



AUSTRALIAN NEWSPRINT MILLS LIMITED

**DELANEY'S QUARRY
HYDROGEOLOGICAL ASSESSMENT REPORT**

MAY 1993

GUTTERIDGE HASKINS & DAVEY PTY LTD
Consulting Engineers, Environmental Scientists & Planners, Project Managers
A.C.N. 008 488 373





GUTTERIDGE HASKINS & DAVEY PTY LTD

380 Lonsdale Street, Melbourne Vic 3000 Australia
Phone (03) 600 1100 Fax (03) 600 1300

Copyright © Gutteridge Haskins & Davey Pty Ltd 1993

"This document is and shall remain the property of Gutteridge Haskins & Davey Pty Ltd. The document may only be used for the purpose for which it was commissioned and in accordance with the Terms of Engagement for the commission. Unauthorised use of this document in any form whatsoever is prohibited *".

REF NO: 311/5245/18/00



TABLE OF CONTENTS

PAGE

1.	INTRODUCTION	1
1.1	Background	1
1.2	Assessment Objectives	1
1.3	Consultation with Regulatory Authorities	3
2.	REGIONAL SETTING	4
2.1	Location	4
2.2	Regional Geology	4
2.3	Surface Hydrology	4
2.4	Climate	6
2.5	Hydrogeology	6
2.6	Land Use	7
3.	LANDFILL OPERATIONS	8
3.1	Existing Waste Disposal	8
3.1.1	Rate and Composition	8
3.1.2	Existing Leachate and Stormwater Management	10
3.1.3	Irrigation System	11
3.2	Future Waste Disposal	13
3.2.1	Future Role and Operation	13
3.2.2	Rate and Composition	13
4.	FIELD INVESTIGATIONS AND LABORATORY RESULTS	14
4.1	Drilling Program	14
4.2	Site Geology	15
4.3	Aquifer Tests	15
4.3.1	Deep Bores	15
4.3.2	Shallow Bores	16
4.3.3	Aquifer Test Results	16
4.4	Water Quality	16
4.4.1	Groundwater	17
4.4.2	Surface Water	18
4.5	Soil Chemistry	20
5.	HYDROGEOLOGICAL ASSESSMENT	21
5.1	Impact of Site Operations on Groundwater Movement	21
5.2	Water Quality	21
6.	FUTURE LANDFILL MANAGEMENT	23
7.	MONITORING PROGRAM	24
7.1	Groundwater Monitoring Strategy	24
7.1.1	Frequency and Duration of Sampling	24
7.1.2	Review	25
7.1.3	Future Revision of Monitoring Strategy	25
7.1.4	Bore Licensing	25
7.1.5	Laboratory Analysis	25
7.1.6	DWR and EPA Sampling	25

TABLE OF CONTENT (Continued)	PAGE
7.1.7 Remediation Action Plan	25
7.2 Surface Water Monitoring Strategy	26
8. CONCLUSIONS	27
REFERENCES	28

APPENDICES

APPENDIX A - BOREHOLE LOGS
APPENDIX B - PUMPING TEST RESULTS
APPENDIX C - FALLING HEAD TEST RESULTS
APPENDIX D - WATER QUALITY ANALYSES
APPENDIX E - SOIL CHEMISTRY
APPENDIX F - RESPONSES OF REGULATORY AUTHORITIES TO DRAFT REPORT

LIST OF TABLES

Table 1: Rainfall and Evaporation
Table 2: Estimated Volumes of Material to be Landfilled (Excluding Sludge)
Table 3: Bore Co-ordinates and Levels
Table 4: Hydraulic Conductivity Estimates
Table 5: Groundwater Analyses
Table 6: Further Groundwater Analyses
Table 7: Surface Water Analyses
Table 8: Soil Sample Analyses

LIST OF FIGURES

1. Location Plan and Regional Geology
2. Hydrological Features
3. Existing Landfill
4. Landfill and Irrigation Area Site Plan
5. Hydrogeological Cross-Section

1. INTRODUCTION

1.1 Background

Gutteridge Haskins & Davey Pty Ltd (GHD) was commissioned in December 1992 by Australian Newsprint Limited (ANM) to conduct a hydrogeological assessment of Delaney's Quarry which is currently been used by ANM as a landfill site. The quarry is located to the north west of the ANM Mill, on elevated land which forms the northern edge of the Kenilworth Valley (Figure 1).

The hydrogeological assessment is a requirement of the Department of Planning's (DEP) Conditions of Consent for the Recycled Fibre Project. Condition No. 18.1 (ii) states that:

"Following consultation with the Department of Conservation and Land Management, Environment Protection Authority and Department of Water Resources, the applicant shall develop and submit to the Department of Water Resources for its approval:

- (ii) *a hydrogeological study followed by a groundwater monitoring strategy for Delaney's landfill site within six months of issue of this consent;"*

The action is required to be completed by 12 April, 1993.

Condition 18.2 stipulates that the groundwater monitoring strategy shall include:

"1. Delaney's Landfill Site

- *the hydrogeological study of the site;*
- *construction of 6 shallow and 6 deep piezometers around the site including the irrigated area (and any proposed extension) consistent with the findings of the hydrogeological study;*
- *surveying of all piezometers (to AHD datum);*
- *monitoring and analysis of groundwater at a frequency and duration to the requirements of the Environment Protection Authority for:*
 - i) *Metals (As, Cd, Co, Cr, Cu, Fe, Hg, Mn, Ni, Pb, Zn);*
 - ii) *SWL, RWL and Conductivity;*
 - iii) *pH, TOC, TKN, NO₃(N);*
- *a contingency plan indicating measures to mitigate potential adverse impacts on groundwater. "*

1.2 Assessment Objectives

The objectives of the hydrogeological assessment are to determine the existing and future environmental impact of the landfilling operation, and to satisfy the requirements of the DEP Conditions of Consent.

The following tasks were considered necessary to achieve these objectives:

- Conduct a site investigation,
- Review existing hydrogeological and landfilling operational data,
- Assess the environmental performance of the landfill,



- Recommend future landfill management strategies,
- Recommend a groundwater monitoring programme.

The findings of the site inspections, field investigations and subsequent analyses and hydrogeological interpretation and recommendations are presented in this report.

1.3 Consultation with Regulatory Authorities

A requirement of Condition of Consent 18.1(ii) was to consult with the Department of Conservation and Land Management, Environment Protection Authority and the Department of Water Resources prior to submitting the Delaney's Quarry hydrogeological assessment report to the Department of Water Resources.

To satisfy this condition, a draft report was submitted to the above authorities in May 1993 for comment. The comments are attached as Appendix F.

These comments have been incorporated into this final report. The recommendations of the authorities are now incorporated in the recommendations for future landfill management (Section 6), and the monitoring program (Section 7).

2. REGIONAL SETTING

2.1 Location

Delaney's quarry is located 9 km north of Albury, approximately 1 km west of the Olympic Way (Figure 1). It is also situated approximated 700 m to the west of "The Rock", an exposed granite outcrop with an elevation of 360 m AHD which can be seen from the Olympic Way. The ANM mill is situated about 3 km to the south-east.

An 8 ha area to the north-west of the main quarry is irrigated with leachate collected from the landfill site.

2.2 Regional Geology

The regional geology consists of Palaeozoic bedrock which forms the local highlands. The stratigraphic history commences with thick sedimentary sequences of claystones and sandstones of Ordovician age. In the late Ordovician, these sedimentary rock formations were folded and deformed imposing strong axialplane slaty cleavage. Broad areas also were subjected to high grade metamorphism and recrystallised to form quartz-mica schists and gneisses.

During the late Ordovician and Silurian, granitic melts, intruded the meta-sedimentary rocks and crystallised as granite and granodiorite bodies that presently underlie much of the region. Acid volcanics were also extruded, probably later, in the Early Devonian. Subsequent uplift and erosion have occurred with the most recent deposition in Tertiary and Quaternary times as riverine sediments (NSW DWR; 1992).

Delaney's quarry, the irrigation area and the Mill site are underlain by the Jindera Granite which locally is a fine-grained biotite granite (Figure 1). The fine grain size suggests that the local area is a chilled margin of the main body of granite. Delaney's quarry and the irrigation area are sited on "The Rock" outcrop, a residual hill within the region. Elsewhere such as at the mill the depth of weathering of this granite is substantial and colluvium and alluvium along the major drainage systems are present.

2.3 Surface Hydrology

To the north of the ridge, the site drains to Sandy Creek, an intermittent tributary stream of Bowna Creek, which ultimately discharges to the Hume Reservoir. The stream channel is deeply incised into the surficial sediments in the upper catchment. These and other hydrological local features are shown in Figure 2.

To the south of the ridge, the site drains in a south-westerly direction into the Kenilworth Valley and finally to a tributary of Eight Mile Creek, an ephemeral stream, which usually runs only after rainfall. It is generally dry between October and May. The stream drains east only along the southern boundary of the Mill, but further on it turns and runs south adjacent to the Thurgoona Golf Course and then through open farmland to the River Murray.

Downstream the Eight Mile Creek the stream channel is well defined with some marshy areas. When it reaches the River Murray floodplain, the stream channel disappears and the flow becomes dissipated in sinks, billabongs and swamps.



There are four dams that are used for run-off and leachate collection within the study area. The operation, management and impact of these dams upon the local hydrology is discussed in Section 3.1.2.

In addition to these dams a permanent pool of deep water is present in the old quarry workings on the eastern side of the irrigation area. After rainfall water ponds in the older quarry workings along the north-western boundary of landfill site. When present this water is turbid and shallow.

2.4 Climate

The mean annual rainfall of 694 mm/year for the study area was obtained from the Hume Reservoir Meteorological Station using 101 years of data provided by the Murray-Darling Basin Commission. In the 90 percentile year, it increases to 904 mm/yr. The mean annual pan evaporation is 1 487 mm/yr reducing to 1 358 mm/yr in the 90 percentile year based upon Hume data from 1986 to the present, and a correlation with the Wagga Wagga station prior to 1986. The distribution of monthly rainfall and evaporation for the mean and 90 percentile years are presented in Table 1.

Table 1: Rainfall and Evaporation

Month	Rainfall		Evaporation	
	Mean (mm)	90 Percentile (mm)	Mean (mm)	90 Percentile (mm)
January	42.3	55.1	251.1	229.3
February	38.8	50.6	212.6	194.1
March	46.5	60.6	169.5	154.8
April	51.3	66.9	86.2	78.7
May	61.8	80.5	47.5	43.4
June	75.6	98.5	29.7	27.2
July	77.7	101.2	31.2	28.5
August	74.3	96.7	47.6	43.4
September	48.3	78.6	71.4	65.2
October	69.4	90.4	127.9	116.7
November	47.9	62.4	182.9	167.0
December	47.9	62.4	229.0	209.1

Source: Hume Reservoir Meteorological Station

2.5 Hydrogeology

DWR bore records indicate that a number of bores have failed to encounter useable supplies from the Jindera Granite. Bore depths have ranged to about 90 metres. This suggests that the permeability of this rock unit is low (NSW DWR; 1992).

A monitoring bore drilled into the Jindera Granites on the western boundary of the Mill site intersected groundwater in the fresh granites between 86 m and 92 m. At less than 0.1 L/s the bore yield was found to be negligible. With a salinity of 741 μ S/cm, and a pH of 7.34 the water is suitable for stock and domestic purposes.





Due to the limited regional data, groundwater movement within the granite aquifer is uncertain, however it is expected to reflect the regional topography.

2.6 Land Use

The quarry area is abutted to the north, west and south by agricultural land mostly used for grazing. The areas have been fenced into paddocks and provided with farm dams.

The Kenilworth Valley area, to the south of the quarry (and west of Olympic Way), has been recently considered as a location for industries, particularly those likely to have off site emissions and/or high energy consumption requirements. The land has undergone a rezoning to allow broadscale industrial uses. The zone does not allow dangerous or offensive industries. It is understood that there is a current proposal for development of a motor racing circuit and entertainment facility on this land.



3. LANDFILL OPERATIONS

The layout of the quarry is shown in Figure 3. It is comprised of five main areas. Area E in the south-west corner, and Area A to the east are currently being quarried. Landfilling of quarried areas C and D to the north each is presently underway, whilst landfilling of quarried area B has been completed following capping. Dams A, B, and C, located within the quarry area, have been formed with in-situ materials. These are used for leachate and run-off collection as discussed in Section 3.1.2.

Quarrying of the Jindera granite is limited by the ripping capacity of the excavation equipment. This generally occurs at the base of the highly weathered granite at a depth of about 8 m. In both the quarried and non quarried areas the moderately to highly weathered granites are overlain by about 2 m of extremely weathered granite and clayey gravel.

The fill material, comprised of pressed wastewater sludges and boiler ash, is fibrous and spongy. Landfilling of Area B has been completed with a 850 mm thick capping of good quality clean fill which over the last few years has been obtained off-site mainly from excavations, and compacted with a backhoe. Organic matter is excluded from this fill. A 150 mm layer of topsoil is placed on the capping as part of the rehabilitation program. Capping of Areas C and D will be carried out with similar materials once the filling of these areas is completed.

Whilst the primary objective of the landfilling operation is to dispose of ANM's solid wastes, a secondary objective is to infill the quarry to as close as possible to its natural surface for rehabilitation. Thus landfilling is restricted to the approximate height of the pre-quarry land surface.

To maintain slope stabilities, ANM have formed embankments of in-situ granitic gravelly clays to retain the sludges and other wastes. Low pore pressures are maintained by 200 mm diameter tile drains installed along the floor of the landfill areas. These drains drain to a common collector sump before discharging to the leachate collection pond, Dam B (Figure 3). Drains in Area C, are believed to be partially blocked, despite ANM attempts to clear debris and modify the drainage design.

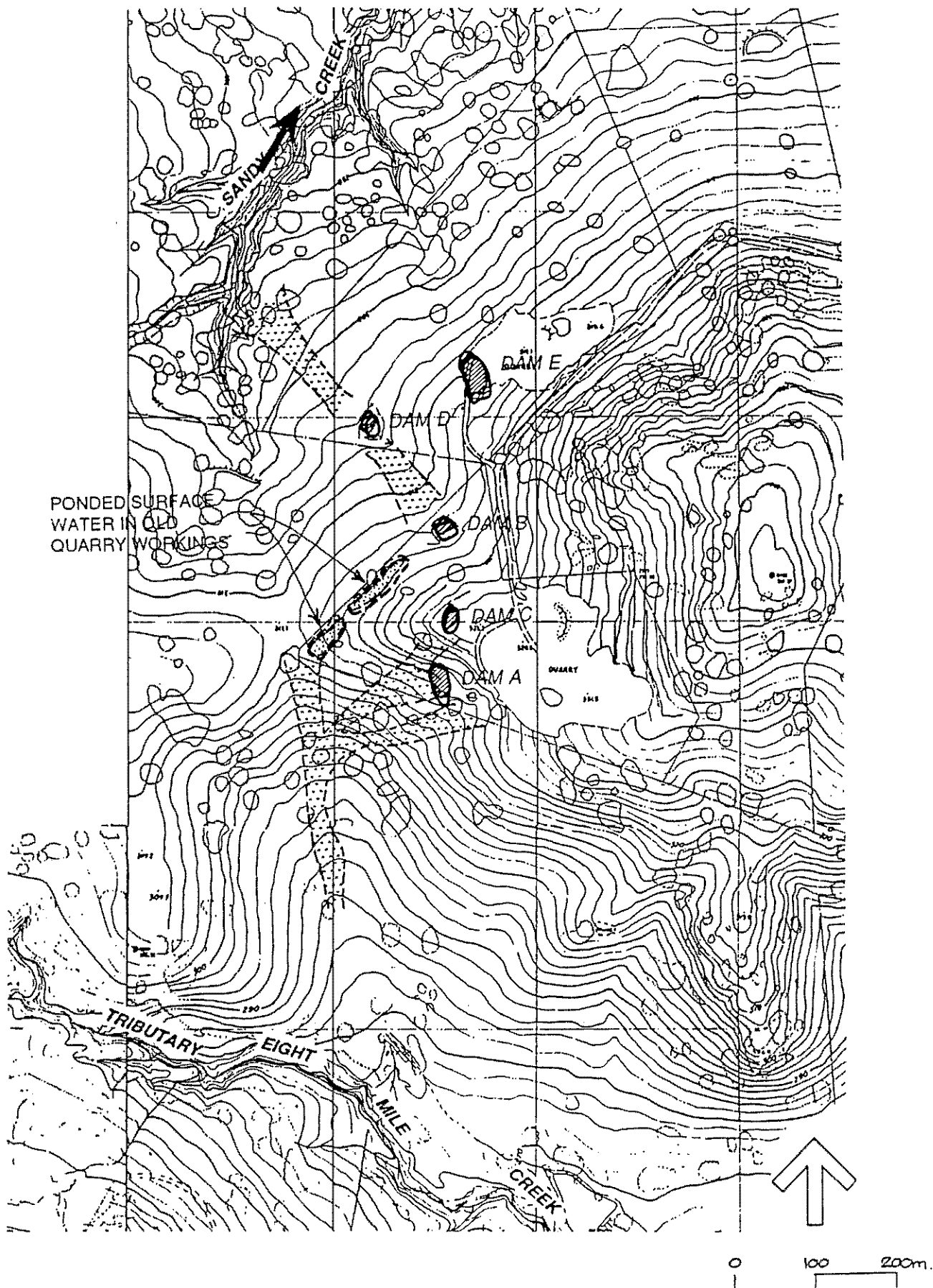
3.1 Existing Waste Disposal

3.1.1 Rate and Composition

Solid waste is currently collected and disposed of at an annual rate of 49 800 m³. This is an uncompacted volume, however there is currently little compaction. The waste includes wastewater treatment sludge (48 700 m³/yr) and screenings (500 m³/yr), and boiler ash (600 m³/yr).

The chemical composition of the existing wastewater treatment sludge, is anticipated to be below that of the proposed RCF wastewater treatment plant sludge. The estimated composition of the proposed RCF treatment plant sludge is shown in the following table together with the estimated composition of the RCF plant sludge and combined sludges at full RCF plant development.





- SWAMPY GROUND, SOFT MUDDY, DIFFERENT VEGETATION
- ➔ GENERAL DIRECTION OF SEEPAGE FROM DAMS

Figure 2
HYDROLOGICAL FEATURES

ANM NEWSPRINT MILLS, ALBURY
DELANEY'S QUARRY
HYDROGEOLOGICAL ASSESSMENT



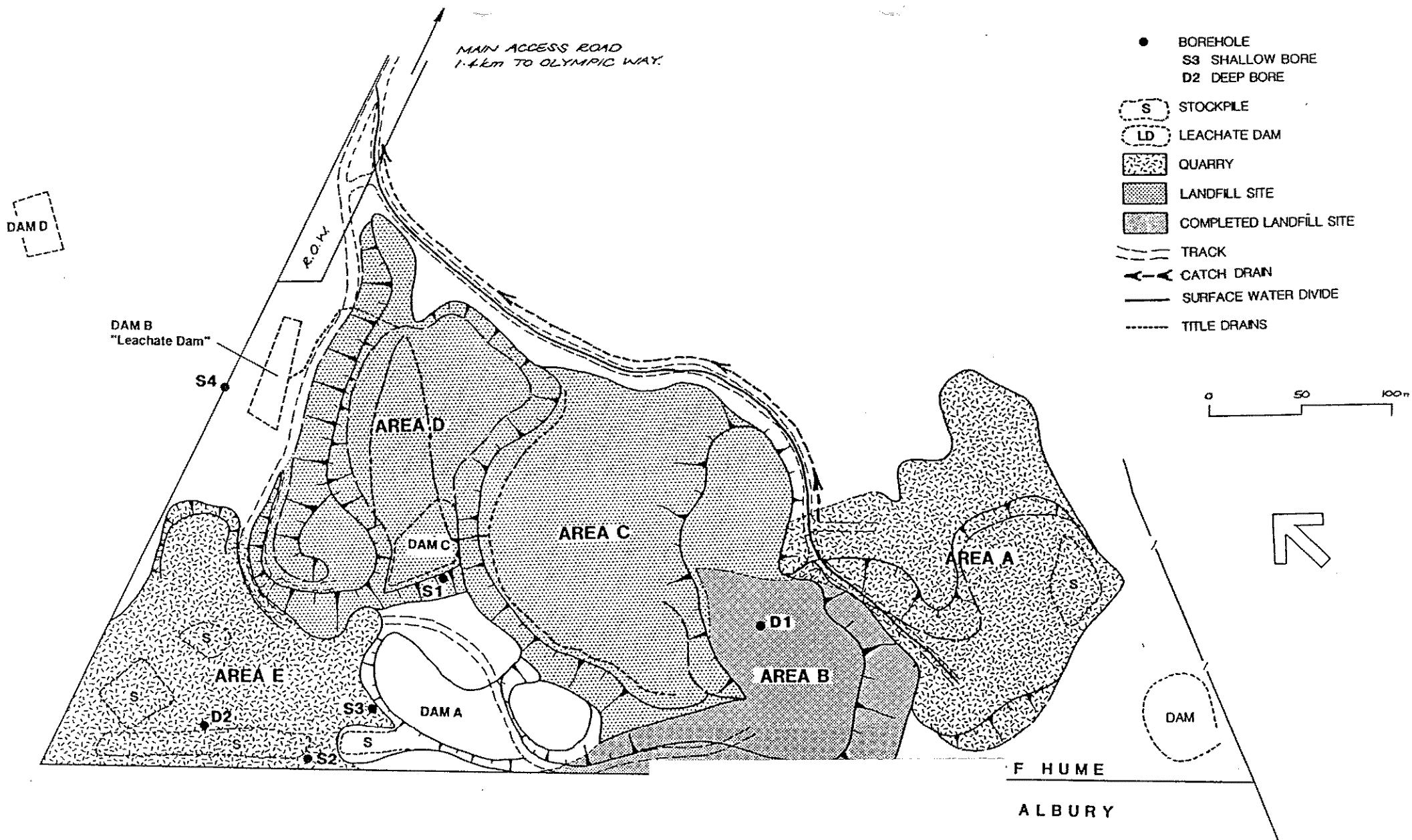


Figure 3
EXISTING LANDFILL
ANM NEWSPRINT MILLS, ALBURY
DELANEY'S QUARRY
HYDROGEOLOGICAL ASSESSMENT

RCF Sludge Composition

Component	Treatment Plant mg/kg ds ⁽¹⁾	RCF Plant mg/kg ds ⁽¹⁾	Combined Sludge Full Development mg/kg ds ⁽¹⁾
Arsenic	-	0.04	0.3
Barium	0.13	3.1	2.25
Cadmium	0.01	0.04	0.03
Chromium	0.01	-	-
Copper	0.59	78	55.9
Mercury	0.9	0.04	0.29
Manganese	1.8	62	44.8
Nickel	0.02	0.04	-
Lead	1.2	1.6	1.5
Selenium	-	0.04	0.03
Strontium	0.3	0.8	0.03
Zinc	1.0	17.0	12.4
Total Nitrogen	16 300	Not Detected	2 800
Total Phosphorus	2 500	3 000	4 700
Organic Matter as Carbon	400 000	110 000	140 000
Polyvinyl Chloride	-	800	570
Polyethylene	-	7 300	5 200
TCDD eq	-	1 x 10 ⁻⁶	7.1 x 10 ⁻⁷

⁽¹⁾: ds is dry solids concentration

The chemical composition of the boiler ash is as follows:

Boiler Ash Composition

Element	Concentration (mg/kg)
Sodium	383
Potassium	16 670
Calcium	19 171
Magnesium	4 251
Iron	8 163
Manganese	483
Copper	17.5
Zinc	8.8
Lead	6.8
Chromium	5.3
Total Phosphorus	375
Ash	81.83 %

3.1.2 Existing Leachate and Stormwater Management

The existing leachate and stormwater management system is shown in Figures 3 and 4.

Most runoff and leachate generated from within the landfilled areas of the site is collected in dams treated on the landfill site. Run-on is prevented from entering the site by the interceptor drain located to the north of the northern access road (Figure 3).

The leachate management system comprises a landfill drainage system, a leachate collection dams, and an irrigation system.

Within the landfill site Dams A and B are used for leachate collection and run-off management. Dam D at the southern boundary of the irrigation area is a farm dam. It is independent of the landfill leachate and stormwater management system. Dam C is located in a depression within the landfilled portion of Area D. Whilst not formally part of the leachate management system, it collects leachate from Area C. The location of these dams is shown in Figure 3.

Dam A is located along the southern boundary of the landfill site. Leachate seeps from the toe of dam towards Kenilworth Valley. When full, it is pumped across the top of Area D before draining to Dam B.

Dam B, the "leachate pond" is located on the western side of the landfill site. This pond receives leachate from agricultural drainage pipes constructed within the landfilled areas to minimise pore pressures. These pipes are connected to a central pit before discharging to the leachate dam. Water from this pond is lost through seepage and irrigation. Waterlogging between Dam B and Dam D, suggest that seepage from Dam B is occurring. This seepage passes through the Albury-Wodonga Clay Target Club property. The leachate is pumped to the irrigation area for distribution once Dam B fills.

ANM intend to fill Dam C so that landfill area D will drain towards the interception sump, before discharge to Dam B, the "leachate pond".

Dam D is located toward the southern boundary of the irrigation area. It is mostly filled by surface runoff, although some surface seepage emanating from Dam B has been observed to drain in its direction. Within the irrigation area a 15 m wide waterlogged zone was observed running in a northerly direction from Dam D to Sandy Creek. This area was muddy and boggy when inspected on 18 December 1992. This area is covered by grass and various "swamp type" bushes.

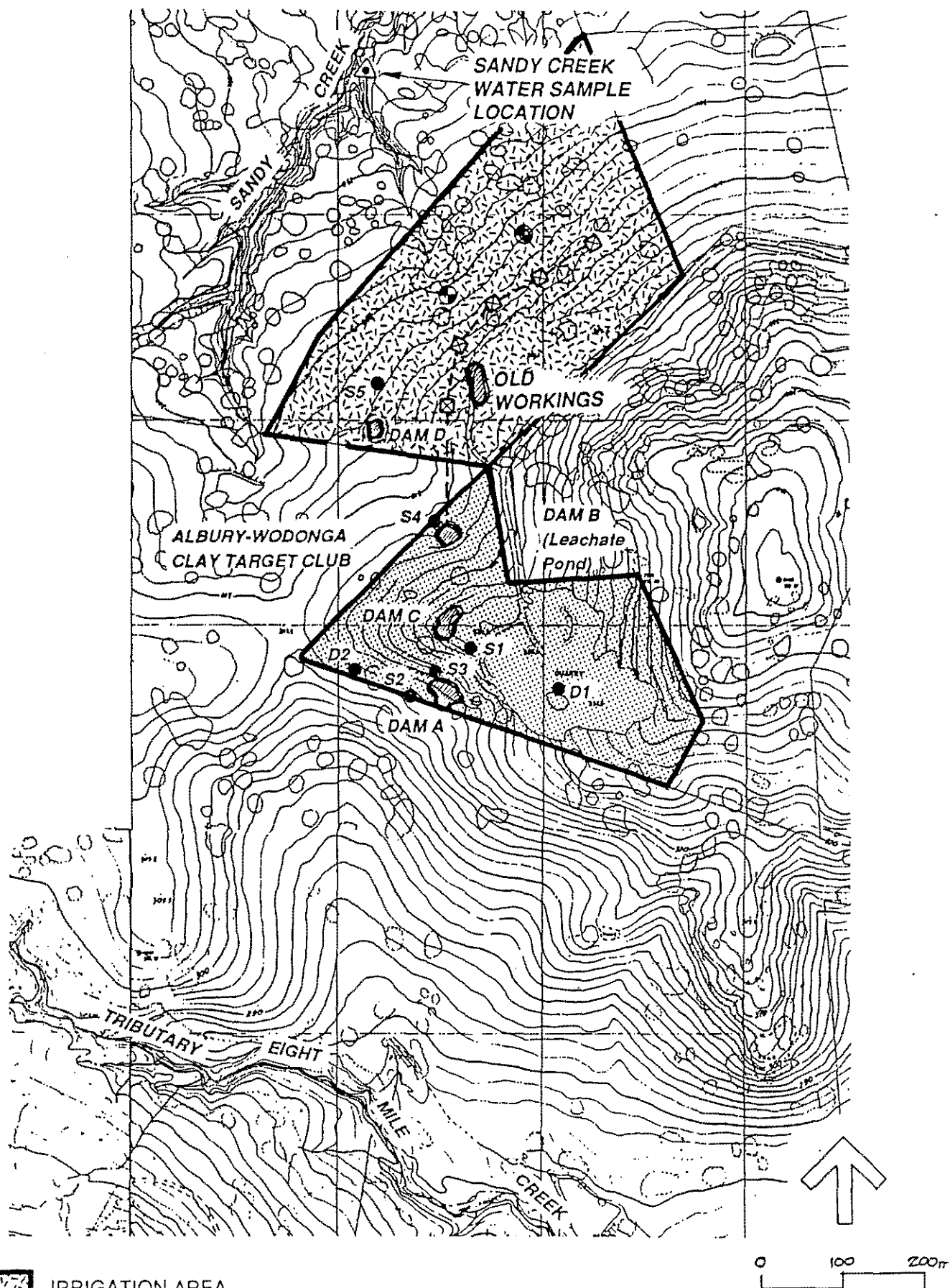
The capacity of the leachate and runoff collection system is not known. At present there are no catch drains along the quarry boundaries to intercept surface runoff or leachates generated on site which are not intercepted by or pumped to Dam B.

3.1.3 Irrigation System

The 8 ha irrigation area, Figure 4, is owned by Delaney whilst the land between the two properties is owned by the Albury Wodonga Development Corporation and is leased by the Albury Wodonga Clay Target Club. The irrigation area is vegetated with native pastures and "Patterson's Curse".

The leachate irrigation area consists of about five fixed sprinkler heads mounted along a pipeline running from Dam B, Figure 2. The sprinklers are never moved. Irrigation occurs when Dam B becomes full and finishes when the dam empties. Most irrigation occurs during the winter months with daily irrigation during the wetter periods.





-  IRRIGATION AREA
-  LANDFILL AREA
-  PROPOSED SHALLOW BORES
-  S2 SHALLOW BORE
-  D2 DEEP BORE
-  DAMS
-  SPRINKLER SYSTEM (LEACHATE)

LANDFILL & IRRIGATION AREA SITE PLAN

ANM NEWSPRINT MILLS, ALBURY
DELANEY'S QUARRY
HYDROGEOLOGICAL ASSESSMENT



3.2 Future Waste Disposal

3.2.1 Future Role and Operation

The future role of the existing landfill will be to accept RCF-plant rejects, boiler ash and wastewater treatment plant screenings and grit. Landfilling of sludge will cease when the proposed sludge utilisation schemes on agricultural land and pine forests are fully implemented.

It is proposed that the landfill remains available in future for temporary sludge storage in case of unforeseen interruptions with the land disposal scheme. Temporary storage of sludge in the landfill is expected to be an infrequent event as there are several safeguards provided in the land utilisation scheme which negate the use of the landfill. These safeguards are discussed in the Solid Waste Management Plan.

3.2.2 Rate and Composition

The estimated volumes of the materials to be landfilled, excluding sludge, are summarised in Table 2.

Table 2: Estimated Volumes of Material to be Landfilled (Excluding Sludge)

Description	Stage 1 RCF-plant m ³ /yr	Stage 2 RCF-plant m ³ /yr
Boiler Ash	450	320
RCF Rejects	2 750	5 500
Wastewater Treatment Plant Screenings	400	300
TOTAL	3 600	6 120

The landfill has an estimated residual capacity of 175 000 m³.

The planned staging of the RCF plant is to commission Stage 1 by December 1993 and Stage 2 by 1997. Stage 1 will have an annual discharge rate of 3 600 m³ (excluding wastewater treatment plant sludge) and Stage 2, 6 120 m³/yr. During development and expansion of the sludge reuse scheme some sludge will need to be deposited in the landfill. It is planned, that by 1996 sludge disposal to the landfill will cease and that sludge will be spread in forests and on agricultural land. Between now and 1996 there will be a gradual phasing out of sludge disposal to the landfill. It is estimated that the remaining landfill capacity to 1996 will be about 78 000 m³. This will provide a landfill life of about 13 years based on an assumed filling rate of 6 120 m³.



4. FIELD INVESTIGATIONS AND LABORATORY RESULTS

Field investigations were conducted between December 14 and December 18, 1992. The investigations included drilling, soil and groundwater sampling and aquifer testing. The program was aimed at obtaining sufficient information to satisfy the study objectives described in section 1.2.

4.1 Drilling Program

Drilling commenced on Monday 14 December 1992 and work terminated on Friday 18 December 1992. All drilling was carried out by K H Adams & Sons using a Bourne 1250 R Air Rotary Drilling Rig. Initially six deep (90 m) and six shallow (10 m) bores were proposed, however this was revised to two deep and five shallow bores following consultation with the NSW DWR after they were advised that the first deep bore, at a 130 m depth, did not intersect water during drilling.

The drilling sites, Figure 3 and 4, were restricted to areas which were not affected by landfill materials, ponded water, dams, stockpiles, steep terrain and boggy ground. The co-ordinates and surface elevations of these bores are shown in Table 3. Bore logs and construction details are presented in Appendix A.

Table 3: Bore Co-ordinates and Levels

Bore	Easting (m)	Northing (m)	Level (m) AHD	
			Ground Surface	Top of Pipe
D1	296608	1016300	344.32	345.32
D2	296293	1016346	315.79	317.13
S1	296459	1016370	324.74	325.15
S2	296342	1016312	314.30	314.77
S3	296386	1016326	317.11	317.66
S4	296364	1016518	313.11	313.56
S5	296284	1016658	304.00	304.50

The deep monitoring bore D1 is sited in Area B, the capped landfill area, whilst the other deep bore D2, is located in the current south-west quarry area adjacent to a stockpile. The location of the five shallow bores were selected in areas which had a high probability of intersecting "perched" aquifers. Four of these bores are positioned down-gradient of existing waterbodies. Within the irrigation area, shallow bore S5 is situated in a waterlogged area.

Monitoring bore D1 was drilled at a diameter of 170 mm through the landfill to a depth of 8.5 m. From this depth it was drilled at a 115 mm diameter to its total depth of 130 m. A surface casing of 125 mm diameter PVC casing was then installed from ground level to 8.5 m. A rubber seal was then placed at the bottom of the surface casing to prevent landfill leachate entering the bore. A 50 mm diameter PVC casing was then installed from ground level to 130 m and slotted from 124 to 130 m with a covering filter sock. A gravel pack was then installed from 70 m to 130 m with a 2.5 m bentonite seal.

No water was intersected during drilling however the bore did develop water at a slow but steady rate after the bore was constructed. The static water level 48 hours after the completion of drilling was 43 m from the ground surface.



Monitoring bore D2 was drilled to 103 m at a diameter of 170 mm. This bore was installed with 125 mm diameter PVC casing for its full length. An 18 m slotted section was included at the bottom of the well and covered by a filter sock. No gravel pack was used as the hole was in competent rock, but a rubber seal was installed at a depth of 55 m to stop any inflow into the well from higher up the bore. A water flow was intersected at between 93 and 97 m flowing at about 0.3 l/sec, with no significant increase in flow to the total depth of 103 m. The bore was developed by airlifting for 1½ hours and a 6 hour pumping test and recovery measurements also undertaken.

Four shallow monitoring bores were drilled to 10 m depth, whilst one, S3, was drilled to 20 m depth. All shallow bores were drilled at a diameter of 115 mm and installed with 50 mm diameter PVC casing. The 10 m deep bores were slotted over the bottom 3 m, whilst the 20 m deep bore was slotted over the bottom 6 m. All screened lengths were covered by a filter sock.

A gravel pack and bentonite seal was placed above the screened interval in all shallow bores. No water flows were intersected during drilling in any of these bores, however monitoring bore S1, S4 and S5 developed water at a slow rate once the bores were constructed. Two days after bore construction monitoring bores S2 and S3 remained dry. At a recent inspection groundwater was found in monitoring bore S2. Monitoring bore S3 is still dry.

4.2 Site Geology

The lithological logs of the two deep bores, as shown in the hydrogeological section shown in Figure 5, confirms that the site is underlain by variably weathered granites up to a depth of 130 m. This variation occurs both across the site, and at depth. The only exception is the uniform thickness of about 2 m of gravelly clay found at the surface in both the quarried and non-quarried areas.

Below the surficial gravelly clays the granite is competent with only minor intersections of extremely weathered granite. As indicated by the lack of significant water intersections, no major clean fissures were intersected during drilling.

4.3 Aquifer Tests

4.3.1 Deep Bores

Aquifer tests were attempted on both deep bores to obtain an estimate of their hydraulic conductivity.

An air lift test was conducted on bore D1 for 1 hour 10 minutes on 18 December 1992. The flow was too small to measure as mostly air was coming out. The recovery was measured after the water level had risen to 100 m, the maximum length of the dipmeter. As the recovery was extremely slow it was not possible to obtain a permeability measurement.

A six hour pumping test was carried out on 21 December 1992 on bore D2 using a Lowara BC-30 3HP electro-submersible pump at a constant discharge rate. Discharge rates were estimated regularly by measuring the time to fill a 10 litre container. Water level measurements were obtained with an electrical contact dipmeter.



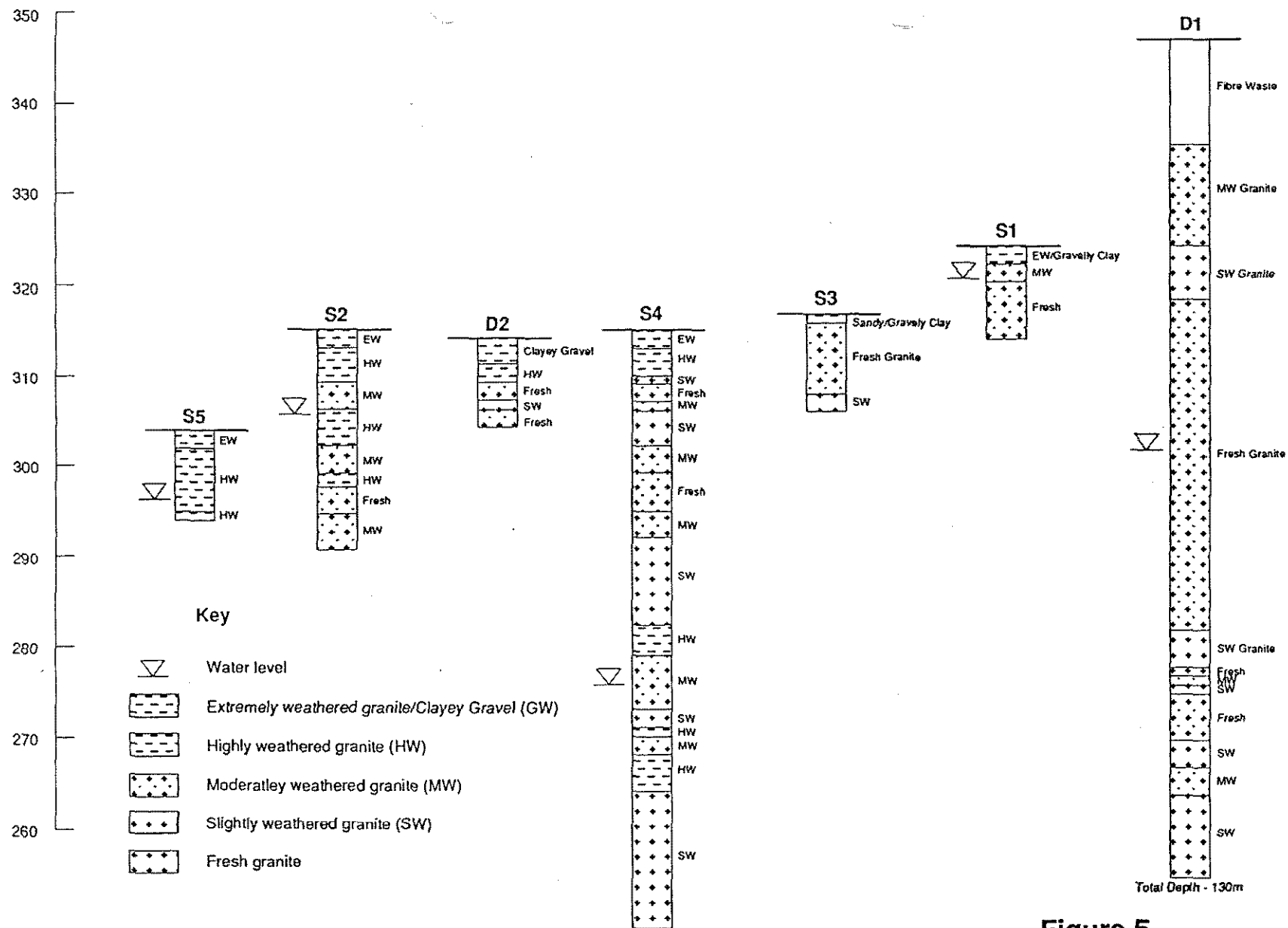


Figure 5

HYDROGEOLOGICAL CROSS-SECTION

ANM NEWSPRINT MILLS, ALBURY
 DELANEY'S QUARRY
 HYDROGEOLOGICAL ASSESSMENT

During the test there was a small variation in the abstraction rate ranging from 0.27 L/s to 0.33 L/s but was reasonably constant for the last half of the test at about 0.31 L/s. After pumping ceased recovery measurements were taken for 4½ hours.

The data obtained from these tests on bore D2 are graphically presented in Appendix B.

4.3.2 Shallow Bores

Falling head tests were conducted on the three shallow bores which were not dry on 21 December 1992 by injecting water into the boreholes. The data obtained from the tests is presented in Appendix C.

In each case the monitoring bores were filled to the top of the casing. Water level measurements were taken for two hours using a tape measure or electrical contact dipmeter.

4.3.3 Aquifer Test Results

The hydraulic conductivity of the lithological units intersected in both deep bores and the three shallow bores which have groundwater were obtained using a variety of analytical techniques. The results are presented in Table 4, based upon the analyses plots shown in Appendix C.

Table 4: Hydraulic Conductivity Estimates

Bore	Hydraulic Conductivity (m/day)	Analyses Plot Figure No(s)
D2	0.022	6 and 7
S1	0.021	8
S4	0.037	9
S5	0.096	10

These test results are considered representative of variously weathered granite, however it was expected that the hydraulic conductivity of monitoring bore D2 may have been higher as it intersected water between 93 m and 97 m. Over a saturated thickness of about 40 m, the transmissivity at D2 is estimated to be 0.7 m²/d.

4.4 Water Quality

Groundwater samples were obtained from all monitoring bores which had groundwater, four dams, the old quarry workings and Sandy Creek. The results of all laboratory water quality analyses are presented in Appendix D. These results are also presented against drinking water guideline values in Tables 6 and 7. Where available the guidelines are from the raw water quality criteria presented in the ANZECC (1992) Australian Water Quality Guidelines for fresh and marine waters. In their absence the NHMRC (1987) Guidelines for Drinking Water in Australia have been used. Values in exceedance of these guideline values do not necessarily mean contamination from the landfill. Although there is no recognised guideline concentration for TOC as it is an indicator of other organic contaminants, a concentration of above 10 mg/L is generally accepted as unsuitable for drinking purposes.

4.4.1 Groundwater

After bore construction and aquifer development groundwater samples were obtained from the two deep bores and the three shallow bores which were not dry (S1, S4 and S5). All samples were analysed for pH, conductivity, nutrients, total organic carbon and several metals. The results are shown in Table 5. All analyses, presented in Table 5, were conducted by the ANM Albury laboratory with the exception of arsenic, mercury, cadmium and nickel which were analysed by EML (Chem) Pty Ltd.

Table 5: Groundwater Analyses

Analyte ¹	D1	D2	S1	S4	S5	Drinking Water Guidelines ²
pH	7.68	7.70	6.75	6.58	5.81	6.5 to 8.5
Conductivity ($\mu\text{S/cm}$)	1884.0	1885.0	1935.0	3270.0	2620.0	1000
Ammonia	1.650	0.049	17.941	0.029	0.137	0.01
Kjeldahl N	0.179	<0.05	<0.05	0.128	<0.05	-
Total Nitrogen	3.905	0.058	18.253	0.875	5.078	-
Nitrate	2.076	0.009	0.312	0.718	4.941	10
Phosphorus	0.117	0.058	<0.0	0.288	0.053	0.1 ²
TOC	18.1	12.1	98.0	26.9	26.3	-
Iron	0.060	1.587	0.055	0.650	0.054	0.3
Copper	0.002	<0.05	0.017	0.005	0.015	1.0
Magnesium	1.221	0.172	6.189	1.528	0.547	0.1 ²
Zinc	0.029	0.011	0.053	0.047	0.140	5
Lead	0.102	<0.01	0.169	0.029	0.141	0.05
Cobalt	0.029	0.012	0.471	0.139	0.409	0.05 ²
Arsenic	<0.02	<0.02	<0.02	<0.02	<0.02	0.05
Mercury	<0.001	<0.001	<0.001	<0.001	<0.001	0.001
Cadmium	<0.005	<0.005	<0.005	<0.005	<0.005	0.005
Nickel	0.03	<0.02	0.27	0.10	0.23	0.1
Chromium	0.008	<0.005	0.005	<0.005	<0.005	0.05

¹ Units are mg/L unless stated otherwise.

² Guideline levels obtained from the NHMRC (1987) Guidelines for Drinking Water Quality in Australia.

Shaded Above drinking water quality guidelines.

The groundwater analyses indicate that:

- The salinity is within the range anticipated for groundwaters in granite aquifers;
- Groundwater at monitoring bore S1, which is directly down-gradient of dam C is contaminated by ammonia at 18 mg/L, and TOC at 98 mg/L. These concentrations are well above water supply acceptance criteria;
- Whilst the magnesium concentration of 6.2 mg/L at monitoring bore S1 is also higher than the surrounding bores, it is not considered to be due to contamination as the concentration in Dam C, the suggested source of the contamination is only 2.6 mg/L;
- Monitoring bore D1 may be contaminated by nitrate TOC;

- Whilst some of the monitoring bores have lead, cobalt and nickel concentrations above drinking water guideline concentrations, the levels are not considered to have been affected by the leachate, as the dam water analyses are much lower.

As no contamination was anticipated in the deep monitoring bores, a further sampling and analyses program of the monitoring bores was conducted on all monitoring bores on 22/23 January 1993. The bores were analysed for nitrate, ammonia, kjeldahl-N, total nitrogen and TOC. The results of the analyses together with depth to watertable are shown in Table 6.

Table 6: Further Groundwater Analyses

Analyte ¹	D1	D2	S1	S2	S4	S5
Nitrate	2.20	0.09	0.18	1.3	0.66	1.40
Ammonia	0.15	0.14	4.89	0.13	0.45	0.18
Kjeldahl-N	<0.05	<0.05	16.31	3.84	<0.05	0.44
Total N	2.35	0.23	21.38	5.17	1.11	2.03
TOC	9.4	12.0	52.0	11.0	9.8	6.4

¹ Units are mg/L

These results confirm that the nitrate concentration at monitoring bore D1 is higher than that of other bores. Whilst it may indicate some seepage from the landfill sludging, it is not of concern as the nitrate concentration of 2 mg/L is well below the potable standard of 10 mg/L.

4.4.2 Surface Water

Water samples were obtained from all dams, as well as from Sandy Creek, which at the time of sampling had a small flow. The results are shown in Table 7.



Table 7: Surface Water Analyses

Analyte ¹	Dam A	Dam B	Dam C	Dam D	Old Quarry Workings	Sandy Creek	Drinking Water Guidelines
pH	8.09	8.40	7.77	7.94	7.54	7.63	6.5 to 8.5
Conductivity (µS/cm)	541.0	1429.0	1848.0	756.0	751.0	211.0	1000
Ammonia	2.310	22.968	24.403	11.729	0.180	0.027	0.9
Kjeldahl N	6.408	14.67	30.566	<0.05	<0.05	0.06	-
Total Nitrogen	8.951	37.654	54.969	12.248	0.202	0.100	-
Nitrate	0.233	0.016	<0.005	0.519	0.022	0.013	10
Phosphorus	4.489	5.192	7.356	3.840	0.703	0.053	0.1 ²
TOC	176.9	219.7	445.6	130.8	32.4	19.3	-
Iron	0.809	2.931	3.917	2.621	0.036	0.144	0.3
Copper	0.005	0.015	0.011	0.003	<0.005	<0.005	1.0
Magnesium	0.564	0.964	2.036	1.076	0.017	0.013	0.1 ²
Zinc	0.033	0.051	0.059	0.029	0.010	0.017	5
Lead	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.05
Cobalt	0.019	0.032	0.034	0.023	0.023	0.011	0.05 ²
Arsenic	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.05
Mercury	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001
Cadmium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.005
Nickel	0.02	0.02	0.04	<0.02	<0.02	<0.02	0.1
Chromium	<0.005	<0.005	0.005	<0.005	<0.005	<0.005	0.05

¹ Units are mg/L unless stated otherwise.

² Drinking Water Guidelines are the Level B Canadian Criteria for contamination notification for potable waters.

³ Guideline levels obtained from the NHMRC (1987) Guidelines for Drinking Water Quality in Australia.

Shaded Above drinking water quality guidelines.

The surface water analyses clearly indicate that the dams within the landfill area are receiving landfill leachates. The primary indicators are ammonia concentrations of between 11 mg/L and 24 mg/L, total phosphorus concentrations of between 3.8 mg/L and 7.4 mg/L, and TOC concentrations ranging from 130 mg/L to 445 mg/L. Some iron and magnesium contamination may also be present. As with the groundwater samples, no significant heavy metals contamination is evident.

The highest concentrations are found at Dam C, as this dam has a limited surface catchment area, and is not as regularly drained as Dam A and B.

The farm dam at the southern corner of the irrigation area, Dam C, is also contaminated by the leachate as indicated by the relatively high ammonia, phosphorus, and TOC concentrations. The most likely cause of this contamination is the evident leakage from the toe of Dam B, whilst the perched aquifer at the toe of Dam B may be contributing to Dam A. Its impact upon the overall water quality is considered to be minor, as the groundwater concentrations of ammonia, TOC and phosphorus at S4 are generally less than ten percent of the farm dam water.

The old quarry workings on the elevated portion of the irrigation area does not appear to have been affected by the leachate, with the possible exception of phosphorus at a concentration of 0.7 mg/L and TOC at 32 mg/L. These concentrations, however, are more likely to be due to runoff from the unaffected catchment to the north, and some concentration due to discharge being limited to major wet periods.



With the exception of TOC, concentrations of all parameters analysed from the Sandy Creek sample are within the Drinking Water Guideline levels. The most likely origin of the TOC contamination of 19.3 mg/L is considered to be organic material within the catchment. However some seepage and hence TOC loading from Dam D may also be occurring.

4.5 Soil Chemistry

Soil samples obtained at depths of 0.5 m and between 1.0 m and 2.0 m were obtained from D1, S1 and S5. They were analysed by EML (Chem) Pty Ltd for cation exchange capacity, total organic carbon, barium, manganese, zinc, copper, nitrogen, phosphorus and pH. The results of the analyses are shown in Table 8, and presented in full in Appendix E.

Table 8: Soil Sample Analyses

Sample Description ¹	S1 0.5 m	S1 0.5-2 m	S5 0.5 m	S5 0.5-2 m	D2 0-0.5 m	D2 0.5-2 m
Total Barium, as Ba	280	180	280	220	330	200
Total Manganese as Mn	220	260	35	19	240	82
Total Zinc as Zn	46	51	23	15	42	20
Total Copper as Cu	24	3.3	12	7.8	8.5	2.5
T.O.C (% w/w)	0.2	0.2	0.3	0.1	0.2	<0.1
Kjeldahl Nitrogen as N	230	220	410	180	290	39
Total Phosphorus as P	240	280	240	190	180	150
Cation Exchange Capacity (meq/100g)	6.6	1.5	9.5	7.8	8.2	3.2
pH (1+5 Water Extract)	4.6	5.7	5.1	4.9	5.2	5.6
Total Solids (% w/w)	91.3	97.3	84.6	88.9	88.2	98.8

¹ Units are mg/kg unless otherwise stated.

Typical of biotitic granite parent materials, the soils are moderately acidic ranging from 4.6 to 5.7. Whilst the mobility of metals are higher in acidic soils than alkaline soils, the water analytical results indicate that neither groundwater or water metals contamination is occurring. The cation exchange capacities ranging from 1.5 meq/100 g to 9.5 meq/100 g indicates low to moderate metals attenuation capacity.



5. HYDROGEOLOGICAL ASSESSMENT

5.1 Impact of Site Operations on Groundwater Movement

The occurrence and movement of groundwater is strongly influenced by the geology, topography, the landfilling, and the leachate management operations.

The regional permanent watertable is deep at 40 m to 45 m below the natural ground surface. The direction of groundwater movement within the regional aquifer is strongly influenced by the surface water divide (Figure 3). South of the divide groundwater flows to the south-west at a gradient of approximately 1 in 12 as indicated by the 25 m head differential between bores D1 and D2. The transmissivity estimated from the pumping test conducted at bore D2 of about 0.7 m²/d is consistent with the rate of 1.6 m²/d found in the deep monitoring bore drilled at the mill site (NSW DWR; 1992).

Groundwater is present at depths of between 3 m and 8 m from the ground surface down-gradient of the leachate collection ponds within the highly to moderately weathered surficial granites. These occurrences were found down-gradient of dams B, C, and D, but not A.

Prior to quarrying, recharge to the regional aquifer occurred through rainfall infiltration. Although recharge would probably have been limited by the lower permeability of the surficial extremely weathered sediments, the investigation conducted as part of this study showed no evidence of perching in unaffected parts of the landscape.

Quarrying and landfilling have altered the natural hydrogeological equilibrium by:

- Exposing the fresher granites to the climatic conditions which may increase recharge in the short term as the in-situ material weather.
- Introducing a landfill capping material which has a different hydraulic conductivity to the parent material.
- Providing surface and underdrainage which discharges to leachate collection ponds, which are constructed of in-situ materials
- Generating leachate seepage at the toe of the leachate collection dams
- Irrigating with the leachate collected.
- Removing vegetation, limiting evapotranspiration.

Overall the site operations have probably marginally increased recharge to the regional aquifer, and resulted in localised perched aquifers at the toe of the dams. These changes in the hydrogeological regime are minor in a regional sense, hence will not adversely impact upon regional groundwater levels and hence soil and stream salinity.

5.2 Water Quality

Landfill leachates have been shown to be relatively high in ammonia, phosphorus, TOC, iron and possibly manganese, whilst nitrate and heavy metal concentrations are generally in the range which is suitable for drinking purposes.

These leachates are evident on-site within all dams, and the perched aquifers located near these dams. No significant contamination of the regional granite aquifer is indicated.





Off-site, leachate contamination has been found within the farm dam, located at the southern boundary, and to a lesser extent with the perched groundwaters at the toe of this dam. This contamination is suspected to be due to seepage from the toe of the leachate collection dam.

Whilst seepage from the farm dam in the direction of a tributary of Sandy Creek is evident, it does not appear to be adversely affecting the Sandy Creek water quality.

Localised perching, and possibly some groundwater contamination may occur within the irrigation area during wet periods, as the irrigation system is fixed.



6. FUTURE LANDFILL MANAGEMENT

As part of its solid waste management strategy ANM intends to continue landfilling operations at Delaney's quarry with operations extending from the existing landfill areas to Area E in the south-west corner of the site. Until the sludge land spreading scheme is fully implemented, the landfill will accept both sludge and boiler ash. In the long term the quarry will be utilised for boiler ash and RCF rejects disposal only.

The landfill must be operated to avoid off-site contamination of both surface water and localised perched aquifers, and to minimise landfill pore pressures. The landfill must also be managed in accordance with the operation conditions of the current EPA waste disposal site licence No 00412.

To fully satisfy the operational and licence requirements it is recommended that:

- 1 Dam C be infilled and capped to provide surface drainage back into the leachate collection system;
- 2 The existing leachate dams be clay lined in the drier summer months over the next two years to prevent seepage, and perched groundwater systems;
- 3 The existing tile drainage system within the landfilled areas be maintained, ensuring that its efficiency does not decrease over time;
- 4 The existing tile drainage system is extended to collect leachate and provide pore pressure relief in capped areas;
- 5 One of the leachate ponds be designed to provide a degree of winter storage, and hence limit irrigation to pasture requirements;
- 6 The leachate interceptor sump be cleaned of all debris, and sealed with a concrete cap;
- 7 The irrigation system be modified to redistribute the collected leachate over the entire irrigation area, excluding a buffer zone of 50 m;
- 8 A runoff interception drain be constructed along the western boundary of the irrigation area to prevent contaminated runoff leaving the site. This drain should discharge to a re-use dam, for recycling to the irrigation area;
- 9 Once landfilling commences within Area E, all leachate should be collected, and pumped to leachate Dam B, or to an irrigation system to the south, if the relevant planning approvals are obtained and environmental controls are implemented;
- 10 The current system of capping continues;
- 11 The groundwater and surface water monitoring program as proposed in Section 7 of this report is conducted.

The leachate and run-off management system should be continued during and after rehabilitation, until the leachate dam TOC concentration reduces to less than 10 mg/L, and the ammonia concentration reduces to less than 5 mg/L.

After individual discrete landfill cells are capped and revegetated, it is recommended that leachate be sprayed upon the site in addition to the irrigation area, particularly during periods of excess water demand.

The revegetation strategy for completed landfill cells should be prepared in consultation with the Department of Conservation and Land Management.



7. MONITORING PROGRAM

The Conditions of Consent for Australian Newsprint Mills Limited (ANM) Recycled Fibre Project and the Local Wastewater Reuse Scheme issued by the Department of Planning on 12 October, 1992 requires ANM to develop and submit to the Department of Water Resources for its approval a groundwater monitoring strategy for the Delaney's Quarry Landfill within six months of consent being issued (Condition 18.1(i)).

In compliance with these requirements the groundwater monitoring strategy is proposed in Section 7.1. As required by the Conditions of Consent the strategy must be approved by the NSW DWR following consultation with the Department as well as the Department of Conservation and Land Management and the Environment Protection Authority.

In addition to the groundwater monitoring strategy a surface water monitoring strategy as described in Section 7.2 is also recommended.

7.1 Groundwater Monitoring Strategy

As required by the Department of Water Resources two shallow monitoring bores (north-north east of S5 and approximately 150 m apart) should be constructed in the leachate irrigation area. The locations are shown in Figure 4.

The monitoring program will comprise the monitoring of the five shallow and two deep bores drilled as part of the Delaney's Quarry Hydrogeological Assessment and the additional two proposed bores in the irrigation area. It will also include the analysis of groundwater for:

- (i) metals (As, Cd, Co, Cr, Cu, Fe, Hg, Mn, Ni, Pb, Zn);
- (ii) SWL, RWL and conductivity;
- (iii) pH, TOC, TKN and NO₃N(N).

The locations of the monitoring bores are shown in Figures 3 and 4 of this report. The surface level of these bores is shown in Table 3 of this report. Details of the two additional monitoring bores should be submitted to the Department of Water Resources within one month of bore construction.

7.1.1 Frequency and Duration of Sampling

The frequency of sampling and analyses for the first year of monitoring will be:

- Monthly sampling and analyses of all monitoring bores for SWL, RWL, and conductivity;
- Quarterly sampling and analyses of all monitoring bores for pH, TOC, TKN and NO₃(N);
- Half yearly analyses of all monitoring bores for metals (As, Cd, Co, Cr, Cu, Fe, Hg, Mn, Ni, Pb, and Zn).

7.1.2 Review

An interpreted report on the groundwater monitoring will be submitted for review to the Department of Water Resources and the Environmental Protection Authority on an annual basis initially with copies of the raw data. During the review process, the date of the next review will be determined in consultation with ANM. The review report should be submitted to these authorities prior to the EPA licence renewal to allow revisions of the monitoring strategy to be incorporated in the following year's licence.

7.1.3 Future Revision of Monitoring Strategy

The monitoring strategy will be revised in accordance with requirements of the Department of Water Resources should the Department of Water Resources consider that the monitoring is, in its opinion, in need of revision following consideration of the monitoring results.

A deep monitoring bore will be constructed in the irrigation area, if contamination is identified in either of the two deep monitoring bores, D1 and D2, in the quarry area.

7.1.4 Bore Licensing

All monitoring bores are licensed under Part V of the *Water Act*. The licence number is 50 BL15272.

7.1.5 Laboratory Analysis

All chemical analysis will be undertaken at the ANM Laboratory at Albury or an EPA approved laboratory.

7.1.6 DWR and EPA Sampling

The Department of Water Resources and the Environment Protection Authority have the right to collect (or have collected) random independent samples from any or all monitoring bores to be analysed at a laboratory of their choice.

7.1.7 Remediation Action Plan

A thorough understanding of the cause of any problem is required before any remedial action can be undertaken.

In the event that a watertable rise in either the shallow or deep piezometers exceed an average 20 cm per year rise over a five year period of record (or part thereof for the first five years) at either site, ANM will undertake investigations to determine the cause. If the cause of the rise is found to be increased recharge from the landfill, ANM will following consultation, implement the recommendations of the Department of Water Resources.

In the event that the salinity of the regional aquifer increases by more than 20% or water quality is found to be deteriorating beyond acceptable limits, ANM will forthwith notify the Department of Water Resources. ANM will then undertake appropriate investigations as discussed and agreed by DWR/EPA. If the cause of the deterioration in quality is found to be landfill leachate the ANM will, following consultation implement the recommendations of the Department of Water Resources.

One of the most likely remediation options would be re-capping the landfill with a more controlled, low permeability clay.

7.2 Surface Water Monitoring Strategy

Surface water monitoring of dams A, B, C and D and the Sandy Creek tributary, and any additional leachate collection dams which are constructed should be conducted for as long as these dams remain operational. The analyses should be carried out for the parameters identified in Section 7.1, at an identical frequency to the groundwater analyses.

It is also recommended that the review, revision and reporting procedures should be co-ordinated with the groundwater monitoring strategy.



8. CONCLUSIONS

The assessment of the hydrogeological and water quality data has clearly identified evidence of landfill leachate in the surface water bodies and shallow perched aquifers within the site and along the southern boundary of the landfill. This leachate is high in ammonia, TOC, and phosphorus. No evidence of metals contamination was found both on-site and off-site.

No significant contamination of the regional groundwater and Sandy Creek was found, although moderate levels of TOC and nitrate did indicate some minor seepage into both of these water bodies.

The existing leachate management system should be upgraded to minimise the off-site seepage of leachate. This will include clay lining off the leachate dams, upgrading of the irrigation system.

Both surface water and groundwater monitoring programmes are recommended as part of the ongoing landfill management strategy. This monitoring should continue after rehabilitation until the leachate concentration reduces to acceptable levels.



REFERENCES

NSW Department of Water Resources Consulting Services (1992), *"Maryvale and Mill Site Hydrogeological Investigation, Albury NSW"*.





BOREHOLE LOG AND MONITORING BORE DETAIL

CLIENT: AUSTRALIAN NEWSPRINT MILLS LIMITED
 PROJECT: HYDROGEOLOGICAL ASSESSMENT
 DELANEYS QUARRY
 BOREHOLE LOCATION: 296 608 E
 1016 300 N

JOB NUMBER: 311/5245/1800
 HOLE COMMENCED: 14/12/92
 HOLE COMPLETED: 16/12/92
 SUPERVISED BY: ITH
 LOG CHECKED BY: FJM

DRILL MODEL AND MOUNTING: BOURNE 1250R - AIR ROTARY
 HOLE DIAMETER: 115mm BORE DIAMETER: 50mm

R.L. SURFACE 344.32m
 DATUM: AHD

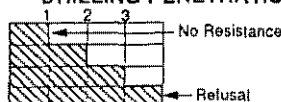
METHOD	SUPPORT	WATER	DRILLING PENETRATION	NOTES SAMPLES TESTS	DEPTH (m)	GRAPHIC LOG	U.S. CI SYMBOL	MATERIAL SOIL TYPE: PLASTICITY OR PARTICLE CHARACTERISTICS: COLOUR SECONDARY & MINOR COMPONENTS	MOISTURE CONDITION	CONSISTENCY DENSITY INDEX	100 HAND 200 PENETRO- 300 METER (kPa)	STRUCTURE TEST RESULTS AND ADDITIONAL OBSERVATIONS	MONITORING BORE DETAILS
AR								Soil/Rock Fill.	M			Capping Layer	C
					2			Fibre Waste.	M			Capped Sludge	BF
					4								
					6								
					8			Moderately weathered GRANITE, light brown.	M			Possible floater	BF
					10								
					12			Moderately weathered GRANITE in fibre waste (10% fibre).	W			Hole making water from fibre at base of dump	BF
					14			Moderately weathered GRANITE, light brown.	M				BF
					16								
					18								
								Slightly weathered GRANITE, very light brown.	D				BF

KEY TO LOG

METHOD
 A - AUGER
 R - ROLLER / TRICONE
 W - WASH BORING
 T - TRIPLE TUBE CORING
 DT - DOUBLE TUBE
 CORING
 C - CABLE TOOL
 HA - HOLLOW AUGER
 H - HAND AUGER
 RH - ROTARY/HAMMER
 AR - AIR ROTARY
SUPPORT
 M - MUD
 C - CASING

WATER
 WATER LEVEL
 WATER INFLOW
 WATER OUTFLOW
 GNE - GROUNDWATER NOT ENCOUNTERED

DRILLING PENETRATION



SAMPLES & NOTES

SV - INSITU SHEAR VANE TEST (kPa)
 pp - HAND PENETROMETER TEST (kPa)
 U63 - UNDISTURBED TUBE
 SAMPLE, 63mm DIAMETER
 D - DISTURBED SAMPLE
 CS - CORE SAMPLE
 N - STANDARD PENETRATION TEST
 Nd - SPT + DISTURBED SAMPLE
 R - SPT PENETRATION REFUSAL
 BCH - BENTONITE CEMENT GROUT
MOISTURE CONDITION
 D - DRY
 M - MOIST
 W - WET

CONSISTENCY / DENSITY INDEX

VS - VERY SOFT FB - FRIABLE
 S - SOFT VL - VERY LOOSE
 F - FIRM L - LOOSE
 ST - STIFF MD - MEDIUM DENSE
 VST - VERY STIFF D - DENSE
 H - HARD VD - VERY DENSE

MONITORING BORE DETAILS

BF - BACKFILL S - SAND
 C - CEMENT G - GRAVEL
 SP - STANDPIPE
 BP - BENTONITE PELLETS
 BG - GRANULATED BENTONITE

Gutteridge Haskins & Davey Pty Ltd



BOREHOLE NO. D1

SHEET 2 OF 7

BOREHOLE LOG AND MONITORING BORE DETAIL

CLIENT: AUSTRALIAN NEWSPRINT MILLS LIMITED
PROJECT: HYDROGEOLOGICAL ASSESSMENT
DELANEYS QUARRY
BOREHOLE LOCATION: 296 608 E
1016 300 N

JOB NUMBER: 311/5245/1800
HOLE COMMENCED: 14/12/92
HOLE COMPLETED: 16/12/92
SUPERVISED BY: ITH
LOG CHECKED BY: FJM

DRILL MODEL AND MOUNTING: BOURNE 1250R - AIR ROTARY
HOLE DIAMETER: 115mm BORE DIAMETER: 50mm

R.L. SURFACE 344.32m
DATUM: AHD

METHOD	SUPPORT	WATER	DRILLING PENETRATION	NOTES SAMPLES TESTS	DEPTH (m)	GRAPHIC LOG	U.S. CI SYMBOL	MATERIAL SOIL TYPE: PLASTICITY OR PARTICLE CHARACTERISTICS: COLOUR SECONDARY & MINOR COMPONENTS	MOISTURE CONDITION	CONSISTENCY DENSITY INDEX	100 HAND - 200 PENETRO- - 300 METER (kPa)	STRUCTURE TEST RESULTS AND ADDITIONAL OBSERVATIONS	MONITORING BORE DETAILS
AR					22	+		Slightly weathered GRANITE, very light brown.	D				BF
					24	+							
					26	+		Fresh GRANITE, white, very fine grained cuttings.	D				BF
					28	+							
					30	+							
					32	+							
					34	+							
					36	+							
					38	+							

KEY TO LOG METHOD A - AUGER R - ROLLER / TRICONE W - WASH BORING T - TRIPLE TUBE CORING DT - DOUBLE TUBE CORING C - CABLE TOOL HA - HOLLOW AUGER H - HAND AUGER RH - ROTARY/HAMMER AR - AIR ROTARY SUPPORT M - MUD C - CASING	WATER WATER LEVEL WATER INFLOW WATER OUTFLOW GNE GROUNDWATER NOT ENCOUNTERED DRILLING PENETRATION 	SAMPLES & NOTES SV - INSITU SHEAR VANE TEST (kPa) pp - HAND PENETROMETER TEST (kPa) U63 - UNDISTURBED TUBE SAMPLE, 63mm DIAMETER D - DISTURBED SAMPLE CS - CORE SAMPLE N - STANDARD PENETRATION TEST Nd - SPT + DISTURBED SAMPLE R - SPT PENETRATION REFUSAL BCH - BENTONITE CEMENT GROUT MOISTURE CONDITION D - DRY M - MOIST W - WET	CONSISTENCY / DENSITY INDEX VS - VERY SOFT F8 - FRIABLE S - SOFT VL - VERY LOOSE F - FIRM L - LOOSE ST - STIFF MD - MEDIUM DENSE VST - VERY STIFF D - DENSE H - HARD VD - VERY DENSE MONITORING BORE DETAILS BF - BACKFILL S - SAND C - CEMENT G - GRAVEL SP - STANDPIPE BP - BENTONITE PELLETS BG - GRANULATED BENTONITE
--	--	--	---

Gutteridge Haskins & Davey Pty Ltd



BOREHOLE NO. D1

SHEET 3 OF 7

BOREHOLE LOG AND MONITORING BORE DETAIL

CLIENT: AUSTRALIAN NEWSPRINT MILLS LIMITED
PROJECT: HYDROGEOLOGICAL ASSESSMENT
DELANEYS QUARRY
BOREHOLE LOCATION: 296 608 E
1016 300 N

JOB NUMBER: 311/5245/1800
HOLE COMMENCED: 14/12/92
HOLE COMPLETED: 16/12/92
SUPERVISED BY: ITH
LOG CHECKED BY: FJM

DRILL MODEL AND MOUNTING: BOURNE 1250R - AIR ROTARY
HOLE DIAMETER: 115mm BORE DIAMETER: 50mm

R.L. SURFACE 344.32m
DATUM: AHD

METHOD	SUPPORT	WATER	DRILLING PENETRATION	NOTES SAMPLES TESTS	DEPTH (m)	GRAPHIC LOG	U.S. CI SYMBOL	MATERIAL SOIL TYPE: PLASTICITY OR PARTICLE CHARACTERISTICS: COLOUR SECONDARY & MINOR COMPONENTS	MOISTURE CONDITION	CONSISTENCY DENSITY INDEX	100 HAND PENETRO- METER (kPa)	STRUCTURE TEST RESULTS AND ADDITIONAL OBSERVATIONS	MONITORING BORE DETAILS
AR								Fesh GRANITE, white, very fine grained cuttings.	D				BF
					42								
					44								
					46								
					48								
					50								
					52								
					54								
					56								
					58								

KEY TO LOG METHOD

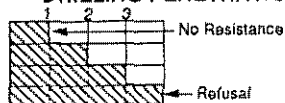
A - AUGER
R - ROLLER / TRICONE
W - WASH BORING
T - TRIPLE TUBE CORING
DT - DOUBLE TUBE CORING
C - CABLE TOOL
HA - HOLLOW AUGER
H - HAND AUGER
RH - ROTARY/HAMMER
AR - AIR ROTARY
SUPPORT
M - MUD
C - CASING

WATER

WATER LEVEL
WATER INFLOW
WATER OUTFLOW

GNE GROUNDWATER NOT ENCOUNTERED

DRILLING PENETRATION



SAMPLES & NOTES

SV - INSITU SHEAR VANE TEST (kPa)
pp - HAND PENETROMETER TEST (kPa)
U63 - UNDISTURBED TUBE
SAMPLE, 63mm DIAMETER
D - DISTURBED SAMPLE
CS - CORE SAMPLE
N - STANDARD PENETRATION TEST
Nd - SPT + DISTURBED SAMPLE
R - SPT PENETRATION REFUSAL
BCH - BENTONITE CEMENT GROUT
MOISTURE CONDITION
D - DRY
M - MOIST
W - WET

CONSISTENCY / DENSITY INDEX

VS - VERY SOFT FB - FRIABLE
S - SOFT VL - VERY LOOSE
F - FIRM L - LOOSE
ST - STIFF MD - MEDIUM DENSE
VST - VERY STIFF D - DENSE
H - HARD VD - VERY DENSE

MONITORING BORE DETAILS

BF - BACKFILL S - SAND
C - CEMENT G - GRAVEL
SP - STANDPIPE
BP - BENTONITE PELLETS
BG - GRANULATED BENTONITE

Gutteridge Haskins & Davey Pty Ltd



BOREHOLE NO. D1

SHEET 4 OF 7

BOREHOLE LOG AND MONITORING BORE DETAIL

CLIENT: AUSTRALIAN NEWSPRINT MILLS LIMITED
PROJECT: HYDROGEOLOGICAL ASSESSMENT
DELANEYS QUARRY
BOREHOLE LOCATION: 296 608 E
1016 300 N

JOB NUMBER: 311/5245/1800
HOLE COMMENCED: 14/12/92
HOLE COMPLETED: 16/12/92
SUPERVISED BY: ITH
LOG CHECKED BY: FJM

DRILL MODEL AND MOUNTING: BOURNE 1250R - AIR ROTARY
HOLE DIAMETER: 115mm BORE DIAMETER: 50mm

R.L. SURFACE 344.32m
DATUM: AHD

METHOD	SUPPORT	WATER	DRILLING PENETRATION	NOTES SAMPLES TESTS	DEPTH (m)	GRAPHIC LOG	U.S. CI SYMBOL	MATERIAL SOIL TYPE: PLASTICITY OR PARTICLE CHARACTERISTICS: COLOUR SECONDARY & MINOR COMPONENTS	MOISTURE CONDITION	CONSISTENCY DENSITY INDEX	100 HAND - 200 PENETRO- - 300 METER (kPa)	STRUCTURE TEST RESULTS AND ADDITIONAL OBSERVATIONS	MONITORING BORE DETAILS
AR								Fesh GRANITE, white, very fine grained cuttings.	D				BF
					62			Slightly weathered GRANITE, very light brown.	D				BF
					64								
					66								
					68			Fresh GRANITE, white.	D				BG
								Moderately weathered GRANITE, light brown.	D			Coarse cuttings Fracture zone	BG
					70			Slightly weathered GRANITE, very light brown.	D				BG
					72			Fresh GRANITE, white, very fine grained cuttings.	D				G
					74								
					76			Slightly weathered GRANITE, very light brown, fine grained cuttings.	D				G
					78			Moderately weathered GRANITE, light brown, some very coarse cuttings.	D			Fracture zone	G

KEY TO LOG METHOD

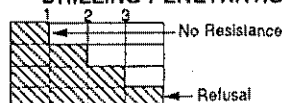
A - AUGER
R - ROLLER / TRICONE
W - WASH BORING
T - TRIPLE TUBE CORING
DT - DOUBLE TUBE
CORING
C - CABLE TOOL
HA - HOLLOW AUGER
H - HAND AUGER
RH - ROTARY/HAMMER
AR - AIR ROTARY
SUPPORT
M - MUD
C - CASING

WATER

WATER LEVEL
WATER INFLOW
WATER OUTFLOW

GNE GROUNDWATER NOT ENCOUNTERED

DRILLING PENETRATION



SAMPLES & NOTES

SV - INSITU SHEAR VANE TEST (kPa)
pp - HAND PENETROMETER TEST (kPa)
U63 - UNDISTURBED TUBE
SAMPLE, 63mm DIAMETER
D - DISTURBED SAMPLE
CS - CORE SAMPLE
N - STANDARD PENETRATION TEST
Nd - SPT + DISTURBED SAMPLE
R - SPT PENETRATION REFUSAL
BOH - BENTONITE CEMENT GROUT
MOISTURE CONDITION
D - DRY
M - MOIST
W - WET

CONSISTENCY / DENSITY INDEX

VS - VERY SOFT FB - FRIABLE
S - SOFT VL - VERY LOOSE
F - FIRM L - LOOSE
ST - STIFF MD - MEDIUM DENSE
VST - VERY STIFF D - DENSE
H - HARD VD - VERY DENSE

MONITORING BORE DETAILS

BF - BACKFILL S - SAND
C - CEMENT G - GRAVEL
SP - STANDPIPE
BP - BENTONITE PELLETS
BG - GRANULATED BENTONITE

Gutteridge Haskins & Davey Pty Ltd



BOREHOLE NO. D1

SHEET 5 OF 7

BOREHOLE LOG AND MONITORING BORE DETAIL

CLIENT: AUSTRALIAN NEWSPRINT MILLS LIMITED
PROJECT: HYDROGEOLOGICAL ASSESSMENT
DELANEYS QUARRY
BOREHOLE LOCATION: 296 608 E
1016 300 N

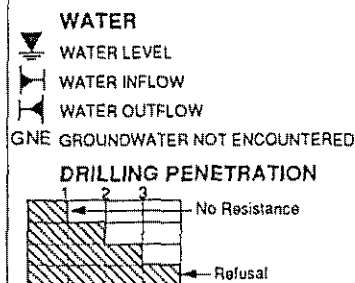
JOB NUMBER: 311/5245/1800
HOLE COMMENCED: 14/12/92
HOLE COMPLETED: 16/12/92
SUPERVISED BY: ITH
LOG CHECKED BY: FJM

DRILL MODEL AND MOUNTING: BOURNE 1250R - AIR ROTARY
HOLE DIAMETER: 115mm BORE DIAMETER: 50mm

R.L. SURFACE 344.32m
DATUM: AHD

METHOD	SUPPORT	WATER	DRILLING PENETRATION	NOTES SAMPLES TESTS	DEPTH (m)	GRAPHIC LOG	U.S. CI SYMBOL	MATERIAL SOIL TYPE: PLASTICITY OR PARTICLE CHARACTERISTICS: COLOUR SECONDARY & MINOR COMPONENTS	MOISTURE CONDITION	CONSISTENCY DENSITY INDEX	HAND PENETRO- METER (kPa)	STRUCTURE TEST RESULTS AND ADDITIONAL OBSERVATIONS	MONITORING BORE DETAILS
AR								Moderately weathered GRANITE, light brown.	D				G
					82			Slightly weathered GRANITE, very light brown.	D				G
					84								
					86								
					88			Slightly weathered GRANITE, grey.	D				G
					90								
					92			Moderately weathered GRANITE, light brown.	D			Fracture zone	G
					94			Slightly weathered GRANITE, very light brown.	D				G
					96								
					98								

KEY TO LOG METHOD
A - AUGER
R - ROLLER / TRICONE
W - WASH BORING
T - TRIPLE TUBE CORING
DT - DOUBLE TUBE CORING
C - CABLE TOOL
HA - HOLLOW AUGER
H - HAND AUGER
RH - ROTARY/HAMMER
AR - AIR ROTARY
SUPPORT
M - MUD
C - CASING



SAMPLES & NOTES
SV - INSITU SHEAR VANE TEST (kPa)
pp - HAND PENETROMETER TEST (kPa)
U63 - UNDISTURBED TUBE
SAMPLE, 63mm DIAMETER
D - DISTURBED SAMPLE
CS - CORE SAMPLE
N - STANDARD PENETRATION TEST
Nd - SPT - DISTURBED SAMPLE
R - SPT PENETRATION REFUSAL
BCH - BENTONITE CEMENT GROUT
MOISTURE CONDITION
D - DRY
M - MOIST
W - WET

CONSISTENCY / DENSITY INDEX
VS - VERY SOFT FB - FRIABLE
S - SOFT VL - VERY LOOSE
F - FIRM L - LOOSE
ST - STIFF MD - MEDIUM DENSE
VST - VERY STIFF D - DENSE
H - HARD VD - VERY DENSE

MONITORING BORE DETAILS
BF - BACKFILL S - SAND
C - CEMENT G - GRAVEL
SP - STANDPIPE
BP - BENTONITE PELLETS
BG - GRANULATED BENTONITE

Gutteridge Haskins & Davey Pty Ltd



BOREHOLE NO. D1

SHEET 6 OF 7

BOREHOLE LOG AND MONITORING BORE DETAIL

CLIENT: AUSTRALIAN NEWSPRINT MILLS LIMITED
PROJECT: HYDROGEOLOGICAL ASSESSMENT
DELANEYS QUARRY
BOREHOLE LOCATION: 296 608 E
1016 300 N

JOB NUMBER: 311/5245/1800
HOLE COMMENCED: 14/12/92
HOLE COMPLETED: 16/12/92
SUPERVISED BY: ITH
LOG CHECKED BY: FJM

DRILL MODEL AND MOUNTING: BOURNE 1250R - AIR ROTARY R.L. SURFACE 344.32m
HOLE DIAMETER: 115mm BORE DIAMETER: 50mm DATUM: AHD

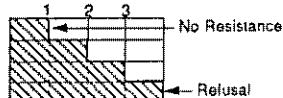
METHOD	SUPPORT	WATER	DRILLING PENETRATION	NOTES SAMPLES TESTS	DEPTH (m)	GRAPHIC LOG	U.S. CI SYMBOL	MATERIAL SOIL TYPE: PLASTICITY OR PARTICLE CHARACTERISTICS: COLOUR SECONDARY & MINOR COMPONENTS	MOISTURE CONDITION	CONSISTENCY INDEX	100 HAND PENETRO- METER (NPa)	STRUCTURE TEST RESULTS AND ADDITIONAL OBSERVATIONS	MONITORING BORE DETAILS
AR								Moderately weathered GRANITE, light brown.	D				G
					102								
					104								
					106								
					108								
					110			Slightly weathered GRANITE, very light brown.	D				G
					112								SP, G
					114								
					116								
					118								

KEY TO LOG METHOD

A - AUGER
R - ROLLER / TRICONE
W - WASH BORING
T - TRIPLE TUBE CORING
DT - DOUBLE TUBE CORING
C - CABLE TOOL
HA - HOLLOW AUGER
H - HAND AUGER
RH - ROTARY/HAMMER
AR - AIR ROTARY
SUPPORT
M - MUD
C - CASING

WATER
 WATER LEVEL
 WATER INFLOW
 WATER OUTFLOW
 GNE GROUNDWATER NOT ENCOUNTERED

DRILLING PENETRATION



SAMPLES & NOTES

SV - INSITU SHEAR VANE TEST (kPa)
pp - HAND PENETROMETER TEST (kPa)
U63 - UNDISTURBED TUBE
SAMPLE, 63mm DIAMETER
D - DISTURBED SAMPLE
CS - CORE SAMPLE
N - STANDARD PENETRATION TEST
Nd - SPT + DISTURBED SAMPLE
R - SPT PENETRATION REFUSAL
BCH - BENTONITE CEMENT GROUT
MOISTURE CONDITION
D - DRY
M - MOIST
W - WET

CONSISTENCY / DENSITY INDEX

VS - VERY SOFT FB - FRIABLE
S - SOFT VL - VERY LOOSE
F - FIRM L - LOOSE
ST - STIFF MD - MEDIUM DENSE
VST - VERY STIFF D - DENSE
H - HARD VD - VERY DENSE

MONITORING BORE DETAILS

BF - BACKFILL S - SAND
C - CEMENT G - GRAVEL
SP - STANDPIPE
BP - BENTONITE PELLETS
BG - GRANULATED BENTONITE

Gutteridge Haskins & Davey Pty Ltd



BOREHOLE NO. D1

SHEET 7 OF 7

BOREHOLE LOG AND MONITORING BORE DETAIL

CLIENT: AUSTRALIAN NEWSPRINT MILLS LIMITED
PROJECT: HYDROGEOLOGICAL ASSESSMENT
DELANEYS QUARRY
BOREHOLE LOCATION: 296 608 E
1016 300 N

JOB NUMBER: 311/5245/1800
HOLE COMMENCED: 14/12/92
HOLE COMPLETED: 16/12/92
SUPERVISED BY: ITH
LOG CHECKED BY: FJM

DRILL MODEL AND MOUNTING: BOURNE 1250R - AIR ROTARY R.L. SURFACE 344.32m
HOLE DIAMETER: 115mm BORE DIAMETER: 50mm DATUM: AHD

METHOD	SUPPORT	WATER	DRILLING PENETRATION	NOTES SAMPLES TESTS	DEPTH (m)	GRAPHIC LOG	U.S. CI SYMBOL	MATERIAL SOIL TYPE: PLASTICITY OR PARTICLE CHARACTERISTICS: COLOUR SECONDARY & MINOR COMPONENTS	MOISTURE CONDITION	CONSISTENCY DENSITY INDEX	100 HAND PENETRO- METER (kPa)	STRUCTURE TEST RESULTS AND ADDITIONAL OBSERVATIONS	MONITORING BORE DETAILS
AR	OPEN				122	***		Slightly weathered GRANITE, very light brown.	D				SP,G
					124	***							
					126	***							
					128	***		Slightly weathered GRANITE, very light brown.	D			Alot of coarse black cuttings	SP,G
					130	***		Slightly weathered GRANITE, very light brown.	D				SP,G
					132			END OF BOREHOLE 130m					
					134								
					136								
					138								

KEY TO LOG METHOD

A - AUGER
R - ROLLER / TRICONE
W - WASH BORING
T - TRIPLE TUBE CORING
DT - DOUBLE TUBE CORING
C - CABLE TOOL
HA - HOLLOW AUGER
H - HAND AUGER
RH - ROTARY/HAMMER
AR - AIR ROTARY
SUPPORT
M - MUD
C - CASING

WATER
 WATER LEVEL
 WATER INFLOW
 WATER OUTFLOW
 GNE GROUNDWATER NOT ENCOUNTERED

DRILLING PENETRATION



SAMPLES & NOTES

SV - INSITU SHEAR VANE TEST (kPa)
pp - HAND PENETROMETER TEST (kPa)
U63 - UNDISTURBED TUBE
SAMPLE, 63mm DIAMETER
D - DISTURBED SAMPLE
CS - CORE SAMPLE
N - STANDARD PENETRATION TEST
Nd - SPT + DISTURBED SAMPLE
R - SPT PENETRATION REFUSAL
BCH - BENTONITE CEMENT GROUT
MOISTURE CONDITION
D - DRY
M - MOIST
W - WET

CONSISTENCY / DENSITY INDEX

VS - VERY SOFT
S - SOFT
F - FIRM
ST - STIFF
VST - VERY STIFF
H - HARD
FB - FRIABLE
VL - VERY LOOSE
L - LOOSE
MD - MEDIUM DENSE
D - DENSE
VD - VERY DENSE

MONITORING BORE DETAILS

BF - BACKFILL
C - CEMENT
SP - STANDPIPE
BP - BENTONITE PELLETS
BG - GRANULATED BENTONITE
S - SAND
G - GRAVEL



BOREHOLE LOG AND MONITORING BORE DETAIL

CLIENT: AUSTRALIAN NEWSPRINT MILLS LIMITED
 PROJECT: HYDROGEOLOGICAL ASSESSMENT
 DELANEYS QUARRY
 BOREHOLE LOCATION: 296 293 E
 1016 346 N

JOB NUMBER: 311/5245/1800
 HOLE COMMENCED: 16/12/92
 HOLE COMPLETED: 17/12/92
 SUPERVISED BY: ITH
 LOG CHECKED BY: FJM

DRILL MODEL AND MOUNTING: BOURNE 1250R - AIR ROTARY
 HOLE DIAMETER: 170mm BORE DIAMETER: 125mm

R.L. SURFACE 315.79m
 DATUM: AHD

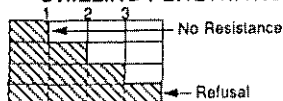
METHOD	SUPPORT	WATER	DRILLING PENETRATION	NOTES SAMPLES TESTS	DEPTH (m)	GRAPHIC LOG	U.S. CI SYMBOL	MATERIAL SOIL TYPE: PLASTICITY OR PARTICLE CHARACTERISTICS: COLOUR SECONDARY & MINOR COMPONENTS	MOISTURE CONDITION	CONSISTENCY DENSITY INDEX	100 HAND PENETRO- METER (kPa)	STRUCTURE TEST RESULTS AND ADDITIONAL OBSERVATIONS	MONITORING BORE DETAILS
AR				D				Extremely weathered GRANITE, red brown, clayey.	M				C
				D	2			Highly weathered GRANITE, light brown.	M				BF
					4								
					6			Slightly weathered GRANITE, very light brown.	D				BF
					8			Fresh GRANITE, white grey.	D				BF
					10			Moderately weathered GRANITE, brown.	D				BF
					12			Slightly weathered GRANITE, very light brown.	D				BF
					14			Moderately weathered GRANITE, brown.	D				BF
					16			Fresh GRANITE, white, grey.	D				BF
					18								

KEY TO LOG METHOD

A - AUGER
 R - ROLLER / TRICONE
 W - WASH BORING
 T - TRIPLE TUBE CORING
 DT - DOUBLE TUBE CORING
 C - CABLE TOOL
 HA - HOLLOW AUGER
 H - HAND AUGER
 RH - ROTARY/HAMMER
 AR - AIR ROTARY
 SUPPORT
 M - MUD
 C - CASING

WATER
 WATER LEVEL
 WATER INFLOW
 WATER OUTFLOW
 GNE GROUNDWATER NOT ENCOUNTERED

DRILLING PENETRATION



SAMPLES & NOTES

SV - INSITU SHEAR VANE TEST (kPa)
 pp - HAND PENETROMETER TEST (kPa)
 U63 - UNDISTURBED TUBE
 SAMPLE, 63mm DIAMETER
 D - DISTURBED SAMPLE
 CS - CORE SAMPLE
 N - STANDARD PENETRATION TEST
 Nd - SPT + DISTURBED SAMPLE
 R - SPT PENETRATION REFUSAL
 BCH - BENTONITE CEMENT GROUT
 MOISTURE CONDITION
 D - DRY
 M - MOIST
 W - WET

CONSISTENCY / DENSITY INDEX

VS - VERY SOFT FB - FRIABLE
 S - SOFT VL - VERY LOOSE
 F - FIRM L - LOOSE
 ST - STIFF MD - MEDIUM DENSE
 VST - VERY STIFF D - DENSE
 H - HARD VD - VERY DENSE

MONITORING BORE DETAILS

BF - BACKFILL S - SAND
 C - CEMENT G - GRAVEL
 SP - STANOP/PE
 BP - BENTONITE PELLETS
 BG - GRANULATED BENTONITE

Gutteridge Haskins & Davey Pty Ltd



BOREHOLE NO. D2

SHEET 2 OF 6

BOREHOLE LOG AND MONITORING BORE DETAIL

CLIENT: AUSTRALIAN NEWSPRINT MILLS LIMITED
PROJECT: HYDROGEOLOGICAL ASSESSMENT
DELANEYS QUARRY
BOREHOLE LOCATION: 296 608 E
1016 300 N

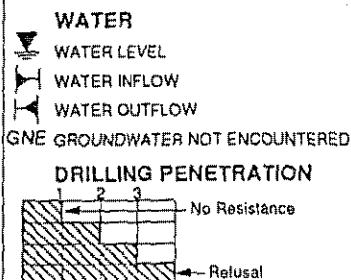
JOB NUMBER: 311/5245/1800
HOLE COMMENCED: 16/12/92
HOLE COMPLETED: 17/12/92
SUPERVISED BY: ITH
LOG CHECKED BY: FJM

DRILL MODEL AND MOUNTING: BOURNE 1250R - AIR ROTARY
HOLE DIAMETER: 170mm BORE DIAMETER: 125mm
R.L. SURFACE 315.79m
DATUM: AHD

METHOD	SUPPORT	WATER	DRILLING PENETRATION	NOTES SAMPLES TESTS	DEPTH (m)	GRAPHIC LOG	U.S. CI SYMBOL	MATERIAL SOIL TYPE: PLASTICITY OR PARTICLE CHARACTERISTICS: COLOUR SECONDARY & MINOR COMPONENTS	MOISTURE CONDITION	CONSISTENCY DENSITY INDEX	100 HAND PENETRO- METER (kPa)	STRUCTURE TEST RESULTS AND ADDITIONAL OBSERVATIONS	MONITORING BORE DETAILS
AR								Moderately weathered GRANITE, brown.	D				BF
					22								
					24			Slightly weathered GRANITE, very light brown.	D				BF
					26								
					28								
					30								
					32								
					34			Highly weathered GRANITE, brown.	D			Fracture zone	BF
					36								
					38			Moderately weathered GRANITE, brown.	D				BF

KEY TO LOG METHOD

A - AUGER
R - ROLLER / TRICONE
W - WASH BORING
T - TRIPLE TUBE CORING
DT - DOUBLE TUBE CORING
C - CABLE TOOL
HA - HOLLOW AUGER
H - HAND AUGER
RH - ROTARY/HAMMER
AR - AIR ROTARY
SUPPORT
M - MUD
C - CASING



SAMPLES & NOTES

SV - INSITU SHEAR VANE TEST (kPa)
pp - HAND PENETROMETER TEST (kPa)
U63 - UNDISTURBED TUBE
SAMPLE, 63mm DIAMETER
D - DISTURBED SAMPLE
CS - CORE SAMPLE
N - STANDARD PENETRATION TEST
Nd - SPT + DISTURBED SAMPLE
R - SPT PENETRATION REFUSAL
BCH - BENTONITE CEMENT GROUT
MOISTURE CONDITION
D - DRY
M - MOIST
W - WET

CONSISTENCY / DENSITY INDEX

VS - VERY SOFT FB - FRIABLE
S - SOFT VL - VERY LOOSE
F - FIRM L - LOOSE
ST - STIFF MD - MEDIUM DENSE
VST - VERY STIFF D - DENSE
H - HARD VD - VERY DENSE

MONITORING BORE DETAILS

BF - BACKFILL S - SAND
C - CEMENT G - GRAVEL
SP - STANDPIPE
BP - BENTONITE PELLETS
BG - GRANULATED BENTONITE

Gutteridge Haskins & Davey Pty Ltd



BOREHOLE NO. D2

SHEET 3 OF 6

BOREHOLE LOG AND MONITORING BORE DETAIL

CLIENT: AUSTRALIAN NEWSPRINT MILLS LIMITED
PROJECT: HYDROGEOLOGICAL ASSESSMENT
DELANEYS QUARRY
BOREHOLE LOCATION: 296 293 E
1016 346 N

JOB NUMBER: 311/5245/1800
HOLE COMMENCED: 16/12/92
HOLE COMPLETED: 17/12/92
SUPERVISED BY: ITH
LOG CHECKED BY: FJM

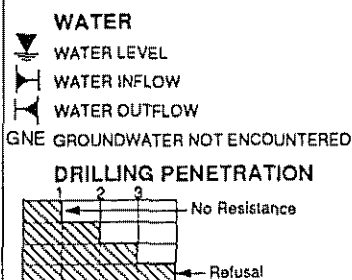
DRILL MODEL AND MOUNTING: BOURNE 1250R - AIR ROTARY
HOLE DIAMETER: 170mm BORE DIAMETER: 125mm

R.L SURFACE 315.79m
DATUM: AHD

METHOD	SUPPORT	WATER	DRILLING PENETRATION	NOTES SAMPLES TESTS	DEPTH (m)	GRAPHIC LOG	U.S. CI SYMBOL	MATERIAL SOIL TYPE: PLASTICITY OR PARTICLE CHARACTERISTICS: COLOUR SECONDARY & MINOR COMPONENTS	MOISTURE CONDITION	CONSISTENCY DENSITY INDEX	100 HAND PENETRO- METER (kPa)	STRUCTURE TEST RESULTS AND ADDITIONAL OBSERVATIONS	MONITORING BORE DETAILS
AR								Moderately weathered GRANITE, brown.	D				BF
					42			Slightly weathered GRANITE, very light brown.	D				BF
					44			Highly weathered GRANITE, brown.	D				BF
					46			Moderately weathered GRANITE, brown.	D				BF
					48			Highly weathered GRANITE, brown.	D				BF
					50								
					52								
					54			Moderately weathered GRANITE, brown.	D				BF
					56								BF
					58			Slightly weathered GRANITE, grey.	D				Rubber Seal

KEY TO LOG

METHOD
A - AUGER
R - ROLLER / TRICONE
W - WASH BORING
T - TRIPLE TUBE CORING
DT - DOUBLE TUBE
C - CABLE TOOL
HA - HOLLOW AUGER
H - HAND AUGER
RH - ROTARY/HAMMER
AR - AIR ROTARY
SUPPORT
M - MUD
C - CASING



SAMPLES & NOTES

SV - INSITU SHEAR VANE TEST (kPa)
pp - HAND PENETROMETER TEST (kPa)
U63 - UNDISTURBED TUBE
SAMPLE, 63mm DIAMETER
D - DISTURBED SAMPLE
CS - CORE SAMPLE
N - STANDARD PENETRATION TEST
Nd - SPT + DISTURBED SAMPLE
R - SPT PENETRATION REFUSAL
BGH - BENTONITE CEMENT GROUT
MOISTURE CONDITION
D - DRY
M - MOIST
W - WET

CONSISTENCY / DENSITY INDEX

VS - VERY SOFT FB - FRIABLE
S - SOFT VL - VERY LOOSE
F - FIRM L - LOOSE
ST - STIFF MD - MEDIUM DENSE
VST - VERY STIFF D - DENSE
H - HARD VD - VERY DENSE

MONITORING BORE DETAILS

BF - BACKFILL S - SAND
C - CEMENT G - GRAVEL
SP - STANDPIPE
BP - BENTONITE PELLETS
BG - GRANULATED BENTONITE



BOREHOLE LOG AND MONITORING BORE DETAIL

CLIENT: AUSTRALIAN NEWSPRINT MILLS LIMITED
 PROJECT: HYDROGEOLOGICAL ASSESSMENT
 DELANEYS QUARRY
 BOREHOLE LOCATION: 296 293 E
 1016 346 N

JOB NUMBER: 311/5245/1800
 HOLE COMMENCED: 16/12/92
 HOLE COMPLETED: 17/12/92
 SUPERVISED BY: ITH
 LOG CHECKED BY: FJM

DRILL MODEL AND MOUNTING: BOURNE 1250R - AIR ROTARY
 HOLE DIAMETER: 170mm BORE DIAMETER: 125mm

R.L. SURFACE 315.79m
 DATUM: AHD

METHOD	SUPPORT	WATER	DRILLING PENETRATION	NOTES SAMPLES TESTS	DEPTH (m)	GRAPHIC LOG	U.S. CI SYMBOL	MATERIAL SOIL TYPE: PLASTICITY OR PARTICLE CHARACTERISTICS: COLOUR SECONDARY & MINOR COMPONENTS	MOISTURE CONDITION	CONSISTENCY DENSITY INDEX	100 HAND 200 PENETRO- 300 METER (kPa) 400	STRUCTURE TEST RESULTS AND ADDITIONAL OBSERVATIONS	MONITORING BORE DETAILS
AR								Slightly weathered GRANITE, grey.	D				
					62								
					64			Slightly weathered GRANITE, very light brown.	D				
								Highly weathered GRANITE, brown.	D				
					66			Slightly weathered GRANITE, grey.	D				
								Highly weathered GRANITE, brown.	D				
					68			Slightly weathered GRANITE, grey.	D				
					70								
					72								
					74								
					76								
					78								
								Moderately weathered GRANITE, grey brown.	D			Larger pebbles in cutting	

KEY TO LOG
METHOD

A - AUGER
 R - ROLLER / TRICONE
 W - WASH BORING
 T - TRIPLE TUBE CORING
 DT - DOUBLE TUBE
 CORING
 C - CABLE TOOL
 HA - HOLLOW AUGER
 H - HAND AUGER
 RH - ROTARY/HAMMER
 AR - AIR ROTARY

SUPPORT

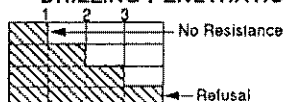
M - MUD
 C - CASING

WATER

WATER LEVEL
 WATER INFLOW
 WATER OUTFLOW

GNE GROUNDWATER NOT ENCOUNTERED

DRILLING PENETRATION



SAMPLES & NOTES

SV - INSITU SHEAR VANE TEST (kPa)
 pp - HAND PENETROMETER TEST (kPa)
 U63 - UNDISTURBED TUBE
 SAMPLE, 63mm DIAMETER
 D - DISTURBED SAMPLE
 CS - CORE SAMPLE
 N - STANDARD PENETRATION TEST
 Nd - SPT + DISTURBED SAMPLE
 R - SPT PENETRATION REFUSAL
 BCH - BENTONITE CEMENT GROUT
 MOISTURE CONDITION
 D - DRY
 M - MOIST
 W - WET

CONSISTENCY / DENSITY INDEX

VS - VERY SOFT FB - FRIABLE
 S - SOFT VL - VERY LOOSE
 F - FIRM L - LOOSE
 ST - STIFF MD - MEDIUM DENSE
 VST - VERY STIFF D - DENSE
 H - HARD VD - VERY DENSE

MONITORING BORE DETAILS

BF - BACKFILL S - SAND
 C - CEMENT G - GRAVEL
 SP - STANDPIPE
 BP - BENTONITE PELLETS
 BG - GRANULATED BENTONITE

Gutteridge Haskins & Davey Pty Ltd



BOREHOLE NO. D2

SHEET 5 OF 6

BOREHOLE LOG AND MONITORING BORE DETAIL

CLIENT: AUSTRALIAN NEWSPRINT MILLS LIMITED
PROJECT: HYDROGEOLOGICAL ASSESSMENT
DELANEYS QUARRY
BOREHOLE LOCATION: 296 293 E
1016 346 N

JOB NUMBER: 311/5245/1800
HOLE COMMENCED: 16/12/92
HOLE COMPLETED: 17/12/92
SUPERVISED BY: ITH
LOG CHECKED BY: FJM

DRILL MODEL AND MOUNTING: BOURNE 1250R - AIR ROTARY R.L. SURFACE 315.79m
HOLE DIAMETER: 170mm BORE DIAMETER: 125mm DATUM: AHD

METHOD	SUPPORT	WATER	DRILLING PENETRATION	NOTES SAMPLES TESTS	DEPTH (m)	GRAPHIC LOG	U.S. CI SYMBOL	MATERIAL SOIL TYPE: PLASTICITY OR PARTICLE CHARACTERISTICS: COLOUR SECONDARY & MINOR COMPONENTS	MOISTURE CONDITION	CONSISTENCY DENSITY INDEX	100 HAND PENETRO- METER (kPa)	STRUCTURE TEST RESULTS AND ADDITIONAL OBSERVATIONS	MONITORING BORE DETAILS
AR								Slightly weathered GRANITE, grey.	D				
					82								SP
					84								
					86								
					88								
					90			Slightly weathered GRANITE, grey.	M				SP
					92								
					94			Moderately weathered GRANITE, grey brown.	W			Flow at 0.3 l/sec	SP
					96								
					98			Highly weathered GRANITE, red brown.	W			Some coarse fragments	SP

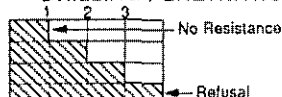
KEY TO LOG METHOD

A - AUGER
R - ROLLER / TRICONE
W - WASH BORING
T - TRIPLE TUBE CORING
DT - DOUBLE TUBE CORING
C - CABLE TOOL
HA - HOLLOW AUGER
H - HAND AUGER
RH - ROTARY/HAMMER
AR - AIR ROTARY
SUPPORT
M - MUD
C - CASING

WATER

WATER LEVEL
WATER INFLOW
WATER OUTFLOW
GNE GROUNDWATER NOT ENCOUNTERED

DRILLING PENETRATION



SAMPLES & NOTES

SV - INSITU SHEAR VANE TEST (kPa)
pp - HAND PENETROMETER TEST (kPa)
U63 - UNDISTURBED TUBE
SAMPLE, 63mm DIAMETER
D - DISTURBED SAMPLE
CS - CORE SAMPLE
N - STANDARD PENETRATION TEST
Nd - SPT + DISTURBED SAMPLE
R - SPT PENETRATION REFUSAL
BCH - BENTONITE CEMENT GROUT
MOISTURE CONDITION
D - DRY
M - MOIST
W - WET

CONSISTENCY / DENSITY INDEX

VS - VERY SOFT FB - FRIABLE
S - SOFT VL - VERY LOOSE
F - FIRM L - LOOSE
ST - STIFF MD - MEDIUM DENSE
VST - VERY STIFF D - DENSE
H - HARD VD - VERY DENSE

MONITORING BORE DETAILS

BF - BACKFILL S - SAND
C - CEMENT G - GRAVEL
SP - STANDPIPE
BP - BENTONITE PELLETS
BG - GRANULATED BENTONITE

Gutteridge Haskins & Davey Pty Ltd



BOREHOLE NO. D2

SHEET 6 OF 6

BOREHOLE LOG AND MONITORING BORE DETAIL

CLIENT: AUSTRALIAN NEWSPRINT MILLS LIMITED
PROJECT: HYDROGEOLOGICAL ASSESSMENT
DELANEYS QUARRY
BOREHOLE LOCATION: 296 293 E
1016 346 N

JOB NUMBER: 311/5245/1800
HOLE COMMENCED: 16/12/92
HOLE COMPLETED: 17/12/92
SUPERVISED BY: ITH
LOG CHECKED BY: FJM

DRILL MODEL AND MOUNTING: BOURNE 1250R - AIR ROTARY R.L SURFACE 315.79m
HOLE DIAMETER: 170mm BORE DIAMETER: 125mm DATUM: AHD

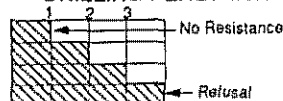
METHOD	SUPPORT	WATER	DRILLING PENETRATION	NOTES SAMPLES TESTS	DEPTH (m)	GRAPHIC LOG	U.S. CI SYMBOL	MATERIAL SOIL TYPE: PLASTICITY OR PARTICLE CHARACTERISTICS: COLOUR SECONDARY & MINOR COMPONENTS	MOISTURE CONDITION	CONSISTENCY INDEX	100 HAND 200 PENETRO- 300 METER (kPa)	STRUCTURE TEST RESULTS AND ADDITIONAL OBSERVATIONS	MONITORING BORE DETAILS
AR	OPEN				102			Moderately weathered GRANITE, grey brown.	W				SP
								Highly weathered GRANITE, red brown.	W				SP
					104			END OF BOREHOLE AT 103m					
					106								
					108								
					110								
					112								
					114								
					116								
					118								

KEY TO LOG METHOD

A - AUGER
R - ROLLER / TRICONE
W - WASH BORING
T - TRIPLE TUBE CORING
DT - DOUBLE TUBE CORING
C - CABLE TOOL
HA - HOLLOW AUGER
H - HAND AUGER
RH - ROTARY/HAMMER
AR - AIR ROTARY
SUPPORT
M - MUD
C - CASING

WATER
 WATER LEVEL
 WATER INFLOW
 WATER OUTFLOW
GNE GROUNDWATER NOT ENCOUNTERED

DRILLING PENETRATION



SAMPLES & NOTES

SV - INSITU SHEAR VANE TEST (kPa)
pp - HAND PENETROMETER TEST (kPa)
U63 - UNDISTURBED TUBE
SAMPLE, 63mm DIAMETER
D - DISTURBED SAMPLE
CS - CORE SAMPLE
N - STANDARD PENETRATION TEST
Nd - SPT + DISTURBED SAMPLE
R - SPT PENETRATION REFUSAL
BCH - BENTONITE CEMENT GROUT
MOISTURE CONDITION
D - DRY
M - MOIST
W - WET

CONSISTENCY / DENSITY INDEX

VS - VERY SOFT FB - FRIABLE
S - SOFT VL - VERY LOOSE
F - FIRM L - LOOSE
ST - STIFF MD - MEDIUM DENSE
VST - VERY STIFF D - DENSE
H - HARD VD - VERY DENSE

MONITORING BORE DETAILS

BF - BACKFILL S - SAND
C - CEMENT G - GRAVEL
SP - STANDPIPE
BP - BENTONITE PELLETS
BG - GRANULATED BENTONITE

Gutteridge Haskins & Davey Pty Ltd



BOREHOLE NO. S1

SHEET 1 OF 1

BOREHOLE LOG AND MONITORING BORE DETAIL

CLIENT: AUSTRALIAN NEWSPRINT MILLS LIMITED
PROJECT: HYDROGEOLOGICAL ASSESSMENT
DELANEYS QUARRY
BOREHOLE LOCATION: 296 459 E
1016 370 N

JOB NUMBER: 311/5245/1800
HOLE COMMENCED: 17/12/92
HOLE COMPLETED: 17/12/92
SUPERVISED BY: ITH
LOG CHECKED BY: FJM

DRILL MODEL AND MOUNTING: BOURNE 1250R - AIR ROTARY R.L. SURFACE 324.74m
HOLE DIAMETER: 115mm BORE DIAMETER: 50mm DATUM: AHD

METHOD	SUPPORT	WATER	DRILLING PENETRATION	NOTES SAMPLES TESTS	DEPTH (m)	GRAPHIC LOG	U.S. CI SYMBOL	MATERIAL SOIL TYPE: PLASTICITY OR PARTICLE CHARACTERISTICS: COLOUR SECONDARY & MINOR COMPONENTS	MOISTURE CONDITION	CONSISTENCY DENSITY INDEX	100 HAND 200 PENETRO- 300 METER (kPa)	STRUCTURE TEST RESULTS AND ADDITIONAL OBSERVATIONS	MONITORING BORE DETAILS
AR				D				Extremely weathered GRANITE, red brown, gravelly clay.	M				C
				D	2			Moderately weathered GRANITE, brown.	M				BG
					4			Fresh GRANITE, grey.	D				G
					6								G
					8								SP, G
					10			END OF BOREHOLE AT 10m					
					12								
					14								
					16								
					18								

KEY TO LOG METHOD

A - AUGER
R - ROLLER / TRICONE
W - WASH BORING
T - TRIPLE TUBE CORING
DT - DOUBLE TUBE CORING
C - CABLE TOOL
HA - HOLLOW AUGER
H - HAND AUGER
RH - ROTARY/HAMMER
AR - AIR ROTARY
SUPPORT
M - MUD
C - CASING

WATER
WATER LEVEL
WATER INFLOW
WATER OUTFLOW
GNE GROUNDWATER NOT ENCOUNTERED

DRILLING PENETRATION



SAMPLES & NOTES

SV - INSITU SHEAR VANE TEST (kPa)
pp - HAND PENETROMETER TEST (kPa)
U63 - UNDISTURBED TUBE
SAMPLE, 63mm DIAMETER
D - DISTURBED SAMPLE
CS - CORE SAMPLE
N - STANDARD PENETRATION TEST
Nd - SPT + DISTURBED SAMPLE
R - SPT PENETRATION REFUSAL
BCH - BENTONITE CEMENT GROUT
MOISTURE CONDITION
D - DRY
M - MOIST
W - WET

CONSISTENCY / DENSITY INDEX

VS - VERY SOFT FB - FRIABLE
S - SOFT VL - VERY LOOSE
F - FIRM L - LOOSE
ST - STIFF MD - MEDIUM DENSE
VST - VERY STIFF D - DENSE
H - HARD VD - VERY DENSE

MONITORING BORE DETAILS

BF - BACKFILL S - SAND
C - CEMENT G - GRAVEL
SP - STANDPIPE
BP - BENTONITE PELLETS
BG - GRANULATED BENTONITE

Gutteridge Haskins & Davey Pty Ltd



BOREHOLE NO. S2

SHEET 1 OF 1

BOREHOLE LOG AND MONITORING BORE DETAIL

CLIENT: AUSTRALIAN NEWSPRINT MILLS LIMITED
PROJECT: HYDROGEOLOGICAL ASSESSMENT
DELANEYS QUARRY
BOREHOLE LOCATION: 296 342 E
1016 312 N

JOB NUMBER: 311/5245/1800
HOLE COMMENCED: 17/12/92
HOLE COMPLETED: 17/12/92
SUPERVISED BY: ITH
LOG CHECKED BY: FJM

DRILL MODEL AND MOUNTING: BOURNE 1250R - AIR ROTARY
HOLE DIAMETER: 115mm BORE DIAMETER: 50mm
R.L. SURFACE 314.30m
DATUM: AHD

METHOD	SUPPORT	WATER	DRILLING PENETRATION	NOTES SAMPLES TESTS	DEPTH (m)	GRAPHIC LOG	U.S. CI SYMBOL	MATERIAL SOIL TYPE: PLASTICITY OR PARTICLE CHARACTERISTICS: COLOUR SECONDARY & MINOR COMPONENTS	MOISTURE CONDITION	CONSISTENCY DENSITY INDEX	100 HAND PENETRO- METER (kPa)	STRUCTURE TEST RESULTS AND ADDITIONAL OBSERVATIONS	MONITORING BORE DETAILS
AR	OPEN			D	2			Clayey GRAVEL, red brown.	M			Extremely weathered granite	BG
				D	4			Highly weathered GRANITE, brown.	M				G
					6			Fresh GRANITE, grey.	D				G
					8			Slightly weathered GRANITE, light brown.	D				SP, G
					10			Fresh GRANITE, grey.	D				SP, G
					12			END OF BOREHOLE AT 10m					
					14								
					16								
					18								

KEY TO LOG METHOD A - AUGER R - ROLLER / TRICONE W - WASH BORING T - TRIPLE TUBE CORING DT - DOUBLE TUBE CORING C - CABLE TOOL HA - HOLLOW AUGER H - HAND AUGER RH - ROTARY/HAMMER AR - AIR ROTARY SUPPORT M - MUD C - CASING	WATER WATER LEVEL WATER INFLOW WATER OUTFLOW GNE GROUNDWATER NOT ENCOUNTERED DRILLING PENETRATION 	SAMPLES & NOTES SV - INSITU SHEAR VANE TEST (kPa) pp - HAND PENETROMETER TEST (kPa) U63 - UNDISTURBED TUBE SAMPLE, 63mm DIAMETER D - DISTURBED SAMPLE CS - CORE SAMPLE N - STANDARD PENETRATION TEST Nd - SPT - DISTURBED SAMPLE R - SPT PENETRATION REFUSAL BCH - BENTONITE CEMENT GROUT MOISTURE CONDITION D - DRY M - MOIST W - WET	CONSISTENCY / DENSITY INDEX VS - VERY SOFT S - SOFT F - FIRM ST - STIFF VST - VERY STIFF H - HARD FB - FRIABLE VL - VERY LOOSE L - LOOSE MD - MEDIUM DENSE D - DENSE VD - VERY DENSE MONITORING BORE DETAILS BF - BACKFILL C - CEMENT SP - STANDPIPE BP - BENTONITE PELLETS BG - GRANULATED BENTONITE S - SAND G - GRAVEL
--	--	---	---

Gutteridge Haskins & Davey Pty Ltd



BOREHOLE NO. S3

SHEET 1 OF 1

BOREHOLE LOG AND MONITORING BORE DETAIL

CLIENT: AUSTRALIAN NEWSPRINT MILLS LIMITED
PROJECT: HYDROGEOLOGICAL ASSESSMENT
DELANEYS QUARRY
BOREHOLE LOCATION: 296 386 E
1016 326 N

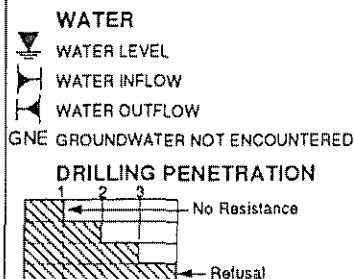
JOB NUMBER: 311/5245/1800
HOLE COMMENCED: 17/12/92
HOLE COMPLETED: 17/12/92
SUPERVISED BY: ITH
LOG CHECKED BY: FJM

DRILL MODEL AND MOUNTING: BOURNE 1250R - AIR ROTARY
HOLE DIAMETER: 115mm BORE DIAMETER: 50mm
R.L. SURFACE 317.11m
DATUM: AHD

METHOD	SUPPORT	WATER	DRILLING 1-2-3 PENETRATION	NOTES SAMPLES TESTS	DEPTH (m)	GRAPHIC LOG	U.S. CI SYMBOL	MATERIAL SOIL TYPE: PLASTICITY OR PARTICLE CHARACTERISTICS: COLOUR SECONDARY & MINOR COMPONENTS	MOISTURE CONDITION	CONSISTENCY DENSITY INDEX	100 HAND PENETRO- METER (kPa)	STRUCTURE TEST RESULTS AND ADDITIONAL OBSERVATIONS	MONITORING BORE DETAILS
AR								Sandy clayey GRAVEL, red brown.	W				BG
								Fresh GRANITE, grey.	D				BG
	OPEN				2								G
					4								SP, G
					6								
					8								
					10			Slightly weathered GRANITE, light brown.	D				SP, G
								END OF BOREHOLE AT 10m					
					12								
					14								
					16								
					18								

KEY TO LOG METHOD

A - AUGER
R - ROLLER / TRICONE
W - WASH BORING
T - TRIPLE TUBE CORING
DT - DOUBLE TUBE CORING
C - CABLE TOOL
HA - HOLLOW AUGER
H - HAND AUGER
RH - ROTARY/HAMMER
AR - AIR ROTARY
SUPPORT
M - MUD
C - CASING



SAMPLES & NOTES

SV - INSITU SHEAR VANE TEST (kPa)
pp - HAND PENETROMETER TEST (kPa)
U63 - UNDISTURBED TUBE
SAMPLE, 63mm DIAMETER
D - DISTURBED SAMPLE
CS - CORE SAMPLE
N - STANDARD PENETRATION TEST
Nd - SPT + DISTURBED SAMPLE
R - SPT PENETRATION REFUSAL
BCH - BENTONITE CEMENT GROUT
MOISTURE CONDITION
D - DRY
M - MOIST
W - WET

CONSISTENCY / DENSITY INDEX

VS - VERY SOFT FB - FRIABLE
S - SOFT VL - VERY LOOSE
F - FIRM L - LOOSE
ST - STIFF MD - MEDIUM DENSE
VST - VERY STIFF D - DENSE
H - HARD VD - VERY DENSE

MONITORING BORE DETAILS

BF - BACKFILL S - SAND
C - CEMENT G - GRAVEL
SP - STANDPIPE
BP - BENTONITE PELLETS
BG - GRANULATED BENTONITE



BOREHOLE LOG AND MONITORING BORE DETAIL

CLIENT: AUSTRALIAN NEWSPRINT MILLS LIMITED
 PROJECT: HYDROGEOLOGICAL ASSESSMENT
 DELANEYS QUARRY
 BOREHOLE LOCATION: 296 364 E
 1016 518 N

JOB NUMBER: 311/5245/1800
 HOLE COMMENCED: 17/12/92
 HOLE COMPLETED: 17/12/92
 SUPERVISED BY: ITH
 LOG CHECKED BY: FJM

DRILL MODEL AND MOUNTING: BOURNE 1250R - AIR ROTARY

R.L. SURFACE 313.11m

HOLE DIAMETER: 115mm

BORE DIAMETER: 50mm

DATUM: AHD

METHOD	SUPPORT	WATER	DRILLING PENETRATION	NOTES SAMPLES TESTS	DEPTH (m)	GRAPHIC LOG	U.S. CI SYMBOL	MATERIAL SOIL TYPE: PLASTICITY OR PARTICLE CHARACTERISTICS: COLOUR SECONDARY & MINOR COMPONENTS	MOISTURE CONDITION	CONSISTENCY DENSITY INDEX	100 HAND PENETRO- METER (kPa)	STRUCTURE TEST RESULTS AND ADDITIONAL OBSERVATIONS	MONITORING BORE DETAILS
AR				D				MUD, brown, clayey.	W				C
				D				Extremely weathered GRANITE, red brown.	M				BF
					2			Highly weathered GRANITE, brown.	D				BF
					4								
					6			Moderately weathered GRANITE, light brown.	D				BF
					8			Highly weathered GRANITE, brown.	D				BF
					10								BG
					12			Moderately weathered GRANITE, light brown.	D				G
					14			Highly weathered GRANITE, light brown.	D				G
					16			Fresh GRANITE, grey white.	D				SP, G
					18			Moderately weathered GRANITE, brown grey.	M				SP, G
								END OF BOREHOLE 20.0m					

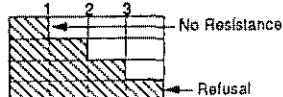
KEY TO LOG METHOD

A - AUGER
 R - ROLLER / TRICONE
 W - WASH BORING
 T - TRIPLE TUBE CORING
 DT - DOUBLE TUBE CORING
 C - CABLE TOOL
 HA - HOLLOW AUGER
 H - HAND AUGER
 RH - ROTARY/HAMMER
 AR - AIR ROTARY
 SUPPORT
 M - MUD
 C - CASING

WATER

WATER LEVEL
 WATER INFLOW
 WATER OUTFLOW
 GNE GROUNDWATER NOT ENCOUNTERED

DRILLING PENETRATION



SAMPLES & NOTES

SV - INSITU SHEAR VANE TEST (kPa)
 pp - HAND PENETROMETER TEST (kPa)
 U63 - UNDISTURBED TUBE SAMPLE, 63mm DIAMETER
 D - DISTURBED SAMPLE
 CS - CORE SAMPLE
 N - STANDARD PENETRATION TEST
 Nd - SPT + DISTURBED SAMPLE
 R - SPT PENETRATION REFUSAL
 BCH - BENTONITE CEMENT GROUT
 MOISTURE CONDITION
 D - DRY
 M - MOIST
 W - WET

CONSISTENCY / DENSITY INDEX

VS - VERY SOFT FB - FRIABLE
 S - SOFT VL - VERY LOOSE
 F - FIRM L - LOOSE
 ST - STIFF MD - MEDIUM DENSE
 VST - VERY STIFF D - DENSE
 H - HARD VD - VERY DENSE

MONITORING BORE DETAILS

BF - BACKFILL S - SAND
 C - CEMENT G - GRAVEL
 SP - STANDPIPE
 BP - BENTONITE PELLETS
 BG - GRANULATED BENTONITE

Gutteridge Haskins & Davey Pty Ltd



BOREHOLE NO. S5

SHEET 1 OF 1

BOREHOLE LOG AND MONITORING BORE DETAIL

CLIENT: AUSTRALIAN NEWSPRINT MILLS LIMITED
PROJECT: HYDROGEOLOGICAL ASSESSMENT
DELANEYS QUARRY
BOREHOLE LOCATION: SEE SITE PLAN

JOB NUMBER: 311/5245/1800
HOLE COMMENCED: 17/12/92
HOLE COMPLETED: 17/12/92
SUPERVISED BY: ITH
LOG CHECKED BY: FJM

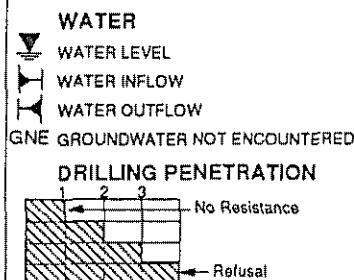
DRILL MODEL AND MOUNTING: BOURNE 1250R - AIR ROTARY
HOLE DIAMETER: 115mm BORE DIAMETER: 50mm

R.L. SURFACE 304.00m
DATUM: AHD

METHOD	SUPPORT	WATER	DRILLING PENETRATION	NOTES SAMPLES TESTS	DEPTH (m)	GRAPHIC LOG	U.S. CI SYMBOL	MATERIAL SOIL TYPE: PLASTICITY OR PARTICLE CHARACTERISTICS: COLOUR SECONDARY & MINOR COMPONENTS	MOISTURE CONDITION	CONSISTENCY DENSITY INDEX	100 HAND PENETRO- METER (kPa)	STRUCTURE TEST RESULTS AND ADDITIONAL OBSERVATIONS	MONITORING BORE DETAILS
AR				D				Extremely weathered Granite, clayey GRAVEL, red brown.	M				G
				D	2			Very lightly weathered GRANITE, brown.	M			Minor clay	BF
					4								BG
					6								G
					8								SP,G
					10			Highly weathered GRANITE, light brown.	M				SP,G
					12			END OF BOREHOLE AT 10m					
					14								
					16								
					18								

KEY TO LOG METHOD

A - AUGER
R - ROLLER / TRICONE
W - WASH BORING
T - TRIPLE TUBE CORING
DT - DOUBLE TUBE CORING
C - CABLE TOOL
HA - HOLLOW AUGER
RH - ROTARY/HAMMER
AR - AIR ROTARY
SUPPORT
M - MUD
C - CASING



SAMPLES & NOTES

SV - INSITU SHEAR VANE TEST (kPa)
pp - HAND PENETROMETER TEST (kPa)
U63 - UNDISTURBED TUBE SAMPLE, 63mm DIAMETER
D - DISTURBED SAMPLE
CS - CORE SAMPLE
N - STANDARD PENETRATION TEST
Nd - SPT + DISTURBED SAMPLE
R - SPT PENETRATION REFUSAL
BGH - BENTONITE CEMENT GROUT
MOISTURE CONDITION
D - DRY
M - MOIST
W - WET

CONSISTENCY / DENSITY INDEX

VS - VERY SOFT FB - FRIABLE
S - SOFT VL - VERY LOOSE
F - FIRM L - LOOSE
ST - STIFF MD - MEDIUM DENSE
VST - VERY STIFF D - DENSE
H - HARD VD - VERY DENSE

MONITORING BORE DETAILS

BF - BACKFILL S - SAND
C - CEMENT G - GRAVEL
SP - STANDPIPE
BP - BENTONITE PELLETS
BG - GRANULATED BENTONITE