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THE ESTABLISHMENT OF A LEACHATE MONITORING SYSTEM
AT THE WEST BELCONNEN LANDFILL SITE, ACT, 1976-77

by

G. JACOBSON

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SUMMARY

A leachate monitoring system has been established at a sanitary landfill site at West Belconnen, ACT. Leachate from the landfill will drain to small dams which will act as retention and evaporation ponds. Eight bores have been installed to monitor groundwater for pollution by leachate. The main water quality parameter being monitored is dissolved organic carbon and background values are 1-3 mg/l in groundwater and 8-20 mg/l in the dams.

INTRODUCTION

The West Belconnen landfill site is intended to serve as the main landfill site for North Canberra and Belconnen for the next 25 years. The location of the site is shown in Figure 1.

Geotechnical investigations of the site before development were made by BMR and included augering (Vanden Broek, 1971) and seismic traverses (Hill, 1972) to evaluate subsurface conditions. Subsequently the site was designed by L.T. Frazer & Associates Pty Ltd (1973), consultants to the National Capital Development Commission. In order to minimise the possibility of groundwater pollution the designers adopted the following measures:

1. A dry fill technique whereby the solid waste is laid in trenches, and sealed with a low-permeability clay layer; surface water is diverted around the landfill in order to minimise infiltration.
2. A clay layer is left in the base of the trenches to act as a low-permeability barrier between the solid waste and the underlying fractured-rock aquifer.
3. Leachate that drains from the solid waste, and contaminated runoff, are treated on site in storage ponds by anaerobic decomposition and oxidation.
4. Groundwater is regularly monitored to determine the effects of the landfill operation, and to assess the future requirements for leachate disposal or treatment.

In order to establish the groundwater monitoring program an additional investigation was made by BMR in November-December 1976. It included the drilling of 12 auger holes, of which eight intersected groundwater and were equipped with slotted casing to serve as monitoring bores. Drilling was done by Stewart Bros Pty Ltd of Sydney under the BMR/NCDC period drilling contract. Groundwater samples have been chemically analysed by M.J. Story of the Conservation and Agriculture Laboratory, Department of the Capital Territory, Canberra, and by the Australian Mineral Development Laboratory (AMDEL), Adelaide.

This report presents results of the leachate monitoring program up to April 1978, including background water quality data for the site. Operations on the site began in 1976, and the southeast part has been used as a

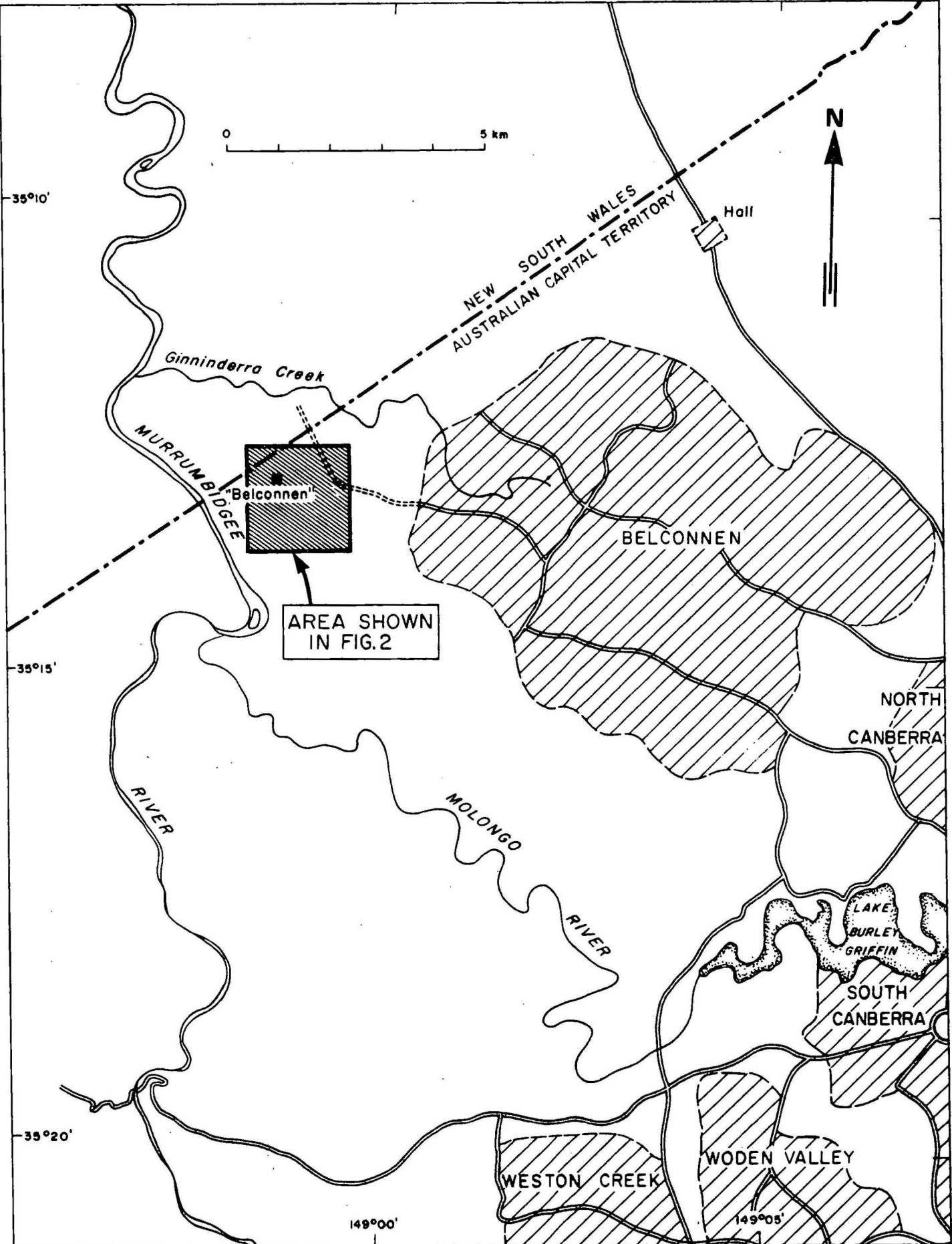


Fig. 1 Location map

householders' tip since then. Trenching operations in the central part of the site began in mid-1978.

HYDROGEOLOGY

The site (Fig. 2) is about 50 ha in area and is drained to the west by a tributary of the Murrumbidgee River.

Geological mapping and augering of the site have shown that up to 3 m of clay overlies weathered Silurian sedimentary and volcanic rocks (Vanden Broek, 1971). The clay is yellowish brown, silty to sandy, and of medium to high plasticity, classified as CL to CH in the Unified Soil Classification. It is residual on weathered bedrock, the topmost part of which is generally clayey sand which is classified as extremely weathered rock (Appendix 1).

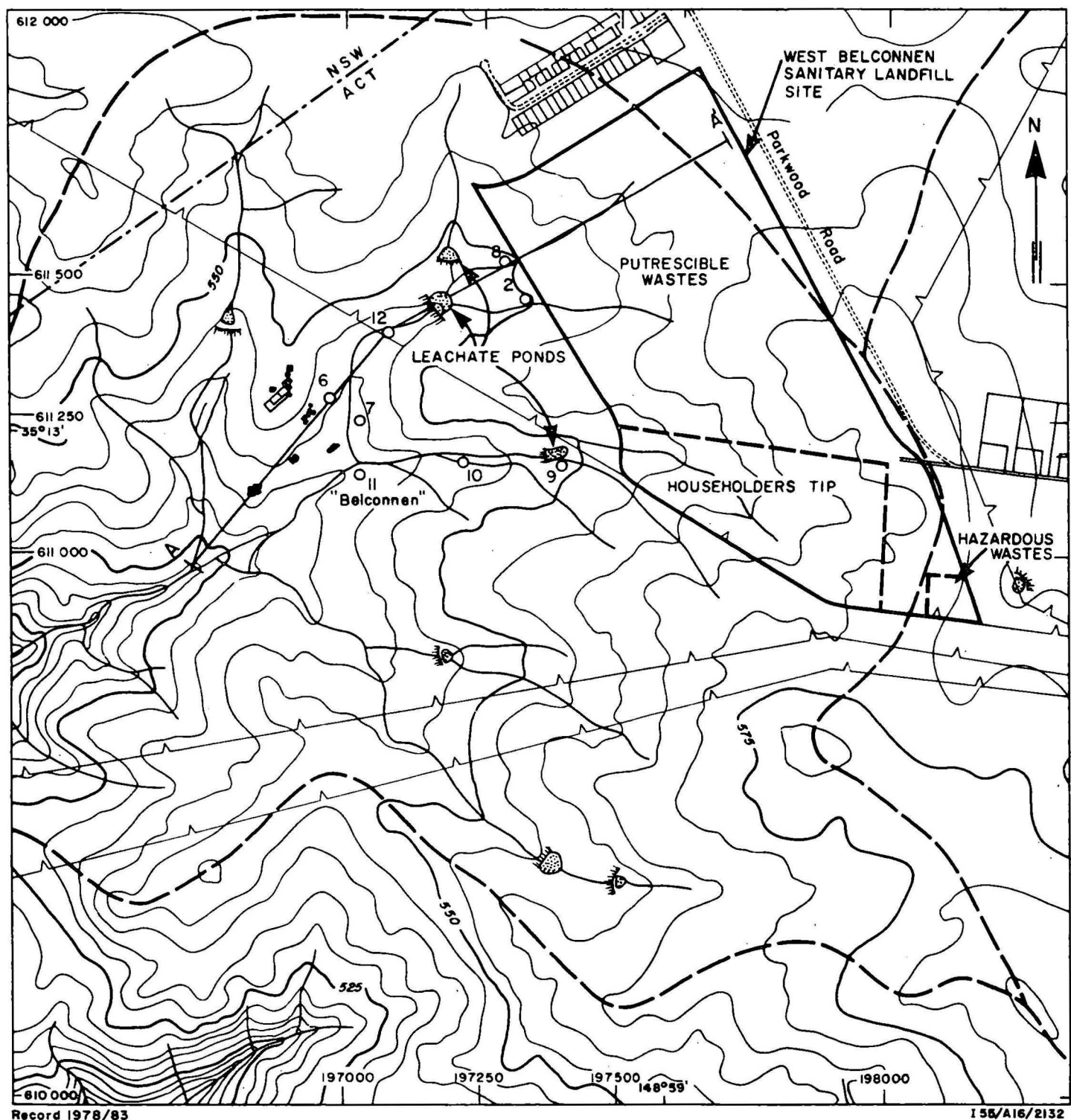
Figure 3 shows the bedrock geology of the investigated area and the locations of drillholes in the present investigation. Figure 4 shows a cross-section through the site based on the logs of drillhole cuttings (Appendix 1).

Groundwater occurs in fractured-rock aquifers and is confined by the overlying clay. Of the 12 holes drilled in this investigation, 8 encountered groundwater at depths ranging from 2.0 to 7.6 m. Three of the bores showed an artesian rise to ground level or just above (Fig. 5); two of these have since ceased to flow. The depth of the bores range from 4.6 to 10.1 m.

The bores were equipped with slotted plastic casing and then packed with gravel to serve as monitoring bores. The casing protrudes about 1 m above the ground, and is surrounded by a concrete apron - to stop surface inflow - and a protective fence.

Contours on the piezometric surface in November 1976 are shown in Figure 5. The groundwater flow direction is generally to the southwest below the landfill site. A spring occurs on the edge of the landfill site near bore 8. Fluctuations in the piezometric surface have been monitored for 18 months; they range seasonally from 0.16 m in bore 10 to 2.51 m in bore 12. Maximum levels are generally reached in October-November and minimum levels in February-April.

Three existing farm dams below the site are intended to serve as leachate collection and evaporation ponds. The monitoring bores have been sited so as to intersect groundwater flow containing leachates.



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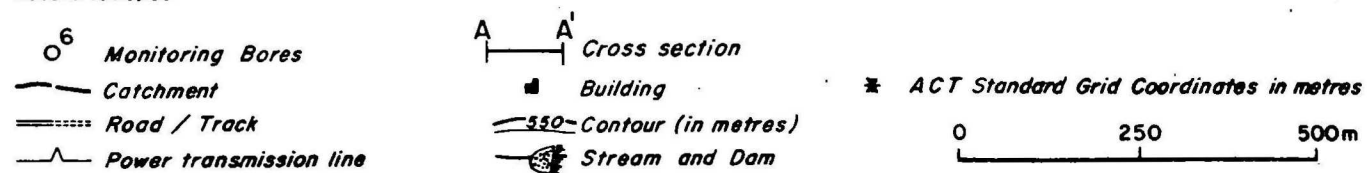
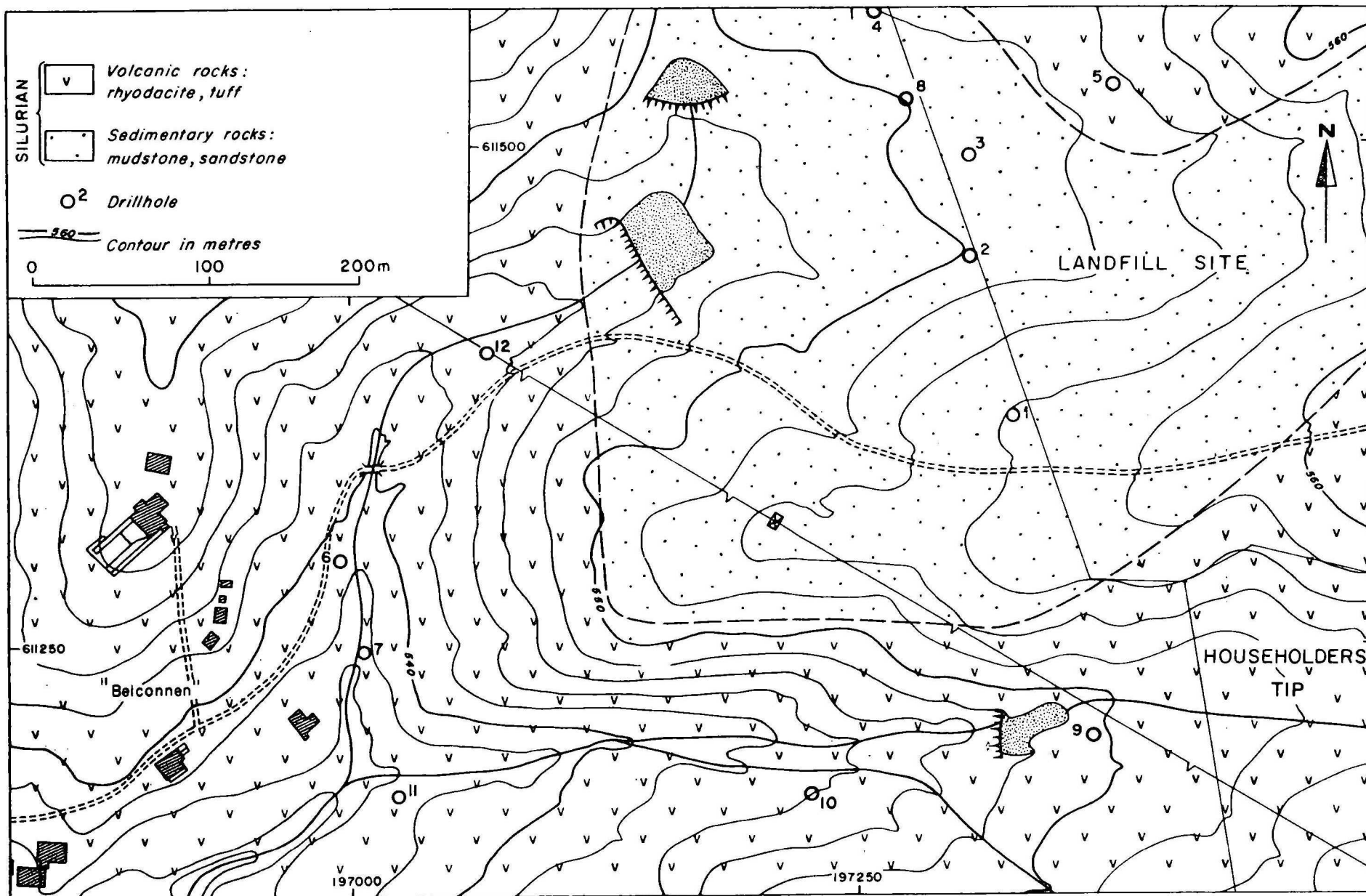


Fig.2 West Belconnen Sanitary Landfill Site



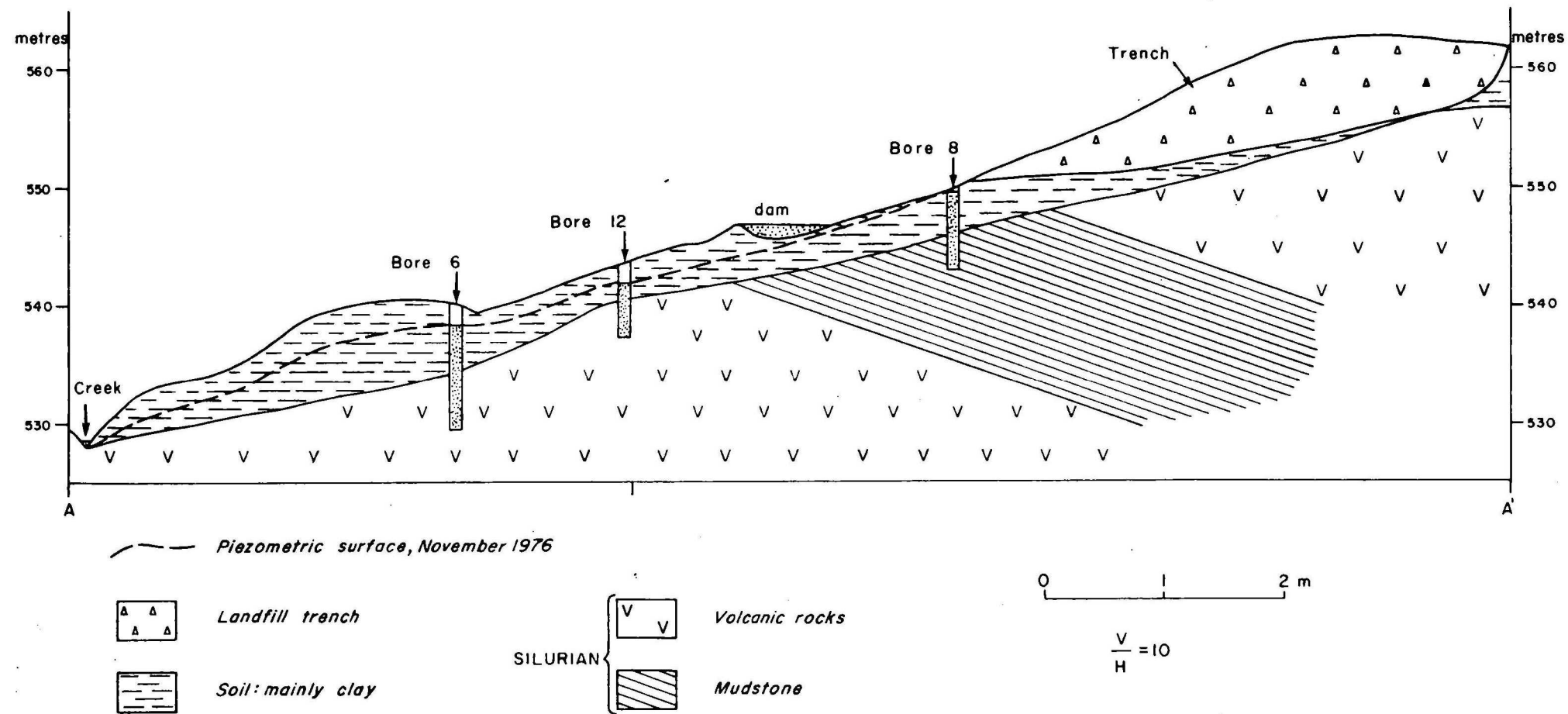
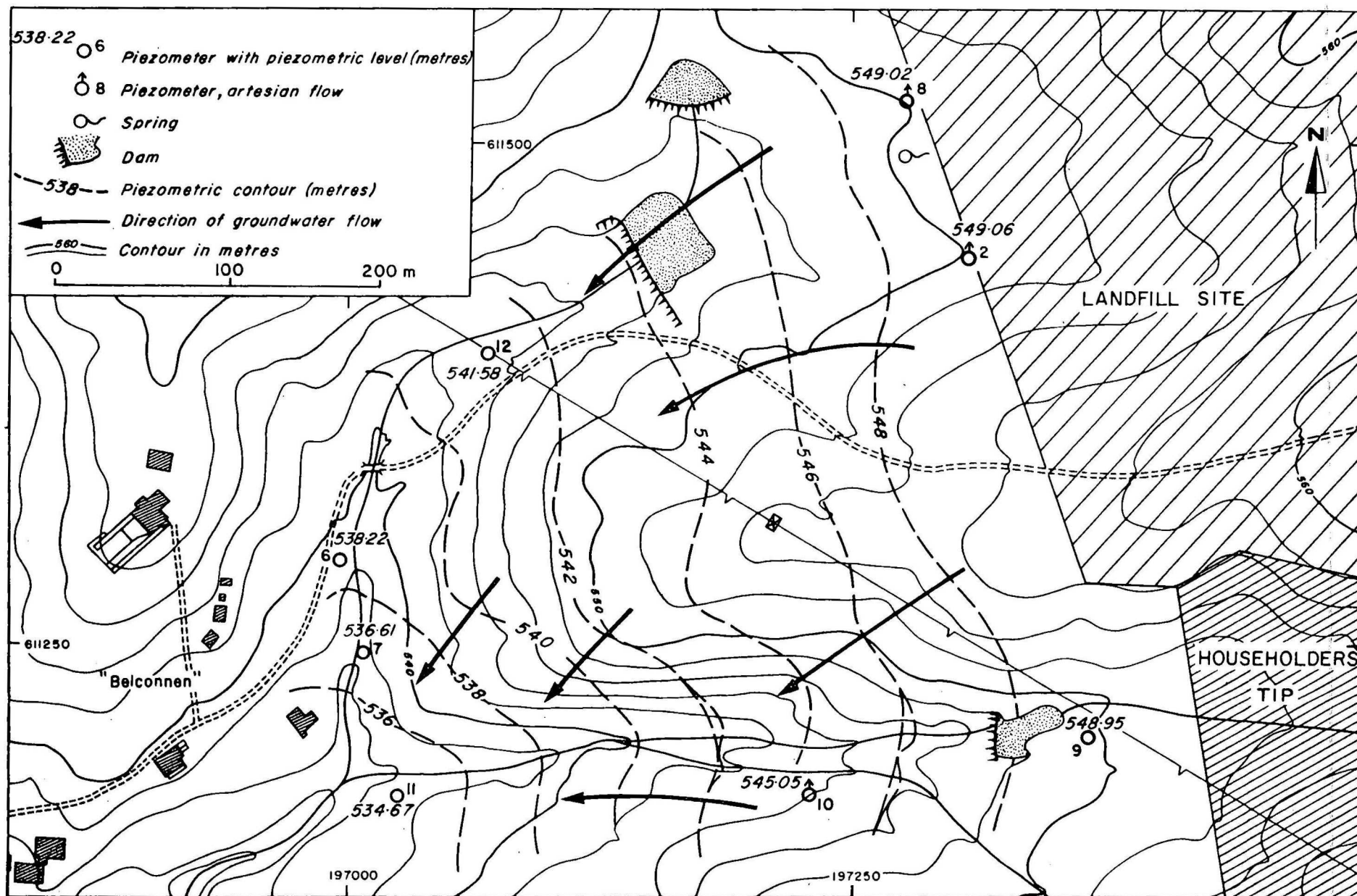


Fig.4 Geological Section of the West Belconnen Landfill Site
(For location of section, see Fig. 2)



WATER QUALITY

The locations of monitoring bores and surface water sampling points are shown in Figure 6. The bores were bailed to remove possibly stagnant water, then left for 24 hours to recover, before they were sampled with a bailer made from plastic pipe.

The Conservation and Agriculture Laboratory of the Department of the Capital Territory, Canberra, tested the water samples for chloride, hardness, and dissolved organic carbon (DOC). Table 1 shows the results of the tests, which indicate an appreciable variation in chloride and hardness throughout the site but consistent values of DOC. The background values of DOC were 1-3 mg/l in bore water and 8-20 mg/l in dams on the site.

It is proposed to sample and test the bores every 6 months using DOC as the main water quality parameter. The use of this parameter is a rapid and cost effective method of indicating organic contamination (Hughes, Eccles, & Malcolm, 1974). DOC may be an indicator of the presence of many water-soluble organic compounds, and, if these contaminants are detected, other appropriate tests can be carried out. The production and escape of leachate from the site, and the effectiveness of the treatment ponds can thus be assessed.

Detailed chemical analyses of groundwater samples by AMDEL (Table 2) will serve as baseline reference data for the site. These analyses show a range in total dissolved solids content ranging from 219 mg/l in bore 9 to 1334 mg/l in bore 2, and a corresponding variation in other parameters. This variability probably reflects different aquifer depths (Hohnen, Kellett, & Jacobson, 1978).

TABLE 1
CHEMICAL TESTS ON WATER SAMPLES, 1977

Site no.	Location	8 July 1977		3 November 1977	
		Dissolved Organic Carbon (mg/l)		Total Hardness (mg/l)	Chloride (mg/l)
2	Bore	1.5	2	355	373
6	Bore	1.5	2	320	318
7	Bore	3	1.5	255	189
8	Bore	2	2	516	252
9	Bore	1	1	107	117
10	Bore	1	1.5	395	199
11	Bore	1.5	1	409	245
12	Bore	2	2	134	104
13	Dam	8	11	65	49
14	Dam	16	20	102	136
15	Dam	10	8	123	46
16	Creek	3.5	dry	-	-

Samples analysed by the Conservation and Agriculture Laboratory, Department of the Capital Territory, Canberra.

CONCLUSIONS

1. At the West Belconnen landfill site groundwater occurs in confined fractured-rock aquifers; the gradient of the potentiometric surface is southwest towards the Murrumbidgee River.
2. Treatment of leachate that drains from the landfill is designed to be by retention and evaporation in ponds.
3. A leachate monitoring system for groundwater has been established using eight bores equipped with slotted plastic casing and protected from surface inflow.
4. Background water quality values at the commencement of trenching operations in the main part of the site were 1-3 mg/l dissolved organic carbon in groundwater, and 8-20 mg/l in the dams which will act as leachate retention ponds.

TABLE 2
CHEMICAL ANALYSES OF GROUNDWATER SAMPLES
by AMDEL, Adelaide, February 1978, in mg/l

	Bore 2	Bore 8	Bore 9	Bore 12
Calcium	83	110	8	21
Magnesium	43	62	16	25
Sodium	385	156	44	66
Potassium	1	1	-	-
Bicarbonate	878	452	25	188
Sulphate	49	130	16	33
Chloride	334	217	88	92
Nitrate	7	70	35	1
Conductivity (micros./cm)	2039	1433	384	525
Total Dissolved Solids	1334	969	219	331
Total Hardness as Ca CO ₃	384	530	86	155
Total Alkalinity as Ca CO ₃	720	370	21	154
Silica	21	16	37	27
Boron	-	0.05	-	-
pH	7.8	7.8	6.4	6.9
C.O.D.	25	39	44	40
Total Nitrogen	0.2	0.2	0.2	0.2
Surfactants	0.075	0.15	0.02	-
Pet. Spirit Extract	2.5	-	2.0	-
Cadmium		less than	0.01	
Chromium		less than	0.05	
Copper		less than	0.04	
Iron	0.7	-	0.08	0.47
Manganese	-	-	0.05	0.01
Nickel		less than	0.05	
Lead	0.15	-	-	-
Zinc	0.02	-	0.03	0.01

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APPENDIX 1

LOGS OF DRILLHOLES, WEST BELCONNEN LANDFILL SITE,
DECEMBER, 1976

DRILLHOLE 1

<u>Depth (m)</u>	<u>Description</u>
0-0.9	Yellow-brown mottled silty clay.
0.9-1.8	Greyish brown clayey silt (extremely weathered mudstone).
1.8-6.1	Extremely to highly weathered mudstone.

Abandoned, dry.

DRILLHOLE 2

<u>Depth (m)</u>	<u>Description</u>
0-0.9	White clayey silt.
0.9-1.8	Yellow-brown mottled sandy clay.
1.8-2.7	Yellow-brown mottled clayey sand (extremely weathered sandstone).
2.7-4.6	Extremely to highly weathered sandstone.

Water encountered - hole equipped with slotted casing.

DRILLHOLE 3

<u>Depth (m)</u>	<u>Description</u>
0-1.5	Light brown sandy clay.
1.5-3.0	Olive-brown sandy clay.
3.0-4.6	Olive-brown clayey silt (extremely weathered mudstone).

Abandoned, dry.

DRILLHOLE 4

<u>Depth (m)</u>	<u>Description</u>
0-1.5	Yellowish brown sandy clay.
1.5-3.0	Greyish brown silt (extremely weathered mudstone).

Abandoned, dry.

DRILLHOLE 5

<u>Depth (m)</u>	<u>Description</u>
0-1.5	Brown silty clay.
1.5-4.6	Light brown clayey silt (extremely weathered volcanic rock).

Abandoned, dry.

DRILLHOLE 6

<u>Depth (m)</u>	<u>Description</u>
0-1.5	Yellowish brown sandy, gravelly clay.
1.5-6.1	Yellowish brown sandy clay.
6.1-7.6	Brown sandy clay.
7.6-10.1	Light brown clayey sand (extremely weathered volcanic rock).

Water encountered at 7.6 m. Equipped with slotted casing.

DRILLHOLE 7

<u>Depth (m)</u>	<u>Description</u>
0-1.5	Olive-brown silty clay.
1.5-3.0	Light brown sandy clay.
3.0-4.6	Brown silty clay.
4.6-6.4	Brown clayey sand (extremely weathered volcanic rock).

Water encountered. Equipped with slotted casing.

DRILLHOLE 8

<u>Depth (m)</u>	<u>Description</u>
0-1.5	Yellow-brown mottled sandy clay.
1.5-3.0	Greyish brown silty clay (extremely weathered mudstone).
3.0-6.4	Extremely weathered mudstone.

Water encountered in top 2 m. Equipped with slotted casing.

DRILLHOLE 9

<u>Depth (m)</u>	<u>Description</u>
0-3.0	Yellow-brown mottled sandy clay.
3.0-6.1	Yellowish brown clayey sand (extremely weathered volcanic rock).

Water encountered at 4.9 m. Equipped with slotted casing.

DRILLHOLE 10

<u>Depth (m)</u>	<u>Description</u>
0-3.7	Light brown sandy clay.
3.7-6.1	Light brown clayey sand (extremely weathered volcanic rock).

Water encountered at 4.0 m, rose to ground level.
Equipped with slotted casing.

DRILLHOLE 11

<u>Depth (m)</u>	<u>Description</u>
0-1.5	Brown sandy clay.
1.5-3.7	Brown sandy clay (extremely weathered volcanic rock).
3.7-6.1	Light brown clayey sand (extremely weathered volcanic rock).

Water encountered at 4.6 m. Equipped with slotted casing.

DRILLHOLE 12

<u>Depth(m)</u>	<u>Description</u>
0-1.5	Light brown sandy clay.
1.5-3.0	Brown sandy, gravelly clay.
3.0-6.1	Light brown clayey sand (extremely weathered volcanic rock).

Water encountered. Equipped with slotted casing.