Leopard Court Building, 1st Floor, South Wing
56 Jerome Street, Lynnwood Glen, Pretoria, South Africa
Tel: +27 (0) 12 348 1114 **Fax:** +27 (0) 12 348 1180 **Web:** www.gcs-sa.biz

CONTAMINATED SITE – SCREENING LEVEL ASSESSMENT

Report

Version – 01

31 October 2017

Alley Roads Mega Projects

GCS Project Number: 17-0538

Client Reference: Grootfontein Rock Stockpiles

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Unit Manager	Pieter de Coning		30 October 2017

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1 INTRODUCTION

The property (Portion 1 Farm Grootfontein Number165-IR and Portion 83 Farm Grootfontein Number 165-IR) hereafter referred to as "the property" is an historic gold mine Vlakfontein. Parts for the property are now operated by the Ekurhuleni Municipality (EM), namely the Electrical Sub-Station, and Concrete Water Reservoir. The property is surrounded by mixed residential developments in the north, east, south and west direction. The property does not have any historic mining infrastructure that still exists on site. However the rehabilitated shaft enclosure is present on the property. The property does however have approximately 70 000m^3 of rock that was stockpiled from the historic mining activities on various locations and at varying heights.

Approximately 1.2km from the property in a south – easterly direction is a quarry and concrete batching plant that is owned and operated by Afrisam. Afrisam is currently systematically removing the rock stockpiles on the property for use in the concrete batching plant.

Alley Roads ("the client") is currently investigating the option of developing the property into a residential development. The client is concerned about any potential environmental and legal liability that might emanate from the historic mining activities on the property.

GCS Environmental Engineering (GCS EE) was appointed to conduct a screening level contaminated site assessment to determine if any possible pollutants are present on the site at levels of concern to the general public. Additionally the screening level investigation will determine if any further investigations are required to determine the suitability of the site for development.

2 SCOPE OF WORK

The soil testing will be for an initial screening testing on the soils on the location of the site to establish any soil contaminants (if any) from historic mining activities on and in close proximity of the site. The screening testing will establish the need for any further testing and remedial actions if any contaminants of concern is found at concentrations of concern.

The assessment focus on soil quality risk indicators as presented by the Soil Screening values as part of the National Environmental Management: Waste Act, Act 59 of 2008 as well as the National Norms and Standards for the Remediation of Contaminated Land and Soil Quality.

GCS will collect and analyse 12 soil samples for metal concentrations. 5 Samples will be analysed for leachable concentrations to determine possible environmental and health risks. In addition the pH, electrical conductivity, and common anions (SO4-S, Cl-, NO3-N and F-) will be included for all 12 samples.

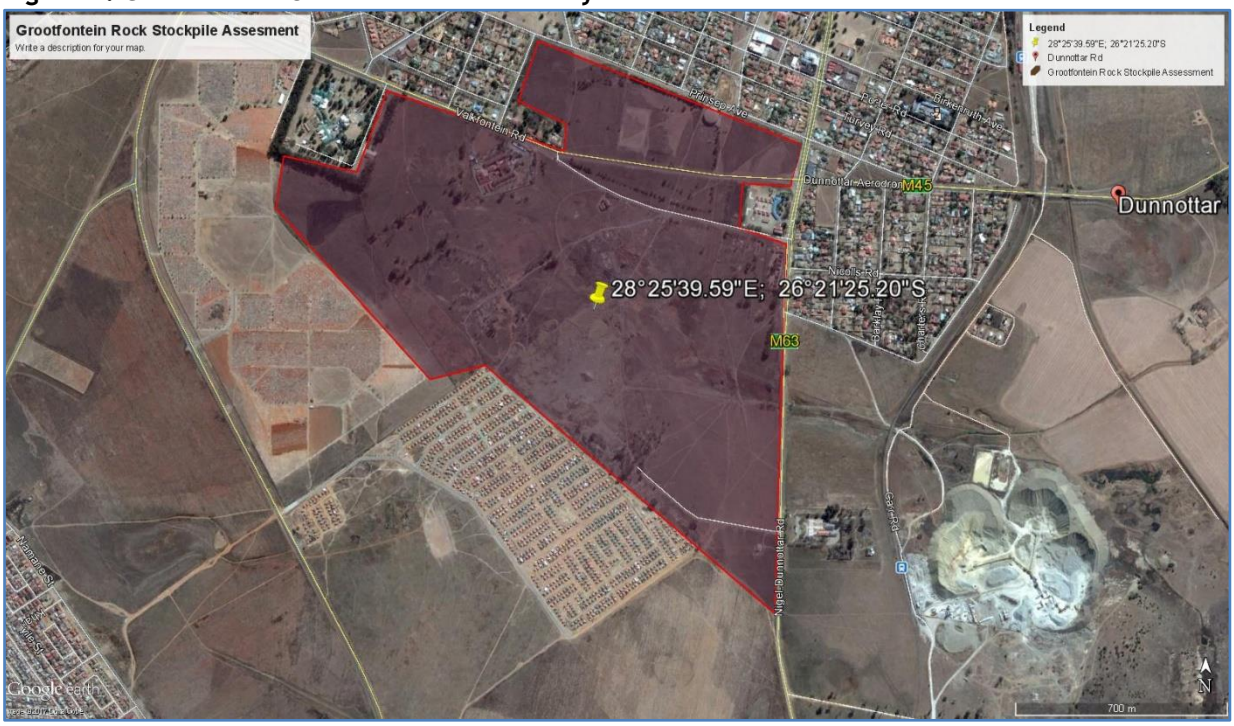
GCS will provide the client with a final report which would include the sampling points and contaminated areas (if any) that will be shown on a map.

3 BACKGROUND INFORMATION

3.1 Site Location and General Description

The property can be located on the M45 Dunnotar Road. The coordinates for the property is 28 28°25'39.59"E; 26°21'25.20"S. The location of the property and area assessed can be seen in the following figure.

Figure 1: Grootfontein Site Assessment Locality



4 LITERATURE REVIEW

4.1 Findings from the Property Valuation

The following statements are made in the Property Valuation Report that are applicable to the assessment of the rock stockpiles on the property:

- The site is encumbered with a range of servitudes, environmental sensitive aspects, possible contaminated land and also potential heritage' sites',
- None of the said servitudes, conditions or issues are so severe as to sterilise the entire property,
- It was confirmed that the land is considered undetermined agricultural land with a 'Special' zoning allocated to the Rock Stockpiles servitude area,

- Based on the Ekurhuleni Growth and Development Strategy (GDS) one of the key priorities is densification and infill in the Mining Belt. Therefore development of the subject land, or those parts of the land not sterilised and providing a realistic development potential, is supported. The land also falls within the Urban Development Boundary and is surrounded by formal townships,
- The main rock dump has been extensively reworked as a road aggregate source since 1995 and is currently serviced by Afrisam who have servitude rights to access the rock stockpiles. Some areas have been cleared to natural ground and are beginning to re-vegetate.

5 LEGISLATION REVIEW

The following legislation was reviewed for the purposes of this assessment:

- National Environmental Management: Waste Act, Act 59 of 2008 (NEMWA),
- National Environmental Management: Waste Amendment Act, Act 26 of 2014 (NEMWAA),
- NEMWA Regulation 331 National Norms and Standards for the Remediation of Contaminated Land and Soil Quality

5.1 NEMWA Definitions Applicable to this Assessment

"Waste" means - (a) any substance, material or object, that is unwanted, rejected, abandoned, discarded or disposed of, or that is intended or required to be discarded or disposed of, by the holder of that substance, material or object, whether or not such substance, material or object can be re-used, recycled or recovered and includes all wastes as defined in Schedule 3 to this Act;

but any waste or portion of waste, referred to in paragraphs (a), ceases to be a waste-

(i) once an application for its re-use, recycling or recovery has been approved or, after such approval, once it is, or has been re-used, recycled or recovered;

(ii) where approval is not required, once a waste is, or has been re-used, recycled or recovered;

"waste disposal facility" means any site or premise used for the accumulation of waste with the purpose of disposing of that waste at that site or on that premise;

"waste management activity" means any activity listed in Schedule 1 or published by notice in the Gazette under section 19, and includes-

(a) the importation and exportation of waste;

(b) the generation of waste, including the undertaking of any activity or process that is likely to result in the generation of waste;

(c) the accumulation and storage of waste;

(d) the collection and handling of waste;

(e) the reduction, re-use, recycling and recovery of waste;

(f) the trading in waste;

(g) the transportation of waste;

(h) the transfer of waster;

(i) the treatment of waste; and

(j) the disposal of waste;

Section 43A. Residue stockpiles and residue deposits

(1) Residue stockpiles and residue deposits must be managed in the prescribed manner on any site demarcated for that purpose in the environmental management plan or environmental management programme for that prospecting, mining, exploration or production operation.

(2) No person may temporarily or permanently deposit any residue stockpile or residue deposit on any site other than on a site contemplated in subsection (1).

Schedule 3: Defined Wastes

Category A: Hazardous Waste

''**hazardous waste**'' means any waste that contains organic or inorganic elements or compounds that may, owing to the inherent physical, chemical or toxicological characteristics of that waste, have a detrimental impact on health and the environment and includes hazardous substances, materials or objects within business waste, residue deposits and residue stockpiles;

"**residue deposits**" means any residue stockpile remaining at the termination, cancellation or expiry of a prospecting right, mining right, mining permit, exploration right or production right;

"residue stockpile" means any debris, discard, tailings, slimes, screening, slurry, waste rock, foundry sand, mineral processing plant waste, ash or any other product derived from or incidental to a mining operation and which is stockpiled, stored or accumulated within the mining area for potential re-use, or which is disposed of, by the holder of a mining right, mining permit or, production right or an old order right, including historic mines and dumps created before the implementation of this Act.

Category B: General Waste

"general waste" means waste that does not pose an immediate hazard or threat to health or to the environment, and includes-

(d) inert waste; or

(e) any waste classified as non-hazardous waste in terms of the regulations made under section 69, and includes non-hazardous substances, materials or objects within business, domestic, inert, building and demolition wastes;

"inert waste" means waste that-

(a) does not undergo any significant physical, chemical or biological transformation after disposal;

(b) does not burn, react physically or chemically biodegrade or otherwise adversely affect any other matter or environment with which it may come into contact; and

(c) does not impact negatively on the environment, because of its pollutant content and because the toxicity of its leachate is insignificant; and which include: discarded soil, stones and dredging spoil,

5.2 Regulation 331 Definitions Applicable to this Assessment

"Contaminant" means any substance present in an environmental medium at concentrations in excess of natural background concentrations that has a potential to cause harm to human health or the environment;

"Informal Residential" means an unplanned settlement on land which has not been zoned as a residential consisting mainly of makeshift structure not erected according to approved architectural plans;

"Remediation" means the management of a contaminated site to prevent, minimise, or mitigate harm to human health or the environment;

"**Soil Screening Value 1**" means soil quality values that are protective of both human health and eco-toxicological risk for multi-exposure pathways, inclusive of contaminant migration to the water resource;

"**Soil Screening Value 2**" means soil quality values that are protective of risk to human health in the absence of a water resource;

"**Standard Residential**" means settlement that is formally zoned and serviced, and generally developed according to approved building plans, including land parcels such as plots or erven.

5.2.1 Soil Screening Values

The soil screening values for metals and Anions are shown in the following Table 1 and Table 2 are used for the screenings assessment. Due to nature of the historic mining activity the organics portion of the assessment was not required.

Table 1: Soil Screening Values for Metals

Parameter	Units	SSV1 All Land-Uses Protective of the Water Resource	SSV2 Informal Residential	SSV2 Standard Residential	SSV2 Commercial/ Industrial	Protection of Ecosystem Health
Metals and metalloids						
As, Arsenic	mg/kg	5.8	23	47	150	580
Cd, Cadmium	mg/kg	7.5	15	32	260	37
Cr(III), Chromium (III)	mg/kg	46000	46000	96000	790000	N/A
Cr(VI), Chromium (VI)	mg/kg	6.5	6.5	13	40	260
Co, Cobalt	mg/kg	300	300	630	5000	22000
Cu, Copper	mg/kg	16	1100	2300	19000	16
Pb, Lead	mg/kg	20	110	230	1900	100
Mn, Manganese	mg/kg	740	740	1500	12000	36000
Hg, Mercury	mg/kg	1	1	1	6.5	4.1
Ni, Nickel	mg/kg	91	620	1200	10000	1400
V, Vanadium	mg/kg	150	150	320	2600	-
Zn, Zinc	mg/kg	240	9200	19000	150000	240

Table 2: Soil Screening Values for Anions

Anions		
Parameter	Units	Soil Screening Level
Chlorides	mg/kg	12000
Fluorides	mg/kg	30
Nitrates-nitrite	mg/kg	120
Sulphates	mg/kg	4000

6 SITE ASSESSMENT

The property has several Rock Stockpiles left over from the historic mining activities with varying heights of 2m to approximately 5m. The property being a historic mining site is relatively disturbed. Vegetative growth has been naturally reinstated most areas except for the areas where the Rock Stockpiles are present and some areas with derelict infrastructure.

A high level estimation was conducted on the Rock Stockpiles and the approximate quantity of the material is 70 000m^3. This estimation can be seen in a Stockpile Map that is attached in **Appendix A** of this report.

The material is clean rock with a varying range of size distribution. Some examples of the rock stockpiles can be seen in the followings photos. The rock stockpiles are relatively old and has been exposed to the elements for over a decade.

It is evident that some of the rock stockpiles has recently been consolidated into higher stockpiles. This would most likely have been done by Afrisam to assist in the loading of the material. Please see **photo 2** below for reference to the previous statement.

Photo 1: On Top of Rock Stockpile, Height Approximately 3.5m

Photo 2: High Rock Stockpile, Height Approximately 4.5m

Photo 3: View of Smaller Stockpiles Spread Over the Site

Photo 4: Smaller Rock Stockpiles

A total of 12 Samples were taken over the entire site. The assessment focus on soil quality risk indicators as presented by the Soil Screening values as described in .

GCS will collect and analyse 12 soil samples for metal concentrations. 5 Samples will be analysed for leachable concentrations to determine possible environmental and health risks. In addition the pH, electrical conductivity, and common anions (SO4-S, Cl-, NO3-N and F-) was included for all 12 samples. For the 12 samples taken 2 were taken from the Waste Rock Present on site. For the two Waste Rock Samples Cyanide was also tested for to determine any possible tailings contamination. The 12 Samples were numbered P1 to P12.

The location of the 12 samples can be seen in the Map provided in **Appendix A** of this Report.

7 MATERIAL CLASSIFICATION/CHARACTERISATION

7.1 Introduction

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 NEM:WA definition of waste includes mining residues and the determination of the final management or disposal criteria. 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.

All the samples were classified according to the above to determine the risk factor of any of the chemical constituents present in the soil samples and the water rock samples. .

7.2 Classification Methodology

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 particular techniques and analysis methods required.

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.

7.3 Classification Threshold Limits

The Total Concentration Threshold (TCT) Limits (mg/kg) as listed in the Regulations to which the results of the analysis were compared too is given below. Please note that the organics component of the classification was omitted in this case as per the allowance made for this in the regulations that it is unlikely that these substances would be present in the waste rock.

Table 3: Waste Classification Total Concentration Threshold Limits (Inorganic Substances Only)

Elements & Chemical Substances in Waste	**TCT0** mg/kg	**TCT1** mg/kg	**TCT2** mg/kg
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

Elements & Chemical Substances in Waste	TCT0 mg/kg	TCT1 mg/kg	TCT2 mg/kg
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

The Leachable Concentration Threshold (LCT) Limits (mg/l) as listed in the Regulations to which the results of the analysis were compared too is given below. Please note that the organics component of the classification was omitted in this case as per the allowance made for this in the regulations that it is unlikely that these substances would be present in the waste rock.

Table 4: Waste Classification Leachable Concentration Threshold Limits (Inorganic Substances Only)

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
CrTotal, 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

Elements & Chemical Substances in Waste	LCT0	LCT1	LCT2	LCT3
F, Fluoride	1.5	75	150	600
CN- (total), Cyanide Total	0.07	3.5	7	28

7.4 Soil Screening Assessment Results

A summary of the Soil Screening Results is presented below. The full laboratory results and analysis is attached in **Appendix B** of this report.

1. **Sample P1:**

   All elements are below the SSV1 value except for Lead which slightly exceed the SSV2 value for Informal Residential but is well below the SSV2 value for Standard Residential Development.

   All elements were well below the soil screening levels for Anions.

2. **Sample P2:**

   All elements are below the SSV1 value except for Copper which slightly exceed the SSV1 value but is well below the SSV2 value for Informal Residential Development.

   All elements were well below the soil screening levels for Anions.

3. **Sample P3:**

   All elements are below the SSV1 value.

   All elements were well below the soil screening levels for Anions except of Fluorides which slightly exceeded the soil screening level.

4. **Sample P4:**

   All elements are below the SSV1 value.

   All elements were well below the soil screening levels for Anions.

5. **Sample P5:**

   All elements are below the SSV1 value except for Copper which slightly exceed the SSV1 value but is well below the SSV2 value for Informal Residential Development.

   All elements were well below the soil screening levels for Anions.

6. **Sample P6:**

   All elements are below the SSV1 value except for Copper which slightly exceed the SSV1 value but is well below the SSV2 value for Informal Residential Development.

   All elements were well below the soil screening levels for Anions.

7. **Sample P7:**

All elements are below the SSV1 value.

All elements were well below the soil screening levels for Anions.

8. Sample P6:

All elements are below the SSV1 value except for Copper and Lead which slightly exceed the SSV1 value but is well below the SSV2 value for Informal Residential Development.

All elements were well below the soil screening levels for Anions.

9. Sample P9:

All elements are below the SSV1 value.

All elements were well below the soil screening levels for Anions.

10. Sample P10:

All elements are below the SSV1 value except for Copper which slightly exceed the SSV1 value but is well below the SSV2 value for Informal Residential Development.

All elements were well below the soil screening levels for Anions.

11. Sample P11 - Waste Rock:

All elements are below the SSV1 value except for Arsenic, Copper and Nickel. Arsenic slightly exceeds the SSV2 Residential Development value but is well below the SSV2 value for Commercial/Industrial.

All elements were well below the soil screening levels for Anions.

12. Sample P12 - Waste Rock:

All elements are below the SSV1 value except for Arsenic, Copper and Nickel. Arsenic slightly exceeds the SSV2 Residential Development value but is well below the SSV2 value for Commercial/Industrial.

All elements were well below the soil screening levels for Anions.

7.5 Summary of the Soil Classification Results

The soil and waste rock samples were analysed for total and leachable concentration tests, as per the legal requirements. The analyses include metal ions and inorganic anions, which are reasonably expected to occur in the discard material. Organic elements and pesticides were not included in the analyses, as these elements are not expected to occur in the discard material. However because this is a historic gold mining site cyanide was included in the analysis.

Leaching in the context of the project refers to the process of transferring chemical constituents from a solid particle to an aqueous solution. It is noted that the total concentration of a chemical element in a solid form will only have a limited influence on the extent to which the element can be leached and thus affect the receiving environment. It is therefore important not to make assumptions about the magnitude of a leaching risk posed from the total concentration tests alone. The quantity of any element that could leach from a solid rock will depend on several factors, including *inter alia* particle size, permeability, surface area, temperature, pH, redox potential, presence of non-reactive soluble salts, biological activity, etc.

7.5.1 Total Concentration Discussion

The results of the total concentration test are compared to Total Concentration Threshold (TCT) values in and

Table 5 for the two samples.

For Sample P1, P5, P6, P8, P10, P11, and P12, some of the results slightly exceed the TCT0 threshold, but are well below the TCT1 threshold.

For Sample P2, P3, P4, P7, and P9, the results indicate that all elements are below the TCT0 concentration.

7.5.2 Leachable Concentration Discussion

Leach tests have an important role in providing information to support the assessment of the environmental risks associated with the discard material as it determines the concentrations of chemical constituents in soil pore water that may come in contact with surface water bodies, groundwater, fauna and flora. In order to understand the risk of depositing the discard material on the proposed expansion to the existing Discard Dump, it is important to understand whether or not the leachable chemical constituents are below the threshold values set in the Norms and Standards.

For the leachable concentration tests, reagent water (deionised water) extraction was used as leaching fluids, according to the requirements for non-putrescible waste. The results of the total concentration test are compared to Total Concentration Threshold (TCT) values in Table 5 for the twelve samples.

None of the elements tested exceed the LCT0 threshold for the discard samples analyzed. The leach tests further indicate although some elements TC concentrations exceed the TCT0 threshold, as discussed above, that the leachable concentrations the elements fall well below the LCT0 threshold.

Table 5: Soil Screening Values and Classification Results Summary

Sample Number	Analysis Classification Type		Development SSV
	TCT	LCT	
P1	3	4	SSV2 - IR
P2	4	4	SSV2 - IR
P3	4	4	SSV1 - ALW
P4	4	4	SSV1 - ALW
P5	3	4	SSV2 - IR
P6	3	4	SSV1 - ALW
P7	4	4	SSV1 - ALW
P8	3	4	SSV2 - IR
P9	4	4	SSV1 - ALW
P10	3	4	SSV2 - IR
P11	3	4	SSV2 - CI
P12	3	4	SSV2 - CI

Code	Description
SSV1 - ALW	SSV1 - All Land-Uses Protective of the Water Resource
SSV2 - IR	SSV2 - Informal Residential
SSV2 - SR	SSV2 - Standard Residential
SSV2 - CI	SSV2 - Commercial/ Industrial

The detailed results on the analysis of the samples is attached in **Appendix B** of this report.

7.6 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.

Waste types are determined through comparison of the TC and LC concentrations with threshold limits presented in Table 3 and Table 4. Five waste type categories were developed, as detailed in Table 6.

Table 6: Waste Categories

Criteria	**Waste Type**
LC > LC3; or TC > TC2	Type 0
LCT2 < LC ≤ LCT3; or TCT1 < TC ≤ TCT2	Type 1
LCT1 < LC ≤ LCT2; and TC ≤ TCT1	Type 2
LCT0 < LC ≤ LCT1; and TC ≤ TCT1	Type 3
LC ≤ LCT0; and TC ≤ TCT0	Type 4*

* All chemical substance concentration levels must also be below the following values to be characterised as a Type 4 waste:

TOC	< 30 000 mg/kg (=3%)
BTEX	< 6 mg/kg
PCBs	< 500 mg/kg
Aldrin + Dieldrin	< 0,05 mg/kg
DDT + DDD + DDE	< 0,05 mg/kg
2,4-D	< 0,05 mg/kg
Chlordane	< 0,05 mg/kg
Hetachlor	< 0,05 mg/kg

In addition to the above, a waste will be classified as Type 1 if a particular substance in the waste is not listed in Table 3 and Table 4 and the waste has been classified as hazardous in terms of Section 4(2) of NEM:WA, based on health or environmental hazard characteristics of the specific element or chemical substance.

If the TC of an element is above TCT2 and the concentration cannot be reduced to below the TCT2 limit, but the LC is below the LCT3 limit, the waste will also be considered a Type 1 waste.

Wastes with metal ions and inorganic anions below or equal to LCT0 limits are considered Type 4 waste, irrespective of the TC of the waste, provided that the inherent physical and chemical character of the waste is stable and will not change over time, the waste is disposed of to a landfill without any other waste and the concentrations for organics and pesticides, as listed beneath Table 6, are complied with.

7.6.1 Outcome of Waste Type Determination

Based on the outcome of the both the Total Concentration and Leachable Concentration Tests, it is shown that the soil sample material does not exceed any of the LCT0 threshold values. The TC concentrations from the tests are all below the TCT1 threshold value.

For this reason all the samples are classified as Type 4, according to the criteria presented in Table 6. Type 4 material is Inert. .

7.7 Assessed Disposal Requirements

Based on the outcome of the assessment, it is shown that the waste rock will require a Class D liner based on the fact that the material is classified as a Type 4 waste.

As the waste rock is historic and a liner cannot be placed under the material it is recommended that the material is either removed off site or capped with a 300mm soil layer as per the barrier requirement.

8 CONCLUSIONS AND RECOMMENDATIONS

All the areas sampled in the screening level assessment with the exception of Sample P11 and P 12 from the waste rock stockpiles qualify to be developed into a formal residential area. The area where the waster rock is stockpiles can be developed into Commercial or Industrial area unless the water rock material is removed. In this instance the entire study area will be deemed safe for development into a residential area.

All the soil samples are classified as a **Waste Type 4**. The required containment barrier according to Regulation 636 for a Waste Type 4 is a Class D containment barrier or capping.

It is the professional opinion of GCS EE the main possible chemical constituents in Mining Waste Rock is not harmful and poses very little or no risk to the environment or human health.

The following recommendations are made:

1. It is recommended that:
    - Sub-regulation 2 of the Waste Classification Regulations (R634) requires that the discard material must be re-classified every five years, or within 30 days of modification to the treatment process or if changes to the raw material input are made.

2. It is recommended that the following records be kept by the client:
    - A copy of this waste classification report.
    - A record to the quantity of waste rock on the site.
    - These records must be kept for a minimum of 5 years.

3. As this is a potential housing development zone the following is recommended:
    - That the waste rock is either removed for commercial purposes, and/or,
    - Used in the development for landfilling or stabilisation, and/or,
    - Consolidated and Capped with a 300mm growth medium.

4. It is recommended that the Environmental Assessment Practitioner (EAP) applies for or locates a closure certificate for the historic mine which includes a sign off from the Department of Minerals and Resources (DMR).
5. It is recommended that a formal agreement is entered into with Afrisam to remove the waste rock material within an agreed timeframe,

9 ADDITIONAL STUDIES REQUIRED

The following additional studies are anticipated for the development with regards to the Rock Stockpiles (to be confirmed after negotiations with the relevant authorities),

1. A Geotechnical investigation on the Rock Stockpiles to confirm the following:
    a. characterisation of the soil and rock profiles over the entire area to be covered by residue stockpile facility and associated infrastructure to define the spatial extent and depth of the different soil horizons; and
    b. characterisation of the relevant engineering properties of foundations soils and the assessment of strength and drainage characteristics.
2. Risk analysis must be conducted and documented on all residue stockpiles and deposits.

10 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 – September 2017
5. SANS 10234:2008, 2008. South African National Standard – Globally Harmonized System of Classification and Labelling of Chemicals (GHS), ISBN 978-0-626-22221-5.
6. SANS 241-1:2015, 2015. South African National Standard – Drinking water – Part 1: Microbiological, physical, aesthetic and chemical determinants, ISBN 978-0-626-29841-8.
7. DEAT, 2010. Framework for the Management of Contaminated Land, Department of Environmental Affairs, dated May 2010.

APPENDIX A: SAMPLING AND RESULTS MAPS

APPENDIX B: LABORATORY RESULTS AND ANALYSIS