SASOL MINING - VULINDLELA BRIDGE MAINTENANCE AND DESILTING PROJECT -

WASTE CLASSIFICATION AND ASSESSMENT REPORT

August 2019

Volume 4 of 4

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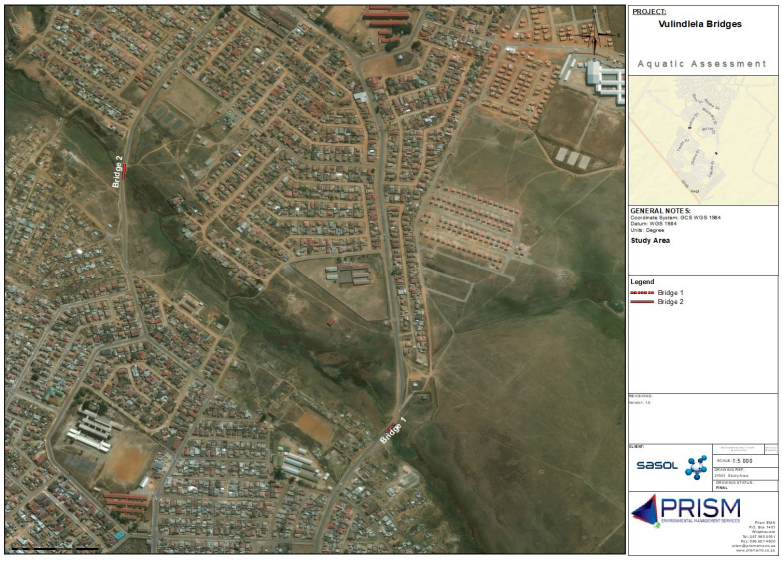
1. INTRODUCTION

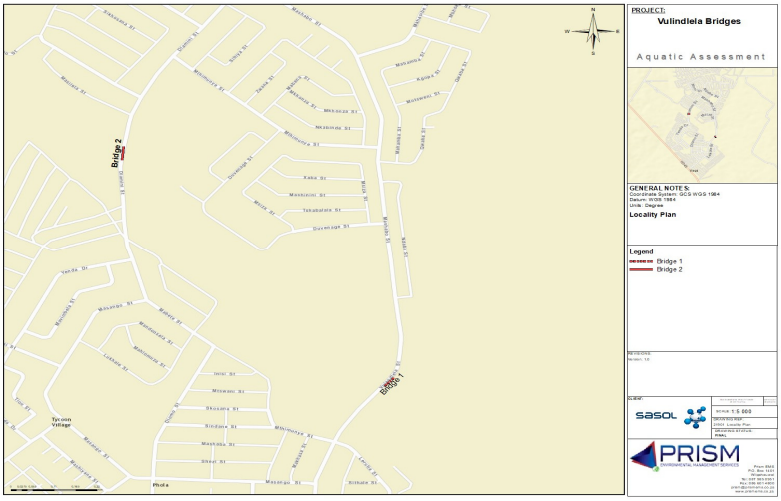
MDT Environmental has been appointed by Sasol Mining to undertake the Basic Assessment and General Authorisation applications for the Vulindlela Bridge Maintenance and desilting project.

Emalahleni Local Municipality is planning to conduct maintenance, as well as desilting activities, upstream and downstream of the Vulindlela Bridges, which is situated at Phola Township, Ogies, within the Emalahleni Local Municipality, Mpumalanga. The activities will be undertaken at two bridge crossings. The two bridge crossings are located at 26°0'18.03" S, 29°2'18.13" E and S25°59'55.17" S, 29°1'56.67" E. The Project is undertaken as part of the Local Economic Development contribution provided by Sasol Mining (Pty) Ltd and is part of the projects committed to in their social and labour plan.

The project site is located as per Figure 1 below:

Figure 1: Locality and project site area





A large quantity of silt must be removed and disposed, and for this purpose the silt has to be analysed and classified. iX engineers was appointed by MDT Environmental to conduct the waste classification.

The National Environmental Management Waste Act, 2008 (Act No. 59 of 2008) (NEM:WA), the Waste Classification and Management Regulations, 2013 (published under Government Notice R634 in Government Gazette 36784 of 23 August 2013) (Regulations) require under regulation 4(2), that all waste generated by waste generators, be classified in accordance with SANS 10234 within one-hundred-and-eighty (180) days of generation.

Waste must be assessed in terms of the NEM:WA , the National Norms and Standards for the Assessment of Waste for Landfill Disposal (published under Government Notice R635 in Government Gazette 36784 of 23 August 2013) (Norms and Standards). Waste is assessed for the purpose of disposal to landfill through identifying the chemical substances present in the waste. The total concentrations (TC) and leachable concentrations (LC) of the elements that have been identified in the waste is sampled and analysed, this is then compared to the threshold limits specified in regulation 6 of the Norms and Standards.

2. SCOPE OF WORK

MDT Environmental requested iX engineers to classify and assess 3 (three) composite desilt waste samples from the Vulindlela Bridge Maintenance and Desilting Project, for disposal in accordance with South African waste legislation. The classification will be used to confirm the classification type (Type 0 to type 4) of the waste produced at the facility and to determine the type of containment barrier to be used for the waste management or waste treatment facility in accordance with the waste legislation.

The scope of work entails the following actions:

- SANS 1023 Classification
- Analysing and classification of the samples in according with South African waste legislation;
- Recommended methods of disposal;
- Development of Safety Data Sheet (SDS), and,
- Compilation of the Waste Classification Report.

The waste samples were collected on Wednesday 15 May 2019 and taken to the UIS Organic Laboratory in Pretoria for analysis. Clearly marked 2kg composite samples of the waste was obtained and utilised for analysis. Grid sampling was conducted to obtain the three (3) composite samples to ensure that the samples are a true representative indication of the waste stream. An additional sample was collected to conduct the SANS classification.

3. WASTE CLASSIFICATION METHODOLOGY

3.1 Sans 10234 Classification

According to section 4(2) of GN R.634 of 2013, all waste generators must ensure that their waste is classified in accordance with SANS 10234 within 180 days of generation, except if it is listed in Annexure 1 of the GN R.634. Furthermore, waste must be re-classified every 5 years.

Waste classification according to SANS 10234 (based on the Global Harmonised System) indicates physical, health and environmental hazards. The SANS 10234 covers the harmonised criteria for classification of potentially hazardous substances and mixtures, including wastes, in terms of its intrinsic properties/hazards.

3.2 Waste Assessment

In accordance with the Norms and Standards, all analyses of the TC and LC of elements and chemical substances contained in the waste, must be conducted by laboratories accredited by the South African National Accreditation System (SANAS) to conduct the techniques and analysis methods required. UIS Organic Laboratory is SANAS accredited (refer to **Appendix C** for copy of Certificate of Accreditation).

The methodology, as described in the Norms and Standards determined the methodology followed in this report. The Norms and Standards state the following:

"4 Total Concentration (TC) Analysis

(1) The TC of all the elements and chemical substances specified in section 6 of these Norms and Standards that are known to occur, likely to occur or can reasonably be expected to occur in the waste must be determined.

(2) The TC of elements and chemical substances in waste must be determined using techniques and analysis methods that will provide reliable, accurate and repeatable results of the TC of elements and chemical substances specified in section 6 of these Norms and Standards.

5 Leachable Concentration (LC) Analysis

(1) The LC of elements and chemical substances must be determined using the Australian Standard Leaching Procedure (AS 4439.1, 4439.2 and 4439.3).

(2) The type of leaching fluid (section 5.2 and 5.3 of AS 4439.3) used in the leaching procedure must be selected as follows -

(a) Waste to be disposed of with, or waste that contains, putrescible wastes: Use 0.1M acetic acid solution with altered pH 5.0 or pH 2.9 determined as per section 7.5 (a-e) of AS 4439.3;

(b) Waste to be disposed of with non-putrescible waste: Use a basic 0.1M sodium tetraborate decahydrate solution of pH 9.2 ±0.1, as well as an acetic acid solution with pH 5.0 or pH 2.9) determined as per section 7.5(a-e) of AS 4439.3; or

(c) Non-putrescible waste to be disposed of without any other wastes: Use reagent water.

(3) Existing LC results for elements and chemical substances in wastes, which have been determined in terms of the Toxicity Characteristic Leaching Procedure (TCLP) leach test criteria of the Minimum Requirements for the Handling, Classification and Disposal of Hazardous Waste (2nd Edition, 1998; Department of Water Affairs and Forestry) prior to the Regulations taking effect, may be utilised for comparison with the LCT limits in section 6 of these Norms and Standards to asses waste for the purpose of disposal of the waste to landfill, for a period not exceeding three (3) years from the date of publication of the Notice."

4. WASTE SAMPLING AND ANALYSIS

Grid sampling was conducted to obtain the three (3) composite samples to ensure that the samples are a true representative of the waste stream (desilt waste). An additional sample was collected to conduct the SANS 10234 classification. The 4 (four) samples in total were delivered to UIS Organic Laboratory for the prescribed tests to be performed on the samples.

UIS Organic Laboratory is an independent testing laboratory and is accredited through the SANAS which ensures that the analytical methods used, and the results achieved are traceable to international standards.

UIS Organic Laboratory assisted in the analysis and interpretation of the waste samples to ensure the correct classification in accordance with the International United Nations Globally Harmonised System of Classification (GHS) of SANS 10234 and to align this analysis with the NEM:WA requirements.

5. WASTE CLASSIFICATION: SANS 10234 CLASSIFICATION

The standard used for waste classification is the; Globally Harmonised System of Classification and Labelling of Chemicals (GHS); SANS 10234:2008.

In terms of the Waste Classification and Management Regulations of 23 August 2013, Section 4 (2) states:

All waste generators must ensure that the waste they generate is classified in accordance with SANS 10234 within one hundred and eighty (180) day of generation.

These regulations also state in Section 5 (1), that generators of hazardous waste must ensure that a safety data sheet for the hazardous waste is prepared in accordance with SANS 10234.

According to SANS 10234:2008, the classification criteria includes the following hazard Classes:

1. Physical Hazards
2. Health Hazards
3. Environmental Hazards

The SANS 10234 classification was done by iX engineers with the analysis done by UIS Organic Laboratory. The detailed results are reflected in the UISOL Waste Assessment and Classification Report, dated August 2019, attached to this report as **Appendix A**).

Table 1 below summarised the classification of the Vulindlela Desilt waste, according to SANS 10234:2008.

Table 1: Summary of the Physical, Health and Aquatic Hazards of Desilt Waste

Hazard Class	Hazard Category	Hazard Statement
Physical Hazard		
Explosives	Not Explosive – Division 1.6	None
Flammable Gasses	N/A	None
Flammable Aerosols	N/A	None
Oxidising Gasses	N/A	None
Gasses under Pressure	N/A	None
Flammable Liquids (Up to 93 ^{0}C)	N/A	None
Flammable solids	Not Flammable	None
Self-Reactive Substances and Mixture	Self-Reactive Type G	None
Pyrophoric Substances	Not Pyrophoric	None
Self-Heating Substance and Mixtures	Not Self Heating	None

Substances and mixture that on contact with water emits flammable gasses	Not flammable gas emitted	None
Oxidising substances and Mixtures	Not Oxidising – 3b	None
Organic Peroxides	Not a Peroxide	None
Corrosive to Metals	Not Corrosive	None
Health Hazards		
Acute Toxicity: Oral	Not Classified	None
Acute Toxicity: Dermal	Not Classified	None
Acute Toxicity: Inhalation	Not Classified	None
Skin corrosion and irritation	Not Classified	None
Serious Eye Damage and Irritation	Not Classified	None
Respiratory sensitization and skin sensitization	Not Classified	None
Germ Cell Mutagenicity	Not Classified	None
Carcinogenicity	Category 1A	H350
Reproductive Toxicity	Not Classified	None
STOT-SE	Not Classified	None
STOT-RE	Category 1	H372
Aspiration hazard	Not Classified	None
Aquatic Hazards		
Acute Aquatic Toxicity	Not Classified	None
Chronic Aquatic Toxicity	Not Classified	None

The classification showed that there are no physical and aquatic hazards associated with the sediment. The sediment does have a carcinogenic hazard as well as a specific target organ toxicity hazard. The main driver for the health hazards is the quartz at a concentration of 93.2%.

The sediment contains microbial contaminants (Faecal Coliforms and E. coli). E. coli infection can lead to diarrhoea, high blood pressure, kidney problems, heart disease and even haemolytic uremic syndrome.

6. WASTE ASSESSMENT THRESHOLD LIMITS

The Total Concentration Threshold (TCT) Limits (mg/kg) as listed in the Regulations to which the results of the analysis were compared with is given below:

Table 2: Total Concentration Threshold (TCT) Limits

Elements & Chemical Substances in Waste	TCT0	TCT1	TCT2
Metal Ions			
As, Arsenic	5.8	500	2000
B, Boron	150	15000	60000
Ba, Barium	62.5	6250	25000
Cd, Cadmium	7.5	260	1040
Co, Cobalt	50	5000	20000
Cr Total, Chromium Total	46000	800000	N/A
Cr (VI), Chromium (VI)	6.5	500	2000
Cu, Copper	16	19500	78000
Hg, Mercury	0.93	160	640
Mn, Manganese	1000	25000	100000
Mo, Molybdenum	40	1000	4000
Ni, Nickel	91	10600	42400
Pb, Lead	20	1900	7600
Sb, Antimony	10	75	300
Se, Selenium	10	50	200
V, Vanadium	150	2680	10720
Zn, Zinc	240	160000	640000
Inorganic Anions			
TDS			
Chloride			
Sulphate			
N03 as N, Nitrate-N			
F, Fluoride	100	10000	40000
CN- (total), Cyanide Total	14	10500	42000
Organics			
Benzene		10	40
Benzo(a)pyrene		1.7	6.8
Carbon tetrachloride		4	16
Chlorobenzene		8800	35200
Chloroform		700	2800
2-Chlorophenol		2100	8400
Di (2 ethylhexyl} phthalate		40	160
1,2-Dichlorobenzene		31900	127600
1,4-Dichlorobenzene		18400	73600

Elements & Chemical Substances in Waste	TCT0	TCT1	TCT2
1,2-Dichloroethane		3.7	14.8
1,1-Dichloroethylene		150	600
1-2-Dichloroethylene		3750	15000
Dichloromethane		16	64
2,4-Dichlorophenol		800	3200
2,4-Dinitrotoluene		5.2	20.8
Ethylbenzene		540	2160
Formaldehyde		2000	8000
Hexachlorobutadiene		2.8	5.4
Methyl ethyl ketone		8000	32000
MTBE (Methyl t-butyl ether)		1435	5740
Nitrobenzene		45	180
PAHs (total)		50	200
Petroleum H/Cs, C6 to C9		650	2600
Petroleum H/Cs, C10 to C36		10000	40000
Phenols (total, non-halogenated)		560	2240
Polychlorinated biphenyls		12	48
Styrene		120	480
1,1,1,2-Tetrachloroethane		400	1600
1,1,2,2-Tetrachloroethane		5.0	20
Tetrachloroethylene		200	800
Toluene		1150	4600
Trichlorobenzenes (total)		3300	13200
1,1,1-Trichloroethane		1200	4800
1,1,2-Trichloroethane		48	192
Trichloroethylene		11600	46400
2,4,6-Trichlorophenol		1770	7080
Vinyl chloride		1.5	6.0
Xylenes (total)		890	3560
Pesticides			
Aldrin + Dieldrin	0.05	1.2	4.8
DDT + ODD + ODE	0.05	50	200
2,4-D	0.05	120	480
Chlordane	0.05	4	16
Heptachlor	0.05	1.2	4.8

The Leachable Concentration Threshold (LCT) Limits (mg/l) as listed in the Regulations to which the results of the analysis were compared with is given below:

Table 3: Leachable Concentration Threshold (LCT) Limits

Elements & Chemical Substances in Waste	LCT0	LCT1	LCT2	LCT3
Metal Ions				
As, Arsenic	0.01	0.5	1	4
B, Boron	0.5	25	50	200
Ba, Barium	0.7	35	70	280
Cd, Cadmium	0.003	0.15	0.3	1.2
Co, Cobalt	0.5	25	50	200
Cr Total, Chromium Total	0.1	5	10	40
Cr (VI), Chromium (VI)	0.05	2.5	5	20
Cu, Copper	2.0	100	200	800
Hg, Mercury	0.006	0.3	0.6	2.4
Mn, Manganese	0.5	25	50	200
Mo, Molybdenum	0.07	3.5	7	28
Ni, Nickel	0.07	3.5	7	28
Pb, Lead	0.01	0.5	1	4
Sb, Antimony	0.02	1.0	2	8
Se, Selenium	0.01	0.5	1	4
V, Vanadium	0.2	10	20	80
Zn, Zinc	5.0	250	500	2000
Inorganic Anions				
TDS	1000	12500	25000	100000
Chloride	300	15000	30000	120000
Sulphate	250	12500	25000	100000
N03 as N, Nitrate-N	11	550	1100	4400
F, Fluoride	1.5	75	150	600
CN- (total), Cyanide Total	0.07	3.5	7	28
Organics				
Benzene		0.01	0.02	0.08
Benzo(a)pyrene		0.035	0.07	0.28
Carbon tetrachloride		0.20	0.40	1.6
Chlorobenzene		5.0	10	40
Chloroform		15	30	120
2-Chlorophenol		15	30	120
Di (2 ethylhexyl) phthalate		0.50	1	4
1,2-Dichlorobenzene		5	10	40
1,4-Dichlorobenzene		15	30	120
1,2-Dichloroethane		1.5	3	12
1,1-Dichloroethylene		0.35	0.7	2.8
1-2-Dichloroethylene		2.5	5	20
Dichloromethane		0.25	0.5	2
2,4-Dichlorophenol		10	20	80

Elements & Chemical Substances in Waste	LCT0	LCT1	LCT2	LCT3
2,4-Dinitrotoluene		0.065	0.13	0.52
Ethylbenzene		3.5	7	28
Formaldehyde		25	50	200
Hexachlorobutadiene		0.03	0.06	0.24
Methyl ethyl ketone		100	200	800
MTBE (Methyl t-butyl ether)		2.5	5.0	20.0
Nitrobenzene		1	2	8
PAHs (total)		N/A	N/A	N/A
Petroleum H/Cs, C6 to C9		N/A	N/A	N/A
Petroleum H/Cs, C10 to C36		N/A	N/A	N/A
Phenols (total, non-halogenated)		7	14	56
Polychlorinated biphenyls		0.025	0.05	0.2
Styrene		1.0	2	8
1,1,1,2-Tetrachloroethane		5	10	40
1,1,2,2-Tetrachloroethane		0.65	1.3	5.3
Tetrachloroethylene		0.25	0.5	2
Toluene		35	70	280
Trichlorobenzenes (total)		3.5	7	28
1,1,1-Trichloroethane		15	30	120
1,1,2-Trichloroethane		0.6	1	4
Trichloroethylene		0.25	2	8
2,4,6-Trichlorophenol		10.0	20	80
Vinyl chloride		0.015	0.03	0.12
Xylenes (total)		25	50	200
Pesticides				
Aldrin + Dieldrin		0.015	0.03	0.03
DDT + DDD + DOE		1	2	2
2,4-D		1.5	3	3
Chlordane		0.05	0.1	0.1
Heptachlor		0.015	0.03	0.03

7. TC AND LC RESULTS AND SUMMURY OF THE WASTE ASSESSMENT

The TC and LC results for the composite samples are provided in Annexure B. shows the Total Concentration Threshold Values (TCT), as well as the analysed results for Vulindlela Sediment. The results were determined using the average results of the 3 samples. If results for any of the 3 samples are below the detection limit for any specific compound, but at least one of the samples are above the detection limit, those under the detection limit were ignored in the average calculation. For the leachable concentrations the Borax and TCLP samples were average separately, and the worst-case scenario used. If any of the three samples had results under the detection limit for a specific compound, but there were results above the detection as well, the results under the detection limit were ignored.

7.1 TC and LC Results Findings

The findings on TC and LC results indicate that the highest Total Concentration Value is ≤TCT1 and that the highest Leachable Concentration Value is ≤TCT1.

8. WASTE TYPE DETERMINATION

Regulation 7 of the Norms and Standards lists the conditions to which the results must be compared to, in order to determine the type of waste. This will ultimately determine the barrier requirements for landfill disposal for the specific waste type.

Based on the above assessment, the waste samples are all classified as a **Waste Type 3**, based on the results of the TC and LC analysis (worst case scenario) and the determination of waste types for landfill disposal regulation7(2)(d) of the Norms and Standards stipulates that;

- Wastes with any element or chemical substance concentration above the LCT0 but below or equal to the LCT1 limits and all TC concentrations below or equal to the TCT1 limits (LCT0 < LC ≤ LCT1 and TC ≤ TCT1) are Type 3 Wastes.

9. DISPOSAL BARRIER REQUIREMENTS

The National Norms and Standards for Disposal of Waste to Landfill (published under Government Notice R636 in Government Gazette 36784 of 23 August 2013) (Regulation 636) contains the standard containment barriers for all of the various waste types, namely Types 1 to 4.

Regulation 4(1) of Regulation 636 stipulates that waste assessed in terms of the Norms and Standards and classified as a Waste Type 3 must be disposed to a licensed landfill as follows:

- *"Type 3 waste may only be disposed of at a Class C landfill designed in accordance with section 3(1) and (2) of these Norms and Standards, or, subject to section 3(4) of these Norms and Standards, may be disposed of at a landfill site designed in accordance with the requirements for a GLB+ landfill as specified in the Minimum Requirements for Waste Disposal by Landfill (2nd Ed., DWAF, 1998)."*

The class of landfill is determined using GN R. 636. Table 1.4 indicates the Class landfill for each of the different waste types. However, there are other landfill restrictions in GN R. 636, such as pH. The pH of 7.72 for Vulindlela Sediments fall within the disposal limits. The pH between the different samples varies between pH 7.4 and 8.2.

Therefore, based on the above and the provisions for containment barriers contained in Regulation 636, the specified barrier for Waste Type 3 waste is a Class C Liner. The liner is depicted below.

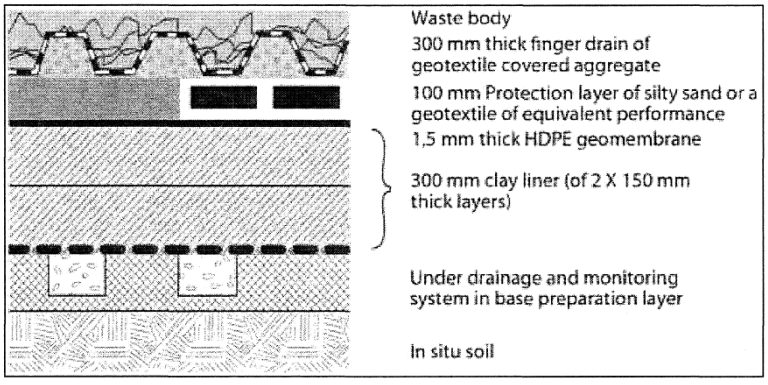


Figure 2- Class C Containment Barrier

10. MATERIAL SAFETY DATA SHEET

A Material Safety Data Sheet (MSDS) was developed for the waste stream to provide comprehensive information related to:

- health effects of exposure to the waste,
- hazard evaluation related to the waste handling, storage or use,
- measure to protect workers at risk of exposure, and,
- emergency procedures.

The MSDS is attached as **Annexure D** to the report.

11. CONCLUSION

iX engineers was requested to conduct a waste assessment on three composite desilt waste samples obtained through grid sampling, from the Vulindlela Maintenance and Desilt project, to confirm the type of waste and to determine the type of barrier to be used for the waste management facility in accordance with the waste legislation of South Africa where these waste can be disposed of. An additional sample was also collected to conduct SANS 10234 Waste Classification.

The detailed results are reflected in the UISOL Waste Assessment and Classification Report, dated August 2019, attached to this report as **Appendix A**.

The classification showed that there are no physical and aquatic hazards associated with the sediment. The sediment does have a carcinogenic hazard as well as a specific target organ toxicity hazard. The main driver for the health hazards is the quartz at a concentration of 93.2%.

The sediment contains microbial contaminants (Faecal Coliforms and E. coli). E. coli infection can lead to diarrhoea, high blood pressure, kidney problems, heart disease and even haemolytic uremic syndrome.

Following the above, an assessment of the waste stream was conducted by iX engineers. UIS Organic Laboratory, an independent and SANAS accredited laboratory, assisted in the analysis of the waste samples to assess and classify the waste and recommend the disposal requirements in terms of the the waste legislation of South Africa.

The waste samples are classified as a **Waste Type 3**, based on the findings of the TC and LC results. **The required containment barrier according to Regulation 636 for a Waste Type 3 waste is a Class C containment barrier**.

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12. REFERENCES

1. National Environmental Management: Waste Act, 2008 (Act No.59 of 2008);
2. Waste Classification and Management Regulations, 2013 (published under Government Notice R634 in Government Gazette 36784 of 23 August 2013);
3. The National Norms and Standards for Disposal of Waste to Landfill (published under Government Notice R636 in Government Gazette 36784 of 23 August 2013); and
4. UIS Organic Analytical Reports – August 2019

APPENDIX A

UIS ORGANIC LABORATORY WASTE ASSESSMENT AND CLASSIFICATION REPORT, DATED AUGUST 2019

Waste Assessment

&

Classification Report

IX ENGINEERS

WASTE STREAM:

VULINDLELA SEDIMENT DESILT SAMPLING

August 2019

UIS Organic Disclaimer:

All the samples mentioned in this report were analysed as received by the laboratory. UIS Organic laboratory takes no responsibility for sample/s prior to submission: this includes sampling, sample container, storage and shipping to our testing facility. The sample is analysed as per customer request.

The information contained in this report is based upon data considered to be accurate at the time of preparation. UIS Organic Laboratory (Pty) Ltd, has taken reasonable care in the preparation of this report, however it assumes no responsibility or liability to the accuracy as well as the suitability of the information, for both the intended purpose of this waste stream or any consequences of its use. Since regulatory standards and guideline recommendations are revised on a continues basis, UIS Organic Laboratory cannot insure that the information contained in this report will be current at the time of use.

Storage Conditions in the Laboratory: Fridge @ <6 ^{0}C

Abbreviations:

UTD – Unable to Determine

NR – Not Requested

BDL – Below Detection Limit (Please note that if the results for an analyte is below our detection limit, it does not indicate that the sample is clean or that the analyte result is equal to zero.)

TOM – Total Organic Matter

TOC – Total Organic Carbon

LD50 - Lethal Dose, 50% kill

NOEC – No Observed Effect Concentration

NOAEL – No Observed Adverse Effect Level

LOAEC – Lowest Observed Adverse Effect Level

CCOHS - Canadian Centre for Occupational Health and Safety

XRF - X-ray fluorescence spectroscopy

Executive Summary

Vulindlela sediment were submitted by IX Engineers to UIS Organic Laboratory (Pty) Ltd for Waste Assessment and Waste Classification. The sample were registered on 15 May 2019.

After the waste assessment the sample were determined to be a Type 3 Waste, that should be disposed at a Class C landfill. We analysed three (3) samples for waste assessment, however the average is used in this report.

The classification showed that there are no physical and aquatic hazards associated with the sediment. The sediment does have a carcinogenic hazard as well as a specific target organ toxicity hazard. The main driver for the health hazards is the quartz at a concentration of 93.2%.

The sediment contains microbial contaminants (Faecal Coliforms and *E. coli*). *E. coli* infection can lead to diarrhoea, high blood pressure, kidney problems, heart disease and even haemolytic uremic syndrome.

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Introduction

UIS Organic Laboratory was appointed to do Waste Assessment, Classification and compile an SDS (not part of this report). This was performed using mainly the following standards and/or regulations. Please note that the report contains various quotes or copied section, directly from the following regulations.

- GN R. 634: Waste Classification and Management Regulations (National Environmental Management: Waste Act, 2008 (Act no.59 of 2008))
- GN R. 635: National Norms and Standards for the Assessment of Waste for Landfill Disposal (National Environmental Management: Waste Act, 2008 (Act no.59 of 2008))
- GN R. 636: National Norms and Standards for Disposal of Waste to Landfill (National Environmental Management: Waste Act, 2008 (Act no.59 of 2008))
- Globally Harmonised System of Classification and Labelling of Chemicals (GHS); SANS 10234:2008.

The Waste Classification and Management regulations were published on 23 August 2013. This were published in conjunction with two other acts, GN R. 635 and GN R.636. The purpose of these regulations is as follow;

1. Regulates the classification and management of waste
2. Establish a mechanism and procedure for the listing of waste management activities that do not require a Waste Management Licence
3. Prescribe requirement for the disposal of waste to landfill
4. Prescribe requirements and timeframes for the management of certain wastes
5. Prescribe general duties of waste generators, transporters and managers
6. Prescribe the requirements for the assessment of waste prior to disposal to landfill
7. Determine the requirements for the disposal of waste to landfill.

In terms of the Waste Classification and Management Regulations of 23 August 2013, Section 4 (2) states;

All waste generators must ensure that the waste they generate is classified in accordance with SANS 10234 within one hundred and eighty (180) day of generation.

These regulations also state in Section 5 (1);

That generators of hazardous waste must ensure that a safety data sheet for the hazardous waste is prepared in accordance with SANS 10234.

According to SANS 10234:2008, the classification criteria includes the following hazards;

1. Physical Hazards
2. Health Hazards
3. Environmental Hazards

1 Waste Assessment

1.1 Waste Material

Sedimente sample, Vulindlela sediment desilt, were submitted for analysis.

1.2 Legal Framework

- GN R. 635: National Norms and Standards for the Assessment of Waste for Landfill Disposal (National Environmental Management: Waste Act, 2008 (Act no.59 of 2008))

- GN R. 636: National Norms and Standards for Disposal of Waste to Landfill (National Environmental Management: Waste Act, 2008 (Act no.59 of 2008))

1.3 Methodology

To assess waste, the following is required;

- Identification of chemical substances present in the waste
- Determination of the Total Concentration (TC) and Leachable Concentration (LC) for the elements and chemical substances identified in the waste.
- These analyses must be conducted by laboratories that is accredited by the South African National Accreditation System (SANAS).
- The tested TC and LC values must be compared to the threshold limits found in GN R. 635 (Section 6 (1 and 2)).
- Based on the TC and LC values found in the waste, exceeding the TCT and LCT limits, the specific Type of Waste can be determined.
- Leachable concentration is determined by using the Australian Standard AS 4439.1 – AS 4439.3.
- The TC for the metal concentration were determined using an aqua regia digestion.

1.4 Results and Laboratory Analysis

Table 1.1 shows the Total Concentration Threshold Values (TCT), as well as the analysed results for Vulindlela Sediment. The results were determined using the

average results of the 3 samples submitted to UIS Organic Laboratory under the lab number 14178, registered 15 February 2019. If results for any of the 3 samples are below the detection limit for any specific compound, but at least one of the samples are above the detection limit, those under the detection limit were ignored in the average calculation.

For the leachable concentrations the Borax and TCLP samples were average separately, and the worst-case scenario used for Table 1.3. If any of the three samples had results under the detection limit for a specific compound, but there were results above the detection as well, the results under the detection limit were ignored.

Table1.1: TCT value Comparison in mg/kg.

Element/ Chemical substance in waste	Tested Analysis	TCT0	TCT1	TCT2
Metal Ions in mg/kg				
As, Arsenic	4.025	5.8	500	2000
B, Boron	54.1	150	15000	60000
Ba, Barium	60.097	62.5	6250	25000
Cd, Cadmium	<4	7.5	260	1040
Co, Cobalt	6.1	50	5000	20000
Cr (total), Chromium Total	44.207	46000	800000	N/A
Cr (VI), Chromium (VI)	<2	6.5	500	2000
Cu, Copper	15.213	16	19500	78000
Hg, Mercury	<0.16	0.93	160	640
Mn, Manganese	101.047	1000	25000	100000
Mo, Molybdenum	<7.467	40	1000	4000
Ni, Nickel	11.917	91	10600	42400
Pb, Lead	20.753	20	1900	7600
Sb, Antimony	<3.733	10	75	300
Se, Selenium	4.32	10	50	200
V, Vanadium	33.963	150	2680	10720
Zn, Zinc	62.74	240	160000	640000
Inorganic Anions				
TDS	N/A			
Chloride	N/A			
Sulphate	N/A			
NO3 as N, Nitrate-N	N/A			
F, Fluoride	<4	100	10000	40000
CN- (Total), Cyanide Total	<0.1	14	10500	42000
Organics				
Benzene	<0.024		10	40
Benzo(a)pyrene	<0.2		1.7	6.8
Carbon tetrachloride	<1		4	16
Chlorobenzene	<0.4		8800	35200
Chloroform	<1		700	2800

2-Chlorophenol	<0.4		2100	8400
Di (2 ethylhexyl) phthalate	0.46		40	160
1,2-Dichlorobenzene	<0.4		31900	127600
1,4-Dichlorobenzene	<0.4		18400	73600
1,2-Dichloroethane	<0.4		3.7	14.8
1,1-Dichloroethylene	<2		150	600
1,2-Dichloroethylene	<2		3750	15000
Dichloromethane	<10		16	64
2,4-Dichlorophenol	<0.4		800	3200
2,4-Dinitrotoleune	<1		5.2	20.8
Ethylbenzene	<0.4		540	2160
Formaldehyde	<2		2000	8000
Hexachlorobutadiene	<0.4		2.8	5.4
Methyl ethyl Ketone	<2		8000	32000
MTBE (Methyl t-butyl ether)	<0.1		1435	5740
Nitrobenzene	<0.2		45	180
PAHs (total)	0.41		50	200
Petroleum H/Cs, C6 to C9	0.26		650	2600
Petroleum H/Cs, C10 to C36	<38		10000	40000
Phenols Speciated (total, non-halogenated)	<0.4		560	2240
Polychlorinated biphenyls	<0.35		12	48
Styrene	<1		120	480
1,1,1,2-Tetrachloroethane	<2		400	1600
1,1,2,2-Tetrachloroethane	<2		5	20
Tetrachloroethane	<2		200	800
Toluene	0.26		1150	4600
Trichlorobenzenes (total)	<1		3300	13200
1,1,1-Trichloroethane	<1		1200	4800
1,1,2-Trichloroethane	<1		48	192
Trichloroethylene	<2		11600	46400
2,4,6-Trichlorophenol	<0.4		1770	7080
Vinyl chloride	<0.02		1.5	6
Xylenes (total)	<1		890	3560
Pesticides				
Aldrin + Dieldrin	<0.02	0.05	1.2	4.8
DDT + DDD + DDE	<0.02	0.05	50	200
2,4-D	UTD	0.05	120	480
Chlordane	<0.02	0.05	4	16
Heptachlor	<0.02	0.05	1.2	4.8

Table 1.2: TCT values to determine if Type 4 waste is applicable

Chemical Substances in Waste	Total Concentration (mg/kg)
Organics	
TOC	95 667 (should be < 30 000)
BTEX	<6
PCB's	<1
Mineral Oil (C10 to C40)	<500
Pesticides	
Aldrin + Dieldrin	<0.05
DDT + DDD + DDE	<0.05
2,4-D	UTD
Chlordane	<0.05
Heptachlor	<0.05

Table 1.3 shows the Leachable Concentration Threshold Values (LCT), as well as the analysed results for

Table1.3: LCT value Comparison in mg/liter.

Element/ Chemical substance in waste	Tested Analysis	LCT0	LCT1	LCT2	LCT3
Metal Ions mg/liter					
As, Arsenic	<0.01	0.01	0.5	1	4
B, Boron*	0.1	0.5	25	50	200
Ba, Barium	0.427	0.7	35	70	280
Cd, Cadmium	0.014	0.003	0.15	0.3	1.2
Co, Cobalt	0.023	0.5	25	50	200
Cr (total), Chromium Total	0.04	0.05	2.5	5	20
Cr (VI), Chromium (VI)	<0.05	0.05	2.5	5	20
Cu, Copper	0.033	2	100	200	800
Hg, Mercury	0.005	0.006	0.3	0.6	2.4
Mn, Manganese	1.27	0.5	25	50	200
Mo, Molybdenum	0.08	0.07	3.5	7	28
Ni, Nickel	0.02	0.07	3.5	7	28
Pb, Lead	<0.01	0.01	0.5	1	4
Sb, Antimony	0.016	0.02	1	2	8
Se, Selenium	<0.01	0.01	0.5	1	4
V, Vanadium	0.077	0.2	10	20	80
Zn, Zinc	0.287	5	250	500	2000
Inorganic Anions mg/liter					
TDS	637	1000	12500	25000	100000
Chloride	<20	300	15000	30000	120000
Sulphate	<20	250	12500	25000	100000
NO3 as N, Nitrate-N	<5	11	550	1100	4400
F, Fluoride	0.06	1.5	75	150	600

Cn- (Total), Cyanide Total	<0.07	0.07	3.5	7	28
Organics mg/liter					
Benzene	<0.001		0.01	0.02	0.08
Benzo(a)pyrene	<0.001		0.035	0.07	0.28
Carbon tetrachloride	<0.005		0.2	0.4	1.6
Chlorobenzene	<0.002		5	10	40
Chloroform	0.006		15	30	120
2-Chlorophenol	<0.02		15	30	120
Di (2 ethylhexyl) phthalate	<0.1		0.5	1	4
1,2-Dichlorobenzene	<0.002		50	10	40
1,4-Dichlorobenzene	<0.002		15	30	120
1,2-Dichloroethane	<0.002		1.5	3	12
1,1-Dichloroethylene	<0.01		0.35	0.7	2.8
1,2-Dichloroethylene	<0.01		2.5	5	20
Dichloromethane	<0.05		0.25	0.5	2
2,4-Dichlorophenol	<0.02		10	20	80
2,4-Dinitrotoluene	<0.05		0.065	0.13	0.52
Ethylbenzene	<0.002		3.5	7	28
Formaldehyde	<0.1		25	50	200
Hexachlorobutadiene	<0.002		0.03	0.06	0.24
Methyl ethyl Ketone	<0.1		100	200	800
MTBE (Methyl t-butyl ether)	<0.005		2.5	5	20
Nitrobenzene	<0.01		1	2	8
PAHs (total)	<0.2		N/A	N/A	N/A
Petroleum H/Cs, C6 to C9	0.076		N/A	N/A	N/A
Petroleum H/Cs, C10 to C36	1.33		N/A	N/A	N/A
Phenols Speciated (total, non halogenated)	<0.2		7	14	56
Polychlorinated biphenyls	<0.01		0.025	0.05	0.2
Styrene	<0.005		1	2	8
1,1,1,2-Tetrachloroethane	<0.01		5	10	40
1,1,2,2-Tetrachloroethane	<0.01		0.65	1.3	5.3
Tetrachloroethane	<0.01		0.25	0.5	2
Toluene	0.067		35	70	280
Trichlorobenzenes (total)	<0.005		3.5	7	28
1,1,1-Trichloroethane	<0.005		15	30	120
1,1,2-Trichloroethane	<0.005		0.6	1	4
Trichloroethylene	<0.01		0.25	2	8
2,4,,6-Trichlorophenol	<0.02		10	20	80
Vinyl chloride	<0.001		0.015	0.03	0.12
Xylenes (total)			25	50	200
Pesticides mg/liter					
Aldrin + Dieldrin	<0.001		0.015	0.03	0.03
DDT + DDD + DDE	<0.001		1	2	2

2,4-D	UTD		1.5	3	3
Chlordane	<0.001		0.05	0.1	0.1
Heptachlor	<0.001		0.015	0.03	0.03

* Only the Boron from the TCLP were used.

1.5 Type of Waste

The type of waste is determined by using section 7 of GN R.365, as explained below.

(1) The specific type of waste for disposal to landfill must be determined by comparing the TC and LC of the elements and chemical substances in the waste with the TCT and LCT limits specified in section 6 of these Norms and Standards.

(2) Based on the assessment of the particular waste destined for disposal to landfill, the type of waste is determined as follows:

(a) Wastes with any element or chemical substance concentration above the LCT3 or TCT2 limits (LC > LCT3 or TC > TCT2) are Type 0 Wastes;

(b) Wastes with any element or chemical substance concentration above the LCT2 but below or equal to the LCT3 limits, or above the TCT1 but below or equal to the TCT2 limits (LCT2 < LC > LCT3 or TCT1 < TC TCT2), are Type 1 Wastes;

(c) Wastes with any element or chemical substance concentration above the LCT1 but below or equal to the LCT2 limits and all concentrations below or equal to the TCT1 limits (LCT1 < LC ≤ LCT2 and TC ≤ TCT1) are Type 2 Wastes;

(d) Wastes with any element or chemical substance concentration above the LCT0 but below or equal to the LCT1 limits and all TC concentrations below or equal to the TCT1 limits (LCT0 < LC ≤ LCT1 and TC ≤ TCT1) are Type 3 Wastes; or

(e) Wastes with all element and chemical substance concentration levels for metal ions and inorganic anions below or equal to the LCT0 and TCT0 limits (LC ≤ LCT0 and TC ≤ TCT0), and with all the chemical substance listed in table 1.2 below the total concentration limits for organics and pesticides, is considered a Type 4 Wastes.

(3) If a particular chemical substance in a waste is not listed with corresponding LCT and TCT limits in section 6 of these Norms and Standards, and the waste has been classified as hazardous in terms of regulation 4(2) of the Regulations based on the health or environmental hazard characteristics of the particular element or chemical substance, the following applies:

(a) the waste is considered to be Type 1 Waste; and
(b) the Department must be informed in writing in 30 days of the particular element or chemical substance not listed in section 6 of these Norms and Standards.

(4) Notwithstanding section 7(2) of these Norms and Standards, if the TC of an element or chemical substance is above the TCT2 limit, and the concentration cannot be reduced to below the TCT2 limit, but the LC for the particular element or chemical substance is below the LCT3 limit, the waste is considered to be a Type 1 Waste.

(5) Wastes listed in item (2)(b) of Annexure 1 to the Regulations are considered to be Type 1 Waste, unless assessed and determined otherwise in terms of these Norms and Standards.

(6) Notwithstanding section 7(2) of these Norms and Standards, wastes with all element or chemical substance leachable concentration levels for metal ions and inorganic anions below or equal to the LCT0 limits are considered to be Type 3 waste, irrespective of the total concentration of elements or chemical substances in the waste, provided that-

(a) all chemical substance concentration levels are below the total concentration limits for organics and pesticides in table 1.2:

1.6 Conclusion regarding the Type of Waste

To determine the waste type, both TC and LC results are necessary.

According to the analysed results, this waste stream is a Type 3 waste. This can be seen using the below legend, and looking at Table 1.1, 1.2 and 1.3.

LEGEND	TYPE 0	TYPE 1	TYPE 2	TYPE 3	TYPE 4

1.7 Class of Landfill and/or Liner to use

The class of landfill is determined using GN R. 636. Table 1.4 indicates the Class landfill for each of the different waste types. However, there are other landfill restrictions in GN R. 636, such as pH. The pH of 7.72 for Vulindlela Sedimentis within the disposal limits. The pH between the different samples varies between pH 7.4 and 8.2. The applicable landfill design for a type 3 waste is indicated by the coloured block in Table 1.4, and Figure 1.1.

Table 1.4: Waste Type corresponding to landfill design.

Waste Type	Landfill Disposal Requirements
Type 0	The disposal of Type 0 waste to landfill is not allowed. The waste must be treated and re-assessed in terms of the Norms and Standards for Assessment of Waste for Landfill Disposal.
Type 1	Type 1 waste may only be disposed of at a Class A landfill designed in accordance with section 3(1) and (2) of these Norms and Standards, or, subject to section 3(4) of these Norms and Standards, may be disposed of at a landfill site designed in accordance with the requirements for a Hh / HH landfill as specified in the Minimum Requirements for Waste Disposal by Landfill (2nd Ed., Department of Water Affairs and Forestry, 1998).
Type 2	Type 2 waste may only be disposed of at a Class B landfill designed in accordance with section 3(1) and (2) of these Norms and Standards, or, subject to section 3(4) of these Norms and Standards, may be disposed of at a landfill site designed in accordance with the requirements for a GLB+ landfill as specified in the Minimum Requirements for Waste Disposal by Landfill (2nd Ed., DWAF, 1998).
Type 3	Type 3 waste may only be disposed of at a Class C landfill designed in accordance with section 3(1) and (2) of these Norms and Standards, or, subject to section 3(4) of these Norms and Standards, may be disposed of at a landfill site designed in accordance with the requirements for a GLB+ landfill as specified in the Minimum Requirements for Waste Disposal by Landfill (2nd Ed., DWAF, 1998).
Type 4	Type 4 waste may only be disposed of at a Class D landfill designed in accordance with section 3(1) and (2) of these Norms and Standards, or, subject to section 3(4) of these Norms and Standards, may be disposed of at a landfill site designed in accordance with the requirements for a GLB landfill as specified in the Minimum Requirements for Waste Disposal by Landfill (2nd Ed., DWAF, 1998).

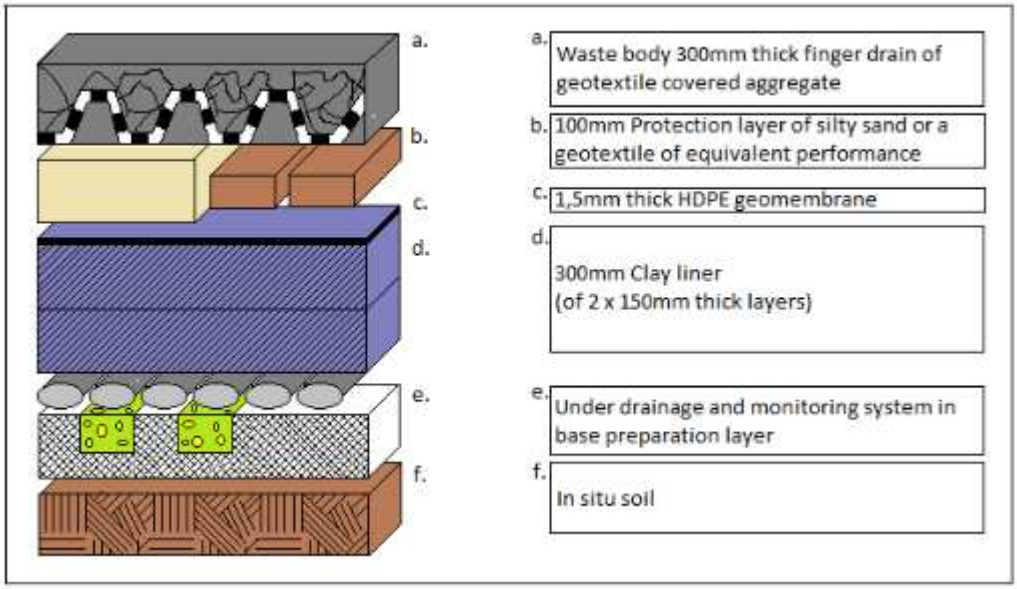

Figure 1.1: Class C Landfill Design

2 Waste Classification

2.1 Waste Material

Sediment sample, Vulindlela Sediment, were submitted for analysis.

2.2 Legal Framework

The standard used for waste classification is the; Globally Harmonised System of Classification and Labelling of Chemicals (GHS); SANS 10234:2008.

2.3 Methodology

Classification consist of three Hazard Classes, as seen in table 2.1.

Table 2.1: Hazard Classes and associated methods.

Hazard Class	**Methods**
Physical Hazards	All 14 Physical Hazard categories has different methods specified by SANS 10234.
Health Hazards	Bio-Elution analysis; Gastric Extraction, Intestinal fluid, Alveolar fluid and Sweat. As well as estimates using the ingredients.
Aquatic Hazards	Acute Toxicity: Fish species *P. reticulata* (Guppy), OECD 203; Crustacea species *D. magna* (Water flea), OECD 202; Aquatic Plant Species *S. polyrhiza* (Duckweed), OECD 201.

2.4 Results and Lab Analysis

For most of the analysis the product as such was tested. However, in some instances estimations was made, based on the composition of the waste stream. According to SANS 10234, the following criteria (cut-off values) is used to determine if a compound should be included in both an SDS and Classification report.

- If a compound is ≥ 1 % and this compound contributes to; Acute Toxicity, Skin Corrosion, Skin irritation, Serious eye damage or eye irritation, respiratory

sensitisation, skin sensitivity, Mutagenicity – Category 2, target organ toxicity or if its hazardous to the aquatic environment.

- If a compound is ≥ 0.1 % and this compound contributes to; Mutagenicity – Category 1, Carcinogenicity or reproductive toxicity.

Table 2.2 shows the composition for this waste stream.

Table 2.2: The composition of waste stream – Vulindlela Sediment

Element	Cas No	XRF (%)	XRD (%)
Iron (Fe)	7439-89-6	3.78	1.02
Silicon (Si)	7440-21-3	39.44	44.2
Aluminium (Al)	7429-90.5	2.30	1.1
Potassium (K)	7440-09-7	0.17	0.08
Phosphorus (P)	7723-14-0	0.04	N/A
Manganese (Mn)	7439-96-5	0.17	N/A
Calcium (Ca)	7440-70-2	0.71	0.27
Magnesium (Mg)	7439-95-4	0.15	0.2
Titanium (Ti)	7440-32-6	0.19	N/A
Vanadium (V)	7440-62-2	0.01	N/A
Barium (Ba)	7440-39-3	0.02	N/A
Chromium (Cr)	7440-47-3	0.10	N/A
Strontium (Sr)	7440-24-6	0.01	N/A
Zirconium (Zr)	7440-67-7	0.02	N/A
Sulphur (S)	7704-34-9	0.00	0.15
Lead (Pb)	7439-92-1	0.01	N/A
Zinc (Zn)	7440-66-6	0.01	N/A
Oxide		49.3	52.3
Other (% unless stated otherwise)			
Carbon	0.98		
Sulphur	0.046		
TOM	57.21		
Moisture	14.89		
Total Volatiles	20.29		
Faecal Coliforms	452 1g dry weight		
E. coli	325 1g dry weight		

The results of the XRD analysis are below;

Quartz 93.2 %

Kaolinite 2.1%

Geothite 1.4%

Spinel 1.2%

Muscovite 0.8%

Gypsum 0.8%

Calcite 0.2%

Hematite 0.2%

2.4.1 Physical Analysis

The parameters listed below were analysed as per SANS10234:2008. Therefore, it's not estimations, but actual laboratory results.

2.4.1. A. Explosive

Extremely insensitive article that do not present a mass explosion hazard and the probability of accidental initiation or propagation is negligible. (1.6)

2.4.1. B. Flammable Gasses

There was no measurable flammable gas produced

2.4.1. C. Flammable Aerosols

N/A

2.4.1. D. Oxidising Gasses

N/A and no oxidising gasses were produced

2.4.1. E. Gasses under Pressure

N/A

2.4.1. F. Flammable Liquids (Up to 93 ºC)

N/A

2.4.1. G. Flammable Solids

Not Flammable

2.4.1. H. Self-Reactive Substances and Mixture

Type G: A substance or mixture that, during laboratory testing, neither detonates in the cavitated state nor deflagrates at all, shows little or no effect when heated under confinement, and shows no explosive power. However, the substance or mixture shall be thermally stable with a self-accelerating decomposition temperature (SADT) of 60 ºC to 75 ºC for a 50kg package.

2.4.1. I. Pyrophoric Substances

Not pyrophoric

2.4.1. J. Self-Heating Substance and Mixtures

Not self-heating

2.4.1. K. Substances and mixture that on contact with water emits flammable gasses

No flammable gas emitted

2.4.1. L. Oxidising substances and Mixtures

Not oxidising, Category 3b; The criteria for category 1 and 2 are not met.

2.4.1. M. Organic Peroxides

Not a peroxide

2.4.1. N. Corrosive to Metals

Not Corrosive

2.4.2. Health Hazards

Table 2.3 below shows the metals analysed in the bio-elution (Bio-accessibility) analysis done on artificial Gastric, Intestinal, Alveolar and Sweat fluid. Table 2.4 shows the results of the metals that are above the detection limit. The % is shown to 2 decimals only, if there is no value to the second decimal the result in percentage are indicated as 0. The results from Table 2.4 are used to estimate the health hazards and not the XRF and XRD results from Table 2.2, unless Table 2.2 contains compounds that is not included in Table 2.4. Table 2.4 shows how bio-available the metals in

Vulindlela sediment is, as appose to the total concentration using XRF, XRD or Aqua Regia digestion used for Waste Assessment Table 1.1.

Table 2.3: Metals analysed in the Bio-elution analysis

Ag	**Cr**	**Ho**	**Nd**	**Sc**	**Tm**
Al	**Cs**	**In**	**Ni**	**Se**	**U**
As	**Cu**	**Ir**	**Os**	**Si**	**V**
Au	**Dy**	**K**	**P**	**Sm**	**W**
B	**Er**	**La**	**Pb**	**Sn**	**Y**
Ba	**Eu**	**Li**	**Pd**	**Sr**	**Yb**
Be	**Fe**	**Lu**	**Pr**	**Ta**	**Zn**
Bi	**Ga**	**Mg**	**Pt**	**Tb**	**Zr**
Ca	**Gd**	**Mn**	**Rb**	**Te**	
Cd	**Ge**	**Mo**	**Rh**	**Th**	
Ce	**Hf**	**Na**	**Ru**	**Ti**	
Co	**Hg**	**Nb**	**Sb**	**Tl**	

Table 2.4: Bio-Elution results for Vulindlela Sediment.

	Gastric		Intestinal		Alveolar		Sweat	
	mg/kg	%	mg/kg	%	mg/kg	%	mg/kg	%
Al	1580	0.16	11	0.00	2	0.00	723	0.07
B	1	0.00	0	0.00	0	0.00	1	0.00
Ba	50	0.01	12	0.00	3	0.00	50	0.01
Ca	4640	0.46	845	0.08	230	0.02	4487	0.45
Ce	12	0.00	0	0.00	0	0.00	2	0.00
Co	4	0.00	0	0.00	0	0.00	2	0.00
Cr	33	0.00	0	0.00	0	0.00	8	0.00
Cu	2	0.00	0	0.00	0	0.00	0	0.00
Fe	1994	0.20	2	0.00	0	0.00	643	0.06
Ga	2	0.00	0	0.00	0	0.00	1	0.00
K	147	0.01	0	0.00	0	0.00	120	0.01
La	1	0.00	0	0.00	0	0.00	0	0.00
Li	1	0.00	0	0.00	0	0.00	0	0.00
Mg	402	0.04	36	0.00	0	0.00	267	0.03
Mn	586	0.06	7	0.00	8	0.00	556	0.06
Nd	1	0.00	0	0.00	0	0.00	1	0.00
Ni	2	0.00	0	0.00	0	0.00	1	0.00
P	29	0.00	2	0.00	0	0.00	2	0.00
Pb	18	0.00	0	0.00	0	0.00	2	0.00
Si	1299	0.13	114	0.01	207	0.02	773	0.08
Sr	3	0.00	0	0.00	0	0.00	2	0.00
Ti	12	0.00	0	0.00	0	0.00	15	0.00
U	1	0.00	0	0.00	0	0.00	0	0.00

V	4	0.00	0	0.00	0	0.00	1	0.00
Zn	10	0.00	0	0.00	0	0.00	6	0.00

To determine the various toxicities (ATE) below, LC_{50} values for the constitutes of this waste stream, were sourced from the Internet, mainly RTECS and ECHA CLP online. Table 2.5 below shows the LC_{50} values. If the LC_{50} value is > 2000 mg/kg you do not need to include it in the ATE calculations.

2.4.2. A. Acute Toxicity

According to SANS 10234:2008, chemical substances can be allocated to one of five hazard categories, based on acute toxicity by oral, dermal or inhalation route of exposure. To establish the toxicity, the results from the bio-elution analysis were used; the gastric and intestinal fluid for oral toxicity, alveolar fluid for inhalation toxicity, and sweat fluid for dermal toxicity.

Acute toxicity estimates (ATE) are used to determine the toxicity. According to SANS 10234:2008 you only need to calculate the ATE's for compounds that exceeds either 0.1% or 1% as per the above explanation under section 2.4. Table 2.5 summarises the acute toxicity hazard.

Table 2.5: Acute toxicity hazards of Vulindlela Sediment

	Oral Toxicity (mg/kg)	Dermal Toxicity (mg/kg)	Inhalation Toxicity (mg/l)
Calculated ATE:	> 5000 mg/kg	> 5000 mg/kg	> 20 mg/l
Acute Toxicity Category:	Not Classified	Not Classified	Not Classified
Symbol:	N/A	N/A	N/A
Signal Word:	N/A	N/A	N/A
Hazard Statement:	N/A	N/A	N/A

Table 2.6 shows the available LC_{50} data used in the acute toxicity classification. In some instances, the element is used to source LD_{50} and in other instances salts are used.

Table 2.6: LC_{50} values obtained from databases.

Compound	Oral	Inhalation	Dermal
Iron	98,6 g/kg	< 250 mg/m3	No Data
Aluminium	> 15900mg/kg	6.1 mg/l/4h	> 5000 mg/kg
Potassium	333 - 338 mg/kg	5.1 mg/l/h	No Data
Calcium	300 mg/kg	No Data	No Data
Magnesium	> 2000 mg/kg	No Data	> 2000 mg/kg
Manganese	> 2000 mg/kg	> 5.14 mg/l/4h	No Data
Hematite	14.6 mg/kg	>2.2 mg/l/1h	No Data

Apart from the metals tested for in the bio-elution analysis, the sample also contain microbial contaminants (Faecal Coliforms and *E. coli*). *E. coli* infection can lead to diarrhoea, high blood pressure, kidney problems, heart disease and even haemolytic uremic syndrome.

The most likely route of exposure to Vulindlela Sediment would be inhalation of dust. It's unlikely that it will be orally consumed, especially not chronically. It's also unlikely that will be applied to the skin, although it can come into contact with skin should you work with the sediment.

2.4.2. B. Skin corrosion and skin irritation

According to SANS 10234:2008, a substance can be classified as a skin corrosive or irritant based on hazards of its constituents. SANS 10234:2008 also states that if the substance has a pH ≤ 2 or ≥ 11.5, the substance is an eye and/or skin corrosive, unless there is data to indicate that the statement is false. For this the sweat bio-elution results were used.

Hematite is a category 2 skin irritant, however the concentration in sediment is only 0.2% which does not warrant classification.

2.4.2. C. Serious eye damage and eye irritation

Muscovite is a category 2 eye irritant and Hematite is a eye corrosive. However the sediment does not need to be classify, because the concentration is only 0.8% and 0.2% respectively. This is also the total concentration and not the bioavailable concentrations.

2.4.2. D. Respiratory sensitization and skin sensitization

According to SANS 10234:2008, respiratory sensitization is when a substance induces specific respiratory hypersensitivity of the airways following inhalation. Examples of this is asthma, rhinitis (conjunctivitis) and alveolitis. Skin sensitization is an allergic reaction after skin contact.

Vulindlela Sediment is not classified as a respiratory or skin sensitizer.

2.4.2. E. Germ cell mutagenicity

According to SANS 10234, this hazard class are for substances that cause mutations in the germ cells of humans and that can be transferred to the progeny.

Mutation is a heritable genetic change that can manifest at phenotypic level and to underlying DNA modifications, such as base pare changes and chromosomal translocations. The term mutagenic and mutagen are used for substances that increases the incidents of mutations in populations of cells or the whole organism.

Genotoxic and genotoxicity applies to substances that alter DNA structure or information, such as interfering with normal replication. Genotoxicity test results are used as indications for mutagenic effects.

According to the RTECS database ingestion of nanoparticles aluminium oxide in rats showed positive results. However larger particles 50 – 200 micron showed negative results. The positive results obtained were numerical chromosome aberrations in bone morrow and bone morrow micronuclei. In cultured mammalian cells both positive and negative results were obtained, rendering it inconclusive.

Vulindlela Sedimentis not classified as a germ cell mutagen, based on its constituents.

2.4.2. F. Carcinogenicity

According to SANS 10234:2008, the carcinogenicity of a substance is based on the inherent properties of the substance. It does not provide information on the level of human cancer risk, which use of the substance may lead to.

According to the Canadian Centre for Occupational Health and Safety (CCOHS), the International Agency for Research on Cancer (IARC) has concluded that crystalline silica in the form of quartz or cristobalite dust is a human carcinogen. Under SANS 10234:2008 Quartz dust is a Carcinogen, Category 1A.

Since the waste stream is a fine material, it is very likely that dust may be created which contains quartz. For this reason, the waste stream will need to be classified. However, if it's not in dust form or in conditions that creates dust this is not necessary. Table 2.7 indicates the carcinogenic classification.

Table 2.7: Carcinogenic Classification

	Category 1A
Symbol	
Signal Word	Danger
Hazard Statement	H350: May Cause Cancer, due to inhalation.

2.4.2. G. Reproductive Toxicity (Teratogenicity in MRHW)

According to SANS 10234:2008, reproductive toxicity can refer to impairment of sexual function, fertility or developmental toxicity. Effects on sexual function and fertility include, alterations to reproductive systems, the onset of puberty, gamete production and transport, sexual behaviour, fertility, the ability to give birth, premature aging or any other effect dependant on the reproductive system.

ECHA has two studies regarding aluminium. Female rats treated with 102 mg/kg body weight per day, had less living pups than untreated females. The body weight, body length and tail length were also significantly lower in the treated group. Therefore, aluminium could have a reproductive impact if consumed daily for a certain time. However, there is no clear human data to classify this waste stream as toxic to reproduction, although it is suspected.

ECHA Reach dossier list one (1) human study, sourced from Gilbert-Barness et al. (1998). A four (4) month old girl were diagnosed with severe mental retardation. At nine (9) years of age her autopsy reveals the following; CNS cortical atrophy, small basal ganglia and hypomyelination of the spinal cord, cerebral cortex, sub cortex and cerebellar white matter. It was later found that the mother took Maalox tablets during pregnancy, which contains 200 mg of aluminium hydroxide per tablet. Later studies suggest that the high aluminium intake by the mother during the critical stages of foetus brain development, caused neurological damage to the infant. The link between aluminium and mental retardation were not proven.

The constituent of Vulindlela Sedimentdoes not signal classification for reproductive toxicity.

2.4.2. H. Specific target organ toxicity – Single exposure (STOT-SE)

For a substance to be classified as a STOT-SE reliable evidence of the following is necessary; consistent identifiable toxic effects in humans and test animals, the toxicological effect should be significant bringing change to the function and morphology of tissue and/or organs, thus there should be serious changes to the biochemistry or haematology of the organism. Human data should be the primary source for classification, considering all the changes that occurred to various organs.

Based on the constituents of Vulindlela Sediment, this waste stream is not considered to be a STOT-SE. However, exposure to pathogens within the waste stream could lead to health effects, however not as severe to be classified as a STOT.

2.4.2. I. Specific target organ toxicity – Repeated exposure (STOT-RE)

The criteria for classification as a STOT-RE is the same as that for STOT-SE, with the exception that the effect only occur after repeated exposure.

Rats were exposed to carbonyl iron in their feed at 2.5% and 3%, for six (6) and nine (9) weeks respectively, followed by a liquid diet. Hepatoxic effects were noticed. This study is from the ECHA Dossier website, and the examinations were done five (5) to nine (9) weeks after the carbonyl iron diet.

Carbonyl iron also showed a positive response in a subacute inhalation study. The NOAEC were determined to be 5 mg/m^3. The rats showed a clear inflammatory reaction in the lungs as well as increased cell proliferation, hypertrophy and hyperplasia at 50 and 250 mg/m^3. No systemic endpoints were investigated.

In animal studies using airborne aluminium oxide fumes or aluminium dust, chronic exposure showed significant temporary lung effects such as pneumonia, granuloma and alveolar proteinosis, but no scaring of the lungs. The sub chronic inhalation LOAEC is 50 mg Al/m^3 as aluminium powder However according to DSD (67/548/EEC) or CLP (1272/2008/EC) classification is not required.

The effects of aluminium in drinking water were also studied to see if there is an increased risk of Alzheimer's disease with an increase in aluminium. The study concluded that there is probably a link between aluminium intake and the risk of developing Alzheimer disease. However, the study showed that drinking water plays a small role in aluminium ingestion. The factors that contribute largely to oral ingestion of aluminium is dietary and pharmacological sources.

The oral chronic NOAEL for aluminium is 30 mg Al/kg bw/day as aluminium citrate. Various studies have been done on rats, that showed that chronic ingestion of aluminium leads to harmful effects on the blood system and nervous system. The oral route of exposure is unlikely for Vulindlela Sediment, and even more unlikely for chronic exposure.

Quartz dust is a Category 1 STOT RE. Table 2.8 shows the STOR RE classification for Vulindlela sediment.

Table 2.8: STOT RE Classification

	Category 1
Symbol	
Signal Word	Danger
Hazard Statement	H372: Causes damage to lungs through prolonged or repeated exposure via inhalation.

2.4.2. J. Aspiration Hazard

According to SANS 10234:2008 this is a substance that causes severe acute effects, such as chemical pneumonia, pulmonary injury or death after aspiration. Aspiration is initiated from the moment of inhalation.

Vulindlela Sediment is not seen to be an aspiration hazard.

2.4.3. Hazards to the Aquatic Environment

To determine if a substance is hazardous to the aquatic environment, the following elements are looked at; acute toxicity, bioaccumulation, degradation and chronic toxicity.

The sample were tested for acute toxicity and the results are displayed in Table 2.8.

The below Toxicity is based on the Direct Estimate of Ecological Effect Potential (DEEEP) Protocol. From table 2.9 the classification statement, “No acute/short-chronic hazards”, means that none of the test showed an toxic effect. According to SANS 10234:2008, this test is only applicable to the acute toxicity. The Toxicity Unit (TU), will be converted to mg/l to use as part of the SANS 10234 classification. The higher the TU the lower to mg/l value, therefore the toxicity increase as TU increase. TU can be converted to mg/l based on the following; 100% v/v solution is 100g of product in 100 ml of water. 1 g/ml Is equivalent to 1 000 000 mg/l. Also, a 100% v/v toxicity response is equivalent to 1 toxic unit (100/100% v/v = 1 TU), therefore 1 TU corresponds to 1 000 000 mg/l. Therefor a TU of 250 corresponds to 4000 mg/l. The TU is calculated as follows; TU = $\frac{Concentration}{EC_{50}}$. This explanation is from Environmental Xenobiotics by Mervyn Richardson, page 167.

Table 2.9: Acute Toxicity Test Results (From BiotoxSA)

	Results	Vulindlela Sediment
Water quality	pH @ 25°C (A)	7.2
	EC (Electrical conductivity) (mS/m) @ 25°C (A)	25.3
	Dissolved oxygen (mg/l) (NA)	7.0
	Chemical oxygen demand (COD) (total) as O2 (OS)	<10
	Biological oxygen demand (BOD) (mg/l) as O2 (OS)	<10
S. capricomutum (micro-algae) (A)	Test started on yy/mm/dd	19/06/04
	%72hour inhibition (-) / stimulation (+) (%)	34
	EC/LC20 (72hours)	n.r.
	EC/LC50 (72hours)	n.r.
	Toxicity unit (TU) / Description	<1
D. magna (waterflea) (A)	Test started on yy/mm/dd	19/05/27
	%48hour mortality rate (-%)	-5
	EC/LC10 (48hours)	n.r.
	EC/LC50 (48hours)	n.r.
	Toxicity unit (TU) / Description	<1
P. reticulata (guppy) (A)	Test started on yy/mm/dd	19/05/23
	%96hour mortality rate (-%)	0
	EC/LC10 (96hours)	n.r.
	EC/LC50 (96hours)	n.r.
	Toxicity unit (TU) / Description	<1
Estimated safe dilution factor (%) [for definitive testing only]		**None Required**
Overall classification - Hazard class***		Class I - No acute/short-chronic hazard
Weight (%)		0

Table 2.10 shows the results from the Transformation/Dissolution Test. The elements that were tested are the same as those in Table 2.3.

Table 2.10: Transformation/Dissolution results for Vulindlela Sediment

	mg/kg	%
Al	320	0.032
Ca	22700	2.27
K	8550	0.855
Mn	150	0.015
Si	400	0.04

Transformation/Dissolution test are done to access the impact of heavy metals on the aquatic environment.

2.4.3. A. Acute Aquatic Toxicity

Acute toxicity is determined by the following three (3) species. A fish population for 96 h to determine the LC_{50} using OECD 203. A crustacea (daphnia, water flea) species for 48 h to determine the EC_{50}, using OECD 202. Lastly an algae species or an aquatic plant species for 72 h or 96 h to determine ErC_{50} using OECD 201. The acute hazard

categories are summarised in table 2.11 below. The LC_{50} values for the acute and chronic classification were mainly sourced from ECHA CLP inventory.

Table 2.11: Acute toxicity categories for substances hazardous to the aquatic environment, from SANS 10234:2008.

Hazard Category of Acute Toxicity	**Classification Criteria**	**Values**
1	96 h LC_{50} (For Fish) 48 h EC_{50} (For Crustacea) 72 h or 96 h ErC50 (For Algae or aquatic plant)	≤ 1 mg/l ≤ 1 mg/l ≤ 1 mg/l
2	96 h LC_{50} (For Fish) 48 h EC_{50} (For Crustacea) 72 h or 96 h ErC50 (For Algae or aquatic plant)	>1 to ≤ 10 mg/l and/or >1 to ≤ 10 mg/l and/or >1 to ≤ 10 mg/l
3	96 h LC_{50} (For Fish) 48 h EC_{50} (For Crustacea) 72 h or 96 h ErC50 (For Algae or aquatic plant)	>10 to ≤ 100 mg/l and/or >10 to ≤ 100 mg/l and/or >10 to ≤ 100 mg/l

According to the tested product, Vulindlela sediment does not pose an acute aquatic risk.

The Transformation/Dissolution analysis also indicates that classification is not necessary for acute toxicity.

The DEEEP analysis are used for classification, since this is the results on the tested product/waste stream. Therefore, Vulindlela sediment does not need to be classified in terms of acute aquatic toxicity.

2.4.3. B. Chronic Aquatic Toxicity

Table 2.12 below shows the classification criteria for chronic aquatic toxicity.

Table 2.12: Hazards categories of chronic toxicity for substances hazardous to the aquatic environment, from SANS 10234:2008.

Hazard Category	**Classification Criteria**
1	a) 96 h LC_{50} (For Fish) ≤ 1mg/L; and/or b) 48 h EC_{50} (For Crustacea) ≤ 1mg/L; and/or c) 72 h or 96 h ErC50 (For Algae or aquatic plant) ≤ 1mg/L; and d) The substance is not rapidly degradable; and/or e) The log K_{ow} ≥ 4 (unless the experimentally determined BCF < 500)
2	a) 96 h LC_{50} (For Fish) > 10 to ≤ 100 mg/L; and/or b) 48 h EC_{50} (For Crustacea) > 10 to ≤ 100 mg/L; and/or c) 72 h or 96 h ErC50 (For Algae or aquatic plant) > 10 to ≤ 100 mg/L; and d) The substance is not rapidly degradable; and/or e) The log K_{ow} ≥ 4 (unless the experimentally determined BCF < 500) and f) Unless the chronic NOECs are > 1mg/L
3	a) 96 h LC_{50} (For Fish) > 1 to ≤ 10 mg/L; and/or b) 48 h EC_{50} (For Crustacea) > 1 to ≤ 10 mg/L; and/or c) 72 h or 96 h ErC50 (For Algae or aquatic plant) > 1 to ≤ 10 mg/L; and d) The substance is not rapidly degradable; and/or e) The log K_{ow} ≥ 4 (unless the experimentally determined BCF < 500) and f) Unless the chronic NOECs are > 1mg/L
4	Poorly soluble substances for which no acute toxicity is recorded at levels up to the water solubility, that are not rapidly degradable and have a log Kow ≥ 4, indicating a potential to bioaccumulate are to be classified in this category, unless other scientific evidence shows classification to be unnecessary. Such evidence would include an experimentally determined BCF < 500, or a chronic toxicity NOECs >1 mg/L, or evidence of rapid degradation in the environment.

The chronic toxicity was calculated mainly from the Transformation/Dissolution analysis, however constituents that were not reported in Transformation/Dissolution scan were sourced from the sample composition Table 2.2.

From the calculations using the Transformation/Dissolution results this waste stream has no chronic classification.

According to SANS 10234 a product is rapidly degradable when the BOD_5/COD is ≥ 0.5. The BOD and COD were analysed but its below the detection limit of the lab.

2.5. Conclusion

Table 2.13 summarised the classification of Vulindlela Sediment, according to SANS 10234:2008.

Table 2.13: Summary of the Physical, Health and Aquatic Hazards of Vulindlela Sediment.

Hazard Class	Hazard Category	Hazard Statement
Physical Hazard		
Explosives	Not Explosive – Division 1.6	None
Flammable Gasses	N/A	None
Flammable Aerosols	N/A	None
Oxidising Gasses	N/A	None
Gasses under Pressure	N/A	None
Flammable Liquids (Up to 93 ^{0}C)	N/A	None
Flammable solids	Not Flammable	None
Self-Reactive Substances and Mixture	Self-Reactive Type G	None
Pyrophoric Substances	Not Pyrophoric	None
Self-Heating Substance and Mixtures	Not Self Heating	None
Substances and mixture that on contact with water emits flammable gasses	No flammable gas emitted	None
Oxidising substances and Mixtures	Not Oxidising – 3b	None
Organic Peroxides	Not a Peroxide	None
Corrosive to Metals	Not Corrosive	None
Health Hazards		
Acute Toxicity: Oral	Not Classified	None
Acute Toxicity: Dermal	Not Classified	None
Acute Toxicity: Inhalation	Not Classified	None
Skin corrosion and irritation	Not Classified	None
Serious Eye Damage and Irritation	Not Classified	None
Respiratory sensitization and skin sensitization	Not Classified	None
Germ Cell Mutagenicity	Not Classified	None
Carcinogenicity	Category 1A	H350
Reproductive Toxicity	Not Classified	None

STOT-SE	Not Classified	None
STOT-RE	Category 1	H372
Aspiration hazard	Not Classified	None
Aquatic Hazards		
Acute Aquatic Toxicity	Not Classified	None
Chronic Aquatic Toxicity	Not Classified	None

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APPENDIX B

UIS TC & LC ANALYTICAL RESULTS

UIS SEDIBA LABORATORY

Analysis Report

Client Information

Company: IX Engineers
Attention: Gerrie Le Roux
Tel: 012 745 2000
Fax:
Address: 270 Lynwood Service road
Lynnwood Ridge
Pretoria, 0081

Lab No: 24178

Test Information: *Waste Assesment for Disposal, GNR 635 (Gazette No. 36784)*
Australian Standard Leaching
AS4439 - 1997 , ICP-OES/MS and IC

Date Received: 2019/05/15
Date Completed: 2019/06/25
Date Issued: 2019/08/01

Sample Information

Matrix: Solid Composite - TCLP and Borax Leaches
Sample ID: Composite 1: Bridge 1
Ref No: Vulindlela Sediment Desilt Sampling

Parameters	Results			TCT	LCT
	Solids	TCLP	Borax		
pH - Leach Fluid	N/A	4.93	9.38		
PH - Sample	6.75	5.06	9.35		
Metal Ions	mg/kg *	mg/liter *	mg/liter *		
As - Arsenic *	< 4	< 0.01	< 0.01	< TCT0	= LCT0
B - Boron *	< 40	0.1	1062	< TCT0	> LCT3
Ba - Barium *	85.14	0.5	0.05	< TCT1	< LCT0
Cd - Cadmium *	< 4	0.014	< 0.003	< TCT0	= LCT0
Co - Cobalt *	6.86	0.02	< 0.02	< TCT0	< LCT0
Cr Total - Chromium Total *	51.19	0.04	0.05	< TCT0	< LCT0
Cr (VI) - Chromium (VI) *	< 2	< 0.05	< 0.05	< TCT0	= LCT0
Cu - Copper *	19.09	0.03	0.04	< TCT1	< LCT0
Hg - Mercury *	< 0.16	0.0057	0.0046	< TCT0	< LCT0
Mn - Manganese *	101.3	1.68	0.07	< TCT0	< LCT1
Mo - Molybdenum *	< 8	0.08	< 0.07	< TCT0	= LCT0
Ni - Nickel *	13.5	0.02	< 0.02	< TCT0	< LCT0
Pb - Lead *	26.71	< 0.01	< 0.01	< TCT1	= LCT0
Sb - Antimony *	< 4	< 0.009	0.0169	< TCT0	< LCT0
Se - Selenium *	< 8	< 0.01	< 0.01	< TCT0	= LCT0
V - Vanadium *	37.1	< 0.02	0.08	< TCT0	< LCT0
Zn - Zinc *	119.6	0.32	0.07	< TCT0	< LCT0
Anions	mg/kg *	mg/liter	mg/liter		
Fluoride - F	< 4	< 0.5	< 0.5	< TCT0	< LCT0
Chloride - Cl	N/A	< 20	< 20	N/A	< LCT0
Nitrate as NO3	N/A	< 22.2	< 22.2	N/A	N/A
NO3 as N	N/A	< 5	< 5	N/A	< LCT0
Sulphate - SO4	N/A	< 20	< 20	N/A	< LCT0
CN - Total Cyanide *	< 0.1	< 0.07	< 0.07	< TCT0	= LCT0
Total Dissolved Solids	mg/kg	mg/liter	mg/liter		
TDS	N/A	706	< 10	N/A	< LCT0

Authorized Signatory

C. Swanepoel

sanas Testing Laboratory T0584

Disclaimer:

The above-mentioned sample/s were analysed as received by the laboratory on the date stated above. UIS Organic laboratory takes no responsibility for sample/s prior to submission: this includes sampling, sample container, storage and shipping to our testing facility. The sample is analysed per customer request for analysis.
This report may not be reproduced, except in full, without the prior written approval of the laboratory.
Analysis mark with (*), have been outsourced.
UTD – Unable to Determine
NR – Not Requested
RTF – Results to Follow
BDL – Below Detection Limit (Please note that if the results for an analyte is below our detection limit, it does not indicate that the sample is clean or that the analyte result is equal to zero.)
Storage Conditions in the Laboratory: Fridge @ <6 ºC

UIS ORGANIC LABORATORY

Analysis Report

Client Information

Company: IX Engineers
Attention: Gerrie Le Roux
Tel: 012 745 2000
Fax:
Address: 270 Lynwood Service road
Lynnwood Ridge
Pretoria, 0081

Lab No: 24178

Test Information: *Waste Assesment for Disposal, GN R. 635 (Gazette No. 36784)*
Australian Standard Leaching
AS4439 - 1997 , SPME Extraction & GC/MS

Date Received: 2019/05/15
Date Completed: 2019/05/27
Date Issued: 2019/08/01

Sample Information
Matrix: Solid Composite - TCLP and Borax Leaches
Sample ID: Composite 1: Bridge 1
Ref No: Vulindlela Sediment Desilt Sampling

Parameters		Results			TCT	LCT
		Solids ug/kg	TCLP ug/liter	Borax ug/liter		
VOC's	**Dilution**	**X20**	**X1**	**X1**		
Benzene		< 20	< 1	< 1	< TCT1	< LCT1
Carbon Tetrachloride		< 100	< 5	< 5	< TCT1	< LCT1
Chlorobenzene		< 40	< 2	< 2	< TCT1	< LCT1
Chloroform		< 100	< 5	< 5	< TCT1	< LCT1
1,2-Dichlorobenzene		< 40	< 2	< 2	< TCT1	< LCT1
1,4-Dichlorobenzene		< 40	< 2	< 2	< TCT1	< LCT1
1,2-Dichloroethane		< 40	< 2	< 2	< TCT1	< LCT1
Ethylbenzene		< 40	< 2	< 2	< TCT1	< LCT1
Hexachlorobutadiene		< 40	< 2	< 2	< TCT1	< LCT1
MTBE		< 100	< 5	< 5	< TCT1	< LCT1
Styrene		< 100	< 5	< 5	< TCT1	< LCT1
1,1,1,2-Tetrachloroethane		< 200	< 10	< 10	< TCT1	< LCT1
1,1,2,2-Tetrachloroethane		< 200	< 10	< 10	< TCT1	< LCT1
Toluene		260	67	< 10	< TCT1	< LCT1
1,1,1-Trichloroethane		< 100	< 5	< 5	< TCT1	< LCT1
1,1,2-Trichloroethane		< 100	< 5	< 5	< TCT1	< LCT1
Xylenes total		< 100	< 5	< 5	< TCT1	< LCT1
Trichlorobenzene (Total)		< 100	< 5	< 5	< TCT1	< LCT1
Dichloromethane		< 1000	< 50	< 50	< TCT1	< LCT1
1,1-Dichloroethylene		< 200	< 10	< 10	< TCT1	< LCT1
1,2-Dichloroethylene		< 200	< 10	< 10	< TCT1	< LCT1
Tetrachloroethylene		< 200	< 10	< 10	< TCT1	< LCT1
Trichloroethylene		< 200	< 10	< 10	< TCT1	< LCT1
TPH	**Dilution**	**x20**	**X1**	**X1**		
Petroleum H/Cs,C6-C9		260	76	< 10	< TCT1	N/A
Petroleum H/Cs,C10 to C36		< 38000	2200	1900	< TCT1	N/A
Formaldehyde	**Dilution**	**X10 ***	**X2**	**X2**		
Formaldehyde		< 2000	< 100	< 100	< TCT1	< LCT1

Authorized Signatory

H. Richter

sanas Testing Laboratory T0419

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UTD – Unable to Determine
NR – Not Requested
RTF – Results to Follow
BDL – Below Detection Limit (Please note that if the results for an analyte is below our detection limit, it does not indicate that the sample is clean or that the analyte result is equal to zero.)
Storage Conditions in the Laboratory: Fridge @ <6 °C

UIS ORGANIC LABORATORY

Analysis Report

Client Information

Company: IX Engineers
Attention: Gerrie Le Roux
Tel: 012 745 2000
Fax:
Address: 270 Lynwood Service road
Lynnwood Ridge
Pretoria, 0081

Lab No: 24178

Test Information: *Waste Assesment for Disposal, GN R. 635 (Gazette No. 36784)*
Australian Standard Leaching
AS4439 - 1997 , SPME Extraction & GC/MS

Date Received: 2019/05/15
Date Completed: 2019/05/27
Date Issued: 2019/08/01

Sample Information
Matrix: Solid Composite - TCLP and Borax Leaches
Sample ID: Composite 1: Bridge 1
Ref No: Vulindlela Sediment Desilt Sampling

Parameters	Results			TCT	LCT
	Solids	TCLP	Borax		
	ug/kg	ug/liter	ug/liter		
SVOCs **Dilution**	**X20 ***	**X10**	**X10**		
Benzo(a)pyrene *	24	< 1	< 1	< TCT1	< LCT1
Di (2 ethylhexyl) Phthalate *	460	< 100	< 100	< TCT1	< LCT1
Nitrobenzene *	< 200	< 10	< 10	< TCT1	< LCT1
2,4 Dinitrotoluene *	< 1000	< 50	< 50	< TCT1	< LCT1
Total PAH's	410	< 200	< 200	< TCT1	N/A
PHENOLS **Dilution**	**X200**	**X10**	**X10**		
2-Chlorophenol *	< 400	< 20	< 20	< TCT1	< LCT1
2,4-Dichlorophenol *	< 400	< 20	< 20	< TCT1	< LCT1
2,4,6-Trichlorophenol *	< 400	< 20	< 20	< TCT1	< LCT1
Phenols Speciated (total,non-halogenated) *	< 4000	< 200	< 200	< TCT1	< LCT1
Pesticides **Dilution**	**X200**	**X10**	**X10**		
Aldrin *	< 20	< 1	< 1	< TCT0	< LCT1
Dieldrin *	< 20	< 1	< 1	< TCT0	< LCT1
DDT *	< 20	< 1	< 1	< TCT0	< LCT1
DDE *	< 20	< 1	< 1	< TCT0	< LCT1
DDD *	< 20	< 1	< 1	< TCT0	< LCT1
Heptachlor *	< 20	< 1	< 1	< TCT0	< LCT1
Chlordane *	< 20	< 1	< 1	< TCT0	< LCT1
2,4 Dichlorophenoxyacetic Acid		Unable to Detect		UTD	UTD
Polychlorinated Biphenyl **Dilution**	**X1**	**X10**	**X10**		
Ballsmitters Totals *	< 350	< 10	< 10	< TCT1	< LCT1
Polars **Dilution**	**X20**	**X1**	**X1**		
Methyl Ethyl Ketone (2-Butanone) *	< 2000	< 100	< 100	< TCT1	< LCT1
Vinyl Chloride *	< 20	< 1	< 1	< TCT1	< LCT1
	mg/kg	mg/liter	mg/liter		
Total Organic Carbon *	150000	< 1000	< 100		

Type Assessment, based only on results and not detection limits

Highest Total Concentration Value		≤ TCT1
Highest Leachable Concentration Value	excluding Boron from the Borax leaches	≤ LCT 1
Final Waste Type Classification		Type 3

Authorized Signatory

H. Richter

sanas Testing Laboratory T0419

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NR – Not Requested
RTF – Results to Follow
BDL – Below Detection Limit (Please note that if the results for an analyte is below our detection limit, it does not indicate that the sample is clean or that the analyte result is equal to zero.)
Storage Conditions in the Laboratory: Fridge @ <6 ºC

UIS SEDIBA LABORATORY

Analysis Report

Client Information

Company: IX Engineers
Attention: Gerrie Le Roux
Tel: 012 745 2000
Fax:
Address: 270 Lynwood Service road
Lynnwood Ridge
Pretoria, 0081

Lab No: 24178

Test Information: *Waste Assesment for Disposal, GNR 635 (Gazette No. 36784)*
Australian Standard Leaching
AS4439 - 1997 , ICP-OES/MS and IC

Date Received: 2019/05/15
Date Completed: 2019/06/25
Date Issued: 2019/08/01

Sample Information
Matrix: Solid Composite - TCLP and Borax Leaches
Sample ID: Composite 2: Bridge 1
Ref No: Vulindlela Sediment Desilt Sampling

Parameters	Results			TCT	LCT
	Solids	TCLP	Borax		
pH - Leach Fluid	N/A	4.93	9.38		
PH - Sample	6.68	4.97	9.37		
Metal Ions	mg/kg *	mg/liter *	mg/liter *		
As - Arsenic *	3.97	< 0.01	< 0.01	< TCT0	= LCT0
B - Boron *	54.1	< 0.02	867	< TCT0	> LCT3
Ba - Barium *	40.1	0.39	0.03	< TCT0	< LCT0
Cd - Cadmium *	< 3.2	< 0.003	< 0.003	< TCT0	= LCT0
Co - Cobalt *	5.64	0.03	< 0.02	< TCT0	< LCT0
Cr Total - Chromium Total *	46.55	0.04	0.08	< TCT0	< LCT0
Cr (VI) - Chromium (VI) *	< 2	< 0.05	< 0.05	< TCT0	= LCT0
Cu - Copper *	9.28	0.03	0.02	< TCT0	< LCT0
Hg - Mercury *	< 0.16	< 0.002	0.0051	< TCT0	< LCT0
Mn - Manganese *	82.94	< 0.01	< 0.02	< TCT0	< LCT0
Mo - Molybdenum *	< 6.4	< 0.07	< 0.07	< TCT0	= LCT0
Ni - Nickel *	11.74	< 0.02	< 0.02	< TCT0	< LCT0
Pb - Lead *	19	< 0.01	< 0.01	< TCT0	= LCT0
Sb - Antimony *	< 3.2	0.0158	0.017	< TCT0	< LCT0
Se - Selenium *	4.32	< 0.01	< 0.01	< TCT0	= LCT0
V - Vanadium *	32.9	< 0.02	0.07	< TCT0	< LCT0
Zn - Zinc *	24.44	0.29	0.04	< TCT0	< LCT0
Anions	mg/kg *	mg/liter	mg/liter		
Fluoride - F	< 4	< 0.5	< 0.5	< TCT0	< LCT0
Chloride - Cl	N/A	< 20	< 20	N/A	< LCT0
Nitrate as NO3	N/A	< 22.2	< 22.2	N/A	N/A
NO3 as N	N/A	< 5	< 5	N/A	< LCT0
Sulphate - SO4	N/A	< 20	< 20	N/A	< LCT0
CN - Total Cyanide *	< 0.1	< 0.07	< 0.07	< TCT0	= LCT0
Total Dissolved Solids	mg/kg	mg/liter	mg/liter		
TDS	N/A	267	673	N/A	< LCT0

Authorized Signatory

C. Swanepoel

sanas Testing Laboratory T0584

Disclaimer:

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NR – Not Requested
RTF – Results to Follow
BDL – Below Detection Limit (Please note that if the results for an analyte is below our detection limit, it does not indicate that the sample is clean or that the analyte result is equal to zero.)
Storage Conditions in the Laboratory: Fridge @ <6 ºC

UIS ORGANIC LABORATORY

Analysis Report

Client Information

Company: IX Engineers
Attention: Gerrie Le Roux
Tel: 012 745 2000
Fax:
Address: 270 Lynwood Service road
Lynnwood Ridge
Pretoria, 0081

Lab No: 24178

Test Information: *Waste Assesment for Disposal, GN R. 635 (Gazette No. 36784)*
Australian Standard Leaching
AS4439 - 1997 , SPME Extraction & GC/MS

Date Received: 2019/05/15
Date Completed: 2019/05/27
Date Issued: 2019/08/01

Sample Information
Matrix: Solid Composite - TCLP and Borax Leaches
Sample ID: Composite 2: Bridge 1
Ref No: Vulindlela Sediment Desilt Sampling

Parameters		Results			TCT	LCT
		Solids ug/kg	TCLP ug/liter	Borax ug/liter		
VOC's	**Dilution**	**X20**	**X1**	**X1**		
Benzene		< 20	< 1	< 1	< TCT1	< LCT1
Carbon Tetrachloride		< 100	< 5	< 5	< TCT1	< LCT1
Chlorobenzene		< 40	< 2	< 2	< TCT1	< LCT1
Chloroform		< 100	< 5	< 5	< TCT1	< LCT1
1,2-Dichlorobenzene		< 40	< 2	< 2	< TCT1	< LCT1
1,4-Dichlorobenzene		< 40	< 2	< 2	< TCT1	< LCT1
1,2-Dichloroethane		< 40	< 2	< 2	< TCT1	< LCT1
Ethylbenzene		< 40	< 2	< 2	< TCT1	< LCT1
Hexachlorobutadiene		< 40	< 2	< 2	< TCT1	< LCT1
MTBE		< 100	< 5	< 5	< TCT1	< LCT1
Styrene		< 100	< 5	< 5	< TCT1	< LCT1
1,1,1,2-Tetrachloroethane		< 200	< 10	< 10	< TCT1	< LCT1
1,1,2,2-Tetrachloroethane		< 200	< 10	< 10	< TCT1	< LCT1
Toluene		< 200	< 10	< 10	< TCT1	< LCT1
1,1,1-Trichloroethane		< 100	< 5	< 5	< TCT1	< LCT1
1,1,2-Trichloroethane		< 100	< 5	< 5	< TCT1	< LCT1
Xylenes total		< 100	< 5	< 5	< TCT1	< LCT1
Trichlorobenzene (Total)		< 100	< 5	< 5	< TCT1	< LCT1
Dichloromethane		< 1000	< 50	< 50	< TCT1	< LCT1
1,1-Dichloroethylene		< 200	< 10	< 10	< TCT1	< LCT1
1,2-Dichloroethylene		< 200	< 10	< 10	< TCT1	< LCT1
Tetrachloroethylene		< 200	< 10	< 10	< TCT1	< LCT1
Trichloroethylene		< 200	< 10	< 10	< TCT1	< LCT1
TPH	**Dilution**	**X1**	**X1**	**X1**		
Petroleum H/Cs,C6-C9		< 200	< 10	< 10	< TCT1	N/A
Petroleum H/Cs,C10 to C36		< 38000	1300	1000	< TCT1	N/A
Formaldehyde	**Dilution**	**X10 ***	**X2**	**X2**		
Formaldehyde		< 2000	< 100	< 100	< TCT1	< LCT1

Authorized Signatory

H. Richter

sanas Testing Laboratory T0419

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NR – Not Requested
RTF – Results to Follow
BDL – Below Detection Limit (Please note that if the results for an analyte is below our detection limit, it does not indicate that the sample is clean or that the analyte result is equal to zero.)
Storage Conditions in the Laboratory: Fridge @ <6 °C

UIS ORGANIC LABORATORY

Analysis Report

Client Information

Company: IX Engineers
Attention: Gerrie Le Roux
Tel: 012 745 2000
Fax:
Address: 270 Lynwood Service road
Lynnwood Ridge
Pretoria, 0081

Lab No: 24178

Test Information: *Waste Assesment for Disposal, GN R. 635 (Gazette No. 36784)*
Australian Standard Leaching
AS4439 - 1997 , SPME Extraction & GC/MS

Date Received: 2019/05/15
Date Completed: 2019/05/27
Date Issued: 2019/08/01

Sample Information
Matrix: Solid Composite - TCLP and Borax Leaches
Sample ID: Composite 2: Bridge 1
Ref No: Vulindlela Sediment Desilt Sampling

Parameters		Results			TCT	LCT
		Solids	TCLP	Borax		
		ug/kg	ug/liter	ug/liter		
SVOCs	**Dilution**	**X20 ***	**X10**	**X10**		
Benzo(a)pyrene *		< 2	< 1	< 1	< TCT1	< LCT1
Di (2 ethylhexyl) Phthalate *		< 200	< 100	< 100	< TCT1	< LCT1
Nitrobenzene *		< 200	< 10	< 10	< TCT1	< LCT1
2,4 Dinitrotoluene *		< 1000	< 50	< 50	< TCT1	< LCT1
Total PAH's		< 40	< 200	< 200	< TCT1	N/A
PHENOLS	**Dilution**	**X200**	**X10**	**X10**		
2-Chlorophenol *		< 400	< 20	< 20	< TCT1	< LCT1
2,4-Dichlorophenol *		< 400	< 20	< 20	< TCT1	< LCT1
2,4,6-Trichlorophenol *		< 400	< 20	< 20	< TCT1	< LCT1
Phenols Speciated (total,non-halogenated) *		< 4000	< 200	< 200	< TCT1	< LCT1
Pesticides	**Dilution**	**X200**	**X10**	**X10**		
Aldrin *		< 20	< 1	< 1	< TCT0	< LCT1
Dieldrin *		< 20	< 1	< 1	< TCT0	< LCT1
DDT *		< 20	< 1	< 1	< TCT0	< LCT1
DDE *		< 20	< 1	< 1	< TCT0	< LCT1
DDD *		< 20	< 1	< 1	< TCT0	< LCT1
Heptachlor *		< 20	< 1	< 1	< TCT0	< LCT1
Chlordane *		< 20	< 1	< 1	< TCT0	< LCT1
2,4 Dichlorophenoxyacetic Acid			Unable to Detect		UTD	UTD
Polychlorinated Biphen	**Dilution**	**X1**	**X10**	**X10**		
Ballsmitters Totals *		< 350	< 10	< 10	< TCT1	< LCT1
Polars	**Dilution**	**X20**	**X1**	**X1**		
Methyl Ethyl Ketone (2-Butanone) *		< 2000	< 100	< 100	< TCT1	< LCT1
Vinyl Chloride *		< 20	< 1	< 1	< TCT1	< LCT1
		mg/kg	mg/liter	mg/liter		
Total Organic Carbon *		27000	< 1000	< 100		

Type Assessment, based only on results and not detection limits

Highest Total Concentration Value		≤ TCT 1
Highest Leachable Concentration Value	excluding Boron from the Borax leaches	≤ LCT 1
Final Waste Type Classification		Type 4

Authorized Signatory

H. Richter

sanas Testing Laboratory T0419

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RTF – Results to Follow
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Storage Conditions in the Laboratory: Fridge @ <6 ºC

UIS SEDIBA LABORATORY

Client Information

Company: IX Engineers
Attention: Gerrie Le Roux
Tel: 012 745 2000
Fax:
Address: 270 Lynwood Service road
Lynnwood Ridge
Pretoria, 0081

Analysis Report

Lab No: 24178

Test Information: *Waste Assesment for Disposal, GNR 635 (Gazette No. 36784)*
Australian Standard Leaching
AS4439 - 1997 , ICP-OES/MS and IC

Date Received: 2019/05/15
Date Completed: 2019/06/25
Date Issued: 2019/08/01

Sample Information
Matrix: Solid Composite - TCLP and Borax Leaches
Sample ID: Composite 3: Bridge 2
Ref No: Vulindlela Sediment Desilt Sampling

Parameters	Results			TCT	LCT
	Solids	TCLP	Borax		
pH - Leach Fluid	N/A	4.93	9.38		
PH - Sample	7.22	5.03	9.37		
Metal Ions	mg/kg *	mg/liter *	mg/liter *		
As - Arsenic *	4.08	< 0.01	< 0.01	< TCT0	= LCT0
B - Boron *	< 40	< 0.02	1401	< TCT0	> LCT3
Ba - Barium *	55.05	0.39	0.06	< TCT0	< LCT0
Cd - Cadmium *	< 4	< 0.003	< 0.003	< TCT0	= LCT0
Co - Cobalt *	5.89	< 0.02	< 0.02	< TCT0	< LCT0
Cr Total - Chromium Total *	34.88	0.04	0.05	< TCT0	< LCT0
Cr (VI) - Chromium (VI) *	< 2	< 0.05	< 0.05	< TCT0	= LCT0
Cu - Copper *	17.27	< 0.02	0.04	< TCT1	< LCT0
Hg - Mercury *	< 0.16	0.0025	< 0.005	< TCT0	< LCT0
Mn - Manganese *	118.9	1.46	< 0.02	< TCT0	< LCT1
Mo - Molybdenum *	< 8	< 0.07	< 0.07	< TCT0	= LCT0
Ni - Nickel *	10.51	< 0.02	< 0.02	< TCT0	< LCT0
Pb - Lead *	16.55	< 0.01	< 0.01	< TCT0	= LCT0
Sb - Antimony *	< 4	< 0.009	0.0154	< TCT0	< LCT0
Se - Selenium *	< 8	< 0.01	0.01	< TCT0	= LCT0
V - Vanadium *	31.89	< 0.02	0.08	< TCT0	< LCT0
Zn - Zinc *	44.18	0.25	0.06	< TCT0	< LCT0
Anions	mg/kg *	mg/liter	mg/liter		
Fluoride - F	< 4	< 0.5	0.6	< TCT0	< LCT0
Chloride - Cl	N/A	< 20	< 20	N/A	< LCT0
Nitrate as NO3	N/A	< 22.2	< 22.2	N/A	N/A
NO3 as N	N/A	< 5	< 5	N/A	< LCT0
Sulphate - SO4	N/A	< 20	< 20	N/A	< LCT0
CN - Total Cyanide *	< 0.1	< 0.07	< 0.07	< TCT0	= LCT0
Total Dissolved Solids	mg/kg	mg/liter	mg/liter		
TDS	N/A	465	15	N/A	< LCT0

Authorized Signatory

C. Swanepoel

sanas Testing Laboratory T0584

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RTF – Results to Follow
BDL – Below Detection Limit (Please note that if the results for an analyte is below our detection limit, it does not indicate that the sample is clean or that the analyte result is equal to zero.)
Storage Conditions in the Laboratory: Fridge @ <6 ºC

UIS ORGANIC LABORATORY

Analysis Report

Client Information

Company: IX Engineers
Attention: Gerrie Le Roux
Tel: 012 745 2000
Fax:
Address: 270 Lynwood Service road
Lynnwood Ridge
Pretoria, 0081

Lab No: 24178

Test Information: *Waste Assesment for Disposal, GN R. 635 (Gazette No. 36784)*
Australian Standard Leaching
AS4439 - 1997 , SPME Extraction & GC/MS

Date Received: 2019/05/15
Date Completed: 2019/05/27
Date Issued: 2019/08/01

Sample Information
Matrix: Solid Composite - TCLP and Borax Leaches
Sample ID: Composite 3: Bridge 2
Ref No: Vulindlela Sediment Desilt Sampling

Parameters		Results			TCT	LCT
		Solids ug/kg	TCLP ug/liter	Borax ug/liter		
VOC's	**Dilution**	**X20**	**X1**	**X1**		
Benzene		< 20	< 1	< 1	< TCT1	< LCT1
Carbon Tetrachloride		< 100	< 5	< 5	< TCT1	< LCT1
Chlorobenzene		< 40	< 2	< 2	< TCT1	< LCT1
Chloroform		< 100	< 5	< 5	< TCT1	< LCT1
1,2-Dichlorobenzene		< 40	< 2	< 2	< TCT1	< LCT1
1,4-Dichlorobenzene		< 40	< 2	< 2	< TCT1	< LCT1
1,2-Dichloroethane		< 40	< 2	< 2	< TCT1	< LCT1
Ethylbenzene		< 40	< 2	< 2	< TCT1	< LCT1
Hexachlorobutadiene		< 40	< 2	< 2	< TCT1	< LCT1
MTBE		< 100	< 5	< 5	< TCT1	< LCT1
Styrene		< 100	< 5	< 5	< TCT1	< LCT1
1,1,1,2-Tetrachloroethane		< 200	< 10	< 10	< TCT1	< LCT1
1,1,2,2-Tetrachloroethane		< 200	< 10	< 10	< TCT1	< LCT1
Toluene		< 200	< 10	< 10	< TCT1	< LCT1
1,1,1-Trichloroethane		< 100	< 5	< 5	< TCT1	< LCT1
1,1,2-Trichloroethane		< 100	< 5	< 5	< TCT1	< LCT1
Xylenes total		< 100	< 5	< 5	< TCT1	< LCT1
Trichlorobenzene (Total)		< 100	< 5	< 5	< TCT1	< LCT1
Dichloromethane		< 1000	< 50	< 50	< TCT1	< LCT1
1,1-Dichloroethylene		< 200	< 10	< 10	< TCT1	< LCT1
1,2-Dichloroethylene		< 200	< 10	< 10	< TCT1	< LCT1
Tetrachloroethylene		< 200	< 10	< 10	< TCT1	< LCT1
Trichloroethylene		< 200	< 10	< 10	< TCT1	< LCT1
TPH	**Dilution**	**X1**	**X1**	**X1**		
Petroleum H/Cs,C6-C9		< 200	< 10	< 10	< TCT1	N/A
Petroleum H/Cs,C10 to C36		< 38000	< 382	1100	< TCT1	N/A
Formaldehyde	**Dilution**	**X10 ***	**X2**	**X2**		
Formaldehyde		< 2000	< 100	< 100	< TCT1	< LCT1

Authorized Signatory

H. Richter

sanas Testing Laboratory T0419

Disclaimer:

The above-mentioned sample/s were analysed as received by the laboratory on the date stated above. UIS Organic laboratory takes no responsibility for sample/s prior to submission: this includes sampling, sample container, storage and shipping to our testing facility. The sample is analysed per customer request for analysis.

Analysis mark with (*), have been outsourced.
UTD – Unable to Determine
NR – Not Requested
RTF – Results to Follow
BDL – Below Detection Limit (Please note that if the results for an analyte is below our detection limit, it does not indicate that the sample is clean or that the analyte result is equal to zero.)
Storage Conditions in the Laboratory: Fridge @ <6 °C

UIS ORGANIC LABORATORY

Analysis Report

Client Information

Company: IX Engineers
Attention: Gerrie Le Roux
Tel: 012 745 2000
Fax:
Address: 270 Lynwood Service road
Lynnwood Ridge
Pretoria, 0081

Lab No: 24178

Test Information: *Waste Assesment for Disposal, GN R. 635 (Gazette No. 36784)*
Australian Standard Leaching
AS4439 - 1997 , SPME Extraction & GC/MS

Date Received: 2019/05/15
Date Completed: 2019/05/27
Date Issued: 2019/08/01

Sample Information
Matrix: Solid Composite - TCLP and Borax Leaches
Sample ID: Composite 3: Bridge 2
Ref No: Vulindlela Sediment Desilt Sampling

Parameters		Results			TCT	LCT
		Solids	TCLP	Borax		
		ug/kg	ug/liter	ug/liter		
SVOCs	**Dilution**	**X20 ***	**X10**	**X1**		
Benzo(a)pyrene *		< 2	< 1	< 1	< TCT1	< LCT1
Di (2 ethylhexyl) Phthalate *		< 200	< 100	< 100	< TCT1	< LCT1
Nitrobenzene *		< 200	< 10	< 10	< TCT1	< LCT1
2,4 Dinitrotoluene *		< 1000	< 50	< 50	< TCT1	< LCT1
Total PAH's		< 40	< 200	< 200	< TCT1	N/A
PHENOLS	**Dilution**	**X200**	**X10**	**X10**		
2-Chlorophenol *		< 400	< 20	< 20	< TCT1	< LCT1
2,4-Dichlorophenol *		< 400	< 20	< 20	< TCT1	< LCT1
2,4,6-Trichlorophenol *		< 400	< 20	< 20	< TCT1	< LCT1
Phenols Speciated (total,non-halogenated) *		< 4000	< 200	< 200	< TCT1	< LCT1
Pesticides	**Dilution**	**X200**	**X10**	**X10**		
Aldrin *		< 20	< 1	< 1	< TCT0	< LCT1
Dieldrin *		< 20	< 1	< 1	< TCT0	< LCT1
DDT *		< 20	< 1	< 1	< TCT0	< LCT1
DDE *		< 20	< 1	< 1	< TCT0	< LCT1
DDD *		< 20	< 1	< 1	< TCT0	< LCT1
Heptachlor *		< 20	< 1	< 1	< TCT0	< LCT1
Chlordane *		< 20	< 1	< 1	< TCT0	< LCT1
2,4 Dichlorophenoxyacetic Acid			Unable to Detect		UTD	UTD
Polychlorinated Biphen	**Dilution**	**X1**	**X10**	**X10**		
Ballsmitters Totals *		< 350	< 10	< 10	< TCT1	< LCT1
Polars	**Dilution**	**X20**	**X1**	**X1**		
Methyl Ethyl Ketone (2-Butanone) *		< 2000	< 100	< 100	< TCT1	< LCT1
Vinyl Chloride *		< 20	< 1	< 1	< TCT1	< LCT1
		mg/kg	mg/liter	mg/liter		
Total Organic Carbon *		110000	< 1000	< 100		

Type Assessment, based only on results and not detection limits

Highest Total Concentration Value		≤ TCT1
Highest Leachable Concentration Value	excluding Boron from the Borax leaches	≤ LCT 1
Final Waste Type Classification		Type 3

Authorized Signatory

H. Richter

sanas Testing Laboratory T0419

Disclaimer:

The above-mentioned sample/s were analysed as received by the laboratory on the date stated above. UIS Organic laboratory takes no responsibility for sample/s prior to submission: this includes sampling, sample container, storage and shipping to our testing facility. The sample is analysed per customer request for analysis.

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Storage Conditions in the Laboratory: Fridge @ <6 ºC

APPENDIX C

UIS SANAS ACCREDITATION

sanas
South African National Accreditation System

CERTIFICATE OF ACCREDITATION

In terms of section 22(2) (b) of the Accreditation for Conformity Assessment, Calibration and Good Laboratory Practice Act, 2006 (Act 19 of 2006), read with sections 23(1), (2) and (3) of the said Act, I hereby certify that:-

UIS ORGANIC LABORATORY (PTY) LTD

Co. Reg. No.: 2007/001896/07

Facility Accreditation Number: **T0419**

is a South African National Accreditation System accredited Testing laboratory provided that all SANAS conditions and requirements are complied with

This certificate is valid as per the scope as stated in the accompanying schedule of accreditation Annexure "A", bearing the above accreditation number for

CHEMICAL ANALYSIS

The facility is accredited in accordance with the recognised International Standard

ISO/IEC 17025:2005

The accreditation demonstrates technical competency for a defined scope and the operation of a laboratory quality management system

While this certificate remains valid, the Accredited Facility named above is authorised to use the relevant SANAS accreditation symbol to issue facility reports and/or certificates

Mr M Phaloane
Acting Chief Executive Officer

Effective Date: 05 October 2014
Certificate Expires: 04 October 2019

APPENDIX D

MATERIAL SAFETY DATA SHEET

Safety Data Sheet

Vulindlela Sediment

Section 1: Identification

Product Name:	Desilt / Sediment Waste : Vulindlela Bridge Maintenance and desilting project
Synonyms:	None
CAS Number:	Not Applicable
EC Number:	Not Applicable
Product Use:	None
Company Identification:	
Emergency Telephone Number:	Papa Mkhabela, Project Manager, Sasol Mining
	Tel +27 17 614 3016
	Fax +27 11 219 3172
	Mobile +27 79 505 8023

Section 2: Hazard(s) Identification

Classification per SANS 10234 (GHS), CLP and (EC) No 1272/2008:

Physical Hazard: **Not Classified**

Health Hazard: **Carcinogenic Category 1A**

STOT-RE Category 1

Aquatic Hazard: **Not Classified**

Pictogram:

Signal Word: **Danger**

Hazard Statement:

H303	May be Harmful if Swallowed (Due to Faecal Coliforms)
H350	May Cause Cancer, due to inhalation
H372	Causes damage to lungs through prolonged or repeated exposure via inhalation.

Precautionary Statement:

P260	Do not breath dust
P262	Do not get in eyes, on skin, or on clothing
P264	Wash skin and clothes thoroughly after handling, where and if spills occurred.
P270	Do not eat drink or smoke when handling the sediment
P363	Wash contaminated clothing before reuse
P305+P351+P338	If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses if present, and easy to do. Continue rinsing.

Section 3: Composition and Information on Ingredients

Element	Cas No	XRF (%)	XRD (%)
Iron (Fe)	7439-89-6	3.78	1.02
Silicon (Si)	7440-21-3	39.44	44.2
Aluminium (Al)	7429-90.5	2.30	1.1
Potassium (K)	7440-09-7	0.17	0.08
Phosphorus (P)	7723-14-0	0.04	N/A
Manganese (Mn)	7439-96-5	0.17	N/A
Calcium (Ca)	7440-70-2	0.71	0.27
Magnesium (Mg)	7439-95-4	0.15	0.2

Titanium (Ti)	7440-32-6	0.19	N/A
Vanadium (V)	7440-62-2	0.01	N/A
Barium (Ba)	7440-39-3	0.02	N/A
Chromium (Cr)	7440-47-3	0.10	N/A
Strontium (Sr)	7440-24-6	0.01	N/A
Zirconium (Zr)	7440-67-7	0.02	N/A
Sulphur (S)	7704-34-9	0.00	0.15
Lead (Pb)	7439-92-1	0.01	N/A
Zinc (Zn)	7440-66-6	0.01	N/A
Oxide		49.3	52.3
Other (% unless stated otherwise)			
Carbon	0.98		
Sulphur	0.046		
TOM	57.21		
Moisture	14.89		
Total Volatiles	20.29		
Faecal Coliforms	452 1g dry weight		
E. coli	325 1g dry weight		

XRD Species	Percentage (%)
Quartz	93.2
Kaolinite	2.1
Goethite	1.4
Spinel	1.2
Muscovite	0.8
Gypsum	0.8
Calcite	0.2
Hematite	0.2

Section 4: First Aid Measures

Eye Contact: Do not rub eyes. Thoroughly wash out the opened eye/s with plenty of water for at least 15 min. Remove contact lenses if it's easy to do so and continue rinsing the eyes. Consult a doctor.

Inhalation: Move into fresh air and consult a doctor if necessary. If not breathing give artificial respiration or oxygen by a qualified person.

Skin contact: Wash off with plenty of soap and water, consult a doctor if necessary. Remove any contaminated clothing.

Ingestion: Rinse out the mouth and drink plenty of water. Consult a doctor. Never induce vomiting.

Most important symptoms and effects, both acute and delayed:
The sediment consists mainly of Quarts which is carcinogenic. Chronic exposure to quartz dust can also lead to lung damage, such as inflammation or silicosis.

Indication of any immediate medical attention and special treatment needed:
Consult a doctor, you may need to be treated for diarrhoea or bloody diarrhoea, due to faecal contamination.

Section 5: Fire Fighting Measures

Suitable extinguishing media:
Use extinguishing media appropriate to surroundings.

Unsuitable extinguishing media:
None identified.

Special Hazards arising from the substance or mixture:
Do not create dust.

Advice to firefighters and protective equipment:
Wear a self-contained breathing apparatus with full protective clothing to prevent contact with skin and eyes.

Section 6 – Accidental Release Measures

Personal Precaution:
Wear personal protective clothing including a respiratory mask, to prevent inhaling dust. Wash with soap and water after handling the sediment. Remove contaminated clothing immediately after spilling and rinse skin. For further information, see Section 8.

Emergency Procedure:
Immediately isolate the spill and prevent further leakage or spillage. Keep un authorized personnel or bystanders away from the spill.

Environmental Precaution:
Prevent entry of spilled product into waterbodies, waterways or confined areas.

Methods for Clean up:
It can be shovelled up into labelled containers but wet it first if its dry. This is to limit dust creation and breathing in quartz dust.

Other Information: See Section 13 for disposal Considerations.

Section 7 – Handling and Storage

Precautions for safe handling:

Use respiratory masks with dust filters and other personal protective equipment and clothing, such as gloves and safety glasses. Do not smoke, drink or eat while handling the product.

After working with the sediment ensure you wash your hands before eating, drinking or smoking.

Conditions for safe storage, including any incompatibilities:

Store in a well-ventilated area. Ensure that the containers are tightly sealed, and correctly labelled, if applicable. Ensure no unauthorised entry.

Section 8 – Exposure Controls and Personal protection

Components Occupational Exposure limit:

Particulates not otherwise regulated – Total Dust
OSHA PEL: TWA 10 mg/m^3 (total) TWA 5 mg/m^3 (respirable)
General Industry - TWA 15 mg/m^3
Construction Industry – TWA 15 mg/m^3
NIOSH REL: TWA 10 mg/m^3 (total) TWA 5 mg/m^3 (resp)
ACGIH Guideline: TWA 10 mg/m^3 (Inhalable Particles)

Quartz (Crystalline Silica) [CAS No: 14808-60-7]
OSHA PEL: TWA 0.1 mg/m^3
NIOSH REL: TWA 0.05 mg/m^3
ACGIH Guideline: TLV-TWA - 0.025 mg/m3 (Respirable particulate matter)

Information from the REACH Dossier (ECHA Website):

The Derived No- or Minimal Effect Level (DN(M)EL), is the level above which a human should not be exposed to a substance. The information below is for constituents of the waste stream.

Aluminium [CAS No: 7429-90-5]

Workers			**General Population**		
Inhalation	**Threshold**	**Most Sensitive study**	**Inhalation**	**Threshold**	**Most Sensitive study**
Systemic Effects			Systemic Effects		
Long Term	(DNEL) 3.72 mg/m^3	Repeated Dose Toxicity	**Long Term**	No Data	No Data
Acute/Short Term	No Identified Hazard	No Data	**Acute/Short Term**	No Data	No Data
Local Effects			Local Effects		
Long Term	(DNEL) 3.72 mg/m^3	Repeated Dose Toxicity	**Long Term**	No Data	No Data
Acute/Short Term	No Data	No Data	**Acute/Short Term**	No Data	No Data
Dermal	**Threshold**	**Most Sensitive study**	**Dermal**	**Threshold**	**Most Sensitive study**
Systemic Effects			Systemic Effects		
Long Term	No Data	No Data	**Long Term**	No Data	No Data
Acute/Short Term	No Data	No Data	**Acute/Short Term**	No Data	No Data
Local Effects			Local Effects		
Long Term	No Data	No Data	**Long Term**	No Data	No Data
Acute/Short Term	No data	No Data	**Acute/Short Term**	No Data	No Data
Oral	**Threshold**	**Most Sensitive study**	**Oral**	**Threshold**	**Most Sensitive study**
Systemic Effects			Systemic Effects		
Long Term	No Data	No Data	**Long Term**	(DNEL) 3.95 mg/kg bw/day	Repeated Dose Toxicity
Acute/Short Term	No Data	No Data	**Acute/Short Term**	No Identified Hazard	No Data
Local Effects			Local Effects		
Long Term	No Data	No Data	**Long Term**	No Data	No Data
Acute/Short Term	No Data	No Data	**Acute/Short Term**	No Data	No Data

Iron [CAS No. 7439-89-6]

No hazards have been identified by EHCH, REACH Dossier.

Engineering Controls:
No Specific engineering controls.

Personal Protection:
Avoid contact with skin, eyes and clothing. Use safety glasses (preferably with side shields), dust coat/overall and gloves when handling the waste stream. Respiration masks should be NIOSH certified, equipped with an N100, R100 or P100 filter, or P2 (EN 143) equivalent (OSHA 29 CRF 1910.134). All PPE must be approved under standards such as OSHA 29 CFR 1910.132 or EU directive 89/686/EEC.

Section 9 - Physical and Chemical Properties

Appearance	Muddy course heterogenous sand
Colour	Brown with white and black particles
Odour	Wer sand smell
pH	7.35
Melting Point	< -8 °C
Boiling Point	Not Applicable
Flash Point	Not Available
Evaporation Rate	Not Applicable
Flammability	Not Flammable
Upper/Lower explosion limits	Not AExplosive
Vapour Pressure	Not Available
Bulk Density	1744 kg/m^3
Relative Density	Not Determined
Solubility in Water	Not Soluble
Partition Coefficient: n-octanol/water	Not Determined
Auto-ignition temperature	> 1200 °C
Decomposition temperature	> 1200 °C

Oxidising Properties	Not Oxidising
Pyrophoricity	Not Pyrophoric

Section 10 – Stability and Reactivity

Reactivity:
None known.

Stability:
Stable under normal conditions, ensure no unauthorised entry.

Possibility of Hazardous Reactions:
None Known

Conditions to Avoid:
Generating Dust

Incompatible Materials:
Strong oxidizing agents.

Hazardous Decomposition Products:
None Known

Corrosivity:
Quartz is not corrosive to metals, it also does not attack plastic.

Section 11 – Toxicological information

The Health Hazards are estimated from bio-elution analysis.

a) **Acute Toxicity**

Oral:	**Not Classified**
Dermal:	**Not Classified**
Inhalation:	**Not Classified**

Likely routes of exposure: Inhalation of dust.

Target Organs: Respiratory System

b)	**Skin Corrosion/irritation:**	Not Classified
c)	**Serious eye Damage/irritation:**	Not Classified
d)	**Respiratory and Skin Sensation:**	Not Classified
e)	**Germ Cell Mutagenicity:**	Not Classified
f)	**Carcinogenicity:**	Category 1A
g)	**Reproductive Toxicity:**	Not Classified
h)	**Specific Target organ Toxicity – Single Exposure:**	Not Classified
i)	**Specific Target organ Toxicity – Repeated Exposure:**	Category 1
j)	**Aspiration hazard:**	Not Classified

Additional Information:

Pathogens in this waste stream may present a risk.

Section 12 – Ecological Information

This product was tested at Biotox laboratory Services (PTY) LTD, and the results are displayed below. In addition, Transformation/Dissolution tests were also done, estimate the dangers of metal and heavy metal compounds in this waste stream.

	Results	Vulindlela Sediment
Water quality	pH @ 25°C (A)	7.2
	EC (Electrical conductivity) (mS/m) @ 25°C (A)	25.3
	Dissolved oxygen (mg/l) (NA)	7.0
	Chemical oxygen demand (COD) (total) as O2 (OS)	<10
	Biological oxygen demand (BOD) (mg/l) as O2 (OS)	<10
S. capricomutum (micro-algae) (A)	Test started on yy/mm/dd	19/06/04
	%72hour inhibition (-) / stimulation (+) (%)	34
	EC/LC20 (72hours)	n.r.
	EC/LC50 (72hours)	n.r.
	Toxicity unit (TU) / Description	<1
D. magna (waterflea) (A)	Test started on yy/mm/dd	19/05/27
	%48hour mortality rate (-%)	-5
	EC/LC10 (48hours)	n.r.
	EC/LC50 (48hours)	n.r.
	Toxicity unit (TU) / Description	<1
P. reticulata (guppy) (A)	Test started on yy/mm/dd	19/05/23
	%96hour mortality rate (-%)	0
	EC/LC10 (96hours)	n.r.
	EC/LC50 (96hours)	n.r.
	Toxicity unit (TU) / Description	<1
Estimated safe dilution factor (%) [for definitive testing only]		**None Required**
Overall classification - Hazard class***		Class I - No acute/short-chronic hazard
Weight (%)		0

The above Toxicity is based on the Direct Estimate of Ecological Effect Potential (DEEEP) Protocol.

Acute Aquatic Toxicity: **Not Classified**

Chronic Aquatic Toxicity: **Not Classified**

Persistence and Degradability: Not analysed, but not expected

Bio accumulative potential: Not analysed

Mobility in soil: Not analysed

Other Adverse effects: None known

Section 13 – Disposal Considerations

Disposal should comply with the waste disposal legislation (GN R. 634, 635 and 636) as well as any other municipal regulations. This waste stream should be disposed at a Class C landfill, since it's a Type 3 Waste.

Section 14 – Transport Information

UN Number:	None Known for the waste
UN Proper Shipping Name:	None Known
Transport Hazard Class:	None Known
Environmental hazard:	None Known
Special Precaution for User:	Wear proper personal protective equipment (PPE) when handling the sediment

Section 15 – Regulatory Information

Sediment is not listed in SANS 10234a of 2008, however compounds within the sediment may be listed. Estimations were done in accordance with SANS 10234 to access the hazards, if it were not tested.

Section 16 – Any other Relevant information

Date of issue:	1ste Issue; 1 August 2019
Compiled by:	UIS Organic Laboratory (Pty) Ltd, Hugonette Richter

To be noted:

The information contained in this SDS is based upon data considered to be accurate at the time of preparation. UIS Organic Laboratory (Pty) Ltd, has taken reasonable care in the preparation of this SDS, however it assumes no responsibility or liability to the accuracy as

well as the suitability of the information, for any consequences of its use. Since regulatory standards and guideline recommendations are revised on a continues basis, UIS Organic Laboratory cannot insure that the information contained in this SDS will be current at the time of use.

Abbreviations:

C:	Under exposure limits, the C stands for ceiling. A ceiling value should not be exceeded at any time.
IC_{50}:	Inhibitor Concentration
LDL_0:	Lowest Published Toxic Dose
LD50:	Lethal Dose, 50% kill
TCL_0:	Lowest Published Toxic Concentration
TWA:	Time-Weighted Average
ST:	Short Term Exposure Limit
RDT:	Repeated Dose Toxicity
REL:	Recommended Exposure Limits
PEL:	Permissible Exposure Limit
ACGIH:	American Conference of Governmental Industrial Hygienists
NIOSH:	National Institute for Occupational Safety and Health