Stephen's Gulch Conservation Area
Soper Creek subwatershed

Long Sault Conservation Area
Bowmanville Creek subwatershed

BOWMANVILLE/SOPER CREEK WATERSHED EXISTING CONDITIONS REPORT
CHAPTER 6 - PHYSICAL GEOGRAPHY

FINAL – December 2011

DURHAM REGION

Central Lake Ontario Conservation

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1.0 INTRODUCTION

Considered to be one element of the larger discipline of geography, physical geography covers several topics of study used to describe the earth's surface (Pidwirny, 2006). In the context of watershed planning, physical geography explores the physical characteristics of the land surface through the local physiography, topography and soils. Physiography describes the physical features or landforms as controlled by the underlying rock structure and glaciation; glaciation and deglaciation has created the composition and orientation of the moraines, drumlins, eskers, abandoned shorelines and various sediments that exist today (Chapman and Putnam, 1984). Spatial extents, elevations, and slopes describe the topography of the watershed landscape, while various soil classifications are used to describe the characteristics of the mineral soils.

Applicable Legislation and Policies

Oak Ridges Moraine Conservation Act and Plan

The Oak Ridges Moraine (ORM) has been identified as an area of provincial importance and since enactment of the Oak Ridges Moraine Conservation Act (ORMCA) and Plan (ORMCP), the Moraine is subject to development restrictions. The legislation is aimed at protecting the integrity of important hydrogeological and ecological functions of the Moraine. With respect to the physical features of a watershed, the ORMCP delineates specific protected landform types and provides technical direction in the application of associated landform conservation policies to be implemented with development applications.

Municipal Act

The Municipal Act, 2001 provides for the organization and operation of municipalities in Ontario and identifies the types of by-laws that municipalities can adopt. Of importance to physical geography, the Municipal Act allows for the adoption of bylaws that regulate site alteration, placing or removal of fill and grading. Clarington By-law No. 2008-114 regulates the dumping of fill, removal of fill and alteration of grades. This By-law is applicable in the Bowmanville and Soper Creek watersheds.

Aggregate Resources Act

The extraction of mineral aggregates is administered by the Ministry of Natural Resources under the Aggregate Resources Act. The objectives of this legislation are in-part to minimize adverse impacts of aggregate operations on the environment and to control and regulate aggregate operations on private and crown lands.

2.0 STUDY AREA AND SCOPE

The Bowmanville/Soper Creek watershed is situated entirely within the Regional Municipality of Durham and covers an area of approximately 170 km^2 (Figure 1). The watershed drains southerly towards Lake Ontario from its headwaters in the Oak Ridges Moraine. The Bowmanville/Soper Creek watershed consists of two primary subwatersheds: Bowmanville Creek and Soper Creek, whose tributaries join together prior to outletting to Lake Ontario.

Key elements covered in this Chapter include the major physiographic regions, the topography and soils at the watershed scale. Estimations of the spatial extent of the subwatershed areas and their associated elevations, slopes, soils and protected landforms are also included. Implicit in the review is an evaluation of the interrelationships of these phenomena and the natural environment.

Soper Creek subwatershed

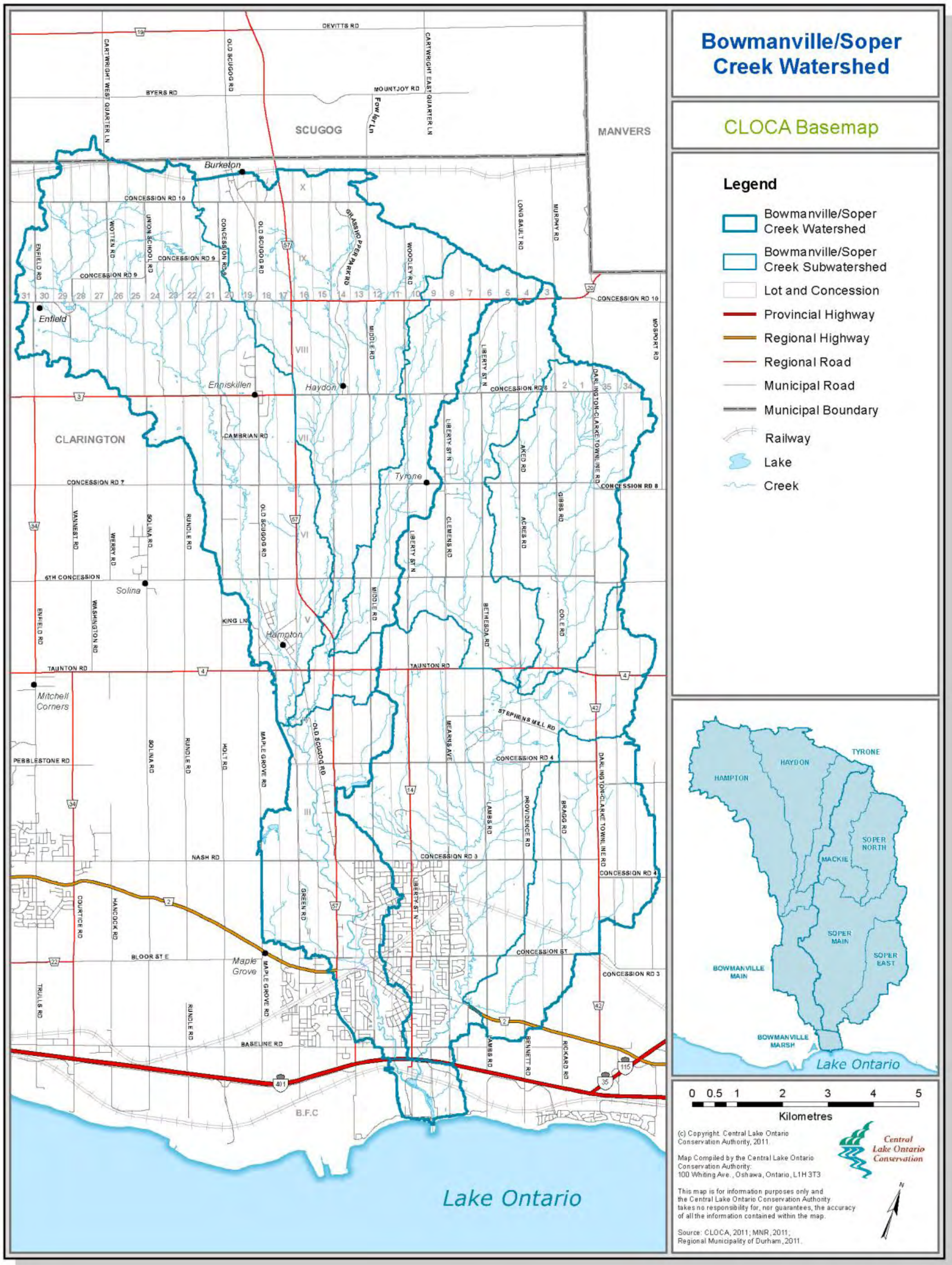


Figure 1: Bowmanville/Soper Creek watershed.

3.0 METHODOLOGY

3.1 Physiographic Regions

Physiography of the Bowmanville/Soper Creek watershed was assessed through a description of the land surface and form as controlled by the underlying rock and unconsolidated soil material. Landforms identified in '*The Physiography of Southern Ontario*' by L. J. Chapman and D. F. Putnam, 1984 provides excellent reference material and forms the primary source of physiographic information described in this chapter. Two additional sources of information used were the Oak Ridges Moraine planning boundary (Ontario Ministry of Municipal Affairs and Housing, 2002) and the Lake Iroquois Beach delineated from the Environmental Sensitivity Mapping Project report (Gartner Lee Associates Limited, 1978).

3.1.1 Landform Conservation Features

A component of the Oak Ridges Moraine Plan (ORMCP) was the identification of Landform Conservation Areas. The Ministry of Natural Resources (MNR) mapped at a 1:50,000 scale two distinct Landform Conservation Areas in the ORM. The landforms depicted in this mapping are areas of high landform complexity and as such are subject to a higher level of protection. Category 1 landforms are dominated by areas where 50% or more of the land surface has slopes >10%, lands with distinctive landform features and/or land with diverse slope classes. Category 2 lands are those areas where 20% to 50% of the land surface either has slopes >10%, lands with distinctive landform features and/or diverse slope classes.

3.2 Topography

Topics used to describe the topography of the Bowmanville/Soper Creek watershed include the terrain, specific elevations, and slopes or relief. Terrain is a term used in physical geography and is often considered synonymous with the term topography.

Elevations and slopes in general control the regional flow of surface water and shallow groundwater within these watersheds. In addition, changes in elevations or relief affect the type of land cover, habitat, land use practices, and climate patterns including the distribution and type of precipitation (i.e. rain or snow), humidity and temperatures. A Digital Elevation Model (DEM) is currently used to delineate ground surface elevations in electronic form. The DEM is used in many types of landscape analysis including (sub) watershed boundary delineation, relief mapping, hydrologic and water budget modelling, and estimates of overland flow directions.

In addition, areas of hummocky topography have been identified by the Ontario Ministry of Natural Resources. Hummocky areas are regions of small hills or areas with complex sequences of slopes such as hummocky moraine and hummocky glaciofluvial deposits. These areas are often associated with areas of high groundwater recharge.

3.3 Soils

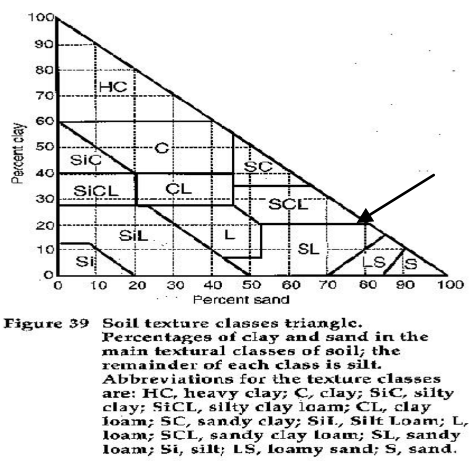
Soils have a significant influence on hydrology as well as the type and productivity of vegetation within the watershed. Soil classifications assist in evaluating the productivity of the soil, its flexibility or the range of vegetation it can sustain, and associated management needs with respect to soil conservation practices.

Soil Survey data for Ontario has been classified according to the federal standard (CANSIS). Soil types for the Bowmanville/Soper Creek watershed are derived from the Ontario Soils data model. This model is based on the National Soil Database data model for Detailed Soil Surveys found on the CANSIS website. Where applicable, Ontario Soil data items follow The Canadian System of Soil Classification (2nd Edition) 1987 or The Canadian System of Soil Classification (3rd edition) 1998.

Textural soil classes are defined in terms of the size distribution of primary particles as estimated by sieve and sedimentation analysis. The named size classes of primary particles and their dimensions are noted in Table 1 and soil textural classes are shown in Figure 2.

Table 1: Named Soil Size Classes.
(source:http://sis.agr.gc.ca/cansis/references/1998sc_a.html)

Name of Separate	Diameter(mm)
very coarse sand	2.0-1.0
coarse sand	1.0-0.5
medium sand	0.5-0.25
fine sand	0.25-0.10
very fine sand	0.10-0.05
silt	0.05-0.002
clay	<0.0002



Percentages are the amount of clay and sand in the main textural classes of the soil, the remainder is silt;

Abbreviations
HC – heavy clay; C - clay; SiC – silty clay;
SiCL – silty clay loam; CL – clay loam; SC– sandy clay;
SiL – silt loam; Si – silt; L – loam
SCL – sandy clay loam; SL – sandy loam; LS – loamy sand; S- sand.

Figure 2: Soil textural triangle (source: Soil Classification Working Group, 1998 http://sis.agr.gc.ca/cansis/references/1998sc_a.html).

In addition to the importance of textural classes of soils relative to soil productivity, flexibility and management needs, the physical properties of soils determine their capability in the amount of water that infiltrates and is transmitted through the soil and how much water runs off. The US Soil Conservation Services has classified soil types into hydrologic soil groups (HSG) as shown in Table 2. Groups of soils have similar runoff potential under similar storm and cover conditions.

Table 2: Hydrologic soil groups (HSG) (source: Chisholm at al., 1981).

HSG	Criteria[a]
A	Soils have low runoff potential and high infiltration rates even when thoroughly wetted. They consist chiefly of deep, well to excessively drained sands, loamy sand, sandy loam or gravels and have a high rate of water transmission (greater than 0.75 cm/hr.).
B	Soils have moderate infiltration rates when thoroughly wetted and consist chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission (0.40 to 0.75 cm/hr.).
C	Soils have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately coarse textures such as sandy clay loam. These soils have a moderate rate of water transmission (0.15-0.40 cm/hr.).
D	Soils have high runoff potential. They have very low infiltration rates when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a clay pan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils, such as clay loam, silty clay loam, sandy clay, silty clay and clay have a very low rate of water transmission (0.00 to 0.15 cm/hr.).
a. The criteria are estimations only.	

While every effort has been made to accurately present the findings reported in this chapter, factors such as significant digits and rounding, and processes such as computer digitizing and data interpretation may influence results. For instance, in data tables no relationship between significant digits and level of accuracy is implied, and values may not always sum to the expected total.

For the purposes of visual presentation, the mapped data layers (where available) have been shown as faded areas beyond the watershed and subwatershed boundaries. For areas outside of the Bowmanville/Soper Creek watershed boundary, these visual data layers may not have been analyzed for discussion purposes and therefore have not been included in the discussion of this chapter.


Bowmanville Creek subwatershed

4.0 FINDINGS

The following sections provide a brief description of the glacial history of the area and the available physiographic, topographic and soil information that was identified for the Bowmanville/Soper Creek watershed. Additionally, discussions of the information by primary subwatershed area are included to provide support for on-going ecological and hydrological investigations.

4.1 Glacial History

The physiographic and topographic features of the Bowmanville/Soper Creek watershed are a reflection of a complex geologic and glacial history. While Chapter 14 - Hydrogeology provides a detailed description of the geology of the watershed, a brief summary of the major glacial, fluvial and lacustrine processes herein helps explain how certain watershed features were formed.

A stratigraphic framework is typically used to describe the geologic structure of a watershed (Figure 3). The framework describes each geologic unit, the order in which they were deposited and the deposition and erosion processes that affected them. The framework described in detail in the Conservation Authorities Moraine Coalition (CAMC) and the York Peel Durham Toronto (YPDT) Groundwater Management Study Technical Report # 01-06 Groundwater Modelling Of The Oak Ridges Moraine Area (Earthfx, 2007) is used for this discussion. This stratigraphic profile is fairly consistent across the CLOCA jurisdiction. From the lowest unit (oldest geologic unit) to the youngest unit they are described as follows (from Earthfx, 2007):

1. Canadian Shield (Precambrian shield rocks are estimated to be between 1.45 and 1.1 billion years old and are at least 70 km thick);
2. Paleozoic Bedrock (Paleozoic bedrock layers were deposited on the Canadian Shield between 550 and 350 million years ago);
3. Bedrock Unconformity (Extensive erosion of the bedrock surface occurred between 350 million and 135,000 years ago); and
4. Late Pliestocene Overburden (Complex deposition and reworking of overburden materials occurred 135,000 to 12,000 years ago during glacial advances and retreats).

The physiographic and topographic features present today were created around 25,000 to 12,000 years ago during the last major ice advance (Late Wisconsinan). During this time the Laurentide Ice Sheet deposited a regional till sheet referred to as Newmarket Till over thick lower deposits. Over time, areas of this till were eroded by meltwater forming depositional networks and drumlins.

Approximately 13,000 years ago, the Oak Ridges Moraine (ORM) was deposited over this eroded terrain. The Moraine is associated with a glacial lake ponded between two glacial ice lobes of the Laurentide Ice Sheet (the Simcoe and Ontario Lobes). The last glacial ice advance occurred from the Lake Ontario basin and deposited a thin till layer (Halton Till) over portions of the south flank of the ORM.

The Oak Ridges Moraine covers most of the northern portions of the Bowmanville/Soper Creek watershed (Figure 4). The youngest deposit in the watershed consists of glaciolacustrine sediments that form a thin veneer over the Halton Till. Further to the south, the sediments are associated with ancestral Lake Ontario, where the water levels were at least 40 to 60 metres higher than present-day Lake Ontario. This lake, referred to as Lake Iroquois (ancestral Lake Ontario) resulted in the deposition of shoreline sands and gravels, and finer sediments to the south (Iroquois Beach Deposits). Recent Age deposits consist of wind blown sand, beach sediment and organic material.

4.2 Physiography

The Bowmanville/Soper Creek watershed falls within three physiographic regions which, from north to south, include the Oak Ridges Moraine, the South Slope and the Lake Iroquois Plain (Chapman and Putnam, 1984). Because of the difference in material, hydrologic and ecological functions, the Lake Iroquois Plain, which was formed in glacial Lake Iroquois, is separated into the Iroquois Beach including the shoreline, and the Iroquois Plain regions as depicted in Figure 4.

The headwaters of the watershed reside in the Oak Ridges Moraine physiographic region which represents approximately 30% or over 5151 ha of the total area covered by this watershed. The ORM exists as an easterly trending feature with its full extent reaching from the Niagara Escarpment to east of Rice Lake. For planning purposes, the southern boundary of the ORM within the watershed is delineated by the 245 metres above sea level (masl) elevation contour. This boundary is delineated in the map series established by Ontario Regulation 01/02 designated under the Oak Ridges Moraine Conservation Act, 2001.

The South Slope physiographic region extends southward from the base of the Moraine and is characterized as being much flatter. Chapman and Putnam (1984) describe the South Slope as a drumlinized area, consisting of areas of thin (<1 m thick) aeolian sand deposits underlain by glacial deposits, mainly till. The slope is characterized by southerly trending drainage with sharply incised valleys and numerous gullies that have been cut by rapid streams. The South Slope represents the largest physiographic unit in the Bowmanville/Soper Creek watershed at approximately 41% or over 6970 ha of the total watershed area.

The Iroquois Beach region is a west-east trending band of sandy beach deposits and represents approximately 11% or 1847 ha of the total watershed area. The Iroquois Beach region is marked by low-lying shoreline bluffs and gravel bars generally 1-8 metres in depth which overlay a till material. This easterly trending band is approximately 3 km in width across the centre portion of the watershed.

The Iroquois Plain region is a finer-grained lacustrine plain covering approximately 17.5% or 1846 ha of the watershed. The Iroquois Plain region drops off from the Iroquois Beach bluffs, covering the rest of the watershed down to Lake Ontario. This region is characterized as being flatter; however, drumlins are present, providing for rolling topography.

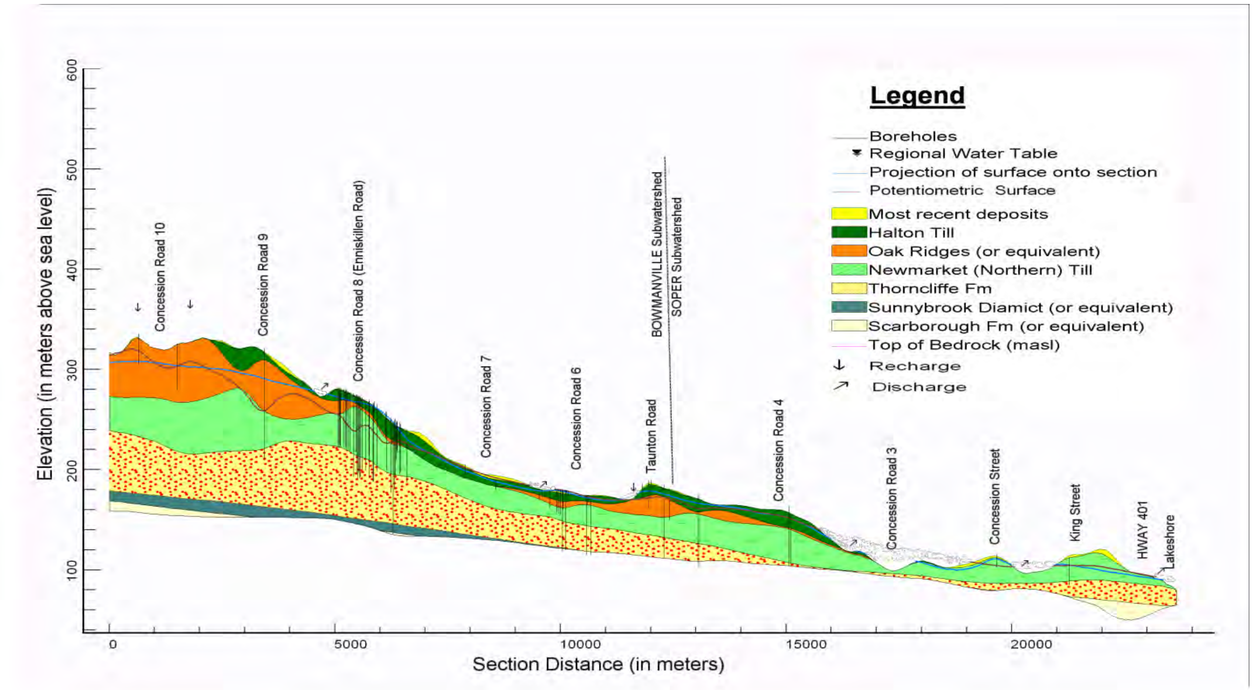


Figure 3: Bowmanville/Soper Creek watershed geological profile

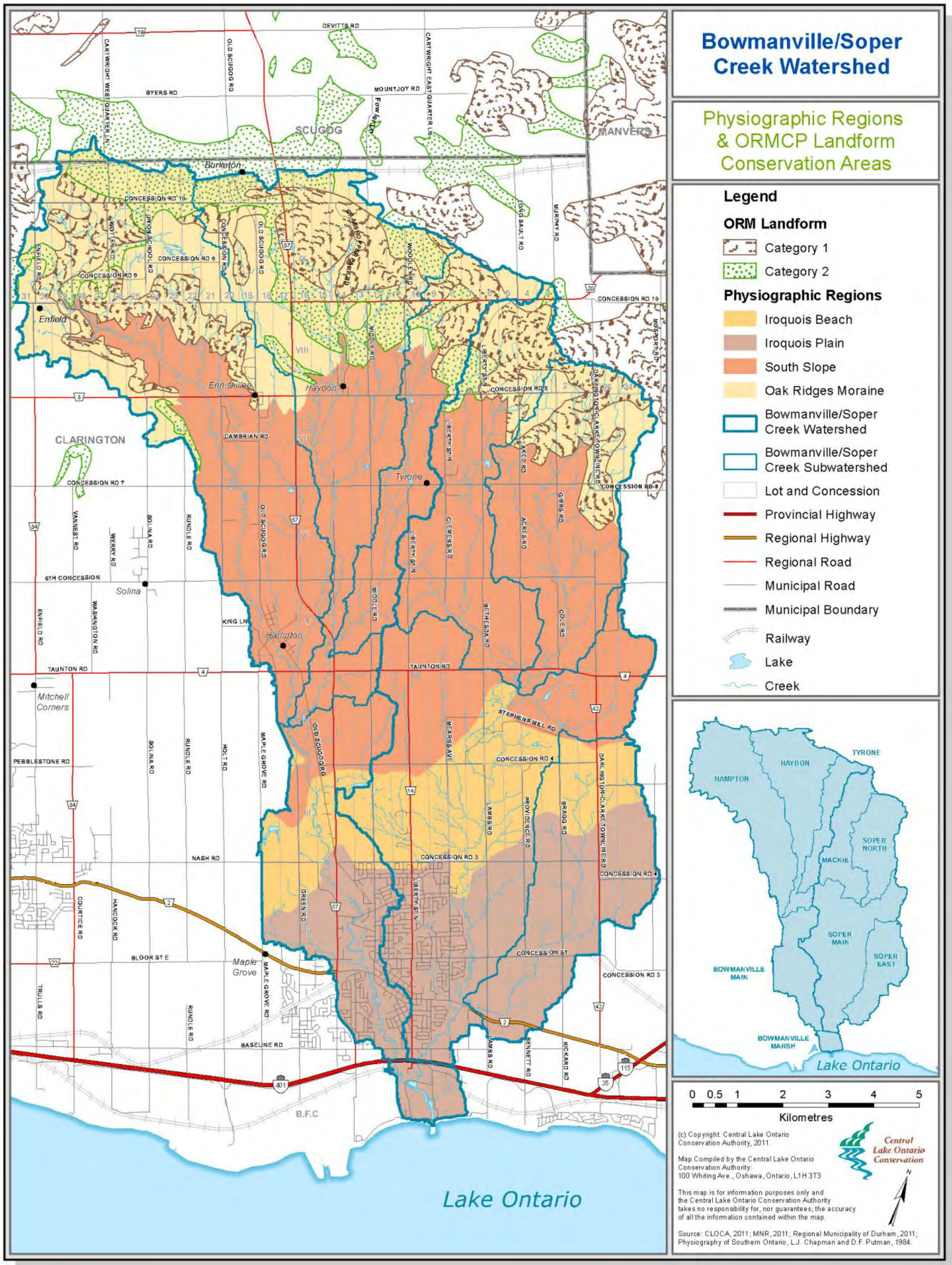


Figure 4: Physiographic regions and ORMCP Landform Conservation Categories (sources: Chapman and Putnam, 1984; MMAH, 2002).

4.3 Topography

Figure 5 depicts the ground surface elevations within the Bowmanville/Soper Creek watershed. The ground surface elevations range from 352 metres above sea level (masl) around Burketon in the north to approximately 75 masl at the Lake Ontario shoreline to the south. This translates into an average elevation rise of 6.4% or 270 metres over the 20 km watershed length from south to north.

The highest elevations of the Oak Ridges Moraine (ORM) planning boundary mark the northern boundary of the watershed and function as surface water divides. As mentioned previously, the ORM represents approximately 30% of the total watershed area. The slopes within the moraine are generally steep (Gartner Lee Ltd., 1994) with many areas exceeding 10%. The Oak Ridges Moraine Conservation Plan identifies these steep slopes as Landform Conservation Areas (LCAs). Landform Conservation is defined in the ORMCP guidance material as 'the protection and wise use of the land base including its form, soils and associated biophysical processes' (Ministry of Natural Resources (MNR), 2004a). Category 1 and Category 2 Landforms represent approximately 42.7% and 24.21% of the ORM area within the watershed; therefore 67% of the ORM within the watershed has been identified for added conservation measures through the ORMCP. It is also noted that the Ontario Ministry of Natural Resources (MNR) has mapped hummocky terrain. This information is based on land slope information, predates the ORMCP LCA designations, and delineates slightly broader areas. Approximately 2450 ha in this watershed has been identified as areas having hummocky topography.

The South Slope covers an area of approximately 41% of the total watershed area and is topographically lower (average elevation 192 masl) and flatter than the Oak Ridges Moraine. Slopes within this area are moderate and trend southward towards Lake Ontario (Gartner Lee Ltd., 1994) with the typical average slope being about 5.6%. This physiographic region is characterized by drumlin fields oriented in a northeast to southwest direction. These features are elongated hills formed by glacial action and their long axis lie parallel with the movement of the ice (Shaw et al, 1984). These drumlins present the distinct hilly scenic landforms seen today.

The Iroquois Beach area, being remnant glacial lake shoreline deposits, covers approximately 11% of the total watershed area and is typically an area of moderate slopes (Gartner Lee Ltd., 1994). However, slopes within this area may be highly variable locally due to shoreline effects of the historic lake. The average elevation within the Iroquois Beach is 140 masl and the average slope is 5.7%.

The Iroquois Plain, represents approximately 18% of the total watershed area. This region drops off from the beach bluffs to an elevation of less than 75 masl. With an average elevation of 109 masl, this region is flatter with an average slope of 4.3%.

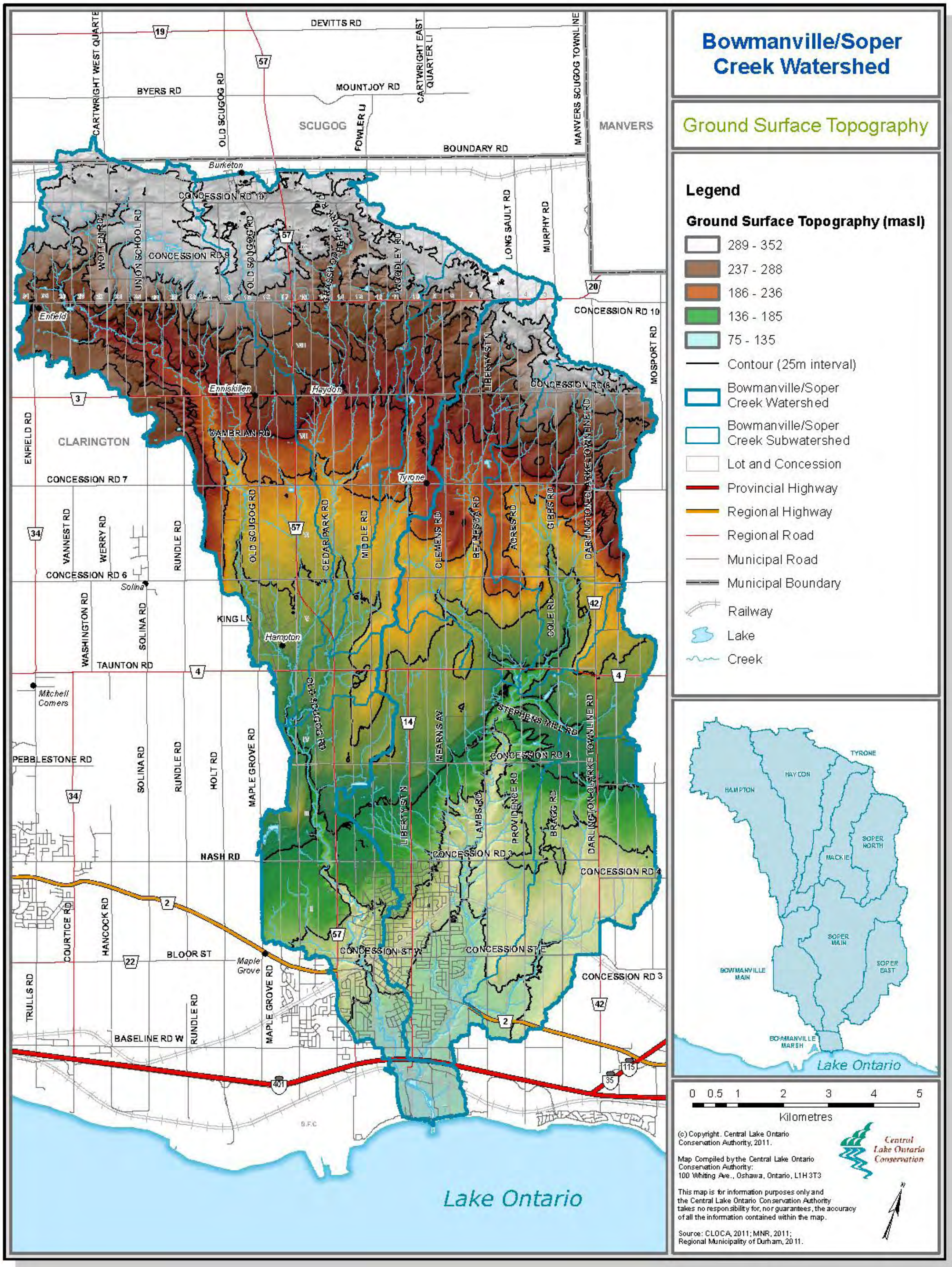


Figure 5: Bowmanville/Soper Creek watershed Ground surface elevation.

4.4 Soils

Soil types within the Oak Ridges Moraine (ORM) are dominated by Pontypool sand and Dundonald sandy loam and pockets of muck occurring locally. The South Slope is predominately Otonabee loam with pockets of Darlington, Bondhead, Guerin, and Brighton sandy loam, distributed primarily in the south of the physiographic unit within the watershed. The Iroquois Beach is dominated by Brighton gravelly sand and Bondhead sandy loam in the easterly areas, Brighton gravelly sand in westerly areas, and in the central areas Bridgeman sand with pockets of Brighton sandy, Darlington and Bondhead sandy loams occurring locally. The Iroquois Plain contains a concentration of Newcastle loam and Simcoe clay loams in the middle of the physiographic unit, which is adjacent to Darlington sandy loams, and Marsh soil types. Areas of Muck and Bottom Land occur throughout the watershed typically adjacent to or surrounding water features.

In general, the deposits of the ORM planning boundary area and South Slope physiographic region are reflective of the parent bedrock material. The bedrock material in the Bowmanville/Soper Creek watershed is limestone associated with the Lindsay Formation. The till deposits thus, are highly calcareous. This differs from the soils to the west which are increasingly more acid being associated with shale parent material.

Soil properties have a significant influence on hydrological processes as they control the amount of water that can infiltrate and can be transmitted to the water table and how much water can be lost to evaporation and transpiration by plants. Identification of soil types grouped by their infiltration potential is required to support hydrologic studies. Infiltration is the downward movement of water through the soils. Field capacity is the moisture content below which the soils can retain water against gravity. Fine-grained soils tend to be able to retain water better than coarse-grained soils. Water can be removed from the upper part of the soils zone by evaporation and by evapotranspiration by plants. Table 3 provides spatial estimates of the soil types classified by the hydrologic soil groups as represented by percent of the total watershed area. Figure 6 illustrates the spatial distribution of the hydrologic soils groups noted in Table 3.

Table 3: Bowmanville/Soper Creek watershed Hydrologic soil groups.

General Description	Hydrologic Soil Group	Percent of Watershed*
Sandy Loam – high infiltration/low runoff potential	A	19%
	AB	21%
Silt Loam – moderate infiltration potential	B	26%
	BC	9%
Sandy Clay Loam – low infiltration potential	C	14%
	CD	<1%
Clay Loam – very low infiltration/high runoff potential	D	11%

* values may not add to 100% due to rounding.

Three dual classes of AB, BC, and CD represent subgroups of the four main soil groups. For instance, soils with very low infiltration due to higher water tables such as Muck, Bottom Land and Marsh soils tend to be classified as D, while soils such as Smithfield clay loam fall into the subgroup CD. Sandy loams such as Brighton, Bondhead, Techumseth and Pontypool fall within the subgroup A/B while sands and gravely soils are grouped in hydrologic group A.

Moderate to highly permeable soils (A-BC) occur within approximately 75% of the watershed (Figure 6) comprised predominately of sandy loams and loams located generally within the ORM, Iroquois Beach and South Slope areas. These areas represent potential groundwater recharge and interflow to streams, and on average contribute a relatively lower runoff potential. With loam soils of moderate infiltration capacities predominate over the South Slope region (e.g. Bondhead loam, Guerin loam, etc.), this area, due to its size within the watershed (41%), becomes an important area of potential groundwater recharge. Loam to clay loam soils with low rates of water transmission are found at larger concentrations in the Iroquois Plain region.


Bowmanville and Soper Creek subwatershed divide

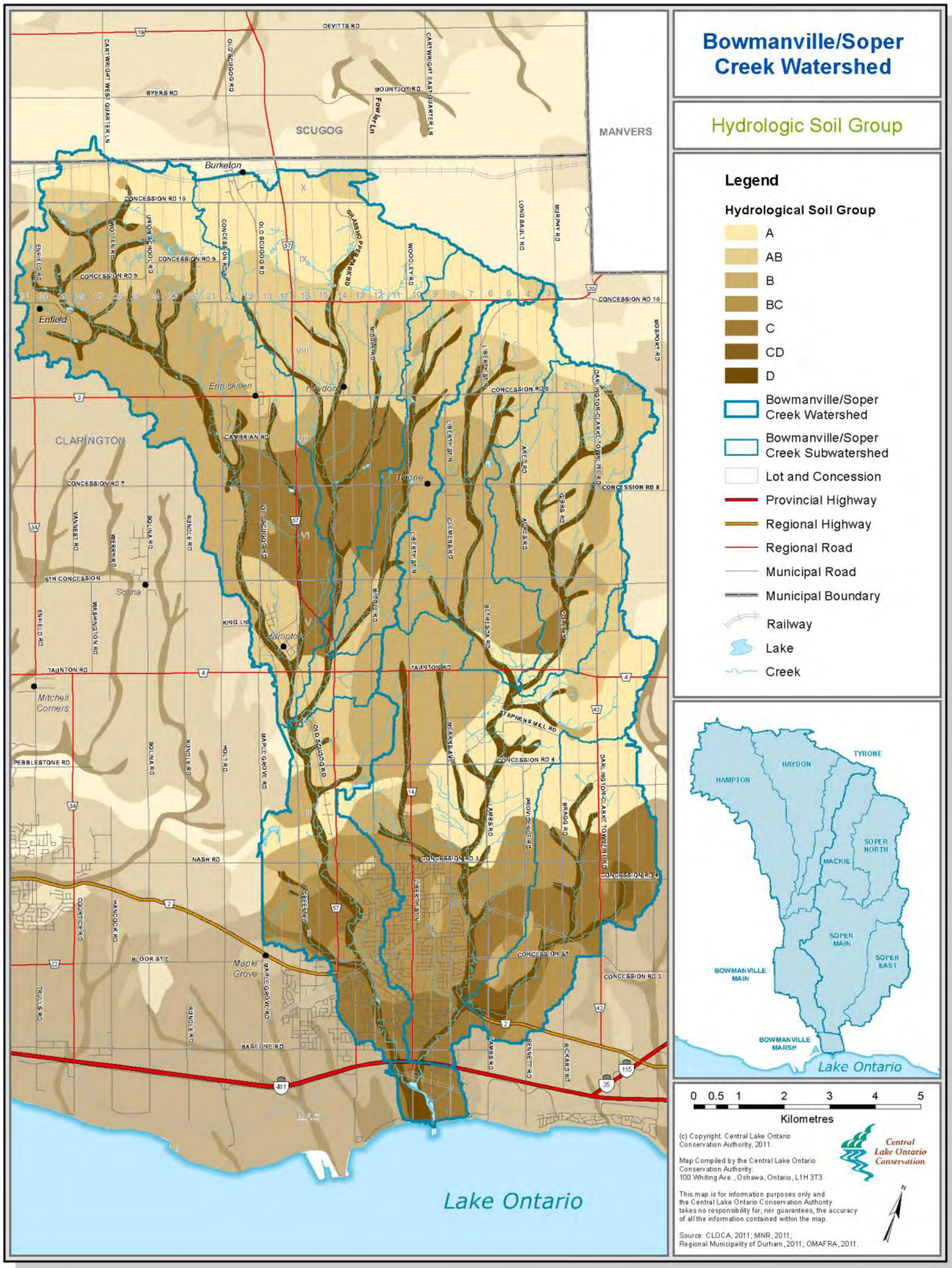


Figure 6: Hydrologic soil groups (source: Ontario Ministry of Agriculture, Food and Rural Affairs, 1989)

4.5 Subwatershed Findings

4.5.1 Bowmanville Creek Subwatershed

The Bowmanville Creek subwatershed covers approximately 9205 ha. The subwatershed extends through the Municipality of Clarington from Lake Ontario to just within the Township of Scugog municipal boundary. The ORM planning boundary is found within the northern half of this subwatershed, representing approximately 44.5% or 4102 ha of the subwatershed area. The South Slope physiographic region covers approximately 3750 ha (41%) of the Bowmanville Creek subwatershed drainage area. A relatively small portion lies within the Iroquois Beach (450 ha or 5% of subwatershed area). About 10% (900 ha) of the subwatershed is found within the Iroquois Plain (Figure 7). Generally considered as hydrologically sensitive areas, the combined ORM and Iroquois Beach areas covers 4553 ha, representing approximately 49.5% of the total subwatershed area.

The subwatershed has a maximum elevation of 352 meters above sea level (masl) on the ORM to a low of approximately 75 masl at Lake Ontario (Figure_8). With an estimated centreline length of 20 km, the overall average slope of land surface approximates 7%.

The subwatershed is dominated by soils of moderate to high infiltration (B/C to A) rates (73% subwatershed area) (Figure 9). The ORM area is primarily Bondhead Loam with a pocket of Granby Sandy Loam and Guerin Loam. The South Slope is dominated by Bondhead Loam with pockets of Guerin and Lyons Loam, Brighton Gravelly Sandy Loam and Muck. The Iroquois Beach is predominately Brighton Sandy Loam to the east with a mix of Granby Sandy Loam, Brighton Gravelly Sand, Guerin Sandy Loam – Bouldery Phase, Darlington Loam, and Guerin Loam to the west. A few pockets of Muck, Tecumseth Sandy Loam, and Guerin Loam occur locally within the Iroquois Beach. The Iroquois Plain is comprised of a mix of sandy loam to clay loam types: Brighton Sandy Loam, Bondhead and Darlington Loams, Schomberg, Smithfield and Simcoe Clay Loams, Brighton Sandy Loam – Stony Phase, Guerin Sandy Loam – Bouldery Phase, and Muck.

Enniskillen Conservation Area

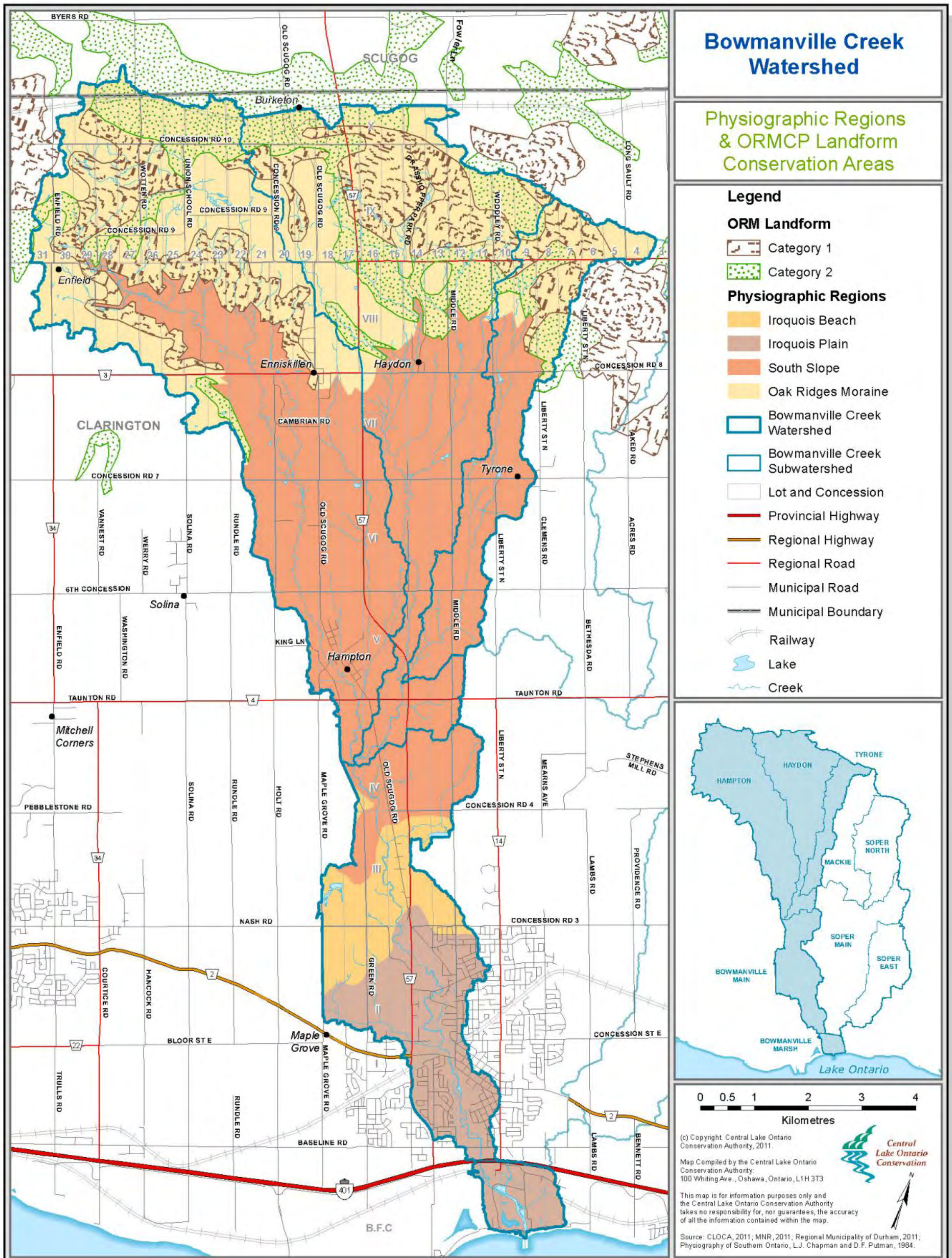


Figure 7: Bowmanville Creek subwatershed physiographic regions and ORMCP Landform Conservation Categories (sources: Chapman and Putnam, 1984; MMAH, 2002)

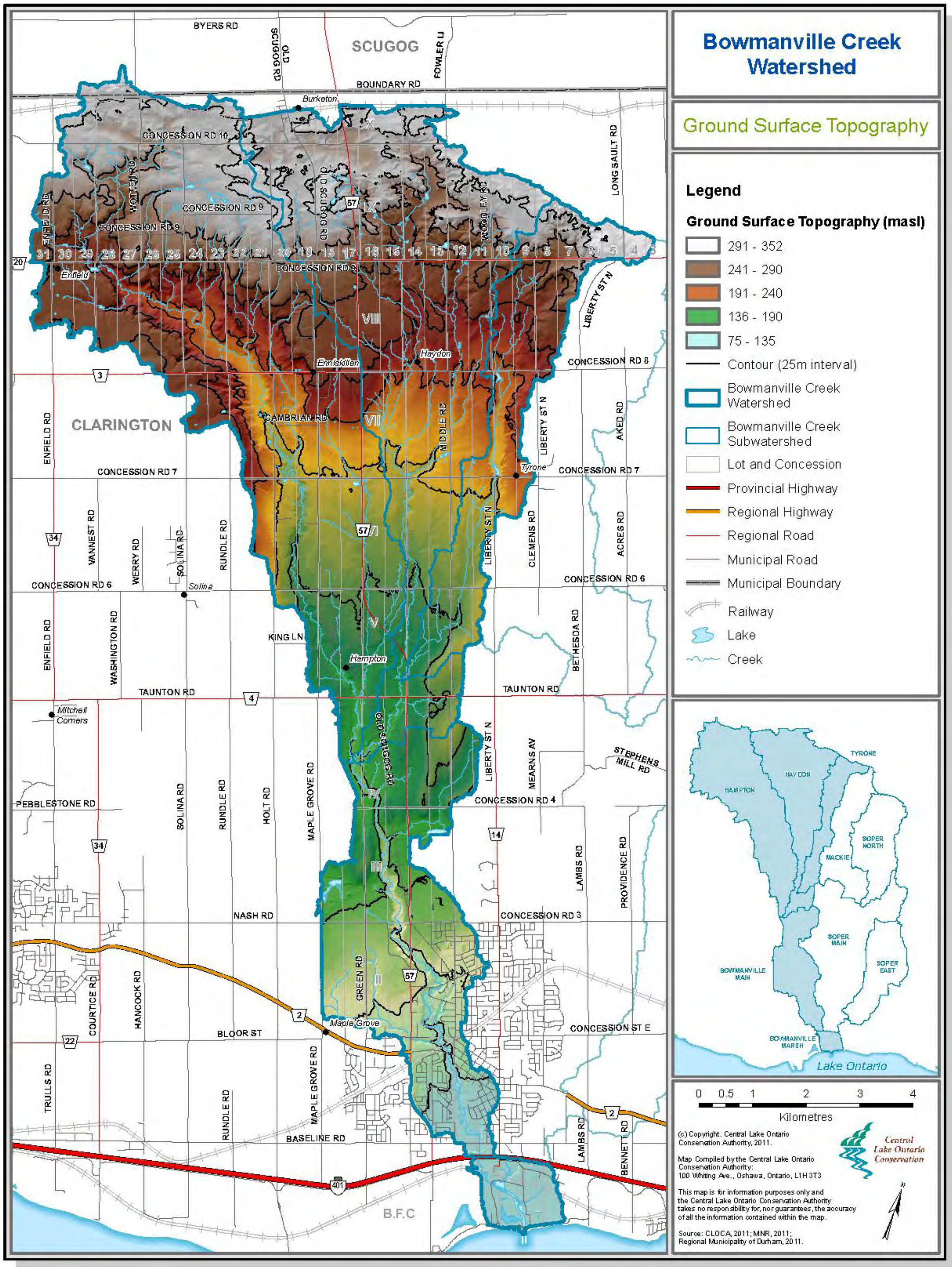


Figure 8: Bowmanville Creek subwatershed ground surface elevation

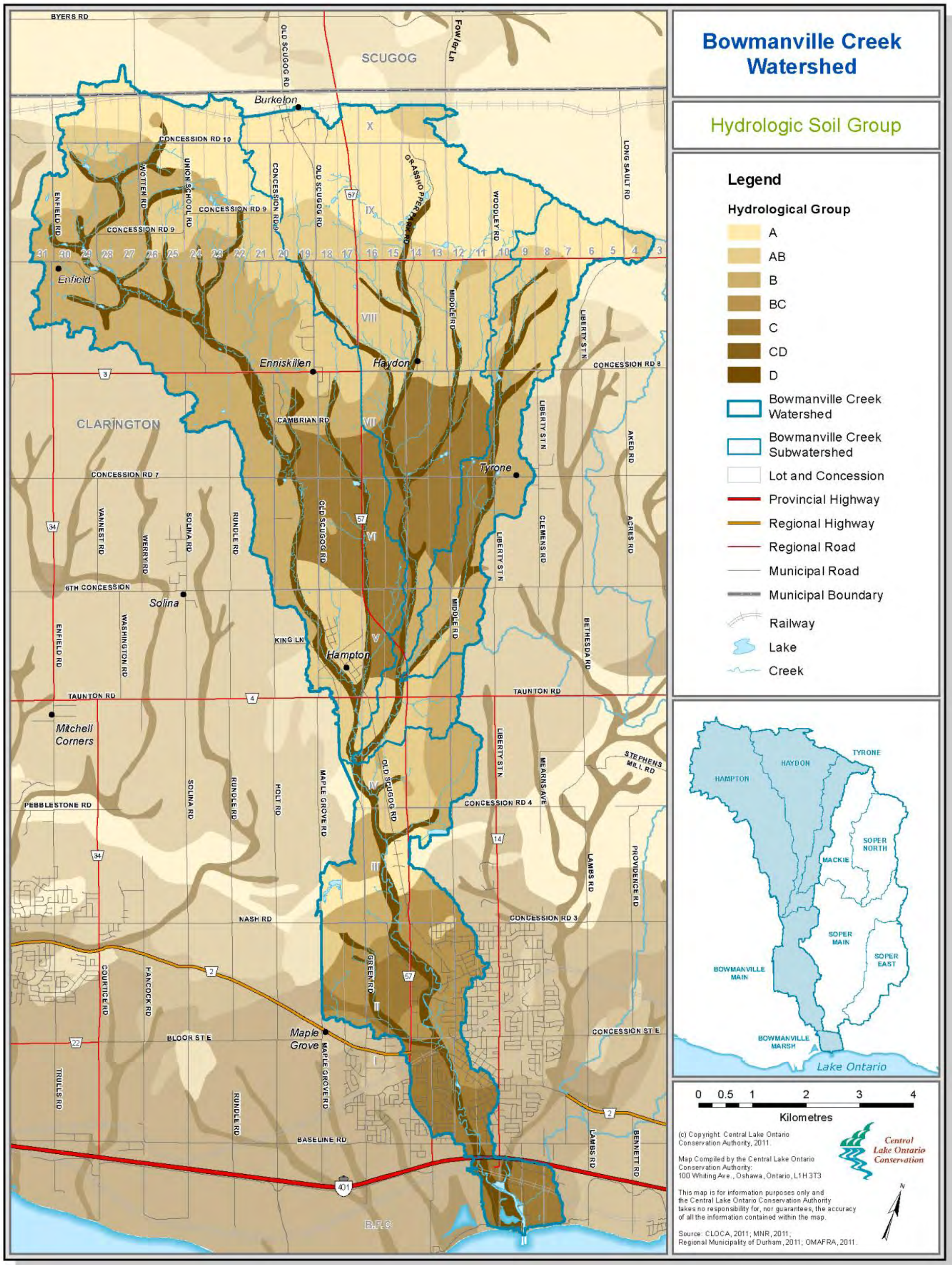


Figure 9: Bowmanville Creek subwatershed hydrologic soil groups (source: Ontario Ministry of Agriculture, Food and Rural Affairs, 1989).

4.5.2 Soper Creek Subwatershed

The Soper Creek subwatershed drains the eastern half of the Bowmanville/Soper Creek watershed. Just south of the Canadian National Railway, Soper Creek outlets into Bowmanville Creek in the Provincially Significant Wetland (PSW) known as the Bowmanville Coastal Wetland Complex in the Bowmanville Marsh subwatershed. The drainage area for this subwatershed is 7729 ha. The headwaters originate in the ORM around the intersection of Regional Road 20 and Liberty Street. The ORM represents approximately 13.5% or 1049 ha of the subwatershed area. In addition, almost 770 ha of the Soper Creek subwatershed lies within either Landform Conservation Area Category 1 (691 ha) or Category 2 (77 ha) as identified in the ORMCP. In other words, approximately 1,050 ha or 73% of the area within the ORM in this subwatershed receives additional protection in accordance with the Oak Ridges Moraine Conservation Plan. Hummocky terrain covers approximately 409 ha of this subwatershed.

The South Slope physiographic region covers approximately 42% or 3219 ha of the Soper Creek subwatershed, 18% (1,395 ha) of this subwatershed lies within the Iroquois Beach, and 27% or 2,065 ha is in the Iroquois Plain physiographic region (Figure 10). Generally considered significant areas of recharge, the combined ORM and Iroquois Beach areas represent approximately 32% (2444 ha) of the total subwatershed area.

The north south elevations range from approximately 349 masl to 75 masl (Figure 11). The overall average slope of land surface over an estimated 17 km centreline length of the subwatershed is approximately 5.8%. Slightly above average slopes occur over the ORM and South Slope areas.

The combined impact of the ORM, South Slope and Iroquois Beach features on the Soper Creek subwatershed is reflected by the area being dominated by soils of moderate to high infiltration (B/C to A) rates (77% subwatershed area) (Figure 12). The ORM area is primarily Bondhead Loam with pockets of Muck and Lyons Loam occurring locally. The South Slope is dominated by Bondhead Loam with a local pocket of Smithfield Clay Loam and a section of Guerins Loam located north of the Iroquois Beach. The Iroquois Beach is dominated by a mix of Sand and Sandy Loams, comprised of Granby Sand Loam, Brighton Sand and Gravelly Sand, Guerin and Granby Sandy Loams- Bouldery Phase, Darlington Sandy Loam, Guerin Loam, Bottomland and pockets of Muck. The Iroquois Plain is dominated by Darlington Loam and Sandy Loam with pockets of Simcoe and Smithfield Clay Loams, and Brighton and Granby Sandy Loams.

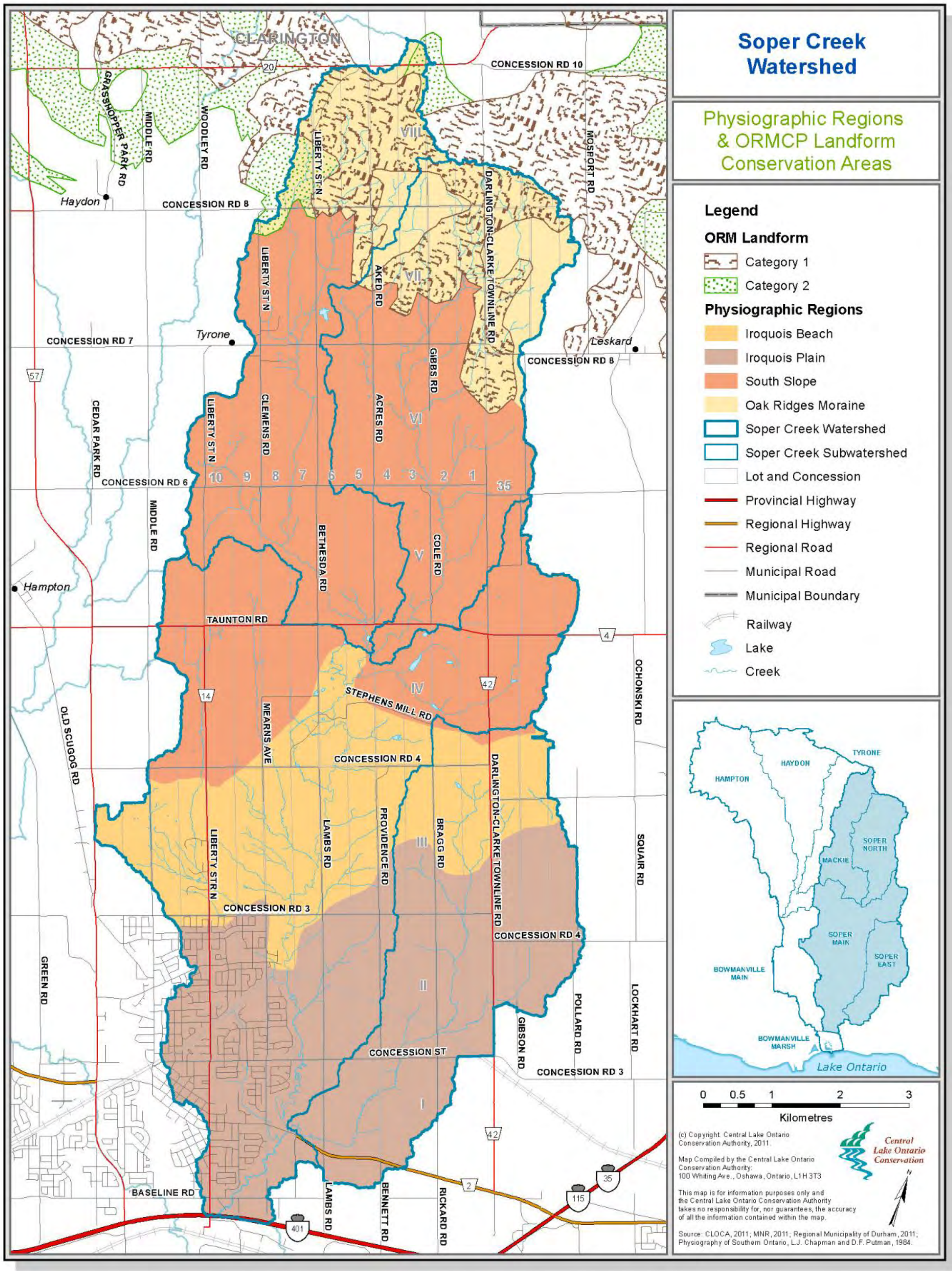


Figure 10: Soper Creek subwatershed physiographic regions and ORMCP Landform Conservation Categories (sources: Chapman and Putnam, 1984; MMAH, 2002).

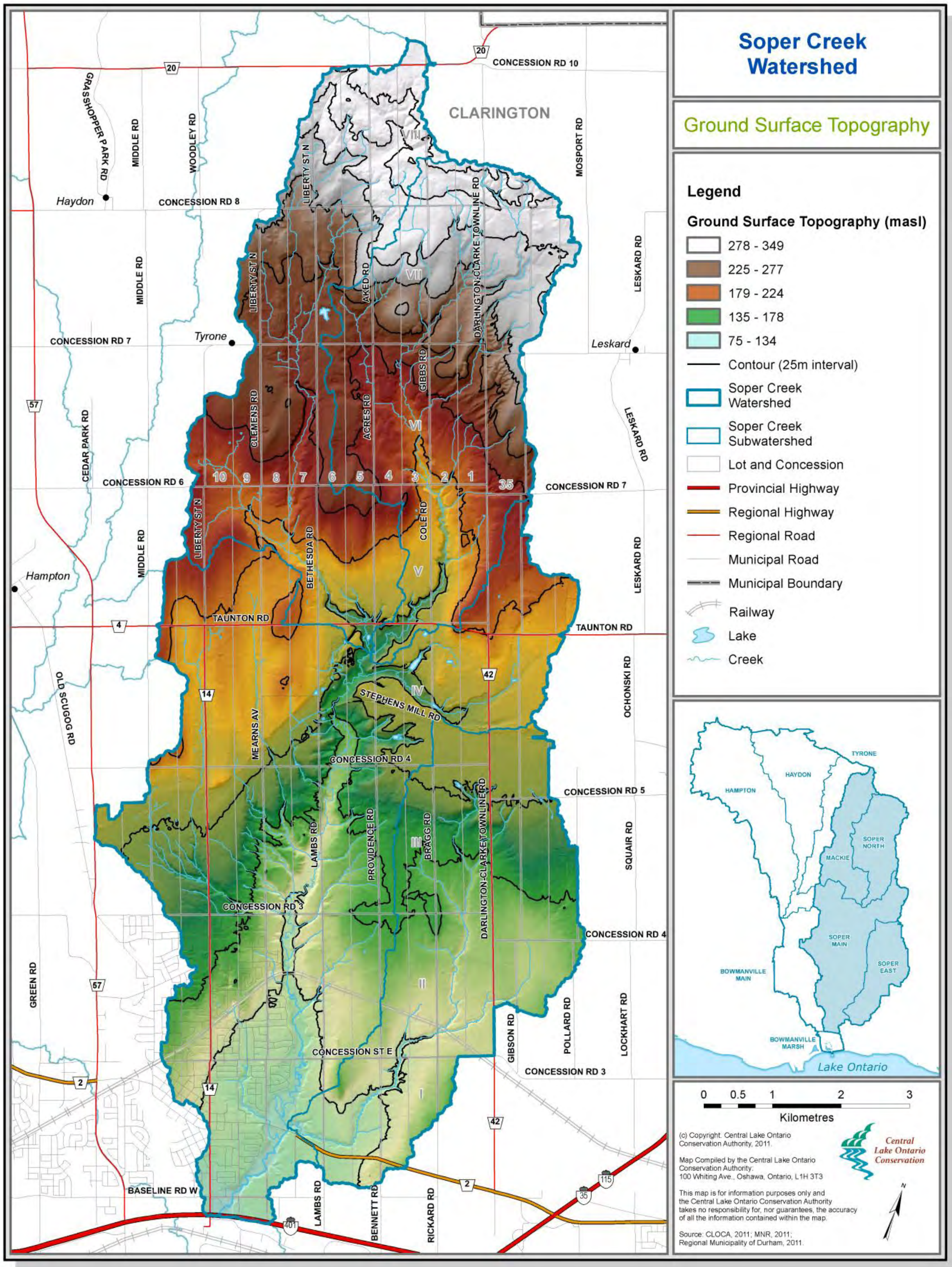


Figure 11: Soper Creek subwatershed ground surface elevation.

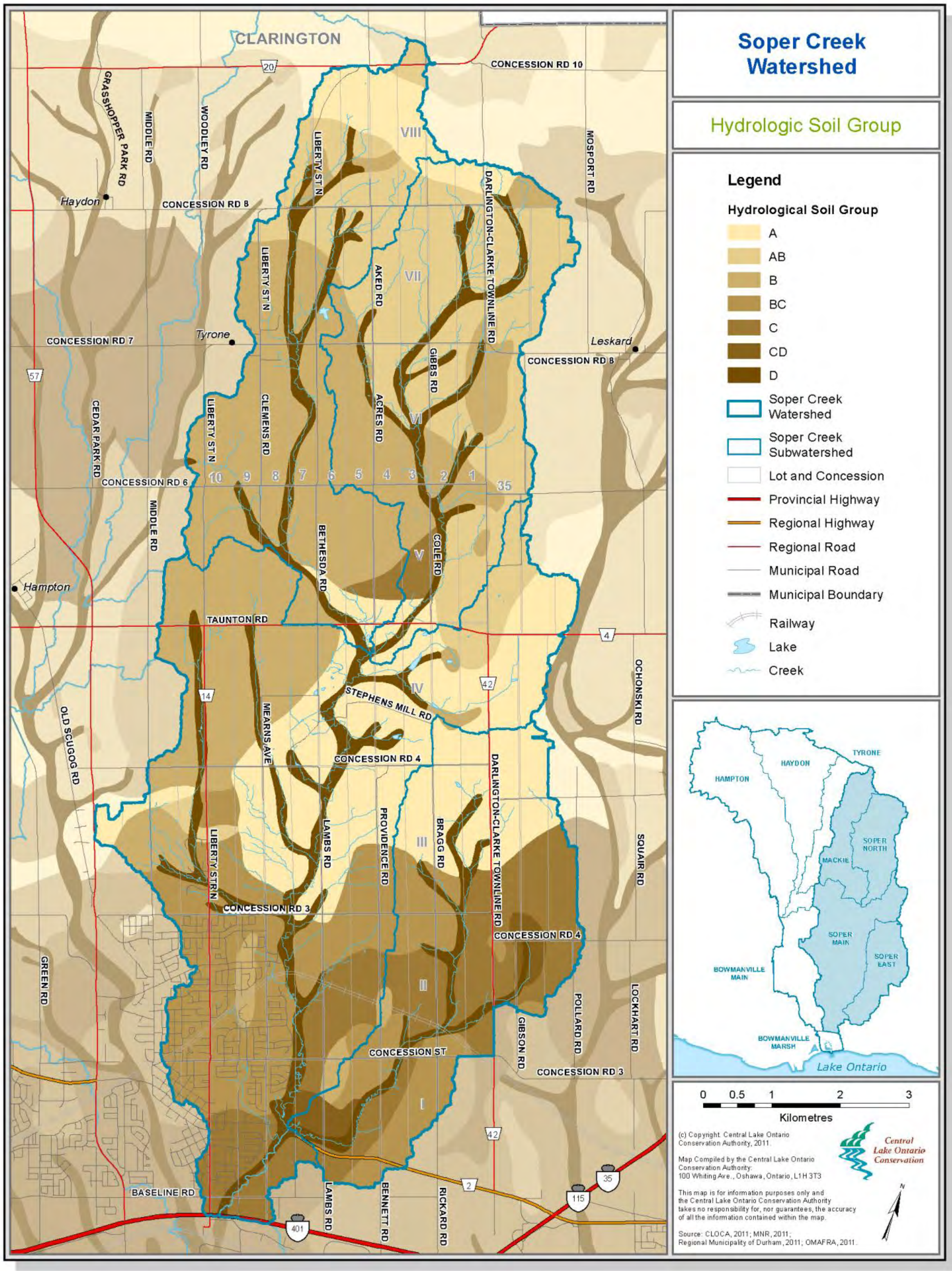


Figure 12: Soper Creek subwatershed hydrologic soil groups (source: Ontario Ministry of Agriculture, Food and Rural Affairs, 1989).

5.0 CONCLUSIONS

The physiography, topography and soils of the Bowmanville/Soper Creek subwatersheds have been summarized using various sources of existing information. Maps of the major features have been produced and assessed on a subwatershed scale. Both the Bowmanville and Soper Creek subwatersheds extend into the environmentally sensitive and significant Oak Ridges Moraine (ORM). With the headwaters of these subwatersheds arising in the ORM, the Moraine is important from an ecological and hydrological perspective. The significance of the Moraine in supporting and maintaining the health of this watershed cannot be overlooked.

Through the middle of this watershed crosses the Iroquois Beach. This physiographic feature plays a significant supporting role in this watershed. As a groundwater recharge and discharge zone, this area is important hydrologically and ecologically; supporting many diverse and sensitive habitats.

The ORM and Iroquois Beach areas represent just over 41% of the total watershed area. The spatial extent of the South Slope and Iroquois Plain represents approximately 59% of the total watershed area. As such, from a spatial perspective these areas can be significant controlling features. For instance, while the South Slope physiographic region may be seen to have soils of lower infiltration rates compared to those in the ORM or Iroquois Beach, and ultimately resulting in lower groundwater infiltration locally, the region is in fact contributing significantly to groundwater due to its proportion of watershed area. In addition, large areas of the watershed are covered by highly productive soils with approximately 75% comprised predominately of moderate to high infiltration soils (A to B/C) located generally within the ORM, Iroquois Beach and South Slope physiographic regions.

The methods and descriptions provided in this chapter are anticipated to be at a scale that 1) suitably supports the integrated review of ecological and hydrologic studies such as on-going advanced terrestrial, fisheries, hydrologic, and water budget modelling on a subwatershed basis, and 2) support the development of recommendations and integrated resource management planning options as required by the ORMCP.

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