



Driefontein Masakhane Shaft

Permanent Mesh
05/04/2024



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Safety Moment

- Sibanye Stillwater Gold Division is on permanent blast-on mesh on all the shafts, except for the lower risk shafts which the implementation is on a Risk assessment base.
- Several examples on all the shafts where lives have been saved by the installation of permanent nets.
- Photo below is fall of ground arrest post a M11,9 event at one of the Kloof shafts.



Sibanyestillwater has successfully implemented 3 types of permanent blast-on mesh across the different shafts; Geoburg Mesh, LAW Mining Steel Nets, Rope nets.

Today's presentation is the journey of the LAW Mining permanent blast on mesh.

Masakhane shaft experienced a large number of fall of ground accidents over the last 3 years, which resulted in serious injuries.

Most sources were gravity and dynamic related falls of ground which resulted in rocks dislodging from the working place hangingwalls.

During this last three years we have worked tirelessly on enforcing proper entry examination and safe declaration, barring practices, marking and drilling practices, mining lay-outs and reporting of poor ground conditions through the TARP process.

We as a team are moving to the next phase of zero harm and that is by installing permanent in-stope mesh.

The primary focus on permanent mesh installation is to eliminate all rocks from falling uncontrolled (**reactive control**) also by ensuring that the integrity of the stope or any other excavations on the reef plane are secure and supported until the life of the specific excavation expires (**effectiveness control**).

Permanent mesh is to deal with such controls to ensure the **probability of injuries unlikely**.

 INNOVATION	Are you understanding the need for innovation?
 COMMITMENT	Are you committed to the SAFETY and WELL BEING of yourself and your team members?
 ACCOUNTABILITY	Are you taking accountability for the conditions in your working area?
 RESPECT	Are you respecting the SAFETY and WELL BEING of your fellow employees?
 ENABLING	Are you assisting fellow members in working safe?
 SAFETY	Are you fit and competent to perform your job safely?

THE CRITICAL COMPONENTS REQUIRED TO BLOCK THE PATH TO DEATH



CRITICAL CONTROL:

Key component, system or activity that is introduced to prevent an unwanted event or to minimise harm, should it occur.

CRITICAL LIFE-SAVING BEHAVIOR:

Conscious decisions or actions that I must take in line with procedures, that will save my life or the lives of others.

CRITICAL MANAGEMENT ROUTINE:

Action or system process that checks that our Critical Controls are effective and everyone is choosing to follow Critical Life-Saving Behaviours.

NO MORE FATALITIES
BECAUSE WE **CARE**
ENOUGH!

1. ROCK MASS MANAGEMENT



Critical Controls

Preventing:

- Mining plan execution;
- Entry examination and safe declaration;
- TARP's for ground conditions
- Ground monitoring;
- No-Go Zones.

Mitigating:

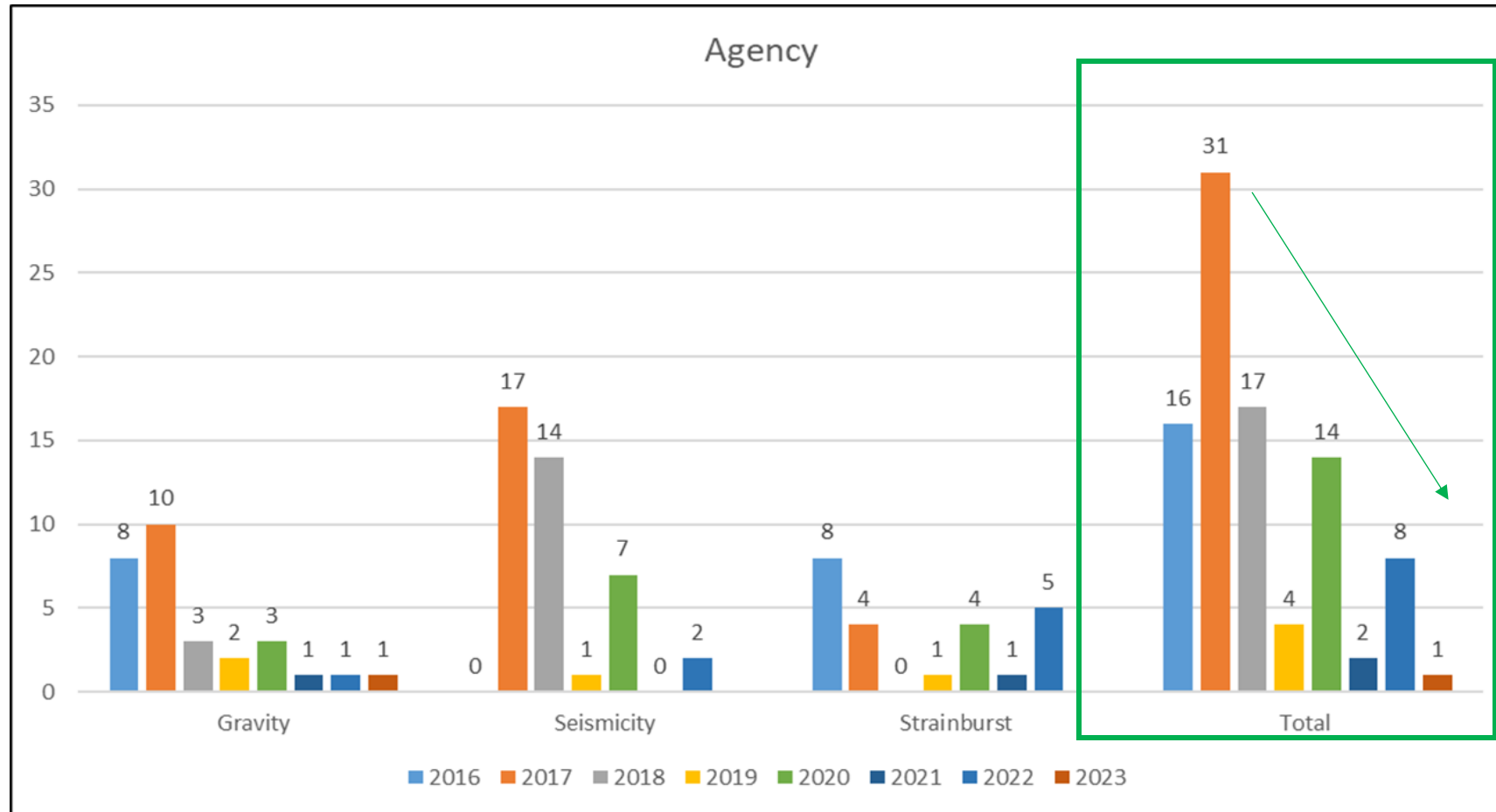
- Safe barring practice;
- Blasting practice.

Critical Life-Saving Behaviours:

- I will only enter a workplace declared as safe by a competent official.
- I will only initiate a blast within the approved design limitations.
- I will never enter an unsupported area.
- I will never enter a barricaded area or No-Go Zone without permission.

Critical Management Routines:

- Daily seismic rating and withdrawal procedures;
- Risk Management & Standards;
- Safe Planned Work (No Plan, No Work);
- Two-way communication;
- Effective Supervision;
- Continuous Risk Assessment;
- HPI reporting and investigations;
- Auditing & Critical Control Verification.



Criteria for application

- Overall breaking strength of 450kg
- Easy to transport and handle
- Must be easy to install in the panels.

1. Objective of Test

- The objective is to determine the maximum load that the nets would be able to carry without breakage as well as the impact resistance and to see if it meets the criteria.
- The impact test was conducted on a LAW Mine Safety 3mm Galvanized Steel Wire(6 x 7) Safety Net at LAW Mine Safety testing area.

2. Sample

2.1 Description of Sample

- The sample was tested as per description below:
 - 2.1.1 LAW test net is a 1.5m x 2.2m with 150mm aperture, made from 3mm galvanized steel wire (6 x 7 Poly-cor)
 - The steel wire is fastened with aluminum ferrules. The net was secured to the frame with 6 x Law TIM Hooks.

2.2 Date of Test

- 15 November 2019

3. Method of Test

3.1 Impact load test

- The net as described in section 2.1 was fastened, to LAW Mine Safety test frame manufactured from 100x150 I Beam with a lifting height of 3 m fitted with 3 ton lifting winch with a quick release mechanism. The net was loaded sequentially by adding a variety of 1 steel drums weighing 1007kg and dropped from a height of 300mm above the net until net failure or the maximum load exceeded. The same net was used for impact test of 1007kg and 1007kg again.

Law Mining Impact load Test on Law Mining's 3 mm Galvanized Steel Wire(6 x 7) Safety Net



Photo1 – Law Testing area



Photo 2.1 – Law Net before test



Photo 2.4 – Law Net before test



Photo 2.4 – Law Net before test
Sag With load 250mm



Photo 2.2 – Law Net before test



Photo 2.3 – Law Net before test



Photo 4 – Law test Net after test

Table 1 – Test result for impact load test on Law Mining net

Sample	Test type	Load, Kg	Observation and damage report
LAW net	First Impact test from 300mm	1007 kg	This net configuration sustained a load of 1007 kg. There was no damage to the net. Photo 3 and 4
LAW net	Sag	1007 kg	The sag on the net loaded is 250mm. Photo 3
LAW net	Second Impact test from 300mm on same net	1007 kg	This net configuration sustained a load of 1007 kg. There was no damage to the net.
LAW net	Sag	1007 kg	The sag on the net loaded is 300mm.

Law Mining Mesh Specification



114821	LAW S-Hooks 12mm
114822	LAW S-Hook Net Tensioner 500mm
114823	LAW Suspender Pin 150mm
114858	LAW 8.5m x 1.6m Steel Safety Net 3mm 130/130 No Hooks
114992/115049	LAW 10m x 2.4m Steel Safety Net 3mm 130/130 No Hooks
114820	LAW 10m x 2m Steel Safety Net 3mm 100/100 No Hooks
114862	LAW 3m x 2m Steel Safety Net 3mm 100/100 No Hooks
114892	LAW 1m x 4.5m Steel Safety Net 3mm 100/100 No Hooks
114959	LAW 10m x 3.5m Steel Safety Net 3mm 100/100 c/w Hooks
114960	LAW 5m x 3.5m Steel Safety Net 3mm 100/100 c/w Hooks
114961	LAW 5m x 2m Steel Safety Net 3mm 100/100 c/w Hooks

Roll out action plan

Masakhane Shaft Permanent Mesh Roll Out Schedule				
Ref.	Aspect	Start Date	End date	Duration
1.	Introduction			
1.1	Ordering mesh per section	08-11-2021	On going	-
1.2	Delivering of mesh to the shaft	12-11-2021	On going	-
1.3	Introduction - Union Discussion	08-11-2021	08-11-2021	1 Day
1.4	Introduction - Safety Meeting (Shift bosses & Service departments)	15-11-2021	22-09-2022	7 Months
1.5	Introduction - Safety Meeting (Miners)	20-07-2022	22-09-2022	Multiple meetings to discussed nets
1.6	Review and design of new support standards	19-09-2022	23-09-2022	5 Days
1.7	Developed support installation method	12-11-2021	24-11-2021	12 Days

Implementation success

- Will entirely depend on the buy-in from all stakeholders.
- All supervision and crews to be trained on the installation of the mesh.
- Not allowing to initiating any blast before the mesh are installed to standard.
- The mesh installation depend 100% on the support design, once support units are not installed to standard, it would jeopardise the function of our hanging wall mesh.

Way forward - Roll out action plan

Section 10	Working place	Panel	Steel nets used	Section 11	Working place	Panel	Steel nets used
	CL36-28	6E	Yes		VC40-20	9E	Yes
	CL38-28	5E Up-dip	Yes			9W & 10W	Yes
		5E			CL42-11	3W	Yes
	CL40-28	8E	Yes		CL38-12	6W Up-dip	Not mining yet Crew trained Yes
	VC38-21	4E	Yes			6AW Up-dip	Not mining yet Crew trained Yes
		6W	Yes		CL42-12	10W	Yes
	VC40-21	2AE	Yes		CL38-13A	5E	Not mining yet Crew trained Yes
		3W & 4W	Yes			6E	
		5W	Yes		CL42-13A	10W	Yes
		8W & 9W	Yes		CL42-16	4E	Yes
		10W	Yes			5E	Yes
		8E	Yes				
	VC40-22	8W	Yes				
8AW		Yes					
Total - Oct	13 Crews /13 Crews = 100%			Total - Oct	10 Crews /10 Crews (3 Crews not mining) – 100%		
Total Shaft	23 Crews /23 Crews = 100% (3 Crews not mining but trained)						

CL38-28 5E Breast



Photos taken on the 12-01-2022

CL38-28 5E Up-dip



Photos taken on the 31-01-2022

CL42-16 5E Permanent netting



CL42-16 4E Permanent netting



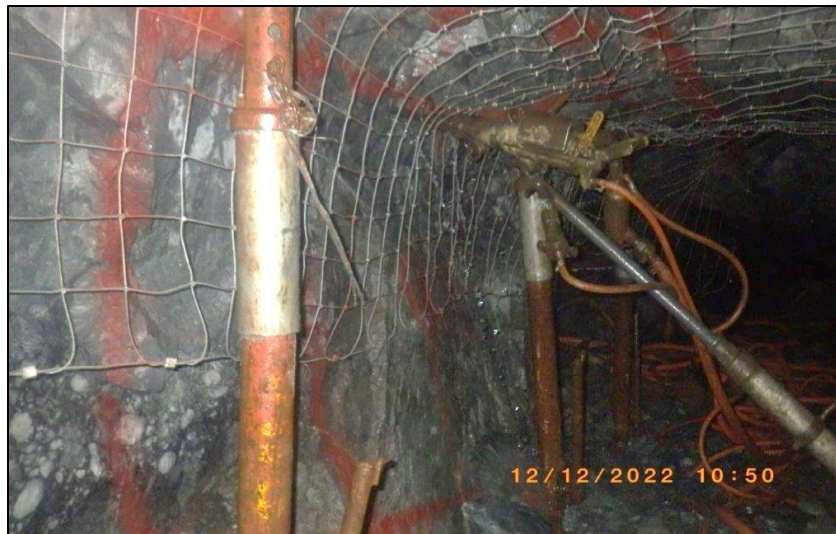
Before



After



Photos taken on the 23-09-2022 – Charged up panel before blasting



Photos taken on the 21-09-2022



Photos taken on the 23-09-2022 – New Start up panel (First Safety Net)

CL40-28 8E Breast



Photos taken on the 01-11-2022



Photo taken on the 18-11-2022 – Nets after blasting the face, Hydra bolts 0,5m from the face before the blast 24

VC40-20 9W Ledging

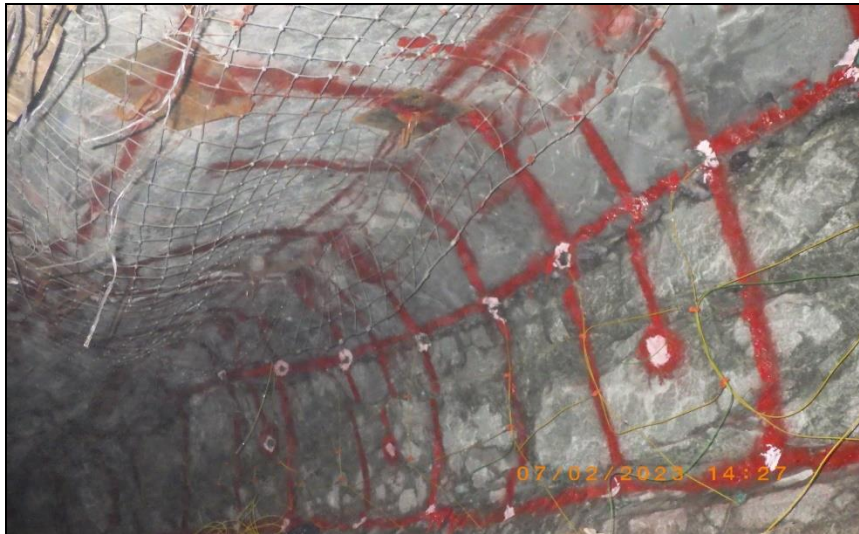


Supported with Steel nets, Hydrabolts and 300mm x 300mm plates

VC40-20 Back Area



Supported with Steel nets, Hydrabolts and 300mm x 300mm plates

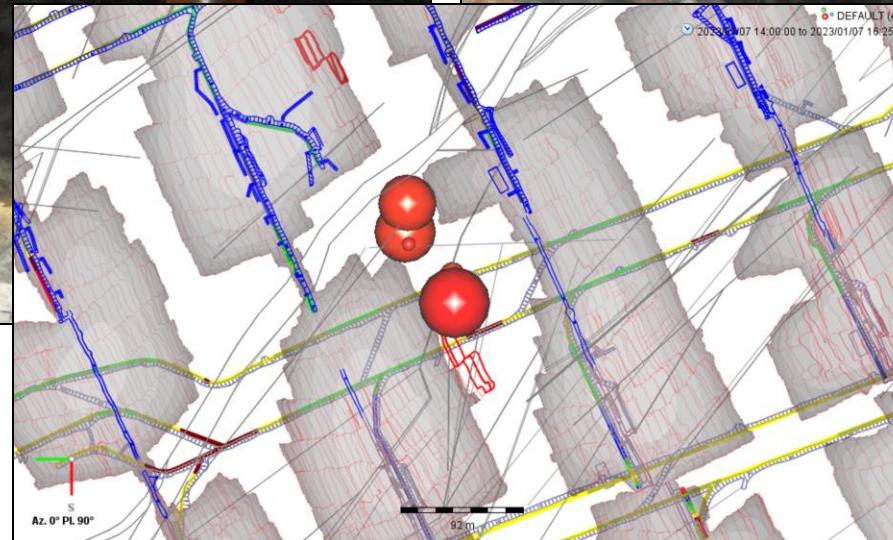
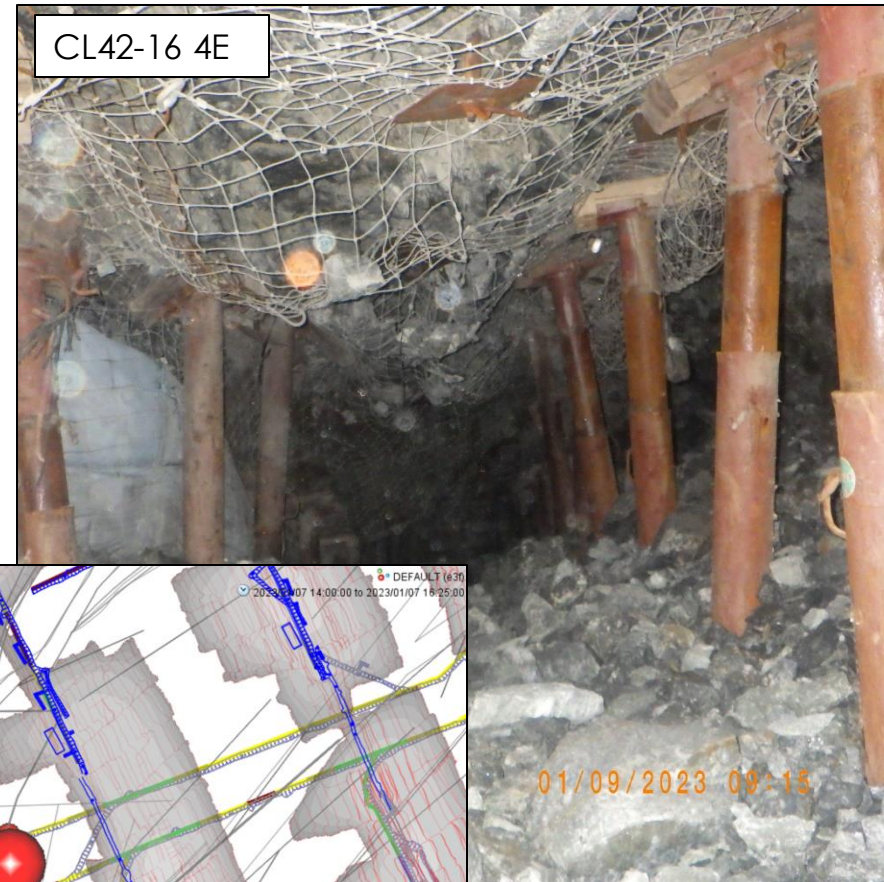


CL42-16 5E Permanent netting



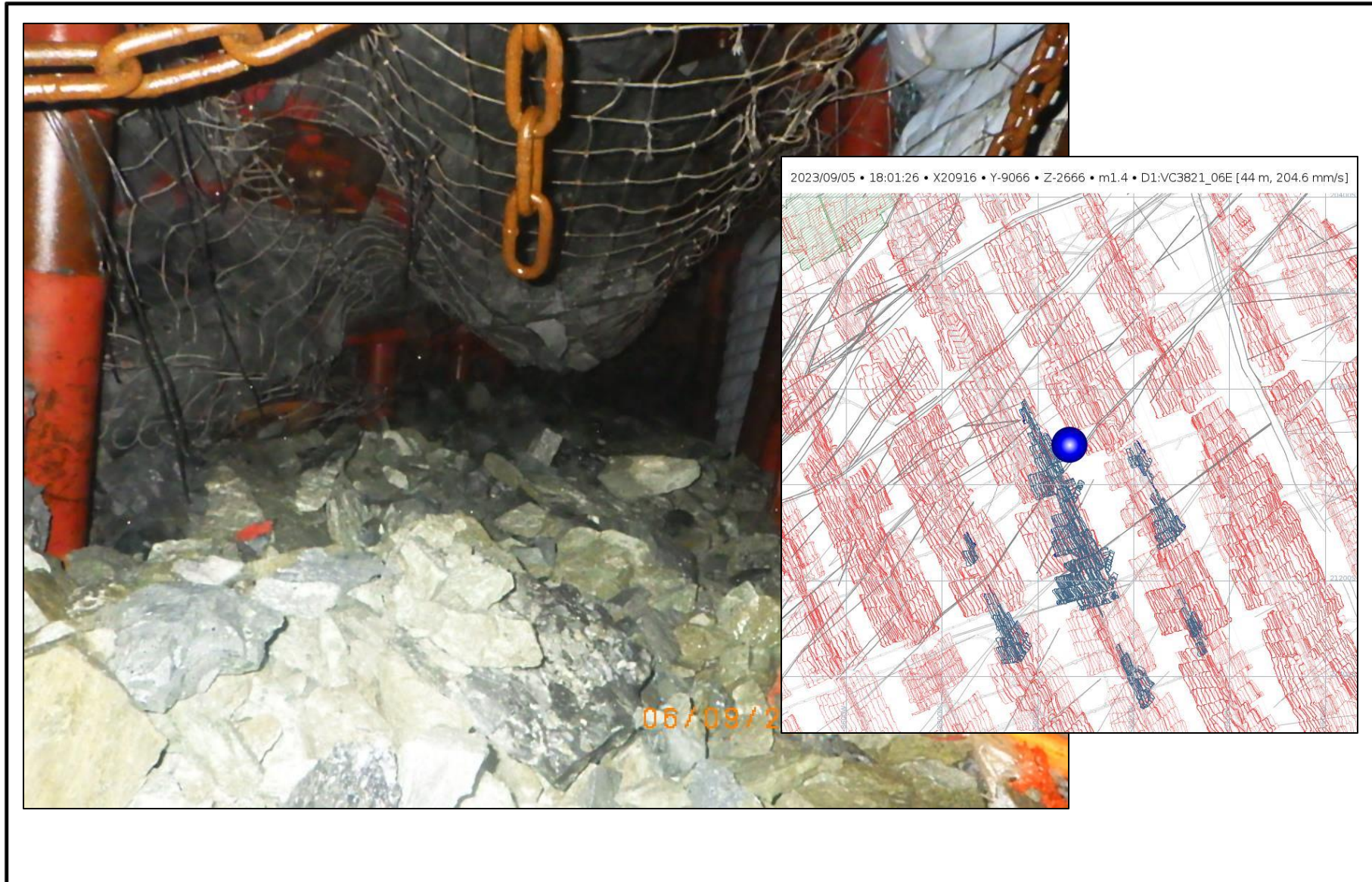
Photos taken on the 06-10-2022 after ML2,1 seismic event

CL42-16 3E & 4E



Photos of the stopping panels post MI3,3, MI2,5, MI2,2 events. No damages observed on Reef

Underground installation of permanent mesh



A M11,4 seismic event occurred at blasting time.



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Advantages - LAW Mining Net

- ✓ First and most important advantage is we are SAVING LIVES.
- ✓ Light in weight to transport into the panel, less wastage due to mono winch.
- ✓ Permanent arial coverage eliminating fall grounds.
- ✓ Blast-on mesh (handling the blast with limited to no blast damage).
- ✓ High tensile strength with flexible ability to absorb kinetic energy.
- ✓ Corrosion resistant (Short term) – Shaft is using backfill.
- ✓ No sharp knots.
- ✓ No safety stoppages due to blocky/fractured ground conditions.
- ✓ Less time spend on entry examination.
- ✓ An instructor on site permanent to do training per crew.

- × High tensile strength permanent nets are expensive compared to temporary (reusable) nylon netting: (R243m²)
- × Additional bolting might be required in cavity areas – additional hydra bolts needed to pin the mesh into cavities with 300mm x 300mm plates.
- × Cutting mesh for bleeding purposes not as easy as the other netting - The rope cutter for the mesh is expensive +-R765 each.
- × Prone to corrosion over the long term – Additional gully mesh still to be installed.

- ☺ Proper MOSH Entry Examination is required prior to the mesh installation.
- ☺ Installation of the mesh will only be as strong as its suspension points – additional hydra bolts needed to pin the mesh into cavities with 300mm x 300mm plates.
- ☺ The Hydra bolts round washer 90cm was changed to 150 cm square washer for better tensioning.
- ☺ Panel face shape needs to be always straight.
- ☺ Correct scraper to be used on the face to avoid damaging the mesh
- ☺ No shortcuts can be taken as it would result in fall of grounds.
- ☺ Overlapping must be at least 20cm to ensure no gaps between the old and new mesh installation.
- ☺ The installation of permanent nets does not hamper the production.
- ☺ The success of the nets used is reliant on a mindset change rather than the type of the mesh used.

- **Average Panel length:** 30 meter – (3 sheets on dip required for every 2 blasts (1,6m - face advance)
- **Average blast advance:** 0,8m – (Width of sheet 2,0m)
- **Face advance per month:** 4,8m (4,8m/0,8m = 6 blasts)
- **Total mesh sheets required:** 9 mesh sheets per month (3 mesh sheets on dip direction)
- **Total cost for 30m panel per month:** R35 100 (9 mesh sheets x R3 900)
- **Total square meters planned at Masakhane shaft is 3800m² per month:** R923 400 (3800m² total shaft square meters per month x R243 per square meter)

Key Adoption Considerations

- Communications with all the key labour is very important.
- Draw up a team and training to be done per crew and not a blanket rule to roll it the nets.
- Initially a huge additional cost but with a great benefit of minimizing accidents and stoppages.
- Important to have an instructor on the shaft – To assist with the TARP reports and net issues.
- Mining not to be done with stoping width less than 120cm.

Questions ???