Lukisa Invest 100 (Pty) Ltd:

GEOCHEMICAL ASSESSMENT OF THE LUKISA URANIUM PROJECT 2025

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Table of Contents

List of Figures

List of Tables

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1 Introduction and Scope of Report

Aquatox Consulting (Pty) Ltd (Aquatox) were appointed by Lukisa Invest 100 (Pty) Ltd (Lukisa) to assist with the compilation of an Environmental Impact Assessment (EIA) and associated documentation to apply for a Mining Right. This Lukisa Ryst Kuil Project (LRP) involves several specialist reports to be compiled, which includes an opinion from a geochemical perspective. The focus of this report is on an update of the geochemical characterisation of the waste and tailings being dealt with in the LRP. The aim of this report is, furthermore, to present an overall assessment of the geochemical impact and to verify the potential of acid mine drainage (AMD), considering the addition of new data, as well as the monitoring data.

1.1 The qualifications of specialist

Rudy Boer graduated with a PhD (Geochemistry) in 1995 from the University of the Witwatersrand. He, furthermore, received post-graduate tuition during long-term sojourns at the following institutions:

- Centre de Recherches sur la Geologie des Matieres Premieres Minerales et Energetiques (CREGU), Nancy, France;
- Laboratoire de Spectrométrie de Vibrations, Université de Nancy I, Nancy, France;
- Department of Geological Sciences, University of Michigan, Ann Arbor, United States of America.

After four years with the Economic Geology Research Unit, he joined the Department of Geology at the University of the Witwatersrand. During the eight years that he was employed at the University of the Witwatersrand, he was involved in a wide variety of applied economic geology and exploration geochemistry projects. Subsequently, he took up a professorship at the University of the Free State where his main responsibilities included the development, co-ordination and management of a newly introduced Masters degree programme in Mineral Resource Management. Rudy is a Fellow of the Geological Society of South Africa (Mem. No. 964609), from which he has also received the Jubilee Medal. He served on several Water Research Commission Project Steering Committees and is registered with the South African Council for Natural Scientific Professions (Reg. No. 400010/03).

2 DECLARATION OF INDEPENDENCE

2.1 SPECIALIST DECLARATION OF INDEPENDENCE AND STATEMENT OF OBJECTIVITY

I, Rudolf Hans Boer (ID 6011125085085), hereby declare that I have no conflict of interest related to the work of this report. Specially, I declare that I have no personal financial interests in the property and/or development being assessed in this report, and that I have no personal or financial connections to the relevant property owners, developers, planners, financiers or consultants of the development. I declare that the opinions expressed in this report are my own and a true reflection of my professional expertise.

Rudy Boer

R.H. Boer PhD, Pr Sci Nat, FGSSA

2.1.1 Summary of the specialist's experience

He was author and co-author of more than 30 technical peer reviewed publications in international journals and approximately 40 extended abstracts published in conference proceedings, as well as numerous technical publications. He has also been responsible for the project management of over 140 environmental projects ranging from water use license applications to mining right environmental management plans.

3 Background and Brief

The geochemical characterisation of the waste rock on the farms Ryst Kuil (Main, Abante, and Extension) and Haanekuil is required for inclusion in the EIA of the Lukisa Ryst Kuil Project (LRP).

The Ryst Kuil project comprises a number of uranium mineralized lenses occurring within a sandstone paleochannel, some 50km south-east of Beaufort West in the Western Cape Province. The proposed mine plan comprises potentially several open pits and underground works.

3.1 Deliverable

The deliverable would be a geochemical report that include the following:

- An updated assessment of waste rock, surface water and groundwater geochemistry to provide an evaluation of the potential geochemical reactivity and stability of residues for the project;
- Verification of classification of the waste rock in terms of the National Environmental Management: Waste Act 59 of 2008 (NEM:WA).

4 Legislated requirements

4.1 Waste Classification and Management Regulations

The National Norms & Standards for the Assessment of Waste for Landfill Disposal (GN 635) have replaced the Minimum Requirements for the Handling, Classification and Disposal of Hazardous Waste (DWAF, 1998). In terms of Regulation 7(2) of GN 635, the potential level of risk associated with disposal or downstream use of wastes must be determined by following the prescribed and appropriate leach test protocols. The Regulations Regarding the Planning and Management of Residue Stockpiles and Residue Deposits from a Prospecting, Mining, Exploration or Production Operation' published in Government Gazette No 39020 dated 24 July 2015, require that mining residues be assessed in terms of the National Environmental Management: Waste Act 59 of 2008 (NEM: WA).

5 Methodology

The approach that was followed for the geochemical assessment of the waste material was to perform a desktop study of existing data of representative samples of material. Information on the site geology and the project sites were sourced from several reports (amongst others SRK, 2007, 2008 & 2017, and Rosewarne, 2025), monitoring data collected by Aquatox, as well as on-site observations.

6 Reporting Standards

6.1 Metal Enrichment versus Average Crustal Abundance

The Geochemical Abundance Index (GAI) is a semi-quantitative tool used to assess the degree of elemental enrichment or depletion in geological samples relative to a reference median abundance, typically crustal values or those specific to a lithological context. The GAI provides a standardized method to identify potentially anomalous concentrations of elements, which may have implications for environmental management and mineral resource evaluation.

The GAI was used to evaluate potential elemental enrichment in samples from four areas, i.e. Haanekuil, Ryst Kuil Abante, Ryst Kuil Extension, and Ryst Kuil Main.

The GAI is calculated by comparing the measured concentration of an element in a sample to its background or median abundance in a relevant reference medium. The resulting value is expressed on a logarithmic scale and truncated to an integer between 0 and 6.

A GAI value of 3 or higher is generally considered to indicate significant enrichment, potentially warranting further geochemical or environmental investigation.

Analytical data from SRK (2017) indicate that several elements display GAI values ≥3 across the Ryst Kuil project area. These results are summarized in the Table below.

Table 1: Elements with GAI ≥3 at Ryst Kuil

Element	GAI Value	Number of Samples	Observations
Silver (Ag)	3	5	Notable silver enrichment across multiple samples
Arsenic (As)	3	1	Isolated arsenic anomaly
Boron (B)	3	1	Localised enrichment
Selenium (Se)	≥3	All waste lithologies	Enrichment may be overstated due to high detection limits
Uranium (U)	≥3	All sampled lithologies	Consistent and widespread enrichment observed

Of particular significance is the widespread enrichment of uranium (U) and selenium (Se) across all waste rock lithologies. These elements may pose environmental risks due to their potential mobility and toxicity, especially in oxidizing conditions.

However, the apparent selenium enrichment must be interpreted with caution. The reported method detection limit for Se was approximately six times higher than the average crustal abundance. Consequently, the calculated GAI values for Se may reflect analytical limitations rather than actual geochemical anomalies.

The presence of GAI ≥3 values for silver, arsenic, selenium, and uranium suggests that the Ryst Kuil project area exhibits zones of significant geochemical enrichment. These findings have several implications:

- Environmental Risk: Enriched elements such as As, Se, and U are known for their toxicological profiles and may require monitoring and mitigation during mining or waste rock disposal.
- Resource Potential: The silver and uranium enrichment may also indicate mineralisation zones of potential economic interest.
- Analytical Considerations: The influence of detection limits on GAI calculations, particularly for selenium, highlights the need for method validation and supplementary analyses to ensure robust interpretations.

The application of the Geochemical Abundance Index at Ryst Kuil provides a valuable framework for identifying geochemically enriched elements in the Karoo Basin lithologies. The observed enrichment of silver, arsenic, selenium, and uranium, particularly where GAI ≥ 3, is of environmental and geological significance.

6.2 Criteria for Assessing Acid Potential

The screening criteria set by Prediction Manual for Drainage Chemistry from Sulfidic Geological Materials (MEND Report 1.20.1, 2009) were used on the Acid Base Accounting (ABA) data (presented in SRK, 2017) to assess the potential for Acid Mine Drainage (AMD) generation.

These classifications are based on the Modified Sobek ABA method. The Modified SOBEK ABA method is a geochemical tool used to assess whether mine waste materials, such as waste rock or tailings, have the potential to generate AMD. It evaluates the balance between:

- Acid Potential (AP) – from sulphur (typically sulphide) content.
- Neutralization Potential (NP) – from carbonate or other alkaline minerals.

Key Calculations:

- AP = % Sulphur × 31.25 (kg $CaCO_3$ equivalent/tonne).
- NNP = NP – AP (Net Neutralization Potential).
- NPR = NP / AP (Neutralization Potential Ratio).

Table 2. Classification criteria for accessing acid potential.

Classification	NNP (kg $CaCO_3$/t)	NPR (NP/AP)	Interpretation
Potentially Acid Forming (PAF)	< 0	< 1	Likely to generate acid
Uncertain / Borderline	0 to +20	1 to 2	May generate acid
Non-Acid Forming (NAF)	> +20	> 2	Unlikely to generate acid

6.3 Criteria for assessing Net Acid Generation (NAG) results

The NAG test is used to assess whether a sample is capable of neutralizing the potential acidity. A strong oxidising agent, hydrogen peroxide (H_2O_2), is used to rapidly oxidise sulphide minerals in the sample. Single addition NAG test involves the addition of 250 ml of 15% H_2O_2 to a 2.5 g of pulverised sample. The NAG screening criteria to assess the capacity of a sample to neutralise acidity generated during the test procedure, is set by MEND (2009), and is presented Table 3.

Table 3: NAG Test Assessment Criteria

Acid Generating Potential	Final NAG pH
Potential acid generating	NAG pH < 4.5
Uncertain	NAG H < 4.5
Uncertain	NAG pH ≥4.5
Non-Acid Forming	NAG pH ≥4.5

Typically, NAG testing is not used in isolation to determine acid generating potential of a sample. However, the NAG tests, coupled with mineralogical analyses and ABA tests provide a more comprehensive picture of the potential for acid mine drainage (AMD), bearing in mind that actual acid generating and metal leaching potential is best determined through confirmatory test work, such as kinetic tests. The interpretation of NAG test results and ABA on its own are, however burdened by an inherent flaw. Both these techniques involve the crushing of sample material, which significantly enlarge the reactive surface exposed for reaction. By implication this change in available reactive surface area renders these laboratory tests not representative of the natural conditions. Thus, the solution lies in the use of the NAG and ABA results in conjunction with quantitative mineralogical result.

7 Geology

The geology of the Main Karoo Basin is summarized from Woodford (2002), as well as making use of ChatGPT (2025). The lithostratigraphic units of the Karoo Supergroup outcrop concentrically around the Main Karoo Basin. Lateral facies changes, particularly in the lower half of the succession, have given rise to inter-tonguing of lithologies in various parts of the basin.

The Karoo Supergroup near Beaufort West represents a well-exposed sequence of sedimentary and volcanic rocks that span from the Late Carboniferous to the Early Jurassic (approximately 300 to 180 million years ago). The stratigraphy in this region captures important transitions in climate, tectonics, and biotic evolution and is especially well known for its fossil vertebrate assemblages (Figure 1 & Figure 2).

Overview of the Karoo Supergroup Stratigraphy near Beaufort West

The Karoo Supergroup is typically subdivided into five major groups, though not all are present near Beaufort West. In this area, the exposed stratigraphy primarily includes the Ecca, Beaufort, and Stormberg groups. The Dwyka Group and Drakensberg Group are either absent or only sparsely represented in this specific area. Importantly are the dolerite intrusion into the Karoo Supergroup.

The Karoo Dolerite consists of an interconnected network of dykes and sills and it is not possible to single out any intrusive or tectonic event responsible for these intrusions (Woodford 2002). The emplacement of dykes within the Western Karoo Basin appears to be lithological controlled (Woodford, 2002) where a decrease in intrusion density is noted at the boundary between the lower and upper Ecca. This boundary corresponds to the appearance of the first sandstone units in the Karoo Basin. The bulk of the dykes are strata bound and concentrate in the upper Ecca and Beaufort Groups (Adelaide and Tarkastad Subgroups), although some dykes are present in the lower Ecca and Dwyka Group (Woodford 2002).

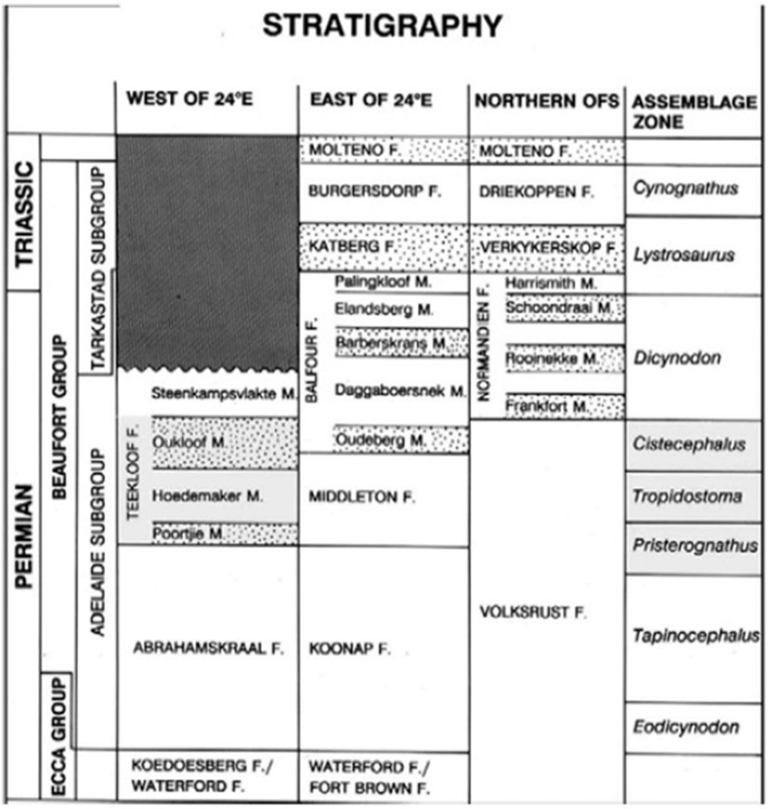


Figure 1: Major lithostratigraphic units of the Karoo Supergroups (Woodford. 2002).

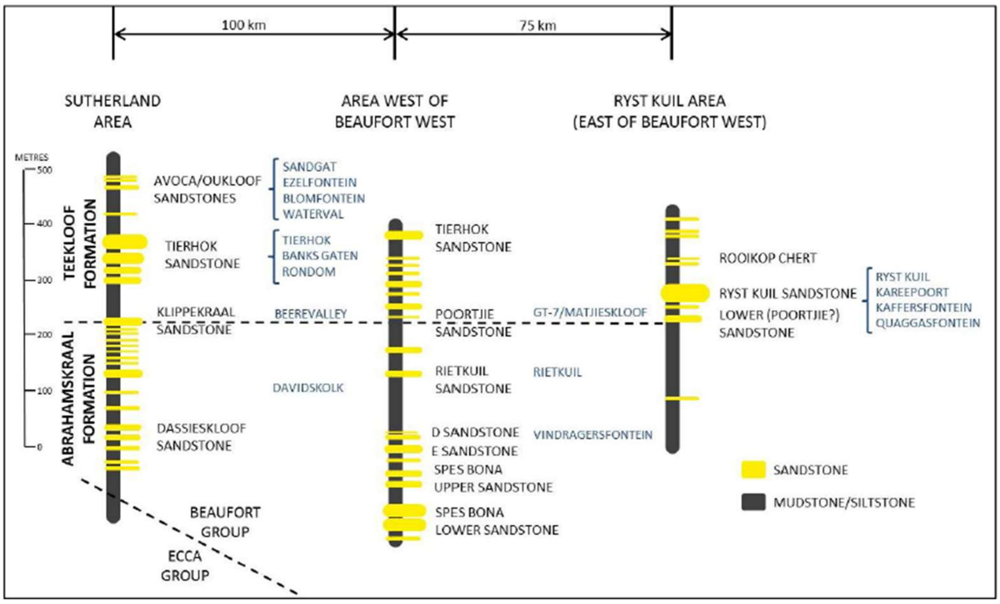


Figure 2: Regional stratigraphy of the south-western Karoo Basin showing the relative levels of various uranium deposits (after Esso, 1979).

1. Dwyka Group (Late Carboniferous – Early Permian)

- Lithology: Predominantly diamictites, tillites, and mudstones.
- Environment: Deposited in glacial and glaciomarine settings during the late Palaeozoic Gondwanan glaciation.
- -Presence near Beaufort West: Generally absent or deeply buried; rarely exposed in this area.

2. Ecca Group (Early to Middle Permian)

- Lithology: Dark grey to black shales, mudstones, siltstones, and fine sandstones.
- Formations near Beaufort West:
    - Prince Albert Formation: Basal unit (if present), composed of laminated black shales.
    - Whitehill Formation: Organic-rich black shales with evidence of anoxic marine conditions.
    - Collingham Formation: Finer-grained tuffaceous shales and siltstones.
    - Vaalbank and Ripon Formations: Represent deltaic to fluvial sandstones and siltstones.
- Environment: Initially deep marine, transitioning to deltaic and shallow marine.

3. Beaufort Group (Middle Permian to Early Triassic)

This group is the most extensively exposed and important in the Beaufort West area. It is subdivided into several biostratigraphic zones based on fossil vertebrate assemblages. The sediments reflect fluvial and overbank deposits -with significant vertebrate fossil content.

Subgroups:

a. Adelaide Subgroup (Middle to Late Permian)

- Abrahamskraal Formation:
    - -Lithology: Mudstones, siltstones, and sandstones.
    - Fossils: Contains dinocephalian therapsids (e.g. *Tapinocephalus*).
    - Deposition: Low-energy meandering river systems.
- Teekloof Formation:
    - Lithology: More sandstone-rich; fining-upward cycles.
    - Fossils: Therocephalians, dicynodonts, and gorgonopsians.
    - Palaeoclimate: Semi-arid with increasing seasonality.

b. Tarkastad Subgroup (Late Permian to Early Triassic)

- Balfour Formation:

    - Lithology: Alternating mudstones and sandstones; evidence of floodplain deposition.
    - Fossils: *Dicynodon* and *Lystrosaurus* Assemblage Zones.
    - Significance: Span the Permo-Triassic extinction boundary.
- Katberg Formation (Early Triassic):
    - Lithology: Coarse, sheet-like sandstones and minor mudstone.
    - Environment: High-energy braided rivers during climatic instability.
    - Fossils: Early Triassic fauna dominated by *Lystrosaurus*.

4. Stormberg Group (Late Triassic to Early Jurassic)

- Clarens Formation (topmost part exposed in some areas near Beaufort West):
    - Lithology: Fine-grained, cross-bedded sandstones.
    - Environment: Aeolian (desert) dunes and ephemeral streams.
    - Fossils: Less fossiliferous, but may include early dinosaur tracks.
- Molteno and Elliot Formations may be present to the northeast but are less prominent in Beaufort West proper.

5. Drakensberg Group (Early Jurassic)

- Lithology: Basaltic lavas.
- Presence: Generally not exposed in the Beaufort West area; more common in the eastern Karoo.

Structural and Tectonic Context

- The rocks dip gently toward the northeast, consistent with the regional Karoo Basin syncline.
- The sequence thickens toward the southeast, indicating a foreland basin setting influenced by the Cape Fold Belt.
- Post-depositional faulting is minor in this region, preserving a largely continuous stratigraphic succession.

Palaeontological Significance

- The Beaufort Group rocks near Beaufort West are known for therapsid ("mammal-like reptile") fossils.
- The Karoo vertebrate biostratigraphy, particularly the *Dicynodon* and *Lystrosaurus* Assemblage Zones, is significant for understanding the end-Permian mass extinction and subsequent recovery.

Table 4. Summary of aspects of palaeontological significance.

Group	Formation(s)	Age	Environment	Fossil Content
Ecca	Whitehill, Collingham, Vaalbank	Early–Middle Permian	Marine to deltaic	Invertebrates, trace fossils

Group	Formation(s)	Age	Environment	Fossil Content
Beaufort (Adelaide)	Abrahamskraal, Teekloof	Middle–Late Permian	Meandering rivers, floodplains	Therapsids (e.g., *Tapinocephalus*)
Beaufort (Tarkastad)	Balfour, Katberg	Late Permian–Early Triassic	Braided rivers, semi-arid plains	*Lystrosaurus*, early archosauriforms
Stormberg	Clarens (local)	Late Triassic–Early Jurassic	Aeolian dune fields	Trace fossils, early dinosaur tracks

The stratigraphy near Ryst Kuil, situated southeast of Beaufort West in the Western Cape, provides a more complete and fossil-rich succession of the Karoo Supergroup, particularly in the Beaufort Group. This area is important for its role in defining the Karoo vertebrate biostratigraphy, especially across the Permian–Triassic boundary. The Ryst Kuil basin is considered one of the stratotype localities for some of the most critical biozones in the Karoo sequence.

Below is a detailed comparative stratigraphy of the Karoo Supergroup near Beaufort West and Ryst Kuil:

Table 5. Comparative Stratigraphy: Beaufort West vs. Ryst Kuil

Group	Formation	Beaufort West	Ryst Kuil	Notes
Ecca	Whitehill, Collingham, Ripon/Vaalbank	Present but less exposed	Present; marine shale sequences well studied	Ryst Kuil shows more detailed tuffaceous layering and geochemical dating potential.
Beaufort (Adelaide Subgroup)	Abrahamskraal	Well developed	Well developed	Fossil therapsids (*Tapinocephalus* zone) present in both.
	Teekloof	Prominent	Prominent	Contains several subzones (*Pristerognathus*, *Tropidostoma*, *Cistecephalus*, *Dicynodon*).
Beaufort (Tarkastad Subgroup)	Balfour	Exposed, spans PTB	*Exceptionally well exposed*, high-resolution PTB stratigraphy	Ryst Kuil provides one of the most detailed Permian–Triassic boundary sections in the Karoo. Key for extinction and recovery studies.
	Katberg	Present	Present	Thick, laterally extensive sandstone bodies indicate braided fluvial systems post-PT extinction.
Stormberg	Clarens (possibly)	Thin or absent	Thin	Both regions show limited Stormberg exposure.

Group	Formation	Beaufort West	Ryst Kuil	Notes
Drakensberg	Basalts	Not exposed	Not exposed	Lies farther east in Lesotho and KwaZulu-Natal.

Key Differences and Significance

1. Permo-Triassic Boundary (PTB) Exposure

- Ryst Kuil is *significant* for its continuous sedimentary record across the PTB, including:
    - Well-preserved transition from Dicynodon to Lystrosaurus Assemblage Zones.
    - Evidence for a mass extinction event, including vertebrate turnover, palynological changes, and geochemical shifts (e.g., carbon isotopes).
    - Several detailed studies have focused on high-resolution sedimentology, taphonomy, and biostratigraphy in this area.
- Beaufort West also preserves the PTB, but not as continuously or in as much resolution. The focus there tends to be broader sedimentological studies and fossil collection rather than stratigraphic detail.

2. Fossil Assemblages

- Ryst Kuil offers an exceptional record of:
    - Late Permian *Dicynodon* fauna.
    - Early Triassic *Lystrosaurus*-dominated recovery fauna.
    - Microvertebrates and invertebrates preserved in fine floodplain deposits.
    - Palynological and trace fossil records.
- Beaufort West preserves similar taxa but fewer high-resolution palaeoecological or taxonomic studies have been conducted in that immediate area.

3. Stratigraphic Control

- Ryst Kuil sections have been tied to radiometric dating (via zircon-bearing tuffs in the Collingham and Teekloof formations), allowing more accurate age constraints.
- Beaufort West has fewer such radiometric constraints and more regional correlation-based stratigraphy.

Table 6. Summary of comparison between Beaufort West and Ryst Kuil areas.

Criterion	Beaufort West	Ryst Kuil
PTB exposure	Present but less complete	Exceptionally complete
Fossil diversity	High	Very high

Criterion	Beaufort West	Ryst Kuil
Radiometric control	Limited	Present (tuffs, correlation)
Biostratigraphy resolution	Moderate	High – Karoo biozones defined here
Palaeoenvironmental studies	Regional scale	Detailed local reconstructions
Sedimentology	Well studied	Intensively studied, esp. floodplain dynamics

Geological Context

Both Ryst Kuil and Haanekuil are characterized by sandstone-hosted uranium mineralization (also known as roll-front type deposits). Uranium is primarily found in reduced zones at the base of upward-fining megacycles within the Adelaide Subgroup of the Beaufort Group, specifically in the Teekloof and Abrahamskraal Formations. The host rock comprises fine-grained greywacke to mud-pebble conglomerate, often enriched in organic matter, which facilitates uranium precipitation. Mineralization is localized within smaller-scale sedimentary features, such as palaeochannels, with ore bodies ranging from 1 to 2 meters in thickness and extending several hundred meters in length.

The Southern Karoo region holds the dominant portion of the Karoo Basin's total uranium resources, with Ryst Kuil and Haanekuil being among the four major ore bodies, along with Kareepoort and De Pannen. These deposits also contain molybdenum resources, underscoring their economic significance.

Host Rocks

- Formations: Most of the sandstone-hosted uranium mineralization is found within the Adelaide Subgroup of the Beaufort Group, specifically in the lower members of the Teekloof Formation (Esso, 1979).
- Lithology:
  - Medium- to fine-grained sandstones, often cross-bedded, sometimes interbedded with siltstones and mudstones.
  - Occasional mud-pebble conglomerates.
  - Carbonaceous material, plant debris, and pyrite are common in mineralized zones.
- These sediments were deposited in a fluvial floodplain environment, with channel sands being the main hosts.

Uranium Mineralization Characteristics

Style of Mineralization

- Uranium occurs as disseminated grains or coatings along grain boundaries and within pore spaces in reduced sandstone units.
- The deposits are often lenticular or tabular bodies, typically a few meters thick but laterally extensive.
- Redox boundaries are key: uranium precipitated where oxidizing groundwater carrying uranium encountered reducing conditions, such as organic matter-rich or pyritic zones.

Minerals Present

- Primary uranium minerals:
    - Uraninite (UO_2): Occurs in unweathered, reduced zones.
    - Coffinite ($USiO_4 \cdot nH_2O$): Often replaces uraninite.
- Secondary uranium minerals (from weathering):
    - Carnotite ($K_2(UO_2)_2(VO_4)_2 \cdot 3H_2O$)
    - Tyuyamunite ($Ca(UO_2)_2(VO_4)_2 \cdot nH_2O$)
- Associated minerals include pyrite, organic matter, iron oxides, and sometimes molybdenite (MoS_2).

Geochemical Controls

- Uranium is mobile under oxidizing conditions and immobile in reducing conditions.
- The most favourable host sandstones are those with:
    - High porosity and permeability, allowing groundwater flow.
    - Interbedded reducing units (e.g., organic-rich mudstone or siltstone).
    - Local abundance of Fe^{2+}, organic carbon, and sulphides that create redox interfaces.

8 Project description

The Lukisa Ryst Kuil Project comprises several uranium mineralized lenses occurring within a channel of sandstone some 50km south-east of Beaufort West. The proposed mine plan comprises a series of open pits at each deposit. These included the following deposits: Ryst Kuil Main; Ryst Kuil Extension; Ryst Kuil Abante, and; Haanekuil.

8.1 Work Programme

8.1.1 Sample Collection

Waste rock samples were selected from the exploration boreholes (see SRK, 2017, report for orientation and sampling positions). Composite samples representing the lithological units present in each mining area, were submitted for analysis at an accredited laboratory.

Details of the individual samples and drill-hole code, depth and lithology are provided in Table 5-1 of the SRK report of 2017.

8.2 Waste Rock Geochemistry

The data are discussed in the subsections below.

8.2.1 Whole Rock Geochemistry

Elemental composition was carried out to identify the metals and metalloids in the composite waste rock samples (SRK, 2017). The purpose of these analyses is to quantify the total metal content of the material. The presence of a potential element of concern does not necessarily indicate a potential impact on the receiving environment; however, it does indicate where to focus needs when assessing the potential for metal mobility.

The elemental composition and corresponding GAI values compared to average crustal abundance of waste rock lithologies is given in Table 7.

Table 7. Elemental Concentrations and GAI of the Various Waste Rock Types (from SRK, 2017)

Sample ID	**SRK8616**		**SRK8618**		**SRK8617**		**SRK8606**		**SRK8605**	
Deposit	Haanekuil						Abante			
Lithology	MDST	GAI	SDST	GAI	SLST	GAI	SDST	GAI	SLST	GAI
Silver	0.55	2	<0.4	1	<0.4	1	1.2	3	1.3	3
Arsenic	3	0	15.7	2	4	0	13.7	2	8.2	1
Boron	93	2	57	1	86	2	58	1	100	2
Barium	411	0	392	0	372	0	327	0	443	0
Berylium	<0.2	0	<0.2	0	<0.2	0	<0.2	0	<0.2	0
Bismuth	<0.5	2	<0.5	2	<0.5	2	<0.5	2	<0.5	2
Cadmium	<0.1	0	<0.1	0	<0.1	0	0.24	0	0.63	1
Cobalt	15.7	0	13.5	0	17.8	0	12.6	0	18.2	0
Chromium	54	0	46	0	55	0	45	0	54	0
Copper	26	0	16.7	0	27	0	47	0	63	0
Mercury	<0.1	0	<0.1	0	<0.1	0	<0.1	0	<0.1	0
Manganese	290	0	247	0	326	0	602	0	388	0
Molybdenum	<0.1	0	13.2	2	<0.1	0	2.8	0	<0.1	0
Nickel	23	0	17.9	0	22	0	17.5	0	23	0
Phosphorus	508	0	427	0	467	0	370	0	774	0
Lead	13.4	0	13.5	0	24	0	9.6	0	22	0
Antimony	<1	1	<1	1	<1	1	<1	1	<1	1
Selenium	<3	5	<3	5	<3	5	<3	5	<3	5
Tin	5.4	0	4.1	0	6.3	1	6	0	5.7	0
Strontium	76	0	169	0	137	0	150	0	111	0
Thorium	28	1	29	1	29	1	13.3	0	16.1	0
Titanium	3272	0	2168	0	3191	0	1952	0	3363	0
Thallium	<0.9	0	<0.9	0	<0.9	0	<0.9	0	<0.9	0
Uranium	<0.4	0	<0.4	0	<0.4	0	<0.4	0	<0.4	0
Vanadium	90	0	57	0	83	0	53	0	85	0
Zinc	83	0	51	0	82	0	55	0	92	0
Zirconium	89	0	47	0	74	0	44	0	85	0

Sample ID	SRK8608		SRK8620		SRK8607		SRK8609	
Deposit	Ryst Kuil Extension							
Lithology	MDST	GAI	MDST	GAI	SDST	GAI	SLST	GAI
Silver	<0.4	1	<0.4	1	0.9	2	<0.4	1
Arsenic	5.1	0	<1	0	19	2	8.8	1
Boron	93	2	95	2	66	2	82	2
Barium	600	0	516	0	490	0	562	0
Berylium	<0.2	0	<0.2	0	<0.2	0	<0.2	0
Bismuth	<0.5	2	<0.5	2	<0.5	2	<0.5	2
Cadmium	<0.1	0	<0.1	0	0.17	0	0.56	1
Cobalt	16.8	0	17.8	0	13.4	0	15.8	0
Chromium	53	0	56	0	49	0	47	0
Copper	59	0	23	0	40	0	21	0
Mercury	<0.1	0	<0.1	0	<0.1	0	<0.1	0
Manganese	281	0	337	0	378	0	433	0
Molybdenum	<0.1	0	<0.1	0	<0.1	0	<0.1	0
Nickel	23	0	23	0	16.3	0	20	0
Phosphorus	371	0	537	0	455	0	513	0
Lead	17.4	0	21	0	11.5	0	27	0
Antimony	<1	1	<1	1	<1	1	<1	1
Selenium	<3	5	<3	5	<3	5	<3	5
Tin	6.8	1	7	0	6.1	0	6.5	1
Strontium	139	0	215	0	229	0	173	0
Thorium	15.8	0	30	1	17.8	0	21	0
Titanium	3105	0	3166	0	2466	0	2980	0
Thallium	<0.9	0	<0.9	0	<0.9	0	<0.9	0
Uranium	<0.4	0	<0.4	0	<0.4	0	<0.4	0
Vanadium	86	0	87	0	67	0	76	0
Zinc	135	0	84	0	57	0	82	0
Zirconium	79	0	77	0	70	0	89	0

Sample ID	SRK8624		SRK8625		SRK8627		SRK8603		SRK8604		SRK8630		SRK8623		SRK8626		SRK8628	
Deposit	Ryst Kuil Main																	
Lithology	MDST	GAI	MDST	GAI	MDST	GAI	SDST	GAI	SDST	GAI	SDST	GAI	SLST	GAI	SLST	GAI	SLST	GAI
Silver	<0.4	1	<0.4	1	0.66	2	1.1	3	<0.4	1	0.42	1	<0.4	1	1.8	3	0.63	2
Arsenic	3.3	0	4.8	0	2.6	0	37	3	18.3	2	16.3	2	<1	0	5.1	0	6	1
Boron	104	2	101	2	129	3	51	1	57	1	60	2	98	2	63	2	80	2
Barium	516	0	449	0	399	0	513	0	538	0	502	0	363	0	333	0	440	0
Berylium	<0.2	0	<0.2	0	<0.2	0	<0.2	0	<0.2	0	<0.2	0	<0.2	0	<0.2	0	<0.2	0
Bismuth	<0.5	2	<0.5	2	<0.5	2	<0.5	2	<0.5	2	<0.5	2	<0.5	2	<0.5	2	<0.5	2
Cadmium	0.1	0	0.13	0	0.19	0	0.19	0	0.13	0	0.18	0	0.13	0	0.48	1	0.1	0
Cobalt	17.3	0	17.2	0	18.8	0	15.1	0	11.4	0	14.5	0	14.7	0	12.6	0	14.3	0
Chromium	51	0	60	0	57	0	45	0	39	0	43	0	46	0	46	0	45	0
Copper	26	0	19	0	53	0	60	0	16.8	0	11	0	22	0	31	0	24	0
Mercury	<0.1	0	<0.1	0	<0.1	0	<0.1	0	<0.1	0	<0.1	0	<0.1	0	<0.1	0	<0.1	0
Manganese	392	0	362	0	442	0	392	0	409	0	355	0	463	0	327	0	258	0
Molybdenum	<0.1	0	<0.1	0	<0.1	0	2.5	0	0.72	0	0.46	0	<0.1	0	<0.1	0	<0.1	0
Nickel	21	0	24	0	27	0	15.8	0	14.9	0	19.3	0	18.4	0	16	0	18.4	0
Phosphorus	580	0	502	0	484	0	353	0	348	0	337	0	469	0	527	0	476	0
Lead	23	0	14.3	0	58	1	12.4	0	9.5	0	12.6	0	21	0	20	0	17.6	0
Antimony	<1	1	<1	1	<1	1	<1	1	<1	1	<1	1	<1	1	<1	1	<1	1
Selenium	<3	5	<3	5	<3	5	<3	5	<3	5	<3	5	<3	5	<3	5	<3	5
Tin	8.2	1	6.4	1	8	1	5.7	0	5.2	0	5.3	0	6.7	1	2.4	0	4.1	0
Strontium	118	0	89	0	99	0	149	0	190	0	138	0	90	0	336	0	119	0
Thorium	30	1	33	1	38	1	6.1	0	6.1	0	38	1	29	1	40	1	38	1
Titanium	3109	0	3276	0	3210	0	2189	0	2032	0	1944	0	2803	0	2478	0	2983	0
Thallium	<0.9	0	<0.9	0	<0.9	0	<0.9	0	<0.9	0	<0.9	0	<0.9	0	<0.9	0	<0.9	0
Uranium	<0.4	0	<0.4	0	<0.4	0	<0.4	0	<0.4	0	<0.4	0	<0.4	0	<0.4	0	<0.4	0
Vanadium	82	0	95	0	97	0	59	0	49	0	55	0	73	0	57	0	66	0
Zinc	79	0	93	0	106	0	44	0	48	0	60	0	69	0	58	0	62	0
Zirconium	76	0	75	0	85	0	52	0	53	0	43	0	80	0	54	0	77	0

Sample ID	SRK8609	
Deposit	Tailings	
Lithology	Tailings	GAI
Silver		
Arsenic	492	6
Boron	62.5	2
Barium	601	0
Berylium		
Bismuth		
Cadmium	4.9	4
Cobalt	<500	3
Chromium	<500	1
Copper	46.5	0
Mercury	0.7	1
Manganese	871	0
Molybdenum	317	6
Nickel	25.1	0
Phosphorus		
Lead	60.6	1
Antimony	4.4	2
Selenium	4	5
Tin	0	1
Strontium		
Thorium		
Titanium		
Thallium		
Uranium	203	5
Vanadium	64	1
Zinc		
Zirconium		

A sample of the tailings material was prepared by MINTEK as part of the metallurgical test work (SRK, 2017).

8.3 Mineralogy

The results of the X-Ray Diffraction (XRD) analyses show that the waste rocks are primarily composed of feldspar and mica group mineral (alumina-silicate minerals) and quartz (Table 8). Although calcite vein infilling was observed in the core and very minor disseminated sulphide. The concentrations of these phases in the rock appears, on average, to be below the detection limit.

Calcite was the only carbonate phase detected, which was reported in all samples from the Ryst Kuil South orebody, and in a single sample from the Ryst Kuil Main siltstone sample. No sulphide minerals were detected in any of the samples analysed. Other minor mineral phases reported are hematite in a single sample from the Depanne orebody (SRK, 2017). Samples from other potential mining areas that are located adjacent to the areas of interest for the current project, where included for the sake of completeness.

Table 8: Mineralogy of composite samples from the various mining areas (SRK, 2017).

	Mineral	**Calcite**	**Chlorite**	**Muscovite**	**Biotite**	**Microcline**	**Plagioclase**	**Quartz**	**Enstatite**	**Hematite**	**Gypsum**
Sample no.	**Deposit**										
SRK8610	Ryst Kuil Ext.		6.5	8.8		5.4	49.5	29.8			
SRK8625-1	Ryst Kuil Main		14.3	21.7		4.7	16.7	42.5			
SRK86034	Ryst Kuil Main		4.7	9.6		3	51	31.8			
SRK8626-1	Ryst Kuil Main	6.4	8	15.7		3.4	28.1	38.5			
SRK8631	Depanne		14.8	20.6		6.1	17.4	38.8		2.3	
SRK8633	Depanne		9.6	10.6		2.9	37.5	39.3			
SRK8632	Depanne		10.5	12.4		7	20.5	49.7			
SRK8616-2	Haanekuil		13.1	18		5.6	19.4	44			
SRK8618-2	Haanekuil		9.6	10.8		2.8	38.6	38.2			
SRK8617-2	Haanekuil		12.6	20.6		3.7	18.9	44.2			
SRK8311-2	Quaggafontein		7.5	10.1		2.7	30.6	49.1			
MO401	Ryst Kuil South	1.6	14.1	19.9			24	40.4			
MO411	Ryst Kuil South	1.8	9.7	19.5		5.8	23.4	39.8			
MO410	Ryst Kuil South	1.5	7.3	9.3			38.1	43.8			
Tailings			3.6		7.4	5.2	27.2	46.1	1.4		9

8.4 Leachate Quality

To assess the leachability of the major and trace elements, the waste rock samples were subjected to short-term leach tests. The results were used as a qualitative screening tool to identify parameters of potential environmental concern (SRK, 2017).

Contact leach testing involved the leaching of waste rock samples using deionised water at a solid to liquid ratio of 1:1, have shown that the potentially leachable concentrations of the trace elements are generally low, and below their respective drinking water guideline values. The concentrations of F, Mo, Al and Se all exceed their respective drinking water guideline values in at least one sample (SANS 241-1: 2015 – Edition 2: Drinking water standards, DWS).

The quality of the actual leachate which is likely to be generated by the waste rock dumps must be determined through appropriate scaling up, mass balance calculations based on the relative proportions of the various waste rock lithologies.

8.5 Acid Base Accounting

Acid Base Accounting (ABA) is a static geochemical test that evaluates the balance between a rock's acid-generating potential and its neutralization potential. The goal is to predict whether mining or processing of a deposit will produce acidic drainage, which can mobilize heavy metals, including uranium, and cause environmental harm.

Sulphide-sulphur is the primary source of acid, acidity and potentially deleterious elemental species (including mobilisation thereof in an acidic environment) in the drainage from the waste rock. The total sulphur concentration of the waste rock lithologies was below the laboratory detection limit of 0.01 weight percent in all samples. As a precautionary approach, the concentration of sulphide-sulphur in the waste rock has been taken as being equal to the detection limit for the calculation of the total acid potential (TAP).

The ABA analysis indicates the relative proportions of acid generating (AP) and acid neutralising (NP) components of a sample.

The paste pH is determined by the relative magnitudes of the rates of acid generation (AP) and neutralisation (NP). The paste pH of the waste rock samples ranged from 7.7 to 9.2 (see Table 9), and indicates that the samples are characterised by short-term net alkalinity. This high pH is indicative of calcite solubilisation, and there is no indication of any acid generating processes effecting pH.

The TAP was below the detection limit for all waste rock lithology's (SRK, 2017). The ARD potential of the waste rock samples was evaluated using the commonly applied criteria indicated in the Prediction Manual for Drainage Chemistry from sulphidic geological materials (MEND Report 1.20.1, 2009). The criteria show that, except for one sample (from Ryst Kuil Extension sandstone), all waste rock samples are classified as non-acid generating.

Table 9: ABA Results for the Waste Rock Samples (SRK, 2017)

Sample No.	Mine area	Rock type	Paste pH	Total S	TAP	NP	NNP	TNPR
				%	(CaCO3) kg/t			
SRK8606	Ryst Kuil Abante	Sst	8.8	<0.01	<0.31	11.9	11.6	38.39
SRK8606		Sst	8.5	<0.01	<0.31	21.4	21.1	69.03
SRK8605		Slst	8.8	<0.01	<0.31	6.88	6.6	22.19
SRK8605		Slst	8.2	<0.01	<0.31	22.4	22.1	72.26
SRK8615		Sst	8.1	<0.01	<0.31	9.43	9.1	30.42
SRK8614		Slst	8.3	<0.01	<0.31	7.13	6.8	23
SRK8616	Haanekuil	Mst	7.7	<0.01	<0.31	12	11.7	38.71
SRK8618		Sst	8.7	<0.01	<0.31	13.2	12.9	42.58
SRK8617		Slst	8.4	<0.01	<0.31	23.9	23.6	77.1
SRK8620	Ryst Kuil Ext.	Mst	8.1	<0.01	<0.31	15	14.7	48.39
SRK8607		Sst	8.7	<0.01	<0.31	0.26	-0.1	0.84
SRK8609		Slst	8.4	<0.01	<0.31	15.8	15.5	50.97
SRK8625	Ryst Kuil Main	Mst	8.6	<0.01	<0.31	13.8	13.5	44.52
SRK8627		Mst	8.5	<0.01	<0.31	16.8	16.5	54.19
SRK8603		Sst	9	<0.01	<0.31	3.82	3.5	12.32
SRK8604		Sst	9.2	<0.01	<0.31	6.36	6.1	20.52
SRK8630		Sst	8.7	<0.01	<0.31	11.7	11.4	37.74
SRK8603		Sst	8.6	<0.01	<0.31	4.08	3.8	13.16
SRK8604		Sst	8.2	<0.01	<0.31	13	12.7	41.94
SRK8626		Slst	8.9	<0.01	<0.31	33.1	32.8	106.77
SRK8628		Slst	8.4	<0.01	<0.31	13.8	13.5	44.52

8.6 Net Acid Generation

The results of the NAG tests are given in Table 6-5 of the SRK report of 2017. The waste rock samples all produced a final NAG solution with a pH greater than the 4.5 pH units set by the MEND (2009) criteria, and thus indicates that the waste rock samples are non-acid forming (NAF). It also confirms the short-term net alkalinity indicated by the paste pH (see SRK, 2017).

The NAG findings were compared to the ABA assessment and mineralogy of the waste rock samples. This combination was adopted to identify trends in the findings of the different analytical methods used to assess the acid generating potential of the tailings. The results of this comparison, indicate that the static prediction methods are in good agreement with each other.

8.7 Waste Classification and Management Regulations

The National Norms & Standards for the Assessment of Waste for Landfill Disposal (GN 635) have replaced the Minimum Requirements for the Handling, Classification and Disposal of Hazardous Waste (DWAF, 1998). In terms of Regulation 7(2) of GN 635, the potential level of risk associated with disposal or downstream use of wastes must be determined by following the prescribed and appropriate leach test protocols. The Regulations Regarding the Planning and Management of Residue Stockpiles and Residue Deposits from a Prospecting, Mining, Exploration or Production Operation' published in Government Gazette No 39020 dated 24 July 2015, require that mining residues be assessed in terms of the National Environmental Management: Waste Act 59 of 2008 (NEM:WA).

The procedures require the determination of both the Total Concentration (TC in mg/kg) and Leachable Concentration (LC in mg/L) of a particular contaminant in a waste to be assessed against the Total Concentration Thresholds (TCT) and the Leachable Concentration Thresholds (LCT) for certain contaminants in a waste. Various threshold levels for the TCT (TCT0, TCT1, TCT2) and LCT (LCT0, LCT1, LCT2 and LCT3) are provided which, in combination, determine the Risk Profile and corresponding waste types as set out below.

Type 4 Waste: wastes with all determinand concentrations below the LCT0 and TCT0 values;

Type 3 Waste: wastes with any determinand concentration above the LCT0 but below the LCT1 value and all determinand concentrations below the TCT1 values;

Type 2 Waste; wastes with any determinand concentration above the LCT1 but below the LCT2 values, and all determinand concentrations below the TCT1 values;

Type 1 Waste: wastes with any determinand concentration above the LCT2 but below the LCT3 values, or above the TCT1 but below the TCT2 values; and

Type 0 Waste: wastes with any determinand concentration above the LCT3 or TCT2 values.

Based on the results of the waste classification analyses for selected the waste rock samples, all materials are classified as Type 3 wastes. Based on the total concentrations reported for the aqua regia extracts of the composite waste rock samples, Ba and Cu exceed the TCT0 value in all samples. Arsenic exceeds in most samples while Pb exceeds the TCT0 value in nine samples. Based on the GAI neither of these elements is significantly enriched in the waste rocks. The LCT0 values are derived from the drinking water guideline values (refer Table 6.1), and indicate that the leachable concentrations of F, Mo and Se exceed the LCT0 values in five samples.

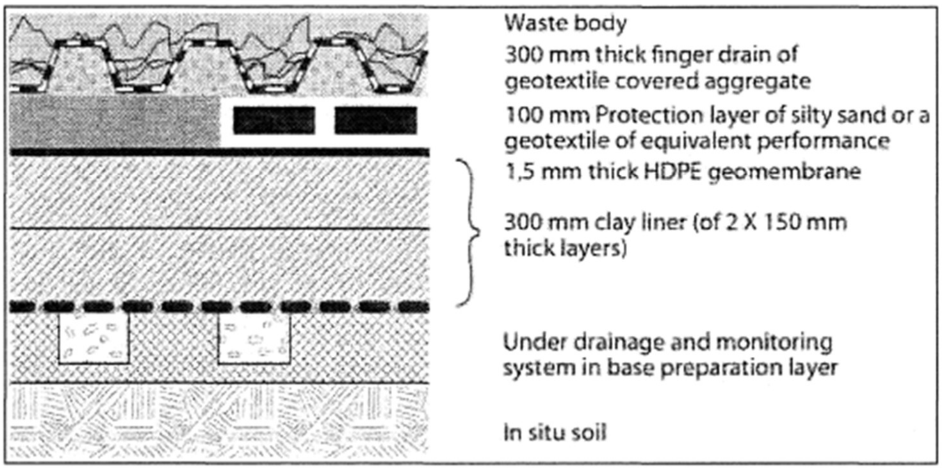
Although based on the total concentrations, the waste rock would classify as a Type 3 waste material, the concentrations are not considered to be significantly enriched relative to crustal abundances.

The tailings material, however, classifies as a Type 3 waste based on elevated total concentrations of As, Ba, and Mo. Furthermore, the leachate concentrations of SO_4, total dissolved solids, As, Cd and Mn exceed the LCT0 values and the un-mineralised waste rock samples.

Based on the results of the TCT and LCT (Appendix 1, SRK, 2017) of the waste rock and tailings material, the materials are classified as Type 4 and Type 3 wastes. Because of the small margins by which the values exceed the LCT0 limits, and the compacted nature of the foundations of the waste rock material it is our recommendation that a Class C landfill would suffice (see **Error! Reference source not found.**Figure below). This recommendation is also based on the nature of the underlying rock considering the geology, i.e. compacted weathered sandstone of the Stormberg Group with it's abundance of secondary clay minerals, as well as the associated mineralogy and whole rock geochemistry.

Type 4 waste may be disposed of at a Class D landfill (Figure 3) designed in accordance with section 3(1) and (2) of the Norms and Standards. However, the mineralogy of the waste rock indicates a high modal proportion of clay minerals in the waste material. This has the distinct effect of inhibiting the flow of the polluting elements through the waste material.

(c) Class C Landfill:



(d) Class D Landfill:

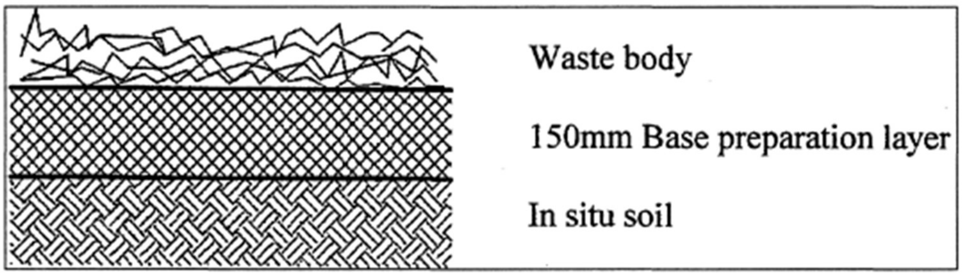


Figure 3. Typical characteristics of a Class C & D Landfills.

The results of geochemical characterisation can be summarised as follows:

- The results of the waste rock geochemical assessment indicate that the major lithologies present in any of the proposed mining areas are classified as non-acid generating;
- The waste rock lithologies are not significantly enriched with respect to other trace elements, with GAI generally ≤ 3;

- The potentially leachable concentrations of trace elements from the waste rocks are generally low and below their respective drinking water guideline values;
- Although based on the total concentrations, the waste rock would classify as a Type 3 waste material, but the concentrations are not considered to be significantly enriched.
- According to the norms and standards a Class C liner is required for stockpiling of waste rock, as well as tailings.

8.8 Water Quality Analyses

Water samples collected during the hydrocensus were submitted to UIS Laboratories in Centurion for metals scans and macro-chemical analyses. A summary of the main indicators and ions (in mg/L) is given in Table 10.

Table 10: Summary of Macro-Chemistry for 2016 Sampled Boreholes from the Ryst Kuil area (SRK, 2017)

Borehole No.	pH	EC mS/m	Total Hardness (as CaCO3)	Na	K	Ca	Mg	Cl	SO4	NO3 as N	F	As
LKL1	7.8	416	1360	264	14.7	389	95.2	637	508	0.167	1.85	0.011
RSK13	8	284	630	287	9.47	171	49.5	402	394	0.236	1.49	<0.01
KPS9	7.8	173	403	174	4.76	113	29.2	195	237	0.636	0.983	<0.01
RSP6	7.6	327	785	306	9.47	226	53.5	552	351	0.19	1.32	0.01
HKL13	7.7	112	357	112	7.72	92.7	30.6	125	70.4	10.8	1.69	<0.01
LTS11	7.7	119	344	136	5.73	85.5	31.8	136	80.9	9.18	1.92	<0.01
KGT9	8.1	298	570	339	10.7	133	57.6	444	358	21.7	1.99	<0.01
KGT3	8	207	433	242	13.9	116	34.7	242	243	19.6	2.67	<0.01
BDK1	8	188	449	171	6.91	110	42.5	228	163	0.614	2.02	<0.01
1KS2	7.6	306	683	295	8.98	172	61.3	509	347	0.201	1.68	0.011
VPS5	7.9	420	328	745	10.2	132	113	941	634	<0.13	2.09	<0.01
VKL01	7.9	88.3	191	116	3.31	76.7	21.1	88.8	123	4.55	1.41	<0.01
KD0002	8	99.5	240	115	6.67	96.1	26.8	134	119	4.03	0.962	<0.01
RSK14	8	200	298	301	9.74	119	53.8	374	305	0.634	1.79	0.021

The groundwater is alkaline and most ECs are within the range c.90 – c.400mS/m. The higher ECs may be associated with boreholes along river courses and in pediment areas, probably due to evaporative effects on shallow groundwater and incorporation of evaporite salts into local, direct recharge. EC is a measure of the ability of water to conduct an electrical current.

The groundwater is hard to very hard and is mostly a mixed $NaCl/Ca\text{-}MgSO_4$, $Na_2Ca(HCO_3)_2$ type. Fluoride (F) is generally elevated compared to drinking water standards (<1.5 mg/L recommended by SANS 241), commonly 1 - 2 mg/L and up to 2.67 mg/L (KGT3). Elevated F is a common feature of Karoo groundwater and is usually attributed to dissolution of detrital apatite (a calcium phosphate mineral containing F) grains in sandstones. Nitrate levels (<11mg/L as nitrogen - N – recommended by SANS 241) are also generally elevated-to-highly elevated, up to 22mg/L as N, e.g. in KGT3 and KGT9. Some comparisons of ECs with 2007 and 2016 measurements are available and are listed in Table 11, showing significant improvement in water quality, in general.

Table 11: Comparison of 2007 and 2016 EC readings. Noteworthy changes are indicated in blue (>20% decrease), although this is a small sample population (SRK, 2017).

Borehole No.	2007 EC (mS/m)	2016 EC (mS/m)
HKL13	118	112
VKL01	134	88.3
KDK0002	162	99.5
KKL001	192	121

Most readings show a decrease in 2016 compared to 2007.

Monitoring in the area since 2007 has shown generally good quality groundwater. This provides backing for the predicted relatively small plume development reported in SRK (2017).

The 2016 acid-base accounting results (see Table 9) show that the waste rock is classified as non-acid generating and this is supported by the monitoring data collected over recent years, i.e. acid rock drainage is unlikely to occur. Leach testing of waste rock also shows no mobilisation of U, (results below laboratory detection limit) (SRK, 2017).

8.9 Water Quality Monitoring Data

The groundwater quality in the Ryst Kuil area has been assessed through multiple monitoring efforts spanning from 2013 to 2025. The groundwater is generally alkaline, with electrical conductivity (EC) values mostly ranging between 10 and 250 mS/m. These values indicate fresh to slightly saline conditions, although elevated ECs are observed in boreholes situated along river courses and in pediment areas. These higher values are likely due to evaporative concentration of salts in shallow groundwater and incorporation of evaporite minerals during local recharge. EC levels reflect the presence of dissolved ions such as bicarbonate, chloride, sulphate, nitrate, sodium, potassium, calcium, and magnesium.

Chemically, the groundwater is characterized as hard to very hard and falls predominantly within a mixed NaCl/Ca-$MgSO_4$, $Na_2Ca(HCO_3)_2$ water type, as illustrated in the Piper diagram (Figure 1). Fluoride concentrations are typically elevated compared to the SANS 241 drinking water standard of 1.5 mg/L, with values commonly ranging from 1 to 2 mg/L and peaking at 3.14 mg/L. This is a well-documented feature of Karoo aquifers and is attributed to the dissolution of detrital apatite grains in the sandstone formations. Nitrate levels are also generally elevated, with concentrations ranging from 0 to 59 mg/L as nitrogen, exceeding the recommended SANS 241 limit of 11 mg/L in some locations, such as borehole RKMA0254. These elevated nitrate values are most likely linked to agricultural activities in the area.

A comparison of chemical data from 2013, 2022, and 2023, as presented in Table 12, indicates no significant temporal changes (i.e., no variations exceeding 20%), although the sample size remains small. The monitoring data suggest that the placement of backfill material has not caused any measurable impact on groundwater quality. Additionally, acid-base accounting performed in 2016 classified the waste rock as non-acid generating, a finding supported by the current groundwater chemistry, which shows no signs of acid rock drainage. Leach testing of waste rock also revealed no mobilization of uranium, with concentrations below laboratory detection limits. Overall, the data indicate that the groundwater system remains chemically stable, with localized quality concerns linked to natural geochemical processes and land use rather than mining or waste disposal activities

Table 12: Comparison of 2013, 2022 and 2023 chemical parameters for Ryst Kuil

Sample No.	pH	EC	TDS	Alkalinity	Ca	Fe	K	Mg	Na	F	Cl	NO3 as N	SO4
		(mS/m)	(mg/l)	(mg/l CaCO3)	(mg/l)								
RKM A0254/17/10/2023	7.56	187	1352	104	145	<0.05	20.2	37.54	197.88	3.44	186.12	59.2	429.1
RKM A025U/21/04/2022	7.17	213	1270	189	188	<0.05	6.77	18.5	213	1.76	218	19.8	346.8
RKN2242H/17/10/2023	7.33	81.9	498	281	36.2	<0.05	12.1	10.09	127.22	2.45	77.9	0.3	46.48
RKN2242H/21/04/2022	7.22	123	644	441	55.2	<0.05	17.1	14.5	158	3.14	98	<0.1	37.95
RKM A0644/17/10/2023	7.34	68.9	446	267	49.2	<0.05	3.8	7.79	96.19	0.98	46.64	<0.1	45.24
RKMA064U/21/04/2022	7.16	73.4	414	263	51.8	<0.05	3.54	7.3	94.4	1.44	35.1	<0.1	34.87
RKMA064U/19/07/2013	7.9	20.3	168	81	12.8	0.1	2.3	2.4	23	1	2.9	<0.1	2.9
KDKW6/17/10/2023	7.44	12.4	63.8	57.7	11.4	<0.05	2.69	1.67	7.55	0.132	5.67	<0.1	<1
KDKW6/21/04/2022	7.03	13.1	66	54.3	12.7	<0.05	3.45	1.6	7.33	0.12	5.26	<0.1	<1
KDKW6/19/07/2013	7.6	36	58	41	10.1	0.02	2.7	1.5	7	0.1	4.5	<0.1	0.2

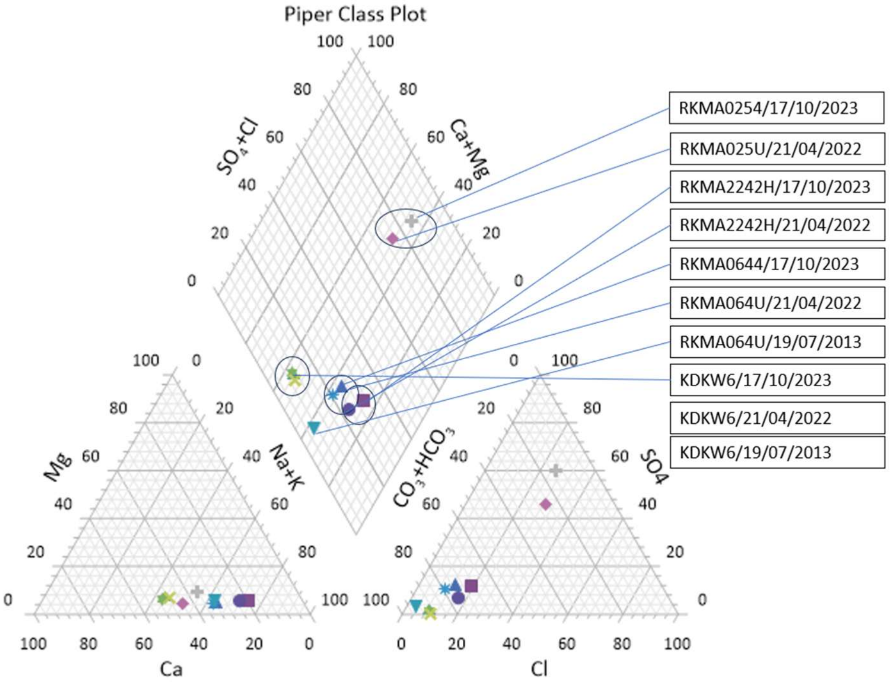


Figure 4: Comparison of 2013, 2022 and 2023 chemical parameters for Ryst Kuil.

Samples from Rietkuil were collected during October 2023. Post-rehabilitation (December 2021) another sample set was collected in April 2022 (see Table 13). The Rietkuil samples were included into this report for the sake of comparison, as well as showing the insignificant effect that back-filling of an open cast pit will have on water quality, even after a ten-year period.

Table 13. Comparison of 2014, 2022 and 2023 chemical parameters for Rietkuil

Sample No.	pH	EC	TDS	Alkalinity	Ca	Fe	K	Mg	Na	F	Cl	NO3 as N	SO4
		(mS/m)	(mg/l)	(mg/l CaCO3)	(mg/l)								
RTKHouse/17/10/2023	7.47	134	922	297	137.8	<0.05	7.07	23.14	130.5	0.703	131.67	3.81	262.5
RTKHOUSE/21/04/2022	7.78	155	896	306	152	<0.05	6.15	24.3	128	0.791	112	2.28	252
RTKDAM1/17/10/2023	8.49	37.3	202	175	48.8	0.03	10.2	7.86	12.96	0.311	8.22	<0.44	19.35
RTKDAM1/21/04/2022	6.78	7.05	80.3	42.2	15.3	0.29	4.72	2.25	7.34	0.171	3.2	0.145	15.71
RTKDAM2/21/04/2022	7.33	15.4	128	61.5	18.4	0.66	7.49	3.57	4.61	0.229	3.71	0.103	6.44
RIET1/11/08/2014	7.05	214	1484	302	151	0.26	14.1	163	238	1.67	295	9.58	374
RIET2/11/08/2014	7.05	215	1532	325	141	0.39	7.56	177	265	1.64	303	3.5	377
RIET3/11/08/2014	7.04	187	1338	264	170	0	3.66	70	207	1.13	215	3.86	435
RIET4/11/08/2014	6.9	242	2302	171	421	0	2.28	44	155	0.75	126	1.04	1170

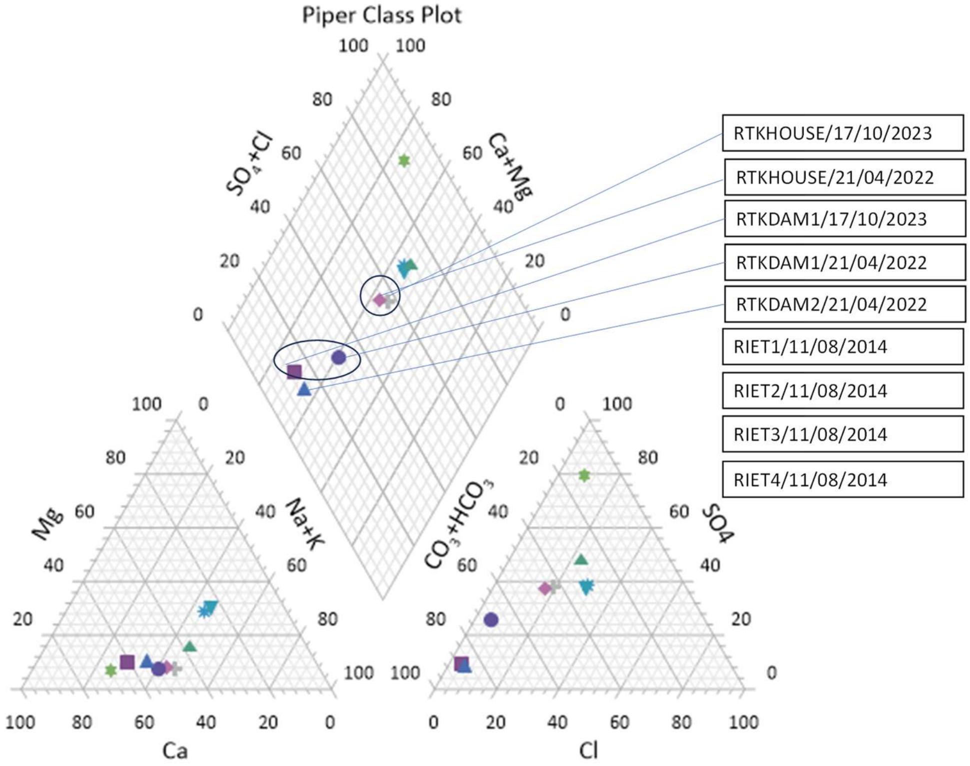


Figure 5. Piper diagram defining the type of the water, using 2014, 2022 and 2023 data for Rietkuil.

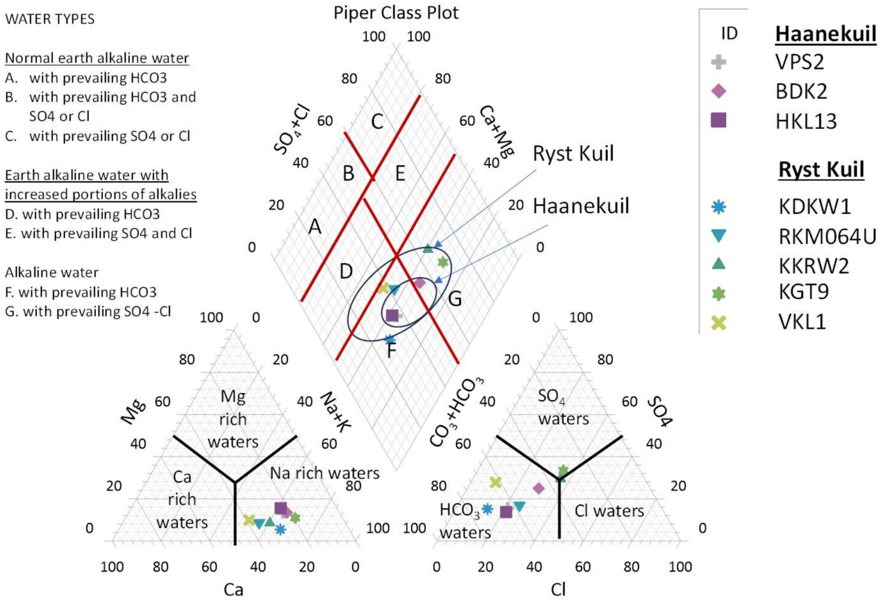


Figure 6. Characteristics of macro-chemistry for groundwater sampled from boreholes on Ryst Kuil and Haanekuil, as indicated, during 2025 (from Rosewarne, 2025), plotted on a Piper diagram.

Table 14. Macro-chemistry of groundwater samples collected during 2025 (from Rosewarne, 2025). SANS 241-1: 2015 – Edition 2 Drinking water standards are indicated.

BH No.	pH (>5 - <9.7)	EC (mS/m) (<170)	Total Alkalinity (as $CaCO_3$)	Na (<200)	K (<50)	Ca (<32)	Mg (<30)	Cl (<300)	SO_4 (<250)	NO_3 (as N) (<11.0)	F (<1.5)	As (<0.01)	Mo	U (<0.03)
Haanekuil														
VPS2	7.10	139	440	158	6.72	60.35	35.36	148	108	2.69	1.69	0.002	0.019	0.062
BDK2	7.21	169	337	171	7.31	59.22	37.40	215	183	10.2	1.71	0.002	0.019	0.053
HKL13	7.59	108	326	92.11	7.09	36.59	24.88	108	68.79	10.68	1.42	0.004	0.014	0.04
Ryst Kuil														
KDKW1	7.01	54.36	175	57.72	3.51	25.88	4.70	31.91	37.06	5.45	1.30	0.003	0.013	0.008
RKM064U	7.14	102	277	90.11	3.65	58.61	12.70	123	77.01	1.59	1.11	0.093	0.534	0.082
KKRW2	7.4	183	265	173	4.27	91.09	24.87	276	226	2.93	0.923	0.006	0.019	0.045
KGT9	7.41	265	356	335	16.71	97.92	55.36	398	379	13.86	1.61	0.005	0.024	0.060
VKL1	7.36	67.75	208	59.13	2.97	47.39	12.25	34.44	92.77	4.77	1.44	0.009	0.029	0.013

9 Effluent Impact – the effective use of synthetic geomembrane liners

The type of liner system used depends mainly on the material to be used on top of the structure, local hydraulic pressure gradient, and climate conditions. A summary of more practical information and scientific knowledge on the use of base liners is being presented in this document. Apart from preventing polluted leachate from seeping into the groundwater, an additional benefit of lining a waste disposal facility is that more water in the waste disposal facility can be captured and returned to the processing plant.

In the mining industry, geomembranes and other geosynthetic products used in basal structures face harsh conditions that are not comparable to those in other industrial applications or landfill constructions. The chemistry of the waste effluent may increase the hydraulic conductivity of geosynthetic clay liners, among others. Little information is currently available because of suspicions that high sulphate content and very high salinity can reduce the durability of geomembranes.

The usage of geomembrane-lined basal structures is known worldwide, but all the structures described in the literature are more or less unique. Geomembranes used in basal structures are typically made from one of the following materials: linear low-density polyethylene (LLDPE), high-density polyethylene (HDPE), polyvinyl chloride (PVC), polypropylene (PP), ethylene propylene diene monomer (EPDM), and ethylene interpolymer alloy (EIA). When choosing geomembrane type, key properties that need to be considered are chemical resistance of the geomembrane, tensile strength, temperature resistance, installation conditions, cost, and previous experiences of its use (Table 15).

Selection of an appropriate geomembrane requires a clear understanding of the combined operation of the geomembrane liner and the underliner and overliner layers, as well as the relevant normal and shear loads. Based on practical experiences (Tuomela, 2021), developed a selection chart to facilitate determination of a suitable geomembrane material (only for HDPE and LLDPE) and its strength (

Table 16). The chart takes into consideration the foundation conditions (the bearing capacity of the subsoil), the underliner and overliner materials, geomembrane thickness, and the load directed at the geomembrane.

Table 15. Listing and comparison of different geomembrane types

Material	Advantages	Disadvantages
HDPE 1	• Broad chemical resistance • Good weld strength • Good low temperature properties	• Potential for stress cracking • High degree of thermal expansion • Potential poor puncture resistance • Potential poor multiaxial strain resistance
LLDPE 2	• Better flexibility than HDPE • Better layflat than HDPE • Good multiaxial strain properties	• Inferior UV resistance compared with HDPE • Inferior chemical resistance compared with HDPE
PP 3	• Can be fabricated and folded at the factory, so fewer field-fabricated seams • Excellent multiaxial properties • Good conformability • Broad seaming temperature window	• Limited resistance to hydrocarbons and chlorinated water
PVC 4	• Good workability and layflat behavior • Easy to seam • Can be folded, so fewer field-fabricated seams	• Potential poor resistance to UV and ozone • Potential poor resistance to weathering • Potential poor performance at high and low temperatures
BGM	• Can be used in challenging climates • Not so sensitive to the quality of the upper material • Being heavy, can also be installed in windy conditions • The only tools needed for installation are a welding torch and roller	• Heavier and thicker (although these can also be advantages) • Thickness is a critical factor for good properties • The chemical resistance of bitumen
EPDM 5	• Good resistance to UV and ozone • High strength characteristics • Excellent layflat behavior • Good low temperature performance	• Potential low resistance to hydrocarbons and solvents • Potential poor seam quality

Table 16. General guide to selecting an appropriate linear low-density (LLDPE) or high-density (HDPE) polyethylene geomembrane.

Foundation Conditions	Underliner	Overliner	Effective Normal Stress (MPa)		
			<0.5	0.5–1.2	>1.2
Firm or high stiffness	Coarse-grained	Coarse-grained	2 mm LLDPE or HDPE	2 mm LLDPE or HDPE	2.5 mm LLDPE or HDPE
		Fine-grained	1.5 mm LLDPE or HDPE	2 mm LLDPE or HDPE	2.5 mm LLDPE or HDPE
	Fine-grained	Coarse-grained	1.5 mm LLDPE or HDPE	1.5 mm LLDPE or HDPE	2 mm LLDPE or HDPE
		Fine-grained	1 mm LLDPE or HDPE	1.5 mm LLDPE or HDPE	2 mm LLDPE or HDPE
Soft or low stiffness	Coarse-grained	Coarse-grained	2 mm LLDPE	2 mm LLDPE	2.5 mm LLDPE
		Fine-grained	1.5 mm LLDPE	2 mm LLDPE	2.5 mm LLDPE
	Fine-grained	Coarse-grained	2 mm LLDPE	2 mm LLDPE	2.5 mm LLDPE
		Fine-grained	1.5 mm LLDPE	2 mm LLDPE	2.5 mm LLDPE

The foundation conditions need to be subjected to appropriate investigations and tests to determine compatibility with the geomembrane. Description of foundation conditions is a relative measure of stiffness. Underliner (Table 16) refers to the material directly beneath the geomembrane (primary geomembrane for double composite liner systems). Testing and design calculations are required to assess the impacts on the geomembrane. The overliner refers to the material directly above the geomembrane. Testing and design calculations are required to assess the impacts on the geomembrane. The effective normal stress is the maximum stress on the geomembrane due to the ore and other externally applied loads

10 Groundwater Resource Protection

Effectively monitoring quantity and quality of groundwater is essential when assessing aquifer vulnerability, degradation tendency and identifying groundwater protection zones. Groundwater contamination and the identification of vulnerable points/areas and the mapping thereof has played a key role in preserving aquifers as it identifies and distinguishes the role of natural aquifer properties and anthropogenic activities on groundwater quality. The fundamental approach towards groundwater protection is to keep it safe from contamination.

11 Conclusions and Recommendations

The important conclusions include:

- From a geochemical perspective the various static tests indicates that the waste rock samples are non-acid forming (NAF). The NAG findings were compared to the ABA assessment and mineralogy of the waste rock samples. This combination was adopted to identify trends in the findings of the different analytical methods used to assess the acid generating potential of the waste rock. These results all were in good agreement with each other.
- The waste rock has been characterized and classified as Type 3;
- Type 3 waste requires, per legislation, a Class C liner to manage and prevent any drainage or seepage that may occur.

The data used in this study are still regarded as preliminary in terms of geochemical characterisation. It is recommended that additional data should still be added for this project to proceed. A continues monitoring program which oversee variations and trends in water quality is essential.

12 Source of information

Portions of the text and data in this document have been sourced from the following reports:

- SRK Report, Ryst Kuil Uranium Project: Definitive Feasibility Study: Groundwater Investigation Phase 1, Report No 377859, August 2007, pp. 78.
- SRK Report, Ryst Kuil Uranium Project: Definitive Feasibility Study: Groundwater Investigation Phase 2, Report No 377859/1, July 2008, pp. 274.
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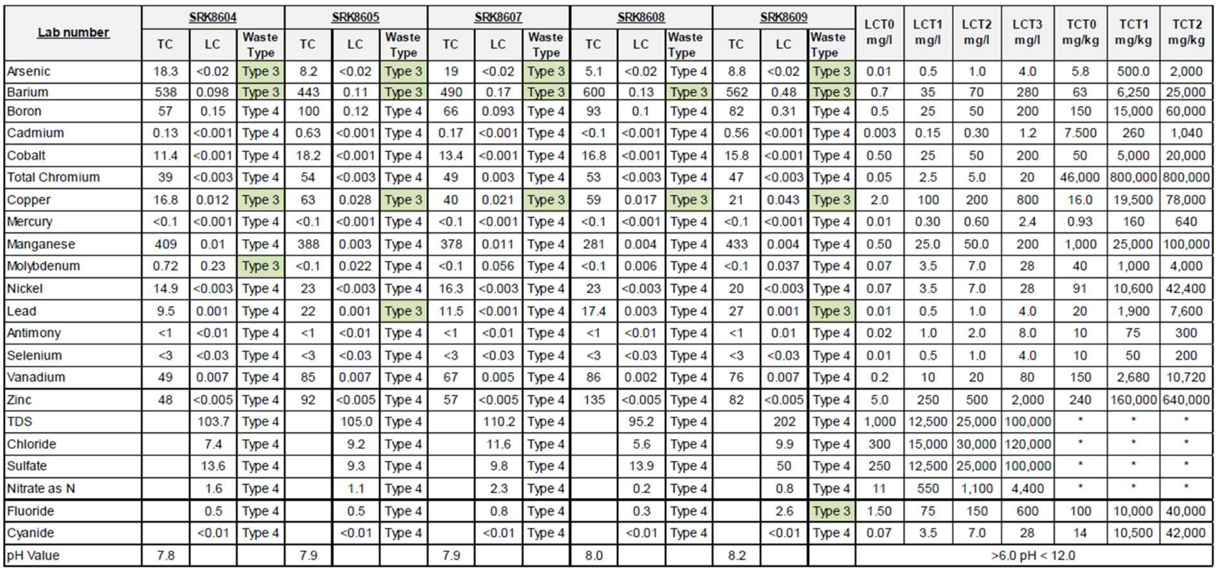
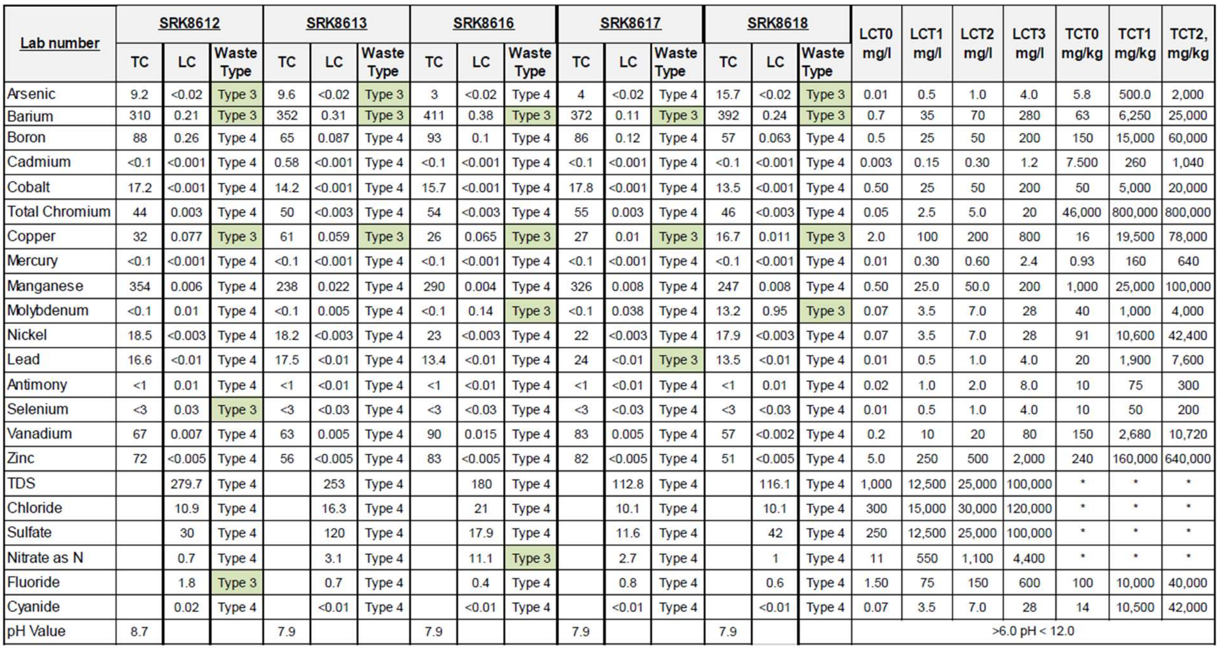
14 Appendix 1 - Waste Classification

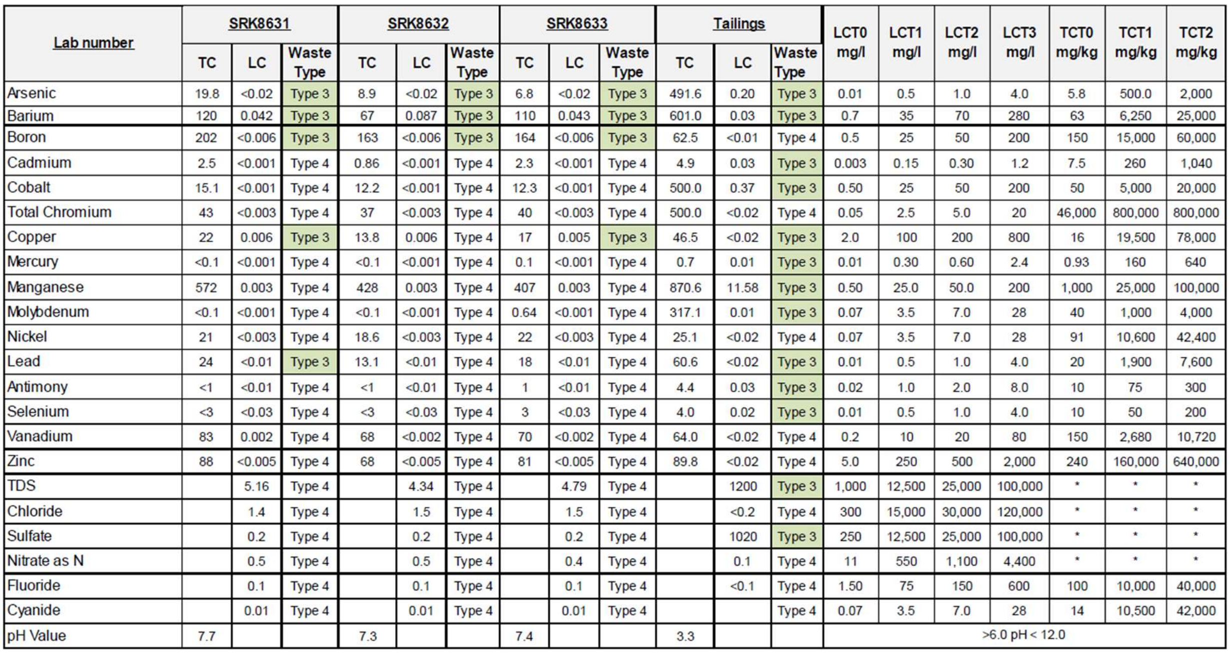
Waste Rock and Tailings Waste Classification (From SRK Consulting Report 508208 Ryst Kuil Geochem Assessment, 2017)



Lab number	SRK8604			SRK8605			SRK8607			SRK8608			SRK8609			LCT0 mg/l	LCT1 mg/l	LCT2 mg/l	LCT3 mg/l	TCT0 mg/kg	TCT1 mg/kg	TCT2 mg/kg
	TC	LC	Waste Type	TC	LC	Waste Type	TC	LC	Waste Type	TC	LC	Waste Type	TC	LC	Waste Type							
Arsenic	18.3	<0.02	Type 3	8.2	<0.02	Type 3	19	<0.02	Type 3	5.1	<0.02	Type 4	8.8	<0.02	Type 3	0.01	0.5	1.0	4.0	5.8	500.0	2,000
Barium	538	0.098	Type 3	443	0.11	Type 3	490	0.17	Type 3	600	0.13	Type 3	562	0.48	Type 3	0.7	35	70	280	63	6,250	25,000
Boron	57	0.15	Type 4	100	0.12	Type 4	66	0.093	Type 4	93	0.1	Type 4	82	0.31	Type 4	0.5	25	50	200	150	15,000	60,000
Cadmium	0.13	<0.001	Type 4	0.63	<0.001	Type 4	0.17	<0.001	Type 4	<0.1	<0.001	Type 4	0.56	<0.001	Type 4	0.003	0.15	0.30	1.2	7.500	260	1,040
Cobalt	11.4	<0.001	Type 4	18.2	<0.001	Type 4	13.4	<0.001	Type 4	16.8	<0.001	Type 4	15.8	<0.001	Type 4	0.50	25	50	200	50	5,000	20,000
Total Chromium	39	<0.003	Type 4	54	<0.003	Type 4	49	0.003	Type 4	53	<0.003	Type 4	47	<0.003	Type 4	0.05	2.5	5.0	20	46,000	800,000	800,000
Copper	16.8	0.012	Type 3	63	0.028	Type 3	40	0.021	Type 3	59	0.017	Type 3	21	0.043	Type 3	2.0	100	200	800	16.0	19,500	78,000
Mercury	<0.1	<0.001	Type 4	<0.1	<0.001	Type 4	<0.1	<0.001	Type 4	<0.1	<0.001	Type 4	<0.1	<0.001	Type 4	0.01	0.30	0.60	2.4	0.93	160	640
Manganese	409	0.01	Type 4	388	0.003	Type 4	378	0.011	Type 4	281	0.004	Type 4	433	0.004	Type 4	0.50	25.0	50.0	200	1,000	25,000	100,000
Molybdenum	0.72	0.23	Type 3	<0.1	0.022	Type 4	<0.1	0.056	Type 4	<0.1	0.006	Type 4	<0.1	0.037	Type 4	0.07	3.5	7.0	28	40	1,000	4,000
Nickel	14.9	<0.003	Type 4	23	<0.003	Type 4	16.3	<0.003	Type 4	23	<0.003	Type 4	20	<0.003	Type 4	0.07	3.5	7.0	28	91	10,600	42,400
Lead	9.5	0.001	Type 4	22	0.001	Type 3	11.5	<0.001	Type 4	17.4	0.003	Type 4	27	0.001	Type 3	0.01	0.5	1.0	4.0	20	1,900	7,600
Antimony	<1	<0.01	Type 4	<1	<0.01	Type 4	<1	<0.01	Type 4	<1	<0.01	Type 4	<1	0.01	Type 4	0.02	1.0	2.0	8.0	10	75	300
Selenium	<3	<0.03	Type 4	<3	<0.03	Type 4	<3	<0.03	Type 4	<3	<0.03	Type 4	<3	<0.03	Type 4	0.01	0.5	1.0	4.0	10	50	200
Vanadium	49	0.007	Type 4	85	0.007	Type 4	67	0.005	Type 4	86	0.002	Type 4	76	0.007	Type 4	0.2	10	20	80	150	2,680	10,720
Zinc	48	<0.005	Type 4	92	<0.005	Type 4	57	<0.005	Type 4	135	<0.005	Type 4	82	<0.005	Type 4	5.0	250	500	2,000	240	160,000	640,000
TDS		103.7	Type 4		105.0	Type 4		110.2	Type 4		95.2	Type 4		202	Type 4	1,000	12,500	25,000	100,000	*	*	*
Chloride		7.4	Type 4		9.2	Type 4		11.6	Type 4		5.6	Type 4		9.9	Type 4	300	15,000	30,000	120,000	*	*	*
Sulfate		13.6	Type 4		9.3	Type 4		9.8	Type 4		13.9	Type 4		50	Type 4	250	12,500	25,000	100,000	*	*	*
Nitrate as N		1.6	Type 4		1.1	Type 4		2.3	Type 4		0.2	Type 4		0.8	Type 4	11	550	1,100	4,400	*	*	*
Fluoride		0.5	Type 4		0.5	Type 4		0.8	Type 4		0.3	Type 4		2.6	Type 3	1.50	75	150	600	100	10,000	40,000
Cyanide		<0.01	Type 4		<0.01	Type 4		<0.01	Type 4		<0.01	Type 4		<0.01	Type 4	0.07	3.5	7.0	28	14	10,500	42,000
pH Value	7.8			7.9			7.9			8.0			8.2			>6.0 pH < 12.0						



Lab number	SRK8612			SRK8613			SRK8616			SRK8617			SRK8618			LCT0 mg/l	LCT1 mg/l	LCT2 mg/l	LCT3 mg/l	TCT0 mg/kg	TCT1 mg/kg	TCT2, mg/kg
	TC	LC	Waste Type	TC	LC	Waste Type	TC	LC	Waste Type	TC	LC	Waste Type	TC	LC	Waste Type							
Arsenic	9.2	<0.02	Type 3	9.6	<0.02	Type 3	3	<0.02	Type 4	4	<0.02	Type 4	15.7	<0.02	Type 3	0.01	0.5	1.0	4.0	5.8	500.0	2,000
Barium	310	0.21	Type 3	352	0.31	Type 3	411	0.38	Type 3	372	0.11	Type 3	392	0.24	Type 3	0.7	35	70	280	63	6,250	25,000
Boron	88	0.26	Type 4	65	0.087	Type 4	93	0.1	Type 4	86	0.12	Type 4	57	0.063	Type 4	0.5	25	50	200	150	15,000	60,000
Cadmium	<0.1	<0.001	Type 4	0.58	<0.001	Type 4	<0.1	<0.001	Type 4	<0.1	<0.001	Type 4	<0.1	<0.001	Type 4	0.003	0.15	0.30	1.2	7.500	260	1,040
Cobalt	17.2	<0.001	Type 4	14.2	<0.001	Type 4	15.7	<0.001	Type 4	17.8	<0.001	Type 4	13.5	<0.001	Type 4	0.50	25	50	200	50	5,000	20,000
Total Chromium	44	0.003	Type 4	50	<0.003	Type 4	54	<0.003	Type 4	55	0.003	Type 4	46	<0.003	Type 4	0.05	2.5	5.0	20	46,000	800,000	800,000
Copper	32	0.077	Type 3	61	0.059	Type 3	26	0.065	Type 3	27	0.01	Type 3	16.7	0.011	Type 3	2.0	100	200	800	16	19,500	78,000
Mercury	<0.1	<0.001	Type 4	<0.1	<0.001	Type 4	<0.1	<0.001	Type 4	<0.1	<0.001	Type 4	<0.1	<0.001	Type 4	0.01	0.30	0.60	2.4	0.93	160	640
Manganese	354	0.006	Type 4	238	0.022	Type 4	290	0.004	Type 4	326	0.008	Type 4	247	0.008	Type 4	0.50	25.0	50.0	200	1,000	25,000	100,000
Molybdenum	<0.1	0.01	Type 4	<0.1	0.005	Type 4	<0.1	0.14	Type 3	<0.1	0.038	Type 4	13.2	0.95	Type 3	0.07	3.5	7.0	28	40	1,000	4,000
Nickel	18.5	<0.003	Type 4	18.2	<0.003	Type 4	23	<0.003	Type 4	22	<0.003	Type 4	17.9	<0.003	Type 4	0.07	3.5	7.0	28	91	10,600	42,400
Lead	16.6	<0.01	Type 4	17.5	<0.01	Type 4	13.4	<0.01	Type 4	24	<0.01	Type 3	13.5	<0.01	Type 4	0.01	0.5	1.0	4.0	20	1,900	7,600
Antimony	<1	0.01	Type 4	<1	<0.01	Type 4	<1	<0.01	Type 4	<1	<0.01	Type 4	<1	0.01	Type 4	0.02	1.0	2.0	8.0	10	75	300
Selenium	<3	0.03	Type 3	<3	<0.03	Type 4	<3	<0.03	Type 4	<3	<0.03	Type 4	<3	<0.03	Type 4	0.01	0.5	1.0	4.0	10	50	200
Vanadium	67	0.007	Type 4	63	0.005	Type 4	90	0.015	Type 4	83	0.005	Type 4	57	<0.002	Type 4	0.2	10	20	80	150	2,680	10,720
Zinc	72	<0.005	Type 4	56	<0.005	Type 4	83	<0.005	Type 4	82	<0.005	Type 4	51	<0.005	Type 4	5.0	250	500	2,000	240	160,000	640,000
TDS		279.7	Type 4		253	Type 4		180	Type 4		112.8	Type 4		116.1	Type 4	1,000	12,500	25,000	100,000	*	*	*
Chloride		10.9	Type 4		16.3	Type 4		21	Type 4		10.1	Type 4		10.1	Type 4	300	15,000	30,000	120,000	*	*	*
Sulfate		30	Type 4		120	Type 4		17.9	Type 4		11.6	Type 4		42	Type 4	250	12,500	25,000	100,000	*	*	*
Nitrate as N		0.7	Type 4		3.1	Type 4		11.1	Type 3		2.7	Type 4		1	Type 4	11	550	1,100	4,400	*	*	*
Fluoride		1.8	Type 3		0.7	Type 4		0.4	Type 4		0.8	Type 4		0.6	Type 4	1.50	75	150	600	100	10,000	40,000
Cyanide		0.02	Type 4		<0.01	Type 4		<0.01	Type 4		<0.01	Type 4		<0.01	Type 4	0.07	3.5	7.0	28	14	10,500	42,000
pH Value	8.7			7.9			7.9			7.9			7.9			>6.0 pH < 12.0						



Lab number	SRK8631			SRK8632			SRK8633			Tailings			LCT0 mg/l	LCT1 mg/l	LCT2 mg/l	LCT3 mg/l	TCT0 mg/kg	TCT1 mg/kg	TCT2 mg/kg
	TC	LC	Waste Type	TC	LC	Waste Type	TC	LC	Waste Type	TC	LC	Waste Type							
Arsenic	19.8	<0.02	Type 3	8.9	<0.02	Type 3	6.8	<0.02	Type 3	491.6	0.20	Type 3	0.01	0.5	1.0	4.0	5.8	500.0	2,000
Barium	120	0.042	Type 3	67	0.087	Type 3	110	0.043	Type 3	601.0	0.03	Type 3	0.7	35	70	280	63	6,250	25,000
Boron	202	<0.006	Type 3	163	<0.006	Type 3	164	<0.006	Type 3	62.5	<0.01	Type 4	0.5	25	50	200	150	15,000	60,000
Cadmium	2.5	<0.001	Type 4	0.86	<0.001	Type 4	2.3	<0.001	Type 4	4.9	0.03	Type 3	0.003	0.15	0.30	1.2	7.5	260	1,040
Cobalt	15.1	<0.001	Type 4	12.2	<0.001	Type 4	12.3	<0.001	Type 4	500.0	0.37	Type 3	0.50	25	50	200	50	5,000	20,000
Total Chromium	43	<0.003	Type 4	37	<0.003	Type 4	40	<0.003	Type 4	500.0	<0.02	Type 4	0.05	2.5	5.0	20	46,000	800,000	800,000
Copper	22	0.006	Type 3	13.8	0.006	Type 4	17	0.005	Type 3	46.5	<0.02	Type 3	2.0	100	200	800	16	19,500	78,000
Mercury	<0.1	<0.001	Type 4	<0.1	<0.001	Type 4	0.1	<0.001	Type 4	0.7	0.01	Type 3	0.01	0.30	0.60	2.4	0.93	160	640
Manganese	572	0.003	Type 4	428	0.003	Type 4	407	0.003	Type 4	870.6	11.58	Type 3	0.50	25.0	50.0	200	1,000	25,000	100,000
Molybdenum	<0.1	<0.001	Type 4	<0.1	<0.001	Type 4	0.64	<0.001	Type 4	317.1	0.01	Type 3	0.07	3.5	7.0	28	40	1,000	4,000
Nickel	21	<0.003	Type 4	18.6	<0.003	Type 4	22	<0.003	Type 4	25.1	<0.02	Type 4	0.07	3.5	7.0	28	91	10,600	42,400
Lead	24	<0.01	Type 3	13.1	<0.01	Type 4	18	<0.01	Type 4	60.6	<0.02	Type 3	0.01	0.5	1.0	4.0	20	1,900	7,600
Antimony	<1	<0.01	Type 4	<1	<0.01	Type 4	1	<0.01	Type 4	4.4	0.03	Type 3	0.02	1.0	2.0	8.0	10	75	300
Selenium	<3	<0.03	Type 4	<3	<0.03	Type 4	3	<0.03	Type 4	4.0	0.02	Type 3	0.01	0.5	1.0	4.0	10	50	200
Vanadium	83	0.002	Type 4	68	<0.002	Type 4	70	<0.002	Type 4	64.0	<0.02	Type 4	0.2	10	20	80	150	2,680	10,720
Zinc	88	<0.005	Type 4	68	<0.005	Type 4	81	<0.005	Type 4	89.8	<0.02	Type 4	5.0	250	500	2,000	240	160,000	640,000
TDS		5.16	Type 4		4.34	Type 4		4.79	Type 4		1200	Type 3	1,000	12,500	25,000	100,000	*	*	*
Chloride		1.4	Type 4		1.5	Type 4		1.5	Type 4		<0.2	Type 4	300	15,000	30,000	120,000	*	*	*
Sulfate		0.2	Type 4		0.2	Type 4		0.2	Type 4		1020	Type 3	250	12,500	25,000	100,000	*	*	*
Nitrate as N		0.5	Type 4		0.5	Type 4		0.4	Type 4		0.1	Type 4	11	550	1,100	4,400	*	*	*
Fluoride		0.1	Type 4		0.1	Type 4		0.1	Type 4		<0.1	Type 4	1.50	75	150	600	100	10,000	40,000
Cyanide		0.01	Type 4		0.01	Type 4		0.01	Type 4			Type 4	0.07	3.5	7.0	28	14	10,500	42,000
pH Value	7.7			7.3			7.4			3.3			>6.0 pH < 12.0						