MINERAL RESOURCES TASMANIA

Tasmania

DEPARTMENT *of* INFRASTRUCTURE, ENERGY *and* RESOURCES

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Natural Heritage Trust

Helping Communities Helping Australia

The effects of waste disposal on groundwater quality in Tasmania

McRobies Gully waste depot, South Hobart

Tasmanian Geological Survey Record 2002/16

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Hydrogeological investigations at the McRobies Gully waste depot, South Hobart

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Abstract

The McRobies Gully waste depot is a landfill located in a valley in the suburb of South Hobart. Data were collected for the site, including the testing of 14 groundwater bores within or adjacent to the landfill. Water within the landfill contained some contaminants at levels significantly greater than bedrock water, but generally at the lower end of the range considered typical of operating landfills. Analysis of chemical signatures and water levels indicated limited hydraulic connection between fill and bedrock waters and generally only minor effects on groundwater quality.

A localised impact of high nitrate concentrations was observed in groundwater adjacent to the western gully of the landfill. Surface water inflows to the fill appear critical in the management of the site. Slope stability of the filled material and the associated level of risk were identified as issues requiring further investigation.

INTRODUCTION

Mineral Resources Tasmania (MRT) initiated a project to investigate the effects of waste disposal on groundwater quality in Tasmania. The project was funded by MRT and the Natural Heritage Trust (NHT) and included a number of sites for detailed study. The McRobies Gully waste depot at South Hobart was one of these sites. The Hobart City Council (HCC) provided additional funding for contract drilling at the site.

The objectives of the investigations at the McRobies Gully waste depot were to:

- Determine the geological nature of the host materials;
- Identify the depth of the water table for development of a hydrogeological model;
- Examine the quality of the groundwater with respect to leachate generation and migration; and
- Indicate potential future monitoring and/or remediation options for the site.

SITE DESCRIPTION

Site history

The McRobies Gully waste depot is located at the end of McRobies Gully Road in South Hobart (523 500 mE, 5 251 500 mN) (fig. 1). The waste depot, which has been in continuous operation since 1975, is currently licensed by the Department of Primary Industries, Water and Environment (DPIWE).

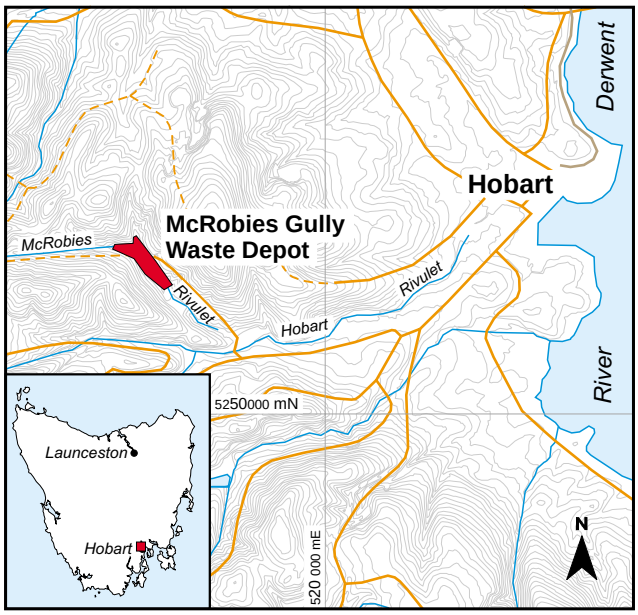


Figure 1
Location of the McRobies Gully waste disposal depot.

The majority of the waste stream received at the site is general household, commercial, construction and demolition waste, with smaller volumes of sewage sludge, fish processing and medical waste. Green waste is mulched and composted with sewage sludge on an area filled in the 1980s.

The separation of waste streams has only occurred over the last decade. A weighbridge on the access road allows Council to record an inventory of current waste streams being disposed of at the site. The landfill contains approximately two million cubic metres of fill with a surface area of about 21 hectares.

No basal clay liner was installed at the site. A pipeline has been installed in the original valley drainage line (beneath the waste fill material) to allow passage of stormwater from the catchments above the site. Leachate is also entering this pipe and is collected by a weir system at the toe of the landfill. The integrity of the stormwater infrastructure beneath the landfill may also allow stormwater to recharge the waste fill material. The concentration of leachate discharging from the pipe appears to be subject to dilution by rainfall events. Leachate emanating from the pipe passes through a pond system and is then discharged to sewer. The infrastructure at the toe of the landfill is shown in Plate 1.

Council has recently undertaken a closed circuit television inspection of the pipeline under the landfill. The results of this inspection indicate that the pipe is in relatively good condition, particularly up-gradient from the recycling centre area. Calcified deposits have, to a large degree, sealed the joins between the lengths of concrete pipe and direct leakage into the pipe was observed mainly as relatively small inflows.

Site management

The site is managed by the Hobart City Council. The original engineering design was undertaken at a time when environmental concerns were not as great and while dry weather flows can be diverted to sewer, the system was designed to discharge excess diluted leachate to the Hobart Rivulet during the more significant rain events.

Surface water at the site is currently difficult to control during rainfall events. Discharges to the Hobart Rivulet sometimes occur in wet periods and may vary in water quality and flow rate based on hydraulic conditions at the site. Other inputs into the stormwater pipe include run off from several local roads and houses. Plate 2 demonstrates visually the flow rate, water discolouration and foaming affects at the discharge point into the Hobart Rivulet. Increases in environmental standards now indicate that the current system is inadequate and needs to be improved to reduce the frequency and volume of discharges.

Surface water is also collected in a cut-off drain on the western side of the landfill footprint, with the drain being re-excavated as the footprint expands further upslope. The drain is back-filled with a range of waste streams, including sewage sludge (Plate 3), which results in permeability differentials along the edge of the fill pile as it rises. This practice has now been altered, and after filling the drain is capped with clay and rock materials.

Geology

The geology of the McRobies Gully area is shown in Figure 2. This geological map was based on geological data compiled for the MRT Hobart 1:25 000 scale geological map sheet (Clarke and Forsyth, 2002). Several small changes have been made near the landfill footprint and to the distribution of the Permian rocks.

The landfill footprint is variously located on Jurassic dolerite or Permian and Triassic rocks. Areas of Quaternary colluvium (derived from all rock types) exist on the valley walls.

Plate 1

Infrastructure at the toe of the landfill.

Plate 2

Outpour into the Hobart Rivulet on 24 April 2001.

Plate 3

Back filling the western stormwater drain on 17 May 2001.

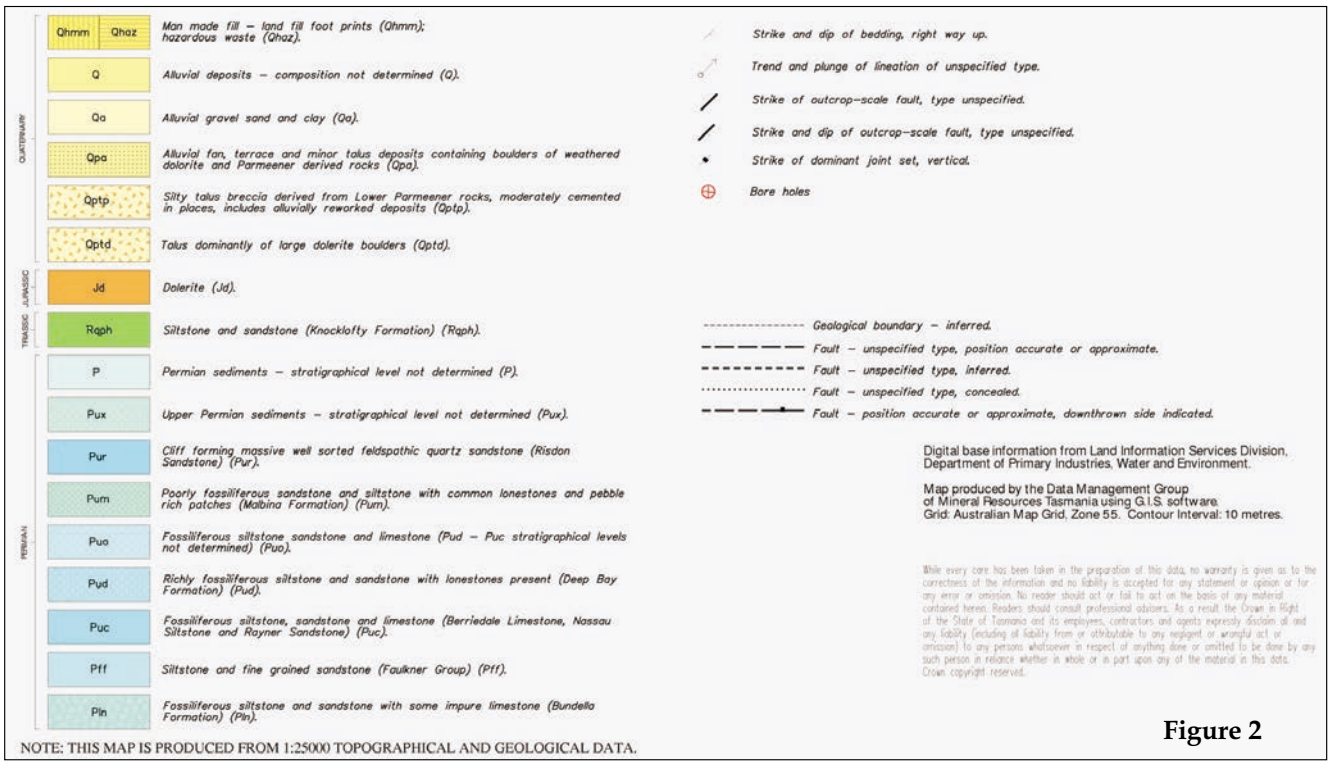
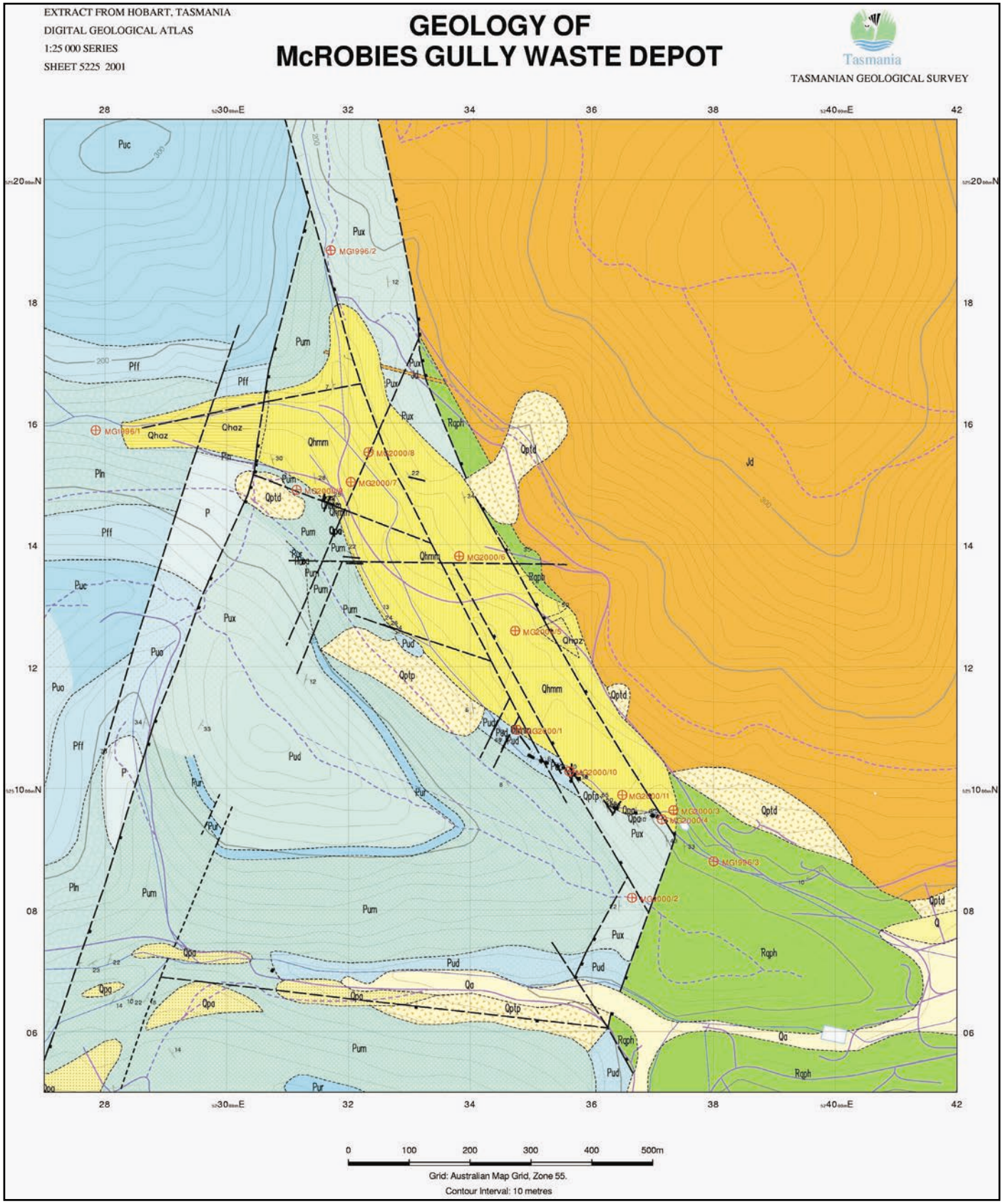


Figure 2


EXTRACT FROM HOBART, TASMANIA
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GEOLOGY OF
McROBIES GULLY WASTE DEPOT
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Figure 2

The main shear zone of the regional horst and graben structural system passes beneath the toe of the landfill. This structure is known as the Cascades Fault Zone (CFZ) and has produced a complex set of faulted and fractured features within all rock types in McRobies Gully. A seismic risk assessment, undertaken by geological consultants Leaman Geophysics, is included as Appendix 1. This report concluded that Hobart is subject to earthquakes of moderate magnitude and areas on poorly consolidated materials, or close to main faults, are likely to suffer damage. As these conditions are both present at McRobies Gully, the risk of significant damage is high in the event of an earthquake. The report recommended that "It is important that this risk be recognised and that measures be enacted which improve the consolidation and drainage of the fill".

Hydrology

The McRobies Gully waste depot is located on McRobies Gully Rivulet, a tributary of the Hobart Rivulet. The Hobart Rivulet discharges into the River Derwent estuary at Macquarie Point, about four kilometres northeast of the waste depot.

Australian Bureau of Meteorology rainfall station 094066 (Mount Wellington, The Springs) is located close to the site, in the next catchment south of the landfill footprint. This station has an average annual rainfall of 1344.9 mm; the chart of average monthly recorded rainfall is shown in Figure 3. Other rainfall stations located close to the site include Hobart (Waterworks Reserve) and Strickland Avenue No. 2, with average annual rainfalls of 837 mm and 952 mm respectively.

There are two catchments above the landfill footprint (fig. 4). The larger western catchment (McRobies Gully) has an approximate catchment area of 2.5 km^2, while the smaller northern catchment has an area of approximately 0.5 km^2.

INVESTIGATION METHODS

Borehole drilling and installation

Three environmental monitoring bores were percussion drilled by KMR Drilling Pty Ltd for the HCC in 1996. Little is known about these bores. The bores had a diameter of 165 mm and 100 mm PVC casing was installed.

For this project eleven additional monitoring bores were drilled by KMR Drilling during October 2000. Four were percussion drilled with a diameter of 165 mm and 80 mm PVC casing was installed. A short section of diamond drilling was attempted in the Cascades Fault Zone during the drilling of hole MG2000/2 (Plate 4). Core loss was very high due to the weathered and fractured nature of the material.

Seven boreholes were drilled into the landfill waste fill materials using the solid stem auger technique. A site safety plan was implemented for the drilling of these boreholes and extreme care was required by the contractor to avoid injury to staff or the loss of drilling equipment (Plate 5). Site supervision was undertaken by MRT (Plate 6). All seven boreholes had an approximate diameter of 300 mm and 80 mm PVC casing was installed. Slotted screens with bentonite seals were installed in each hole. Bore locations are shown in Figure 4. All bores were logged in accordance with AS 1726-1993; engineering logs are presented in Appendix 2. The installation and water depth information for the boreholes is summarised in Table 1.

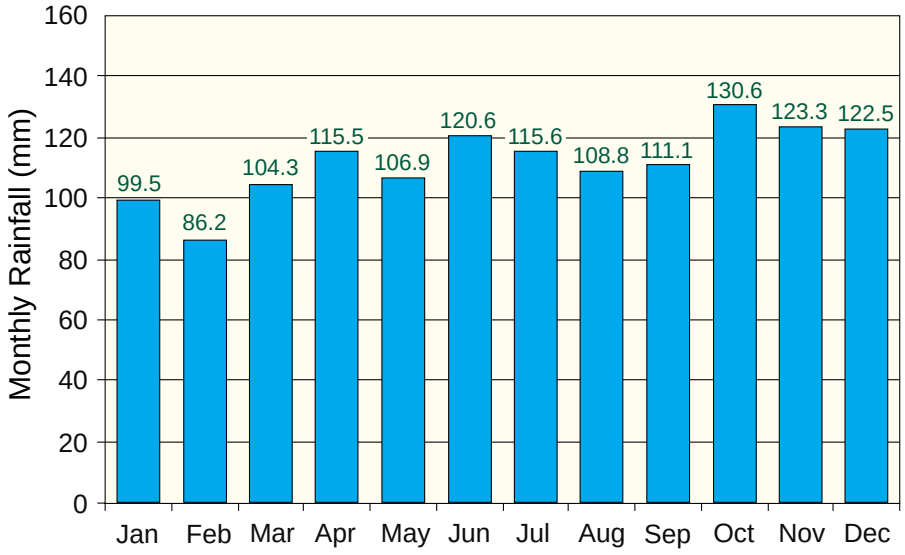

Figure 3

Average monthly rainfall for Australian Bureau of Meteorology rainfall station 094066, Mount Wellington, The Springs.

Plate 4
Drilling borehole MG2000/2 during October 2000.

Plate 5
Drilling borehole in waste fill material.

Plate 6
Supervision of drilling contractors.

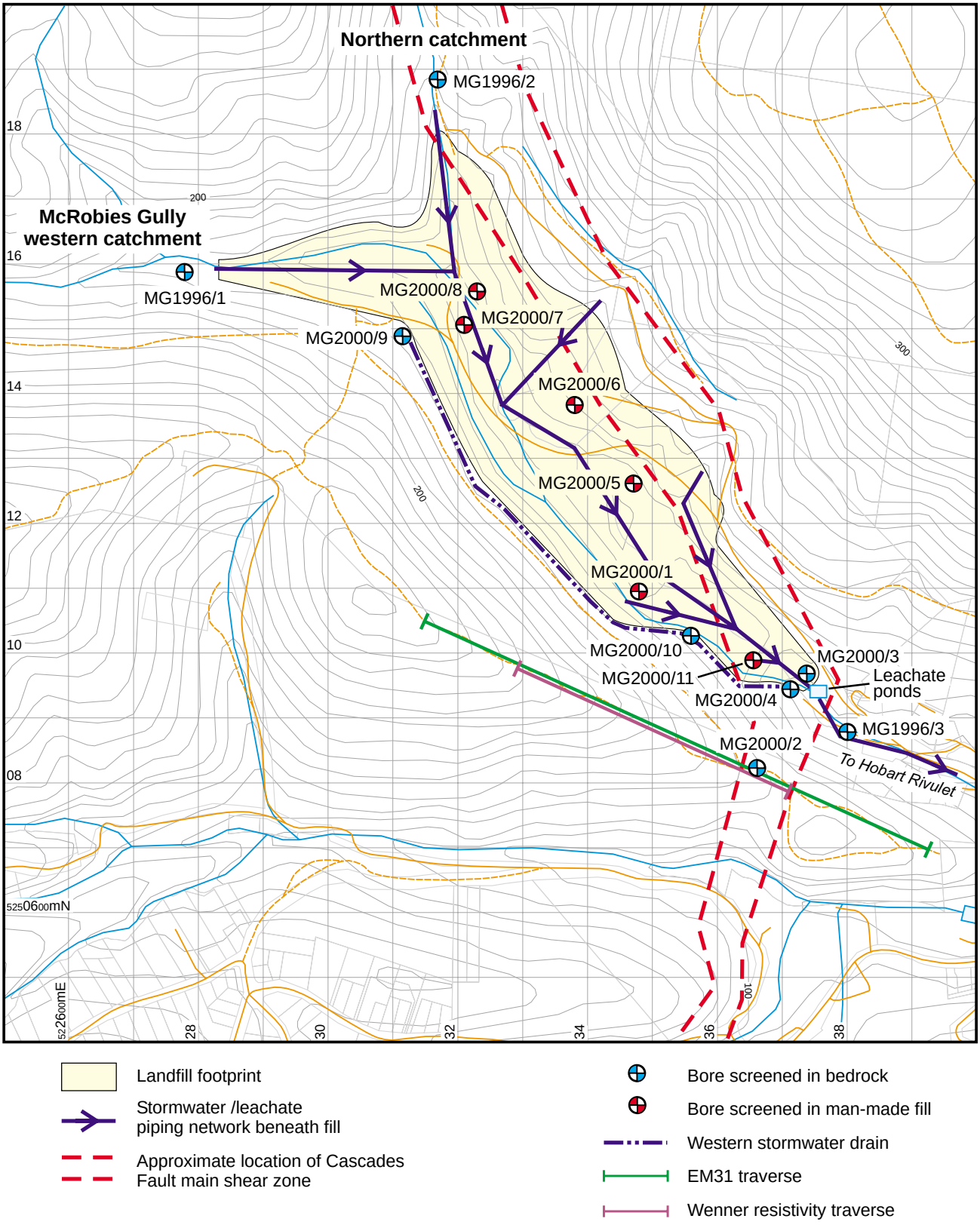

Figure 4

Locations of monitoring bores installed at the McRobies Gully waste depot with respect to the landfill footprint and key infrastructure.

Table 1

Summary of installation and water depth information for the boreholes.

Borehole number	*Total depth (metres)*	*Screened interval below collar (metres)*	*Approx. collar RL (metres)*	*Intersected material*	*Depth water struck (metres)**	*Standing water level (metres)**
MG1996/1	12.0	Unknown	150	Mudstone	Unknown	145.2
MG1996/2	24.0	Unknown	160	Mudstone	Unknown	155.9
MG1996/3	18.0	Unknown	95	Fill/sandstone	Unknown	89.5
MG2000/1	17.8	5.5–11.5	139	Waste fill	131.3	134.1
MG2000/2	66.0	54–66	145	Mudstone/sandstone/siltstone	81	102.5
MG2000/3	12.0	5.5–6.5	97	Fill/mudstone/sandstone/siltstone	95.0, 91.7	95.0
MG2000/4	30.0	19–30	97	Waste fill/mudstone	74.0	95.5
MG2000/5	17.0	10.2–16.2	144	Waste fill	136.0	134.2
MG2000/6	16.2	10.2–16.2	149	Waste fill	136.0	136.3
MG2000/7	16.0	10.0–16.0	160	Waste fill	152.0	150.0
MG2000/8	11.5	5.5–11.5	160	Waste fill	151.0	150.4
MG2000/9	18.7	12.7–18.7	155	Mudstone	143.5	150.0
MG2000/10	24.0	16.0–22.0	124	Siltstone/mudstone/dolerite	104.5	106.35
MG2000/11	13.2	5.0–11.0	121	Waste fill	No water	No water

* Depths based on approximate RL heights

Groundwater was encountered in all boreholes expect MG2000/11. Bores drilled in waste fill materials discharged various amount of landfill gas. Flow during the drilling of bores within the landfill indicated that the groundwater in these boreholes was unconfined. Drilling refusal for most of the waste fill bores was most likely due to bedrock.

Flow during the drilling of bores MG2000/2, 3, and 4 in the Cascades Fault Zone implied that groundwater is semi-confined within this fractured aquifer. Water was struck at 64 m in MG2000/2 and the ongoing post-installation standing water level has remained around 40 metres.

Geophysical investigations

Bore MG 2000/2 is located on a hill spur cut by the fault zone. This bore was sited on the main shear fault zone down-gradient of the landfill footprint to investigate the permeability of the fault zone. Two resistivity surveys were conducted on the same traverse line (fig. 4). A Wenner-style 20 m array spacing survey was initially undertaken and followed by an EM31 survey. Appendix 3 contains the profiles of both surveys. Both surveys clearly identified the contacts between the main shear area of the Cascades Fault Zone and less fractured Permian and Triassic rocks to the north and south. This work implied that the Cascades Fault Zone is approximately 70 m wide along the nose of the spur line.

In situ permeability testing

Eleven slug extraction tests were attempted at the site. Failure of equipment prevented all tests providing useful data. A summary of the data collected during the slug extraction tests is presented in Appendix 6, which may aid in planning future work.

Test data were analysed in the software package *AquiferWin32* (Version 2.17, Environmental Simulations Inc.). Each respective method(s) used was selected as the most appropriate available within the software package. All useful data are summarised in Table 2.

Hydraulic conductivity values for bores screened within the waste fill material range between 0.66 and 4.14 metres/day. Although it would be expected that permeability would decrease with decay time, the highest hydraulic conductivity value was recorded in material deposited in the early 1980s (MG2000/1). This may reflect the impact of daily cover material in the area of bore MG2000/7 (screened in material deposited in the last five years) limiting the flow between progressive lift/cells. In general, these data indicate that infiltrating water can move freely through the landfill assisting in degradation and the generation of leachate.

Bedrock permeability at the toe of the landfill in the Cascades Fault Zone ranged between 0.04 and 0.11 metres/day. Permeability appears to decrease within the CFZ down-gradient of the site (as seen in the hydraulic conductivity range for MG2000/2 — 0.002 to 0.006 m/d).

The waste fill material appears to be several orders of magnitude more permeable than the down-gradient bedrock within the Cascades Fault Zone. The migration of leachate reaching the bedrock aquifer(s) will probably be very slow (less than two metres/year depending on the hydraulic gradient).

Table 2

Summary of values calculated in AquiferWin32 (Version 2.17, Environmental Simulations Inc.)

Pump test	*Date*	*Pumping well*	*Observation well(s)*	*Aquifer Win32 method used for calculations*	*Hydraulic conductivity value (m/d)*
1	05/07/2000	MG1996/2	N/A	Unusable data	-
2	06/07/2000	MG1996/3	N/A	Unusable data	-
3	07/07/2000	MG1996/1	N/A	Unusable data	-
4	05/04/2001	MG2000/2 (1st attempt)	MG2000/4	Unusable data	-
5	09/04/2001	MG2000/1 (1st attempt)	MG2000/5	Unusable data	-
6	10/04/2001	MG2000/7	MG2000/8	Bouwer and Rice, 1976	0.66
7	10/04/2001	MG2000/1 (2nd attempt)	MG2000/5	Bouwer and Rice, 1976	2.03
8	10/04/2001	MG2000/1 (3rd attempt)	N/A	Bouwer and Rice, 1976	4.14
9	12/04/2001	MG2000/4 (1st attempt)	MG2000/3	Hvorslev, 1951	0.09
				KGS Model	0.04
				Bouwer and Rice, 1976	0.11
10	02/05/2001	MG2000/4 (2nd attempt)	MG2000/3	Hvorslev, 1951	0.10
				KGS Model	0.03
				Bouwer and Rice, 1976	0.10
11	03/05/2001	MG2000/2 (2nd attempt)	MG2000/3	Hvorslev, 1951	0.005
			MG2000/4	KGS Model	0.002
			MG2000/10	Bouwer and Rice, 1976	0.006

HYDROGEOLOGICAL MODEL

Two distinct groundwater systems occur at the site. Bedrock groundwater occurs within all bedrock lithologies, while fill water occurs within the unconsolidated waste material, perched by the hydraulic boundary at the bedrock interface. The nature of this hydraulic interface may not be continuous, with upward and/or downward movement occurring at various locations within the valley setting.

Fractured bedrock aquifers

Groundwater occurs in fractured aquifers within all consolidated rock types that underlie the landfill footprint. Jointing within these rock types provides fracture porosity that assists in the movement of groundwater. The orientation and width of the joint patterns influence the flow rate and the flow vectors within the groundwater system. Jointing is heterogeneous in most cuttings in the area of the waste depot, implying complex flow paths.

The dolerite and sedimentary rocks both appear to have been repetitively overprinted with fractures relating to geological movements on the Cascades Fault Zone. The nature of the jointing has produced increased weathering to clay in some areas, which may produce hydraulic boundary conditions within each rock unit.

Unconsolidated waste fill material aquifers

Fill groundwater occurs in the northern two-thirds of the valley waste filling area. Figure 5 shows two cross sections after Cromer (2002). These cross sections indicate that a significant volume of the waste fill material in the northern section of the valley is saturated by fill water. Based on current evidence (borehole MG2000/11), the southern section of the fill material below the recycling area is unsaturated.

Conceptual model

Recharge of the waste fill aquifers is by rainfall and stormwater leakage not diverted from the fill material. During rainfall events the main discharge from the waste fill aquifers appears to occur via the off-site stormwater discharge to the Hobart Rivulet. During low flow periods discharged fill water (leachate) is diverted from the stormwater pipe to the leachate ponds and discharged to sewer. When blockages occur in the diversion infrastructure to the leachate ponds (mainly due to sediment build up during rainfall events) off-site discharge to the Hobart Rivulet occurs.

The bedrock aquifers appear to be at greater depth than the landfill basement. A groundwater connection may be made with the original valley floor axis, such that groundwater discharge may also occur using the off-site stormwater pipe.

The direction of the local bedrock groundwater flow system appears to be from the northwest sloping down-gradient along the valley floor axis towards the southeast. The Cascades Fault Zone at the base of the valley, in combination with the faulted Triassic sedimentary contact, most likely represents a hydraulic boundary condition.

GROUNDWATER CHEMISTRY

All yielding bores were sampled between 27 March and 4 April 2001 in accordance with Australian/New Zealand Standard AS/NZS 5667.11:1998. Plate 7 shows the sampling of MG2001/1.

Additional surface water samples were collected on 24 April and 17 May 2001. The aim of the surface water

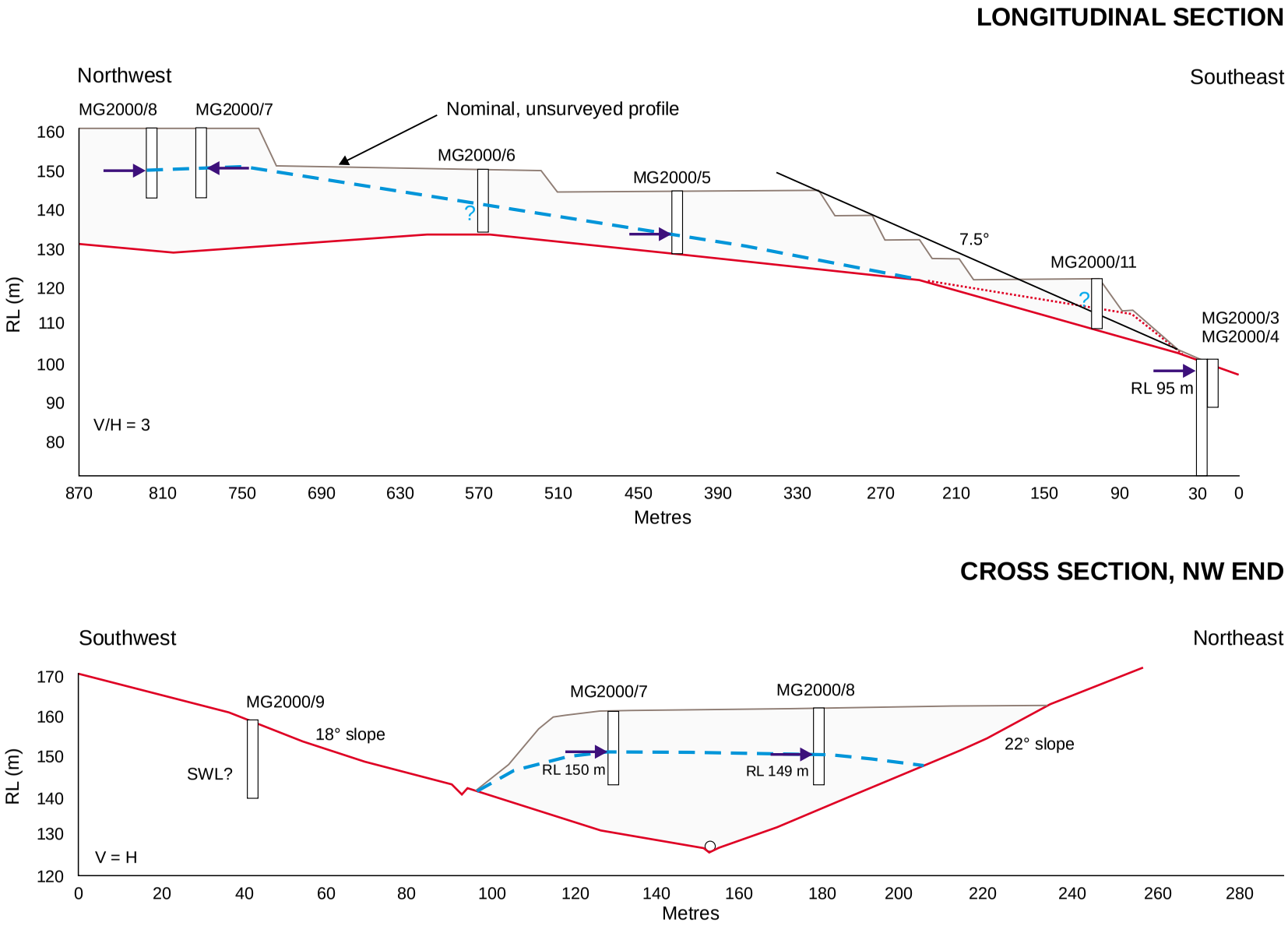

Figure 5

Cross sections at McRobies Gully, showing standing water level of fill water in the landfill (after Cromer, 2002)

Plate 7
Sampling borehole MG2001/1.

samples was to investigate the quality of various surface seepages, pipes and drains across the site and the outpour stormwater drain into the Hobart Rivulet. The leachate line was also sampled to provide a combined leachate chemical signature of the waste fill material.

Analytical Services Tasmania (in accordance with relevant Australian and international standards) carried out laboratory testing of all the surface and groundwater samples (Appendix 4). Analytical results for surface and groundwater samples are presented on site maps in Appendix 5. Figure 6 shows cation Ternary plots from the results of testing surface and groundwater samples at the McRobies Gully waste depot. Tables 3 and 4 compare the groundwater analytical results against international standards where a guideline/emission value is stated by the relevant standard.

The boreholes penetrating and screened into waste fill show generally high chloride, bromide, some petroleum hydrocarbons, ammonia, plus variable iron and manganese. The Na, K, Ca and Mg contents are

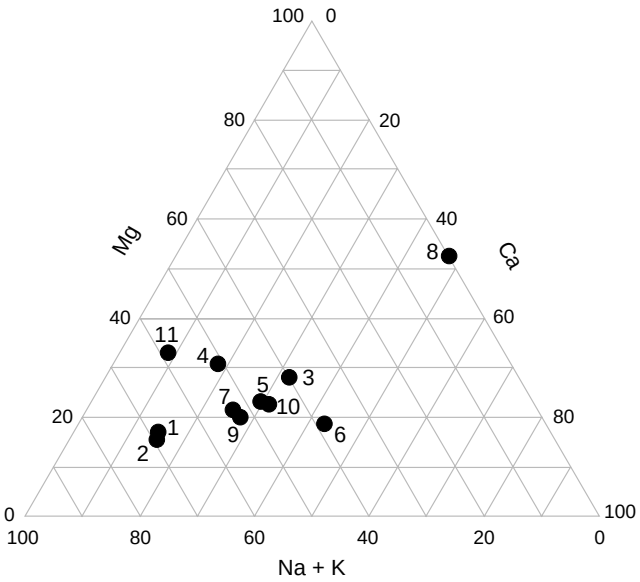

Figure 6a

Cation Ternary plot for surface water samples at the McRobies Gully waste depot. 1 – Western drain base; 2 – Western drain middle; 3 – Eastern pipe; 4 – Stage 2 spring ; 5 – Hobart Rivulet outpour (24/04/2001); 6 – Hobart Rivulet outpour (17/05/2001); 7 – Western drain base; 8 – Car park flow; 9 – Western drain middle; 10 – Western drain top; 11 – leachate line.

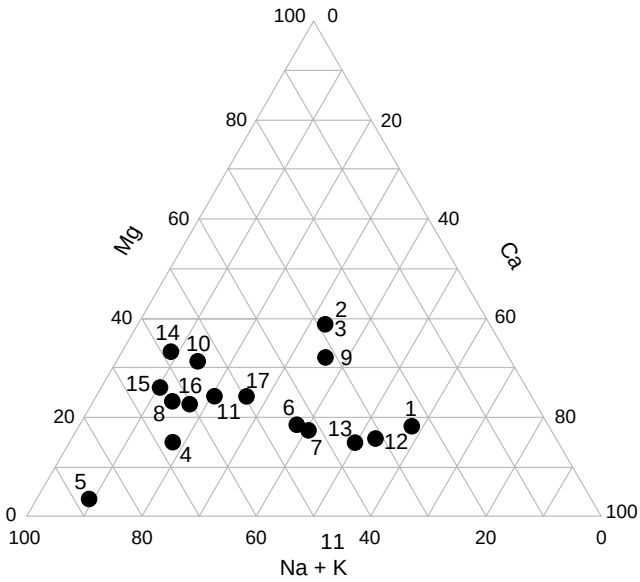

Figure 6b

Cation Ternary plot for groundwater samples at the McRobies Gully waste depot. 1 – MG1996/1; 2 – MG1996/2; 3 – MG1996/3; 4 – MG2000/1; 5 – MG2000/2; 6 – MG2000/3; 7 – MG2000/4; 8 – MG2000/5; 9 – MG2000/6; 10 – MG 2000/7; 11 – MG2000/8; 12 – MG2000/9; 13 - MG2000/10; 14 – leachate line; 15 – average of all MRT groundwater records for Triassic rocks; 16 – average of all MRT groundwater records for Permian rocks; 17 – average of all MRT groundwater records for Jurassic dolerite.

Table 3

Comparison of analytical results against water quality standards (guideline value listed when stated by a relevant standard). Highlighted values exceed emission limits

Groundwater

Parameter	*MG1996/1 (04/04/01)*	*MG1996/2 (03/04/01)*	*MG1996/3 (03/04/01)*	*MG2000/1 (02/04/01)*	*MG2000/2 (04/04/01)*	*MG2000/3 (02/04/01)*	*MG2000/4 (27/03/01)*	*Emission limit*
Bromide (mg/L)	0.10	<0.01	0.98	3.4	0.93	0.82	1.4	N/A
Chloride (mg/L)	74	160	130	**1800**	**340**	150	220	250* (mg/L)
Fluoride (mg/L)	0.38	<0.20	<0.020	0.28	0.28	0.36	0.31	1.5* (mg/L)
Sulphate (mg/L)	46	**510**	54	1.1	100	130	100	250* (mg/L)
Ammonia (mg/L)	**0.730**	<0.1	**0.500**	**110.0**	<0.100	0.270	0.019	0.5* (mg/L) nitrogen (as ammonia)
Nitrate + Nitrite (mg/L)	**14.00**	<0.2	<0.200	<0.200	<0.200	<0.200	0.004	10.0* (mg/L) nitrogen (as nitrate or nitrite)
Nitrite (mg-N/L)	0.310	<0.050	<0.050	<0.050	<0.050	<0.050	<0.002	10.0* (mg/L) nitrogen (as nitrate or nitrite)
Ortho-P (mg-P/L)	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	0.002	2.0* (mg/L) as phosphorus
N (Total) (mg/L)	-	-	-	-	-	-	-	N/A
P (Total) (mg/L)	-	-	-	-	-	-	-	N/A
Aluminium (mg/L)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	N/A
Arsenic (mg/L)	<0.005	<0.005	<0.005	<0.005	0.011	<0.005	<0.005	0.05* (mg/L)
Cadmium (mg/L)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.01* (mg/L)
Cobalt (mg/L)	<0.001	<0.001	<0.001	0.014	0.002	0.003	<0.0010.003	N/A
Chromium (mg/L)	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	0.5* (mg/L)
Copper (mg/L)	0.008	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	1.0* (mg/L)
Iron (mg/L)	0.063	<0.020	0.024	**0.433**	<0.020	<0.020	<0.020	(Combined iron and manganese total
Manganese (mg/L)	0.017	0.962	0.159	**2.580**	0.345	0.605	0.356	(1.0* (mg/L)
Nickel (mg/L)	0.017	0.001	0.002	0.028	0.005	<0.001	<0.001	0.1** (mg/L)
Lead (mg/L)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.05* (mg/L)
Zinc (mg/L)	0.004	0.006	<0.001	0.004	<0.001	0.004	<0.001	5.0* (mg/L)
Calcium (mg/L)	96.7	275	117	300	71.2	134	142	N/A
Potassium (mg/L)	6.13	3.11	1.16	84.3	3.06	3.72	3.40	N/A
Magnesium (mg/L)	18.4	71.8	71.7	155	17.2	39.7	36.9	N/A
Sodium (mg/L)	42.0	98.5	98.3	1260	815	176	168	N/A
TPH (mg/L)	0.144	<0.040	<0.040	2.650	0.047	0.129	<0.040	N/A
TPH C_{06}–C_{09} (mg/L)	0.121	<0.010	<0.010	0.324	<0.010	0.129	<0.010	N/A
TPH C_{10}–C_{14} (mg/L)	0.012	<0.010	<0.010	0.143	<0.010	<0.010	<0.010	N/A
TPH C_{15}–C_{28} (mg/L)	0.012	<0.010	<0.010	1.120	0.018	<0.010	<0.010	N/A
TPH C_{29+} (mg/L)	<0.010	<0.010	<0.010	1.020	0.029	<0.010	<0.010	N/A

* *Environment Protection (Water Pollution) Regulations 1974*, emissions into inland water ** Australian Water Quality Guidelines for Fresh and Marine Waters 1992
N/A — no emission limit available Bold numbers exceed respective limit.

Table 3 (*Continued)*

Groundwater

Parameter	*MG2000/5 (04/04/01)*	*MG2000/6 (03/04/01)*	*MG2000/7 (02/04/01)*	*MG2000/8 (02/04/01)*	*MG2000/9 (30/03/01)*	*MG2000/10 (02/04/01)*	*Leachate line (02/05/01)*	*Emission limit*
Bromide (mg/L)	12	7.0	7.8	13	<0.01	1.5	4.5	N/A
Chloride (mg/L)	980	**740**	**750**	**1200**	**260**	240	**520**	250* (mg/L)
Fluoride (mg/L)	0.33	<0.20	0.37	0.52	0.52	0.40	0.18	1.5* (mg/L)
Sulphate (mg/L)	<0.20	20	15	<2.00	60	140	34	250* (mg/L)
Ammonia (mg/L)	0.330	**17.0**	**180.0**	**220**	0.047	<0.100	**42.0**	0.5* (mg/L) nitrogen (as ammonia)
Nitrate + Nitrite (mg/l)	<0.200	<0.200	<0.200	<0.200	0.006	<0.200	0.325	10.0* (mg/l) nitrogen (as nitrate or nitrite)
Nitrite (mg-N/L)	<0.050	0.090	<0.050	<0.050	<0.002	<0.050	0.120	10.0* (mg/L) nitrogen (as nitrate or nitrite)
Ortho-P (mg-P/L)	<0.100	<0.100	<0.100	<0.100	0.003	<0.100	0.008	2.0* (mg/L) as phosphorus
N (Total) (mg/L)	-	-	-	-	-	-	75.5	N/A
P (Total) (mg/L)	-	-	-	-	-	-	17.9	N/A
Aluminium (mg/L)	<0.02	<0.02	<0.02	<0.020	<0.02	<0.020	<0.02	N/A
Arsenic (mg/L)	<0.005	<0.005	<0.005	0.013	<0.005	<0.005	<0.005	0.05* (mg/L)
Cadmium (mg/L)	<0.001	<0.001	0.001	<0.001	<0.001	0.001	<0.001	0.01* (mg/L)
Cobalt (mg/L)	0.023	0.011	0.013	0.048	0.005	0.013	0.011	N/A
Chromium (mg/L)	0.003	0.002	<0.001	0.009	<0.001	<0.001	0.001	0.5* (mg/L)
Copper (mg/L)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	1.0* (mg/L)
Iron (mg/L)	0.522	46.0	<0.020	**16.8**	<0.020	<0.020	0.177	(Combined iron and manganese total
Manganese (mg/L)	0.161	2.020	0.555	**0.606**	0.881	0.555	0.348	(1.0* (mg/L)
Nickel (mg/L)	0.033	0.048	0.017	0.058	0.009	0.017	0.028	0.1** (mg/L)
Lead (mg/L)	<0.005	0.006	<0.005	<0.005	,0.005	<0.005	<0.005	0.05* (mg/L)
Zinc (mg/L)	0.036	0.005	0.026	<0.005	,0.005	<0.005	<0.005	5.0* (mg/L)
Calcium (mg/L)	173	367	139	367	223	238	39.3	N/A
Potassium (mg/L)	184	30.4	164	230	6.79	3.85	33.8	N/A
Magnesium (mg/L)	178	199	190	267	40.1	43.0	97.1	N/A
Sodium (mg/L)	815	359	532	1020	146	192	303	N/A
TPH (mg/L)	0.443	4.820	2.210	95.800	<0.040	0.095	0.303	N/A
TPH C_{06}–C_{09} (mg/L)	0.063	0.196	0.329	0.603	<0.010	0.095	<0.010	N/A
TPH C_{10}–C_{14} (mg/L)	0.128	0.838	0.204	21.200	<0.010	<0.010	0.012	N/A
TPH C_{15}–C_{28} (mg/L)	0.258	2.470	1.100	65.900	<0.010	<0.010	0.292	N/A
TPH C_{29+} (mg/L)	<0.010	1.320	0.573	8.040	<0.010	<0.010	<0.010	N/A

* *Environment Protection (Water Pollution) Regulations 1974*, emissions into inland water ** Australian Water Quality Guidelines for Fresh and Marine Waters 1992
N/A — no emission limit available Bold numbers exceed respective limit.

Table 3 *(Continued)*

Surface water

Parameter	*Western drain base (24/04/01)*	*Western drain mid (24/04/01)*	*Eastern pipe (24/04/01)*	*Stage 2 spring (24/04/01)*	*Hobart Rivulet outpour (24/04/01)*	*Hobart Rivulet outpour (17/05/01)*	*Emission limit*
pH	7.0	6.7	6.9	6.8	7.4	7.4	N/A
Conductivity (µS/cm)	452	503	560	4530	823	576	N/A: note average sea water value 36 000
TDS (mg/L)	325	511	365	2930	571	429	N/A
Bromide (mg/L)	0.20	0.20	<0.01	10	0.96	0.32	N/A
Chloride (mg/L)	78	83	34	**800**	120	74	250* (mg/L)
Fluoride (mg/L)	0.16	0.12	0.27	0.07	0.14	0.07	1.5* (mg/L)
Sulphate (mg/L)	38	39	6.6	15	42	49	250* (mg/L)
Ammonia (mg/L)	**1.78**	**2.480**	0.028	**157.0**	**7.910**	**2.16**	0.5* (mg/L) nitrogen (as ammonia)
Nitrate + Nitrite (mg/L)	2.460	2.270	0.284	3.770	3.960	-	10.0* (mg/L) nitrogen (as nitrate or nitrite)
Nitrite (mg-N/L)	0.143	0.167	0.013	0.124	0.272	0.43	10.0* (mg/L) nitrogen (as nitrate or nitrite)
Ortho-P (mg-P/L)	0.393	0.467	0.781	0.010	0.020	<0.10	2.0* (mg/L) as phosphorus
Aluminium (mg/L)	0.098	0.091	0.033	<0.020	<0.020	<0.020	N/A
Arsenic (mg/L)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.05* (mg/L)
Cadmium (mg/L)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.01* (mg/L)
Cobalt (mg/L)	<0.001	<0.001	<0.001	0.016	0.001	<0.001	N/A
Chromium (mg/L)	0.002	0.003	<0.001	0.002	<0.001	0.001	0.5* (mg/L)
Copper (mg/L)	0.007	0.007	0.009	<0.001	0.006	0.003	1.0* (mg/L)
Iron (mg/L)	0.174	0.166	0.248	0.228	0.144	0.249	(Combined iron and manganese total
Manganese (mg/L)	<0.005	0.006	<0.005	0.370	0.163	0.048	(1.0* (mg/L)
Nickel (mg/L)	0.005	0.006	0.007	0.043	0.009	0.003	0.1** (mg/L)
Lead (mg/L)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.05* (mg/L)
Zinc (mg/L)	0.014	0.021	0.005	0.023	0.004	0.011	5.0* (mg/L)
Calcium (mg/L)	11.3	12.0	33.5	179	56.0	47.7	N/A
Potassium (mg/L)	11.6	12.5	20.8	110	13.7	7.30	N/A
Magnesium (mg/L)	7.82	7.68	17.9	185	26.6	12.7	N/A
Sodium (mg/L)	53.2	56.0	36.1	514	93.5	44.9	N/A
TPH (mg/L)	-	-	-	-	-	-	N/A
TPH C_{06}–C_{09} (mg/L)	-	-	-	-	-	-	N/A
TPH C_{10}–C_{14} (mg/L)	-	-	-	-	-	-	N/A
TPH C_{15}–C_{28} (mg/L)	-	-	-	-	-	-	N/A
TPH C_{29+} (mg/L)	-	-	-	-	-	-	N/A

* *Environment Protection (Water Pollution) Regulations 1974*, emissions into inland water ** Australian Water Quality Guidelines for Fresh and Marine Waters 1992
N/A — no emission limit available Bold numbers exceed respective limit.

Table 3 *(Continued)*

Surface water

Parameter	*Western drain base (17/05/01)*	*Car park flow (17/05/01)*	*Wester drain mid (17/05/01)*	*Western drain top (17/05/01)*	*Leachate line (02/05/01)*	*Emission limit*
pH	7.0	7.6	7.1	6.4		N/A
Conductivity (µS/cm)	590	2190	646	1280		N/A: note average sea water value 36 000
TDS (mg/L)	390	1410	410	622		N/A
Bromide (mg/L)	0.36	0.98	0.37	0.51	4.5	N/A
Chloride (mg/L)	79	330	79	120	**520**	250* (mg/L)
Fluoride (mg/L)	0.18	0.29	0.17	0.48	0.18	1.5* (mg/L)
Sulphate (mg/L)	83	96	<0.003	<0.003	34	250* (mg/L)
Ammonia (mg/L)	**2.98**	**2.55**	**3.71**	**16.5**	**42.0**	0.5* (mg/L) nitrogen (as ammonia)
Nitrate + Nitrite (mg/L)	-	-	-	-	0.325	10.0* (mg/L) nitrogen (as nitrate or nitrite)
Nitrite (mg-N/L)	<0.10	1.1	<0.010	<0.010	0.120	10.0* (mg/L) nitrogen (as nitrate or nitrite)
Ortho-P (mg-P/L)	<0.10	<0.10	<0.010	<0.010	0.008	2.0* (mg/L) as phosphorus
Aluminium (mg/L)	0.060	<0.020	0.075	<0.02	<0.02	N/A
Arsenic (mg/L)	<0.005	<0.005	<0.005	<0.005	<0.005	0.05* (mg/L)
Cadmium (mg/L)	<0.001	<0.001	<0.001	<0.001	<0.001	0.01* (mg/L)
Cobalt (mg/L)	0.001	0.004	0.002	0.003	0.011	N/A
Chromium (mg/L)	0.007	0.002	0.010	0.013	0.001	0.5* (mg/L)
Copper (mg/L)	0.004	0.024	0.004	<0.001	0.001	1.0* (mg/L)
Iron (mg/L)	0.425	0.189	**0.641**	**3.950**	0.177	(Combined iron and manganese total
Manganese (mg/L)	0.091	0.019	**0.134**	**0.489**	0.348	(1.0* (mg/L)
Nickel (mg/L)	0.008	0.013	0.010	0.008	0.028	0.1** (mg/L)
Lead (mg/L)	<0.005	<0.005	<0.005	<0.005	<0.005	0.05* (mg/L)
Zinc (mg/L)	0.130	0.019	0.104	<0.001	0.002	5.0* (mg/L)
Calcium (mg/L)	24.9	113	28.7	74.4	39.3	N/A
Potassium (mg/L)	14.6	0.51	15.8	11.1	33.8	N/A
Magnesium (mg/L)	12.5	76.5	13.1	33.8	97.1	N/A
Sodium (mg/L)	50.5	0.62	53.6	122	303	N/A
TPH (mg/L)	-	-	-	-	0.303	N/A
TPH C_{06}–C_{09} (mg/L)	-	-	-	-	<0.010	N/A
TPH C_{10}–C_{14} (mg/L)	-	-	-	-	0.012	N/A
TPH C_{15}–C_{28} (mg/L)	-	-	-	-	0.292	N/A
TPH C_{29+} (mg/L)	-	-	-	-	<0.010	N/A

* *Environment Protection (Water Pollution) Regulations 1974*, emissions into inland water ** Australian Water Quality Guidelines for Fresh and Marine Waters 1992
N/A — no emission limit available Bold numbers exceed respective limit.

Table 4

Comparison of analytical results against the Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000.

Groundwater and Leachate Line analyses

	McROBIES GULLY WASTE DEPOT														ANZECC 2000		
	MG1996/1 (04/04/01)	MG1996/2 (03/04/01)	MG1996/3 (03/04/01)	MG2000/1 (02/04/01)	MG2000/2 (04/04/01)	MG2000/3 (02/04/01)	MG2000/4 (27/03/01)	MG2000/5 (04/04/01)	MG2000/6 (03/04/01)	MG2000/7 (02/04/01)	MG2000/8 (03/04/01)	MG2000/9 (30/03/01)	MG2000/10 (02/04/01)	Leachate line (02/05/01)	IRRIGATION STV (Short-term)	IRRIGATION LTV (Long-term)	LIVESTOCK DRINKING
Analyte																	
Bromide (mg/L)	0.1	<0.01	0.98	3.4	0.93	0.82	1.4	12	7	7.8	13.00	<0.01	1.5	4.5			
Chloride (mg/L)	74	160	130	**1800**	**340**	150	**220**	**980**	**740**	**750**	**1200**	**260**	**240**	**520**	(1)MT (Refer Table 4.2.6)		
															MR (Refer Table 4.2.7)		
Fluoride (mg/L)	0.38	<0.20	<0.020	0.28	0.28	0.36	0.31	0.33	<0.20	0.37	0.52	0.52	0.4	0.18	4	1	
Sulphate (mg/L)	46	510	54	1.1	100	130	100	<0.20	20	15	<2.00	60	140	34			
NH_3-N (mg/L)	0.73	<0.1	0.500	110.0	<0.100	0.270	0.019	0.330	17.0	180.0	220	0.047	<0.100	42.0			
NO_2-N (mg/L)	0.310	<0.050	<0.050	<0.050	<0.050	<0.050	<0.002	<0.050	0.090	<0.050	<0.050	<0.002	<0.050	0.120			
PO_4-P (mg/L)	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	0.002	<0.100	<0.100	<0.100	<0.100	0.003	<0.100	0.008			
Calcium (mg/L)	96.7	275	117	300	71.2	134	142	173	367	139	367	223	238	39.3			1,000
Potassium (mg/L)	6.13	3.11	1.16	84.3	3.06	3.72	3.40	184	30.4	164	230	6.79	3.85	33.8			
Magnesium (mg/L)	18.4	71.8	71.7	155	17.2	39.7	36.9	178	199	190	267	40.1	43.0	97.1			250–2,000
Sodium (mg/L)	42.0	98.5	98.3	**1260**	**815**	**176**	**168**	**815**	**359**	**532**	**1020**	**146**	**192**	**303**	(1)MT (Refer Table 4.2.8)		
Aluminium (µg/L)	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	20,000	5,000	5,000
Arsenic (µg/L)	<5	<5	<5	<5	11	<5	<5	<5	<5	<5	13	<5	<5	<5	2000	100	500
Cadmium (µg/L)	<1	<1	<1	<1	<1	<1	<1	<1	<1	1	<1	<1	1	<1	50	10	10
Cobalt (µg/L)	<1	<1	<1	14	2	3	3	23	11	13	48	5	13	11	100	50	1,000
Chromium (µg/L)	<1	<1	<1	2	<1	<1	<1	3	2	<1	9	<1	<1	1	1,000*	100*	1,000
Copper (µg/L)	8	<1	2	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1	5,000	200	400–5,000
Iron (µg/L)	63	<20	24	**433**	<20	<20	<20	**522**	**46000**	<20	**16800**	<20	<20	177	10,000	200	NST
Manganese (µg/L)	17	**962**	159	**2580**	**345**	**605**	**356**	161	**2020**	**555**	**606**	**881**	**551**	**348**	10,000	200	NST
Nickel (µg/L)	17	1	2	28	5	<1	<1	33	48	17	58	9	17	28	2000	200	1,000
Lead (µg/L)	<5	<5	<5	<5	<5	<5	<5	<5	6	<5	<5	<5	<5	<5	5,000	2,000	100
Zinc (µg/L)	4	6	<1	4	<1	4	<1	36	5	26	<1	6	7	2	5,000	2,000	20,000

Bold values indicate values above relevant guideline levels

Notes:

* Chromium (VI)

(1) Suitability depends on salt tolerance of crop & calculation of ECse, the average root zone salinity. ECse depends on soil type & average root zone leaching fraction.

(2) Depending on animal type, within this salinity range may be reluctance to drink or may be some scouring but stock should adapt without loss of production.

(3) ES = Suits extremely sensitive crops
MS = Suits moderately sensitive crops, may affect sensitive crops
MT = Suits moderately tolerant crops
MR = Medium risk of increasing crop cadmium concentrations
MA = May affect crops sensitive to foliar injury through foliar absorption

STV — Short term trigger value for contaminant in irrigation water (<20 years) use

LTV — Long term trigger value for contaminant in irrigation water (100 years) use

NST — Not sufficiently toxic

Table 4 *(Continued)*

Groundwater and Leachate Line analyses

	McROBIES GULLY WASTE DEPOT											ANZECC 2000		
	Western drain base (24/04/01)	Western drain mid (24/04/01)	Eastern pipe (24/04/01)	Stage 2 spring (24/04/01)	Hobart Rivulet outpour (24/04/01)	Hobart Rivulet outpour (17/05/01)	Western drain base (17/05/01)	Car park flow (17/05/01)	Western drain mid (17/05/01)	Western drain top (17/05/01)	Leachate line (17/05/01)	IRRIGATION STV (Short-term)	IRRIGATION LTV (Long-term)	LIVESTOCK DRINKING
Bromide (mg/L)	0.20	0.20	<0.01	10	0.96	0.32	0.36	0.98	0.37	0.51	4.5			
Chloride (mg/L)	78	83	34	**800**	120	74	79	**330**	79	120	**520**		(1)MT (Refer Table 4.2.6) MR (Refer Table 4.2.7)	
Fluoride (mg/L)	0.16	0.12	0.27	0.07	0.14	0.07	0.18	0.29	0.17	0.48	0.18	4	1	
Sulphate (mg/L)	38	39	6.6	15	42	49	83	96	<0.003	<0.003	34			
NH_3-N (mg/L)	1.78	2.480	0.028	157.0	7.910	2.16	2.98	2.55	3.71	16.5	42.0			
NO_2-N (mg/L)	0.143	0.167	0.013	0.124	0.272	0.43	<0.10	1.1	<0.010	<0.010	0.120			
PO_4-P (mg/L)	0.393	0.467	0.781	0.010	0.020	<0.10	<0.10	<0.10	<0.010	<0.010	0.008			
Calcium (mg/l)	11.3	12	33.5	179	56.0	47.7	24.9	113	28.7	74.4	39.3			1,000
Potassium (mg/L)	11.6	12.5	20.8	110	13.7	7.30	14.6	0.51	15.8	11.1	33.8			
Magnesium (mg/L)	7.82	7.68	17.9	185	26.6	12.7	12.5	76.5	13.1	33.8	97.1			250–2,000
Sodium (mg/L)	53.2	56.0	36.1	**514**	93.5	44.9	50.5	0.62	53.6	**122**	**303**		(1)MT (Refer Table 4.2.8)	
Aluminium (µg/L)	98	91	33	<20	<20	<20	60	<20	75	<20	<20	20,000	5,000	5,000
Arsenic (µg/L)	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	2000	100	500
Cadmium (µg/L)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	50	10	10
Cobalt (µg/L)	<1	<1	<1	16	1	<1	1	4	2	3	11	100	50	1,000
Chromium (µg/L)	2	3	<1	2	<1	1	7	2	10	13	1	1,000*	100*	1,000
Copper (µg/L)	7	7	9	<1	6	3	4	24	4	<1	1	5,000	200	400–5,000
Iron (µg/L)	174	166	**248**	**228**	144	**249**	**425**	189	**641**	**3950**	177	10,000	200	NST
Manganese (µg/L)	<5	6	<5	**370**	163	48	91	19	134	**489**	**348**	10,000	200	NST
Nickel (µg/L)	5	6	7	43	9	3	8	13	10	8	28	2000	200	1,000
Lead (µg/L)	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	5,000	2,000	100
Zinc (µg/L)	14	21	5	23	4	11	130	19	104	<1	<2	5,000	2,000	20,000

Bold values indicate values above relevant guideline levels

Notes:

* Chromium (VI)

(1) Suitability depends on salt tolerance of crop & calculation of ECse, the average root zone salinity. ECse depends on soil type & average root zone leaching fraction.

(2) Depending on animal type, within this salinity range may be reluctance to drink or may be some scouring but stock should adapt without loss of production.

(3) ES = Suits extremely sensitive crops
MT = Suits moderately tolerant crops
MR = Medium risk of increasing crop cadmium concentrations

STV — Short term trigger value for contaminant in irrigation water (<20 years) use

LTV — Long term trigger value for contaminant in irrigation water (100 years) use

NST — Not sufficiently toxic

significantly higher than those for the bedrock aquifer, whilst sulphate is generally much lower. Trace metals, such as nickel and cobalt, are also present in greater concentrations in the waste fill waters than in bedrock, but these levels are still relatively low.

The boreholes screened into the bedrock aquifer(s) show different chemistry (e.g. higher sulphate and generally lower chloride), but significantly MG2000/2, 3 and 10 show trace amounts of petroleum hydrocarbons. This does suggest limited hydraulic connection with bedrock waters.

Ammonia was elevated in the bore screened in the Triassic rocks south of the landfill toe (MG1996/3). Chloride appears elevated in bores MG2000/4, 9 and 10 when compared to the background bore MG1996/2. Ammonia was also elevated in all surface water samples (except that collected from the eastern pipe on 24 April 2002). Discharges from behind the recycling area (samples Stage 2 spring, 24/04/01 and car park flow, 17/05/01) also contained additional chloride, indicating that this water is a spring discharge of the poor quality fill water.

The Ternary plot for groundwater demonstrates a cluster of the degraded ammonia/chloride contaminated waters. The remaining spread of points reflects the chemical variations within the boreholes screened in the various lithologies and their position with respect to the Cascades Fault Zone and the landfill footprint.

The Ternary plot for surface waters shows a greater spread of points, which reflects the point sources, dilution factor and complex hydrological system at the site.

CONTAMINATION ASSESSMENT

Water held within saturated fill (fill water) is enriched in at least chloride, ammonia, iron, manganese and all fractions of total petroleum hydrocarbons. Fill water is seen as the main source of contamination within the hydrogeological system.

Chloride and hydrocarbon migration into the bedrock aquifers seems to be occurring, as shown by bores MG1996/1, MG2000/3, 4, 9 and 10. Nitrogen contamination of MG1996/1 may be related to the large volume of fish waste disposed of in this part of the valley over the last five years. Ammonia detected in MG1996/3 could indicate migration of degraded groundwater to the south of the site.

Surface waters within and adjacent to the landfill footprint are outside selective guideline limits. Based on existing data, ammonia contamination of surface waters is prevalent during and immediately following wet weather events. Contamination of surface water in the southern area behind the recycling shop was significantly higher than any other contaminated surface water sampled at the site. Ammonia levels in the existing western stormwater cut-off drain indicate contamination by fill water discharging from the landfill footprint western perimeter. This is supported by the gradient of the water table in the waste fill, demonstrated by the cross section through MG2000/7 and 8 (fig. 5).

Off-site discharge to the Hobart Rivulet of ammonia-contaminated water has been shown to occur. The environmental impact of these discharges is beyond the scope of this report, although downstream of the discharge point the Hobart Rivulet enters a highly urbanised area which would be expected to generate surface water of degraded quality during wet weather run off.

PRINCIPAL CONCLUSIONS

The data gathered indicate that there is a generally low level of groundwater contamination being generated by the McRobies Gully waste depot relative to the quantity of waste that has been deposited at the site. This appears to be a result of limited hydraulic connection with bedrock waters and the fill material having a permeability several orders of magnitude greater than the underlying rock. The hydraulic conductivity down-gradient of the site is estimated as probably being less than two metres per year.

The leachate collection system at the toe of the landfill is well located and appears to intercept nearly all of the fill water moving through the landfill. In dry weather and low rainfall events all of the collected fill water flow is diverted to sewer for treatment at the Macquarie Point waste water treatment plant. Sampling from the bore immediately down-gradient of the toe of the landfill produced ammonia levels at about 0.5% of the typical fill water concentration, indicating that a small proportion of fill water is not being intercepted by the leachate collection system.

Locally the results indicate that there is an area of degraded groundwater in the northwest end of the valley, with elevated ammonia and nitrate levels in the groundwater. It appears that this may be due to the significant volumes of fish waste which have been disposed of in this area over a number of years. Better management of surface water in this area will be required to lower the hydraulic level in the fill and reduce the potential for further groundwater contamination.

The fill water is of very poor quality relative to the groundwater in the surrounding bedrock. It would appear that there is an unquantified degree of biodegradation of pollutants occurring as the water travels through the fill.

During significant wet weather events the capacity of the site's surface water and leachate management systems to transfer flows to sewer is exceeded and diluted leachate discharges occur to the Hobart Rivulet, together with stormwater flows. Based on the evidence collected it is considered that the existing

surface water management infrastructure could be improved to reduce the frequency and quantity of degraded water passing to the Hobart Rivulet in wet weather.

The results of the hydrogeological modelling of the McRobies Gully waste depot, the water levels measured in the fill, and the presence of significant landfill gas pressure have implications relating to the ongoing management of the stability risks at the site.

The data collected in this investigation were insufficient to quantify the level of risk associated with seismic events. Further work could be taken to assess the degree of risk.

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[30 September 2002]

Appendix 1

Seismic risk — McRobies Gully

D. E. Leaman
Leaman Geophysics

Summary

McRobies Gully in South Hobart, now occupied by a major waste disposal depot operated by the Hobart City Council, is a most interesting location. The gully drainage system, now covered by many metres of fill, is engraved into the fault system which forms the western margin of the Derwent Rift — a structure born from long term tectonic stress and seismicity. Variably, or poorly, compacted water-saturated fills, whether natural or man-made, are sensitive to vibration and may consolidate, collapse or flow catastrophically in the event of tremors. The fault system has been active since European settlement and several comparable parts of Hobart have been damaged by earthquakes with distant epicentres due to resonant or sympathetic vibration in poorly consolidated materials.

The risk taken in placing relatively unstable materials at such a site depends upon appraisal of the probability of seismic events (or even abnormal rain events) and the nature of consequent damage possible should the fill be breached. Natural risk is never easy to estimate due to uncertainties about event frequency but a damaging event is likely within the working life of the site as presently envisaged (say 30–50 years). Site location adjacent to an urban area means that consequent damage, including loss of life, might be substantial.

It is important that this risk be recognised and that measures be enacted which improve the consolidation and drainage of the fill. Such management cannot alter the chance of seismic events but may reduce levels of consequent damage. Sites of this type (with relatively high probability of seismic events and abnormal drainage) should be recorded in planning schemes, be subject to special developmental codes and be avoided by large or critical pieces of infrastructure, for example emergency services, hospitals, factories, bridges or waste depots.

McRobies Gully seismic risk — Supporting information

NATURAL RISK

Any assessment of natural risk is fraught with difficulty since it inevitably involves incomplete data or understanding and requires an appreciation of chaotic or quasi-random systems which operate on planet Earth. Einstein commented, when contemplating the not too dissimilar quantum (uncertainty) theory, that "God does not play dice". Unfortunately, natural processes do.

Our word 'risk' derives from the early Italian risicare which means to dare. Risk means, therefore, that we make a choice, or gamble: it is not a fate or certainty.

When we take a risk, we are betting on an outcome that will result from a decision we have made, although we do not know for certain what the outcome will be. The essence of risk management lies in maximising those areas where we have some control over the outcome while minimising those areas where we have absolutely no control and where the linkage between cause and effect is unclear (Bernstein, 1998).

Time transforms risk, since we change our degree of exposure to possible actions. In the case of natural events especially, what has happened can happen again for similar reasons although the precise working out of the event will almost certainly be varied. There is also nothing in the past which can insure the future or allow accurate predictions: the next event may be 'record-breaking'.

A simple example illustrates these principles.

Cliffs collapse. Continuing exposure to the elements (wind, rain, seepage, hot, cold, weathering processes) leads to slow transformation of the rock mass. It is difficult to predict which piece of cliff will fail next, or when, but fail it surely will, piece by piece.

Now add people. When we stand at cliff edge we are taking a risk — choosing to dare that a particular portion will not fail while we are upon it. (We also overlook the effect which our own weight or vibration might have on the outcome). We are not maximising our control; we could stay away. But, if we return day after day, as many do, then the chance of failure involving people increases. The damage level, including potential loss of life, rises; yet it is avoidable or could be minimised.

The cliff example also teaches us something else.

If a part of the cliff fails today then it is equally possible that part, or indeed the same section, may fail tomorrow — or that no failure may occur for some time. Further failure, and eventually complete retreat of the cliff, will occur at some time.

The final conceptual problem relates to the difference between human and natural time frames. Unless the event was catastrophic in damage terms we may not

remember it or record it and with time it will be forgotten. We may not even notice the changes to the cliff. We then leap across the risk chasm to say that it could not, or does not, happen.

All risk depends on the product of opportunity and exposure. How many events and how many people or places are exposed to them?

Seismic risk is no different in principle but the nature of the hazard and consequent damage means that the level of risk (the gamble) is much higher.

GEOLOGICAL SETTING McROBIES GULLY

The lowlands between the slopes of the Wellington Range and the hills east of Sorell form the heart of a complex rift valley (Leaman, 1999). The rifting, crustal extension accompanied by seismic activity over a long period (Leaman, 2001), has developed a complex fracture pattern in the Hobart area. Figure 7, modified from Leaman (2000, 2001), is based on mapping by Leaman (1972) and Clarke and Forsyth (2002). The diagram suggests the principal faults and features in the western half of the rift zone. Most faults are limited in both continuity, displacement and effect on adjacent rocks. Some, however, including those at the western margin, extend over considerable distances with displacements in excess of 1500 metres (up to 2200 m). The collection of faults produces a giant, regional structure.

The Cascades Fault, so named because it passes beneath the brewery, is the largest fault in the Hobart area and it links equivalent breaks between Snug and Bothwell. Elevated terrain and ranges occur west of this fault family (Cascades Fault Zone, CFZ). Portions of the region west of the Cascades Fault contain many smaller faults which splinter the rock sequence and a large monoclinal fold related to the uplift of the Wellington Range and the local deformation and stresses introduced by the split of the fault system about Mt Nelson (Leaman, 1999). The particular geological results in the South Hobart region include widespread shattering, alteration, deep weathering, block rotations and increased subsurface water flows. The main fault zone is also abnormally wide (100 m) and compound: many movement events have braided the structure. All these characteristics are evident near Halls Saddle at Fern Tree, in the Waterworks, at McRobies Gully, near Rosetta and at Granton.

The fault network, as shown in Figure 7, has evolved over 180 million years but there are suggestions in Permian rocks of precursor rifting (280 Ma; Leaman, 1992) and basement rocks older than Cambrian indicate an ancient crustal boundary in the general location of the CFZ (Leaman, 1990). Crustal control on the activity and evolution of the modern rift system may span more than a billion years.

The geological implication of this history is that the fault system is ancient, has been rejuvenated, and is either modestly active or dormant at present. It is not a dead structure. A wider regional context may be applied since southern Tasmania is still being stressed and uplifted at an average rate of 2 mm/decade (refer Murray-Wallace and Goede, 1995). Coastal terrace deposits indicate a stuttering rise (normal, episodic Earth process) rather than a smooth uplift during the last 125 000 years.

The McRobies Gully waste disposal site is located upon the intensely disrupted CFZ west of Knocklofty; one of the most active and stressed parts of the rift margin. The structure will fail again. The only uncertainty attaches to 'when?'.

KNOWN SEISMIC HISTORY

Two classes of events have caused problems in the Hobart area: those centred locally and those which have occurred elsewhere in Tasmania.

Local events

The entire rift network has been relatively quiet seismically since instrumental recording began between 1957–1959 but several small events have been observed. All have been located on faults in the net. Most events have had Richter magnitudes of less than 2 (felt, not damaging) but one exceeded M = 3.5 (old branch CFZ, Kingston, 1959, minor damage). The largest known earthquake in the rift since settlement occurred in 1854 (epicentre approximately Montrose on CFZ, M ~ 5, building damage in Glenorchy). This event was news for several days (Alexander, 1986) but has been forgotten and, indeed, has yet to be included in the earthquake data base. This is a common problem since funding, research or search limitations restrict the depth of archival searches. A similar issue arose at Newcastle after the 1989 earthquake raised the question of previous events. Searches from 1859, upon which risk factors had been based, had not recovered any history or expectation of events yet extended review discovered that two previous large events had occurred there in the 1830s: see Gaull *et al*. (1990). This information transformed the risk assessment for that city.

It is not yet possible to offer any meaningful estimate of recurrence intervals for events within the rift area due to lack of data but the pattern is probably of SW Tasmania type.

The stated interval is a long period estimation based on available records expressed in years for an event somewhere in the region. Such an estimation does not constitute a prediction due to the chaotic character of events.

Magnitude	*Interval (SW Tas)*	*Interval (NE Tas)*
3	3.5	3.9
4	6.7	4.2
5	25	12.5
6	-	50.5

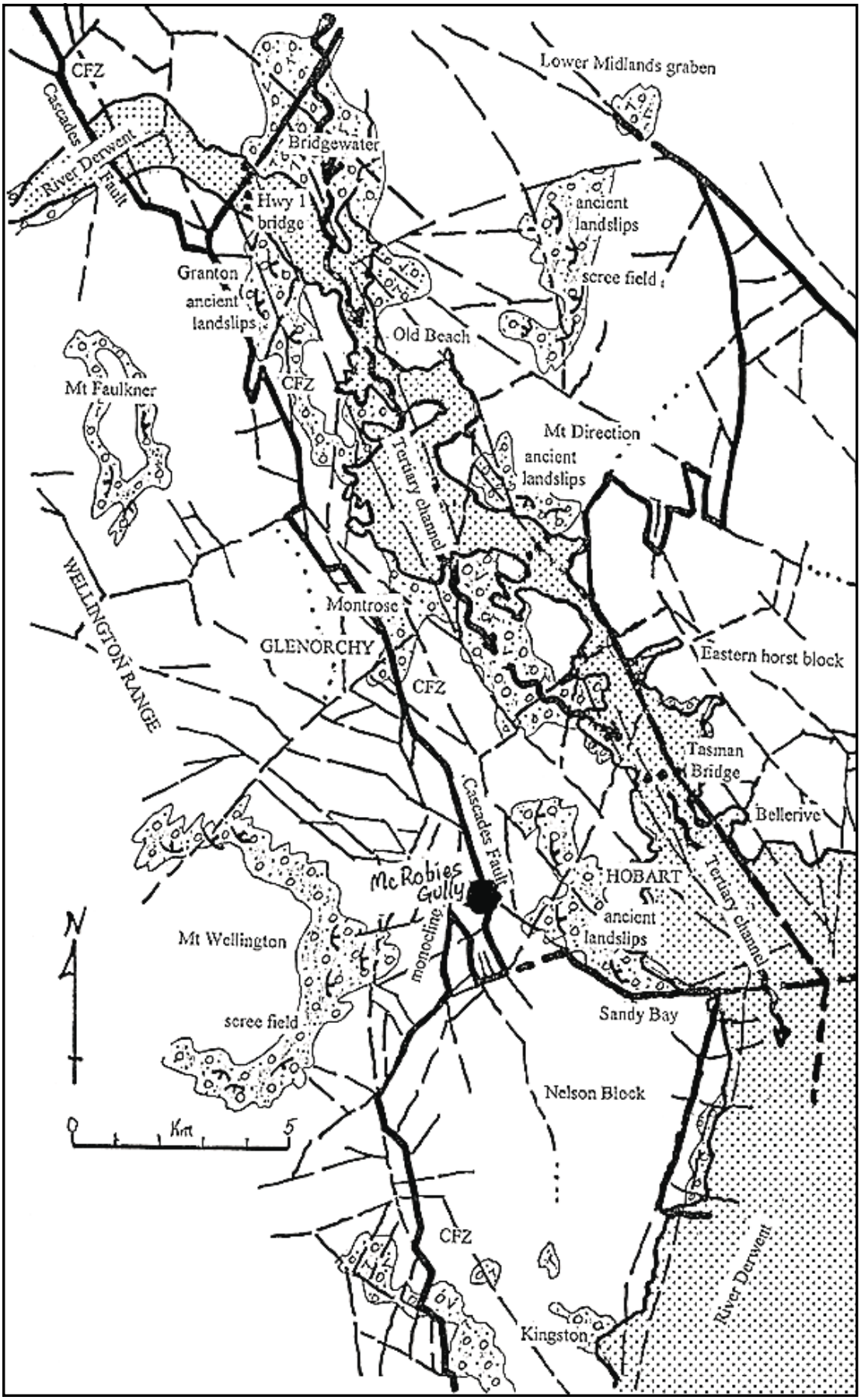

Figure 7

Simplified outline of rift zone faults between the River Derwent and the Wellington Range near Hobart. Major faults are indicated by heavy lines. Rock and fill materials subject to vibration resonance or failure are patterned. Note the unfortunate location of the McRobies Gully waste depot within this structural framework.

Any part of the fault network may act as a focus but relative activity or local stressing is not known due to lack of research, microseismic analysis or complete search for rock indicators as at Granton (Leaman, 2000).

Earthquakes have clearly occurred in the Hobart area in the past as demonstrated by the existence of the rift fault system. Such events may be termed local and are capable of wreaking considerable damage: worst on or near the mobile structure. An event of the 1854 type anywhere in the Lenah Valley–Waterworks–Fern Tree part of the CFZ would likely lead to failure of the fill in McRobies Gully.

Distant events

Earthquakes generated in two particular distant regions have caused damage in Hobart; those centred off northeast Tasmania and those generated in the Lake Pedder–Port Davey region in southwest Tasmania.

Each type of event has been able to generate magnitudes and dispersed wave frequencies at the range of Hobart city which lead to local amplification and resonance in susceptible materials. Most damage of this type has been recorded in Sandy Bay and parts of New Town and Glenorchy in the past but future effects will be more widespread (Taroona, Claremont, Austins Ferry, Old Beach) due to recent urban expansion across other tracts of responsive materials. This is a planning failure since no protective design codes exist for the Hobart Metropolitan Area (no risk management of factors which could be minimised).

Enough is known about each class of earthquake region to provide crude estimates of recurrence periods (above). Note that these estimates do not provide any measure of risk and that only the largest events cause damage in Hobart.

The last event of NE-type was in 1946 (M = 6, see Michael-Leiba and Jensen, 1993) but this was the fourth since European settlement. Three others occurred in the period 1883–1892; two with magnitudes in excess of 6.8. These were major earthquakes in any terms.

The most recent event of SW type was in 1958 but there had been at least four previous events with magnitude greater than 5 since 1803. The first of these was described in 1827 and felt statewide (also Gibson *et al*., 2000).

All nine events have caused structural damage in Hobart, including wall and chimney failure.

Damage levels rated on the international Modified Mercalli scale (VI, VII) are serious and have caused Hobart, amongst Australian cities, to be very highly rated for seismic risk (Gaull and Kelsey, 1999).

The implied recurrence intervals are of the order of 50 years for NE events and 30 years for SW events. Variability of occurrence limits the value of such estimates. It should be noted that three of the four very large NE events occurred in a single decade. This swarm characteristic is typical of natural processes. Other swarms have affected (and damaged) Launceston (1883–1885; see Carey, 1960) and the Bream Creek region (1986–1987). Throughout this report I have quoted recurrence and probability in terms of years rather than frequency or chance of event within a given period (the method of the National Earthquake Observatory: Gaull *et al*., 1990) since this form of expression is more readily assimilated.

The message is clear: Hobart is subject to earthquake damage. The materials most at risk, or structures built upon them, are Tertiary sedimentary rocks, slope deposits and fill of all types. Loose fill, saturated fill or those with a gaseous component — all present at McRobies Gully — are most at risk from distant events and recurrence estimations suggest that an event is probable within a decade.

Conclusions

- Hobart is subject to local earthquakes of moderate magnitude (at least).
- Hobart has been periodically damaged by large distant earthquakes. These are of two types and the combined recurrence interval is less than 30 years. An event is probable in the short term.
- Those areas developed on poorly consolidated materials, or which are proximal to the main fault systems, are likely to suffer enhanced or localised damage; the extent depending on locality and epicentral distance.
- Fill materials, as in McRobies Gully, are most likely to be damaged, or cause damage, by a local or distant event.
- The risk of significant damage is high in the McRobies Gully area.
- We cannot prevent earthquakes but we can minimise the risk of damage.

Recommendations

- Establish a regional microseismic monitoring program in order to locate sensitive, stressed segments in the fault system. (This has been done for other cities as part of the Cities Program, including Launceston as pilot, but Hobart did not participate!). This relatively low budget study could be undertaken as post graduate research work.
- Combine monitoring results with known material distributions in order to define planning and building codes for local development and construction (as in Launceston, Jensen, 2000). Note that some materials are best avoided.

- Engineer fills and supporting infrastructure to resist failure. Good drainage, gas removal and improved consolidation/compaction are essential elements after recognition that a risk exists.
- The waste at McRobies Gully must be made as coherent (and dry) as possible.
- Future waste depots should not be placed in valleys with significant surface and subsurface catchments, nor on any major fault zone; indeed, any fault zone.

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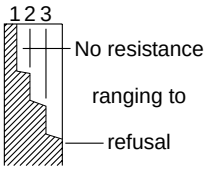
[12 November 2001]

Appendix 2

Engineering logs of boreholes

EXPLANATION SHEET FOR ENGINEERING LOGS
Borehole and excavation log

Penetration



Water

22 Jan, 80 Water level on date shown

Water inflow

Water outflow

Notes — samples and tests

U50	Undisturbed sample 50 mm diameter
D	Disturbed sample
N	Standard penetrometer blow count for 300 mm
N*	SPT + Sample

Material classification

Based on Unified Soil Classification System.

In Graphic Log materials are represented by clear contrasting symbols consistent for each project.

Moisture content

D	Dry, looks and feels dry
M	Moist, no free water on hand when remoulding
W	Wet, free water on hand when remoulding
LL	Liquid limit
PL	Plastic limit
PI	Plasticity index

e.g. M>PL — Moist, moisture content greater than the plastic limit

Consistency

		: hand penetrometer
VS	Very soft	<25 (kPa)
S	Soft	25 – 50
F	Firm	50 – 100
St	Stiff	100 – 200
VSt	Very stiff	200 – 400
H	Hard	>400
Fb	Friable	

Notes: X on log is test result
— is range of results

Density index

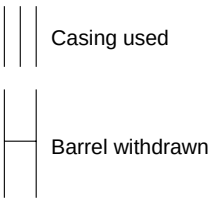
		%
VL	Very loose	0 – 15
L	Loose	15 – 35
MD	Medium dense	35 – 65
D	Dense	65 – 85
VD	Very dense	85 – 100

Fracture description

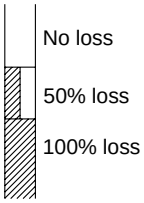
RP	Rough planar
RL	Rough irregular
SP	Smooth planar
SL	Smooth irregular

Cored borehole log

Case - lift



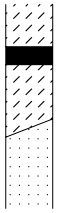
Fluid loss



Lugeons

Lugeon units (uL) are a measure of rock mass permeability. For a 46 to 74 mm diameter borehole 1 Lugeon is defined as a rate of loss of 1 litre per metre per minute. 1 Lugeon is roughly equivalent to a permeability of 1 x 10^{-4} mm / sec.

Graphic log



No core

Rock substances represented by clear, contrasting symbols consistent for each project.

Weathering

Fr	Fresh
SW	Slightly weathered
HW	Highly weathered
EW	Extremely weathered

Strength

		point load strength index $I_{s\,(50)}$ (MPa)
EL	Extremely low	< 0.03
VL	Very low	0.03 – 0.1
L	Low	0.1 – 0.3
M	Medium	0.3 – 1
H	High	1 – 3
VH	Very high	3 – 10
EH	Extremely high	>10

Notes: X on log is test result.

Significant defects

Significant defects shown graphically

Joint

Sheared zone

Crushed seam

Infill seam

Extremely weathered seam

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **MG 2000/1**
Sheet 1 of 4

Project	McRobies Gully waste depot	Location	McRobies Road, South Hobart
Co-ordinates	55 523477 mE 5251096 mN	Drill type	Auger
		Drill method	Rotary
		Drill fluid	Nil
R.L.		Hole commenced	2 October 2000
Inclination	Vertical	Hole completed	10 October 2000
Bearing		Drilled by	KMR Drilling Pty Ltd
		Logged by	Mr Andrew Ezzy
		Checked by	Mr Adrian Waite

penetration 1 2 3	support	water	notes samples, tests	metres R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
		Cement		0.5		CI	CLAY - medium plasticity, grey, rock fragments ***Large quantity of landfill gas vented***	D	H	Capping material
	No Screen - Class 12 pipe	7 mm Gravel		1.0 1.5 2.0 2.5 3.0			WASTE fill - wood, plastic, metals, tyres, cement	D		Domestic refuse
		Bentonite		3.5						
		Coarse sandy gravel	S.W.L. 10/10/00	4.0 4.5						

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **MG 2000/1**
Sheet 2 of 4

Project	McRobies Gully waste depot	Location	McRobies Road, South Hobart
Co-ordinates	55 523477 mE 5251096 mN	Drill type	Auger
		Drill method	Rotary
		Drill fluid	Nil
R.L.		Hole commenced	2 October 2000
Inclination	Vertical	Hole completed	10 October 2000
Bearing		Drilled by	KMR Drilling Pty Ltd
		Logged by	Mr Andrew Ezzy
		Checked by	Mr Adrian Waite

penetration 1 2 3	support	water	notes samples, tests	metres R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
	No Screen			5.5			(As sheet 1)			
	6 metre 1 mm slotted screen - Class 12 pipe			6.0						
				6.5						
		Coarse sandy gravel		7.0						
				7.5						
			In flow 02/10/01	8.0			WASTE fill - wood, plastic, metals, tyres, cement	W		Domestic refuse
				8.5						
				9.0						
				9.5						

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **MG 2000/1**
Sheet 3 of 4

Project	McRobies Gully waste depot	Location	McRobies Road, South Hobart
Co-ordinates	55 523477 mE 5251096 mN	Drill type	Auger
		Drill method	Rotary
		Drill fluid	Nil
R.L.		Hole commenced	2 October 2000
Inclination	Vertical	Hole completed	10 October 2000
Bearing		Drilled by	KMR Drilling Pty Ltd
		Logged by	Mr Andrew Ezzy
		Checked by	Mr Adrian Waite

penetration 1 2 3	support	water	notes samples, tests	metres R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
	Screen	Coarse sandy gravel		10.5			(As sheet 2)			
			↓	11.0						
				11.5						
				12.0						
				12.5						
	Back in fill	Back in fill		13.0						
			↓	13.5						
				14.0						
				14.5						

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **MG 2000/1**
Sheet 4 of 4

Project	McRobies Gully waste depot	Location	McRobies Road, South Hobart
Co-ordinates	55 523477 mE 5251096 mN	Drill type	Auger
		Drill method	Rotary
		Drill fluid	Nil
R.L.		Hole commenced	2 October 2000
Inclination	Vertical	Hole completed	10 October 2000
Bearing		Drilled by	KMR Drilling Pty Ltd
		Logged by	Mr Andrew Ezzy
		Checked by	Mr Adrian Waite

penetration 1 2 3	support	water	notes samples, tests	metres R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
	Back in fill	Back in fill		15.5 16.0 16.5 17.0 17.5			(As sheet 3)			
							End of hole due to jamming of auger bit at 17.8 m. Water samples for metals and nutrient collected during pull out of rods on 02/10/2000.			Auger refusal may be due to bedrock

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **MG 2000/2**
Sheet 1 of 2

Project	McRobies Gully waste depot	Location	McRobies Road, South Hobart
Co-ordinates	55 523666 mE 5250820 mN	Drill type	Percussion / Diamond
		Drill method	Down hole hammer / Core barrel
R.L.		Drill fluid	Air / Drillers mud
Inclination	Vertical	Hole commenced	3 October 2000
Bearing		Hole completed	8 October 2000
		Drilled by	KMR Drilling Pty Ltd
		Logged by	Mr Andrew Ezzy
		Checked by	Mr Adrian Waite

penetration 1 2 3	support	water	notes: samples, tests	metres: R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
	No Screen - Class 12 pipe 7 mm Gravel	Cement		5.0 10.0 15.0 20.0 25.0 30.0 35.0 40.0			Interbedded MUDSTONE, SILTSTONE AND SANDSTONE - Alternating sequences of mudstone, siltstone and sandstone. (Down hole hammer drilling 03/10/2000)	D		Permian sediments
		Bentonite								
	▼		S.W.L. 08/10/00							
	Coarse sandy gravel			45.0			SANDSTONE - coarse, grey, highly fractured, mudstone grey Diamond drilling (04/10/2000 – 06/10/2000) High degree of core loss due to fracture intensity	D		Fault zone with highly fractured Permian sediments Cascades Fault shear zone

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **MG 2000/2**
Sheet 2 of 2

Project	McRobies Gully waste depot	Location	McRobies Road, South Hobart
Co-ordinates	55 523666 mE 5250820 mN	Drill type	Percussion / Diamond
		Drill method	Down hole hammer / Core barrel
R.L.		Drill fluid	Air / Drillers mud
Inclination	Vertical	Hole commenced	3 October 2000
Bearing		Hole completed	8 October 2000
		Drilled by	KMR Drilling Pty Ltd
		Logged by	Mr Andrew Ezzy
		Checked by	Mr Adrian Waite

penetration 1 2 3	support	water	notes: samples, tests	metres: R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
	No screen						(As sheet 1)			
	12 m Screen - Class 12 pipe	Coarse sandy gravel		55.0			SANDSTONE - coarse, grey Percussion drilling (06/10/2000)	M		Permian sediments Cascade Fault zone
			In flow 08/10/00	60.0						
				65.0			SANDSTONE - coarse, grey	W		Permian sediments Fractured aquifer
							End of hole at 66.0 m Hole installation occurred on 08/10/2000			

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **MG 2000/3**
Sheet 1 of 3

Project	McRobies Gully waste depot	Location	McRobies Road, South Hobart
Co-ordinates	55 523734 mE 5250964 mN	Drill type	Auger / Percussion
		Drill method	Rotary /Down hole hammer
		Drill fluid	Air
R.L.		Hole commenced	8 October 2000
Inclination	Vertical	Hole completed	9 October 2000
Bearing		Drilled by	KMR Drilling Pty Ltd
		Logged by	Mr Andrew Ezzy
		Checked by	Mr Adrian Waite

penetration 1 2 3	support	water	notes samples, tests	metres R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
		Cement		0.5		CI	CLAY - medium plasticity, grey, various rock fragments - cover material (Auger drilling)	M	F	Fill
		7 mm Gravel		1.0		GC	GRAVEL - green-grey, clayey sand	W	VL	Weathered Permian sediments
				1.5			SANDSTONE - grey Percussion drilling	M		Permian sediments
	No Screen - Class 12 pipe		1st in flow 08/10/00	2.0		GC	Recovered as GRAVEL - dark grey, clayey sand	W	L	Weathered Permian sediments
		Bentonite		2.5						
				3.0						
				3.5						
		Coarse sandy gravel		4.0						
				4.5						

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **MG 2000/3**
Sheet 2 of 3

Project	McRobies Gully waste depot	Location	McRobies Road, South Hobart
Co-ordinates	55 523734 mE 5250964 mN	Drill type	Auger / Percussion
		Drill method	Rotary /Down hole hammer
R.L.		Drill fluid	Air
Inclination	Vertical	Hole commenced	8 October 2000
Bearing		Hole completed	9 October 2000
		Drilled by	KMR Drilling Pty Ltd
		Logged by	Mr Andrew Ezzy
		Checked by	Mr Adrian Waite

penetration 1 2 3	support	water	notes samples, tests	metres R.L.	metres depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
	No Screen		2nd in flow 08/10/00					(As sheet 1)			
	1 m Screen - 1mm slots	Coarse sandy gravel	D Sample ID 1		5.5			Interbedded sequence of SILTSTONE, MUDSTONE AND SANDSTONE - grey, extremely weathered	W		Highly fractured Permian sediments
					6.0						
					6.5						
	Back fill	Back fill	D Sample ID 1		7.0						
					7.5						
					8.0						
					8.5						
					9.0						
			D Sample ID 1								
					9.5						

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **MG 2000/3**
Sheet 3 of 3

Project	McRobies Gully waste depot	Location	McRobies Road, South Hobart
Co-ordinates	55 523734 mE 5250964 mN	Drill type	Auger / Percussion
		Drill method	Rotary /Down hole hammer
R.L.		Drill fluid	Air
Inclination	Vertical	Hole commenced	8 October 2000
Bearing		Hole completed	9 October 2000
		Drilled by	KMR Drilling Pty Ltd
		Logged by	Mr Andrew Ezzy
		Checked by	Mr Adrian Waite

penetration 1 2 3	support	water	notes samples, tests	metres R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
	Back fill	Back fill	D Sample ID 1	10.5			(As sheet 2)			
				11.0						
				11.5						
				12.0			End of hole at 12.0 m Installation 09/10/2000.			
			Sample ID numbers refer to samples stored in MRT core shed							

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **MG 2000/4**
Sheet 1 of 1

Project	McRobies Gully waste depot	Location	McRobies Road, South Hobart
Co-ordinates	55 523715 mE 5250949 mN	Drill type	Percussion
		Drill method	Down hole hammer
		Drill fluid	Air
R.L.		Hole commenced	9 October 2000
Inclination	Vertical	Hole completed	10 October 2000
Bearing		Drilled by	KMR Drilling Pty Ltd
		Logged by	Mr Andrew Ezzy
		Checked by	Mr Adrian Waite

penetration 1 2 3	support	water	notes samples, tests	metres R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
		Cement	D Sample ID 1				WASTE fill - wood, plastic, sand, rock fragments	D		Domestic refuse
			D Sample ID 2				MUDSTONE - grey and brown	D		Permian sediments
	No Screen - Class 12 pipe	7 mm Gravel	D Sample ID 3,4, 5, 6, 7	5.0			MUDSTONE - grey, with occasional siltstone	D		Permian sediments
		Bentonite	D Sample ID 8, 9, 10	10.0						
		Coarse sandy gravel		15.0						
	11 m screen - 1mm slots		D Sample ID 11, 12	20.0			MUDSTONE - grey, with occasional siltstone	M		Fractured Permian sediments
			D Sample ID 13, 14, 15	25.0			MUDSTONE - grey, with occasional siltstone	W		Fractured Permian sediments
			Sample ID numbers refer to samples stored in MRT core shed	30.0			End of hole at 30.0 m Installation 10/10/2000.			

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **MG 2000/5**
Sheet 1 of 4

Project	McRobies Gully waste depot	Location	McRobies Road, South Hobart
Co-ordinates	55 523474 mE 5251259 mN	Drill type	Auger
		Drill method	Rotary
		Drill fluid	Nil
R.L.		Hole commenced	10 October 2000
Inclination	Vertical	Hole completed	16 October 2000
Bearing		Drilled by	KMR Drilling Pty Ltd
		Logged by	Mr Andrew Ezzy
		Checked by	Mr Adrian Waite

penetration 1 2 3	support	water	notes samples, tests	metres R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
		Cement		0.5		CL	CLAY - low plasticity, brown, 10% rock fragments	M	D	Capping material
				1.0			***Landfill gas vented***			
	No Screen - Class 12 pipe						WASTE fill - wood, plastic, metals, tyres, cement	D		Domestic refuse
				1.5						
				2.0						
		7 mm Gravel		2.5						
				3.0						
				3.5						
				4.0						
				4.5						

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **MG 2000/5**
Sheet 2 of 4

Project	McRobies Gully waste depot	Location	McRobies Road, South Hobart
Co-ordinates	55 523474 mE 5251259 mN	Drill type	Auger
		Drill method	Rotary
		Drill fluid	Nil
R.L.		Hole commenced	10 October 2000
Inclination	Vertical	Hole completed	16 October 2000
Bearing		Drilled by	KMR Drilling Pty Ltd
		Logged by	Mr Andrew Ezzy
		Checked by	Mr Adrian Waite

penetration 1 2 3	support	water	notes samples, tests	metres R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
		7 mm Gravel		5.5			(As sheet 1)			
				6.0						
				6.5						
				7.0			Left to vent 10/10/2000 Drilling recommenced 12/10/2000			
	No Screen - Class 12 pipe	Bentonite		7.5						
			In flow 12/10/00	8.0			WASTE fill - wood, plastic, metals, tyres, cement	W		Domestic refuse
		Coarse sandy gravel		8.5						
				9.0						
				9.5						

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **MG 2000/5**
Sheet 3 of 4

Project	McRobies Gully waste depot	Location	McRobies Road, South Hobart
Co-ordinates	55 523474 mE 5251259 mN	Drill type	Auger
		Drill method	Rotary
		Drill fluid	Nil
R.L.		Hole commenced	10 October 2000
Inclination	Vertical	Hole completed	16 October 2000
Bearing		Drilled by	KMR Drilling Pty Ltd
		Logged by	Mr Andrew Ezzy
		Checked by	Mr Adrian Waite

penetration 1 2 3	support	water	notes samples, tests	metres R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
	6 metre screen - Class 12 pipe with 1 mm slots	Coarse sandy gravel		10.5 11.0 11.5 12.0 12.5 13.0 13.5 14.0 14.5			(As sheet 2)			

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **MG 2000/5**
Sheet 4 of 4

Project	McRobies Gully waste depot	Location	McRobies Road, South Hobart
Co-ordinates	55 523474 mE 5251259 mN	Drill type	Auger
		Drill method	Rotary
		Drill fluid	Nil
R.L.		Hole commenced	10 October 2000
Inclination	Vertical	Hole completed	16 October 2000
Bearing		Drilled by	KMR Drilling Pty Ltd
		Logged by	Mr Andrew Ezzy
		Checked by	Mr Adrian Waite

penetration 1 2 3	support	water	notes samples, tests	metres R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
	6 metre screen with 1 mm slots	Coarse sandy gravel		15.5			(As sheet 3)			
	Back fill	Back fill		16.0						
				16.5						
				17.0			End of hole due to auger refusal at 17.0 m Installation 16/10/2000			Auger refusal may be due to bedrock

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **MG 2000/6**
Sheet 1 of 4

Project	McRobies Gully waste depot	Location	McRobies Road, South Hobart
Co-ordinates	55 523382 mE 5251381 mN	Drill type	Auger
		Drill method	Rotary
		Drill fluid	Nil
R.L.		Hole commenced	10 October 2000
Inclination	Vertical	Hole completed	18 October 2000
Bearing		Drilled by	KMR Drilling Pty Ltd
		Logged by	Mr Andrew Ezzy
		Checked by	Mr Adrian Waite

penetration 1 2 3	support	water	notes samples, tests	metres R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
	No Screen - Class 12 pipe 7 mm Gravel	Cement		0.5 1.0		CL	CLAY - low plasticity, brown, rock fragments - cover material ***Landfill gas vented***	M	D	Capping material
				1.5			WASTE fill - wood, plastic, metals, tyres, cement	D		Domestic refuse
				2.0			Drilling stopped 10/10/2000 to vent gas Recommenced drilling 12/10/2000 with continuous pockets of venting landfill gas.			
				2.5 3.0 3.5 4.0 4.5						

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **MG 2000/6**
Sheet 2 of 4

Project	McRobies Gully waste depot	Location	McRobies Road, South Hobart
Co-ordinates	55 523382 mE 5251381 mN	Drill type	Auger
		Drill method	Rotary
		Drill fluid	Nil
R.L.		Hole commenced	10 October 2000
Inclination	Vertical	Hole completed	18 October 2000
Bearing		Drilled by	KMR Drilling Pty Ltd
		Logged by	Mr Andrew Ezzy
		Checked by	Mr Adrian Waite

penetration 1 2 3	support	water	notes samples, tests	metres R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
	No Screen - Class 12 pipe	7 mm Gravel		5.5			(As sheet 1)			
				6.0						
				6.5						
				7.0						
				7.5						
		Bentonite		8.0						
				8.5						
		Coarse sandy gravel		9.0						
				9.5						

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **MG 2000/6**
Sheet 3 of 4

Project	McRobies Gully waste depot	Location	McRobies Road, South Hobart
Co-ordinates	55 523382 mE 5251381 mN	Drill type	Auger
		Drill method	Rotary
		Drill fluid	Nil
R.L.		Hole commenced	10 October 2000
Inclination	Vertical	Hole completed	18 October 2000
Bearing		Drilled by	KMR Drilling Pty Ltd
		Logged by	Mr Andrew Ezzy
		Checked by	Mr Adrian Waite

penetration 1 2 3	support	water	notes samples, tests	metres R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
	6 metre screen - Class 12 pipe with 1 mm slots	Coarse sandy gravel		10.5 11.0 11.5 12.0 12.5 13.0 13.5 14.0 14.5			(As sheet 1)			

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **MG 2000/6**
Sheet 4 of 4

Project	McRobies Gully waste depot	Location	McRobies Road, South Hobart
Co-ordinates	55 523382 mE 5251381 mN	Drill type	Auger
		Drill method	Rotary
		Drill fluid	Nil
R.L.		Hole commenced	10 October 2000
Inclination	Vertical	Hole completed	18 October 2000
Bearing		Drilled by	KMR Drilling Pty Ltd
		Logged by	Mr Andrew Ezzy
		Checked by	Mr Adrian Waite

penetration 1 2 3	support	water	notes: samples, tests	metres: R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
	6 metre screen with 1 mm slots	Coarse sandy gravel		15.5			(As sheet 1)			
			In flow 12/10/00	16.0			WASTE fill - wood, plastic, metals, tyres, cement	W		Domestic refuse
	Back fill	Back fill		16.5						
				17.0			End of hole due to auger refusal at 17.0 m Installation 18/10/2000.			Auger refusal may be due to bedrock

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **MG 2000/7**
Sheet 1 of 4

Project	McRobies Gully waste depot	Location	McRobies Road, South Hobart
Co-ordinates	55 523204 mE 5251503 mN	Drill type	Auger
		Drill method	Rotary
		Drill fluid	Nil
R.L.		Hole commenced	16 October 2000
Inclination	Vertical	Hole completed	18 October 2000
Bearing		Drilled by	KMR Drilling Pty Ltd
		Logged by	Mr Andrew Ezzy
		Checked by	Mr Adrian Waite

penetration 1 2 3	support	water	notes samples, tests	metres R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
		Cement		0.5		CL	CLAY - low plasticity, brown, rock fragments	M	D	Capping material
	No Screen - Class 12 pipe	7 mm Gravel		1.0			WASTE fill - wood, plastic, metals, tyres, cement ***Venting landfill gas***	D		Domestic refuse
				1.5						
				2.0						
				2.5						
				3.0						
				3.5						
				4.0						
				4.5						

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **MG 2000/7**
Sheet 2 of 4

Project	McRobies Gully waste depot	Location	McRobies Road, South Hobart
Co-ordinates	55 523204 mE 5251503 mN	Drill type	Auger
		Drill method	Rotary
		Drill fluid	Nil
R.L.		Hole commenced	16 October 2000
Inclination	Vertical	Hole completed	18 October 2000
Bearing		Drilled by	KMR Drilling Pty Ltd
		Logged by	Mr Andrew Ezzy
		Checked by	Mr Adrian Waite

penetration 1 2 3	support	water	notes samples, tests	metres R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
							(As sheet 1)			
	No Screen - Class 12 pipe	7 mm Gravel		5.5			WASTE fill - wood, plastic, metals, tyres, cement	M		Domestic refuse
		Bentonite	↓	6.0						
				6.5						
				7.0						
				7.5						
				8.0			WASTE fill - wood, plastic, metals, tyres, cement	W		Domestic refuse
		Coarse sandy gravel		8.5						
				9.0						
		▼	S.W.L. 18/10/00	9.5						

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **MG 2000/7**
Sheet 3 of 4

Project	McRobies Gully waste depot	Location	McRobies Road, South Hobart
Co-ordinates	55 523204 mE 5251503 mN	Drill type	Auger
		Drill method	Rotary
		Drill fluid	Nil
R.L.		Hole commenced	16 October 2000
Inclination	Vertical	Hole completed	18 October 2000
Bearing		Drilled by	KMR Drilling Pty Ltd
		Logged by	Mr Andrew Ezzy
		Checked by	Mr Adrian Waite

penetration 1 2 3	support	water	notes samples, tests	metres R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
	6 metre screen - Class 12 pipe with 1 mm slots	Coarse sandy gravel		10.5 11.0 11.5 12.0 12.5 13.0 13.5 14.0 14.5			(As sheet 2)			

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **MG 2000/7**
Sheet 4 of 4

Project	McRobies Gully waste depot	Location	McRobies Road, South Hobart
Co-ordinates	55 523204 mE 5251503 mN	Drill type	Auger
		Drill method	Rotary
		Drill fluid	Nil
R.L.		Hole commenced	16 October 2000
Inclination	Vertical	Hole completed	18 October 2000
Bearing		Drilled by	KMR Drilling Pty Ltd
		Logged by	Mr Andrew Ezzy
		Checked by	Mr Adrian Waite

penetration 1 2 3	support	water	notes samples, tests	metres R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
	6 metre screen with 1 mm slots	Coarse sandy gravel		15.5			(As sheet 3)			
	Back fill	Back fill		16.0						
				16.5						
				17.0						
				17.5						
				18.0			End of hole due to auger refusal at 18.0 m Installation 18/10/2000.			Auger refusal may be due to bedrock

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **MG 2000/8**
Sheet 1 of 4

Project	McRobies Gully waste depot	Location	McRobies Road, South Hobart
Co-ordinates	55 523233 mE 5251552 mN	Drill type	Auger
		Drill method	Rotary
		Drill fluid	Nil
R.L.		Hole commenced	16 October 2000
Inclination	Vertical	Hole completed	18 October 2000
Bearing		Drilled by	KMR Drilling Pty Ltd
		Logged by	Mr Andrew Ezzy
		Checked by	Mr Adrian Waite

penetration 1 2 3	support	water	notes samples, tests	metres R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
	No Screen - Class 12 pipe	Cement		0.0			WASTE fill - bandages, needles, blood covered materials, plastics with medical waste sign	M		**Medical waste**
		7 mm Gravel		3.0			WASTE fill - wood, plastic, metals, tyres, cement	D		Domestic refuse
		Bentonite								
		Coarse sandy gravel								

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **MG 2000/8**
Sheet 2 of 4

Project	McRobies Gully waste depot	Location	McRobies Road, South Hobart
Co-ordinates	55 523233 mE 5251552 mN	Drill type	Auger
		Drill method	Rotary
		Drill fluid	Nil
R.L.		Hole commenced	16 October 2000
Inclination	Vertical	Hole completed	18 October 2000
Bearing		Drilled by	KMR Drilling Pty Ltd
		Logged by	Mr Andrew Ezzy
		Checked by	Mr Adrian Waite

penetration 1 2 3	support	water	notes: samples, tests	metres: R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
	No screen			5.5			(As sheet 1)			
	6 metre class 12 pipe screnn with 1 mm slots	Coarse sandy gravel		6.0						
				6.5						
				7.0						
				7.5						
				8.0			WASTE fill - wood, plastic, metals, tyres, cement	M		Domestic refuse
				8.5						
			In flow 16/10/00	9.0			WASTE fill - wood, plastic, metals, tyres, cement	W		Domestic refuse
				9.5						

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **MG 2000/8**
Sheet 3 of 4

Project	McRobies Gully waste depot	Location	McRobies Road, South Hobart
Co-ordinates	55 523233 mE 5251552 mN	Drill type	Auger
		Drill method	Rotary
		Drill fluid	Nil
R.L.		Hole commenced	16 October 2000
Inclination	Vertical	Hole completed	18 October 2000
Bearing		Drilled by	KMR Drilling Pty Ltd
		Logged by	Mr Andrew Ezzy
		Checked by	Mr Adrian Waite

penetration 1 2 3	support	water	notes samples, tests	metres R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
	6 metre screen - Class 12 pipe with 1 mm slots	Coarse sandy gravel					(As sheet 2)			
	Back fill	Back fill		10.5 11.0 11.5 12.0 12.5 13.0 13.5 14.0 14.5						

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **MG 2000/8**
Sheet 4 of 4

Project	McRobies Gully waste depot	Location	McRobies Road, South Hobart
Co-ordinates	55 523233 mE 5251552 mN	Drill type	Auger
		Drill method	Rotary
		Drill fluid	Nil
R.L.		Hole commenced	16 October 2000
Inclination	Vertical	Hole completed	18 October 2000
Bearing		Drilled by	KMR Drilling Pty Ltd
		Logged by	Mr Andrew Ezzy
		Checked by	Mr Adrian Waite

penetration 1 2 3	support	water	notes samples, tests	metres R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
	Back fill	Back fill		15.5			(As sheet 2)			
				16.0						
				16.5						
				17.0						
				17.5						
				18.0			End of hole due to auger refusal at 18.0 m Installation 18/10/2000.			Auger refusal may be due to bedrock

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **MG 2000/9**
Sheet 1 of 4

Project	McRobies Gully waste depot	Location	McRobies Road, South Hobart
Co-ordinates	55 523115 mE 5251490 mN	Drill type	Percussion
		Drill method	Down hole hammer
		Drill fluid	Air
R.L.		Hole commenced	17 October 2000
Inclination	Vertical	Hole completed	18 October 2000
Bearing		Drilled by	KMR Drilling Pty Ltd
		Logged by	Mr Andrew Ezzy
		Checked by	Mr Adrian Waite

penetration 1 2 3	support	water	notes samples, tests	metres R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
	No Screen - Class 12 pipe	Cement	D Sample ID 1	0.5		CL	CLAY - low plasticity, brown, siltstone, sandstone and mudstone sub-angular cobbles	D	St	Reworked Quaternary colluvium
			D Sample ID 1	1.0						
		7 mm Gravel		1.5						
			D Sample ID 2	2.0		CL	CLAY - low plasticity, orange, cobbles of brown siltstone and sandstone recovered as gravel	D	H	Quaternary colluvium
				2.5						
				3.0						
				3.5						
				4.0			MUDSTONE - light grey	D		Permian sediments
			D Sample ID 3	4.5						

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **MG 2000/9**
Sheet 2 of 4

Project	McRobies Gully waste depot	Location	McRobies Road, South Hobart
Co-ordinates	55 523115 mE 5251490 mN	Drill type	Percussion
		Drill method	Down hole hammer
		Drill fluid	Air
R.L.		Hole commenced	17 October 2000
Inclination	Vertical	Hole completed	18 October 2000
Bearing		Drilled by	KMR Drilling Pty Ltd
		Logged by	Mr Andrew Ezzy
		Checked by	Mr Adrian Waite

penetration 1 2 3	support	water	notes samples, tests	metres R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
	No Screen - Class 12 pipe	7 mm Gravel	D Sample ID 4	5.5			(As sheet 1)			
				6.0						
				6.5						
				7.0						
				7.5						
			D Sample ID 5	8.0						
				8.5						
				9.0						
		Bentonite		9.5						

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **MG 2000/9**
Sheet 3 of 4

Project	McRobies Gully waste depot	Location	McRobies Road, South Hobart
Co-ordinates	55 523115 mE 5251490 mN	Drill type	Percussion
		Drill method	Down hole hammer
		Drill fluid	Air
R.L.		Hole commenced	17 October 2000
Inclination	Vertical	Hole completed	18 October 2000
Bearing		Drilled by	KMR Drilling Pty Ltd
		Logged by	Mr Andrew Ezzy
		Checked by	Mr Adrian Waite

penetration 1 2 3	support	water	notes samples, tests	metres R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
			D Sample ID 6	10.5			MUDSTONE - light grey	M		Permian sediments
			D Sample ID 6	11.0						
	No Screen - Class 12 pipe		In flow 17/10/00	11.5			MUDSTONE - dark grey	W		Fractured Permian sediments
			D Sample ID 7							
		Coarse sandy pebbles	D Sample ID 8	12.0			Interbedded SILTSTONE, SANDSTONE and MUDSTONE - dark grey	W		Fractured Permian sediments
				12.5						
	6 metre class 12 pipe screen with 1 mm slots		D Sample ID 8	13.0						
				13.5						
				14.0						
			D Sample ID 9	14.5						

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **MG 2000/9**
Sheet 4 of 4

Project	McRobies Gully waste depot	Location	McRobies Road, South Hobart
Co-ordinates	55 523115 mE 5251490 mN	Drill type	Percussion
		Drill method	Down hole hammer
		Drill fluid	Air
R.L.		Hole commenced	17 October 2000
Inclination	Vertical	Hole completed	18 October 2000
Bearing		Drilled by	KMR Drilling Pty Ltd
		Logged by	Mr Andrew Ezzy
		Checked by	Mr Adrian Waite

penetration 1 2 3	support	water	notes samples, tests	metres R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
	6 metre class 12 pipe screen with 1 mm slots	Coarse sandy pebbles	D Sample ID 9	15.5			(As sheet 3)			
			D Sample ID 10	16.0						
				16.5						
			D Sample ID 10	17.0						
				17.5						
			D Sample ID 10	18.0						
				18.5						
			Sample ID numbers refer to samples stored in MRT core shed				End of hole at 18.7 m			

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **MG 2000/10**
Sheet 1 of 5

Project	McRobies Gully waste depot	Location	McRobies Road, South Hobart
Co-ordinates	55 523563 mE 5251028 mN	Drill type	Percussion
		Drill method	Down hole hammer
		Drill fluid	Air
R.L.		Hole commenced	18 October 2000
Inclination	Vertical	Hole completed	18 October 2000
Bearing		Drilled by	KMR Drilling Pty Ltd
		Logged by	Mr Andrew Ezzy
		Checked by	Mr Adrian Waite

penetration 1 2 3	support	water	notes samples, tests	metres R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
	No Screen - Class 12 pipe	Cement	D Sample ID 1	0.5		CL	CLAY - low plasticity, brown	D	Vst	Reworked weathered Permian sediments
				1.0						
				1.5						
		7 mm Gravel	D Sample ID 2	2.0			SILTSTONE - light brown, light grey mudstone	D		Permian sediments
				2.5						
				3.0						
				3.5						
			D Sample ID 3	4.0						
				4.5						

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **MG 2000/10**
Sheet 2 of 5

Project	McRobies Gully waste depot	Location	McRobies Road, South Hobart
Co-ordinates	55 523563 mE 5251028 mN	Drill type	Percussion
		Drill method	Down hole hammer
		Drill fluid	Air
R.L.		Hole commenced	18 October 2000
Inclination	Vertical	Hole completed	18 October 2000
Bearing		Drilled by	KMR Drilling Pty Ltd
		Logged by	Mr Andrew Ezzy
		Checked by	Mr Adrian Waite

penetration 1 2 3	support	water	notes samples, tests	metres R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
				5.5			(As sheet 1)			
	No Screen - Class 12 pipe	7 mm Gravel	D Sample ID 4	6.0			MUDSTONE - light grey, sandstone grey	D		Permian sediments
				6.5						
				7.0						
				7.5						
			D Sample ID 5	8.0						
				8.5						
				9.0						
				9.5						

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **MG 2000/10**
Sheet 3 of 5

Project	McRobies Gully waste depot	Location	McRobies Road, South Hobart
Co-ordinates	55 523563 mE 5251028 mN	Drill type	Percussion
		Drill method	Down hole hammer
		Drill fluid	Air
R.L.		Hole commenced	18 October 2000
Inclination	Vertical	Hole completed	18 October 2000
Bearing		Drilled by	KMR Drilling Pty Ltd
		Logged by	Mr Andrew Ezzy
		Checked by	Mr Adrian Waite

penetration 1 2 3	support	water	notes samples, tests	metres R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
			D Sample ID 6	10.5			(As sheet 2)			
				11.0						
				11.5						
			D Sample ID 7	12.0						
				12.5						
			D Sample ID 8	13.0						
				13.5						
	No Screen - Class 12 pipe	7 mm Gravel		14.0						
		Bentonite	D Sample ID 8				MUDSTONE - grey	D		Permian sediments
				14.5						

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **MG 2000/10**
Sheet 4 of 5

Project	McRobies Gully waste depot			Location	McRobies Road, South Hobart
Co-ordinates	55 523563 mE 5251028 mN	Drill type	Percussion	Hole commenced	18 October 2000
		Drill method	Down hole hammer	Hole completed	18 October 2000
R.L.		Drill fluid	Air	Drilled by	KMR Drilling Pty Ltd
Inclination	Vertical			Logged by	Mr Andrew Ezzy
Bearing				Checked by	Mr Adrian Waite

penetration 1 2 3	support	water	notes samples, tests	metres R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
	No screen			15.5			(As sheet 3)			
				16.0						
			D Sample ID 9	16.5						
		Coarse sandy pebbles		17.0						
				17.5						
	6 metre class 12 pipe screen with 1 mm slots		D Sample ID 10	18.0			MUDSTONE - grey	M		Fractured Permian sediments
				18.5						
				19.0						
		In flow 18/10/00		19.5			MUDSTONE - grey	W		Fractured Permian sedimentary aquifer

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **MG 2000/10**
Sheet 5 of 5

Project McRobies Gully waste depot — Location McRobies Road, South Hobart

Co-ordinates 55 523563 mE
5251028 mN
R.L.
Inclination Vertical
Bearing

Drill type Percussion
Drill method Down hole hammer
Drill fluid Air

Hole commenced 18 October 2000
Hole completed 18 October 2000
Drilled by KMR Drilling Pty Ltd
Logged by Mr Andrew Ezzy
Checked by Mr Adrian Waite

penetration 1 2 3	support	water	notes samples, tests	metres R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
	6 metre class 12 pipe screen with 1 mm slots	Coarse sandy pebbles	D Sample ID 11	20.5			DOLERITE - fine grained, highly fractured	W		Highly fractured Jurassic dolerite. Possible remobilised faulted thermal contact
				21.0						
				21.5						
	Back fill	Back fill	D Sample ID 12	22.0			DOLERITE - medium grained, fractured	W		Fractured Jurassic dolerite aquifer
				22.5						
				23.0						
				23.5						
			Sample ID numbers refer to samples stored in MRT core shed	24.0			End of hole due to collapse of base of hole in heavily fractured rock at 24.0 m			

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **MG 2000/11**
Sheet 1 of 3

Project	McRobies Gully waste depot	Location	McRobies Road, South Hobart
Co-ordinates	55 523650 mE 5250989 mN	Drill type	Auger
		Drill method	Rotary
		Drill fluid	Nil
R.L.		Hole commenced	18 October 2000
Inclination	Vertical	Hole completed	18 October 2000
Bearing		Drilled by	KMR Drilling Pty Ltd
		Logged by	Mr Andrew Ezzy
		Checked by	Mr Adrian Waite

penetration 1 2 3	support	water	notes samples, tests	metres R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
				0.0		CL	CLAY - orange-brown	M	L	Cover material
		Cement		0.5			WASTE fill - wood, plastic, rusted metals, cement	D		Highly decomposed domestic refuse
	No Screen - Class 12 pipe	7 mm Gravel		1.0						
				1.5						
				2.0						
				2.5						
				3.0						
		Bentonite		3.5						
				4.0						
		Coarse sandy gravel		4.5						

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

Borehole no. **MG 2000/11**
Sheet 2 of 3

Project	McRobies Gully waste depot	Location	McRobies Road, South Hobart
Co-ordinates	55 523650 mE 5250989 mN	Drill type	Auger
		Drill method	Rotary
		Drill fluid	Nil
R.L.		Hole commenced	18 October 2000
Inclination	Vertical	Hole completed	18 October 2000
Bearing		Drilled by	KMR Drilling Pty Ltd
		Logged by	Mr Andrew Ezzy
		Checked by	Mr Adrian Waite

penetration 1 2 3	support	water	notes samples, tests	metres R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	structure, geology
	6 metre 1 mm slotted screen - Class 12 pipe	Coarse sandy gravel		5.5 6.0 6.5 7.0 7.5 8.0 8.5 9.0 9.5			(As sheet 1)			

MINERAL RESOURCES TASMANIA

ENGINEERING LOG - BOREHOLE

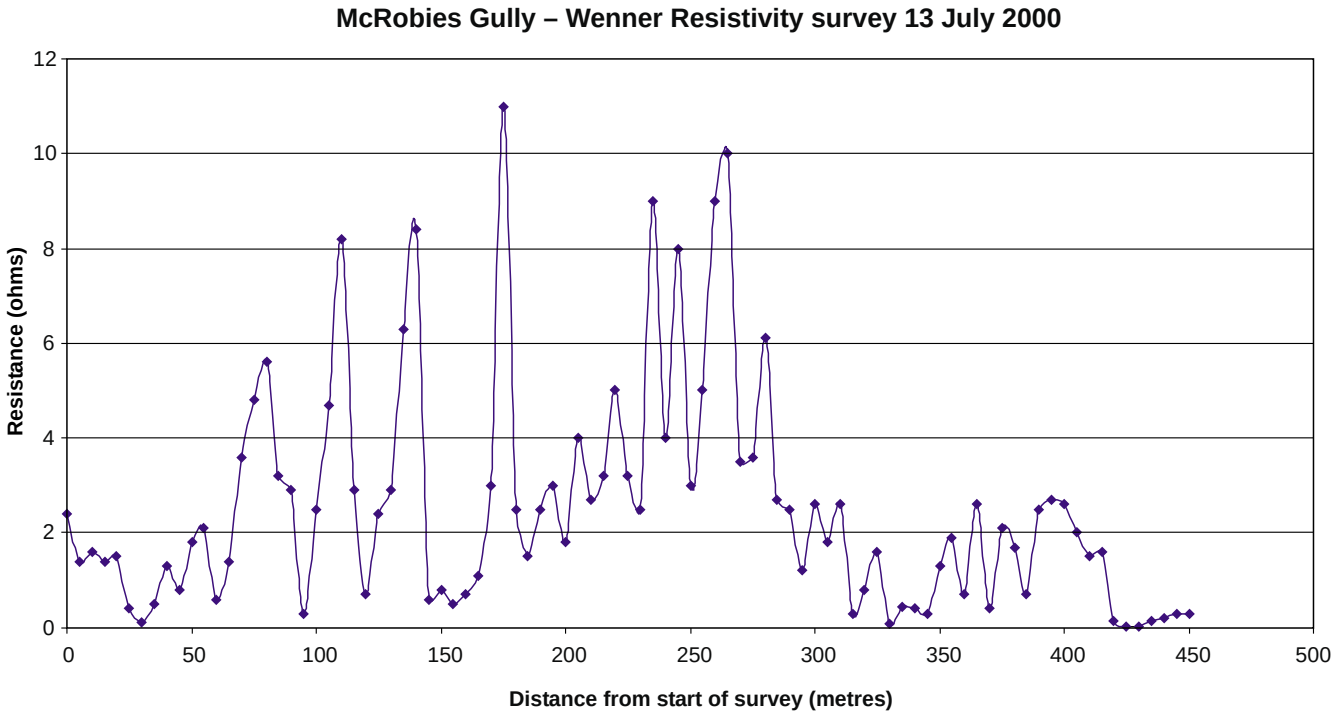
Borehole no. **MG 2000/11**
Sheet 3 of 3

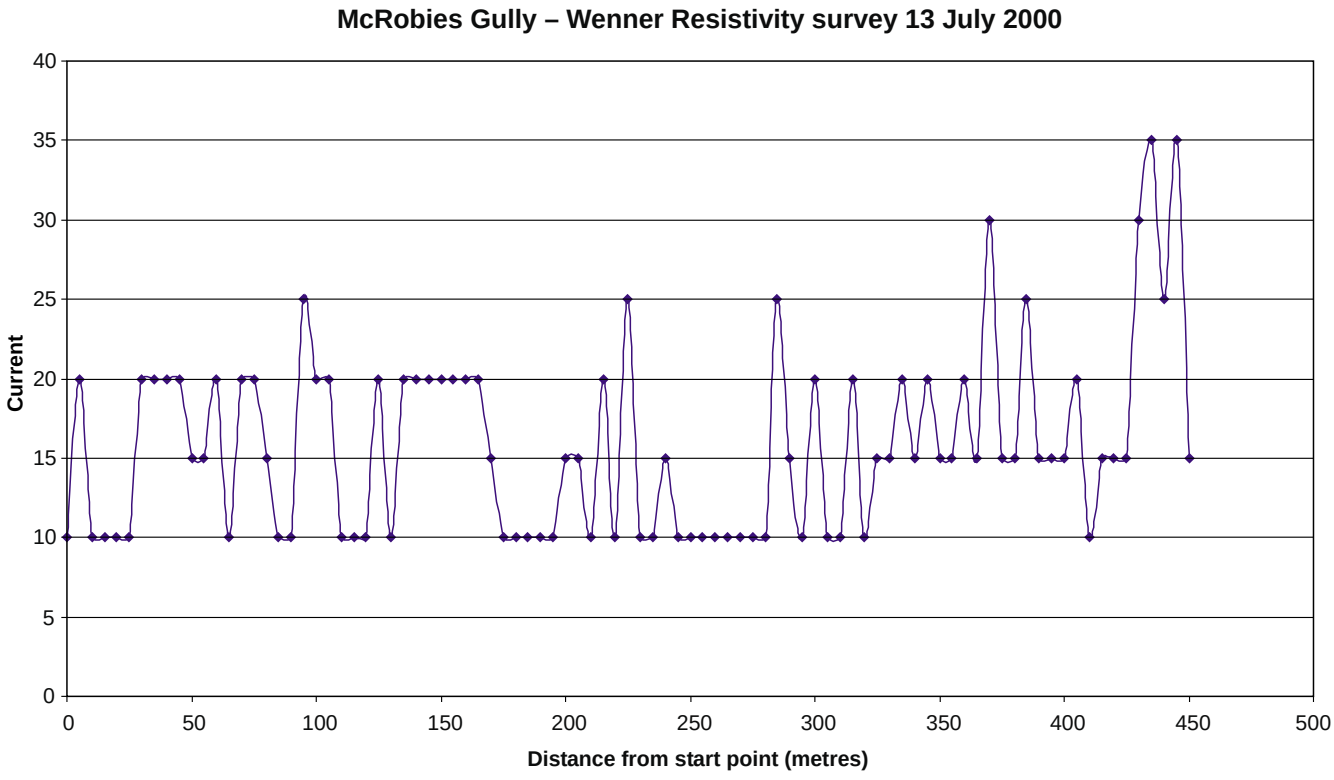
Project	McRobies Gully waste depot	Location	McRobies Road, South Hobart
Co-ordinates	55 523650 mE 5250989 mN	Drill type	Auger
		Drill method	Rotary
		Drill fluid	Nil
R.L.		Hole commenced	18 October 2000
Inclination	Vertical	Hole completed	18 October 2000
Bearing		Drilled by	KMR Drilling Pty Ltd
		Logged by	Mr Andrew Ezzy
		Checked by	Mr Adrian Waite

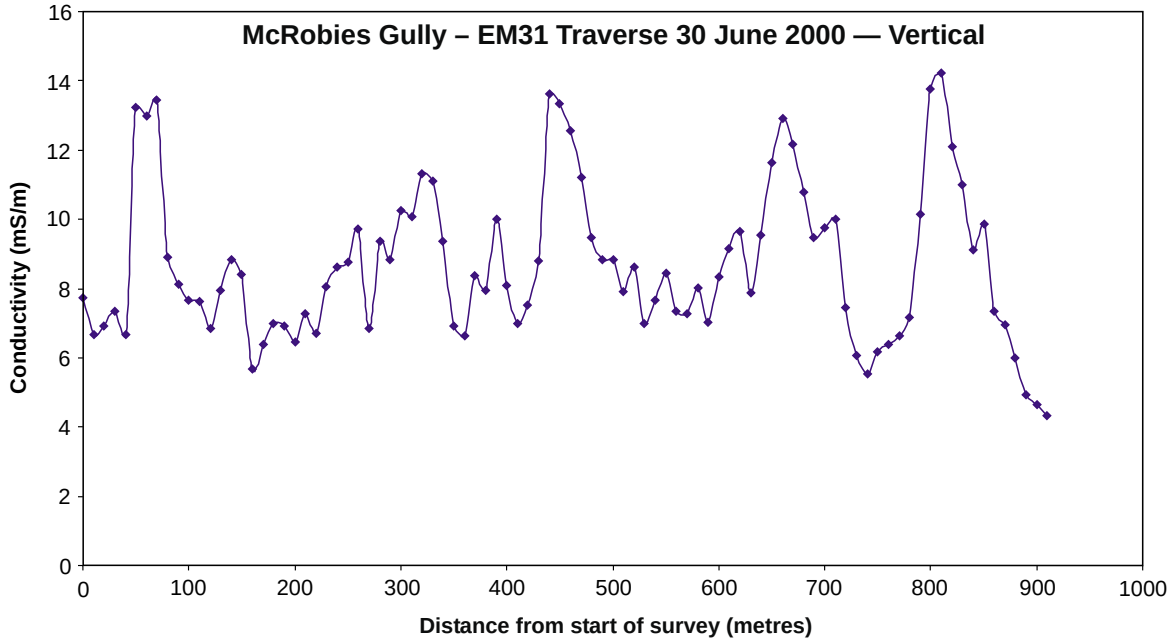
penetration 1 2 3	support	water	notes samples, tests	metres R.L. / depth	graphic log	classification symbol	material (soil type: plasticity or particle characteristics, colour, secondary and minor components.)	moisture condition	consistency density index	structure, geology
	6 metre screen	Coarse sandy gravel		10.5			(As sheet 1)			
	Back fill	Back fill		11.0						
				11.5						
				12.0						
				12.5						
				13.0						
							End of hole due to auger refusal at 13.2 m			Auger refusal probably in fill

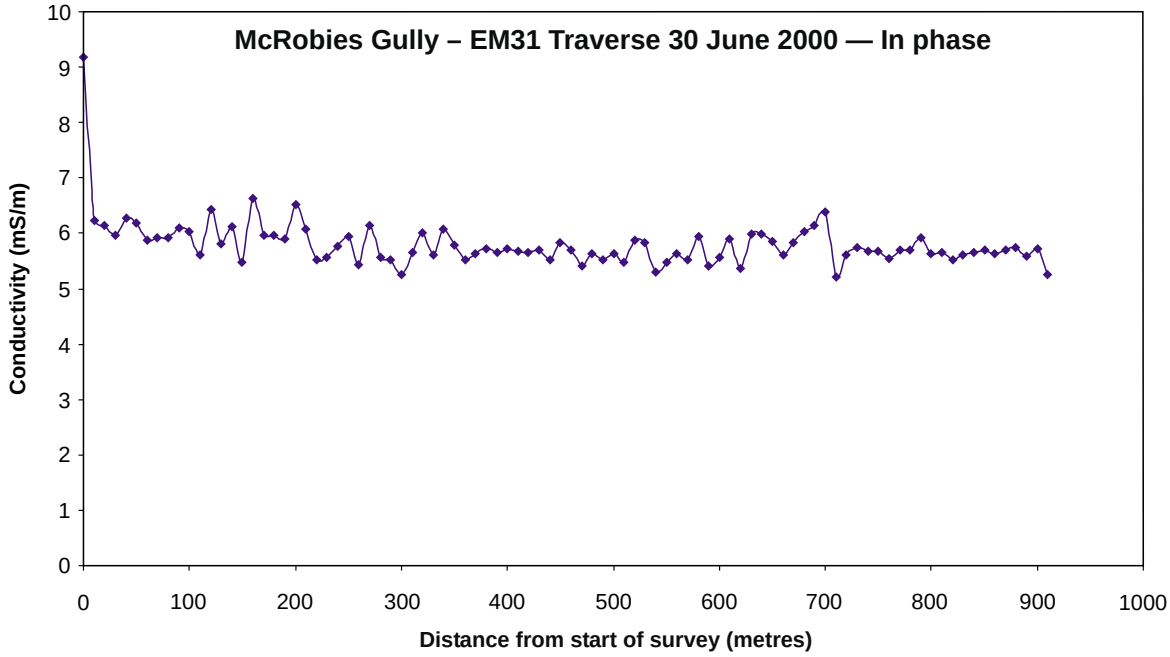
Appendix 3
Results of resistivity survey

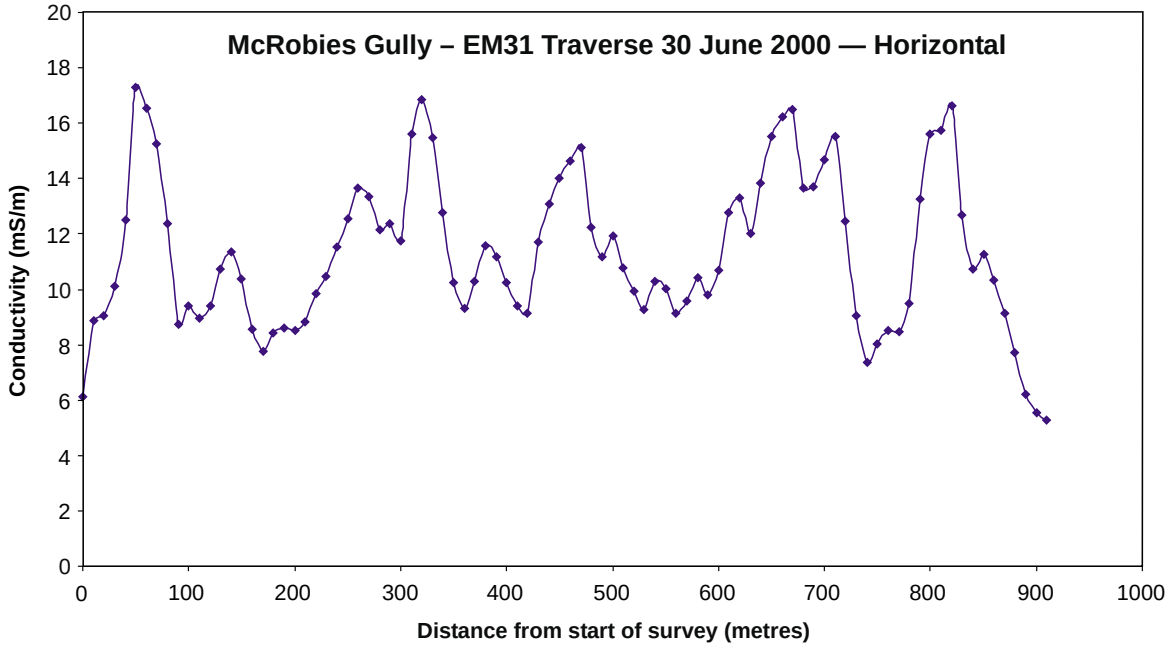
See Figure 4 for location of traverse






McRobies Gully – EM31 Traverse 30 June 2000 — Vertical
Conductivity (mS/m)
Distance from start of survey (metres)


McRobies Gully – EM31 Traverse 30 June 2000 — In phase
Conductivity (mS/m)
Distance from start of survey (metres)


McRobies Gully – EM31 Traverse 30 June 2000 — Horizontal
Conductivity (mS/m)
Distance from start of survey (metres)

Appendix 4
Laboratory reports — Analytical Services Tasmania

ANALYTICAL SERVICES TASMANIA
Sandy Bay Laboratory
c/- Chemistry Department University of Tasmania
Sandy Bay Tasmania 7005
Telephone: (03) 6226 7175 Fax: (03) 6226 7825
Email: ast.sandybay@dpiwe.tas.gov.au

NATA Accreditation Number: 5589

Laboratory Report

Report No:	14665 *Please quote this number when making enquiries about this report*
Submitted By:	A. Ezzy
Client:	E&P Division MRT Groundwater
Site Description:	Mc Robies Gully
Received:	04-Apr-01 **Client Order No:**
Report Date:	23-Apr-01
Report To:	A. Ezzy
Address:	C/- MRT

Test Method(s) :

1103-Water:	Anions by Ion Chromatography APHA Method 4110C
1201-Water:	Nutrients by APHA Method 4500
1301-Water:	Metals in Water by APHA Method 3030/3120
1302-Water:	Major Cations in Water by APHA Method 3030/3120
1406-Water:	TPH and BTEX in Water by GC-FID *

NATA Accreditation Number: 5589

Greg Hince
Senior Chemist

ANALYTICAL SERVICES TASMANIA
Sandy Bay Laboratory
c/- Chemistry Department University of Tasmania
Sandy Bay Tasmania 7005

NATA Accreditation Number: 5589

Report No: 14665 **Report Date:** 23-Apr-01

Method	Analyte	Lab.No.: / Sample Id.: / Units / Sampled On :	19271 MG1996/2 03/04/01 13:18	19272 MG1996/3 03/04/01 11:29	19273 MG2000/6 03/04/01 12:18	19274 MG2000/8 03/04/01 09:57
1103-Water	Bromide	mg/L	<0.01	0.98	7.0	13
	Chloride	mg/L	160	130	740	1200
	Fluoride	mg/L	<0.20	<0.20	<0.20	0.52
	Sulphate	mg/L	510	54	20	<2.00
1201-Water	Ammonia	µg-N/L	<100	500	17000	220000
	Nitrate+Nitrite	µg-N/L	<200	<200	<200	<200
	Nitrite	µg-N/L	<50	<50	90	<50
	Ortho-P	µg-P/L	<100	<100	<100	<100
1301-Water	Al (Dissolved)	µg/L	<20	<20	<20	<20
	As (Dissolved)	µg/L	<5	<5	<5	13
	Cd (Dissolved)	µg/L	<1	<1	<1	<1
	Co (Dissolved)	µg/L	<1	<1	11	48
	Cr (Dissolved)	µg/L	<1	<1	2	9
	Cu (Dissolved)	µg/L	<1	2	<1	<1
	Fe (Dissolved)	µg/L	<20	24	46000	16800
	Mn (Dissolved)	µg/L	962	159	2020	606
	Ni (Dissolved)	µg/L	1	2	48	58
	Pb (Dissolved)	µg/L	<5	<5	6	<5
	Zn (Dissolved)	µg/L	6	<1	5	<1
1302-Water	Ca (Dissolved)	mg/L	275	117	367	367
	K (Dissolved)	mg/L	3.11	1.16	30.4	230
	Mg (Dissolved)	mg/L	71.8	71.7	199	267
	Na (Dissolved)	mg/L	98.5	98.3	359	1020
1406-Water	TPH	µg/L	<40	<40	4820	95800
	TPH C06-C09	µg/L	<10	<10	196	603
	TPH C10-C14	µg/L	<10	<10	838	21200
	TPH C15-C28	µg/L	<10	<10	2470	65900
	TPH C29+	µg/L	<10	<10	1320	8040

ANALYTICAL SERVICES TASMANIA
Sandy Bay Laboratory
c/- Chemistry Department University of Tasmania
Sandy Bay Tasmania 7005
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Email: ast.sandybay@dpiwe.tas.gov.au

NATA Accreditation Number: 5589

Laboratory Report

Report No:	14666	***Please quote this number when making enquiries about this report***
Submitted By:	A. Ezzy	
Client:	E&P Division MRT Groundwater	
Site Description:	Mc Robies Gully	
Received:	04-Apr-01	**Client Order No:**
Report Date:	23-Apr-01	
Report To:	A. Ezzy	
Address:	C/- MRT	

Test Method(s) :

1103-Water:	Anions by Ion Chromatography APHA Method 4110C
1201-Water:	Nutrients by APHA Method 4500
1301-Water:	Metals in Water by APHA Method 3030/3120
1302-Water:	Major Cations in Water by APHA Method 3030/3120
1406-Water:	TPH and BTEX in Water by GC-FID *

NATA Accreditation Number: 5589

Greg Hince
Senior Chemist

ANALYTICAL SERVICES TASMANIA
Sandy Bay Laboratory
c/- Chemistry Department University of Tasmania
Sandy Bay Tasmania 7005

NATA Accreditation Number: 5589

Report No: 14666 **Report Date:** 23-Apr-01

Method	Analyte	Lab.No.: / Sample Id.: / Units / Sampled On :	19275 / MG2000/1 / 02/04/01 14:17	19276 / MG2000/3 / 02/04/01 09:11	19277 / MG2000/7 / 02/04/01 12:14	19278 / MG2000/10 / 02/04/01 10:34
1103-Water	Bromide	mg/L	3.4	0.82	7.8	1.5
	Chloride	mg/L	1800	150	750	240
	Fluoride	mg/L	0.28	0.36	0.37	0.40
	Sulphate	mg/L	1.1	130	15	140
1201-Water	Ammonia	µg-N/L	110000	270	180000	<100
	Nitrate+Nitrite	µg-N/L	<200	<200	<200	<200
	Nitrite	µg-N/L	<50	<50	<50	<50
	Ortho-P	µg-P/L	<100	<100	<100	<100
1301-Water	Al (Dissolved)	µg/L	<20	<20	<20	<20
	As (Dissolved)	µg/L	<5	<5	<5	<5
	Cd (Dissolved)	µg/L	<1	<1	<1	1
	Co (Dissolved)	µg/L	14	3	31	13
	Cr (Dissolved)	µg/L	2	<1	7	<1
	Cu (Dissolved)	µg/L	<1	<1	<1	<1
	Fe (Dissolved)	µg/L	433	<20	325	<20
	Mn (Dissolved)	µg/L	2580	605	31	555
	Ni (Dissolved)	µg/L	28	<1	38	17
	Pb (Dissolved)	µg/L	<5	<5	<5	<5
	Zn (Dissolved)	µg/L	4	4	26	7
1302-Water	Ca (Dissolved)	mg/L	300	134	139	238
	K (Dissolved)	mg/L	84.3	3.72	164	3.85
	Mg (Dissolved)	mg/L	155	39.7	190	43.0
	Na (Dissolved)	mg/L	1260	176	532	192
1406-Water	TPH	µg/L	2650	129	2210	95
	TPH C06-C09	µg/L	324	129	329	95
	TPH C10-C14	µg/L	143	<10	204	<10
	TPH C15-C28	µg/L	1120	<10	1100	<10
	TPH C29+	µg/L	1020	<10	573	<10

Tasmania

ANALYTICAL SERVICES TASMANIA
Sandy Bay Laboratory
c/- Chemistry Department University of Tasmania
Sandy Bay Tasmania 7005
Telephone: (03) 6226 7175 Fax: (03) 6226 7825
Email: ast.sandybay@dpiwe.tas.gov.au

NATA Accreditation Number: 5589

Laboratory Report

Report No:	14650 *Please quote this number when making enquiries about this report*
Submitted By:	Andrew Ezzy
Client:	E&P Division - Scientific & Technical
Site Description:	McRobies Gully
Received:	30-Mar-01 **Client Order No:**
Report Date:	26-Apr-01
Report To:	Andrew Ezzy
Address:	134 Macquarie St Hobart TAS 7001

Test Method(s) :

1001-Water:	pH in Water by APHA Method 4500-H
1002-Water:	Conductivity by APHA Method 2510
1004-Water:	Solids, Total Dissolved by APHA Method 2540C
1103-Water:	Anions by Ion Chromatography APHA Method 4110C
1201-Water:	Nutrients by APHA Method 4500
1301-Water:	Metals in Water by APHA Method 3030/3120
1302-Water:	Major Cations in Water by APHA Method 3030/3120
1406-Water:	TPH and BTEX in Water by GC-FID *

NATA Accreditation Number: 5589

Mike Johnson
Manager

Tasmania

ANALYTICAL SERVICES TASMANIA
Sandy Bay Laboratory
c/- Chemistry Department University of Tasmania
Sandy Bay Tasmania 7005

NATA Accreditation Number: 5589

Report No: 14650 **Report Date:** 26-Apr-01

Method	Analyte	Lab.No.: / Sample Id.: / Units / Sampled On :	19180 / MG2000/4 / 27/03/01 13:05	19181 / MG2000/9 / 30/03/01 11:43
1001-Water	pH		7.6	7.1
1002-Water	Conductivity	µS/cm	1580	1840
1004-Water	TDS	mg/L	993	1240
1103-Water	Bromide	mg/L	1.4	<0.01
	Chloride	mg/L	220	260
	Fluoride	mg/L	0.31	0.52
	Sulphate	mg/L	100	60
1201-Water	Ammonia	µg-N/L	19	47
	Nitrate+Nitrite	µg-N/L	4	6
	Nitrite	µg-N/L	<2	<2
	Ortho-P	µg-P/L	2	3
1301-Water	Al (Dissolved)	µg/L	<20	<20
	As (Dissolved)	µg/L	<5	<5
	Cd (Dissolved)	µg/L	<1	<1
	Co (Dissolved)	µg/L	<1	5
	Cr (Dissolved)	µg/L	<1	<1
	Cu (Dissolved)	µg/L	<1	<1
	Fe (Dissolved)	µg/L	<20	<20
	Mn (Dissolved)	µg/L	356	881
	Ni (Dissolved)	µg/L	<1	9
	Pb (Dissolved)	µg/L	<5	<5
	Zn (Dissolved)	µg/L	<1	6
1302-Water	Ca (Dissolved)	mg/L	142	223
	K (Dissolved)	mg/L	3.40	6.79
	Mg (Dissolved)	mg/L	36.9	40.1
	Na (Dissolved)	mg/L	168	146
1406-Water	TPH	µg/L	<40	<40
	TPH C06-C09	µg/L	<10	<10
	TPH C10-C14	µg/L	<10	<10
	TPH C15-C28	µg/L	<10	<10
	TPH C29+	µg/L	<10	<10

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NATA Accreditation Number: 5589

Laboratory Report

Report No:	14667	***Please quote this number when making enquiries about this report***
Submitted By:	A. Ezzy	
Client:	E&P Division MRT Groundwater	
Site Description:	Mc Robies Gully	
Received:	04-Apr-01	**Client Order No:**
Report Date:	23-Apr-01	
Report To:	A. Ezzy	
Address:	C/- MRT	

Test Method(s) :

1103-Water:	Anions by Ion Chromatography APHA Method 4110C
1201-Water:	Nutrients by APHA Method 4500
1301-Water:	Metals in Water by APHA Method 3030/3120
1302-Water:	Major Cations in Water by APHA Method 3030/3120
1406-Water:	TPH and BTEX in Water by GC-FID *

Greg Hince
Senior Chemist

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NATA Accreditation Number: 5589

Report No: 14667 **Report Date:** 23-Apr-01

		Lab.No.:	19279	19280	19281
		Sample Id.:	MG1996/1	MG2000/2	MG2000/8
Method	Analyte	Units / Sampled On :	04/04/01 09:44	04/04/01 11:58	04/04/01 10:32
1103-Water	Bromide	mg/L	0.10	0.93	12
	Chloride	mg/L	74	340	980
	Fluoride	mg/L	0.38	0.28	0.33
	Sulphate	mg/L	46	100	<0.20
1201-Water	Ammonia	µg-N/L	730	<100	330
	Nitrate+Nitrite	µg-N/L	14000	<200	<200
	Nitrite	µg-N/L	310	<50	<50
	Ortho-P	µg-P/L	<100	<100	<100
1301-Water	Al (Dissolved)	µg/L	<20	<20	<20
	As (Dissolved)	µg/L	<5	11	<5
	Cd (Dissolved)	µg/L	<1	<1	<1
	Co (Dissolved)	µg/L	<1	2	23
	Cr (Dissolved)	µg/L	<1	<1	3
	Cu (Dissolved)	µg/L	8	<1	<1
	Fe (Dissolved)	µg/L	63	<20	522
	Mn (Dissolved)	µg/L	17	345	161
	Ni (Dissolved)	µg/L	17	5	33
	Pb (Dissolved)	µg/L	<5	<5	<5
	Zn (Dissolved)	µg/L	4	<1	36
1302-Water	Ca (Dissolved)	mg/L	96.7	71.2	173
	K (Dissolved)	mg/L	6.13	3.06	184
	Mg (Dissolved)	mg/L	18.4	17.2	178
	Na (Dissolved)	mg/L	42.0	815	815
1406-Water	TPH	µg/L	144	47	443
	TPH C06-C09	µg/L	121	<10	63
	TPH C10-C14	µg/L	12	<10	128
	TPH C15-C28	µg/L	12	18	253
	TPH C29+	µg/L	<10	29	<10

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NATA Accreditation Number: 5589

Laboratory Report

Report No: 14853 *Please quote this number when making enquiries about this report*
Submitted By: A. Ezzy
Client: E&P Division MRT Groundwater
Site Description: McRobies Gully
Received: 03-May-01 **Client Order No:**
Report Date: 28-Jun-2001 18:05
Report To: A. Ezzy
Address: C/- MRT

Test Method(s) :

1001-Water:	pH in Water by APHA Method 4500-H
1002-Water:	Conductivity by APHA Method 2510
1004-Water:	Solids, Total Dissolved by APHA Method 2540C
1103-Water:	Anions by Ion Chromatography APHA Method 4110C
1201-Water:	Nutrients by APHA Method 4500
1202-Water:	Total N & P by APHA Method 4500
1301-Water:	Metals in Water by APHA Method 3030/3120
1302-Water:	Major Cations in Water by APHA Method 3030/3120
1405-Water:	PCB in Water by GC-ECD *
1406-Water:	TPH and BTEX in Water by GC-FID *

NATA Accreditation Number: 5589

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Manager

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Sandy Bay Tasmania 7005

NATA Accreditation Number: 5589

Report No: 14853 **Report Date:** 28-Jun-2001 18:05

		Lab.No.:	20383	20384	20385	20386
		Sample Id.:	MG2000/4-1	MG2000/4-2	MG2000/4-3	Leachate - Pipe
Method	Analyte	Units / Sampled On :	02/05/01 10:00	02/05/01 10:15	02/05/01 10:45	02/05/01 10:51
1001-Water	pH		7.3	7.5	7.5	7.5
1002-Water	Conductivity	µS/cm	1620	1630	1590	2540
1004-Water	TDS	mg/L	971	965	987	1700
1103-Water	Bromide	mg/L	0.75	0.75	0.68	4.5
	Chloride	mg/L	230	200	230	520
	Fluoride	mg/L	0.26	0.28	0.28	0.18
	Sulphate	mg/L	120	120	120	34
1201-Water	Ammonia	µg-N/L	27	34	20	42400
	Nitrate+Nitrite	µg-N/L	5	4	5	325
	Nitrite	µg-N/L	<2	2	<2	120
	Ortho-P	µg-P/L	5	4	5	8
1202-Water	N (Total)	µg/L	127	87	68	75500
	P (Total)	µg/L	10	9	9	17900
1301-Water	Al (Dissolved)	µg/L	<20	<20	<20	<20
	As (Dissolved)	µg/L	<5	<5	<5	<5
	Cd (Dissolved)	µg/L	<1	<1	<1	<1
	Co (Dissolved)	µg/L	<1	<1	<1	11
	Cr (Dissolved)	µg/L	<1	<1	<1	1
	Cu (Dissolved)	µg/L	<1	<1	<1	1
	Fe (Dissolved)	µg/L	28	28	28	177
	Mn (Dissolved)	µg/L	197	152	215	348
	Ni (Dissolved)	µg/L	2	1	2	28
	Pb (Dissolved)	µg/L	<5	<5	<5	<5
	Zn (Dissolved)	µg/L	<1	<1	<1	2
1302-Water	Ca (Dissolved)	mg/L	83.9	77.8	92.3	39.3
	K (Dissolved)	mg/L	3.18	3.29	3.28	33.8
	Mg (Dissolved)	mg/L	30.7	31.1	31.3	97.1
	Na (Dissolved)	mg/L	152	158	165	303
1405-Water	PCB	µg/L				<0.1
1406-Water	TPH	µg/L	280	<40	59	303
	TPH C06-C09	µg/L	138	<10	<10	<10
	TPH C10-C14	µg/L	34	<10	16	12
	TPH C15-C28	µg/L	90	<10	38	292
	TPH C29+	µg/L	18	<10	<10	<10

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NATA Accreditation Number: 5589

Laboratory Report

Report No: 14963 ***Please quote this number when making enquiries about this report***
Submitted By: Andrew Ezzy (Mineral Resources Tasmania)
Client: E&P Division MRT Groundwater
Site Description: McRobies Gully
Received: 17-May-01 **Client Order No:**
Report Date: 05-Jun-2001 16:19
Report To: Andrew Ezzy (Mineral Resources Tasmania)
Address: Gordons Hill Road Rosny TAS 7018

Test Method(s) :

1001-Water:	pH in Water by APHA Method 4500-H
1002-Water:	Conductivity by APHA Method 2510
1004-Water:	Solids, Total Dissolved by APHA Method 2540C
1103-Water:	Anions by Ion Chromatography APHA Method 4110C
1204-Water:	Ammonia by Ion Selective Electrode APHA Method 4500-NH3 *
1301-Water:	Metals in Water by APHA Method 3030/3120
1302-Water:	Major Cations in Water by APHA Method 3030/3120

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NATA Accreditation Number: 5589

Report No: 14963 **Report Date:**

		Lab.No.:	20946	20947	20948	20949	20950
		Sample Id.:	MainPipe-Outpour	WesternD-Base	Carpark-Flow	WesternD-Mid	WesternD-Top
Method	**Analyte**	**Units / Sampled On :**	17-05-01 12:00	17-05-01 12:17	17-05-01 12:38	17-05-01 12:50	17-05-01 13:25
1001-Water	pH		7.4	7.0	7.6	7.1	6.4
1002-Water	Conductivity	µS/cm	576	590	2190	646	1280
1004-Water	TDS	mg/L	429	390	1410	410	622
1103-Water	Bromide	mg/L	0.32	0.36	0.98	0.37	0.51
	Chloride	mg/L	74	79	330	79	120
	Fluoride	mg/L	0.07	0.18	0.29	0.17	0.48
	Nitrate	mg-N/L	3.2	<0.03	24	<0.03	<0.03
	Nitrite	mg-N/L	0.43	<0.10	1.1	<0.10	<0.10
	Phosphate	mg-P/L	<0.10	<0.10	<0.10	<0.10	<0.10
	Sulphate	mg/L	49	83	96	86	170
1204-Water	Ammonia	mg-N/L	2.16	2.98	2.55	3.71	16.5
1301-Water	Al (Dissolved)	µg/L	<20	60	<20	75	<20
	As (Dissolved)	µg/L	<5	<5	<5	<5	<5
	Cd (Dissolved)	µg/L	<1	<1	<1	<1	<1
	Co (Dissolved)	µg/L	<1	1	4	2	3
	Cr (Dissolved)	µg/L	1	7	2	10	13
	Cu (Dissolved)	µg/L	3	4	24	4	<1
	Fe (Dissolved)	µg/L	249	425	189	641	3950
	Mn (Dissolved)	µg/L	48	91	19	134	489
	Ni (Dissolved)	µg/L	3	8	13	10	8
	Pb (Dissolved)	µg/L	<5	<5	<5	<5	<5
	Zn (Dissolved)	µg/L	11	103	19	104	<1
1302-Water	Ca (Dissolved)	mg/L	47.7	24.9	113	28.7	74.4
	K (Dissolved)	mg/L	7.30	14.6	0.51	15.8	11.1
	Mg (Dissolved)	mg/L	12.7	12.5	76.5	13.1	33.8
	Na (Dissolved)	mg/L	44.9	50.5	0.62	53.6	122

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NATA Accreditation Number: 5589

Laboratory Report

Report No:	14806	***Please quote this number when making enquiries about this report***
Submitted By:	A. Ezzy	
Client:	E&P Division MRT Groundwater	
Site Description:	McRobies Gully	
Received:	24-Apr-01	**Client Order No:**
Report Date:	18-May-2001 14:09	
Report To:	Andrew Ezzy (Mineral Resources Tasmania)	
Address:	Gordons Hill Road Rosny TAS 7018	

Test Method(s) :

1001-Water:	pH in Water by APHA Method 4500-H
1002-Water:	Conductivity by APHA Method 2510
1004-Water:	Solids, Total Dissolved by APHA Method 2540C
1103-Water:	Anions by Ion Chromatography APHA Method 4110C
1201-Water:	Nutrients by APHA Method 4500
1301-Water:	Metals in Water by APHA Method 3030/3120
1302-Water:	Major Cations in Water by APHA Method 3030/3120

Mike Johnson
Manager

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Sandy Bay Tasmania 7005

NATA Accreditation Number: 5589

Report No: 14806 **Report Date:** 18-May-2001 14:09

Lab.No.	Sample Id.	Method: / Analyte: / Date/Time Sampled	1001-Water pH	1002-Water Conductivity µS/cm	1004-Water TDS mg/L	1103-Water Bromide mg/L	1103-Water Chloride mg/L	1103-Water Fluoride mg/L	1103-Water Sulphate mg/L	1201-Water Ammonia µg-N/L	1201-Water Nitrate+Nitrite µg-N/L	1201-Water Nitrite µg-N/L
20122	Western D-Base	24/04/2001 11:15	7.0	452	325	0.20	78	0.16	38	1780	2460	143
20123	Western D-Mid	24/04/2001 11:35	6.7	503	511	0.20	83	0.12	39	2480	2270	167
20124	Eastern-Pipe	24/04/2001 12:05	6.9	560	365	<0.01	34	0.27	6.6	28	284	13
20125	Stage 2-Spring	24/04/2001 11:55	6.8	4530	2930	10	800	0.07	15	157000	3770	124
20126	Hobart R-Outpond	24/04/2001 12:55	7.4	823	571	0.96	120	0.14	42	7910	3960	272

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NATA Accreditation Number: 5589

Report No: 14806 **Report Date:** 18-May-2001 14:09

Lab.No.	Sample Id.	Method: / Analyte: / Date/Time Sampled	1201-Water Ortho-P µg-P/L	1301-Water Al (Dissolved) µg/L	1301-Water As (Dissolved) µg/L	1301-Water Cd (Dissolved) µg/L	1301-Water Co (Dissolved) µg/L	1301-Water Cr (Dissolved) µg/L	1301-Water Cu (Dissolved) µg/L	1301-Water Fe (Dissolved) µg/L	1301-Water Mn (Dissolved) µg/L	1301-Water Ni (Dissolved) µg/L
20122	Western D-Base	24/04/2001 11:15	393	98	<5	<1	<1	2	7	174	<5	5
20123	Western D-Mid	24/04/2001 11:35	467	91	<5	<1	<1	3	7	166	6	6
20124	Eastern-Pipe	24/04/2001 12:05	781	33	<5	<1	<1	<1	9	248	<5	7
20125	Stage 2-Spring	24/04/2001 11:55	10	<20	<5	<1	16	2	<1	228	370	43
20126	Hobart R-Outpond	24/04/2001 12:55	20	<20	<5	<1	1	<1	6	144	163	9

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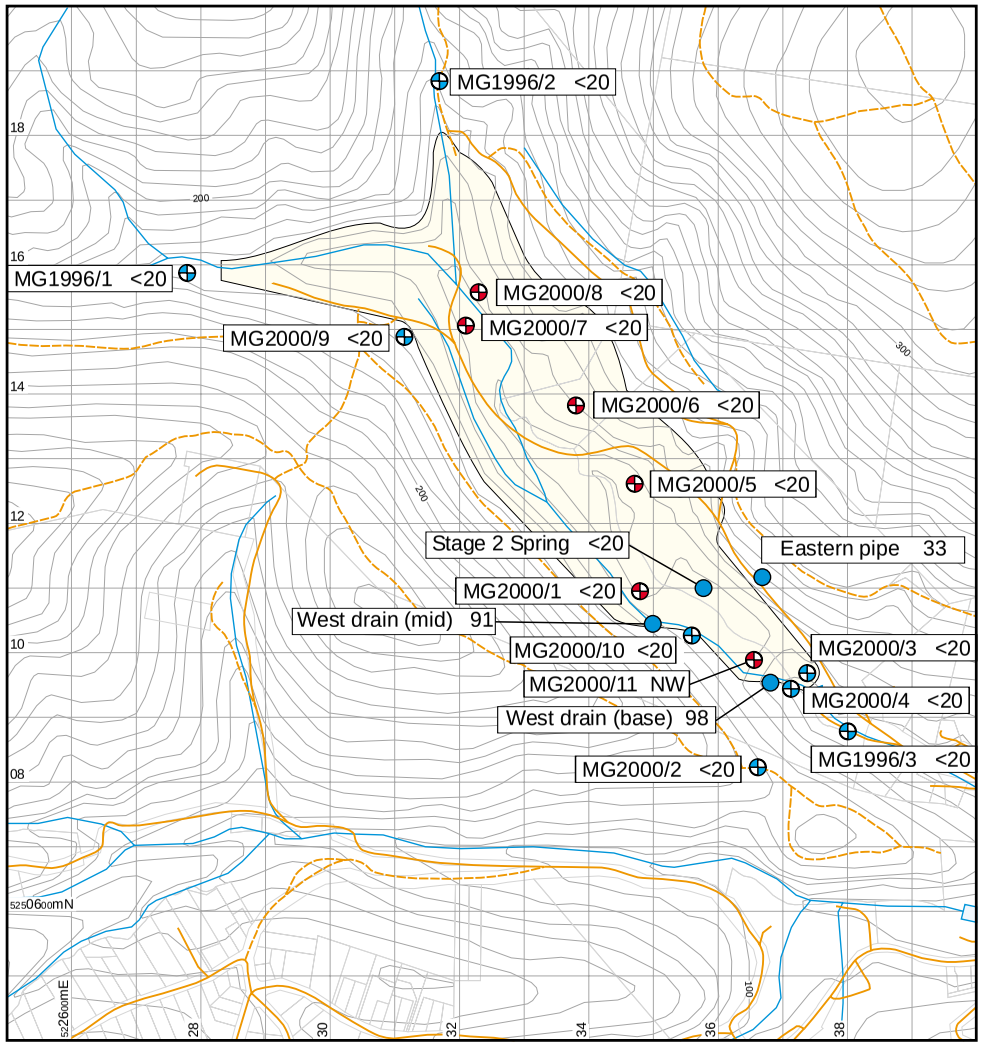
NATA Accreditation Number: 5589

Report No: 14806 **Report Date:** 18-May-2001 14:09

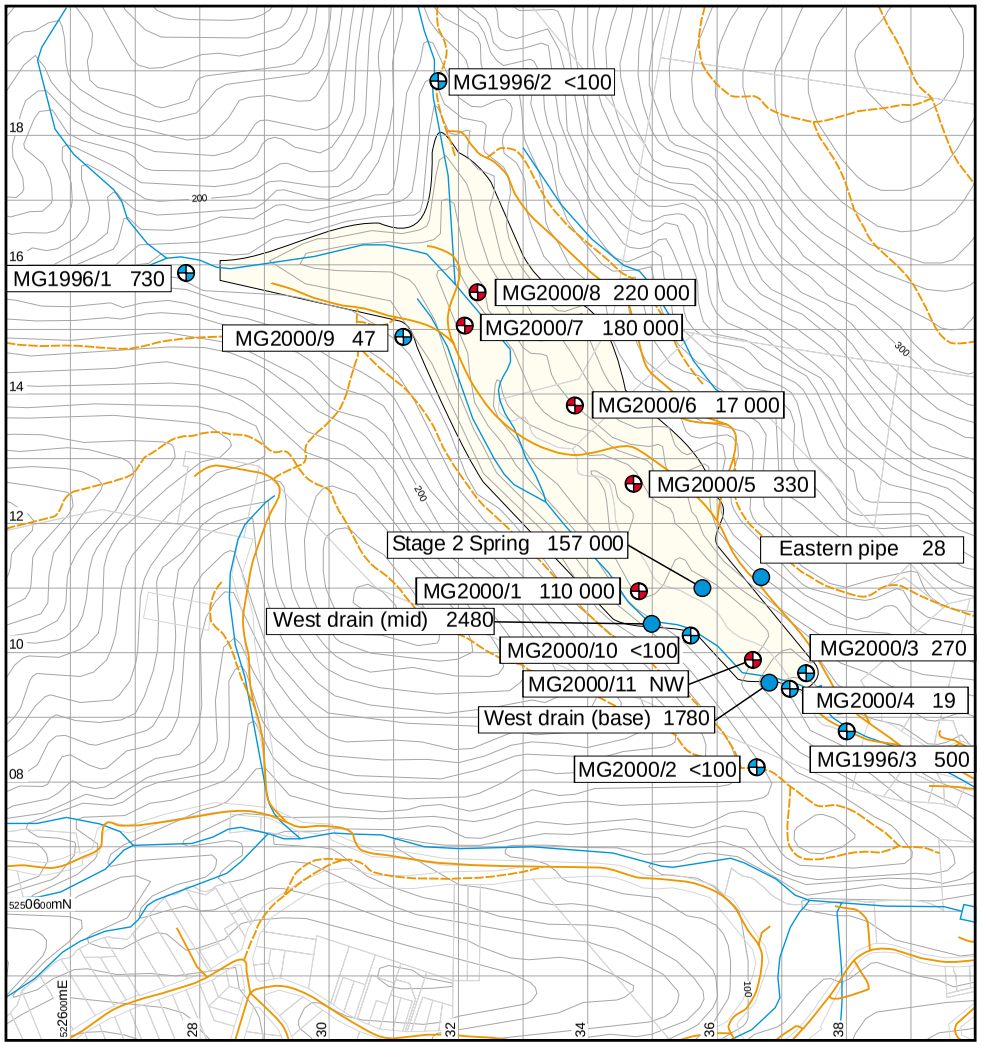
Lab.No.	Sample Id.	Method: / Analyte: / Date/Time Sampled	1301-Water Pb (Dissolved) µg/L	1301-Water Zn (Dissolved) µg/L	1302-Water Ca (Dissolved) mg/L	1302-Water K (Dissolved) mg/L	1302-Water Mg (Dissolved) mg/L	1302-Water Na (Dissolved) mg/L
20122	Western D-Base	24/04/2001 11:15	<5	14	11.3	11.6	7.82	53.2
20123	Western D-Mid	24/04/2001 11:35	<5	21	12.0	12.5	7.68	56.0
20124	Eastern-Pipe	24/04/2001 12:05	<5	5	33.5	20.8	17.9	36.1
20125	Stage 2-Spring	24/04/2001 11:55	<5	23	179	110	185	514
20126	Hobart R-Outpond	24/04/2001 12:55	<5	4	56.0	13.7	26.6	93.5

Appendix 5
Analytical results on site maps

McRobies Gully waste depots
April 2001
Al (µg/L)



McRobies Gully waste depots
April 2001
Ammonia (µg/L)



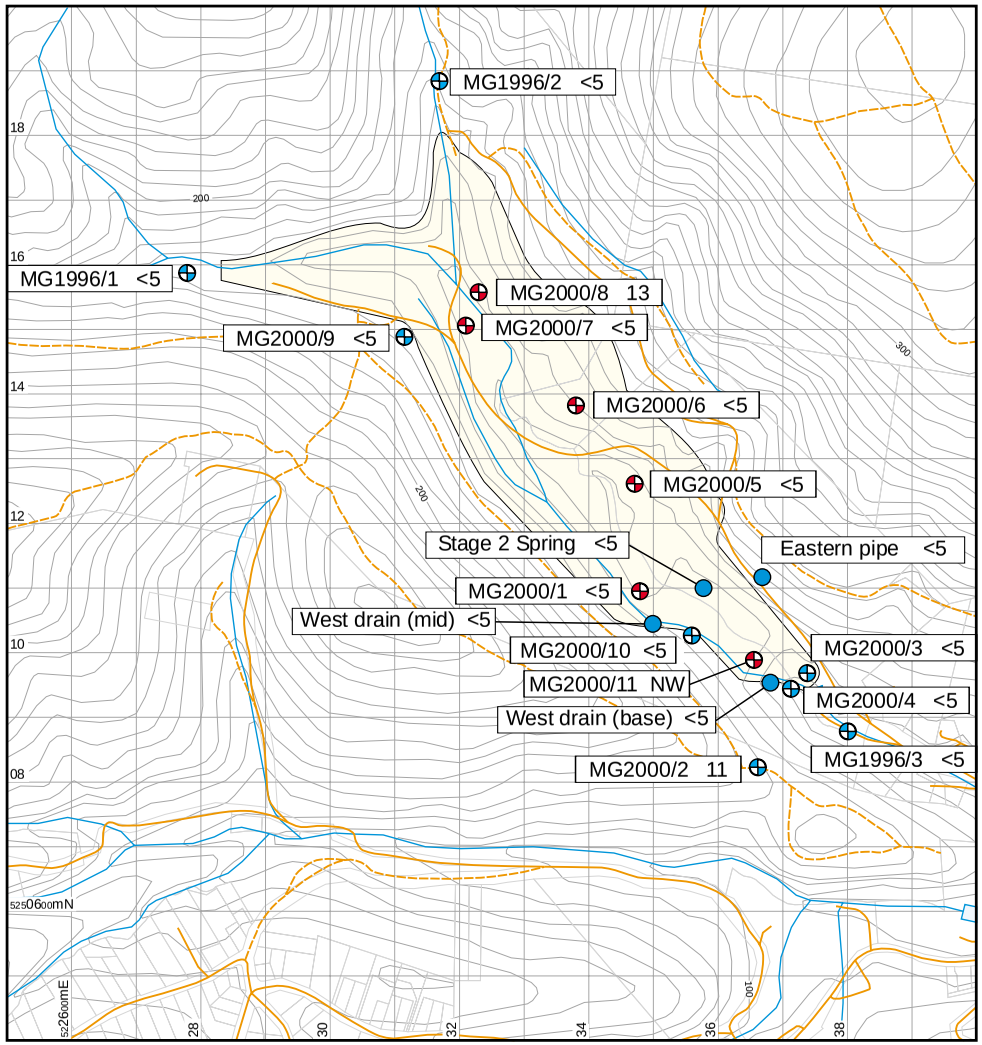
Landfill footprint

Surface water monitoring point

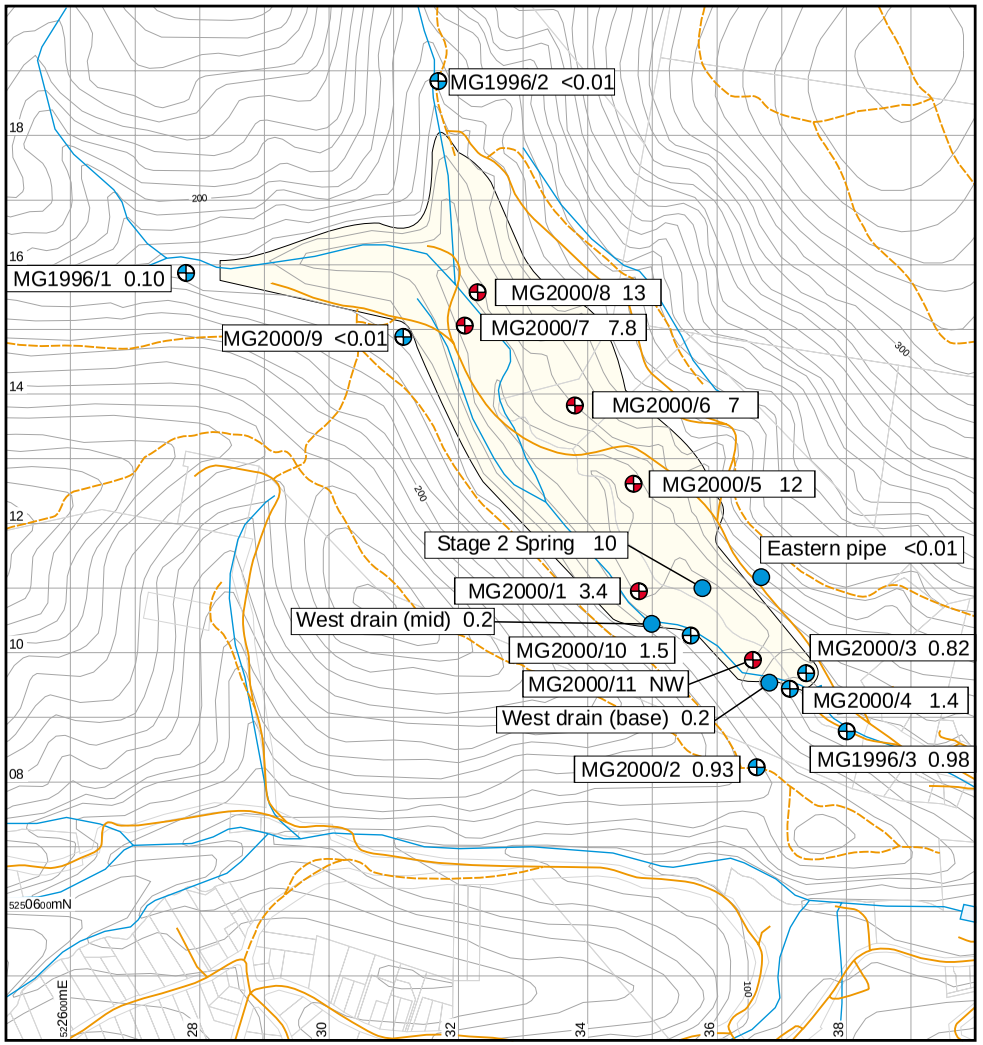
Bore screened in bedrock

Bore screened in man made fill

McRobies Gully waste depots
April 2001
As (µg/L)



McRobies Gully waste depots
April 2001
Bromide (mg/L)



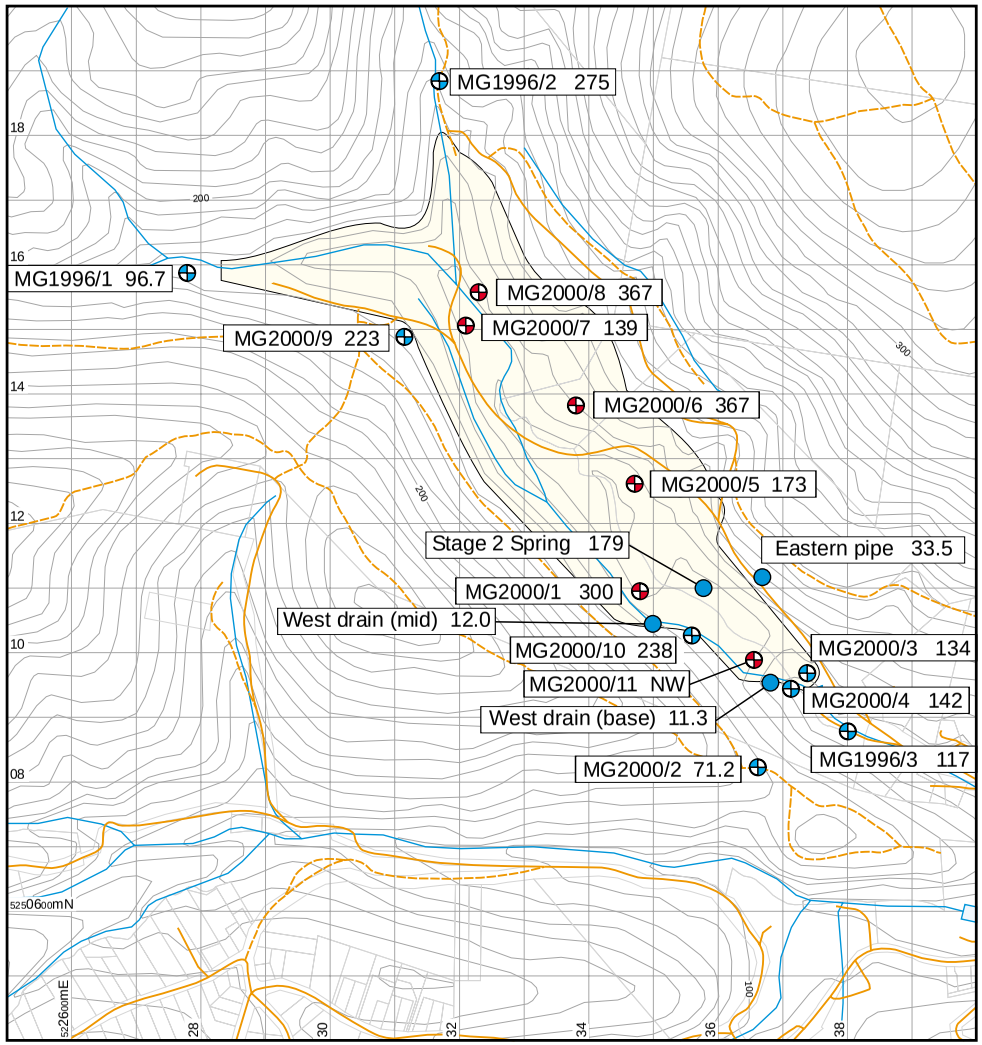
Landfill footprint

Surface water monitoring point

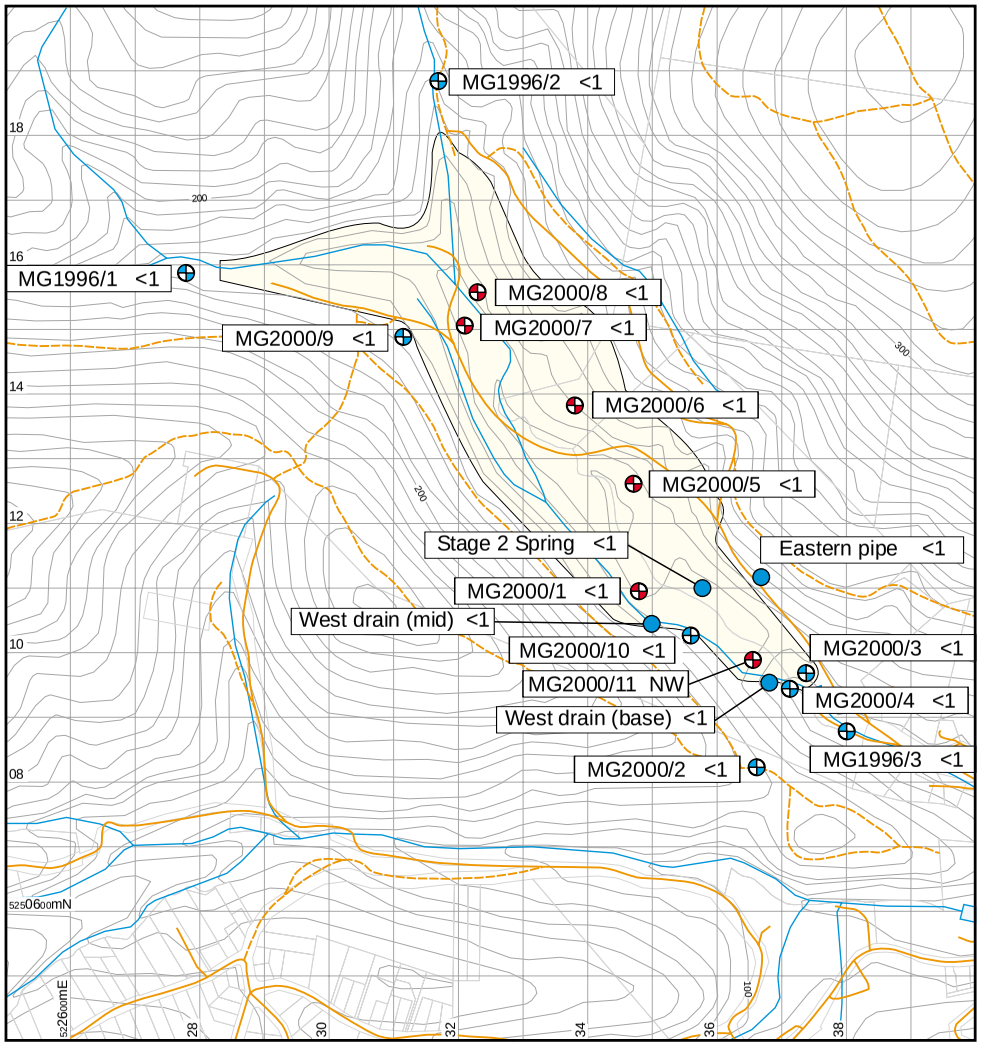
Bore screened in bedrock

Bore screened in man made fill

McRobies Gully waste depots
April 2001
Ca (mg/L)



McRobies Gully waste depots
April 2001
Cd (μg/L)



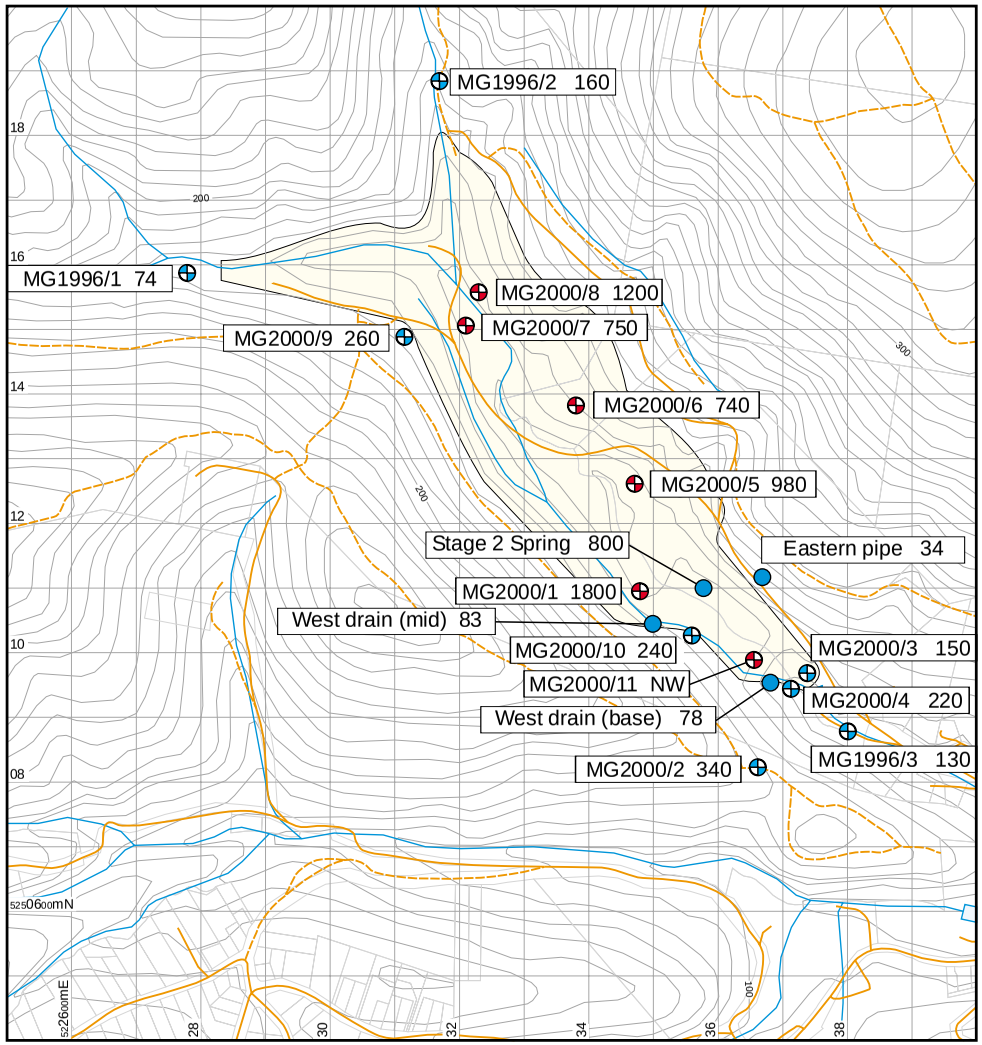
Landfill footprint

Surface water monitoring point

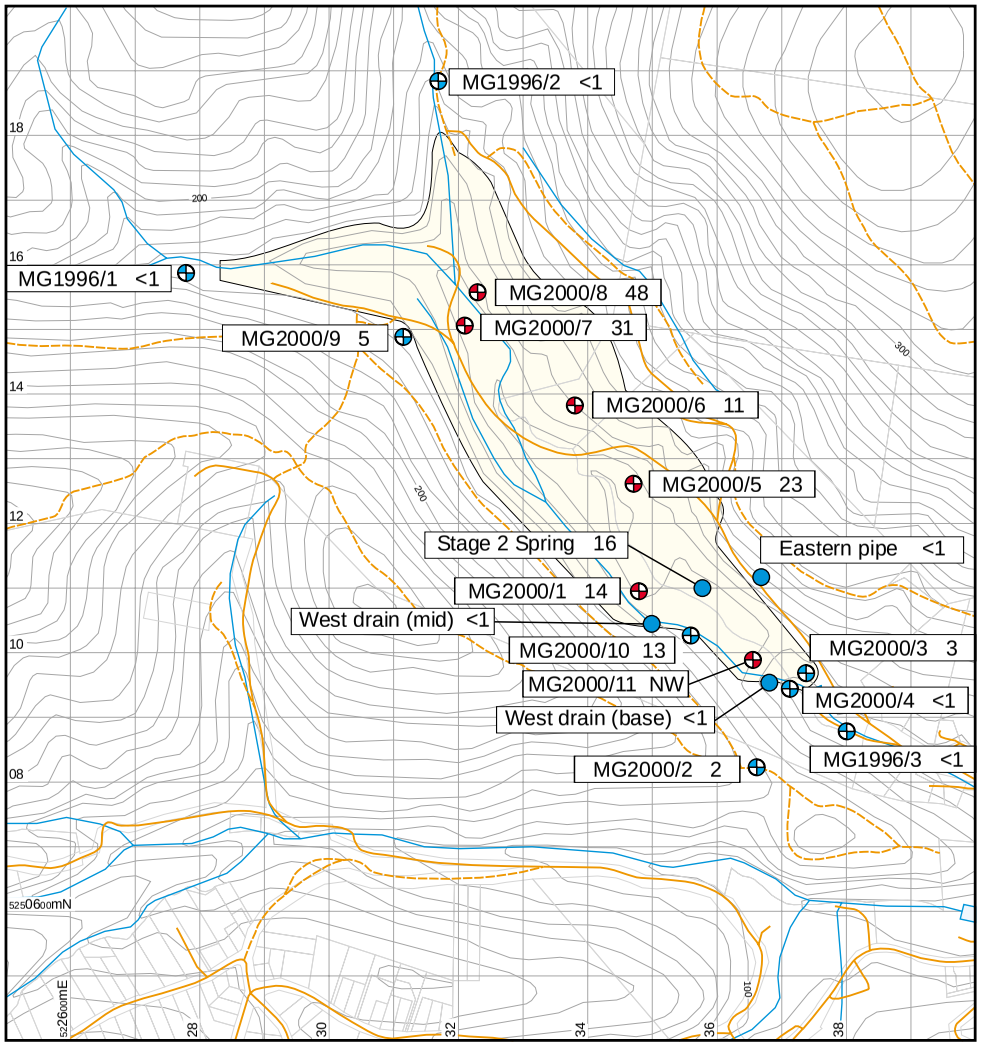
Bore screened in bedrock

Bore screened in man made fill

McRobies Gully waste depots
April 2001
Chloride (mg/L)



McRobies Gully waste depots
April 2001
Co (μg/L)



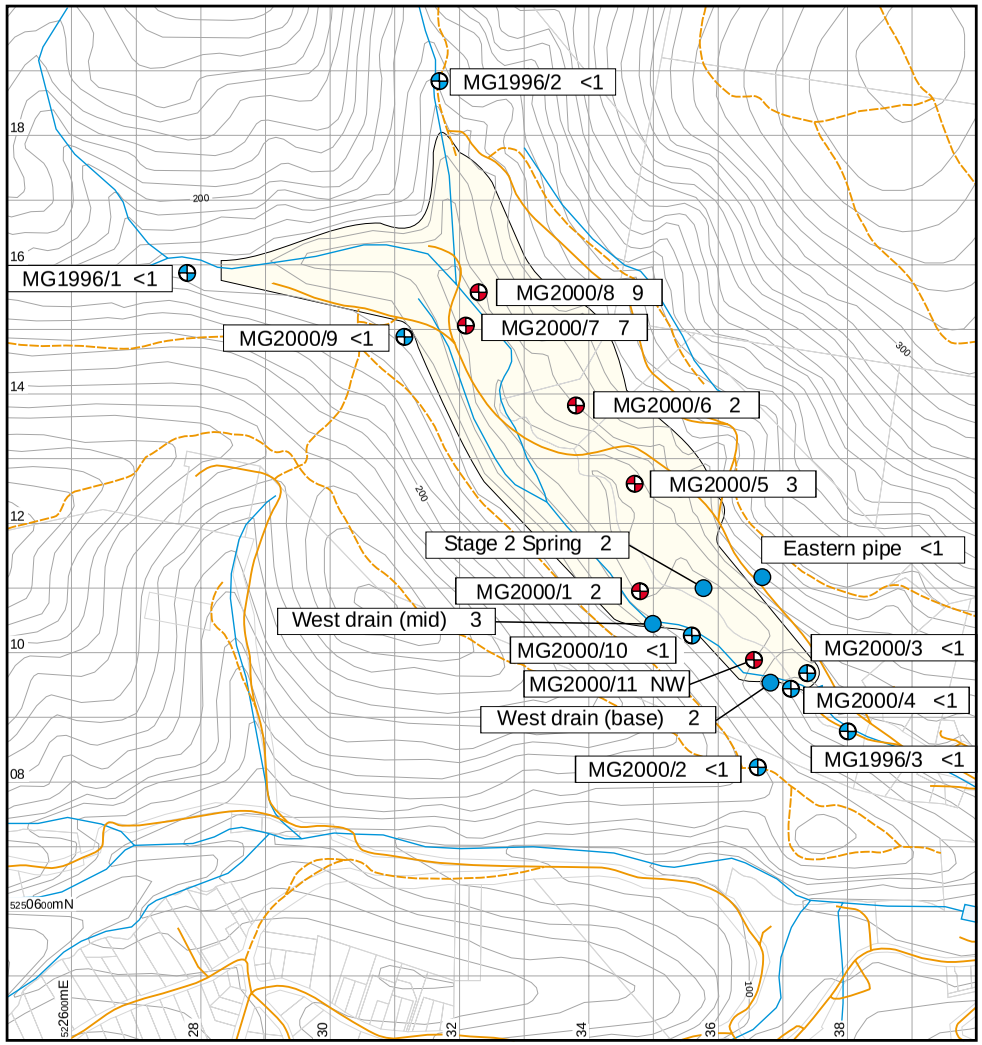
Landfill footprint

Surface water monitoring point

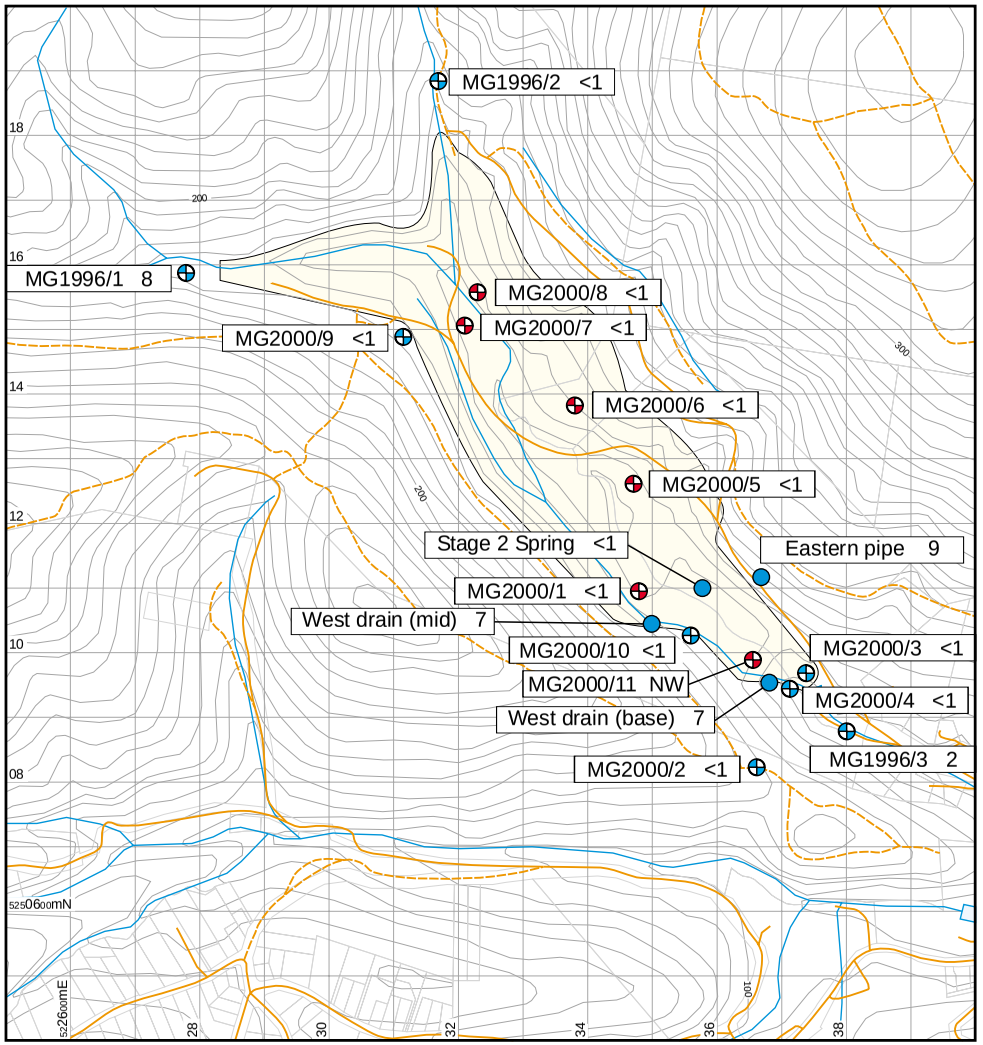
Bore screened in bedrock

Bore screened in man made fill

McRobies Gully waste depots
April 2001
Cr (µg/L)



McRobies Gully waste depots
April 2001
Cu (µg/L)



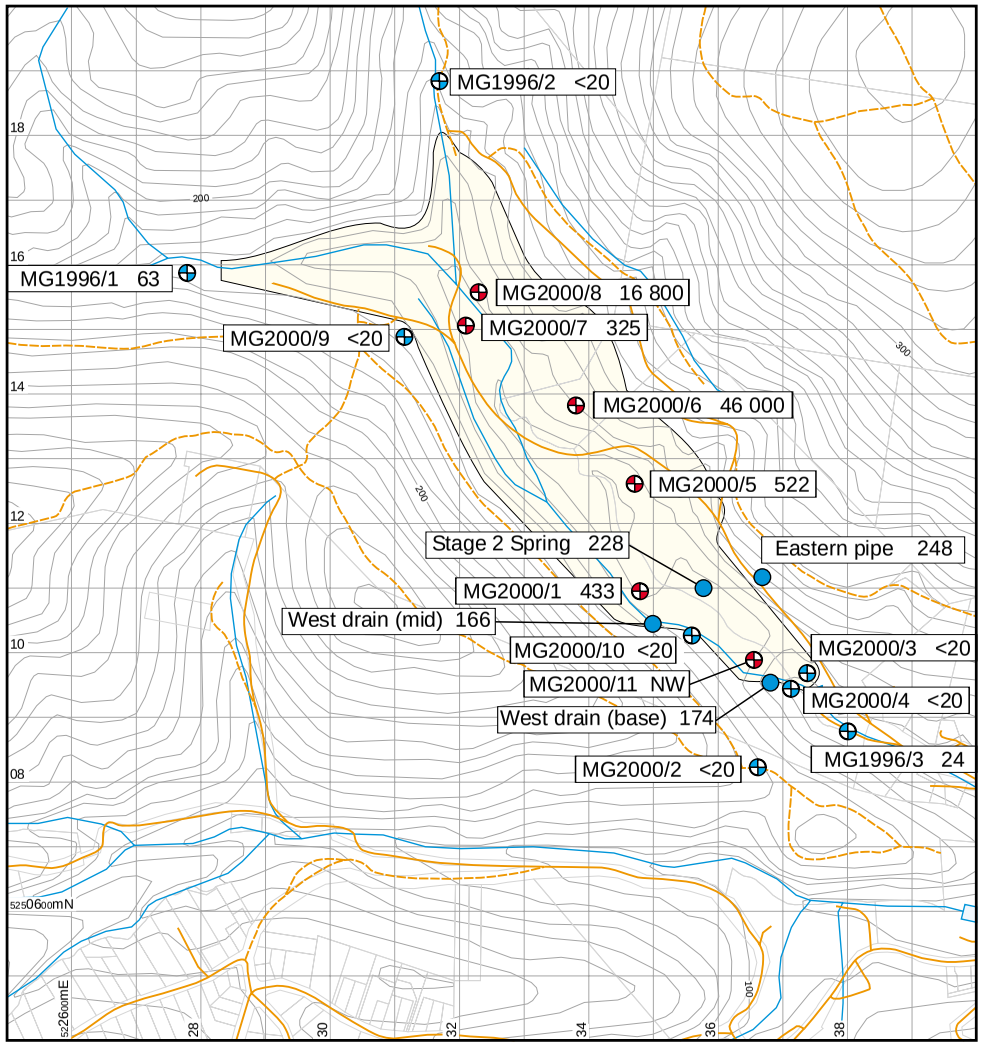
Landfill footprint

Surface water monitoring point

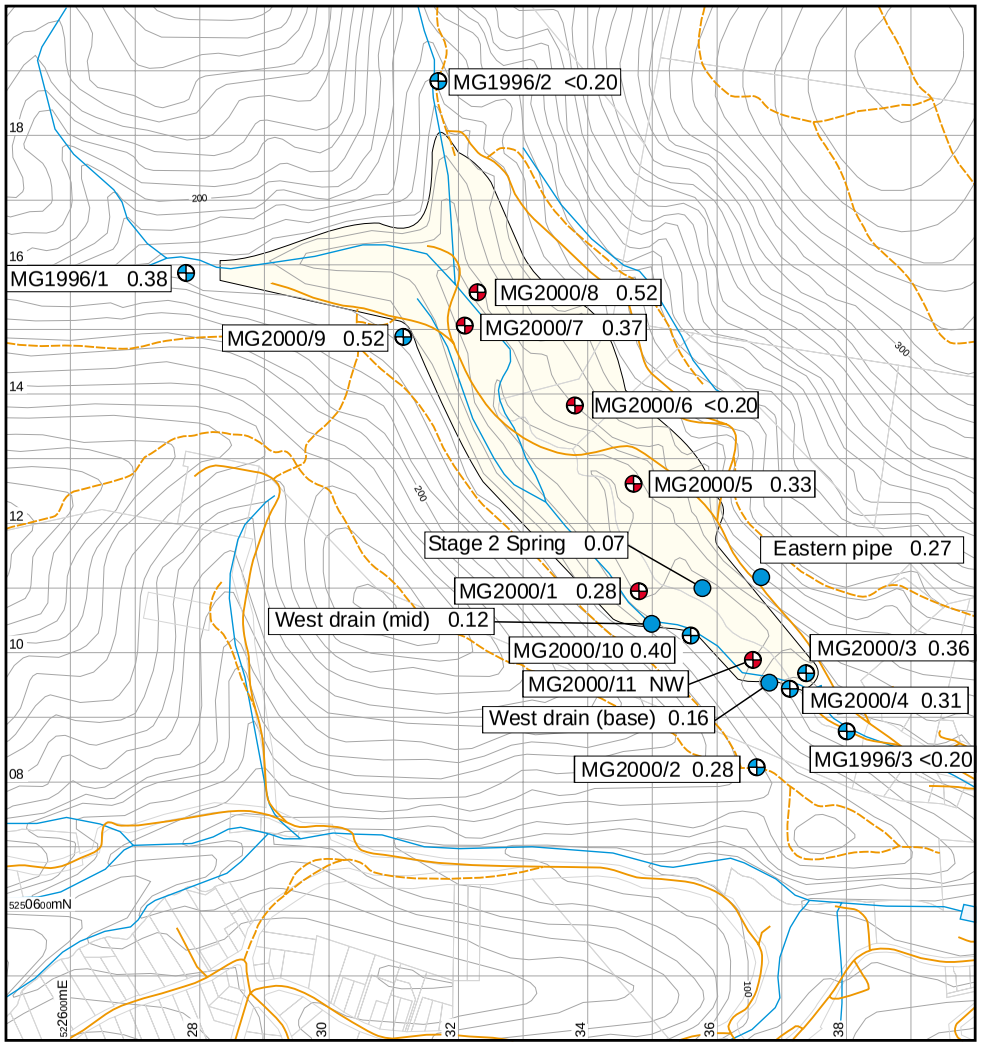
Bore screened in bedrock

Bore screened in man made fill

McRobies Gully waste depots
April 2001
Fe (μg/L)



McRobies Gully waste depots
April 2001
Fluoride (mg/L)



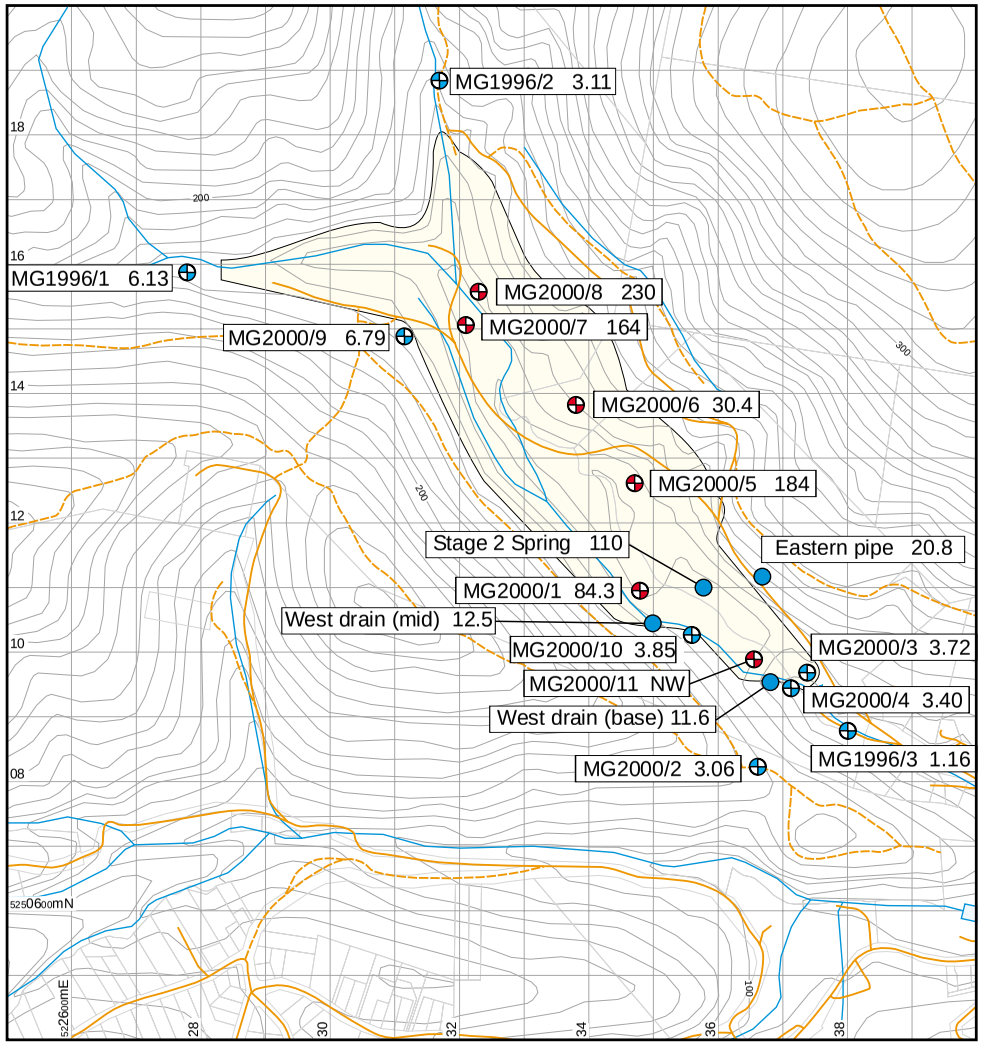
Landfill footprint

Surface water monitoring point

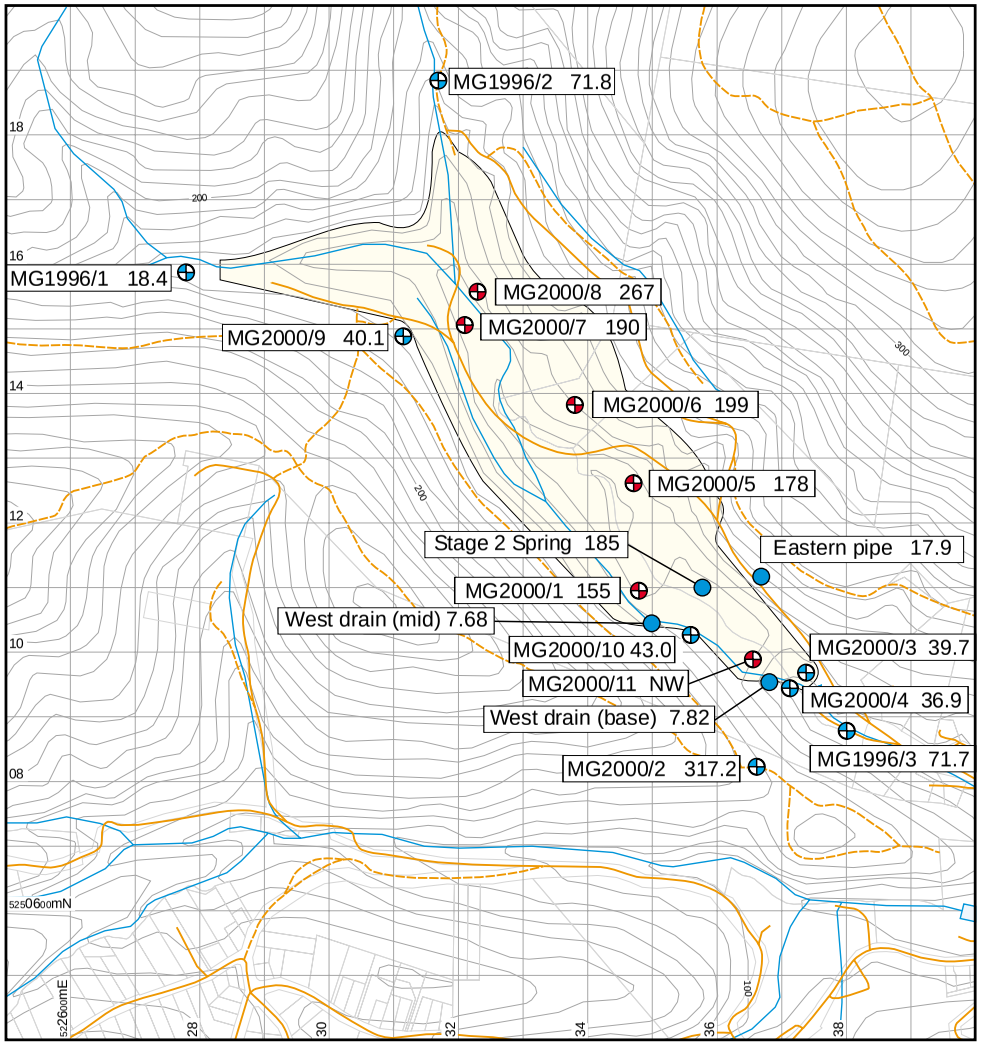
Bore screened in bedrock

Bore screened in man made fill

McRobies Gully waste depots
April 2001
K (mg/L)



McRobies Gully waste depots
April 2001
Mg (mg/L)



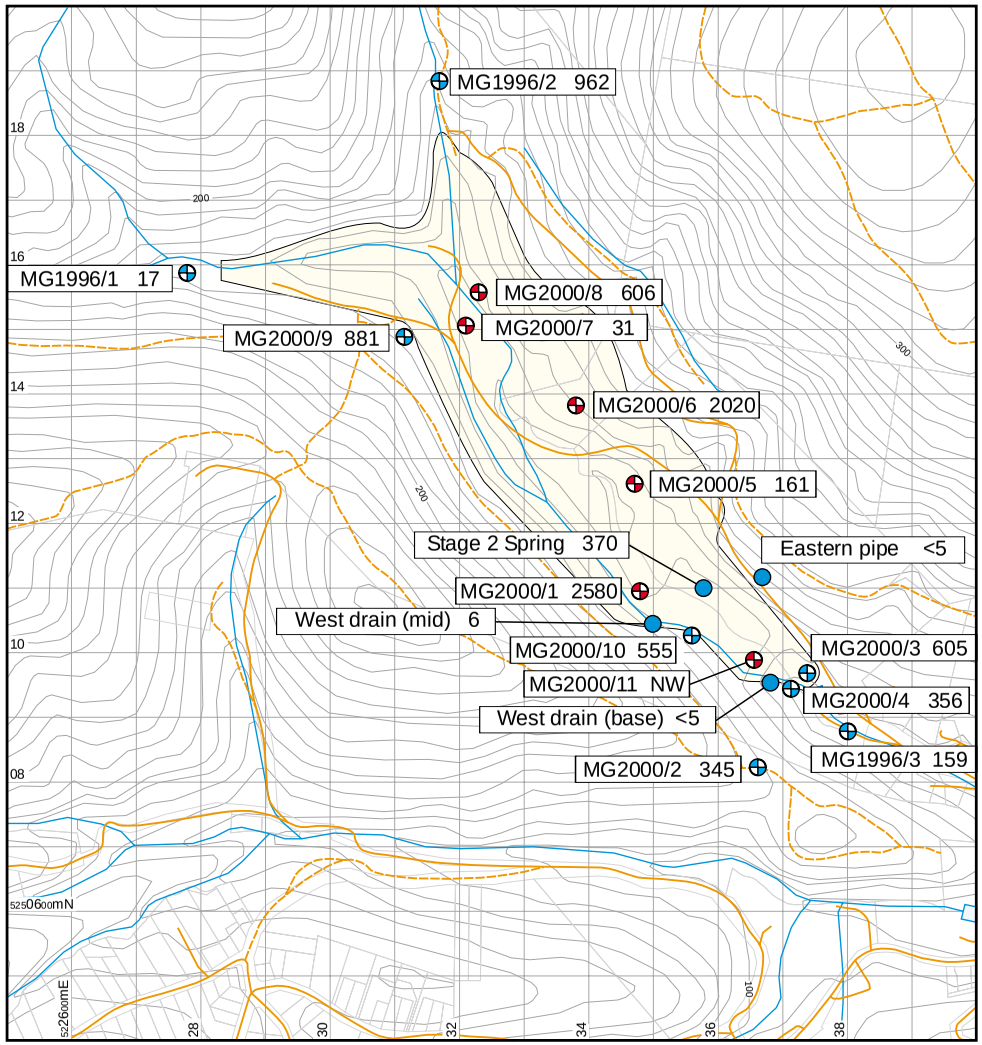
Landfill footprint

Surface water monitoring point

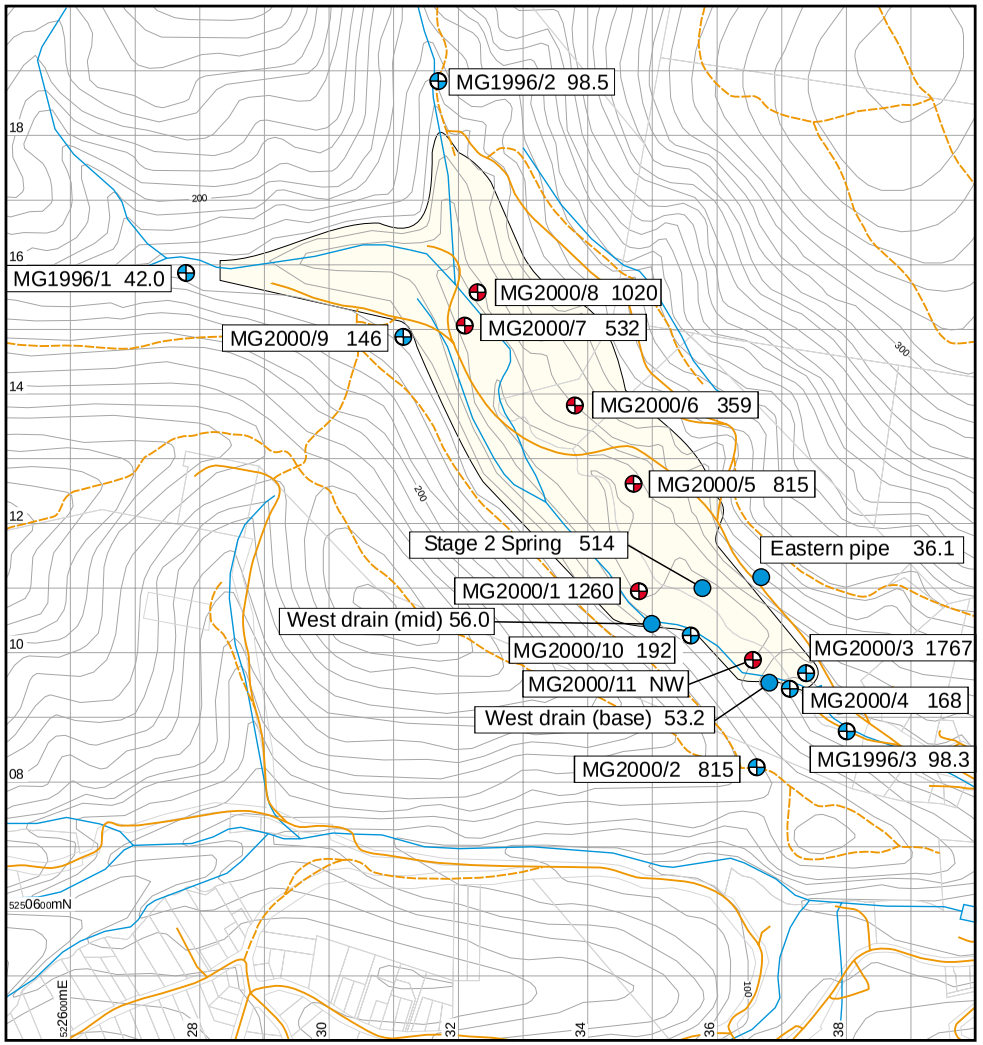
Bore screened in bedrock

Bore screened in man made fill

McRobies Gully waste depots
April 2001
Mn (µg/L)



McRobies Gully waste depots
April 2001
Na (mg/L)



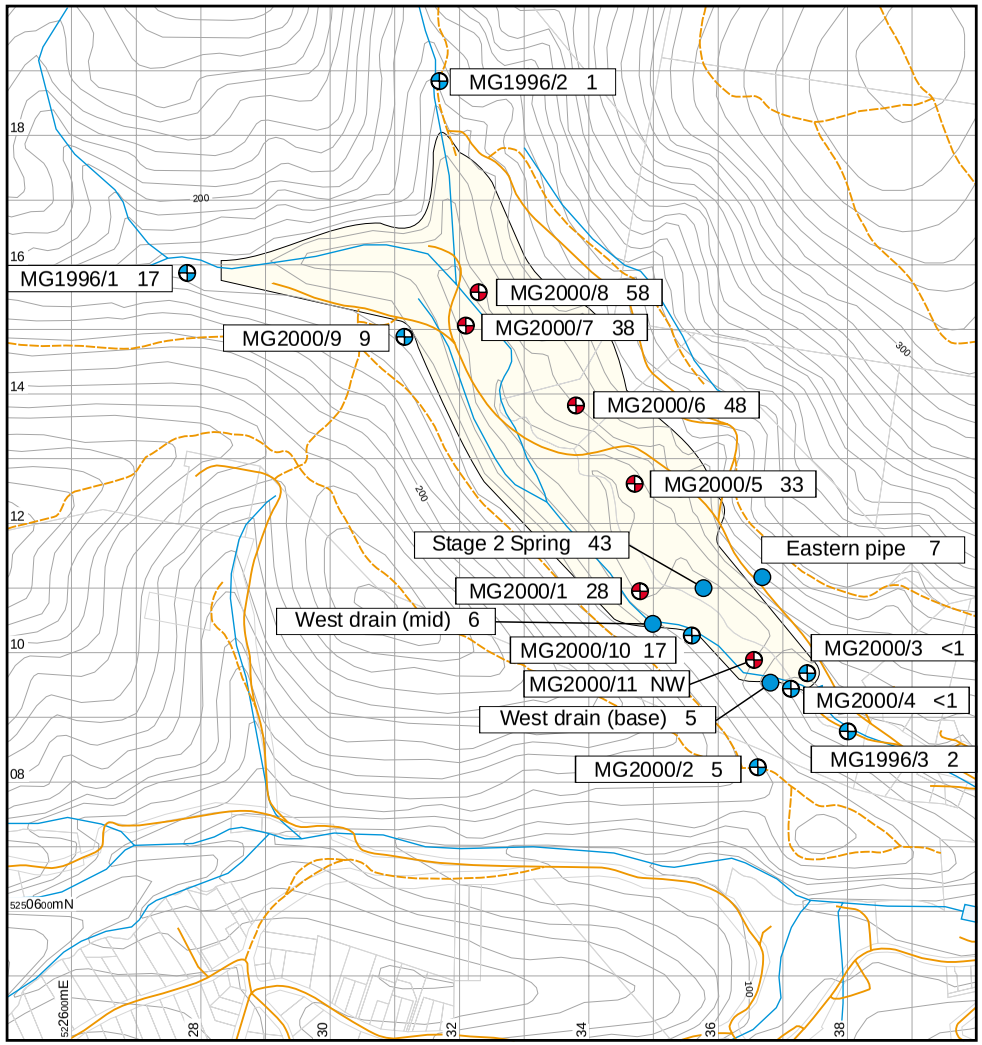
Landfill footprint

Surface water monitoring point

Bore screened in bedrock

Bore screened in man made fill

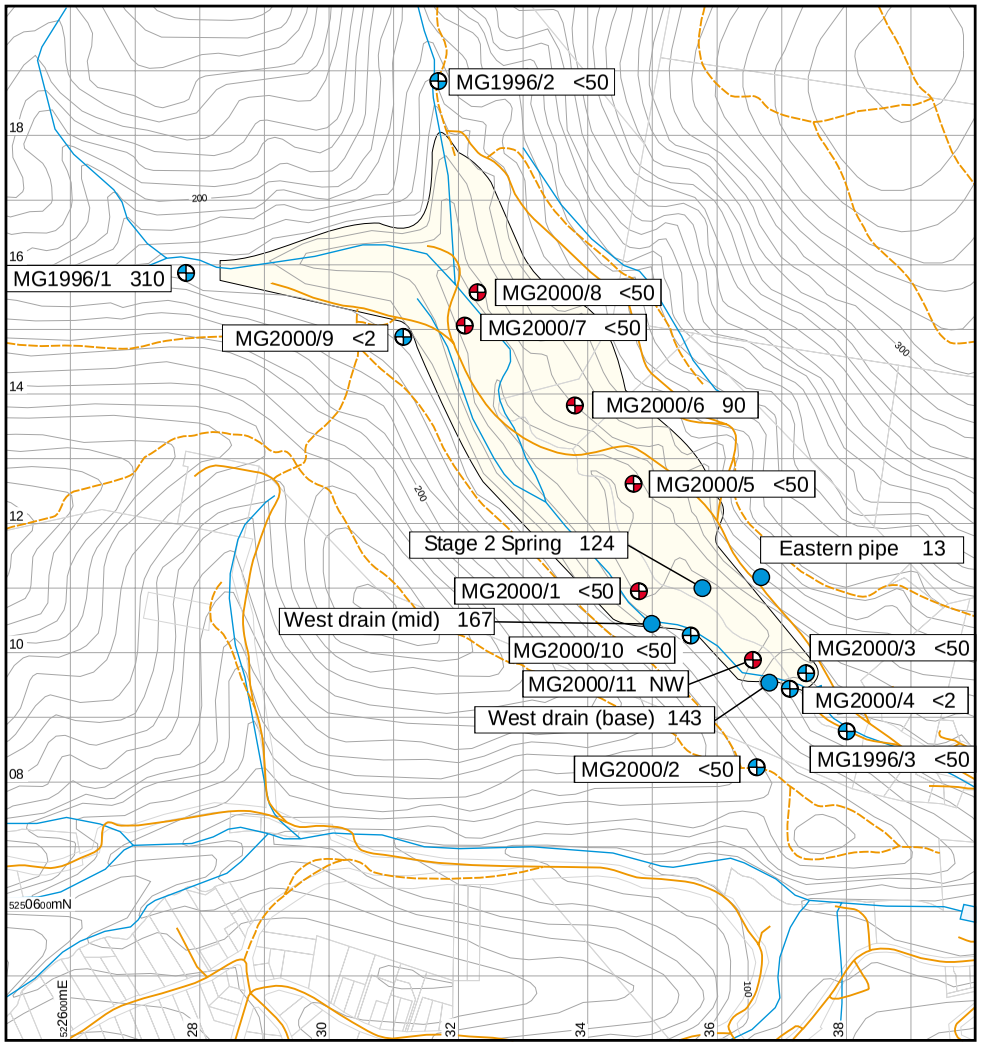
McRobies Gully waste depots
April 2001
Ni (µg/L)



Landfill footprint

Surface water monitoring point

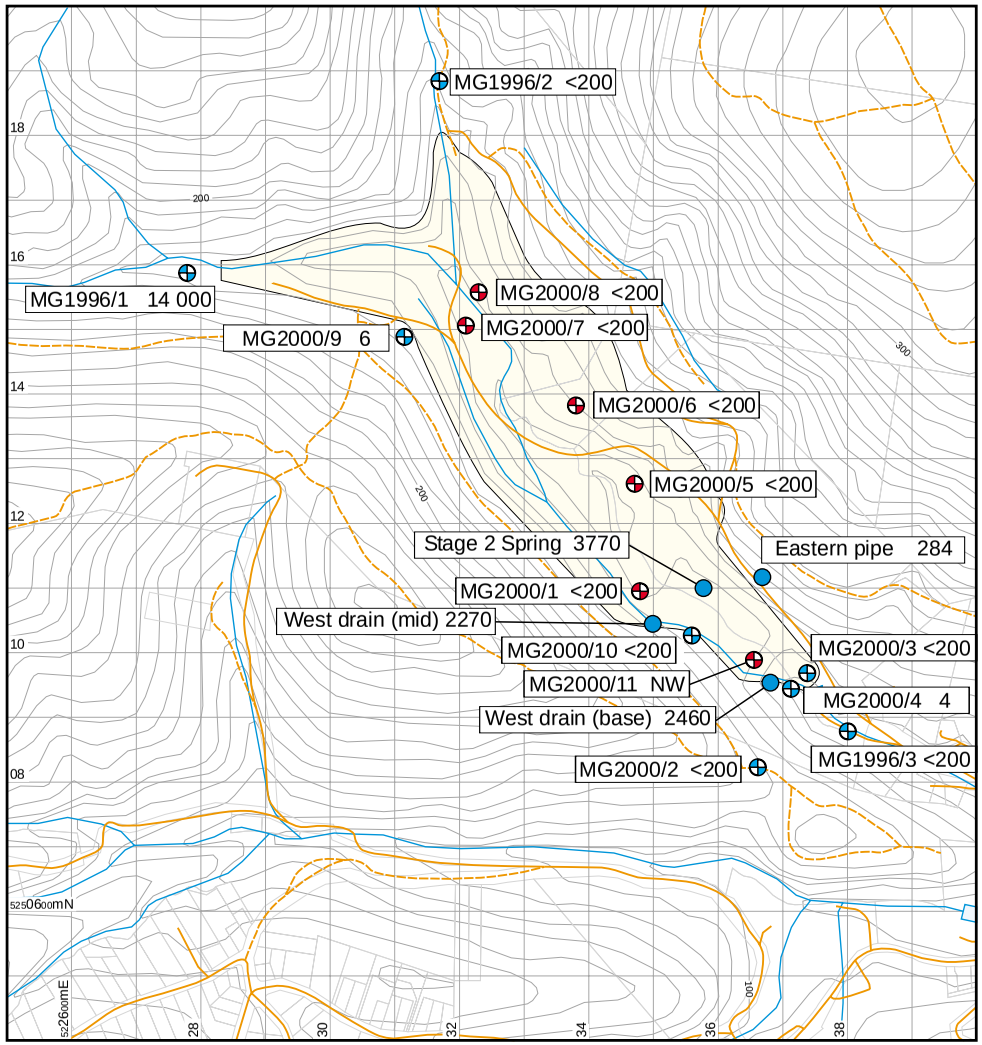
McRobies Gully waste depots
April 2001
Nitrite (µg/L)



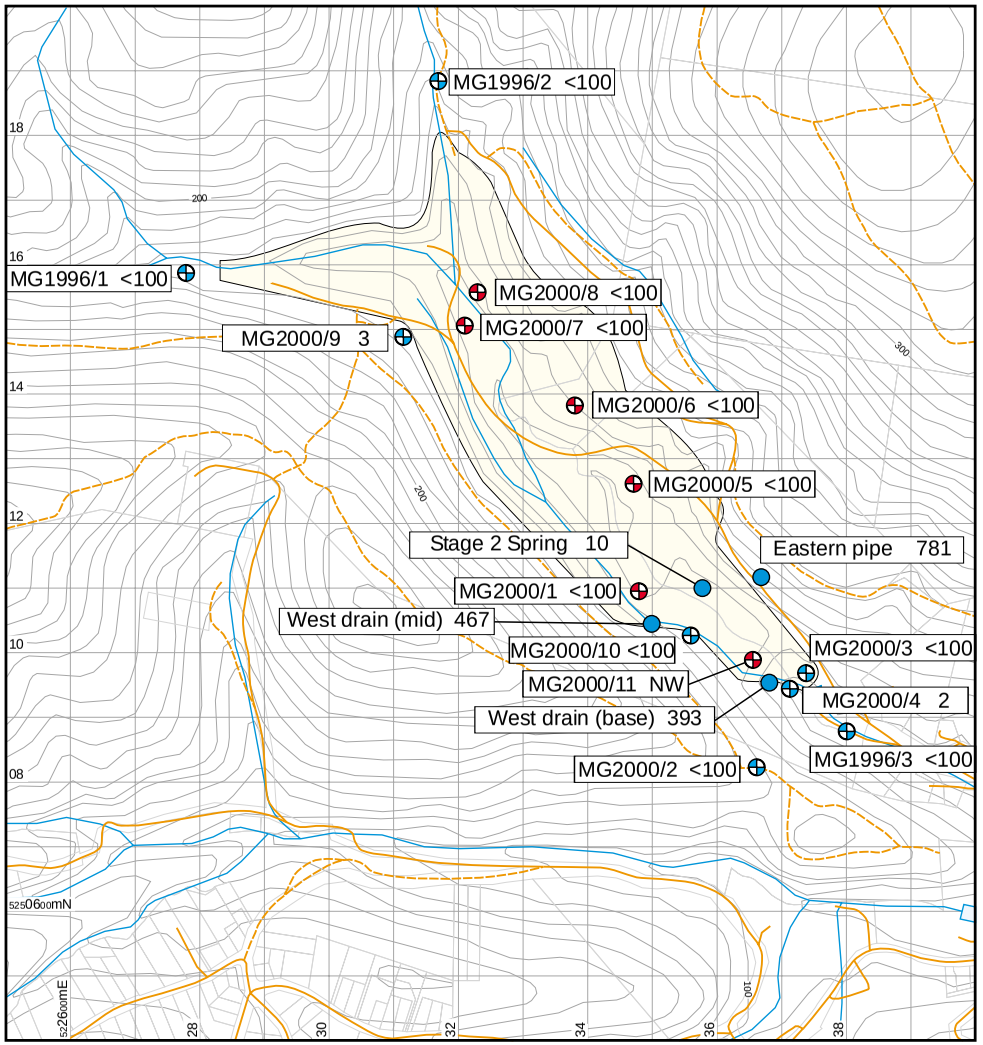
Bore screened in bedrock

Bore screened in man made fill

McRobies Gully waste depots
April 2001
Nitrate + Nitrite (μg/L)



McRobies Gully waste depots
April 2001
Ortho-P (μg/L)



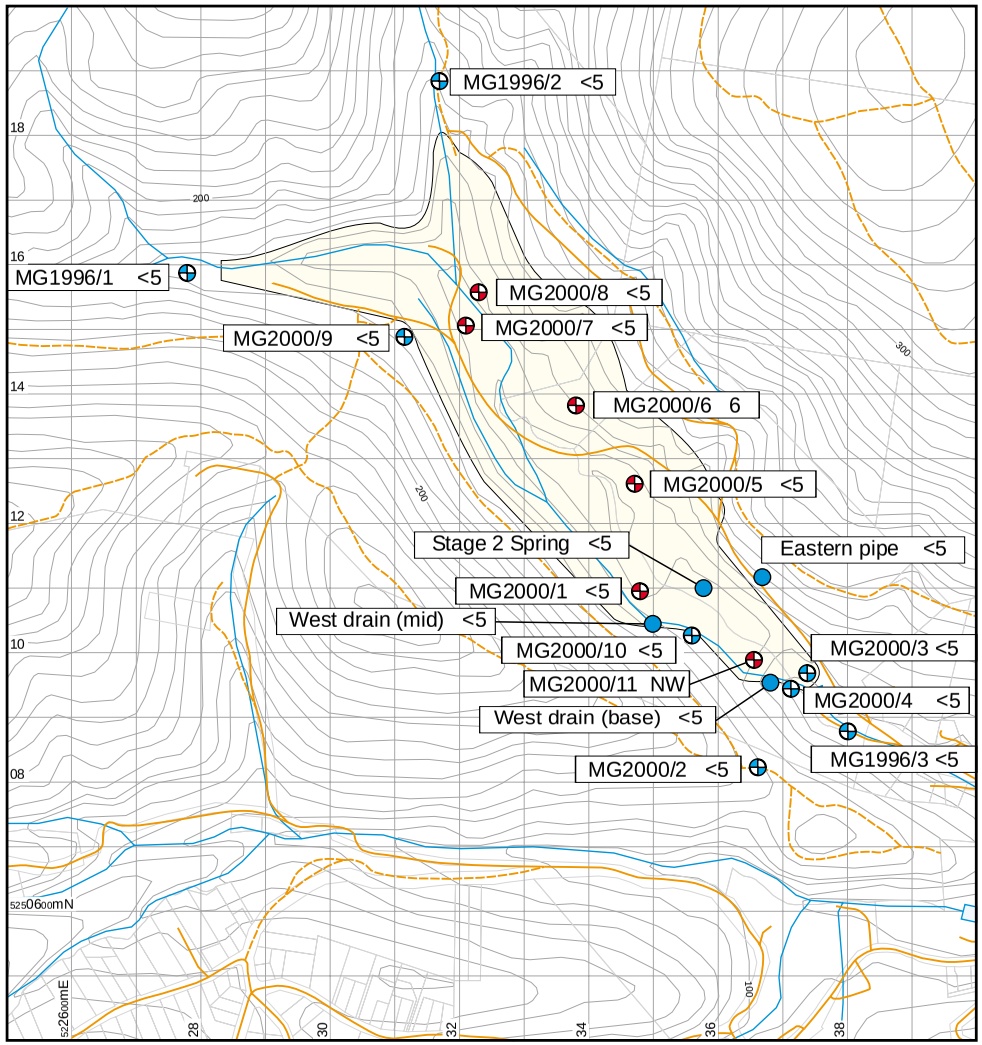
Landfill footprint

Surface water monitoring point

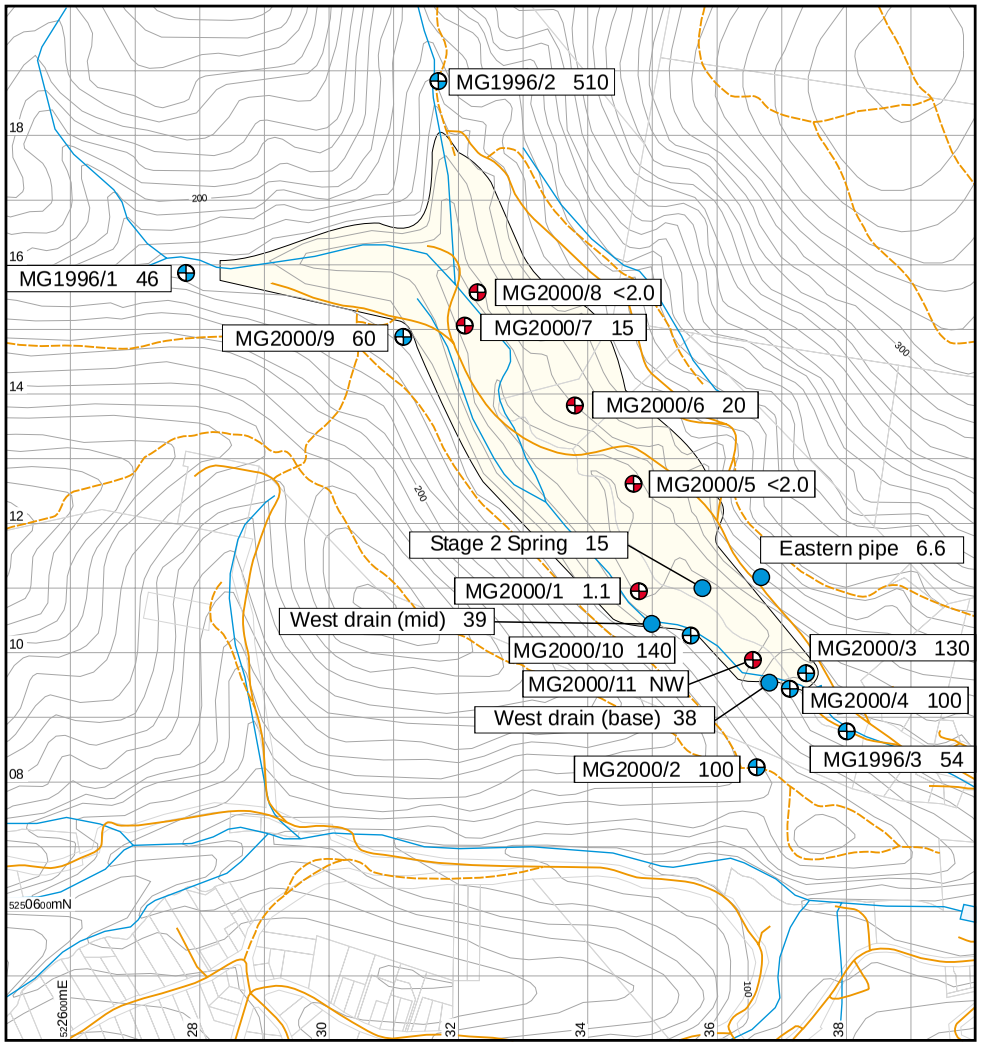
Bore screened in bedrock

Bore screened in man made fill

McRobies Gully waste depots
April 2001
Pb (µg/L)



McRobies Gully waste depots
April 2001
Sulphate (mg/L)



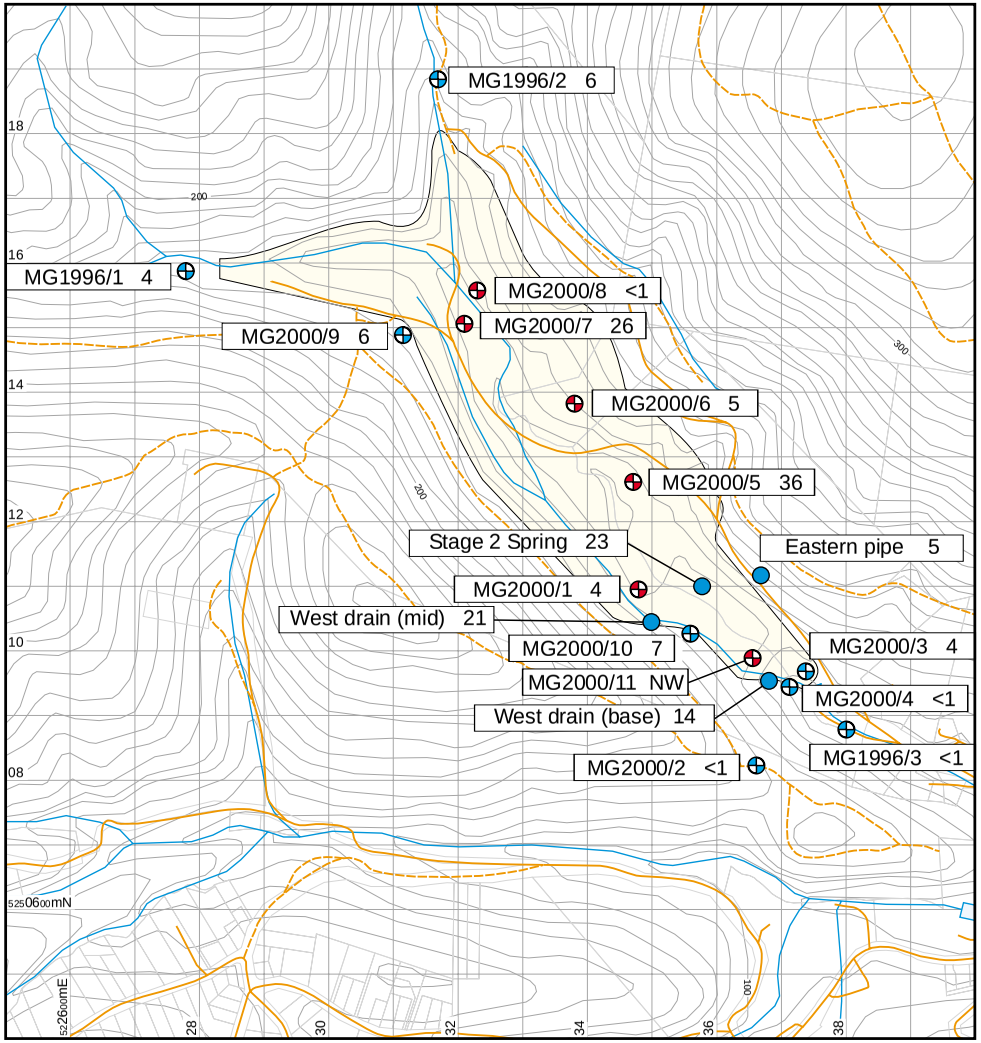
Landfill footprint

Surface water monitoring point

Bore screened in bedrock

Bore screened in man made fill

McRobies Gully waste depots
April 2001
Zn (µg/L)



Landfill footprint

Surface water monitoring point

Bore screened in bedrock

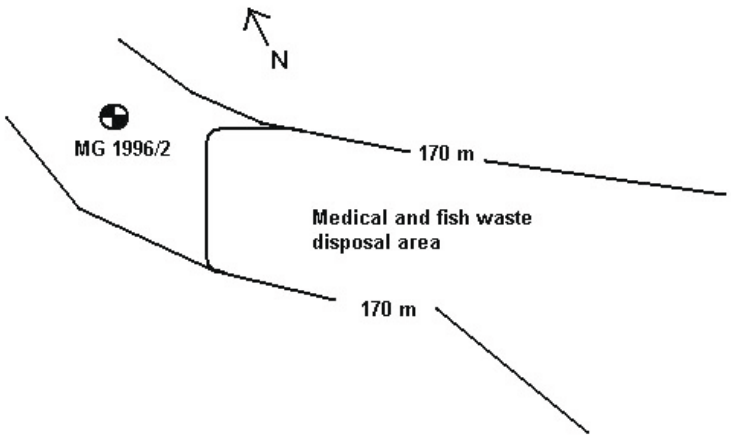
Bore screened in man made fill

Appendix 6
In situ permeability testing

Pump test	*Date*	*Pumping well*	*Observation well(s)*	*Aquifer Win32 method used for calculations*	*Hydraulic conductivity value (m/d)*	*Page*
1	05/07/2000	MG1996/2	N/A	Unusable data	-	89
2	06/07/2000	MG1996/3	N/A	Unusable data	-	92
3	07/07/2000	MG1996/1	N/A	Unusable data	-	95
4	05/04/2001	MG2000/2 (1st attempt)	MG2000/4	Unusable data	-	98
5	09/04/2001	MG2000/1 (1st attempt)	MG2000/5	Unusable data	-	102
6	10/04/2001	MG2000/7	MG2000/8	Bouwer and Rice, 1976	0.66	106
7	10/04/2001	MG2000/1 (2nd attempt)	MG2000/5	Bouwer and Rice, 1976	2.03	113
8	10/04/2001	MG2000/1 (3rd attempt)	N/A	Bouwer and Rice, 1976	4.14	120
9	12/04/2001	MG2000/4 (1st attempt)	MG2000/3	Hvorslev, 1951	0.09	124
				KGS Model	0.04	
				Bouwer and Rice, 1976	0.11	
10	02/05/2001	MG2000/4 (2nd attempt)	MG2000/3	Hvorslev, 1951	0.10	131
				KGS Model	0.03	
				Bouwer and Rice, 1976	0.10	
11	03/05/2001	MG2000/2 (2nd attempt)	MG2000/3	Hvorslev, 1951	0.005	138
			MG2000/4	KGS Model	0.002	
			MG2000/10	Bouwer and Rice, 1976	0.006	

Pump Test 1: Well MG1996/2

PUMPING TEST SET-UP SHEET

WELL DESCRIPTION	**Owner** Hobart City Council		**Well No.** MG 1996/2		
	Address 16 Elizabeth Street		**Name/Site** McRobies Gully Waste Depot		
	Hobart				
	Tested by Mineral Resources Tasmania		**Date** 5 July 2000		
WELL CASING DETAILS	**Material Description**		**Diameter (mm)**	**From (m)**	**Seated (m)**
	4 inch sewer pipe		103	0	
	Screen length unknown				20.6
ENTRY DETAILS	**Type of entry**	**Aperture**	**Diameter (mm)**	**Top (m)**	**Bottom (m)**
	Screen seal at Unknown		**Gravel Pack size** 1 to 3 mm		
	Bottom cap 24 m		**Hole diameter** 165 mm		
AQUIFERS	**Aquifer type**	**above BWL below GL (m)**	**Date measured**	**From (m)**	**To (m)**
	Unconfined				
PUMP/HEADWORKS	**Type**	**Size** 4 inch		**Suction at** 19.2 m	
WATER LEVELS	**Measured by** Dip Probe	**Airline at**		**Reference pt** 160m (agl)	
DISCHARGE MEASUREMENT	**Method used**	**Size (plate/tank)**		**Period of measurement**	
	Calibrated container and stop watch	9L container		1-2 minutes	
SKETCH SHOWING LOCATION OF ALL MEASURED WELLS					

DRAWDOWN SHEET **Sheet No 1 of 1**

MEASURED WELL	Owner N/A					Well No.		
						Site		
PUMPED WELL	Owner Hobart City Council					Well No. MG 1996/2		
	Address 16 Elizabeth Street, Hobart					Site McRobies Gully		
TEST DETAILS	Date pumping commenced 05/07/01 Time 2.09 pm					Test		
	Date pumping ceased 05/07/01 Time 2.13 pm					No. **1**		
Are the measurements below for the pumped well? N/A						Distance from pumped well N/A		
Standing water level Or Static pressure	8.68m below Meas. pt					Meas. pt above ground level 0.0 m		
WATCH TIME			ELAPSED TIME (t) min.	DRAWDOWN metres	WATER LEVEL OR PRESSURE metres	DISCHARGE		REMARKS, etc
h	min	am pm				Piezometer mm	L/s	
2	09	pm	0.00	0.00	8.68	103		
2	10		1.00				1.00	Samples
2	12		3.00				0.83	
2	13		4.00					No flow
								Pumping rate too high
								Recovery time
3	58						0.92	2nd pumping - Samples

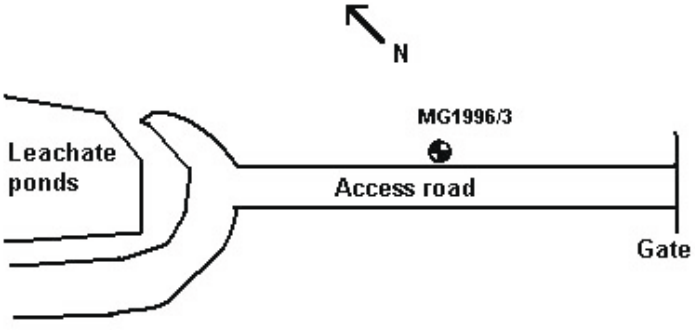
RECOVERY SHEET **Sheet No 1 of 1**

MEASURED WELL	Owner N/A					Well No.		
	Address					Site		
PUMPED WELL	Owner Hobart City Council					Well No. MG 1996/2		
	Address 16 Elizabeth Street, Hobart					Site McRobies Gully		
TEST DETAILS	Date pumping commenced 05/07/01 Time 2.09 pm Date pumping ceased 05/07/01 Time 2.13 pm					Test No. **1**		
Are the measurements below for the pumped well? N/A						Distance from pumped well N/A		
Standing water level Or Static pressure	8.68 m below Meas. pt					Meas. pt above ground level 0.0 m		

WATCH TIME			RECOVERY TIME (t_1) min.	RESIDUAL DRAWDOWN metres	WATER LEVEL OR PRESSURE metres	ELAPSED TIME (t) min.	t / t_1	REMARKS, etc
h	min	am pm						
2	13	pm	0.00	11.19	19.87	4.00	0.00	
2	14		1.00	10.47	19.15	5.00	5.00	
2	15		2.00	10.23	18.91	6.00	3.00	
2	16		3.00	9.94	18.62	7.00	2.33	
2	18		5.00	9.58	18.26	9.00	1.80	
2	20		7.00	9.30	17.98	11.00	1.57	
2	21		8.00	9.20	17.88	12.00	1.50	
2	23		10.00	9.03	17.71	14.00	1.40	
2	30		17.00	8.46	17.14	21.00	1.24	
2	33		20.00	8.24	16.92	24.00	1.20	
2	38		25.00	7.88	16.56	29.00	1.16	
2	53		40.00	6.89	15.57	44.00	1.10	
3	03		50.00	6.24	14.92	54.00	1.08	
3	23		70.00	5.11	13.79	74.00	1.06	
3	33		80.00	4.56	13.24	84.00	1.05	
3	53		100.00	3.49	12.17	104.00	1.04	

Pump Test 2: Well MG1996/3

PUMPING TEST SET-UP SHEET

WELL DESCRIPTION	**Owner** Hobart City Council		**Well No.** MG 1996/3		
	Address 16 Elizabeth Street		**Name/Site** McRobies Gully Waste Depot		
	Hobart				
	Tested by Mineral Resources Tasmania		**Date** 6 July 2000		
WELL CASING DETAILS	**Material Description**		**Diameter (mm)**	**From (m)**	**Seated (m)**
	4 inch sewer pipe		103	0	
	Screen length unknown				18.00
ENTRY DETAILS	**Type of entry**	**Aperture**	**Diameter (mm)**	**Top (m)**	**Bottom (m)**
	Screen seal at Unknown		**Gravel Pack size** 1 to 3 mm		
	Bottom cap 18.00 m		**Hole diameter** 165 mm		
AQUIFERS	**Aquifer type**	**above BWL below GL (m)**	**Date measured**	**From (m)**	**To (m)**
	Unconfined				
PUMP/HEADWORKS	**Type**	**Size** 4 inch		**Suction at** 15.5 m	
WATER LEVELS	**Measured by** Dip Probe	**Airline at**		**Reference pt** 95 m (agl)	
DISCHARGE MEASUREMENT	**Method used**	**Size (plate/tank)**		**Period of measurement**	
	Calibrated container and stop watch	9L container		3–9 minutes	
SKETCH SHOWING LOCATION OF ALL MEASURED WELLS					

DRAWDOWN SHEET **Sheet No 1 of 1**

MEASURED WELL	Owner N/A	Well No.	
	Address	Site	
PUMPED WELL	Owner Hobart City Council	Well No.	MG 1996/3
	Address 16 Elizabeth Street, Hobart	Site	McRobies Gully
TEST DETAILS	Date pumping commenced 06/09/00 Time 10.46 pm Date pumping ceased 06/07/00 Time 12.00 pm	Test No.	**2**
Are the measurements below for the pumped well? N/A		Distance from pumped well N/A	
Standing water level Or Static pressure	5.80 m below Meas. pt	Meas. pt below ground level 0.35 m	

WATCH TIME			ELAPSED TIME (t) min.	DRAWDOWN metres	WATER LEVEL OR PRESSURE metres	DISCHARGE		REMARKS, etc
h	min	am pm				Piezometer mm	L/s	
10	46	am	0.00	0.00	5.80	103		
10	48		2.00					Samples/ leachate odour
10	49		3.00				1.25	
10	50		4.00				0.50	Orange brown water
10	52		6.00				0.42	
10	54		8.00					Cloudy water
10	55		9.00				0.42	
10	56		10.00					Samples
10	58		12.00				0.20	
11	01		15.00					Pump obstruction
11	04		18.00				0.15	Clear water
11	09		23.00				0.15	
11	14		28.00				0.15	
11	20		34.00					Samples
11	22		36.00				0.13	
11	31		45.00				0.14	
11	41		55.00				0.12	
11	49		63.00				0.13	
11	58		72.00				0.13	
12	00	pm	74.00					End of pumping

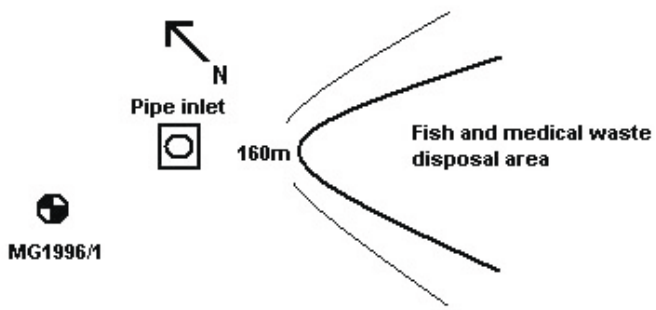
RECOVERY SHEET **Sheet No 1 of 1**

MEASURED WELL	Owner N/A					Well No.		
	Address					Site		
PUMPED WELL	Owner Hobart City Council					Well No. MG 1996/3		
	Address 16 Elizabeth Street, Hobart					Site McRobies Gully		
TEST DETAILS	Date pumping commenced 06/07/00 Time 10.46 pm					Test		
	Date pumping ceased 06/07/00 Time 12.00 pm					No. **2**		
Are the measurements below for the pumped well? N/A					Distance from pumped well N/A			
Standing water level Or Static pressure	5.80 m below Meas. pt				Meas. pt below ground level 0.35 m			

WATCH TIME			RECOVERY TIME (t_1) min.	RESIDUAL DRAWDOWN metres	WATER LEVEL OR PRESSURE metres	ELAPSED TIME (t) min.	t / t_1	REMARKS, etc
h	min	am pm						
12	00	pm	0.00	3.35	9.15	74.00	0.00	
12	01		1.00	3.16	8.96	75.00	75.00	Pump removed
12	02		2.00	2.85	8.79	76.00	38.00	Remaining numbers adjusted
12	03		3.00	2.76	8.70	77.00	25.67	(initial SWL = 5.94)
12	05		5.00	2.54	8.48	79.00	15.80	
12	07		7.00	2.34	8.28	81.00	11.57	
12	08		8.00	2.32	8.26	82.00	10.25	
12	10		10.00	2.21	8.15	84.00	8.40	
12	20		20.00	1.75	7.69	94.00	4.70	
12	30		30.00	1.48	7.42	104.00	3.47	
12	50		50.00	1.17	7.11	124.00	2.48	
1	10		70.00	1.00	6.94	144.00	2.06	
1	20		80.00	0.92	6.86	154.00	1.93	
1	40		100.00	0.83	6.77	174.00	1.74	
2	00		120.00	0.77	6.71	194.00	1.62	
3	00		180.00	0.61	6.55	254.00	1.41	
4	30		280.00	0.50	6.44	354.00	1.26	
6	00		370.00	0.48	6.42	444.00	1.20	
7	00		430.00	0.47	6.41	504.00	1.17	

Pump Test 3: Well MG1996/1

PUMPING TEST SET-UP SHEET

WELL DESCRIPTION	**Owner** Hobart City Council		**Well No.** MG 1996/1		
	Address 16 Elizabeth Street		**Name/Site** McRobies Gully Waste Depot		
	Hobart				
	Tested by Mineral Resources Tasmania		**Date** 7 July 2000		
WELL CASING DETAILS	**Material Description**		**Diameter (mm)**	**From (m)**	**Seated (m)**
	4 inch sewer pipe		103	0	
	Screen length unknown				12
ENTRY DETAILS	**Type of entry**	**Aperture**	**Diameter (mm)**	**Top (m)**	**Bottom (m)**
	Unknown				
	Screen seal at m		**Gravel Pack size** 1 to 3 mm		
	Bottom cap 12 m		**Hole diameter** 165 mm		
AQUIFERS	**Aquifer type**	**above BWL below GL (m)**	**Date measured**	**From (m)**	**To (m)**
	Unconfined				
PUMP/HEADWORKS	**Type**	**Size** 4 inch		**Suction at** 11.5 m	
WATER LEVELS	**Measured by** Dip Probe	**Airline at**		**Reference pt** 150 m (agl)	
DISCHARGE MEASUREMENT	**Method used**	**Size (plate/tank)**		**Period of measurement**	
	Calibrated container and stop watch	9L container		4-5 minutes	
SKETCH SHOWING LOCATION OF ALL MEASURED WELLS					

DRAWDOWN SHEET **Sheet No 1 of 1**

MEASURED WELL	Owner N/A					Well No.		
	Address					Site		
PUMPED WELL	Owner Hobart City Council					Well No. MG 1996/1		
	Address 16 Elizabeth Street, Hobart					Site McRobies Gully		
TEST DETAILS	Date pumping commenced 07/07/01 Time 12.06 pm					Test		
	Date pumping ceased 07/07/01 Time 1.05 pm					No. **3**		
Are the measurements below for the pumped well? N/A						Distance from pumped well N/A		
Standing water level 5.39 m below Meas. pt						Meas. pt below ground level 0.25 m		

WATCH TIME			ELAPSED TIME (t) min.	DRAWDOWN metres	WATER LEVEL OR PRESSURE metres	DISCHARGE		REMARKS, etc
h	min	am pm				Piezometer mm	L/s	
12	06	pm	0.00	0.00	5.39	103		Completed OH&S gear required
12	07		1.00	1.36	6.75			Black water/samples
12	08		2.00	3.03	8.42			Extreme H_2S odour
12	09		3.00	4.25	9.64			
12	10		4.00	4.46	9.85		0.66	
12	11		5.00	5.29	10.68			
12	12		6.00	5.87	11.26			Sample
12	15		9.00					Pump obstruction
12	16		10.00				0.50	
12	20		14.00				0.40	Slowly losing black colour
12	27		21.00				0.5	1222 samples
12	30		24.00				0.5	Slight reduce in odour
12	37		31.00				0.45	
12	45		39.00				0.40	1240 samples
12	51		45.00				0.40	
12	55		49.00				0.40	
1	00							Samples
1	05							Stopped pumping

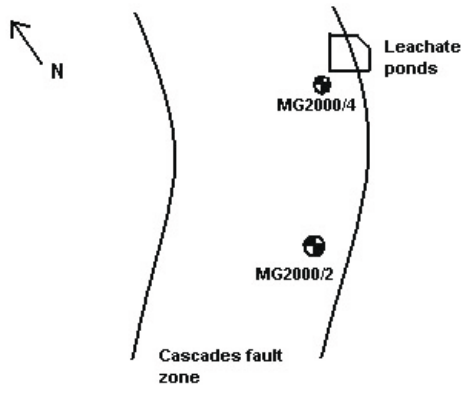
RECOVERY SHEET **Sheet No1 of 1**

MEASURED WELL	Owner N/A					Well No.		
	Address					Site		
PUMPED WELL	Owner Hobart City Council					Well No. MG 1996/1		
	Address 16 Elizabeth Street, Hobart					Site McRobies Gully		
TEST DETAILS	Date pumping commenced 07/07/01 Time 12.06 pm					Test		
	Date pumping ceased 07/07/01 Time 13.05 pm					No. **3**		
Are the measurements below for the pumped well? N/A					Distance from pumped well N/A			
Standing water level 5.39 m below Meas. pt					Meas. pt below ground level 0.25 m			

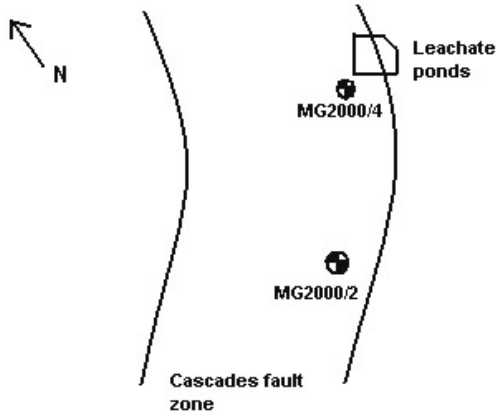
WATCH TIME			RECOVERY TIME (t_1) min.	RESIDUAL DRAWDOWN metres	WATER LEVEL OR PRESSURE metres	ELAPSED TIME (t) min.	t / t_1	REMARKS, etc
h	min	am pm						
1	05	pm	0.00	6.41	11.80	59.00	0.00	
1	06		1.00	4.46	9.85	60.00	60.00	
1	07		2.00	3.01	8.40	61.00	30.50	
1	08		3.00	2.39	7.78	62.00	20.66	
1	09		4.00	1.81	7.20	63.00	15.75	
1	10		5.00	1.65	7.04	64.00	12.80	
1	11		6.00	1.57	6.96	65.00	10.83	
1	12		7.00	1.49	6.88	66.00	9.43	
1	13		8.00	1.42	6.81	67.00	8.38	
1	14		9.00	1.35	6.74	68.00	7.56	
1	15		10.00	1.24	6.63	69.00	6.90	
1	20		15.00	1.06	6.45	74.00	4.93	
1	25		20.00	0.93	6.32	79.00	3.95	
1	30		25.00	0.87	6.26	84.00	3.36	
1	45		40.00	0.83	6.22	99.00	2.48	
1	55		50.00	0.71	6.10	109.00	2.18	
2	05		60.00	0.65	6.04	119.00	1.98	
2	25		80.00	0.58	5.97	139.00	1.74	
2	45		100.00	0.52	5.91	159.00	1.59	
3	05		120.00	0.47	5.86	179.00	1.49	
3	35		150.00	0.33	5.72	209.00	1.39	
4	05		180.00	0.37	5.76	239.00	1.33	

Pump Test 4: Well MG2000/2 (First attempt)

PUMPING TEST SET-UP SHEET

WELL DESCRIPTION	**Owner** Hobart City Council		**Well No.** MG 2000/2		
	Address 16 Elizabeth Street		**Name/Site** McRobies GullyWaste Depot		
	Hobart				
	Tested by Mineral Resources Tasmania		**Date** 5 April 2001		
WELL CASING DETAILS	**Material Description**		**Diameter (mm)**	**From (m)**	**Seated (m)**
	Class 12 PVC		80	0	54
	Class 12 PVC slotted screen		80	54	66
ENTRY DETAILS	**Type of entry**	**Aperture**	**Diameter (mm)**	**Top (m)**	**Bottom (m)**
	Cement			0	1.5
	Gravel		7	1.5	37
	Bentonite			37	40
	Coarse Sand		1-3	40	66
	Screen seal at 40 m		**Gravel Pack size** 1 to 4 mm		
	Bottom cap 66 m		**Hole diameter** 165 mm		
AQUIFERS	**Aquifer type**	**above BWL below GL (m)**	**Date measured**	**From (m)**	**To (m)**
	Semi confined	Below GL	4 October 2000	64	66
PUMP/HEADWORKS	**Type** Grundfos	**Size** SQE		**Suction at** 57m	
WATER LEVELS	**Measured by** Dip Probe	**Airline at**		**Reference pt** 145 m (agl)	
DISCHARGE MEASUREMENT	**Method used**	**Size (plate/tank)**		**Period of measurement**	
	Flow meter (m^3/day)	210 litre drum		Constant	
SKETCH SHOWING LOCATION OF ALL MEASURED WELLS					

PUMPING TEST SET-UP SHEET

WELL DESCRIPTION	**Owner** Hobart City Council		**Well No.** MG 2000/4		
	Address 16 Elizabeth Street		**Name/Site** McRobies Gully Waste Depot		
	Hobart				
	Tested by Mineral Resources Tasmania		**Date** 5 April 2001		
WELL CASING DETAILS	**Material Description**		**Diameter (mm)**	**From (m)**	**Seated (m)**
	Class 12 PVC pipe		80	0	19
	Class 12 PVC slotted screen		80	19	30
ENTRY DETAILS	**Type of entry**	**Aperture**	**Diameter (mm)**	**Top (m)**	**Bottom (m)**
	Cement			0	2
	Gravel		7	2	10
	Bentonite			10	12.5
	Coarse sand		1-3	12.5	30
	Screen seal at 12.5 m		**Gravel Pack size** 1 to 3 mm		
	Bottom cap 30 m		**Hole diameter** 165 mm		
AQUIFERS	**Aquifer type**	**above BWL below GL (m)**	**Date measured**	**From (m)**	**To (m)**
	Fractured	Below GL	9 October 2000	23	30
PUMP/HEADWORKS	**Type**	**Size**		**Suction at** m	
WATER LEVELS	**Measured by** Dip Probe	**Airline at**		**Reference pt** 97m (agl)	
DISCHARGE MEASUREMENT	**Method used**	**Size (plate/tank)**		**Period of measurement**	
SKETCH SHOWING LOCATION OF ALL MEASURED WELLS					

DRAWDOWN SHEET **Sheet No 1 of 1**

MEASURED WELL	Owner N/A					Well No.		
	Address					Site		
PUMPED WELL	Owner Hobart City Council					Well No. MG 2000/2		
	Address 16 Elizabeth Street, Hobart					Site McRobies Gully		
TEST DETAILS	Date pumping commenced 05/04/01 Time 12.30 pm					Test		
	Date pumping ceased 05/04/01 Time 2.15 pm					No. **4**		
Are the measurements below for the pumped well? N/A						Distance from pumped well N/A		
Standing water level Or Static pressure	42.99 m below Meas. pt					Meas. pt above ground level 0.58 m		

WATCH TIME			ELAPSED TIME (t) min.	DRAWDOWN metres	WATER LEVEL OR PRESSURE metres	DISCHARGE		REMARKS, etc
h	min	am pm				Piezometer mm	m^3/day	
12	30	pm	0.00	0.00	42.99	80	8.2	Light grey water
12	30.50		0.50	2.83	45.82			
12	31		1.00	4.19	47.18			Flow meter blockage
12	32		2.00	3.25	46.24			
12	33		3.00	1.62	44.61			
12	34		4.00	0.30	43.29			
12	36		6.00	0.30	43.29			
12	38		8.00	0.29	43.28			Flow 1239 – 0.06L/s
12	40		10.00	0.30	43.29			
12	45		15.00	0.21	43.21		12.25	Flow 43 – 0.06 L/s
12	50		20.00	0.23	43.22			
12	55		25.00	0.24	43.23			Flow – 0.06 L/s
1	00		30.00	0.28	43.27		12.26	Flow – 0/06 L/s
1	15		45.00	0.24	43.23			Flow 1.16 – 0.06 L/s
1	30		60.00	0.30	43.29		12.26	1.17 – 1.19 pink water
1	45		75.00	0.31	43.30			Flow 1.40 – 0.06 L/s
2	00		90.00	0.31	43.30		12.26	Flow 1.58 – 0.06 L/s
2	15							Pump test abandoned
								due to flow metre failure
								and lack of draw down

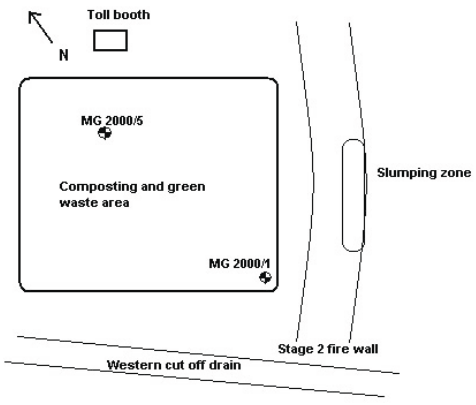
DRAWDOWN SHEET **Sheet No 1 of 1**

MEASURED WELL	Owner	Hobart City Council				Well No.	MG 2000/4	
	Address	16 Elizabeth Street, Hobart				Site	McRobies Gully	
PUMPED WELL	Owner	N/A				Well No.		
	Address					Site		
TEST DETAILS	Date pumping commenced 05/04/01 Time 12.30 pm						Test	
	Date pumping ceased 05/04/01 Time 2.15 pm						No. **4**	
Are the measurements below for the pumped well? No					Distance from pumped well 132 m			
Standing water level Or Static pressure	2.47 m below Meas. pt				Meas. pt above ground level 0.46 m			

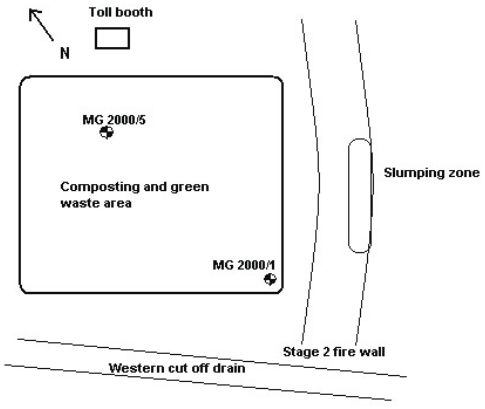
WATCH TIME			ELAPSED TIME (t) min.	DRAWDOWN metres	WATER LEVEL OR PRESSURE metres	DISCHARGE		REMARKS, etc
h	min	am pm				Piezometer mm	L/s	
12	30	pm	0.00	0.00	2.47	80		
12	45		15.00	0.00	2.47			
1	00		30.00	0.00	2.47			
1	15		45.00	0.00	2.47			
1	30		60.00	0.00	2.47			
2	00		90.00	0.00	2.47			No draw down
2	15							Pump test abandoned
								due to flow metre failure
								and lack of draw down

Pump Test 5: Well MG2000/1 (First attempt)

PUMPING TEST SET-UP SHEET

WELL DESCRIPTION	**Owner** Hobart City Council		**Well No.** MG 2000/1		
	Address 16 Elizabeth Street		**Name/Site** McRobies Gully Waste Depot		
	Hobart				
	Tested by Mineral Resources Tasmania		**Date** 9 April 2001		
WELL CASING DETAILS	**Material Description**		**Diameter (mm)**	**From (m)**	**Seated (m)**
	Class 12 PVC pipe		80	0	5.5
	Class 12 PVC pipe slotted screen		80	5.5	11.5
ENTRY DETAILS	**Type of entry**	**Aperture**	**Diameter (mm)**	**Top (m)**	**Bottom (m)**
	Cement			0	0.9
	Gravel		7	0.9	3.3
	Bentonite			3.3	3.8
	Coarse sand		1-3	3.8	11.5
	Screen seal at 3.8 m		**Gravel Pack size** 1 to 3 mm		
	Bottom cap 11.5 m		**Hole diameter** 280 mm		
AQUIFERS	**Aquifer type**	**above BWL below GL (m)**	**Date measured**	**From (m)**	**To (m)**
	Unconfined (fill material)	Below GL	10 October 2000	7.8	17.8
PUMP/HEADWORKS	**Type** Grundfos	**Size** SQE		**Suction at** 10.8 m	
WATER LEVELS	**Measured by** Dip Probe	**Airline at**		**Reference pt** 139m (agl)	
DISCHARGE MEASUREMENT	**Method used**	**Size (plate/tank)**		**Period of measurement**	
	Calibrated container and stop watch	Drum – 210L Container – 9 L			
SKETCH SHOWING LOCATION OF ALL MEASURED WELLS					

PUMPING TEST SET-UP SHEET

WELL DESCRIPTION	**Owner** Hobart City Council		**Well No.** MG 2000/5		
	Address 16 Elizabeth Street		**Name/Site** McRobies Gully Waste Depot		
	Hobart				
	Tested by Mineral Resources Tasmania		**Date** 9 April 2001		
WELL CASING DETAILS	**Material Description**		**Diameter (mm)**	**From (m)**	**Seated (m)**
	Class 12 PVC pipe		80	0	10.2
	Class 12 PVC slotted screen		80	10.2	16.2
ENTRY DETAILS	**Type of entry**	**Aperture**	**Diameter (mm)**	**Top (m)**	**Bottom (m)**
	Cement			0	0.9
	Gravel		7	0.9	7.0
	Bentonite			7.0	7.8
	Coarse sand		1-3	7.8	16.2
	Screen seal at 7.8 m		**Gravel Pack size** 1 to 3 mm		
	Bottom cap 16.2 m		**Hole diameter** 270 mm		
AQUIFERS	**Aquifer type**	**above BWL below GL (m)**	**Date measured**	**From (m)**	**To (m)**
	Unconfined	Below GL	11 October 2000	8.0	17.0
PUMP/HEADWORKS	**Type**	**Size**		**Suction at** m	
WATER LEVELS	**Measured by** Dip Probe	**Airline at**		**Reference pt** 144m (agl)	
DISCHARGE MEASUREMENT	**Method used**	**Size (plate/tank)**		**Period of measurement**	
SKETCH SHOWING LOCATION OF ALL MEASURED WELLS					

DRAWDOWN SHEET **Sheet No 1 of 1**

MEASURED WELL	Owner N/A					Well No.		
	Address					Site		
PUMPED WELL	Owner Hobart City Council					Well No. MG2000/1		
	Address 16 Elizabeth Street, Hobart					Site McRobies Gully		
TEST DETAILS	Date pumping commenced 09/04/01 Time 9.42 am Date pumping ceased 09/04/01 Time 9.43 am					Test No. **5**		
Are the measurements below for the pumped well? N/A						Distance from pumped well N/A		
Standing water level Or Static pressure	5.80 m below Meas. pt					Meas. pt above ground level 0.51 m		

WATCH TIME			ELAPSED TIME (t) min.	DRAWDOWN metres	WATER LEVEL OR PRESSURE metres	DISCHARGE		REMARKS, etc
h	min	am pm				Piezometer mm	L/s	
9	42	am	0.00	0.00	5.80	80	0.20	
9	43		1.00					Pump test abandoned due to OH&S critical incident situation

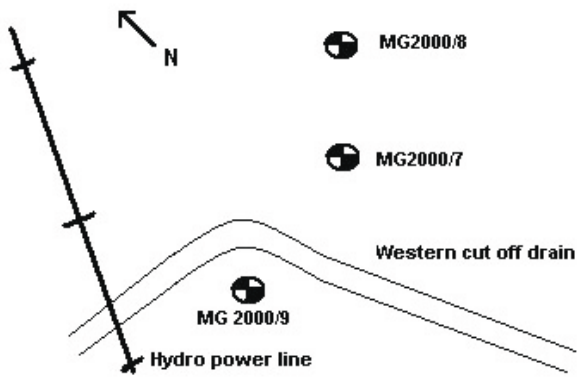
DRAWDOWN SHEET **Sheet No 1 of 1**

MEASURED WELL	Owner	Hobart City Council				Well No.	MG 2000/5	
	Address	16 Elizabeth Street, Hobart				Site	McRobies Gully	
PUMPED WELL	Owner	N/A				Well No.		
	Address					Site		
TEST DETAILS	Date pumping commenced 09/04/01 Time 9.42 am						Test	
	Date pumping ceased 09/04/01 Time 9.43 am						No. **5**	
Are the measurements below for the pumped well? No					Distance from pumped well 147 m			
Standing water level Or Static pressure	10.65 m below Meas. pt				Meas. pt above ground level 0.44 m			

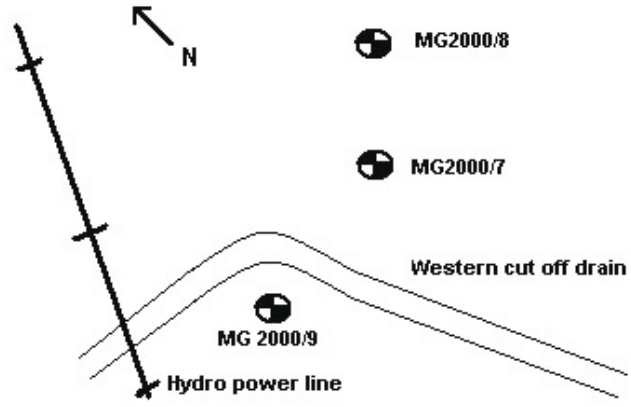
WATCH TIME			ELAPSED TIME (t) min.	DRAWDOWN metres	WATER LEVEL OR PRESSURE metres	DISCHARGE		REMARKS, etc
h	min	am pm				Piezometer mm	L/s	
9	42	am	0.00	0.00	10.65	80		
9	55	am	13.00	0.00	10.65			Pump test abandoned due to critical incident situation

Pump Test 6: Well MG2000/7

PUMPING TEST SET-UP SHEET

WELL DESCRIPTION	**Owner** Hobart City Council		**Well No.** MG 2000/7		
	Address 16 Elizabeth Street		**Name/Site** McRobies Gully Waste Depot		
	Hobart				
	Tested by Mineral Resources Tasmania		**Date** 10 April 2001		
WELL CASING DETAILS	**Material Description**		**Diameter (mm)**	**From (m)**	**Seated (m)**
	Class 12 PVC pipe		80	0	10
	Class 12 PVC slotted screen		80	10	16
ENTRY DETAILS	**Type of entry**	**Aperture**	**Diameter (mm)**	**Top (m)**	**Bottom (m)**
	Cement			0	0.9
	Gravel		7	0.9	7.0
	Bentonite			7.0	7.8
	Coarse sand		1-3	7.8	16.0
	Screen seal at 7.8 m		**Gravel Pack size** 1 to 3 mm		
	Bottom cap 16.0 m		**Hole diameter** 280 mm		
AQUIFERS	**Aquifer type**	**above BWL below GL (m)**	**Date measured**	**From (m)**	**To (m)**
	Unconfined	Below GL	17 October 2000	8.0	18.0
PUMP/HEADWORKS	**Type** Grundfos	**Size** SQE		**Suction at** 15.1 m	
WATER LEVELS	**Measured by** Dip Probe	**Airline at**		**Reference pt** 160m (agl)	
DISCHARGE MEASUREMENT	**Method used**	**Size (plate/tank)**		**Period of measurement**	
	Calibrated container and stop watch	Drum – 210L Container – 9L			
SKETCH SHOWING LOCATION OF ALL MEASURED WELLS					

PUMPING TEST SET-UP SHEET

WELL DESCRIPTION	**Owner** Hobart City Council		**Well No.** MG 2000/8		
	Address 16 Elizabeth Street		**Name/Site** McRobies Gully Waste Depot		
	Hobart				
	Tested by Mineral Resources Tasmania		**Date** 10 April 2001		
WELL CASING DETAILS	**Material Description**		**Diameter (mm)**	**From (m)**	**Seated (m)**
	Class 12 PVC		80	0	5.5
	Class 12 PVC slotted screen		80	5.5	11.5
ENTRY DETAILS	**Type of entry**	**Aperture**	**Diameter (mm)**	**Top (m)**	**Bottom (m)**
	Cement			0	1.0
	Gravel		7	1.0	3.0
	Bentonite			3.0	4.0
	Coarse sand		1-3	4.0	11.5
	Screen seal at 4.0 m		**Gravel Pack size** 1 to 3 mm		
	Bottom cap 11.5 m		**Hole diameter** 270 mm		
AQUIFERS	**Aquifer type**	**above BWL below GL (m)**	**Date measured**	**From (m)**	**To (m)**
	Unconfined	Below GL	17 October 2000	9.0	18.0
PUMP/HEADWORKS	**Type**	**Size**		**Suction at** m	
WATER LEVELS	**Measured by** Dip Probe	**Airline at**		**Reference pt** 160m (agl)	
DISCHARGE MEASUREMENT	**Method used**	**Size (plate/tank)**		**Period of measurement**	
SKETCH SHOWING LOCATION OF ALL MEASURED WELLS					

DRAWDOWN SHEET **Sheet No 1 of 1**

MEASURED WELL	Owner N/A					Well No.		
	Address					Site		
PUMPED WELL	Owner Hobart City Council					Well No. MG 2000/7		
	Address 16 Elizabeth Street, Hobart					Site McRobies Gully		
TEST DETAILS	Date pumping commenced 10/04/01 Time 12.15 pm					Test		
	Date pumping ceased 10/04/01 Time 1.45 pm					No. **6**		
Are the measurements below for the pumped well? N?A						Distance from pumped well N/A		
Standing water level Or Static pressure	11.01 m below Meas. pt					Meas. pt above ground level 0.63 m		

WATCH TIME			ELAPSED TIME (t) min.	DRAWDOWN metres	WATER LEVEL OR PRESSURE metres	DISCHARGE		REMARKS, etc
h	min	am pm				Piezometer mm	L/s	
12	15	pm	0.00	0.00	11.01	80	0.17	
12	15.50		0.50	0.87	11.88			
12	16		1.00	0.87	11.88			
12	17		2.00	0.64	11.65		0.17	
12	18		3.00	0.63	11.64			
12	19		4.00	0.80	11.81			
12	21		6.00	1.47	12.48		0.17	
12	23		8.00	1.57	12.58			
12	25		10.00	1.38	12.39		0.17	
12	30		15.00	0.77	11.78			
12	35		20.00	1.18	12.19		0.17	
12	40		25.00	1.32	12.33		0.17	
12	45		30.00	1.33	12.34			
1	00		45.00	1.29	12.30		0.17	
1	15		60.00	1.39	12.40		0.17	
1	30		75.00	1.25	12.26		0.17	
1	45		90.00	1.29	12.30			

DRAWDOWN SHEET **Sheet No 1 of 1**

MEASURED WELL	Owner	Hobart City Council				Well No.	MG 2000/8	
	Address	16 Elizabeth Street, Hobart				Site	McRobies Gully	
PUMPED WELL	Owner	N/A				Well No.		
	Address					Site		
TEST DETAILS	Date pumping commenced 10/04/01 Time 12.15 pm						Test	
	Date pumping ceased 10/04/01 Time 1.45 pm						No. **6**	
Are the measurements below for the pumped well? Same					Distance from pumped well 49 m			
Standing water level Or Static pressure	11.04 m below Meas. pt				Meas. pt above ground level 0.53 m			

WATCH TIME			ELAPSED TIME (t) min.	DRAWDOWN metres	WATER LEVEL OR PRESSURE metres	DISCHARGE		REMARKS, etc
h	min	am pm				Piezometer mm	L/s	
12	15	pm	0.00	0.00	11.04	80		
12	30		15.00	0.00	11.04			
12	45		30.00	0.00	11.04			
1	00		45.00	0.00	11.04			
1	15		60.00	0.00	11.04			
1	30		75.00	0.00	11.04			
1	45		90.00	0.00	11.04			No draw down

RECOVERY SHEET **Sheet No 1 of 1**

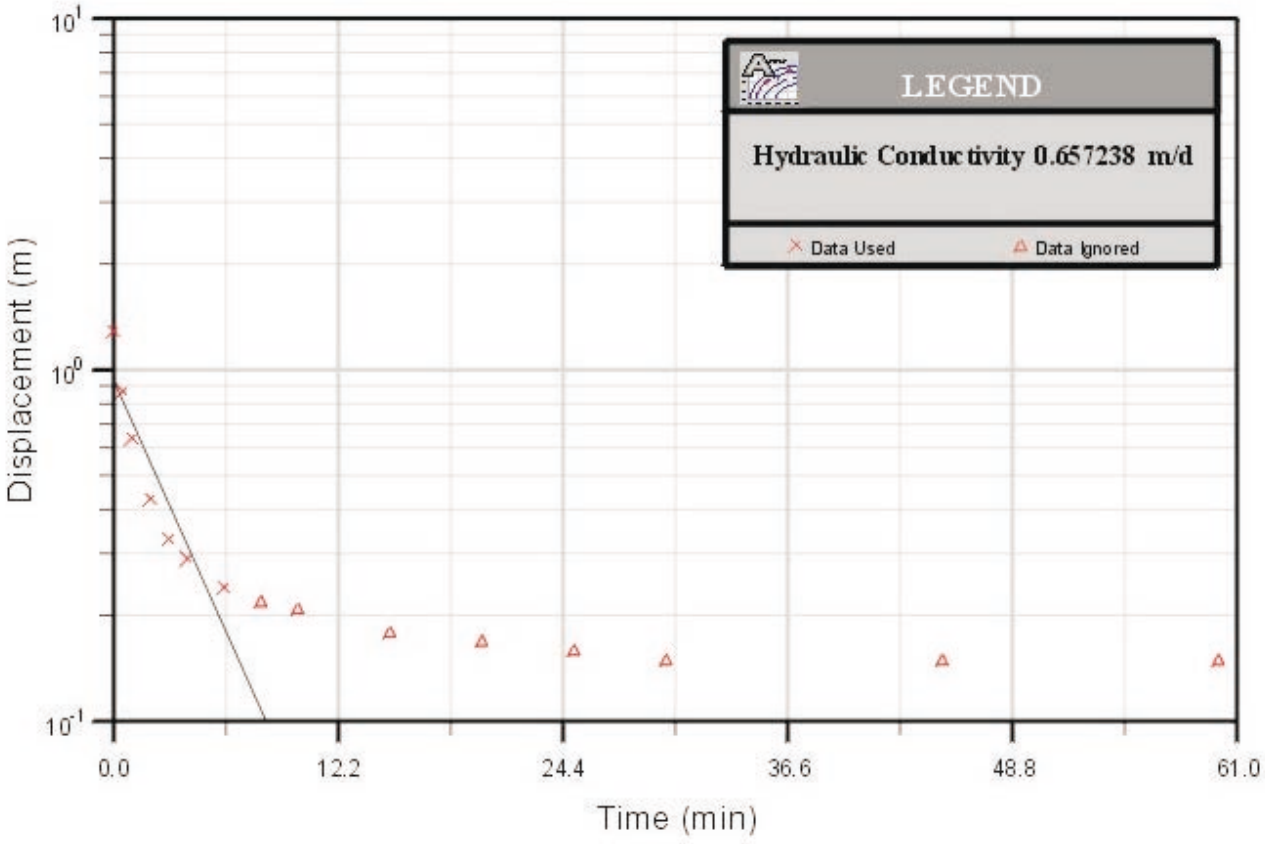
MEASURED WELL	Owner N/A					Well No.		
	Address					Site		
PUMPED WELL	Owner Hobart City Council					Well No. MG 2000/7		
	Address 16 Elizabeth Street, Hobart					Site McRobies Gully		
TEST DETAILS	Date pumping commenced 10/04/01 Time 12.15 pm					Test		
	Date pumping ceased10/04/01 Time 1.45 pm					No. **6**		
Are the measurements below for the pumped well? N/A					Distance from pumped well N/A			
Standing water level Or Static pressure	11.01 m below Meas. pt				Meas. pt above ground level 0.63 m			

WATCH TIME			RECOVERY TIME (t_1) min.	RESIDUAL DRAWDOWN metres	WATER LEVEL OR PRESSURE metres	ELAPSED TIME (t) min.	t / t_1	REMARKS, etc
h	min	am pm						
1	45	pm	0.00	1.29	12.30	90.00	0.00	
1	45.50		0.50	0.87	11.88	90.50	181.00	
1	46		1.00	0.64	11.65	91.00	91.00	
1	47		2.00	0.43	11.44	92.00	46.00	
1	48		3.00	0.33	11.34	93.00	31.00	
1	49		4.00	0.29	11.30	94.00	23.50	
1	51		6.00	0.24	11.25	96.00	16.00	
1	53		8.00	0.22	11.23	98.00	12.25	
1	55		10.00	0.21	11.22	100.00	10.00	
2	00		15.00	0.18	11.19	105.00	7.00	
2	05		20.00	0.17	11.18	110.00	5.50	
2	10		25.00	0.16	11.17	115.00	4.60	
2	15		30.00	0.15	11.16	120.00	4.00	
2	30		45.00	0.15	11.16	135.00	3.00	
2	45		60.00	0.15	11.16	150.00	2.50	

RECOVERY SHEET **Sheet No1 of 1**

MEASURED WELL	Owner	Hobart City Council				Well No.	MG 2000/8	
	Address	16 Elizabeth Street, Hobart				Site	McRobies Gully	
PUMPED WELL	Owner	N/A				Well No.		
	Address					Site		
TEST DETAILS	Date pumping commenced 10/04/01 Time 12.15 pm					Test No.	**6**	
	Date pumping ceased10/04/01 Time 1.45 pm							
Are the measurements below for the pumped well? Same					Distance from pumped well 49 m			
Standing water level Or Static pressure	11.04 m below Meas. pt				Meas. pt above ground level 0.53 m			

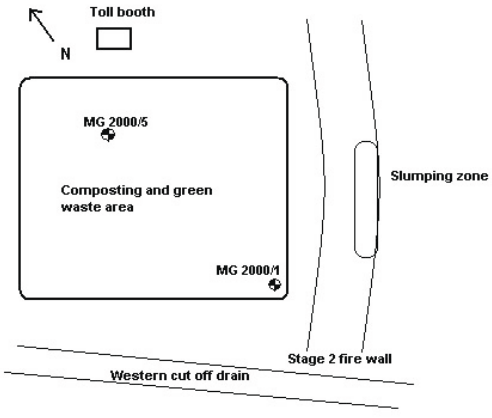
WATCH TIME			RECOVERY TIME (t_1) min.	RESIDUAL DRAWDOWN metres	WATER LEVEL OR PRESSURE metres	ELAPSED TIME (t) min.	t / t_1	REMARKS, etc
h	min	am pm						
1	45	pm	0.00	0.00	11.04	90.00	0.00	
2	00		15.00	0.00	11.04	105.00	7.00	
2	15		30.00	0.00	11.04	120.00	4.00	
2	30		45.00	0.00	11.04	135.00	3.00	
2	45		60.00	0.00	11.04	150.00	2.50	



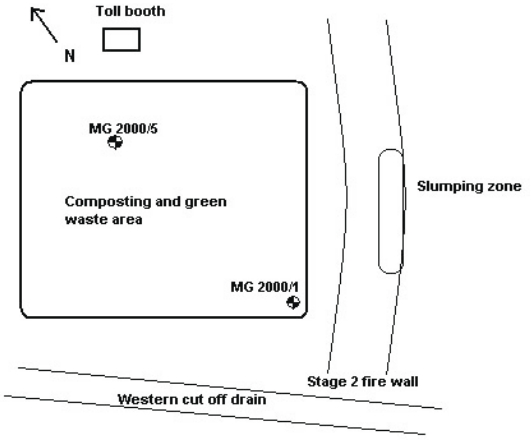
MG2000/7 RECOVERY – BOUWER AND RICE

Pump Test 7: Well MG2000/1 (Second attempt)

PUMPING TEST SET-UP SHEET

WELL DESCRIPTION	**Owner** Hobart City Council		**Well No.** MG 2000/1		
	Address 16 Elizabeth Street		**Name/Site** McRobies Gully Waste Depot		
	Hobart				
	Tested by Mineral Resources Tasmania		**Date** 10 April 2001		
WELL CASING DETAILS	**Material Description**		**Diameter (mm)**	**From (m)**	**Seated (m)**
	Class 12 PVC pipe		80	0	5.5
	Class 12 PVC pipe slotted screen		80	5.5	11.5
ENTRY DETAILS	**Type of entry**	**Aperture**	**Diameter (mm)**	**Top (m)**	**Bottom (m)**
	Cement			0	0.9
	Gravel		7	0.9	3.3
	Bentonite			3.3	3.8
	Coarse sand		1-3	3.8	11.5
	Screen seal at 3.8 m		**Gravel Pack size** 1 to 3 mm		
	Bottom cap 11.5 m		**Hole diameter** 280 mm		
AQUIFERS	**Aquifer type**	**above BWL below GL (m)**	**Date measured**	**From (m)**	**To (m)**
	Unconfined	Below GL	10 October 2000	7.8	17.8
PUMP/HEADWORKS	**Type** Grundfos	**Size** SQE		**Suction at** 9.8 m	
WATER LEVELS	**Measured by** Dip Probe	**Airline at**		**Reference pt** 139m (agl)	
DISCHARGE MEASUREMENT	**Method used**	**Size (plate/tank)**		**Period of measurement**	
	Calibrated container and stop watch	Drum – 210L Container – 9L			
SKETCH SHOWING LOCATION OF ALL MEASURED WELLS					

PUMPING TEST SET-UP SHEET

WELL DESCRIPTION	**Owner** Hobart City Council		**Well No.** MG 2000/5		
	Address 16 Elizabeth Street		**Name/Site** McRobies Gully Waste Depot		
	Hobart				
	Tested by Mineral Resources Tasmania		**Date** 10 April 2001		
WELL CASING DETAILS	**Material Description**		**Diameter (mm)**	**From (m)**	**Seated (m)**
	Class 12 PVC pipe		80	0	10.2
	Class 12 PVC slotted screen		80	10.2	16.2
ENTRY DETAILS	**Type of entry**	**Aperture**	**Diameter (mm)**	**Top (m)**	**Bottom (m)**
	Cement			0	0.9
	Gravel		7	0.9	7.0
	Bentonite			7.0	7.8
	Coarse sand		1-3	7.8	16.2
	Screen seal at 7.8 m		**Gravel Pack size** 1 to 3 mm		
	Bottom cap 16.2 m		**Hole diameter** 270 mm		
AQUIFERS	**Aquifer type**	**above BWL below GL (m)**	**Date measured**	**From (m)**	**To (m)**
	Unconfined	Below GL	11 October 2000	8.0	17.0
PUMP/HEADWORKS	**Type**	**Size**		**Suction at** m	
WATER LEVELS	**Measured by** Dip Probe	**Airline at**		**Reference pt** 144m (agl)	
DISCHARGE MEASUREMENT	**Method used**	**Size (plate/tank)**		**Period of measurement**	
SKETCH SHOWING LOCATION OF ALL MEASURED WELLS					

DRAWDOWN SHEET **Sheet No 1 of 1**

MEASURED WELL	Owner N/A					Well No.		
	Address					Site		
PUMPED WELL	Owner Hobart City Council					Well No. MG 2000/1		
	Address 16 Elizabeth Street, Hobart					Site McRobies Gully		
TEST DETAILS	Date pumping commenced 10/04/01 Time 9.15 am					Test		
	Date pumping ceased 10/04/01 Time 10.34 am					No. **7**		
Are the measurements below for the pumped well? N/A						Distance from pumped well N/A		
Standing water level Or Static pressure 5.76 m below Meas. pt						Meas. pt above ground level 0.35 m		

WATCH TIME			ELAPSED TIME (t) min.	DRAWDOWN metres	WATER LEVEL OR PRESSURE metres	DISCHARGE		REMARKS, etc
h	min	am pm				Piezometer mm	L/s	
9	15	am	0.00	0.00	5.76	80		
9	15.50		0.50	2.02	7.78			
9	16		1.00	2.11	7.87			
9	17		2.00	-0.38	5.38		0.07	
9	18		3.00	0.16	5.92			
9	19		4.00	0.16	5.92		0.07	
9	21		6.00	0.07	5.83			
9	23		8.00	0.11	5.87		0.07	
9	25		10.00	0.09	5.85			
9	30		15.00	0.13	5.89		0.07	
9	35		20.00	0.09	5.85			
9	40		25.00	0.12	5.88			
9	45		30.00	0.12	5.88		0.07	
10	00		45.00	0.11	5.87		0.07	
10	15		60.00	0.12	5.88			
10	30		75.00	0.11	5.87			
10	34		79.00	0.12	5.88			Pump automatically switched off (reason unknown)

DRAWDOWN SHEET **Sheet No 1 of 1**

MEASURED WELL	Owner	Hobart City Council				Well No.	MG 2000/5	
	Address	16 Elizabeth Street, Hobart				Site	McRobies Gully	
PUMPED WELL	Owner	N/A				Well No.		
	Address					Site		
TEST DETAILS	Date pumping commenced 10/04/01 Time 9.15 am						Test	
	Date pumping ceased 10/04/01 Time 10.34 am						No. **7**	
Are the measurements below for the pumped well? Yes					Distance from pumped well 250 m			
Standing water level Or Static pressure	11.80 m below Meas. pt				Meas. pt above ground level 0.54 m			

WATCH TIME			ELAPSED TIME (t) min.	DRAWDOWN metres	WATER LEVEL OR PRESSURE metres	DISCHARGE		REMARKS, etc
h	min	am pm				Piezometer mm	L/s	
9	15	am	0.00	0.00	11.80	80		
9	30		15.00	0.00	11.80			
9	45		30.00	0.00	11.80			
10	00		45.00	0.00	11.80			
10	15		60.00	0.00	11.80			
10	30		75.00	0.00	11.80			No draw down

RECOVERY SHEET **Sheet No 1 of 1**

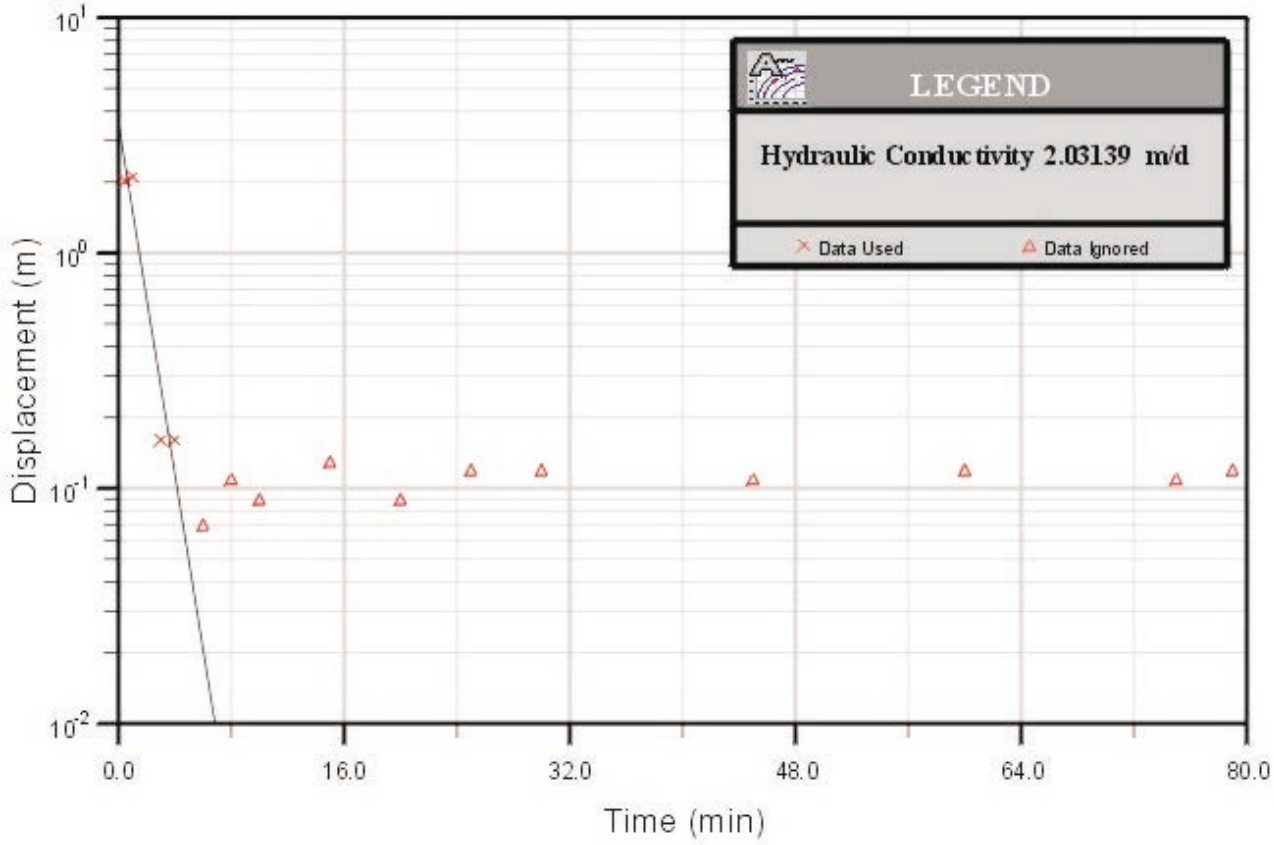
MEASURED WELL	Owner N/A					Well No.		
	Address					Site		
PUMPED WELL	Owner Hobart City Council					Well No. MG 2000/1		
	Address 16 Elizabeth Street, Hobart					Site McRobies Gully		
TEST DETAILS	Date pumping commenced 10/04/01 Time 9.15 am					Test		
	Date pumping ceased 10/04/01 Time 10.34 am					No. **7**		
Are the measurements below for the pumped well? N/A					Distance from pumped well N/A			
Standing water level Or Static pressure	5.76 m below Meas. pt				Meas. pt above ground level 0.35 m			

WATCH TIME			RECOVERY TIME (t_1) min.	RESIDUAL DRAWDOWN metres	WATER LEVEL OR PRESSURE metres	ELAPSED TIME (t) min.	t / t_1	REMARKS, etc
h	min	am pm						
10	34	am	0.00	1.12	5.88	79.00	0.00	
10	35		1.00	0.03	5.79	80.00	80.00	
10	36		2.00	0.00	5.76	81.00	40.50	Extremely rapid recovery
10	37		3.00	0.00	5.76	82.00	27.33	
10	38		4.00	0.00	5.76	83.00	20.75	
10	40		6.00	0.00	5.76	85.00	14.17	
10	42		8.00	0.00	5.76	87.00	10.86	
10	44		10.00	0.00	5.76	89.00	8.90	

RECOVERY SHEET **Sheet No 1 of 1**

MEASURED WELL	Owner	Hobart City Council			Well No.	MG 2000/5	
	Address	16 Elizabeth Street, Hobart			Site	McRobies Gully	
PUMPED WELL	Owner	N/A			Well No.		
	Address				Site		
TEST DETAILS	Date pumping commenced 10/04/01 Time 9.15 am					Test	
	Date pumping ceased 10/04/01 Time 10.34 am					No.	**7**
Are the measurements below for the pumped well? Yes					Distance from pumped well 250 m		
Standing water level Or Static pressure	11.80 m below Meas. pt				Meas. pt above ground level 0.54 m		

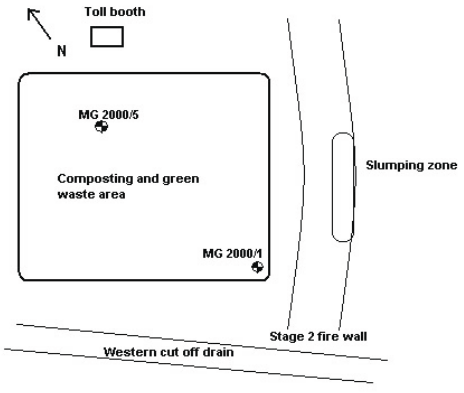
WATCH TIME			RECOVERY TIME (t_1) min.	RESIDUAL DRAWDOWN metres	WATER LEVEL OR PRESSURE metres	ELAPSED TIME (t) min.	t / t_1	REMARKS, etc
h	min	am pm						
10	35	am	1.00	0.00	11.80	78.00	78.00	
10	55		21.00	0.00	11.80	98.00	4.67	



MG2000/1 FIRST DRAWDOWN – BOUWER AND RICE

Pump Test 8: Well MG2000/1 (Third attempt)

PUMPING TEST SET-UP SHEET

WELL DESCRIPTION	**Owner** Hobart City Council		**Well No.** MG 2000/1		
	Address 16 Elizabeth Street		**Name/Site** McRobies Gully Waste Depot		
	Hobart				
	Tested by Mineral Resources Tasmania		**Date** 10 April 2001		
WELL CASING DETAILS	**Material Description**		**Diameter (mm)**	**From (m)**	**Seated (m)**
	Class 12 PVC pipe		80	0	5.5
	Class 12 PVC pipe slotted screen		80	5.5	11.5
ENTRY DETAILS	**Type of entry**	**Aperture**	**Diameter (mm)**	**Top (m)**	**Bottom (m)**
	Cement			0	0.9
	Gravel		7	0.9	3.3
	Bentonite			3.3	3.8
	Coarse sand		1-3	3.8	11.5
	Screen seal at 3.8 m		**Gravel Pack size** 1 to 3 mm		
	Bottom cap 11.5 m		**Hole diameter** 280 mm		
AQUIFERS	**Aquifer type**	**above BWL below GL (m)**	**Date measured**	**From (m)**	**To (m)**
	Unconfined	Below GL	10 October 2000	7.8	17.8
PUMP/HEADWORKS	**Type** Grundfos	**Size** SQE		**Suction at** 9.8 m	
WATER LEVELS	**Measured by** Dip Probe	**Airline at**		**Reference pt** 139m (agl)	
DISCHARGE MEASUREMENT	**Method used**	**Size (plate/tank)**		**Period of measurement**	
	Calibrated container and stop watch	Tank – 210L Container – 9L			
SKETCH SHOWING LOCATION OF ALL MEASURED WELLS					

DRAWDOWN SHEET **Sheet No 1 of 1**

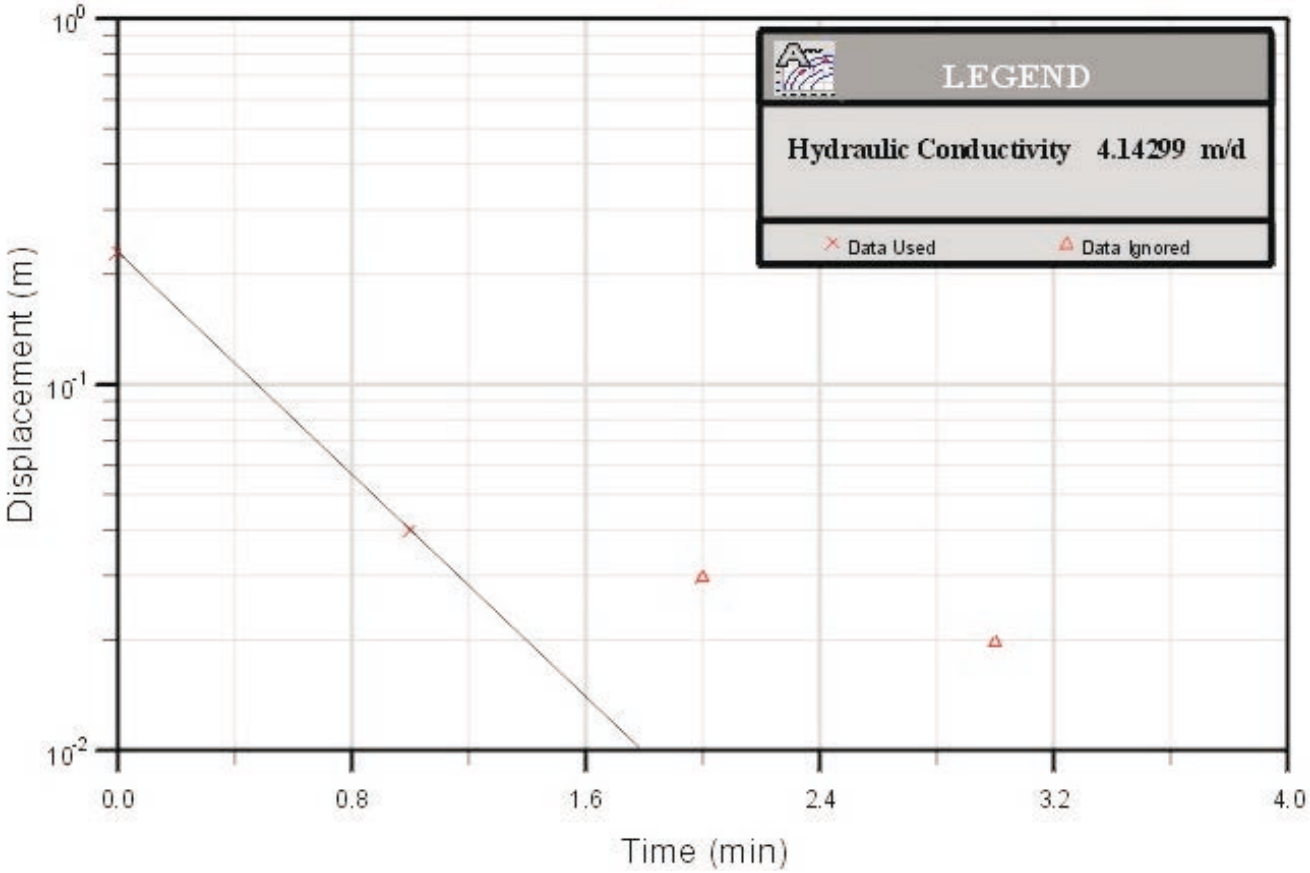
MEASURED WELL	Owner N/A					Well No.		
	Address					Site		
PUMPED WELL	Owner Hobart City Council					Well No. MG 2000/1		
	Address 16 Elizabeth Street, Hobart					Site McRobies Gully		
TEST DETAILS	Date pumping commenced 10/04/01 Time 11.00 am					Test		
	Date pumping ceased 10/04/01 Time 11.10 am					No. **8**		
Are the measurements below for the pumped well? N/A						Distance from pumped well N/A		
Standing water level Or Static pressure	5.76 m below Meas. pt					Meas. pt above ground level 0.35 m		

WATCH TIME			ELAPSED TIME (t) min.	DRAWDOWN metres	WATER LEVEL OR PRESSURE metres	DISCHARGE		REMARKS, etc
h	min	am pm				Piezometer mm	L/s	
11	00	am	0.00	0.00	5.76	80	0.10	
11	01.50		0.50	0.06	5.82			
11	01		1.00	0.23	5.96		0.10	
11	02		2.00	0.20	5.99		0.10	
11	03		3.00	0.20	5.99			
11	04		4.00	0.20	5.99		0.10	
11	06		6.00	0.20	5.99			
11	08		8.00	0.20	5.99		0.10	
11	10		10.00	0.20	5.99		0.10	

RECOVERY SHEET **Sheet No1 of 1**

MEASURED WELL	Owner N/A					Well No.		
	Address					Site		
PUMPED WELL	Owner Hobart City Council					Well No. MG 2000/1		
	Address 16 Elizabeth Street, Hobart					Site McRobies Gully		
TEST DETAILS	Date pumping commenced 10/04/01 Time 11.00 am					Test		
	Date pumping ceased 10/04/01 Time 11.10 am					No. **8**		
Are the measurements below for the pumped well? N/A					Distance from pumped well N/A			
Standing water level Or Static pressure	5.76 m below Meas. pt				Meas. pt above ground level 0.35 m			

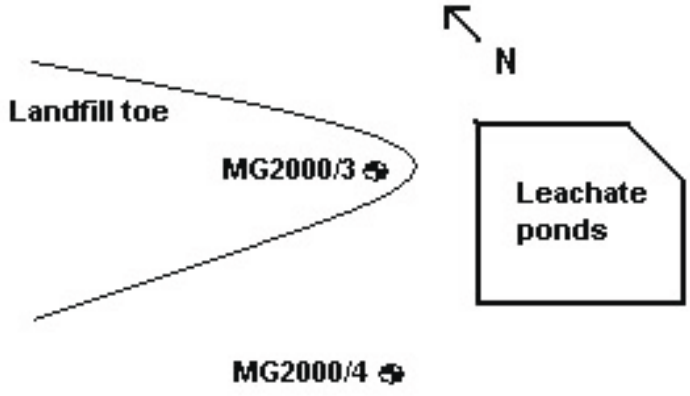
WATCH TIME			RECOVERY TIME (t_1) min.	RESIDUAL DRAWDOWN metres	WATER LEVEL OR PRESSURE metres	ELAPSED TIME (t) min.	t / t_1	REMARKS, etc
h	min	am pm						
11	10	am	0.00	0.23	5.99	10.00	0.00	
11	11		1.00	0.04	5.80	11.00	11.00	
11	12		2.00	0.03	5.79	12.00	6.00	
11	13		3.00	0.02	5.78	13.00	4.33	
11	14		4.00	0.00	5.76	14.00	3.50	
11	16		6.00	0.00	5.76	16.00	2.66	



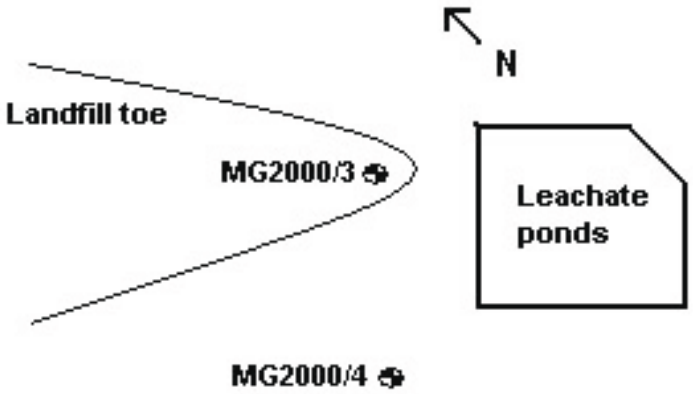
MG2000/1 SECOND RECOVERY – BOUWER AND RICE

Pump Test 9: Well MG2000/4 (First attempt)

PUMPING TEST SET-UP SHEET

WELL DESCRIPTION	**Owner** Hobart City Council		**Well No.** MG 2000/4		
	Address 16 Elizabeth Street		**Name/Site** McRobies Gully Waste Depot		
	Hobart				
	Tested by Mineral Resources Tasmania		**Date** 12 April 2001		
WELL CASING DETAILS	**Material Description**		**Diameter (mm)**	**From (m)**	**Seated (m)**
	Class 12 PVC pipe		80	0	19
	Class 12 PVC slotted screen		80	19	30
ENTRY DETAILS	**Type of entry**	**Aperture**	**Diameter (mm)**	**Top (m)**	**Bottom (m)**
	Cement			0	2
	Gravel		7	2	10
	Bentonite			10	12.5
	Coarse sand		1-3	12.5	30
	Screen seal at 12.5 m		**Gravel Pack size** 1 to 3 mm		
	Bottom cap 30 m		**Hole diameter** 165 mm		
AQUIFERS	**Aquifer type**	**above BWL below GL (m)**	**Date measured**	**From (m)**	**To (m)**
	Fractured	Below GL	9 October 2000	23	30
PUMP/HEADWORKS	**Type** Grundfos	**Size** SQE		**Suction at** 28.37m	
WATER LEVELS	**Measured by** Dip Probe	**Airline at**		**Reference pt** 97m (agl)	
DISCHARGE MEASUREMENT	**Method used**	**Size (plate/tank)**		**Period of measurement**	
	Calibrated container and stop watch	Drum – 210L Container – 9L			
SKETCH SHOWING LOCATION OF ALL MEASURED WELLS					

PUMPING TEST SET-UP SHEET

WELL DESCRIPTION	**Owner** Hobart City Council		**Well No.** MG 2000/3		
	Address 16 Elizabeth Street		**Name/Site** McRobies Gully Waste Depot		
	Hobart				
	Tested by Mineral Resources Tasmania		**Date** 12 April 2001		
WELL CASING DETAILS	**Material Description**		**Diameter (mm)**	**From (m)**	**Seated (m)**
	Class 12 PVC pipe		80	0	5.5
	Class 12 PVC slotted screen		80	5.5	6.5
ENTRY DETAILS	**Type of entry**	**Aperture**	**Diameter (mm)**	**Top (m)**	**Bottom (m)**
	Cement			0	1.0
	Gravel		7	1.0	2.5
	Bentonite			2.5	3.0
	Coarse sand		1-3	3.0	6.5
	Screen seal at 3.0 m		**Gravel Pack size** 1 to 3 mm		
	Bottom cap 6.5 m		**Hole diameter** 165 mm		
AQUIFERS	**Aquifer type**	**above BWL below GL (m)**	**Date measured**	**From (m)**	**To (m)**
	Unconfined	Below GL	8 October 2000	5.2	12.0
PUMP/HEADWORKS	**Type**	**Size**		**Suction at** m	
WATER LEVELS	**Measured by** Dip Probe	**Airline at**		**Reference pt** 97m (agl)	
DISCHARGE MEASUREMENT	**Method used**	**Size (plate/tank)**		**Period of measurement**	
SKETCH SHOWING LOCATION OF ALL MEASURED WELLS					

DRAWDOWN SHEET **Sheet No 1 of 1**

MEASURED WELL	Owner N/A					Well No.		
	Address					Site		
PUMPED WELL	Owner Hobart City Council					Well No. MG 2000/4		
	Address 16 Elizabeth Street, Hobart					Site McRobies Gully		
TEST DETAILS	Date pumping commenced 12/04/01 Time 10.30 am					Test		
	Date pumping ceased 12/04/01 Time 11.30 am					No. **9**		
Are the measurements below for the pumped well? N/A						Distance from pumped well N/A		
Standing water level Or Static pressure 3.12 m below Meas. pt						Meas. pt above ground level 0.51 m		

WATCH TIME			ELAPSED TIME (t) min.	DRAWDOWN metres	WATER LEVEL OR PRESSURE metres	DISCHARGE		REMARKS, etc
h	min	am pm				Piezometer mm	L/s	
10	30	am	0.00	0.00	3.12	80	0.4	
10	30.50		0.50	4.36	7.48			
10	31		1.00	5.90	9.02			
10	32		2.00	9.66	12.78		0.4	
10	33		3.00	12.86	15.98			
10	34		4.00	15.30	18.42			
10	36		6.00	18.73	21.85			
10	38		8.00	21.45	24.57			
10	40		10.00	24.12	27.24		0.3	
10	45		15.00				0.3	Water level below top of pump
11	15		45.00				0.2	
11	30		60.00				0.2	Total volume removed approximately 930 litres.

DRAWDOWN SHEET **Sheet No1 of 1**

MEASURED WELL	Owner	Hobart City Council				Well No.	MG 2000/3	
	Address	16 Elizabeth Street, Hobart				Site	McRobies Gully	
PUMPED WELL	Owner	N/A				Well No.		
	Address					Site		
TEST DETAILS	Date pumping commenced 12/04/00 Time 10.30 am						Test	
	Date pumping ceased 12/04/00 Time 11.30 am						No. **9**	
Are the measurements below for the pumped well? No					Distance from pumped well 14.4 m			
Standing water level Or Static pressure	3.31 m below Meas. pt				Meas. pt above ground level 0.61 m			

WATCH TIME			ELAPSED TIME (t) min.	DRAWDOWN metres	WATER LEVEL OR PRESSURE metres	DISCHARGE		REMARKS, etc
h	min	am pm				Piezometer mm	L/s	
10	30	am	0.00	0.00	3.32	80		
10	45		15.00	0.20	3.52			
11	00		30.00	0.44	3.76			
11	15		45.00	0.64	3.96			
11	30		60.00	0.80	4.12			

RECOVERY SHEET **Sheet No1 of 1**

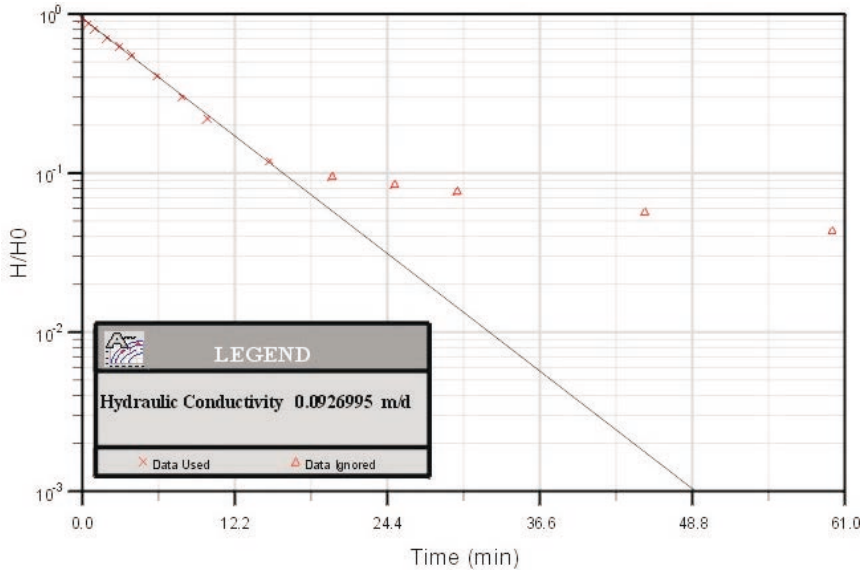
MEASURED WELL	Owner N/A					Well No.		
	Address					Site		
PUMPED WELL	Owner Hobart City Council					Well No. MG 2000/4		
	Address 16 Elizabeth Street, Hobart					Site McRobies Gully		
TEST DETAILS	Date pumping commenced 12/04/01 Time 10.30 am Date pumping ceased 12/04/01 Time 11.30 am					Test No. **9**		
Are the measurements below for the pumped well? N/A						Distance from pumped well N/A		
Standing water level Or Static pressure	3.12 m below Meas. pt					Meas. pt above ground level 0.51 m		

WATCH TIME			RECOVERY TIME (t_1) min.	RESIDUAL DRAWDOWN metres	WATER LEVEL OR PRESSURE metres	ELAPSED TIME (t) min.	t / t_1	REMARKS, etc
h	min	am pm						
11	30	am	0.00	25.25	28.37	60.00	0.00	
11	30.50		0.50	23.52	26.64	60.50	121.00	
11	31		1.00	21.87	24.99	61.00	61.00	
11	32		2.00	19.13	22.25	62.00	31.00	
11	33		3.00	16.97	20.09	63.00	21.00	
11	34		4.00	14.91	18.03	64.00	16.00	
11	36		6.00	11.05	14.17	66.00	11.00	
11	38		8.00	8.13	11.25	68.00	8.50	
11	40		10.00	5.94	9.06	70.00	7.00	
11	45		15.00	3.23	6.35	75.00	6.00	
11	50		20.00	2.60	5.72	80.00	4.00	
11	55		25.00	2.32	5.44	85.00	3.40	
12	00		30.00	2.10	5.22	90.00	3.00	
12	15		45.00	1.56	4.68	105.00	2.33	
12	30		60.00	1.19	4.31	120.00	2.00	

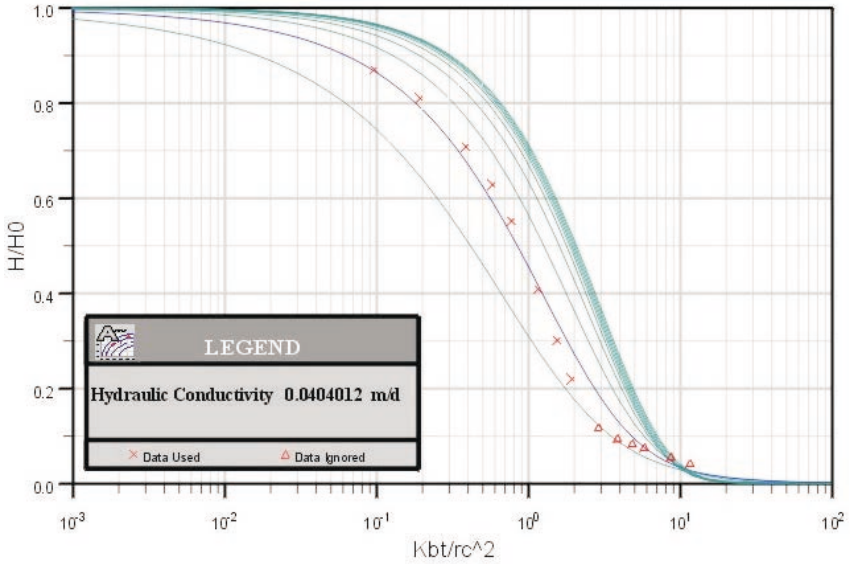
RECOVERY SHEET **Sheet No 1 of 1**

MEASURED WELL	Owner	Hobart City Council		Well No.	MG 2000/3
	Address	16 Elizabeth Street, Hobart		Site	McRobies Gully
PUMPED WELL	Owner	N/A		Well No.	
	Address			Site	
TEST DETAILS	Date pumping commenced 12/04/01 Time 10.30 am			Test No.	**9**
	Date pumping ceased 12/04/01 Time 11.30 am				
Are the measurements below for the pumped well? No			Distance from pumped well 14.4 m		
Standing water level Or Static pressure	3.32 m below Meas. pt		Meas. pt above ground level 0.61 m		

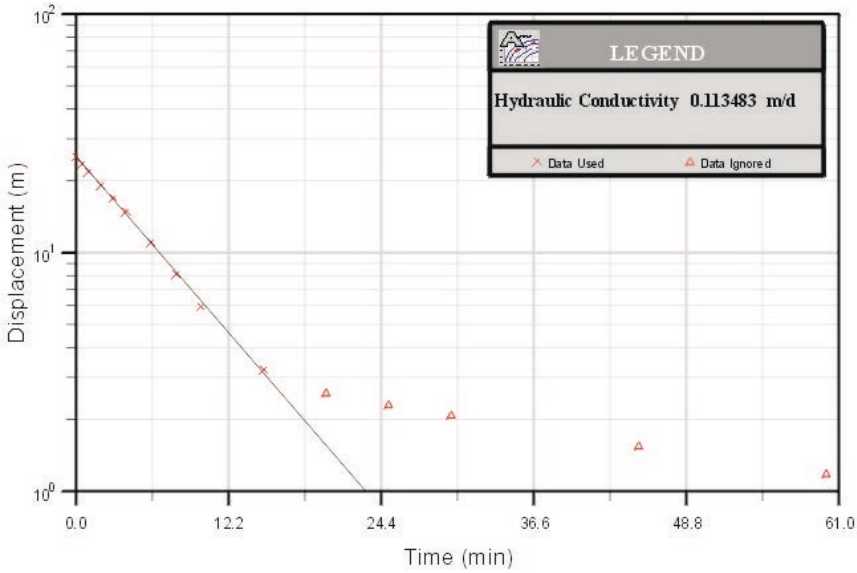
WATCH TIME			RECOVERY TIME (t_1) min.	RESIDUAL DRAWDOWN metres	WATER LEVEL OR PRESSURE metres	ELAPSED TIME (t) min.	t / t_1	REMARKS, etc
h	min	am pm						
11	30	am	0.00	0.80	4.12	60.00	0.00	
11	30.50		0.50	0.80	4.12	60.50	121.00	
11	31		1.00	0.81	4.13	61.00	61.00	
11	32		2.00	0.82	4.14	62.00	31.00	
11	33		3.00	0.83	4.15	63.00	21.00	
11	34		4.00	0.83	4.15	64.00	16.00	
11	36		6.00	0.85	4.17	66.00	11.00	
11	38		8.00	0.85	4.17	68.00	8.50	
11	40		10.00	0.86	4.18	70.00	7.00	
11	45		15.00	0.85	4.17	75.00	5.00	
11	50		20.00	0.83	4.15	80.00	4.00	
11	55		25.00	0.79	4.11	85.00	3.401	
12	00	pm	30.00	0.75	4.07	90.00	3.00	
12	15		45.00	0.62	3.94	105.00	2.33	
12	30		60.00	0.50	3.82	120.00	2.00	



MG2000/4 FIRST RECOVERY — HVORSLEV, 1951



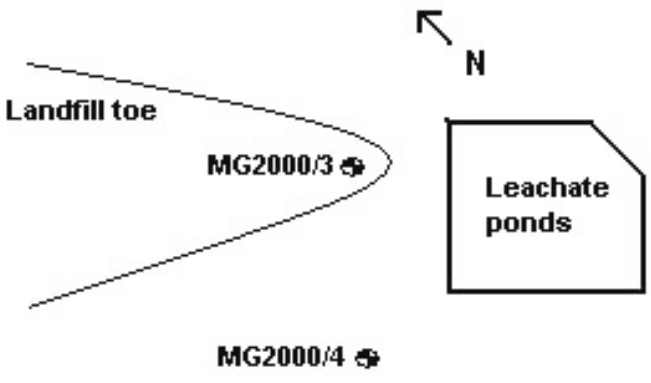
MG2000/4 FIRST RECOVERY — KGS MODEL



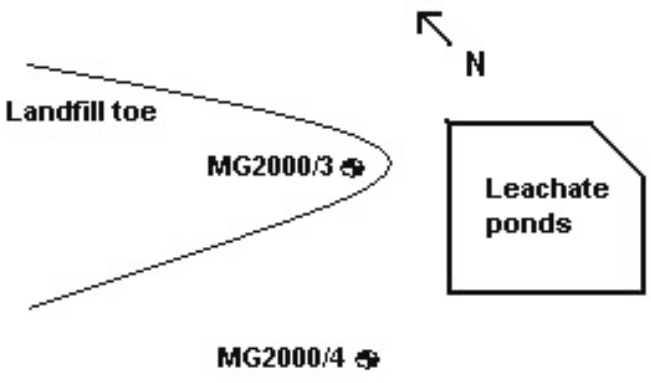
MG2000/4 FIRST RECOVERY — BOUWER AND RICE, 1976

Pump Test 10: Well MG2000/4 (Second attempt)

PUMPING TEST SET-UP SHEET

WELL DESCRIPTION	**Owner** Hobart City Council		**Well No.** MG 2000/4		
	Address 16 Elizabeth Street		**Name/Site** McRobies Gully Waste Depot		
	Hobart				
	Tested by Mineral Resources Tasmania		**Date** 2 May 2001		
WELL CASING DETAILS	**Material Description**		**Diameter (mm)**	**From (m)**	**Seated (m)**
	Class 12 PVC pipe		80	0	19
	Class 12 PVC slotted screen		80	19	30
ENTRY DETAILS	**Type of entry**	**Aperture**	**Diameter (mm)**	**Top (m)**	**Bottom (m)**
	Cement			0	2
	Gravel		7	2	10
	Bentonite			10	12.5
	Coarse sand		1-3	12.5	30
	Screen seal at 12.5 m		**Gravel Pack size** 1 to 3 mm		
	Bottom cap 30 m		**Hole diameter** 165 mm		
AQUIFERS	**Aquifer type**	**above BWL below GL (m)**	**Date measured**	**From (m)**	**To (m)**
	Fractured	Below GL	9 October 2000	23	30
PUMP/HEADWORKS	**Type** Grundfos	**Size** SQE		**Suction at** 28.0 m	
WATER LEVELS	**Measured by** Dip Probe	**Airline at**		**Reference pt** 97m (agl)	
DISCHARGE MEASUREMENT	**Method used**	**Size (plate/tank)**		**Period of measurement**	
	Calibrated container and stop watch	Drum – 210L Container – 9L			
SKETCH SHOWING LOCATION OF ALL MEASURED WELLS					

PUMPING TEST SET-UP SHEET

WELL DESCRIPTION	**Owner** Hobart City Council		**Well No.** MG 2000/3		
	Address 16 Elizabeth Street		**Name/Site** McRobies Gully Waste Depot		
	Hobart				
	Tested by Mineral Resources Tasmania		**Date** 2 May 2001		
WELL CASING DETAILS	**Material Description**		**Diameter (mm)**	**From (m)**	**Seated (m)**
	Class 12 PVC pipe		80	0	5.5
	Class 12 PVC slotted screen		80	5.5	6.5
ENTRY DETAILS	**Type of entry**	**Aperture**	**Diameter (mm)**	**Top (m)**	**Bottom (m)**
	Cement			0	1.0
	Gravel		7	1.0	2.5
	Bentonite			2.5	3.0
	Coarse sand		1-3	3.0	6.5
	Screen seal at 3.0 m		**Gravel Pack size** 1 to 3 mm		
	Bottom cap 6.5 m		**Hole diameter** 165 mm		
AQUIFERS	**Aquifer type**	**above BWL below GL (m)**	**Date measured**	**From (m)**	**To (m)**
	Unconfined	Below GL	8 October 2000	5.2	12.0
PUMP/HEADWORKS	**Type**	**Size**		**Suction at** m	
WATER LEVELS	**Measured by** Dip Probe	**Airline at**		**Reference pt** 97m (agl)	
DISCHARGE MEASUREMENT	**Method used**	**Size (plate/tank)**		**Period of measurement**	
SKETCH SHOWING LOCATION OF ALL MEASURED WELLS					

DRAWDOWN SHEET **Sheet No 1 of 1**

MEASURED WELL	Owner N/A					Well No.		
	Address					Site		
PUMPED WELL	Owner Hobart City Council					Well No. MG 2000/4		
	Address 16 Elizabeth Street, Hobart					Site McRobies Gully		
TEST DETAILS	Date pumping commenced 02/05/01 Time 9.45 am Date pumping ceased 02/05/01 Time 11.45 am					Test No. **10**		
Are the measurements below for the pumped well? N/A						Distance from pumped well N/A		
Standing water level Or Static pressure	2.76 m below Meas. pt					Meas. pt above ground level 0.46 m		

WATCH TIME			ELAPSED TIME (t) min.	DRAWDOWN metres	WATER LEVEL OR PRESSURE metres	DISCHARGE		REMARKS, etc
h	min	am pm				Piezometer mm	L/s	
9	45	am	0.00	0.00	2.76	80	0.17	Strong H_2S odour from water
9	45.50		0.50	1.53	4.29			
9	46		1.00	1.82	4.58			
9	47		2.00	2.32	5.08			
9	48		3.00	2.94	5.07		0.13	
9	49		4.00	3.44	6.20		0.20	Gate valve adjusted
9	51		6.00	5.17	7.93		0.20	
9	53		8.00	5.33	8.09		0.17	
9	55		10.00	5.50	8.26		0.17	
10	00		15.00	5.84	8.60		0.13	Samples
10	05		20.00	6.15	8.91		0.13	
10	10		25.00	6.35	9.11		0.13	
10	15		30.00	6.50	9.26		0.13	Samples
10	30		45.00	6.88	9.64		0.13	
10	45		60.00	7.20	9.96		0.13	Samples
11	00		75.00	7.47	10.23		0.13	
11	15		90.00	7.70	10.46		0.13	
11	45		120.00	8.12	10.88		0.13	

DRAWDOWN SHEET **Sheet No 1 of 1**

MEASURED WELL	Owner	Hobart City Council				Well No.	MG 2000/3	
	Address	16 Elizabeth Street, Hobart				Site	McRobies Gully	
PUMPED WELL	Owner	N/A				Well No.		
	Address					Site		
TEST DETAILS	Date pumping commenced 02/05/01 Time 9.45 am					Test		
	Date pumping ceased 02/05/01 Time 11.45 am					No.	**10**	
Are the measurements below for the pumped well? N/A					Distance from pumped well 14.4 m			
Standing water level Or Static pressure	3.35 m below Meas. pt				Meas. pt above ground level 0.61 m			

WATCH TIME			ELAPSED TIME (t) min.	DRAWDOWN metres	WATER LEVEL OR PRESSURE metres	DISCHARGE		REMARKS, etc
h	min	am pm				Piezometer mm	L/s	
9	45	am	0.00	0.00	3.35	80		
10	00		15.00	0.14	3.49			
10	15		30.00	0.32	3.67			
10	30		45.00	0.48	3.83			
10	45		60.00	0.58	3.93			
11	00		75.00	0.69	4.04			
11	15		90.00	0.76	4.11			
11	30		105.00	0.83	4.18			
11	45		120.00	0.89	4.24			

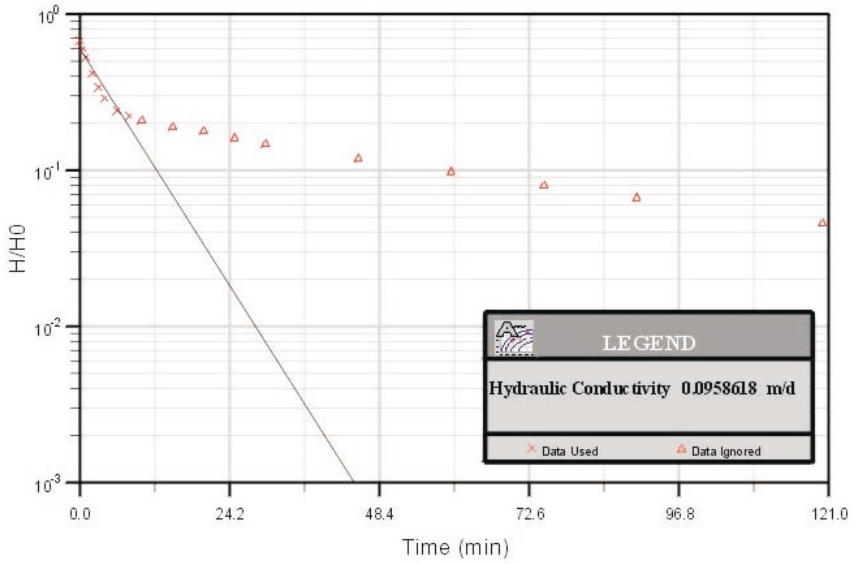
RECOVERY SHEET **Sheet No 1 of 1**

MEASURED WELL			Owner N/A				Well No.	
			Address				Site	
PUMPED WELL			Owner Hobart City Council				Well No. MG 2000/4	
			Address 16 Elizabeth Street, Hobart				Site McRobies Gully	
TEST DETAILS			Date pumping commenced 02/05/01 Time 9.45 am Date pumping ceased 02/05/01 Time 11.45 am				Test No. **10**	
Are the measurements below for the pumped well? N/A						Distance from pumped well N/A		
Standing water level Or Static pressure			2.76 m below Meas. pt			Meas. pt above ground level 0.46 m		
WATCH TIME			RECOVERY TIME (t_1) min.	RESIDUAL DRAWDOWN metres	WATER LEVEL OR PRESSURE metres	ELAPSED TIME (t) min.	t / t_1	REMARKS, etc
h	min	am pm						
11	45	am	0.00	8.12	10.88	120.00	0.00	
11	45.05		0.50	7.21	9.97	120.50	241.00	
11	46		1.00	6.37	9.13	121.00	121.00	
11	47		2.00	5.02	7.78	122.00	61.00	
11	48		3.00	4.08	6.84	123.00	41.00	
11	49		4.00	3.47	6.23	124.00	31.00	
11	51		6.00	2.89	5.65	126.00	21.00	
11	53		8.00	2.67	5.43	128.00	16.00	
11	55		10.00	2.55	5.31	130.00	13.00	
12	00	pm	15.00	2.31	5.07	135.00	9.00	
12	05		20.00	2.18	4.94	140.00	7.00	
12	10		25.00	1.96	4.72	145.00	5.80	
12	15		30.00	1.80	4.56	150.00	5.00	
12	30		45.00	1.45	4.21	165.00	3.67	
12	45		60.00	1.19	3.95	180.00	3.00	
1	00		75.00	0.98	3.74	195.00	2.60	
1	15		90.00	0.81	3.58	210.00	2.34	
1	45		120.00	0.56	3.32	240.00	2.00	

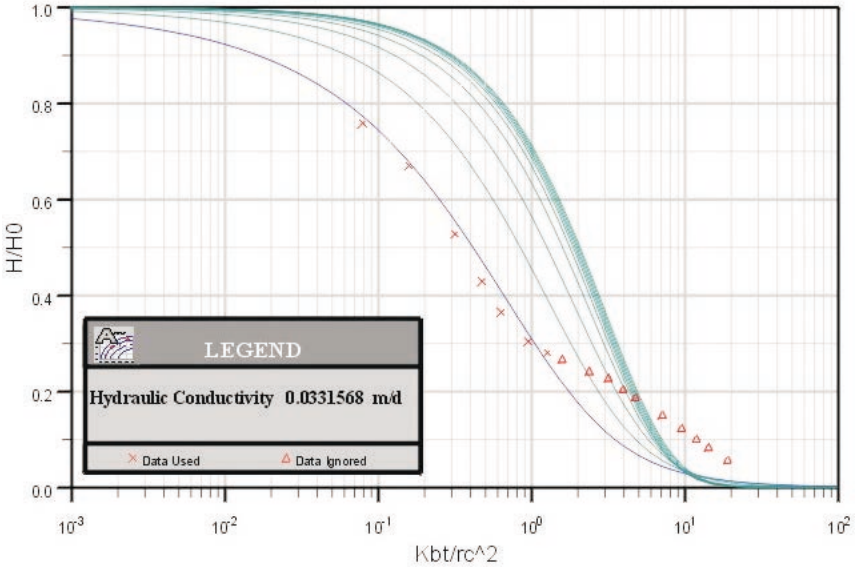
RECOVERY SHEET **Sheet No 1 of 1**

MEASURED WELL	Owner	Hobart City Council		Well No.	MG 2000/3
	Address	16 Elizabeth Street, Hobart		Site	McRobies Gully
PUMPED WELL	Owner	N/A		Well No.	
	Address			Site	
TEST DETAILS	Date pumping commenced 02/05/01 Time 9.45 am			Test No.	**10**
	Date pumping ceased02/05/01 Time 11.45 am				
Are the measurements below for the pumped well? No			Distance from pumped well 14.4 m		
Standing water level Or Static pressure	3.35 m below Meas. pt		Meas. pt above ground level 0.61 m		

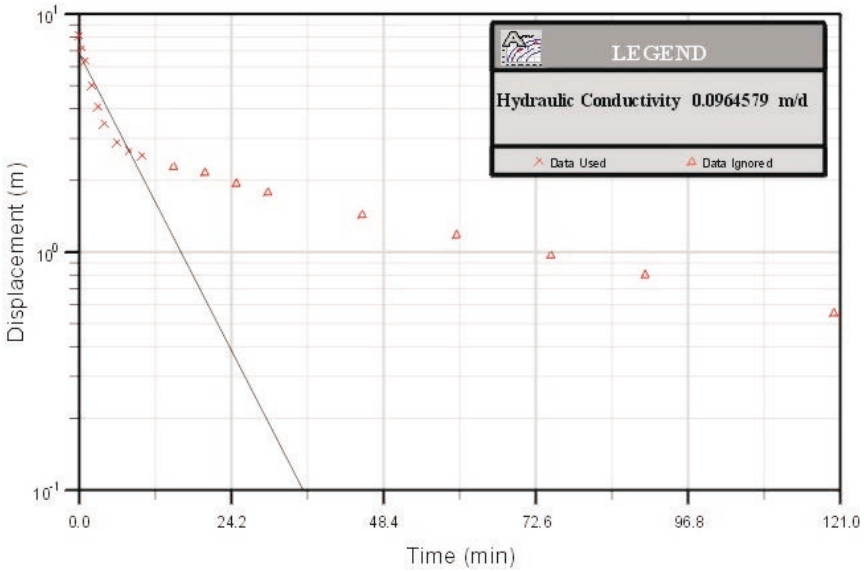
WATCH TIME			RECOVERY TIME (t_1) min.	RESIDUAL DRAWDOWN metres	WATER LEVEL OR PRESSURE metres	ELAPSED TIME (t) min.	t / t_1	REMARKS, etc
h	min	am pm						
11	45	am	0.00	0.89	4.24	120.00	0.00	
11	45.50		0.50	0.89	4.24	120.50	241.00	
11	46		1.00	0.89	4.24	121.00	121.00	
11	47		2.00	0.89	4.24	122.00	61.00	
11	48		3.00	0.89	4.24	123.00	41.00	
11	49		4.00	0.89	4.24	124.00	31.00	
11	51		6.00	0.89	4.24	126.00	21.00	
11	53		8.00	0.88	4.23	128.00	16.00	
11	55		10.00	0.87	4.22	130.00	13.00	
12	00	pm	15.00	0.83	4.18	135.00	9.00	
12	05		20.00	0.79	4.14	140.00	7.00	
12	10		25.00	0.75	4.10	145.00	5.80	
12	15		30.00	0.71	4.06	150.00	5.00	
12	30		45.00	0.60	3.95	165.00	3.67	
12	45		60.00	0.51	3.86	180.00	3.00	
1	00		75.00	0.43	3.78	195.00	2.60	
1	15		90.00	0.36	3.71	210.00	2.34	
1	45		120.00	0.25	3.60	240.00	2.00	



MG2000/4 SECOND RECOVERY – HVORSLEV, 1951



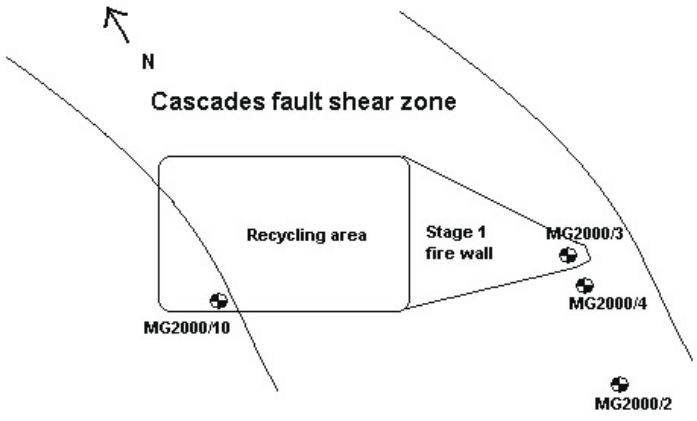
MG2000/4 SECOND RECOVERY – KGS MODEL



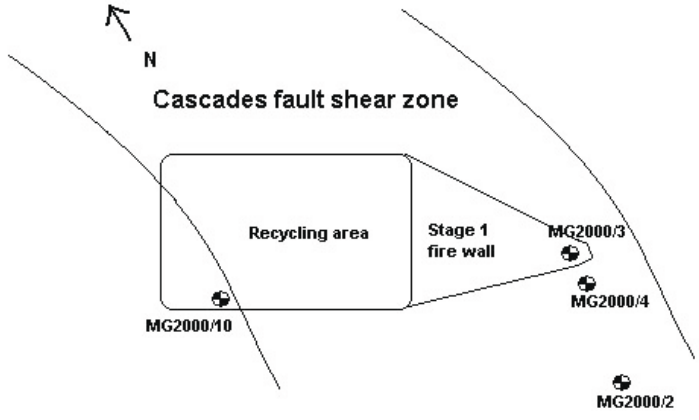
MG2000/4 SECOND RECOVERY – BOUWER AND RICE, 1976

Pump Test 11: Well MG2000/2 (Second attempt)

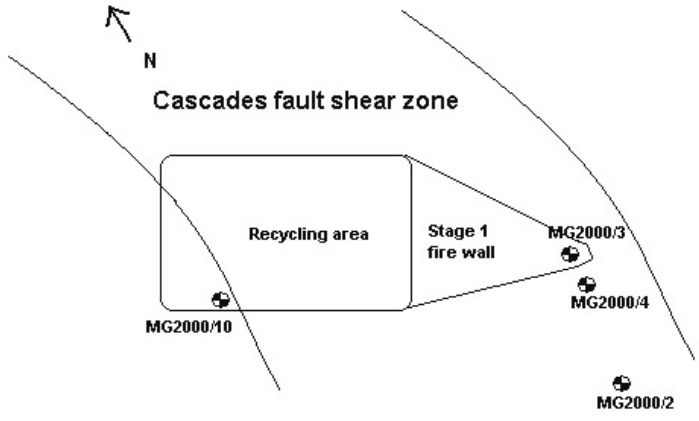
PUMPING TEST SET-UP SHEET

WELL DESCRIPTION	**Owner** Hobart City Council		**Well No.** MG 2000/2		
	Address 16 Elizabeth Street		**Name/Site** McRobies Gully Waste Depot		
	Hobart				
	Tested by Mineral Resources Tasmania		**Date** 3 May 2001		
WELL CASING DETAILS	**Material Description**		**Diameter (mm)**	**From (m)**	**Seated (m)**
	Class 12 PVC		80	0	54
	Class 12 PVC slotted screen		80	54	66
ENTRY DETAILS	**Type of entry**	**Aperture**	**Diameter (mm)**	**Top (m)**	**Bottom (m)**
	Cement			0	1.5
	Gravel		7	1.5	37
	Bentonite			34	40
	Screen seal at 40 m		**Gravel Pack size** 1 to 3 mm		
	Bottom cap 66 m		**Hole diameter** 165 mm		
AQUIFERS	**Aquifer type**	**above BWL below GL (m)**	**Date measured**	**From (m)**	**To (m)**
	Semiconfined	Below GL	4 October 2000	64	66
PUMP/HEADWORKS	**Type** Grundfos	**Size** SQE		**Suction at** 56 m	
WATER LEVELS	**Measured by** Dip Probe	**Airline at**		**Reference pt** 145m (agl)	
DISCHARGE MEASUREMENT	**Method used**	**Size (plate/tank)**		**Period of measurement**	
	Container and stop watch	Drum – 210L Container – 9L			
SKETCH SHOWING LOCATION OF ALL MEASURED WELLS					

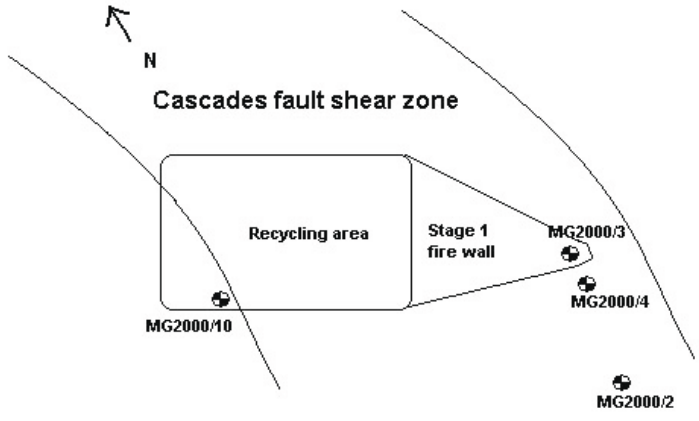
PUMPING TEST SET-UP SHEET

WELL DESCRIPTION	**Owner** Hobart City Council		**Well No.** MG 2000/3		
	Address 16 Elizabeth Street		**Name/Site** McRobies Gully Waste Depot		
	Hobart				
	Tested by Mineral Resources Tasmania		**Date** 3 May 2001		
WELL CASING DETAILS	**Material Description**		**Diameter (mm)**	**From (m)**	**Seated (m)**
	Class 12 PVC pipe		80	0	5.5
	Class 12 PVC slotted screen		80	5.5	6.5
ENTRY DETAILS	**Type of entry**	**Aperture**	**Diameter (mm)**	**Top (m)**	**Bottom (m)**
	Cement			0	1.0
	Gravel		7	1.0	2.5
	Bentonite			2.5	3.0
	Coarse sand		1-3	3.0	6.5
	Screen seal at 3.0 m		**Gravel Pack size** 1 to 3 mm		
	Bottom cap 6.5 m		**Hole diameter** 165 mm		
AQUIFERS	**Aquifer type**	**above BWL below GL (m)**	**Date measured**	**From (m)**	**To (m)**
	Unconfined	Below GL	8 October 2000	5.2	12.0
PUMP/HEADWORKS	**Type**	**Size**		**Suction at** m	
WATER LEVELS	**Measured by** Dip Probe	**Airline at**		**Reference pt** 97m (agl)	
DISCHARGE MEASUREMENT	**Method used**	**Size (plate/tank)**		**Period of measurement**	
SKETCH SHOWING LOCATION OF ALL MEASURED WELLS					

PUMPING TEST SET-UP SHEET

WELL DESCRIPTION	**Owner** Hobart City Council		**Well No.** MG 2000/4		
	Address 16 Elizabeth Street		**Name/Site** McRobies Gully Waste Depot		
	Hobart				
	Tested by Mineral Resources Tasmania		**Date** 3 May 2001		
WELL CASING DETAILS	**Material Description**		**Diameter (mm)**	**From (m)**	**Seated (m)**
	Class 12 PVC pipe		80	0	19
	Class 12 PVC slotted screen		80	19	30
ENTRY DETAILS	**Type of entry**	**Aperture**	**Diameter (mm)**	**Top (m)**	**Bottom (m)**
	Cement			0	2
	Gravel		7	2	10
	Bentonite			10	12.5
	Coarse sand		1-3	12.5	30
	Screen seal at 12.5 m		**Gravel Pack size** 1 to 3 mm		
	Bottom cap 30 m		**Hole diameter** 165 mm		
AQUIFERS	**Aquifer type**	**above BWL below GL (m)**	**Date measured**	**From (m)**	**To (m)**
	Fractured	Below GL	9 October 2000	23	30
PUMP/HEADWORKS	**Type**	**Size**		**Suction at** m	
WATER LEVELS	**Measured by** Dip Probe	**Airline at**		**Reference pt** 97m (agl)	
DISCHARGE MEASUREMENT	**Method used**	**Size (plate/tank)**		**Period of measurement**	
SKETCH SHOWING LOCATION OF ALL MEASURED WELLS					

PUMPING TEST SET-UP SHEET

WELL DESCRIPTION	**Owner** Hobart City Council		**Well No.** MG 2000/10		
	Address 16 Elizabeth Street		**Name/Site** McRobies Gully Waste Depot		
	Hobart				
	Tested by Mineral Resources Tasmania		**Date** 3 May 2001		
WELL CASING DETAILS	**Material Description**		**Diameter (mm)**	**From (m)**	**Seated (m)**
	Class 12 PVC pipe		80	0	16
	Class 12 PVC slotted screen		80	16	22
ENTRY DETAILS	**Type of entry**	**Aperture**	**Diameter (mm)**	**Top (m)**	**Bottom (m)**
	Cement			0	1.0
	Gravel		7	1.0	14.0
	Bentonite			14.0	15.0
	Coarse sand		1-3	15.0	22.0
	Screen seal at 15.0 m		**Gravel Pack size** 1 to 3 mm		
	Bottom cap 22.0 m		**Hole diameter** 165 mm		
AQUIFERS	**Aquifer type**	**above BWL below GL (m)**	**Date measured**	**From (m)**	**To (m)**
	Fractured	Below GL	18 October 2000	19.5	24.0
PUMP/HEADWORKS	**Type**	**Size**		**Suction at** m	
WATER LEVELS	**Measured by** Dip Probe	**Airline at**		**Reference pt** 124m (agl)	
DISCHARGE MEASUREMENT	**Method used**	**Size (plate/tank)**		**Period of measurement**	
SKETCH SHOWING LOCATION OF ALL MEASURED WELLS					

DRAWDOWN SHEET **Sheet No 1 of 1**

MEASURED WELL	Owner N/A					Well No.		
	Address					Site		
PUMPED WELL	Owner Hobart City Council					Well No. MG 2000/2		
	Address 16 Elizabeth Street, Hobart					Site McRobies Gully		
TEST DETAILS	Date pumping commenced 03/05/01 Time 10.45 am					Test		
	Date pumping ceased 03/05/01 Time 1.15 pm					No. **11**		
Are the measurements below for the pumped well? N/A						Distance from pumped well N/A		
Standing water level Or Static pressure	42.93 m below Meas. pt					Meas. pt above ground level 0.53 m		

WATCH TIME			ELAPSED TIME (t) min.	DRAWDOWN metres	WATER LEVEL OR PRESSURE metres	DISCHARGE		REMARKS, etc
h	min	am pm				Piezometer mm	L/s	
10	45	am	0.00	0.00	42.93	80	0.2	H_2S odour to water
10	45.50		0.50	0.42	43.35		0.2	
10	46		1.00	0.64	43.57		0.2	
10	48		3.00	0.65	43.58			
10	49		4.00	1.84	44.77			Gate valve opened
10	51		6.00	2.21	45.14		0.3	
10	53		8.00	2.25	45.18		0.3	
10	55		10.00	2.32	45.25			
11	00		15.00	2.45	45.38		0.7	Samples
11	05		20.00	2.58	45.51		0.7	
11	10		25.00	2.71	45.64		0.7	
11	15		30.00	2.79	45.72		0.7	
11	30		45.00	3.06	45.99		0.7	(11.42 – 11.43 – 1 minute of black water)
11	45		60.00	3.41	46.34		0.7	
12	15	pm	90.00	3.78	46.71		0.7	12.30 - cloudy water
12	45		120.00	4.07	47.00		0.7	Water becoming clear
1	15		150.00	4.29	47.22		0.7	Samples

DRAWDOWN SHEET **Sheet No 1 of 1**

MEASURED WELL	Owner	Hobart City Council		Well No.	MG 2000/3
	Address	16 Elizabeth Street, Hobart		Site	McRobies Gully
PUMPED WELL	Owner	N/A		Well No.	
	Address			Site	
TEST DETAILS	Date pumping commenced 03/05/01 Time 10.45 am			Test	
	Date pumping ceased 03/05/01 Time 1.15 pm			No.	**11**
Are the measurements below for the pumped well? No				Distance from pumped well 146 m	
Standing water level Or Static pressure	3.15 m below Meas. pt			Meas. pt above ground level 0.61 m	

WATCH TIME			ELAPSED TIME (t) min.	DRAWDOWN metres	WATER LEVEL OR PRESSURE metres	DISCHARGE		REMARKS, etc
h	min	am pm				Piezometer mm	L/s	
10	45	am	0.00	0.00	3.15	80		
11	00		15.00	0.00	3.15			
11	15		30.00	0.00	3.15			
11	30		45.00	0.00	3.15			
11	45		60.00	0.00	3.15			
12	00	pm	75.00	0.00	3.15			
12	15		90.00	0.00	3.15			
12	30		105.00	0.00	3.15			
12	45		120.00	0.00	3.15			
1	00		135.00	0.00	3.15			
1	15		150.00	0.00	3.15			

DRAWDOWN SHEET **Sheet No1 of 1**

MEASURED WELL	Owner	Hobart City Council				Well No.	MG 2000/4	
	Address	16 Elizabeth Street, Hobart				Site	McRobies Gully	
PUMPED WELL	Owner	N/A				Well No.		
	Address					Site		
TEST DETAILS	Date pumping commenced 03/05/01 Time 10.45 am						Test	
	Date pumping ceased 03/05/01 Time 1.15 pm						No.	**11**
Are the measurements below for the pumped well? No					Distance from pumped well 132 m			
Standing water level Or Static pressure	2.46 m below Meas. pt				Meas. pt above ground level 0.46 m			

WATCH TIME			ELAPSED TIME (t) min.	DRAWDOWN metres	WATER LEVEL OR PRESSURE metres	DISCHARGE		REMARKS, etc
h	min	am pm				Piezometer mm	L/s	
10	45	am	0.00	0.00	2.46	80		
11	00		15.00	0.00	2.46			
11	15		30.00	0.00	2.46			
11	30		45.00	0.00	2.46			
11	45		60.00	0.00	2.46			
12	00	pm	75.00	0.00	2.46			
12	15		90.00	0.00	2.46			
12	30		105.00	0.00	2.46			
12	45		120.00	0.00	2.46			
1	00		135.00	0.00	2.46			
1	15		150.00	0.00	2.46			

DRAWDOWN SHEET **Sheet No1 of 1**

MEASURED WELL	Owner	Hobart City Council				Well No.	MG 2000/10	
	Address	16 Elizabeth Street, Hobart				Site	McRobies Gully	
PUMPED WELL	Owner	N/A				Well No.		
	Address					Site		
TEST DETAILS	Date pumping commenced 03/05/01 Time 10.45 am						Test	
	Date pumping ceased 03/05/01 Time 1.15pm						No.	**11**
Are the measurements below for the pumped well? No					Distance from pumped well 315 m			
Standing water level Or Static pressure	17.95 m below Meas. pt				Meas. pt above ground level 0.48 m			

WATCH TIME			ELAPSED TIME (t) min.	DRAWDOWN metres	WATER LEVEL OR PRESSURE metres	DISCHARGE		REMARKS, etc
h	min	am pm				Piezometer mm	L/s	
10	45	am	0.00	0.00	17.95	80		
11	00		15.00	0.00	17.95			
11	15		30.00	0.00	17.95			
11	30		45.00	0.00	17.95			
11	45		60.00	0.00	17.95			
12	00	pm	75.00	0.00	17.95			
12	15		90.00	0.00	17.95			
12	30		105.00	+0.01	17.94			
12	45		120.00	+0.01	17.94			
1	00		135.00	+0.01	17.94			
1	15		150.00	+0.01	17.94			

RECOVERY SHEET **Sheet No 1 of 1**

MEASURED WELL	Owner N/A					Well No.		
	Address					Site		
PUMPED WELL	Owner Hobart City Council					Well No. MG 2000/2		
	Address 16 Elizabeth Street, Hobart					Site McRobies Gully		
TEST DETAILS	Date pumping commenced 03/05/01 Time 10.45 am Date pumping ceased 03/05/01 Time 1.15 pm					Test No. **11**		
Are the measurements below for the pumped well? N/A						Distance from pumped well N/A		
Standing water level Or Static pressure	42.93 m below Meas. pt					Meas. pt above ground level 0.53 m		

WATCH TIME			RECOVERY TIME (t_1) min.	RESIDUAL DRAWDOWN metres	WATER LEVEL OR PRESSURE metres	ELAPSED TIME (t) min.	t / t_1	REMARKS, etc
h	min	am pm						
1	15	pm	0.00	4.29	47.22	150.00	0.00	
1	15.50		0.50	2.34	45.27	150.50	301.00	
1	16		1.00	2.20	45.13	151.00	151.00	
1	17		2.00	2.14	45.07	152.00	76.00	
1	18		3.00	2.10	45.03	153.00	51.00	
1	19		4.00	2.07	45.00	154.00	38.50	
1	21		6.00	2.02	44.95	156.00	26.00	
1	23		8.00	1.97	44.90	158.00	19.75	
1	25		10.00	1.93	44.86	160.00	16.00	
1	30		15.00	1.84	44.77	165.00	11.00	
1	35		20.00	1.76	44.69	170.00	8.50	
1	40		25.00	1.69	44.62	175.00	7.00	
1	45		30.00	1.62	44.55	180.00	6.00	
2	00		45.00	1.45	44.38	195.00	4.33	
2	15		60.00	1.31	44.24	210.00	3.50	
2	45		90.00	1.09	44.02	240.00	2.67	
3	15		120.00	0.93	43.86	270.00	2.25	

RECOVERY SHEET **Sheet No 1 of 1**

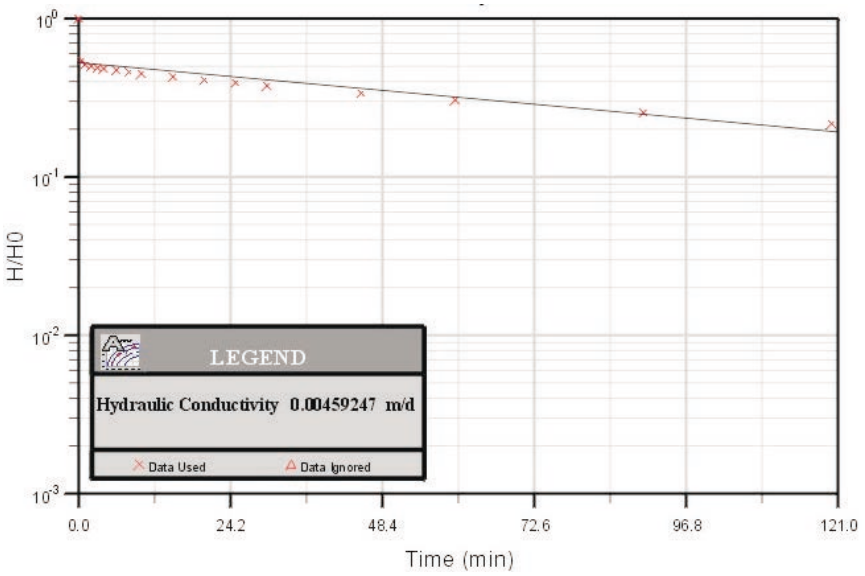
MEASURED WELL	Owner	Hobart City Council				Well No.	MG 2000/3	
	Address	16 Elizabeth Street, Hobart				Site	McRobies Gully	
PUMPED WELL	Owner	N/A				Well No.		
	Address					Site		
TEST DETAILS	Date pumping commenced 03/05/01 Time 10.45 am					Test No.	**11**	
	Date pumping ceased 03/05/01 Time 1.15 pm							
Are the measurements below for the pumped well?					Distance from pumped well 146m			
Standing water level Or Static pressure	3.14 m below Meas. pt				Meas. pt above ground level 0.53m			

WATCH TIME			RECOVERY TIME (t_1) min.	RESIDUAL DRAWDOWN metres	WATER LEVEL OR PRESSURE metres	ELAPSED TIME (t) min.	t / t_1	REMARKS, etc
h	min	am pm						
1	15	pm	0.00	0.00	3.14	150.00	0.00	
1	30		15.00	0.00	3.14	165.00	11.00	
1	45		30.00	0.00	3.14	180.00	6.00	

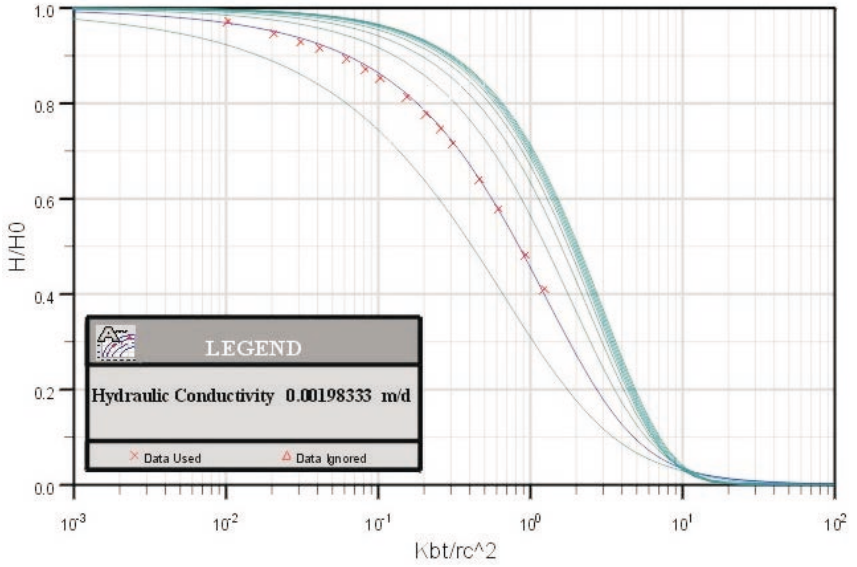
RECOVERY SHEET **Sheet No 1 of 1**

MEASURED WELL	Owner	Hobart City Council				Well No.	MG 2000/4	
	Address	16 Elizabeth Street, Hobart				Site	McRobies Gully	
PUMPED WELL	Owner	N/A				Well No.		
	Address					Site		
TEST DETAILS	Date pumping commenced 03/05/01 Time 10.45 am					Test No.	**11**	
	Date pumping ceased 03/05/01 Time 1.15 pm							
Are the measurements below for the pumped well? N/A					Distance from pumped well 132 m			
Standing water level Or Static pressure	2.46 m below Meas. pt				Meas. pt above ground level 0.46 m			

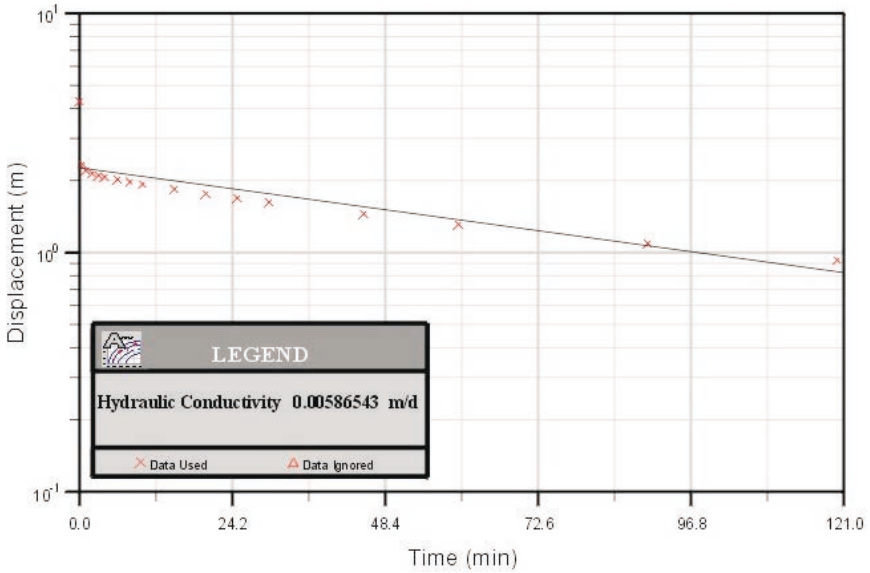
WATCH TIME			RECOVERY TIME (t_1) min.	RESIDUAL DRAWDOWN metres	WATER LEVEL OR PRESSURE metres	ELAPSED TIME (t) min.	t / t_1	REMARKS, etc
h	min	am pm						
1	15	pm	0.00	0.00	2.46	150.00	0.00	
1	30		15.00	0.00	2.46	165.00	11.00	
1	45		30.00	0.00	2.46	180.00	6.00	



MG2000/2 RECOVERY – HVORSLEV, 1951



MG2000/2 RECOVERY – KGS MODEL



MG2000/2 RECOVERY – BOUWER AND RICE, 1976