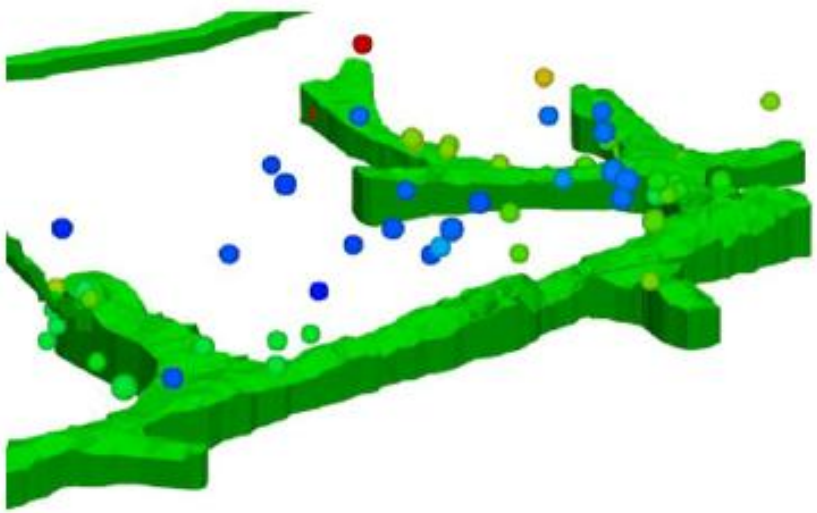
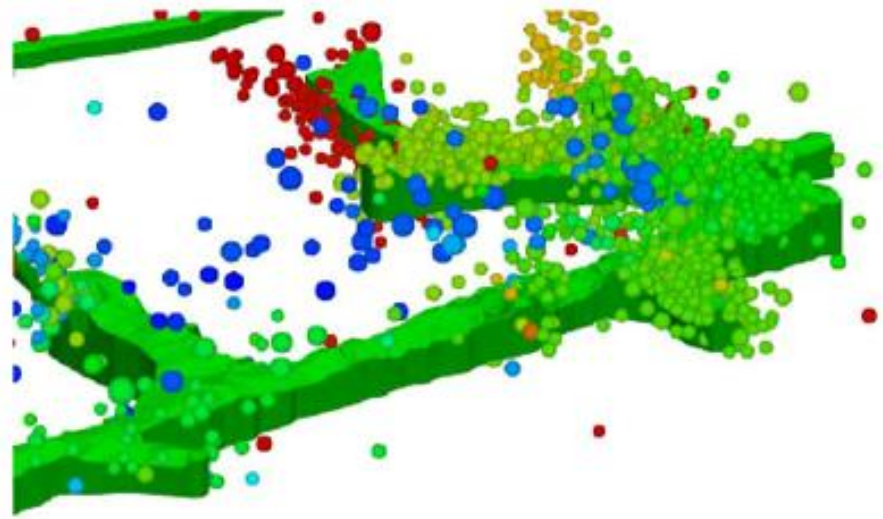
Rehabilitation of Highly Fractured Ground

Introduction

- Area identified for rehab is the sole access for a stoping complex
- Area with past history of seismicity
- Stress and structure resulted in extensively fractured ground, causing overbreak during development and subsequent bagging/bulking



Events >-1.0 Mw



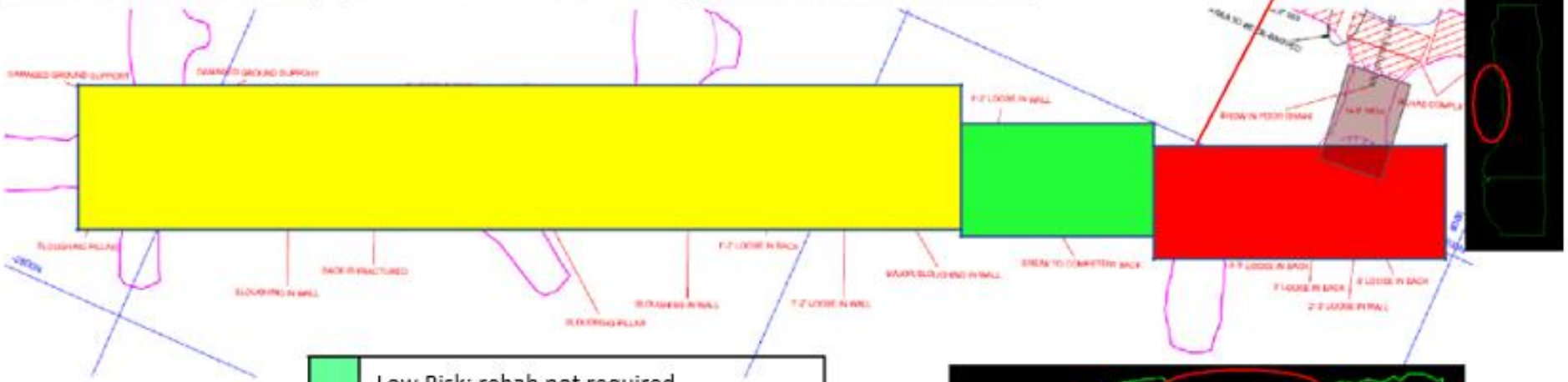
Most recent events in red

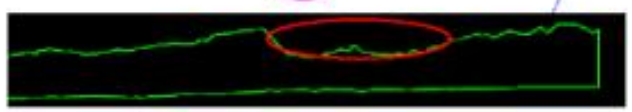
Observations

- 7’ bagging in high risk zone
- Undulating back height presents elevated seismic risk

Sloughing walls

Bagging

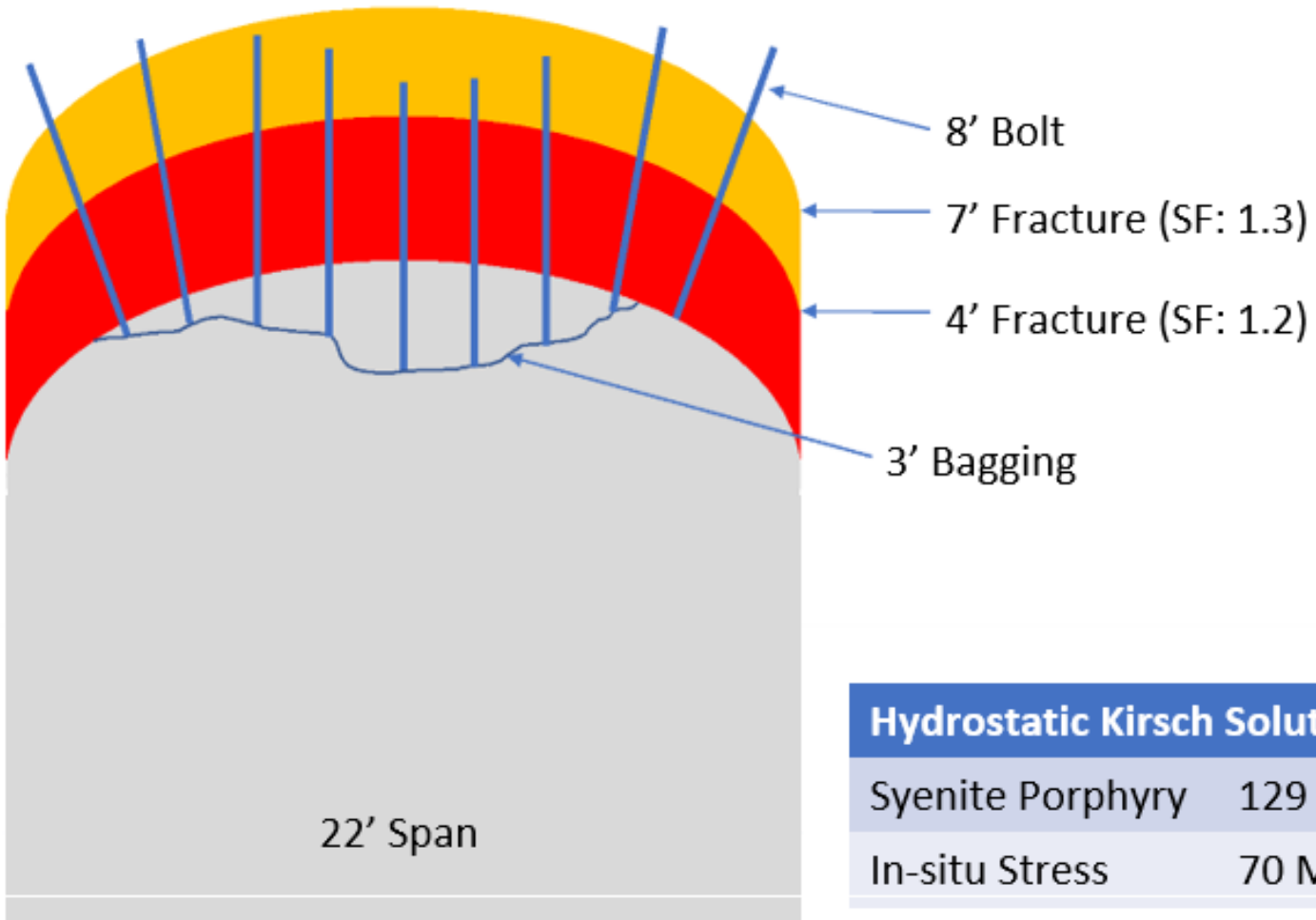




Undulating back height

Analysis

- Facture zone extends well beyond excavation
- Bolt capacity compromised by fracture zone
- Effective bolt length reduced by extensive bagging



		Consequence				
		Negligible 1	Minor 2	Moderate 3	Major 4	Catastrophic 5
Likelihood	5 Almost certain	Moderate 5	High 10	Extreme 15	Extreme 20	Extreme 25
	4 Likely	Moderate 4	High 8	High 12	Extreme 16	Extreme 20
	3 Possible	Low 3	Moderate 6	High 9	High 12	Extreme 15
	2 Unlikely	Low 2	Moderate 4	Moderate Development	High 8	High Loaded
	1 Rare	Low 1	Low 2	Low As-Built	Moderate 4	Moderate 5

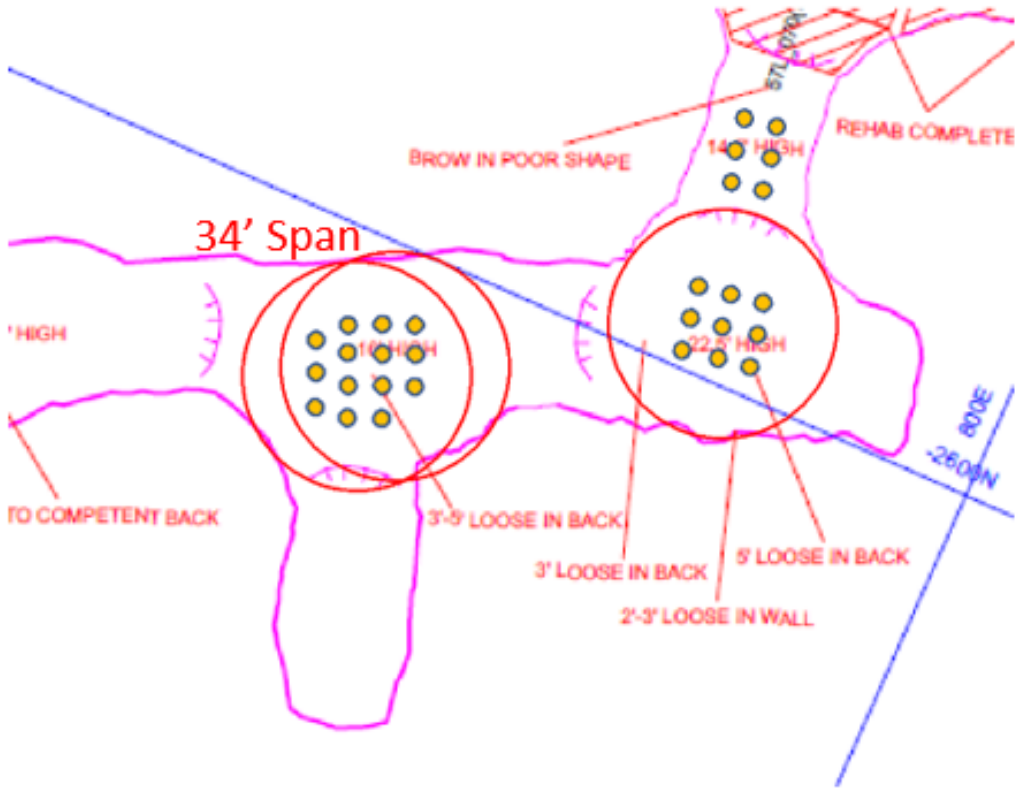
Hydrostatic Kirsch Solution	
Syenite Porphyry	129 MPa (50%)
In-situ Stress	70 MPa

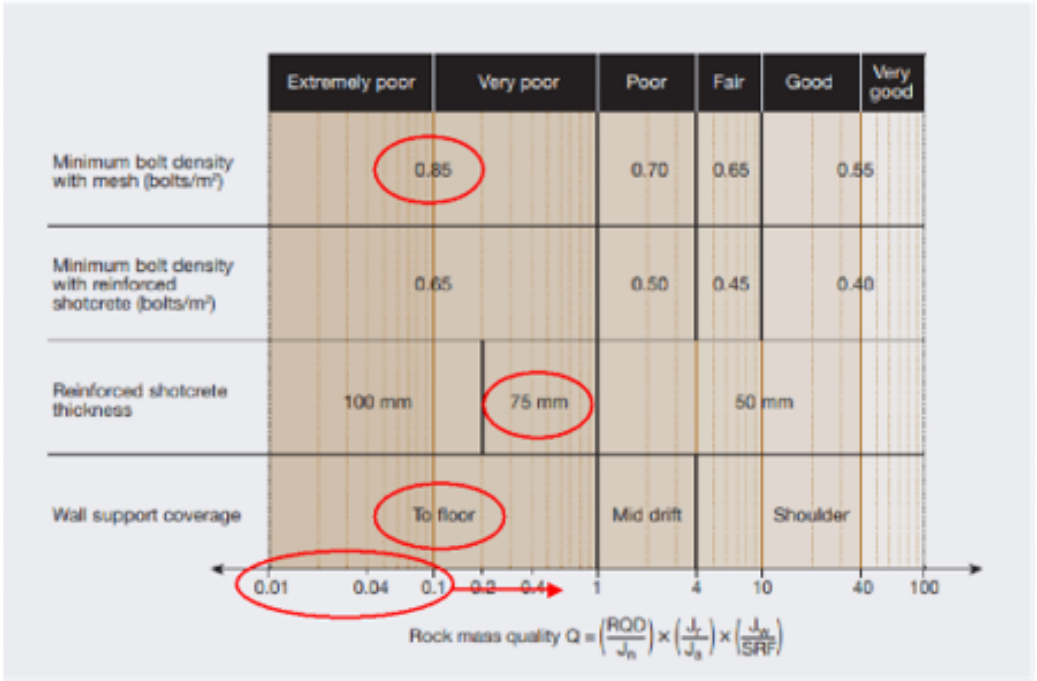
Support Condition	Risk of Burst (>10 t)
As-Built	5% - 10%
Loaded	10% - 25%

Ground Support Selection

- Use of unreinforced shotcrete prior to bolting improves rockmass quality from "Extremely poor" (Q: 0.01 - 0.1) to "Very poor" (0.1 – 1)
- Control span with 3" shotcrete on walls
- Remove screen from back, apply 3" shotcrete, bolt with 8' MDX and weldmesh, install 15' cables as secondary support

Bolt Pattern	4' Dice with mesh
Shotcrete Thickness	3"
Coverage	To Floor





Concluding Remarks

- Large spans and seismicity presents increased risk
- Rehab program considers availability of on-site equipment, turnaround time, and performance required
- Seismic risk solely based on number of workers spent in the area; risk increases when factoring in losing sole egress, critical infrastructure, and production
- Implementation of the rehab plan requires precise coordination between crews; high level of commitment and high degree of supervision is required
- QA/QC from Engineering is essential to successful implementation of the rehab plan

Bibliography

J. Hadjigeorgiou, Y. Potvin “Ground Support for Underground Mines”, *Australian Centre for Geomechanics*, 2020.

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