MINE SHIFT: EXAMINING GROUND DISPLACEMENT IMPACT ON MINES AROUND THE WORLD

The Collapse of the Jagersfontein Diamond Mine Tailings Pond.

CATALYST

The Jagersfontein Dam

On 11 September 2022, the south east side of the Jagersfontein tailings pond in Freestate Province, South Africa, collapsed.

The breach was sudden and catastrophic.

A tidal wave of grey sludge slammed into the neighbouring environment and residential areas, obliterating property, polluting waterways and claiming the lives of two people.

40 more were injured. Another remains missing.

One member of the local town was swept for six miles, left helpless as the thundering surge carried her through field after field, which – according to reports – resembled giant cement lakes.

For many, though, while the event was sudden and devastating, it wasn't a surprise.

Residents, workers, and even local authorities had flagged cracks, overflow, and several operational issues as the dam filled with mining waste from the diamond mine.

"We were not even contemplating something like this would happen."

Marius De Villiers, legal compliance officer, Jagersfontein Development

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The Jagersfontein Dam

One worker admitted “we saw that one day this dam will burst.”

In total, an estimated 6,000 cubic meters of waste was released, contaminating the Kalkfontein Dam and the 200km Riet River, threatening one of the few remaining refuge areas for aquatic biodiversity in South Africa.

The resulting tailings plume grew to more than 6km long with a maximum width of approximately 1.2 km, and an estimated a surface area of 4.7 km².

In the period since, the total cost of the damage has been difficult to assess but it is expected to be “significant”.

What is clear is that while this event might only have taken moments, the impact is set to last.

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Jagersfontein Mine

KEY FACTS

Ownership	**Stargems Group**
Opened	**1870**
Closed	**1971**
Depth	**275m**
Mining method	**Open pit**
Capacity	**9.6 million carats**

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CATALYST Analysis:

In March 2022, CATALYST teams began monitoring Jagersfontein and the surrounding environmental and residential areas.

Work started with mapping the key features (fig.1) to provide a clear view of the critical infrastructure, property and geographical structures most at risk of impact from a significant breach.

At the two largest residential sites, an Object Based classification workflow was used to identify and extract building footprints from BlackSky imagery (fig.2), before a Copernicus Global 30 meter elevation model was combined with the Global Surface Water Extent database to generate a local flood risk area surrounding the Jagersfontein tailings pond.

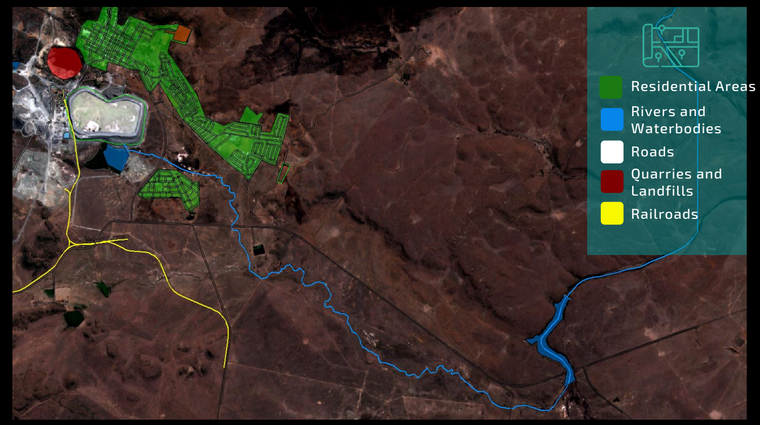

Fig.1

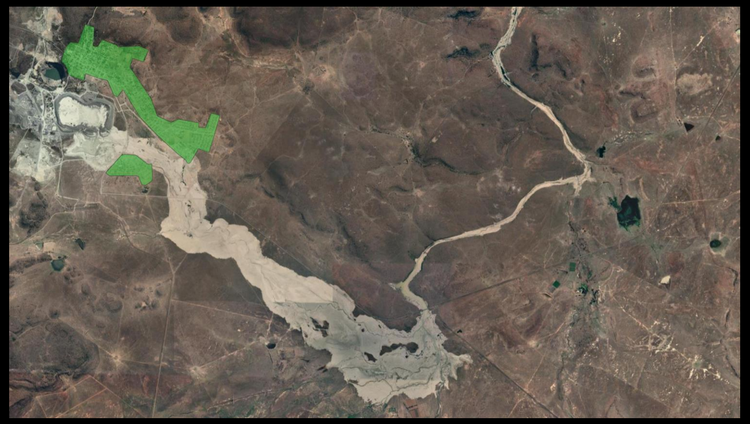

Fig.2

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CATALYST Analysis:

This analysis (fig.3), revealed an expansive area at high risk of any potential tailings breach, with spill extents likely to impact residents and natural resources across the entire south east area.

The risk was increased significantly following further InSAR analysis of the dam itself.

Small-Baseline Differential Interferometry SBAS-DInSAR methodology was used to extract displacements, velocities and cumulative displacements between March and August 2022.

Our teams paired displacement points using the small baseline subset (SBAS) technique, with a maximum perpendicular baseline of +/- 200m and a maximum temporal baseline of 120 days identifying 117 InSAR pairs across the 15 scenes.

Over the entire area of the dam, these pairs recorded a cumulative displacement range between -22mm and +4mm.

Most interestingly though, we identified significant movement of -15mm to -22mm in the south east corner – the same area where the dam breach occurred. (Fig.4)

What this indicates is during the months preceding the breach, the ground beneath the dam was moving – possibly putting additional strain on the structural integrity of that part of the wall.

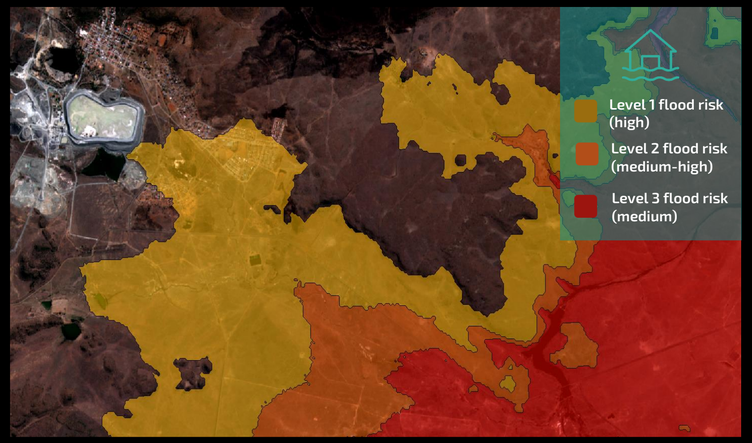

Fig.3

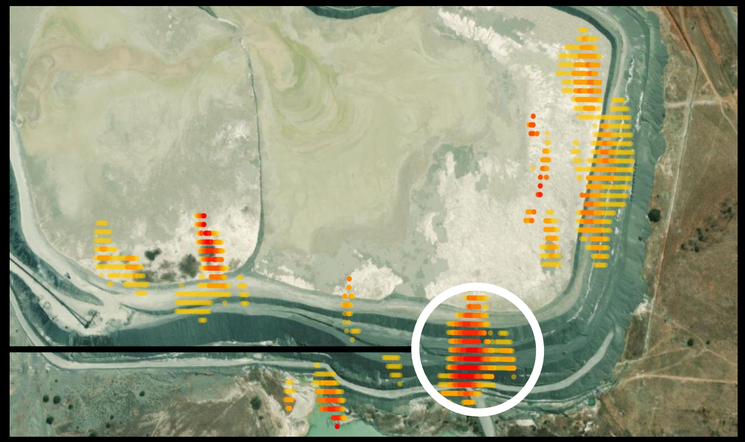

Fig.4

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CATALYST Analysis:

For the teams with both operational and regulatory responsibility for the dam, this movement was hidden to them and the traditional monitoring techniques they had employed.

What's more, when the breach did occur the tailings flow surged through the residential areas and into the same flood risk areas CATALYST analysis had identified. (Fig.5)

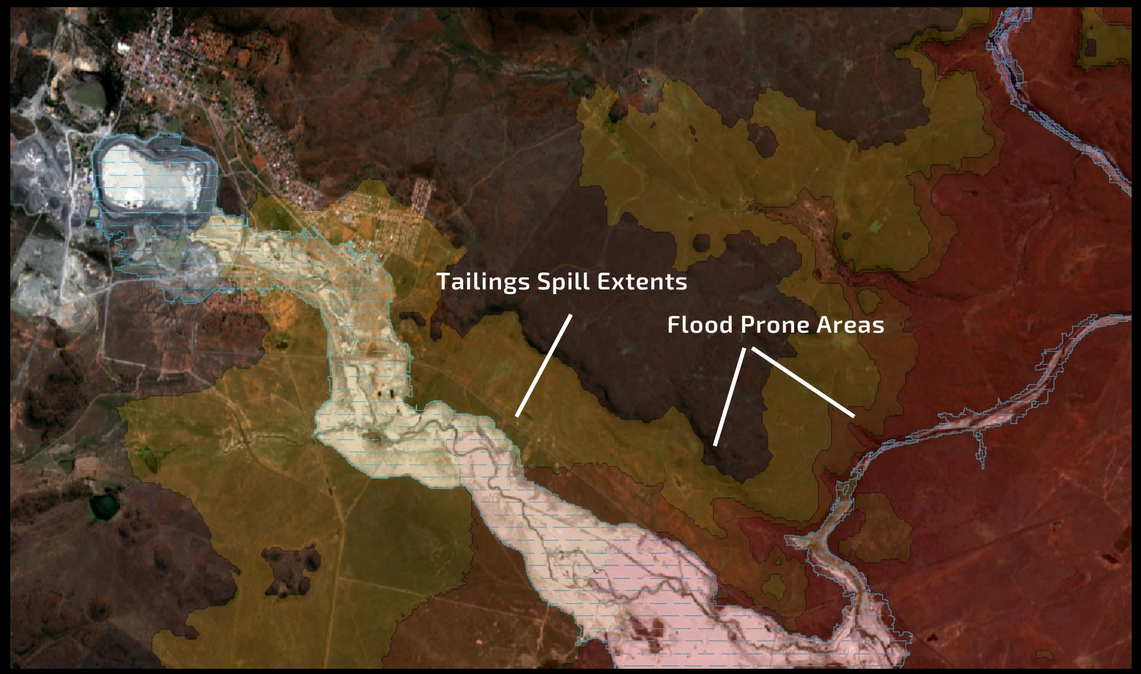


Fig. 5

Following The Breach

In the days after the breach, CATALYST monitoring continued with a particular focus on the impacted residential properties.

Using intersection analysis between building footprints and the flood extents, our teams could still clearly identify the impacted buildings through the spill extents. (Fig.6)

In a post catastrophe scenario such as this, having clear visibility of impacted property has incredibly powerful applications for recovery and emergency teams to inform their strategies and focus resources.

Fig. 6

The value of this analysis

The intent of our analysis, and indeed of earth observation in general, is to highlight how the sensitivity to ground changes can be used as an early warning indicator of areas that require more monitoring.

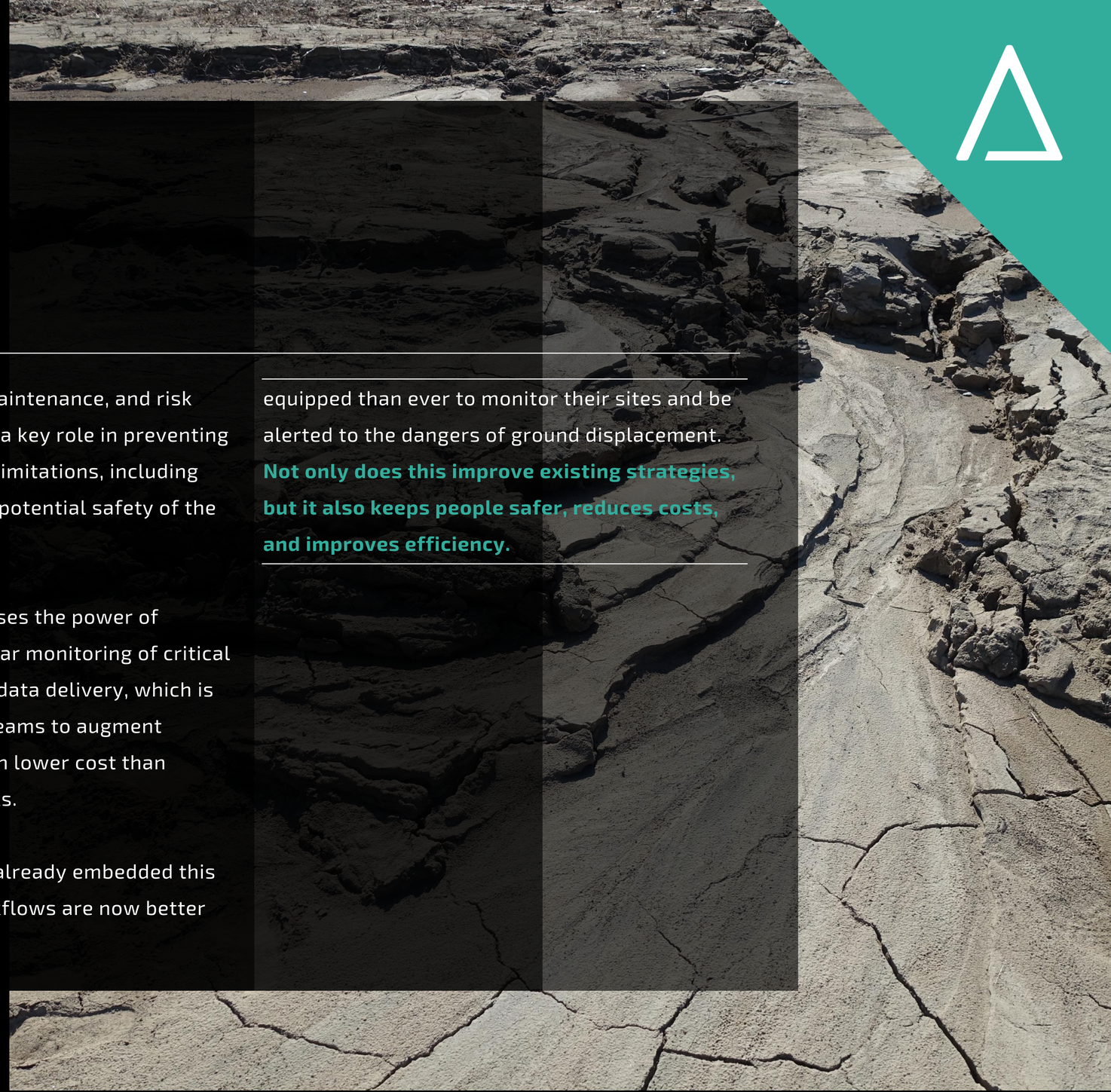
Satellite-based change analysis coupled with in situ ground monitoring equipment and surveying can be used as an effective risk reduction solution.

Significant structural failures, breaches or collapses can occur suddenly, and they can have both catastrophic human and economic impact.

Traditional monitoring, maintenance, and risk mitigation strategies play a key role in preventing them, but they have their limitations, including operational costs and the potential safety of the maintenance teams.

Earth observation harnesses the power of satellites to conduct regular monitoring of critical sites, with near-real time data delivery, which is perfect for maintenance teams to augment existing strategies at much lower cost than intermittent manual checks.

For businesses who have already embedded this technology into their workflows are now better equipped than ever to monitor their sites and be alerted to the dangers of ground displacement. **Not only does this improve existing strategies, but it also keeps people safer, reduces costs, and improves efficiency.**



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From exploration to decommissioning:
CATALYST analysis supports each stage of the mining lifecycle

Exploration & Discovery

Leverage satellite imagery to map lineaments, plan access routes through terrain analysis and assessment of land cover types.

Tailings Dam

Reduce your dependency on conventional surveying to measure surface displacement and horizontal slips for tailings dams of any size.

Slope & Bench Stability

Keep your personnel and equipment safe by monitoring ground displacement, a common precursor to slope failure.

Deep-mine Surface Monitoring

Identify risks to surface infrastructure and assets due to subsidence caused by underground mining operations.

Decommissioning

Apply multi-temporal analytics using repeat pass satellite imagery to quantify vegetation growth, water conditions and habitats.

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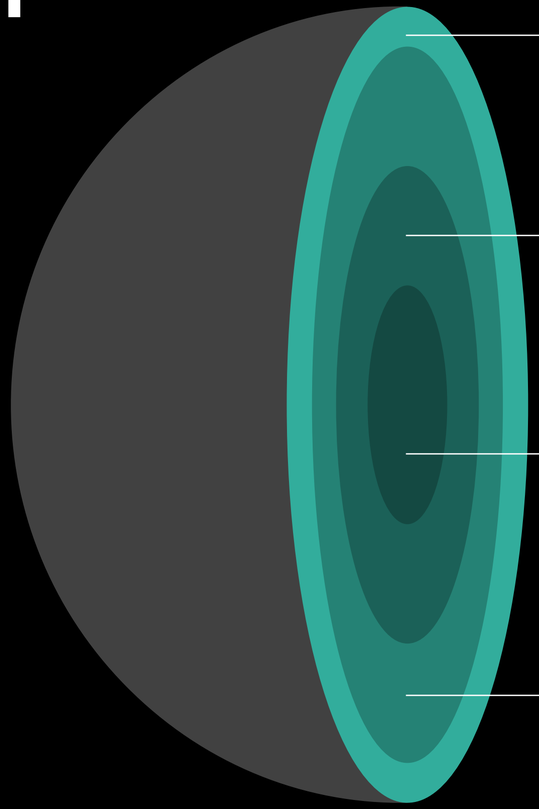
Discover what CATALYST can do for you



Earth observation and ground displacement technology is no longer a tool for the specialists.

CATALYST's cloud based innovative solutions are available to all businesses, teams and decision makers

Integrated seamlessly into your workflows without the need for technology upgrades, they can have an immediate transformative impact on your strategies and outcomes.

Discover how CATALYST's solutions can support you and engage with our team today

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