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WITNESS STATEMENT

OF

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IN THE MATTER OF THE PROPOSED
BURLINGTON LANDFILL SITE
HYDROGEOLOGICAL ASPECTS

MAY 8, 1984.

of the report entitled "Hydrogeological study, final report, proposed Burlington Landfill site expansion", This report formed part of a previous application for approval before the Environmental Protection Act board. Results from these previous reports have been included in the current submission to the board to provide complete documentation and a comprehensive data base.

5.1 General Hydrogeological Concerns at all Landfills:

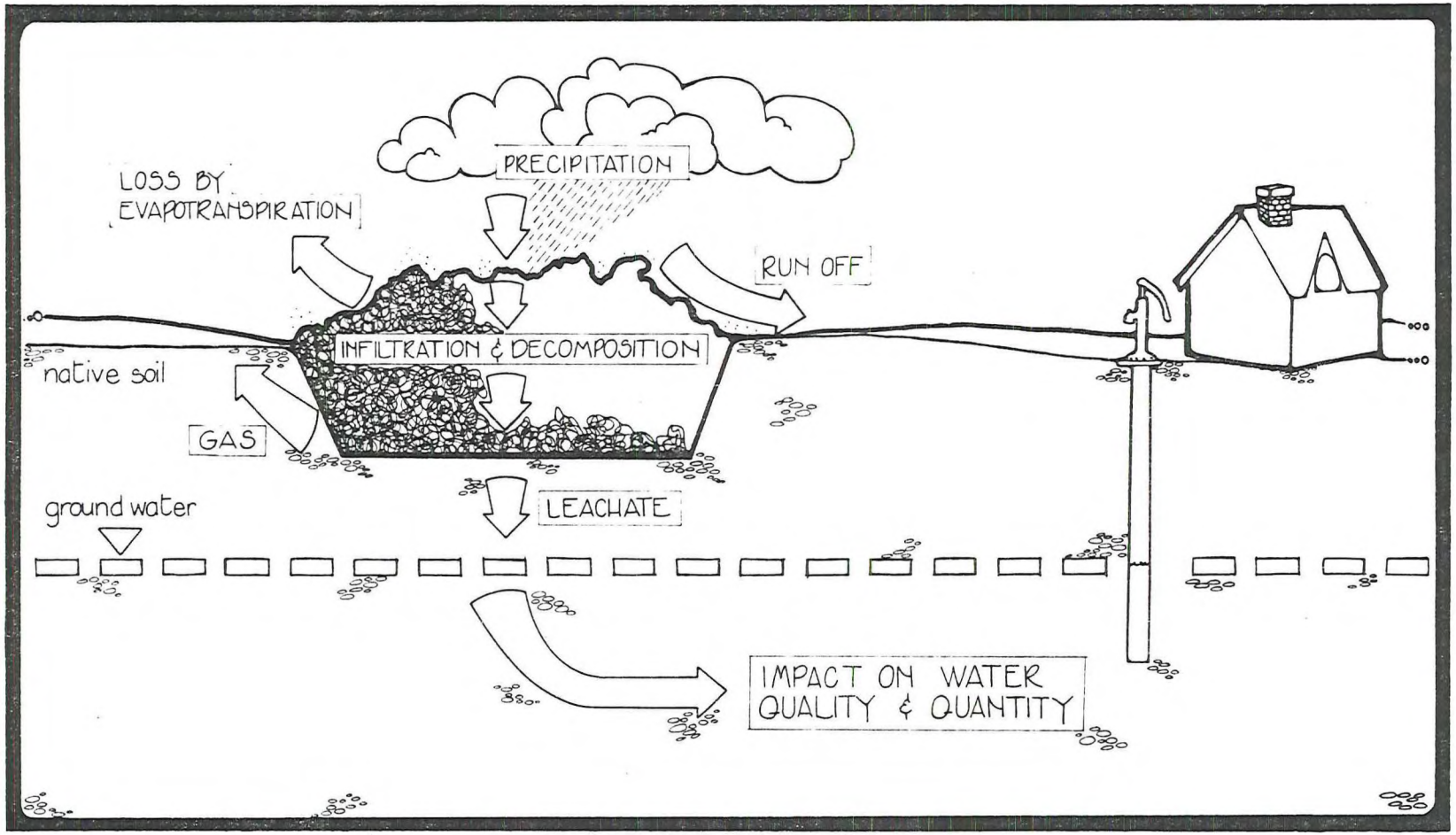
When considering the siting, design and operation of a landfill, one must assess the potential effects on the natural environment.

The following diagram called Landfill Hydrogeologic Concerns depicts refuse placed below the ground in an uncontrolled manner. As noted on the diagram, the two primary concerns of hydrogeologists are:

(i) the movement of leachate and its potential impact on the ground water and surface water resources adjacent to the site, and

(ii) the movement of gas and its potential impact on developments adjacent to the site.

Water from precipitation infiltrates the refuse and migrates vertically downwards towards the water table. Some of this precipitation will run off overland and some will evapo-transpire back into the atmosphere. That fraction that



LANDFILL HYDROGEOLOGIC CONCERNS

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infiltrates the refuse, during its migration, will suspend and/or dissolve contaminants creating what is commonly referred to as leachate. These physio-chemical reactions also create gases, methane and carbon dioxide being of major concern. Methane is lighter than air and potentially explosive. Carbon dioxide is heavier than air and mixes with the ground water increasing its hardness.

The contaminated water infiltrates to the water table where it enters the ground water and migrates with the flow system. Simply stated, a site can be considered hydrogeologically suitable for landfilling if it can be shown that leachate and gas will not migrate to impact adjacent properties. Thus it is important to know the hydrogeological setting in the vicinity of any proposed disposal area.

For example, if a landfill was placed within an environment which consisted of sand and gravel, many adverse potential problems would have to be overcome. Leachate generally moves very quickly through these soils (30 to 100 m/a) and contamination a long way from the site can result. Similarly, methane would also probably migrate long distances creating potential hazards to adjacent development. These are poor areas to place solid waste.

On the other hand, if a landfill was placed in a clayey environment, hydrogeological problems would be minimal. Gases would naturally vent through the garbage, and not the adjacent soils (garbage being more permeable than clayey soils). Thus, no impact would occur on adjacent development. Also leachate would move less than 0.3 m/a compared with the 30 to 100 m/a for sand and gravel. Thus no impact on ground water quality would likely occur either.

The above concepts are general, but will be discussed specifically in my evidence on the Burlington landfill.

5.2 Hydrogeological Aspects of the Burlington Landfill Site:

The investigations carried out at this site consisted of the following main components:

(i) based on existing available data, a drilling program was designed to assess the continued use lands for waste disposal. The monitors thus constructed were supplemented by soil sampling from backhoe test pits.

(ii) the ground water installations were monitored for water levels over a period of five months. In addition, monitors were tested to provide hydraulic parameters and water samples were also collected for chemical analysis,

(iii) preparation of a detailed report defining the hydrogeology and making recommendations for design of future operations in the continued use area. The report also includes data from previous hydrogeological studies conducted at the Burlington landfill site.

The results of this study are described in detail in the report entitled "Hydrogeological study - Burlington landfill site - continued use" dated March 30th, 1984. The report is divided into a descriptive report forming the main body with supportive data appended.

The Burlington landfill site is located on the lower slopes of the Niagara Escarpment. The upper portion of the slope is underlain by low permeability till soils while to the south the till thins and bedrock exposures predominate. At the landfill site, there are two distinct geological settings, to the north in the proposed continued use area clayey silt tills up to 15 m thick predominate, and to the south where the existing landfill is located the till thins and in the extreme south landfilling has taken place directly onto bedrock. The bedrock in this area comprises the Queenston Formation, commonly referred to as the Queenston shale.

Assessment of the Ministry of the Environment water well records indicate that there are no extensive aquifers down-gradient from the site. Ground water in the Queenston shale is of extremely poor quality in the vicinity of this site.

The clayey silt till is dense to very dense and uniform throughout its thickness. No extensive sand lenses occur. The till varies in thickness up to 15 m. The till has a cation exchange capacity greater than 10me/100g which would assist in leachate attenuation. The till has an average permeability of 1×10^{-9} m/s based on both field and laboratory tests.

The Queenston shale is reddish, brown with thin beds of greenish, grey limestone. The shale is fractured and jointed. The shale has a similar cation exchange capacity to that of the till, and has an average permeability of 5×10^{-8} m/s.

Ground water movement at the landfill site is mainly to the south with minor components to the east and west. A ground water divide occurs to the north of the site where a small component of flow is toward Falcon Creek. Flow directions in both the overburden and bedrock are similar. Ground water flow velocities in the unfractured till are about 0.02 m/a and in the fractured till about 6 m/a. In the shale a wide range of flow velocities occur up to a maximum of about 15 m/a.

The current monitoring program has shown that a leachate plume exists to the south of the existing landfill. This plume emanates from the filled area which has no underdrain leachate collection system, and where the till cover is thin or non-existent.

The monitoring program indicates that the plume has migrated about 100 m through the shale bedrock. The monitoring program also indicates that considerable attenuation takes place downgradient from the landfill.

The glacial tills underlying the continued use area provide for good contaminant attenuation. The shale formation contains ground water of very poor quality and as such a leachate collection system may not be necessary in certain situations. However, a leachate collection system has been recommended for this site for the continued use areas, to provide for additional protection of the surface water resources. A leachate collection system has been in operation under part of the site for several years and has been operating effectively. In addition, a buffer zone has been recommended around the proposed fill areas.

A monitoring program at the existing facility has been carried out since 1980. It is recommended that this program be extended to include the continued use area.

The detailed studies indicate that the continued use proposal can be operated safely without detrimental effect on local ground and surface water. The continued use proposal stands on its own merit, it does not interfere with the existing plume, nor does the existing plume have much bearing on the proposal. Even if the continued use proposal were not initiated, the situation with the existing site would continue.

6.0 OTHER EXPERTS:

Gartner Lee Associates Limited has not relied on the opinions of any other experts. Our conclusions and recommendations are based on our own studies.

7.0 WITNESS AVAILABILITY:

I will be available for examination and cross examination if required.