WITNESS STATEMENT OF

A. K. MITCHELL P. Eng.
HYDROLOGIST
M. M. DILLON LIMITED

IN THE MATTER OF AN APPLICATION BY
THE REGIONAL MUNICIPALITY OF HALTON
FOR A
CERTIFICATE OF APPROVAL
FOR THE CONTINUED USE OF
THE BURLINGTON LANDFILL SITE

IN THE MATTER OF an Application by the Regional Municipality of Halton for Continued Use of the Burlington Landfill Site

WITNESS STATEMENT

of

Allan K. Mitchell, P.Eng., Branch Manager
Environmental Engineering and Science
M.M. Dillon Limited

NAME: Allan K. Mitchell, P.Eng.
Branch Manager
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TESTIMONY REQUESTED BY: Regional Municipality of Halton

SUMMARY OF QUALIFICATIONS

Memberships: Professional Engineer
Association of Professional Engineers of Ontario
American Water Works Association

Education: B.Sc. Civil Engineering (1972) with specialty in Water Resources Engineering, University of Guelph, Guelph, Ontario.

Specialty courses in Water Resources Engineering included:

- Fluid Mechanics
- Watershed Engineering

- Open Channel Flow
- Water and Waste Treatment
- Irrigation and Drainage
- Ground Water Development

Undergraduate Thesis:

- Stream Sediment Derived from Construction Activities and its Control

Employment History:

1972 - 1973 University of Guelph

- Sessional Lecturer, fluid mechanics; responsible for complete course development and instruction

- Research Assistant on Hanlon Creek Ecological Study (Guelph, Ontario) and Marmot Creek Snowmelt Model (Kananaksis, Alberta)

1973 - 1978 M.M. Dillon Limited
Environmental Engineering Division
London, Ontario

Project Engineer in the Environmental Engineering Division for various hydrology, flood control and water supply projects including:

- W. Darcy McKeough Dam and Diversion; involved with the design of a major flood control scheme on the North Sydenham River to protect the Town of Wallaceburg, Ontario. Project involved design of dam and control works, together with a major diversion channel approximately 7 km in length and having a design capacity of 385 m^3/sec.

- Chenal Ecarte Water Level Study and Dyking Project, including supervision of field crew for collection of hydrologic data, stream gauging and micro drainage survey

- Cooks Lake Dam Hydrologic Study involving hydrologic investigation for spillway design and water balance to determine source suitability for water supply for Township of Schreiber in northwestern Ontario

- Ausable Bayfield Hydrologic Study, involving development of design flows using synthetic hydrologic techniques for two large agricultural drainage basins

- Water supply projects for several communities and regions including East Lambton County, Killaloe Station, Plympton Township, and the Regional Municipality of Haldimand-Norfolk

1978 - 1983 Department Head, Water Resources Engineering, functioning as Project Manager on a variety of projects for flood and erosion control, flood plain and fill line mapping, highway and urban drainage, storm water management and water supply. Representative projects include:

- Humber River at Oak Ridges, Preliminary Engineering Study
- Highway 404, Drainage Design and Creek Diversion
- Rouge River and Highland Creek, Flood Plain Mapping
- Town of Coniston, Flood Control Remedial Works
- Onakawana River Diversion, Conceptual Design
- Truro Hydrotechnical Study, Bay of Fundy, Nova Scotia
- Cedar, Wigle and Mill Creeks, Flood and Fill Line Mapping
- Turkey Creek, Flood Plain Mapping
- Duval River Hydrology Study for the Government of the Northwest Territories
- Parkhill Dam, Review of Operational Procedures
- City of Kitchener, Urban Drainage Studies
- Town of Markham, Storm Water Management Studies
- St. Paul Storm Water Management Study for City of Windsor
- Whitefish River, Flood Plain Mapping
- Moon River, Feasibility Study for Fish Habitat Improvement
- Drainage Design and Erosion Control for several proposed and existing landfill sites including Halton Region Landfill - Site F, Ridge Landfill, and Oxford County Landfill

1984 - Date Appointed Branch Manager, Environmental Engineering and Science; responsible for Water Resources Engineering, Solid Waste Engineering and Hazardous Materials Departments.

TOPICS TO BE ADDRESSED

- General hydrologic concerns at landfill sites
- Hydrology of site and surrounding area
- Design flows before and after landfilling
- Water levels before and after landfilling
- Erosion and sedimentation control

SUMMARY OF EVIDENCE

The evidence presented by Mr. Mitchell is in accordance with the hydrological analysis of the Burlington Landfill site expansion. The surface drainage report, which comprised Section R of the Burlington Landfill Site - Application for Continued Use Report was prepared under the supervision of Mr. Mitchell. This evidence, as outlined in the topics to be addressed, can be summarized as follows:

a) General Hydrologic Concerns at Landfill Sites

- Criteria to be used in the design of new runoff conveyance systems and hydraulic structures in the vicinity of the landfill site.

- The effect that the landform (and associated steeper overland flow slopes) will have on on-site drainage patterns and peak flows.

- The effect of the landfill on flood levels in adjacent watercourses and mitigation of flood problems where required.

- Potential erosion resulting from site operations and the control of erosion to minimize adverse effects on surface water quality and reduction in downstream channel capacity by sediment deposition.

b) Hydrology of Site and Surrounding Area

Approximately 80% of the site is located within the Falcon Creek watershed, while the remaining 20% (northeast corner of the site) is located within the Indian Creek watershed. Both watersheds are very steep, and soils are generally categorized under the Oneida series. Sieve analyses indicate the soils are comprised primarily of silts and clays (approximately 80%).

At present, surface runoff is conveyed off-site via three perimeter ditches, which together completely encircle the completed portion of the landform. The west ditch conveys runoff through a sediment pond to the south of the site, then along the Service Road to the main branch of Falcon Creek where it crosses beneath the Service Road (3.0 m x 1.5 m box culvert) and Highway 403 (4.3 m x 1.5 m box). The east ditch conveys runoff from the east portion of the completed landform and has its outlet near the south end of the landform, to an intermittant swale on National Sewer Pipe property. This swale is also tributary to Falcon Creek. The tributary crosses the Service Road and Highway 403 via 0.9 m diameter culverts and joins the main branch of Falcon Creek approximately 100 m downstream from Highway 403. The northeast

again no sedimentation pond.

ditch is located at the extreme northeast corner of the site and conveys runoff from this area to a tributary of Indian Creek. This tributary crosses beneath the Service Road (1.8 m x 1.5 m box culvert) and Highway 403 (2.5 m x 1.5 m box culvert) approximately 500 m east of the landfill access road, and joins the main branch of Indian Creek approximately 1200 m downstream from Highway 403.

The landfill expansion will result in additional developed lands contributing runoff to both the Indian Creek and Falcon Creek watersheds. This runoff must be accommodated by existing or new site ditches and ultimately by off-site watercourses. The impact on the site drainage system and on the receiving watercourses is discussed below.

c) Design Flows Before and After Landfilling

The proposed landform has been contoured to maintain existing flow patterns as closely as possible. Fifty-year return period flows for before and after expansion conditions were estimated for several locations in the vicinity of the site using the Rational Method. This 50-year criterion was previously approved as the design standard by the Halton Region Conservation Authority. Flow estimates are summarized in Table 1.

Flows have been estimated, both to properly size on-site ditches and culverts, and to assess impacts on adjacent watercourses (Falcon Creek and Indian Creek).

d) Effects of Flow Increases on Water Levels

i) On-Site

Prior to implimentation of the proposed landfill expansion, all existing on-site drainage works will be upgraded if

TABLE 1

FLOW SUMMARY

LOCATION	DRAINAGE AREA (ha) EXISTING	FUTURE	PEAK FLOW (50-Year Return Period) EXISTING cms	(cfs)	FUTURE cms	(cfs)
	(11.5)	(13.4)				
West Ditch (sediment pond)	13.9	15.1	0.88	(31)	1.16	(41)
East Ditch (property boundary)	8.6	7.7 (6.8)	0.82	(29)	0.88	(31)
Northeast Expansion Area (property boundary)	10.5	9.8	0.68	(24)	0.93	(33)
Falcon Creek (North Service Road)	260.0	261.0	10.90	(385)	10.96	(387)
Indian Creek (North Service Road)	51.8	51.1	1.67	(59)	1.93	(68)

necessary, to accommodate the anticipated increases in runoff (based on the 50-year return period storm). The west ditch will be extended uptream to ensure that overland runoff from the landform will continue to be intercepted and diverted away from the very steep and easily erodable valley walls of Falcon Creek.

All new on-site works (northeast perimeter ditches) will be constructed to the same 50-year criterion as the existing ditches. The new perimeter ditches will drain to two existing swales to the south of the expansion area which outlet to a tributary of Indian Creek at the property boundary.

Preliminary calculations indicate that flow depths in all of the perimeter ditches will be less than one meter.

ii) Off-Site

Regarding off-site impacts of anticipated flow increases, each outlet has been assessed as follows:

a) West Ditch

The estimated flow increase (at the sediment pond) is approximately 30% (.88 m^3/sec. to 1.16 m^3/sec.).

Field survey indicates that the outlet ditch along the north side of the Service Road (from the sediment pond to Falcon Creek) can easily accommodate this flow increase, with only minor increases in flow depth (0.06 m) and velocity (0.06 m/sec.).

The Falcon Creek watershed area upstream from the Highway 403 outlet (261 ha) is very large compared to the landfill expansion area (12 ha) which contributes runoff to the west ditch, and ultimately to Falcon Creek. Therefore, the minor increase in runoff due to the expanded landfill site (approximately 0.28 m^3/sec.) is not significant in comparison to the total Falcon Creek flow of ~~10.6~~ 10.96 m^3/sec.

Consequently, off-site impacts resulting from increased flow being conveyed off-site by the west ditch are negligible in terms of both velocity and water level increases.

iii) East Ditch

The estimated flow increase to the east ditch at the property boundary is approximately 6% (0.83 m^3/sec. to 0.89 m^3/sec.).

This minor flow increase will not cause any measureable increase in flow velocity or depth in the outlet swale which runs through the adjacent property.

Therefore, increased flows to the east ditch will not have any significant effect on the downstream property nor will it affect peak flows in Falcon Creek.

iv) Northeast Ditch

The proposed expansion in the northeast corner of the site will be drained via perimeter ditching to two separate swales which join a tributary of Indian Creek at the property boundary. This tributary drains through National Sewer Pipe property to the south and has its outlet beneath the North Service Road via a 1.8 m x 1.5 m box culvert.

The estimated peak flow increase at the property boundary is approximately 38% (0.68 m^3/sec. to 0.93 m^3/sec.). This increase is reduced to approximately 15% at the crossing beneath the North Service Road, located 1200 m downstream.

This flow increase through the adjacent property could increase the flow depth by approximately 0.06 m and velocity by 0.14 m/sec. This will not have a significant effect on either erosion or water levels on the adjacent property.

The difference in water surface elevation at the North Service Road crossing (1.8 m x 1.5 m box) due to this flow increase will be approximately 0.15 m. The steep upstream channel slope (3.5%) will eliminate this increase a very short distance upstream (5 m).

Therefore, the flow increases as a result of the landfill expansion in the northeast corner of the site will have no significant effect on water levels or velocities through the downstream property or at the downstream crossings.

e) Erosion and Sediment Control

i) Existing Conditions

The on-site erosion control program for the existing landfill site comprises the following:

- the application of seed and mulch to all completed landform areas where overland flow could cause erosion

- rip-rap or gabion lining of perimeter ditching where steep slopes would encourage erosion of unprotected ditches

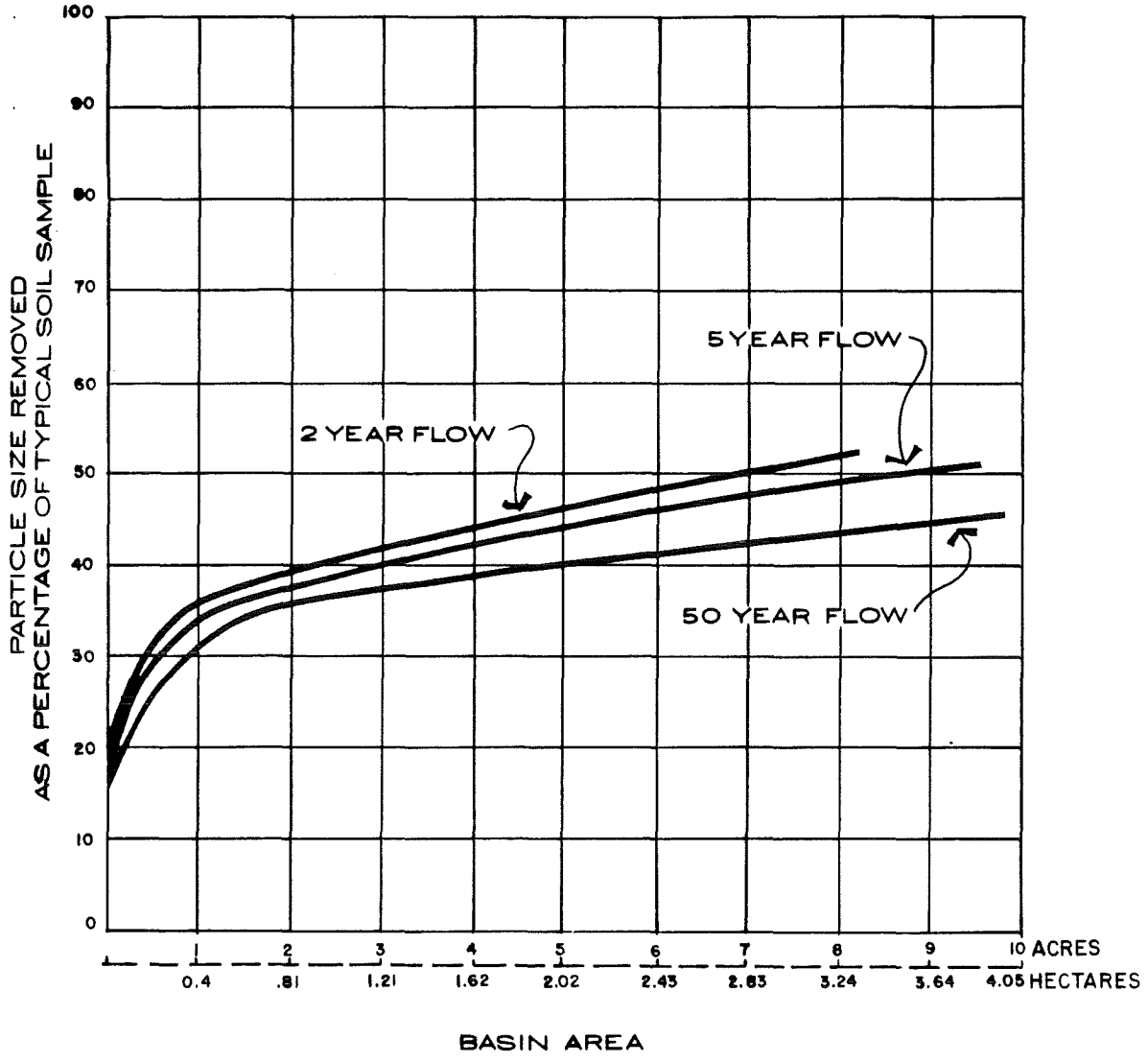
- grass lining in perimeter ditches where anticipated flow velocities would not pose an erosion threat

- gabion drop structures to decrease perimeter ditch slopes and avoid the need for gabion or rip-rap lining

- a sediment pond at the outlet of the west ditch to minimize the amount of sediment reaching Falcon Creek

In addition to the above, the condition of the ditches and sediment pond are continuously being monitored and upgraded, and sediment cleaned out when necessary.

Siltation problems had been experienced in the past at the northern-most access road culvert. However, the



DILLON **BURLINGTON LANDFILL SITE EXPANSION**

REQUIRED BASIN AREA VS. PARTICLE SIZE AS A PERCENTAGE OF TYPICAL SOIL SAMPLE

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construction of a weir across the invert of the perimeter ditch immediately upstream from this crossing has been effective in reducing the required frequency of culvert cleanout.

ii) Future Conditions

Under expansion conditions, increased areas of bare soils will increase the potential for erosion and downstream sediment deposition. Also, increased flows will require reassessment of perimeter ditch linings and provision of additional erosion protection where required.

The effectiveness of the existing west ditch sediment pond has been assessed to determine how efficient it is at removing sediment and how its efficiency will be affected by the anticipated increase in flows with the proposed expansion. The existing basin has a surface area of approximately 0.06 ha (.15 acres). This basin will remove approximately 20% of the sediment based on the 50-year peak flow, and 26% based on the 2-year peak flow. These removal percentages are based on the particle size distribution curve of a typical soil sample taken from the site. The effect of the efficiency of the pond due to increased flows after expansion is not significant.

Owing to the low sediment removal capability of the existing basin, the potential for increased removal has been assessed by analyzing the effectiveness of larger basin sizes (see Figure 1). The curves plotted on this Figure suggest that basin areas up to 0.4 ha in area

yield a reasonable increase in percentage removal, but beyond this point there is very little gain associated with large increases in basin area.

To improve the existing basin efficiency from approximately 25% to 35% would require an increase in basin area of approximately seven times (0.06 ha to 0.4 ha).

Given that the basin will only be required for two years of operation, and its limited effectiveness (only 35% removal even if increased in area by seven times), increasing the sediment basin area cannot be justified.

Based on the low maximum achievable efficiency of the sediment basin at the west ditch outlet, the steep northeast and east ditch slopes, and the lack of land to the east of the landform upon which to construct new sediment basins, it is recommended that alternative erosion control measures be utilized to discourage transport of sediment off-site via the east and northeast ditches. That is, erosion should be controlled at the source rather than trying to trap it in a sediment basin just prior to leaving the site. As part of the overall plan to minimize erosion and sediment transport off-site, it is imperative that the area and length of time that soils remain exposed be minimized. Staging of the landfill will ensure that the exposed area is kept to a minimum and seeding and mulching immediately after completion of each stage will minimize the length of time that erodible soil slopes remain exposed.

In the interim, it is recommended that staked straw bales be placed around the perimeter of areas proposed for expansion to form a continuous dyke, to intercept and filter sediment-laden overland runoff.

Ditch weirs will also be used in the northeast ditch to act as sediment traps. There is already a trap of this type in the west ditch and it has proven effective in preventing downstream culverts from becoming clogged with silt. These traps should be cleaned of sediment after each significant runoff event.

The steep swales draining the proposed northeast expansion area (10% slope) should be protected with rip-rap or gabion lining to the property line to offset the concentration of runoff at these locations.

In summary, erosion control must begin at the source if the impact of the landfill operation on surface waters is to be minimized. Erosion and sediment transport from the proposed expansion will be minimized by the following:

i) continued monitoring of all ditches and swales for erosion, and upgrading where necessary;

ii) maintenance of the west ditch sediment pond by cleaning it out at least two times per year (fall and spring);

iii) minimizing the area of exposed soils, with staging of works;

iv) minimization of length of time soils remain exposed by seeding and mulching immediately after completion of a stage;

v) use of straw bale dykes at the perimeter of all active landfill areas to intercept sediment-laden overload flow until a permanent grass cover is in place;

vi) construction of weir sediment traps in perimeter ditching around the northeast expansion area, and clean out after each significant runoff event;

vii) gabion or rip-rap protection of the swales draining the northeast expansion area to the Indian Creek tributary.

The plan outlined above will ensure that erosion and sediment transport from the proposed landfill expansion will be minimized.

OTHER EXPERTS

The evidence presented herein is consistent with the proposals contained in the Continued Use Report. The evidence does not rely on evidence of any other experts or opinions advanced by other experts.

AVAILABILITY

Mr. Mitchell will be available for examination and cross-examination if required.

SIGNATURE

I have read the foregoing and affirm that the matters referred to are true to the best of my knowledge and belief.

A.K. Mitchell

A.K. Mitchell, P.Eng.
M.M. Dillon Limited