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Memo

To:	Will Brits, Wentzel Coetzer	**Client:**	Cabot Corporation
From:	Bruce Murphy	**Project No:**	1CC041.000
Cc:	John Egan (Cabot Corporation)	**Date:**	June 25, 2014
Subject:	TDR and Triaxial Geophone Installation Project – Safety Aspects		

1 Project Description

The project is intended to install monitoring equipment within drillholes drilled into the crown pillar above the East Main Zone, from a barge on the lake. The monitoring equipment includes two Time Domain Reflectometry (TDR) cables and a seismic triaxial geophone. The intent is to drill three holes, one for each instrument (Figure 1 – Figure 3).

The TDR's are to be installed by SRK personnel assisted by Tanco's selected drilling contractor. The geophone install will be under the supervision of ESG (Seismic System Supplier) - a representative from which needs to be present during installation. Table 1 provides a list of drillholes.

Table 1: Drillholes

Proposed Hole ID	Easting (ft)	Northing (ft)	Lake Elev. (ft)	Target Depth (ft)	Azi. (˚)	Dip (˚)	Purpose	Hole Size
SRK14-05	10050	9740	1082	150	135	-55	TDR install hole	NQ
SRK14-06	10280	9720	1082	170	220	-55	TDR install hole	NQ
SRK14-07	9845	9870	1080	71	0	-90	Vertical hole for triaxial geophone sensor install	HQ

1.1 Project Purpose

The Geotechnical Mining Review Board (GMRB) recommended that TDR cables should be installed from surface into the crown pillar above the current Fall of Ground (FOG) to help monitor the occurrence of failure (dilation on joints/faults). These will also help to assess the depth of failure if additional falls do occur within the 14N FOG area.

Following a SRK review of the accuracy of the seismic system and discussions with ESG, they recommended the addition of a triaxial geophone closer to surface in the East Main Zone Area. This geophone and the improved 3D velocity model mayl help improve the location accuracy and enable a better understanding of the micro-seismic data – which could possibly provide an indication of potential instability.

1.2 Project Objective

Further enhancing the crown rockmass monitoring system will help manage the risk to personnel by increasing the monitoring capability in the 14N FOG area, and by being able to understand rock mass changes, exhibited as seismicity, that may occur in the East Main Zone and the West Zone.

2 Project Risk

Two potential project risks have been identified: 1) drilling into the mine resulting in potential flooding, and 2) stability impacts on the crown pillar as a result of the proposed drilling. The mitigation measures to manage these risks are discussed in the separate sections below.

2.1 Project Risk – Drilling into the mine (flooding)

The drillholes have been designed to stop short of the current excavation, just as was undertaken in the recent crown pillar exploration program. The same practises will be followed to prevent a major occurrence of water in-rush into the mine. Figure 4 shows the details of the water to rock seal procedure that serves to reduce the likelihood, to acceptable levels, of the lake water entering into the drill hole. If a hole-through to the underground does occur, the fact that the drillhole system has been isolated from the lake, that a plug can be installed into the hole, and the hole can then be grouted, will reduce the risk of mine flooding to reasonably acceptable levels.

The stoping distance of +20 ft back from the excavation should address the lake level fluctuation and reduce the risk related to breakthrough as a result of scan and hole-surveying inaccuracy. Set-up on the drilling for collaring of the drill hole and the checking of the orientation during drilling will help manage the risk related to drilling accuracy.

The Rodren Drilling procedure to deal with the breakthrough hazard is attached in Appendix A. The risk of breakthrough is real and it is that procedure, which aims to mitigate the risk of lake water and underground interaction.

2.2 Project Risk – Impact on crown pillar

The two TDR monitoring holes are being drilled into the FOG area. These will likely have a limited impact on the stability of the existing FOG. The benefits of having the TDR cables installed far outweigh the risks related to the impact of the drilling. Drilling water and vibrations could induce some localised instability if there is breakthrough into the excavation, especially since the excavation is unsupported. This would occur in the currently “restricted zone” and is unlikely to affect currently accepted mine safety levels.

The same drilling practises as those used in the recent crown pillar geotechnical drilling program will be employed, as discussed above and attached. These successfully drilled into similar rocks, under similar conditions, using currently accepted practice

The proposed drilling contractor has previously drilled holes off barges on unfrozen lakes and has drilled holes into the same crown pillar area recently. They understand the risks related to this type of drilling and are, in our opinion, capable of managing the associated risks.

When the TDR drill holes are drilled into the 14N FOG area an underground spotter should be used to monitor the occurrence of any water ingress or potential instability in the excavation back. This would need to be undertaken at a safe distance from the break-through point, from a point deemed safe by mine personnel, having reviewed the drill hole orientation and potential hole-through point, following measurements made where the drill hole is adequately cased and set into the bedrock.

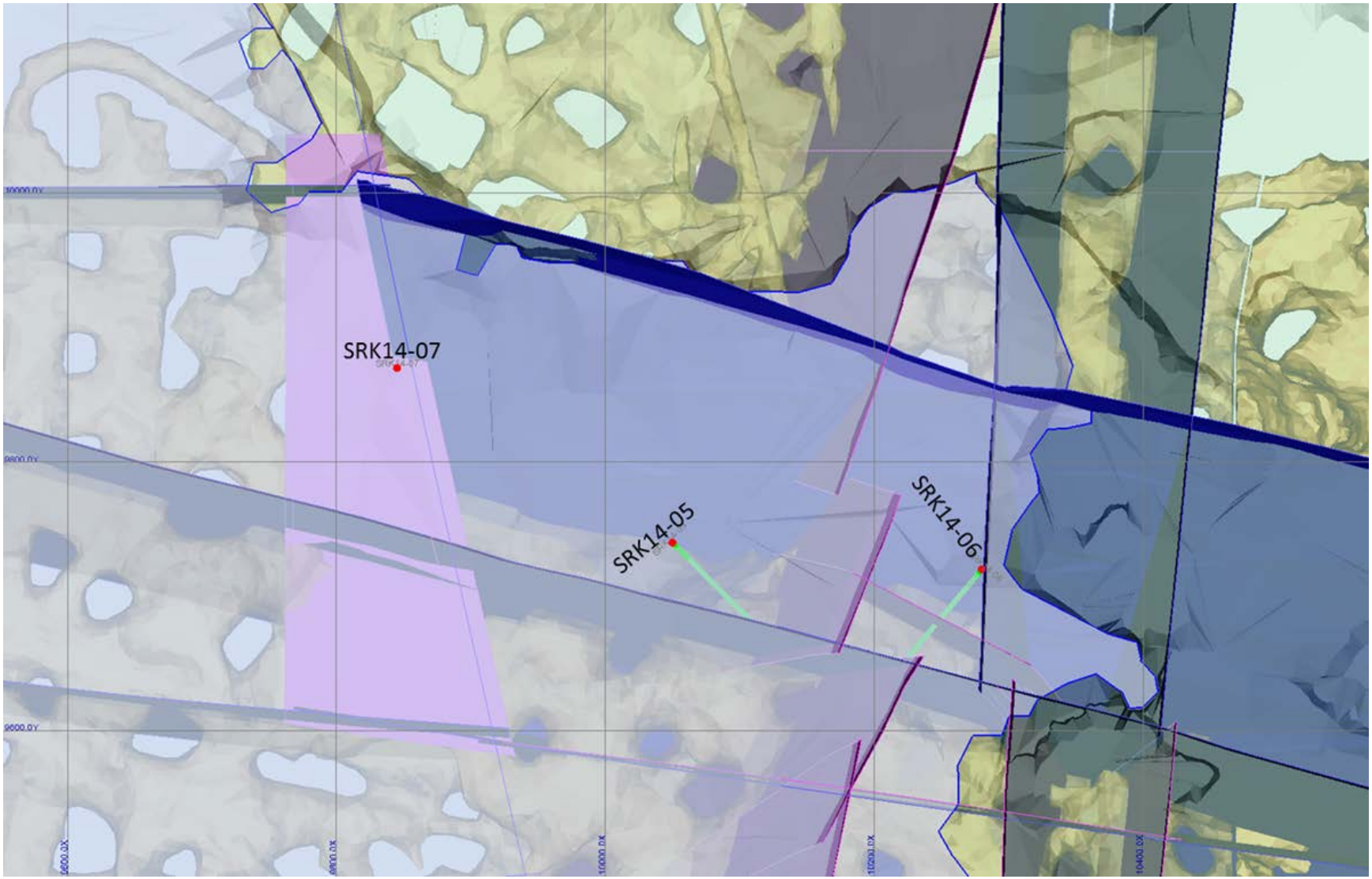
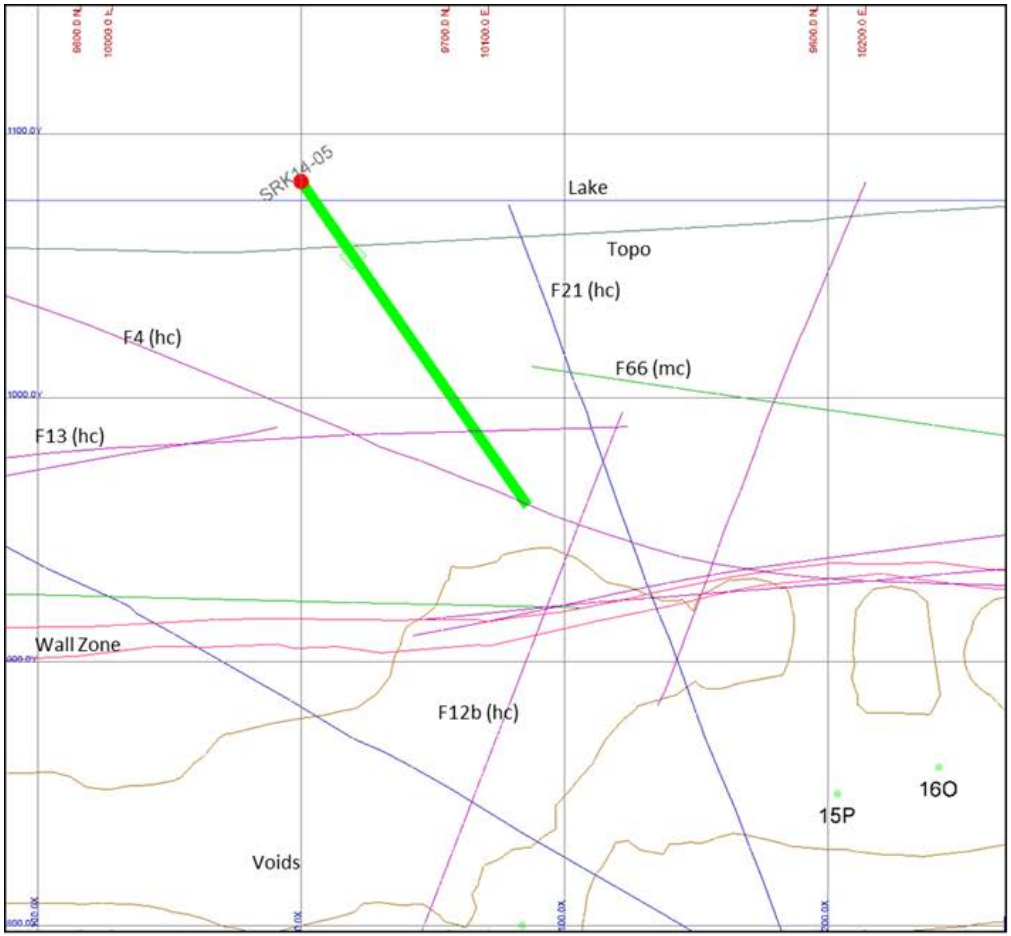
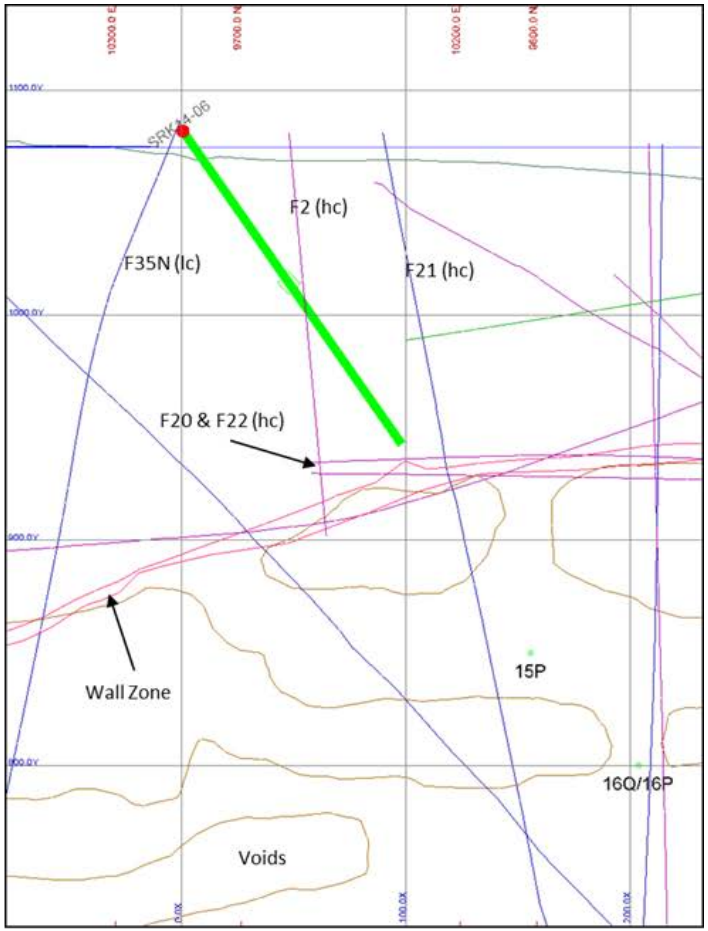


Figure 1: Plan view showing lake edge, void, and sub-vertical to vertical faults. SRK14-07 is the vertical hole for triaxial geophone sensor install. SRK14-05 and SRK14-06 are TDR install holes.



Long-section through proposed TDR hole 14-05



Long-section through proposed TDR hole 14-06

Figure 2: SRK14-05 and SRK14-06 are the holes required for installation of the TDR cables above the 14N FOG.

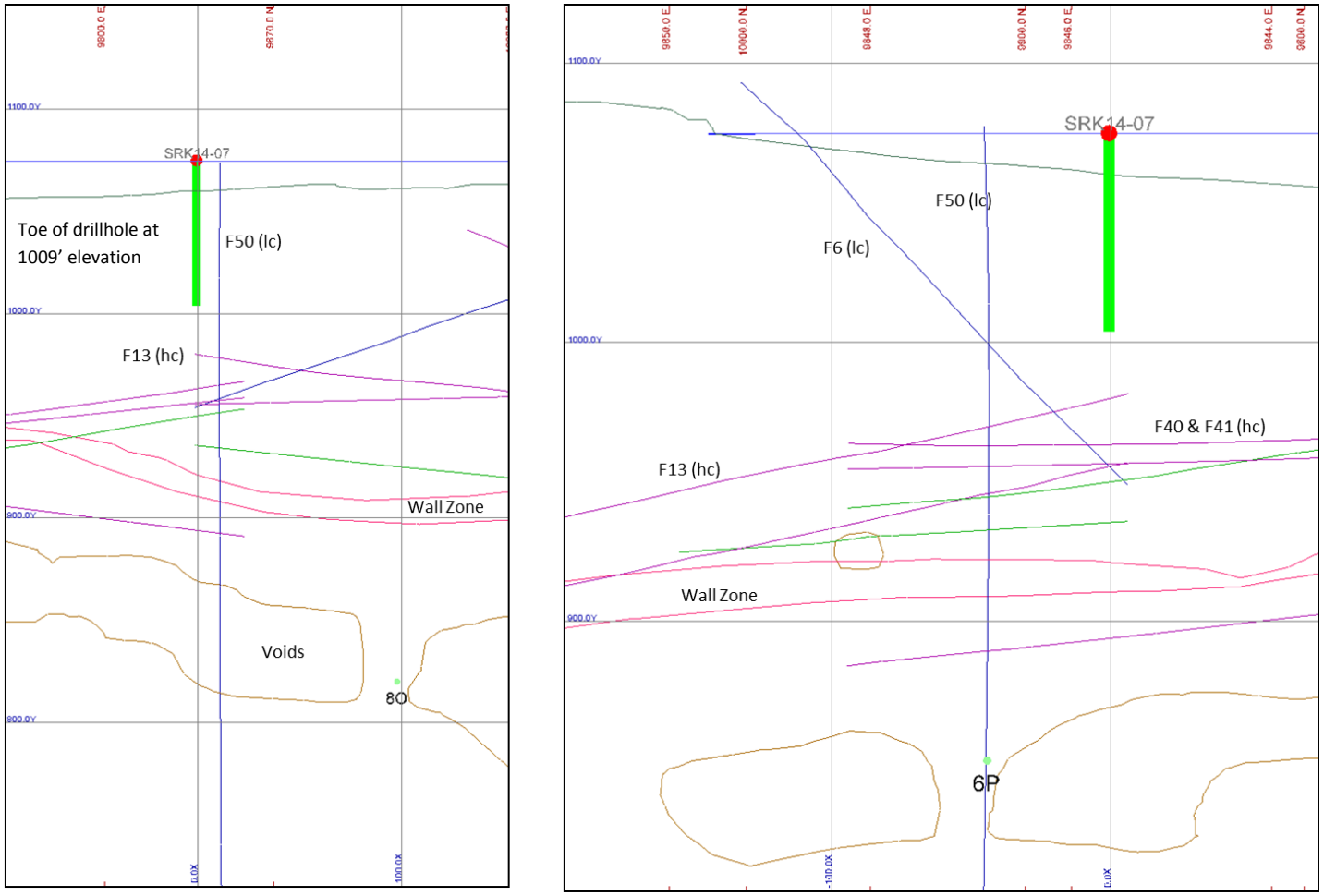


Figure 3: SRK14-07 is a vertical hole for the installation of the triaxial geophone.

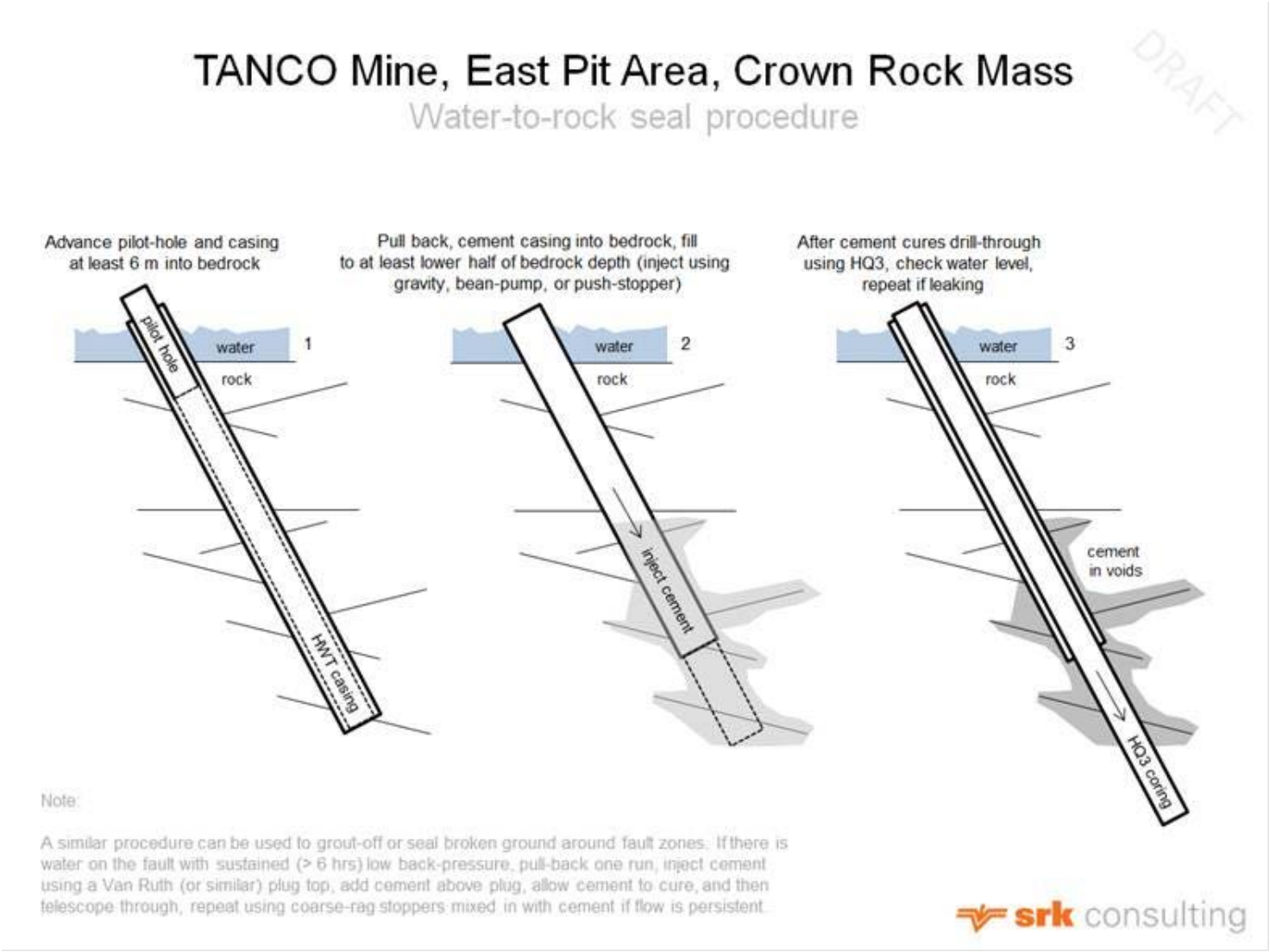


Figure 4: Water to rock sealing procedure.

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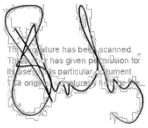

Bruce Murphy,
Principal Consultant

Appendix A: Rodren Drilling Procedure

Tanco Site Specific - Break Through of Borehole Into Mine

Facility:	Written By:	Approved By:	Date Created:	Date of Last Revision
Rodren Drilling	Ian Wilson	Rod Cyr	Feb 19, 2014	Feb 19, 2014

Hazards Present:	*PPE or Devices Required:*	*Additional Training Required:*
Drop Drill rods into mine	Monitor of Drill Bit Location	First Aid
Overhead hazard to miners	Communication with mine Eng.	
Loss to process	Accurate Planning of drill hole	
Crushing injuries to drill crew	Standard drill guarding	
	Standard Drilling PPE	

Safe Work Procedure:

1. This has been done in the past and is always a real possibility when working above old or current mine sites. The problem becomes prevalent when the drill crew is unaware and unprepared.
2. Knowledge of the ground below is absolutely necessary. In the past this situation arose, the crew was not prepared for this to happen and lost the core barrel plus drill rods and damaged the drill head costing approximately $12,000.00 damage.
3. The hole was easily plugged from surface using a safety plug and then cementing the hole back to lake bottom.
    a. Possible Risks
        i. Drop rods onto workers or operating equipment.
        ii. Damage to drill equipment.
        iii. Crushing injuries to drill crew.

Keys to being Prepared:

1. ***Communication and hole planning is extremely important. Information must be communicated from the hole planner (Tanco) to the drill crew, making them aware at what depth they may encounter the mine.***
2. Accurate count of hole depth must be checked and double-checked. Measure this distance from the top of the ice, subtracting stickup, and keep this information available for both shifts.
3. When re-chucking ensure NOT to use the Clamp Lock feature of the Discovery drill, it is important to always have hold of your drill string by either the top or the bottom clamp.
4. Supervisor will make himself available during times where break through may be likely; supervisor will alert Mining supervisor of times when break-though may occur, and suggest that work in the likely area is stopped, and equipment is moved to prevent accidents underground.
5. Driller and supervisor ensure proper steps are taken throughout hole plugging process.

In the even of a break though:

1. Water pressure will drop to zero.
2. Head Pressure will drop to zero.
3. Immediately notify supervisor, Mine Security and all on drill site personnel of the situation.
4. Pull drill rods.
5. Attach Safety Plug / or go down open rod to a location 6 – 10 feet above break-though, Install safety plug. Pull back 20’ – 30’ pour cement down borehole, and slowly pump down the hole with a wiper.
6. In the event that water is still entering the mine site, install additional plugs above break though area and stop water.
7. Do not remove drill from collar until it is confirmed that the hole has been plugged and that

<table>
<tr><td colspan="2">water entering mine site has stopped.</td></tr>
<tr><td colspan="2">If an emergency situation occurs while conducting this task, or there is an equipment malfunction, engage the emergency stop and follow the lock out procedure

REPORT ANY HAZARDOUS SITUATIONS TO YOUR SUPERVISOR</td></tr>
<tr><td rowspan="2">Guidance Documents/Standards:

MB Workplace Safety & Health Act & Regulations:</td><td>This Safe Work Procedure will be reviewed any time the task, equipment or materials change and at a minimum of every three years</td></tr>
<tr><td>Reviewed By WSH Committee:

Date:</td></tr>
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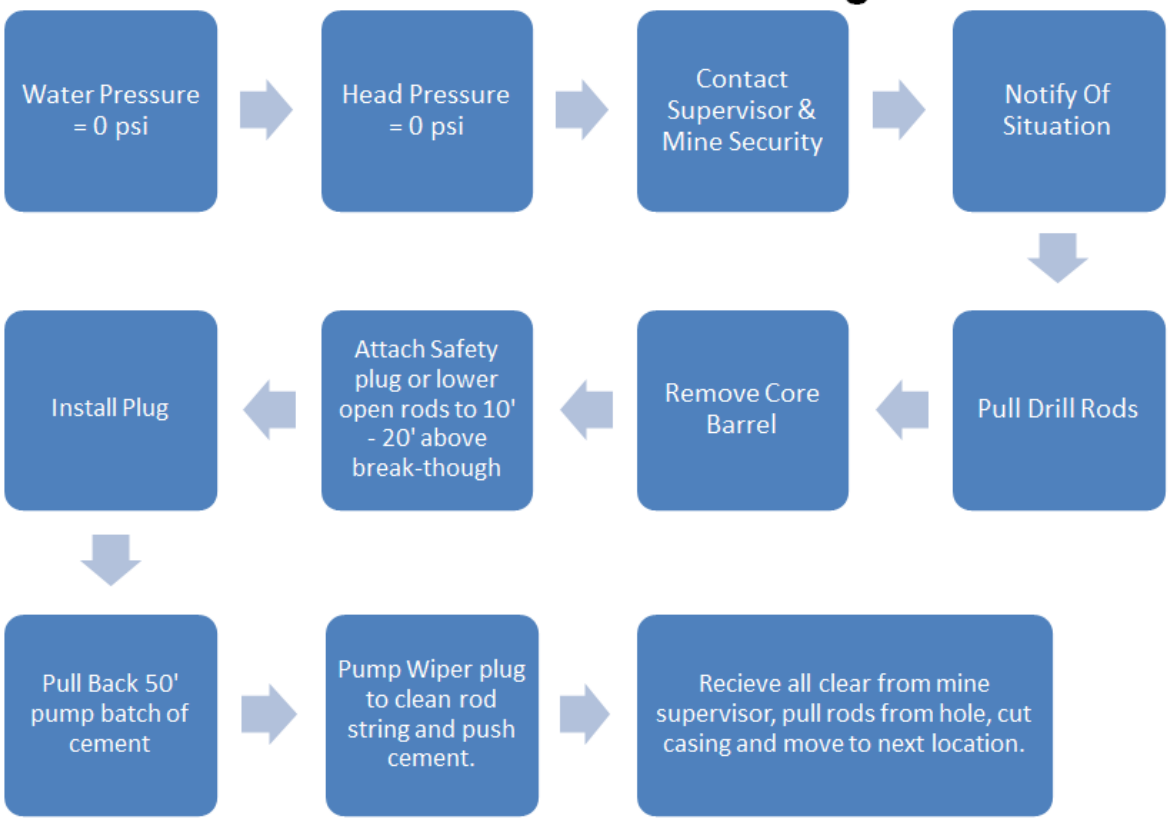
Tanco - Mine Breakthrough



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