Regional Monitoring Program - Fluvial Geomorphology Component

Don River, Rouge River and Highland Creek Watersheds

Highland Creek at site H-10, Scarborough, Ontario.

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Introduction

The Greater Toronto Area (GTA) is situated in the lower portion of nine watersheds which drain into Lake Ontario. Due to the large volume of urbanization that has occurred within these watersheds, especially throughout the GTA, the watercourses are experiencing various degrees of stress. Understanding of existing conditions, normal variations, and long-term changes in the quality and characteristics of aquatic habitat is inhibited due to the limited information that is available, and the lack of an on-going monitoring program. To track changes in physical habitat, the Toronto and Region Conservation Authority has initiated a long-term monitoring program. Since the physical form and function of a watercourse are key elements of aquatic habitat, the monitoring program includes a fluvial geomorphology component. The TRCA has committed to establishing 150 monitoring sites over a period of three years. This is the second year (2002) of the program, in which PARISH Geomorphic Ltd. has been retained to set up the second set of 50 sites within the GTA.

The second set of 50 sites were located in central GTA and were established to monitor aquatic habitat along Highland Creek , Don River, and the Rouge River **(Figure 1)**. At each site standard fluvial geomorphology measurement techniques were used to characterize channel form and benchmarks were set-up to enable repeated surveys within a 3-year period. The collected data were entered into a database (Access 2000) and for each site, a detailed map was created to identify locations of monitoring sites, erosion pins, bed chain and benchmarks. The following report presents an overview of the type and methodology of field data collection, historical assessments, channel stability scores, steps for future monitoring, and for improving future monitoring work are presented.

Field Site Selection

- At the outset of the monitoring program, the Highland, Don and Rouge drainage networks were stratified into valley segments along all 3rd order or higher channels (see PARISH Geomorphic Ltd., May 24, 2002). Valley segments are relatively homogenous geomorphic units in which all controls and modifiers of channel and valley form and of channel characteristics are similar. In total, 109 valley segments were identified **(Figure 2)**. To facilitate the selection of representative field sites, the segments were classified according to average grade and catchment area and then further grouped according to geologic materials (i.e., percentage of coarse-textured soil in the subwatershed area). As a result, the 109 valley segments were distributed over a total of

27 classification groupings (see **Figure 3**). To ensure that the field sites would adequately represent the variability that occurs within the GTA watershed areas, the process of site selection was guided by results of the classification groupings. Wherever possible, the proportion of the 109 sites within a specific classification and grouping was maintained amongst the 50 monitoring sites. Similarly, the number of field sites within any watershed area was dictated by the number of valley segments that were identified within it. Also, several of these sites were linked to fisheries monitoring sites to allow for greater efficiency in subsequent monitoring and more direct linkage and integration between disciplines. A breakdown of the number of site locations are as follows: Highland Creek (7), Don River (17), Rouge River (26).

Field Methods

Once the field site locations were identified, the process of collecting detailed field data was initiated. At each site, standard geomorphological techniques were used to quantify and characterize channel dimensions. In addition to collecting data of existing conditions and establishing a control section, various tools were implemented that will enable an evaluation of rates of channel change (e.g., bank erosion). The work that was completed at each site is as follows:

- At each of 8-10 cross-sections:
    - Dimensions: bankfull width, bankfull depth, wetted width and water depth.
    - Substrate: Pebble counts, particle shape, hydraulic roughness, embeddedness, sub-pavement
    - Banks: bank height, angle, materials, cohesiveness of bank materials, root depth and percent protected by vegetation
    - General observations of the channel and the surrounding
- Amongst the 8-10 cross-sections, one would be established as a control cross-section. This section was typically situated in the middle of the site and on a riffle. At these sections, a pin (usually 12 inch nails in a washer painted orange) was embedded on the top of each bank. These pins remain in place so that a tape can easily and accurately be tied to the pins so that the cross-section can re-measured in the future. Flagging tape and spray paint marks on trees were placed in the vicinity of the monitoring cross-section to aid in future recognition of the section location.

- One bed chain was usually installed (flush to the bed) at, or near, the monitoring cross-section (typically in the bottom 1/3 of a riffle) and in the middle of the channel. The bed chain consisted of an 8 inch nail with a painted (usually orange) 30 cm chain attached to it.
- Up to five erosion pins were installed at varying heights along banks at each field site. Each erosion pin was a 1 m piece of 1 cm diameter re-bar, which was driven horizontally into the face of an eroding bank. The amount of bar left exposed was recorded. During subsequent visits, the exposed area of the bar will be re-measured to enable a rate of bank retreat to be quantified. Erosion pin locations are presented graphically for each site and the amount of each pin exposed is found in the Access Database.
- A long profile level survey was conducted along the length of the channel within the field site. The survey included bankfull elevations, detailed bed morphology (riffle-pool sequences, any variation in bed configuration), and other modifying factors (i.e., log jams, weirs, rock check dams). During the survey an arbitrary datum was established (and given an elevation of zero), typically on a hard structure such as a culvert or a bridge. This point was described in the notes, marked with orange paint and in some cases the letter 'P' was etched into nearby concrete/stone. The purpose of this datum is to allow future surveys to tie in to this benchmark, enabling observation of changes in bed elevation over time to be made.
- Photos of the sites were taken from known documented vantage points so that they can easily be repeated.
- A GPS reading was taken at each of the monitoring cross-section.

Historical Assessment

An historical assessment was completed for each of the 50 sites using digital air photos (1999) and floodline maps for 1964 (1:2400) and 1987 (1:2000). The floodline maps were based on air photography from 1954 and 1978 respectively. The historic assessment was intended to identify changes in land use and channel structure and to make general observations of the watercourse and surrounding area. In addition, measurements of channel width were made and migration rates (measure the rate a particular area of stream moves across its valley) were calculated. Results of the historic assessment are presented in **Table 1**. The measurements likely have a degree of error inherent in any measurements made on historic air photos (i.e., scale variability, measurement error).

Data summary/Database

The collected field data was entered into the Access 2000 Geomorphology Database (provided by TRCA). Summary sheets (showing monitoring cross-section, bankfull measurements, survey profile, etc.) are presented in **Appendix A**. The summary sheets show most of the data entered into the database, but are missing some bank information. For example, the dominant bank material and the associated Torvane values for each site are not included in the summary sheets. These values are important, as they are strong indicators of shear stress and stability of the banks. Measurements of embeddedness and hydraulic roughness were also collected in the field and entered in the database but a summary sheet of the data was not generated by the database.

Appendix B presents summary pages of each site that the Access database fails to summarize. For example, survey calculations and pebble count calculations (i.e., D10) have been done manually. In order to increase efficiency, these calculations should be built into the structure of the database. The database will also have to be re-designed to accommodate future monitoring. For example, the survey profile and the monitoring site should have additional columns for the new data to facilitate year-to-year comparisons.

Channel Stability

The primary method used to evaluate the stability of the 50 sites assessed was by utilizing two different types of channel assessment evaluations, Rapid Geomorphic Assessment (RGA) and Rapid Stream Assessment Technique (RSAT).

The Rapid Geomorphic Assessment (RGA) was developed by the Ontario Ministry of Environment (1999) to assess reaches in urban channels. RGA's were undertaken for each reach and involved indicators of instability, such as exposed tree roots, undercutting, presence of chutes, etc. The presence or absence of these indicators were identified in the following adjustment categories: aggradation, degradation, channel widening and planimetric form. The instability features for each category were tallied and used to calculate a reach stability index, which corresponds to a stability classification. (Table 2).

Table 2: Stability index values and corresponding stability classification for the RGA

Stability Index	Classification
≤ 0.2	Channel is in regime or stable
0.21 – 0.4	Channel is in a transitional state
>0.4	Channel is stressed and evidence of instability is prevalent

The second assessment was the Rapid Stream Assessment Technique (RSAT, Galli 1996) and involved a broader, qualitative assessment of the health of the reach. This included observations of channel stability, scour/deposition, instream habitat, water quality, riparian conditions and biological indicators, such as the abundance of benthic invertebrates. Each indicator was ranked numerically and the ranking scores were summed up with lower values indicating poorer stream health and a high value representing a rich healthy stream (Table 3). Also included in the RSAT were general observations of channel dimensions, such as bankfull width and depth, substrate size, bank height, vegetation cover, channel hardening and other disturbances.

Table 3: RSAT scores and corresponding stream quality classification.

Score	Stream Quality
42-50	Excellent
30-41	Good
16-29	Fair
<16	Poor

Table 4 indicates the findings of the field investigation undertaken for the 50 detailed sites. In the Highland Creek Watershed all the reaches were in a transitional state except the two lower reaches in the watershed exhibited stressed states. In the Don River Watershed, of the 17 detailed sites investigated, there were four sites that were stressed and the rest were in transitional states. The four stressed reaches were located within the city corridor. For both the Highland Creek and Don River Watersheds there were not any reaches found to be 'in regime'. In the Rouge River Watershed, there were six unstable reaches, three healthy reaches and the rest were in transitional states. The majority of the unstable reaches were found to be above Hwy. 407, while the healthy ones were generally found downstream.

Table 4: Stability ranking for each reach.

Valley Segments	RGA	Stability Index	RSAT	Stability Index
GD-1	0.37	Transitional	24.0	Moderate
GD-3	0.27	Transitional	22.0	Moderate
GD-4	0.27	Transitional	20.0	Moderate
GD-5	0.32	Transitional	30.0	Moderate
GD-7	0.31	Transitional	24.5	Moderate
GD-13	0.24	Transitional	23.0	Moderate
GD-14	0.41	Stressed	21.0	Moderate
GD-7	0.27	Transitional	23.5	Moderate
GD-19	0.29	Transitional	22.5	Moderate
GD-20	0.39	Transitional	21.5	Moderate
GD-22	0.50	Stressed	14.0	Low
GD-26	0.46	Stressed	19.0	Low
GD-30	0.46	Stressed	16.0	Low
GD-31	0.37	Transitional	21.0	Moderate
GD-3b	0.22	Transitional	19.5	Low
GD-4a	0.34	Transitional	20.0	Moderate
GD-4b	0.22	Transitional	22.0	Moderate
GH-1	0.26	Transitional	19.0	Low
GH-9	0.41	Stressed	14.0	Low
GH-10	0.54	Stressed	27.5	Moderate
GH-6	0.32	Transitional	19.0	Low
GH-2a	0.35	Transitional	22.0	Moderate
GH-2b	0.22	Transitional	22.5	Moderate
GH-4a	0.28	Transitional	19.5	Low
GR-2	0.22	Transitional	24.0	Moderate
GR-4	0.25	Transitional	24.0	Moderate
GR-5	0.45	Stressed	24.5	Moderate
GR-7	0.25	Transitional	24.5	Moderate
GR-10	0.51	Stressed	24.0	Moderate
GR-11	0.28	Transitional	25.0	Moderate
GR-12	0.28	Transitional	21.5	Moderate
GR-13	0.43	Stressed	33.5	Moderate
GR-14	0.36	Transitional	25.0	Moderate
GR-16	0.29	Transitional	31.0	Moderate
GR-17	0.29	Transitional	25.0	Moderate
GR-21	0.29	Transitional	17.0	Low
GR-24	0.40	Stressed	31.0	Moderate
GR-25	0.41	Stressed	25.5	Moderate
GR-26	0.26	Transitional	27.0	Moderate
GR-27	0.25	Transitional	27.0	Moderate
GR-32	0.26	Transitional	23.5	Moderate
GR-33	0.48	Stressed	24.0	Moderate
GR-37	0.35	Transitional	25.5	Moderate
GR-38	0.28	Transitional	24.0	Moderate
GR-39	0.23	Transitional	22.0	Moderate
GR45	0.23	Transitional	25.5	Moderate
GR-47	0.11	In Regime	35.0	High
GR-51	0.19	In Regime	21.5	Moderate
GR-52	0.24	Transitional	26.0	Moderate
GR-53	0.29	Transitional	34.0	Moderate

Future Monitoring

The TRCA has committed to establishing a total of 150 monitoring sites over a period of three years. As part of this program the 50 sites established in the Highland Creek, Don River and Rouge River watersheds in 2002 would need to be revisited in 2005. At that time all monitoring cross-sections, erosion pins, bed chains and the long profile survey are to be re-measured.

The monitoring cross-section has been set-up so that on each bank a fixed pin is embedded on top of the bank. These pins remain in place so that a tape can easily and accurately be tied to the pins to be re-measured. The start of the cross-section (zero end of the tape) always begins at the left bank pin (left side while facing downstream) and terminates at the right bank pin.

Typically, there were five erosion pins installed at varying heights along banks at each field site. The amount of pin left exposed was recorded. During subsequent visits, the exposed length of the pin will be re-measured and recorded to compare from previous years. If the amount of erosion at any site has been sufficient enough to indicate that the pin may be lost, then the exposed area of the pin will be recorded and then reset (driving the pin back into the bank). The new length of exposed pin should also be recorded and a note shall be made to indicate that the erosion pin has been 'reset'.

One bed chain was usually installed (flush to the bed) at, or near, the monitoring cross-section and typically in the thalweg. The bed chain consisted of an 8-inch nail with a 30 cm section of chain (usually painted orange or pink) attached to it. During the revisit scheduled for 2005, the bed chain should be relocated (based on instructions from benchmark; a "Magne-wane" or similar apparatus may be required) and in the event that aggradation (sediment accumulation) has occurred, carefully lift the loose end of the chain from the new sediment. The substrate should then be carefully excavated along one side of the chain (being careful not to disturb the sediment on the opposite side) until the head of the nail is uncovered. The depth of accumulated sediment should then be measured based on the length of chain left between the head of the nail and the surface of the substrate. In the event that the channel has degraded (a loss of bed substrate) a measurement from the surface of the substrate to the head of the nail shall be made. After this measurement is made the nail should be driven flush with the substrate and a note should be made to indicate that the bed chain has been 'reset'.

The final monitoring work involves a long profile survey of the site. The survey included bankfull elevations, detailed bed morphology (riffle-pool sequences, any variation in bed configuration), and other modifying factors (i.e., log jams, weirs, rock check dams). During the survey an arbitrary datum was established (and given an elevation of zero), typically on a hard structure such as a culvert, or a re-bar was installed on top of a bank at the monitoring cross-section. This point was described in the notes, marked with orange paint and in some cases the letter 'P' was etched into nearby concrete/stone. The purpose of this datum is to allow future surveys to tie in to this benchmark, enabling observation of changes in bed elevation over time to be made. All the benchmark elevations are zero; therefore, during the monitoring work the survey station can be set up anywhere making sure the benchmark is also surveyed.

Improvements from last years work

The following were improvements made from last year's suggestions to the monitoring program:

- A GPS reading of the monitoring cross-section was recorded for all 50 sites.
- For sites that were not located near permanent structures, a re-bar was installed near the monitoring cross-sections. Last year the nails used for the monitoring cross-section were occasionally used as the benchmark if no existing hard structure was present.
- The appropriate amounts of flagging or other obvious markings were made to allow those involved in the subsequent re-measuring to easily locate the pins, nails and benchmarks.
- A clear, accurate and detailed description of the pin, nail and benchmark location was recorded to ensure that subsequent visits to the site are efficient**.** In some of the sites this year, a picture was taken of the benchmark to ensure proper identification of the area.

Future Improvements

The following are suggestions for improving and/or adding to the monitoring program:

- In some of the sites this year, a picture was taken of the benchmark to ensure proper identification of the area. It should be proper protocol for the next year's project to collect a picture of the benchmark for every site investigated.

References

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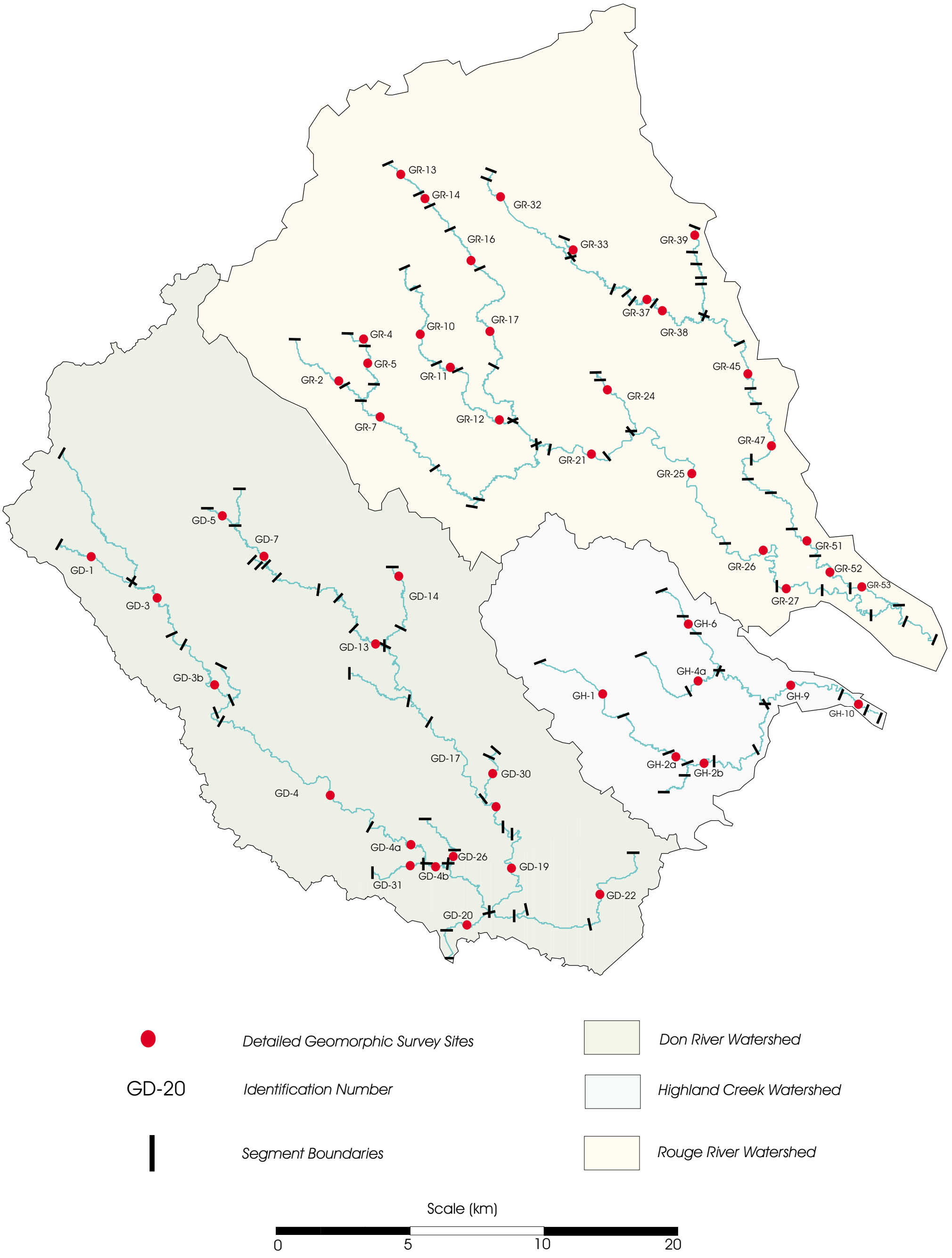


Figure 1: Geomorphic Monitoring Sites within the Don River, Highland Creek and Rouge River Watershed.

Figure 2: Valley segment locations for the Don River, Highland Creek and Rouge River Watershed.

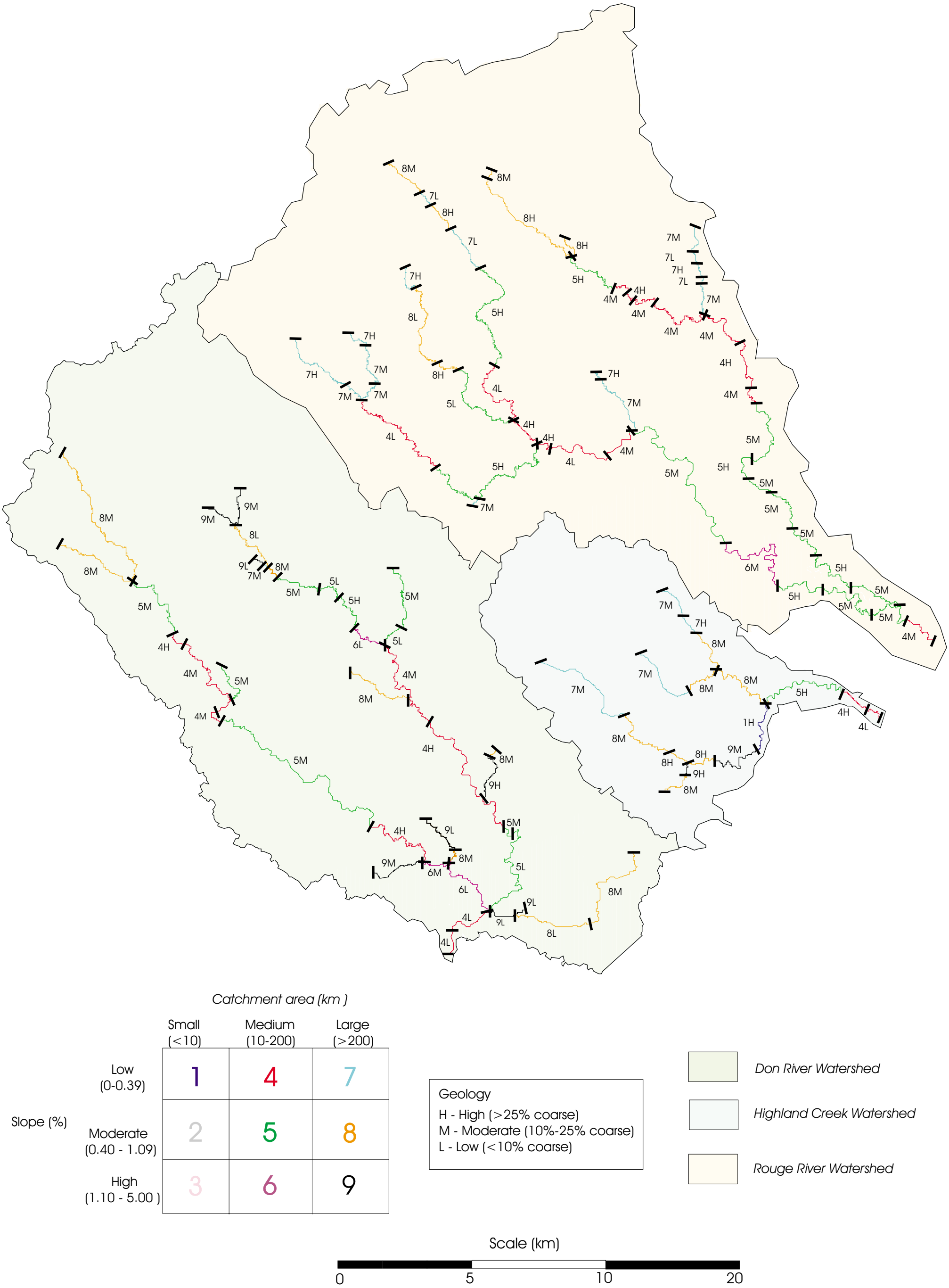


Figure 3: Valley segment classification for the Don River, Highland Creek and Rouge River Watershed.

Table 1: Historic Analysis for all 50 Sites Investigated within the Don River, Highland Creek and Rouge River Watershed.

Reach	Land-Use	Channel Change	Channel Width	Migration Rates (m/yr)
GD-1	1999- Predominant land use is deciduous/scrubforest and agriculture. Mapping not available for 1954 and 1977.	Not available because there is no mapping to compare the 1999 photos to.	Not Available	Not available.
GD-3	1954 - dominant land use, small residential and scrubforest. 1997-1999 - dominant land use is commercial and industrial	Channel appears virtually unaltered.	1954 - 4.56 m 1977 - 3.71 m 1999 - 4.87 m	0.15 m/yr migration down channel valley
GD-3b	Urban residential growth has increased since 1954. Dominant land use for 1999 is scrublands.	G. Ross Lord Dam was built after 1954 and significantly altered the southern portion of this segment of the channel. Upstream appears unaltered except for footbridges.	1954 - 9.41 m 1977 - 9.50 m 1999 - 9.45 m	Altered Channel since 1954 in lower portion of this segment. Negligible migration for the upper portion of this segment.
GD-4	Predominant land use is residential and scrubforest for all three years. No noticeable changes. Golf courses present in all three years as well.	401 was widened after 1954, so the bridge crossing the expanse was also widened. Footbridges for the golf carts were present in all three years. Erosion protection/bank supports noticed along bends near 401 and Younge Street.	1954 - 11.51 m 1977 - 8.27 m 1999 - 9.85 m	Altered Channel between 1954 and 1977. Negligible for 1977 and 1999.
GD-4a	Urban residential growth has increased since 1954. Dominant land use is deciduous/scrubforest.	Platform channel appears to be the same for all three years with little, or no change.	1954 - 10.25 m 1977 - 7.80 m 1999 - 9.66 m	No available benchmarks to measure from.
GD-4b	Predominant land use is residential and scrubforest. No significant changes are apparent in the three years.	A footbridge was constructed after 1954. No other significant channel changes have occurred.	1954 - 9.7 m 1977 - 9.1 m 1999 - 9.1 m	No suitable benchmarks to measure from.
GD-5	Predominant land use is scrubforest and residential for all three years, no change.	1999 - not available, obscured by vegetation. Channel is wider in 1977 and 1999 photos where Bathurst Road crosses river, not visible in 1954.	Obscured by vegetation	Altered Channel between 1954 and 1977 when Bathurst road was built. 1999 was obscured by vegetation.
GD-7	Predominant land use is Golf Courses along the channel for all three years. After 1954 the residential units started infilling. Highway No. 7 not present in 1954 to the extent as it is in 1977 and 1999.	Footbridges for golf courses present in all three years. Bridge culverts installed to accommodate Highway No. 7 after 1954. Channel appears to have been altered after 1977 in the area near the golf course.	1954 - 7.67 m 1977 - 6.92 m 1999 - 7.91 m	Altered channel between 1954 and 1977 because of the installation of Highway 7 culverts. Altered between 1977 and 1999 because of the changes around the golf course.
GD-13	Predominantly residential for 1977-1999, scrublands/forest. 1954 agriculture and some residential	Obscured by vegetation.	Obscured by vegetation	Obscured by vegetation for all three years.
GD-14	1954 - residential and agriculture/scrubforest 1977-1999 Intensive residential/scrubforest	1999 channel obscured by vegetation. Bridge installed after 1954 to accommodate the building of the CPR railway line.	1954 - 10.46 m 1977 - 7.20 m 1999 - obscured by vegetation.	1999- obscured by vegetation Negligible between 1977 and 1954.
GD-17	1954 - residential. Dominant land use is mixed forest. 1977-1999 golf course built around river in middle of the segment, river was altered during construction. York Mills Road, Don Valley Parkway and Highway 401, not present in 1954. Predominantly residential for 1977-1999.	A few islands present in 1954. Footbridges and cart path crossings were built for the golf course after 1954. Channel was altered and relocated during construction of course. Bridges for 401, Don Valley Parkway and York Mills Road built after 1954. Reinforcement walls visible along bends near DVP.	1954 - 14.99 m 1977 - 10.74 m 1999 - 12.04	Altered channel between 1954 and 1977, negligible between 1977 and 1999.
GD-19	Land use predominantly industrial and commercial. Golf course next to river was not seen in 1954. Don Valley Parkway not seen in 1954.	More islands in 1977 and 1999 then in 1954. Bridges installed after 1977 for Eglinton Avenue and the DVP.	1954 - 14.44 m 1977 - 12.00 m 1999 - 14.78 m	Negligible for three years.

Reach	Land-Use	Channel Change	Channel Width	Migration Rates (m/yr)
GD-20	The Don Valley Parkway was built after 1954. Therefore, prior to 1954 the dominant land was industrial and open space. After the DVP was built, the dominant land use became industrial and scrubforest/scrublands.	The channel was altered when the Don Valley Parkway was built after 1954. The channel was straightened in some places to accommodate the new highway.	1954 - 20.02 m 1977 - 19.92 m 1999 - 17.43 m	Channel was altered prior to 1977 photos. Negligible for 1977 and 1999.
GD-22	Predominately urban parkland since 1954 and includes a golf course in the lower reaches of the segment and a cemetery in the upper reaches of the segment.	There were a lot more meanders in 1954 then 1977. A footbridge was built after 1954. Channel poorly visible in 1999 due to vegetation.	1954 - 5.44 m 1977 - 6.61 m 1999 - not available	Negligible for three years.
GD-26	Urban growth has increased since 1954. Construction of a roadway near river in 1977. Dominant land use is deciduous forest and parklands.	Point at which Wilket Creek meets the west branch of the Don River has migrated north through the years. Channel appears intermittent in 1954. Foot bridges across the creek have been installed since 1954.	1954 - obscured by vegetation 1977 - 4.92 1999 = 4.2m	No set benchmarks to measure from.
GD-30	1954 = Rural agriculture 1978 = Urban residential, Urban parklands 1999 = Urban residential, Urban parklands, mixed forest.	Has been straightened since 1954, channel length has decreased by 26.2% by 1978 because of the construction of Hwy 40. Obscured in 1999.	1954 = 8.7m 1978 = 9.0m 1999 = 8.8m (in areas not obscured)	Altered channel between 1954 and 1977. Obscured by vegetation for 1999.
GD-31	1954 = Rural agriculture 1978 = Urban commercial, Urban parklands vacant 1999 = Urban commercial, Urban parklands golf course	Some alteration has occurred to accommodate the building of Hwy 409	1954 = 7.9m 1978 = 7.5m 1999 = 9.0m	Between 1954 to 1978 = 0.04 m/yr Negligible between 1977 and 1999.

Reach	Land-Use	Channel Change	Channel Width	Migration Rates (m/yr)
GH-1	1999 - land uses include mainly industrial with some residential uses and a golf course 1977 and 1954, not available	1999- the channel appears to have been straightened and dykes prior to 1999 photos 1977 and 1954 - not available	1999 - 5.92 m 1977 and 1954 - not available	Not available because there is nothing to compare to
GH-2a	Predominant land use is residential/parklands for all three years studied.	The channel meandered more in 1954 then in 1977 and 1999 below Lawrence Avenue but straighten out after 1954.	1954 - 3.49 m 1977 - 5.08 m	1999 - obscured by trees Altered channel between 1954 and 1977
GH-2b	1999 and 1977 - Golf course just downstream of this segment. Predominant land uses are open space and residential 1954 - Predominant land use is open space with few residential dwellings	Channel appears unaltered for the three years reviewed. 1999 - Erosion protection/reinforcements walls apparent in 1999 photos only 1977 and 1999 foot bridges at various locations across channel that were not in	1954 - 8.37 m 1977 - 7.80 m 1999 - 9.00 m	Negligible for all three years
GH-4a	1954 - agriculture and residential lawns were dominant land uses 1977 and 1999 residential and industrial are the dominant land uses	1954 - significant meandering with channel turning back on itself numerous times 1977 - 1999 less and less meandering and more relatively straight stretches of creek	1954 - 6.27 m 1977 - 7.10 m 1999 - 6.35 m	0.13 m/yr migration through channel for the three years.
GH-6	1954 - agriculture and railway lands are the dominant land uses 1977 - no coverage 1999 - predominant land uses are industrial, residential and railway lands	1954 - channel was a very thin meandering channel through agricultural fields 1977 - no coverage 1999-Channel was straightened and appear to be dyke for the extent of the segment	1954 - less than 1m in average width 1977- no coverage 1999 - 3.45 m	Altered channel between the two years available.
GH-9	Predominant land use for all years is scrubforest and residential development. No significant changes over the three years.	Channel meandered more prior to 1977 between Kingston Road and Moringside Ave. After 1954 the channel straighten out more in this area.	1954 - 10.67 m 1977 - 9.32 m 1999 - 11.33 m	1999-1977 - 0.09 m/yr down valley 1999-1954 - 0.03 m/yr down valley 1977-1954 - 0.07 m/yr down valley
GH-10	Predominant land use is scrubforest and open space. The residential development has continued to occur since 1954 but nothing has been developed immediately next to the creek except the expansion of Lawrence Avenue prior to 1954 across the creek.	1954 - lower reaches of segment appeared to have a lot of sand bars and a relatively thin channel, channel actually splits into two separate channels around one large island, not present in 1977 or 1999. 1977 - channel appeared to have less sand bars and a broader channel width 1999- channel appears to meander between several sand bars	1954 - 11.91 m 1977 - 13.06 m 1999 - 14.35 m	Historically the creek has changed from a meandering channel around a large island to a meandering channel around sand bars and other erosional deposits in the creek.

Reach	Land-Use	Channel Change	Channel Width	Migration Rates (m/yr)
GR-2	Dominant land use in 1954 and 1977 was agriculture. Dominant land use in 1999 was residential and remnant agricultural fields.	Channel platform appears similar for all three years. A few more bridges were built after 1977 across the channel.	1954 - 2.09 m 1977 - 1.98 m 1999 - 2.42 m	Not available because there are no suitable benchmarks to measure from.
GR-4	Dominant land use is agricultural fields and mown lawns for 1999, no coverage for 1977 and 1954	No obvious change for 1999, no coverage for 1977 and 1954	1999 2.07 m 1977 - no coverage 1954 - no coverage	No suitable benchmarks to measure to for 1999, not covered for 1977 and 1954.
GR-5	Agriculture is the dominant land use in all the years. No change.	More meanders noticed in 1999 then in other two years, most of segment is obscured by vegetation.	1954 - 3.14 m 1977 - 3.39 m 1999 - 2.13 m	No available because there are no suitable benchmarks to measure from.
GR-7	Golf Course present near river after 1954. Land uses include Buttonville Airfield , golf course and agricultural field. Significant increase in residential units after 1977.	A few more culverts were installed to accommodate the new development after 1977. Channel partially obscured by vegetation in 1999.	1954 - 5.26 1977 - 6.10 m 1999 - 5.97	0.15 m/yr migration down the valley
GR-10	A few more residential units were present in 1999 then the other two years. Dominant land use is agricultural for all three years.	A lot more meanders appear in 1999 then in 1954 and 1977. The channel also widens near Elgin Mills Road in 1999. Channel partially obscured by vegetation.	1954 - 5.23 m 1977 - 4.5 m 1999 - 3.75 m	Channel partially obscured by vegetation, no other suitable benchmarks to use.
GR-11	A few more residential units appeared 1954. Land use is mostly residential lawns and remnant agricultural fields.	A culvert replaced the old road bridge after 1954. The new roadway was built after 1977. A few islands were present in 1954 and not in 1977 and 1999.	1954 - 4.18 m 1977 - 3.53 m 1999 - 5.00 m	Altered channel between 1954 and 1977 and again in 1977 and 1999.
GR-12	Agriculture is the dominant land use in 1954 and 1977. Residential Development started infilling after 1977. Golf Course was not built in 1954.	Most of the channel is obscured by trees and shrubs. Only the lower reaches are un-obscured. Channel is similar for 1954 and 1977.	Not available for 1999 - obscured by vegetation 1954 - 8.79 m 1997 - 78 m	Not available 1999 -obscured by vegetation 1954 - 1977 negligible
GR-13	Dominant land use is scrubforest and a golf course	Some ponding in the middle of the reach but mostly the channel is obscured by vegetation. No coverage for 19977 and 1954.	Channel obscured by vegetation 1999 No coverage for 1977 and 1954.	Channel obscured by vegetation 1999 No coverage for 1977 and 1954.
GR-14	Dominant land use is scubforest and residential lawns	Channel is ponded in between the two highways in 1999. No Coverage for 1977 and 1954.	1999- obscured by vegetation 1977 and 1954 - no coverage	1999- obscured by vegetation 1977 and 1954 - no coverage
GR-16	Agriculture and scrubforest are the dominant land uses.	Channel was widened into ponds/lakes after 1954 at Almira and the south end of Bruce Mills Conservation Area	1954 - 3.24 m 1977 - 4.24 m (not including ponds) 1999- obscured by vegetation.	Altered channel between 1954 and 1977 when the ponds were created. Obscured by vegetation in 1999.
GR-17	Dominant land use is scrub forest and agricultural lands.	Obscured in 1999, no coverage in 1977 or 1954	Obscured by vegetation in 1999, not covered in 1977 and 1954.	Obscured by vegetation in 1999 and no mapping available for 1954 and 1977.
GR-21	More subdivisions were built after 1977. Parkland was create after 1954, after the reservoir was created.	Reservoir was not present in 1954, therefore a significant change in the appearance (width, length, meander) of the river since that time.	1954 - 10.6 m 1977 - 9.89 m 1999 - 112.6 m (including reservoir)	Altered channel between 1954 and 1977 and between 1977 and 1999.

Reach	Land-Use	Channel Change	Channel Width	Migration Rates (m/yr)
GR-24	No Coverage	No Coverage	No Coverage	No aerial photos or floodplain mapping available for all three years.
GR-25	Golf Courses/Residential are the dominant land uses for this segment. Golf courses are located along the river and the residential area on the other side of the golf courses. Upstream portion of segment is scrubforest. CNR railway line not present in 1954.	Footbridges/golf cart paths were not present in 1954. Numerous crossings appear in the 1977 and 1999 photos. 1954 the river had a few islands, not present in the other two years. Bridge footings in river for CNR railway after 1954.	1954 - 15.1 m 1977 - 16.4 m 1999 - 18.4 m	Negligible - no change between 1954 -1999
GR-26	Mainly agriculture as a land use in this region. Reservoir was constructed after 1977 at northern end of segment. More residential buildings in 1999 then in 1954.	Numerous footbridges were installed after 1954 along this segment of River. More islands in 1954 then in other two years. One noticeably larger island is located to the west of Sewells Road. Erosion visible along bends of this segment.	1954 - 13.8 m 1977 - 13.4 m 1999 - 13.9 m	0.13 m/yr migration rate from Reservoir Road west between 1999 and 1977. 0.24 m/yr migration down valley between 1999 and 1954.
GR-27	The Metro Toronto Zoo was not present in 1954. A lot of urban infrastructure was introduced for the construction of the Zoo and its access points.	Footbridge present in 1977 and 1999, not 1954. More islands present in 1954, then in the other two years as well. Monorail for Zoo crosses at various locations.	1954 - 15.69 m 1977 - 12.50 m 1999 - 12.73 m	No benchmarks to measure from in 1954. Negligible between 1977 and 1999.
GR-32	Lumber yard at Whitchurch-Stouffville Town Limits Agriculture the dominant land use. No changes between years.	No Change between the three years.	1954 - 2.96 m 1977 and 1999 - 2.41 m	Negligible - no change between 1954 -1999
GR-33	Dominant land use is scrubforest and agricultural fields.	Unchanged over the three years.	1999 - 9.2m 1977- 8.6m 1954 - 8.9m	Obscured by vegetation for 1999. No suitable benchmark to measure from.
GR-37	Scrubforest and a couple of homes were present around the channel in 1999	Channel planform was similar for 1954 and 1999, deposition visible in 1954 was not seen in 1999 aerial photograph, pond in 1999 not seen in 1954 topo map	1954 = 10m 1999 = 10m	Not available - no set benchmarks to measure from in the 1954 topo map
GR-38	Forest/Scrubforest was the dominate surrounding land use - no change	Channel planform was the same for all of the three years examined	1954 - 10.88 m 1977 - 9.16 m 1999 - 9.73 m	Negligible - no change (1954-1999)
GR-39	Dominant land use is scrubland and agriculture.	Channel may have been altered prior to 1999. Similar for 1977 and 1954.	1999 - average of about 1m 1977 and 1954 about 1 m as well	No suitable benchmarks to measure from.
GR-45	Agriculture was the dominant land use surrounding the river in this area, no change over the three year periods.	A few islands were present only in 1954, not in 1977 and 1999. Low flow crossing in 1977 and 1999, not in 1954.	1954 - 13.18 m 1977 - 12.88 m 1999 - 14.44 m	Negligible- no change between 1954 and 1977 0.07m/yr change between 1977 and 1999.
GR-47	Agriculture and Scrubland/forest were the dominate land uses, no changes	More islands present in 1954 then in 1977 and 1999. in 1999's the bends look eroded.	1954 - 10.67 m 1977 - 10.00 m 1999 - 10.67 m	1999-1977 - 0.16 m/yr 1999-1954 - 0.05 m/yr 1977-1954 - negligible
GR-51	The CNR railway was not present in 1954 photos.	Channel seems to be similar in shape for all of the three years examined. Crossing located near Scarborough/Markham City Limits not present in 1954.	1954 - 8.8 m 1977 - 9.49 m 1999 - 9.83 m	1999-1977 - 0.10 m/yr down valley 1999-1954 - 0.04 m/yr down valley 1977-1954 - negligible
GR-52	Bridge Crossing off of Meadowvale Road was not present in 1954. More urban development in 1977 then 1954	Channel changes slightly when new bridge was built. Channel seems similar from 1977 to 1999.	1954 - 10.84m 1977 - 11.02m 1999 - 10.9 m	1999-1977 - 0.09 m/yr 1999-1954 - 0.04 m/yr 1977-1954 - negligible
GR-53	Urban residential growth has increased substantially since 1954 on eastern side of the site. Scrubland/forest dominant land use on western side of site.	Junction of Little Rouge Creek and the Rouge River is closer to Highway No. 2 in 1999 and 1977 then in 1954. Few more islands in channel in 1977 then in 1954. Channel has meandered more in 1977 then 1954	1999 - 8.8 m 1977 - 9.4 m 1954 - 9.5 m	Negligible for all three years studied.

1999 - Digital Air Photos
1977 - 1:2000 topo map
1954 - 1:2400 topo map

Not available = no aerial photos and/or floodplain mapping for 1954 and 1977 are available

APPENDIX A – ACCESS SUMMARY OUTPUT

Access summary output is not available in this .PDF Report. Please contact Toronto Region Conservation for Fluvial Geomorphology Data if required.

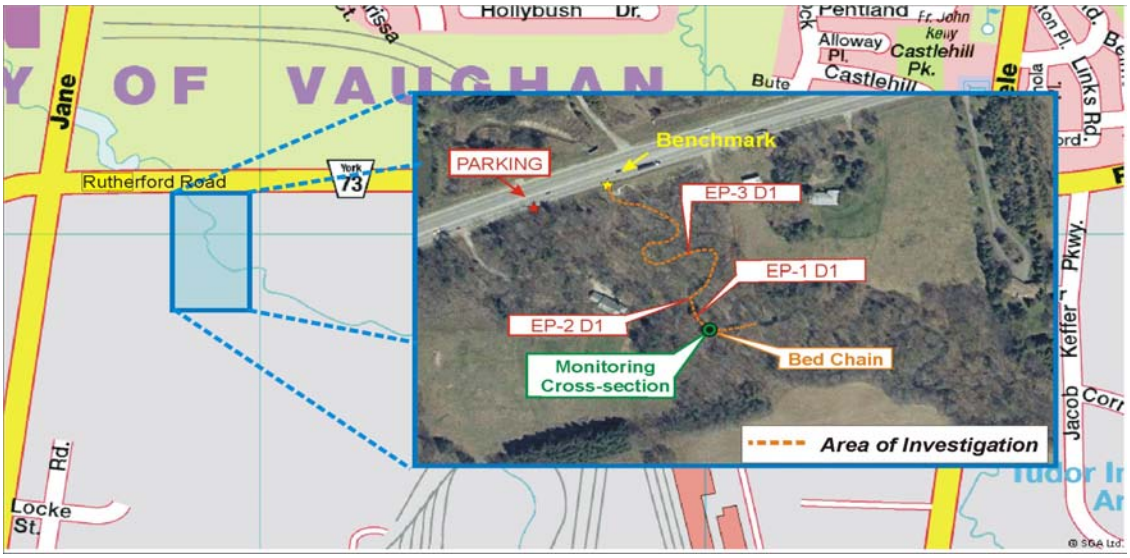
APPENDIX B – EXCEL SUMMARY OUTPUT

FLUVIAL GEOMORPHOLOGY SUMMARY

Don River - GD-1

Date of Survey: 16-Sep-02
Number of cross-sections: 10
Associated Fisheries Site: DN018WM
Access: First stream south of Rutherford Road, just east of Jane Street. Park on shoulder of Rutherford road. Site is immediately downstream (south) of the confluence with tributary.

Site Map



Planform Characteristics

Long Profile (avg)

Bankfull Gradient	0.18 %	**Riffle Length**	30 m
Inter-Pool Gradient	0.97 %	**Riffle-Pool Spacing**	2.84 m
Inter-Riffle Gradient	0.96 %	**Max Pool Depth**	1.3 m
Riffle Gradient	0.57 %		

Particle Sizes (cm)

	Pebble Counts
D10	0.0016
D50	0.046
D90	2.9

Historical Analysis

Land Use: 1999- Predominant land use is deciduous/scrubforest and agriculture.

Channel Change: Not available.

Migration Rates (m/yr): Not available.

Stability

Rapid Geomorphic Assessment **(RGA)** 0.366 **Transitional**

Rapid Stream Assessment **(RSAT)** 24 **Moderate Stability**

Stability Rankings :
<20 - Low, 20-35 - Moderate, >35- High

Stability Index :
0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustment

Site Photo's ***GD-1***

Photo 1. At monitoring cross-section looking downstream.

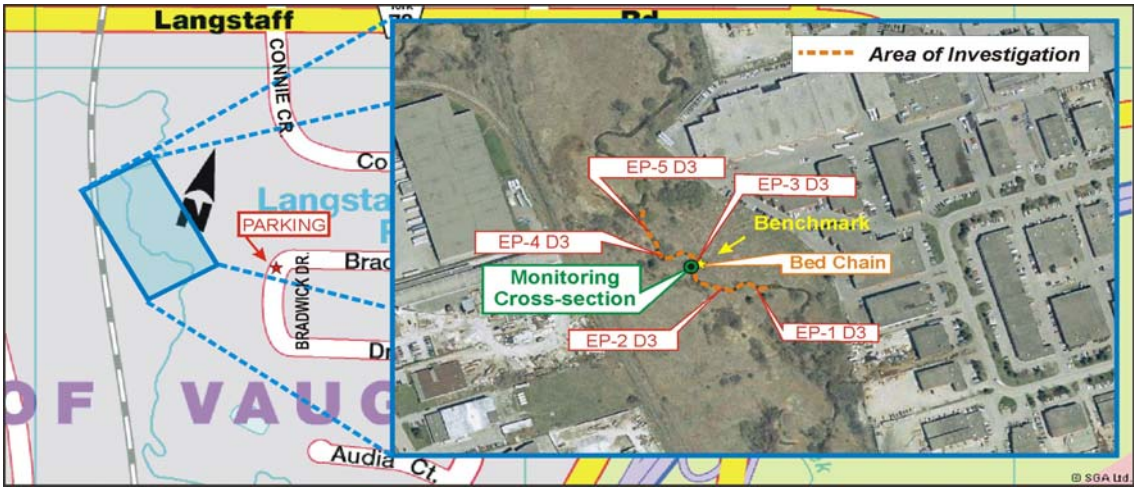
Photo 2. At monitoring cross-section looking upstream.

FLUVIAL GEOMORPHOLOGY SUMMARY

Don River - GD-3

Date of Survey: 10-Oct-02
Number of cross-sections: 10
Associated Fisheries Site: DN017WM
Access: Park at 140 Bradwick Dr., by unit 28A. Site is immediately west of parking lot.

Site Map



Planform Characteristics

Long Profile (avg)

Bankfull Gradient	0.33 %	**Riffle Length**	6 m
Inter-Pool Gradient	0.64 %	**Riffle-Pool Spacing**	20 m
Inter-Riffle Gradient	0.27 %	**Max Pool Depth**	1.4 m
Riffle Gradient	3.5 %		

Particle Sizes (cm)

	Pebble Counts
D10	0.0041
D50	1.02
D90	12.41

Historical Analysis

Land Use: 1954 - dominant land use, small residential and scrubforest.
1997-1999 - dominant land use is commercial and industrial.

Channel Change: Channel appears virtually unaltered.

Migration Rates (m/yr): 0.15 m/yr migration down channel valley for the three years

Stability

Rapid Geomorphic Assessment **(RGA)** 0.272 **Transitional**

Rapid Stream Assessment **(RSAT)** 22 **Moderate Stability**

Stability Rankings :
<20 - Low, 20-35 - Moderate, >35- High

Stability Index :
0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustment

Site Photo's ***GD-3***

Photo 1. At monitoring cross-section looking downstream.

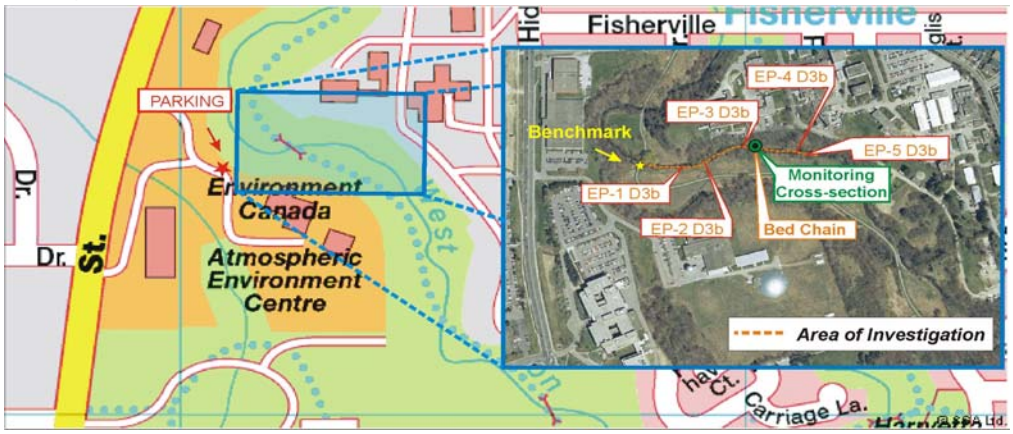
Photo 2. At monitoring cross-section looking upstream.

FLUVIAL GEOMORPHOLOGY SUMMARY

Don River - GD-3b

Date of Survey: 8-Oct-02
Number of cross-sections: 10
Associated Fisheries Site: NONE
Access: Site is on the west Don River just downstream of Environment Canada building, southeast of Dufferin Street and Steeles Ave intersection. Park at EC building, site is directly behind the building.

Site Map



Planform Characteristics

Long Profile (avg)

Bankfull Gradient	0.535	%	**Riffle Length**	8.5	m
Inter-Pool Gradient	1.17	%	**Riffle-Pool Spacing**	20	m
Inter-Riffle Gradient	0.7	%	**Max Pool Depth**	1.7	m
Riffle Gradient	6.07	%			

Particle Sizes (cm)

	Pebble Counts
D10	0.02
D50	5
D90	18.83

Historical Analysis

Land Use: Urban residential growth has increased since 1954. Dominant land use for 1999 is scrublands.

Channel Change: G. Ross Lord Dam was built after 1954 and significantly altered the southern portion of this segment of the channel. Upstream appears unaltered except for footbridges.

Migration Rates (m/yr): Altered Channel since 1954 in lower portion of this segment. Negligible migration for the upper portion of this segment.

Stability

Rapid Geomorphic Assessment **(RGA)** 0.225 **Transitional**

Rapid Stream Assessment **(RSAT)** 19.5 **Low Stability**

Stability Rankings :
<20 - Low, 20-35 - Moderate, >35- High

Stability Index :
0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustment

Site Photo's ***GD-3b***

Photo 1. At benchmark.

Photo 2. At monitoring cross-section looking downstream.

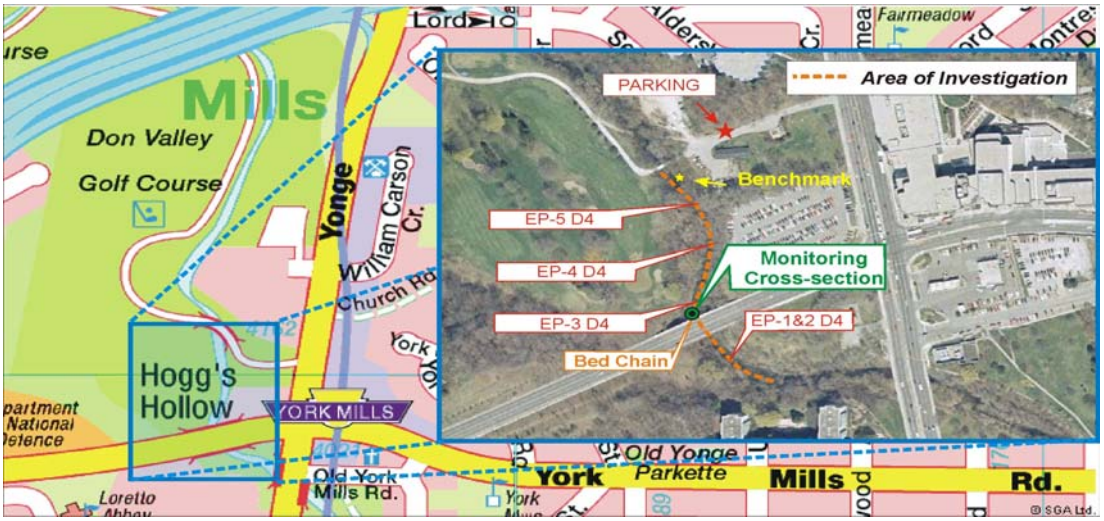
Photo 3. At monitoring cross-section looking upstream.

FLUVIAL GEOMORPHOLOGY SUMMARY

Don River - GD-4

Date of Survey: 16-Oct-02
Number of cross-sections: 10
Associated Fisheries Site: DN015WM
Access: Park at Don Valley Golf Course Service Yard, 4070 Yonge Street. Park outside of gate from maintenance building.

Site Map



Planform Characteristics

Long Profile (avg)

Bankfull Gradient	0.345 %	**Riffle Length**	14 m
Inter-Pool Gradient	0.47 %	**Riffle-Pool Spacing**	30 m
Inter-Riffle Gradient	0.31 %	**Max Pool Depth**	1.4 m
Riffle Gradient	1.23 %		

Particle Sizes (cm)

	Pebble Counts
D10	0.03
D50	2.87
D90	10.75

Historical Analysis

Land Use: Predominant land use is residential and scrubforest for all three years. No noticeable changes. Golf courses present in all three years as well.

Channel Change: 401 was widened after 1954, so the bridge crossing the expanse was also widened. Footbridges for the golf carts were present in all three years. Erosion protection/bank supports noticed along bends near 401 and Younge Street.

Migration Rates (m/yr): Altered Channel between 1954 and 1977. Negligible for 1977 and 1999.

Stability

Rapid Geomorphic Assessment **(RGA)** 0.272 **Transitional**

Rapid Stream Assessment **(RSAT)** 20 **Moderate Stability**

Stability Rankings :
<20 - Low, 20-35 - Moderate, >35- High

Stability Index :
0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustment

Site Photo's ***GD-4***

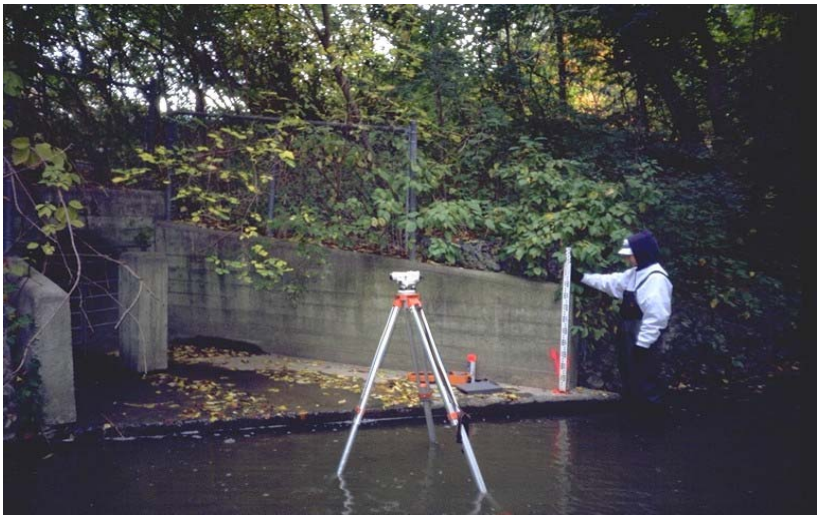


Photo 1. At monitoring cross-section looking downstream.

Photo 2. At monitoring cross-section looking upstream.

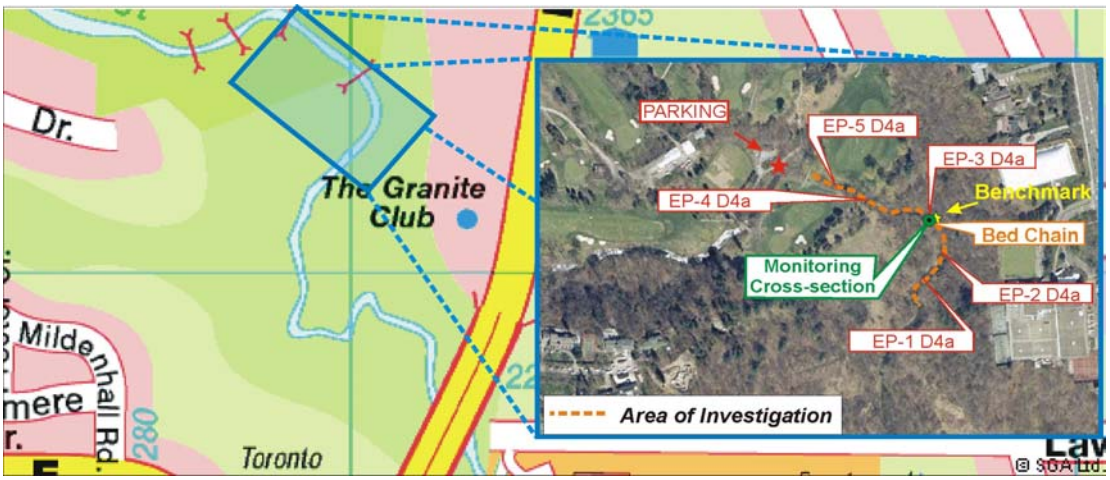
Photo 3. At benchmark.

FLUVIAL GEOMORPHOLOGY SUMMARY

Don River - GD-4a

Date of Survey: 5-Nov-02
Number of cross-sections: 10
Associated Fisheries Site: NONE
Access: Park inside Rosedale Golf course at the maintenance building. The site is immediately downstream of building.

Site Map



Planform Characteristics

Long Profile (avg)

Bankfull Gradient	0.135 %	**Riffle Length**	13.25 m
Inter-Pool Gradient	0.12 %	**Riffle-Pool Spacing**	31.5 m
Inter-Riffle Gradient	0.36 %	**Max Pool Depth**	1.7 m
Riffle Gradient	3.78 %		

Particle Sizes (cm)

	Pebble Counts
D10	0.01
D50	1.65
D90	11.96

Historical Analysis

Land Use: Urban residential growth has increased since 1954. Dominant land use is deciduous/scrubforest.

Channel Change: Platform channel appears to be the same for all three years with little, or no change.

Migration Rates (m/yr): No available benchmarks to measure from.

Stability

Rapid Geomorphic Assessment **(RGA)** 0.343 **Transitional**

Rapid Stream Assessment **(RSAT)** 20 **Moderate Stability**

Stability Rankings :
<20 - Low, 20-35 - Moderate, >35- High

Stability Index :
0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustment

Site Photo's ***GD-4a***

Photo 1. At monitoring cross-section looking downstream.

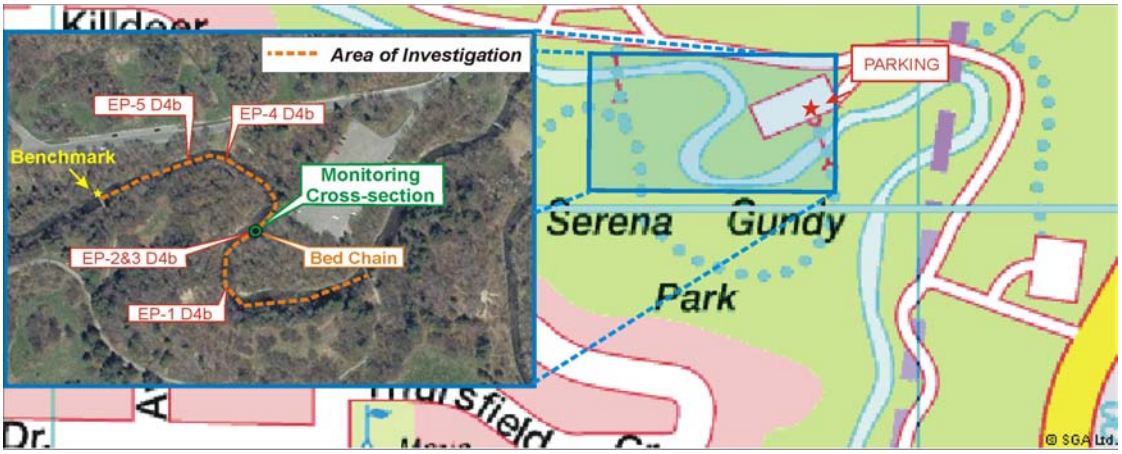
Photo 2. At monitoring cross-section looking upstream.

FLUVIAL GEOMORPHOLOGY SUMMARY

Don River - GD-4b

Date of Survey: 20-Nov-02
Number of cross-sections: 10
Associated Fisheries Site: NONE
Access: Site located in Sunnybrook/Serena Gundy Park. Park in the parking lot upstream of the confluence with Wilket Creek.

Site Map



Planform Characteristics

Long Profile (avg)

Bankfull Gradient	0.11 %	**Riffle Length**	16.6 m
Inter-Pool Gradient	0.81 %	**Riffle-Pool Spacing**	29 m
Inter-Riffle Gradient	0.6 %	**Max Pool Depth**	1.6 m
Riffle Gradient	3.54 %		

Particle Sizes (cm)

	Pebble Counts
D10	0.012
D50	2.9
D90	24.4

Historical Analysis

Land Use: Predominant land use is residential and scrubforest. No significant changes are apparent in the three years.

Channel Change: A footbridge was constructed after 1954. No other significant channel changes have occurred.

Migration Rates (m/yr): No suitable benchmarks to measure from.

Stability

Rapid Geomorphic Assessment	**(RGA)**	0.222	**Transitional**
Rapid Stream Assessment	**(RSAT)**	22	**Moderate Stability**

Stability Rankings :
<20 - Low, 20-35 - Moderate, >35- High

Stability Index :
0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustment

Site Photo's ***GD-4b***

Photo 1. At monitoring cross-section looking upstream.

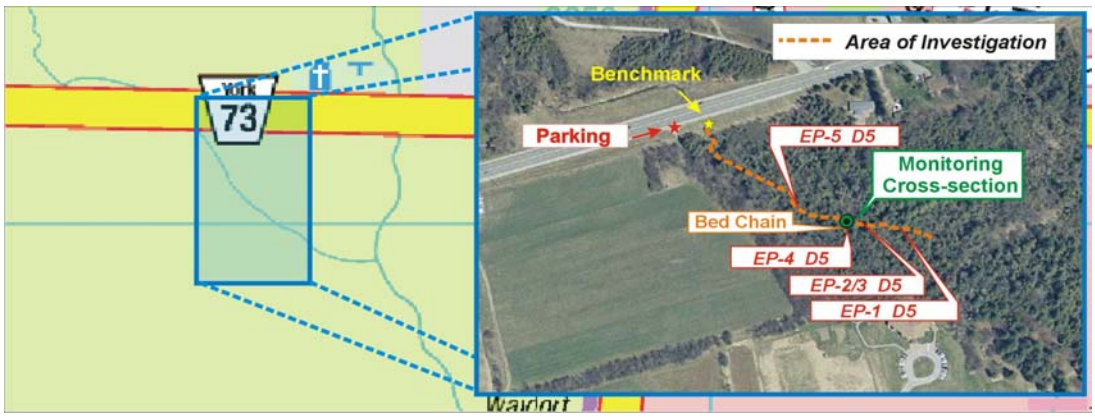
Photo 2. At monitoring cross-section looking downstream.

FLUVIAL GEOMORPHOLOGY SUMMARY

Don River - GD-5

Date of Survey: 10-Sep-02
Number of cross-sections: 10
Associated Fisheries Site: NONE
Access: The second stream located West of Bathurst Road and south of Rutherford Road. Park on the shoulder of Rutherford Road. The site is immediately downstream (South) of Rutherford Road.

Site Map



Planform Characteristics

Long Profile (avg)

Bankfull Gradient	0.99 %	**Riffle Length**	5.43 m
Inter-Pool Gradient	1.13 %	**Riffle-Pool Spacing**	12.17 m
Inter-Riffle Gradient	1.06 %	**Max Pool Depth**	1.1 m
Riffle Gradient	2.16 %		

Particle Sizes (cm)

	Pebble Counts
D10	0.002
D50	0.53
D90	2.51

Historical Analysis

Land Use: Predominant land use is scrubforest and residential for all three years, no change.

Channel Change: 1999 - not available, obscured by vegetation.
Channel is wider in 1977 and 1999 photos where Bathurst Road crosses river, not visible in 1954.

Migration Rates (m/yr): Altered Channel between 1954 and 1977 when Bathurst Road was built. 1999 was obscured by vegetation.

Stability

Rapid Geomorphic Assessment **(RGA)** 0.32 **Transitional**

Rapid Stream Assessment **(RSAT)** 30 **Moderate Stability**

Stability Rankings :
<20 - Low, 20-35 - Moderate, >35- High

Stability Index :
0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustment

Site Photo's ***GD-5***

Photo 1. At monitoring cross-section looking downstream.

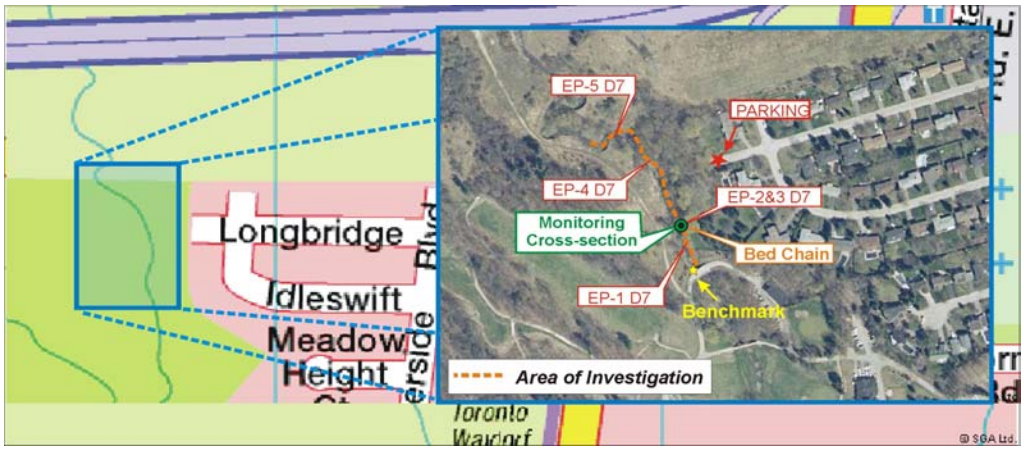
Photo 2. At monitoring cross-section looking upstream.

FLUVIAL GEOMORPHOLOGY SUMMARY

Don River - GD-7

Date of Survey: 10-Oct-02
Number of cross-sections: 10
Associated Fisheries Site: NONE
Access: The site is just off Longbridge road in the Uplands Golf Course. Park at the end of Longbridge road. The top of the site parallels Longbridge road.

Site Map



Planform Characteristics

Long Profile (avg)

Bankfull Gradient	0.405	%	**Riffle Length**	8	m
Inter-Pool Gradient	0.73	%	**Riffle-Pool Spacing**	14	m
Inter-Riffle Gradient	0.57	%	**Max Pool Depth**	2.1	m
Riffle Gradient	2.35	%			

Particle Sizes (cm)

	Pebble Counts
D10	0.0028
D50	0.81
D90	6.98

Historical Analysis

Land Use: Predominant land use is Golf Courses along the channel for all three years.
After 1954 the residential units started infilling.
Highway No. 7 not present in 1954 to the extent as it is in 1977 and 1999.

Channel Change: Footbridges for golf courses present in all three years.
Bridge culverts installed to accommodate Highway No. 7 after 1954.
Channel appears to have been altered after 1977 in the area near the golf course.

Migration Rates (m/yr): Altered channel between 1954 and 1977 because of the installation of Highway 7 culverts. Altered between 1977 and 1999 because of the changes around the golf course.

Stability

Rapid Geomorphic Assessment **(RGA)** 0.307 **in Adjustment**

Rapid Stream Assessment **(RSAT)** 24.5 **Moderate Stability**

Stability Rankings :
<20 - Low, 20-35 - Moderate, >35- High

Stability Index :
0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustment

Site Photo's ***GD-7***

Photo 1. At benchmark.

Photo 2. At monitoring cross-section looking downstream.

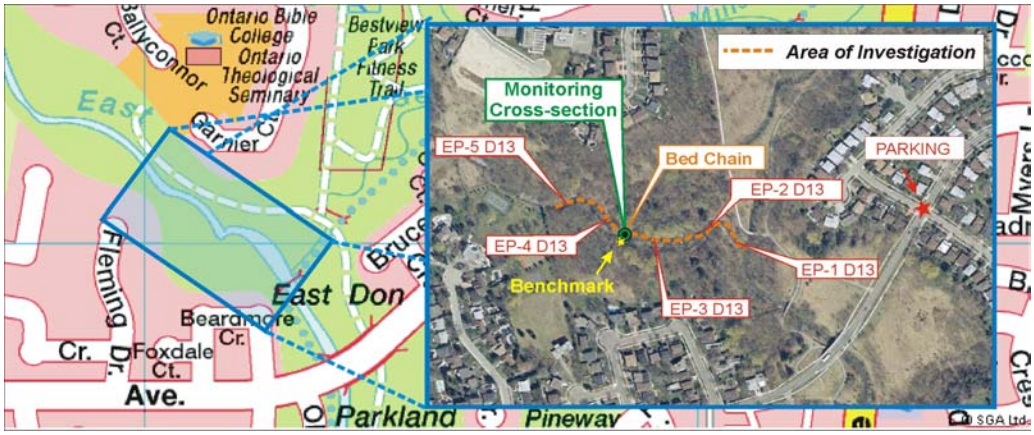
Photo 3. At monitorng cross-section looking upstream.

FLUVIAL GEOMORPHOLOGY SUMMARY

Don River - GD-13

Date of Survey: 15-Oct-02
Number of cross-sections: 10
Associated Fisheries Site: NONE
Access: North of Cummer Ave., immediately upstream of the confluence with German Mills Creek. Park on Craigmont Drive and walk down Cummer Ave. until you reach the Don River. Walk upstream until the confluence with German Mills Creek is reached.

Site Map



Planform Characteristics

Long Profile (avg)

Bankfull Gradient	0.54 %	**Riffle Length**	17	m
Inter-Pool Gradient	0.16 %	**Riffle-Pool Spacing**	47	m
Inter-Riffle Gradient	0.395 %	**Max Pool Depth**	1.6	m
Riffle Gradient	1.735 %			

Particle Sizes (cm)

	Pebble Counts
D10	0.021
D50	1.19
D90	9.7

Historical Analysis

Land Use: Predominantly residential for 1977-1999, scrublands/forest.
1954 agriculture and some residential

Channel Change: Obscured by vegetation for all three years.

Migration Rates (m/yr): Obscured by vegetation for all three years.

Stability

Rapid Geomorphic Assessment	**(RGA)**	0.236	**Transitional**
Rapid Stream Assessment	**(RSAT)**	23	**Moderate Stability**

Stability Rankings :
<20 - Low, 20-35 - Moderate, >35- High

Stability Index :
0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustment

Site Photo's ***GD-13***

Photo 1. At monitoring cross-section looking downstream.

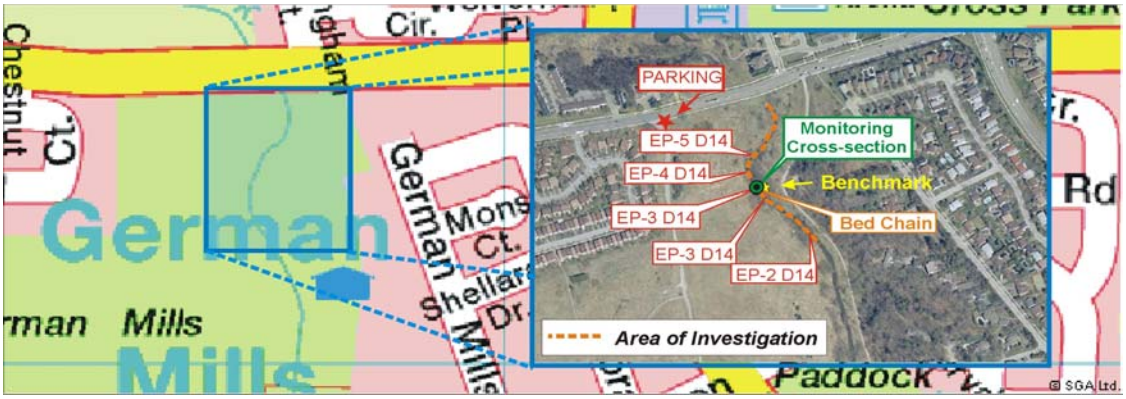
Photo 2. At monitoring cross-section looking upstream.

FLUVIAL GEOMORPHOLOGY SUMMARY

Don River - GD-14

Date of Survey: 11-Oct-02
Number of cross-sections: 10
Associated Fisheries Site: NONE
Access: Site is immediately south of John Street and west of Don Mills road. Park at small parking lot south of John Street by path area.

Site Map



Planform Characteristics

Long Profile (avg)

Bankfull Gradient	0.38 %	**Riffle Length**	7.3 m
Inter-Pool Gradient	0.6 %	**Riffle-Pool Spacing**	28 m
Inter-Riffle Gradient	1.31 %	**Max Pool Depth**	1.8 m
Riffle Gradient	3.27 %		

Particle Sizes (cm)

	Pebble Counts
D10	0.045
D50	4.95
D90	16.94

Historical Analysis

Land Use: 1954 - residential and agriculture/scrubforest
1977-1999 Intensive residential/scrubforest

Channel Change: 1999 - channel obscured by vegetation. Bridge installed after 1954 to accommodate the building of the CPR railway line.

Migration Rates (m/yr): 1999- obscured by vegetation.
Negligible between 1977 and 1954.

Stability

Rapid Geomorphic Assessment **(RGA)** 0.14 **In Regime**

Rapid Stream Assessment **(RSAT)** 21 **Moderate Stability**

Stability Rankings :
<20 - Low, 20-35 - Moderate, >35- High

Stability Index :
0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustment

Site Photo's ***GD-14***

Photo 1. At monitoring cross-section looking downstream.

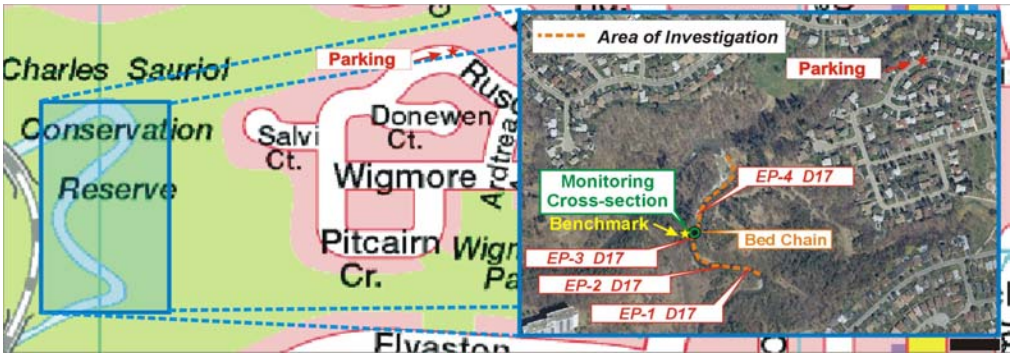
Photo 2. At monitoring cross-section looking upstream.

FLUVIAL GEOMORPHOLOGY SUMMARY

Don River - GD-17

Date of Survey: 6-Dec-02
Number of cross-sections: 8
Associated Fisheries Site: NONE
Access: Park on Rusicica Drive, across house number 92, take the stairs down and turn immediately left down towards the tributary. Walk along the tributary until you hit the Don River. The site is immediately downstream of the trib.

Site Map



Planform Characteristics

Long Profile (avg)

Bankfull Gradient	0.315 %	**Riffle Length**	15 m
Inter-Pool Gradient	0.46 %	**Riffle-Pool Spacing**	25 m
Inter-Riffle Gradient	0.39 %	**Max Pool Depth**	2 m
Riffle Gradient	2.75 %		

Particle Sizes (cm)

	Pebble Counts
D10	0.36
D50	6.64
D90	24.95

Historical Analysis

Land Use: 1954 - residential. Dominant land use is mixed forest. 1977-1999 golf course built around river in middle of the segment, river was altered during construction. York Mills Road, Don Valley Parkway and Highway 401, not present in 1954. Predominantly residential for 1977-1999.

Channel Change: A few islands present in 1954. Footbridges and cart path crossings were built for the golf course after 1954. Channel was altered and relocated during construction of course. Bridges for 401, Don Valley Parkway and York Mills Road built after 1954. Reinforcement walls visible along bends near Don Valley Parkway.

Migration Rates (m/yr): Altered channel between 1954 and 1977. Negligible between 1977 and 1999.

Stability

Rapid Geomorphic Assessment **(RGA)** 0.274 **Transitional**

Rapid Stream Assessment **(RSAT)** 23.5 **Moderate Stability**

Stability Rankings :
<20 - Low, 20-35 - Moderate, >35- High

Stability Index :
0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustment

Site Photo's ***GD-17***

Photo 1. At monitoring cross-section looking downstream.

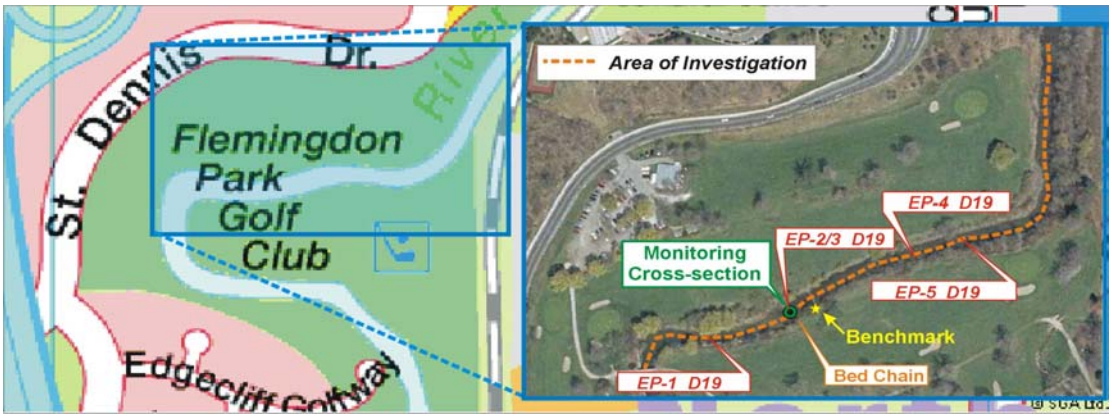
Photo 2. At monitoring cross-section looking upstream.

FLUVIAL GEOMORPHOLOGY SUMMARY

Don River - GD-19

Date of Survey: 25-Nov-02
Number of cross-sections: 10
Associated Fisheries Site: DN005WM
Access: Site is located just off St. Dennis Drive in Flemingdon Park Golf Course. Park in the parking lot by the maintenance building. This sites lower end is immediately downstream of building at the bridge crossing.

Site Map



Planform Characteristics

Long Profile (avg)

Bankfull Gradient	0.36 %	**Riffle Length**	38 m
Inter-Pool Gradient	0.73 %	**Riffle-Pool Spacing**	62.4 m
Inter-Riffle Gradient	0.21 %	**Max Pool Depth**	2.2 m
Riffle Gradient	1.62 %		

Particle Sizes (cm)

	Pebble Counts
D10	0.04
D50	4.66
D90	18.12

Historical Analysis

Land Use: Land use predominantly industrial and commercial. Golf course next to river was not seen in 1954. Don Valley Parkway not seen in 1954.

Channel Change: More islands in 1977 an 1999 then in 1954.
Bridges installed after 1977 for Eglinton Avenue and the DVP.

Migration Rates (m/yr): Negligible for three years.

Stability

Rapid Geomorphic Assessment **(RGA)** 0.297 **Transitional**

Rapid Stream Assessment **(RSAT)** 22.5 **Moderate Stability**

Stability Rankings :
<20 - Low, 20-35 - Moderate, >35- High

Stability Index :
0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustmen

Site Photo's ***GD-19***

Photo 1. At benchmark.

Photo 2. At monitoring cross-section looking downstream.

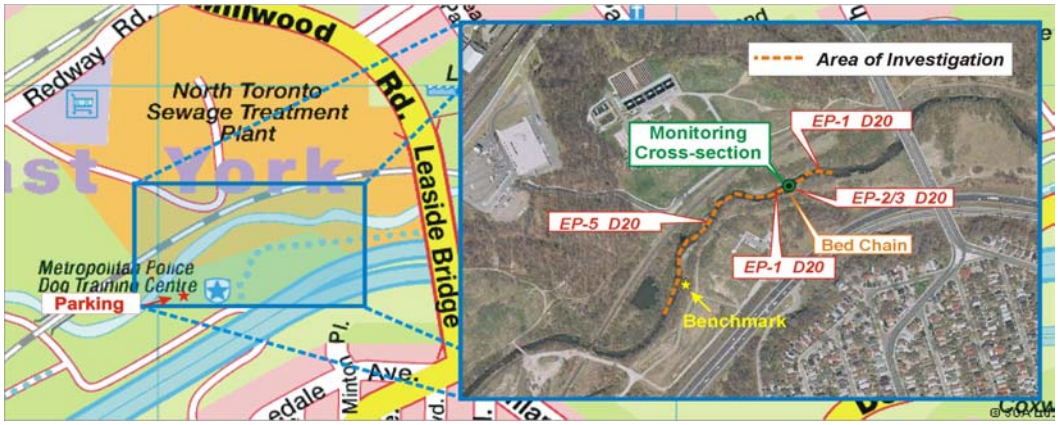
Photo 3. At monitoring cross-section looking upstream.

FLUVIAL GEOMORPHOLOGY SUMMARY

Don River - GD-20

Date of Survey: 13-Nov-02
Number of cross-sections: 10
Associated Fisheries Site: NONE
Access: Site is North of Hwy 404, in between Bayview Avenue and Millwood Road. The site is beside the North Toronto Sewage Treatment Plant. Park beside the Metro Police Dog Training Centre and follow the path to the stream.

Site Map



Planform Characteristics

Long Profile (avg)

Bankfull Gradient	0.14 %	**Riffle Length**	32 m
Inter-Pool Gradient	0.21 %	**Riffle-Pool Spacing**	83 m
Inter-Riffle Gradient	0.35 %	**Max Pool Depth**	2.4 m
Riffle Gradient	0.94 %		

Particle Sizes (cm)

	Pebble Counts
D10	0.003
D50	1.62
D90	22.58

Historical Analysis

Land Use: The Don Valley Parkway was built after 1954. Therefore, prior to 1954 the dominant land use was industrial and open space. After the Don Valley Parkway was built, the dominant land use became industrial and scrubforest/scrublands.

Channel Change: The channel was altered when the Don Valley Parkway was built after 1954. The channel was straightened in some places to accommodate the new highway.

Migration Rates (m/yr): Channel was altered prior to 1977 photos. Negligible for 1977 and 1999.

Stability

Rapid Geomorphic Assessment **(RGA)** 0.393 **Transitional**

Rapid Stream Assessment **(RSAT)** 21.5 **Moderate Stability**

Stability Rankings :
<20 - Low, 20-35 - Moderate, >35- High

Stability Index :
0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustment

Site Photo's ***GD-20***

Photo 1. At monitoring cross-section looking downstream.

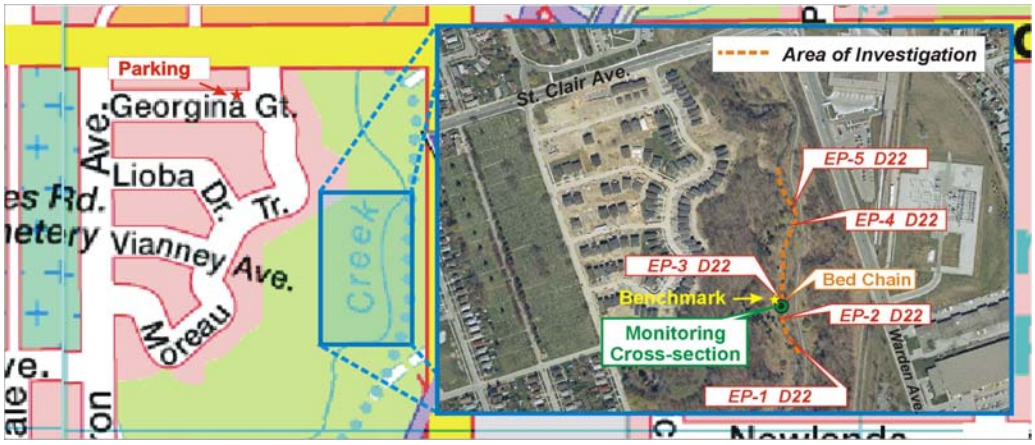
Photo 2. At monitoring cross-section looking upstream.

FLUVIAL GEOMORPHOLOGY SUMMARY

Don River - GD-22

Date of Survey: 21-Nov-02
Number of cross-sections: 10
Associated Fisheries Site: DN003WM
Access: Site located S. of St Clair Ave. & W. of Warden Ave. Park on Moreau Trail and walk down St. Clair Ave. until creek Take the path downstream into the Warden Woods Park. The middle of the site is situated near the life saving equipment & benches.

Site Map



Planform Characteristics

Long Profile (avg)

Bankfull Gradient	1.94 %	**Riffle Length**	12.4 m
Inter-Pool Gradient	2.44 %	**Riffle-Pool Spacing**	21 m
Inter-Riffle Gradient	1.9 %	**Max Pool Depth**	1.5 m
Riffle Gradient	4.44 %		

Particle Sizes (cm)

	Pebble Counts
D10	clay
D50	1.07
D90	17.83

Historical Analysis

Land Use: Predominately urban parkland since 1954 and includes a golf course in the lower reaches of the segment and a cemetery in the upper reaches of the segment.

Channel Change: There were a lot more meanders in 1954 then 1977. A footbridge was built after 1954. Channel poorly visible in 1999 due to vegetation.

Migration Rates (m/yr): No change

Stability

Rapid Geomorphic Assessment **(RGA)** 0.505 **In Adjustment**

Rapid Stream Assessment **(RSAT)** 14 **Low Stability**

Stability Rankings :
<20 - Low, 20-35 - Moderate, >35- High

Stability Index :
0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustment

Site Photo's ***GD-22***

Photo 1. At benchmark.

Photo 2. At monitoring cross-section looking downstream.

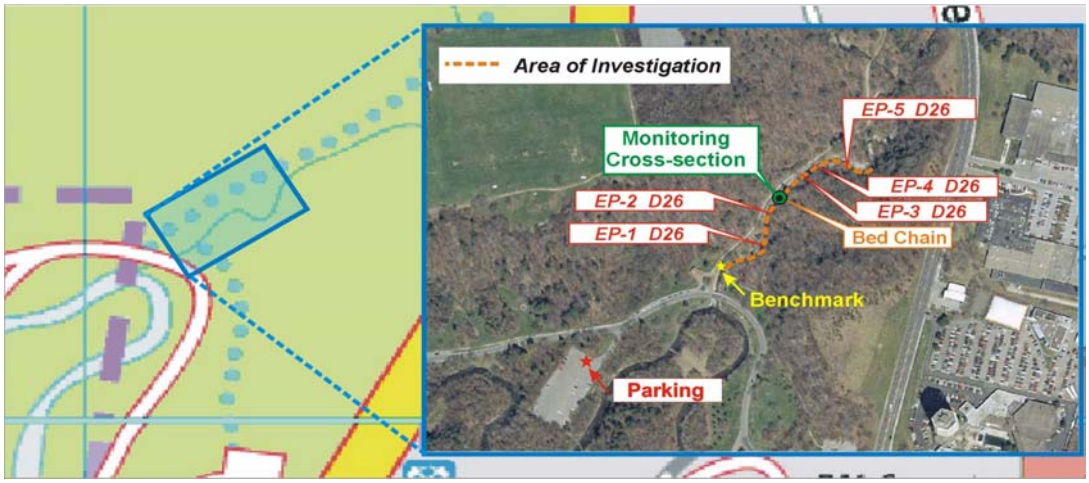
Photo 3. At monitoring cross-section looking upstream.

FLUVIAL GEOMORPHOLOGY SUMMARY

Don River - GD-26

Date of Survey: 8-Nov-02
Number of cross-sections: 10
Associated Fisheries Site: NONE
Access: Site located in Sunnybrook/Wilket Creek Park. Park in the parking lot upstream of the confluence with Wilket Creek. Walk down to confluence with Don River & Wilket Ck., site is immediately upstream of first pedestrian bridge.

Site Map



Planform Characteristics

Long Profile (avg)

Bankfull Gradient	1.52 %	**Riffle Length**	12 m
Inter-Pool Gradient	1.59 %	**Riffle-Pool Spacing**	17 m
Inter-Riffle Gradient	1.51 %	**Max Pool Depth**	1.5 m
Riffle Gradient	4.09 %		

Particle Sizes (cm)

	Pebble Counts
D10	0.016
D50	2.66
D90	25.16

Historical Analysis

Land Use: Urban growth has increased since 1954. Construction of a roadway near river in 1977. Dominant land use is deciduous forest and parklands.

Channel Change: Point at which Wilket Creek meets the west branch of the Don River has migrated north through the years. Channel appears intermittent in 1954. Footbridges across the creek have been installed since 1954.

Migration Rates (m/yr): No set benchmarks to measure from.

Stability

Rapid Geomorphic Assessment **(RGA)** 0.464 **In Adjustment**

Rapid Stream Assessment **(RSAT)** 19 **Low Stability**

Stability Rankings :
<20 - Low, 20-35 - Moderate, >35- High

Stability Index :
0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustment

Site Photo's ***GD-26***

Photo 1. At monitoring cross-section looking downstream.

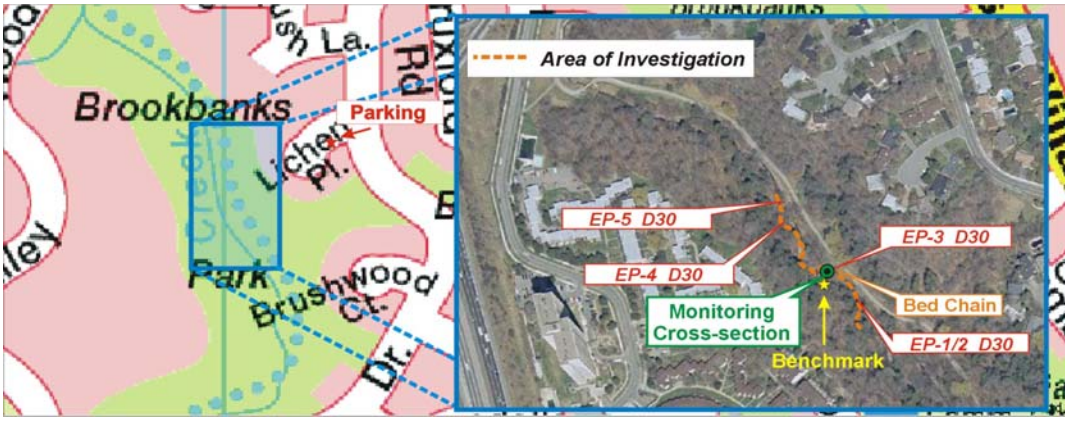
Photo 2. At monitoring cross-section looking upstream.

FLUVIAL GEOMORPHOLOGY SUMMARY

Don River - GD-30

Date of Survey: 26-Nov-02
Number of cross-sections: 10
Associated Fisheries Site: NONE
Access: Park on Lichen Place. Walk down Brookbanks Dr. to park area and follow the small tributary until you get to the main channel. Site is immediately upstream (north) of confluence.

Site Map



Planform Characteristics

Long Profile (avg)

Bankfull Gradient	1.57 %	**Riffle Length**	4.93 m
Inter-Pool Gradient	1.57 %	**Riffle-Pool Spacing**	10.31 m
Inter-Riffle Gradient	1.83 %	**Max Pool Depth**	1.15 m
Riffle Gradient	6.05 %		

Particle Sizes (cm)

	Pebble Counts
D10	0.157
D50	5.31
D90	16.2

Historical Analysis

Land Use: 1954 = Rural agriculture
1978 = Urban residential, Urban parklands
1999 = Urban residential, Urban parklands, mixed forest.

Channel Change: Has been straightened since 1954, channel length has decreased by 26.2% by 1978 because of the construction of Hwy 401

Migration Rates (m/yr): Altered channel between 1954 and 1977. Obscured by vegetation for 1999.

Stability

Rapid Geomorphic Assessment **(RGA)** 0.46 **In Adjustment**

Rapid Stream Assessment **(RSAT)** 16 **Low Stability**

Stability Rankings :
<20 - Low, 20-35 - Moderate, >35- High

Stability Index :
0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustment

Site Photo's ***GD-30***

Photo 1. At monitoring cross-section looking downstream.

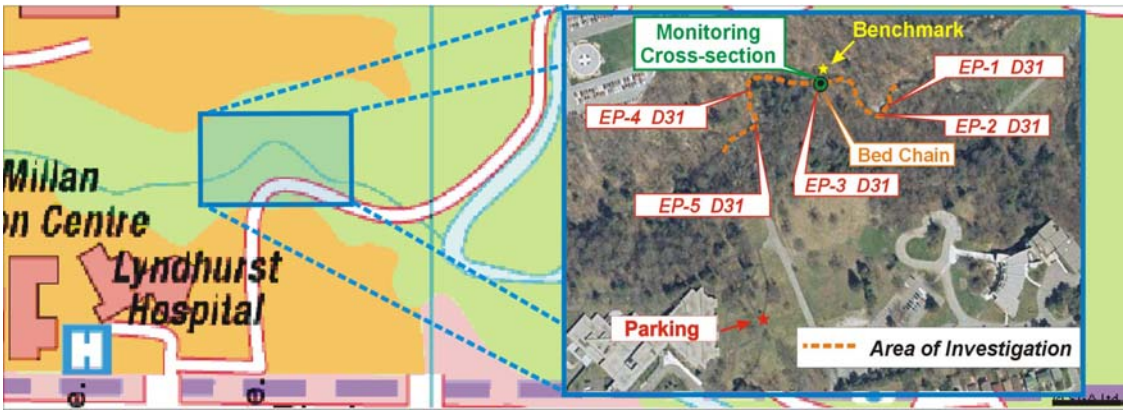
Photo 2. At monitoring cross-section looking upstream.

FLUVIAL GEOMORPHOLOGY SUMMARY

Don River - GD-31

Date of Survey: 17-Oct-02
Number of cross-sections: 10
Associated Fisheries Site: DN014WM
Access: Located north of Glenvale Blvd., east of Bayview Ave., behind The Toronto Lyndhurst Rehab Centre. Park at Toronto Lyndhurst Rehab Centre and take the path down to the stream.

Site Map



Planform Characteristics

Long Profile (avg)

Bankfull Gradient	0.81 %	**Riffle Length**	12.19 m
Inter-Pool Gradient	0.89 %	**Riffle-Pool Spacing**	20 m
Inter-Riffle Gradient	0.92 %	**Max Pool Depth**	1.3 m
Riffle Gradient	3.95 %		

Particle Sizes (cm)

	Pebble Counts
D10	0.03
D50	2.88
D90	11.02

Historical Analysis

Land Use: 1954 = Rural agriculture
1978 = Urban commercial, Urban parklands vacant
1999 = Urban commercial, Urban parklands golf course

Channel Change: Some alteration has occurred to accommodate the building of Hwy 409.

Migration Rates (m/yr): Between 1954 to 1978 = 0.04 m/yr. Negligible between 1977 and 1999.

Stability

Rapid Geomorphic Assessment **(RGA)** 0.366 **Transitional**

Rapid Stream Assessment **(RSAT)** 21 **Moderate Stability**

Stability Rankings :
<20 - Low, 20-35 - Moderate, >35- High

Stability Index :
0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustmen

Site Photo's ***GD-31***

Photo 1. At monitoring cross-section looking downstream.

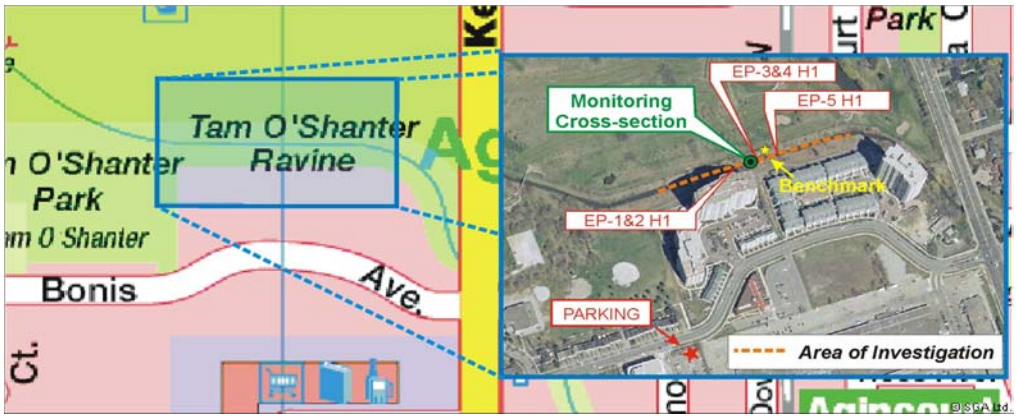
Photo 2. At monitoring cross-section looking upstream.

FLUVIAL GEOMORPHOLOGY SUMMARY

Highland Creek - GH-1

Date of Survey: 20-Nov-02
Number of cross-sections: 10
Associated Fisheries Site: HL011WM
Access: Site is located West of Kennedy Road and North of Bonis Avenue, behind the large apartment buildings. Park across the apartment buildings at the library parking lot. Cross the street and take the path that leads to the stream behind the apartment buildings.

Site Map



Planform Characteristics

Long Profile (avg)

Bankfull Gradient	0.205 %	**Riffle Length**	10.8 m
Inter-Pool Gradient	1.46 %	**Riffle-Pool Spacing**	19 m
Inter-Riffle Gradient	0.5 %	**Max Pool Depth**	1.7 m
Riffle Gradient	5.3 %		

Particle Sizes (cm)

	Pebble Counts
D10	Clay
D50	0.23
D90	12.34

Historical Analysis

Land Use: 1999 - land uses include mainly industrial with some residential uses and a golf course
1977 and 1954, not available

Channel Change: 1999- the channel appears to have been straightened and dykes prior to 1999 photos
1977 and 1954 - not available

Migration Rates (m/yr): Not available because there is nothing to compare to.

Stability

Rapid Geomorphic Assessment	**(RGA)**	0.257	**Transitional**
Rapid Stream Assessment	**(RSAT)**	19	**Low Stability**

Stability Rankings : <20 - Low, 20-35 - Moderate, >35- High

Stability Index : 0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustment

Site Photo's ***GH-1***

Photo 1. At benchmark.

Photo 2. At monitoring cross-section looking downstream.

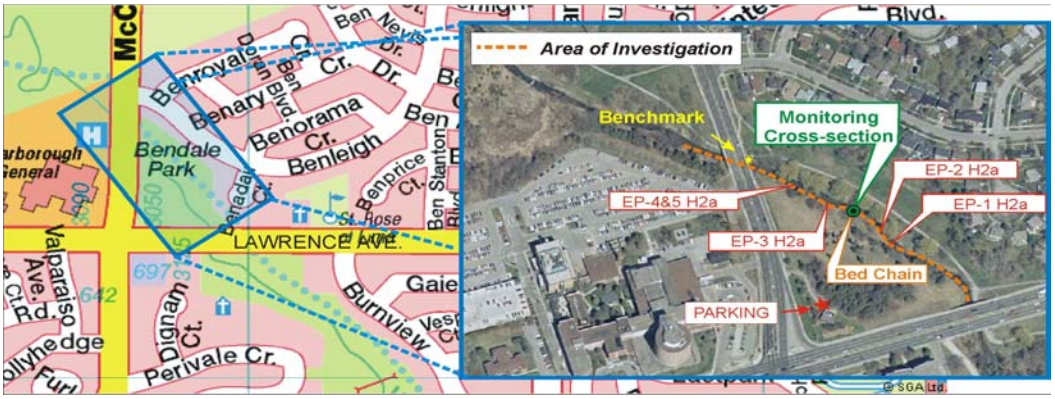
Photo 3. At monitoring cross-section looking upstream.

FLUVIAL GEOMORPHOLOGY SUMMARY

Highland Creek - GH-2a

Date of Survey: 21-Nov-02
Number of cross-sections: 10
Associated Fisheries Site: HL010WM
Access: Site is located North of Lawrence Ave. and East of McCowan Road in Bendale Park. Park at City owned property using McCowan Rd. entrance just N. of Lawrence Rd. and E. of McCowan Rd. Bottom end of site begins at Lawrence Ave. bridge.

Site Map



Planform Characteristics

Long Profile (avg)

Bankfull Gradient	0.37 %	**Riffle Length**	12 m
Inter-Pool Gradient	1.105 %	**Riffle-Pool Spacing**	36 m
Inter-Riffle Gradient	0.49 %	**Max Pool Depth**	2.4 m
Riffle Gradient	3.77 %		

Particle Sizes (cm)

	Pebble Counts
D10	0.027
D50	1.84
D90	12.28

Historical Analysis

Land Use: Predominant land use is residential/parklands for all three years studied.

Channel Change: The channel meandered more in 1954 then in 1977 and 1999 below Lawrence Avenue but straighten out after 1954.

Migration Rates (m/yr): 1999 - obscured by trees
Altered channel between 1954 and 1977

Stability

Rapid Geomorphic Assessment	(RGA)	0.355	**Transitional**
Rapid Stream Assessment	(RSAT)	22	**Low Stability**

Stability Rankings :
<20 - Low, 20-35 - Moderate, >35- High

Stability Index :
0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustment

Site Photo's **GH-2a**

Photo 1. At benchmark.

Photo 2. At monitoring cross-section looking downstream.

Photo 3. At monitoring cross-section looking upstream.

FLUVIAL GEOMORPHOLOGY SUMMARY

Highland Creek - GH-2b

Date of Survey: 11-Dec-02
Number of cross-sections: 8
Associated Fisheries Site: NONE
Access: Site is located West of Markham Rd. and South of Lawrence, directly behind Cedarbrook Community Centre. Park in Cedarbrook Community Centres parking lot. Take the path down to the first pedestrian bridge, site is immediately upstream of bridge.

Site Map

Planform Characteristics

Long Profile (avg)

Bankfull Gradient	0.525 %	**Riffle Length**	15 m
Inter-Pool Gradient	0.69 %	**Riffle-Pool Spacing**	34.5 m
Inter-Riffle Gradient	0.43 %	**Max Pool Depth**	2 m
Riffle Gradient	2.38 %		

Particle Sizes (cm)

	Pebble Counts
D10	0.135
D50	7.78
D90	23.69

Historical Analysis

Land Use: 1999 and 1977 - Golf course just downstream of this segment. Predominant land uses are parklands and residential
1954 - Predominant land use is open space with few residential dwellings

Channel Change: Channel appears unaltered for the three years reviewed.
1999 - Erosion protection/reinforcements walls apparent in 1999 photos only
1977 and 1999 foot bridges at various locations acros
1954 photos

Migration Rates (m/yr): Negligible for all three years

Stability

Rapid Geomorphic Assessment **(RGA)** 0.222 **Transitional**

Rapid Stream Assessment **(RSAT)** 22.5 **Moderate Stability**

Stability Rankings : <20 - Low, 20-35 - Moderate, >35- High

Stability Index : 0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustment

Site Photo's ***GH-2b***

Photo 1. At benchmark.

Photo 2. At monitoring cross-section looking downstream.

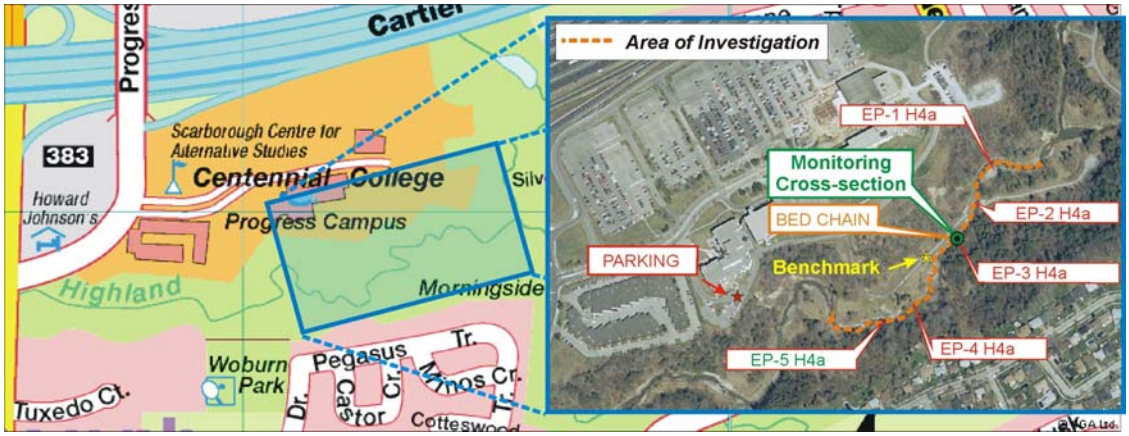
Photo 3. At monitoring cross-section looking upstream.

FLUVIAL GEOMORPHOLOGY SUMMARY

Highland Creek - GH-4a

Date of Survey: 13-Dec-02
Number of cross-sections: 10
Associated Fisheries Site: HL005WM
Access: Site is South of Hwy 401, East of Markham Road, directly behind Centennial College.

Site Map



Planform Characteristics

Long Profile (avg)

Bankfull Gradient	0.715 %	**Riffle Length**	11 m
Inter-Pool Gradient	1.34 %	**Riffle-Pool Spacing**	4.48 m
Inter-Riffle Gradient	0.7 %	**Max Pool Depth**	2 m
Riffle Gradient	2.97 %		

Particle Sizes (cm)

	Pebble Counts
D10	Clay
D50	4.16
D90	21.92

Historical Analysis

Land Use: 1954 - agriculture and residential lawns were dominant land uses
1977 and 1999 residential and industrial are the dominant land uses

Channel Change: 1954 - significant meandering with channel turning back on itself numerous times
1977 - 1999 less and less meandering and more relatively straight stretches of creek

Migration Rates (m/yr): 0.13 m/yr migration through channel for the three years.

Stability

Rapid Geomorphic Assessment **(RGA)** 0.278 **Transitional**

Rapid Stream Assessment **(RSAT)** 19.5 **Low Stability**

Stability Rankings :
<20 - Low, 20-35 - Moderate, >35- High

Stability Index :
0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustment

Site Photo's ***GH-4a***

Photo 1. At benchmark.

Photo 2. At monitoring cross-section looking downstream.

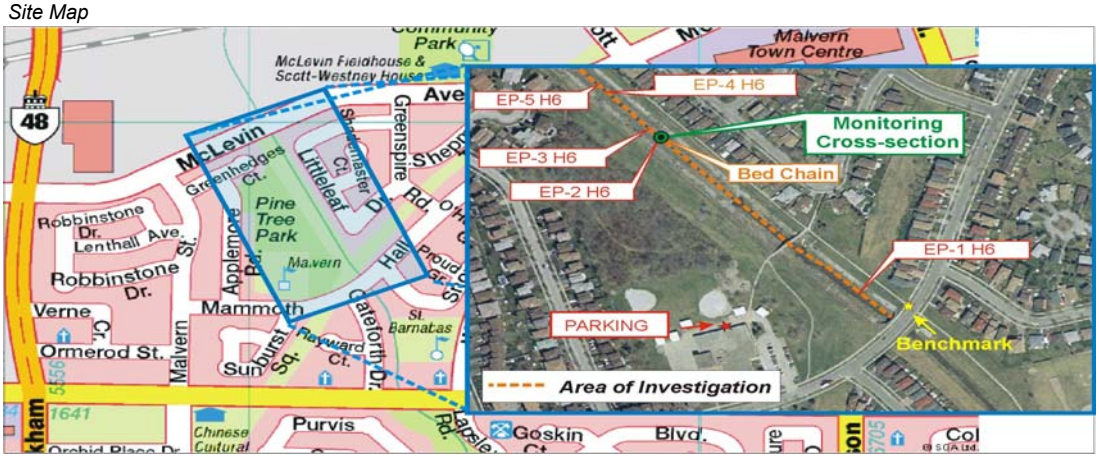
Photo 3. At monitoring cross-section looking upstream.

FLUVIAL GEOMORPHOLOGY SUMMARY

Highland Creek - GH-6

Date of Survey: 2-Dec-02
Number of cross-sections: 10
Associated Fisheries Site: NONE
Access: Site is within Pine Tree Park. Major intersection is Markham Road and McLevin Ave. Reach is immediately east of Malvern Junior School, North of Mammoth Hall Trail. Park at the school. The site begins at the Mammoth Hall Trail bridge.

Site Map



Planform Characteristics

Long Profile (avg)

Bankfull Gradient	0.455	%	**Riffle Length**	10.67	m
Inter-Pool Gradient	0.42	%	**Riffle-Pool Spacing**	37	m
Inter-Riffle Gradient	0.65	%	**Max Pool Depth**	1.8	m
Riffle Gradient	4.35	%			

Particle Sizes (cm)

	Pebble Counts
D10	0.036
D50	2.75
D90	10.36

Historical Analysis

Land Use:
1954 - agriculture and railway lands are the dominant land uses
1977 - no coverage
1999 - predominant land uses are industrial, residential and parklands

Channel Change:
1954 - channel was a very thin meandering channel through agricultural fields
1977 - no coverage
1999 - Channel was straightened and appear to be dyked for the extent of the segment.

Migration Rates (m/yr): Altered channel between the two years available.

Stability

Rapid Geomorphic Assessment **(RGA)** 0.318 **Transitional**

Rapid Stream Assessment **(RSAT)** 19 **Low Stability**

Stability Rankings :
<20 - Low, 20-35 - Moderate, >35- High

Stability Index :
0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustment

Site Photo's ***GH-6***

Photo 1. At benchmark.

Photo 2. At monitoring cross-section looking downstream.

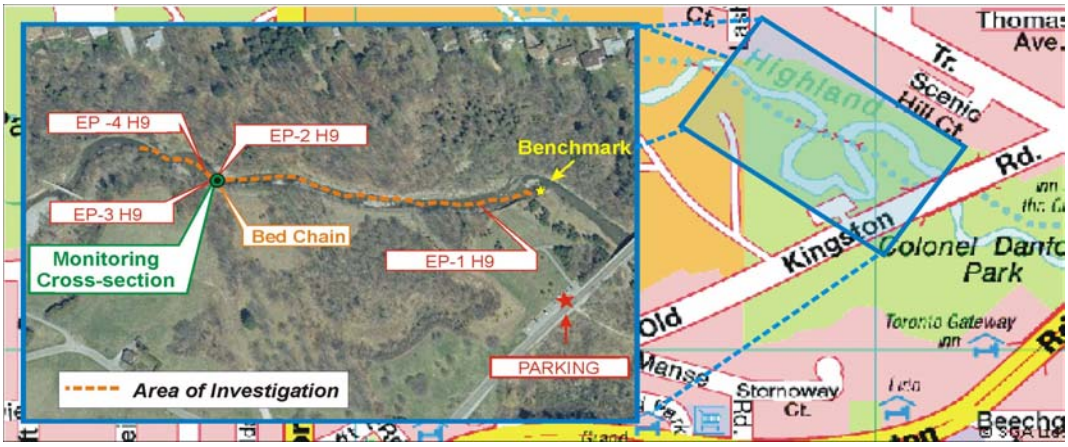
Photo 3. At monitoring cross-section looki upstream.

FLUVIAL GEOMORPHOLOGY SUMMARY

Highland Creek - GH-9

Date of Survey: 12-Dec-02
Number of cross-sections: 8
Associated Fisheries Site: NONE
Access: Site is immediately North of Old Kingston Road, East of Morningside Ave. Park at the parking lot on Old Kinston Road beside Highland Creek. Take the path North until the life saving equipment is visible. The bottom of the site begins at that area.

Site Map



Planform Characteristics

Long Profile (avg)

Bankfull Gradient	0.57 %	**Riffle Length**	30.5 m
Inter-Pool Gradient	0.97 %	**Riffle-Pool Spacing**	85.5 m
Inter-Riffle Gradient	1.29 %	**Max Pool Depth**	2.3 m
Riffle Gradient	1.93 %		

Particle Sizes (cm)

	Pebble Counts
D10	0.0035
D50	1.87
D90	14.95

Historical Analysis

Land Use: Predominant land use for all years is scrubforest/deciduous and residential development. No significant changes over the three years.

Channel Change: Channel meandered more prior to 1977 between Kingston Road and Morningside Ave. After 1954 the channel straighten out more in this area.

Migration Rates (m/yr):
1999-1977 - 0.09 m/yr down valley
1999-1954 - 0.03 m/yr down valley
1977-1954 - 0.07 m/yr down valley

Stability

Rapid Geomorphic Assessment	**(RGA)**	0.408	**In Adjustment**
Rapid Stream Assessment	**(RSAT)**	14	**Low Stability**

Stability Rankings :
<20 - Low, 20-35 - Moderate, >35- High

Stability Index :
0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustment

Site Photo's ***GH-9***

Photo 1. A benchmark.

Photo 2. At monitoring cross-section looking downstream.

Photo 3. At monitoring cross-section looking upstream.

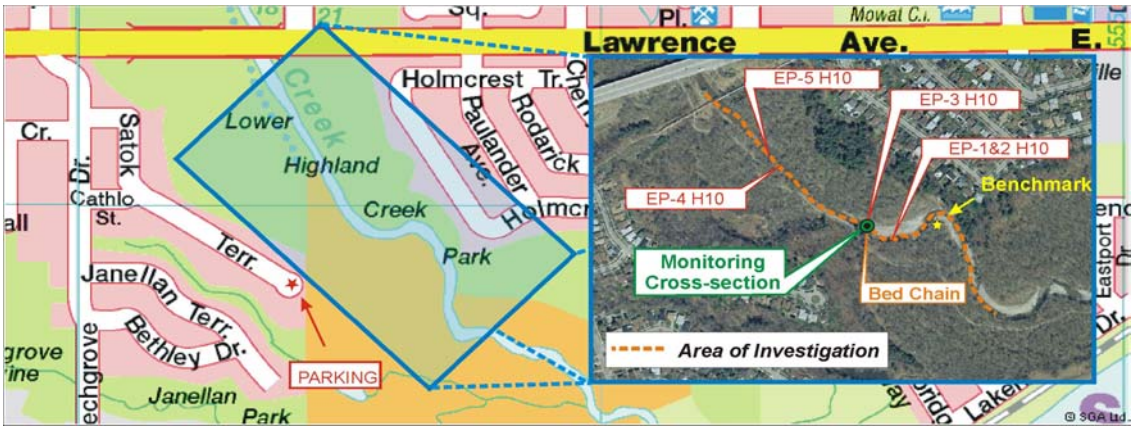
FLUVIAL GEOMORPHOLOGY SUMMARY

Highland Creek - GH-10

Date of Survey: 14-Nov-02
Number of cross-sections: 10
Associated Fisheries Site: NONE

Access: Site is immediately South of Lawrence Ave. E. Park at the end of Satok Terrace road. Take the path down the valley wall until paved path is reached. Go upstream (North) on the path until the life saving equipment is reached. This is the middle of the site.

Site Map



Planform Characteristics

Long Profile (avg)

Bankfull Gradient	0.365 %	**Riffle Length**	85 m
Inter-Pool Gradient	0.5 %	**Riffle-Pool Spacing**	137 m
Inter-Riffle Gradient	0.3 %	**Max Pool Depth**	2.3 m
Riffle Gradient	0.72 %		

Particle Sizes (cm)

	Pebble Counts
D10	0.0036
D50	1.53
D90	8.04

Historical Analysis

Land Use: Predominant land uses are scrubforest , deciduous forest and open space. The residential development has continued to occur since 1954 but nothing has been developed immediately next to the creek except the expansion of Lawrence Avenue prior to 1954 across the creek.

Channel Change: 1954 - lower reaches of segment appeared to have a lot of sand bars and a relatively thin channel, channel actually splits into two separate channels around one large island, not present in 1977 or 1999.
1977 - channel appeared to have less sand bars and a broader channel width
1999- channel appears to meander between several sand bars

Migration Rates (m/yr): Historically the creek has changed from a meandering channel around a large island to a meandering channel around sand bars and other erosional deposits in the creek.

Stability

Rapid Geomorphic Assessment	**(RGA)**	0.536	**In Adjustment**
Rapid Stream Assessment	**(RSAT)**	27.5	**Moderate Stability**

Stability Rankings :
<20 - Low, 20-35 - Moderate, >35- High

Stability Index :
0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustment

Site Photo's ***GH-10***

Photo 1. At monitoring cross-section looking downstream.

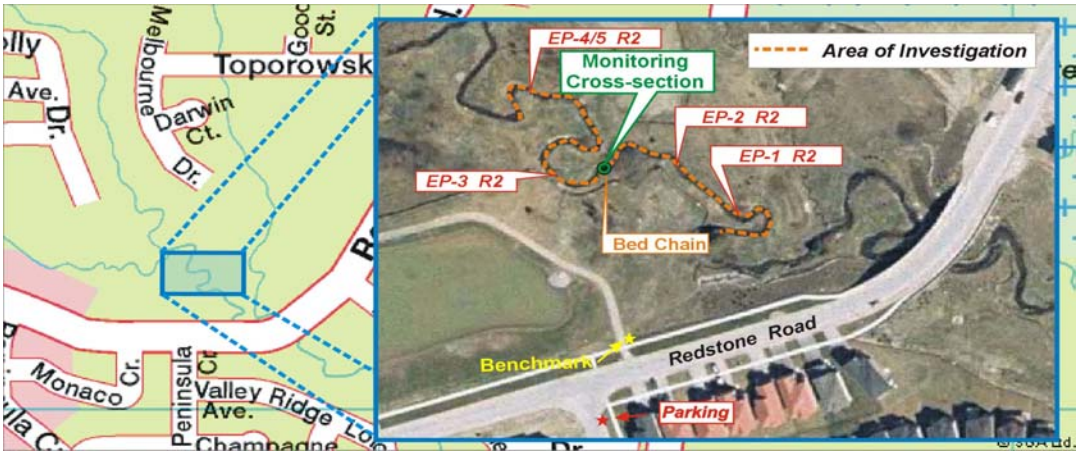
Photo 2. At monitoring cross-section looking upstream.

FLUVIAL GEOMORPHOLOGY SUMMARY

Rouge River - GR-A532

Date of Survey: 23-Jul-02
Number of cross-sections: 10
Associated Fisheries Site: None
Access: Park on Peninsula Crescent, Site is immediately upstream (north) of Redstone Road, approximately 200 m above the confluence with tributary.

Site Map



Planform Characteristics

Long Profile (avg)

Bankfull Gradient	0.15 %	**Riffle Length**	10.43 m
Inter-Pool Gradient	0.37 %	**Riffle-Pool Spacing**	0.16 m
Inter-Riffle Gradient	0.195 %	**Max Pool Depth**	1.3 m
Riffle Gradient	4.47 %		

Particle Sizes (cm)

	Pebble Counts
D10	0.01
D50	0.56
D90	3.15

Historical Analysis

Land Use: Dominant land use in 1954 and 1977 was agriculture. Dominant land use in 1999 was residential and remnant agricultural fields, scrublands.

Channel Change: Channel platform appears similar for all three years.
A few more bridges were built after 1977 across the channel.

Migration Rates (m/yr): Not available because there are no suitable benchmarks to measure from.

Stability

Rapid Geomorphic Assessment **(RGA)** 0.223 **Transitional**

Rapid Stream Assessment **(RSAT)** 24 **Moderate Stability**

Stability Rankings :
<20 - Low, 20-35 - Moderate, >35- High

Stability Index :
0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustment

Site Photo's ***GR-2***

Photo 1. At monitoring cross-section looking downstream.

Photo 2. At monitoring cross-section looking upstream.

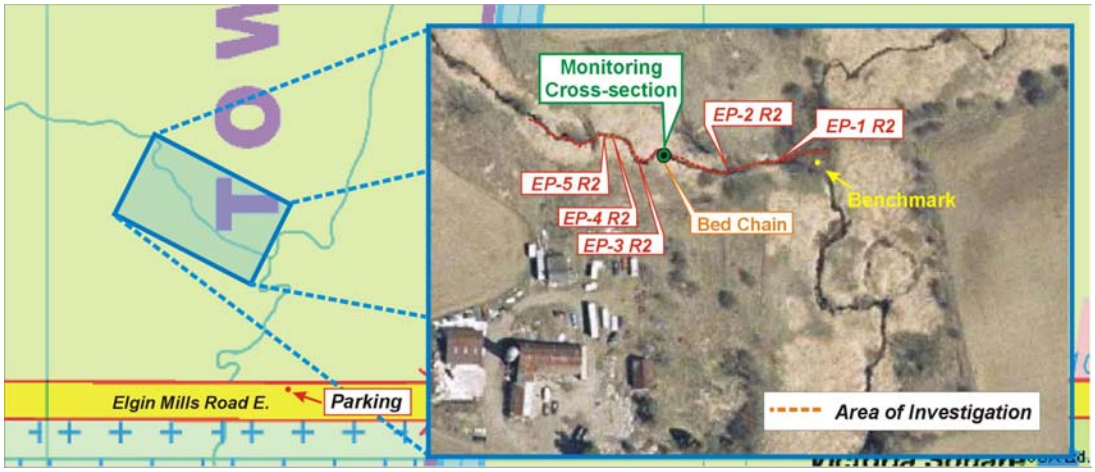
FLUVIAL GEOMORPHOLOGY SUMMARY

Rouge River - GR-4

Date of Survey: 26-Jul-02
Number of cross-sections: 10
Associated Fisheries Site: None

Access: First stream West of Hwy 404, North of Elgin Mills Road, just after the confluence with the tributary. Park on North side of Elgin Mills Road, west of Highway 404 at culvert. Walk upstream until confluence with tributary reached, site begins at confluence.

Site Map



Planform Characteristics

Long Profile (avg)

Bankfull Gradient	0.03 %	**Riffle Length**	9.75 m
Inter-Pool Gradient	0.89 %	**Riffle-Pool Spacing**	2.49 m
Inter-Riffle Gradient	0.88 %	**Max Pool Depth**	1.37 m
Riffle Gradient	2.18 %		

Particle Sizes (cm)

	Pebble Counts
D10	0.01
D50	0.59
D90	11.45

Historical Analysis

Land Use: Dominant land use is agricultural fields and mown lawns for 1999, no coverage for 1977 and 1954.

Channel Change: No obvious change for 1999, no coverage for 1977 and 1954.

Migration Rates (m/yr): No suitable benchmarks to measure to for 1999, not covered for 1977 and 1954.

Stability

Rapid Geomorphic Assessment **(RGA)** 0.247 **Transitional**

Rapid Stream Assessment **(RSAT)** 24 **Moderate Stability**

Stability Rankings :
<20 - Low, 20-35 - Moderate, >35- High

Stability Index :
0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustment

Site Photo's ***GR-4***

Photo 1. A picture of the general area across the monitoring site.

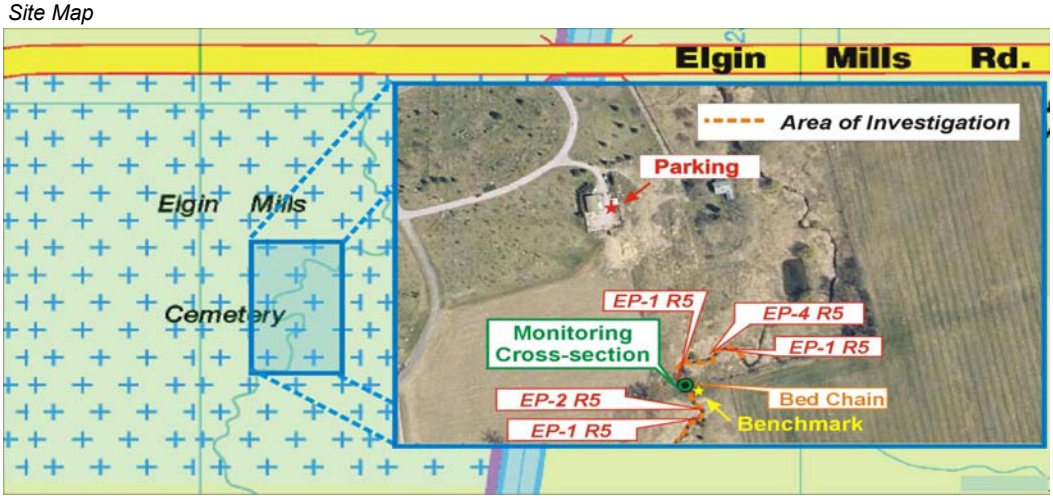
Photo 2. Another picture of the general area across the monitoring site.

FLUVIAL GEOMORPHOLOGY SUMMARY

Rouge River - GR-5

Date of Survey: 1-Aug-02
Number of cross-sections: 10
Associated Fisheries Site: None
Access: Park by maintenance facility inside Elgin Mills Cemetery. Top end of the site is located down the hill of the parking lot maintenance facility center.

Site Map



Planform Characteristics

Long Profile (avg)

Bankfull Gradient	0.395 %	**Riffle Length**	5.8 m
Inter-Pool Gradient	0.62 %	**Riffle-Pool Spacing**	9.2 m
Inter-Riffle Gradient	0.48 %	**Max Pool Depth**	1.2 m
Riffle Gradient	3.77 %		

Particle Sizes (cm)

	Pebble Counts
D10	0.01
D50	0.87
D90	11

Historical Analysis

Land Use: Agriculture/scrublands are the dominant land uses in all the years. No change.

Channel Change: More meanders noticed in 1999 then in other two years, most of segment is obscured by vegetation.

Migration Rates (m/yr): No available because there are no suitable benchmarks to measure from.

Stability

Rapid Geomorphic Assessment **(RGA)** 0.45 **In Adjustment**

Rapid Stream Assessment **(RSAT)** 24.5 **Moderate Stability**

Stability Rankings :
<20 - Low, 20-35 - Moderate, >35- High

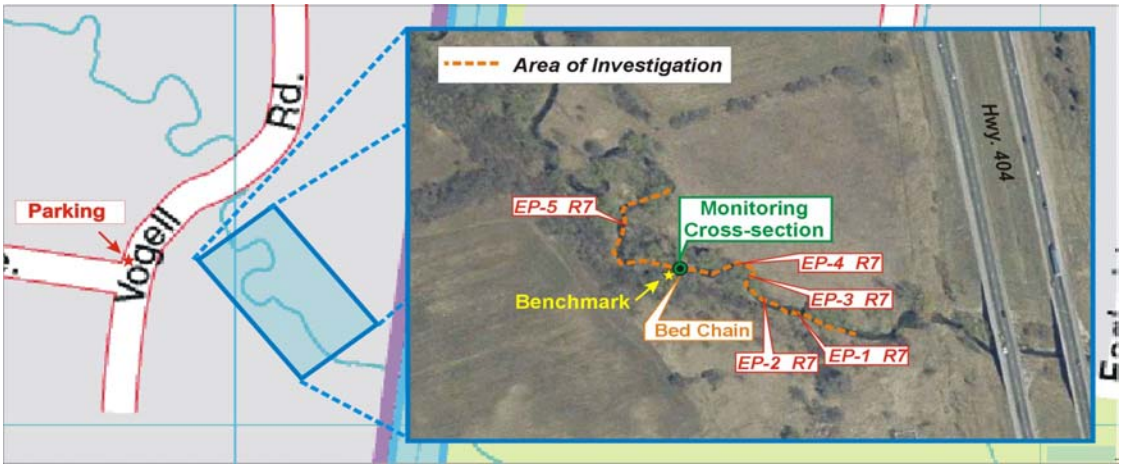
Stability Index :
0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustment

FLUVIAL GEOMORPHOLOGY SUMMARY

Rouge River - GR-7

Date of Survey: 19-Sep-02
Number of cross-sections: 10
Associated Fisheries Site: None
Access: Park on Vogell Road. Site is immediately downstream (South) of Vogell Road.

Site Map



Planform Characteristics

Long Profile (avg)

Bankfull Gradient	0.465 %	**Riffle Length**	6.67 m
Inter-Pool Gradient	0.47 %	**Riffle-Pool Spacing**	14.5 m
Inter-Riffle Gradient	0.48 %	**Max Pool Depth**	1.3 m
Riffle Gradient	4.63 %		

Particle Sizes (cm)

	Pebble Counts
D10	clay
D50	1.66
D90	10.75

Historical Analysis

Land Use: Golf Course present near river after 1954. Land uses include Buttonville Airfield , golf course and agricultural field. Significant increase in residential units after 1977.

Channel Change: A few more culverts were installed to accommodate the new development after 1977. Channel partially obscured by vegetation in 1999.

Migration Rates (m/yr): 0.15 m/yr migration down the valley

Stability

Rapid Geomorphic Assessment **(RGA)** 0.247 **Transitional**

Rapid Stream Assessment **(RSAT)** 24.5 **Moderate Stability**

Stability Rankings :
<20 - Low, 20-35 - Moderate, >35- High

Stability Index :
0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustment

Site Photo's ***GR-7***

Photo 1. At monitoring cross-section looking downstream.

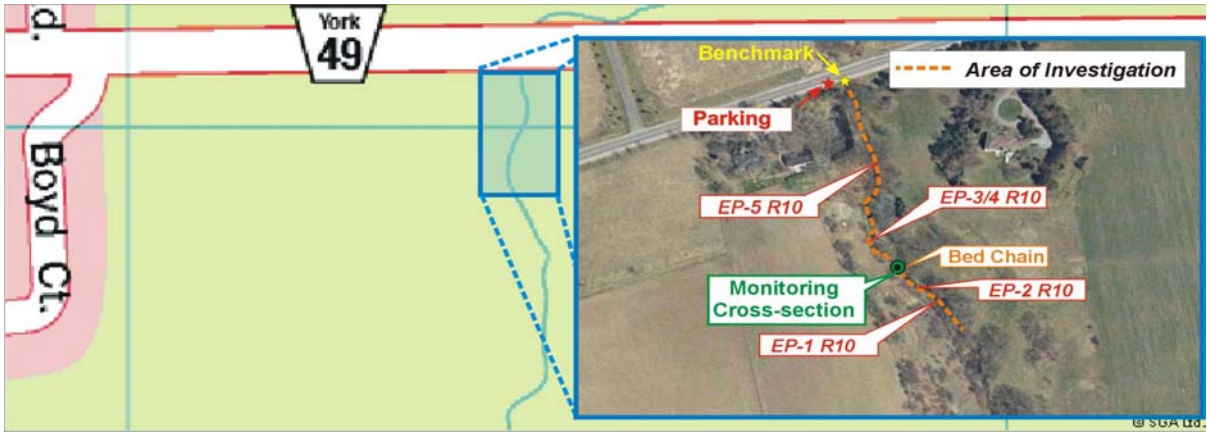
Photo 2. At monitoring cross-section looking upstream.

FLUVIAL GEOMORPHOLOGY SUMMARY

Rouge River - GR-10

Date of Survey: 7-Aug-02
Number of cross-sections: 10
Associated Fisheries Site: RG018WM
Access: Park on south shoulder of Elgin Mills Road East. Top end of site is at culvert.

Site Map



Planform Characteristics

Long Profile (avg)

Bankfull Gradient	0.58 %	**Riffle Length**	5.4 m
Inter-Pool Gradient	0.52 %	**Riffle-Pool Spacing**	12.5 m
Inter-Riffle Gradient	0.7 %	**Max Pool Depth**	1.1 m
Riffle Gradient	3.31 %		

Particle Sizes (cm)

	Pebble Counts
D10	0.01
D50	1.53
D90	12.37

Historical Analysis

Land Use: A few more residential units were present in 1999 then the other two years. Dominant land use is open fields/back yards for all three years.

Channel Change: A lot more meanders appear in 1999 then in 1954 and 1977. The channel also widens near Elgin Mills Road in 1999.
Channel partially obscured by vegetation.

Migration Rates (m/yr): Channel partially obscured by vegetation, no other suitable benchmarks to use.

Stability

Rapid Geomorphic Assessment **(RGA)** 0.509 **In Adjustment**

Rapid Stream Assessment **(RSAT)** 24 **Moderate Stability**

Stability Rankings :
<20 - Low, 20-35 - Moderate, >35- High

Stability Index :
0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustmer

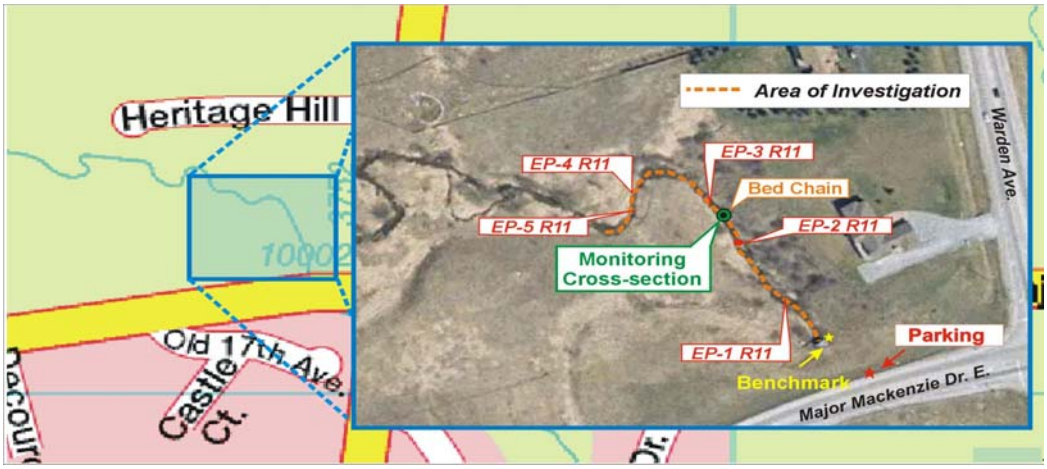
FLUVIAL GEOMORPHOLOGY SUMMARY

Rouge River - GR-11

Date of Survey: 8-Aug-02
Number of cross-sections: 10
Associated Fisheries Site: RG018WM

Access: The site is on Berczy Creek, West of Warden Avenue and North of Mackenzie Drive East. Park on the shoulder Mackenzie Dr. E., the site is immediately upstream (North) of the culvert.

Site Map



Planform Characteristics

Long Profile (avg)

Bankfull Gradient	0.62 %	**Riffle Length**	4 m
Inter-Pool Gradient	1.105 %	**Riffle-Pool Spacing**	8.25 m
Inter-Riffle Gradient	1.18 %	**Max Pool Depth**	1 m
Riffle Gradient	6.78 %		

Particle Sizes (cm)

	Pebble Counts
D10	0.02
D50	2.48
D90	12.55

Historical Analysis

Land Use: A few more residential units appeared 1954. Land use is mostly residential lawns and scrubforests.

Channel Change: A culvert replaced the old road bridge after 1954. The new roadway was built after 1977. A few islands were present in 1954 and not in 1977 and 1999.

Migration Rates (m/yr): Altered channel between 1954 and 1977 and again in 1977 and 1999.

Stability

Rapid Geomorphic Assessment **(RGA)** 0.285 **Transitional**

Rapid Stream Assessment **(RSAT)** 25 **Moderate Stability**

Stability Rankings :
<20 - Low, 20-35 - Moderate, >35- High

Stability Index :
0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustment

Site Photo's ***GR-11***

Photo 1. At monitoring cross-section looking downstream.

Photo 2. At monitoring cross-section looking upstream.

FLUVIAL GEOMORPHOLOGY SUMMARY

Rouge River - GR-12

Date of Survey: 26-Aug-02
Number of cross-sections: 10
Associated Fisheries Site: RG016WM
Access: Park on Rae Crescent. Site is downstream of 16th Ave. There is a pathway leading to the site that is accessed from 16th Ave. Take the pathway down until a fenceline is reached, the end of the site is at the fenceline.

Site Map

Planform Characteristics

Long Profile (avg)

Bankfull Gradient	0.225 %	**Riffle Length**	4.25 m
Inter-Pool Gradient	0.266 %	**Riffle-Pool Spacing**	22 m
Inter-Riffle Gradient	0.057 %	**Max Pool Depth**	1.1 m
Riffle Gradient	4.76 %		

Particle Sizes (cm)

	Pebble Counts
D10	0.01
D50	0.72
D90	7.52

Historical Analysis

Land Use: Agriculture and scrublands are the dominant land uses in 1954 and 1977.
Residential Development started infilling after 1977.
Golf Course was not built in 1954.

Channel Change: Most of the channel is obscured by trees and shrubs. Only the lower reaches are un-obscured. Channel is similar for 1954 and 1977.

Migration Rates (m/yr): Not available 1999 -obscured by vegetation.
1954 - 1977 negligible.

Stability

Rapid Geomorphic Assessment **(RGA)** 0.282 **Transitional**

Rapid Stream Assessment **(RSAT)** 21.5 **Moderate Stability**

Stability Rankings :
<20 - Low, 20-35 - Moderate, >35- High

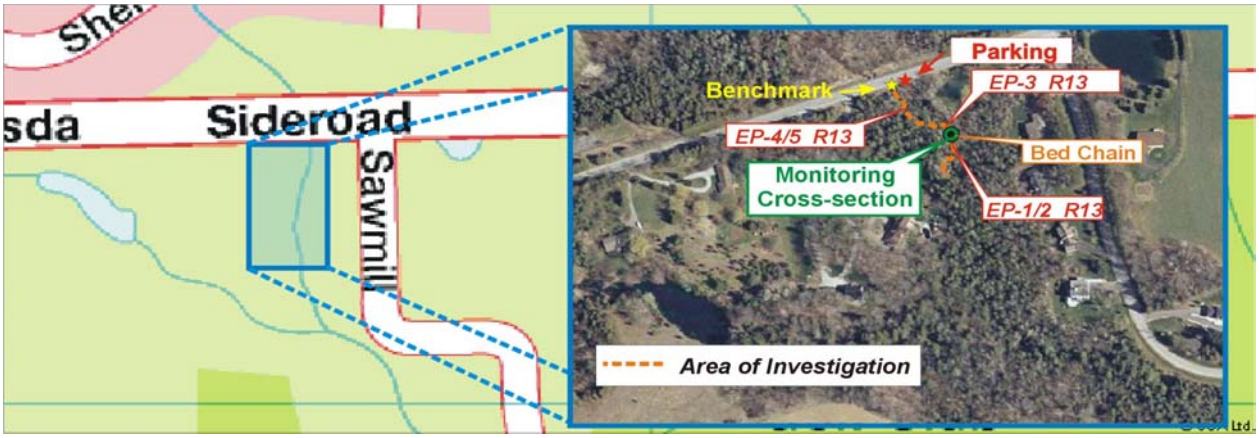
Stability Index :
0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustment

FLUVIAL GEOMORPHOLOGY SUMMARY

Rouge River - GR-13

Date of Survey: 20-Aug-02
Number of cross-sections: 10
Associated Fisheries Site: NONE
Access: Site is located South of Bethesda Sideroad, just West of Sawmill Lane. Park on the shoulder of Bethesda Sideroad. Site is immediately south of the culvert.

Site Map



Planform Characteristics

Long Profile (avg)

Bankfull Gradient	0.73 %	**Riffle Length**	8 m
Inter-Pool Gradient	0.92 %	**Riffle-Pool Spacing**	14 m
Inter-Riffle Gradient	1.3 %	**Max Pool Depth**	0.8 m
Riffle Gradient	2.74 %		

Particle Sizes (cm)

	Pebble Counts
D10	0.0004
D50	0.32
D90	2.03

Historical Analysis

Land Use: Dominant land use is scrub forest and a golf course.

Channel Change: Some ponding in the middle of the reach but mostly the channel is obscured by vegetation. No coverage for 1977 and 1954.

Migration Rates (m/yr): Channel obscured by vegetation 1999
No coverage for 1977 and 1954.

Stability

Rapid Geomorphic Assessment **(RGA)** 0.435 **In Adjustment**

Rapid Stream Assessment **(RSAT)** 33.5 **Moderate Stability**

Stability Rankings :
<20 - Low, 20-35 - Moderate, >35- High

Stability Index :
0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustment

Site Photo's ***GR-13***

Photo 1. At monitoring cross-section looking downstream.

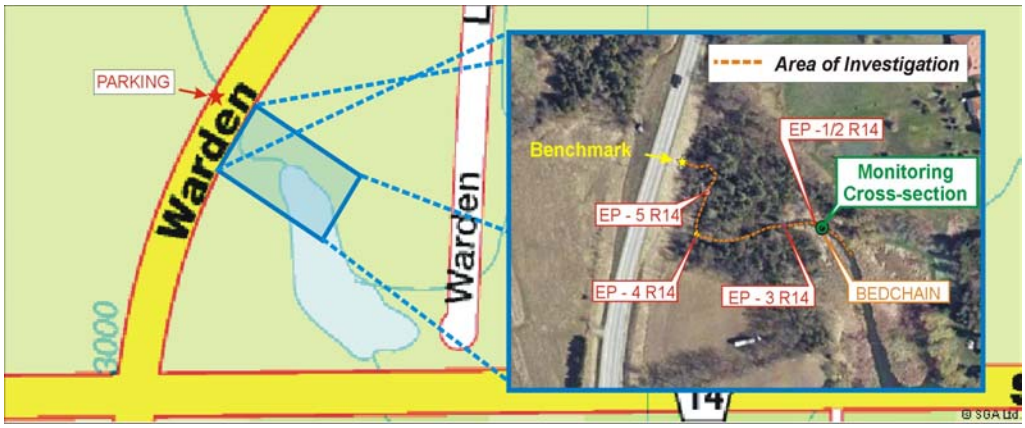
Photo 2. At monitoring cross-section looking upstream.

FLUVIAL GEOMORPHOLOGY SUMMARY

Rouge River - GR-14

Date of Survey: 20-Aug-02
Number of cross-sections: 8
Associated Fisheries Site: NONE
Access: Site is immediately south of Warden Avenue and north of Stouffville Road.

Site Map



Planform Characteristics

Long Profile (avg)

Bankfull Gradient	0.2 %	**Riffle Length**	7.29 m
Inter-Pool Gradient	1.6 %	**Riffle-Pool Spacing**	1.65 m
Inter-Riffle Gradient	0.19 %	**Max Pool Depth**	1 m
Riffle Gradient	1.65 %		

Particle Sizes (cm)

	Pebble Counts
D10	0.0005
D50	0.0064
D90	0.0416

Historical Analysis

Land Use: Dominant land use is scub forest and residential lawns.

Channel Change: Channel is ponded in between the two highways in 1999. No Coverage for 1977 and 1954.

Migration Rates (m/yr): 1999- obscured by vegetation
1977 and 1954 - no coverage

Stability

Rapid Geomorphic Assessment **(RGA)** 0.361 **Transitional**

Rapid Stream Assessment **(RSAT)** 25 **Moderate Stability**

Stability Rankings :
<20 - Low, 20-35 - Moderate, >35- High

Stability Index :
0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustment

Site Photo's ***GR-14***

Photo 1. At monitoring cross-section looking downstream.

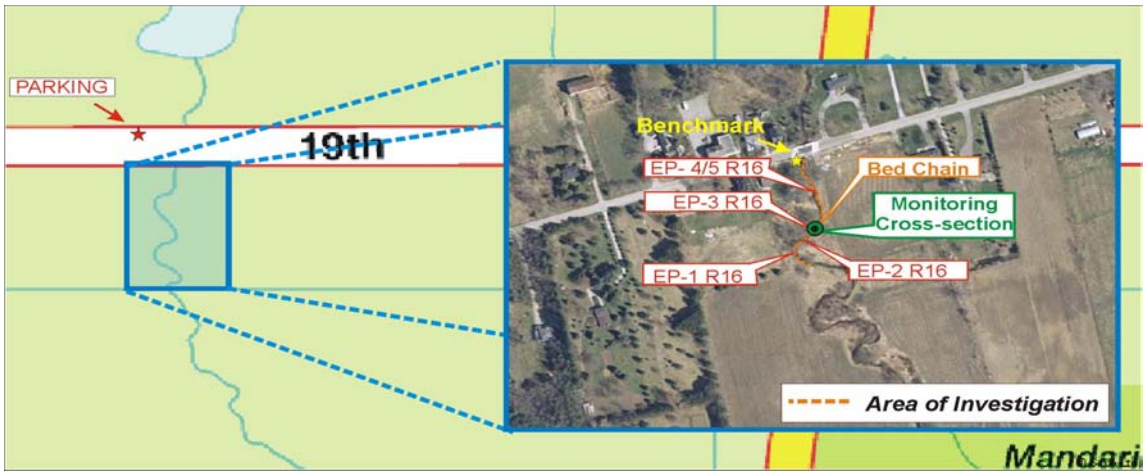
Photo 2. At monitoring cross-section looking upstream.

FLUVIAL GEOMORPHOLOGY SUMMARY

Rouge River - GR-16

Date of Survey: 21-Aug-02
Number of cross-sections: 10
Associated Fisheries Site: RG019WM
Access: Site is immediately South of 19th Avenue, in between Kennedy Road and Warden Avenue. Park on the shoulder 19th Ave., the site is immediately South of the road (top end of the site).

Site Map



Planform Characteristics

Long Profile (avg)

Bankfull Gradient	0.19 %	**Riffle Length**	12.3 m
Inter-Pool Gradient	0.14 %	**Riffle-Pool Spacing**	29 m
Inter-Riffle Gradient	0.18 %	**Max Pool Depth**	1 m
Riffle Gradient	1.17 %		

Particle Sizes (cm)

	Pebble Counts
D10	0.0007
D50	0.23
D90	4.26

Historical Analysis

Land Use: Agriculture and scrubforest dominant land uses.

Channel Change: Channel was widened into ponds/lakes after 1954 at Almira and the south end of Bruce Mills Conservation Area

Migration Rates (m/yr): Altered channel between 1954 and 1977 when the ponds were created. Obscured by vegetation in 1999.

Stability

Rapid Geomorphic Assessment	**(RGA)**	0.29	**Transitional**
Rapid Stream Assessment	**(RSAT)**	31	**Moderate Stability**

Stability Rankings :
<20 - Low, 20-35 - Moderate, >35- High

Stability Index :
0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustment

Site Photo's ***GR-16***

Photo 1. At monitoring cross-section looking downstream.

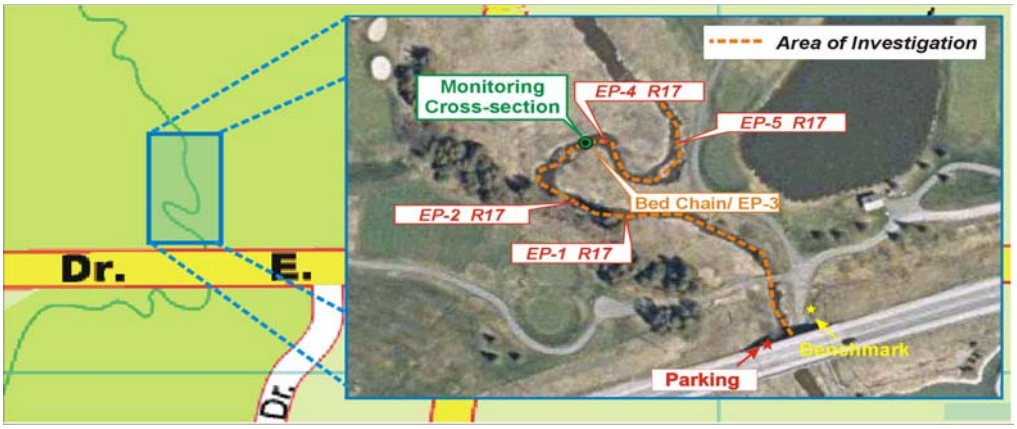
Photo 2. At monitoring cross-section looking upstream.

FLUVIAL GEOMORPHOLOGY SUMMARY

Rouge River - GR-17

Date of Survey: 28-Aug-02
Number of cross-sections: 10
Associated Fisheries Site: NONE
Access: Park on the shoulder of Major Mackenzie Drive, the site is immediately upstream (North) of the bridge.

Site Map



Planform Characteristics

Long Profile (avg)

Bankfull Gradient	0.41 %	**Riffle Length**	6 m
Inter-Pool Gradient	0.48 %	**Riffle-Pool Spacing**	15 m
Inter-Riffle Gradient	0.5 %	**Max Pool Depth**	1 m
Riffle Gradient	3.82 %		

Particle Sizes (cm)

	Pebble Counts
D10	0.0007
D50	0.586
D90	9.25

Historical Analysis

Land Use: Dominant land use is scrub forest and agricultural lands.

Channel Change: Obscured in 1999, no coverage in 1977 or 1954.

Migration Rates (m/yr): Obscured by vegetation in 1999 and no mapping available for 1954 and 1977.

Stability

Rapid Geomorphic Assessment **(RGA)** 0.295 **Transitional**

Rapid Stream Assessment **(RSAT)** 25 **Moderate Stability**

Stability Rankings :
<20 - Low, 20-35 - Moderate, >35- High

Stability Index :
0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustment

Site Photo's ***GR-17***

Photo 1. At benchmark.

Photo 2. At monitoring cross-section looking downstream.

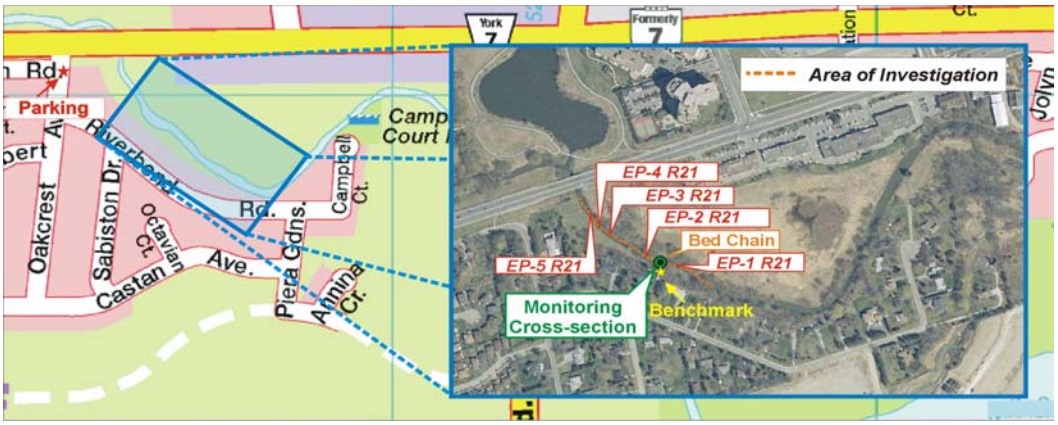
Photo 3. At monitoring cross-section looking upstream.

FLUVIAL GEOMORPHOLOGY SUMMARY

Rouge River - GR-21

Date of Survey: 24-Sep-02
Number of cross-sections: 9
Associated Fisheries Site: NONE
Access: Park on Oakcrest Avenue, walk down Hwy 7 to the river. The site is immediately downstream (South) of the Hwy Bridge.

Site Map



Planform Characteristics

Long Profile (avg)

Bankfull Gradient	0.02 %	**Riffle Length**	10.33 m
Inter-Pool Gradient	0.71 %	**Riffle-Pool Spacing**	1.41 m
Inter-Riffle Gradient	0.23 %	**Max Pool Depth**	2 m
Riffle Gradient	0.8 %		

Particle Sizes (cm)

	Pebble Counts
D10	0.0006
D50	0.61
D90	15.88

Historical Analysis

Land Use: More subdivisions were built after 1977.
Parkland was created after 1954, after the reservoir was created.
Dominant land use is scrubland/forest.

Channel Change: Reservoir was not present in 1954, therefore a significant change in the appearance (width length, meander) of the river since that time.

Migration Rates (m/yr): Altered channel between 1954 and 1977 and between 1977 and 1999.

Stability

Rapid Geomorphic Assessment **(RGA)** 0.293 **Transitional**

Rapid Stream Assessment **(RSAT)** 17 **Low Stability**

Stability Rankings :
<20 - Low, 20-35 - Moderate, >35- High

Stability Index :
0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustment

Site Photo's ***GR-21***

Photo 1. At benchmark.

Photo 2. At monitoring cross-section looking downstream.

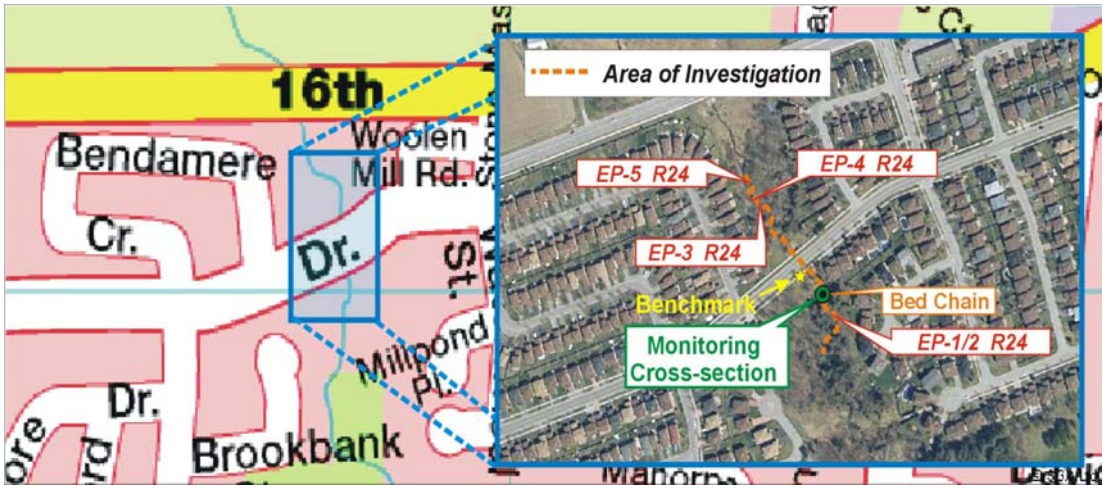
Photo 3. At monitoring cross-sec looking upstream.

FLUVIAL GEOMORPHOLOGY SUMMARY

Rouge River - GR-24

Date of Survey: 1-Oct-02
Number of cross-sections: 10
Associated Fisheries Site: none
Access: The site extends North and South of Raymerville Drive. Park on the shoulder of Raymerville Drive or Bendamere Crescent, the site crosses the Rayemerville Drive culvert.

Site Map



Planform Characteristics

Long Profile (avg)

Bankfull Gradient	0.37 %	**Riffle Length**	16.7 m
Inter-Pool Gradient	0.55 %	**Riffle-Pool Spacing**	28.4 m
Inter-Riffle Gradient	0.7 %	**Max Pool Depth**	1.1 m
Riffle Gradient	2.63 %		

Particle Sizes (cm)

	Pebble Counts
D10	0.0006
D50	0.57
D90	6.59

Historical Analysis

Land Use: No aerial photos or floodplain mapping available for all three years.

Channel Change: No aerial photos or floodplain mapping available for all three years.

Migration Rates (m/yr): No aerial photos or floodplain mapping available for all three years.

Stability

Rapid Geomorphic Assessment **(RGA)** 0.4 **Transitional**

Rapid Stream Assessment **(RSAT)** 31 **Moderate Stability**

Stability Rankings :
<20 - Low, 20-35 - Moderate, >35- High

Stability Index :
0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustment

Site Photo's ***GR-24***

Photo 1. At monitoring cross-section looking downstream.

Photo 2. At monitoring cross-section looking upstream.

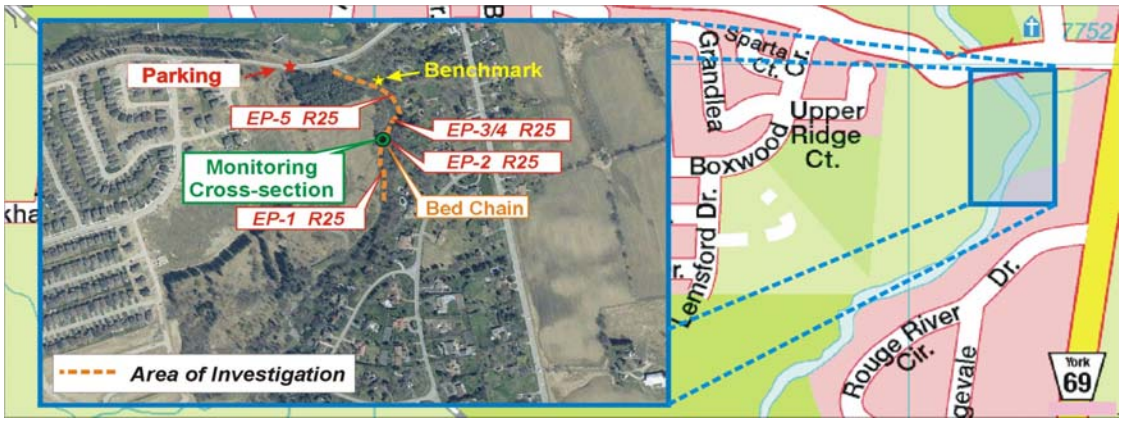
FLUVIAL GEOMORPHOLOGY SUMMARY

Rouge River - GR-25

Date of Survey: 24-Sep-02
Number of cross-sections: 10
Associated Fisheries Site: RG008WM

Access: Park on south side of 14th Avenue. The creek is just West of 14th Avenue and 9th line. Cross sections were conducted downstream (South) of 14th Avenue.

Site Map



Planform Characteristics

Long Profile (avg)

Bankfull Gradient	0.23 %	**Riffle Length**	14 m
Inter-Pool Gradient	0.3 %	**Riffle-Pool Spacing**	30 m
Inter-Riffle Gradient	0.3 %	**Max Pool Depth**	1.8 m
Riffle Gradient	2.17 %		

Particle Sizes (cm)

	Pebble Counts
D10	0.02
D50	1.86
D90	11.15

Historical Analysis

Land Use: Golf Courses/Residential are the dominant land uses for this segment. Golf courses are located along the river and the residential are on the other side of the golf courses. Upstream portion of segment is scrubforest. CNR railway line not present in 1954.

Channel Change: Footbridges/golf cart paths were not present in 1954. Numerous crossings appear in the 1977 and 1999 photos. 1954 the River had a few islands, not present in the other two years.
Bridge footings in river for CNR railway after 1954.

Migration Rates (m/yr): Negligible - no change between 1954 -1999

Stability

Rapid Geomorphic Assessment **(RGA)** 0.414 **in Regime**

Rapid Stream Assessment **(RSAT)** 25.5 **Moderate Stability**

Stability Rankings :
<20 - Low, 20-35 - Moderate, >35- High

Stability Index :
0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustment

Site Photo's ***GR-25***

Photo 1. At monitoring cross-section looking downstream.

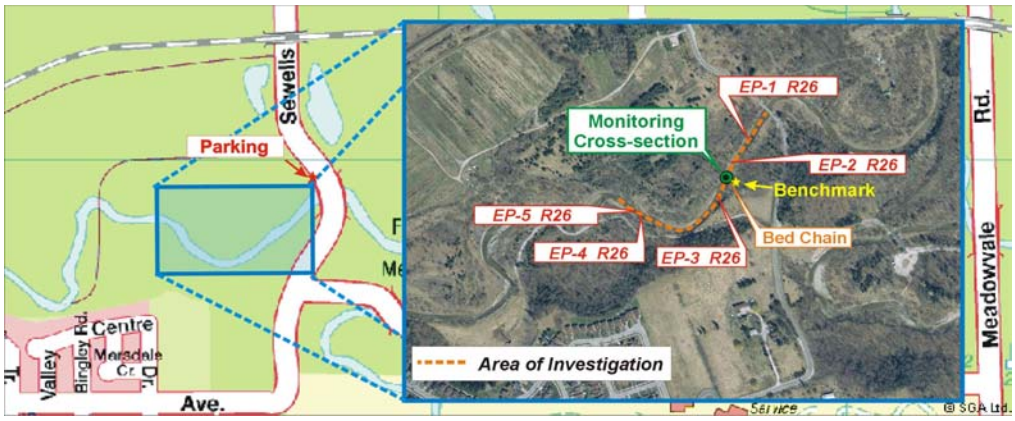
Photo 2. At monitoring cross-section looking upstream.

FLUVIAL GEOMORPHOLOGY SUMMARY

Rouge River - GR-26

Date of Survey: 25-Sep-02
Number of cross-sections: 10
Associated Fisheries Site: RG006WM
Access: Park on Sewells Road at bridge. Site is immediately west of Sewell Road. Site starts at bridge and ends immediately north of the subdivision.

Site Map



Planform Characteristics

Long Profile (avg)

Bankfull Gradient	0.25	%	**Riffle Length**	57	m
Inter-Pool Gradient	0.41	%	**Riffle-Pool Spacing**	63	m
Inter-Riffle Gradient	0.59	%	**Max Pool Depth**	2	m
Riffle Gradient	1.25	%			

Particle Sizes (cm)

	Pebble Counts
D10	0.0023
D50	6.19
D90	17.93

Historical Analysis

Land Use: Mainly scrubland and agriculture as land uses in this region.
Reservoir was constructed after 1977 at northern end of segment.
More residential buildings in 1999 then in 1954.

Channel Change: Numerous footbridges were installed after 1954 along this segment of River.
More islands in 1954 then in other two years.One noticeably larger island is located to the west of Sewells Road.
Erosion visible along bends of this segment.

Migration Rates (m/yr): 0.13 m/yr migration rate from Reservoir.
Road west between 1999 and 1977.
0.24 m/yr migration down valley between 1999 and 1954.

Stability

Rapid Geomorphic Assessment **(RGA)** 0.257 **Transitional**

Rapid Stream Assessment **(RSAT)** 27 **Moderate Stability**

Stability Rankings : <20 - Low, 20-35 - Moderate, >35- High

Stability Index : 0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustment

Site Photo's ***GR-26***

Photo 1. At benchmark.

Photo 2. At monitoring cross-section looking downstream.

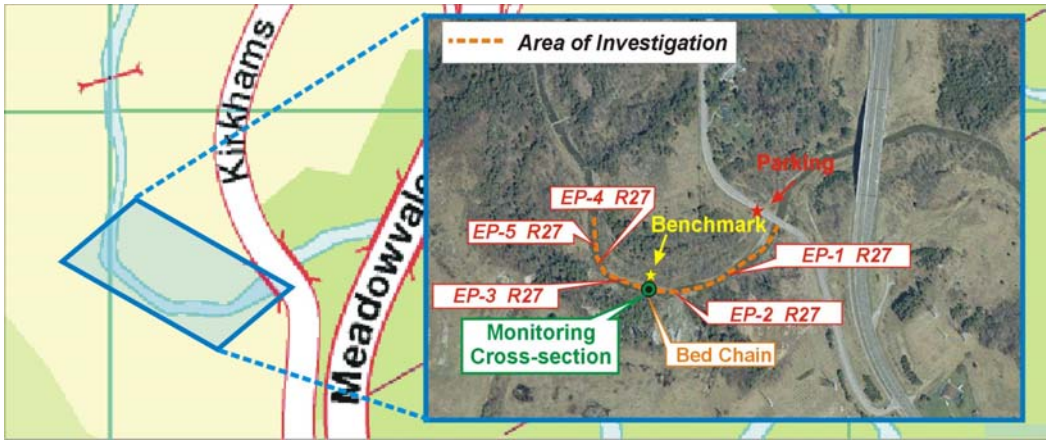
Photo 3. At monitoring cross-section looking upstream.

FLUVIAL GEOMORPHOLOGY SUMMARY

Rouge River - GR-27

Date of Survey: 26-Sep-02
Number of cross-sections: 10
Associated Fisheries Site: NONE
Access: Park on Twyn Rivers Dr., just East of Sheppard Ave. in bend area of road. Site is immediately upstream (North) of Twyn Rivers Drive.

Site Map



Planform Characteristics

Long Profile (avg)

Bankfull Gradient	0.85 %	**Riffle Length**	89 m
Inter-Pool Gradient	0.94 %	**Riffle-Pool Spacing**	96 m
Inter-Riffle Gradient	0.85 %	**Max Pool Depth**	2 m
Riffle Gradient	1.22 %		

Particle Sizes (cm)

	Pebble Counts
D10	0.032
D50	6.94
D90	32.42

Historical Analysis

Land Use: The Metro Toronto Zoo was not present in 1954. A lot of urban infrastructure was introduced for the construction of the Zoo and its access points. Scrubforest and deciduous forests dominant this land use.

Channel Change: Footbridge present in 1977 and 1999, not 1954. More islands present in 1954, then in the other two years as well. Monorail for Zoo crosses at various locations.

Migration Rates (m/yr): No benchmarks to measure from in 1954. Negligible between 1977 and 1999.

Stability

Rapid Geomorphic Assessment **(RGA)** 0.247 **Transitional**

Rapid Stream Assessment **(RSAT)** 27 **Moderate Stability**

Stability Rankings :
<20 - Low, 20-35 - Moderate, >35- High

Stability Index :
0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustment

Site Photo's ***GR-27***

Photo 1. At monitoring cross-section looking downstream.

Photo 2. At monitoring cross-section looking upstream.

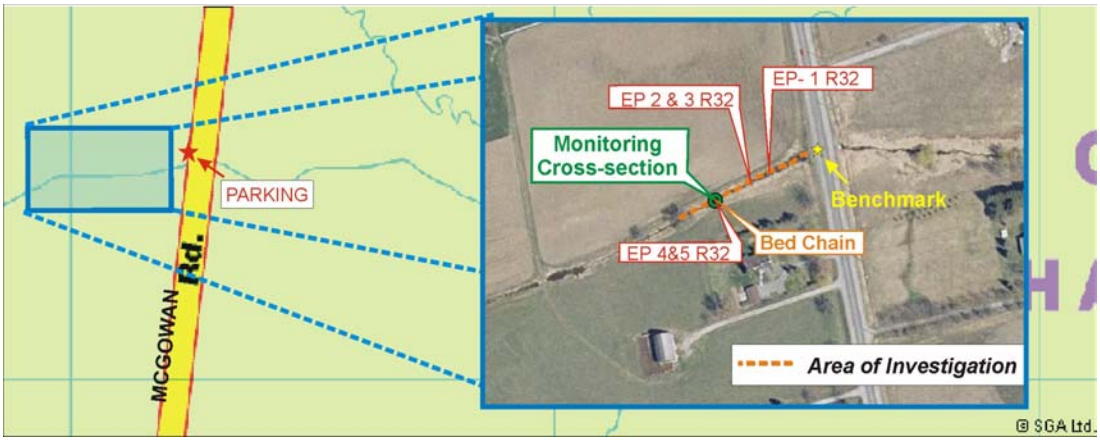
FLUVIAL GEOMORPHOLOGY SUMMARY

Rouge River - GR-32

Date of Survey: 23-Aug-02
Number of cross-sections: 10
Associated Fisheries Site: NONE

Access: Site is West of McCowan Rd., North of Elgin Mills Rd. E. and South of 19th Avenue. Park on the shoulder of McCowan Rd., the site is immediately upstream (West) of the McCowan Rd. culvert. The stream is a straight channel in between agricultural fields.

Site Map



Planform Characteristics

Long Profile (avg)

Bankfull Gradient	0.21 %	**Riffle Length**	2.56 m
Inter-Pool Gradient	0.76 %	**Riffle-Pool Spacing**	2.77 m
Inter-Riffle Gradient	0.47 %	**Max Pool Depth**	0.7 m
Riffle Gradient	3.98 %		

Particle Sizes (cm)

	Pebble Counts
D10	Clay
D50	0.0044
D90	1.38

Historical Analysis

Land Use: Lumber yard at Whitchurch-Stouffville Town Limits.
Agriculture the dominant land use. No changes between years.

Channel Change: No Change between the three years.

Migration Rates (m/yr): Negligible - no change between 1954 -1999.

Stability

Rapid Geomorphic Assessment **(RGA)** 0.26 **Transitional**

Rapid Stream Assessment **(RSAT)** 23.5 **Moderate Stability**

Stability Rankings :
<20 - Low, 20-35 - Moderate, >35- High

Stability Index :
0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustment

Site Photo's ***GR-32***

Photo 1. At monitoring cross-section looking downstream.

Photo 2. At monitoring cross-section looking upstream.

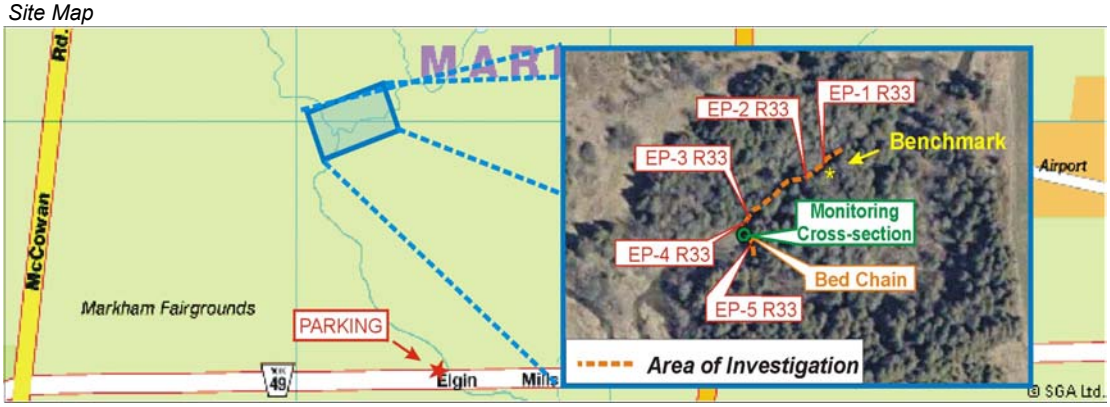
FLUVIAL GEOMORPHOLOGY SUMMARY

Rouge River - GR-33

Date of Survey: 29-Aug-02
Number of cross-sections: 10
Associated Fisheries Site: NONE

Access: Park in the Markham Fairgrounds area. Walk down to the main channel and then walk upstream (North) until the confluence is reached to the tributary. The site is immediately above the confluence on the Eastern tributary.

Site Map



Planform Characteristics

Long Profile (avg)

Bankfull Gradient	0.45 %	**Riffle Length**	15.2 m
Inter-Pool Gradient	0.58 %	**Riffle-Pool Spacing**	26 m
Inter-Riffle Gradient	0.51 %	**Max Pool Depth**	1.2 m
Riffle Gradient	1.33 %		

Particle Sizes (cm)

	Pebble Counts
D10	0.0144
D50	0.74
D90	6.24

Historical Analysis

Land Use: Dominant land use is scrubforest and agricultural fields.

Channel Change: Unchanged over the three years.

Migration Rates (m/yr): Obscured by vegetation for 1999.
No suitable benchmark to measure from.

Stability

Rapid Geomorphic Assessment **(RGA)** 0.479 **In Adjustment**

Rapid Stream Assessment **(RSAT)** 24 **Moderate Stability**

Stability Rankings :
<20 - Low, 20-35 - Moderate, >35- High

Stability Index :
0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustment

Site Photo's ***GR-33***

Photo 1. At monitoring cross-section looking downstream.

Photo 2. At monitoring cross-section looking upstream.

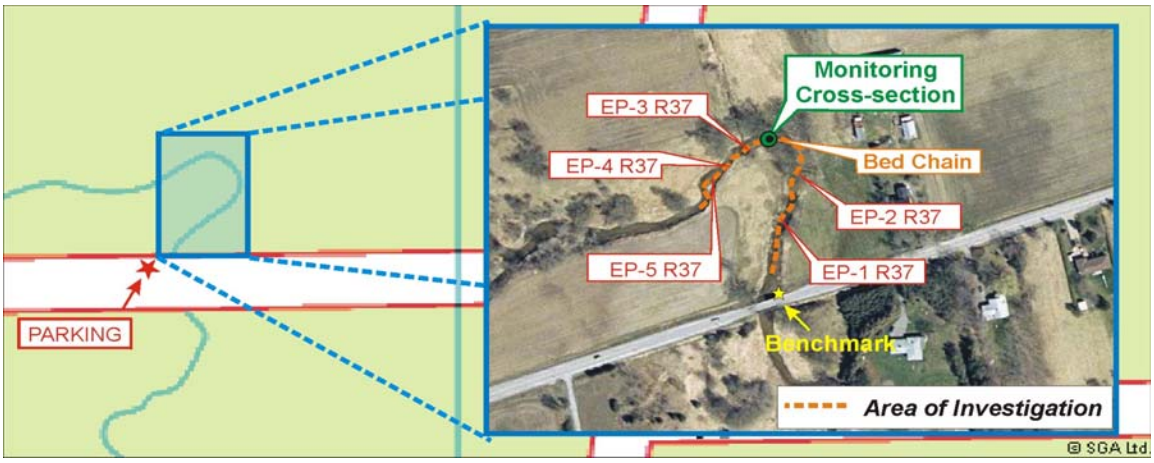
FLUVIAL GEOMORPHOLOGY SUMMARY

Rouge River - GR-37

Date of Survey: 17-Sep-02
Number of cross-sections: 10
Associated Fisheries Site: None

Access: Immediately upstream (north) of Major Mackenzie Dr. E, between Hwy. 48 and 9th line.
Park on shoulder of Major Mackenzie.

Site Map



Planform Characteristics

Long Profile (avg)

Bankfull Gradient	0.15	%	**Riffle Length**	12	m
Inter-Pool Gradient	0.12	%	**Riffle-Pool Spacing**	19.7	m
Inter-Riffle Gradient	0.27	%	**Max Pool Depth**	0.9	m
Riffle Gradient	1.98	%			

Particle Sizes (cm)

	Pebble Counts
D10	0.0478
D50	1.9
D90	6.88

Historical Analysis

Land Use: Scrubforest and a couple of homes were present around the channel in 1999.

Channel Change: Channel planform was similar for 1954 and 1999, deposition visible in 1954 was not seen in 1999 aerial photograph, pond in 1999 not seen in 1954 topo map.

Migration Rates (m/yr): Not available - no set benchmarks to measure from in the 1954 topo map.

Stability

Rapid Geomorphic Assessment **(RGA)** 0.352 **Transitional**

Rapid Stream Assessment **(RSAT)** 25.5 **Moderate Stability**

Stability Rankings :
<20 - Low, 20-35 - Moderate, >35- High

Stability Index :
0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustment

Site Photo's ***GR-37***

Photo 1. At monitoring cross-section looking downstream.

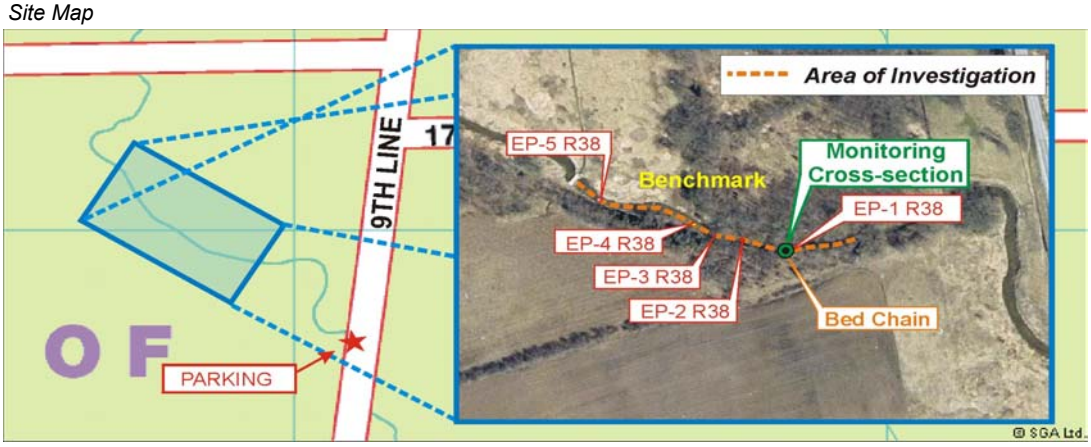
Photo 2. At monitoring cross-section looking upstream.

FLUVIAL GEOMORPHOLOGY SUMMARY

Rouge River - GR-38

Date of Survey: 18-Sep-02
Number of cross-sections: 10
Associated Fisheries Site: RG011WM
Access: Park on 9th Line, and walk West along stream until you get to the fisheries site. Reach (transect 10) starts at fisheries site and goes downstream (South).

Site Map



Planform Characteristics

Long Profile (avg)

Bankfull Gradient	0.05 %	**Riffle Length**	5 m
Inter-Pool Gradient	1.03 %	**Riffle-Pool Spacing**	3.29 m
Inter-Riffle Gradient	0.06 %	**Max Pool Depth**	2.19 m
Riffle Gradient	4.88 %		

Particle Sizes (cm)

	Pebble Counts
D10	0.0008
D50	0.58
D90	6.27

Historical Analysis

Land Use: Deciduous Forest/Scrubforest was the dominate surrounding land use - no change.

Channel Change: Channel planform was the same for all of the three years examined.

Migration Rates (m/yr): Negligible - no change (1954-1999).

Stability

Rapid Geomorphic Assessment **(RGA)** 0.283 **Transitional**

Rapid Stream Assessment **(RSAT)** 24 **Moderate Stability**

Stability Rankings :
<20 - Low, 20-35 - Moderate, >35- High

Stability Index :
0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustment

Site Photo's ***GR-38***

Photo 1. At monitoring cross-section looking downstream.

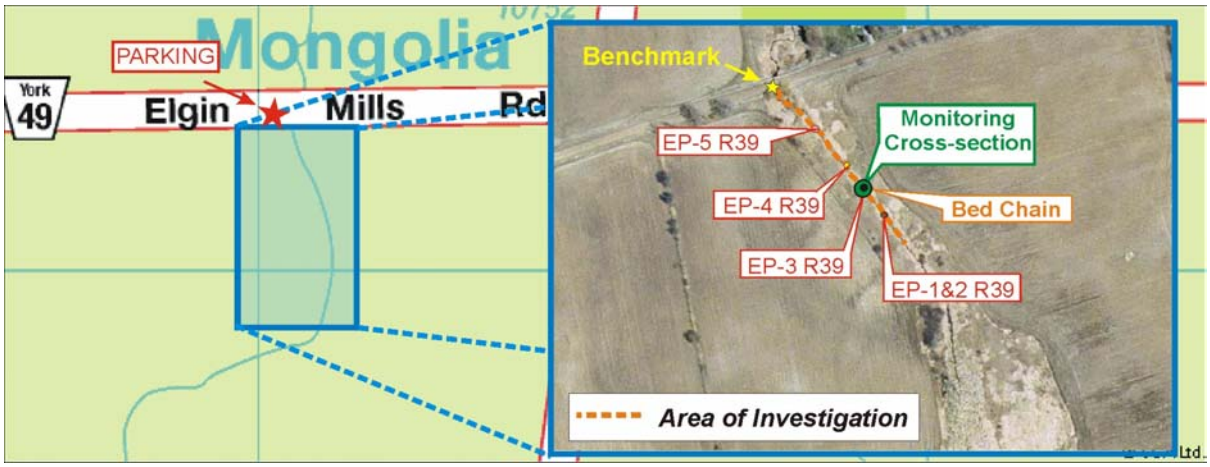
Photo 2. At monitoring cross-section looking upstream.

FLUVIAL GEOMORPHOLOGY SUMMARY

Rouge River - GR-39

Date of Survey: 13-Sep-02
Number of cross-sections: 10
Associated Fisheries Site: NONE
Access: Park on shoulder of Elgin Mills Road E. Site begins immediately downstream (South) of Elgin Mills Road.

Site Map



Planform Characteristics

Long Profile (avg)

Bankfull Gradient	0.65 %	**Riffle Length**	4,57 m
Inter-Pool Gradient	0.49 %	**Riffle-Pool Spacing**	2.1 m
Inter-Riffle Gradient	0.83 %	**Max Pool Depth**	0.6 m
Riffle Gradient	2.44 %		

Particle Sizes (cm)

	Pebble Counts
D10	0.0034
D50	0.54
D90	5.01

Historical Analysis

Land Use: Dominant land use is scrubland and agriculture.

Channel Change: Channel may have been altered prior to 1999. Similar for 1977 and 1954.

Migration Rates (m/yr): No suitable benchmarks to measure from.

Stability

Rapid Geomorphic Assessment	**(RGA)**	0.23	**Transitional**
Rapid Stream Assessment	**(RSAT)**	22	**Moderate**

Stability Rankings :
<20 - Low, 20-35 - Moderate, >35- High

Stability Index :
0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustment

Site Photo's ***GR-39***

Photo 1. General picture at monitoring cross-section.

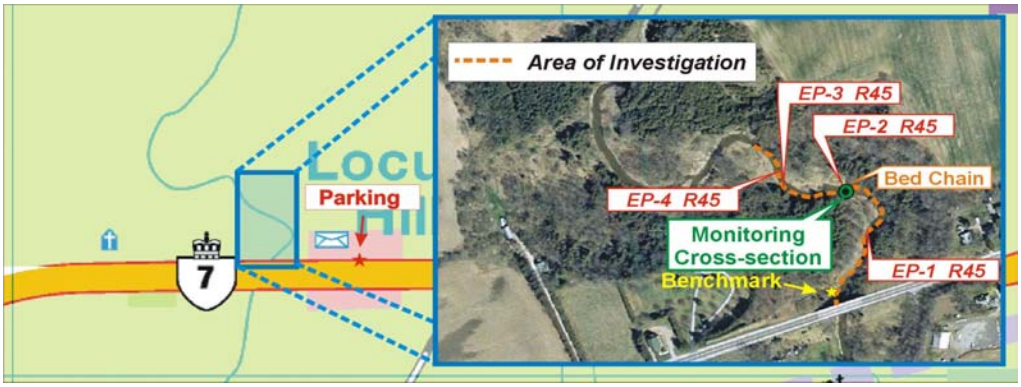
Photo 2. General picture at monitoring cross-section.

FLUVIAL GEOMORPHOLOGY SUMMARY

Rouge River - GR-45

Date of Survey: 23-Sep-02
Number of cross-sections: 10
Associated Fisheries Site: NONE
Access: Site is located immediately upstream (North) of Hwy. 7, East of Reesor Road. Park on the shoulder of Highway 7, the lower end of the site is at the Hwy. 7 bridge.

Site Map



Planform Characteristics

Long Profile (avg)

Bankfull Gradient	0.33 %	**Riffle Length**	19 m
Inter-Pool Gradient	0.6 %	**Riffle-Pool Spacing**	33 m
Inter-Riffle Gradient	0.27 %	**Max Pool Depth**	0.85 m
Riffle Gradient	2.61 %		

Particle Sizes (cm)

	Pebble Counts
D10	0.12
D50	7.08
D90	17.1

Historical Analysis

Land Use: Agriculture was the dominant land use surrounding the river in this area, no change over the three year periods.
Scrubland, mixed forest also dominate the land use.

Channel Change: A few islands were present only in 1954, not in 1977 and 1999.
Low flow crossing in 1977 and 1999, not in 1954.

Migration Rates (m/yr): Negligible- no change between 1954 and 1977
0.07m/yr change between 1977 and 1999.

Stability

Rapid Geomorphic Assessment **(RGA)** 0.232 **Transitional**

Rapid Stream Assessment **(RSAT)** 25.5 **Moderate Stability**

Stability Rankings :
<20 - Low, 20-35 - Moderate, >35- High

Stability Index :
0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustment

Site Photo's ***GR-45***

Photo 1. At benchmark.

Photo 2. At monitoring cross-section looking downstream.

Photo 3. At monitoring cross-sectio looking upstream.

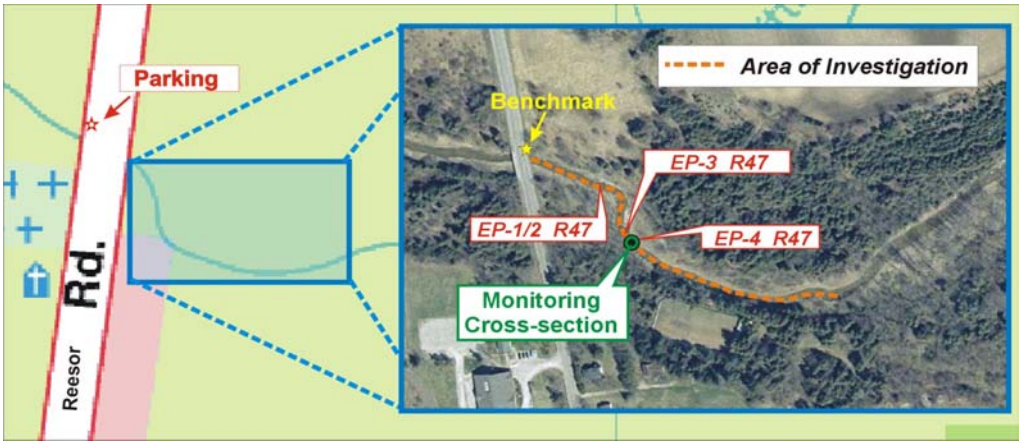
FLUVIAL GEOMORPHOLOGY SUMMARY

Rouge River - GR-47

Date of Survey: 9-Dec-02
Number of cross-sections: 8
Associated Fisheries Site: RGOO7WM

Access: The site is immediately upstream (East) of Reesor Road, South of 14th Ave. on Little Rouge Creek. Park on the shoulder of Reesor Road, site starts upstream (East) of the Reesor Road bridge.

Site Map



Planform Characteristics

Long Profile (avg)

Bankfull Gradient	0.425 %	**Riffle Length**	36 m
Inter-Pool Gradient	1.03 %	**Riffle-Pool Spacing**	51.3 m
Inter-Riffle Gradient	0.64 %	**Max Pool Depth**	1.5 m
Riffle Gradient	1.62 %		

Particle Sizes (cm)

	Pebble Counts
D10	0.51
D50	8.21
D90	20.73

Historical Analysis

Land Use: Agriculture and Scrubland/forest were the dominate land uses, no changes.

Channel Change: More islands present in 1954 then in 1977 and 1999. In 1999's the bends look eroded.

Migration Rates (m/yr): 1999-1977 - 0.16 m/yr.
1999-1954 - 0.05 m/yr.
1977-1954 - negligible.

Stability

Rapid Geomorphic Assessment **(RGA)** 0.107 **In Regime**

Rapid Stream Assessment **(RSAT)** 35 **Moderate Stability**

Stability Rankings :
<20 - Low, 20-35 - Moderate, >35- High

Stability Index :
0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustment

Site Photo's ***GR-47***

Photo 1. At monitoring cross-section looking downstream.

Photo 2. At monitoring cross-section looking upstream.

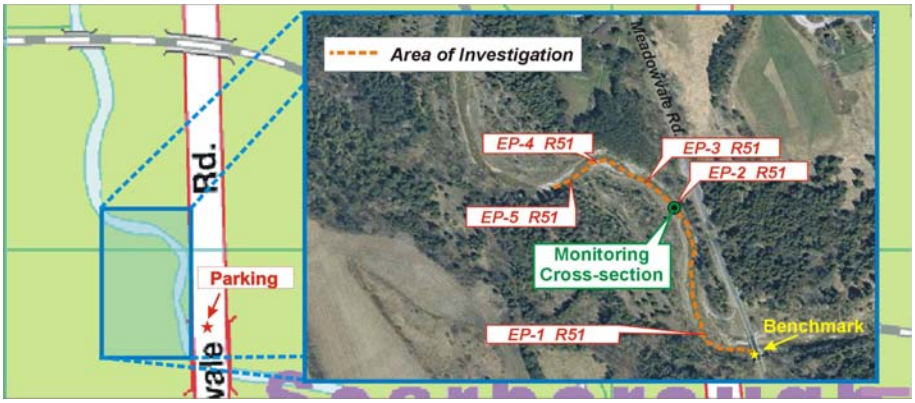
FLUVIAL GEOMORPHOLOGY SUMMARY

Rouge River - GR-51

Date of Survey: 10-Dec-02
Number of cross-sections: 8
Associated Fisheries Site: NONE

Access: Site is North of Old Finch Ave., and immediately West of Meadowvale Road. Park on the shoulder of Old Finch Ave., the site is upstream (West) of Meadowvale Road.

Site Map



Planform Characteristics

Long Profile (avg)

Bankfull Gradient	0.81 %	**Riffle Length**	27 m
Inter-Pool Gradient	1.27 %	**Riffle-Pool Spacing**	52 m
Inter-Riffle Gradient	0.98 %	**Max Pool Depth**	2 m
Riffle Gradient	2.35 %		

Particle Sizes (cm)

	Pebble Counts
D10	0.019
D50	5.64
D90	23.33

Historical Analysis

Land Use: The CNR railway was not present in 1954 photos.
Valley wall and scrubforest dominate this land use.

Channel Change: Channel seems to be similar in shape for all of the three years examined.
Crossing located near Scarborough/Markham City Limits not present in 1954.

Migration Rates (m/yr): 1999-1977 - 0.10 m/yr down valley.
1999-1954 - 0.04 m/yr down valley.
1977-1954 - negligible.

Stability

Rapid Geomorphic Assessment **(RGA)** 0.186 **In Regime**

Rapid Stream Assessment **(RSAT)** 21.5 **Moderate Stability**

Stability Rankings :
<20 - Low, 20-35 - Moderate, >35- High

Stability Index :
0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustment

Site Photo's ***GR-51***

Photo 1. At benchmark.

Photo 2. At monitoring cross-section looking downstream.

Photo 3. At monitoring cross-section looking upstream.

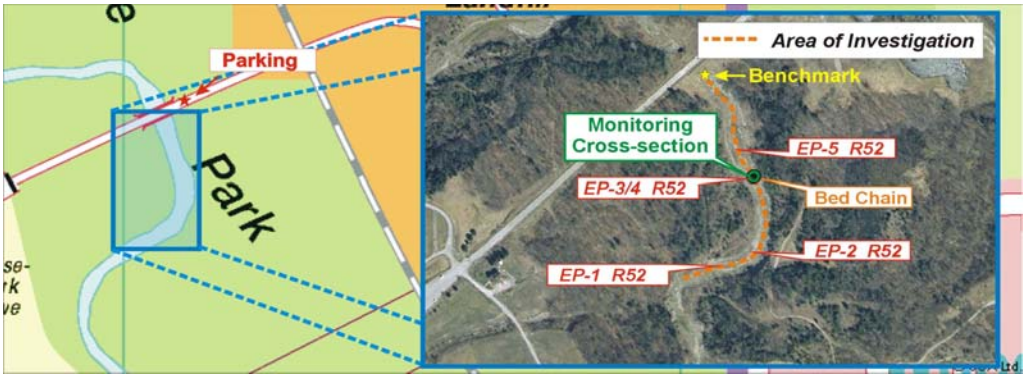
FLUVIAL GEOMORPHOLOGY SUMMARY

Rouge River - GR-52

Date of Survey: 30-Sep-02
Number of cross-sections: 10
Associated Fisheries Site: NONE

Access: Park on shoulder of landfill access road, near culvert. Site is downstream (South) of the culvert crossing.

Site Map



Planform Characteristics

Long Profile (avg)

Bankfull Gradient	1.04 %	**Riffle Length**	14.44 m
Inter-Pool Gradient	1.15 %	**Riffle-Pool Spacing**	2.28 m
Inter-Riffle Gradient	1.1 %	**Max Pool Depth**	4.35 m
Riffle Gradient	2.8 %		

Particle Sizes (cm)

	Pebble Counts
D10	0.11
D50	6.31
D90	23.36

Historical Analysis

Land Use: Bridge Crossing off of Meadowvale Road was not present in 1954.
More urban development in 1977 then 1954.
Valley wall and scrubforest dominate this land use.

Channel Change: Channel changes slightly when new bridge was built. Channel seems similar from 1977 to 1999.

Migration Rates (m/yr): 1999-1977 - 0.09 m/yr.
1999-1954 - 0.04 m/yr.
1977-1954 - negligible.

Stability

Rapid Geomorphic Assessment **(RGA)** 0.243 **Transitional**

Rapid Stream Assessment **(RSAT)** 26 **Moderate Stability**

Stability Rankings :
<20 - Low, 20-35 - Moderate, >35- High

Stability Index :
0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustment

Site Photo's ***GR-52***

Photo 1. At benchmark.

Photo 2. At monitoring cross-section looking downstream.

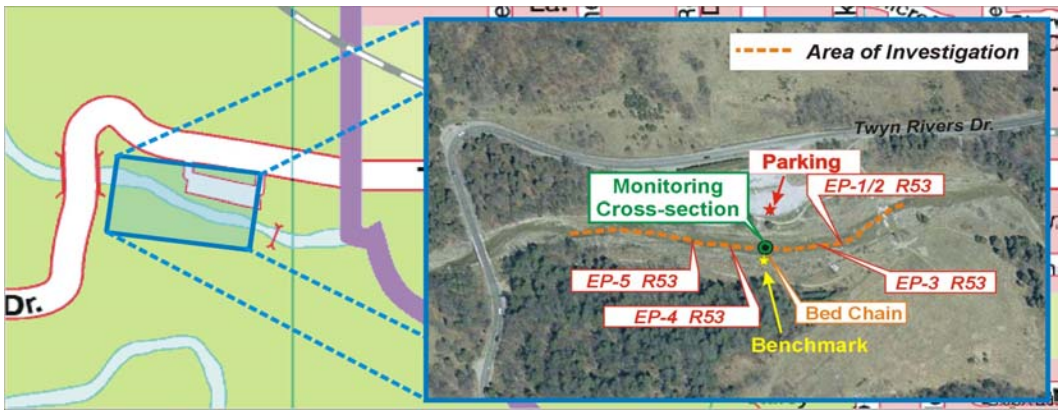
Photo 3. At monitoring cross-section looking upstream.

FLUVIAL GEOMORPHOLOGY SUMMARY

Rouge River - GR-53

Date of Survey: 9-Oct-02
Number of cross-sections: 10
Associated Fisheries Site: RG001WM
Access: Park on shoulder of Twyn Rivers Dr., past parking lot on South side of street. The site is South of the bridge, the detailed work began downstream of the dam (~300 m South of the bridge).

Site Map



Planform Characteristics

Long Profile (avg)

Bankfull Gradient	0.42 %	**Riffle Length**	29 m
Inter-Pool Gradient	0.32 %	**Riffle-Pool Spacing**	55 m
Inter-Riffle Gradient	0.37 %	**Max Pool Depth**	1.7 m
Riffle Gradient	1.41 %		

Particle Sizes (cm)

	Pebble Counts
D10	0.026
D50	5.21
D90	21.82

Historical Analysis

Land Use: Urban residential growth has increased substantially since 1954 on eastern side of the site. Scrubland/forest dominant land use on western side of site.

Channel Change: Junction of Little Rouge Creek and the Rouge River is closer to Highway No. 2 in 1999 and 1977 then in 1954.
Few more islands in channel in 1977 then in 1954. Channel has meandered more in 1977 then 1954.

Migration Rates (m/yr): Negligible for all three years studied.

Stability

Rapid Geomorphic Assessment **(RGA)** 0.292 **Transitional**

Rapid Stream Assessment **(RSAT)** 34 **Moderate Stability**

Stability Rankings :
<20 - Low, 20-35 - Moderate, >35- High

Stability Index :
0.2 - in Regime, 0.21-0.4 - Transitional/Stressed, 0.41 - in Adjustment

Site Photo's ***GR-53***

Photo 1. At monitoring cross-section looking downstream.

Photo 2. At monitoring cross-section looking upstream.