



Tasmania

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The effects of waste disposal on groundwater quality in Tasmania



Blue Ribbon abattoir, Smithton

Tasmanian Geological
Survey Record 2002/06

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Groundwater quality investigations at the Blue Ribbon abattoir, Smithton

A. R. Ezzy

Abstract

Poor weather conditions prevented access for the drilling of an appropriate number of boreholes to assess groundwater quality in the area of the Smithton Blue Ribbon abattoir disposal site. Only limited data was collected at the site and extensive work is still required to assess surface and groundwater water quality and related environmental implications.

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 Blue Ribbon abattoir site at Smithton was one of these sites.

The objectives of the investigations at the Smithton Blue Ribbon abattoir disposal site were to:

- Determine the geological nature of the host materials;
- Identify the depth of the water table;
- Examine the quality of the groundwater; and
- Investigate geological controls influencing groundwater flow directions.

SITE DESCRIPTION

The Blue Ribbon abattoir disposal site is located approximately one kilometre south of Smithton (342 500 mE, 5 474 800 mN) (fig. 1) and has been in operation for over ten years. Prior to the Blue Ribbon development, the site was used as both a piggery and abattoir for over thirty years. The Department of Primary Industries, Water and Environment (DPIWE) currently licenses the facility.

As part of the process of closing the piggery and abattoir, all waste materials were bulldozed into a waste pile to the south of the existing abattoir (Plate 1). Dehydrated Animal Fat (DAF) is buried at various locations on the site (Plate 2). Subsidence related to the

recent DAF trenches was observed in the western area of the site (Plate 3). All disposal areas are located in sand and are covered with minimal local cover material (generally less than 200 mm in depth). No engineered filling sequence was implemented and the various aged waste materials have been placed in a random manner. General refuse, industrial machinery, organic, construction and demolition waste streams have been disposed of at the site.

Geology

The Tasmania Department of Mines 1:50 000 scale Smithton geological map of the area (Lennox *et al.*,

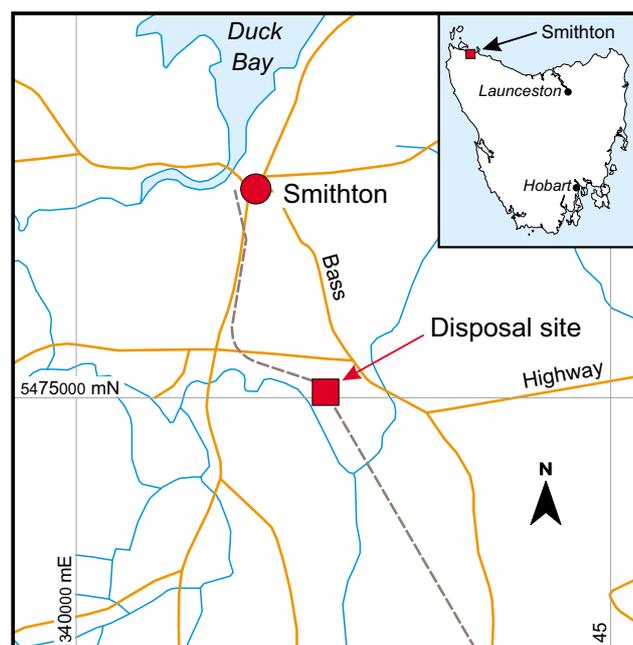


Figure 1. Location of the Blue Ribbon abattoir disposal site, Smithton.



Plate 1. *Waste pile/landfill from the former piggy/abattoir.*



Plate 2. *Active burial trench for dehydrated animal fat.*



Plate 3. *Subsidence related to the recent DAF trenches observed in the western part of the site.*

1982), indicates that the geology of the disposal site (fig. 2) comprises Quaternary deposits overlying Cambrian basic volcanic breccia.

Geological mapping during the current study showed that sand deposits dominate the site, with small areas of medium plasticity clay existing in low-lying areas. Highly weathered bedrock underlies the Quaternary material at shallow depths (between approximately 0.5 m and at least 3.0 m).

Hydrology

The recent DAF trenches and historical landfill are located approximately 40 m east of Coventry Creek. Australian Bureau of Meteorology rainfall station 091092 at Smithton (Grant Street) is the closest rainfall station to the site. The rainfall chart of average monthly recorded rainfall (fig. 3) shows a marked seasonality, with the highest rainfall in autumn/winter (April to October). The average annual rainfall for the station is 1105.6 millimetres.

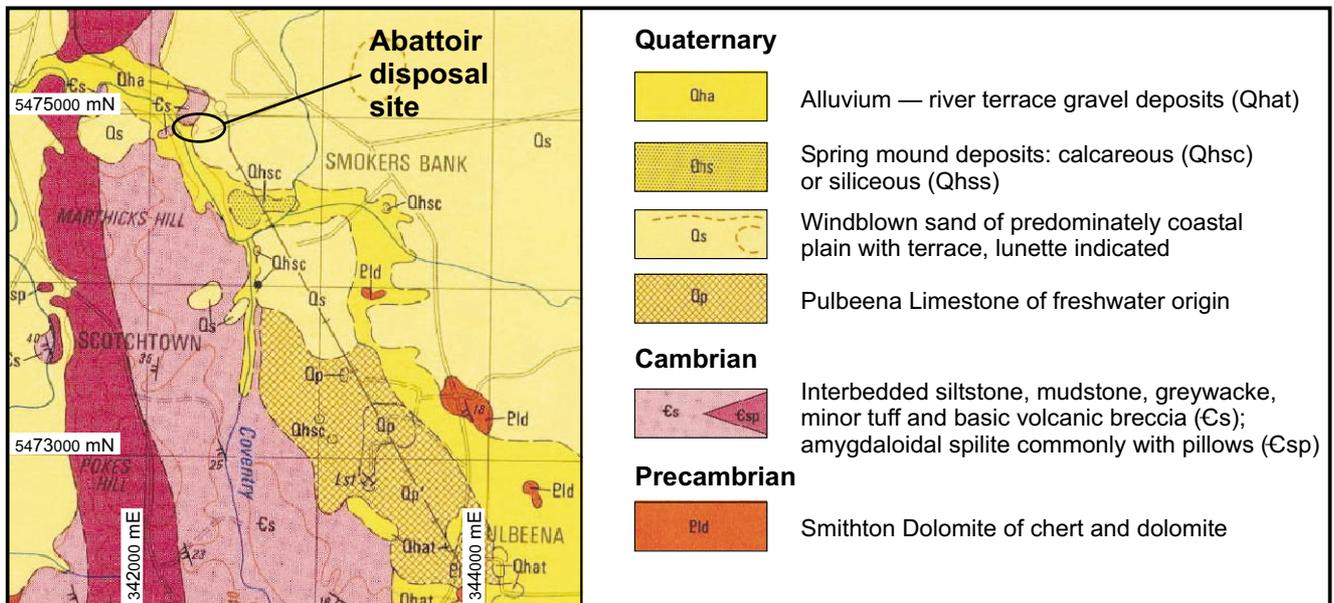


Figure 2

Extract from Smithton geological map (Lennox et al., 1982) of the local area and related geology.



Figure 3

Average monthly rainfall for Australian Bureau of Meteorology rainfall station 091092, Smithton (Grant Street).

INVESTIGATION METHODS

Borehole drilling and installation

Five 120 mm diameter monitoring bores were auger drilled on 6 September 2000 for this project (fig. 4). Fifty millimetre PVC casing and slotted screens with bentonite seals were installed in each hole. All bores were logged in accordance with AS 1726-1993; engineering logs are presented in Appendix 1.

Groundwater was encountered at depths of between 0.6 and 2.3 m below ground level across the site. Flow during drilling indicated that the groundwater in all

boreholes was unconfined, with yields of between 0.009 to 0.021 l/s being recorded from the bores. Figure 5 shows a cross-section and related standing water levels on 13 August 2001.

Both the unsaturated and saturated zones consist mainly of heterogenous layers of fine sand and clay. Layers of low and/or medium plasticity clay were intercepted in boreholes SDA2000/1, SDA2000/2, SDA2000/3 and SDA2000/4. Various degrees of weathered/decomposed rock fragments were intercepted in boreholes SDA2000/3, SDA2000/4 and SDA2000/5.

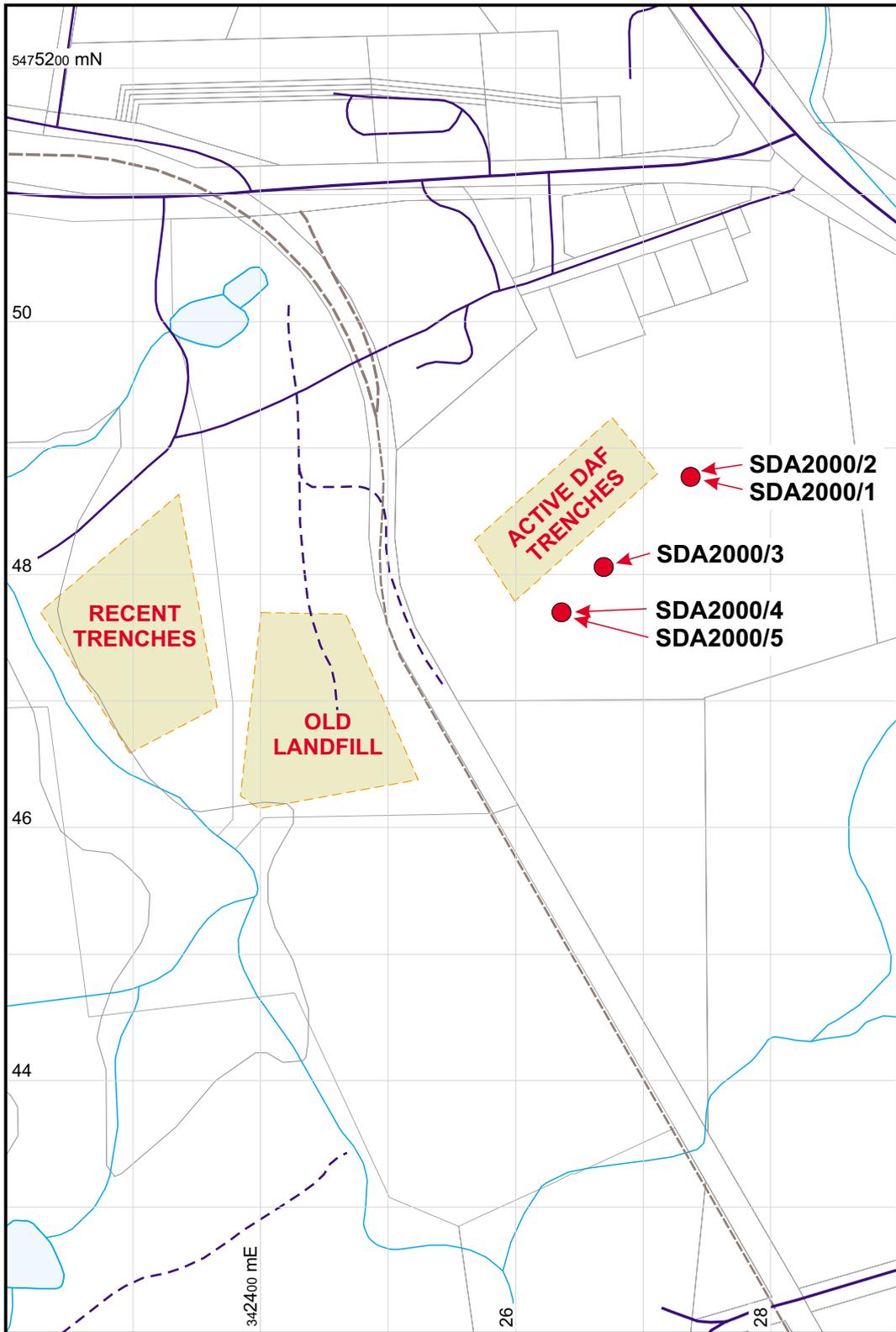


Figure 4
Locations of monitoring bores installed at the Blue Ribbon abattoir Smithton disposal site.

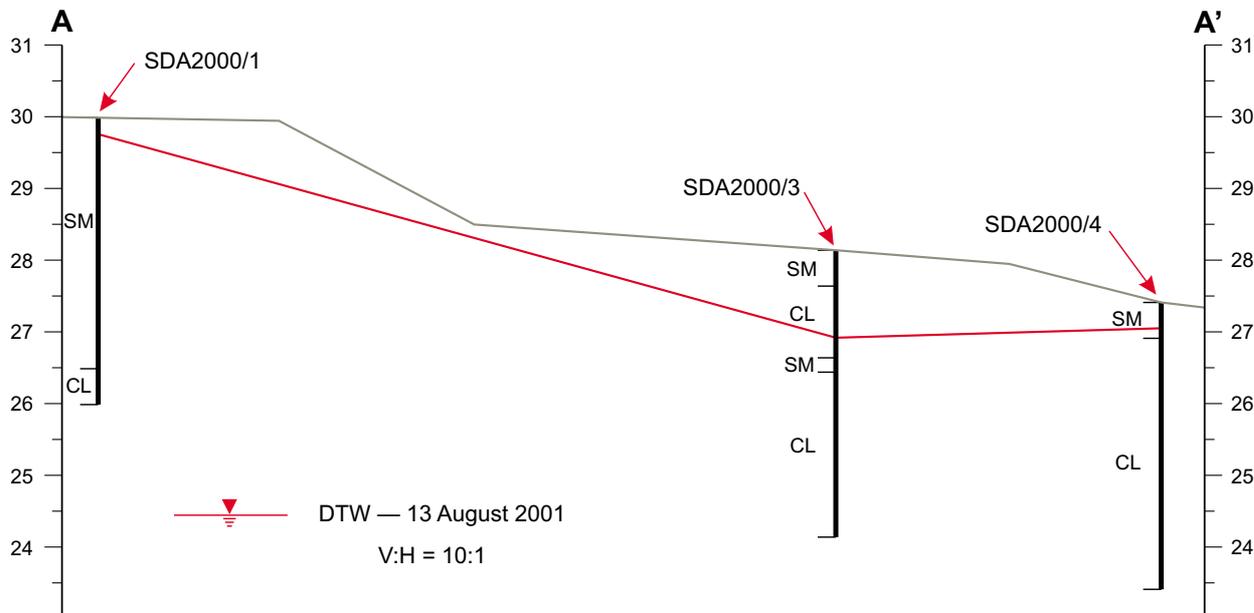


Figure 5

Cross-section and related standing water levels on 13 August 2001 for bores SDA2000/1, 3 and 4 [A-A'].

HYDROLOGICAL MODEL

The cross section of the bores in the area of the active DAF trenches indicates that the water table along this line slopes towards the southwest. As the trenches are located in the water table, this shallow groundwater system appears to have a direct hydraulic connection to the active DAF trenches. Because of access problems associated with poor weather conditions, the drilling undertaken was not sufficient to obtain a detailed interpretation of the piezometric surface at the site.

Analysis of the available data would indicate that a thin Quaternary sand aquifer is perched over clay related to the weathering of the underlying bedrock. The distribution of this clay most likely controls flow direction within the Quaternary sand aquifer, resulting in mounding and related spring discharges across the site.

GROUNDWATER CHEMISTRY

All bores were sampled on 2 November 2000 in accordance with Australian/New Zealand Standard AS/NZS 5667.11:1998. Laboratory testing of samples of groundwater extracted from the bore holes was carried out by Analytical Services Tasmania, in accordance with relevant Australian and international standards. The laboratory report from Analytical Services Tasmania is presented in Appendix 2. Values for pH ranged between 4.5 and 5.9, with conductivity values ranging between 199 and 693 $\mu\text{S}/\text{cm}$. Analytical results are presented on site maps in Appendix 3. Figure 6 is an anion Ternary plot for the results of the groundwater samples, while Tables 1 and 2 present a comparison of the analytical results against international standards where a guideline/emission value is stated by the relevant standard.

Groundwater chemistry results for bore SDA2000/2 were elevated in ammonia and ortho-phosphate. The anion Ternary plot indicates that the bores closest to the active DAF trenches contain chloride as the dominant anion. Bicarbonate levels are low due to the inland nature of the windblown sand distal from coastal beach environments to the north. Bores screened in the sand aquifer (SDA2000/1 and 2) had lower pH values than the remaining three bores screened in the clay weathered bedrock material.

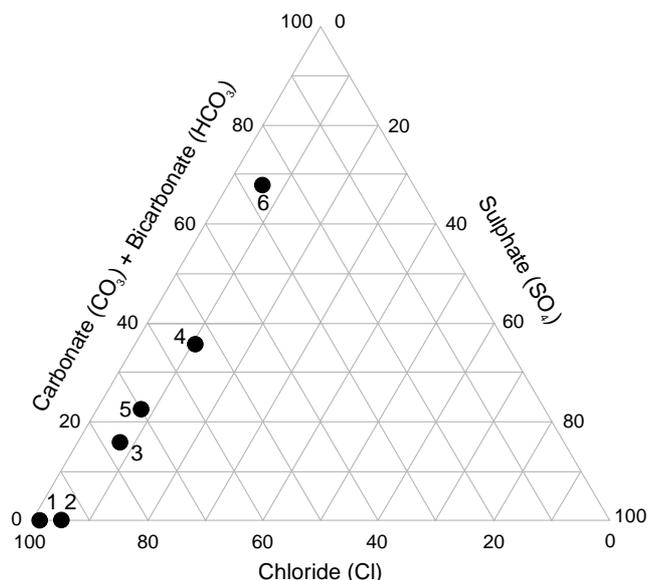


Figure 6

*Anion Ternary plot for groundwater bores at the Blue Ribbon Smithton abattoir disposal site.
1 - SDA2000/1; 2 - SDA2000/2; 3 - SDA2000/3;
4 - SDA2000/4; 5 - SDA2000/5;
6 - average of all MRT groundwater records for Quaternary coastal sands.*

Table 1. Comparison of the analytical results against water quality standards (guideline value listed when stated by a relevant standard). Highlighted values exceed emission limits.

Parameter	SDA2000/1	SDA2000/2	SDA2000/3	SDA2000/4	SDA2000/5	Emission limit
pH	4.5	4.7	5.7	5.9	5.4	N/A
Conductivity ($\mu\text{S}/\text{cm}$)	312	693	345	304	199	N/A: note average sea water value 36 000
TDS (mg/L)	234	832	339	383	358	N/A
Alkalinity CO_3 (mg/L)	<1	<1	<1	<1	<1	N/A
Alkalinity HCO_3 (mg/L)	<1	<1	23	49	20	N/A
Chloride (mg/L)	84	61	65	43	36	250* (mg/L)
Fluoride (mg/L)	0.04	18	<0.02	0.05	0.03	1.5* (mg/L)
Sulphate (mg/L)	1.1	4.1	8.0	11	5.1	250* (mg/L)
Ammonia (mg-N/L)	0.008	3.870	0.021	0.016	0.035	0.5* (mg/L) nitrogen (as ammonia)
Nitrate + Nitrite (mg-N/L)	0.007	0.022	0.039	0.017	0.039	10.0* (mg/L) nitrogen (as nitrate or nitrite)
Nitrite (mg-N/L)	0.002	0.016	0.017	0.012	0.028	10.0* (mg/L) nitrogen (as nitrate or nitrite)
Ortho-P (mg-P/L)	0.253	5.990	0.014	0.008	0.015	2.0* as phosphorus

* Environment Protection (Water Pollution) Regulations 1974, Emission into inland water.

** Australian Water Quality Guidelines for Fresh and Marine Waters 1992.

N/A – no emission limit available.

Table 2. Comparison of analytical results against the Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000.

Bore hole number (SDA)	Blue Ribbon Abattoir					ANZECC 2000	
	2000/1	2000/2	2000/3	2000/4	2000/5	IRRIGATION	LIVESTOCK DRINKING
	Analyte					STV (Short term)	
Standing Water Level (m)	0.44	0.11	1.36	0.26	0.23		
pH (pH Units)	4.5	4.7	5.7	5.9	5.4	**6.0–8.5	
Conductivity ($\mu\text{S}/\text{cm}$)	312	693	345	304	199	(1) (Refer Tables 4.2.3 & 4.2.4)	
Chloride (mg/L)	84	61	65	43	36	(2) MT (Refer Table 4.2.6) MR (Refer Table 4.2.7)	
Fluoride (mg/L)	0.04	18	<0.02	0.005	0.003	4	1
$\text{PO}_4\text{-P}$ (mg/L)	0.253	5.59	0.014	0.008	0.015		
SO_4 (mg/L)	1.1	4.1	8	11	5.1		
$\text{NH}_3\text{-N}$ (mg/L)	0.008	3.870	0.021	0.016	0.035		
$(\text{NO}_2 + \text{NO}_3)\text{-N}$ (mg/L)	0.007	0.022	0.039	0.017	0.039		
$\text{NO}_2\text{-N}$ (mg/L)	0.002	0.016	0.017	0.012	0.028		

Shaded areas indicate values above relevant guideline levels

Notes: ** set to limit potential for corrosion and fouling of pumping, irrigation and stock watering systems

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

(2) ES = Suits extremely sensitive crops

S = Suits crops sensitive to foliar injury through foliar absorption

MS = Suits moderately sensitive crops, may affect sensitive crops

MT = Suits moderately tolerant crops

MA = May affect crops sensitive to foliar injury through foliar absorption

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



Plate 4

Surface water in the area of the toe of the old landfill and Coventry Creek.

CONTAMINATION ASSESSMENT

The potential for degradation of groundwater quality, associated with leachate discharge from the old landfill material into the Quaternary sand aquifer, is considered to be significantly high. Surface discharges of leachate from the landfill and springs from the Quaternary sand aquifer are increased by rainfall events. Surface water from the site enters Coventry Creek, which is considered to be the main off-site transportation pathway for contaminants from the site. Plate 4 shows surface water in the area of the toe of the old landfill and Coventry Creek.

Recharge to a potential underlying fractured aquifer (from groundwater that has a hydraulic connection with the waste materials) may degrade any potential groundwater resource within this aquifer, although overlying clay will most likely adsorb the majority of contaminant ions within a short distance of flow.

PRINCIPAL CONCLUSIONS

Contaminated groundwater is possibly contained within the Quaternary sand aquifer which flows towards Coventry Creek. Additional boreholes should be drilled to investigate groundwater quality in the area of the recent DAF trenches and the old landfill. This action is a high priority for the site. Surface water samples must be taken to gain an understanding of contamination transport pathways.

This site will require substantial engineering works to avoid potential degradation of surface and groundwater quality in the local area. All nearby surface and groundwater users should be identified

and incorporated into future investigations and management of the site.

FURTHER WORK

An electromagnetic (EM31/EM34, TEM) survey is recommended to identify zones of high and low ground conductivity. The survey could help to define variations in the depth of the sand to the underlying shallow clayey material and the extent of the various filling operations at the site.

Future monitoring of microbiological water quality parameters may indicate further degradation of groundwater quality related to the disposal of the abattoir waste. Monitoring of additional shallow and deeper hard-rock bore holes, combined with selective surface water sites, would allow a greater understanding of the extent of water quality degradation and any natural attenuation processes. Considering the expected bio-availability of nutrients at the site, an investigation of pathogens is required for an assessment of the risk to human health in the local down-gradient hydrological system (i.e. Coventry Creek). Additional drilling should include a borehole sited in similar sand well away from any pollution source in the local area.

REFERENCES

LENNOX, P. G.; CORBETT, K. D.; BAILLIE, P. W.; CORBETT, E. B.; BROWN, A. V. 1982. *Geological Atlas 1:50 000 Series. Sheet 21 (7916S)*. *Smithton*. Department of Mines Tasmania.

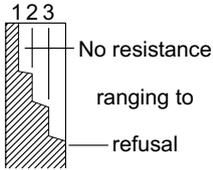
[30 May 2002]

Appendix 1

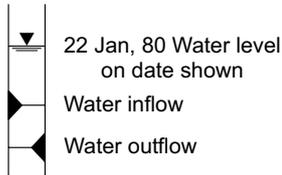
Engineering logs of boreholes

EXPLANATION SHEET FOR ENGINEERING LOGS Borehole and excavation log

Penetration



Water



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

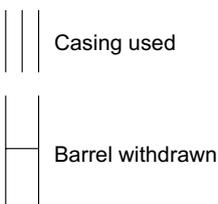
		%
VL	Very loose	0 – 15
L	Loose	15 – 35
MD	Medium dense	35 – 65
D	Dense	65 – 85
VD	Very dense	85 – 100

Fracture description

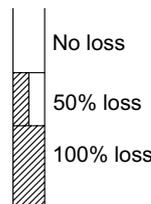
RP	Rough planar
RL	Rough irregular
SP	Smooth planar
SL	Smooth irregular

Cored borehole log

Case - lift



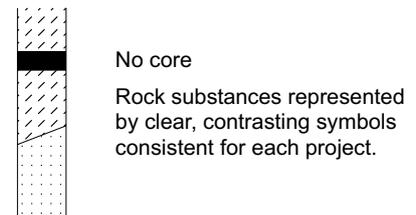
Fluid loss



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 1×10^{-4} mm / sec.

Graphic log



Weathering

Fr	Fresh
SW	Slightly weathered
HW	Highly weathered
EW	Extremely weathered

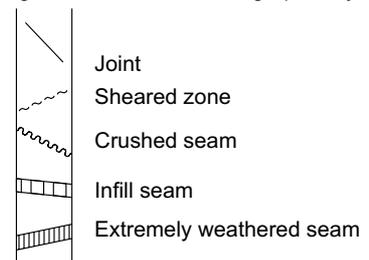
Strength

		point load strength index $1.5^{(50)}$ (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



ENGINEERING LOG - BOREHOLE

Borehole no. SDA 2000/1
Sheet 1 of 1

Project	Blue Ribbon Abattoir	Location	Bass Highway, Smithton
Co-ordinates	55 342738 mE 5474877 mN	Drill type	Auger
		Drill method	Rotary
R.L.		Drill fluid	Nil
Inclination	vertical	Hole commenced	6 September 2000
Bearing		Hole completed	6 September 2000
		Drilled by	Mr Shane Heawood
		Logged by	Mr Andrew Ezzy
		Checked by	Mr Adrian Waite

penetration	support	water	notes	metres	graphic log	classification	material	moisture	consistency	structure, geology
1 2 3			samples, tests	R.L. depth		symbol	soil type: plasticity or particle characteristics, colour, secondary and minor components.	condition	density index	
		Cement	D Sample ID 1			SM	SAND - fine, grey	M	F	Quaternary (wind blown) sand
		Bentonite	D Sample ID 2	0.5		SM	SAND - fine, dark grey and black	M	S L	Quaternary (wind blown) sand
		Minor (winter rain)								
		No screen	D Sample ID 3	1.0		SM	SAND - black humic	M	S L	Quaternary (wind blown) sand
			D Sample ID 4	1.5		SM	SAND - fine dark brown and black	W	S L	Quaternary (wind blown) sand
		1.5 metre slotted screen	Main (water table) D Sample ID 5	2.0		SM	SAND - fine orange and brown	W	VS VL	Quaternary (wind blown) sand
		7 mm Gravel	D Sample ID 6	2.5		SM	SAND - brown silty	W	VS VL	Quaternary (wind blown) sand
			D Sample ID 7	3.0						
		Back fill	D Sample ID 8	3.5		CL	CLAY - medium plasticity, light grey	M	F D	Possibly extremely weathered volcanic rock
		Back fill		4.0						
			Sample ID numbers refer to samples stored in MRT core shed				End of hole at 4.0 m Pumped for 30 minutes at 0.4 L/m with milky brown water. At end of pumping pH 5.8 and conductivity 260 µS/cm.			

ENGINEERING LOG - BOREHOLE

Borehole no. SDA 2000/2
 Sheet 1 of 1

Project	Blue Ribbon Abattoir	Location	Bass Highway, Smithton		
Co-ordinates	55 342737 mE 5474877 mN	Drill type	Auger	Hole commenced	6 September 2000
		Drill method	Rotary	Hole completed	6 September 2000
R.L.		Drill fluid	Nil	Drilled by	Mr Shane Heawood
Inclination	vertical			Logged by	Mr Andrew Ezzy
Bearing				Checked by	Mr Adrian Waite

penetration	support	water	notes	metres	graphic log	classification	material	moisture	consistency	structure, geology
1 2 3			samples, tests	R.L. depth		symbol	soil type: plasticity or particle characteristics, colour, secondary and minor components.	condition	density index	
	No screen	Bentonite/Cement	D Sample ID 1			SM	SAND - fine, grey	M	F	Quaternary (wind blown) sand
	1.0 metre slotted screen	7 mm Gravel	D Sample ID 2 Minor (winter rain)	0.5		SM	SAND - fine, dark grey and black	M	S L	Quaternary (wind blown) sand
			D Sample ID 3	1.0		SM	SAND - black, humic	M	S L	Quaternary (wind blown) sand
			Sample ID numbers refer to samples stored in MRT core shed	1.5			End of hole at 1.5 m Pumped for 30 minutes at 0.3 L/m. At end of pumping pH 4.9 and conductivity 380 µS/cm.			

ENGINEERING LOG - BOREHOLE

Borehole no. SDA 2000/3
 Sheet 1 of 1

Project	Blue Ribbon Abattoir	Location	Bass Highway, Smithton
Co-ordinates	55 342669 mE 5474806 mN	Drill type	Auger
		Drill method	Rotary
R.L.		Drill fluid	Nil
Inclination	vertical	Hole commenced	6 September 2000
Bearing		Hole completed	6 September 2000
		Drilled by	Mr Shane Heawood
		Logged by	Mr Andrew Ezzy
		Checked by	Mr Adrian Waite

penetration	support	water	notes	metres	graphic log	classification	material	moisture	consistency	structure, geology
1	2	3	samples, tests	R.L.	depth	symbol	soil type: plasticity or particle characteristics, colour, secondary and minor components.	condition	index	
			D Sample ID 1			SM	SAND - fine, light grey	M	S L	Quaternary (wind blown) sand
			D Sample ID 2		0.5	CL	CLAY - medium plasticity, dark grey, weathered igneous rock fragments	M	F	Quaternary sediments
			D Sample ID 3		1.0	CL	CLAY - medium plasticity, light grey	M	F	Weathered bedrock
			D Sample ID 4		1.5	SM	SAND - dark brown and black	M	F	Weathered bedrock
			D Sample ID 5		2.0	CL	CLAY - medium plasticity, orange, extremely weathered igneous rock fragments	D	L	Weathered bedrock
			D Sample ID 6		2.5	CL	CLAY - medium plasticity, orange, weathered white rock fragments	W	F	Weathered bedrock
			D Sample ID 7		3.0	CL	CLAY - medium plasticity, orange and brown, weathered white rock fragments	M	Vst	Weathered bedrock
			D Sample ID 8		3.5	CL	CLAY - medium plasticity, brown	M	VS	Weathered bedrock
					4.0		End of hole at 4.0 m Pumped for 40 minutes pre casing. After casing pumped for 30 minutes at 0.6 L/m. At end of pumping pH 6.2 and conductivity 420 µS/cm.			
							* Nylon Rock Fabric Sock			

ENGINEERING LOG - BOREHOLE

Project	Blue Ribbon Abattoir	Location	Bass Highway, Smithton		
Co-ordinates	55 342636 mE 5474770 mN	Drill type	Auger	Hole commenced	6 September 2000
		Drill method	Rotary	Hole completed	6 September 2000
R.L.		Drill fluid	Nil	Drilled by	Mr Shane Heawood
Inclination	vertical			Logged by	Mr Andrew Ezzy
Bearing				Checked by	Mr Adrian Waite

penetration	support	water	notes	metres	graphic log	classification	material	moisture	consistency	structure, geology
1	2	3	samples, tests	R.L.	depth	symbol	soil type: plasticity or particle characteristics, colour, secondary and minor components.	condition	density index	
			D Sample ID 1			SM	SAND - fine, light grey	M	S L	Quaternary (wind blown) sand
			D Sample ID 2 Minor		0.5	CL	CLAY - medium plasticity, 90% brown 10% black	M	F	Quaternary sediments
			D Sample ID 3		1.0	CL	CLAY - low plasticity, orange, weathered rock fragments	W	St	Weathered bedrock
			D Sample ID 4		1.5	CL	CLAY - low plasticity, orange, extremely weathered rock fragments	W	St	Weathered bedrock
			D Sample ID 5 Major		2.0	CL	CLAY - low plasticity, orange, weathered rock fragments	W	F	Weathered bedrock
			D Sample ID 6		2.5	CL	CLAY - low plasticity, orange, weathered rock fragments	W	VS VL	Weathered bedrock
			D Sample ID 7							
			D Sample ID 8		3.0					
			D Sample ID 9		3.5					
					4.0		End of hole at 4.0 m			
			Sample ID numbers refer to samples stored in MRT core shed							
							* Nylon Rock Fabric Sock			

ENGINEERING LOG - BOREHOLE

Borehole no. SDA 2000/5
Sheet 1 of 1

Project	Blue Ribbon Abattoir	Location	Bass Highway, Smithton		
Co-ordinates	55 342637 mE 5474770 mN	Drill type	Auger	Hole commenced	6 September 2000
		Drill method	Rotary	Hole completed	6 September 2000
R.L.		Drill fluid	Nil	Drilled by	Mr Shane Heawood
Inclination	vertical			Logged by	Mr Andrew Ezzy
Bearing				Checked by	Mr Adrian Waite

penetration	support	water	notes	metres	graphic log	classification	material	moisture	consistency	structure, geology
1 2 3			samples, tests	R.L. depth		symbol	soil type: plasticity or particle characteristics, colour, secondary and minor components.	condition	density index	
	No screen	Cement	D Sample ID 1			SM	SAND - fine, light grey	M	S L	Quaternary (wind blown) sand
	1.0m N.R.F.S.* Screen	Bentonite	D Sample ID 2	0.5		CL	CLAY - medium plasticity, 90% brown 10% black	M	F	Weathered bedrock
	1.0m N.R.F.S.* Screen	Gravel	D Sample ID 3	1.0		CL	CLAY - low plasticity, orange, weathered rock fragments	W	St	Weathered bedrock
	No screen	7 mm Gravel	D Sample ID 4	1.5		CL	CLAY - low plasticity, orange, extremely weathered rock fragments	W	St	Weathered bedrock
				2.0			End of hole at 2.0 m			

Sample ID numbers refer to samples stored in MRT core shed

* Nylon Rock Fabric Sock

Appendix 2

Analytical Services Tasmania — laboratory reports



ANALYTICAL SERVICES TASMANIA
Sandy Bay Laboratory
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Email: ast.sandybay@dpiwe.tas.gov.au



NATA Accreditation
Number: 5589

Laboratory Report

Report No: 13770 *Please quote this number when making enquiries about this report*
Submitted By: Andrew Ezzy
Client: Mineral Resources Tasmania
Site Description: Blue Ribbon
Received: 03-Nov-00 **Client Order No:**
Report Date: 01-Dec-00
Report To: Andrew Ezzy
Address: Gordons Hill Rd 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
1101-Water:	Alkalinity by APHA Method 2320/4500-CO2
1103-Water:	Anions by Ion Chromatography APHA Method 4110C
1201-Water:	Nutrients by APHA Method 4500



NATA endorsed test report.
This document shall not be reproduced, except in full.
Samples analysed as received.

NATA Accreditation Number: 5589


Mike Johnson
Manager

Page 1 of 2



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



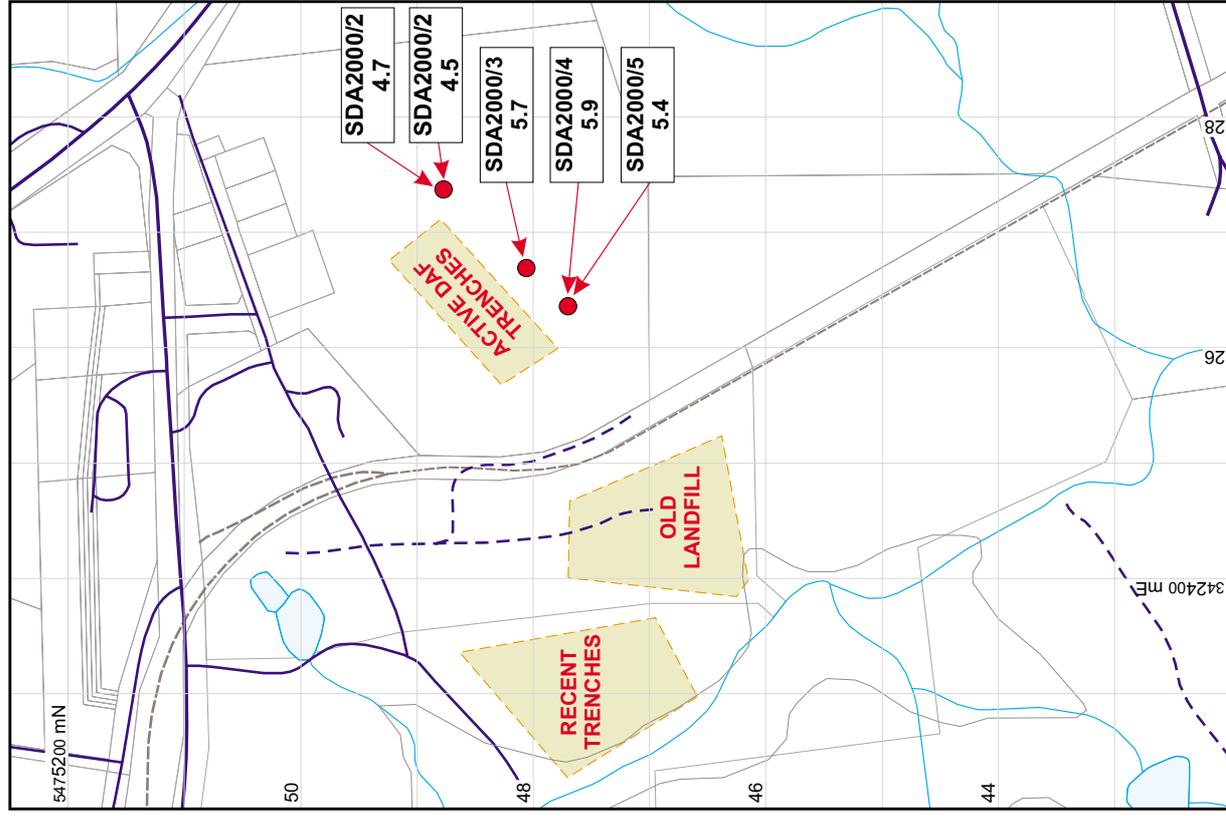
Report No: 13770

Report Date: 01-Dec-00

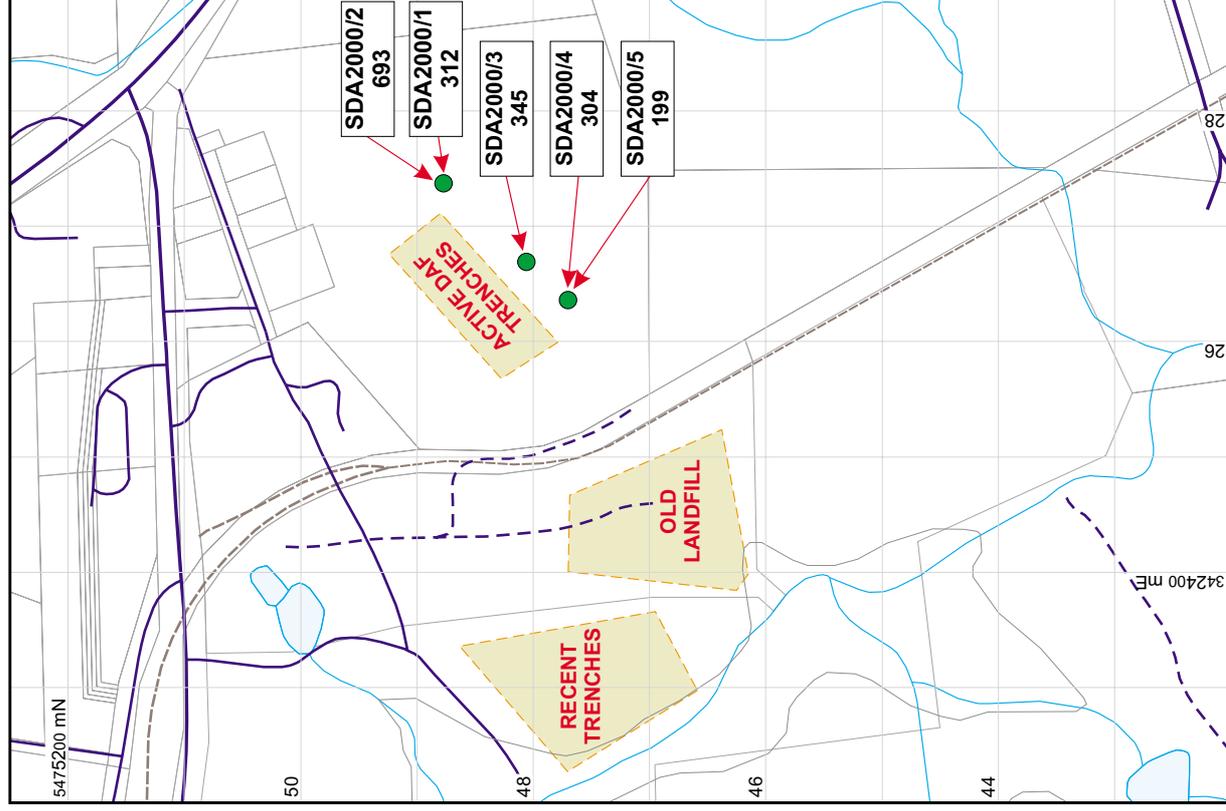
Method	Analyte	Units / Sampled On :	Lab.No.:	13073	13074	13075	13076	13077
			Sample Id.:	SDA 2000/1	SDA 2000/2	SDA 2000/3	SDA 2000/4	SDA 2000/5
				02/11/00	02/11/00	02/11/00	02/11/00	02/11/00
1001-Water	pH			4.5	4.7	5.7	5.9	5.4
1002-Water	Conductivity	µS/cm		312	693	345	304	199
1004-Water	TDS	mg/L		234	832	339	383	358
1101-Water	Alkalinity CO ₃	mg/L CaCO ₃		<1	<1	<1	<1	<1
	Alkalinity HCO ₃	mg/L CaCO ₃		<1	<1	23	49	20
1103-Water	Chloride	mg/L		84	61	65	43	36
	Fluoride	mg/L		0.04	18	<0.02	0.05	0.03
	Sulphate	mg/L		1.1	4.1	8.0	11	5.1
1201-Water	Ammonia	µg-N/L		8	3870	21	16	35
	Nitrate+Nitrite	µg-N/L		7	22	39	17	39
	Nitrite	µg-N/L		2	16	17	12	28
	Ortho-P	µg-P/L		253	5590	14	8	15

Appendix 3
Analytical results on site maps

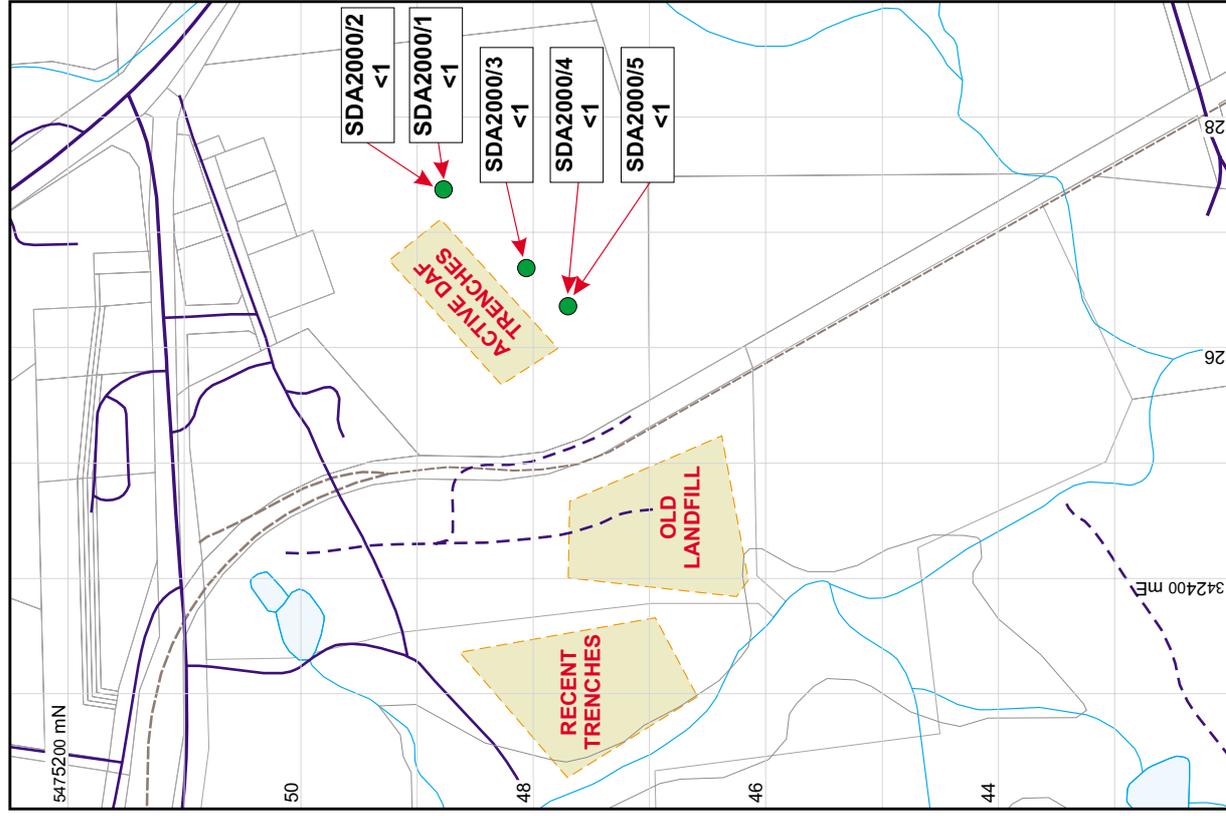
Smithton Blue Ribbon Abbatoir — December 2000
pH



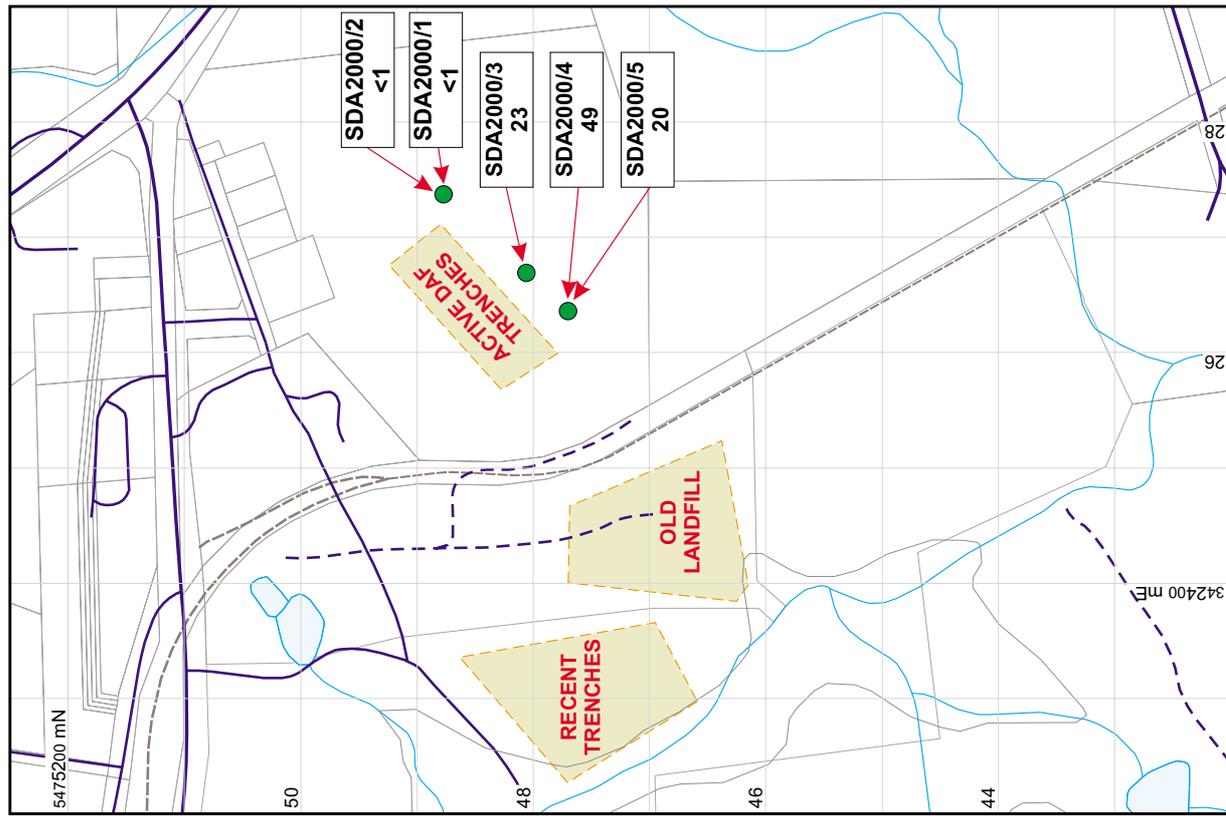
Smithton Blue Ribbon Abbatoir — December 2000
Conductivity ($\mu\text{g/L}$)



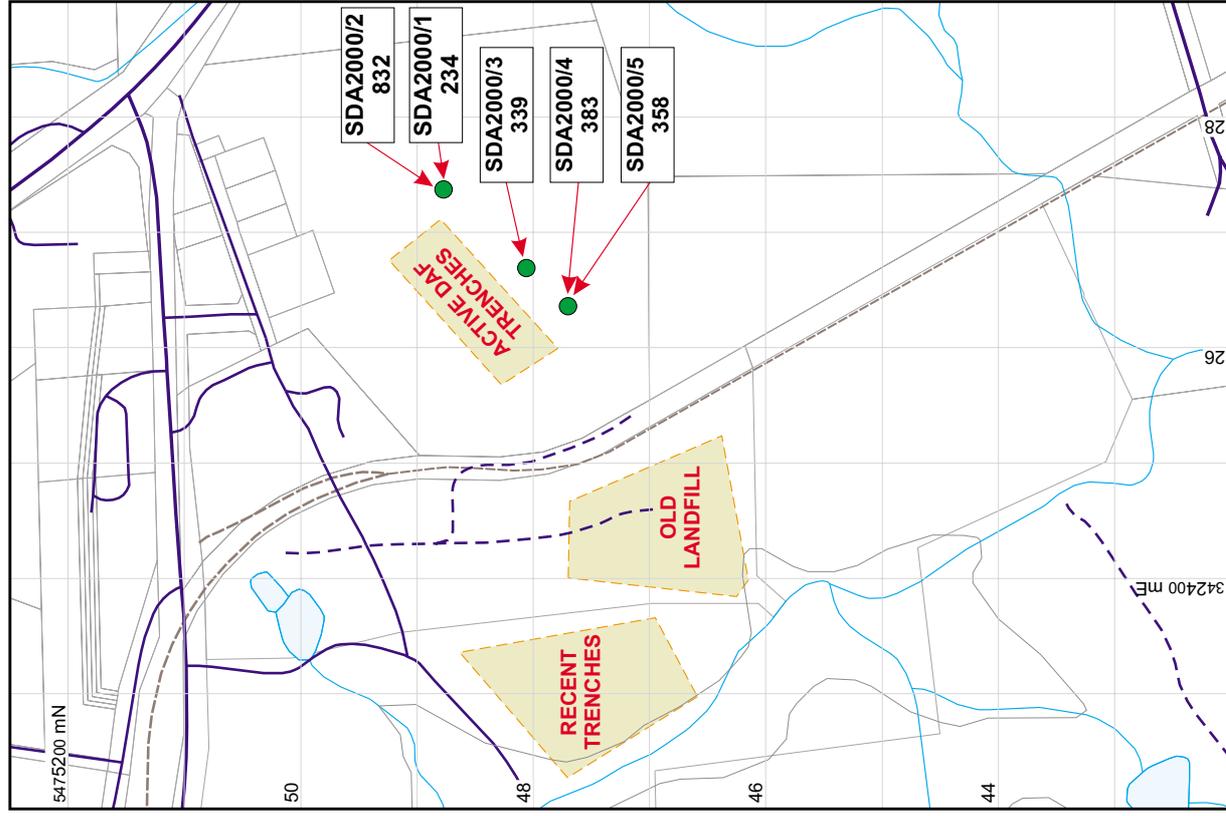
Smithton Blue Ribbon Abbatoir — December 2000
Alkalinity CO₃ (mg/L CaCO₃)



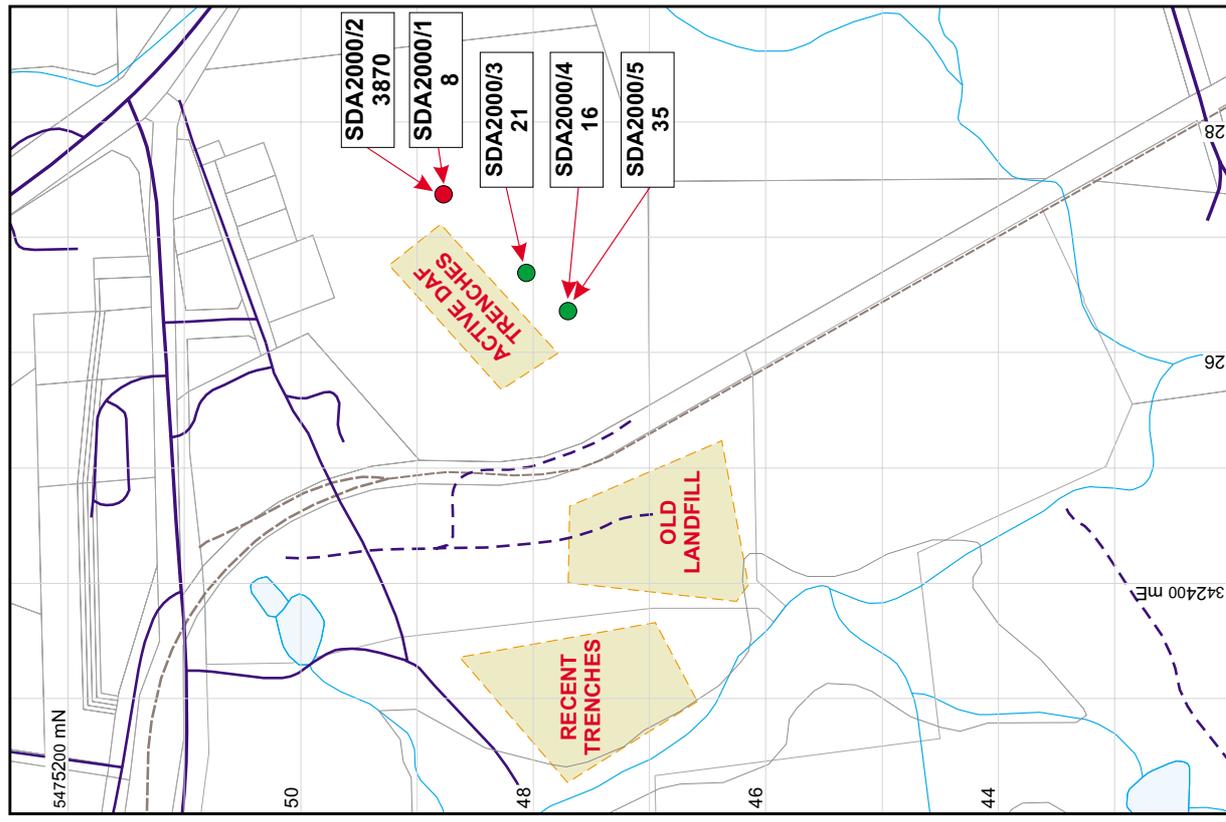
Smithton Blue Ribbon Abbatoir — December 2000
Alkalinity HCO₃ (mg/L CaCO₃)



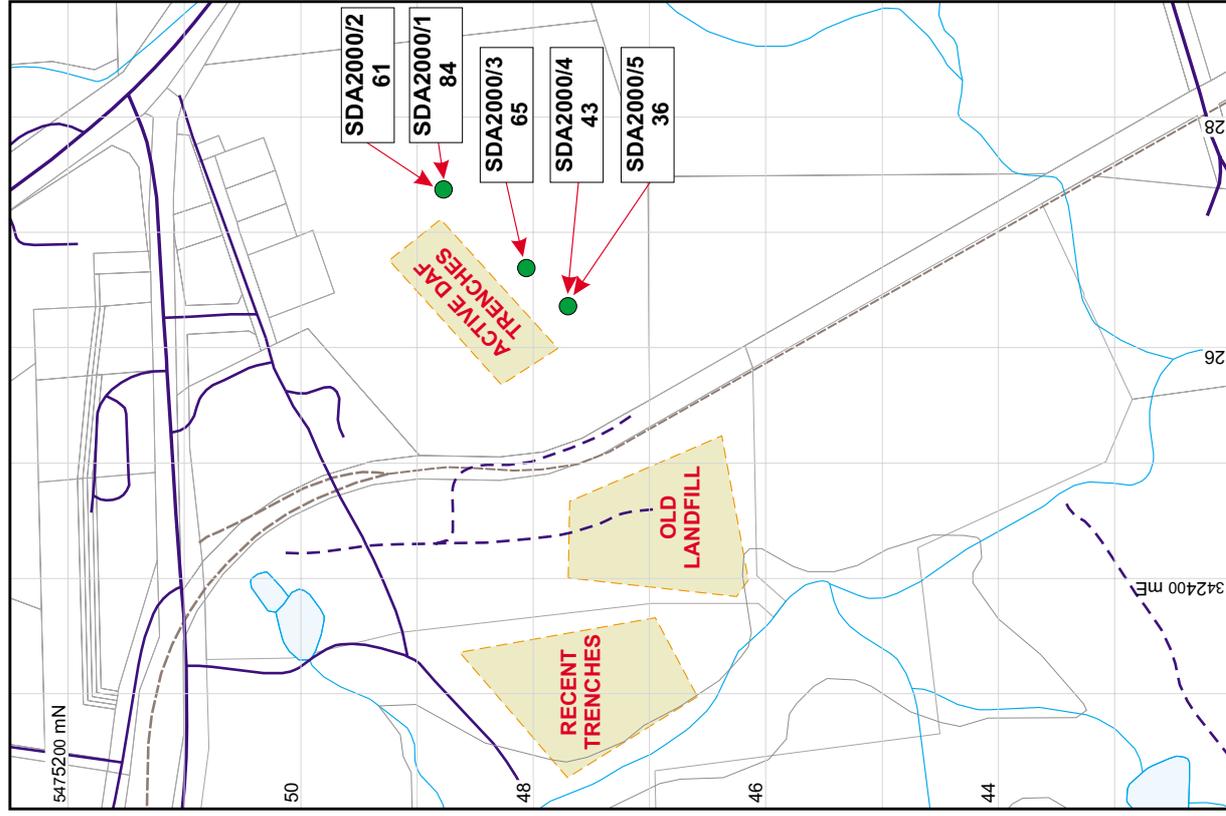
Smithton Blue Ribbon Abbatoir — December 2000
TDS (mg/L)



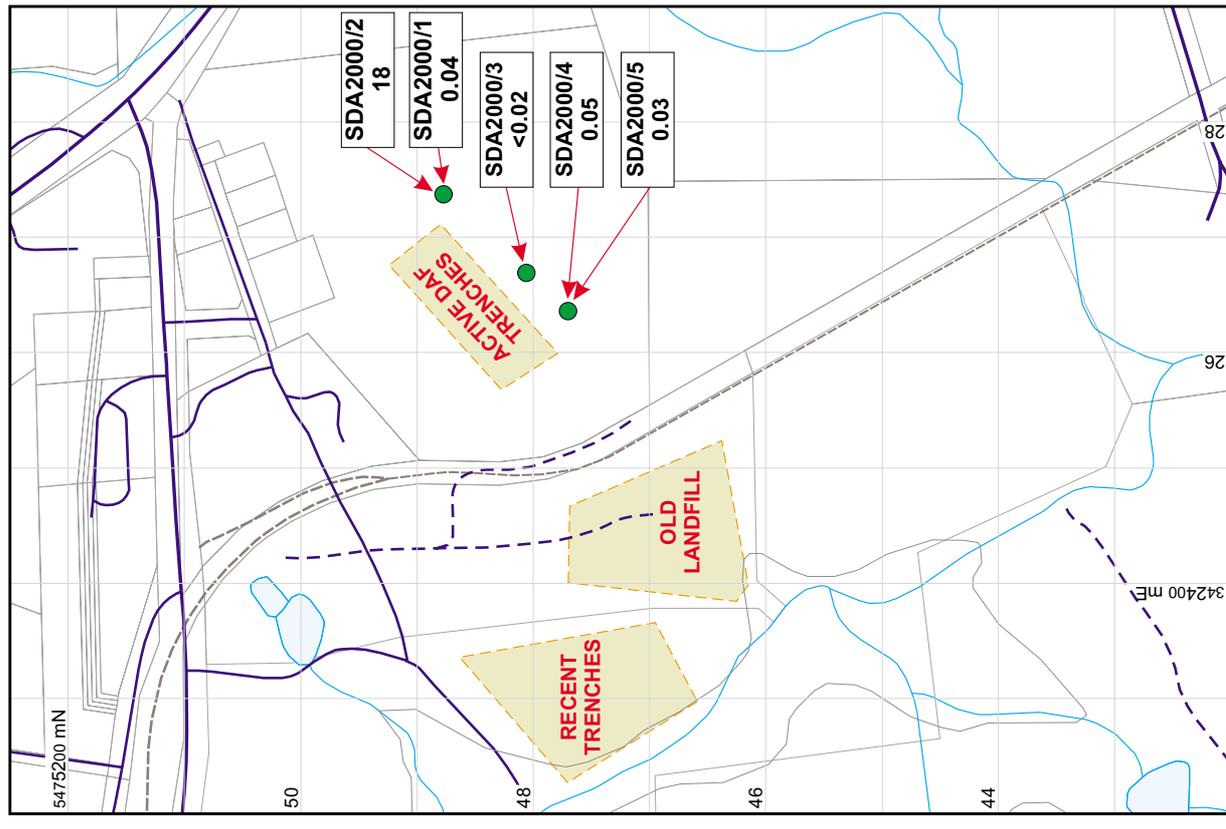
Smithton Blue Ribbon Abbatoir — December 2000
Ammonia ($\mu\text{g-N/L}$)



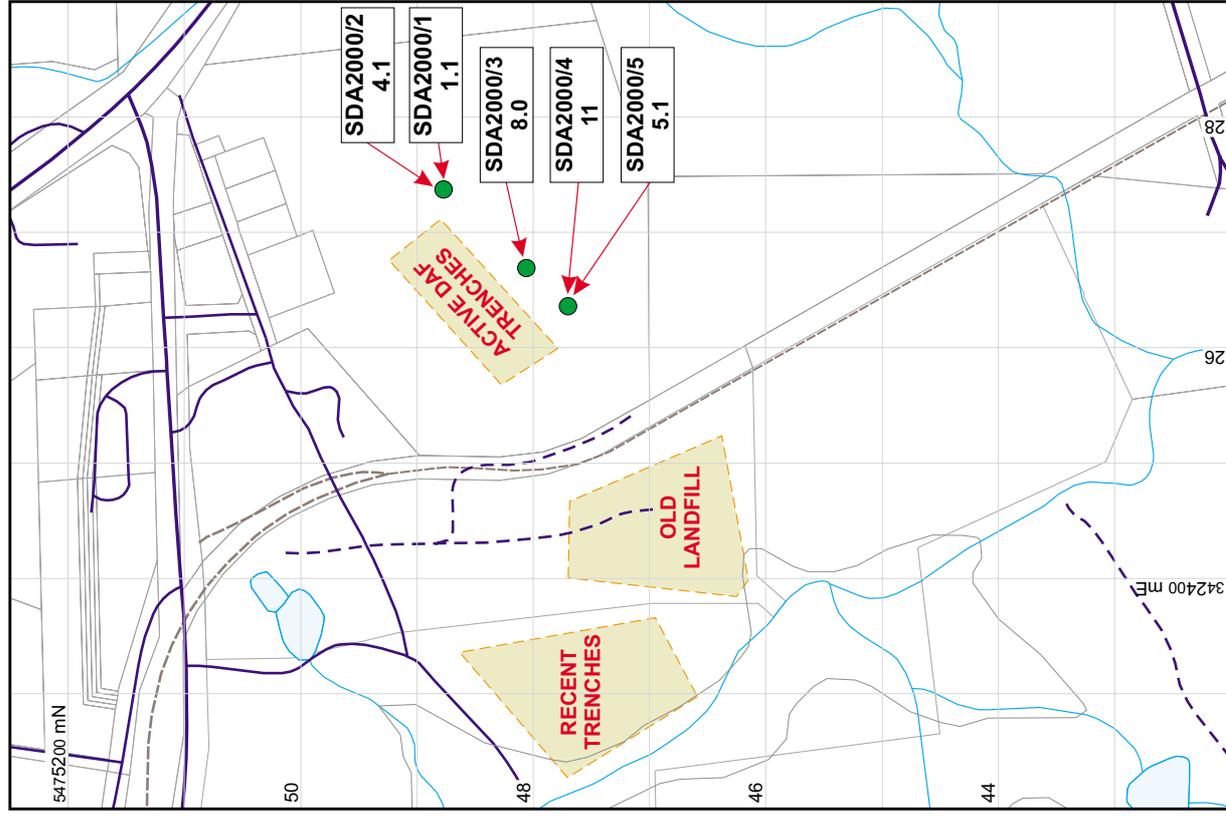
Smithton Blue Ribbon Abbatoir — December 2000
Chloride (mg/L)



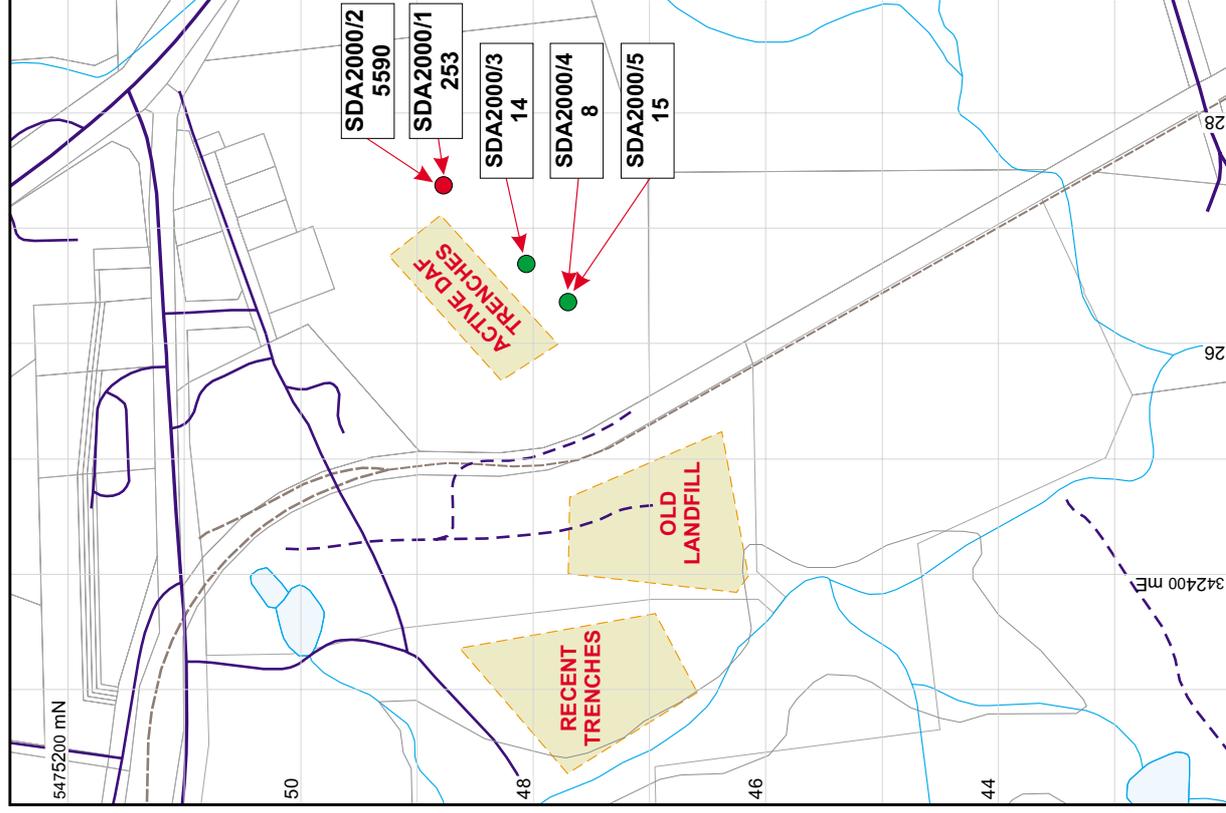
Smithton Blue Ribbon Abbatoir — December 2000
Fluoride (mg/L)



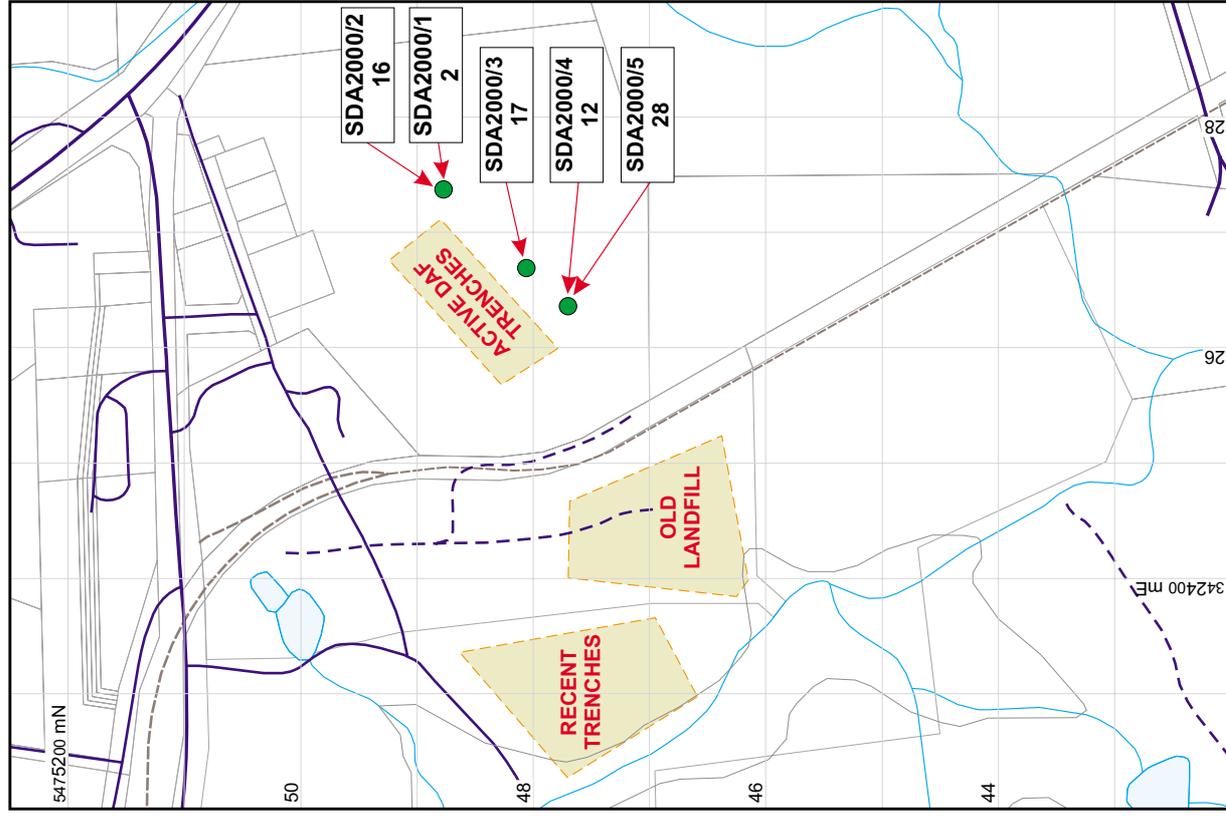
Smithton Blue Ribbon Abbatoir — December 2000
Sulphate (mg/L)



Smithton Blue Ribbon Abbatoir — December 2000
Ortho-P ($\mu\text{g-P/L}$)



Smithton Blue Ribbon Abbatoir — December 2000
Nitrite ($\mu\text{g-N/L}$)



Smithton Blue Ribbon Abbatoir — December 2000
Nitrate + Nitrite ($\mu\text{g-N/L}$)

