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## PARISH GEOMORPHIC LTD

10 MOUNTAINVIEW ROAD, SOUTH, SUITE 207, GEORGETOWN ONTARIO L7G 4J9

PHONE: (905) 877-9531 FAX: (905) 877-4143

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**TO:** SCOTT JARVIE, REGIONAL WATERSHED MONITORING COORDINATOR  
**FROM:** SUSI KOSTYNIUK AND JOHN PARISH  
**SUBJECT:** VALLEY SEGMENTS, CARRUTHERS, PETTICOAT, AND DUFFINS CREEK  
WATERSHEDS  
**DATE:** SEPTEMBER 9, 2003

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### *Introduction*

As part of the natural science investigations currently underway along the watercourses within the Toronto and Region Conservation Authority, a study has been initiated to investigate stream geomorphology. This phase of the work involves the collection of baseline geomorphic information from representative stream sections within Petticoat Creek, Carruthers Creek, and Duffins Creek watersheds. This work like earlier efforts on the Humber, Rouge, and Don River, utilizes map interpretation to stratify the rivers into relatively homogenous geomorphic units or “valley segments”. Sampling within these strata will enable extrapolation of conditions to unsampled segments within the sample area. Thus this exercise represents a parameter estimation survey as defined by Stanfield et. al., (2000).

### *Methods*

Valley segments are defined as relatively homogenous sections of watercourses that exhibit distinct physical elements. As such, valley segment boundaries are determined by primary features of the watersheds such as topography, geology, climate and hydrography (drainage network) Kilgour and Stanfield (2000). Climate is considered to have only a minor influence on local scales and is not considered in this assessment. The attributes used to delineate valley segments for these systems were: differences in hydrography (stream order), catchment size, stream slope and surficial geology.

Development in a watershed can dramatically modify the conditions of a river from its primary state. Measuring the response of these systems to development is one of the main objectives of the natural science surveys in the GTA. Therefore, an effort was made to sample equal proportions of urbanized and rural segments.

This work consisted of three components:

1. Delineation of the watercourses into valley segments.
2. Classification of these segments into distinct morphological units.
3. Assigning sampling sites to a representative number of valley segments

### Valley Segment Partitioning:

River segments were delineated using a hierarchy of rules as outlined by Kilgour and Stanfield (2000), whereby segments were first partitioned based on the drainage network. Segment boundaries were identified where two tributaries merged resulting in an increase in the Strahler (1952) stream order, or where the system met with a lake or wetland of surface area greater than 1 ha. Topographic mapping (1:50,000) was used to determine the stream order. All second order (and larger) streams were considered for Petticoat and Carruthers Creek watersheds because of the small catchment size, while third order (and larger) streams were considered for Duffins Creek watershed due to its larger catchment size

These watersheds drain through large areas of glacial outwash and lake bed materials. Adjacent surficial geology type was considered to be a better characteristic for delineating river segments, as it would pick up local sources or sinks of baseflow. Therefore additional segment boundaries were placed where watercourses crossed a boundary that separated two distinct geological units of differing porosity (e.g. sandy material to clayey material), provided the boundaries were not in conjunction (i.e., within 200 m) with an existing hydrologic junction. For this analysis the surficial geology maps of Markham (Sharpe and Barrett, 1997) and the Toronto and surrounding area (Sharpe 1980) were used. As a precursor to this analysis each deposit type was categorized into high, medium and low hydraulic conductivity (i.e., speed of water passing through the materials), (see **Table 1**).

**Table 1.** Porosity Rating of Surficial deposits found in the Greater Toronto area.

<b>Id #</b>	<b>Name</b>	<b>Description</b>	<b>Hydraulic conductivity</b>
1	Paleozoic bedrock	Limy mudrock and clastic sedimentary rock	Low
2	Lower drift deposits	Till, fine-medium sand and laminated silt and clay	Medium
3	Glacial deposits (till)	Sandy silt to sand	Medium
4	Glacial deposits (till)	Clayey silt to silt	Medium
5	Moraine deposits	Fine sand to gravel	High
6	Glacial river deposits	Sand and gravel	High
7	Glacial lake deposits	Silt and clay	Low
8	Glacial lake deposits	Sand and gravel	High
9	Organic deposits	Peat, muck and marl	High
10	River Deposits	Sand and gravel	High
11	Recent Deposits	Gravel and diamicton	High

Additional segments were identified where gradient changed dramatically within one of the previously identified segments. Typically this occurred where channels dramatically changed confinement, such as where it passed through a gorge or onto a large floodplain. Finally, segment boundaries were placed at the boundary of large dams/reservoirs or where boundaries existed between channelized and natural sections.

### Valley Segment Classification:

Following the delineation of the valley segments, the next step was to classify the segments into distinct geomorphic units (Kilgour and Stanfield, 2000). Catchment area, slope and adjacent surficial geology (see below) were used as primary classification features. Rural and urban landuse designations were used as a secondary classification feature that was used during the site selection process to ensure balance in the sampling regime. Details of each process are provided below.

The first step in the classification was to group valley segments into units based on catchment size (small, < 10 km<sup>2</sup>; medium, 10 – 200 km<sup>2</sup> and large > 200 km<sup>2</sup>) and slope, (resulting in a total of nine possible classes. Segments were further classified based on the hydraulic conductivity of the adjacent surficial geology type. The three categories described above were used for this. Where the rivers straddled two different deposits, the deposit with the greater porosity was used to classify the stream. Including surficial geology- hydraulic conductivity increased the number of categories of valley segments to a total of 27 (3 x 3 x 3).

Finally each valley segment was assigned a designation based on whether it flowed through or was within the zone of influence of an urban center or was flowing through a rural setting. None of the segments were considered to be flowing through wilderness area.

### Selecting Valley Segments and sites for sampling:

The valley length of each segment was measured manually<sup>1</sup> off the 1:50 000 topographic maps. Valley segments were assigned to each of the 27 classes.

A total of 50 sampling sites<sup>2</sup> were allocated to the valley segments using the following criteria. Every segment and modifier category was allocated at least one site. Then, we allocated approximately one site for every two additional segments in each category. Finally minor adjustments were made to the allocation to ensure site allocation reflected the length of available stream for sampling within each watershed.

### **Results:**

A total of 108 valley segments totalling approximately 204 km of valley length were established in all of the watersheds (**Table 2**). There were 23 segments in the Petticoat Creek watershed, 26 for the Carruthers Creek watershed, and 59 for Duffins Creek (**Figure 1**).

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<sup>1</sup> This method underestimates river length. If the proponent chooses to select locations of sites based on river length rather than valley length, a correction factor would need to first be calculated and then applied to the methods described above.

<sup>2</sup> This number is based on previous experience, logistical and cost considerations. The number should be compared to the preferred statistical value for each strata once baseline data is available to calculate the coefficient of variation for the critical parameter.

**Table 2.** Number of valley segments in each watershed and subwatershed.

<b>Watershed</b>	<b>Subwatershed</b>	<b>No of valley segments</b>	<b>Length of segments (m)</b>
Petticoat	Petticoat Main Branch	10	16.47
	Unnamed Tributary South	2	1.23
	Unnamed Tributary West	2	2.65
	Unnamed Tributary East	8	9.00
	Unnamed Tributary	1	0.55
<b>Subtotal</b>		<b>23</b>	<b>29.90</b>
Carruthers	Carruthers Main Branch	12	24.52
	Unnamed Tributary East	5	8.89
	Unnamed Tributary Central	3	3.68
	Unnamed Tributary West	3	2.59
	Unnamed Tributary	3	1.84
<b>Subtotal</b>		<b>26</b>	<b>41.52</b>
Duffins	Duffins Main Branch	11	34.29
	Michell Creek	6	12.27
	Broughman Creek	4	6.46
	Urfe Creek	4	7.33
	Ganatsekiagon Creek	6	7.58
	West Duffins Creek	15	43.12
	Whitevale Creek	1	1.20
	Wixon Creek	3	6.42
	Reesor Creek	3	5.37
	Stouffville Creek	1	1.27
	Unnamed Tributary	5	7.26
<b>Subtotal</b>		<b>59</b>	<b>132.57</b>
<b>Total</b>		<b>108</b>	<b>203.99</b>

Seven of the primary classes of segments were found within the three watersheds (**Table 3**). The most common segment classes were those from moderate slopes with small-medium drainage areas and the majority of these were located in rural settings. The rarest segment classes were those from the low gradient and large sized watersheds, which contained only 2 segments in total (**Figure 2**). Not surprisingly, the distribution of segment classes was not balanced between the rural and urban classed sites (**Table 4**).

**Table 3.** Primary Classification and distribution of valley segments based on Catchment area and channel gradient.

		Catchment area (km <sup>2</sup> )		
		Small (< 10)	Medium (10-200)	Large (> 200)
Slope (%)	Low (0-0.39)	<b>Class 1</b> <b>6</b>	<b>Class 4</b> <b>14</b>	<b>Class 7</b> <b>2</b>
	Moderate (0.40-1.09)	<b>Class 2</b> <b>33</b>	<b>Class 5</b> <b>30</b>	<b>Class 8</b> <b>0</b>
	High (1.10 – 5.00)	<b>Class 3</b> <b>18</b>	<b>Class 6</b> <b>5</b>	<b>Class 9</b> <b>0</b>

**Table 4.** Valley segments of given category and the number of sites where field data will be collected.

Catchment/ slope class	Hydraulic Conductivity of adjacent soils	Number of segments		Number of survey sites	
		Rural	Urban	Rural	Urban
1	Low	2	1	1	1
	Moderate	1	0	0	0
	High	2	0	1	0
2	Low	9	0	4	0
	Moderate	7	2	3	1
	High	15	0	7	0
3	Low	1	0	0	0
	Moderate	8	0	3	0
	High	8	1	3	1
4	Low	0	0	0	0
	Moderate	2	0	1	0
	High	7	5	3	2
5	Low	0	0	0	0
	Moderate	2	1	1	1
	High	21	6	10	3
6	Low	0	0	0	0
	Moderate	1	0	1	0
	High	3	1	1	1
7	Low	0	0	0	0
	Moderate	0	0	0	0
	High	0	2	0	1
<b>Total</b>		<b>89</b>	<b>19</b>	<b>39</b>	<b>11</b>

### Site Selection and Location

Given the lengths that we measured on each stream the target allocation was calculated to be 33, 10 and 7 sites for the three watersheds (Duffins, Carruthers and Petticoat). The number of sites to be sampled from within each class of valley segment is shown in **Table 4**. The approximate locations of the field sampling sites for the various watersheds are illustrated on **Figure 3**. Specific locations are described in Appendix A and are available from the original 1:50 000 topographic maps if required. The final distribution of sites between the streams was 31, 10 and 9 between Duffins, Carruthers and Petticoat watersheds, closely reflecting the target allocation (**Table 5**). In addition, twelve sites within the three watersheds overlap the aquatic monitoring sites established by the TRCA monitoring program.

**Table 5:** Distribution of sample sites by watershed and stream order.

Watershed	Stream Order					Total
	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>	5 <sup>th</sup>	6 <sup>th</sup>	
Petticoat	4	2	3	0	0	9
Carruthers	5	5	0	0	0	10
Duffins	0	18	6	6	1	31
<b>Subtotal</b>	9	25	9	6	1	50

All of the segments identified are listed in Appendix B. The exact location of sites will be determined in the field, when the UTM co-ordinates and location on the stream will be determined.

### *References*

- Kilgour B., and Stanfield, L.W., 2000: Development of a landscape-based protocol for predicting fisheries potential in Ontario. Draft document submitted to Regional Municipality of Ottawa-Carleton. (unpublished).
- Sharpe, D.R., 1980: Quaternary Geology of Toronto and Surrounding Area; Ontario Geological Survey Preliminary Map P. 2204, Geological Series. Scale 1:100 000.
- Sharpe, D. R. and P. J. Barnett, 1997: Surficial Geology of the Markham area, NTS 30M/14, southern Ontario; Geological Survey of Canada, Open File 3300, Scale 1:50 000.
- Stanfield L. W., M. Jones, M. Stoneman, B. Kilgour, J. Parish and G. Wichert 1997. Stream assessment protocol for Ontario. Ontario Ministry of Natural Resources, Peterborough, Ontario.
- Strahler, A.N., 1952: Hypsometric (area altitude) analysis of erosional topography. *Bulletin of the Geological Society of America* **63**, 1117-42.

Appendix A

Geomorphic Sampling Site Locations

River	ID#	Valley Segment Class	Development Status	Geology Class	Length (km)	Valley Segment Location
Petticoat Creek	GPC-1	5	U	H	1.95	South of Highway 401
Petticoat Creek	GPC-3	6	U	H	0.77	North of Sheppard Ave. in Woodlands Park
Petticoat Creek	GPC-4	5	U	M	2.86	South of Finch by Altona Road
Unnamed Tributary South	GTPC-1	3	U	H	0.75	Near CN Railway, North of Sheppard Avenue
Unnamed Tributary East	GTPC-4	2	R	L	1.33	East of Altona Road, North of Railway
Unnamed Tributary East	GTPC-6	1	U	L	1.14	West of Altona Road at Davidson Road
Petticoat Creek	GTPC-11	2	R	L	1.24	North of Finch Avenue, West of Altona Road crossing railway
Petticoat Creek	GTPC-14	3	R	H	2.08	West of Sideline 34, South of 3rd Concession
Petticoat Creek	GTPC-16	2	R	H	1.04	East of 11th Concession, 1 block North of Steeles Ave.
Carruthers Creek	GCC-2	4	U	H	5.76	Picov Downs
Carruthers Creek	GCC-4	5	R	H	1.1	South of Railway, West of Audley Road
Carruthers Creek	GCC-6	4	R	H	1.37	Fawn Brook Golf Course at Taunton Road
Carruthers Creek	GCC-7	5	R	H	1.67	Fawn Brook Golf Course at Sideline 4
Carruthers Creek	GCC-12	2	R	L	2.04	North of Highway 7, South of 7th Concession
Unnamed Tributary East	GTCC-4	2	R	H	2.44	Deer Creek Golf Course
Unnamed Tributary East	GTCC-5	3	R	H	1.92	North of 5th Concession, between Sideline 4 and Audley Road
Unnamed Tributary East	GTCC-6	1	R	H	0.58	South of Highway 7, East of Sideline 4
Unnamed Tributary Central	GTCC-9	2	R	M	2.2	North of Highway 7, West of Sideline 4
Unnamed Tributary Central	GTCC-11	3	R	M	0.86	North of 7th Concession, West of Sideline 5
Duffins Creek	GDC-2	7	U	H	3.05	St. Francis de Sales School
Duffins Creek	GDC-3	4	U	H	1.08	Southwest of Ady Park
Duffins Creek	GDC-4	4	U	H	1.83	Riverside Golf Course
Duffins Creek	GDC-5	4	R	H	8.39	Greenwood Conservation Area
Duffins Creek	GTDC-2	2	R	H	1.24	Claremount Conservation



Unnamed Tributary	GTDC-6	1	R	M	0.55	North of Concession 9, East of Westney Road
Unnamed Tributary	GTDC-8	1	R	H	2.16	North of Concession 9, West of Sideline 12
Michell Creek	GMC-1	6	R	H	4.26	North of 7th Concession, West of Paddock Road
Michell Creek	GMC-2	5	R	H	1.38	East of Claremont By-Pass, South of Brock Road
Michell Creek	GMC-4	2	R	H	2.16	North of Concession 8, East of Sideline 20
Broughman Creek	GBC-3	3	R	H	0.71	North of 5th Concession, East of Sideline 16
Broughman Creek	GBC-4	2	R	H	4.11	North of Highway 7, East of Sideline 14
Urfe Creek	GUC-2	5	R	H	1.28	North of Rossland Road West
Urfe Creek	GUC-4	2	R	H	2.65	North of Taunton Road, West of Brock Road
Ganatsekiagon Creek	GGC-2	5	U	H	1.6	Clearside Court and 3rd Concession
Ganatsekiagon Creek	GGC-4	5	R	H	1.24	North end of Tillings Road by Railway
Ganatsekiagon Creek	GGC-6	2	R	H	0.67	West of Sideline 22's northern end
West Duffins Creek	GWD-2	5	U	H	4.65	Grand Valley Park, East of Dixie Road
West Duffins Creek	GWD-3	4	R	H	4.14	Clarks Hallow, South of Taunton Road
West Duffins Creek	GWD-4	5	R	H	4.51	West of Whitevale Golf Course
West Duffins Creek	GWD-8	5	R	H	5.02	North of 7th Concession, West of Sideline 28
West Duffins Creek	GWD-10	5	R	H	2.72	South of 8th Concession, West of Sideline 30
West Duffins Creek	GWD-13	1	R	L	3.27	South of Concession 8, East of Sideline 28
West Duffins Creek	GWD-14	5	R	M	1.45	South of Concession 9, East of Sideline 30
West Duffins Creek	GWD-15	6	R	M	0.55	North of Concession 9 at Sideline 30
Whitevale Creek	GWV-1	3	R	H	1.2	East of Whitevale Golf Course
Wixon Creek	GWX-2	2	R	M	1.29	South of Uxbridge-Pickering Townline, West of 2nd Concession
Wixon Creek	GWX-3	2	R	H	1.57	North of Uxbridge-Pickering Townline, West of 2nd Concession
Reesor Creek	GRC-1	2	R	M	2.64	South of Concession 9, West of Sideline 34
Reesor Creek	GRC-2	2	R	L	0.59	North of Concession 9, West of Sideline 32
Stouffville Creek	GSV-1	4	R	M	1.27	Bushwood Golf Course

Definitions:

Surficial Geology: See **Table 1**

Geology Class: See Table 1: (L = low, M = Medium, H = high hydraulic conductivity)

Dev. State: U = Urban development, R = Rural Development

Appendix B

Carruthers Creek Valley Segments

River	ID#	Order	Length (km)	Slope	Surficial Geology	Geology Class	Dev. State	Area	Location
Carruthers Creek	CC-1	3	3.79	L	10	H	U	M	Bayly Street East
Carruthers Creek	CC-2	3	5.76	L	10	H	U	M	Picov Downs
Carruthers Creek	CC-3	3	1.76	L	10	H	R	M	Rosland Road East
Carruthers Creek	CC-4	3	1.1	M	10	H	R	M	South of Railway, West of Audley Road
Carruthers Creek	CC-5	3	0.74	L	3	M	R	M	North of Railway, West of Audley Road
Carruthers Creek	CC-6	3	1.37	L	10	H	R	M	Fawn Brook Golf Course at Taunton Road
Carruthers Creek	CC-7	3	1.67	M	10	H	R	M	Fawn Brook Golf Course at Sideline 4
Carruthers Creek	CC-8	3	1.23	M	3	M	R	M	Salem Road, North of Buggy Lane
Carruthers Creek	CC-9	3	2.5	M	8	H	R	M	North of 5th Concession, East of Greenburn Place
Carruthers Creek	CC-10	3	1.49	M	8	H	R	L	West of Salem Cemetery
Carruthers Creek	CC-11	3	1.07	M	3	M	R	L	North of Highway 7, Greenwood Bypass
Carruthers Creek	CC-12	3	2.04	M	7	L	R	L	North of Highway 7, South of 7th Concession
Unnamed Tributary	TCC-1	2	0.42	H	3	M	R	L	South of Rosland Road East, East of Harwood Ave. N.
Unnamed Tributary	TCC-2	2	0.61	M	10	H	R	L	East of Salem Road, North of Rosland Road
Unnamed Tributary	TCC-3	2	0.81	H	3	M	R	L	East of Salem Road, South of Taunton Road East
Unnamed Tributary East	TCC-4	2	2.44	M	10	H	R	L	Deer Creek Golf Course
Unnamed Tributary East	TCC-5	2	1.92	H	10	H	R	L	North of 5th Concession, between Sideline 4 and Audley Road
Unnamed Tributary East	TCC-6	2	0.58	L	10	H	R	L	South of Highway 7, East of Sideline 4
Unnamed Tributary East	TCC-7	2	3.36	H	3	M	R	L	North of Highway 7, West of Sideline 4
Unnamed Tributary East	TCC-8	2	0.59	L	4	M	R	L	North of 7th Concession, West of Sideline 4
Unnamed Tributary Central	TCC-9	2	2.2	M	3	M	R	L	North of Highway 7, West of Sideline 4
Unnamed Tributary Central	TCC-10	2	0.62	H	7	L	R	L	South of 7th Concession, West of Sideline 4
Unnamed Tributary Central	TCC-11	2	0.86	H	3	M	R	L	North of 7th Concession, West of Sideline 5
Unnamed Tributary West	TCC-12	2	0.71	H	3	M	R	L	North of 7th Concession, East of Westney Road
Unnamed Tributary West	TCC-13	2	0.88	M	7	L	R	L	North of 7th Concession, East of Westney Road
Unnamed Tributary West	TCC-14	2	1	H	3	M	R	L	North of 7th Concession, East of Westney Road

### Petticoat Creek Valley Segments

River	ID#	Order	Length (km)	Slope	Surficial Geology	Geology Class	Dev. State	Area	Location
Petticoat Creek	PC-1	4	1.95	M	10	H	U	M	South of Highway 401
Petticoat Creek	PC-2	4	2.2	M	10	H	U	M	East of Woodlands Park
Petticoat Creek	PC-3	4	0.77	H	10	H	U	M	North of Sheppard Ave. in Woodlands Park
Petticoat Creek	PC-4	4	2.86	M	3	M	U	M	South of Finch by Altona Road
Unnamed Tributary South	TPC-1	2	0.75	H	10	H	U	S	Near CN Railway, North of Sheppard Avenue
Unnamed Tributary South	TPC-2	2	0.48	M	3	M	U	S	East of Altona Road, North of Sheppard Avenue
Unnamed Tributary East	TPC-3	3	0.52	L	8	H	R	S	North of Finch Avenue, West of Altona Road by CP Railway
Unnamed Tributary East	TPC-4	3	1.33	M	7	L	R	S	East of Altona Road, North of Railway
Unnamed Tributary East	TPC-5	3	0.6	M	7	L	R	S	East of Altona Road, South of Davidson Road
Unnamed Tributary East	TPC-6	2	1.14	L	7	L	U	S	West of Altona Road at Davidson Road
Unnamed Tributary East	TPC-7	2	1.99	H	3	M	R	S	West of Altona Road, North of 3rd Concession
Unnamed Tributary East	TPC-8	2	1.24	M	3	M	U	S	South of 3rd Concession near Rosebank Road
Unnamed Tributary East	TPC-9	2	1.05	M	7	L	R	S	South of 3rd Concession, between Rosebank Road and Altona Road
Unnamed Tributary East	TPC-10	2	1.13	M	8	H	R	S	North of Cherrywood, East of Altona Road
Petticoat Creek	TPC-11	3	1.24	M	7	L	R	S	North of Finch Avenue, West of Altona Road crossing railway
Unnamed Tributary	TPC-12	2	0.55	L	7	L	R	S	East of Sideline 34, South of 3rd Concession
Petticoat Creek	TPC-13	2	0.87	M	7	L	R	S	East of Sideline 34, North of Finch Avenue
Petticoat Creek	TPC-14	2	2.08	H	8	H	R	S	West of Sideline 34, South of 3rd Concession
Petticoat Creek	TPC-15	2	2.17	M	8	H	R	S	North of Steeles Avenue East, West of York-Durham 30
Petticoat Creek	TPC-16	2	1.04	M	8	H	R	S	East of 11th Concession, 1 block North of Steeles Ave.
Petticoat Creek	TPC-17	2	1.29	M	7	L	R	S	West of 11th Concession, North of 14th Avenue
Unnamed Tributary West	TPC-18	2	1.53	M	8	H	R	S	North of Finch Avenue, end of Woodview Avenue
Unnamed Tributary West	TPC-19	2	1.12	M	3	M	R	S	North of CP Railway, East of Beare Road

### Duffins Creek Valley Segments

River	ID#	Order	Length (km)	Slope	Surficial Geology	Geology Class	Dev. State	Area	Location
Duffins Creek	DC-1	6	5.42	L	10	H	U	L	South of Highway 401
Duffins Creek	DC-2	6	4.41	L	10	H	U	L	St. Francis de Sales School
Duffins Creek	DC-3	5	1.08	L	10	H	U	M	Southwest of Ady Park
Duffins Creek	DC-4	5	1.83	L	10	H	U	M	Riverside Golf Course
Duffins Creek	DC-5	5	8.39	L	10	H	R	M	Greenwood Conservation Area
Duffins Creek	DC-6	5	7.52	M	10	H	R	M	Highway 7 and Paddock Road
Duffins Creek	TDC-1	4	0.45	M	10	H	R	M	North of 7th Concession, East of Paddock Road
Duffins Creek	TDC-2	4	1.24	M	10	H	R	M	Claremont Conservation
Duffins Creek	TDC-3	4	1.28	M	10	H	R	M	North of Concession 8, East of Westney Road
Duffins Creek	TDC-4	4	1.15	M	10	H	R	M	North of Concession 8, East of Westney Road
Duffins Creek	TDC-5	3	2.88	H	10	H	R	M	North of Concession 9, by Sideline 8
Unnamed Tributary	TDC-6	3	0.55	H	4	M	R	S	North of Concession 9, East of Westney Road
Unnamed Tributary	TDC-7	3	2.87	H	10	H	R	S	South of Concession 9 at Westney Road
Unnamed Tributary	TDC-8	3	2.16	H	10	H	R	S	North of Concession 9, West of Sideline 12
Unnamed Tributary	TDC-9	3	1.02	H	10	H	R	S	South of Concession 9, East of Westney Road
Unnamed Tributary	TDC-10	3	0.66	M	10	H	R	S	South of Concession 8, West of Westney Road
Michell Creek	MC-1	4	4.26	H	10	H	R	M	North of 7th Concession, West of Paddock Road
Michell Creek	MC-2	4	1.38	M	10	H	R	M	East of Claremont By-Pass, South of Brock Road
Michell Creek	MC-3	3	0.79	M	10	H	R	S	South of Concession 9, East of Sideline 20
Michell Creek	MC-4	3	2.16	M	10	H	R	S	North of Concession 8, East of Sideline 20
Michell Creek	MC-5	3	0.6	M	3	M	R	S	North of Concession 8, East of Sideline 24
Michell Creek	MC-6	3	3.08	M	10	H	R	S	North of Concession 9, East of Sideline 24
Broughman Creek	BC-1	4	0.53	M	10	H	R	M	South of Whitevale Road in Greenwood Conservation Area
Broughman Creek	BC-2	4	1.11	M	8	H	R	M	North of Whitevale Road, West of Greenwood Road
Broughman Creek	BC-3	3	0.71	H	8	H	R	S	North of 5th Concession, East of Sideline 16
Broughman Creek	BC-4	3	4.11	M	8	H	R	S	North of Highway 7, East of Sideline 14
Urfe Creek	UC-1	4	1	M	10	H	U	M	South of Rossland Road West, West of Riverside Drive
Urfe Creek	UC-2	4	1.28	M	10	H	R	M	North of Rossland Road West
Urfe Creek	UC-3	3	2.4	H	8	H	R	M	Seaton Golf and Country Club
Urfe Creek	UC-4	3	2.65	M	8	H	R	S	North of Taunton Road, West of Brock Road
Ganatsekiagon Creek	GC-1	4	1.05	M	8	H	U	M	Woodruff's Cemetary
Ganatsekiagon Creek	GC-2	3	1.6	M	10	H	U	M	Clearside Court and 3rd Concession
Ganatsekiagon Creek	GC-3	3	1.9	M	10	H	R	M	South end of Tillings Road

Ganatsekiagon Creek	GC-4	3	1.24	M	10	H	R	M	North end of Tillings Road by Railway
Ganatsekiagon Creek	GC-5	3	1.12	H	10	H	R	S	North of Taunton Road, East of Sideline 22
Ganatsekiagon Creek	GC-6	3	0.67	M	10	H	R	S	West of Sideline 22's northern end
West Duffins Creek	WD-1	5	1.58	L	10	H	U	M	Brock Ridge Community Park
West Duffins Creek	WD-2	5	4.65	M	10	H	U	M	Grand Valley Park, East of Dixie Road
West Duffins Creek	WD-3	5	4.14	L	10	H	R	M	Clarks Hallow, South of Taunton Road
West Duffins Creek	WD-4	5	4.51	M	10	H	R	M	West of Whitevale Golf Course
West Duffins Creek	WD-5	5	4.21	M	10	H	R	M	South of Highway 6, West of North Road
West Duffins Creek	WD-6	5	2.01	L	10	H	R	M	West of Green River Community Centre Track
West Duffins Creek	WD-7	4	1.88	M	10	H	R	M	Sideline 32, North of Highway 7
West Duffins Creek	WD-8	4	5.02	M	10	H	R	M	North of 7th Concession, West of Sideline 28
West Duffins Creek	WD-9	4	2.29	M	10	H	R	M	North of 7th Concession, West of Glen Cedars Golf Course
West Duffins Creek	WD-10	4	2.72	M	10	H	R	M	South of 8th Concession, West of Sideline 30
West Duffins Creek	WD-11	4	1.98	L	10	H	R	M	North of 8th Concession, East of Durham-York Boundary
West Duffins Creek	WD-12	3	2.86	M	10	H	R	M	South of Concession 7, West of Sideline 8
West Duffins Creek	WD-13	3	3.27	L	7	L	R	S	South of Concession 8, East of Sideline 28
West Duffins Creek	WD-14	3	1.45	M	4	M	R	M	South of Concession 9, East of Sideline 30
West Duffins Creek	WD-15	3	0.55	H	4	M	R	M	North of Concession 9 at Sideline 30
Whitevale Creek	WV-1	3	1.2	H	10	H	R	S	East of Whitevale Golf Course
Wixon Creek	WX-1	3	3.56	L	10	H	R	M	North of Concession 9, East of Sideline 28
Wixon Creek	WX-2	3	1.29	M	4	M	R	S	South of Uxbridge-Pickering Townline, West of 2nd Concession
Wixon Creek	WX-3	3	1.57	M	9	H	R	S	North of Uxbridge-Pickering Townline, West of 2nd Concession
Reesor Creek	RC-1	3	2.64	M	4	M	R	S	South of Concession 9, West of Sideline 34
Reesor Creek	RC-2	3	0.59	M	7	L	R	S	North of Concession 9, West of Sideline 32
Reesor Creek	RC-3	3	2.14	M	4	M	R	S	North of Uxbridge-Pickering Townline, West of 2nd Concession
Stouffville Creek	SV-1	3	1.27	L	4	M	R	M	Bushwood Golf Course

Definitions:

Slope: L = 0 - .39 %; M = 0.40 – 1.09 %; H = > 1.10 %

Surficial Geology: See **Table 1**

Geology Class: See Table 1: (L = low, M = Medium, H = high hydraulic conductivity)

Dev. State: U = Urban development, R = Rural Development

Area: 1 = < 10 km<sup>2</sup>, 2 = 10 – 200 km<sup>2</sup>

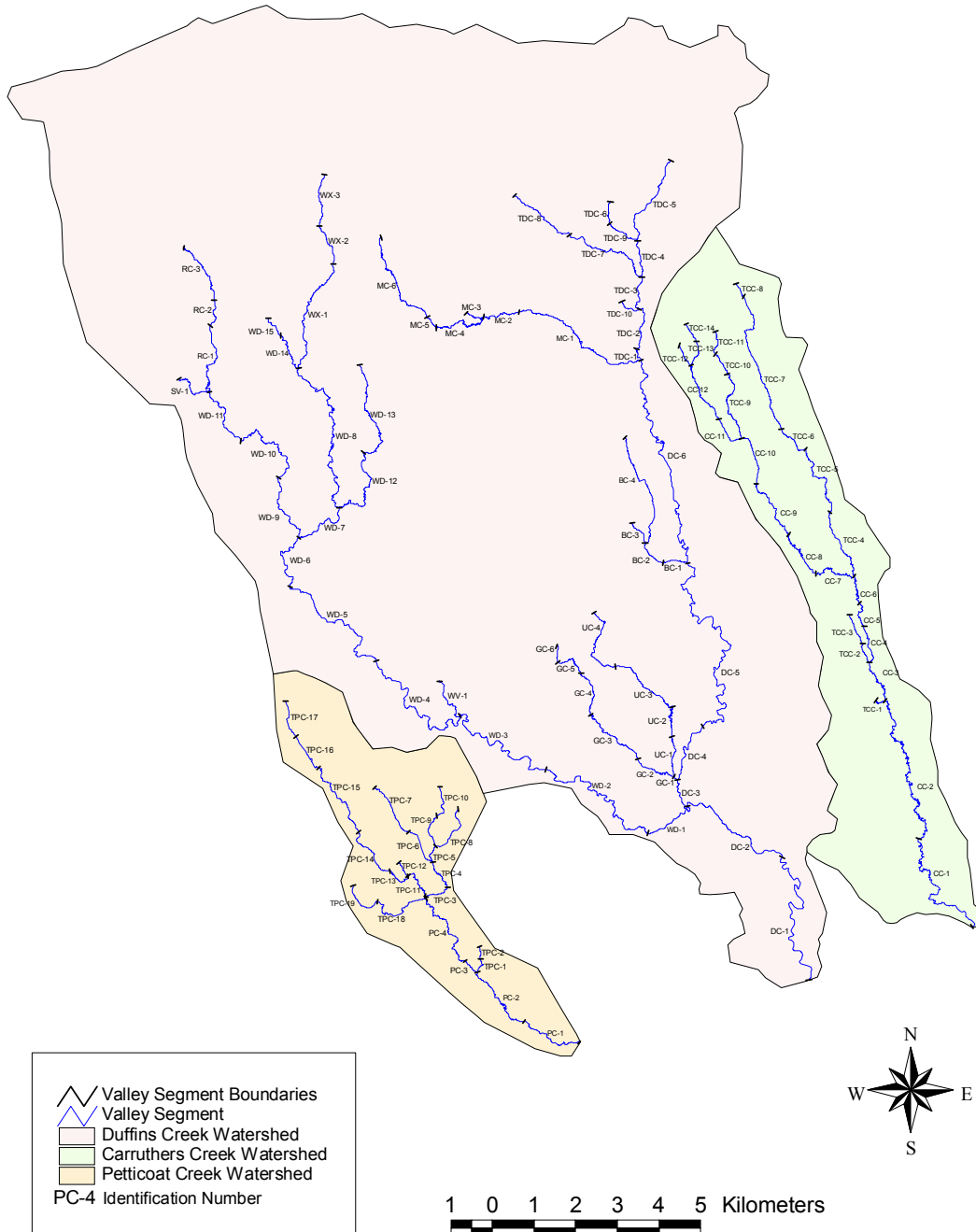


Figure 1: Valley segment locations for the Petticoat Creek, Duffins Creek, and Carruthers Creek Watershed.

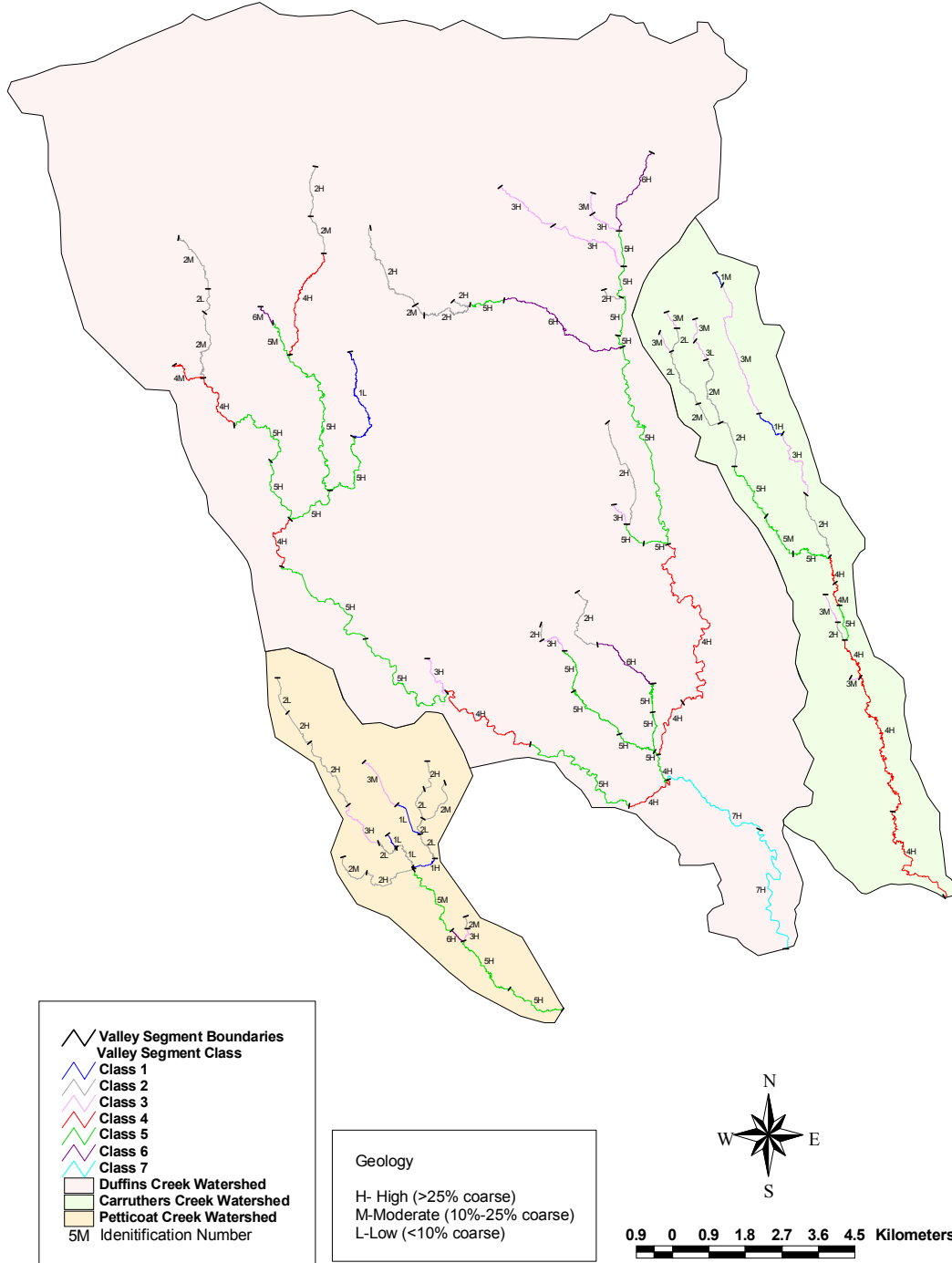


Figure 2: Valley segment classification (catchment area and slope) for the Petticoat Creek, Duffins Creek, and Carruthers Creek Watershed.

