



Lynde Creek Main Subwatershed

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Lynde Creek Watershed

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LYNDE CREEK WATERSHED EXISTING CONDITIONS REPORT CHAPTER 15 - WATER QUANTITY

June 2008

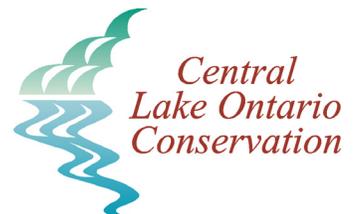


TABLE OF CONTENTS

1.0	INTRODUCTION	4
2.0	STUDY AREA AND SCOPE	5
3.0	METHODOLOGY	7
3.1	Modelling	7
3.1.1	Hydrology – Event Modelling	7
3.1.2	Hydrology – Transient Modelling	8
3.1.3	Hydraulic Modelling	9
3.2	Monitoring.....	9
4.0	FINDINGS	10
4.1	Lynde Creek Watershed	10
4.1.1	Modelling	10
4.1.1.1	Hydrology - Event Modelling	10
4.1.1.2	Hydrology – Transient Modelling.....	12
4.1.1.3	Hydraulic Modelling and Generic Regulation Limits.....	12
4.1.2	Monitoring	15
4.2	Subwatershed Findings	18
4.2.1	Lynde Main Subwatershed	18
4.2.2	Heber Down Subwatershed.....	22
4.2.3	Kinsale Subwatershed.....	26
4.2.4	Ashburn Subwatershed	29
4.2.5	Myrtle Station Subwatershed.....	32
5.0	CONCLUSIONS	35
6.0	REFERENCES	35

LIST OF TABLES

Table 1:	Watershed parameters for “Existing 2005” conditions.....	8
Table 2:	Lynde Creek watershed flow measuring stations.	9
Table 3:	Hydrologic model results comparison.	10
Table 4:	Lynde Main reference nodes.	18
Table 5:	Lynde Main average stream flow.....	20
Table 6:	Heber Down subwatershed reference nodes.	22
Table 7:	Kinsale subwatershed reference nodes.	26
Table 8:	Ashburn reference nodes.....	29
Table 9:	Myrtle Station reference nodes.	32

LIST OF FIGURES

Figure 1: Lynde Creek watershed.6
Figure 2: Catchments & hydrologic reference nodes within the Lynde Creek. 11
Figure 3: Lynde creek hydrograph: Chicago and SCS 100-year storms..... 12
Figure 4: Runoff in the Lynde Creek watershed..... 13
Figure 5: Natural hazard limits for the Lynde Creek watershed by subwatershed..... 14
Figure 6: CLOCA’s water monitoring network in the Lynde Creek watershed. 16
Figure 7: Baseflow stations with average flow in the Lynde Creek watershed. 17
Figure 8: Runoff in the Lynde Main subwatershed. 19
Figure 9: Average monthly streamflow for the Lynde Main gauge stations. 20
Figure 10: Baseflow stations and average flow for the Lynde Main subwatershed..... 21
Figure 11: Runoff in the Heber Down subwatershed..... 23
Figure 12: Average monthly streamflow for the Heber Down gauge station. 24
Figure 13: Baseflow stations and average flow in the Heber Down subwatershed..... 25
Figure 14: Runoff in the Kinsale subwatershed..... 27
Figure 15: Baseflow stations and average flow in the Kinsale subwatershed. 28
Figure 16: Runoff in the Ashburn subwatershed..... 30
Figure 17: Baseflow stations and average flow in the Ashburn subwatershed..... 31
Figure 18: Runoff in the Myrtle Station subwatershed..... 33
Figure 19: Baseflow stations, average flow and recharge in the Myrtle Station subwatershed..... 34

1.0 INTRODUCTION

Quantifying the amount of water within a watershed assists in the understanding of the hydrologic cycle for the watershed. Monitoring the changes in water quantity can assist in identifying changes that may affect the aquatic health, geomorphic stability and water quality of a creek. In addition, stream gauging provides critical information needed for CLOCA's flood forecasting and warning program.

Further, the flows calculated from the stream gauge data support groundwater and surface water modelling and calibration efforts, surface water quality assimilative studies, water use and aquatic health investigations. It is important to monitor changes in flow conditions that reflect changes in climate (precipitation, evapotranspiration, air temperature), water demands, land use (urban, rural, agricultural, recreational) and natural areas (loss of natural heritage features). Changes in flow rates affect urban and rural run-off and wash-off and transport, channel stability and fish habitat. Issues result from groundwater discharge reduction including reduced assimilative capacity, and increased water temperature.

The purpose of this chapter is to report on the existing monitoring and modelling of water quantity conditions within the Lynde Creek watershed and to provide mapping of natural hazards around wetlands and watercourses. The term 'natural hazards' is used to identify features of the landscape that have the potential to negatively impact public safety including unstable slopes, erosion and flooding.

Legislation and Policies

The Central Lake Ontario Conservation Authority (CLOCA) administers Ontario Regulation 42/06 Regulation of Development, Interference with Wetlands and Alteration to Shorelines and Watercourses. This regulation was created for the following reasons:

- to minimize the risk to loss of life and property damage as a result of flooding;
- to direct development away from natural hazard prone land (ie flooding, erosion); and
- to determine whether or not in the opinion of the Authority, the development proposal will affect the control of flooding, pollution, or the conservation of land.

The reader is referred to Chapter 4 - Land Use and Policy Framework for more information on the regulation.



'it is important to monitor changes in flow conditions that reflect changes in climate, water demands, land use and natural areas'

2.0 STUDY AREA AND SCOPE

The Lynde Creek watershed is situated entirely within the Regional Municipality of Durham and covers an area of approximately 130 km² (Figure 1). The watershed drains southerly towards Lake Ontario from its headwaters in the Oak Ridges Moraine. The Lynde Creek watershed is divided into 5 subwatersheds being Lynde Main, Heber Down, Kinsale, Ashburn, and Myrtle Station.

This chapter focuses on the quantity of water found within the watershed and each subwatershed. Descriptions provided primarily focus on the results of existing modelling. In addition, components of CLOCA's water monitoring network within the watershed are described. Information from the network provides valuable information in support of modeling activities. In addition, landscape features within the watershed that are prone to riverine hazards including unstable slopes, erosion and flooding are identified.



'this chapter focuses on the quantity of water found within the watershed and each subwatershed'

3.0 METHODOLOGY

3.1 Modelling

Water quantity modelling can be broken down into 2 components, hydrology and hydraulics. Each component is modeled using different software and is used in CLOCA's daily routine. In order to determine water quantity over time, monitoring is crucial. CLOCA undertakes a monitoring program, the results of which are used in many different Authority programs, including water quantity modeling and predicting.

3.1.1 Hydrology – Event Modelling

The main hydrology model for the Lynde Creek was created by CLOCA in Visual Otthymo 2, and was completed in 2007. Visual Otthymo is a single event hydrologic model meaning that simulations are created from a single storm event.

The hydrology modelling of surface water for Lynde Creek has been completed in 3 stages. The first stage (Stage 1) involved creating an existing, 2005 land use model and the associated parameters for Visual Otthymo. The second stage involves editing the parameters within the existing 2005 land use model, to create a future land use model, and comparing the two models based on their input parameters and resulting peak flows. The third stage involves identifying hydrologic units that had large increases in peak flows due to land use changes, assessing the impact of these flow increases on a watershed basis, and adding stormwater management ponds as necessary to provide quantity control of peak flows. The results of Stage 1 are documented in this chapter and are intended to provide the existing conditions of peak flows within the watershed. Stages 2 and 3 are underway and will be completed prior to the preparation of the plan for the watershed.

Under the existing condition scenario the Lynde Creek watershed was divided into 43 subwatersheds. The subwatersheds were determined based on the 1:10,000 topographic mapping, Digital Elevation Model (DEM) mapping, and surface drainage (storm sewer) mapping for the developed areas of Whitby. Subwatersheds with 20% or more total imperviousness are modeled as urban while all others were modeled as rural.

The rural subwatersheds were modeled using the Nashyd command. Within this command, the CN parameter reflects the soil types, topography, vegetation cover and land use of each subwatershed. Model parameters were determined independently of the model using GIS queries, topographic mapping and published values. The required model parameters and the method used for their determination are listed in Table 1.



'the main hydrology model for the Lynde Creek was created by CLOCA in Visual Otthymo 2, and was completed in 2006'

Table 1: Watershed parameters for "Existing 2005" conditions.

Parameter	Name	Source
CN	SCS Curve Number	U.S. Department of Agriculture US Soil Conservation Services
Ia	Initial Abstraction	SWMHYMO Manual UNESCO, Manual on Drainage in Urbanized Areas, 1987
N	Number of Reservoirs	3
Tp	Unit Hydrograph Time to Peak	Airport (urban areas) and Bransby-Williams (rural areas) Equations
Timp	Total Percent Imperviousness	U.S. Soil Conservation Services
Ximp	Directly Connected Percent Imperviousness	U.S. Soil Conservation Services
LGP / LGI	Overland Flow Length Pervious / Impervious	$L=(Area/1.5)^{0.5}$
SLPP / SLPI	Average Slope Pervious / Impervious	Measured from topographic mapping
MNP / MNI	Manning's Roughness Coefficient for Pervious / Impervious	0.25 Pervious 0.013 Impervious

The urban subwatersheds were modeled using the Standhyd command. CN and Ia values were used for the pervious areas of the units and the Ximp (directly connected impervious area) and Timp (total impervious area) values are used to define the amount of imperviousness within each urban unit.

To determine the appropriate rainfall distribution for the watershed, a storm with a uniform rainfall intensity of 25 mm/hr, lasting 100 hours was simulated over the watershed. The resulting hydrograph will show the time at which the entire watershed is contributing to the peak flow. The Regional Storm (Hurricane Hazel) was used to compute the regulatory flows and flood elevations. The Regional Storm was applied to the Existing condition scenario. CN values were increased to reflect Antecedent Moisture Condition III for the regional storm event.

3.1.2 Hydrology – Transient Modelling

While Visual Otthymo is a single event hydrologic model used to predict peak flows, the United States Geological Survey's transient numerical model Precipitation-Runoff Modelling System (PRMS) has been applied to the watershed by CLOCA as part of water budgeting activities, consistent with the model developed for the Source Water Protection program (Earthfx, 2007). A transient model simulates runoff over days, months and years based primarily on daily average precipitation data recorded at local gauge stations. The reader is referred to Chapter 9 - Water Budget for more detail regarding the PRMS model application. This model has been constructed for a myriad of uses including water budget investigations, estimate land development impacts, water supply investigations, fisheries and aquatics management, and water use reviews. This model was, in-part, calibrated using the draft existing groundwater flow model developed in 2007 for the Source Water Protection Program.

'to determine the appropriate rainfall distribution for the watershed, a storm with a uniform rainfall intensity of 25 mm/hr, lasting 100 hours was simulated over the watershed'

'Antecedent Moisture Condition (AMC) is used to describe the wetness or moisture content of a soil at the onset of a rainfall event. There are three classifications: AMC I describes dry conditions, AMC II describes normal conditions and AMC III describes wet conditions.'

AMC II conditions are used in determining peak flows for the return period storms (2, 5, 10, 25, 50 and 100). The Regional storm (Hurricane Hazel) peak flows are determined using AMC III conditions.'

One of the key outputs of the model is the long-term average distribution of annual runoff over the watershed. This information further refines the spatial distribution of estimated runoff by calculating runoff rates on a 25m x25m grid covering the watershed.

3.1.3 Hydraulic Modelling

Hydraulic modelling is undertaken primarily to establish areas of potential riverine flooding hazards within the watershed. The current hydraulic model was created by Dillon Consulting Engineers in HEC2, and was completed in 1974. An update using HEC-GeoRAS is currently being undertaken by EarthTech and is scheduled to be completed in late 2007. Identified areas of possible flooding hazards are assessed with areas of slope instability, stream erosion, and the shifting tendencies of meandering riverine systems to generate an environmental hazard protection limit commonly referred to as 'hazard limits'.

CLOCA is also working towards the creation of a prediction model and a flood vulnerable database. The two models, when used in conjunction with each other, are used to identify structures, roads and bridges that will be inundated under specific rainfall events. The results from the flood plain mapping are required to run the models, and hence the completion of prediction model and flood vulnerable database is dependant on the completion of the flood plain mapping.

3.2 Monitoring

CLOCA maintains a network of monitoring stations that monitor water quantity parameters including rainfall and stream water level. These stations are permanent gauges that record information on a set interval. Some gauges can be downloaded remotely and others require information to be retrieved on site. Within the Lynde Creek there are 3 water level stations, 2 of which monitor rainfall as well. The stations within Lynde Creek are presented in Table 2.

Table 2: Lynde Creek watershed flow measuring stations.

Station	Description	Period of Record (Flow)	Parameters
02HC055	Heber Down Conservation Area	April 1, 2002 - Current	Water Level (Flow), Rainfall, Water Temperature, Air Temperature
02HC018	Dundas St.	April 1, 1959-Current	Water Level (Flow), Rainfall
02HC054	Brooklin	January 1, 2003 - Current	Water Level (Flow), Water Temperature

In addition to stream flow monitoring CLOCA maintains a snow pack monitoring program, where snow depth and density is obtained on a preset schedule of twice monthly. Within the Lynde Creek watershed there are 2 snow pack monitoring stations, one located west of Heron Rd. just south of Townline Rd. while the second station is located in the Heber Down Conservation Area. This information is used to assist in the development and calibration of the hydrology and hydraulic models.

CLOCA also maintains a baseflow monitoring network. The baseflow monitoring network consists of 138 stations jurisdiction wide, 39 of which are in the Lynde Creek

'the baseflow monitoring network consists of 138 stations jurisdiction wide, 39 of which are in the Lynde Creek watershed'

watershed. These stations are monitored manually during the summer months after 3 consecutive days with no rainfall.

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.



4.0 FINDINGS

4.1 Lynde Creek Watershed

4.1.1 Modelling

4.1.1.1 Hydrology - Event Modelling

The results of the hydrologic model were used to examine peak flows within the watershed, subwatershed and catchments. A map showing the locations of the key reference nodes and the catchments is shown in Figure 2.

The results from the hydrologic model were compared to several past studies; the comparison is shown Table 3.

Table 3: Hydrologic model results comparison.

Node	Description	Peak Flows		
		Regional		
		Lynde Creek Hydrology (CLOCA, 2007)	Lynde Creek Water Resources Management Study (Gartner Lee, 1994)	Lynde Creek Master Drainage Plan (1988)
221	At mouth	937.69	780.50	734.00
59	At Hwy 401	743.20	N/A	650
219	At Hwy 2	739.25	674.80	653
7	Rossland Rd W	325.13	-	320
52	Rossland Rd E	404.76	-	338
35	Hwy 7 Main Subwatershed	279.04	295.90	279

'the results of the hydrologic model were used to examine peak flows'

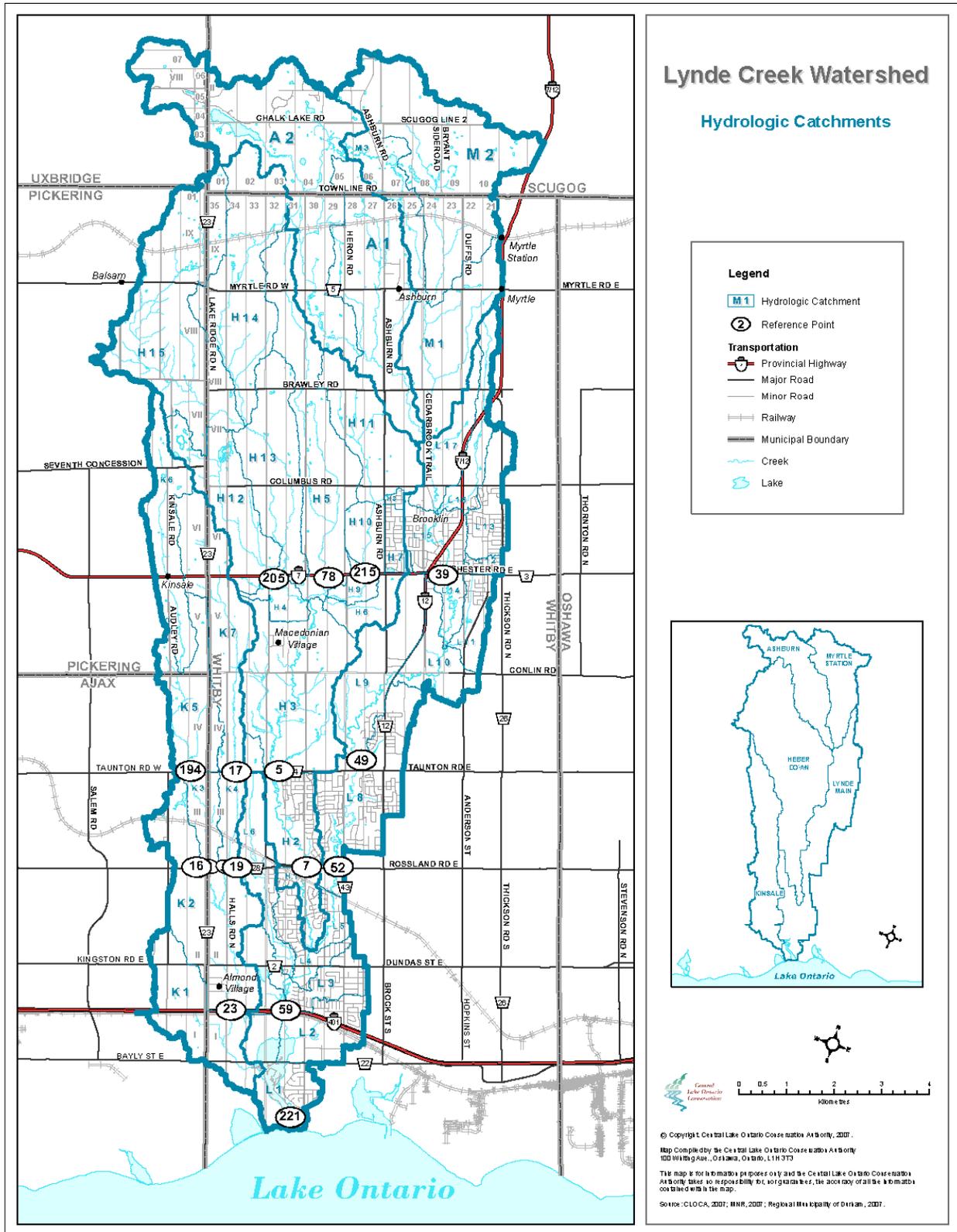


Figure 2: Catchments & hydrologic reference nodes within the Lynde Creek.

A review of Table 3 indicates that the 2007 model results are within 20% of the results from the past models. Node 221, the mouth of Lynde Creek, has the greatest difference in peak flows, this can be attributed to the difference in land use scenarios.

The watershed hydrograph rose steadily and began to level off around the 20th hour. At the 26th hour the flow had reached 95% of its peak. To ensure that the entire watershed is contributing to the peak flow a 12 hour Chicago Distribution and a 24 hour SCS storm were used. The hydrographs for both the Chicago and SCS 100 year storms for the outlet of Lynde Creek are shown on Figure 3.

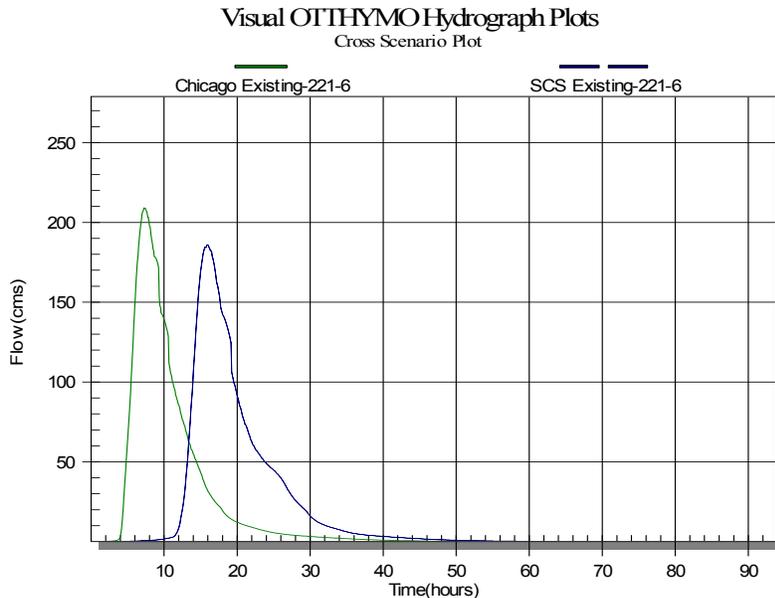


Figure 3: Lynde creek hydrograph: Chicago and SCS 100-year storms.

4.1.1.2 Hydrology – Transient Modelling

The distribution of long-term average annual watershed runoff in mm/year is shown in Figure 4. Note that the higher runoff values are reflected in the urban areas of higher imperviousness. In contrast, low runoff values are predicted within the hummocky topography of the Oak Ridges Moraine area. Areas of less permeable surficial soils generally reflect higher runoff also depending on the degree of slope, on the land cover and the amount of precipitation intercepted. Many stream corridors are predicted to have low runoff potential based on the extent of riparian cover, related rates of evapotranspiration and interception, and soil types. The long-term average annual runoff is estimated at approximately 167mm/year for the watershed (data from Earthfx, 2007).

4.1.1.3 Hydraulic Modelling and Generic Regulation Limits

The natural hazard limits or 'Generic Regulation limits' which include the identified areas of flooding hazards generated by the 1974 hydraulic model, and the calculated erosion hazard lands and wetlands limits, are shown in Figure 5. These limits are used by CLOCA as part of administering O. Reg. 42/06.

'the watershed hydrograph rose steadily and began to level off around the 20th hour'

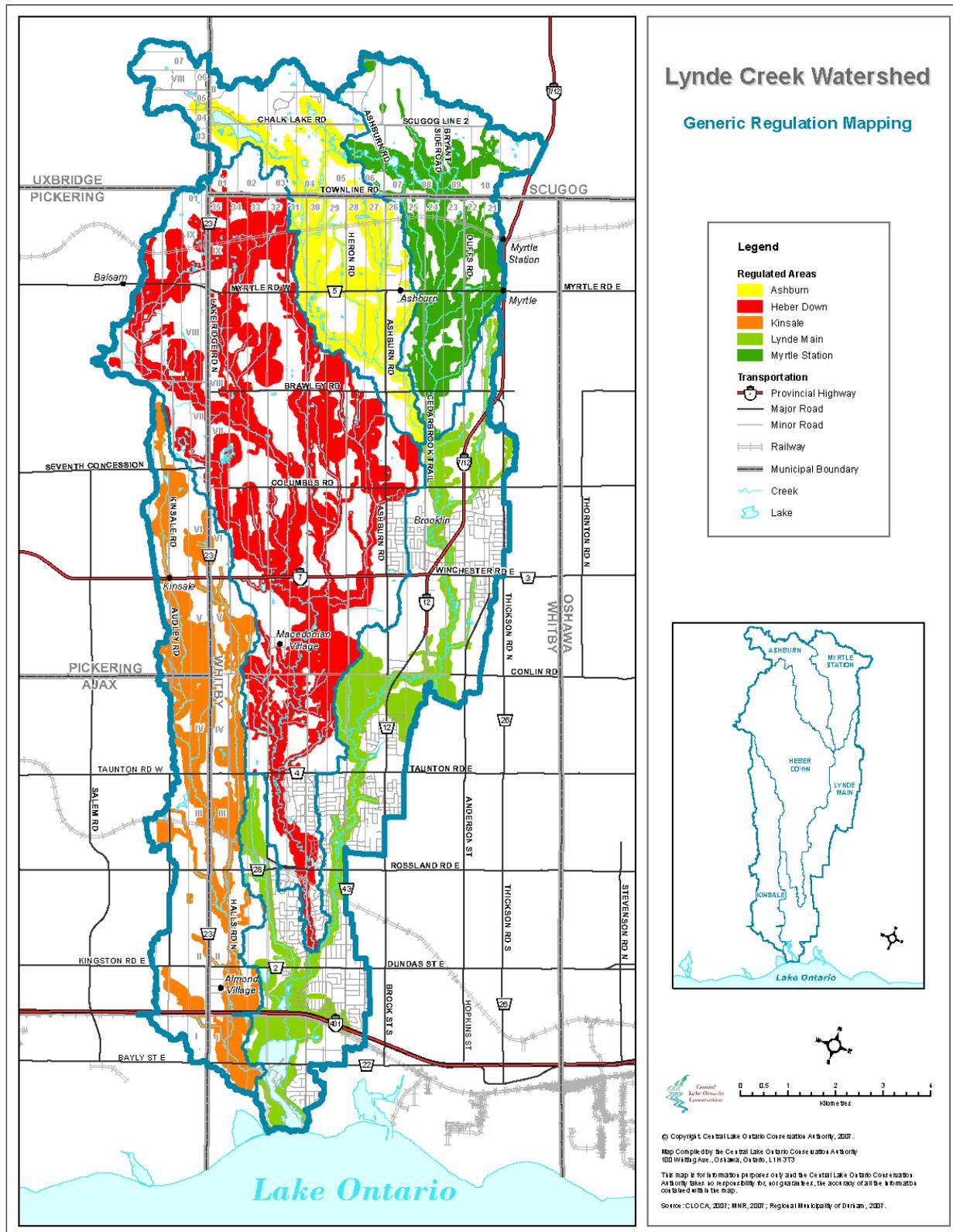


Figure 5: Generic Regulation limits for the Lynde Creek watershed by subwatershed.

4.1.2 Monitoring

CLOCA's monitoring network is shown on Figure 6. The information collected from the stream gauges can be used to identify trends and averages for each of the gauges.

The information collected through CLOCA's baseflow monitoring network (Figure 7) has been formatted and summarized to allow for the identification of trends and relationships for each site. The average baseflow measurement for each site, for the period of record, has been determined and is shown on the figure. In addition the relationship between baseflow sites is currently being examined in an effort to identify stream reaches which are gaining groundwater (groundwater discharge) or are losing streamflow to groundwater (groundwater recharge).

The trend analysis produced from the baseflow measurements occasionally identifies areas of concern. Site LBF 21, within the Heber subwatershed, north of Winchester Road frequently measured a discharge of 0 cms and site visits confirmed the dry conditions (photo below). Areas of concern will continue to be identified and investigated.



'the information collected through CLOCA's baseflow monitoring network has been formatted and summarized to allow for the identification of trends and relationships for each site'

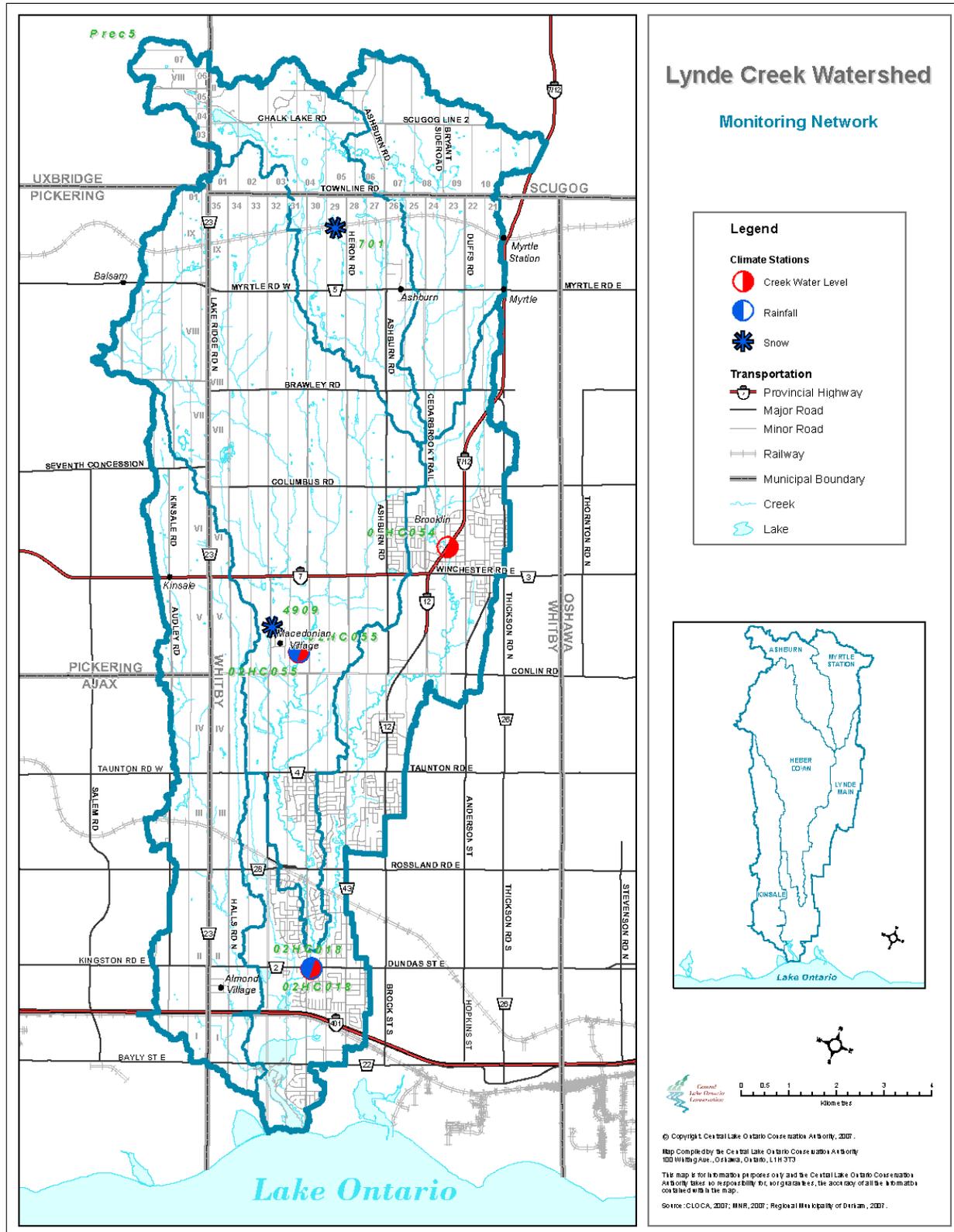


Figure 6: CLOCA's water monitoring network in the Lynde Creek watershed.

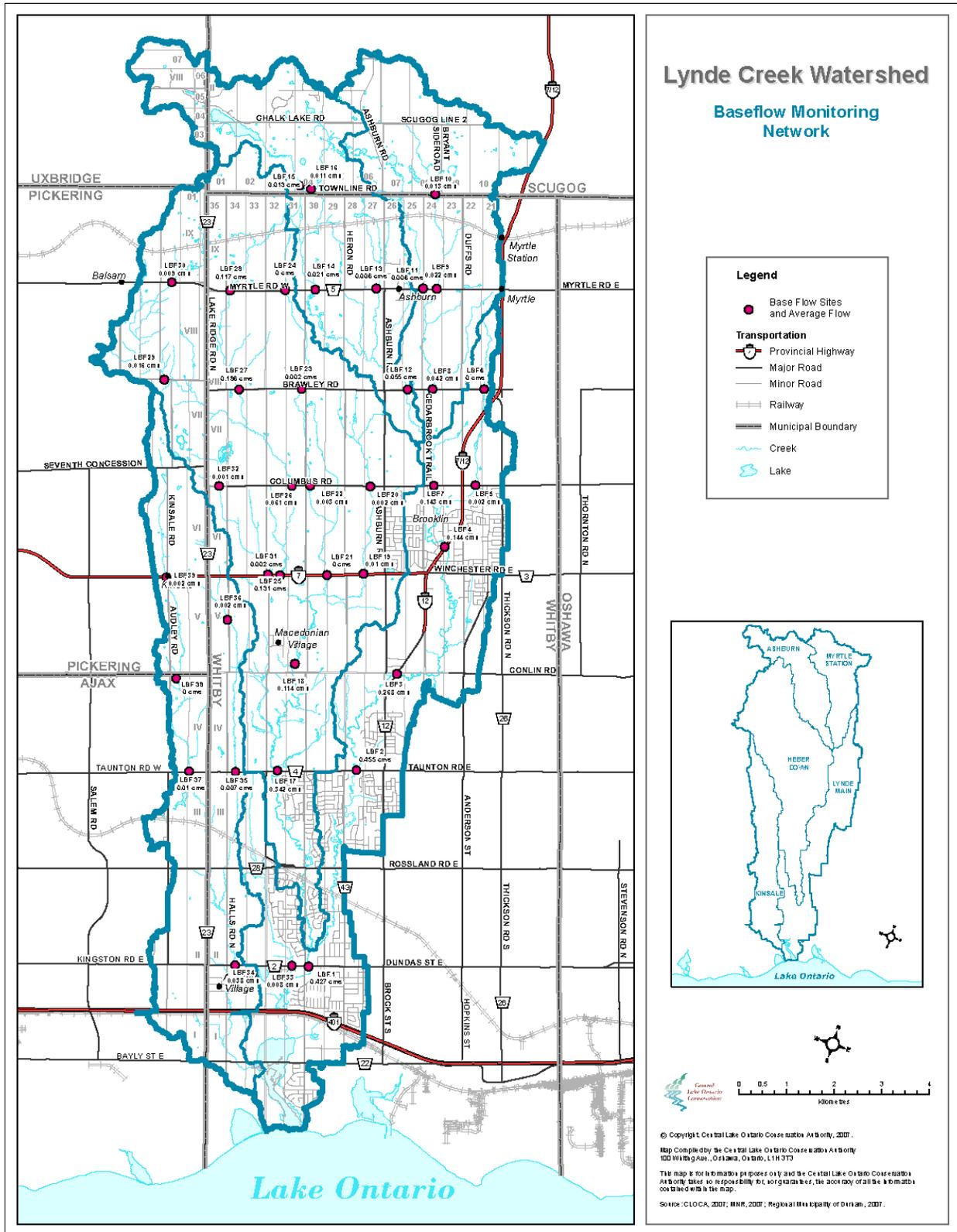


Figure 7: Baseflow stations with average flow in the Lynde Creek watershed.

4.2 Subwatershed Findings

4.2.1 Lynde Main Subwatershed

Hydrology – Event Modelling

The Lynde Main subwatershed has 17 catchments (Figure 2). The large number of catchments is due to the overall size of the subwatershed and the large number of different sewer sheds, due to urban areas. There are 6 reference nodes, the node locations were chosen based on road crossings and the merging of sewer sheds. The reference nodes and the associated peak flows are presented in the table below.

Table 4: Lynde Main reference nodes.

Reference Node (NHYD)	Description	Peak Flow (cms) Regional Storm
221	Mouth of Lynde Creek	937.69
59	Highway 401	743.20
52	Rossland Road	404.76
49	Taunton Road – Lynde Main Subwatershed	377.18
39	Winchester Road – West Subwatershed	305.88
196	Winchester Road – East Subwatershed	23.48

Hydrology – Transient Modelling

The distribution of long-term averaged annual watershed runoff in mm/year is shown in Figure 8 for the subwatershed. Higher runoff values are reflected in the urbanized areas with a higher percentage of imperviousness. On average, the permeable deposits within the Iroquois Beach area and north of Brooklin are predicted to produce lower rates of runoff. The long-term average annual runoff is estimated at approximately 210mm/year for the subwatershed which is well above the watershed average of 167mm/year.

'long-term average annual runoff is estimated at approximately 210mm/year for the subwatershed which is well above the watershed average of 167mm/year'



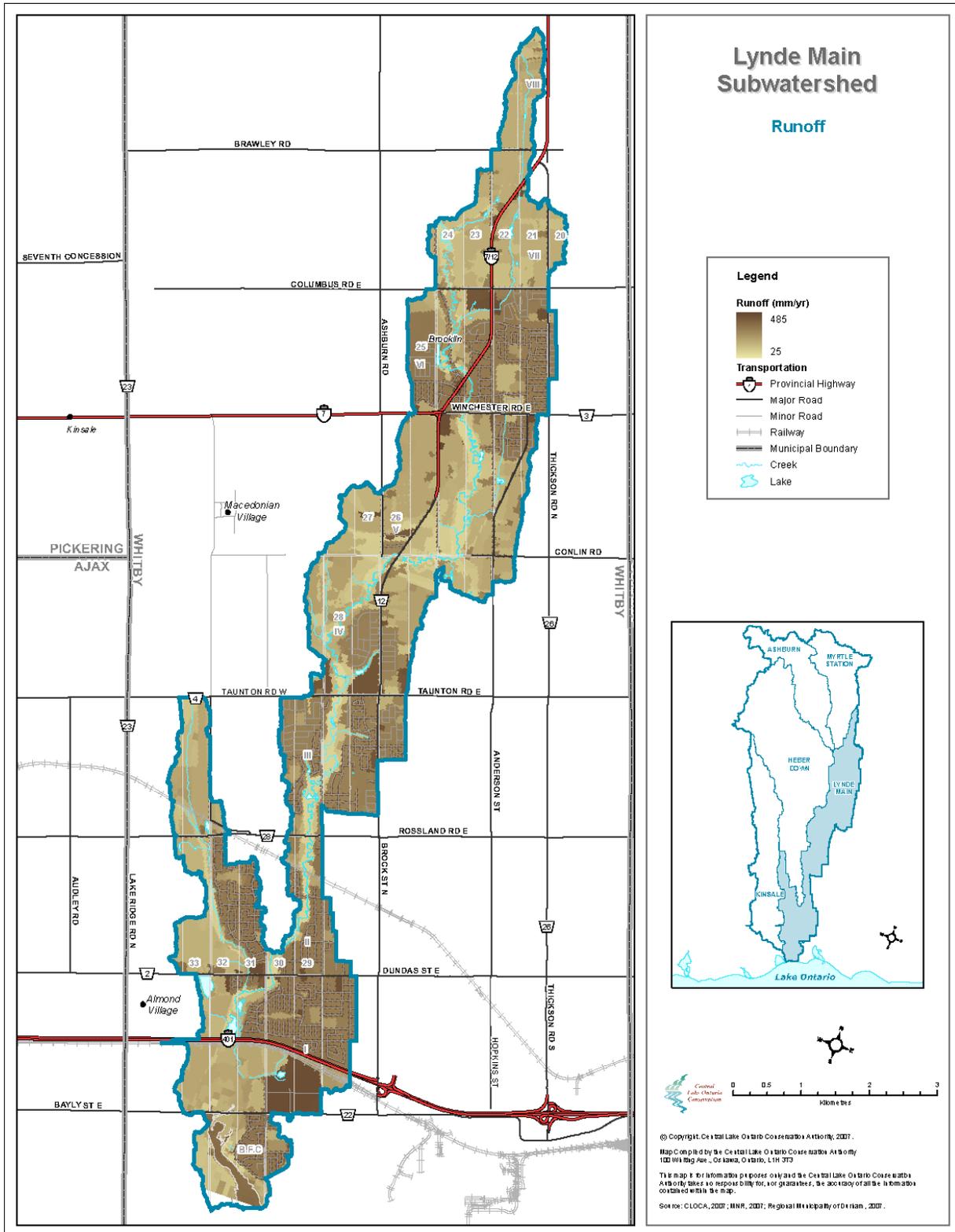


Figure 8: Runoff in the Lynde Main subwatershed (data extracted from Earthfx, 2007).

Monitoring

The Lynde Main subwatershed contains 2 creek flow monitoring stations, the first is located in Brooklin (Station ID 02HC054) and the second is located on Dundas Street in Whitby (Station ID 02HC018). The average stream flow for these stations is presented in Table 5. The average monthly stream flow for these stations is presented in Figure 9.

Table 5: Lynde Main average stream flow.

Station	Description	Average Stream Flow (m ³ /s)
02HC018	Whitby, Dundas St	1.117
02HC054	Brooklin	0.557

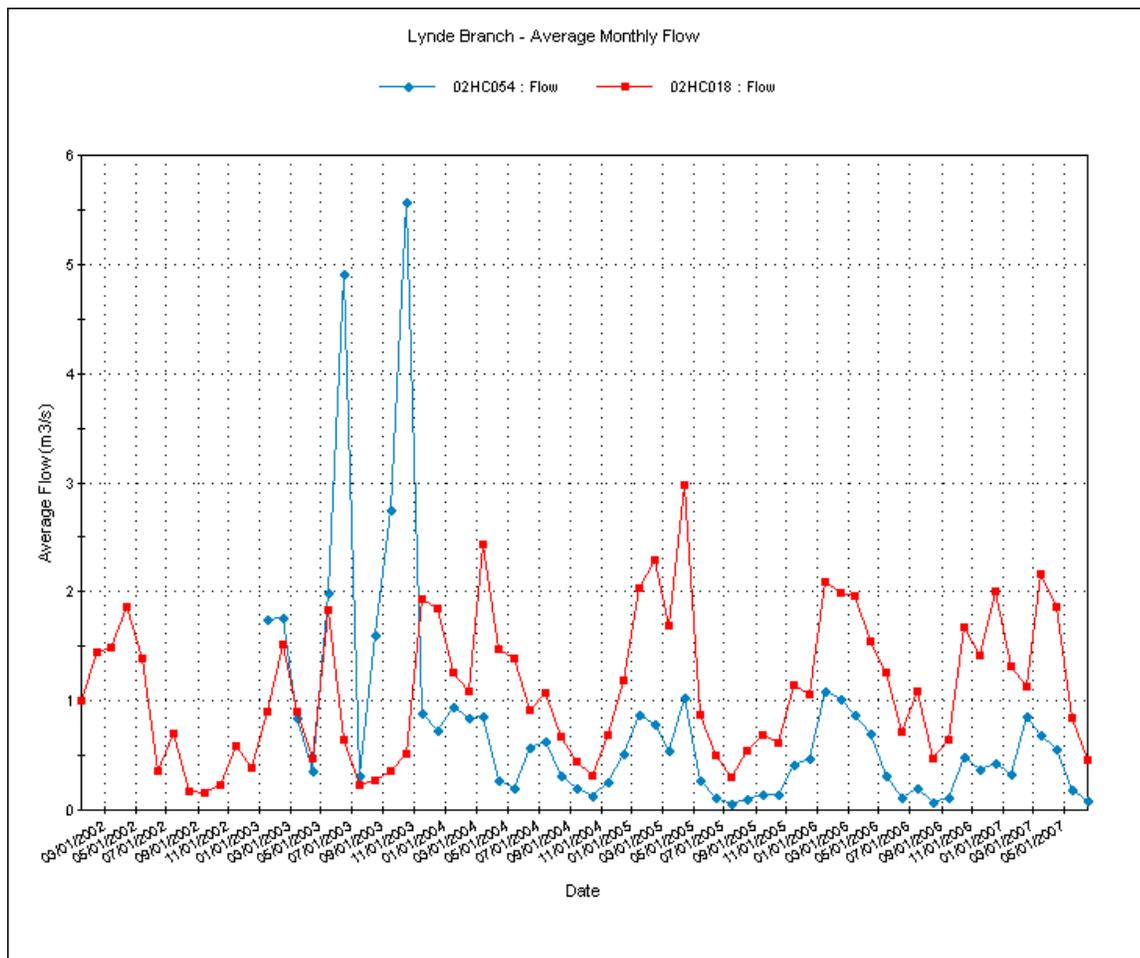


Figure 9: Average monthly streamflow for the Lynde Main gauge stations.

The Lynde Main subwatershed has 8 baseflow stations (Figure 10). The baseflow measurements within the Lynde Creek subwatersheds have a very wide range of values due to the extents of the subwatershed, beginning just south of the Oak Ridges Moraine and ending after the confluence of the Heber Down and Lynde Main subwatersheds. The average baseflow values range from 0 to 0.455 cubic meters per second.

'the Lynde Main subwatershed has eight (8) baseflow stations'

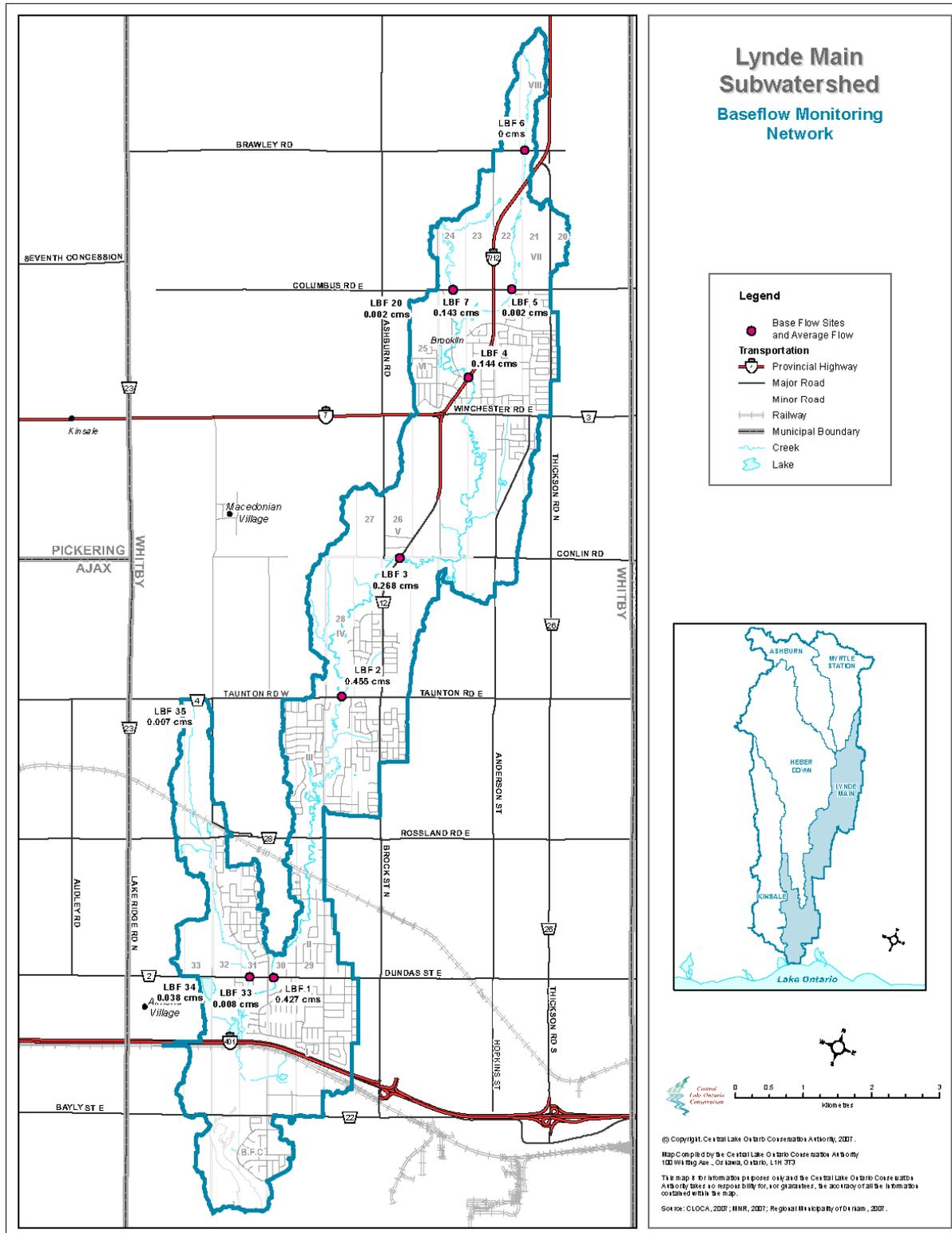


Figure 10: Baseflow stations and average flow for the Lynde Main subwatershed.

4.2.2 Heber Down Subwatershed

Hydrology - Event Modelling

The Heber Down subwatershed contains 15 catchments (Figure 2). The large number of catchments is due to the overall size of the subwatershed and the large number of tributaries within the subwatershed. There are 6 reference nodes within the Heber Down subwatershed, the node locations were chosen based on road crossings and the merging of tributaries. The reference nodes and the associated peak flows are presented in the Table 6.

Table 6: Heber Down subwatershed reference nodes.

Reference Node (NHYD)	Description	Peak Flow (cms) Regional Storm
5	Taunton Road	318.48
205	Winchester Road – Heber West Subwatershed	181.85
78	Winchester Road – Heber Central Subwatershed	60.98
216	Winchester Road – Heber East Subwatershed	40.80
7	Rossland Road	325.13
9	Bottom of Heber Subwatershed	323.36

Hydrology – Transient Modelling

The distribution of long-term average annual watershed runoff in mm/year is shown in Figure 11 for the subwatershed. Higher runoff values are reflected in the urbanized areas to the south between Rossland Rd. and Taunton Rd. which represent areas of higher imperviousness. Floodplain areas can be seen to generate lower runoff rates in many areas of highly permeable soils such as in the northern extent of the Oak Ridges Moraine (ORM) area. The long-term average annual runoff is estimated at approximately 163mm/year for the subwatershed which approximates the watershed average of 167mm/year.



Long-term average annual runoff is estimated at approximately 163mm/year for the subwatershed which approximates the watershed average of 166mm/year'

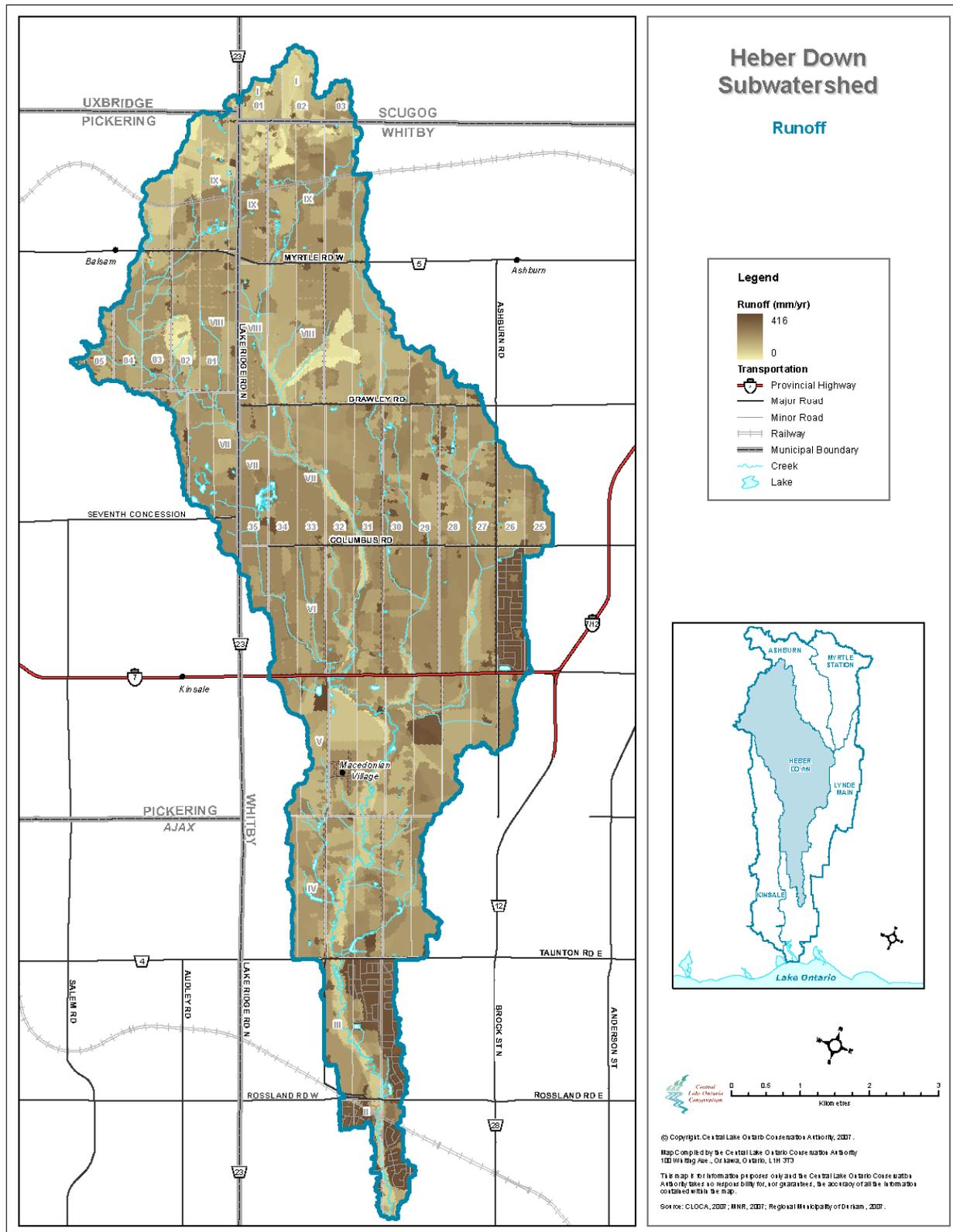


Figure 11: Runoff in the Heber Down subwatershed (data extracted from Earthfx, 2007).

Monitoring

The Heber Down subwatershed contains 1 creek flow monitoring station, located within the Heber Down Conservation Area (Station ID 02HC055). The average stream flow at this station is 0.615 cubic meters per second. The average monthly stream flow for this station is presented in Figure 12.

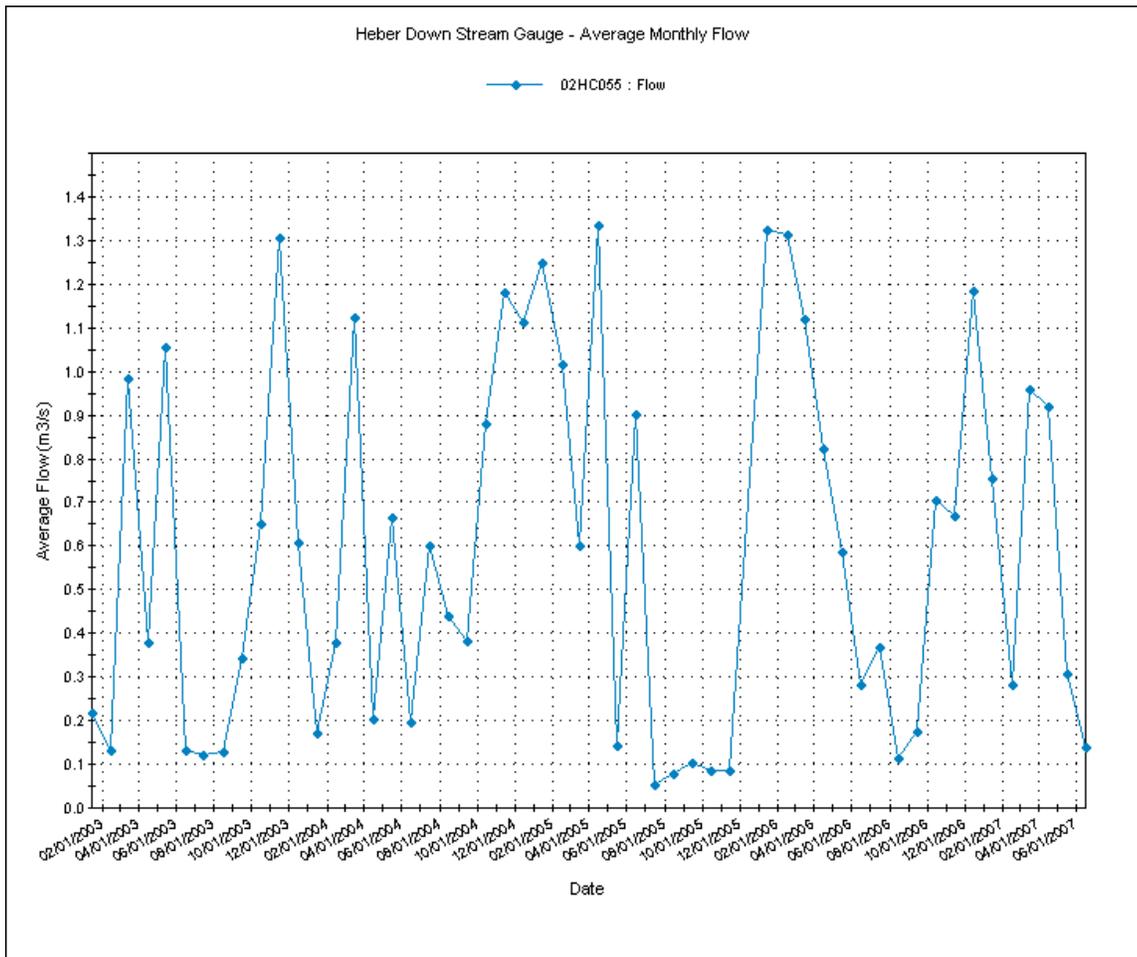


Figure 12: Average monthly streamflow for the Heber Down gauge station.

The Heber Down subwatershed has 16 baseflow stations, 3 of which are located in the Oak Ridges Moraine (Figure 13). The baseflow measurements within the Heber subwatersheds have a very wide range of values due to the extents of the subwatershed, which has its tip in the Oak Ridges Moraine (18% of the total Heber Down subwatershed) to where it joins the Lynde Main subwatershed at Rossland Road. The average baseflow values range from 0 to 0.342 cubic meters per second.

'the average baseflow values range from 0 to 0.342 cubic meters per second'

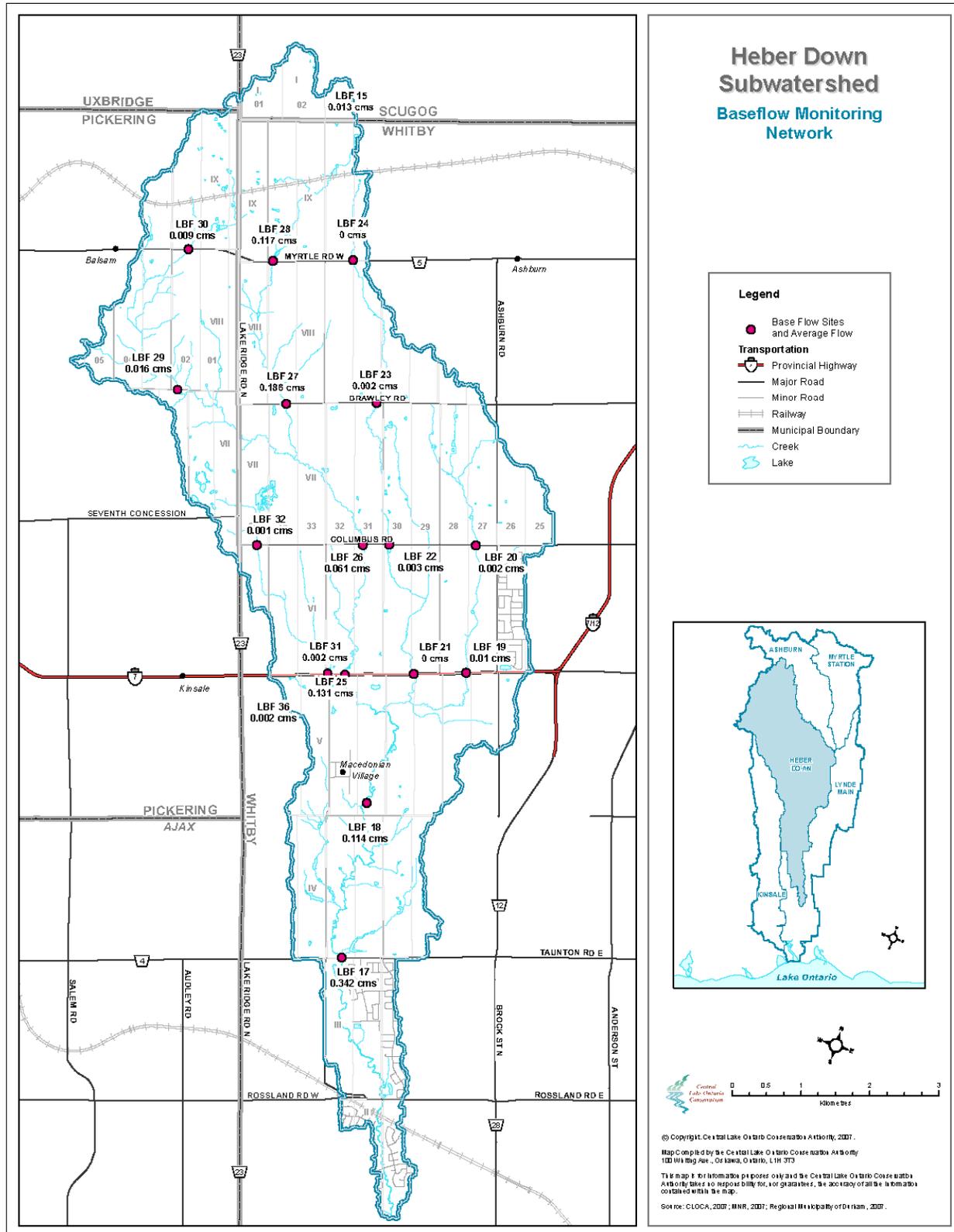


Figure 13: Baseflow stations and average flow in the Heber Down subwatershed.

4.2.3 Kinsale Subwatershed

Hydrology – Event Modelling

The Kinsale Subwatershed has 7 catchments and 6 reference nodes (Figure 2). The reference node and the associated peak flow are presented in Table 7.

Table 7: Kinsale subwatershed reference nodes.

Reference Node (NHYD)	Description	Peak Flow (cms) Regional Storm
23	Highway	160.22
16	Rossland Road –West Subwatershed	61.74
19	Rossland Road –East Subwatershed	51.63
194	Taunton Road –West Subwatershed	53.66
17	Taunton Road –East Subwatershed	45.12
24	Bottom of Kinsale Subwatershed	187.45

Hydrology – Transient Modelling

The distribution of long-term averaged annual watershed runoff in mm/year is shown in Figure 14 for the subwatershed. Moderate runoff rates prevail over most of the subwatershed. The long-term average annual runoff is estimated at approximately 169mm/year for the subwatershed which approximates the watershed average of 167mm/year.

Monitoring

The Kinsale subwatershed has 6 baseflow stations (Figure 15). The baseflow measurements within this subwatershed range in value from 0 to 0.038 cubic metres per second.

There are no streamflow monitoring stations within the Kinsale subwatershed.



'long-term average annual runoff is estimated at approximately 169mm/year for the subwatershed'

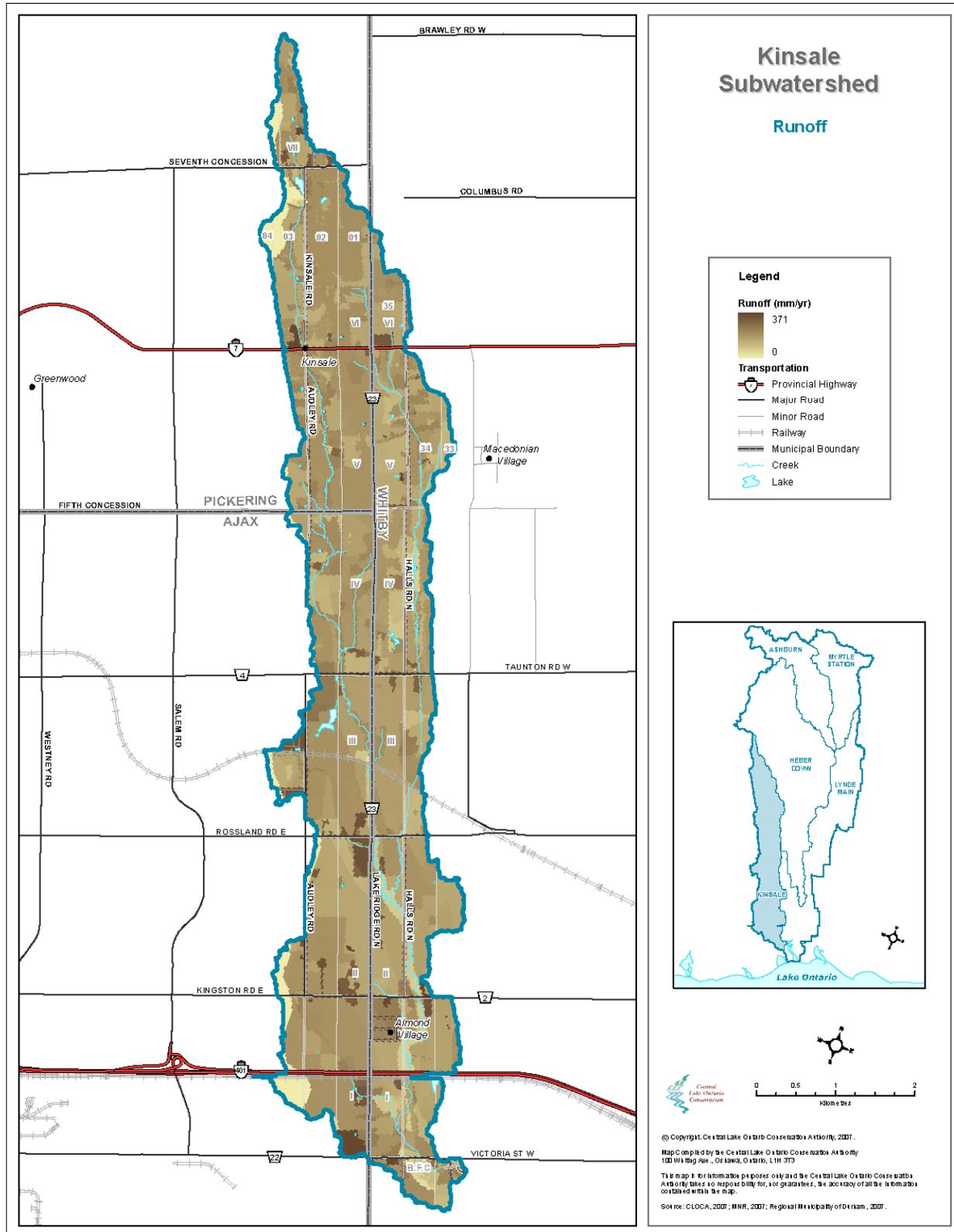


Figure 14: Runoff in the Kinsale subwatershed (data extracted from Earthfx, 2007).

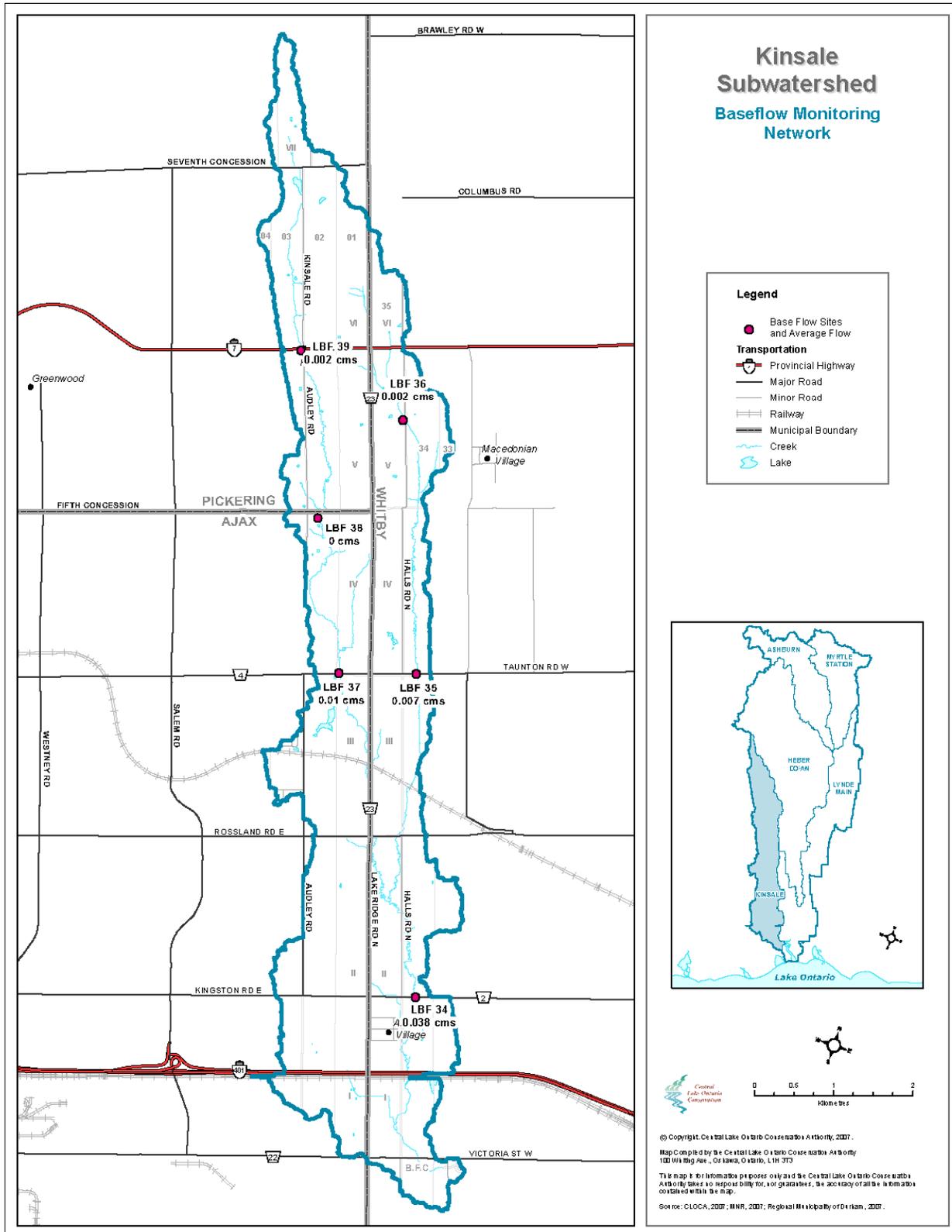


Figure 15: Baseflow stations and average flow in the Kinsale subwatershed.

4.2.4 Ashburn Subwatershed

Hydrology – Event Modelling

The Ashburn subwatershed contains only 2 catchments and 1 reference node (Figure 2). The reference node and the associated peak flow are presented in the Table 8.

Table 8: Ashburn reference nodes.

Reference Node (NHYD)	Description	Peak Flow (cms) Regional Storm
183	Bottom of Ashburn Subwatershed	137.85

Hydrology – Transient Modelling

The distribution of long-term average annual watershed runoff in mm/year is shown in Figure 16 for the subwatershed. Moderate runoff values are reflected in the southern half of the subwatershed. The areas in the ORM show little expected runoff primarily influenced by the permeable surficial deposits and the presence of hummocky topography. The long-term average annual runoff is estimated at approximately 125mm/year for the subwatershed which is well below the watershed average of 167mm/year.

Monitoring

The Ashburn subwatershed, of which approximately 80% is Oak Ridges Moraine, has 5 baseflow stations (Figure 17). These stations represent headwater conditions as all but 1 are located within the Oak Ridges Moraine. The values for the baseflow measurements within the Ashburn subwatershed are very low, ranging between 0.006 to 0.06 cubic meters per second.

There are no streamflow monitoring stations within the Ashburn subwatershed.



'long-term average annual runoff is estimated at approximately 125mm/year for the subwatershed'

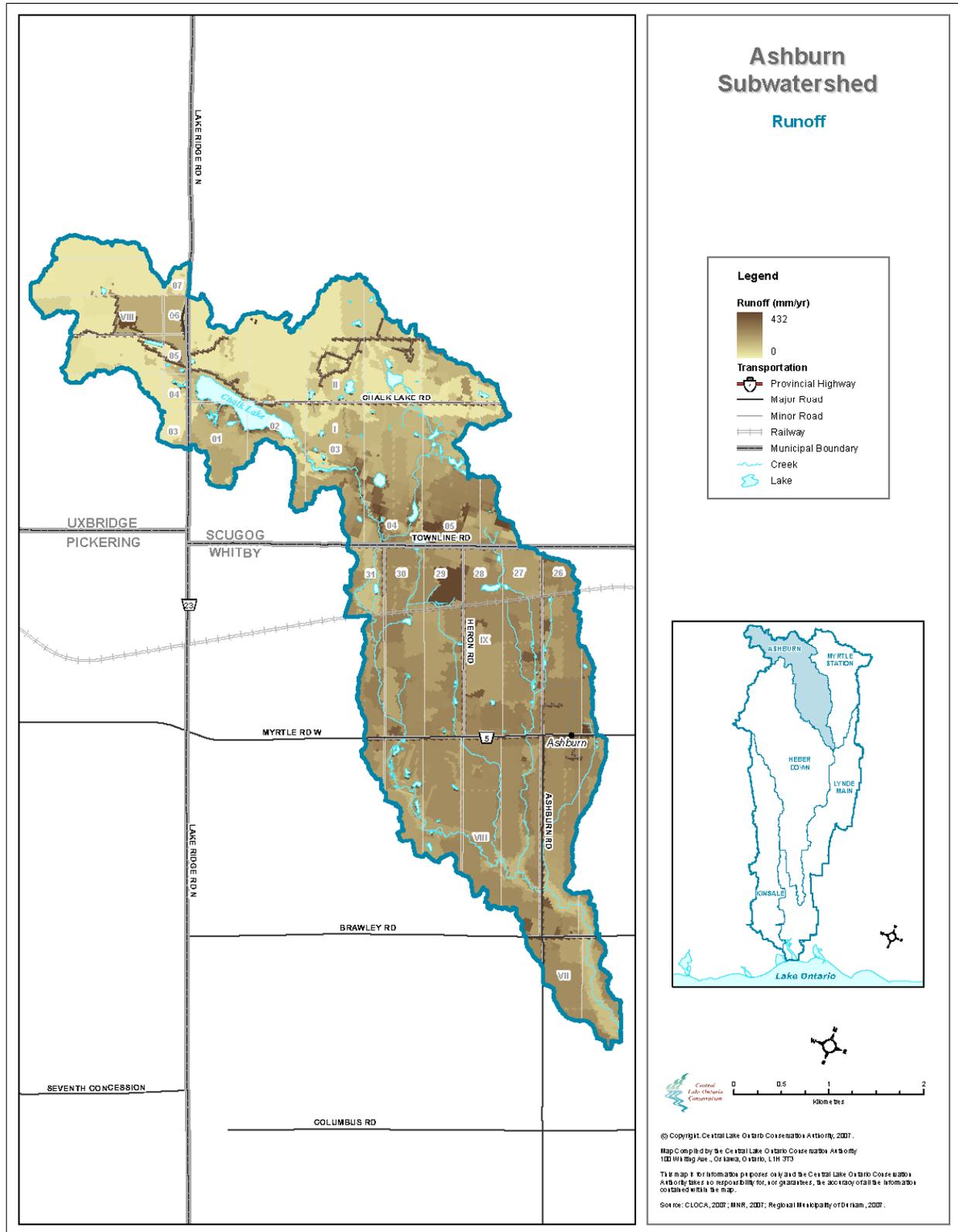


Figure 16: Runoff in the Ashburn subwatershed (data extracted from Earthfx, 2007).

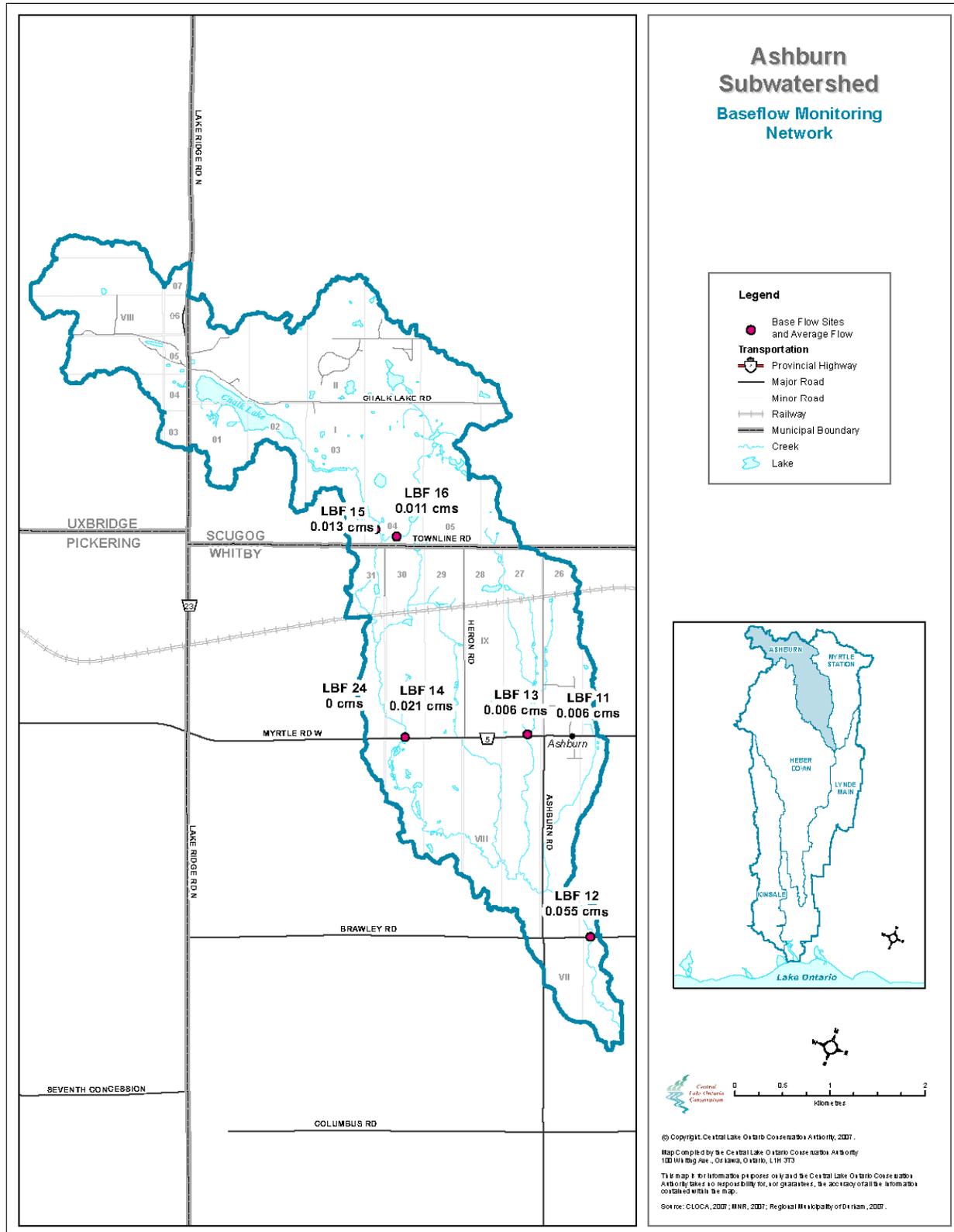


Figure 17: Baseflow stations and average flow in the Ashburn subwatershed.

4.2.5 Myrtle Station Subwatershed

Hydrology – Event Modelling

The Myrtle Station subwatershed contains only 3 catchments and 1 reference node (Figure 2). The reference node and the associated peak flow are presented in Table 9.

Table 9: Myrtle Station reference nodes.

Reference Node (NHYD)	Description	Peak Flow (cms) Regional Storm
190	Bottom of Myrtle Station Subwatershed	131.44

Hydrology – Transient Modelling

The distribution of long-term average annual runoff in mm/year is shown in Figure 18 for the subwatershed. Similar to the Ashburn subwatershed, moderate runoff rates are expected for the southern half of the subwatershed. Runoff rates are predicted to be low in the ORM area. The long-term average annual runoff is estimated at approximately 128mm/year for the subwatershed which is well below the watershed average of 167mm/year.

Monitoring

The Myrtle station subwatershed, of which approximately 76% is Oak Ridges Moraine, has 4 baseflow stations (Figure 2). These stations represent headwater conditions as 2 are located within the ORM. The values for the baseflow measurements within the Myrtle Station subwatershed are very low, ranging between 0.006 to 0.042 cubic meters per second.

There are no streamflow monitoring stations within the Myrtle Station subwatershed.



'long-term average annual runoff is estimated at approximately 128mm/year for the subwatershed'

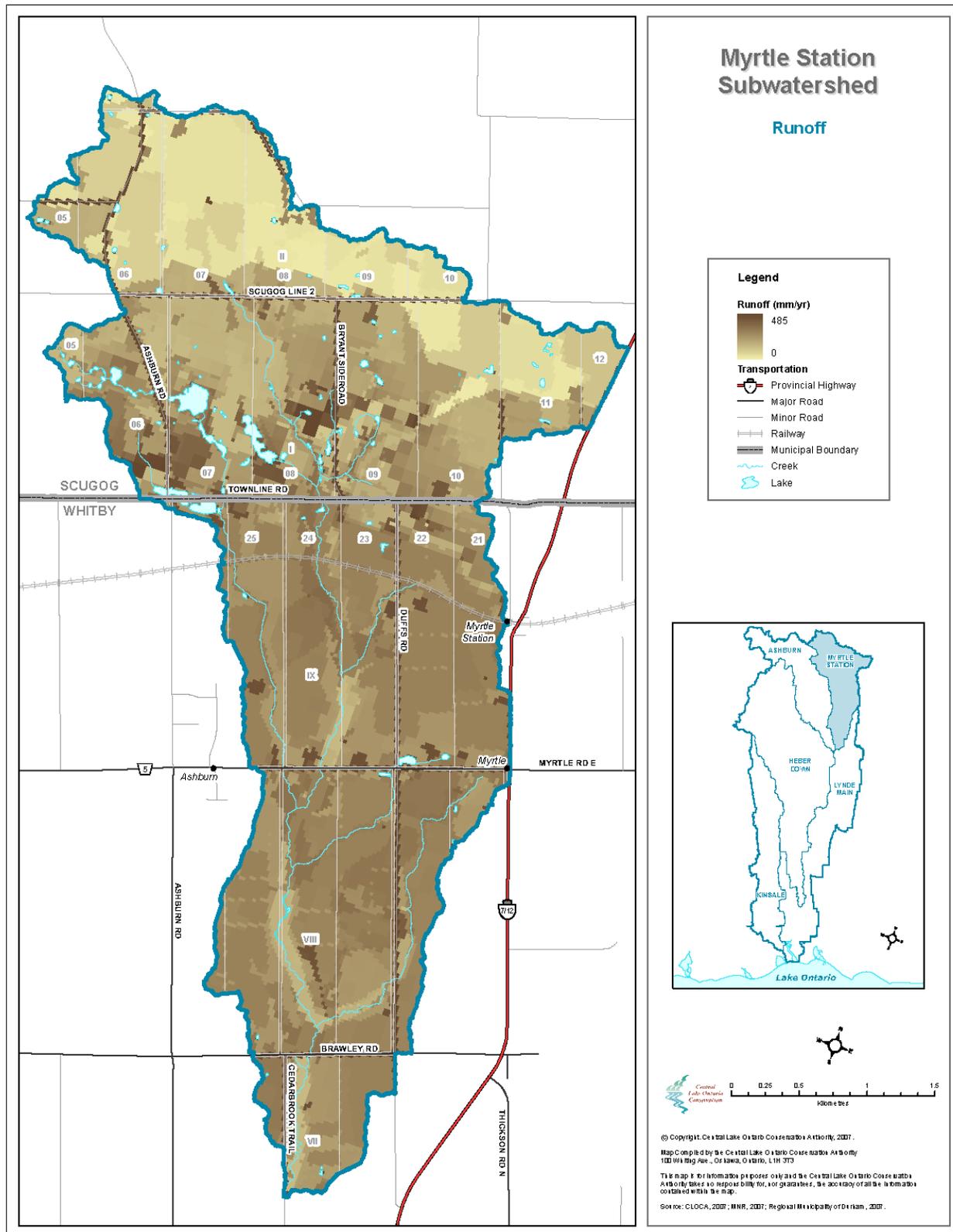


Figure 18: Runoff in the Myrtle Station subwatershed (data extracted from Earthfx, 2007).

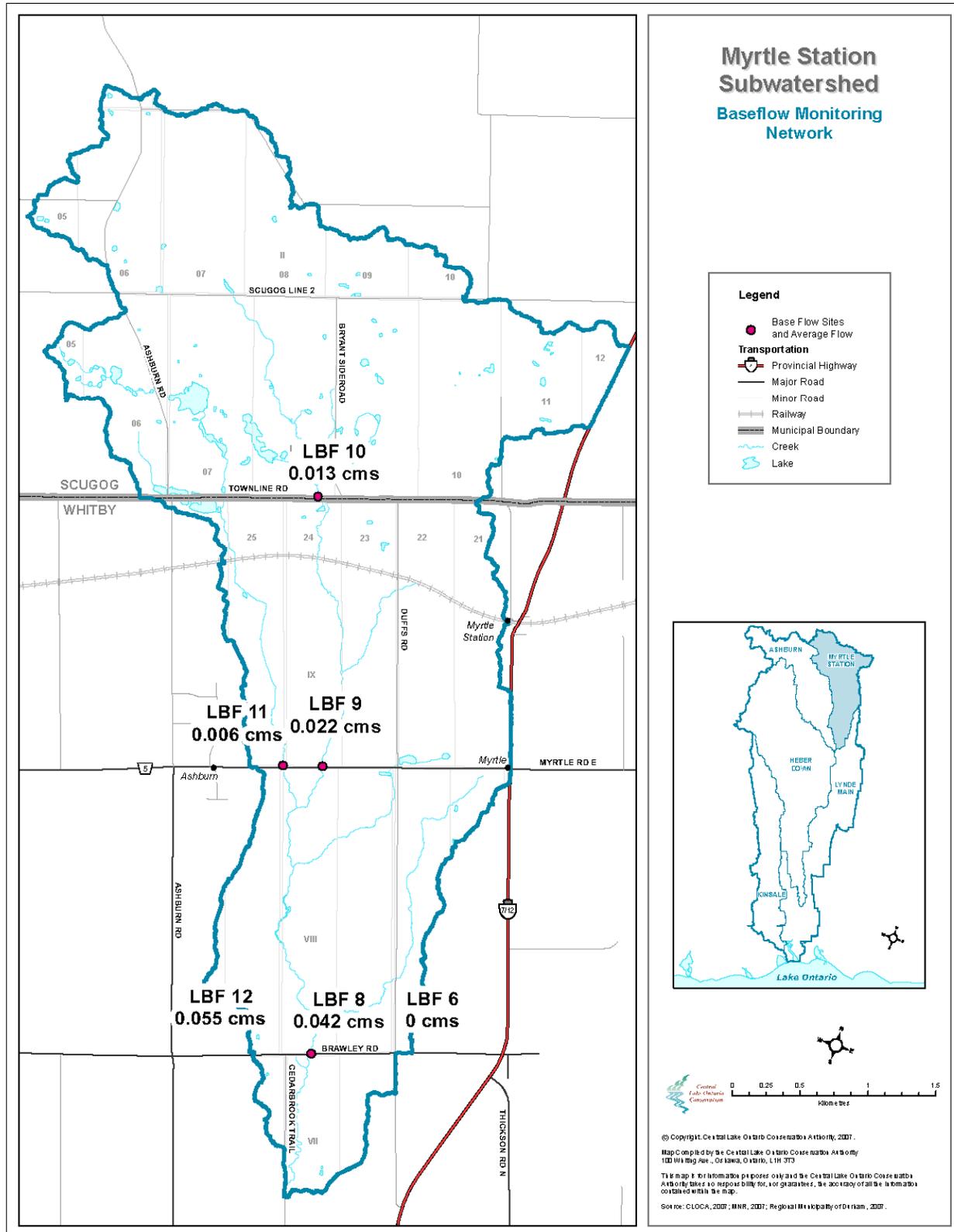


Figure 19: Baseflow stations, average flow and recharge in the Myrtle Station subwatershed.

5.0 CONCLUSIONS

Monitoring and modelling surface water quantity are key activities in gaining an understanding of the surface water flow within the watershed. A stream flow monitoring network has been established within the Lynde Creek watershed along with an extensive baseflow monitoring program. The peak and transient runoff for the watershed and each subwatershed has been modeled using various software applications. Natural hazard limits have been identified for the riverine systems within the watershed and are currently being updated.

This monitoring network, coupled with low flow investigations, snow pack surveys, climate stations, and detailed hydrologic and hydraulic models, provides a good base from which to manage the water resources of Lynde Creek watershed.

6.0 REFERENCES

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'monitoring and modelling surface water quantity are key activities in gaining an understanding of the surface water flow within the watershed'

WHAT WE DO ON THE LAND IS MIRRORED IN THE WATER