MINERAL RESOURCES TASMANIA

Tasmania

DEPARTMENT *of* INFRASTRUCTURE, ENERGY *and* RESOURCES

NHT Funded Project
NLP 13188

Natural Heritage Trust

Helping Communities Helping Australia

The effects of waste disposal on groundwater quality in Tasmania

Blue Ribbon abattoir, Smithton

Tasmanian Geological Survey Record 2002/06

Mineral Resources Tasmania
Tasmanian Geological Survey
Record 2002/06

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.*,

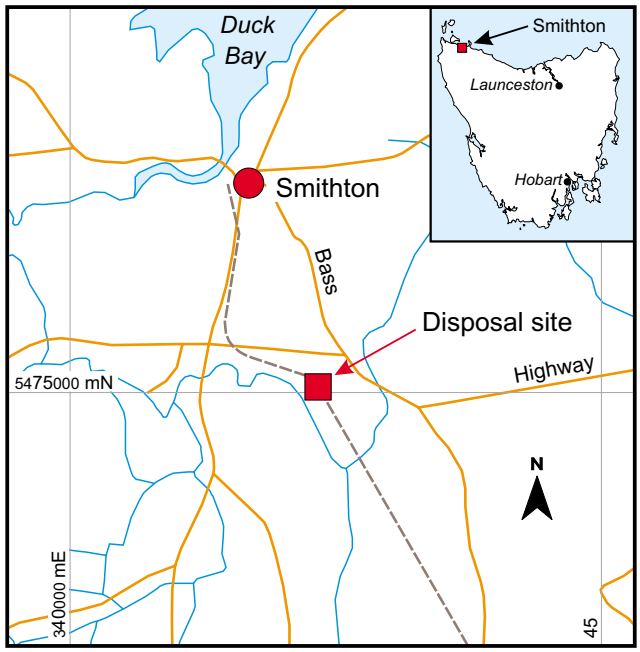


Figure 1. *Location of the Blue Ribbon abattoir disposal site, Smithton.*

Plate 1. *Waste pile/landfill from the former piggery/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.

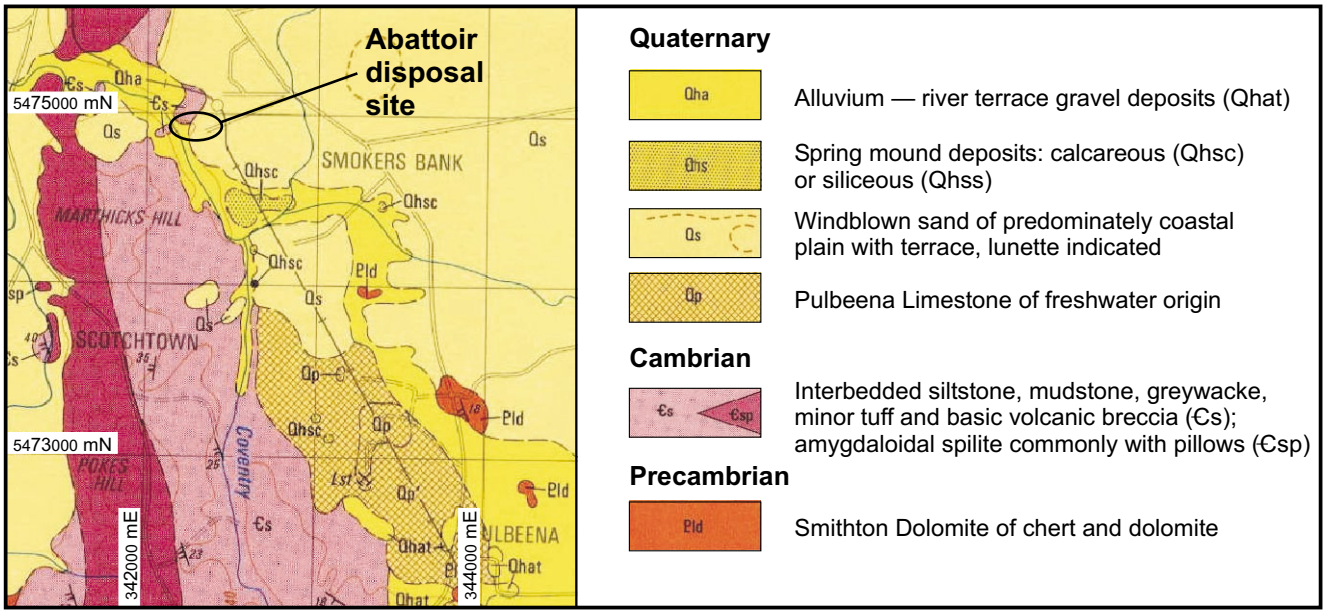


Figure 2

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

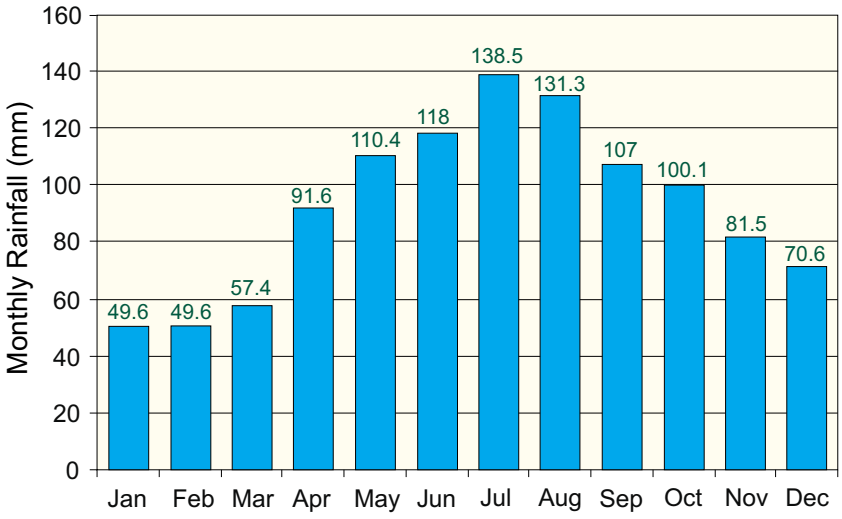


Figure 3

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.

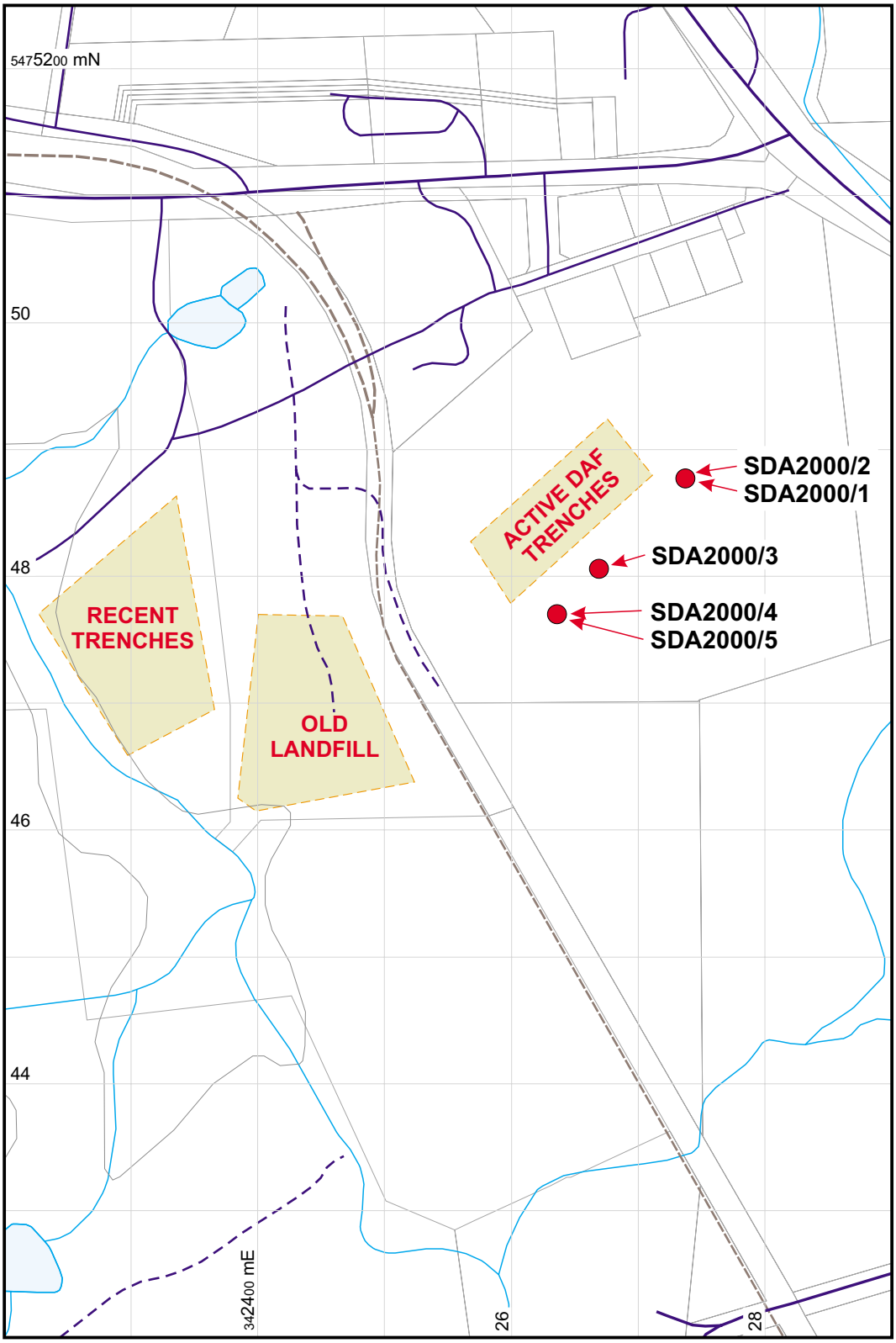


Figure 4

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

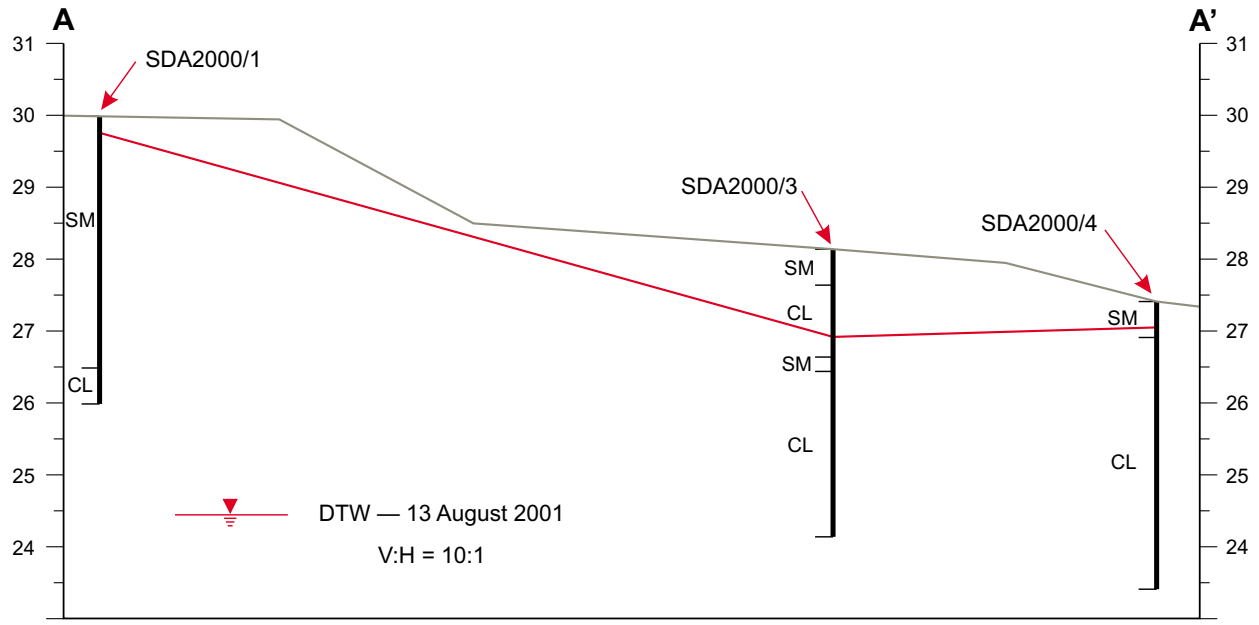


Figure 5

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 µS/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 clayey weathered bedrock material.

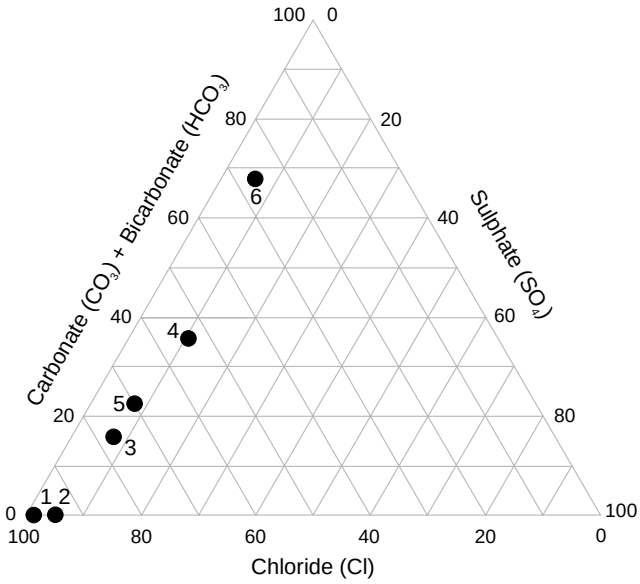


Figure 6

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 (µS/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.*

	Blue Ribbon Abattoir					**ANZECC 2000**		
Bore hole number (SDA)	2000/1	2000/2	2000/3	2000/4	2000/5	IRRIGATION		LIVESTOCK DRINKING
Analyte						STV (Short term)	LTV (Long 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 (µS/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	
PO_4-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			
NH_3-N (mg/L)	0.008	3.870	0.021	0.016	0.035			
(NO_2 + NO_3)-N (mg/L)	0.007	0.022	0.039	0.017	0.039			
NO_2-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 ECse, the average root zone salinity. ECse 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 contaminates 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 to 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.

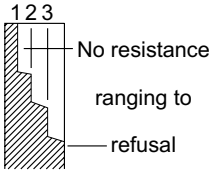
[30 May 2002]

Appendix 1

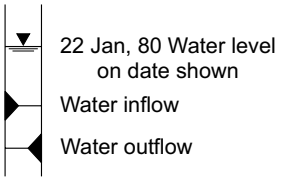
Engineering logs of boreholes

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

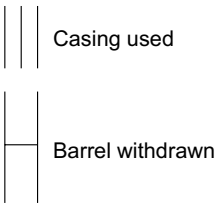
		%
VL	Very loose	0 – 15
L	Loose	15 – 35
MD	Medium dense	35 – 65
D	Dense	65 – 85
VD	Very dense	85 – 100

Fracture description

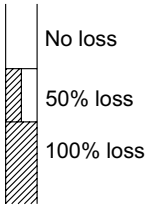
RP	Rough planar
RL	Rough irregular
SP	Smooth planar
SL	Smooth irregular

Cored borehole log

Case - lift



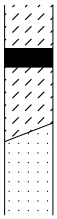
Fluid loss



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 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

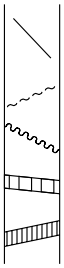
Strength

		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



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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
R.L.
Inclination: vertical
Bearing

Drill type: Auger
Drill method: Rotary
Drill fluid: Nil

Hole commenced: 6 September 2000
Hole completed: 6 September 2000
Drilled by: Mr Shane Heawood
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			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
			Main (water table)							
	1.5 metre slotted screen	7 mm Gravel	D Sample ID 5	2.0		SM	SAND - fine orange and brown	W	VS VL	Quaternary (wind blown) sand
			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	Back fill	D Sample ID 8	3.5		CL	CLAY - medium plasticity, light grey	M	F D	Possibly extremely weathered volcanic rock
				4.0			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.			

Sample ID numbers refer to samples stored in MRT core shed

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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
R.L.
Inclination vertical
Bearing

Drill type Auger
Drill method Rotary
Drill fluid Nil

Hole commenced 6 September 2000
Hole completed 6 September 2000
Drilled by Mr Shane Heawood
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 / 1.0 metre slotted screen	Cement / Bentonite / 7 mm Gravel	D Sample ID 1	0.0		SM	SAND - fine, grey	M	F	Quaternary (wind blown) sand
			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.			

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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
R.L.
Inclination: vertical
Bearing

Drill type: Auger
Drill method: Rotary
Drill fluid: Nil

Hole commenced: 6 September 2000
Hole completed: 6 September 2000
Drilled by: Mr Shane Heawood
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	Cement	D Sample ID 1			SM	SAND - fine, light grey	M	S L	Quaternary (wind blown) sand
		Bentonite	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
						CL	CLAY - medium plasticity, orange, extremely weathered igneous rock fragments	D	L	Weathered bedrock
			D Sample ID 4	1.5		SM	SAND - dark brown and black	M	F	Weathered bedrock
						CL	CLAY - medium plasticity, orange, weathered white rock fragments	W	F	Weathered bedrock
	1.5 N.R.F.S.* Screen 4x150mm spaced 5mm holes		D Sample ID 5	2.0		CL	CLAY - medium plasticity, orange and brown, weathered white rock fragments	M	Vst	Weathered bedrock
		7 mm Gravel	D Sample ID 6	2.5		CL	CLAY - medium plasticity, brown	M	VS	Weathered bedrock
			D Sample ID 7	3.0						
	No screen		D Sample ID 8	3.5						
				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.			

Sample ID numbers refer to samples stored in MRT core shed

* Nylon Rock Fabric Sock

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ENGINEERING LOG - BOREHOLE

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

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 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	Cement	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, 90% brown 10% black	M	F	Quaternary sediments
		Bentonite	Minor							
			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
	1.5 N.R.F.S.* Screen 4x150mm spaced 5mm holes		D Sample ID 5	2.0		CL	CLAY - low plasticity, orange, weathered rock fragments	W	F	Weathered bedrock
			Major			CL	CLAY - low plasticity, orange, weathered rock fragments	W	VS VL	Weathered bedrock
		7 mm Gravel	D Sample ID 6	2.5						
			D Sample ID 7							
			D Sample ID 8	3.0						
	No screen		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

MINERAL RESOURCES TASMANIA

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
R.L.
Inclination vertical
Bearing

Drill type Auger
Drill method Rotary
Drill fluid Nil

Hole commenced 6 September 2000
Hole completed 6 September 2000
Drilled by Mr Shane Heawood
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	Cement / Bentonite	D Sample ID 1			SM	SAND - fine, light grey	M	S L	Quaternary (wind blown) sand
	1.0m N.R.F.S.* Screen	7 mm Gravel	D Sample ID 2	0.5		CL	CLAY - medium plasticity, 90% brown 10% black	M	F	Weathered bedrock
			D Sample ID 3	1.0		CL	CLAY - low plasticity, orange, weathered rock fragments	W	St	Weathered bedrock
	No screen		D Sample ID 4	1.5		CL	CLAY - low plasticity, orange, extremely weathered rock fragments	W	St	Weathered bedrock
			Sample ID numbers referto samples stored in MRT core shed	2.0			End of hole at 2.0 m			

* Nylon Rock Fabric Sock

Appendix 2

Analytical Services Tasmania — laboratory reports

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:	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

Mike Johnson
Manager

Tasmania

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

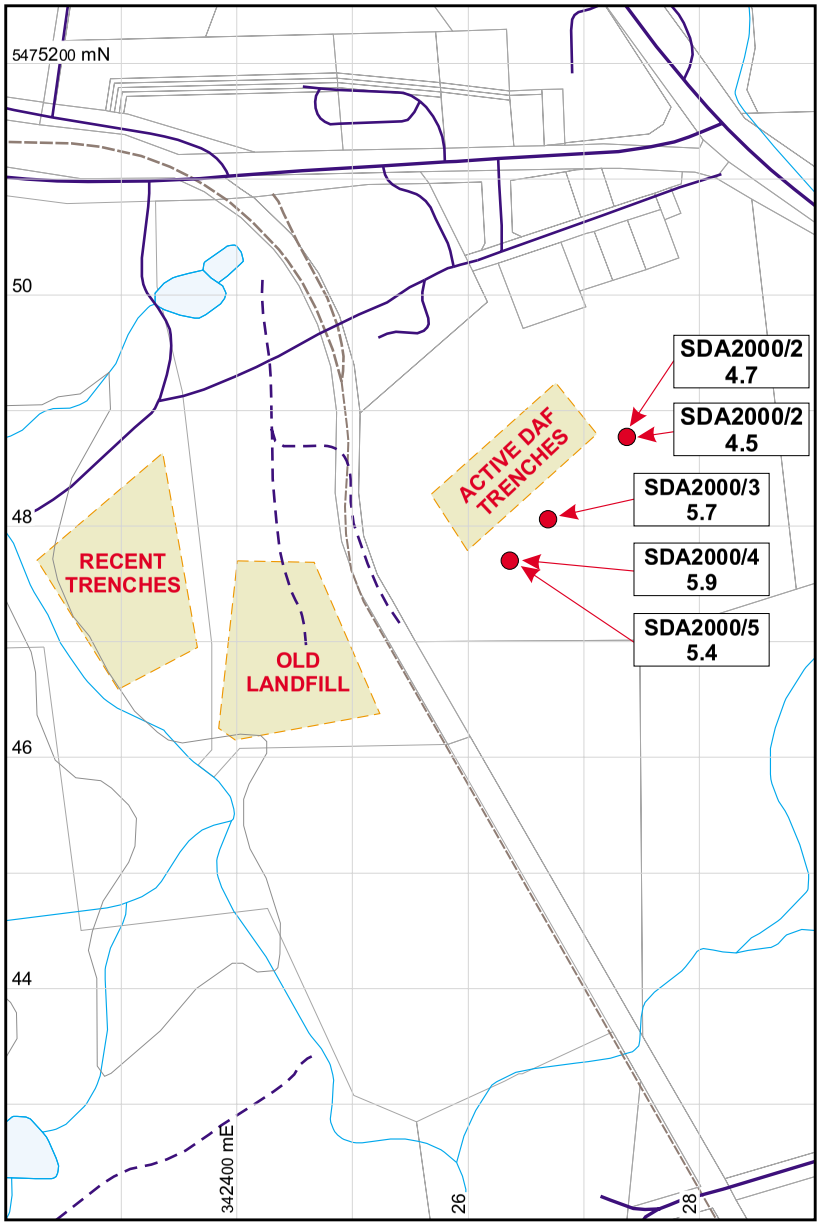
NATA Accreditation Number: 5589

Report No: 13770 **Report Date:** 01-Dec-00

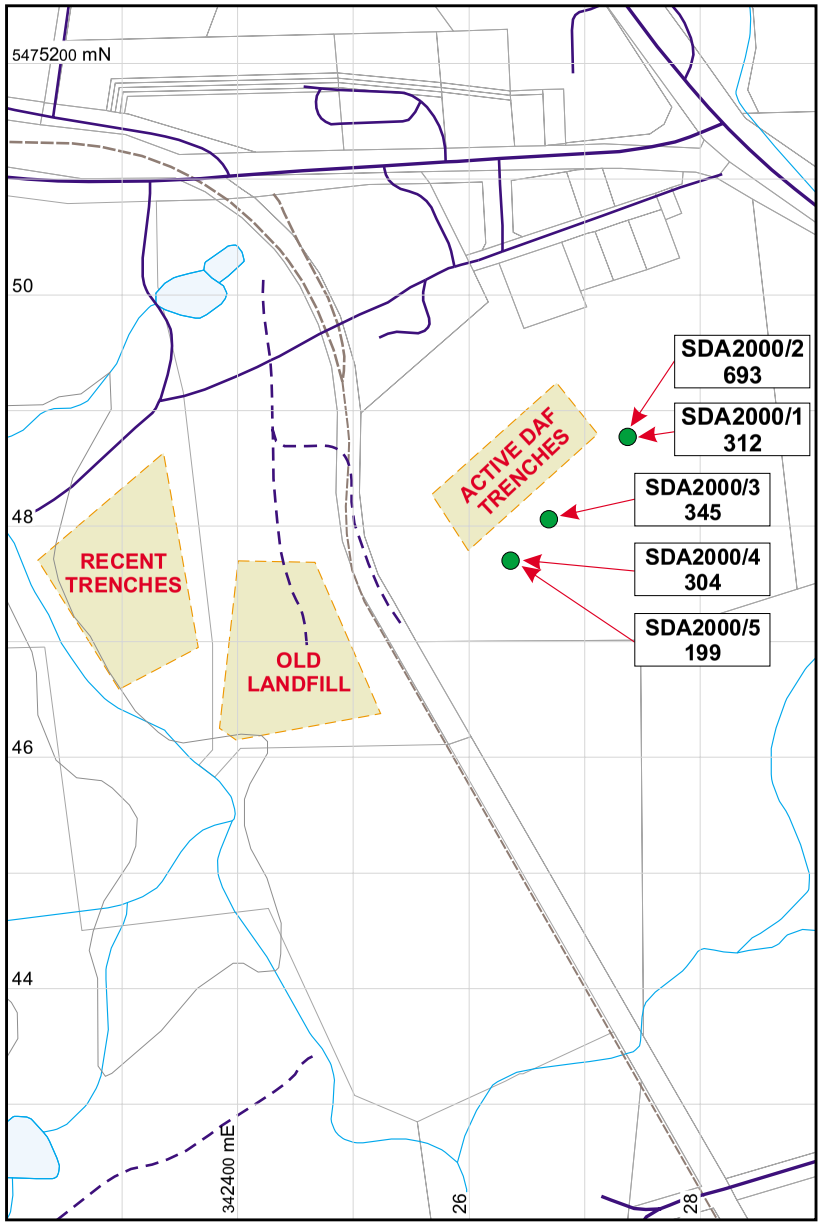
		Lab.No.:	13073	13074	13075	13076	13077
		Sample Id.:	SDA 2000/1	SDA 2000/2	SDA 2000/3	SDA 2000/4	SDA 2000/5
Method	**Analyte**	**Units / Sampled On :**	02/11/00	02/11/00	02/11/00	02/11/00	02/11/00
1001-Water	pH		4.5	4.7	5.7	5.9	5.4
1002-Water	Conductivity	µS/cm	312	693	345	304	199
1004-Water	TDS	mg/L	234	832	339	383	358
1101-Water	Alkalinity CO3	mg/L CaCO3	<1	<1	<1	<1	<1
	Alkalinity HCO3	mg/L CaCO3	<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

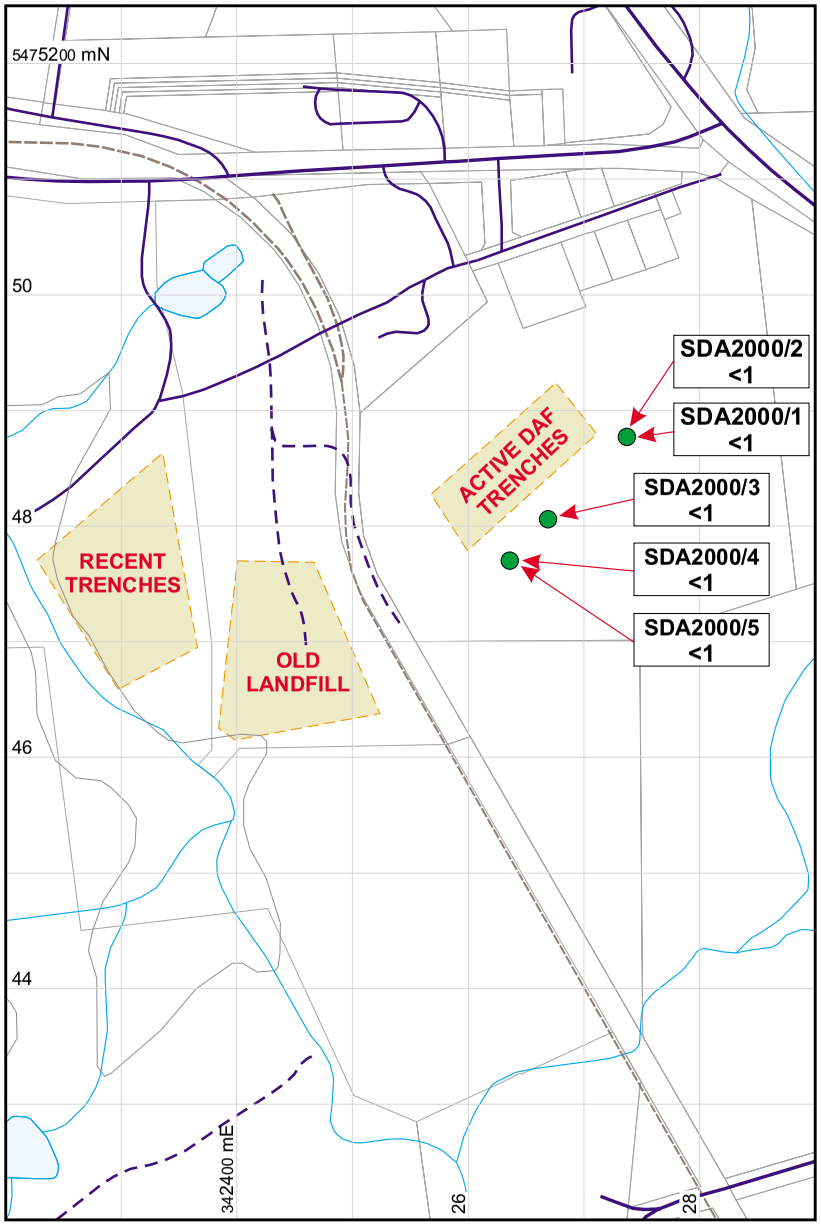
Smithton Blue Ribbon Abbatoir — December 2000
pH



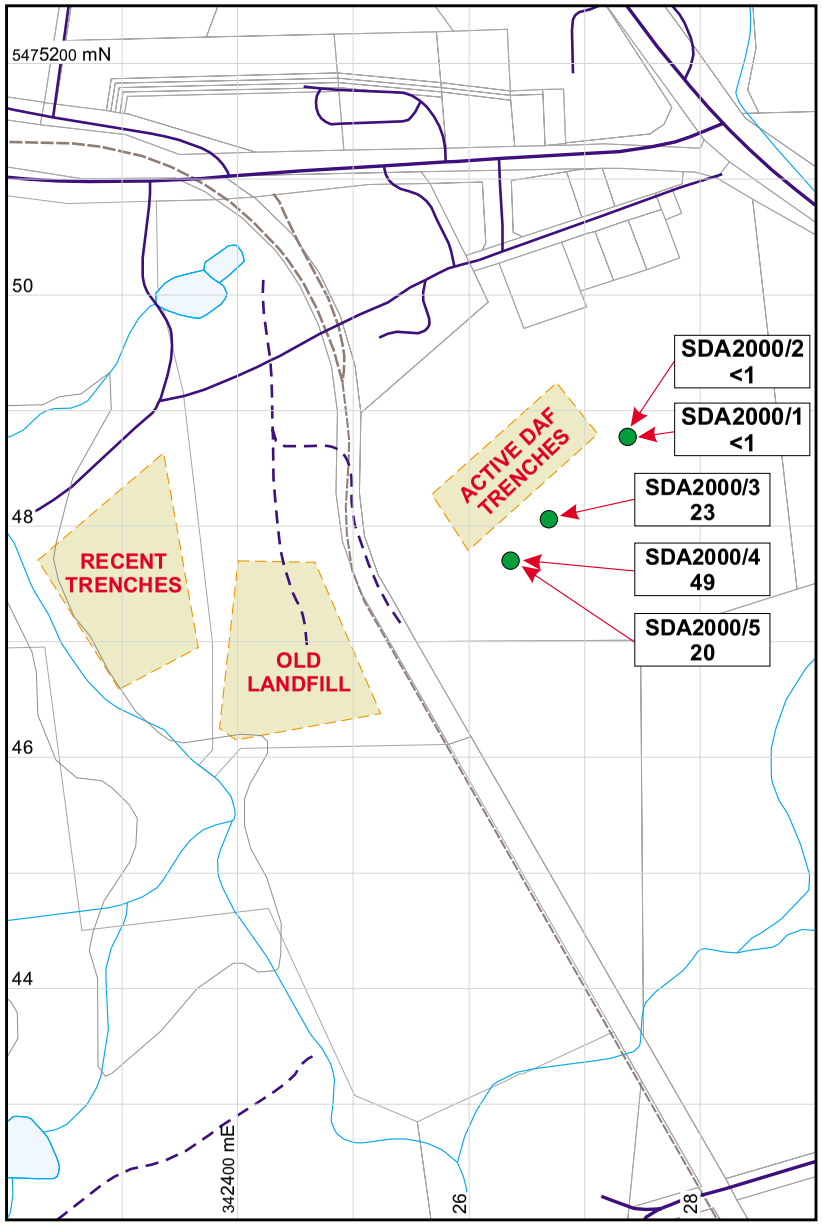
Smithton Blue Ribbon Abbatoir — December 2000
Conductivity (µg/L)



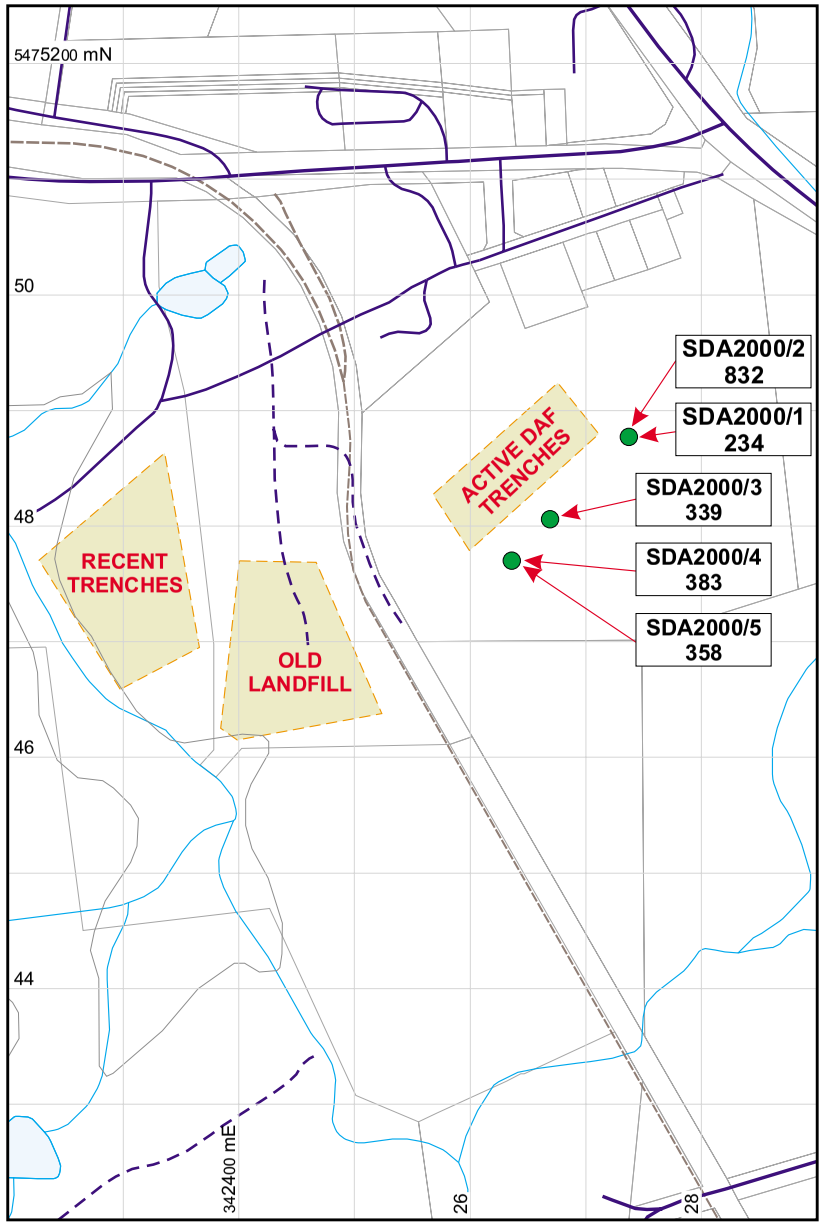
Smithton Blue Ribbon Abbatoir — December 2000
Alkalinity CO_3 (mg/L $CaCO_3$)



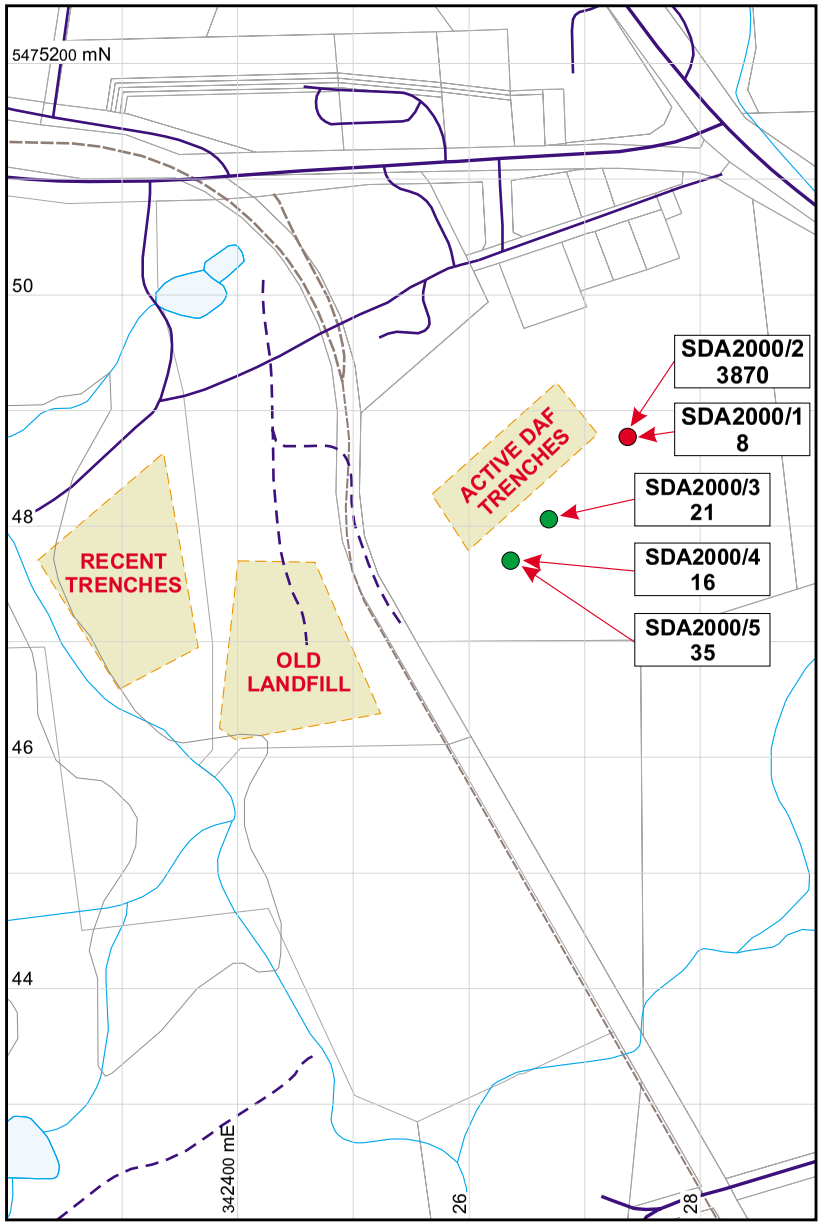
Smithton Blue Ribbon Abbatoir — December 2000
Alkalinity HCO_3 (mg/L $CaCO_3$)



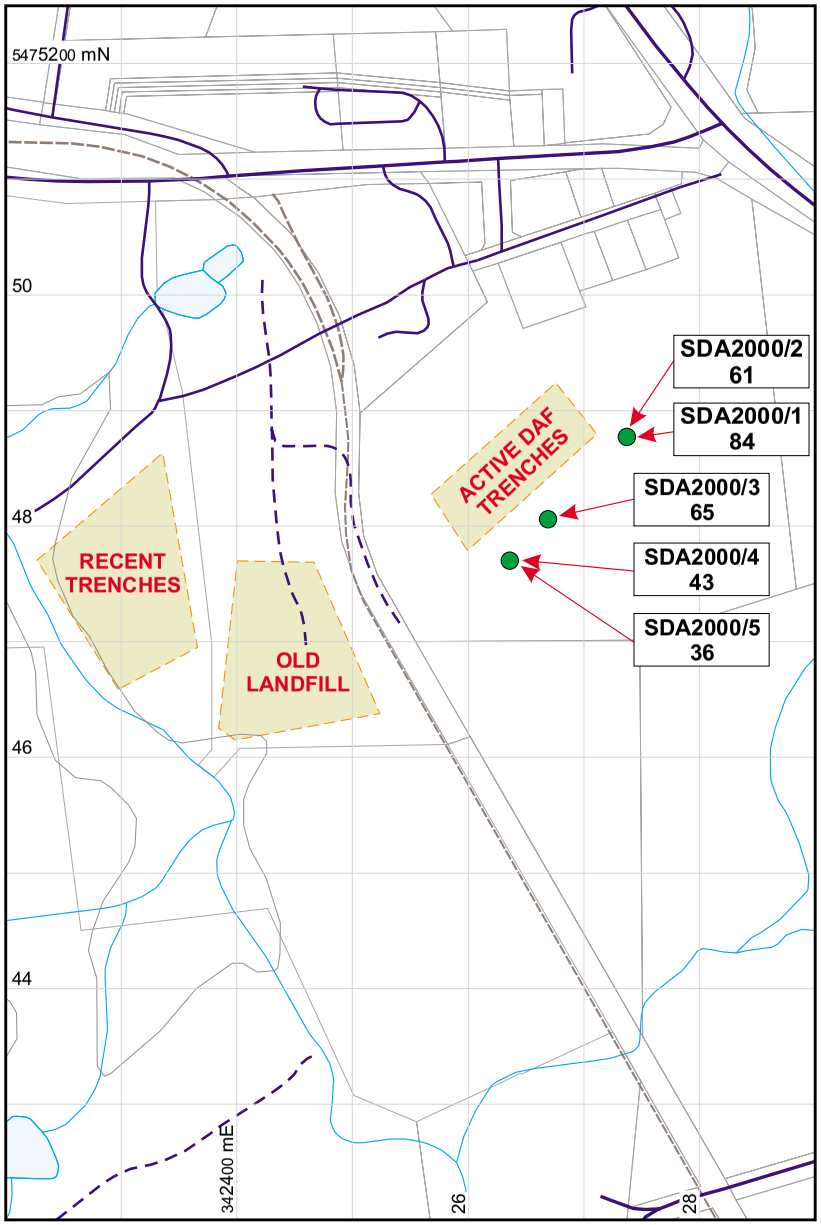
Smithton Blue Ribbon Abbatoir — December 2000
TDS (mg/L)



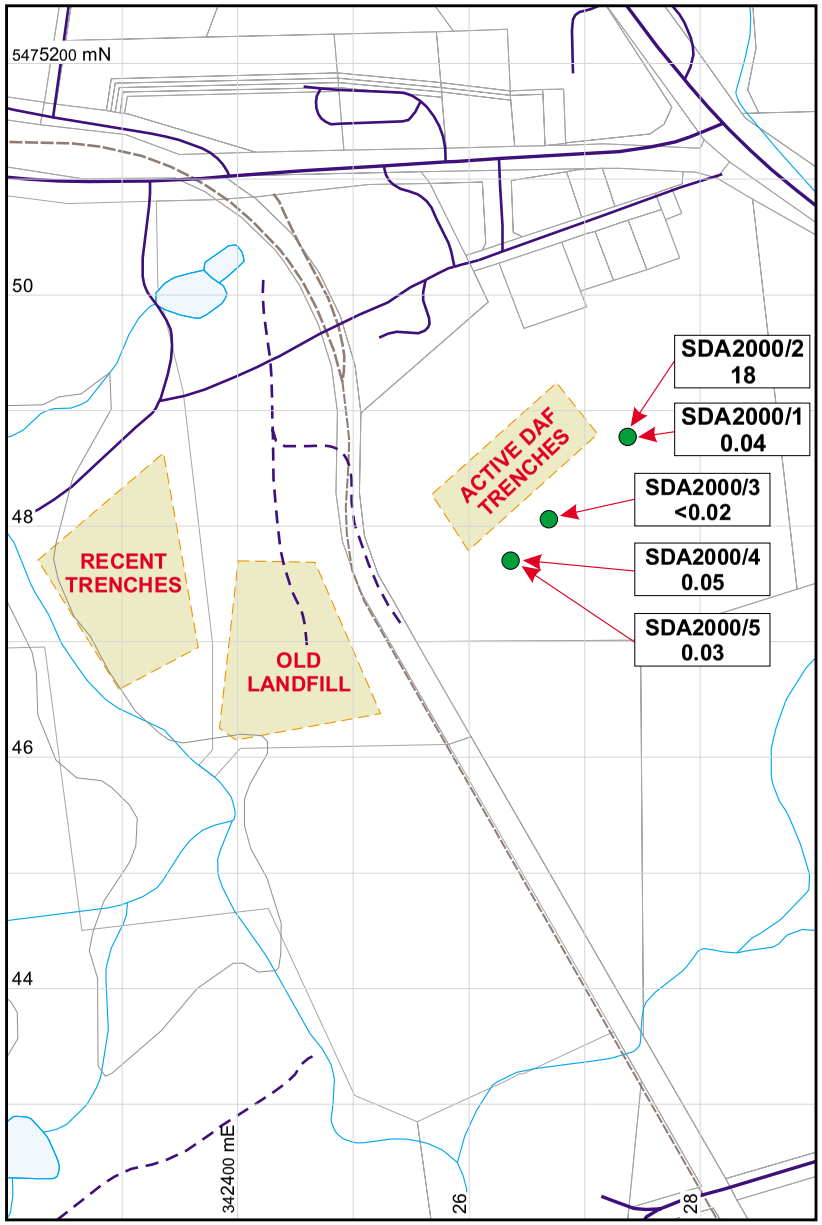
Smithton Blue Ribbon Abbatoir — December 2000
Ammonia (μg-N/L)



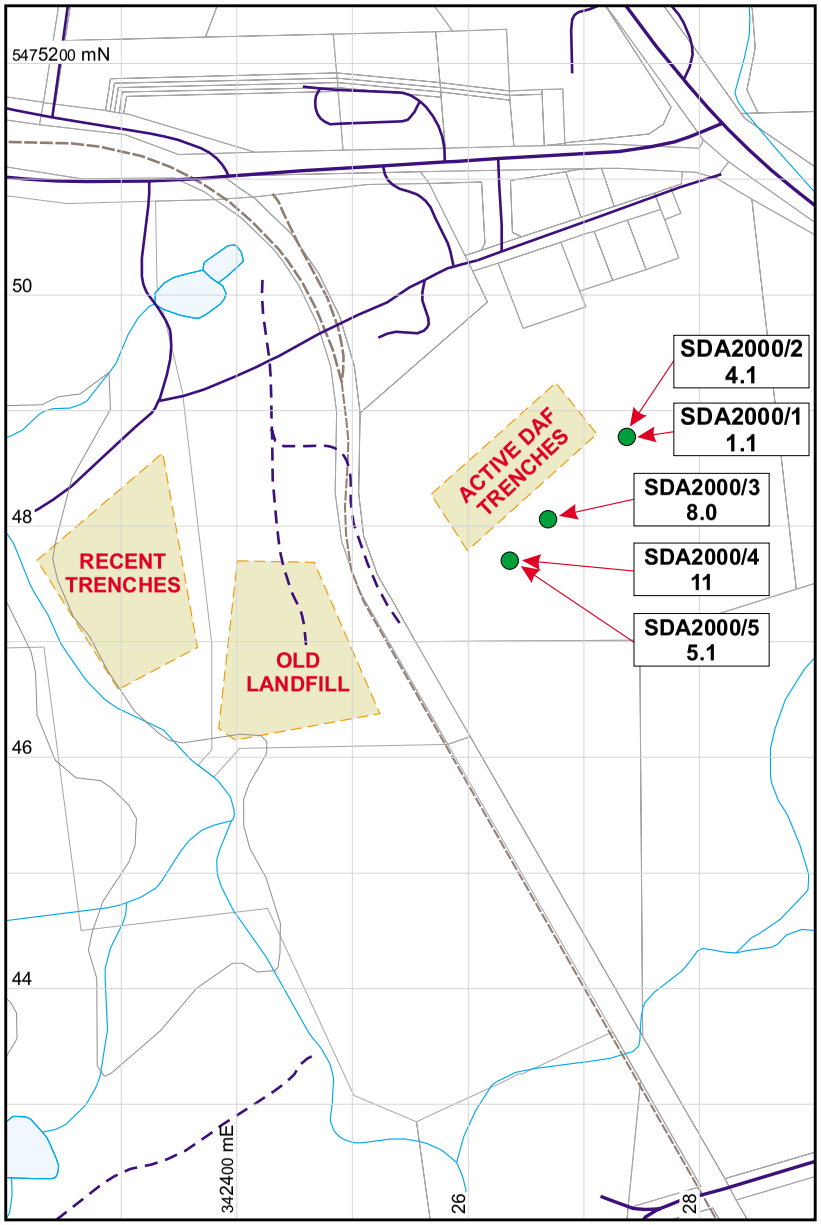
Smithton Blue Ribbon Abbatoir — December 2000
Chloride (mg/L)



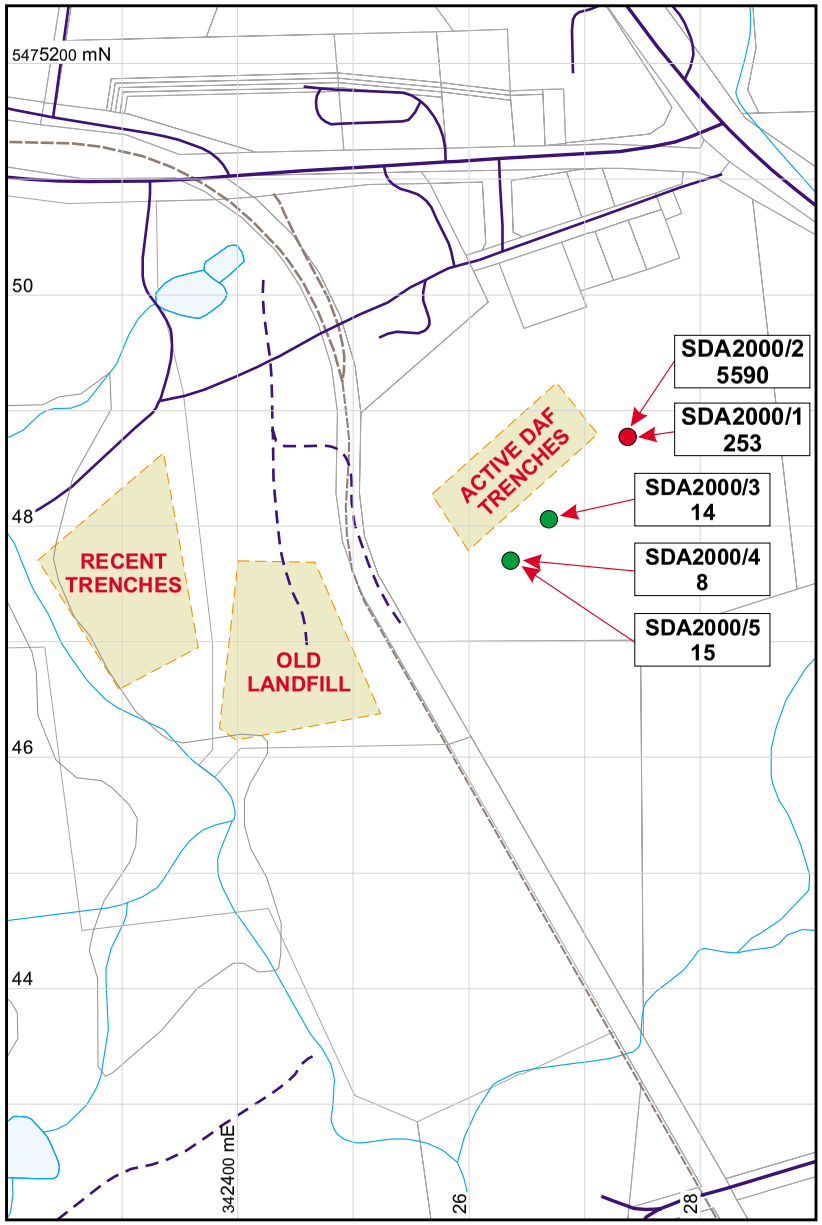
Smithton Blue Ribbon Abbatoir — December 2000
Fluoride (mg/L)



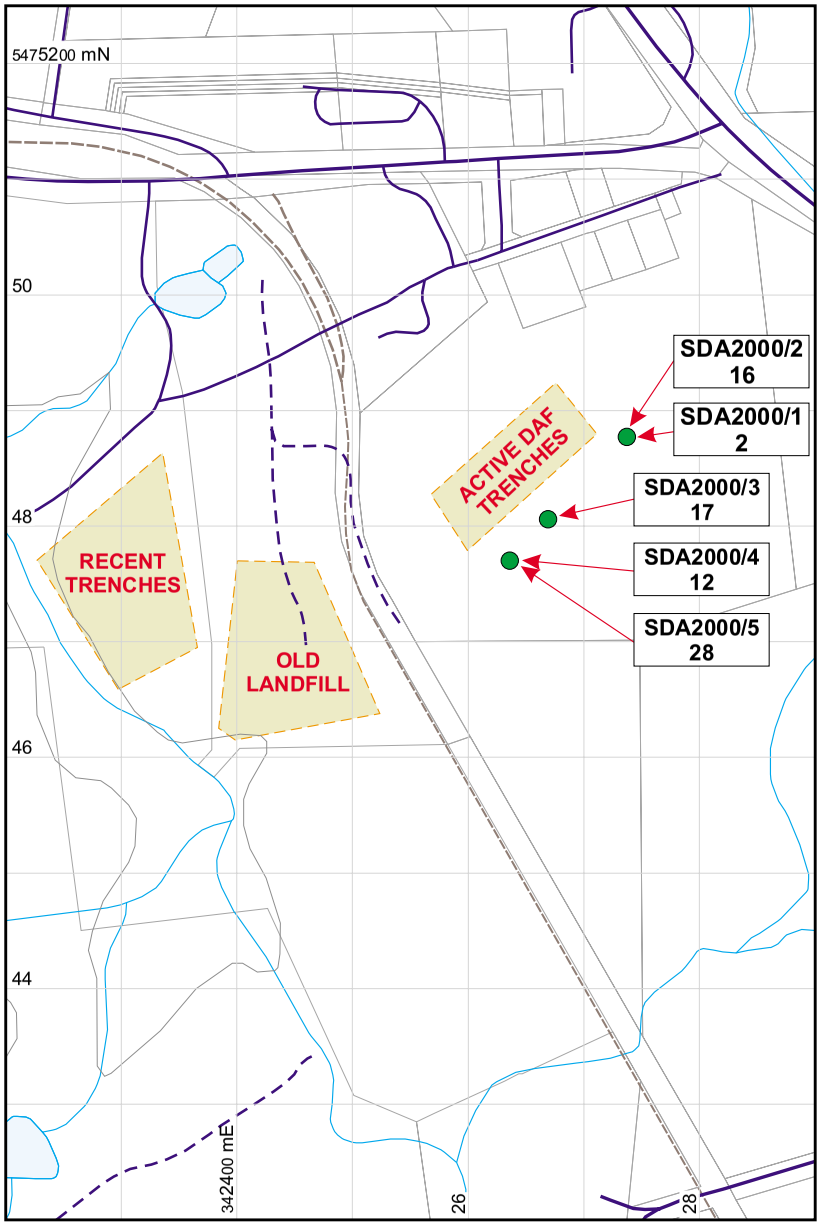
Smithton Blue Ribbon Abbatoir — December 2000
Sulphate (mg/L)



Smithton Blue Ribbon Abbatoir — December 2000
Ortho-P (μg-P/L)



Smithton Blue Ribbon Abbatoir — December 2000
Nitrite (µg-N/L)



Smithton Blue Ribbon Abbatoir — December 2000
Nitrate + Nitrite (µg-N/L)