

# Margot Saner & Associates (Pty) Ltd

a Department of Labour Approved Inspection Authority (Cert no. C I036 OH)

# AIR PATHWAY ANALYSIS SYSTEM (APAS)

Interim Report  
Shongweni WDS  
July 2008 – February 2009

# Air Pathway Analysis System (APAS)

## Air Quality Monitoring Programme

Conducted on the Shongweni WDS since 1997

Programme cycles every year and includes:

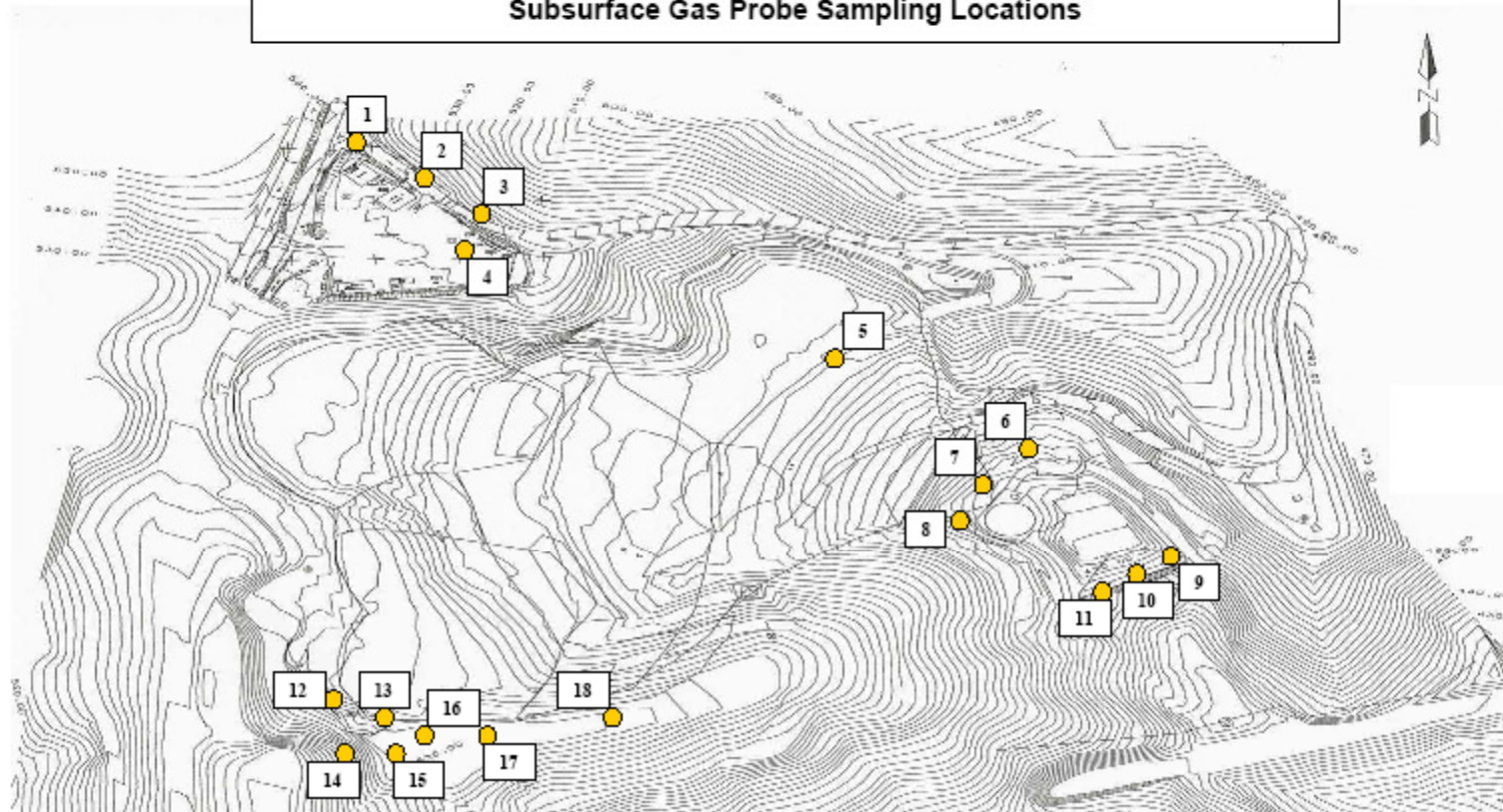
- Source sampling (Sub Surface Gas Probes)
- Ambient air sampling
- Worker exposure sampling
- **Aim:** to assess the health risks to workers and the community associated with exposures to airborne contaminant compounds generated on the site

# Source Sampling (Subsurface Gas Probes)

measurement of:

- Methane
- Carbon dioxide
- Hydrogen sulphide
- Non Methane Organic Compounds
- Oxygen
- Flow rates

**SHONGWENI WASTE DISPOSAL SITE  
Subsurface Gas Probe Sampling Locations**



**Figure 1** Shongweni Waste Disposal Site  
Landfill Gas Monitoring Network

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NOT DRAWN TO SCALE

TABLE 1.19: DISPOSETECH - SHONGWENI SUBSURFACE GAS PROBE MEASUREMENTS							
PROBE NO	PARAMETER						
	CH4 %	CO2 %	O2 %	H2S (ppm)	LEL %	Flow (l/h)	AP (mb)
	Date: 08/07/2008						
1	0	0.1	20	0	0	0	946
2	0	0.1	20	0	0	0	946
3	0	0.1	20.1	0	0	0	946
4	0	0.1	20.1	0	0	1	946
5	27.5	28.4	0.6	1	100	1	946
6	0.1	0.2	19.1	0	2	1	946
7	0.1	0.1	19.9	0	1	1	946
8	0.1	0.1	20	0	0	1	946
9	0	0.1	20.1	0	0	0	946
10	0	0	20.1	0	0	0	946
11	0	0	20.1	0	0	0	946
12	0	0	20.1	0	0	0	950
13	14.3	9.3	15.5	0	100	1	950
14	5.2	3.2	18.3	0	90	0	950
15	1.4	1.6	19.3	0	25	1	950
16	0	0.1	20	0	0	1	950
17	25.5	25.6	6.3	7	100	1	950
18	0.2	0.1	19.6	0	3	1	950

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TABLE 1.20: DISPOSETECH - SHONGWENI SUBSURFACE GAS PROBE MEASUREMENTS							
PROBE NO	PARAMETER						
	CH4 %	CO2 %	O2 %	H2S (ppm)	LEL %	Flow (l/h)	AP (mb)
	Date: 14/10/2008						
1	0	0.1	20.1	0	0	1	954
2	0	0	20.1	0	0	1	954
3	0	0.1	20.1	0	0	1	954
4	0	0	20.2	0	0	1	954
5	11.7	15.2	10.1	0	100	1	960
6	0	0.1	20.2	0	0	1	965
7	0	0	20.2	0	0	0	965
8	0	0.1	20.2	0	0	1	965
9	0	0.4	19.9	0	0	1	965
10	0	0.1	20	0	0	1	965
11	0	0.4	19.8	0	0	1	965
12	0	0	20.4	0	0	1	956
13	22.6	20	10.9	8	100	0	956
14	1.6	1.4	19.5	0	17	1	956
15	1.6	1.1	19.7	0	27	1	956
16	0.1	0.1	20.2	0	1	1	956
17	14.9	9.6	13.5	0	100	1	956
18	0.1	0	20.2	0	2	1	956

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TABLE 1.21: DISPOSETECH - <b>SHONGWENI</b> SUBSURFACE GAS PROBE MEASUREMENTS							
	PARAMETER						
	CH4 %	CO2 %	O2 %	H2S (ppm)	LEL %	Flow (l/h)	AP (mb)
PROBE NO	Date: 06/01/2009						
1	0.1	0	20.3	0	1	1	943
2	0	0	20.3	0	0	0	943
3	0	0.1	20.2	0	0	1	943
4	0	0	20.3	0	0	1	943
5	23.6	19.8	4.8	1	100	2	943
6	0	0	20.8	0	1	0	952
7	0.1	0	20.8	0	1	0	952
8	0.1	0	20.8	0	1	1	952
9	0.1	0.3	20.3	0	2	0	943
10	0.1	0	20.7	0	2	1	943
11	0.1	0.4	20.3	0	3	0	943
12	0	0	21	0	0	0	946
13	42.8	30.1	6.6	10	100	0	946
14	1.9	1	20.2	1	35	1	946
15	1.5	1.2	19	0	23	1	946
16	0.2	0	21.1	0	2	2	946
17	12.9	6	16.4	6	100	0	946
18	0.2	0.1	20.8	0	3	1	946

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# Ambient Air Sampling

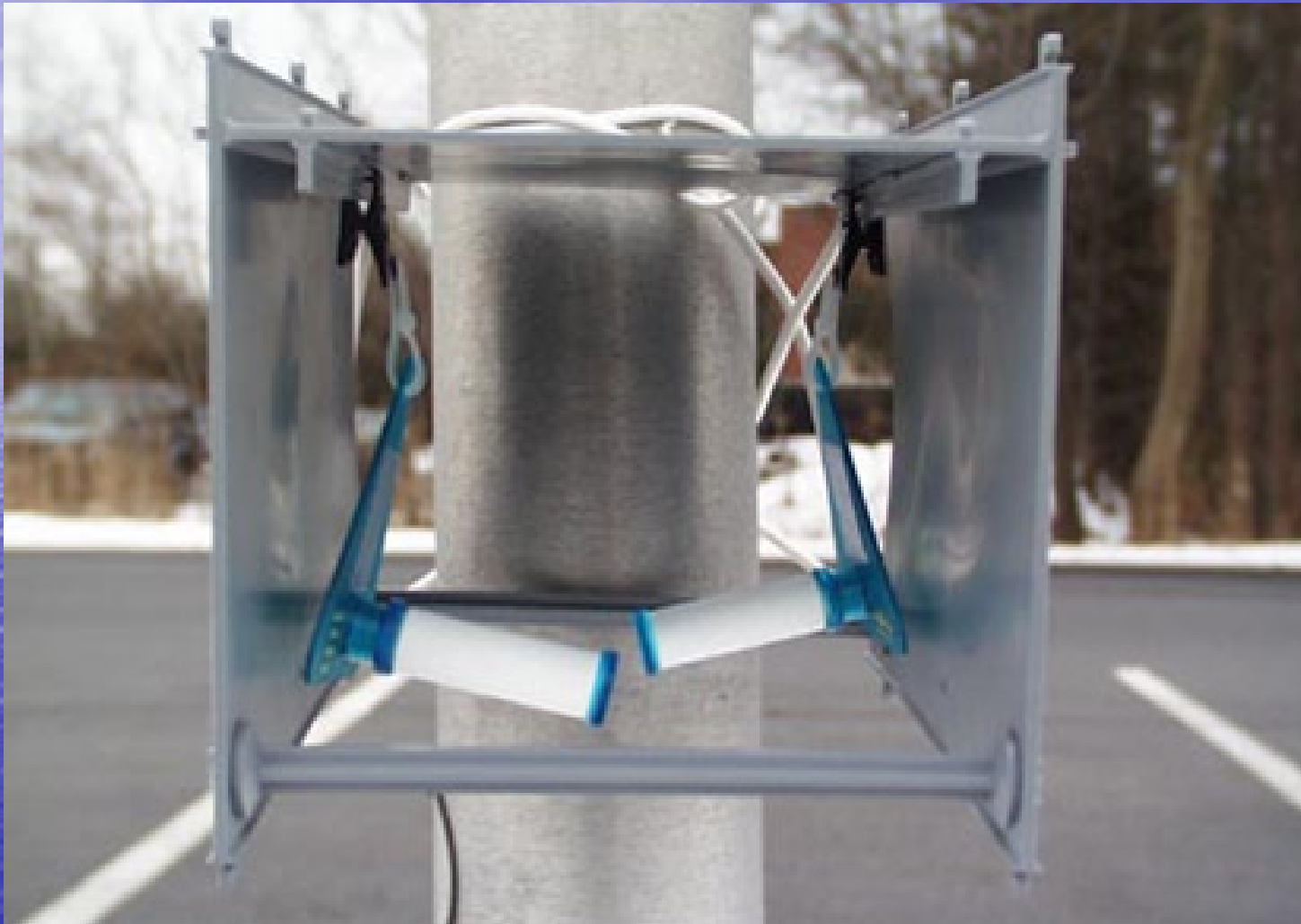
measurement of priority compounds:

- Non Methane Organic Compounds
- Hydrogen sulphide
- Ammonia
- Aldehydes

# Radiello ambient air samplers



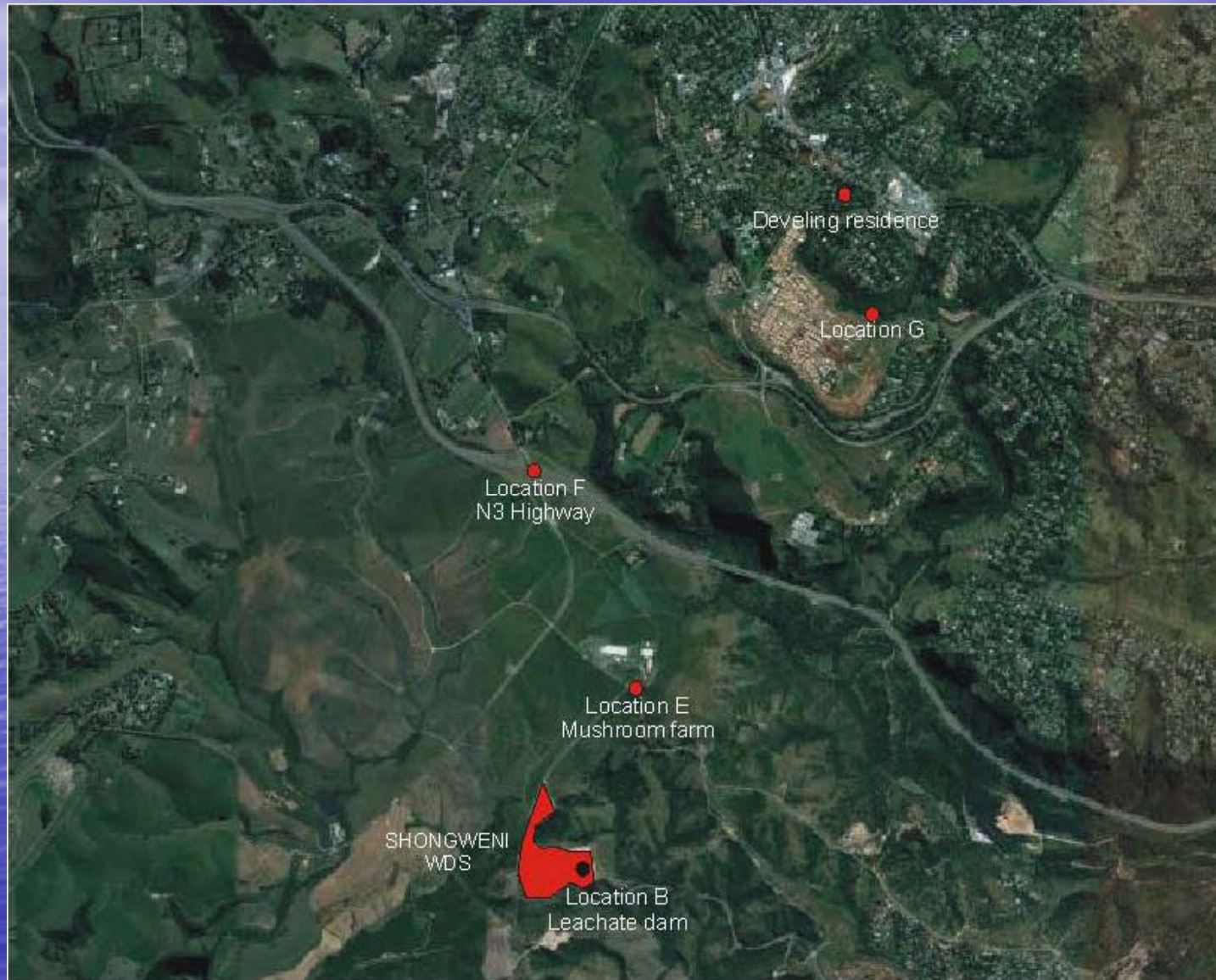
## Radiello ambient air samplers with shelter



## On-site ambient air sampling stations



# Off-site ambient sampling stations Jul 2008 – Jan 2009



Shongweni Waste Disposal Site - Air Quality Monitoring:

Table 1 - Ambient Air Sampling Results: 12 August - 30 September 2008

Substance									Environmental	Odour
Sample ID	SHO0808		SHO0808		SHO0808		SHO0808		Assessment	Detection
Location Description	Leach dam	Hazard	Mush farm	Hazard	N3	Hazard	Hillcrest	Hazard	Level	Threshold
Location ID	On-site	Index	Off-site	Index	Off-site	Index	Off-site	Index		
Date	12/8-30/9	(HI)	12/8-30/9	(HI)	12/8-30/9	(HI)	12/8-30/9	(HI)	EAL	ODT
Units	µg/m <sup>3</sup>		µg/m <sup>3</sup>		µg/m <sup>3</sup>		µg/m <sup>3</sup>		µg/m <sup>3</sup>	µg/m <sup>3</sup>
Sampling Station	Station B		Station E		Station F		Station G			
NMOC									EAL(Health)	Odour Thres.
Benzene	0.02	0.004	0	0	0	0	0	0	5	38400
Toluene	0.08	4.2E-05	0.01	5E-06	0.06	3.1E-05	0.01	5.2E-06	1910	10904
Ethylbenzene	0.2	4.5E-05	0.01	2E-06	0.02	4.5E-06	0.01	2.3E-06	4410	10005
Xylene (all isomers)	0.45	0.0001	0.01	2E-06	0.08	1.8E-05	0.01	2.3E-06	4410	56
Trimethylbenzenes	0.03	2.4E-05	0.01	8E-06	0	0	0.01	8E-06	1250	2706
n-Butyl Acetate	0	0	0	0	0	0	0	0	7240	14040
Trichloroethylene	0		0		0		0		1100	1852
Tetrachloroethylene	0	0	0	0	0	0	0	0	3450	112500
Limonene	0		0		0		0		100	174200
<b>ALDEHYDES</b>										
Formaldehyde	2.48	0.496	0	0	1.61	0.322	1.73	0.346	5	1037
Acetaldehyde	3.8	0.76	0	0	0.43	0.086	0.38	0.076	5	900
Acrolein	1.73	0.346	0	0	0.58	0.116	0.54	0.108	5	367
Propionaldehyde	0	0	0	0	0.62	0.124	0	0	5	
n-Butyraldehyde	0	0	0	0	0	0	0	0	5	
Valeraldehyde	0	0	0	0	0	0	0	0	5	
Glutaraldehyde	0	0	0	0	0	0	0	0	5	
Hexaldehyde	0	0	0	0	0	0	0	0	5	
<b>TRS</b>										
Hydrogen sulphide	0	0	0.17	0.0012	0.01	7.1E-05	0.01	7.1E-05	140	8.1
Ammonia	7.87	0.04372	0	0	0.34	0.00189	0	0	180	3536
<b>Hazard Index (Total)</b>	<b>1.64994</b>		<b>0.0012</b>		<b>0.65001</b>		<b>0.53009</b>			

0 depicts below the detection limit of the analytical method used

Shongweni Waste Disposal Site - Air Quality Monitoring:

Table 2 - Ambient Air Sampling Results: 1 October - 13 November 2008

Substance									Environmental	Odour
Sample ID	SHO1008		SHO1008		SHO1008		SHO1008		Assessment	Detection
Location Description	Leach dam	Hazard	Mush farm	Hazard	N3	Hazard	Hillcrest	Hazard	Level	Threshold
Location ID	On-site	Index	Off-site	Index	Off-site	Index	Off-site	Index		
Date	1/10 - 13/11	(HI)	1/10 - 13/11	(HI)	1/10 - 13/11	(HI)	1/10 - 13/11	(HI)	EAL	ODT
Units	µg/m <sup>3</sup>		µg/m <sup>3</sup>		µg/m <sup>3</sup>		µg/m <sup>3</sup>		µg/m <sup>3</sup>	µg/m <sup>3</sup>
Sampling Station	Station B		Station E		Station F		Station G			
NMOC									EAL(Health)	Odour Thres.
Benzene	0	0	0	0	0	0	0	0	5	38400
Toluene	0.1	5.2E-05	0.01	5E-06	0	0	0	0	1910	10904
Ethylbenzene	0.15	3.4E-05	0.6	0.0001	0	0	0	0	4410	10005
Xylene (all isomers)	0.24	5.4E-05	1.29	0.0003	0	0	0	0	4410	56
Trimethylbenzenes	0	0	0	0	0	0	0	0	1250	2706
n-Butyl Acetate	0	0	0	0	0	0	0	0	7240	14040
Trichloroethylene	0	0	0	0	0	0	0	0	1100	1852
Tetrachloroethylene	0	0	0	0	0	0	0	0	3450	112500
Limonene	0	0	0	0	0	0	0	0	100	174200
<b>ALDEHYDES</b>										
Formaldehyde	1.47	0.294	1.15	0.23	0.55	0.11	0.53	0.106	5	1037
Acetaldehyde	2.29	0.458	1.56	0.312	2.74	0.548	2.41	0.482	5	900
Acrolein	0.2	0.04	0.2	0.04	0.14	0.028	0.14	0.028	5	367
Propionaldehyde	0	0	0.75	0.15	0	0	0	0	5	
n-Butyraldehyde	0	0	0	0	1.49	0.298	0	0	5	
Valeraldehyde	0	0	0	0	0	0	0	0	5	
Glutaraldehyde	0	0	0	0	0	0	0	0	5	
Hexaldehyde	0	0	0	0	0	0	0	0	5	
<b>TRS</b>										
Hydrogen sulphide	0.72	0.00514	0.29	0.0021	0.01	7.1E-05	0.01	7.1E-05	140	8.1
Ammonia	1.98	0.011	3.76	0.0209	0.17	0.00094	0.13	0.00072	180	3536
<b>Hazard Index (Total)</b>	<b>0.80828</b>		<b>0.7554</b>		<b>0.98502</b>		<b>0.61679</b>			

0 depicts below the detection limit of the analytical method used

Shongweni Waste Disposal Site - Air Quality Monitoring:

Table 3 - Ambient Air Sampling Results: 13 November 2008 - 7 January 2009

Substance	SHO0109				SHO0109				Environmental	
Sample ID	SHO0109		SHO0109		SHO0109		SHO0109		Assessment	Odour
Location Description	Leach dam	Hazard	Mush farm	Hazard	N3	Hazard	Hillcrest	Hazard	Level	Threshold
Location ID	On-site	Index	Off-site	Index	Off-site	Index	Off-site	Index		
Date	13/11-7/1	(HI)	13/11-7/1	(HI)	13/11-7/1	(HI)	13/11-7/1	(HI)	EAL	ODT
Units	$\mu\text{g}/\text{m}^3$		$\mu\text{g}/\text{m}^3$		$\mu\text{g}/\text{m}^3$		$\mu\text{g}/\text{m}^3$		$\mu\text{g}/\text{m}^3$	$\mu\text{g}/\text{m}^3$
Sampling Station	Station B		Station E		Station F		Station G			
NMOC									EAL(Health)	Odour Thres.
Benzene	0	0	0.03	0.006	0.86	0.172	0	0	5	38400
Toluene	0	0	0	0	0.81	0.00042	0	0	1910	10904
Ethylbenzene	0	0	0.02	5E-06	0	0	0	0	4410	10005
Xylene (all isomers)	0	0	0.1	2E-05	6.7	0.00152	0	0	4410	56
Trimethylbenzenes	0	0	0.08	6E-05	0	0	0	0	1250	2706
n-Butyl Acetate	0	0	0	0	0	0	0	0	7240	14040
Trichloroethylene	0	0	0	0	0	0	0	0	1100	1852
Tetrachloroethylene	0	0	0	0	0	0	0	0	3450	112500
Limonene	0	0	0	0	0	0	0	0	100	174200
ALDEHYDES										
Formaldehyde	9.91	1.982	5.82	1.164	7.2	1.44	9.45	1.89	5	1037
Acetaldehyde	15.71	3.142	9.62	1.924	4.21	0.842	18.04	3.608	5	900
Acrolein	1.15	0.23	0	0	0	0	1.6	0.32	5	367
Propionaldehyde	0	0	0	0	0	0	2.86	0.572	5	
n-Butyraldehyde	0	0	0	0	2.59	0.518	0	0	5	
Valeraldehyde	0	0	0	0	0	0	0	0	5	
Glutaraldehyde	0	0	0	0	0	0	0	0	5	
Hexaldehyde	0	0	0	0	0	0	0	0	5	
TRS										
Hydrogen sulphide	0.72	0.00514	1.23	0.0088	0.35	0.0025	0.12	0.00086	140	11.2
Ammonia	17.36	0.09644	15.54	0.0863	3.7	0.02056	0.52	0.00289	180	3536
Hazard Index (Total)	<b>5.45559</b>		<b>3.1892</b>		<b>2.997</b>		<b>6.39375</b>			

0 depicts below the detection limit of the analytical method used

Shongweni Waste Disposal Site - Air Quality Monitoring:

Table 4 - Ambient Air Sampling Results: 7 January - 11 February 2009

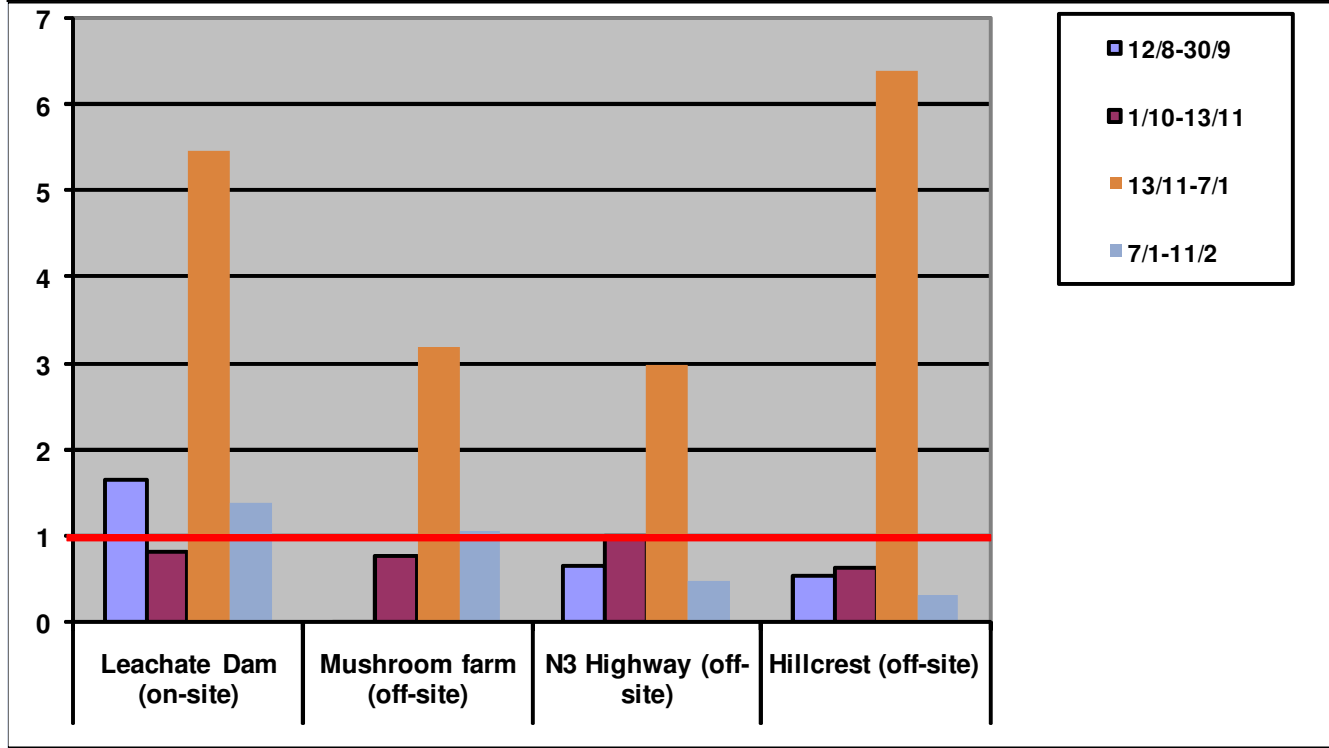
Substance									Environmental	Odour
Sample ID	SHO0209		SHO0209		SHO0209		SHO0209		Assessment	Detection
Location Description	Leach dam	Hazard	Mush farm	Hazard	N3	Hazard	Hillcrest	Hazard	Level	Threshold
Location ID	On-site	Index	Off-site	Index	Off-site	Index	Off-site	Index		
Date	7/1 - 11/2	(HI)	7/1 - 11/2	(HI)	7/1 - 11/2	(HI)	7/1 - 11/2	(HI)	EAL	ODT
Units	µg/m <sup>3</sup>		µg/m <sup>3</sup>		µg/m <sup>3</sup>		µg/m <sup>3</sup>		µg/m <sup>3</sup>	µg/m <sup>3</sup>
Sampling Station	Station B		Station E		Station F		Station G			
NMOC									EAL(Health)	Odour Thres.
Benzene	0.77	0.154	0.16	0.032	0.37	0.074	0.18	0.036	5	38400
Toluene	1.61	0.00084	1.47	0.0008	4.2	0.0022	1.77	0.00093	1910	10904
Ethylbenzene	3.24	0.00073	0.79	0.0002	1.31	0.0003	0.94	0.00021	4410	10005
Xylene (all isomers)	7.92	0.0018	2.9	0.0007	5.13	0.00116	3.47	0.00079	4410	56
Trimethylbenzenes	2.25	0.0018	0.56	0.0004	1.33	0.00106	0.77	0.00062	1250	2706
n-Butyl Acetate	0	0	0.08	1E-05	1.31	0.00018	0.1	1.4E-05	7240	14040
Trichloroethylene	0	0	0	0	0	0	0	0	1100	1852
Tetrachloroethylene	0	0	0.1	3E-05	0	0	0.21	6.1E-05	3450	112500
Limonene	0	0	0	0	0	0	0	0	100	174200
<b>ALDEHYDES</b>										
Formaldehyde	0.86	0.172	0.83	0.166	0.11	0.022	0.33	0.066	5	1037
Acetaldehyde	3.45	0.69	3.81	0.762	1.64	0.328	1.07	0.214	5	900
Acrolein	0.13	0.026	0	0	0	0	0	0	5	367
Propionaldehyde	0	0	0	0	0	0	0	0	5	
n-Butyraldehyde	0	0	0	0	0	0	0	0	5	
Valeraldehyde	0	0	0	0	0	0	0	0	5	
Glutaraldehyde	0	0	0	0	0	0	0	0	5	
Hexaldehyde	0	0	0	0	0	0	0	0	5	
<b>TRS</b>										
Hydrogen sulphide	18.35	0.13107	0.42	0.003	0.28	0.002	0.25	0.00179	140	11.2
Ammonia	35.72	0.19844	18.43	0.1024	10.62	0.059	0.73	0.00406	180	3536
Hazard Index (Total)	<b>1.37669</b>		<b>1.0675</b>		<b>0.4899</b>		<b>0.32446</b>			

0 depicts below the detection limit of the analytical method used

<b>Qualitative Descriptions for Non carcinogenic Health Risks Ratio of Estimated Contaminant Intake to Risk Reference Dose</b>	<b>Qualitative Descriptor</b>
equal to or less than the risk reference dose	minimal
greater than one to five times the risk reference dose	low
greater than five to ten times the risk reference dose	moderate
greater than ten times the risk reference dose	high

**Table 5: Shongweni: Ambient Air Sampling: Jul 08 - Feb 09: Non-cancer risk**

Sampling Station	Station Location	12/8 - 30/09	1/10 - 13/11	13/11 - 7/1	7/1 - 11/2
B	Leachate Dam (on-site)	1.65	0.81	5.46	1.38
E	Mushroom farm (off-site)	0.001	0.76	3.19	1.07
F	N3 Highway (off-site)	0.65	0.99	3	0.49
G	Hillcrest (off-site)	0.53	0.62	6.39	0.33
<b>Non-cancer Risk</b>	<b>National Exposure Limit (NEL)</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>
	<b>Qualitative Descriptor</b>	<b>MIN-LOW</b>	<b>MINIMAL</b>	<b>LOW-MOD</b>	<b>MIN-LOW</b>



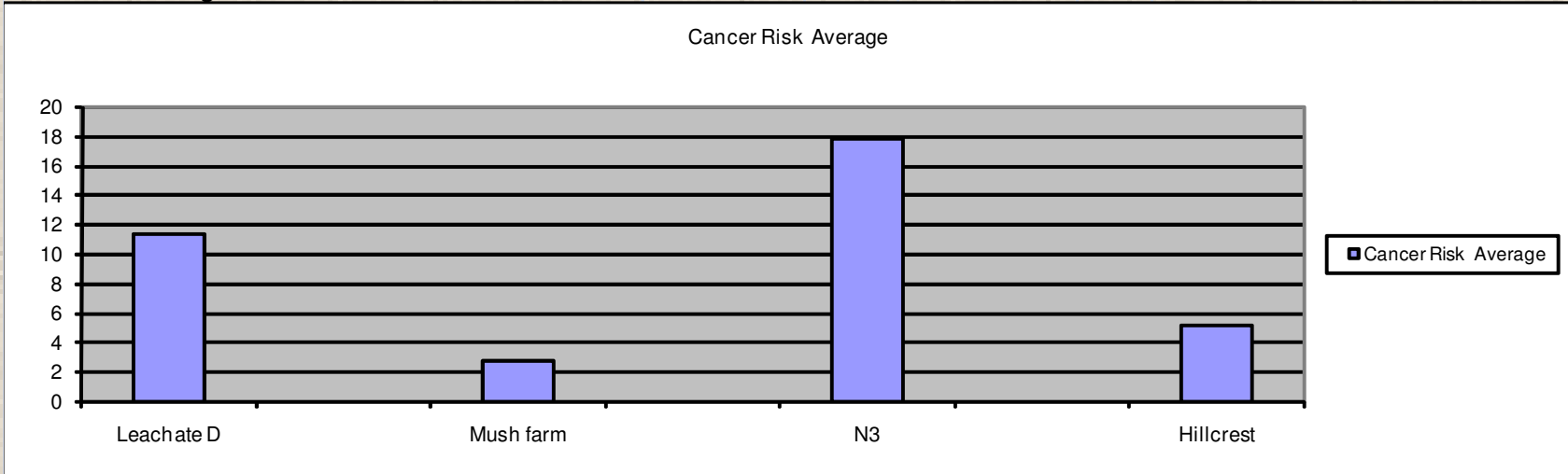
# Cancer Risk – Qualitative Descriptors

Risk Ratio	Qualitative Descriptor
$\leq 1:1000\ 000$	very low
$>1:1000\ 000 < 1:10\ 000$	low
$= 1:10\ 000 < 1:1000$	moderate
$= 1:1000 < 1:10$	high
$\Rightarrow 1:10$	very high

**Table 6: Shongweni WDS: July 2008 - February 2009: Cancer Risk (A1 Carcinogen)**

Description	Sampling Period	Cancer Risk	EC	Cancer Risk	EC	Cancer Risk	EC	Cancer Risk	EC	Inhalation Unit Factor Benzene
Station ID		B		E		F		G		California EPA
Station ID		Leachate D		Mush farm		N3		Hillcrest		
Compound										California EPA
Benzene	12/8 - 30/9	0.58	0.02	0	0	0	0	0	0	2.9 X 10 <sup>-5</sup>
Benzene	1/10 - 13/11	0	0	0	0	0	0	0	0	
Benzene	13/11 - 7/1	0	0	0.87	0.03	24.94	0.86	0	0	
Benzene	7/1 - 11/2	22.33	0.77	4.64	0.16	10.73	0.37	5.22	0.18	
Cancer Risk	Average	11.455		2.755		17.835		5.22		in 1,000,000
Station Description	Cancer Risk									
Station B	1:87,000	LOW								
Station E	1:360,000	LOW								
Station F	1:56,000	LOW								
Station G	1:190,000	LOW								

0 = below detection limit of the test methodology employed  
 A class A1 carcinogen is known to cause cancer in humans

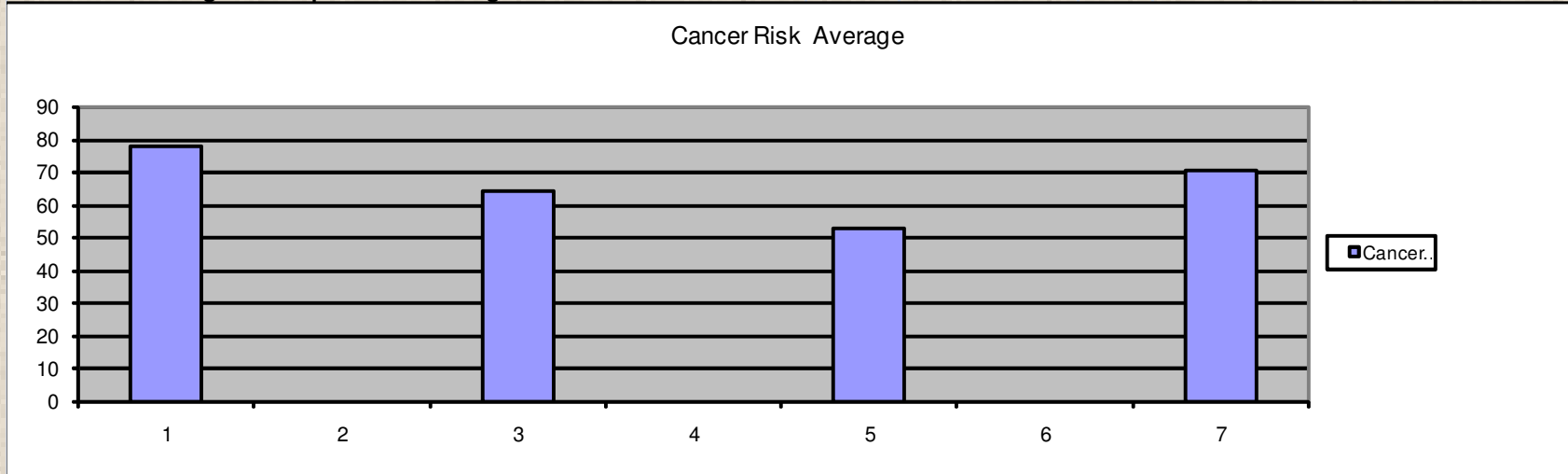


**Table 7: Shongweni WDS: July 2008 - February 2009: Cancer Risk (A2 Carcinogen)**

Description	Sampling Period	Cancer Risk	EC	Cancer Risk	EC	Cancer Risk	EC	Cancer Risk	EC	Inhalation Unit Factor
Sampling Station		B		E		F		G		Formaldehyde
Station ID		Leachate D		Mush farm		N3		Hillcrest		California EPA
Compound										
Formaldehyde	12/8 - 30/9	71.92	2.48	0	0	46.69	1.61	50.17	1.73	6 X 10 <sup>-6</sup>
Formaldehyde	1/10 - 13/11	42.63	1.47	33.35	1.15	15.95	0.55	15.37	0.53	
Formaldehyde	13/11 - 7/1	287.39	9.91	168.78	5.82	208.8	7.2	274.05	9.45	
Formaldehyde	7/1 - 11/2	24.94	0.86	24.07	0.83	3.19	0.11	9.57	0.33	
Cancer Risk	Average	78.0825		64.28333333		52.9975		70.905		in 1,000,000
Station Description	Cancer Risk									
Station B	1:13,000	LOW								
Station E	1:15,000	LOW								
Station F	1:19,000	LOW								
Station G	1:14,000	LOW								

0 = below detection limit of the test methodology employed

A class A2carcinogen is suspected of causing cancer in humans



## Odour complaints register

- Since records began in May 1997, a total of 430 odour complaints have been logged for the Shongweni WDS. Of these:
  - 157 (37%) were from complainants located *downwind* of Shongweni
  - 165 (38%) were from complainants located *upwind* of Shongweni WDS
  - 79 complaints (18%) were logged under calm conditions.
  - 29 complaint (7%) could not be correlated to wind direction
- 121 complaints were logged in 2006
- 75 complaints were logged in 2007
- 17 complaints recorded for the period June - December 2007
- 15 complaints recorded for the period January – June 2008
- 1 complaint was logged between July 2008 – January 2009
- 1 complaint was logged during February 2009
- 1 complaint was logged during March 2009

## RECOMMENDATIONS

- Real-time continuous dust sampling should again be performed on site during the course of 2009
- It is recommended that the locations of the ambient air sampling stations again be reviewed for the 2009 sampling cycle. Sampling should be re-initiating at Location A (on-site) whilst the continued sampling at three off-site locations needs careful consideration.
- The ambient air quality data from the Shongweni site has been input into a formal air dispersion model for the site – generated by Airshed Planning Professionals.
- Monitoring of ambient H<sub>2</sub>S concentrations on the Shongweni site should continue during the course of 2009.



END

Thank You