SILVER CREEK
SUBWATERSHED STUDY

SUPPORTING DOCUMENT

Land Use Scenarios

Silver Creek
Subwatershed Study
Subwatershed 11

June 2003
Silver Creek
Subwatershed Study

SUPPORTING DOCUMENT

LAND USE SCENARIOS

May 2003
TABLE OF CONTENTS

1.0 INTENT OF DOCUMENT ................................................................. 2

2.0 IMPACT ASSESSMENT ................................................................. 2

  2.1 IMPACT ASSESSMENT METHODOLOGIES .......................... 2

3.0 LAND USE SCENARIOS ............................................................ 4

  3.1 SCENARIO 1 - EXISTING CONDITIONS .............................. 6
  3.2 SCENARIO 2 INTERIM CONDITIONS .................................. 6
  3.3 SCENARIO 3 ULTIMATE CONDITIONS ............................... 7
  3.4 SCENARIO 3B ULTIMATE PUMPING CONDITIONS ............... 7

LIST OF FIGURES

  Figure 1  Environmental Impact Flow Model .......................... 4
  Figure 2  Scenario 1 – Existing Conditions ............................ 8
  Figure 3  Scenario 2 – Interim Conditions ............................... 9
  Figure 4  Scenario 3 & 3b – Ultimate Conditions ....................... 10
1.0 INTENT OF DOCUMENT

The intent of this document is to provide greater detail in the development of the land use scenarios used to test the sensitivity of the environmental features, functions and linkages of the Silver Creek Subwatershed. This document supports the findings of the phase II Impact Assessment report.

2.0 IMPACT ASSESSMENT

This section presents an overview of potential changes and predicts the result (impact) that occurs in the subwatershed due to land use changes. For the purposes of this study, aquatics have been selected as the indicator for subwatershed health. Land use change is used as a basis for the impact assessment framework adopted for this study.

The foundation for the impact assessment is that subwatershed development first affects the hydrologic cycle. There are impacts on the subwatershed resulting from increased urbanization caused by a change in surface water and groundwater flow. The techniques used to determine the impacts of land use change on the environmental components of the subwatershed, and particularly the aquatic ecosystem, are discussed. The assessment models used are described.

2.1 IMPACT ASSESSMENT METHODOLOGIES

Unlike the weather forecasters with complex meteorological models, a comprehensive model for forecasting the effects of subwatershed development on aquatic ecosystems does not exist. But like the meteorologist, one can anticipate some imprecision when predicting subwatershed response to change. In this study, a combination of mathematical models, empirical literature and professional experience were utilized to complete the impact assessment.

A framework for a comprehensive integrated assessment was adopted based on stress-response concepts. The main stressor of concern in this subwatershed is urban development.

The framework is a sequential set of hypotheses of effect (Figure 1) linking subwatershed development and the consequential changes to the receiving water ecosystem. The effects occur as a result of sequence of changes that include:

- watershed changes caused by land use changes;
- changes in stream hydrology;
- changes in groundwater infiltration and baseflow recharge;
- changes in stream morphology;
Silver Creek Subwatershed Study

- changes in stream water quality;
- changes in riparian zone stream habitat;
- changes in stream habitat and ecology (instream cover, benthic invertebrates, channel morphology and thermal conditions); and
- changes in the stream ecosystem.

This sequence of changes is called "impact flow". The "flow" of impacts occurs first through physical pathways and then chemical, biophysical or biochemical pathways, dependent upon which part of the sequence that one is considering. For example for the sequence of:

1. hydrogeology
2. hydrology
3. fluvial geomorphology
4. surface water quality
5. fish habitat (instream, riparian canopy)
6. aquatic ecosystem

Numbers 1-3 are physical, 4 is chemical / biochemical while 5 and 6 are physical / biophysical in nature.

Different procedures were used to evaluate development impacts and subwatershed sensitivity, dependent on the component of concern. **Impact** is defined as the anticipated response or the magnitude of the response and **sensitivity** is defined as the capacity of an environmental indicator to be subject to change. The Guelph All Weather Sequential Events Runoff (GAWSER) model was used for the hydrology modeling, and the FEFLOW model was used for hydrogeology modeling. Details of these procedures are provided in section 3.3.1 of the phase II report and in appendix I. Data from Phase I of this study, professional experience, the biophysical characteristics of the subwatershed and the impact flow structure were used to evaluate the other components considered in the impact assessment.
Figure 1  Environmental Impact Flow Model

3.0  LAND USE SCENARIOS

Four scenarios have been developed to assess potential impacts of future land use change to the environmental features, functions and linkages of the Silver Creek Subwatershed. These scenarios have been developed to estimate change in the hydrologic cycle. The four scenarios are:

1. **Scenario 1  - Existing Conditions (Figure 2)**
   Represents existing land use conditions from the year 1999 for vegetation, and the year 2001 for development based on CVC air photo interpretation. Simulates the current average annual pumping rate for wells in the Halton Hills (Georgetown) Area.
2. Scenario 2 - Interim Conditions (Figure 3)
Represented potential development based on approved or pending development applications, licensed aggregate extraction areas, approved land use designations in the current Town of Halton Hills Official Plan, Niagara Escarpment Planning Area development restriction, as well as hypothetical assumptions with respect to development outside the current Georgetown Urban Area, in order to sufficiently stress the system to cause changes in the environment. Simulates the current average annual pumping rate for wells in the Halton Hills (Georgetown) Area.

3. Scenario 3 - Ultimate Conditions (Figure 4)
Represents complete development across the subwatershed for modeling purposes. Natural areas remain static from Scenario 2. Simulates the current average annual pumping rate for wells in the Halton Hills (Georgetown) Area.

4. Scenario 3b - Ultimate Pumping Conditions (Figure 4)
Represents complete development across the subwatershed for modeling purposes, and the maximum permitted average annual pumping rate for wells in the Halton Hills (Georgetown) Area. Natural areas remain static from Scenario 2.

The interim scenario builds upon the existing scenario, and the ultimate scenarios build upon the interim scenario etc. Although the interim and ultimate scenarios may never be realized, they are proposed for the purpose of modeling and assessing ecosystem response and were not intended to form an Official Plan policy framework or be used in a local policy context.

The four scenarios have accounted for the Town of Halton Hills Official Plan, Town of Erin Official Plan, approved or pending development applications, licensed aggregate areas, Niagara Escarpment Planning Areas, and existing land cover. Hypothetical growth was included in Scenarios 2, 3 and 3b to simulate change to assess ecosystem response.

Each scenario was broken down into four land cover types: settled, natural, aggregate and agriculture. The following defines each of the land cover types as determined by ELC (Ecological Land Classification) mapping:

Settled areas - urban, rural development (.5 to 2ha of land that contains buildings), landfill

Natural areas – aquatic, forest, plantation, swamp, marsh, beach/bar/bluff/bog and cultural communities (meadow, savanna, thicket, woodland)

Aggregate – active and inactive pits or quarries
Agriculture – intensive and non-intensive agriculture, and wet meadow.

All natural areas were considered to be static through all 4 scenarios, except for the few where Official Plan designations, development applications or approvals exist. Agricultural areas were assumed to be less impervious than developed areas. The following sections describe the four scenarios.

3.1 Scenario 1 - Existing Conditions

Scenario 1 reflects existing land cover conditions in the field today, or 1999 for vegetation, and 2001 for development (Figure 2). The following land cover categories have been used to model the hydrologic response of the Silver Creek Subwatershed:

a) Settled areas (rural development and urbanized areas)
b) Aggregate (active and inactive)
c) Agricultural (intensive and non-intensive); and
d) Natural areas (e.g. forest, wetland, culturally-influenced natural communities)

The following municipal and public supply wells that directly affect the subwatershed 11 were simulated in the model when evaluating the hydrologic response:

a) Lindsay Court Well Field
b) Princess Ann Well Field
c) Cedarvale Well Field
d) Watchtower Bible Tract Society Well Field

3.2 Scenario 2 Interim Conditions

Scenario 2 takes into account near future changes some of which are already proposed, while others are hypothetical for the purposes of this subwatershed study exercise, i.e. to stress the system sufficiently to cause a change in the environment (Figure 2, Appendix A). The following land cover categories were considered in measuring the response of the Silver Creek Subwatershed:

a) Settled areas (based on Official Plan designations, approved and pending development applications, and hypothetical assumptions only for the purposes of modeling), includes intense urbanization to isolated dwellings, barns etc;
b) Aggregate (active and inactive);
c) Agricultural (intensive and non-intensive); and
d) Natural areas (e.g. forest, wetland, culturally-influenced natural communities)
The following municipal and public supply wells that directly affect the subwatershed 11 were simulated in the model when evaluating the hydrologic response:

- Lindsay Court Well Field;
- Princess Ann Well Field;
- Cedarvale Well Field; and
- Watchtower Bible Tract Society Well Field.

3.3 **SCENARIO 3 ULTIMATE CONDITIONS**

Scenario 3 assumes that all lands not considered “natural” would be developed (Figure 4). Although scenario 3 will never be realized, the intention is to stress the system as much as possible to get a sense of all possible impacts and identify any key functions and linkages that have the potential to break down. The following three land cover categories were considered:

a) Aggregate (inactive and active);
b) Natural areas (e.g. forest, wetland, culturally-influenced natural communities); and
c) Settled areas were assumed for all of the remaining lands. This included existing, proposed/committed development, and all agricultural land.

The following municipal and public supply wells that directly affect the subwatershed 11 were simulated in the model when evaluating the hydrologic response:

- Lindsay Court Well Field;
- Princess Ann Well Field;
- Cedarvale Well Field; and
- Watchtower Bible Tract Society Well Field.

3.4 **SCENARIO 3B ULTIMATE PUMPING CONDITIONS**

Scenario 3b assumes similar land cover conditions as that of scenario 3. However, it also simulates an increased pumping rate in the Halton Hills (Georgetown) wells that are currently in operation, i.e.

- Lindsay Court Well Field;
- Princess Ann Well Field;
- Cedarvale Well Field; and
- Watchtower Bible Tract Society Well Field.
Figure 2: Scenario 1 (Existing Conditions)

Sources:
Credit Valley Conservation, 2002; Ontario Ministry of Natural Resources, 1982
Figure 3: Scenario 2 (Interim Conditions)

Sources:
Credit Valley Conservation, 2002; Ontario Ministry of Natural Resources, 1982
Figure 4: Scenario 3 and 3 B (Ultimate Conditions and Ultimate Conditions with Pumping)

Sources:
Credit Valley Conservation, 2002; Ontario Ministry of Natural Resources, 1982
APPENDIX A

Interim Scenario Urban Expansion
## Interim Scenario
### Silver Creek Subwatershed Study

<table>
<thead>
<tr>
<th>Parcel No.</th>
<th>Halton Hills Development File</th>
<th>Figure 2.2.1 - Existing Land Use</th>
<th>Interim Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Proposed Land Use</td>
<td>Land Use Details</td>
</tr>
<tr>
<td><strong>Georgetown Urban Area [A]</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Eden Oak - D25 Parallax - D09/Pa</td>
<td>Agriculture</td>
<td>Urban</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>[Note: Existing commercial at north-west corner of Guelph/Mountainview intersection]</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Agriculture</td>
<td>Urban</td>
</tr>
<tr>
<td>3</td>
<td>Solnicki - D12/80</td>
<td>Agriculture</td>
<td>Urban</td>
</tr>
<tr>
<td>4</td>
<td>Kurllyowicz - D12/KU Verdeux - D12</td>
<td>Agriculture</td>
<td>Urban</td>
</tr>
<tr>
<td>5</td>
<td>HHVHI-13 - D12</td>
<td>Agriculture</td>
<td>Urban</td>
</tr>
<tr>
<td>6 [two parcels]</td>
<td>HHVHI-13 - D12</td>
<td>Agriculture</td>
<td>Urban</td>
</tr>
<tr>
<td>7</td>
<td>Troisville Phase 3 - D12/TR</td>
<td>Agriculture</td>
<td>Urban</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>Agriculture</td>
<td>Urban</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>Agriculture</td>
<td>Urban</td>
</tr>
<tr>
<td></td>
<td>Rural Area - Development Applications [B]</td>
<td></td>
<td>Interim Scenario</td>
</tr>
<tr>
<td>---</td>
<td>------------------------------------------</td>
<td>---</td>
<td>--------------------</td>
</tr>
<tr>
<td>10</td>
<td>Penson - D12/PE</td>
<td>Cultural Community</td>
<td>Urban</td>
</tr>
<tr>
<td>11</td>
<td>Bosjak - D12/BO</td>
<td>Cultural Community</td>
<td>Urban</td>
</tr>
<tr>
<td>12</td>
<td>Alison - D12/AL</td>
<td>Agriculture</td>
<td>Urban</td>
</tr>
<tr>
<td>13</td>
<td>Beechbrooke - D12/BE</td>
<td>Agriculture</td>
<td>Urban</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hypothetical Assumptions [C]</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>Agriculture</td>
<td>Urban</td>
<td>Logical extension of urban boundary for the Georgetown Urban Area to the west of existing urban form.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Assumptions:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>50% [northern portion of this block] - Low density residential [Subcatchment Area 1111]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>50% [southern portion of this block] - Industrial [outside of Subwatershed area]</td>
</tr>
<tr>
<td>15</td>
<td>Agriculture</td>
<td>Urban</td>
<td>Logical extension of urban boundary for the Georgetown Urban Area to the north of the existing urban form.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Assumptions:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>35% - Institutional [except Watchtower institutional development]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>65% - Industrial</td>
</tr>
<tr>
<td>16</td>
<td>Urban</td>
<td>Logical extension of the existing Ballinafad hamlet/rural cluster in Halton Hills/Erin</td>
<td></td>
</tr>
</tbody>
</table>
Silver Creek Subwatershed Study

Interim Scenario

[Subcatchment Areas 11023, 1103 and 1104]

Notes:
1. All land uses within the Georgetown Urban Area are based on approved and/or in-process development applications, or approved land use designations pursuant to the current Town of Halton Hills Official Plan.
2. Taken from the Town of Halton Hills Development Status List.
3. These land uses are currently not identified in an approved Provincial/Regional/County/local Official Plan and are hypothetical assumptions only for the purposes of modeling the Subwatershed. Due to the limited potential for future development areas within the Subwatershed, alternative hypothetical development areas have been identified for the interim scenario. One of more of these alternative areas may be incorporated into the Subwatershed model.
4. 22 Sideroad represents the limit of the Niagara Escarpment Plan in this area and it has been assumed that no new urban-character development would be permitted within the NEC Plan area.