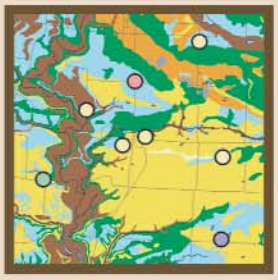
EXECUTIVE SUMMARY



# Kettle Creek Watershed

Characterization Report ▪ January 2008

DRINKING WATER SOURCE PROTECTION

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Ontario

*This report is made possible through the support of the Government of Ontario*

**Kettle Creek Conservation Authority (KCCA)**

**Catfish Creek Conservation Authority (CCCA)**

**Long Point Region Conservation Authority (LPRCA)**

**Grand River Conservation Authority (GRCA)**

*The watershed characterization reports were prepared by the source protection project teams at the four conservation authorities in the Lake Erie Source Protection Region.*

# 1. Introduction

## The Clean Water Act

The Clean Water Act was passed by the Ontario legislature in October 2006 to implement many of the recommendations of the provincial inquiry into the Walkerton tainted water tragedy.

The Act, its regulations and other provincial guidance documents outline a process to develop a source protection plan for the Kettle Creek watershed. This work will be guided by the Lake Erie Region Source Protection Committee.

A source water protection plan is an agreement among the people and the communities of a watershed about the ways to protect water quality and quantity for drinking water systems.

The source protection planning process will:

- identify existing water supply and water quality issues;
- identify sources of drinking water and vulnerable areas in a watershed;
- identify the threats to source water quality and quantity;
- establish the risk posed by threats in vulnerable areas; and
- outline policies and programs to eliminate existing significant threats and to ensure no future drinking water threats become significant threats.

## Documents

In order to accomplish this goal, several documents will be prepared:

- a watershed characterization report;
- a terms of reference for the source protection committee;
- a technical assessment report; and
- a source protection plan.

The first document – the watershed characterization report – is an overview of the current state of the watershed. It includes information on the natural system (bedrock geology, surface geology, forests, wetlands, etc.) and the human system (urban areas, population growth, land use, water systems, etc.). The report describes the links between the natural and human systems.

This executive summary provides an overview of the material in the full Kettle Creek Watershed Characterization Report.

## A note to readers

Both the full characterization report and this summary are draft documents. They will both be updated as more information becomes available.

# 2. Watershed overview

## Watershed characteristics

The Kettle Creek watershed is in the heart of the Carolinian Zone on the north shore of Lake Erie. The watershed is hourglass in shape and drains 520 square kilometres of land. Kettle Creek outlets to Lake Erie at Port Stanley at an elevation of 166 metres above sea level. This represents an elevation drop of about 141 metres from its watershed height to the average Lake Erie water level, approximately 1.75 metres per kilometre. This steep drop in elevation results in flash flooding and a high degree of erosion. In many instances the bed of the stream is more than 30 metres below the level of the surrounding land.

## Population

The population of the Kettle Creek watershed in 2001 was approximately 44,406, distributed between an urban core in the City of St. Thomas and a rural periphery in the Township of Malahide, Municipality of Central Elgin, Township of Southwold, Township of Middlesex Centre and Township of Thames Centre, and the southern, mostly rural portion of the City of London.

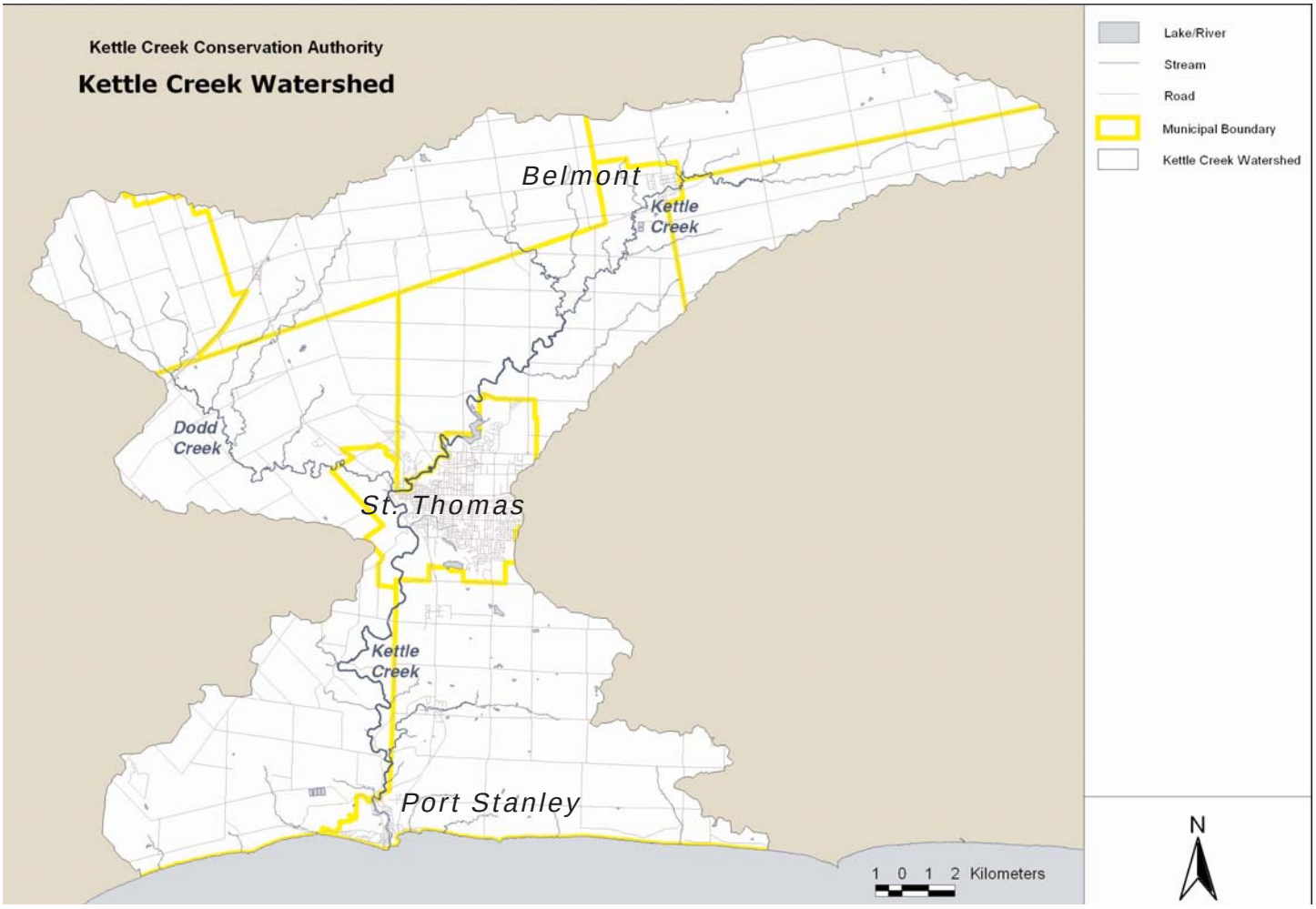
About 83 per cent of the land is designated and used for agricultural purposes. There are a total of 8,900 head of cattle, 14,800 head of swine and 200,000 head of poultry.

## Water quality

Surface water quality within the Kettle Creek watershed appears to be negatively affected by increasing summer temperatures, decreasing base flows, potentially low levels of dissolved oxygen, and extensive nutrient and sediment concentrations.

Nutrient levels, primarily phosphorus and nitrate, are high throughout the watershed.

The creek cuts deeply into the surrounding landscape with the result that soil erosion has become an important



# 2. Watershed overview (cont'd)

issue. A siltation study undertaken for the federal government in 1987 projected that more than 41,000 cubic metres of harbour sediments were coming from the Kettle Creek watershed each year.

A major contamination issue affecting water quality within Lower Kettle Creek at Port Stanley is the presence of polynuclear aromatic hydrocarbons (PAHs) within the bed sediments. Studies have shown one area is significantly contaminated and will continue to be a chronic source of pollution for the waterway if clean up measures are not taken. PAHs are extremely toxic and can lead to odour problems and habitat degradation for aquatic life.

The Kettle Creek watershed has the fastest eroding shoreline in the Great Lakes basin. The shoreline recedes at an average rate of more than two metres a year, averaged over 100 years.

## Uses of the creek

For the earliest inhabitants, both Native and European settlers, the creek was the lifeblood of their communities, providing them with transportation, a source of drinking water and food. However, today, the nature of the creek – deeply incised into the surrounding landscape – means that in many places it is hidden in deep valleys therefore losing some of its connections to surrounding communities.

Small lakes and reservoirs throughout the watershed offer recreational opportunities to residents. Lake Whittaker is the focal point of a conservation area and attracts sport anglers.

Port Stanley has developed as a bustling fishing and tourist community, built around the natural harbour at the mouth of Kettle Creek, which is the largest on the north shore of Lake Erie.

## Sources of drinking water

There are two sources of municipal drinking water in the Kettle Creek watershed:

### Groundwater

- The 1,500 residents of Belmont, in the Municipality of Central Elgin, get their drinking water from two groundwater wells.

### Surface water – Lake Erie

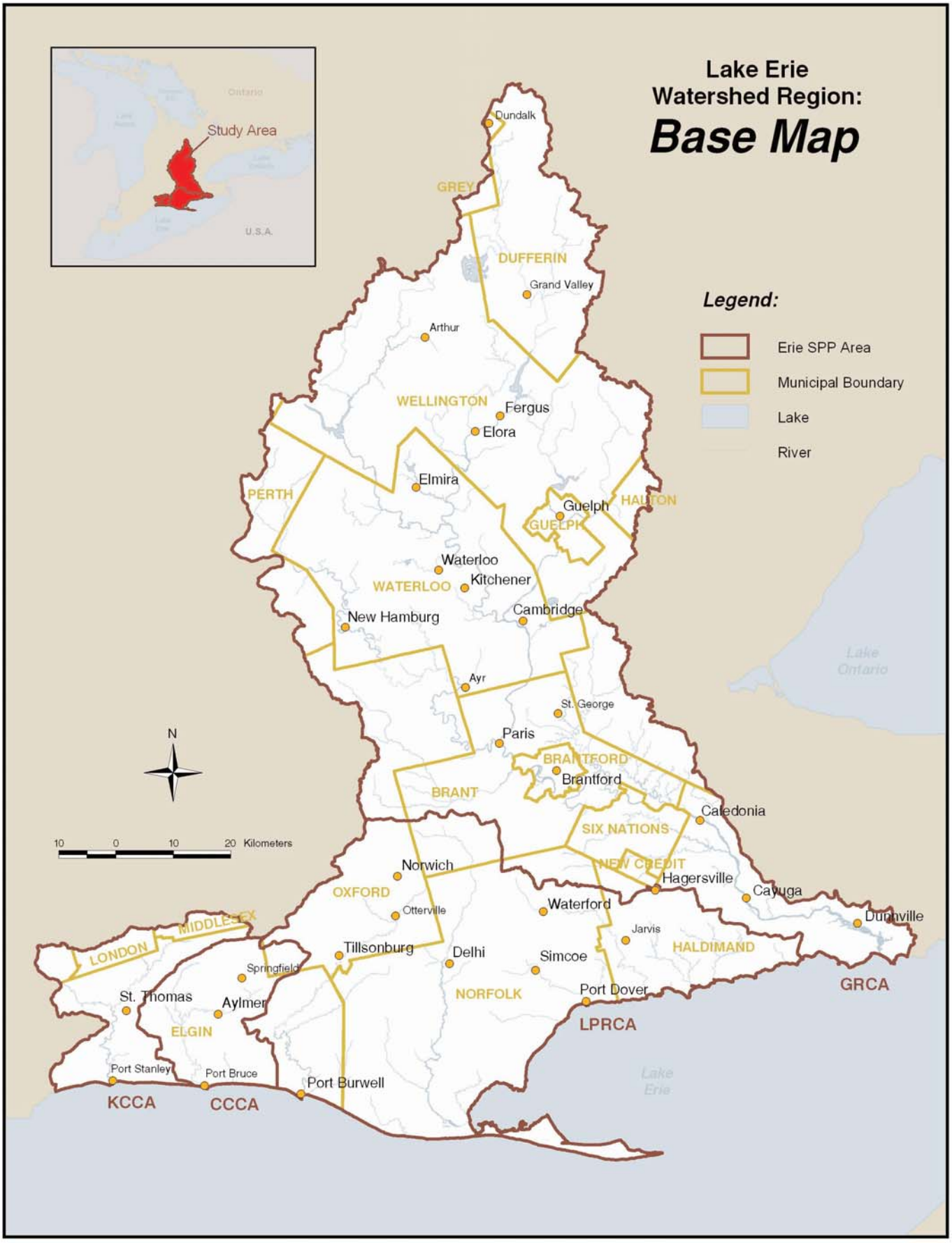
- An intake in the lake near the mouth of Kettle Creek provides water to the Elgin Area Primary Water Supply System, serving residents of Elgin County, the City of St. Thomas and the City of London.

# 3. Lake Erie Source Protection Region

Under the Clean Water Act, conservation authorities have been grouped together into Source Protection Regions for the purpose of sharing resources and expertise. The Kettle Creek watershed is part of the Lake Erie Region which also includes the Long Point Region, Catfish Creek and Grand River watershed areas.

There are several reasons why these four conservation authorities have come together to form the Lake Erie Region:

- all of the watersheds drain into Lake Erie
- they share some geographic attributes
- some of the urban areas within Catfish, Kettle and Long Point share one Lake Erie intake
- they share some political ties. Several municipalities have territory in two or three of these watersheds, so having one source protection region simplifies municipal involvement in the planning process.


Lake Erie
Watershed Region:
Base Map
Study Area
Ontario
U.S.A.
Legend:
Erie SPP Area
Municipal Boundary
Lake
River
Dundalk
GREY
DUFFERIN
Grand Valley
Arthur
WELLINGTON
Fergus
Elora
Elmira
PERTH
Guelph
HALTON
GUELPH
Waterloo
Kitchener
WATERLOO
New Hamburg
Cambridge
Lake Ontario
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Springfield
St. Thomas
Aylmer
NORFOLK
Port Dover
GRCA
LPRCA
ELGIN
Port Stanley
Port Bruce
Port Burwell
KCCA
CCCA
Lake Erie

# 4. Geology and groundwater

## Bedrock geology and groundwater

The bedrock geology across the Kettle Creek watershed consists primarily of limestone (the Dundee Formation) and shales (the Hamilton Group and the Marcellus Formation). Bedrock does not outcrop within the watershed since a thick layer of overburden sediments (40 metres to 140 metres) covers this area. Because of the thick overburden cover, wells are often not completed within the bedrock.

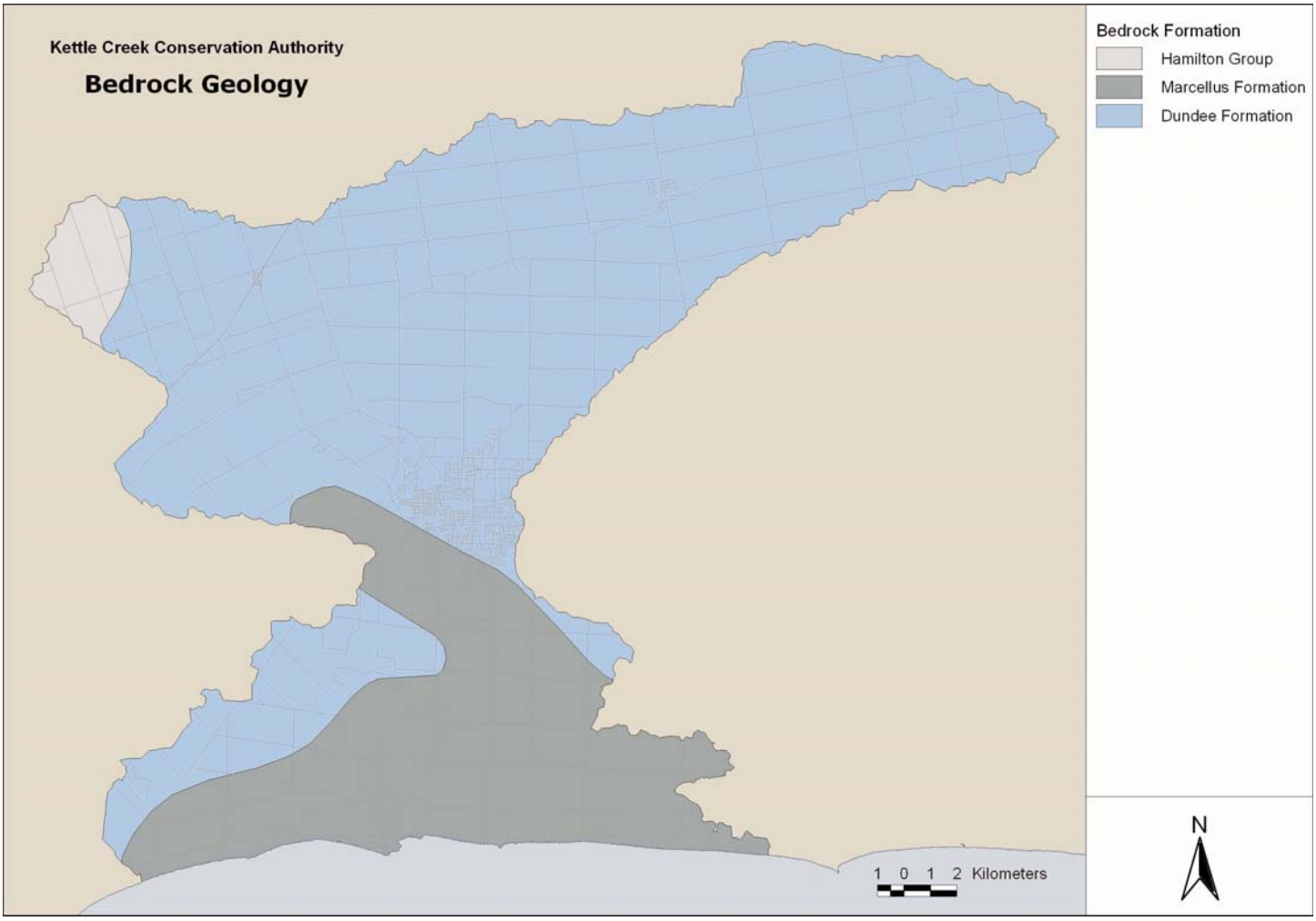
Although water is available in the bedrock aquifers, it is often poor in quality with high naturally occurring concentrations of sulphur, salts and other minerals that it has picked up from the surrounding bedrock.

## Implications of geology and land use

Land use practices in the watershed create an increased risk for ground and surface water, depending on the geology of the area. The geology can determine the infiltration, runoff and recharge rate of precipitation which corresponds to how fast and easily contaminants may be able to move and infiltrate the ground and surface water.

The mix of clay and till materials covering most of the Kettle Creek watershed allows much of the precipitation to run off into the creek and its tributaries. Clearing and draining of land for agricultural use throughout the watershed has increased the rate of runoff and created a flushing effect, where soils and contaminants are carried overland and downstream to the outlet of the creek into Lake Erie. This runoff may impact downstream water users, including the Lake Erie water intake for the Elgin Area Primary Water Supply System.

Conversely, the tight till and clay deposits in the northern portion of the watershed provide significant protection from land uses to the groundwater sources for



# 4. Geology and groundwater (cont'd)

both the municipal supply for the village of Belmont and private wells. The clay and till materials of the Ekfrid Clay Plain and Mount Elgin Ridges reduces infiltration of surface water and contaminants to the drinking water supply aquifer.

## Surface (Quaternary) geology

There are three distinct physiographic regions within the Kettle Creek watershed: the Mount Elgin Ridges, the Ekfrid Clay Plain, and the Norfolk Sand Plain.

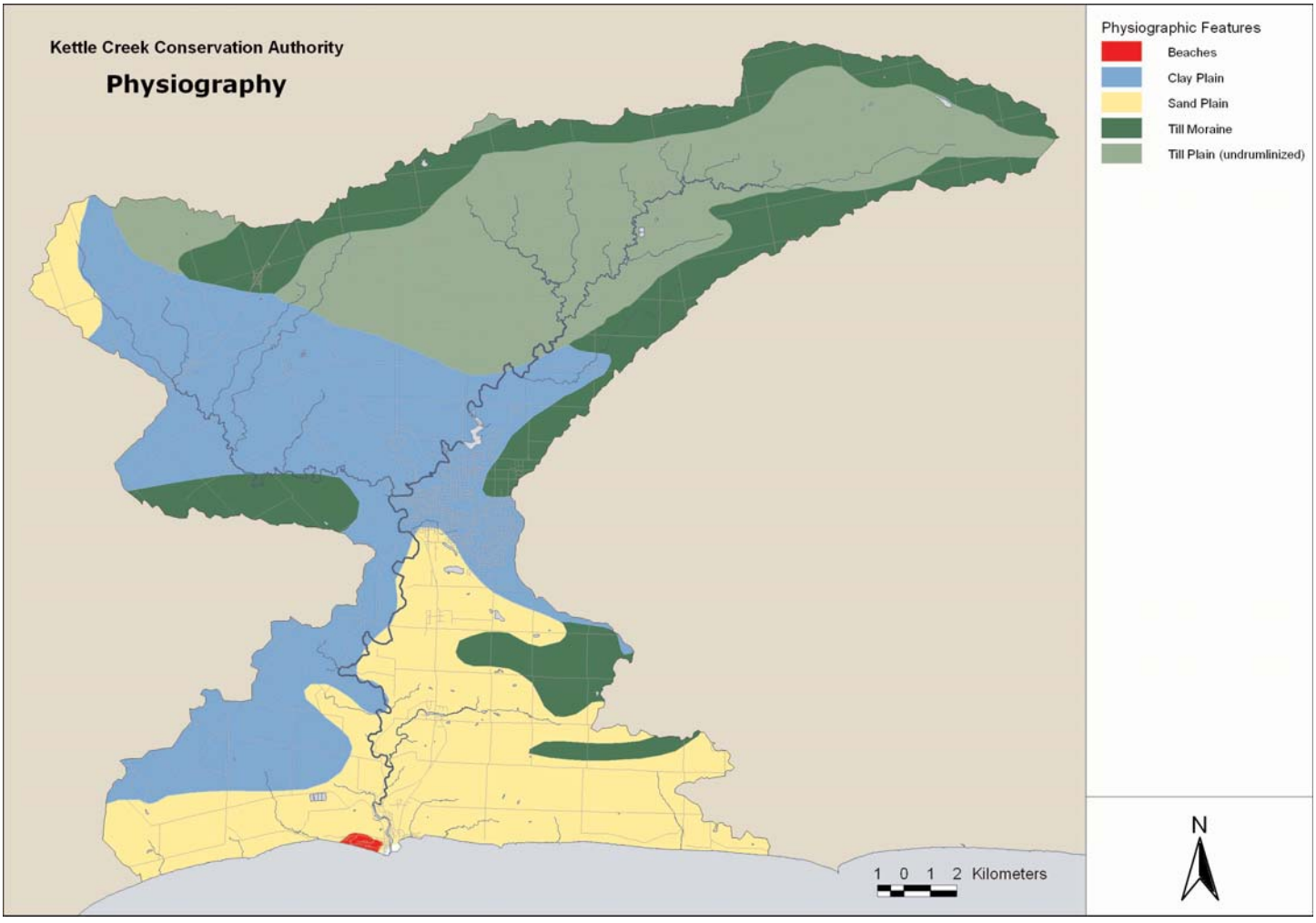
### Mount Elgin Ridges

Located between the Thames River Valley and the sand plains of Norfolk and Elgin counties, the Mount Elgin Ridges cover approximately 270 square kilometres in the northern third of the Kettle Creek watershed. The ground in this area is predominantly covered by Port Stanley Till, a thick, silty clay-rich till unit. This distinct physiographic region is made up of two prominent topographic features, the St. Thomas and Westminster moraines.

The St. Thomas Moraine is the strongest moraine of the series and is up to five kilometres wide between London and Tillsonburg and is prominent as far as Wallacetown. It also forms the drainage divide between the Kettle Creek watershed and the Catfish Creek watershed to the east.

The Westminster moraine trends east to west and is approximately five kilometres wide. It passes about 12 kilometres south of the City of London's centre and is flanked on the north by the parallel Ingersoll Moraine. The Westminster moraine forms the drainage divide along the northern boundary of the Kettle Creek watershed.

Private and municipal wells in the Mount Elgin Ridges are often completed in discontinuous sandy lenses which are located between the layers of the Port Stanley Till.



# 4. Geology and groundwater (cont'd)

### Ekfrid Clay Plain

The Ekfrid Clay Plain comprises a fairly large area in the Lake Erie region and approximately 110 square kilometres in the central portion of the Kettle Creek watershed. The clay plain, located to the south of the Mount Elgin Ridges, is characterized by generally flat topography and underlain by stratified clay and silt which provide little relief and poor drainage. These clays are representative of lake bottom deposits deposited by glacial Lake Maumee about 14,000 years ago. Those areas dominated by clays are used for pasturelands and limited cropping due to slow drainage. Areas of silty sediments are particularly well suited for agriculture resulting in cash cropping as a dominant agricultural activity in this region.

### Norfolk Sand Plain

The Norfolk Sand Plain is an extensive 120 square kilometres and encompasses the south eastern portion of the Kettle Creek watershed, extending to the Lake Erie shoreline. It ranges in thickness from less than a metre to over 25 metres in isolated areas. The sand plain was deposited as a delta in glacial Lakes Whittlesey and Warren, roughly 13,000 years ago. The sand plain is also rich in water and is intensively used for both mixed farming and cash crops. However, the more permeable also make it easier for contaminants to enter the ground and reach the numerous private wells completed in this aquifer.

## Topography

The watershed is characterized by deeply incised valley systems and a steep descent of watercourses from headwater areas to Kettle Creek's outlet at Port Stanley. Kettle Creek and its tributaries decrease in elevation at an average of 1.75 metres per kilometre of watercourse. Given the predominance of moderately impermeable clay soils found throughout the watershed, rainfall and snowmelt runs off quickly to nearby drains and streams. As a result, the watershed's primary natural resource management issues include: low base flows, flash flooding and run-off, erosion and sedimentation, and degrading quality and quantity of water resources.

## Soils

The soils of the Kettle Creek watershed are highly susceptible to erosion. The mix of poorly drained clay soils with glacial till parent material overlying deep clay sub-soils explains the need for upstream agricultural drainage. It also explains the flushing action of the creek during run-off and the high degree of erosion. Given existing land uses, significant erosion rates will continue.

As evidenced by the sediment load calculated for dredging of the Port Stanley harbour, erosion of both shoreline and upstream lands continues to be a significant concern. Intensive row crop production in over 70 per cent of the watershed land base, combined with an extensive system of municipal drains, leads to ongoing sediment flushing.

# 4. Geology and groundwater (cont'd)

## Areas susceptible to groundwater contamination

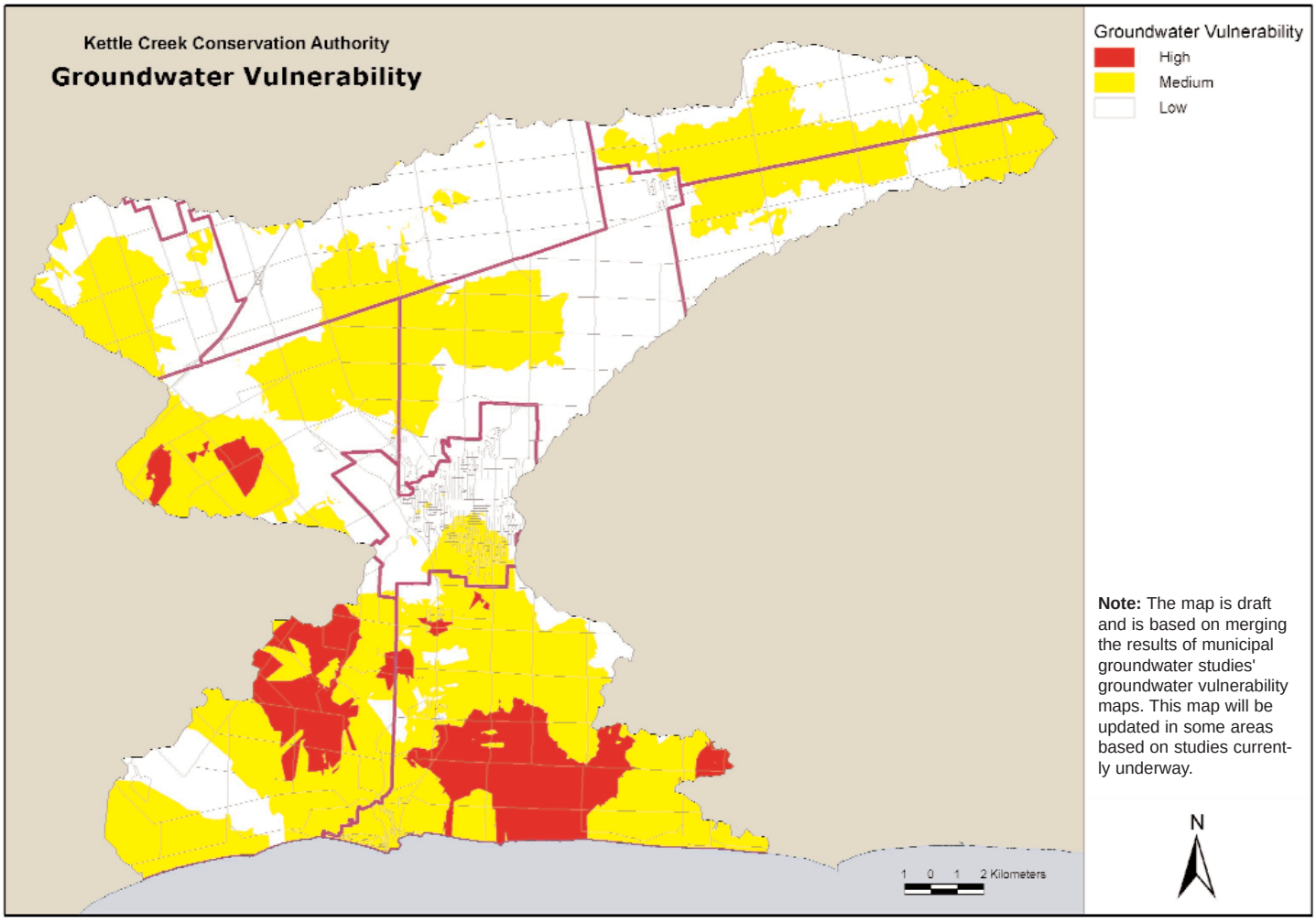
Where overburden sediments are coarse-grained or shallow and the water table is high, groundwater can often become affected by waste or chemicals applied or spilled at ground surface.

Most municipal wells and some private wells use deeper aquifers. They may be protected from surficial influences by thick overlying layers of denser till or clay.

The aquifer vulnerability map shows the relative susceptibility to groundwater contamination for the aquifers that are most commonly used for municipal and private drinking water.

Most of the watershed is mapped as having a low to moderate vulnerability rating. Aquifers throughout most of the watershed are generally deeply situated beneath the clay-rich Port Stanley Till, which provides a larger degree of protection from surface activities.

In the southern part of the watershed, in the Norfolk Sand Plain, there are areas mapped as having a higher vulnerability rating. In these areas, the sand aquifer is either exposed at surface or has a very thin cover of less permeable material. As a result, this aquifer is more susceptible to land use activities and the downward migration of chemicals and waste.



# 5. Hydrology and surface water

## Overview

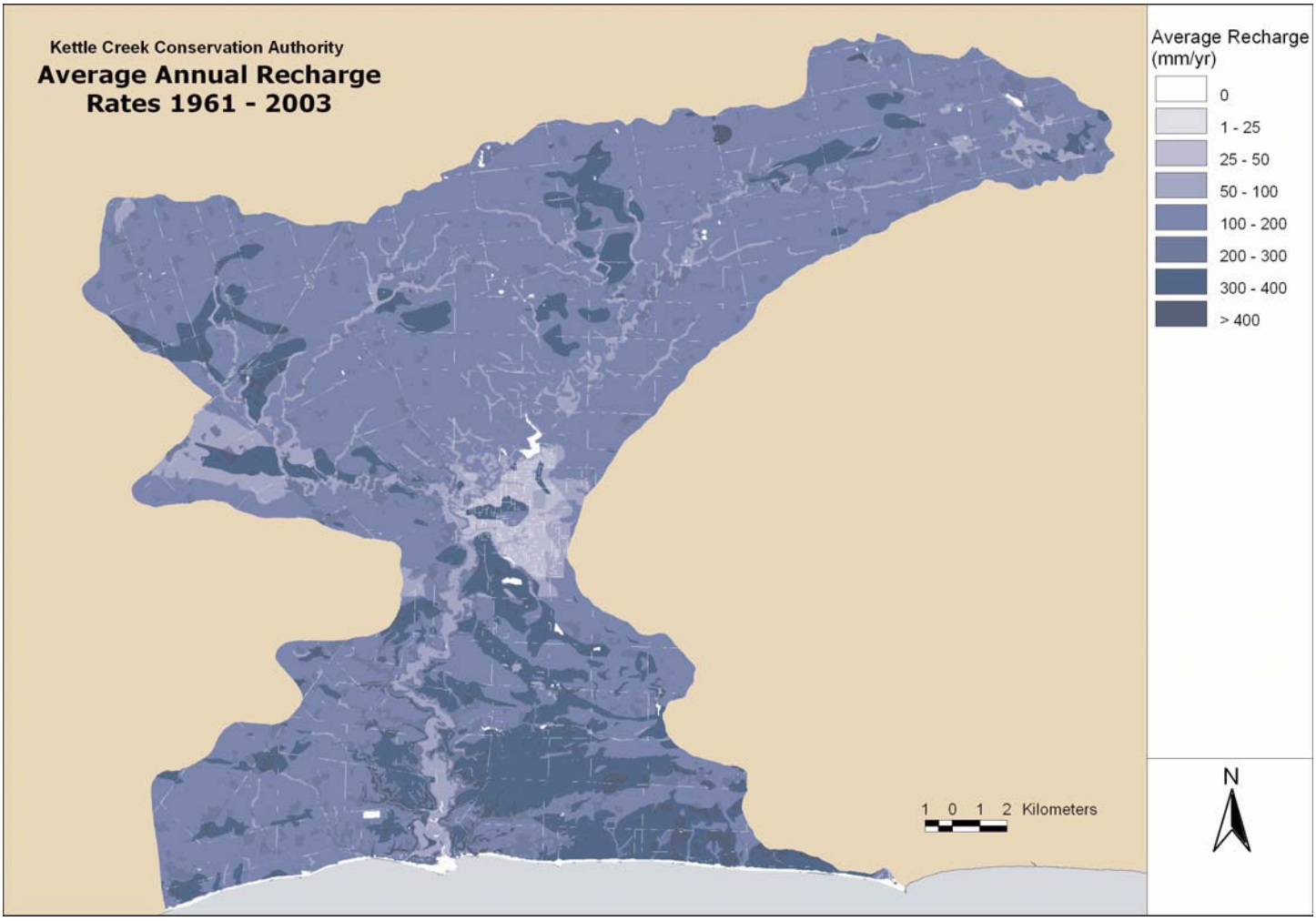
The Kettle Creek watershed drains approximately 520 square kilometres. Kettle Creek originates at Lake Whittaker, a kettle lake in the northeastern portion of the watershed. The upper portion of Kettle Creek flows in a southwesterly direction to the City of St. Thomas where it is joined by a major tributary, Dodd Creek. Kettle Creek then flows predominately southward towards Lake Erie being joined by Beaver and Mill creeks before emptying into Lake Erie at Port Stanley.

Kettle Creek drops approximately 141 metres over its 80 kilometre length. This steep drop causes flash flooding and a high degree of erosion. The creek valley is well defined with steep slopes; in some instances the stream bed is 30 metres below the level of the surrounding landscape.

The flow monitoring network in the Kettle Creek watershed consists of three Water Survey of Canada (WSC) stream gauges with one on Dodd Creek and two on Kettle Creek, near St. Thomas.

### Lake Erie shoreline

Numerous small watercourses along the Lake Erie shoreline drain directly into Lake Erie. They drain a total area of approximately 80 square kilometres with the largest draining 11.5 square kilometres and the smallest less than 0.5 square kilometres. These watercourses are extremely steep with well defined valley sections. There are no flow gauges located on any of these small watercourses.



# 5. Hydrology and surface water (cont'd)

## Major groundwater recharge areas

The nature of the Quaternary geology is the driving force behind recharge in the watershed. Recharge is limited in much of the watershed because of the fine-grained clay till which has a low permeability. This till plain covers the northern portion of the watershed. Pockets of sand deposits coincide with higher recharge rates. An area of higher recharge, located in the southeast corner of the watershed, is characterized by coarser-grained materials which have a higher permeability. The recharge in this area most likely contributes to the shallow groundwater system in this area.

## Major groundwater discharge areas

In the majority of the Kettle Creek watershed, the thick, fine-grained overburden with an overall low permeability inhibits a large degree of interaction between the groundwater and surface water systems. Groundwater influences the surface water system in the headwaters of Kettle Creek by feeding Lake Whittaker which in turn produces base flows for the creek. Beaver Creek, in the south of the watershed, is influenced by shallow groundwater as it passes through sandy deposits, creating a cool water fishery. Additional information on groundwater and surface water interactions will be determined through the water budget process.

# 6. Reservoirs and reservoir operations

There are two main reservoirs in the Kettle Creek watershed that are controlled through dams to collect and retain surface water flows in high and low flow events.

### Dalewood Dam

The Dalewood Dam is located just off of Dalewood Drive in the northern edge of the City of St. Thomas and was constructed in 1928. The dam and reservoir were originally owned by the City of St. Thomas to supply the city's drinking water. However, insufficient surface water flows in Kettle Creek prompted the city to connect to the Lake Erie intake in 1967.

KCCA purchased this reservoir and the surrounding lands (243 hectares) from the city in 1976. Today, through a system of stop logs, KCCA can back up flood water seven kilometers upstream to Highbury Avenue.

### Union Dam

The other dam used for flood control purposes is Union Dam, which backs up water in a series of online ponds along Beaver Creek in the village of Union. The dam was built prior to 1900 and consists of earthern embankment. KCCA acquired the dam in 1972. The reservoir is lowered in response to expected heavy rain events, and allowed to rise in the interim.

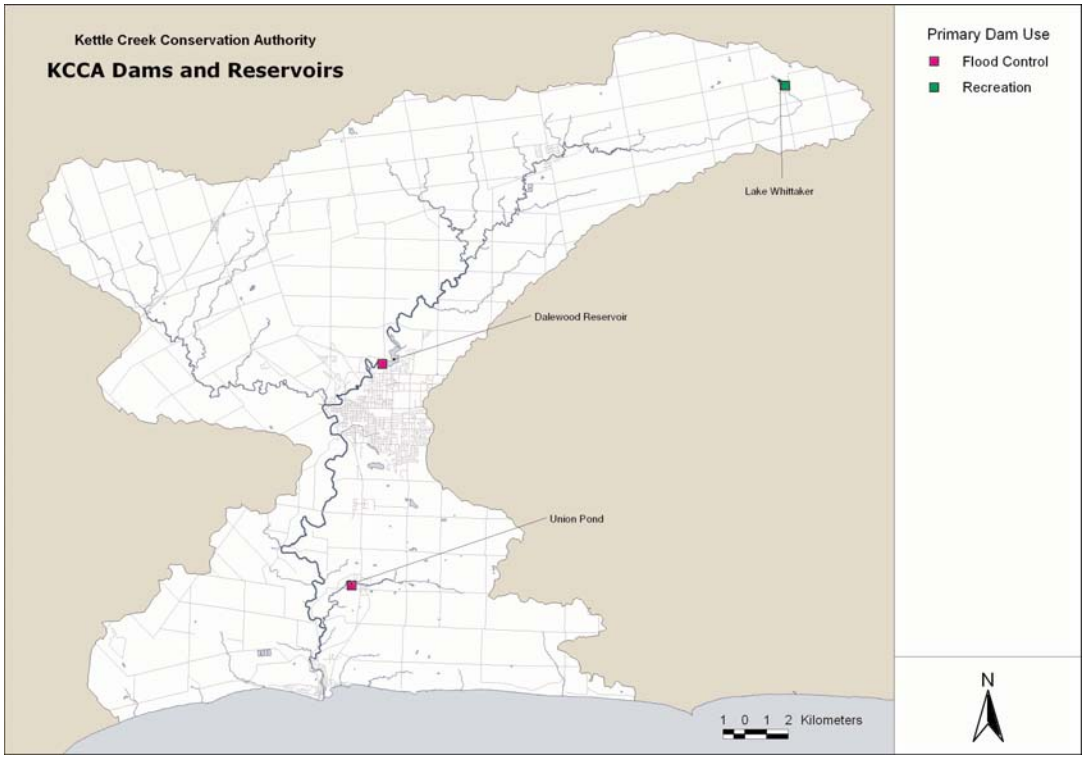
In 2003, the dam was upgraded to meet provincial maintenance and operations standards. The reservoir itself is approximately 13 hectares in area with a holding capacity of approximately 8,000 metres cubed.

### Other dams

In addition to the dams and reservoirs owned by KCCA, a large number of privately-owned reservoirs and ponds supplement base flow in the watershed. Those located in headwater reaches are of highest value, including Lake Margaret, Mill Creek Pond, Corners Pond, and Sandam Pond.

About 27 other dams and associated reservoirs can be found throughout the watershed. All of these reservoirs have a more localized low flow augmentation benefit and are serving as sediment catches. Base flow in most Kettle Creek subwatersheds would otherwise be virtually non-existent except during precipitation events.

These reservoirs also provide refuges for aquatic and terrestrial life in times of low base flow or drought. During such periods, base flows in the watershed can drop well below the Level III designation of the provincial Low Water Response Program.



# 7. Population

## Population centres

The population of the Kettle Creek watershed was 44,406 at the time of the 2001 census. It was distributed between an urban core in St. Thomas and a rural periphery in Elgin and Middlesex counties, as well as south London.

St. Thomas is home to about 71 per cent of the residents of the watershed. The section of London in the watershed is largely rural, but the urban core of the city strongly affects economic development and population growth in the Kettle Creek watershed.

The remaining 29 per cent of the population is relatively evenly distributed through the rural areas.

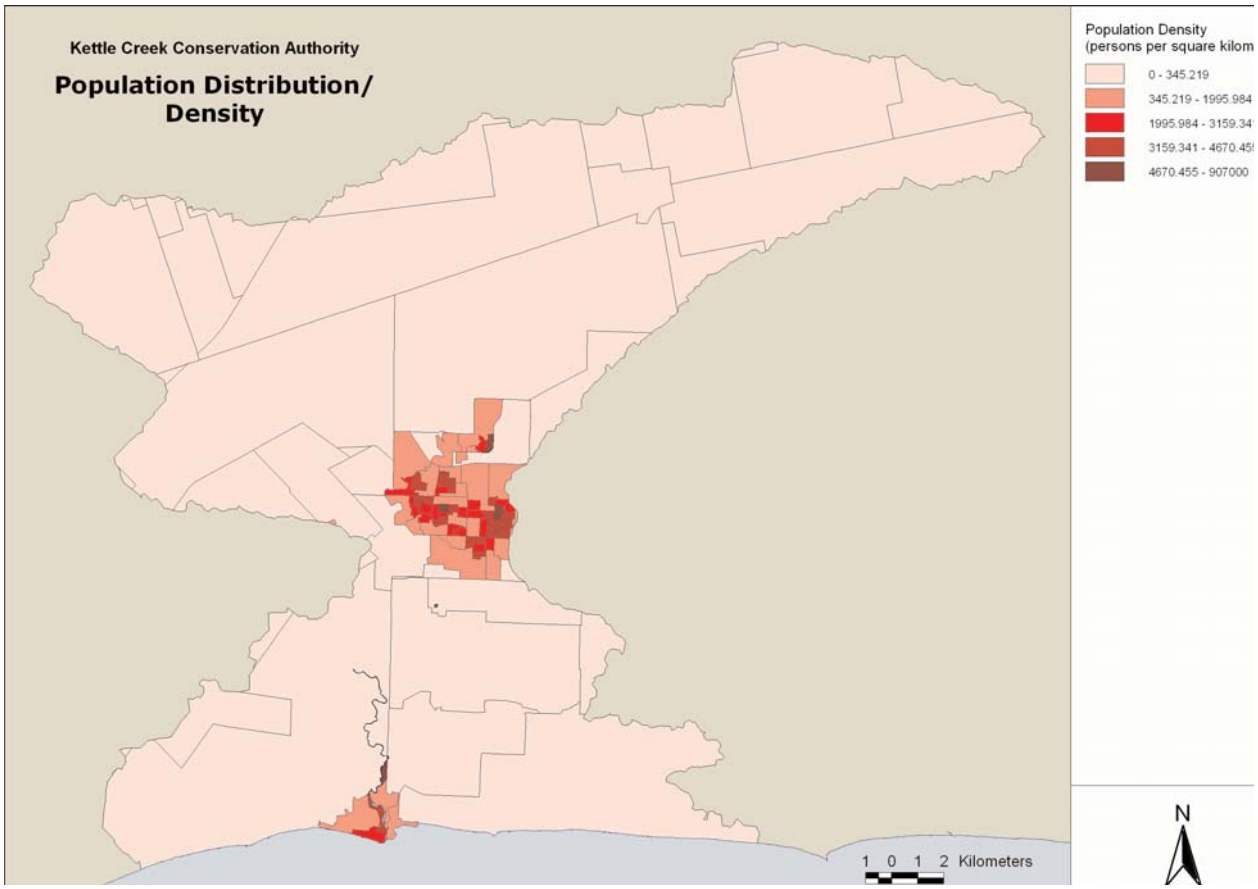
Serviced communities include St. Thomas, Belmont and Port Stanley. The village of Talbotville may be serviced in the future, which may result in additional population growth.

## Population projections

Municipal projections forecast that the population of the watershed will grow by approximately 14,000 people by 2031. The majority of the growth will be in St. Thomas, which is expected to increase by more than 9,000 people by 2031. The city's close proximity to Highway 401 and London makes it an attractive location for home buyers.

**Population projections**

| Municipality | 2001 | 2031 | Growth rate (ppl/yr) |
|---|---|---|---|
| Malahide | 664 | 930 | 8.9 |
| Central Elgin | 8272 | 11,610 | 111.3 |
| St. Thomas | 31,574 | 40,893 | 310.6 |
| Southwold | 2,030 | 3,011 | 32.7 |
| London | 789 | 1,003 | 7.1 |
| Middlesex Centre | 360 | 360 | 0 |
| Thames Centre | 720 | 757 | 1.2 |
| **Total** | **44,406** | **58,564** | **471.8** |



# 8. Land cover and land use

## Settlement history

Natives have inhabited the Kettle Creek watershed for thousands of years. The area was opened to European settlement in the early 1800s, spearheaded by Lt. Colonel Thomas Talbot who oversaw development in the area. He founded Port Stanley at the mouth of Kettle Creek, which became the transportation and commercial hub of the region.

St. Thomas (originally Kettle Creek village) was founded in 1810 and grew rapidly after the arrival of the railroads in the 1870s. The arrival of an auto assembly plant at Talbotville in the middle of the 20th century spurred a burst of industrial development

Several smaller communities developed around mills or as commercial hubs to serve the surrounding farming areas.

## Municipalities and municipal structure

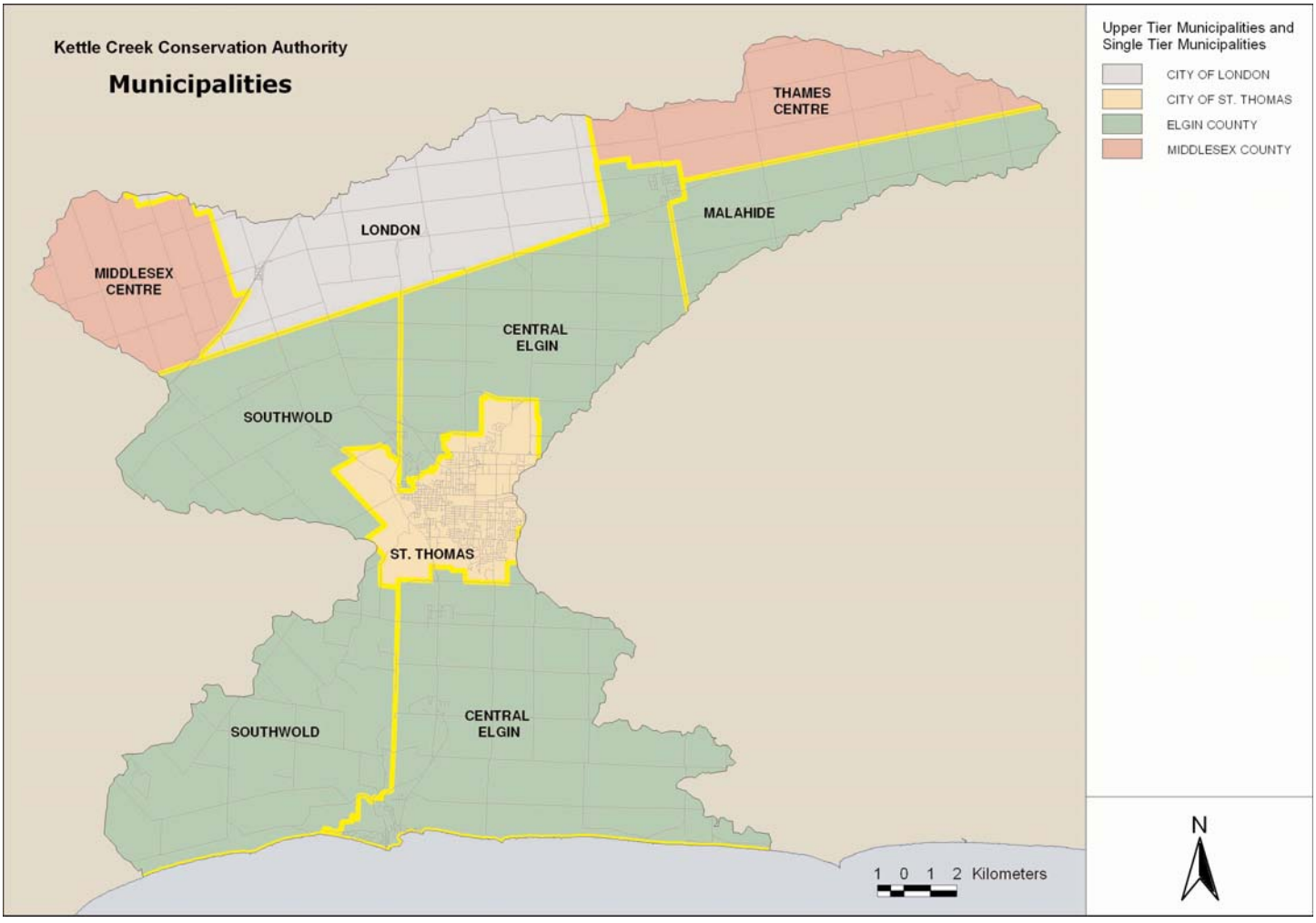
The Kettle Creek watershed spans central Elgin County, including the City of St. Thomas, and the south-central County of Middlesex, including the City of London.

Elgin County makes up about 60 per cent of the southern portion of the watershed, including portions of the municipalities of Southwold, Central Elgin and Malahide.

Middlesex County makes up about 20 per cent of the northern part of the watershed, including portions of the municipalities of Middlesex Centre and Thames Centre.

## Urban areas

The primary economic activities in the Kettle Creek watershed are agriculture and manufacturing. In 2001, the manufacturing industry employed approximately 5,000 people in St. Thomas alone, dominated by auto manufacturing.



# 8. Land cover and land use (cont'd)

Currently, all of the suspected or potential brownfield locations in the Kettle Creek watershed are within the City of St. Thomas and the Village of Port Stanley. The brownfield areas of most immediate concern are those related to the coal tar deposits in the Village of Port Stanley. Several reports show that the Kettle Creek bed sediments in Port Stanley are highly contaminated with polynuclear aromatic hydrocarbons (PAHs).

## Port Stanley Harbour

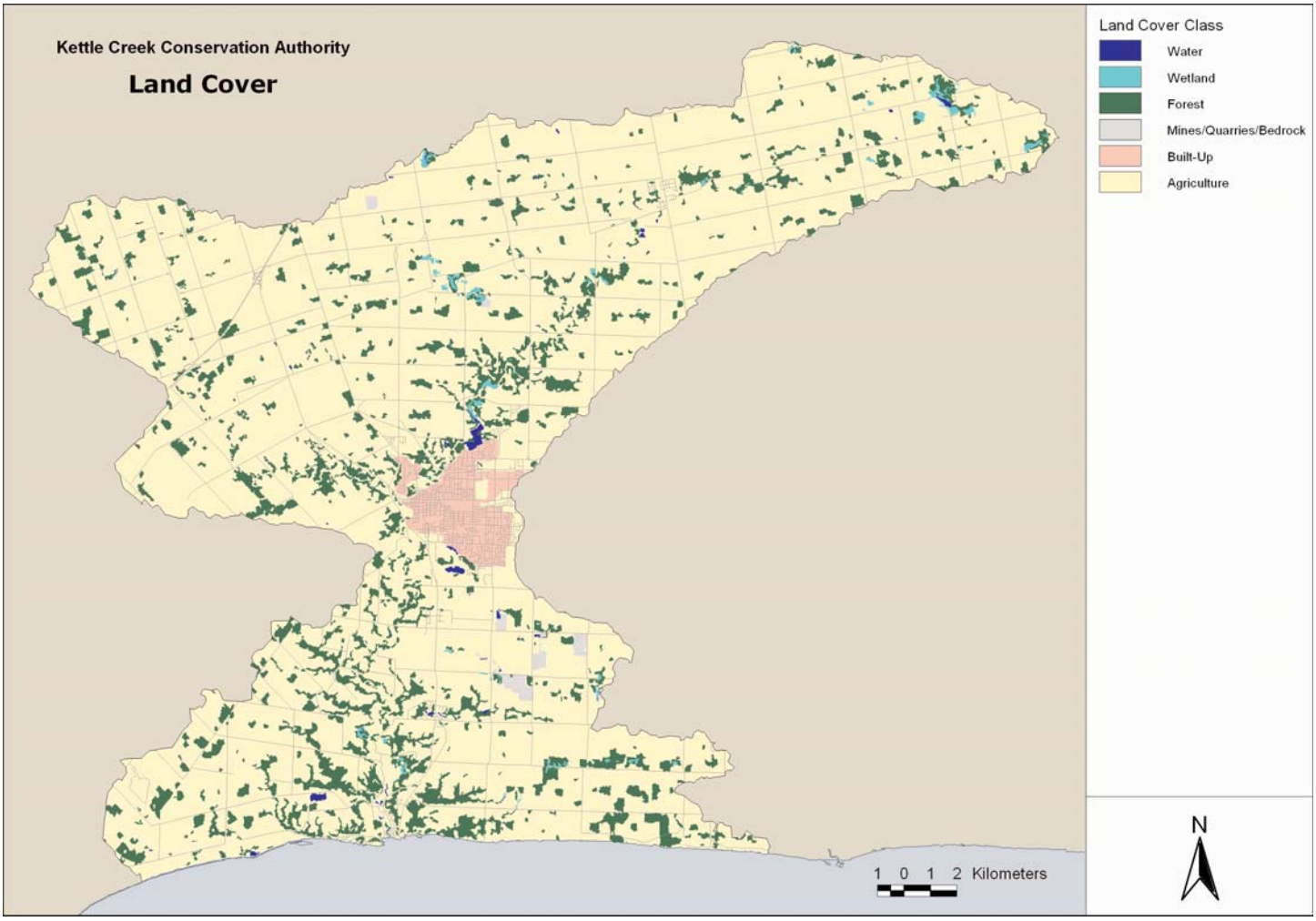
Port Stanley harbour is the largest natural harbour on the north side of Lake Erie. The Port Stanley harbour accommodates commercial and recreational fishing vessels, as well as a large variety of pleasure crafts, such as sailboats. The Municipality of Central Elgin is considering a proposal to introduce a ferry service between Port Stanley and Cleveland, Ohio.

## Agriculture – crops and pasture

Agriculture is the dominant land use, with 83 per cent of the land designated and used for agriculture. Both livestock and agricultural crops are prominent practices, with 70 per cent overall in cropped agricultural use. There are a total of 8,900 head of cattle, 14,800 head of swine and 200,000 head of poultry across the watershed. The major crops grown in the watershed are soybeans (34.5 per cent) and corn (32.5 per cent), with vegetables and grains both at 9.9 per cent.

The Dodd and Upper Kettle Creek subwatersheds are in the till plain while the the Lower Kettle subwatershed is characterized by clay and sand. Consequently, root crops such as tobacco and potatoes, which have high water requirements, are only found in the Lower Kettle subwatershed.

Soybean and corn use the largest land area. However,



# 8. Land cover and land use (cont'd)

vegetable production is prominent throughout the entire watershed and should be considered significant due to the crops' higher water requirements.

### Use of Irrigation

Irrigation in the watershed is not extensive, and is generally only used for specialty crops such as vegetables, sod, fruit and root crops including tobacco, potatoes and ginseng.

## Aggregate extraction

Within the Kettle Creek watershed there are eight aggregate pits in operation, with a total land area of approximately 150 hectares. Licenses issued to these operations allow for extraction of approximately 910,000 tonnes of material, 72 per cent of which comes from the area surrounding the Sparta Moraine.

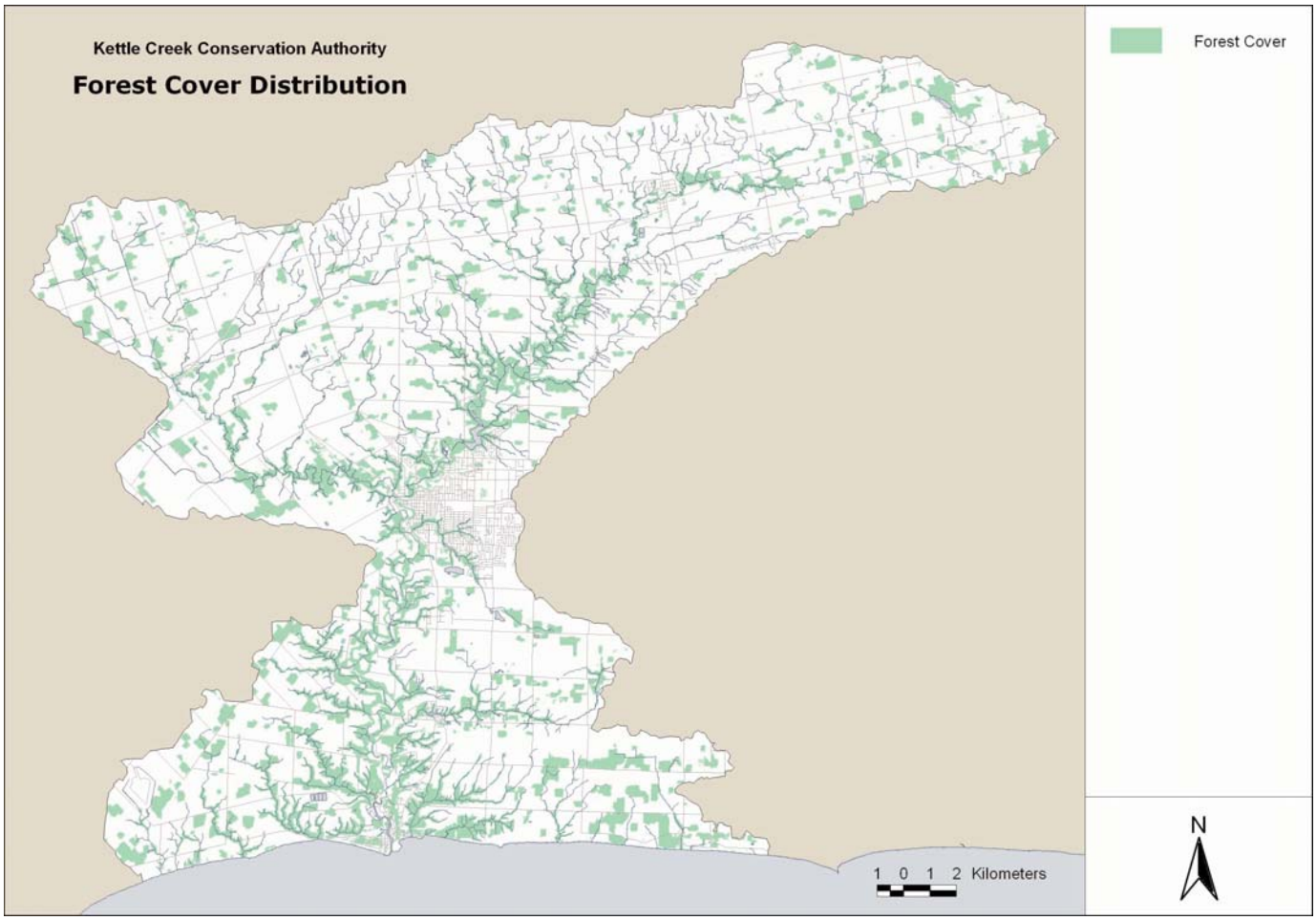
Historically, most of the aggregate operations were also on or near the Sparta Moraine with the exception of some smaller operations near Port Stanley and Lake Whittaker.

## Valley lands

Kettle Creek's extensive valley lands are an important component of the region's natural heritage. Woodlots and shoreline vegetation included in the valley lands serve as buffers, protecting the land against erosion and the impact of agriculture and industry. At the same time, the valley lands offer habitat for species that normally would not be found near the creek. Many species use the stream bank area and forested buffers as wildlife corridors between woodlots and environmentally significant areas.

The depth of the valley offers an array of ecosystems and habitats providing a high diversity of wildlife communities on all levels. Aside from the creek, these areas include shoreline vegetation, clay or sand bluffs, forested uplands, lowlands and wetlands.

The valley acts as a natural water collection system, as it



# 8. Land cover and land use (cont'd)

collects run-off from groundwater seepage. The depths of the valley also provide short-term storage of storm and meltwaters, offering creek recharge and flood control.

Moreover, small riverine wetlands contained within the valley lands also provide nutrients, control erosion and offer flow augmentation to the creek. The scarcity of wetlands in the watershed makes them a valuable resource for that reason alone. Other ecological functions served by the valley include nutrient and sediment transport, wildlife habitat and migration routes, and maintenance of a genetic pool for native flora and fauna.

## Forest and vegetation cover

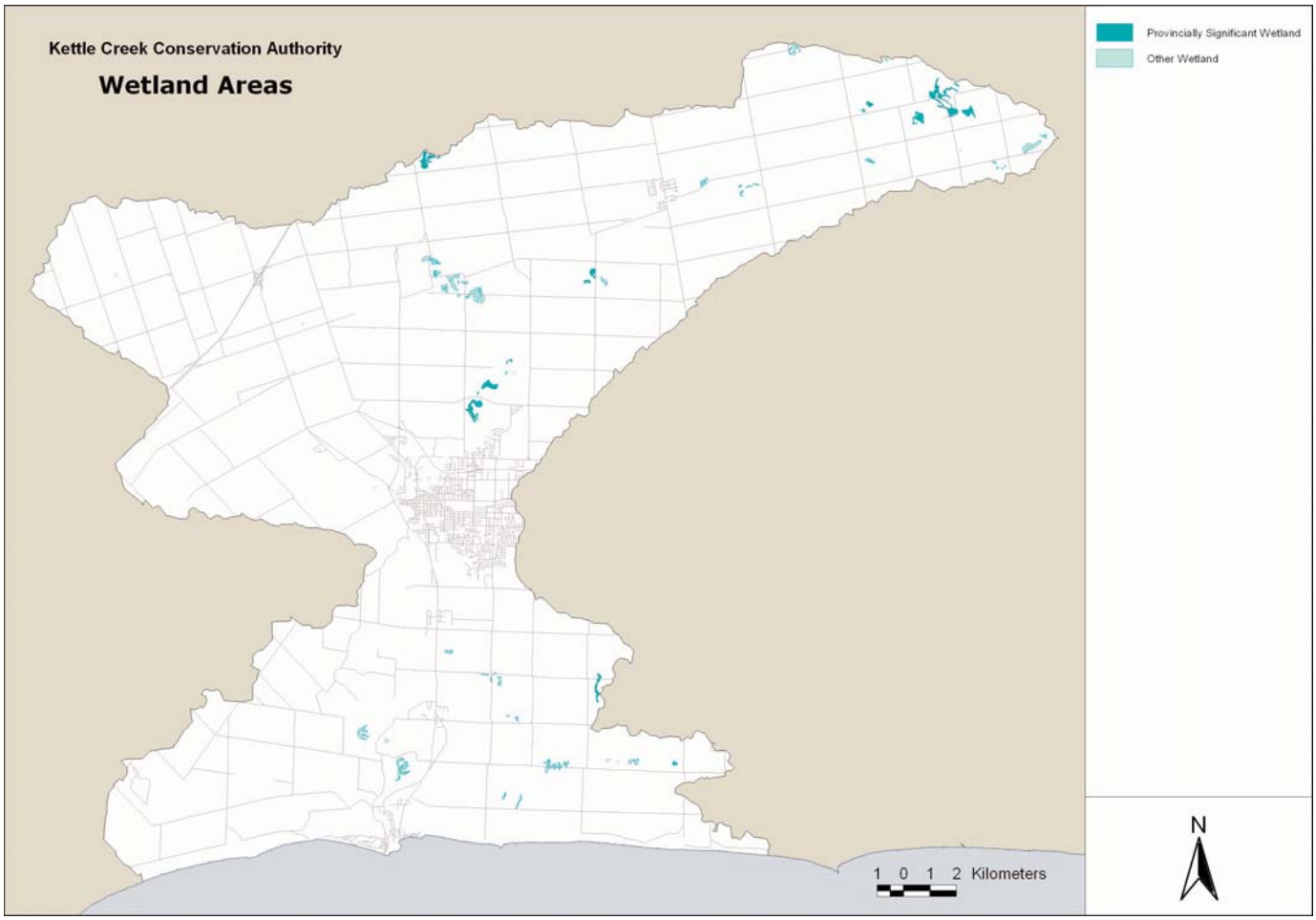
The forest cover in the Kettle Creek watershed is estimated at 15 percent. The most common woodlots in the watershed are generally less than four hectares in size and are often fragmented from other forest tracts.

As a result, forest interior is only about one percent. This is extremely low, indicating that most of the woodlots are too small and/or narrow to support sensitive species that require large habitats within a significant core area.

## Wetlands

In the past, agriculture has had a devastating impact on wetlands in the Kettle Creek watershed. In the 1960s and 1970s agriculture changed in the watershed from mixed farming to cash crop. The result was more intensive agriculture with the removal of hedgerows and the use of marginal lands to make larger fields. Tile and drainage was also established as a common practice to create drier, more workable parcels of land.

Historically, the northwest part of the watershed was scattered with wetlands. Today there are only two natural wetlands remaining: White's Wetland and Sloan's Wetland. The total percentage of wetlands left in the entire Kettle Creek watershed is only half of one per cent.



# 9. Water use

## Overview

Calculating water use involves compiling information from a wide variety of sources. Some water users, such as municipalities, report their annual consumption. In other cases it is necessary to extrapolate total water consumption from information about typical use patterns for categories of consumers, such as rural residents.

Estimates were determined using the best available data, including Census of Population, Census of Agriculture, municipalities, and the Permit to Take Water (PTTW) database, as well as expert opinion of water managers.

Large water users – those taking more than 50,000 litres a day – must have a permit from the Ontario Ministry of the Environment. However, this only establishes the maximum allowable taking and does not necessarily reflect the actual taking.

## Municipal water use and sources

Municipal water use is the supply of water provided through a central distribution system operated by a municipality. Municipal water use includes urban domestic use, whether indoor or outdoor, and also includes uses for industrial, commercial, institutional or other uses.

### Central Elgin -- Belmont

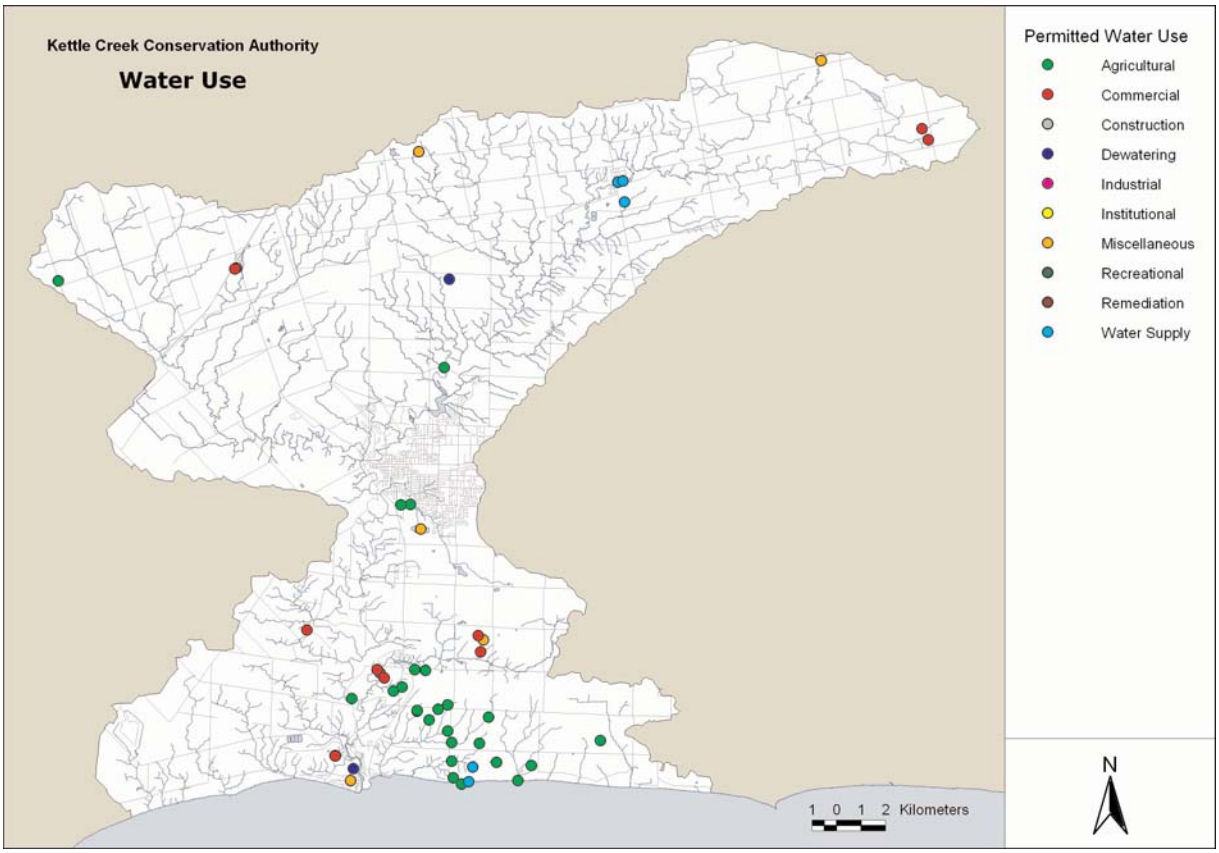
The village of Belmont, in the Municipality of Central Elgin has the only groundwater-based system in the watershed. Two deep artesian wells in a sand-and-gravel aquifer serve about 1,500 people.

### Elgin Area Primary Water Supply System -- Central Elgin (Port Stanley) and St. Thomas

The Elgin Area Primary Water Supply System (EAPWSS) is owned by the EAPWSS Joint Board of Management but operated and maintained by American Water Canada Corp. under contract.

Water is drawn from an intake about 1,290 metres off shore in Lake Erie, just east of the mouth of Kettle Creek in the Municipality of Central Elgin. From a treatment plant in Central Elgin, water is pumped to seven member municipalities including two in the Kettle Creek watershed – Central Elgin and St. Thomas. Other municipalities are Aylmer, Bayham, Malahide, Southwold and London.

This water treatment plant has a current rated capacity of 91,000 cubic metres per day and serves an estimated population of approximately 100,000 people.



# 9. Water use (cont'd)

## Rural domestic

Un-serviced domestic water use is all water for domestic use s(indoor and outdoor residential water use) that are not on a municipal distribution system. Generally, these are rural communities and water could be taken from private wells. The estimation of un-serviced domestic water use was based on population estimates and per capita water use rates for rural residents.

A total of 1,427 domestic wells are located in KCCA's official boundaries, with 54 (3.8 per cent) of these wells being classified as bedrock wells and 1,349 (94.5 per cent) as overburden wells. These wells date back to 1944 and it is unknown how many are still in domestic use today. It is possible that some were drilled to replace abandoned or decommissioned wells.

The rural population in the Kettle Creek watershed is estimated to be 13,000, drawing approximately 0.76 million cubic metres of water per year.

## Agriculture

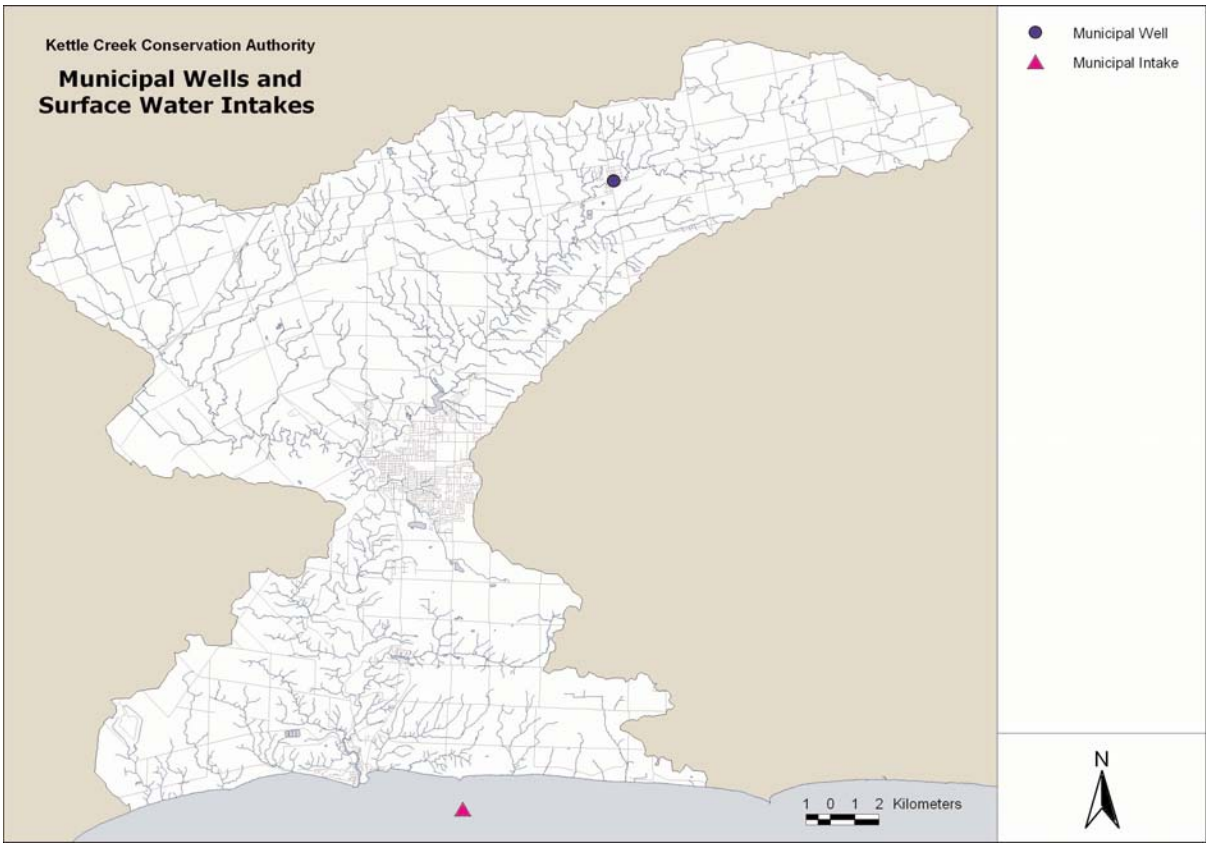
Agricultural water use falls into two categories:

- livestock and farming operations; and
- crop irrigation.

Water for livestock and other general farming operations is generally year-round and Permits to Take Water are not required. Livestock operations require water for drinking and washing water for the animals. The volume of water used is estimated to be relatively small at just 0.4 million cubic metres per year.

Crop irrigation generally only occurs in the summer and permits are required. Generally, irrigation is used for tobacco, root and vegetable crops.

While agricultural irrigation is the third largest water use on an annual basis, these water takings are concentrated from June to August. Agricultural irrigation is actually the second highest water taking and is more than the combined total of all non-municipal water takings during these summer months. During an extremely dry year, which requires more irrigation than an average year, this demand for water is much more pronounced.




It was determined that from the 25 agricultural irrigation sources, ten were supplied by groundwater and 15 were supplied from surface water. The water used for all irrigation activity totals 0.6 million cubic metres per year.

# 9. Water use (cont'd)

## Industrial water use

Factories in the watershed all get their water from municipal water systems, so there are no Permits To Take Water issued for this type of industrial use. Therefore, it is difficult to quantify the number of water takers and the amount of water used for industrial purposes. However, one automotive plant is known to be a major industrial water user.

Dewatering permits, the sixth largest user in the Kettle Creek watershed, can be considered industrial uses as generally these permits are for extracting water from pits, quarries, mines and construction areas. Dewatering accounts for less than one per cent of the total water use.

## Commercial

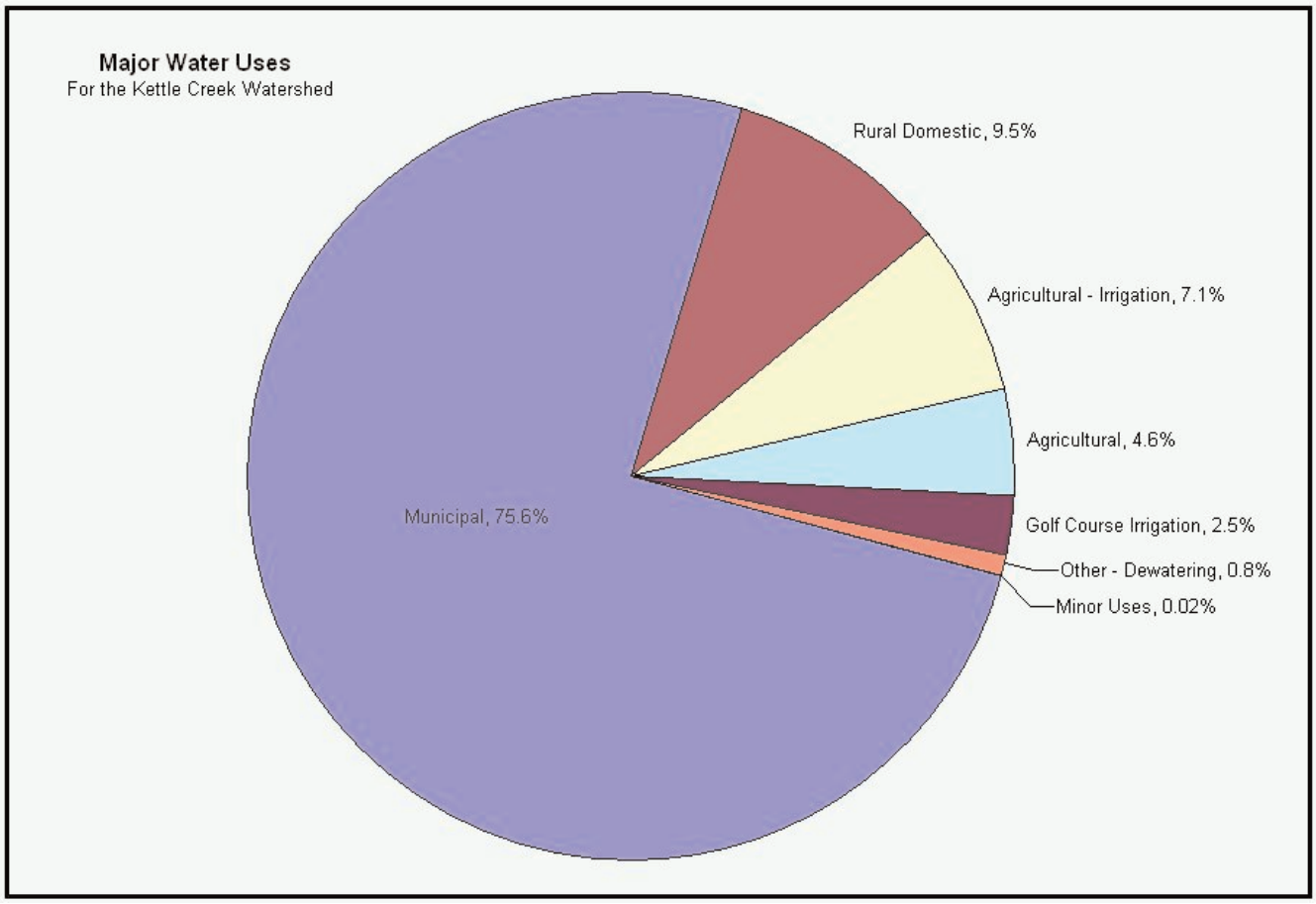
Commercial water uses include both golf courses and commercial businesses. Golf courses require permits to irrigate their greens and fairways on a seasonal basis, generally between April and September. Golf course irrigation accounts for 2.5 percent of total water use in the watershed. Commercial malls or businesses account for a very small percentage (less than 0.02 percent) of the water uses and are likely for sanitary purposes.

## Recreational Water Uses

There are a number of water-related recreational facilities in the Kettle Creek watershed but all pale in comparison in size and economic importance of Lake Erie.

The historic village of Port Stanley is economically dependent on the water-based recreational activities surrounding Lake Erie. The Port Stanley harbour is the largest natural harbour on the north shore of Lake Erie. The size and depth of the harbour still attracts commercial and recreational fishing opportunities.

Consequently, the village has developed as a fishing and tourist community. Businesses such as marinas, marina suppliers, inns and shops predominately target summer tourists who are looking to spend a couple of relaxing hours on sandy, clean beaches.



# 9. Waste treatment and disposal

## Sewage treatment

There are five active wastewater treatment facilities. There is a wastewater treatment plant in St. Thomas, while there are lagoon-based systems in Belmont and Port Stanley.

Regina Mundi Catholic College has a wastewater treatment system.

Ford Motor Company, in Talbotville has its own plant to handle both domestic and industrial wastes.

## Landfills

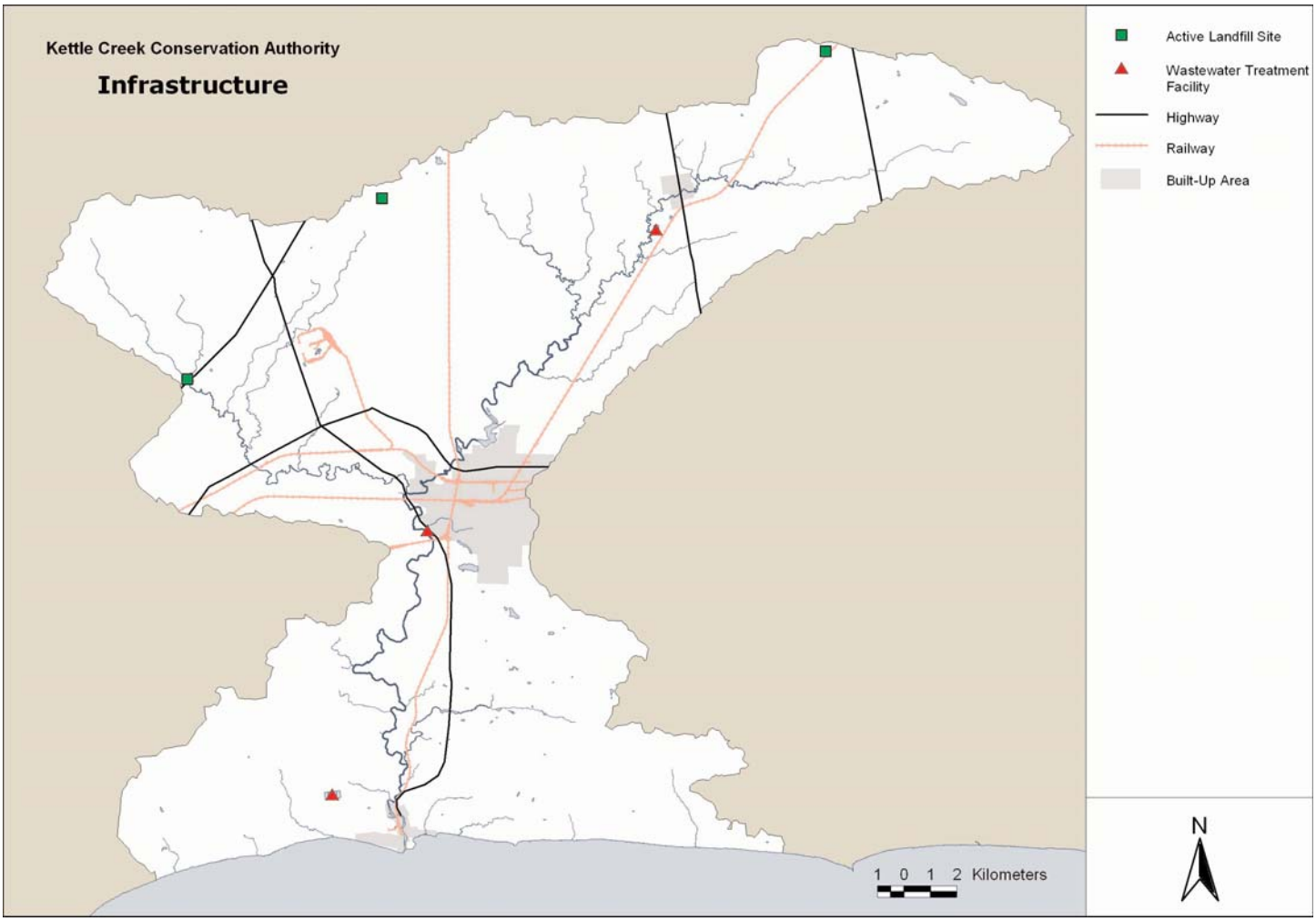
There are three active landfills within the Kettle Creek watershed – the Green Lane Landfill, the W12A Landfill, and the Thames Centre Landfill, all of which are in the creek's headwaters.

Green Lane Landfill is in Southwold Township near Highway 401 and Southminster Bourne. Previously private, the landfill is now owned by the City of Toronto. All surface water including the leachate is directed into Dodd creek via a leachate treatment facility.

The W12A covers 147 hectare of land in South London near the corner of White Oak Road and Manning Drive and serves the City of London.

The Thames Centre Landfill is in the northeastern part of the watershed and serves the Municipality of Thames Centre.

Two other landfills, in St. Thomas and Port Stanley, are no longer in operation.



# 11. Water quality: surface

## Surface water monitoring

Under the Provincial Water Quality Monitoring Network (PWQMN), the Kettle Creek Conservation Authority monitors four sites, which have all been historically sampled. In addition to these sites, five monitoring sites were added in 2005 as part of the KCCA's capacity building, of which three sites were historically monitored as part of the PWQMN program. The provincial program allows for eight samples to be taken each year. Samples from the new sites are analyzed by a private laboratory. All sites are examined for routine chemistry including nutrients, suspended solids, major ions and anions (such as chloride and sodium), pH, and metals (such as lead and manganese).

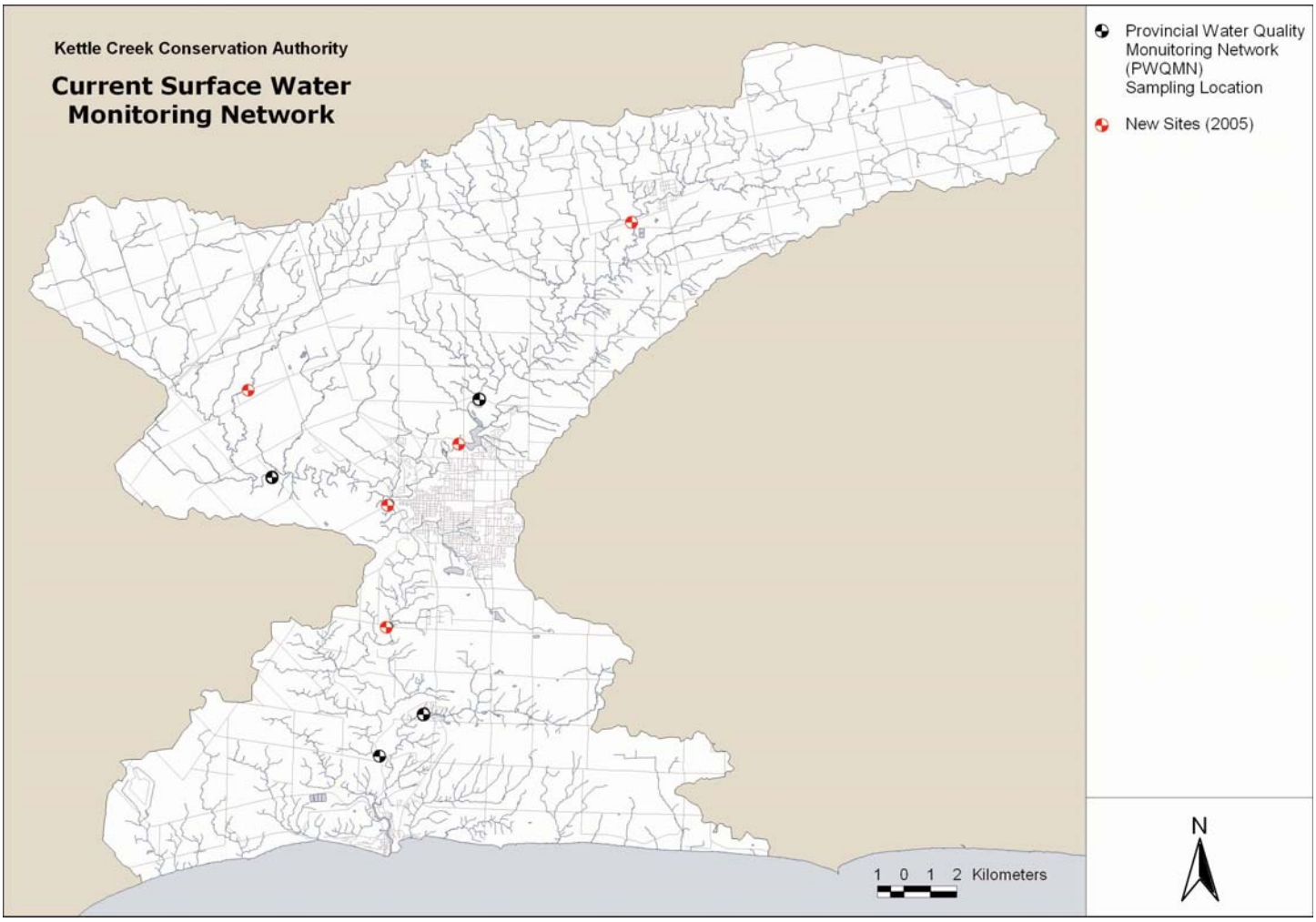
## Surface water conditions and trends

Surface water quality within the Kettle Creek watershed appears to be negatively affected by increasing summer temperatures, decreasing baseflows, potentially low levels of dissolved oxygen, and very high nutrient and sediment concentrations.

The lower Kettle Creek and Dodd Creek sub-basins are the most impaired regions within the watershed where water quality appears to progressively deteriorate from upstream to downstream. Located on the Norfolk Sand Plain, Beaver Creek was found to be the least impaired region within the watershed. This is likely due to the natural characteristics of that sub-basin, primarily the sandy soils and groundwater-sourced stream base flow.

### Nutrients

Nutrient levels, primarily phosphorus and nitrate, are



# 11. Water quality: surface (cont'd)

high throughout the watershed. Nitrate concentrations are significantly higher within Lower Kettle Creek relative to the rest of the watershed. Phosphorus concentrations, although highest in Lower Kettle Creek and Dodd Creek, are consistently high throughout the watershed, and typically exceed the provincial water quality objective of 0.03 milligram per litre.

### Non-filterable residues

Non-filterable residue (NFR) levels are of more concern along Kettle Creek compared to the other tributaries within the watershed. They are routinely above the 25 milligrams per litre general criteria within Kettle Creek and progressively increase from upstream to downstream.

The discharge from the St. Thomas Wastewater Treatment Plant, the bank erosion caused by livestock access to streams, the sediment deposition occurring in Dalewood Reservoir and the general steepness of the watershed topography could all be contributing to the high NFR levels found along Lower Kettle Creek.

### PAHs at Port Stanley

A major contamination issue affecting water quality within Lower Kettle Creek at Port Stanley is the presence of Polynuclear Aromatic Hydrocarbons (PAHs) within the bed sediments. Two main areas within Lower Kettle Creek downstream of the George Street Drain in Port Stanley and adjacent to former petroleum tank farms have been identified as containing contaminated sediments. Several studies (Griffiths, 1988; Riggs Engineering, 2004; Acres and Associates, 2001) have investigated the extent and severity of the contamination. These studies have shown that the area furthest downstream is significantly contaminated and will continue to be a chronic source of pollution for the waterway if clean-up measures are not taken. PAHs are extremely toxic and can lead to odour problems and habitat degradation for aquatic life. Cumming Cockburn and Associates Limited (1987) determined that Kettle Creek deposits approximately 40,000 cubic metres of silty sediment into the Port Stanley harbour every year. This plume of sediment from Kettle Creek into Lake Erie was later identified by the Elgin Area Primary Water Supply System as a significant potential point source of contaminant laden sediments to the drinking water intake.

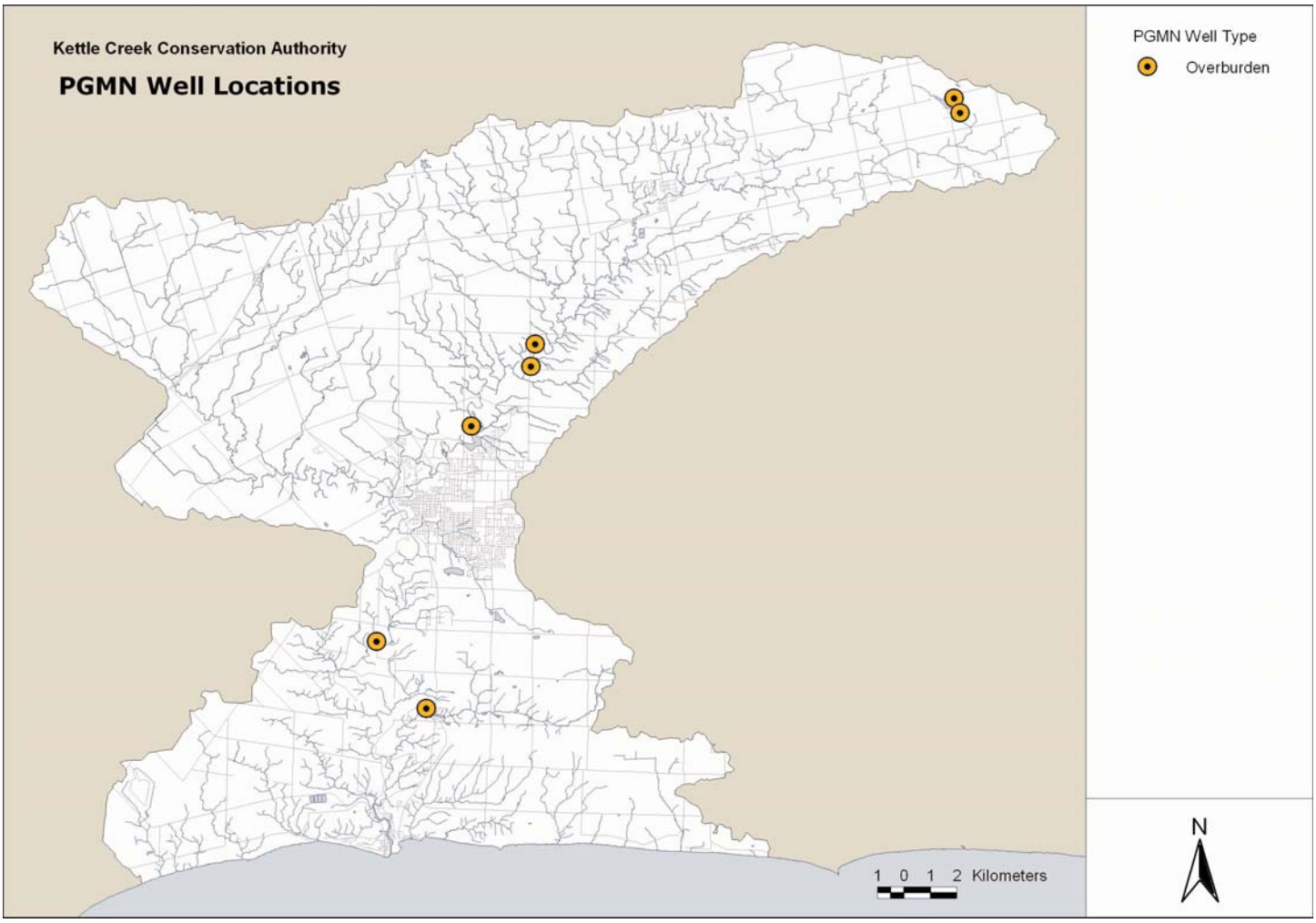
# 11. Water quality: groundwater

## Groundwater quality monitoring

Groundwater is primarily monitored in the Kettle Creek watershed through the Provincial Groundwater Monitoring Network (PGMN), a network of wells distributed throughout the province that provide insight on long-term ambient trends and conditions.

There are currently seven PGMN wells at seven locations within the watershed. The wells are usually located to Kettle Creek or one of its tributaries and each well is completed within the overburden. At this time, the wells are primarily used to monitor changes in water levels however more recently, an annual water quality sampling program has been initiated through the PGMN in which samples are analyzed for a suite of chemical parameters. To date, water samples for quality monitoring have been obtained from five of the seven wells.

Additionally, under Ontario Regulation 170/03, each municipal well is required to be sampled by the municipality on an ongoing basis for bacteria (i.e. total coliform, E. coli) and a suite of organic (i.e. pesticides, chemicals) and inorganic (i.e. sodium, chloride, nitrate) chemicals. Results are compiled into an annual report and publicly posted, often on the municipality's website. Where results exceed the Ontario Drinking Water Standards (MOE, 2006), corrective action is taken by the municipality.



# 11. Water quality: groundwater (cont'd)

## Groundwater quality conditions and trends

Although the municipal well system for Belmont does not have any issues or concerns surrounding the safety of its water quality, consistent trends in groundwater quality in general have become apparent across Ontario through regulations such as the Drinking Water Systems Regulation (O.Reg. 170/03).

Increasing concentrations of sodium and chloride, stemming from the application of road salt, are a problem in a number of municipal wells across Ontario. Numerous Ontario municipal wells have also been affected by chemicals such as those used in manufacturing, farming and industrial applications.

Since groundwater is derived from the downward migration of surface water, the quality of groundwater depends on the quality of the recharge water.

Clean, safe drinking water is generally hundreds of years old, having often entered the groundwater system prior to the introduction of heavy chemical use and waste production at ground surface.

As the quality of surface waters which recharge the groundwater system becomes more heavily impacted by chemicals and waste by-products (i.e. from road salt, manure, manufacturing, pesticide use), it can be expected that the increasing trend in human-related chemicals in the groundwater system will continue until better land use and management practices are put into place.

# 12. Drinking water issues

## Groundwater issues

There are no known issues impacting the groundwater source for the Town of Belmont. The Belmont supply has a low susceptibility to contamination due to a thick aquitard. The municipality has implemented programs like pre-wetting of salt to protect the quality of recharge, although chlorides are not an issue in raw water.

## Potential surface water issues

In the Kettle Creek watershed, most of the population is serviced by the Elgin Area Primary Water Supply System that draws its water from Lake Erie.

Potential surface water quality issues include highly variable suspended sediment levels at the intake due to the movement of sediment from Kettle Creek and resuspension of sediments from the Lake Erie nearshore area during runoff events. Very high suspended sediment levels can interfere with conventional water treatment.

Another potential issue includes the PAH-attached sediments found in Kettle Creek. Sediment found in the intake pipe has been shown to contain PAHs. Therefore, the PAH-attached sediments in Kettle Creek have been identified as a potential point source to the Elgin Area Primary Water Supply intake.

### Spills

Large chemical spills in Kettle Creek or in the vicinity of the intake are likely the greatest concern to the Elgin Area Primary Water Supply. Incidents involving industrial chemicals, such as gasoline or diesel could result in high levels of chemicals that may impact the drinking water supply. In the event of a spill, timely notification is required to implement suitable response protocols (i.e. closing intake).

# 13. Glossary

**Aquifer**

A saturated, permeable geologic unit that can transmit significant quantities of water under ordinary hydraulic gradients.

A *confined aquifer* is one completely filled with pressurized water and separated from the land surface by a relatively impermeable confining bed, such as shale.

An *unconfined aquifer* is one where the water-table marks its upper limit.

**Aquitard**

A water-saturated sediment or rock whose permeability is so low it cannot transmit any useful amount of water. It may function as a confining bed.

**Bedrock**

The solid rock that underlies loose material, such as soil, sand, clay, or gravel. Most bedrock layers are hundreds of millions of years old.

**Brownfield**

Brownfields are abandoned or underused industrial or commercial properties where redevelopment is complicated by actual or perceived environmental contamination.

**Carolinian Zone**

The southernmost part of Ontario, generally south of a line drawn between Toronto and Grand Bend. The climate, moderated by the Great Lakes, is able to support animal and plant species normally found in the Carolinas in the U.S. Many of the species are rare or non-existent in the rest of Canada.

**Moraine**

An accumulation of till either carried on a glacier or left behind after the glacier has receded.

An *end moraine is* a ridge of till deposited along the front edge of a glacier.

A *kame moraine* is an irregularly shaped hill or mound composed of sorted or stratified sand and gravel that is deposited in contact with glacial ice.

The *Horseshoe Moraines* are a series of moraines encircling most of southwestern Ontario, with the 'top' of the horseshoe near Georgian Bay and the tips of the 'legs' at the south, near Lake Erie.

**Overburden**

Unconsolidated soil and other materials such as silt, sand, clay, gravel and stones which lie above bedrock.

**Till**

Unstratified, unsorted glacial sediment deposited directly by a glacier.