

|                                                                                   |              |              |
|-----------------------------------------------------------------------------------|--------------|--------------|
|  | <b>Scope</b> | <b>NTCSA</b> |
|-----------------------------------------------------------------------------------|--------------|--------------|

Title: **Scope of Works – Investigate potential subsurface instability in the vicinity of the NTCSA Vulcan Substation**

Unique Identifier: **240 - 98155775**

Alternative Reference Number:

Area of Applicability: **North East Grid**

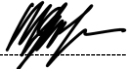
Documentation Type: **Report**

Revision: **1.0**

Total Pages: **21**

Next Review Date: **N/A**

Disclosure Classification: **CONTROLLED DISCLOSURE**

| Compiled by                                                                                                                                                         | Supported by                                                                                                                                                                                                    | Supported by                                                                                                                                                                                                    | Authorized by                                                                                                                                                       |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <br><b>T. Mafutsana</b><br><b>Chief Engineer</b><br><b>NTCSA North East Grid</b> | <br><b>T. Mphaphuli</b><br><b>Chief Advisor</b><br><b>Geoscience/ Real Estate Servitude &amp; Land Management Department</b> | <br><b>N. Leseke</b><br><b>Senior Geologist</b><br><b>Geoscience/ Real Estate Servitude &amp; Land Management Department</b> | <br><b>M. Khumalo</b><br><b>Senior Manager</b><br><b>NTCSA North East Grid</b> |

Date: 21/04/2026

Date: 23 April 2026

Date: 23 April 2026

Date: 23/04/2026

|                                                                                   |                                                                                                                     |              |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|--------------|
|  | <b>Scope of Works – Investigate potential subsurface instability in the vicinity of the NTCSA Vulcan Substation</b> | <b>NTCSA</b> |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|--------------|

## Contents

|                                                           |           |
|-----------------------------------------------------------|-----------|
| <b>1. INTRODUCTION .....</b>                              | <b>3</b>  |
| 1.1 PURPOSE .....                                         | 6         |
| 1.2 APPLICABILITY .....                                   | 6         |
| <b>2. NORMATIVE/INFORMATIVE REFERENCES .....</b>          | <b>6</b>  |
| 2.1 Normative.....                                        | 6         |
| 2.2 Informative .....                                     | 7         |
| 2.3 SAFETY, HEALTH AND ENVIRONMENT .....                  | 7         |
| <b>3 DEFINITIONS AND ABBREVIATIONS.....</b>               | <b>8</b>  |
| 3.1 DEFINITIONS .....                                     | 8         |
| 3.2 ABBREVIATIONS .....                                   | 9         |
| <b>4 ROLES AND RESPONSIBILITIES .....</b>                 | <b>9</b>  |
| <b>5 PROJECT RISKS .....</b>                              | <b>11</b> |
| <b>6 DETAILED SCOPE OF WORK.....</b>                      | <b>11</b> |
| 6.1 SITE WALKOVER .....                                   | 11        |
| 6.2 SAFE WORKING PROCEDURE.....                           | 11        |
| 6.3 GEOTECHNICAL INVESTIGATION SCOPES .....               | 12        |
| 6.3.1 Subsurface assessment by non-invasive methods ..... | 12        |
| 6.3.2 Geotechnical Investigations.....                    | 14        |
| <b>7. DELIVERABLES .....</b>                              | <b>18</b> |
| • <b>APPENDIX A: GENERIC RISK ASSESSMENT .....</b>        | <b>19</b> |

Copy right © of NATIONAL TRANSMISSION COMPANY SOUTH AFRICA SOC LTD

When downloaded from the document management system, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorized version on the system.

No part of this document may be reproduced without the expressed consent of the copyright holder, NATIONAL TRANSMISSION COMPANY SOUTH AFRICA SOC LTD (Registration number: 2021/539129/30)

|                                                                                   |                                                                                                                                           |                                    |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|
|  | <p align="center"><b>Scope of Works – Investigate potential subsurface instability in the vicinity of the NTCSA Vulcan Substation</b></p> | <p align="center"><b>NTCSA</b></p> |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|

## 1. INTRODUCTION

The Vulcan Transmission Substation is located in Emalahleni (Witbank CLN), an area extensively impacted by historic underground and surface coal mining activities. Decades of bord-and-pillar mining have resulted in significant underground voids, many of which are unstable or have partially collapsed. In addition, spontaneous combustion of remnant coal pillars has caused persistent underground fires, leading to thermal fracturing of the overburden, oxidation of support pillars, and progressive subsidence. These conditions have materially contributed to the formation and ongoing enlargement of sinkholes in the broader Emalahleni region. The historical undermining map has been received from the current mine owner and indicates the Arnot Kendal 400kV tower 227 is currently placed on a mine pillar (**Refer Figure 1 below**) and also indicated the sinkholes North West of Vulcan substation.

The area under consideration presents a material risk to public safety and to critical national electricity infrastructure. The Vulcan Transmission Substation, together with the associated 400 kV transmission infrastructure, is located directly above coal seams affected by historic mining. Progressive subsidence and underground combustion threaten the structural integrity of the substation and transmission assets. If not addressed, these risks could result in prolonged operational disruptions, loss of supply to key industrial customers, significant financial exposure, infrastructure failure, and potential serious injury or loss of life.

No details are available on the depth and details of the historically undermined area therefore the extent of the risk to the powerline structures cannot be fully established. Numerous factors can contribute to spontaneous combustion, such as a substantial electrical short beneath the surface or soil composition containing easily combustible materials. Hence the *Employer* intends to investigate as subsidence at Vulcan substation and adjacent areas caused by spontaneous combustion, to define the severity of the risk to NTCSA infrastructure.

Copy right © of NATIONAL TRANSMISSION COMPANY SOUTH AFRICA SOC LTD

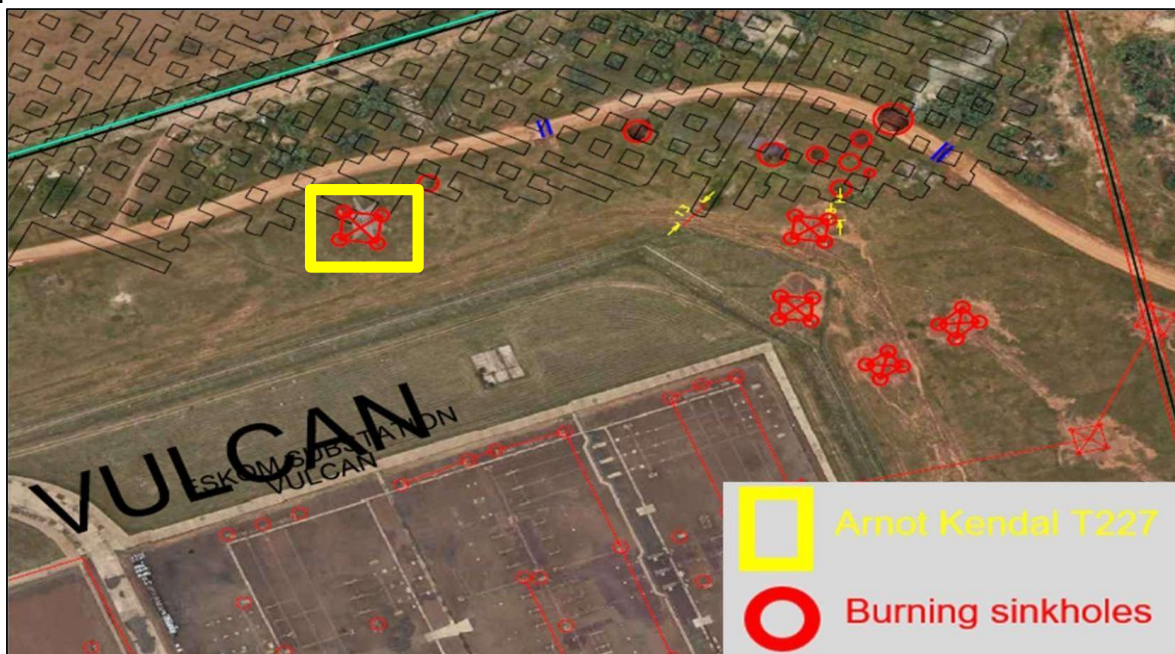
When downloaded from the document management system, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorized version on the system.

No part of this document may be reproduced without the expressed consent of the copyright holder, NATIONAL TRANSMISSION COMPANY SOUTH AFRICA SOC LTD (Registration number: 2021/539129/30)

|                                                                                   |                                                                                                                     |              |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|--------------|
|  | <b>Scope of Works – Investigate potential subsurface instability in the vicinity of the NTCSA Vulcan Substation</b> | <b>NTCSA</b> |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|--------------|

The *Employer* requires a professionally Geologists (referred to hereafter as the *Contractor*) to:

- conduct comprehensive methodology for conducting subsidence investigations at and around the Vulcan Substation and adjacent areas to determine the level of risk of failure NTCSA infrastructure (i.e. Vulcan substation and Arnot Kendal tower 227), refer to figures 1 and 2.
- capture the extent of the phenomenon and its impacts to other critical infrastructure in the area as defined in bullet above.
- Compile and issue detailed report of the finding and proposed solutions to mitigate the potential risk/s



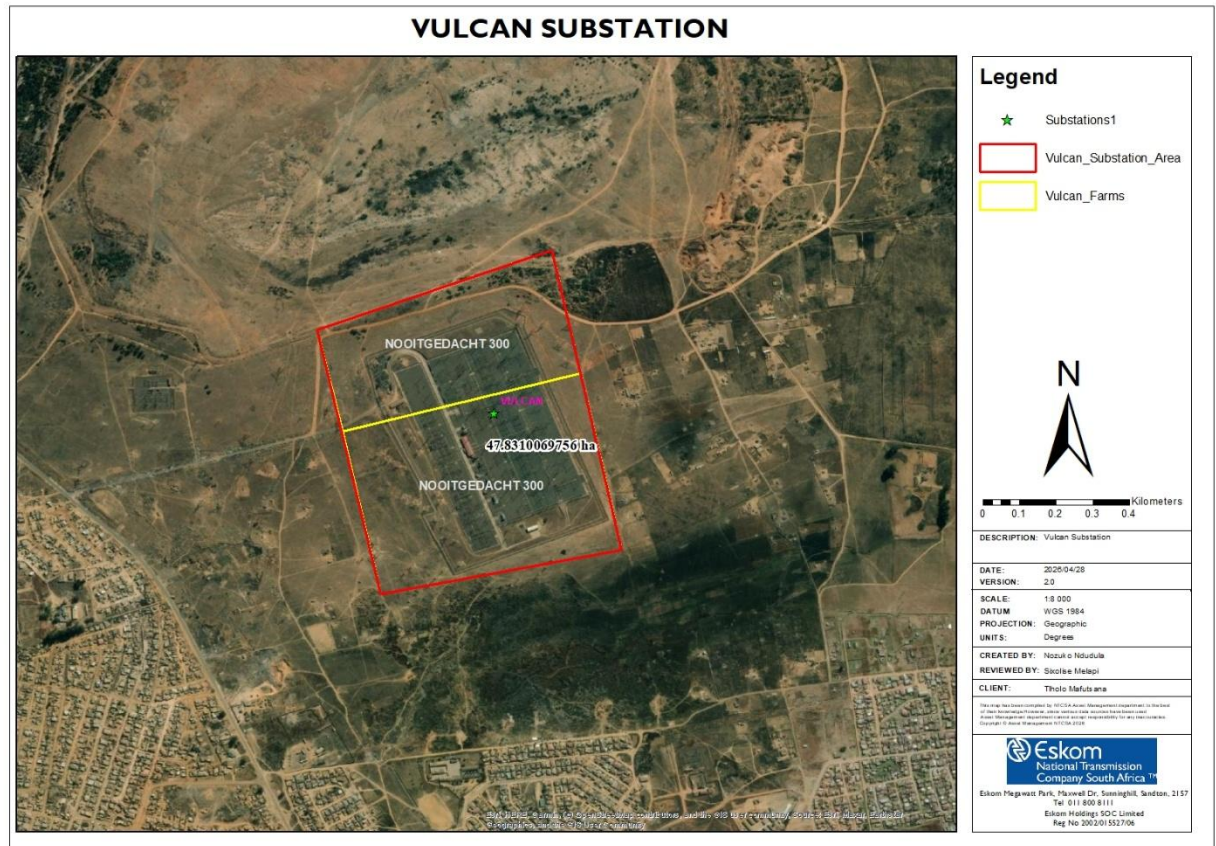
**Figure 1. Arnot Kendal 400kV T227 Tower location indicating undermined area and burning sinkholes**

Copy right © of NATIONAL TRANSMISSION COMPANY SOUTH AFRICA SOC LTD

When downloaded from the document management system, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorized version on the system.

No part of this document may be reproduced without the expressed consent of the copyright holder, NATIONAL TRANSMISSION COMPANY SOUTH AFRICA SOC LTD (Registration number: 2021/539129/30)

|                                                                                   |                                                                                                                     |              |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|--------------|
|  | <b>Scope of Works – Investigate potential subsurface instability in the vicinity of the NTCSA Vulcan Substation</b> | <b>NTCSA</b> |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|--------------|



**Figure 2. Area of Interest (Red Boundary)**

Copy right © of NATIONAL TRANSMISSION COMPANY SOUTH AFRICA SOC LTD

When downloaded from the document management system, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorized version on the system.

No part of this document may be reproduced without the expressed consent of the copyright holder, NATIONAL TRANSMISSION COMPANY SOUTH AFRICA SOC LTD (Registration number: 2021/539129/30)

|                                                                                   |                                                                                                                     |              |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|--------------|
|  | <b>Scope of Works – Investigate potential subsurface instability in the vicinity of the NTCSA Vulcan Substation</b> | <b>NTCSA</b> |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|--------------|

## 1.1 PURPOSE

The purpose of this scope of works is to outline to minimum assessments to be conduct investigations in and around Vulcan Substation area by using Geotechnical investigations and Subsurface assessment by non-invasive methods.

## 1.2 APPLICABILITY

This document applies to the Vulcan Substation and surrounding area.

## 2. NORMATIVE/INFORMATIVE REFERENCES

Parties using this document must apply the most recent revisions of the documents listed in the following paragraphs.

### 2.1 Normative

- [1] 240-47172520 (TRMSCAAC 6.0): *“The Standard for The Construction of Overhead Powerlines”*
- [2] SANS10280: *“Overhead power lines for conditions prevailing in South Africa”*
- [3] ISO 9001 (2015): *“Quality Management System”*
- [4] ISO 14001 (2015): *“Environmental Management System”*
- [5] National Environmental Management Act, 1998 (NEMA) (Act No 107 of 1998)
- [6] Occupational, Health and Safety Act 85 of 1993
- [7] 240-80605256: *“Access to Private Property Standard”*
- [8] 32-846: *“Eskom Operating Regulations for High Voltage System (ORHVS)”*

Copy right © of NATIONAL TRANSMISSION COMPANY SOUTH AFRICA SOC LTD

When downloaded from the document management system, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorized version on the system.

No part of this document may be reproduced without the expressed consent of the copyright holder, NATIONAL TRANSMISSION COMPANY SOUTH AFRICA SOC LTD (Registration number: 2021/539129/30)

|                                                                                   |                                                                                                                     |              |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|--------------|
|  | <b>Scope of Works – Investigate potential subsurface instability in the vicinity of the NTCSA Vulcan Substation</b> | <b>NTCSA</b> |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|--------------|

## 2.2 Informative

- [9] L09482 (June 2025): “*Thermal & Colour Ortho-Imagery Data: METADATA REPORT*”
- [10] PDF/DGN Maps: Undermining (Excelsior Cavities)
- [11] Fenn, D., du Kanda, A., and Dukhan, D. (2015): “*Determining settlement rates and surface stability using in situ density of backfill as a proxy for displacement*”.

## 2.3 SAFETY, HEALTH AND ENVIRONMENT

- Personal Protective Equipment (PPE) as marked below.
- Risk Assessments with Prevention/mitigation measures.
- Emergency procedures.
- Qualification/training requirements.
- Safety regulations applicable to groundwork under power lines will need to be followed (where applicable).
- Detailed safe work procedures by the contractor required as per Construction Regulations.
- Environmental personnel from NTCSA to advise on all necessary permits as work is in proximity to an active stream.

|                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                      |                                                                                       |                                                                                       |                                                                                       |                                                                                       |                                                                                       |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| O/all                                                                               | Pants                                                                               | Top                                                                                 | Dust coat                                                                           | Apron                                                                               | Hard hat                                                                            | Gum boots                                                                           | Safety shoes                                                                        | Safety Glasses                                                                      | Face shield                                                                          | Dust mask                                                                             | Respirator                                                                            | Ear protection                                                                        | Safety (harness)                                                                      | Gloves                                                                                |
| <b>X</b>                                                                            |                                                                                     |                                                                                     |                                                                                     |                                                                                     | <b>X</b>                                                                            | <b>X</b>                                                                            | <b>X</b>                                                                            | <b>X</b>                                                                            |                                                                                      | <b>X</b>                                                                              |                                                                                       | <b>X</b>                                                                              | <b>X</b>                                                                              | <b>X</b>                                                                              |

Copy right © of NATIONAL TRANSMISSION COMPANY SOUTH AFRICA SOC LTD

When downloaded from the document management system, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorized version on the system.

No part of this document may be reproduced without the expressed consent of the copyright holder, NATIONAL TRANSMISSION COMPANY SOUTH AFRICA SOC LTD (Registration number: 2021/539129/30)

|                                                                                   |                                                                                                                     |              |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|--------------|
|  | <b>Scope of Works – Investigate potential subsurface instability in the vicinity of the NTCSA Vulcan Substation</b> | <b>NTCSA</b> |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|--------------|

### 3 DEFINITIONS AND ABBREVIATIONS

#### 3.1 DEFINITIONS

| Term                                | Definition                                                                                                                                                                                                                                             |
|-------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Construction work                   | The erection, maintenance, alteration, renovation, repair, demolition or dismantling of or addition to a building or any similar structure                                                                                                             |
|                                     | The installation, erection, dismantling or maintenance of a fixed plant where such work includes the risk of a person falling                                                                                                                          |
|                                     | The construction, maintenance, demolition or dismantling of any bridge, dam, canal, road, railway, runway, sewer or water reticulation system or any similar civil engineering structure                                                               |
| Contractor                          | An employer who performs scope of work and includes principal contractors                                                                                                                                                                              |
| Professionally registered Geologist | Professional Geologist is a licensed geoscientist qualified to provide geological services that impact public safety, environmental health, and engineering project registered with SACNASP (South African Council for Natural Scientist Professions). |

Copy right © of NATIONAL TRANSMISSION COMPANY SOUTH AFRICA SOC LTD

When downloaded from the document management system, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorized version on the system.

No part of this document may be reproduced without the expressed consent of the copyright holder, NATIONAL TRANSMISSION COMPANY SOUTH AFRICA SOC LTD (Registration number: 2021/539129/30)

|                                                                                   |                                                                                                                     |              |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|--------------|
|  | <b>Scope of Works – Investigate potential subsurface instability in the vicinity of the NTCSA Vulcan Substation</b> | <b>NTCSA</b> |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|--------------|

### 3.2 ABBREVIATIONS

| Term    | Definition                                              |
|---------|---------------------------------------------------------|
| NEG     | North East Grid                                         |
| NTCSA   | National Transmission Company South Africa              |
| OHS Act | Occupational Health and Safety Act                      |
| ORHVS   | Operating Regulations for High Voltage Systems          |
| PPE     | Personal Protective Equipment                           |
| SACNASP | South African Council for Natural Scientist Professions |
| SANAS   | South African National Accreditation System             |
| SANS    | South African National Standards                        |
| SHEQ    | Safety Health Environment and Quality                   |
| SOW     | Scope of Work                                           |
| SWP     | Safe Work Procedure                                     |

## 4 ROLES AND RESPONSIBILITIES

The *Contractor*:

- provides adequate resources including provision of equipment for required *works*,
- sources and reviews existing historical undermining information and confirms the validity thereof,
- ensures all materials and ground checks are conducted timeously and recorded adequately,
- manages cost and a scheduled time frame of *works*,
- ensures the scope is carried out in full,
- manages all works on site and all outputs of sub-contracted works (as needed),
- provides regular feedback on the status of the *works*,
- ensures that all site work is undertaken by and/or supervised by the required professional (i.e., a professionally registered Rock Engineer),

|                                                                                   |                                                                                                                     |              |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|--------------|
|  | <b>Scope of Works – Investigate potential subsurface instability in the vicinity of the NTCSA Vulcan Substation</b> | <b>NTCSA</b> |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|--------------|

- ensures that prior to any works, all parties working on site familiarized themselves with the *Employer's* safety requirements, Mine safety requirements (where applicable) and the Occupational Health and Safety (OSH) Act (85 of 1993),
- ensures all *works* complies with applicable licenses and authorizations,
- obtains all necessary approvals and acceptances (as needed),
- applies his discretion in conducting works in areas of subsidence and sinkholes,
- ensures that, should the ground conditions exhibit notable changes, the *Employer* is informed promptly,
- notifies the *Employer* as soon as possible, if any impedance or ruptured services is encountered,
- ensures that all work conducted in close proximity to live lines within NTCSA servitude is conducted under the supervision of an Authorized Person,
  - NB. The *Employer* will provide an Authorized Person as deemed necessary
- must ensure that all equipment has maintained required height and width clearances as advised by the *Employer* and the Authorized Person (as needed),
- must ensure that all equipment has been earthed to the satisfaction of the *Employer* (see [1] Annexure C) and overseen by the Authorized Person (as needed),
- ensures the successful implementation of ground truthing, structure position feasibility, viable foundation systems and ground rehabilitation (as required).
- **No fieldworks conducted should trigger further ground instability e.g., spontaneous combustion.**

|                                                                                   |                                                                                                                                           |                                    |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|
|  | <p align="center"><b>Scope of Works – Investigate potential subsurface instability in the vicinity of the NTCSA Vulcan Substation</b></p> | <p align="center"><b>NTCSA</b></p> |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|

## 5 PROJECT RISKS

The following risks can be encountered on site and must be considered when compiling Safe Work Procedure/s:

- Substation area is regarded as high security risk
- Surface expressions (sinkholes) – burning and smoking
- Ground hot spots caused by underground coal combustion
- Potential space constraints and access for heavy duty equipment for all towers
- Detailed inspection to be done on all impacted towers to identify additional risks before work commences.
- General EA and or WULA for any construction

A generic risk assessment matrix has been attached on Appendix A: Generic Risk Assessment.

## 6 DETAILED SCOPE OF WORK

### 6.1 SITE WALKOVER

The *Contractor* (and all necessary team members/sub-contractors):

- conduct a site walkover of the impacted area/s,
- identifies areas of notable ground features and contributing environmental factors,
- identifies areas of notable adjacent and bisecting infrastructure,
- makes notes and observations to ensure that the works are not encumbered by the overall site conditions,
- ensures *works* take into consideration the necessary safety considerations for the stability of the area.

### 6.2 SAFE WORKING PROCEDURE

The *Contractor* produces a Safe Work Procedure (SWP) prior to commencement of any works on site. The SWP outlines the tasks to be conducted during fieldworks and elaborates on how the tasks will be conducted safely. The SWP is reviewed and accepted by the *Employer* prior to commencement of site works.

|                                                                                   |                                                                                                                                           |                                    |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|
|  | <p align="center"><b>Scope of Works – Investigate potential subsurface instability in the vicinity of the NTCSA Vulcan Substation</b></p> | <p align="center"><b>NTCSA</b></p> |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|

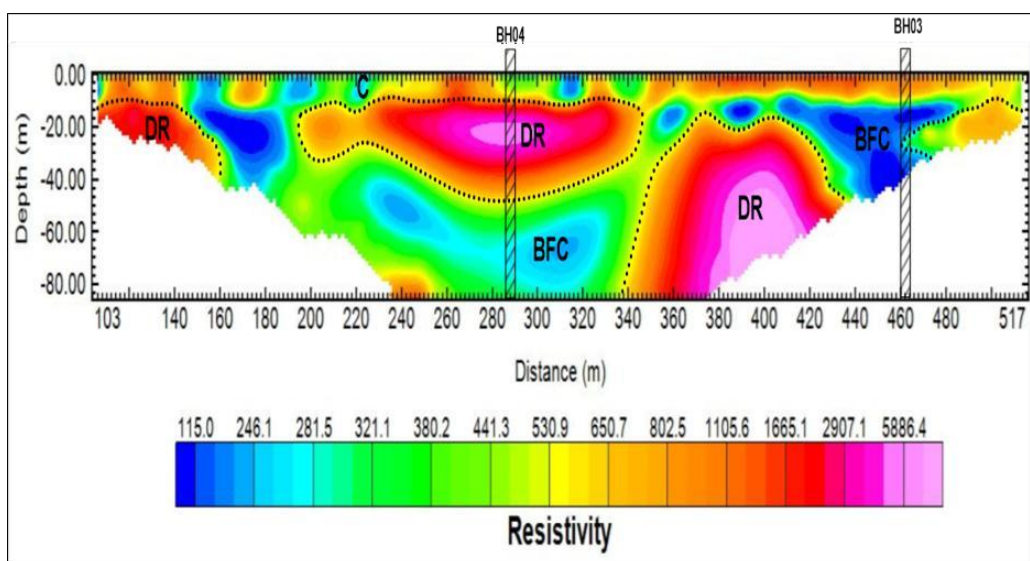
### 6.3 GEOTECHNICAL INVESTIGATION AND METHANE GAS STUDIES

The scope of the investigation will depend upon the size of the proposed investigation area (local or regional). For illustration purposes, we used the polygon highlighted in red in Figure 2 of the approximately 17ha Vulcan Substation area of interest (AOI) near Witbank in Mpumalanga Province.

#### 6.3.1 Subsurface assessment by non-invasive methods

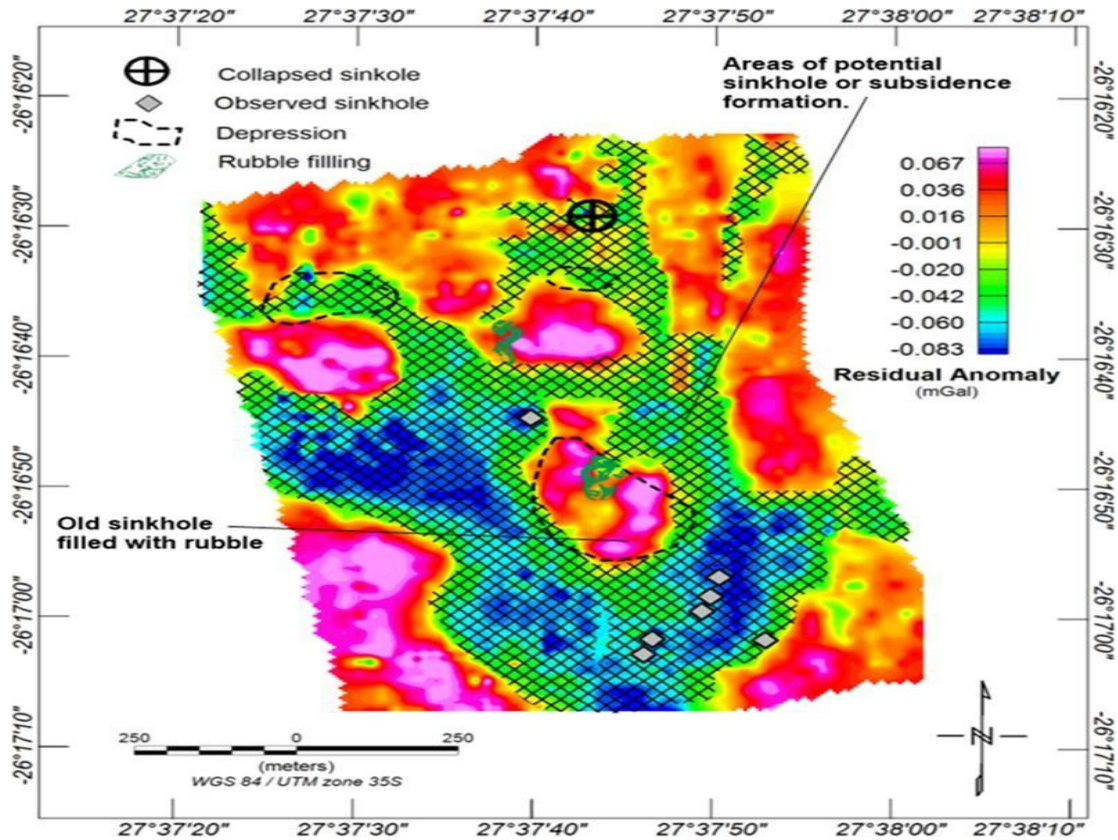
The non-invasive methods include airborne monitoring (Thermal Imagery) and ground geophysics:

- Thermal Imaging with a drone: Conduct a thorough thermal scanning survey encompassing the complete specified perimeter and internal infrastructure of the substation. The supplier is expected to identify and document all thermal anomalies or hotspot, providing detailed reports including location, severity, and potential implications.
- 2D Electrical Resistivity Tomography (ERT): Utilized to identify electrical anomalies in the soil that could be potential sources of combustion. Resistivity anomalies are contingent on the soil composition, with dry materials likely exhibiting high resistivity anomalies compared to the host rock. An example of a single-frame thermal image is shown below in Figure 3.
- Microgravity Surveys: Applied to map density variations in subsurface formations. Areas with combustible materials are anticipated to display low-density anomalies in contrast to the host rock. An example of a single-frame thermal image is shown below in Figure 4.



**Figure 3. Example of an electrical resistivity section displaying the sub-surface geology along a traverse**

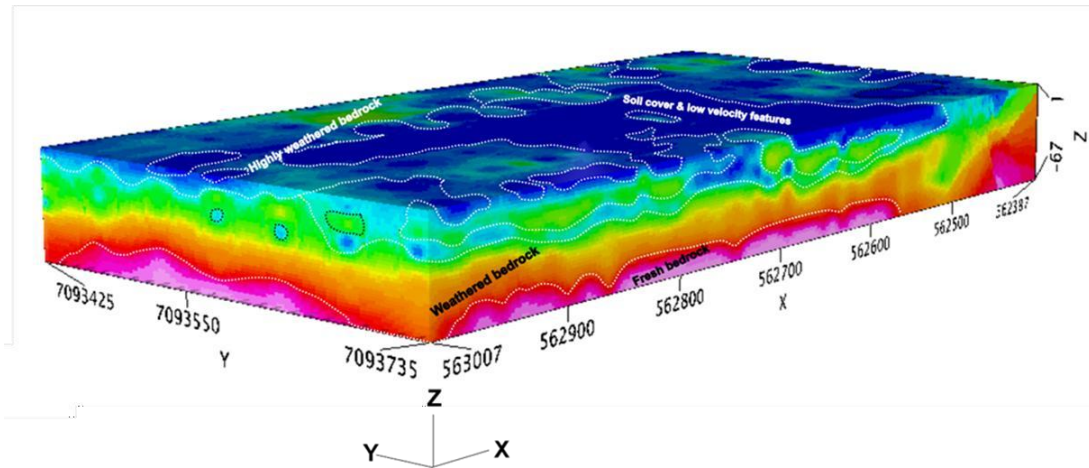
line to a maximum depth of 80 m



**Figure 4. Example of a gravity residual Bouguer anomaly map showing inferred features.**

- d) Multichannel Analysis of Surface Waves (MASW): This geophysical method maps velocity variations in surface wave propagation, reflecting density distribution within the host rock mass. Areas with combustible materials may exhibit reduced surface wave velocity anomalies due to density changes. An example of a single frame thermal image is shown below in Figure 5

|                                                                                   |                                                                                                                                           |                                    |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|
|  | <p align="center"><b>Scope of Works – Investigate potential subsurface instability in the vicinity of the NTCSA Vulcan Substation</b></p> | <p align="center"><b>NTCSA</b></p> |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|



**Figure 5. Example of a derived 3D geological model map showing inferred features.**

### 6.3.2 Methane Gas Studies

Provision of detailed methane gas monitoring and assessment to evaluate the presence, concentration, and migration of methane within and surrounding the affected mining areas, including:

- a) **Compilation and review of historical methane gas data** from previous investigations, including borehole gas readings, mine ventilation records, and any prior gas monitoring studies conducted within the affected mining blocks;
- b) **Validation and reconciliation of historical datasets** with current site conditions to identify trends, data gaps, and potential changes in methane migration behaviour over time;
  - Identification of gas accumulation zones and potential high-risk areas where methane concentrations may approach explosive limits;
- c) **Baseline and continuous monitoring** of methane concentrations in subsurface voids, boreholes, and at surface interfaces; for methane gas release (ventilation)
  - Assessment of methane migration pathways, including fractures, faults, and old mine workings that may facilitate gas movement toward surface or infrastructure;
- d) **Evaluation of explosion and asphyxiation risks** in relation to Eskom NTCSA infrastructure and surrounding communities;
- e) **Recommendations for mitigation measures**, including controlled venting, gas drainage systems, and monitoring protocols to ensure ongoing safety and regulatory compliance.
  - Land subsidence and methane emission risk Assessment Report
  - Potential Rehabilitation Strategies

|                                                                                   |                                                                                                                                           |                                    |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|
|  | <p align="center"><b>Scope of Works – Investigate potential subsurface instability in the vicinity of the NTCSA Vulcan Substation</b></p> | <p align="center"><b>NTCSA</b></p> |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|

## **e) Rehabilitation Strategy**

Guidance on the feasibility of open-cast mining as a potential rehabilitation intervention, including:

- Technical and economic feasibility considerations;
- Environmental authorisation and regulatory requirements;
- Highwall stability and geotechnical modelling; and
- Clarification regarding handling, extraction, and potential commercial treatment of coal exposed during rehabilitation.

## **6.4 Geotechnical Investigations**

The primary objective of a preliminary investigation is to assess the soil and rock profile for the stratigraphical study purposes

The following specific items should be dealt with in the investigation:

- Site geology and stratigraphy.
- Soil and rock classification.
- Identification of geotechnical problems.
- Seismic assessment and classification of the site

### **6.4.1 Investigation Methodology**

#### **6.4.1.1 Desk Study**

Review of existing regional, site and surface information. Sources of information should include:

- Topographical maps, geological maps, aerial photo interpretation - to be able to identify topographical, drainage channels and erosion features of the site.
- Geological data, such as lithology of nearby rock outcrops landforms, erosion patterns that surrounds the proposed site.
- Existing geotechnical information available of the area in the surrounds of the site.
- Data on the performance of existing engineered structures in the area.
- Data on the bodies of groundwater levels in the surrounds of the proposed site.
- Data on seismic aspects, such as ground motion, liquefaction potential.

|                                                                                   |                                                                                                                                           |                                    |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|
|  | <p align="center"><b>Scope of Works – Investigate potential subsurface instability in the vicinity of the NTCSA Vulcan Substation</b></p> | <p align="center"><b>NTCSA</b></p> |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|

#### **6.4.1.2 Scanning for underground services**

Underground scanning shall be undertaken to ensure that no underground services traverse the site prior to undertaking the investigation.

#### **Excavation of Test Pits**

In order to profile the sub-soil stratigraphy and to obtain disturbed samples, undisturbed samples and bulk samples for laboratory testing, test pits (max depth 5m) should be excavated across the site using an excavator or TLB (where shallow bedrock is anticipated). The test pits should be excavated in a minimum grid of 50m x 50m /as shown in a test pit layout/with increased density as required during field work.

All test pits should be profiled by a registered Geotechnical Engineer or a registered Engineering Geologist in accordance with the latest standard of South African practice (after Jennings et. al.1973). The positions all test pits should be coordinated with a valid calibrated hand-held GPS and in accordance with the WGS84 coordinate system.

All excavation test pits should be carried out in accordance to SAICE – “Code of Practice 2007: The Safety of Persons Working in Small Diameter Shafts

#### **DPSH Testing**

DPSH testing should be carried out between the trial holes or next to the hole where there is no certainty of depth of bedrock and the material 3m below NGL or where the soils are predominantly of a loose-medium dense or soft-firm consistency.

#### **Gravity survey**

A gravity survey should be undertaken and a gravity map produced to determine borehole positions. The survey shall be carried out as detailed in SANS 1936:2. The gravimetric survey should cover an area 100m wider than the footprint of the development to allow for detection of geo-features at the edge of the property.

### **6.5 DRILLING OF BOREHOLES**

#### **6.5.1 Rotary Core Boreholes**

Rotary cored boreholes (3m into the bedrock below coal seam) with SPT “N” tests, undisturbed Shelby Samples to determine collapse potential/expansiveness and/or heave of the material must be undertaken.

The drilling contractor should allow for a concrete plug to fill up the boreholes after drilling.

|                                                                                   |                                                                                                                                           |                                    |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|
|  | <p align="center"><b>Scope of Works – Investigate potential subsurface instability in the vicinity of the NTCSA Vulcan Substation</b></p> | <p align="center"><b>NTCSA</b></p> |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|

### 6.5.2 Percussion Drilling

Minimum of four boreholes per hectare (or as directed by ESKOM scope and spec) percussion boreholes should be drilled to:

- A depth of end of coal seam or refusal.
- Where shallow below coal seam bedrock is encountered, the borehole should be drilled a minimum of 6m into the rock.
- On gravity high anomalies, the borehole should be drilled into bedrock to determine depth of the shallowest bedrock
- Where area has been de-watered, a sample of boreholes shall be drilled a minimum depth of a 100m or 6m where bedrock depth is shallow
- Where competent non-dolomitic bedrock overlies the dolomite, the borehole shall be drilled such that
- If depth of rock is more than 15m, then it should be drilled a minimum of 15m into the rock
- If depth more than 15m, then I should be drilled a minimum of 6m into the dolomite bedrock.

### 6.5.2 Laboratory Testing

Undisturbed, samples, Disturbed samples and bulk samples will be taken for laboratory testing and tests carried out as per SANS 3001 method. The following tests should be conducted on representative samples from site:

- Classification tests: grading & indicator (Atterberg Limits and Hydrometer).
- Compaction tests (Bulk density, MDD and OMC)
- Mod AASHTO moisture/density relationship and CBR Tests.
- Dynamic probe super heavy tests
- Swelling pressure tests
- Free swell test
- Specific gravity tests
- Heave test
- UCS tests on rocks (if necessary)
- XRD and XRF analysis
- Proximate analysis
- Petrography
- Gas analysis

|                                                                                   |                                                                                                                                           |                                    |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|
|  | <p align="center"><b>Scope of Works – Investigate potential subsurface instability in the vicinity of the NTCSA Vulcan Substation</b></p> | <p align="center"><b>NTCSA</b></p> |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|

## 7. DELIVERABLES

The *Contractor* report:

- Assesses the impacted area by intrusive and non-intrusive methods,
- Consolidates all field information and produces a comprehensive technical report of findings,
- A thermal imagery of the study area to provide details of surface features that may have high emissivity (thermal hot spot)
- Provide 2D geophysical profiles and 3D models.
- Zonation map of areas of incipient instability.
- Methane gas concentration mapping
- Extent of spontaneous combustion mapping
- Provide all digital dataset in cad or other agreed geospatial or engineering format.
- Final report and recommendation highlighting risks mapping

All documentation to be submitted in digital (word-friendly \*.pdf format, shape files /Cad files) and hardcopy formats (2 x copies).

*NB. Written consent must be received from the Employer for any and all deviations from the works as outlined herein.*

|                                                                                   |                                                                                                                     |              |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|--------------|
|  | <b>Scope of Works – Investigate potential subsurface instability in the vicinity of the NTCSA Vulcan Substation</b> | <b>NTCSA</b> |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|--------------|

## APPENDIX A: GENERIC RISK ASSESSMENT

|             |   |            |     |     |     |     |
|-------------|---|------------|-----|-----|-----|-----|
| Consequence | 6 | III        | II  | I   | I   | I   |
|             | 5 | III        | II  | II  | I   | I   |
|             | 4 | IV         | III | II  | I   | I   |
|             | 3 | IV         | III | II  | II  | I   |
|             | 2 | IV         | IV  | III | II  | II  |
|             | 1 | IV         | IV  | III | III | III |
|             |   | 1          | 2   | 3   | 4   | 5   |
|             |   | Likelihood |     |     |     |     |

### Informative references:

- Occupational Health and Safety Risk Assessment Procedure, 32-520
- Occupational Health and Safety Act, 1993, Construction Regulations, 2014

| Generic risk assessment:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                   |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|
| Risk:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Mitigation:                                                                                                       |
| <ul style="list-style-type: none"> <li>- Work on an unmonitored / unsupervised structure / excavation / site.</li> <li>- Work under supervision of a construction manager(s) appointed on another site.</li> <li>- Work without the supervision of a safety officer(s).</li> </ul>                                                                                                                                                                                                                                                                         | <ul style="list-style-type: none"> <li>- Site management and supervision plan in accordance with CR 8.</li> </ul> |
| <ul style="list-style-type: none"> <li>- Work without a risk assessment performed by a competent person on site which include;</li> <li>- identification of risks, analysis of the risks, documented risk mitigation plan, risk monitoring plan, risk review plan.</li> <li>- Work under impact of ergonomic related and site-specific hazards.</li> <li>- Employees are not trained in mitigating the risks.</li> <li>- Subcontractors are not informed of risks.</li> </ul>                                                                              | <ul style="list-style-type: none"> <li>- Risk assessment plan in accordance with CR 9.</li> </ul>                 |
| <ul style="list-style-type: none"> <li>- Falling into open excavations / from structures / conductors / suspended platforms etc.</li> <li>- On-site deviation from the plan.</li> <li>- Work without the medical fitness records of the employees.</li> <li>- Work without a rescue plan.</li> <li>- Work at height without the appointed supervisor having a copy of the plan.</li> <li>- Work without all unprotected openings being barricaded.</li> <li>- Work with equipment that isn't of sufficient strength or isn't securely attached.</li> </ul> | <ul style="list-style-type: none"> <li>- Fall Prevention plan created in accordance with CR 10.</li> </ul>        |

|                                                                                   |                                                                                                                     |              |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|--------------|
|  | <b>Scope of Works – Investigate potential subsurface instability in the vicinity of the NTCSA Vulcan Substation</b> | <b>NTCSA</b> |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|--------------|

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                    |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>- Temporary works not inspected / approved on site.</li> <li>- Unsupervised temporary works operations.</li> <li>- Temporary works that are: <ul style="list-style-type: none"> <li>(a) not adequately braced, supported, erected, maintained.</li> <li>(b) incompetently trained employees.</li> <li>(c) equipment used aren't examined / checked.</li> <li>(d) release agents cause people to slip.</li> </ul> </li> </ul>                                                                                                                                                                                                                                                                             | <p>Temporary works in accordance with CR 12.</p>                                                   |
| <ul style="list-style-type: none"> <li>- Unsupervised rope access work.</li> <li>- Rope access work is carried out under an incompetent / unlicensed operator.</li> <li>- Work with equipment that doesn't comply with safety standards.</li> <li>- Work at height without a site-specific fall protection plan developed by a competent person for the specific work and environment.</li> </ul>                                                                                                                                                                                                                                                                                                                                               | <p>- Rope access work is done in accordance with CR 18.</p>                                        |
| <ul style="list-style-type: none"> <li>- Inadequate measures in place for rescue procedures after an incident.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                    |
| <ul style="list-style-type: none"> <li>- Poor design and construction of construction vehicles.</li> <li>- Poorly maintained construction vehicles.</li> <li>- Construction vehicles used for something they were not designed for.</li> <li>- Inadequately trained construction vehicle operators / medically unfit.</li> <li>- Unsuitable traffic routes and access / egress to sites.</li> <li>- Unorganized and uncontrolled vehicles in a work situation.</li> <li>- Vehicles aren't prevented from falling into excavations by adequate barriers.</li> <li>- Vehicles aren't fitted with structures protecting the operator from falling material.</li> <li>- Vehicles aren't equipped with acoustic warning reversing alarms.</li> </ul> | <p>- Construction vehicles and mobile plant in accordance with CR 23.</p>                          |
| <ul style="list-style-type: none"> <li>- Vehicles aren't inspected by the operator daily.</li> <li>- People ride on a vehicle not intended / equipped for that purpose.</li> <li>- Vehicles left at night next to public roads do not have adequate lights /reflectors to identify its location.</li> <li>- Vehicles don't have buckets / booms fully lowered, motors stopped, brakes set,when not in use.</li> <li>- Vehicles not fitted with adequate lighting.</li> <li>- Vehicles don't comply with the NRT when traveling on public road</li> </ul>                                                                                                                                                                                        | <p>- Construction vehicles and mobile plant in accordance with CR 23.</p>                          |
| <ul style="list-style-type: none"> <li>- Contact with dangerous electrical potential overhead or underground.</li> <li>- Inadequate steps taken before work to ascertain the presence of dangers to workers by electrical contact.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <p>- Electrical Installation and machinery management plan in accordance with CR 24, IEEE 524.</p> |

|                                                                                   |                                                                                                                     |              |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|--------------|
|  | <b>Scope of Works – Investigate potential subsurface instability in the vicinity of the NTCSA Vulcan Substation</b> | <b>NTCSA</b> |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|--------------|

|                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>- All temporary electrical installations aren't inspected once a week.</li> <li>- Electrical machinery isn't inspected using a checklist prior to use.</li> </ul>                                                                                                                                                                                                                                   |                                                                                                                                                    |
| <ul style="list-style-type: none"> <li>- Fire or explosion on site.</li> <li>- Inadequate fire-fighting equipment on site.</li> <li>- Unearthed metal containers.</li> </ul>                                                                                                                                                                                                                                                               | <ul style="list-style-type: none"> <li>- Use and temporary storage of flammable liquids on construction sites in accordance with CR 25.</li> </ul> |
| <ul style="list-style-type: none"> <li>- Drowning.</li> <li>- Inadequate rescue plans for prevention of drowning when working in proximity of water (dams, water in excavations).</li> <li>- No life jacket if a person is exposed to drowning.</li> </ul>                                                                                                                                                                                 | <ul style="list-style-type: none"> <li>- Construction over or in close proximity to water according to CR 26.</li> </ul>                           |
| <ul style="list-style-type: none"> <li>- Non-compliance with Environmental regulations for workplaces.</li> <li>- Improper storage of material and equipment on sites.</li> <li>- Inadequate access to sites because of obstruction by materials.</li> <li>- Waste and scrap disposed on sites.</li> <li>- Falling of objects from height.</li> <li>- Injury of public due to uncontrolled access / unfenced construction site.</li> </ul> | <ul style="list-style-type: none"> <li>- Housekeeping and general safeguarding on construction sites according to CR 27.</li> </ul>                |
| <ul style="list-style-type: none"> <li>- Damage to lattice steel and galvanizing.</li> <li>- Damage to conductor drums.</li> <li>- Damage to insulators.</li> <li>- Damage to free-issue materials.</li> <li>- Inadequate supervision of storage areas.</li> <li>- Un-demarcated storage areas.</li> </ul>                                                                                                                                 | <ul style="list-style-type: none"> <li>- Stacking and storage on construction sites in accordance with CR 28.</li> </ul>                           |
| <ul style="list-style-type: none"> <li>- Fire causing environmental damage.</li> <li>- Inadequate storage for flammable materials.</li> <li>- Inadequate notices prohibiting smoking.</li> <li>- Insufficient fire-extinguishing equipment at strategic locations.</li> <li>- Fire equipment not inspected.</li> <li>- Workers not trained in the use of fire-extinguishing equipment.</li> <li>- No evacuation plan in place.</li> </ul>  | <ul style="list-style-type: none"> <li>- Fire protection on construction sites according to CR 29.</li> </ul>                                      |
| <ul style="list-style-type: none"> <li>- Unsanitary construction sites.</li> <li>- Unsheltered eating areas.</li> <li>- No living accommodation for workers at the sites if they are removed far from their homes.</li> </ul>                                                                                                                                                                                                              | <ul style="list-style-type: none"> <li>- Construction employees' facilities according to CR 30.</li> </ul>                                         |