring</td>
<td>- provide feedback on success of erosion control measures.</td>
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<td>- Manure Spreading 7 Farms</td>
<td>- increase manure storage</td>
<td></td>
<td>0.2 m</td>
<td>High</td>
<td>Medium</td>
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<td></td>
<td>- reduce bacterial and nutrient loadings.</td>
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<tr>
<td>- Control Livestock Access 7 x $4,000</td>
<td>- loss of productive farmland - reduced access</td>
<td></td>
<td>0.03 m</td>
<td>High</td>
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<td></td>
<td>- reduce stream bank erosion. - reduce bacterial loadings. - loss of land to farm use</td>
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<td>Land Requirements/Impacts</td>
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<tr>
<td>Feedlot Runoff Controls (see Manure Spreading)</td>
<td>- provide covered storage - route clean runoff away (eavestroughs, berms)</td>
<td>- reduce nutrient and bacterial loading.</td>
<td>NA</td>
<td></td>
<td></td>
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<td>2 - 3</td>
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<tr>
<td>Milhouse Waste Control 5 farms</td>
<td>- provide storage/treatment</td>
<td>- reduce nutrient, bacterial and BOD loadings.</td>
<td>NA</td>
<td>0.04 m</td>
<td>High</td>
<td>Medium</td>
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<tr>
<td>Septic System Effluents 54 farms</td>
<td>- upgrade/replace septic systems - soil limitations</td>
<td>- reduce nutrient and bacterial loadings.</td>
<td>NA</td>
<td>0.05 m</td>
<td>High</td>
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<td>Conservation Tillage in High Priority Areas</td>
<td>- some lost production</td>
<td>- reduce soil loss and suspended solid loadings.</td>
<td>400 ha of land affected</td>
<td>$8,000 to upgrade/farm $11,000 to $25,000 new/farm</td>
<td>High</td>
<td>Medium</td>
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<td>Conservation Tillage in Medium Priority Areas</td>
<td>- some lost production</td>
<td>- reduce soil loss and suspended sediment loading</td>
<td>1,230 ha of land affected</td>
<td>see High Priority</td>
<td>Medium</td>
<td>Medium</td>
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<td>Grassed Waterways</td>
<td>- some lands taken out of production</td>
<td>- reduce stream erosion. - flow moderation.</td>
<td>- loss of land to farm use</td>
<td>$5,000/km</td>
<td>High</td>
<td>Low - Medium</td>
<td>note recommended</td>
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<tr>
<td>Vegetated Buffer Strips see plant riparian vegetation</td>
<td>- some lands taken out of production</td>
<td>- provide filtering of runoff.</td>
<td>- loss of land to farm use</td>
<td></td>
<td>High</td>
<td>Low - Medium</td>
<td>2</td>
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<td>Technical Consideration</td>
<td>Environmental Benefit</td>
<td>Land Requirements/Impacts</td>
<td>Cost (millions)</td>
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<tr>
<td>Natural Channel Succession</td>
<td>- reduce stream erosion.</td>
<td></td>
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<td>not recommended</td>
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<td></td>
<td>- flow moderation.</td>
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<td>De-icing Program</td>
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<td>not recommended</td>
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<td></td>
<td>- reduce chloride load to stream.</td>
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<td></td>
<td>- reduce splash impact on vegetation.</td>
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<tr>
<td>Retirement of Lands</td>
<td>- loss of productive farmland</td>
<td>- reduce soil erosion</td>
<td>- loss of productive farmland</td>
<td>Medium</td>
<td>Low - Medium</td>
<td>3</td>
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<td></td>
<td></td>
<td>- reduce nutrient loading</td>
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<td></td>
<td></td>
<td>- create wildlife habitat</td>
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<tr>
<td>Change Crops</td>
<td>- loss of productivity if switch to hay, pasture</td>
<td>- reduce soil erosion</td>
<td>NA</td>
<td>Medium</td>
<td>Low</td>
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<td></td>
<td></td>
<td>- reduce nutrient loading</td>
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<tr>
<td>Top Soil Preservation</td>
<td>- reduce soil loss.</td>
<td>- reduce sediment loading</td>
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<td></td>
<td>- protect groundwater supplies.</td>
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<td>Specific Projects and Programs</td>
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<td>Disconnect Roof Leaders from Storm Sewers</td>
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<td>not applicable</td>
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<tr>
<td>Plant Riparian Vegetation 7 km</td>
<td>select indigenous species for planting</td>
<td></td>
<td>- erosion control</td>
<td>- 7 km of streams</td>
<td>0.04 m</td>
<td>High</td>
<td>Medium - High 1</td>
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<td></td>
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<td>- filtering capacity</td>
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<td>- stabilize banks</td>
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<td>- support aquatic system</td>
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<td></td>
<td>- wildlife habitat</td>
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# Table 8.1: Sharon Creek Subwatershed Study Recommended Subwatershed Plan Component

<table>
<thead>
<tr>
<th>Practices</th>
<th>Technical Consideration</th>
<th>Environmental Benefit</th>
<th>Land Requirements/Impacts</th>
<th>Cost (millions)</th>
<th>Agency Acceptance</th>
<th>Public Acceptance</th>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Specific Projects and Programs, cont’d.</strong></td>
<td></td>
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</tr>
<tr>
<td>- Aquatic/Stream Restoration</td>
<td>- implement through drain maintenance</td>
<td>- recreate natural morphological characteristics</td>
<td>- must consider new hydrological sediment regime</td>
<td>- create aquatic habitat.</td>
<td>- correct instability problems</td>
<td>- stabilize banks</td>
<td></td>
</tr>
<tr>
<td>- Eliminate Barriers to Fish Passage</td>
<td>not applicable</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>- modification of tile drainage, installation of Outlet controls, wetland creation</td>
<td>- pilot study recommended to assess feasibility and benefits</td>
<td>- increase baseflows</td>
<td>- restore stream stability</td>
<td>- loss of farmland</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<p>| Constraint Areas | | | | | | | | |
| <strong>Constraint Areas - Category 1</strong> | | | | | | | | |
| Provincially Significant Areas &amp; Environmentally Significant Areas | - need for EIS of adjacent lands to ensure compatible development | - need for resource management plan | - core natural areas | - representative communities | - unique features | - high biodiversity | - habitat for special status species | - hydrologic function | - wildlife habitat | - support aquatic systems | 25 ha | | High | High | 1 |</p>
<table>
<thead>
<tr>
<th>Practices</th>
<th>Technical Consideration</th>
<th>Environmental Benefit</th>
<th>Land Requirements/Impacts</th>
<th>Cost (millions)</th>
<th>Agency Acceptance</th>
<th>Public Acceptance</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Constraint Areas - Category 1, continued</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>a) Unvegetated Areas within Fill Lines</td>
<td>- need to assess revegetation requirements</td>
<td>- supporting natural areas</td>
<td>261 ha of vegetation areas</td>
<td>High</td>
<td>High</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>b) Areas within Fill Lines and Contiguous Patches</td>
<td>- need for EIS of adjacent lands to ensure compatible development</td>
<td>- hydrologic function</td>
<td>39 ha of unvegetated areas</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>c) Areas within Designated Stream Setbacks and Contiguous Patches</td>
<td></td>
<td>- terrestrial corridor</td>
<td>Total: 300 ha</td>
<td></td>
<td></td>
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<tr>
<td>d) Vegetated Areas in High Recharge</td>
<td></td>
<td>- support aquatic systems</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Constraint Areas - Category 3</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>All Remaining Vegetation Patches</td>
<td>- need for EIS to assess requirements for protection, mitigation compensation</td>
<td>- remnant terrestrial features</td>
<td>42 ha</td>
<td>Medium</td>
<td>Low - High</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Anti-Fragmentation Lands and Terrestrial Corridors</td>
<td>- need to evaluate revegetation requirements</td>
<td>- wildlife habitat</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>- need to complete EIS to define boundary between potential revegetation areas and development</td>
<td>- high proportion of remaining upland vegetation</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- need for research on revegetation/restoration methods</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- linkages between core and supporting natural areas</td>
<td>137 ha</td>
<td>Low - Medium</td>
<td>Low - High</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- linkages between core and supporting natural areas</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>- potential increase in interior forest</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- potential increase in core and supporting natural areas</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>- potential creation of scarce communities</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>- potential increase in upland vegetation types</td>
<td></td>
<td></td>
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<tr>
<td>Constraint Areas - Category 2, continued</td>
<td>- need for hydrogeologic investigation to ensure that infiltration (quantity/quality) maintained</td>
<td>- hydrologic function</td>
<td>735 ha</td>
<td></td>
<td>Medium</td>
<td>Unknown</td>
<td>3</td>
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</table>