

## **APPENDIX A**

### **METHOD STATEMENT**

**For the**

**DRILLING OF ROTARY CORED BOREHOLES  
AND PERFORMING STANDARD  
PENETROMETER TESTING (SPT's) FOR THE  
PROPOSED KUSILE RAILWAY LINE**

# Method Statement

## Drilling Of Rotary Cored Boreholes And Performing Standard Penetrometer Testing (SPT's) For The Proposed Kusile Railway Line

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### 1. Preliminaries

#### 1.1. Purpose and Scope

The Consultant is required to conduct detailed geotechnical investigations for the proposed Kusile Railway Line. These investigations are required to provide an input to the final routing and engineering design for the railroad and for construction planning and evaluation of excavation techniques and / or blasting.

The detailed field investigations will include excavation and profiling of trial pits, the drilling of wash bores in soft ground and the drilling of rotary cored boreholes in rock areas for the full rail line. The intrusive investigations will be supplemented by field logging, in-situ and laboratory testing.

This Method Statement outlines the procedures for the rotary cored boreholes and SPT testing investigation work to be carried out.

#### 1.2. Reference and Requirements

The following documents are directly applicable / related to this work scope:

Type	Reference	Title
Standards	CSRA 1993 1 <sup>st</sup> Edition – ISBN 1-874844-85-2	The CSRA Standard Specifications for Subsurface Investigation
Reference Handbook	Diamond Drilling Handbook – Third Edition 1994	The Diamond Drilling Handbook
Reference Handbook	FRA NKIPILE A Guide to Practical Geotechnical Engineering	FRA NKIPILE A Guide to Practical Geotechnical Engineering
Specification document	2684358-J-PL1-PL-RP-001 [C]	New Multi-Products Pipeline Project

#### 1.3. Responsibilities

Overall responsibilities to:

- Establish and maintain this document – the Geomechanics Contracts Manager.
  - Implement this document – the Geomechanics Site Supervisor.
- Note: more detailed responsibilities are given in the content below as applicable*

#### 1.4. Definitions

NWD4 – Geotechnical rotary core drilling (Borehole diameter = 75.69mm, core diameter = 51.30mm).

CSRA – Committee of State Road Authorities.

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SPT – Standard Penetration Test.

### 2. Introduction

This QA Plan describes the detailed methods for rotary core drilling that are required for the aforementioned subsurface investigation works.

The main works to be performed are:

- Rotary core drilling of vertical N-size holes to depths ranging up to not more than 40 metres deep, and as dictated by ground conditions and as indicated by the Consultant.
- SPT – Standard Penetration Testing is required in certain of the holes.

### 3. Method

#### 3.3 ROTARY CORE DRILLING AND IN-SITU TESTING

##### 3.3.1 PURPOSE

To ensure that Rotary Core Drilling and associated in-situ testing is carried out in an approved and controlled manner.

##### 3.3.2 SCOPE

This method statement applies to all Rotary Core Drilling.

##### 3.3.3 DEFINITIONS

None.

##### 3.3.4 REFERENCES

FRANKIPILE A Guide to Practical Geotechnical Engineering  
CSRA Standard Specifications for Subsurface Investigations 1993

##### 3.3.5 RESPONSIBILITY

Drawing up: the Geomechanics Project Management team.  
Execution: the Geomechanics Site Supervisor.

##### 3.3.6 PROCEDURE

###### 3.3.6.1 Preparation

###### Position

Prior to commencing the subsurface investigation the Consultant shall set out the exact position of the test hole.

Prior to the commencement of any drilling, the position of any underground or overhead services should be identified and referenced to all information available. The Eskom Subsurface Clearance Requirements must be fully implemented for each specific investigation – to be issued by Eskom. Where instructed by the Consultant, hand excavation of inspection pits is to be carried out to a maximum depth of 1.2 metres below existing ground level to confirm the presence or absence of any underground service.

The Geomechanics Site Supervisor must check with the Consultant to ensure that the Subsurface Clearance Requirements have been carried out. The Consultant must sign off the inspection pit details on the Geomechanics Borehole Instruction Sheet prior to commencement of any drilling works.

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### Type of test

The Consultant shall supply all the relevant information as to what type of subsurface investigation has to be done and any other information. This is to be filled out on the Borehole Instruction Sheet prior to commencement.

### Setting up

Some clearing, as may be classified as reasonable to obtain access of a mobile rig may be required, but care should be taken as not to disturb any survey beacons. No trees shall be cut without written agreement from the Consultant.

### 3.3.6.2 **Rotary Core Drilling**

#### Description

This section relates to rotary core drilling through various categories of material. The details of the work to be done and any special tools to be used will be specified on the Borehole instruction sheet.

#### Supervision

Each drilling rig shall be in the charge of a competent drilling operator/foreman, who shall be capable of completing the daily journals.

#### Drilling and Casing

N-size rotary drilling shall be carried out. The drill fluid shall generally be water mixed with Eezymix (where required). Casing will be used to maintain the stability of the drill hole in soft/collapsible formations. Soft formation core samples shall be obtained by means of NWD4 double (split inner tube) tube core barrels and rock core samples shall be obtained by TNW core barrels. Ground water levels (when applicable) are to be measured each day before drilling commences.

#### Completion

Upon completion of any drill hole the Consultant shall be notified by Geomechanics Supervisor (6-hours advance notice to be provided when applicable) and his agreement obtained to terminate the hole.

If required a 50mm diameter piezometer/standpipe may be instructed for installation into the completed hole, or

If no installation is required then the hole shall be left open.

#### Refusal

If the drilling equipment should become stuck or lodged in a borehole, or if, for any other reason, further drilling is not possible in that hole, the Consultant shall be notified immediately.

#### Core Recovery

Unless instructed by the Consultant, continuous core recovery or sampling shall at all times be striven for. Where core recovery falls below the required amount the Supervisor will take the necessary action in an attempt to improve recovery. These may include reducing the core run or changing equipment.

When core is extracted from the core barrel, this shall be carried out:

- in such a way to minimise disturbance of the core (core handling tray to be used if required)
- with minimal hammering on the barrel
- to ensure that the sequence of the core is maintained.

Cores are to be stored in CSRA approved wooden coreboxes. Soft or weathered cores are to be placed into plastic sheathes. Drilling breaks in the core shall be identified by the driller/supervisor and marked on the core/Corebox in a clear manner. The start and end depth of each core box shall be clearly marked on the corebox. Where drilling breaks are identified in

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the rock core the Consultant shall mark this on the corebox prior to logging/photographing the core.

### 3.3.6.3 Standard Penetration Test (Refer to CSRA Section 23)

#### Preparation

Before commencing the test, the borehole shall be cleaned to the depth where the testing is to be done. Where casings are used, the bottom end of the casing shall be no closer than 150 mm to the level where the tests are commenced.

#### Testing below the water table

When drilling in sand or silt below the water table, the water level in the casing shall always be kept higher than the ground water level, so that sand and silt is kept from flowing into the borehole. When boring under said conditions, water shall be continuously added in order to maintain the water level in the casing level with the top of the casing.

#### Testing

The Standard Penetration Test shall be executed in accordance with CSRA standards. ALL of the sample obtained from the Raymond Spoon should be removed and stored in a plastic sample jar and appropriately labelled. This jar is to be marked with the correct depth of the test and stored in the corebox and at the appropriate depth.

#### Refusal

Care shall be taken to ensure that the energy of the hammer is not reduced by friction between hammer and wall or by any other cause. Refusal of the SPT is defined as when the number of blows necessary to penetrate 75 mm exceeds 25 or as otherwise instructed by BCJV. If refusal occurs, the blow counts recorded till refusal and the actual penetration in mm for the last (refusal) cycle shall be recorded on the drillers report sheet.

### 3.3.6.4 Piezometers/standpipes – where instructed (50mm inch diameter)

Piezometers and standpipes shall be installed in investigation holes as instructed by the Consultant. The details of the installation shall be agreed on site and recorded on the relevant Borehole Instruction Sheet. (Refer to CSRA Section 27).

- a) Before installation of the piezometer the water level in the hole shall be measured and recorded.
- b) After measuring the water level the hole must be flushed with clean water to remove all or most of the drilling sludge.
- c) The levels of installation depth, response zone, bentonite plug or plugs and backfilling must be adhered to, but in any event must be measured and noted as an "as built" report.
- d) When installing the piezometer raiser pipe, before installing the filter sand and or bentonite plugs, the raiser pipe should be checked with a dip meter for free access and without any obstructions.
- e) Fill the standpipe with water and observe the water level making sure that the level falls, indicating that the tip is operational.
- f) After installing the Bentonite plug or plugs, the filter sand and backfilling has been carried out, the top 1 meter of hole must be backfilled with a mixture of bentonite and soil fill to prevent any ingress of surface water.
- g) The completed installation must then be capped with the appropriate borehole cap, standpipe and or surface cap.

Records - Refer to Appendix 6.6 for a sample of the piezometer installation report sheet.

### 3.3.7 **DOCUMENTATION**

The following documentation is needed to implement this procedure:

Borehole instruction sheet  
Drilling daily report

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Refer to Appendix 6.6.

### 4. Means

#### 4.1. Materials

Not applicable.

#### 4.2. Plant and equipment

It is intended that six YWE D90 skid/trailer mounted spindle drive drilling machines (or similar) shall be used for this project. These machines are capable of drilling to a depth of 120 metres in N-size. They are spindle drive machines and are typically powered by 4 cylinder Deutz motors.

Each drill rig shall be equipped with the necessary spares and drilling equipment, including NWD4, TNW and SPT testing equipment. See data sheets under section 6.4.

#### 4.3. Services and Subcontractors

None.

### 5. Responsibilities

Main tasks and associated responsibilities are as follows:

Task	Perform	Check	Approve
Settling out	Consultant	Consultant	Consultant
All drilling and in-situ testing	The Operator	The Supervisor	Consultant
SPT testing	The Technician	ERM	ERM
Safety	The Operator	The Supervisor	Consultant
Environment	ESKOM	ESKOM	ESKOM

### 6. Appendices

6.1 Safety Risk Assessment  
See attached.

6.2 Environment Risk Assessment and Measures  
Refer to ESKOM.

6.3 Method Drawings

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6.3.1 General arrangement / layout / section drawings (to be provided by ESKOM)



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### 6.4.2 MSDS for Eezymix

SAMCHEM - Proprietor: S. A. Mud SERVICES (PTY) LTD.  
ENVIRONMENTAL AND SAFETY DATA SHEET

#### SECTION 1 PRODUCT IDENTIFICATION

TRADE NAME: EZEEMIX

DESCRIPTION: An acrylamide/acrylate polymer ( $\pm 40\%$ ) in a hydrocarbon solvent ( $\pm 20\%$ ) and water ( $\pm 40\%$ ).

NFPA 7 RATING: 1 HEALTH 1 FLAMMABILITY 0 REACTIVITY 0 OTHER  
0 = INSIGNIFICANT 1 = SLIGHT 2 = MODERATE 3 = HIGH 4 = EXTREME

#### SECTION 2 HAZARDOUS INGREDIENTS

Our hazard evaluation has identified the following chemical ingredient(s) as hazardous

	CAS #	APPROX.%
Ethoxylated nonylphenol	9016-45-9	1-5
Hydrotreated light distillate	64742-47-8	20-40

#### SECTION 3 PRECAUTIONARY LABEL INFORMATION

CAUTION: May cause irritation to skin and eyes. Avoid contact with skin, eyes, and clothing. Do not take internally.

Empty containers may contain residual product. Do not reuse container unless properly reconditioned.

#### SECTION 4 FIRST AID INFORMATION

EYES: Flush with water for 15 minutes. Call a physician immediately.

SKIN: Wash thoroughly with soap and rinse with water. Call a physician.

INGESTION: Do not induce vomiting. Give water. Call a physician.

INHALATION: Remove to fresh air. Treat symptoms. Call a physician.

NOTE TO PHYSICIAN: Based on the individual reactions of the patient, the physician's judgement should be used to control symptoms and clinical condition.

CAUTION: If unconscious, having trouble breathing or in convulsions, do not induce vomiting or give water.

#### SECTION 5 HEALTH EFFECTS INFORMATION

PRIMARY ROUTE(S) OF EXPOSURE: Eye, skin

EYE CONTACT: Can cause moderate irritation.

SKIN CONTACT: Can cause mild, short-lasting irritation.

SYMPTOMS OF EXPOSURE: A review of available data does not identify any symptoms from exposure not previously mentioned.

AGGRAVATION OF EXISTING CONDITIONS: A review of available data does not identify any worsening of existing conditions.

#### SECTION 6 TOXICOLOGY INFORMATION

TOXICITY STUDIES: No toxicity studies have been conducted on this product.

#### SECTION 7 PHYSICAL AND CHEMICAL PROPERTIES

COLOUR: Clear to opaque, off white

FORM: Liquid

ODOUR: Slight hydrocarbon

SOLUBILITY IN WATER: Dispersible

SPECIFIC GRAVITY: 1.07 @ 25°C ASTM D-1298

VISCOSITY: 1000cps@25°C ASTM D-2983

FLASH POINT: > 93, C (PMCC) ASTM D-93

FREEZE POINT: Less than - 10C ASTM D-1 177

POUR POINT: Less than -10C ASTM D-97

NOTE: These physical properties are typical values for this product.

#### SECTION 8 FIRE AND EXPLOSION INFORMATION

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**EXTINGUISHING-MEDIA:** This product would not be expected to burn unless all the water is boiled away. The remaining organics may be ignitable. Use water to cool containers exposed to fire.  
**UNUSUAL FIRE AND EXPLOSION HAZARD:** May evolve NOx under fire conditions. If the water is driven off, the remaining organics may be ignitable.

### SECTION 9 REACTIVITY INFORMATION

**INCOMPATIBILITY:** Avoid water contamination, which may cause gelling. Avoid contact with strong oxidizers (e.g. chlorine, peroxides, chromates, nitric acid, perchlorates, concentrated oxygen, permanganates) which can generate heat, fires, explosions and the release of toxic fumes.

**THERMAL DECOMPOSITION PRODUCTS:** In the event of combustion CO, CO<sub>2</sub>, NOx may be formed. Do not breathe the smoke or fumes. Wear suitable protective equipment.

### SECTION 10 PERSONAL PROTECTION EQUIPMENT

**RESPIRATORY PROTECTION:** Respiratory protection is not normally needed since the volatility and toxicity is low. If significant mists are generated, use either a chemical cartridge respiratory with a dust/ mist pre-filter or supplied air.

For large spills, entry into large tanks, vessels or enclosed small spaces with inadequate ventilation, a pressure-demand, self-contained breathing apparatus is recommended.

**VENTILATION:** General ventilation is recommended.

**PROTECTIVE EQUIPMENT:** Use impermeable gloves and chemical splash goggles when attaching feeding equipment or doing maintenance or handling product. Examples of impermeable gloves available on the market are neoprene, nitrile, PVC, natural rubber, viton and butyl (compatibility studies have not been performed).

The availability of an eye wash fountain and safety shower is recommended.

If clothing is contaminated, remove clothing and thoroughly wash the affected area. Launder contaminated clothing before reuse.

### SECTION 11 SPILL AND DISPOSAL INFORMATION

**SPILL CONTROL AND RECOVERY:** Small liquid spills: Contain with absorbent material such as clay, soil or any commercially available absorbent. Shovel reclaimed liquid and absorbent into recovery or salvage drums for disposal.

Large liquid spills: Dike to prevent further movement and reclaim into recovery or salvage drums or tank truck for disposal.

For large indoor spills, evacuate employees and ventilate area. Those responsible for control and recovery should wear the protective equipment specified in Section 10.

Spillage of the product will cause extremely slippery conditions.

**DISPOSAL:** If this product becomes a waste, it does not meet the criteria of a hazardous waste.

As a non-hazardous liquid waste, it should be solidified with stabilizing agents (such as sand, fly ash, or cement) so that no free liquid remains before disposal to an industrial waste landfill. A non-hazardous liquid waste can also be incinerated in accordance with local, provincial and government regulations.

### SECTION 12 ENVIRONMENTAL INFORMATION

#### AQUATIC DATA:

Results below based on a 1% aqueous solution of a similar product.

96 hour static acute LC<sub>50</sub> to Rainbow Trout = Greater than 1000 mg/Lt

96 hour no observed effect concentration is 125 mg/Lt based on no mortality or abnormal effects.

**TOXICITY RATING:** Essentially non-toxic

96 hour static acute LC<sub>50</sub> to Sheepshead Minnow = Greater than 1000 mg/ l

96 hour no observed effect concentration is 1 000 mg/Lt based on no mortality or abnormal effects.

**TOXICITY RATING:** Essentially non-toxic

96 hour static acute LC<sub>50</sub> to Mysid Shrimp = 400 mg/ l

96 hour no observed effect concentration is 180 mg/ l based on no mortality or abnormal effects.

**TOXICITY RATING:** Slightly toxic

48 hour static acute LC<sub>50</sub> to Daphnia = 280 mg/ l

48 hour no observed effect concentration is less than 56 mg/Lt (lowest concentration tested) based on no mortality or abnormal effects.

**TOXICITY RATING:** Slightly toxic

Biodegradability: Ezeemix is inherently biodegradable as tested per modified Sturm OECD method 301

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SECTION 13 TRANSPORTATION INFORMATION  
PRODUCT IS NOT REGULATED DURING TRANSPORTATION

SECTION 14 REGULATORY INFORMATION

The following regulations apply to this product.

Based on our hazard evaluation, the following ingredients in this product are hazardous and the reasons are shown below.

Ethoxylated nonylphenol - Eye irritant.

Hydrotreated light distillate - Skin/eye irritant

This product does not contain ingredients listed as an Extremely Hazardous Substance.

Our hazard evaluation has found this product to be hazardous. The product should be reported under the following EPA hazard categories:

xx Immediate (acute) health hazard

— Delayed (chronic) health hazard

— Fire hazard

— Sudden release of pressure hazard

— Reactive hazard

This product does not contain ingredients listed in the: List of Toxic Chemicals.

WATER POLLUTION CONTROL - None of the ingredients are of specification.

AIR POLLUTION CONTROL -This product does not contain ingredients that will contribute to air pollution under normal use conditions.

SECTION 15 ADDITIONAL INFORMATION

None.

SECTION 16 USER'S RESPONSIBILITY

This product material safety data sheet provides health and safety information. The product is to be used in applications consistent with our product literature. Individuals handling this product should be informed of the recommended safety precautions and should have access to this information. For any other uses, exposures should be evaluated so that appropriate handling practices and training programs can be established to ensure safe workplace operations.

SECTION 17 BIBLIOGRAPHY

Hazardous Chemical Desk Reference, Sax, N.I., Lewis R.J. Van Nostrand Rheinhold Company, N.Y., 1987.  
Dangerous Properties of Industrial Materials, Sax, N.I., ed, Van Nostrand Rheinhold Company, N.Y., &h edition, 1984.

Patty's Industrial Hygiene and Toxicology, Clayton, G.D., Clayton, F.E., eds., John Wiley and Sons, 3rd edition, Volume 2 A-C, 1981.

All information, recommendations and suggestions appearing herein concerning our products are based upon tests and data believed to be reliable. However it is the users responsibility to determine the safety, toxicity and suitability for his own use of the product described herein. Since the actual use by others is beyond our control, no guarantee expressed or implied is made by SAMCHEM as to the effects of such use, the results to be obtained, or the safety and toxicity of the product. SAMCHEM does not assume any liability arising out of the use by others of the product referred to herein. Nor is the information herein construed as absolutely complete since additional information may be necessary or desirable when particular or exceptional circumstances exist.

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### APPENDIX 6.6

#### 6.5 Records and registers

See attached samples of the following sheets.

##### 6.6.1 Borehole instruction sheet

Contract No:			
Contract Name:			
Site Name:			
<b>1 GENERAL INFORMATION</b>			
1.1	Borehole number	Planned depth	
1.2	Vertical/Inclined	Inclination	Direction
1.3	Pre dig hole to _____ m	Signature:	Date:
1.4	Sign off pre dug hole by Client/Engineer Name:	NWD4/TNW	Triple Tube
1.5	Required borehole diameter (Specify type)		
<b>2 IN-SITU TESTING</b>			
2.1	Are SPT test required? if yes, At what intervals		
2.2	Are Undisturbed samples required? if yes, Specify diameter (75 or 63mm) and at what intervals		
2.3	Are Packer/Lugeon tests required - single/double? if yes, specify depth of tests and pressures		
2.4	Are Vane Shear tests required? if yes, specify depths + vane size		
2.5	Are Pressuremeter tests required? if yes, specify depths intervals		
2.6	Are core orientations required? Specify type		
2.7	Are any other in-situ tests required - specify?		
<b>3 FINISHING OFF THE BOREHOLE</b>			
3.1	Is permanent casing required in the hole - if yes specify?	Steel	PVC
3.2	Is a Piezometer required - specify?		
3.3	Bentonite Plug Single/Double?	Response Zone	
3.4	Is a concrete block required?		
3.5	Is a lockable manhole/standpipe cover required?		
3.6	Water sample required? Specify		
3.7	Is the hole to be backfilled? Specify		
<b>4 SIGN OFF</b>		Signature	Date



### BOREHOLE INSTRUCTION SHEET

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- 6.6.2 Daily report sheet (see attached .pdf document)
- 6.6.4 Piezometer installation report sheet

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**Piezometer Installation Record**

Borehole Number \_\_\_\_\_

Date of Installation \_\_\_\_\_

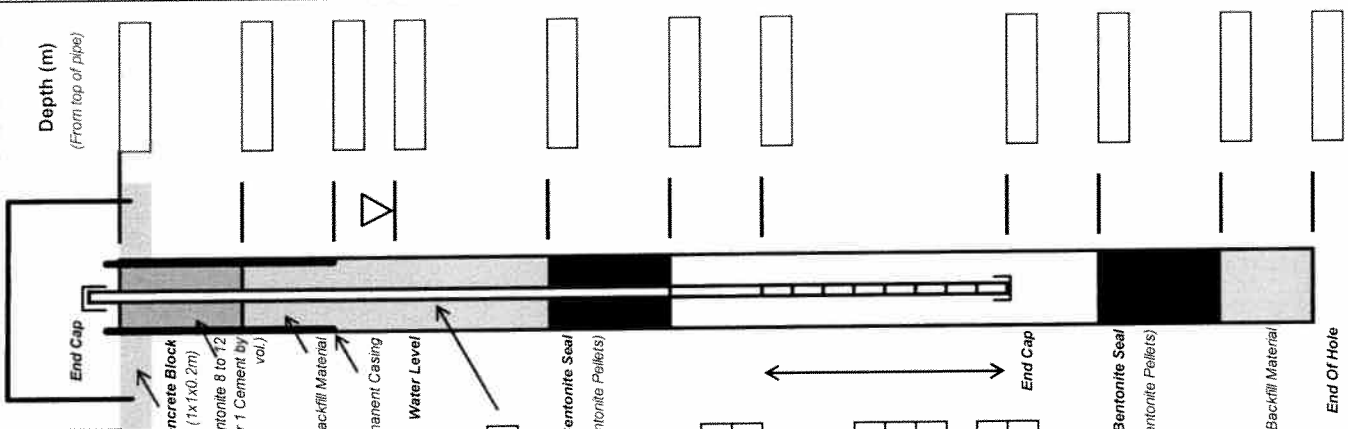
Site Name \_\_\_\_\_



Engineer _____	Lockable cover bedded in concrete	Metal _____	Plastic _____	Depth (m)
Drilling Contractor _____				(From top of pipe)
Site Name _____				
Contract Number _____				

Hole Diameter	From	To	Dia (mm)



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#### APPENDIX 6.7

##### 6.6 Risk Assessments and Safe Work Procedures

See attached the Geomechanics generic risk assessment and safe work procedures.