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APPENDIX A

BURLINGTON LANDFILL SITE EXPANSION
ENVIRONMENTAL ANALYSIS

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1. INTRODUCTION

1.1 Background

In July 1978, the Council of the Regional Municipality of Halton authorized M.M. Dillon Limited to study and recommend the best strategy for the provision of landfill capacity until a major new Regional facility for waste disposal and processing could be approved and developed.

The study, The Interim Waste Disposal Feasibility Study, was prepared by M.M. Dillon Limited in September 1978. It assessed the potential for the development of landfill capacity at four locations which included the extension of the Burlington site. Based on recommendations of that study, Council adopted a plan for the development of additional landfilling on the existing Burlington Site as well as onto lands north of the site.

A preliminary environmental analysis was prepared as part of that study. A further detailed analysis was recommended to be part of the submission of reports required for application for the approval of the proposed expansion of the Burlington site.

This appendix has also been prepared to satisfy the requirements of the Environmentally Sensitive Areas Policy of the Official Plan of the Regional Municipality of Halton.

The Falcon Creek ravine immediately west of the existing site and its proposed expansion is designated as an Environmentally Sensitive Area (ESA) referred to as "Sassafras Woods" in the Official Plan.

An ESA is defined as a land or water area "containing natural features or ecological functions of such significance as to warrant their protection in the best long-term interests of the people and environment of Halton Region."[1]

The Policy states that an Environmental Impact Assessment (EIA) is required where the physical and/or biological features of an ESA may become altered. Included in this report is an assessment of the impact of landfill operations adajcent to Sassafras Woods.

This appendix was also prepared to reflect the concerns expressed by Halton Region's Environmental and Ecological Advisory Committee (EEAC). EEAC is primarily concerned about the impact of landfilling on 3 areas:

i) Sassafras Woods;
ii) the eroded slopes[2] along the west boundary of the existing site;
iii) water quality of Falcon Creek.

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1 *Regional Municipality of Halton, Ecological and Environmental Advisory Committee, Environmentally Sensitive Area Study, Planning Department, 1978.*

2 *Slope is within the boundaries of the Environmentally Sensitive Area.*

1.2 Purpose and Scope

This appendix has been prepared to:

i) address concerns identified in the preliminary environmental analysis contained in The Interim Waste Disposal Feasibility Study;

ii) satisfy the requirements of the Environmentally Sensitive Areas Policy of the Official Plan;

iii) address concerns expressed by EEAC.

The primary objectives of the study were to:

i) survey existing environmental conditions of the site extension;

ii) assess the environmental effects of existing and proposed landfill operations;

iii) recommend measures to minimize adverse environmental effects.

The study area is outlined on Drawing 1.

1.3 Method

This study was carried out in 3 stages. The first stage involved a review of secondary sources, contacting relevant agencies and interpretation of air photos.

A field investigation was conducted in the second stage of the study in June 1979. Additional field work was undertaken in August and September. Terrain, surface drainage characteristics, vegetation and fish and wildlife habitat were surveyed. Air quality, with respect to the potential for dust in dry weather, and potential visibility of landfill operations on the site extension were investigated.

The third stage of the study identified the environmental effects of landfilling and recommended measures to minimize potential effects.

2. EXISTING SITE CONDITIONS

2.1 Physiography and Soils

The site is located on a clay plain underlain by Queenston shale.[1] Two ravine systems form the site boundaries: a ravine extending along the western and northern edge, identified as high hazard land slopes by Ontario Land Inventory and, a ravine extending along the eastern edge, identified as high hazard lands because of soil erosion potential.[2]

The site occurs as a plateau between the ravine systems, and slopes irregularly to the south. The southerly sloping topography has been altered on the adjoining lands by land-fill operations, resulting in raised, hummocky terrain.

The western and eastern ravines are overlain with deep red clay.[3] Shale occurs close to the surface on the western and eastern slopes where ground cover has been removed and surficial materials have been eroded.

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1 *Caley, J.F., Paleozoic Geology of the Toronto-Hamilton Area, Ontario, Geological Survey of Canada, 1961.*

2 *Ministry of Natural Resources, Ontario Land Inventory, Hazard Lands, Hamilton-Burlington Area (no date).*

3 *Regional Municipality of Halton, Ecological and Environmental Advisory Committee, Environmentally Sensitive Area Study, Planning Department, September 1978.*

Soil on the proposed site extension is composed of well drained Oneida loam.[1] The agricultural capability of the site is rated as 60% Class 1 and 40% Class 3. Topography causes the major limitation to agricutural activity in the area.[2]

2.2 Site Drainage

The proposed site extension includes two drainage basins: one draining to Falcon Creek in the ravine to the west and north; and one draining to Indian Creek in the ravine to the east. A small intermittent tributary of Falcon Creek is located in the northwest corner of the site extension. Most of the site extension presently drains to Falcon Creek. Only the eastern-most portion of the site drains into Indian Creek.

Surface runoff from the completed landfilling area is presently collected in drainage ditches along the eastern and northern site boundaries. Runoff is then diverted directly over the steep red shale slopes of the western ravine to Falcon Creek (see Drawing A), and to swales entering Indian Creek southeast of the site.

Collector ditches are not seeded or mulched. The seeding of these pitches was postponed when consideration was given to expanding landfill operations. This has resulted in the

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1 *Gillespie, J.E., and R.E. Wicklund, The Soils of Halton County, 1971.*

2 *ARDA, Soil Capability for Agriculture, 1968.*

severe erosion of the ravine slopes and sedimentation in drainage swales. As a result of the erosion of the ravine slopes, runoff from the site over the western slope has removed vegetation and formed many deep gullies.

2.2.1 Surface Water Quality

Gartner Lee Associates Limited undertook a water quality survey in the spring and summer of 1979.[1] Water quality was tested on samples taken at a station on Falcon Creek downstream of the landfill near Highway 403. Results are presented in Table 1.

The results of testing did not indicate a significant impact on water quality from landfill operations.

Concentrations of phenols recorded a maximum of 1 ppb in one sample at one location only. This is the Ontario Ministry of the Environment's drinking water quality guideline for phenols. This is the only water quality parameter that suggests leachate may have entered Falcon Creek and been detectable. Values for alkalinity, hardness, sulphates, chlorides and iron are somewhat high. However, levels of these chemical parameters are not unusually high for a creek flowing through an area of Queenston shale bedrock.[2] When compared to results from the ground water quality sampling, the measurements recorded for Falcon Creek are considerably lower. The results from two of the boreholes that were drilled to test ground water are also presented in Table 1.

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1 *Results presented in Hydrogeological Study Final Report Proposed Burlington Landfill Site, September 1979.*

2 *Gartner Lee Associates Ltd., Hydrogeologic Study Final Report Proposed Burlington Landfill Site Extension, September 1979.*

TABLE 1

WATER QUALITY - FALCON CREEK

SAMPLE LOCATIONS:

1. Falcon Creek Water Quality near Highway 403
2. Leachate characteristics (Borehole #8 through landfill)
3. Background Water Quality (Borehole #1 located in the north corner of the site extension).

	4 April 1979			2 May 1979			4 June 1979		
	1	2	3	1	2	3	1	2	3
CONDUCTIVITY µMHOS/CM.	540	-	880	630	13,850	3,260	690	15,600	5,400
pH	7.9	-	7.5	8.0	5.5	7.2	8.4	5.7	7.5
HARDNESS ($Ca\ CO_3$)	254	-	238	314	8,000	1,110	351	10,100	1,804
ALKALINITY ($Ca\ CO_3$)	185	-	204	245	6,890	163	-	-	-
CHLORIDES (Cl)	35	-	47	35	1,190	136	28	13,000	203
SULPHATES (SO_4)	53	-	203	-	-	-	61	750	2,950
TOTAL PHOSPHOROUS AS P									
Soluble									
NITROGEN Total Kjeldahl	0.6	-	1.6	-	-	-	0.4	720	5.4
Free Ammonia	-	-	-	-	-	-	-	-	-
Nitrite	-	-	-	-	-	-	-	-	-
Nitrate	-	-	-	-	-	-	-	-	-
METALS Potassium (K)	-	-	-	-	-	-	3.3	570	44
Magnesium (Mg)	-	-	-	-	-	-	-	-	-
Calcium (Ca)	-	-	-	-	-	-	-	-	-
Sodium (Na)	18	-	105	-	-	-	23	930	800
Iron (Fe)	.95	-	15	.40	800	6.0	.27	970	3.1
B.O.D.	0.6	-	135	-	-	-	1.40	26,000	28
PHENOL (ppb)	<1	-	<1	1.1	-	-	-	-	-
C.O.D.									
COLOUR									

Note: Concentrations in ppm unless otherwise noted.

Leachate is seeping from springs along the toe of the landfill. From the toe it appears to be seasonally entering the stream by overland flow. Ground water discharge does not appear to be a major source of leachate contamination to the stream. Ground water flows to depth and moves in a southerly direction.

A more detailed one year water monitoring program is currently being undertaken by Gartner Lee Associates Ltd.

2.3 Vegetation

Vegetation was examined during field surveys in the spring, summer and fall of 1979. Vegetation is described for the ravine forest edge, hedgerows, the eroded western shale/clay slope, fields and stream banks.

2.3.1 Ravine Forest Edge

Mixed ravine forest communities occur along the western, northern and eastern site boundaries (Drawing A). The forest structure is primarily secondary growth, with more mature trees established in the lower ravine areas. The forest presently supports rich canopy and understorey flora which has high ecological value, and very high functional value in controlling slope erosion.

The ravine forest bordering the west and north limits of the proposed site extension, "Sassafras Woods", meets two of the nine criteria for establishing an Environmentally Sensitive Area:[1]

i) the area is a habitat with limited representation in the Region, Ontario or Canada, or a small remnant of particular habitats which have virtually disappeared within the Region;

ii) the area provides habitat for rare or endangered species that are endangered regionally, provincially or nationally.

Sassafras Woods is distinguished for:

i) the provision of habitat for Carolinian species at the northern limit of their range in Ontario;

ii) the presence of nationally, provincially and regionally rare tree and ground flora species; and

iii) the size, location and linkage value of the woods in the context of remaining escarpment forest.[2]

Sassafras Woods is approximately 100 hectares (247 ac) in size. Sugar maple is the dominant species in association with shagbark hickory, witch hazel, ironwood and red oak.

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1 *Regional Municipality of Halton, Ecological and Environmental Advisory Committee, Environmentally Sensitive Area Study, Planning Department, September 1978, (see excerpt in Appendix 2).*

2 *Ibid.*

The western and northern edges of Sassafras Woods abutting the site extension were examined. Table 2 summarizes species information. No rare plants were observed along the ravine forest edge.

The Indian Creek ravine borders part of the eastern property boundary of the existing landfilling area and the proposed site extension. Trees are generally young to semi-mature with a few scattered mature specimens of red and white oak. Table 3 summarizes species information in that area.

Vegetation near the drainage outlet to Indian Creek is dominated by young to semi-mature trembling aspen trees.

Vegetation near the drainage outlet to Falcon Creek largely consists of forbs, grasses and shrubs. Species include:[1]

- goldenrod
- asters
- field horsetail
- wild carrot
- grasses
- clovers
- thistles
- willow shrubs
- red maple and white ash saplings
- ferns

The drainage ditch discharges into Falcon Creek in an area where there are very few mature trees.

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1 *All scientific names are included in Appendix A1.*

TABLE 2

VEGETATION ALONG WESTERN AND NORTHERN EDGE OF SASSAFRAS WOODS

Area (Refer to Base Map)	Dominant Trees	Size Age	Shrubs	Herbaceous Plants	Comments
A	. red oak . shagbark hickory . large-tooth aspen . hawthorn . ironwood . white ash . witchhazel	• young to semi-mature • 20-cm dbh • 3-6m in height	. hawthorn . choke cherry . honeysuckle . serviceberry . sumac . saplings of dominant trees	. sweet brier . false solomon's seal . solomon's seal . common buttercup . sharplobed hepatica . common cinquefoil . common strawberry . thimbleweed . wild grape	. red maple (10-20 cm dbh) . sweetcherry (20-25 cm dbh) in association with the dominants along ravine crest . red oak, sugar maple and white pine (40-50 cm dbh) in depressional areas
B	. white oak . red oak . trembling aspen . white ash . sumac . hawthorn	• mature • 20-55 cm dbh	. same species as in Area A	. same species as in Area A	. sugar maple, black maple, shagbark hickory, white pine in association with dominant trees
C	. white oak . red oak . sugar maple . white maple . white ash . black cherry . witch hazel	• 10-45 cm dbh	. honeysuckle . hawthorn . chokecherry . saplings of dominant trees	. solomon's seal . false solomon's seal . trillium . roundlobed hepatica . thimbleweed . jewelweed . wild lily-of-the-valley . white baneberry . common strawberry . common cinquefoil	. ironwood, sweet cherry, red maple (10-30 cm dbh) in association with dominants

TABLE 3

VEGETATION ALONG EDGE OF INDIAN CREEK RAVINE

Area (Refer to Base Map)	Dominant Trees	Size Age	Shrubs	Herbaceous Plants	Comments
D	. sugar maple . white ash . ironwood . shagbark hickory . red oak . white oak	• less than 30 cm dbh	. hawthorn	. false solomon's seal . common strawberry . common cinquefoil	
E	. large tooth aspen . hawthorn . white oak . red oak . shagbark hickory	• 10-20 cm dbh • several red and white oaks are 40-55 cm dbh	. very few shrubs open understory		. open structure

2.3.2 Hedgerows

Hedgerows form the southern and eastern boundaries of the site extension. The predominantly shrubby structure of these hedgerows distinguishes them from adjoining ravine forest communities.

The hedgerow forming the eastern site extension boundary (Hedgerow 1) is composed of hawthorn and honeysuckle, intermixed with mature white oak, red oak and shagbark hickory. The oaks range in size between 40-65 cm (16-26 in) dbh. Shagbark hickory trees are estimated at up to 25 cm (10 in) dbh. Also present in the hedgerow are mature sugar maple, and white ash and nannyberry estimated at less than 20 cm (8 in) dbh.

The hedgerow along the southern site boundary (Hedgerow 2) is largely comprised of hawthorn and honeysuckle shrubs, with a sparse representation of:

- shagbark hickory
- red oak
- white ash
- american elm
- black maple[1]

With the exception of the elm, the hedgerow trees are generally young to semi-mature, averaging 10-20 cm (4-8 in) dbh. The mature elm tree is approximately 35 cm (14 in) dbh.

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[1] *Black maple is regionally uncommon.*

The hedgerow located along the east side of the existing landfill site entrance road (Hedgerow 3) is composed of bur oak ranging between 10-50 cm (4 in-20 in) dbh and scattered young shagbark hickory. A clump of semi-mature eastern cottonwood forms the northernmost portion of the hedgerow.

2.3.3 Eroded Western Clay/Shale Slope

Young trees, shrubs and herbaceous plants have colonized the more stable crest and toe areas of the actively eroding slope. Vegetation has been displaced from most of the steep west-facing slope.

On stable slope areas, several trees and shrubs (less than 15 cm (6in) dbh) were noted during field investigations:

- red oak
- white oak
- shagbark hickory
- white ash
- large-tooth aspen
- trembling aspen
- sumac
- hawthorn
- choke cherry
- currant
- poison ivy
- honeysuckle

Several species of herbaceous flora were also observed along stable areas of the slope, including:

- white sweet clover
- yellow sweet clover
- red clover
- nightshade
- nipplewort
- pasture rose
- sweet brier
- common buttercup
- common milkweed
- wild carrot
- yarrow
- cow vetch
- common mullein
- shepherd's purse

In actively eroding gullies and along gully spines, these herbaceous species are colonizing most successfully:

- ox-eye daisy
- common strawberry
- field horsetail
- goldenrod
- hawthorn
- common chickory
- choke cherry
- wild carrot
- welted thistle
- pasture rose
- sumac
- winter cress
- great burdock

2.3.4 Fields

The area proposed for the site extension is a typical old field ecosystem composed of timothy grass, asters, goldenrod, cow vetch, thistles, red clover and common buttercup.

The completed landfill site is sparsely covered with herbaceous species similar to those colonizing the eroded clay slopes (see Section 2.3.3). Yellow and white sweet clover, chickory, shepherd's purse, and ox-eye daisy are the most abundant.

2.3.5 Stream Banks

Trees and shrubs noted along the banks of Falcon Creek include:

- american elm
- black willow
- witch hazel
- eastern cottonwood
- ironwood
- white ash
- wild grape
- virginia creeper
- honeysuckle

Two provincially and regionally rare herbaceous plants[1] were noted in the Falcon Creek stream valley: large-bracted tick trefoil (Desmodium cuspidatum) and three-leaved false solomon's seal (Smilacina trifolia). The persistence of these plants will not be affected.

Downstream of the drainage outlet to Falcon Creek, vegetation is dominated by dogwood shrubs, brambles, virginia creeper, sumac and young white elm, cottonwood and shagbark hickory saplings. There are few mature trees in that area.

Along the banks of Indian Creek, these trees and shrubs were noted:

- shagbark hickory
- black willow
- large-tooth aspen
- white ash
- sumac
- honeysuckle

2.4 Fish and Wildlife

2.4.1 Regional

The study area is included in an area rated by Canada Land Inventory as Class 2 (out of 7 classes)[2] for the production

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1 *Regional Municipality of Halton, Ecological and Environmental Advisory Committee, Environmentally Sensitive Area Study, Planning Department, September 1978.*

2 *Class 1 - high; Class 7 - low.*

of deer.[1] Optimum plant growth for forage and cover is limited by a poor soil nutrient content and soil moisture. Canada Land Inventory rates the area as Class 7 for the production of waterfowl.[2]

Ontario Land Inventory rates the capability of the area for the production of seven wildlife species: white-tailed deer, ruffed grouse, hungarian partridge, ring-necked pheasants, european hare, migrant geese and ducks.[3] Table 4 summarizes the rating.

2.4.2 Local

During the site field survey, several birds were observed: red-tailed hawk, turkey vulture, ruffed grouse, herring gull, kildeer, catbird, song sparrow (and nest), bobolink and red-winged blackbird. Other birds such as whip-poor-will, golden-crowned kinglet and the ruby-crowned kinglet have been sighted in Sassafras Woods.[4]

Considerable deer activity has been noted along Falcon Creek. Since deer are usually found only in relatively undisturbed natural areas, Sassafras Woods is generally considered to be a significant local habitat and corridor for many wildlife species.[5]

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1 *Canada Land Inventory, Land Capability for Wildlife - Ungulates, 1971.*

2 *Ibid, Waterfowl, 1971.*

3 *Ontario Land Inventory, Land Capability Classification for Wildlife, 1976.*

4 *Regional Municipality of Halton, Ecological and Environmental Advisory Committee, Environmentally Sensitive Area Study, Planning Department, September 1978.*

5 *Armour, L., Royal Botanical Gardens, Hamilton. Personal communication, 28 June 1979.*

TABLE 4

LAND CAPABILITY CLASSIFICATION FOR WILDLIFE

SPECIES	CLASS (1-high; 7-low)	LIMITATIONS[1]
White-tailed deer	2	deficient soil moisture
Ruffed grouse	2	deficient soil moisture
Hungarian partridge	2	deficient soil moisture
Ring-necked pheasants	3	climate; deficient soil moisture
European hare	2	deficient soil moisture
Migrant geese	2	deficient soil moisture
Puddle ducks; wood ducks, duck hunting	7	lack of free-flowing water; excessively flat or rolling topography restricting water impoundment; unfavourable landform pattern.

1 *Characteristics that limit the production of suitable food and cover for wildlife or have an adverse effect on the species.*

The Ministry of Natural Resources has described the potential of Falcon and Indian Creeks to support fish as limited. These intermittent creeks are assumed to contain minnows and perhaps suckers in the summer. The potential of the Creeks to support fish is limited by their physical parameters, such as low flow, low velocity and relatively high water temperature.[1]

2.5 Air Quality

During field surveys (undertaken in dry weather conditions) dust resulting from vehicular traffic along the site access was observed. Dust was controlled by applying waste oil along the access road. Oil was observed in the drainage swales.

The impact of blowing dust and particulate matter on air quality is local to the site and not of major environmental significance. Of greater significance is the detrimental effect of waste oil that is washed by overland flow into drainage swales.

Observations of air quality consisted of a visual assessment of existing conditions, no quantitiative measures were taken.

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1 *Gingrich, M., Ministry of Natural Resources, Cambridge, Personal communication, 4 and 5 July 1979.*

3. EFFECTS OF LANDFILLING

An analysis was made of the potential for adverse effects on:-

- erodible western clay/shale slope
- stream water quality
- vegetation
- fish and wildlife
- air quality

The visibility of proposed landfill operations is also examined.

A description of some of the effects of current landfill operations are included to predict effects of the proposed site expansion.

The potential environmental effects of proposed landfilling operations are summarized as follows:

- surface runoff causing continued erosion along the west clay/shale slope.

- increased sediment loading and turbidity in Falcon and Indian Creeks as a result of soil erosion during initial site preparation and operation. Water quality could be significantly impaired because of low flow and low velocity of the creeks.

- leachate may enter surface water.

- loss of vegetation in Sassafras Woods as a result of gully erosion.

- removal of, or damage to plants in Sassafras Woods and in the Indian Creek ravine during site preparation, drainage ditch construction and site operation.

- removal of a hedgerow along southern site extension boundary.

- the imposition of landfill activity and noise on the local wildlife habitat.

- reduction in creek water quality and effect on aquatic habitat.

- excessive dust produced by vehicular traffic on site access road.

- impact on water quality as a result of using waste oil for dust control.

- visibility of landfill operations on the site extension from residences and roads.

4. RECOMMENDATIONS

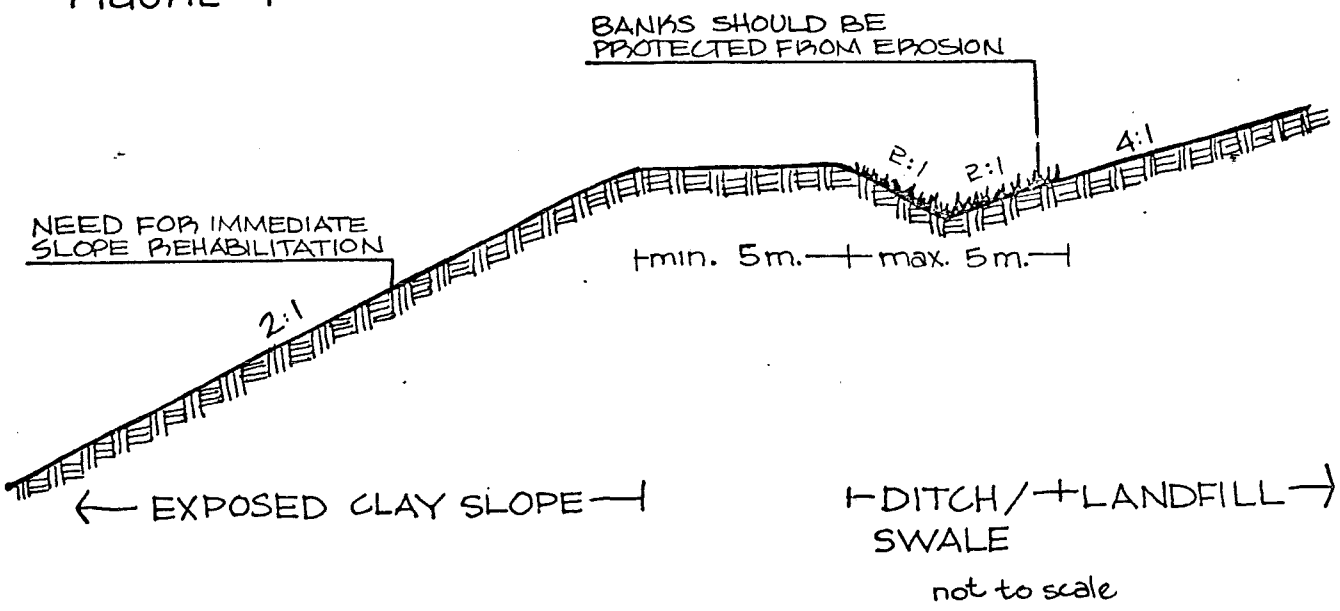
Based on the impact of current landfilling operations, recommendations are made to minimize impact as a result of operations on the proposed site extension. Detailed construction guidelines should be developed for the initial site preparation. Recommendations are described according to environmental features listed in the beginning of Chapter 3.

4.1 Erodible Western Clay/Shale Slope

Surface runoff from past landfill operations was collected in peripheral ditches, and directed to Indian Creek and Falcon Creek. As described in Section 2.1, surface water diverted to the west was routed directly over the steep ravine slope. Runoff has eroded the clay till overburden and has exposed the Queenston shale which is very susceptible to rapid weathering and erosion. The proposed drainage scheme for the site extension will direct runoff from the eastern portion of the site in existing ditches to Indian Creek. Most of the surface runoff will be directed along the western site boundary to outlet into Falcon Creek near Highway 403. At this location, the creek valley is gently sloping and shallow.

The new drainage scheme is designed to ensure that runoff will not be directed over the eroded clay/shale slopes. The proposed ditch will have a large width and depth capacity and a berm along the western ditch wall cut into overburden. The walls of the ditch should be protected to prevent slope back-cutting and channel bed erosion (see Figure 1).

FIGURE 1



Appropriate measures will be identified during design of the drainage works and included in the Design and Operations Final Report.

Temporary erosion control measures should be implemented during construction of the drainage outlet to Falcon Creek. The period and extent of construction activity along this area of the ravine slope should be minimized to avoid unnecessary disturbance to soils and vegetation. Site preparation should be undertaken outside of the heavy rainfall season. This clay/shale slope is very susceptible to erosion and measures must be implemented to ensure that it will be checked. Section 4.2 presents general recommendations for protection of vegetation and subsequent revegetation of the slope in the vicinity of drainage outlet construction.

It is recommended that remedial measures immediately be undertaken to rehabilitate the eroded western slope abutting the existing site. The suitability and feasibility of various erosion control measures should be analyzed to assess the best method of slope stabilization on this very sensitive and significant area.

All-terrain vehicles are causing and aggravating severe degradation of the erodible slopes and the valley bottoms. If erosion control measures are to be successful, all-terrain vehicles must be prohibited from entering the area.

4.2 Surface Water Quality

The site is overlain by clays which contribute to high levels of mineral colloids and surface water turbidity. As clay particles are very difficult to settle out of suspension in water, erosion should be controlled at the source. The Region will undertake a program of progressive site rehabilitation. Areas of completed landfilling will be graded, topsoil will be applied and areas will be hydroseeded.

As described in Section 4.1, erosion control measures for ditches will be identified during design of drainage works. Specific methods to control ditch channel and slope erosion will be selected according to expected runoff intensity. If feasible, sediment barriers (e.g. silt fence, straw bale, sandbags) should be installed in drainage ditches to filter sediment laden runoff before entering Falcon or Indian Creek. During construction of the drainage outlets, a

temporary sediment barrier, or similar protection measure, should be installed downstream in the creeks to filter or trap sediment. The creek banks should be protected from erosion during construction. Permanent erosion control measures should be implemented as soon as construction is complete.

The hydrologic characteristics of the site should be understood to ensure that leachate does not migrate to watercourses.

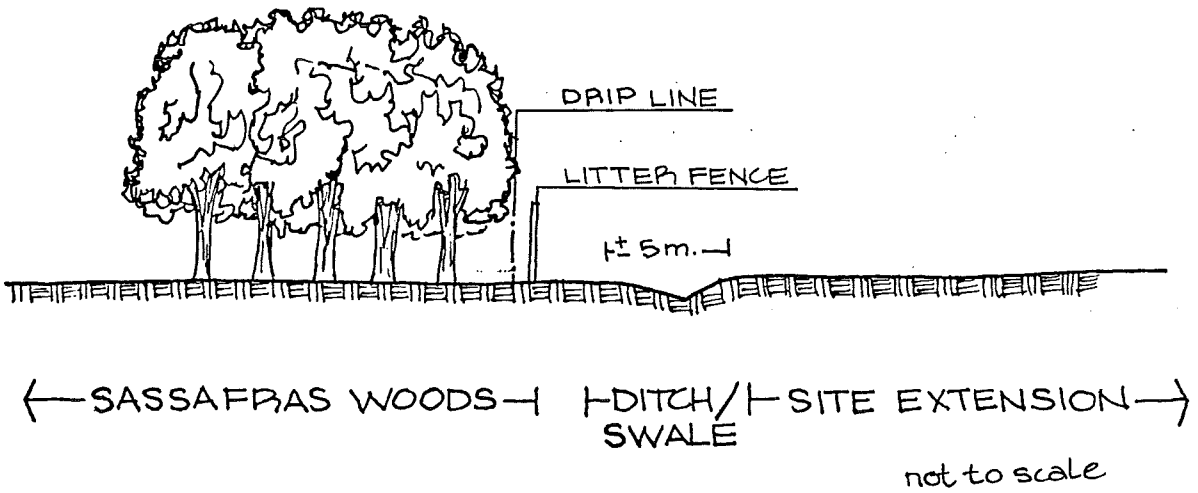
4.3 Vegetation

4.3.1 Sassafras Woods

Surface runoff from the landfill site will be directed to an outlet entering Falcon Creek south of current landfill operations (see Section 4.2). Both the routing of runoff and the capacity of the diversion ditch should protect the slopes of Sassafras Woods Sensitive Area from the initiation of gully erosion along the wooded edge and exposure to potential surface runoff contaminants.

In the initial construction phase, a wire mesh fence should be erected along the edge of Sassafras Woods on the site extension. The fence should be erected outside the drip line zone of the edge trees (set at approximately 5 metres). This fence will serve as a barrier to machinery movement during drainage ditch construction and site preparation, and should prevent serious root, branch or stem damage to trees, shrubs and herbaceous plants (see Figure 2). The fence

FIGURE 2



should remain after initial site preparation is completed to intercept litter blowing from the landfill site. No vegetation should be removed.

The drainage ditch will outlet into Falcon Creek near Highway 403. South of Sassafras Woods the ditch will follow along the top of bank and join Falcon Creek where there are the least topographic and vegetation limitations. There will be very little vegetation removal and the alignment of the ditch will ensure that any large specimen trees are avoided.

A large clearing, dominated by herbaceous vegetation, exists where the ditch will discharge into Falcon Creek. A temporary fence should be installed around the perimeter of the forest edge abutting the clearance to protect plants against damage during construction of the drainage outlet. The slope should then be immediately revegetated to ensure that soil erosion is controlled.

4.3.2 Eastern Ravine Woods and Hedgerows

Site preparation and drainage ditch construction should not require the removal of vegetation from the hedgerow along the east boundary of the proposed site extension or from the edge of the eastern ravine woods (see Drawing A). A wire mesh litter fence (see Section 4.3.1) should be erected along the edge of the hedgerow and the eastern ravine woods to protect vegetation from damage during initial site preparation. The fence set-back specification outlined in Section 4.3.1 should be followed.

Construction of the drainage outlet to Indian Creek will require the removal of some trees along the ravine edge. Young and semi-mature large-tooth aspen and cottonwood trees will be removed. These species are very common in the area.

The hedgerow along the southern site extension boundary will be removed. This hedgerow is presently composed of hawthorn and honeysuckle shrubs, interspersed with young and semi-mature ash, oaks, hickory and a mature elm (see Section 4.3.2). With the exception of the black maple, trees, shrubs and ground flora to be removed in this hedgerow occur throughout the study area.

4.4 Fish and Wildlife

The presence of heavy equipment, dust and noise during the construction and operation phases of landfill development, will create less hospitable habitat conditions for local wildlife. Dust should be controlled by methods outlined in

Section 4.5. Confinement of landfill activity within the site boundaries (see Section 4.3) should prevent any reduction of edge vegetation density or continuity. The present edge structure of the ravine woods provides an advantageous buffer, and its maintenance is critical to continued wildlife activity in the ravine woods.

The drainage ditch outlet to Falcon Creek is located downstream of the Environmentally Sensitive Area and therefore should not affect its fish or wildlife habitat. Downstream of the outlet, Falcon Creek flows through urban areas where there is little aquatic habitat.

The aquatic habitat of Indian Creek should be protected by implementing the erosion control measures suggested in Section 4.1 and 4.2.

4.5 Air Quality

Dust produced by operations on the site extension should be controlled by applying water or calcium chloride to site access roads. Calcium chloride, however, should not be used within 10m from the brow of the Falcon Creek ravine. Waste oil should not be used for dust control because of the risk of contamination of the creeks.

4.6 Landfill Visibility

Most vegetation surrounding the site will be maintained for its value as a visual buffer. Forest vegetation and the ravines west, north and east of the site effectively screen the view from most of the residences along peripheral roads.

Air photo interpretation, land contour analysis and field surveys, revealed that certain stages of landfill operations may be visible from one residence located northwest of the site. Ravine vegetation partially obstructs the view from the residence.

Final landfill contours are designed in such a way that when viewed from areas outside the site, there will be little perceptible change in topography. In addition, the Region will progressively rehabilitate completed landfill areas to help minimize any visual effects of the operations.

Landfill operations on the site extension will not be visible from Highway 403. The existing landfill site will screen proposed operations from Highway 403. There will be a view of the site extension from King Road. The hedgerow along the east site extension boundary will be maintained to help screen operations.

5. SUMMARY

5.1 Conclusions

- Continued erosion along the west clay slope should be prevented by surface drainage design and remedial measures for slope rehabilitation.

- No impairment of surface water quality, as a result of leachate, is anticipated.

- Erosion and sedimentation measures should reduce sediment loading and turbidity in Indian and Falcon Creeks.

- Little impact on Sassafras Woods is anticipated. No vegetation will be removed and perimeter fences will protect plants from damage during initial site preparation and site operation.

- Surface drainage design will protect the ravine slopes of Sassafras Woods from erosion as a result of runoff.

- Litte impact on fish and wildlife habitat is anticipated.

- There will be little perceptible change in topography when the landfill is viewed from areas outside of the property.

- The Region's plan for progressive site rehabilitation will minimize visual effects of site operations.

5.2 Recommendations

1. For protection of erodible clay/shale slope:

   - Prevent runoff flow over slope.
   - Implement erosion control measures in drainage ditches.
   - Implement temporary erosion control measures on banks of Falcon Creek during construction of drainage ditch and outlet.
   - Minimize period and extent of construction activity near Falcon Creek.
   - Undertake site preparation outside of the heavy rainfall period.
   - Minimize vegetation removal and revegetate the valley slope after construction of the drainage outlet.
   - Rehabilitate the eroded slope.
   - Prohibit all-terrain vehicles on the slope.

2. For protection of surface water quality:

   - Erosion control measures in all drainage ditches will reduce sediment input to runoff.

- If feasible, install sediment barriers in drainage ditches to filter runoff before discharging into Falcon or Indian Creek.

- Prohibit migration of leachate into water-courses.

- Install temporary sediment barrier (or similar measure) downstream of construction activity for drainage outlets to Falcon and Indian Creeks.

- Protect creek banks from soil erosion during construction of drainage outlets.

- Implement permanent erosion control measures in valleys as soon as construction is completed.

3. For protection of vegetation:

   - Erect a wire mesh fence along the hedgerow and ravine woods edge on the boundaries of the site extension.

   - Erect a temporary fence around the perimeter of the forest abutting the clearance near the drainage outlet to Falcon Creek.

4. For protection of fish and wildlife habitat:

   - Control dust.

   - Confine landfill operations within fenced boundaries.

   - Protect aquatic habitat with erosion and sedimentation control measures on site, in drainage ditches and in Falcon and Indian Creeks.

5. For protection of air quality:

   - Apply water and/or calcium chloride to site access roads for dust control during dry conditions.

   - Calcium chloride should not be used to control dust within 10 m of the brow of the Falcon Creek ravine.

   - Waste oil should not be used for dust control.

APPENDIX A1
Scientific Names for Plant Species

SCIENTIFIC NAMES

a) Trees:

Common Name	Scientific Name
ash, white	*Fraxinus americana*
aspen, large-tooth	*Populus grandidentata*
aspen, trembling	*Populus tremuloides*
cherry, black	*Prunus serotina*
cherry, sweet	*Prunus avium*
cottonwood, eastern	*Populus deltoides*
elm, american	*Ulmus americana*
hawthorn	*Crataegus* sp.
hickory, shagbark	*Carya ovata*
ironwood	*Ostrya virginiana*
maple, black	*Acer nigrum*
maple, red	*Acer rubrum*
maple, sugar	*Acer saccharum*
nannyberry	*Viburnum lentago*
oak, bur	*Quercus macrocarpa*
oak, red	*Quercus rubra*
oak, white	*Quercus alba*
pine, white	*Pinus strobus*
sumac	*Rhus typhina*
willow, black	*Salix nigra*
witch hazel	*Hamamelis virginiana*

b) Shrubs:

Common Name	Scientific Name
choke cherry	Prunus virginiana
currant	Ribes sp.
hawthorn	Crataegus sp.
honeysuckle	Lonicera sp.
serviceberry	Amelanchier sp.
sumac	Rhus typhina

c) Herbaceous Plants:

sweet brier	Rosa eglanteria
false solomon's seal	Smilacina racemosa
solomons seal	Polygonatum p. pubescens
common buttercup	Ranunculus acris
sharp-lobed hepatica	Hepatica acutiloba
common cinquefoil	Potentilla simplex
common strawberry	Fragaria virginiana
thimbleweed	Anemone virginiana
wild grape	Vitis sp.
trillium	Trillium sp.
round lobed hepatica	Hepatica americana
jewelweed	Impatiens sp.
wild lily-of-the-valley	Maianthemum canadense
white baneberry	Actaea pachypoda

Herbaceous Plants (continued)

Common Name	Scientific Name
poison ivy	Rhus radicans
white sweet clover	Melilotus alba
yellow sweet clover	Melilotus officinalis
red clover	Trifolium pratense
nightshade	Solanum dulcamara
nipplewort	Lapsana communis
pasture rose	Rosa carolina
common milkweed	Asclepias syriaca
wild carrot	Daucus carota
yarrow	Achillea millefolium
cow vetch	Vicia cracca
common mullein	Verbascum thapsus
shepherd's purse	Capsella bursa-pastoris
ox-eye daisy	Chrysanthemum leucanthemum
field horsetail	Equisetum arvense
goldenrod	Solidago sp.
common chickory	Cichorium intybus
welted thistle	Cardus crispus
winter cress	Barbarea vulgaris
great burdock	Arctium lappa
virginia creeper	Parthenocissus quinquefolia
timothy grass	Phleum pratense
asters	Aster sp.

APPENDIX A2
Sassafras Woods Excerpt

from: Regional Municipality of Halton and Ecological and Environmental Advisory Committee. Environmentally Sensitive Area Study. Planning Department. September 1978.

SASSAFRAS WOODS E.S.A. NO 4

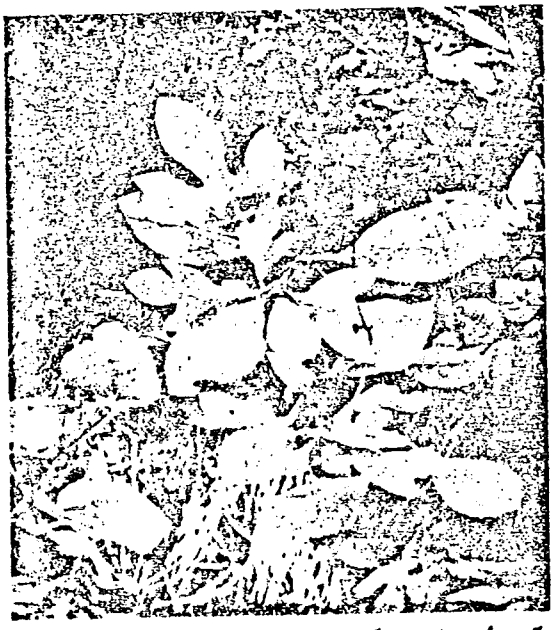


Photo Courtesy of Royal Botanical Gardens

General Description

Sassafras Woods supports a secondary growth hardwood forest overstoried with mature White Pine on a gentle south-facing slope. This is One of the few remaining sizeable woodlots typical of the woodland that once covered most of the Region south of the Escarpment (W. Crins, Pers. comm. 1976). Five small valley systems extend into the area along a north-south axis producing a profile of plateaus alternating with shallow depressions. Soils are deep red clay. The forests of the plateau are quite immature but become more mature in the depressions. Sugar Maple is dominant, with Shagbark Hickory, Witch Hazel, American Hornbeam, and Red Oak well represented. This relatively large woodlot is transected by three hydro lines.

Criteria Fulfilled

Criterion Four:

The long growing season and the immaturity of sections of Sassafras Woods provide suitable conditions for Carolinian species such as Sassafras (Sassafras albidium), Eastern Flowering Dogwood (Cornus florida), and Common Hoptree (Ptelea trifoliata). This woods contains the largest number and best quality of Sassafras and Flowering Dogwood in Halton Region. These Carolinian species are near the northern limit of their range in Ontario. Thus their presence indicates a very unusual habit at for Halton Region. (P. Maycock, Pers. comm. 1976).

Criterion Six:

The most significant plant species found is Common Hoptree (Ptelea trifoliata). Not only is this tree considered nationally rare and provincially rare, but it may be the only known spontaneous specimen in Halton Region (P.F. Rice, Pers. comm.)

A number of other nationally and provincially rare plants are found:

American Columbo (Swertia caroliniensis)
Eastern Flowering Dogwood (Cornus florida)
Large-bracted Tick Trefoil (Desmodium cuspidatum)
Honey Locust (Gleditsia triacanthos)
Red Hickory (Carya ovalis)

Sassafras albidum, a nationally significant species is represented by a healthy colony of about 25 trees reaching heights of 35 feet. Also found in the area is Yellow Ladies' Slipper (Cypripedium calceolus) and Three-leaved False Solomon's Seal (Smilacina trifolia), both regionally rare.

Uncommon birds include Whip Poor-will (Caprimulgus vociferus), Golden-crowned Kinglet (Regulus satrapa), and Ruby-crowned Kinglet (Regulus calendula). (M. Ilyniak, Pers. comm. 1977).

E.S.A. NO 4

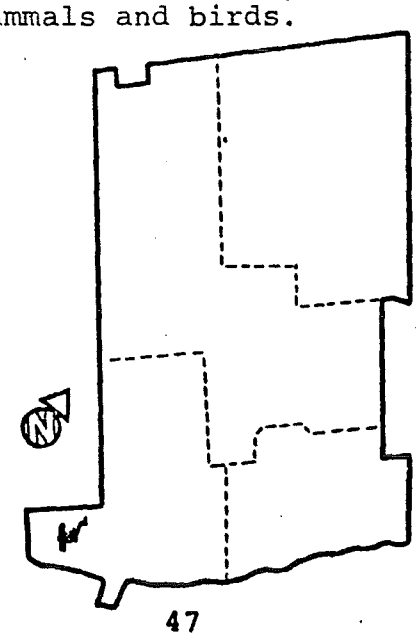
General Comments

At present the major impact on the area is noise. Traffic from Highway #403 and North Service Road, as well as trail bikes in the eastern section of the woodlot are major contributors. The trail bikes have also created local soil disturbances and trampled vegetation especially on the east side of the western valley. This unnecessary destruction of habitat is a continuing problem and may seriously deface the woodlot if it is not curtailed.

Another impact may come from residential development which currently is concentrated along the western valley.

Sassafras Woods may not be well protected because of its private ownership, proximity to a major traffic artery, and its "Complementary Use" designation within the Parkway Belt West Plan. The Ontario Land Inventory has classified the most easterly valley as hazard land.

One of the last remaining sizeable woodlots below the Escarpment, this part of the Region should be protected from the adverse affects of development and from abuse by trail bikes. The eastern-most valley with its fairly mature sugar maple forest extending to connect Sassafras Woods to the Waterdown Escarpment Woods provides a good linkage between the two areas. The only separation between them is a large hydro corridor, which should be revegetated to reduce the obstacle for mammals and birds.



E.S.A. NO 4