Developing an interactive web-based risk assessment framework from the mine waste atlas: A pilot study in the Northern Cape

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SAIMM
THE SOUTHERN AFRICAN INSTITUTE OF MINING AND METALLURGY

ESG IN THE MINERALS INDUSTRY CHALLENGES AND OPPORTUNITIES

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UNIVERSITY OF CAPE TOWN
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minerals to metals

NRF National Research Foundation

Background and Motivation

Current State of Mine Waste Management

- Extensive mining activity
- Fragmented data availability
- Unrehabilitated mine sites

Environmental Risks

- Air pollution
- Water contamination
- Land degradation

Social Risks

- Health risk to communities
- Social Wellbeing

Gamsberg Tailings Storage Facility (International Mining, 2021)

Need for Interactive and Dynamic tool

Up to date monitoring | Integrated data | Proactive management

Aligning with ESG principles to promote sustainable mining practices

MONEY & INVESTING

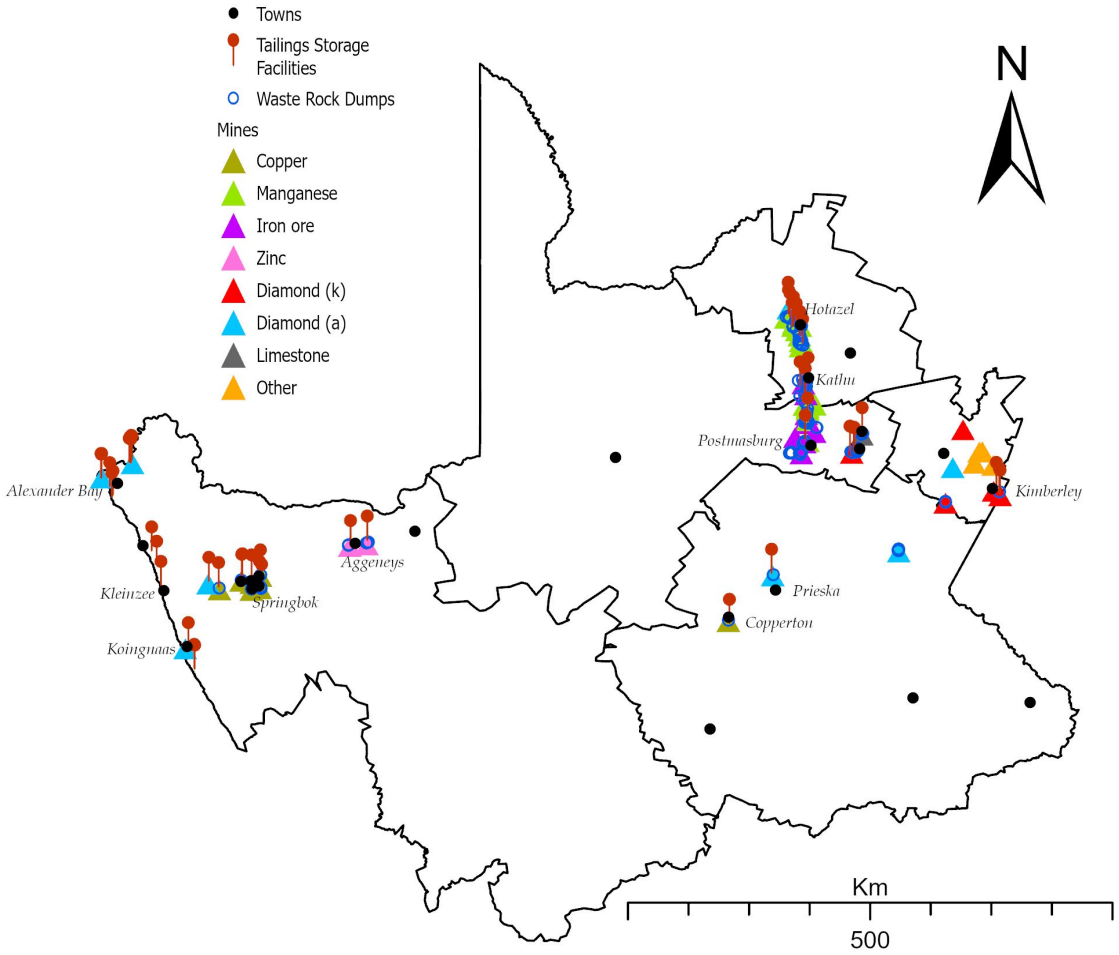
NEW TECH FROM OLD DOGS

Is the Northern Cape the new mining boom province?

Historic mines in the mineral-rich Northern Cape have a new lease of life thanks to the rise of smarter technology

BL PREMIUM

27 JUNE 2019 - 05:00 *by* LISA STEYN



Operating and disused mines, Tailings Storage Facilities and Waster Rock Dumps in the Northern Cape from the Mine Waste Atlas (Koovarjee et al., 2023)

Vedanta Zinc breaks ground on R7bn Gamsberg expansion project

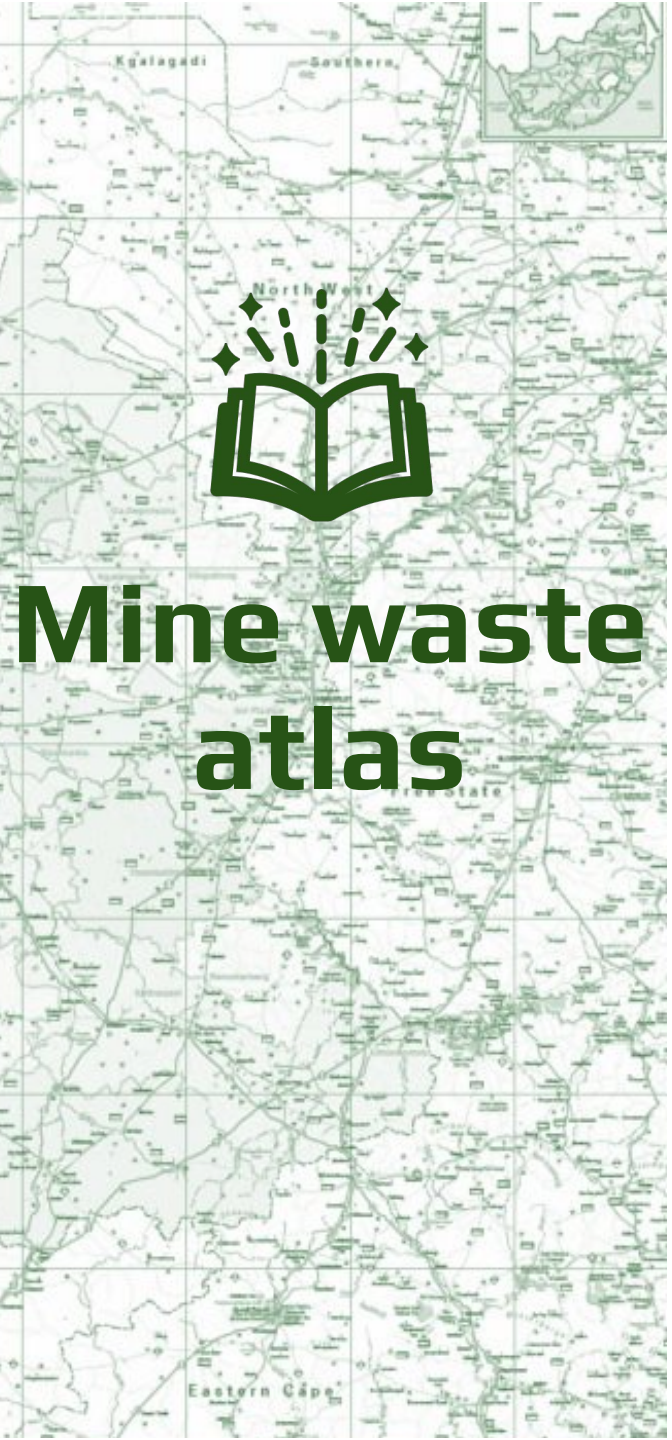
5TH AUGUST 2022 BY: DARREN PARKER - SENIOR ONLINE WRITER

GOVERNMENT

BUSINESSTECH

Government's multi-billion rand development plan for the Northern Cape

Staff Writer · 11 Jul 2023



Mine waste atlas

Infrastructure, Land-use, Meteorological data

- Settlement Information
  Roads, Bridges, Housing
- Agriculture and vegetation
- Hydrology
- Wind speed and direction

+

Mine waste (TSFs) attributes

- Exact location
- Ownership
- Status:
  Active/Inactive
- Size of footprint
- Elevation

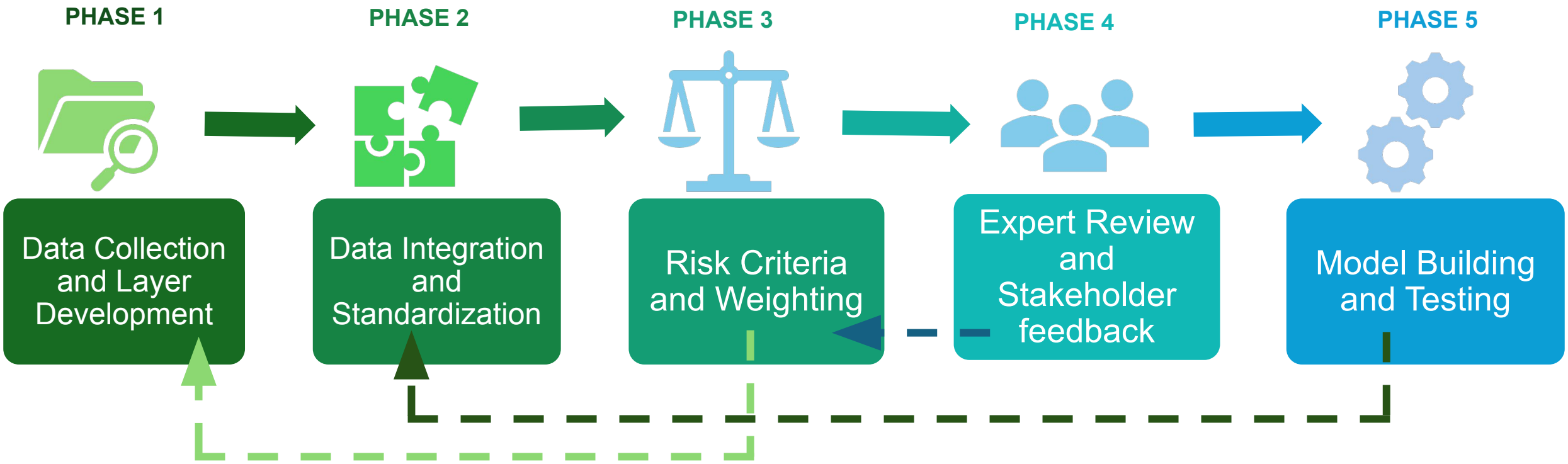
Risk rating system for mine waste

Environmental + Social factors

Integrated risk score to prioritize management actions

Balaniuk et al., 2020; Sarker et al., 2022; Werner et al., 2020; Winde et al., 2019

Overview of the Risk Assessment Methodology

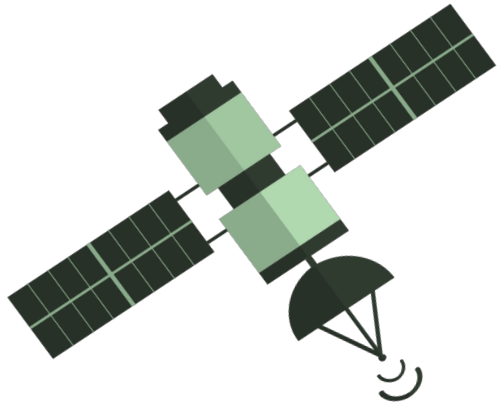


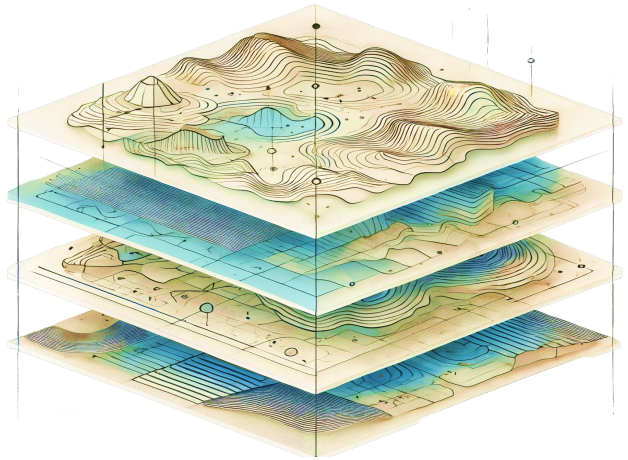
Data Collection and Integration

Phase 1

Data Types Collected

- **Environmental Data:** Hydrology, meteorology, biodiversity.
- **Social Data:** Population density, community health, infrastructure.
- **Mine Waste Data:** Tailings properties, historical incidents, site status.





Phase 2

Integration Process

- Standardizing data from multiple sources.
- Aligning geospatial and temporal data for consistency.
- Ensuring data quality through checks and validation.

Risk Criteria and Weighting Overview

Phase 3

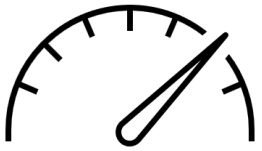
RISK CATEGORIES

- Biodiversity
- Land use
- Climate & weather
- Water

+ **Future Considerations:** Social, Governance, Infrastructure

RISK LEVELS AND WEIGHTING PROCESS

Assess each indicator based on the five-point scale:



Very Low (1)
Low (2)
Moderate (3)
High (4)
Very High (5)

Weighting: based on factor significance according to published literature

Risk Categories

Influencing Factors

Indicators

Risk Rating

Weighting

Preliminary Weighting Tables

Influencing Factor	Indicator	Risk Category :Biodiversity (Exposure)					Weighting
		1: Very Low	2: Low	3: Moderate	4:High	5:Very High	

Influencing Factor	Indicator	Climate and weather (Hazard)					Weighting
		1: Very Low	2: Low	3: Moderate	4:High	5:Very High	

Influencing Factor	Indicator	Landuse (Exposure)					Weighting
		1: Very Low	2: Low	3: Moderate	4:High	5:Very High	

Influencing Factor	Indicator	Water (Exposure)					Weighting
		1: Very Low	2: Low	3: Moderate	4:High	5:Very High	
Type of water body	Type of water body		Non-Perennial	Dams and Reservoirs	Perennial		
Proximity to water body	Distance from mine (km)	>20	>10-20	>5-10	>1-5		
Groundwater							
Surface Water Flow Patterns	Surface run off (mm)	< 1 mm	1–5 mm	5–10 mm	10–25 mm		

\+ Social Governance Infrastructure

Next Steps: Expert Review and Model Testing and Validation

Phase 4

Expert Review and Stakeholder Feedback

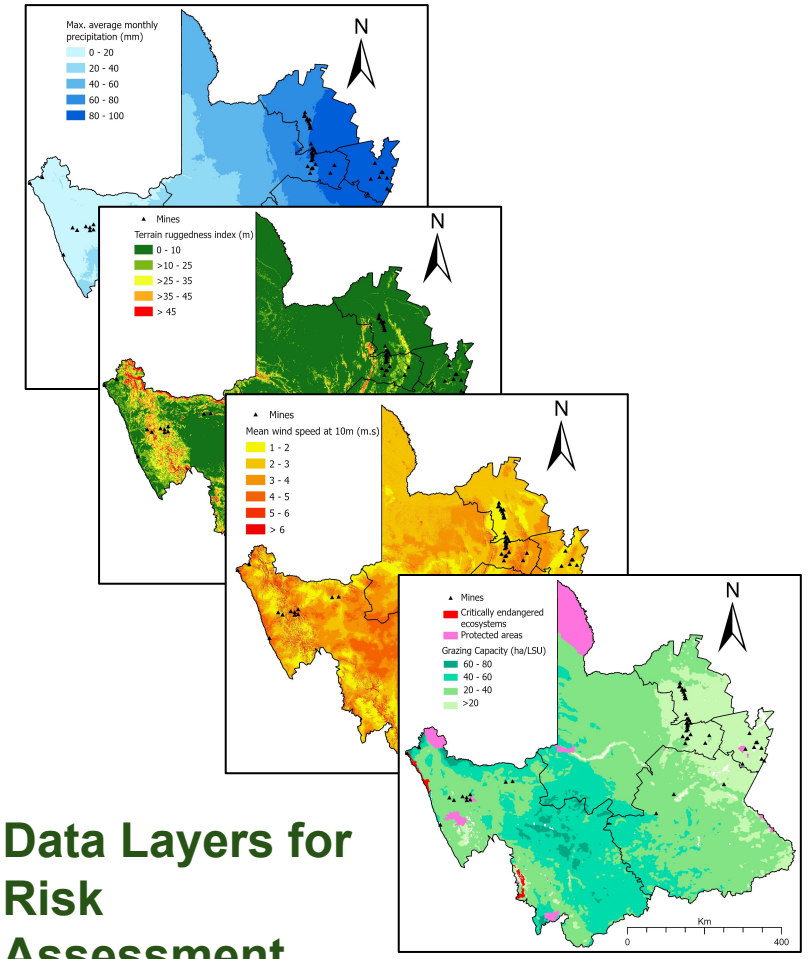
- **Objective:** Refine the risk assessment framework through expert feedback.
- **Stakeholder Engagement:**
  - Collaboration with industry experts, environmental scientists, local authorities, and community representatives.
- **Key Focus Areas for Feedback:**
  - Accuracy of risk indicators.
  - Appropriateness of weightings.
  - Identification of gaps or missing risk factors.
- **Iterative Process:**

Phase 5

Model Testing and Validation

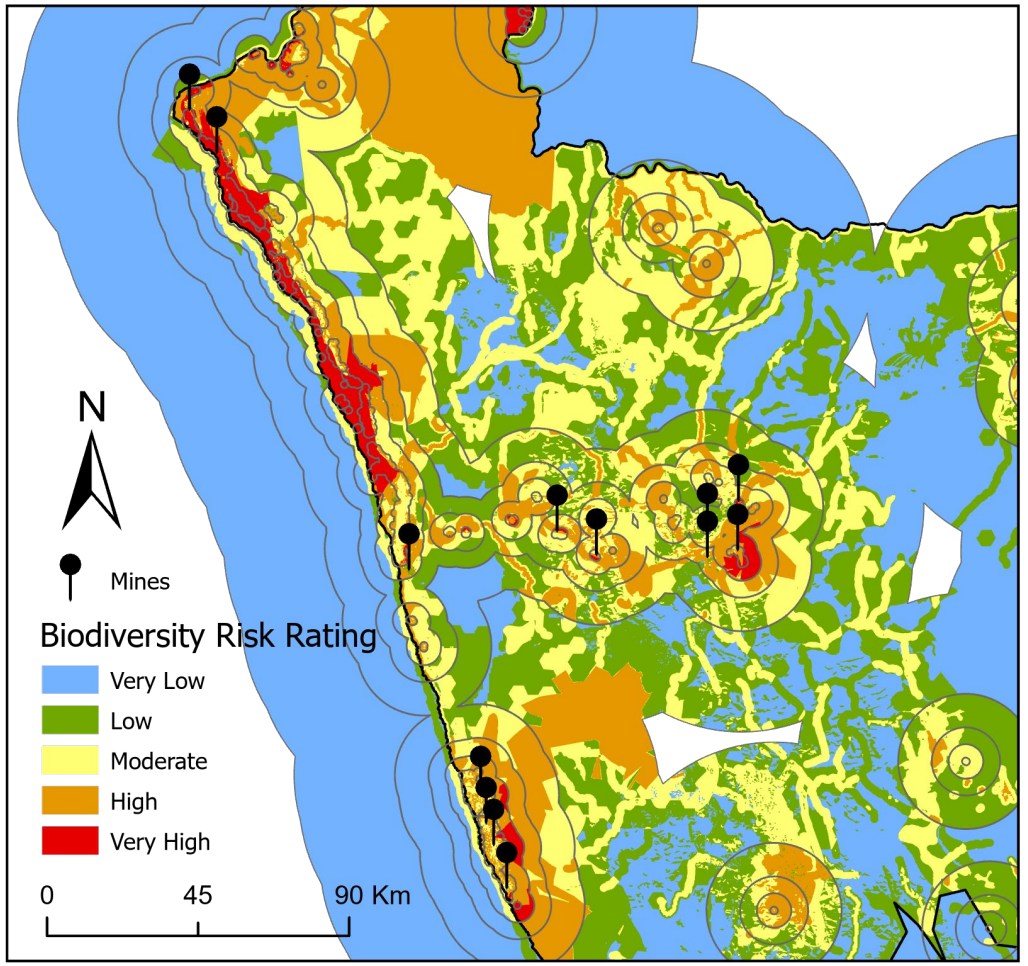
- **Model Testing Approach:**
  - Conduct scenario analysis (e.g., extreme weather, different site conditions).
  - Compare model predictions with historical data (where possible).
- **Validation Process:**
  - Use **case studies** to verify model predictions.
  - Identify discrepancies and refine.
- **Key Metrics for Validation:**
  - Accuracy in identifying high-risk areas.
  - Sensitivity to data changes.
  - Consistency of results across different

Example: Data Integration and Layer Compilation for Risk Mapping



Data Layers for Risk Assessment

Data integration



Biodiversity Risk Map (Example)

This is an illustrative example, and the layers shown here may not reflect the exact datasets used in the final analysis. The process remains the same: multiple layers are compiled to form a holistic view of risk in a given area

Challenges related to developing a Risk Assessment Framework

- Data Availability
- Incomplete and Inconsistent Data
- Defining comprehensive risk criteria
- Adapting to Local Context: Requires Ongoing Evaluation
- Navigating the Interconnectedness of Environmental and Social Variables

Opportunities in Developing the Risk Assessment Framework

- Enhance data integration and Accessibility
- Proactive Risk Management and Mitigation
- Informed Decision-Making for stakeholders
- Scalability and Adaptability to other regions
- Promotes Sustainable Mining Practices

Conclusion

1. The interactive framework is designed to enhance sustainable mining practices.

2. Scalability allows it to be adapted to other regions, setting a new standard for risk management.

3. Alignment with ESG principles ensures the long-term viability of mining operations.

Next Steps

Expert review and feedback integration

Model testing using Northern Cape case studies

Expansion of pilot framework to other regions

Thank you!!

Acknowledgements

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ESG IN THE MINERALS INDUSTRY
CHALLENGES AND OPPORTUNITIES

Imagine a province with vast mining potential and growing environmental and social concern about mine waste management.

How can we turn this challenge into a unique opportunity for responsible mining practices and contribute to sustainable

Namakwaland (SAvenues, 2023)