The City of Hamilton is undertaking this study for the Greensville Rural Settlement Area (RSA) and surrounding Mid-Spencer Creek Subwatershed. The purpose of the study is to investigate and inventory the natural resources within the two areas and identify constraints and opportunities through which future growth may be established in a manner which is environmentally sound and socially and economically sustainable.

Objectives of the First Public Open House

This Public Open House will provide opportunity for the public and property owners to review and evaluate information relating to land uses and environmental conditions. The inputs from this Open House will then be used to refine the environmental inventory and to formulate future Management Strategies.
Existing Land Uses

The Mid-Spencer Creek Subwatershed Area supports a variety of rural and agricultural land uses including farms, natural heritage features, aggregate pits and nurseries. Within the Greensville RSA residential land uses predominate with localized pockets of commercial and institutional services. Residences in the Greensville RSA and Mid-Spencer Creek Subwatershed Area are currently serviced by private septic systems with municipal communal, private communal or individual wells. There are approximately 1,000 residences within the Greensville RSA.

Proposed Land Uses

Land uses within the Mid-Spencer Creek Subwatershed Area, outside of the Greensville RSA, are not expected to change significantly over time. Potential land use changes within the Greensville RSA are outlined in the Greensville Secondary Plan (OPA13). The Secondary Plan, which was prepared in 1992, identified three general growth areas (see accompanying figure). Development within each of these areas, some of which has already occurred, was to take place in phases.

A maximum of 12 lots were permitted in the first phase. Monitoring of surface and groundwater conditions for a two-year period was then to take place prior to proceeding with the second phase. In addition to the above, the Secondary Plan allowed for a maximum of five dwellings per year to be created by consent or Plan of Subdivision.
Introduction

Hydrogeology is the study of the water movement below the ground surface. In general rainwater infiltrates and is stored underground in sand and gravel deposits, or bedrock fractures called aquifers, which may supply drinking water to local wells or supply baseflows to adjacent streams.

Recharge areas, where water infiltrates into the groundwater system, are usually areas of highly permeable soils such as sands and gravels or areas of exposed fractured bedrock. Springs and seepage areas, where groundwater exits the soils, are said to be discharge areas. These discharge zones supply streams with cold baseflows which benefit aquatic life.

What was done

Water well records, geology and soils maps were reviewed to characterize the groundwater system with the RSA. In addition a total of 10 wells were drilled into the ground at representative locations within the RSA in order to assist in the characterization.
Stream Morphology:

The study of the physical environments of streams is called fluvial geomorphology. The nature and distribution of stream flow and sediment movement in streams creates habitats for aquatic life and causes stream channels to alter their shape and pattern, sometimes leading to flooding and erosion issues. As land uses change, the amount of surface runoff and sediment reaches the stream also changes, often leading to erosion and flooding problems and poor aquatic habitats for fish. By undertaking stream restoration works that restore the natural stream morphology through natural channel design, these impacts can be mitigated.

Mid Spencer Creek and its tributaries were divided into reaches based on their morphological characteristics. For each reach, the following information was collected:

- the channel and its general form were described.
- the channel was assessed in terms of stability and evidence of erosion problems.
- the characteristics of the stream banks and the adjacent valley vegetation was noted.
- general aquatic habitat characteristics were noted.

Eleven segments of Mid Spencer Creek were inventoried and are characterized as Hardened (urban), Bedrock Controlled, or Alluvial (coarse or sandy) channels (see accompanying map).

Within the Greensville Rural Settlement Area, tributaries draining the settlement areas A, B, and C were also inventoried and characterized as Vegetated Swales, Ditch-like, Sandy Alluvial, or Bedrock Controlled Channels (see accompanying map).

The tributaries within the Mid-Spencer Study Area are generally ephemeral and/or intermittent in nature (exceptions Logies Ck and urban tributary) and are typically characterized as either:

- Tributary – Wooded Area Swale / Riparian Wetland
- Tributary – Grass / Agricultural / Landscaped Swale

In generally the main creek and its tributaries are stable with limited evidence of stream erosion problems. Urban reaches including lower Spencer Creek and the urban tributary downstream of Greensville have been extensively modified.
The accompanying map illustrates the flow direction of groundwater below the surface together with the water table elevation within the RSA. As is illustrated on the figure the groundwater flow direction is from north to south. Furthermore, the groundwater table is typically 5 to 20 meters below the surface and there is a significant (40m) drop in the groundwater table from the north to the south limit of the RSA. The drop may be attributed to the presence of the Niagara Escarpment.

Also shown are the locations of two hydrogeologic cross sections (denoted as N – S and W – E). The two cross sections, which are shown on another poster board, illustrate the geologic conditions together with the location of water wells as well as the groundwater table elevation.
Field Program

A total of 10 wells were drilled into the shallow and deep aquifer at representative locations with the RSA in December 2006. The objective was to gather further information with respect to:

- groundwater levels, including fluctuations through the year;
- groundwater quality; and
- groundwater temperature

Conditions in both the shallow and deep aquifers were recorded in each well.

What we found

A summary of Nitrate levels that were measured at each well during the January, April and August sampling period is shown on the accompanying figure. Health Canada specifies a maximum allowable drinking water concentration of 10 mg/l of Nitrate in drinking water. The elevated levels are one of concern because they can cause methemoglobinemia in infants (or blue baby syndrome) and eutrophication in surface waters.

The results, in general, suggest that groundwater quality in both aquifers is good as Nitrate levels were found to be well below the Ontario Drinking Water Standard (ODWS). The one exception would be at well MW4 where higher levels were recorded in the shallow overburden well.

It was also found that the groundwater table, at a given location, drops throughout the year. Measurements at the wells typically showed a reduction of 2 metres. The drop in the water level may reduce baseflows to streams and result in a reduction in reliable yield for wells located in the shallow aquifer.
A detailed hydrologic model called MIKE11 has been setup in order to estimate the flows in Spencer Creek at specified points along the channel. The model of the middle section of Spencer Creek starts at Safari Road and ends in the Town of Dundas at Market Street. Rainfall data was obtained from Hamilton Conservation Authority between 2003 and 2005 inclusive as input for the model. The flow at Safari Road is measured by Environment Canada and was used as input to the Mid Spencer Creek flow model. Similar stations at HWY 5 and Market St. (Town of Dundas) were also used to check the accuracy of the model. The following creeks were included in the model:

- West Spencer Creek
- Westover Creek
- Flamboro Creek
- Logies Creek
- Ann St. Creek

The model estimates the amount of water in the creek throughout a particular year. In some places it is known that groundwater flows into the creek bed or some water from the creek works its way into the groundwater system. The surface water model has been linked to the groundwater model (Visual MODFLOW, discussed on another poster) to better understand how water moves between these two systems.

In order to prepare a map illustrating the location of “high water” (flood lines) during a specified flow event the peak flows and the topography of land in which these waters flow needs to be known. The hydrologic model described above provides the flows. A detailed topographic survey of watercourse crossings within the RSA was conducted. Detailed digital topographic mapping from the City of Hamilton for the area. These data, including the flow data, were used to develop another model called HEC-RAS to estimate the elevation of the water surface along a given watercourse. This model was used to determine the “high water” mark for a specific storm event (pre-determined by Hamilton Conservation Authority).
Terrestrial resources include the plants, animals, amphibians and birds and their habitats that occur within the subwatershed. In southern Ontario landscapes, once extensive forests and wetlands have been dramatically reduced in size as a result of a long history of human settlement patterns until only fragments of these features exist. The amount of natural habitat present, the size of individual features and the presence of naturally vegetated corridors linking the features together is called a Natural Heritage System. The health of this system can be assessed based on the diversity of plant and animal communities present, the amount of disturbance from human activities and colonization by non-native species and other measures.

Following a review of existing information on terrestrial communities, inventories of plants and animals were completed on the urbanizing areas of Greensville and on selected features throughout the watershed.

Relative to other parts of southern Ontario, there is an abundance of natural heritage features covering about 30% of the subwatershed. These features are illustrated on the accompanying figure.
MID-SPENCER CREEK / GREENSVILLE
RURAL SETTLEMENT AREA SUBWATERSHED STUDY
KEY FINDINGS

Terrestrial Resources

- Abundant natural heritage features – ANSI’s, PSW’s, ESA’s – 30% of watershed
- Limited natural features within the RSA, except Christie Mills and Escarpment lands
- Significant portions of natural heritage features are in private ownership

Aquatic Resources

- Mid Spencer Creek supports a diverse warm/cool water fish community
- Christie Mills Reservoir supports a warmwater fishery
- Intermittent tributaries provide limited seasonal fish habitat

Groundwater Resources

- The groundwater flow direction is from north to south
- There are two aquifers; a shallow overburden aquifer and deeper bedrock aquifer
- A majority of the wells (85%) are located in the deeper bedrock aquifer
- The groundwater table, at a given location, fluctuates throughout the year
- The groundwater monitoring program suggests that groundwater quality in both aquifers is good. The one exception would be at MW4 in the shallow overburden well.

Surface Water Resources

- Water quality in streams fair to good – nutrient enrichment, high nitrites and chloride, low trace metal levels
- Hydrologic modeling of subwatershed completed to characterize surface water –
  groundwater inter-relationships
- Floodplain mapping through Greensville updated to identify areas of flooding and undersized culverts

Stream Morphology

- Most Tributaries are ephemeral and/or intermittent, poorly defined
- Mid Spencer Creek is cobble-bed or bedrock controlled downstream of Christie Mills
- Mid Spencer Creek is low gradient with vegetated banks upstream of Christie Mills
- Main creek generally stable with limited evidence of erosion problems; tributaries within the Rural Settlement Area are generally stable with only minor local/gradual adjustments; urban tributaries show some instability with minor erosion concerns.
MID-SPENCER CREEK / GREENSVILLE
RURAL SETTLEMENT AREA SUBWATERSHED STUDY
REPRESENTATIVE STREAMS