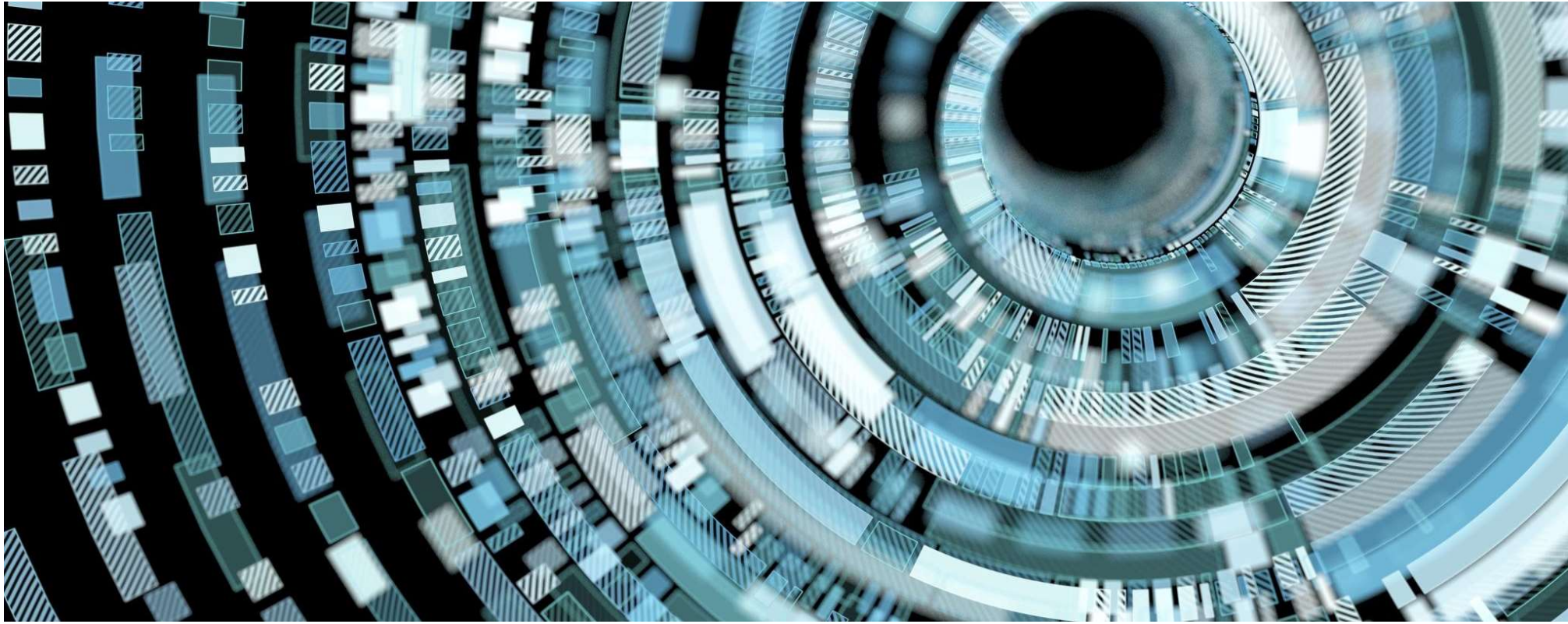




Colorado Mission 2024

Amanda Adams - Stantec

Tailings Dams Data Management Systems: Moving Beyond GISTM Compliance



Tailings Dams Data Management Systems: Moving Beyond GISTM Compliance



GISTM Topics

Best Practice Approach

- To be compliant with GISTM, Operators must use specified measures to prevent the catastrophic failure of tailings facilities and to implement **best practices** in planning, design, construction, operation, maintenance, **monitoring**, closure and post closure activities..

Iterative Data Review

- It asks for the knowledge base to be used by the owners and key stakeholders in an iterative way.

Comprehensive Monitoring System

- A comprehensive monitoring system must support the full implementation of the **Observational Method**, through which “best estimate” design parameters on the basis of available data can be progressively verified, validated, or refined, as real data becomes available.

Instrumentation
Monitoring

Performance-Based
Approach

Alternative Tailings
Technologies
Knowledge
Base

Observational
Method

Adaptive Management



ICMM Company Members

When Global Industry Standard on Tailings Management was published in August 2020, ICMM members committed to conform with the GISTM for all tailings facilities classified as 'extreme' or 'very high' consequences by August 2023, and all other facilities by August 2025.



African Rainbow Minerals

ICMM company member African Rainbow Minerals is a leading South African diversified mining and minerals company. African Rainbow Minerals has its headquarters in Johannesburg, South Africa. >



Alcoa

ICMM company member Alcoa is a global leader in bauxite, alumina and aluminum products. Alcoa has its corporate headquarters in Pittsburgh, USA. >



Anglo American

ICMM company member Anglo American is a globally diversified mining company with operations internationally. Anglo American has its headquarters in London, UK. >



BHP

ICMM company member BHP is among the world's largest producers of major commodities with operations across the globe. BHP has its headquarters in Melbourne, Australia. >



Boliden

ICMM company member Boliden is an industry leader in sustainable metal production operating mining units and smelters across Europe. Boliden has its headquarters in Stockholm, Sweden. >



Codelco

ICMM company member Codelco is the world's largest copper producer and second largest producer of molybdenum. Codelco is a Chilean state-owned company with its headquarters in Santiago, Chile. >



AngloGold Ashanti

ICMM company Member AngloGold Ashanti is a leading gold producer with operations internationally. Anglo Gold Ashanti has its headquarters in Johannesburg, South Africa. >



Antofagasta Minerals

ICMM company member Antofagasta Minerals is a Chilean-based copper mining group with significant by-product production. Antofagasta has registered offices in London, UK, and Santiago, Chile. >



Barrick

ICMM company member is Barrick is a sector-leading gold and copper producer with operations internationally. Barrick has its headquarters in Toronto, Canada. >



Freeport-McMoRan

ICMM company member Freeport-McMoRan is a globally diversified natural resources company with operations internationally. Freeport-McMoRan has its headquarters in Phoenix, USA. >



Glencore

ICMM company member Glencore is one of the world's largest diversified natural resources companies with operations internationally. Glencore has its headquarters in Switzerland. >



Gold Fields

ICMM company member Gold Fields is a diversified producer of gold with operations internationally. Gold Fields has its headquarters in Johannesburg, South Africa. >



Hydro

ICMM company member Hydro is a global aluminium and energy company, and a supplier of extruded aluminium products, including for automotive industries and building systems. Hydro has its headquarters in Oslo, Norway. >



Minera San Cristóbal

ICMM company member Minera San Cristóbal is a world-class Bolivian mining company which operates the world's third-largest open-pit silver mine, which is also the fifth-largest zinc mine. >



Minsur

ICMM company member Minsur operates in Peru and Brazil where they mine tin, gold, niobium and tantalum. Minsur has its headquarters in Lima, Peru. >



Rio Tinto

ICMM company member Rio Tinto is one of the world's largest globally diversified mining groups with operations internationally. Rio Tinto has its headquarters in London, UK. >



Sibanye-Stillwater

ICMM company member Sibanye-Stillwater is the world's largest primary producer of platinum and rhodium, the second largest of palladium and a top tier gold producer. >



South32

ICMM company member South32 is a globally diversified metals and mining company with operations internationally. South32 is based in Perth, Western Australia. >



MMG

ICMM company member MMG is global resources company with operations internationally. MMG's major shareholder is China Minmetals Corporation (CMC), and has its headquarters in Melbourne, Australia. >



Newmont

Formed following the merger of ICMM members Newmont Mining and Goldcorp to create the world's largest gold-mining company, Newmont is headquartered in Greenwood Village, USA. >



Orano

ICMM company member Orano is a leader in uranium production with operations internationally. Orano is largely state-owned with its headquarters in Paris, France. >



Sumitomo Metal Mining

ICMM member company Sumitomo Metal Mining is a global company specialising in mining, smelting, refining and the manufacture of advanced materials. Sumitomo has its headquarters in Tokyo, Japan. >



Teck

ICMM member Teck is Canada's largest diversified resource company with operations in the Americas. Teck has its headquarters in Vancouver, Canada. >



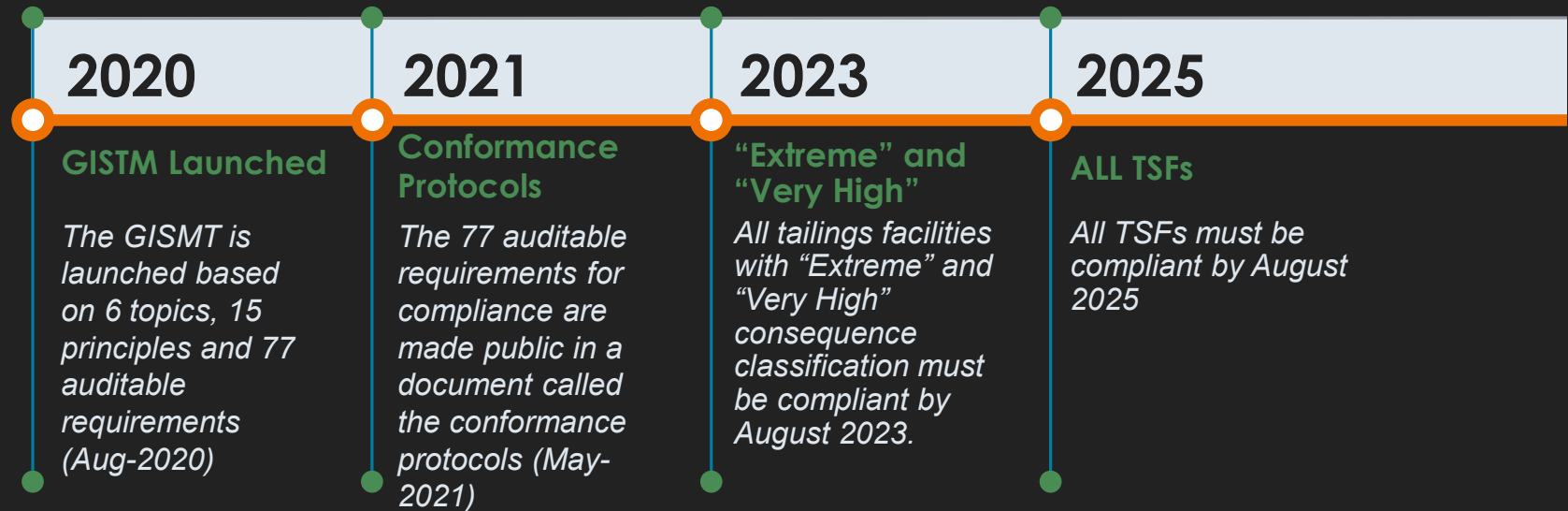
Vale

ICMM member company Vale leads the global market in iron ore and nickel production. Operating in 26 countries on five continents, Vale has its headquarters in Rio de Janeiro, Brazil. >



GISTM Journey

ICMM Members Commitment to Compliance





What comes **after** GISTM?





What GISTM Calls For

Adaptive Management

Design of the monitoring program for the tailings facility should be in accordance with the principles of Adaptive Management, which is a **structured, iterative** process of robust **decision-making** with the aim of reducing uncertainty over time via system monitoring. (Requirement 7.1)

Comprehensive Monitoring System

GISTM calls for **comprehensive** monitoring of tailings facilities for verifying design assumptions and for monitoring potential failure modes. (Requirement 7.2)

Life-Cycle Monitoring

GISTM emphasizes recording and evaluating the data at appropriate frequencies to measure performance **throughout the tailings facility Lifecycle**. (Requirement 7.3)

Monitoring Frequencies Recommend by EOR

GISTM calls for analyzing technical monitoring data at the frequency recommended by the EOR. It requires **promptly** submitting evidence of deterioration to the EOR for review. Performance outside the expected ranges shall be addressed **promptly** through Trigger Action Response Plans (TARPs) or critical controls. Requirement 7.4)

Integrated Tools Can

Provide decision-makers access to real-time, reliable data. It helps in risk assessment, understanding trends, and implementing preventive or corrective actions quickly, all of which align with GISTM's focus on data-driven management

Integrate the performance metrics from various instruments and vendors, providing operators with a comprehensive overview of the facility's health

Store historical data, facilitating long-term trend analysis and aiding in lifecycle decision-making

Integrate TARP notification systems. Real-time data is continuously monitored, with automated alerts activated when thresholds are breached. The dashboard can display these alerts using color-coded statuses.

Log response actions, including the steps taken to address the issue and the time between trigger events and responses. This ensures prompt action and real-time monitoring of response effectiveness.



Holden Mine Data Management System

We worked with Rio Tinto to tailor a more efficient data management system at their Holden Mine, featuring GIS Inspection Forms and Mosaic.

First, we developed 18 customized digital forms for field inspections and routine maintenance tasks.

Mosaic took this further by integrating:

- Data from geotechnical instruments placed around the mine
- Real-time weather station data
- Threshold triggers and notifications
- Automatically generated tables and charts

This system allows real-time access to asset data and easy analysis of trends, regardless of the site's remoteness.

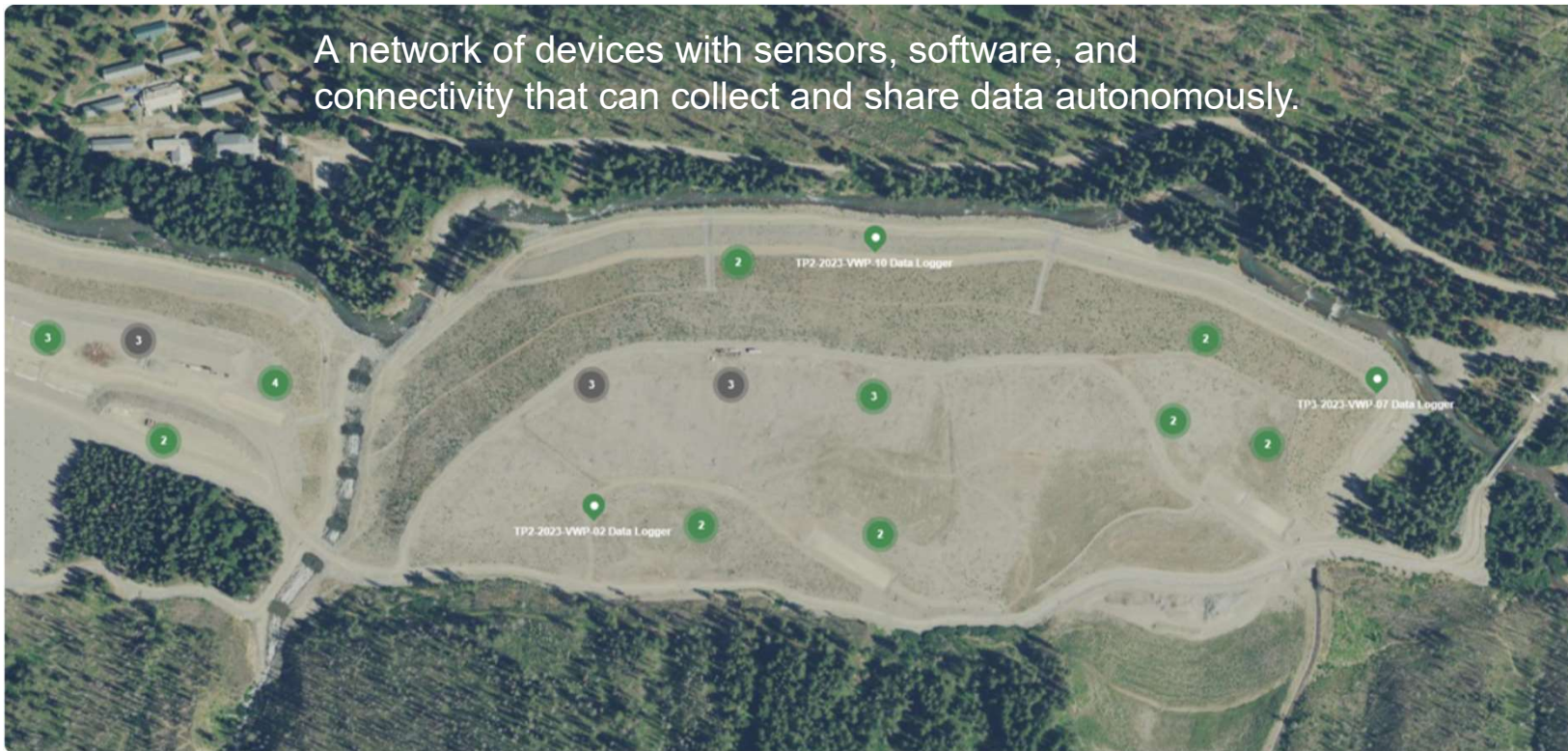
📍 Chelan County, Washington





The Internet of Things (IoT)

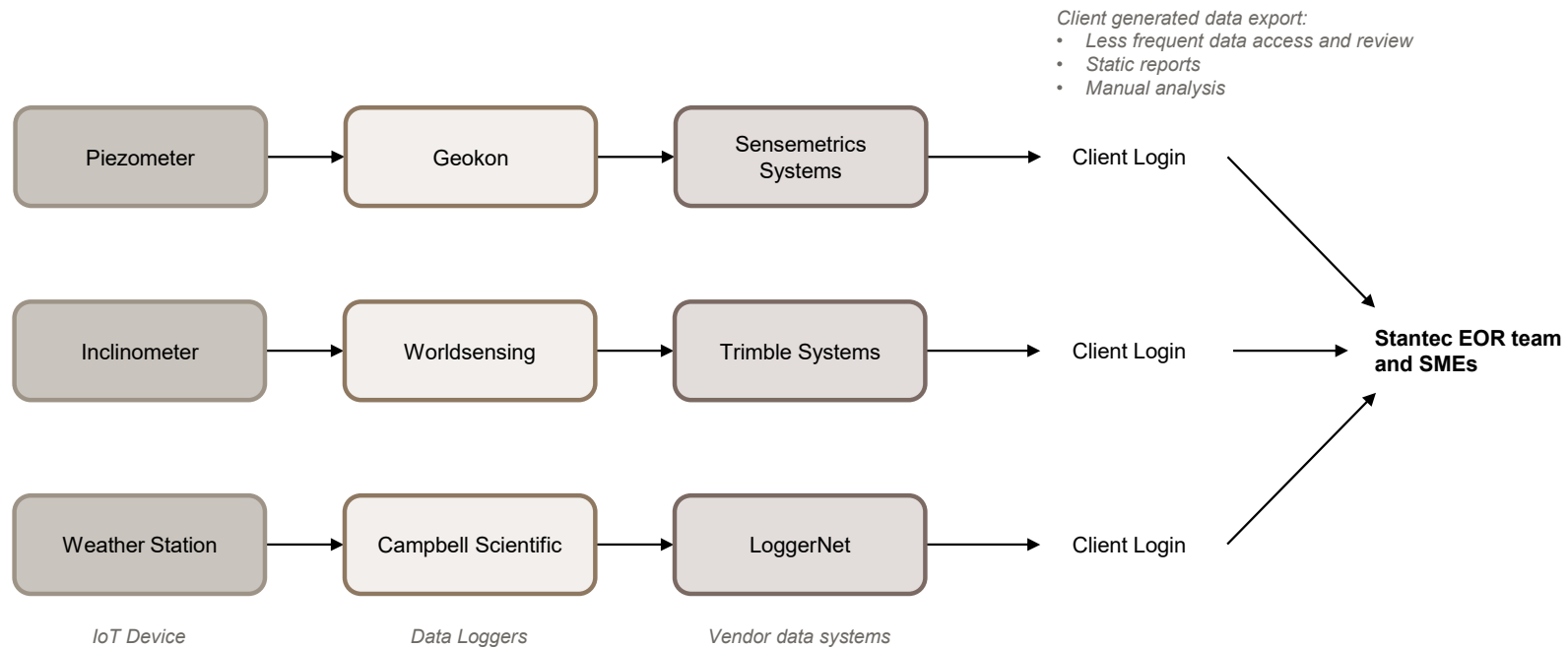
A network of devices with sensors, software, and connectivity that can collect and share data autonomously.



←
Multiple IoT
devices from
different vendors

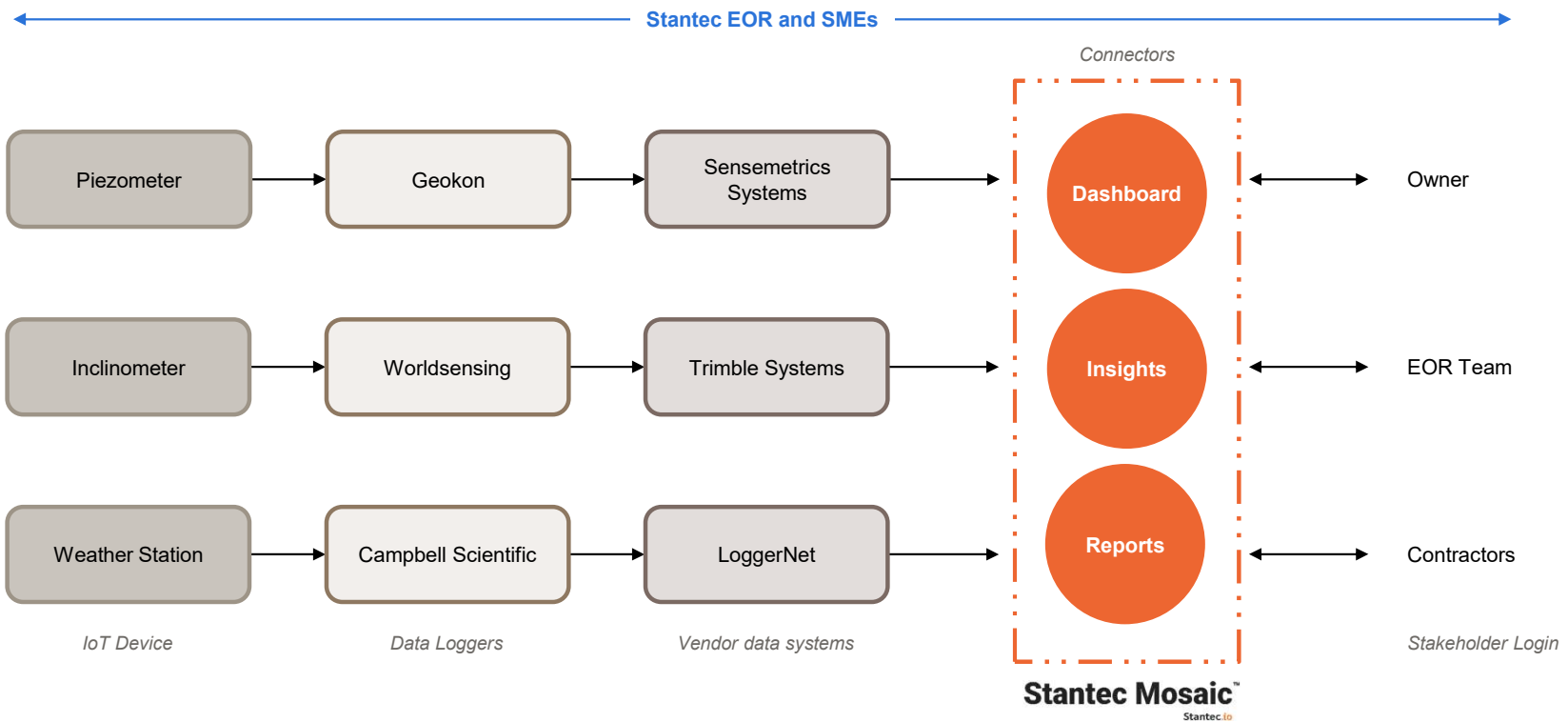


Example data workflow at a mine



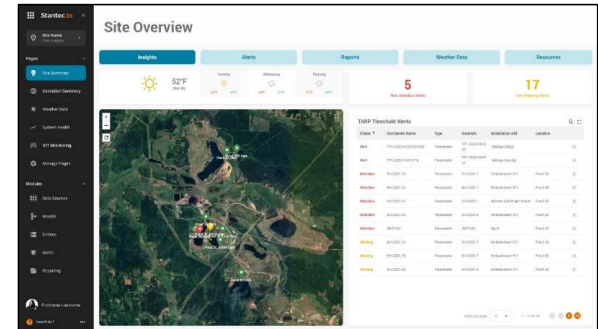
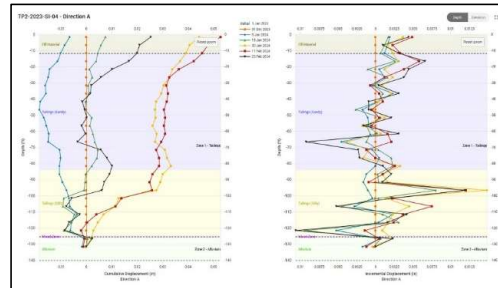
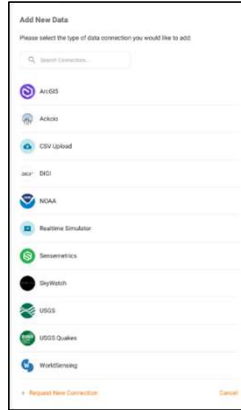


Integrated Data Management Workflow





Data, Data, Data



- Integrates data connectivity with automated data capture from remote areas and from any type of sensor
- Standardizes data management and storage of data over time
- Maintains data integrity and usability

- Embeds engineering algorithms and analytics for real-time insights
- Detects trends that may be indicators of emerging problems
- Raises alerts using TARP thresholds

- Customizable graphical insights
- Provides real-time access to site insights using templated dashboards
- Provides on-demand access and data export



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The SME Guide to Tailings Resources

Access tailings management case studies, research, technical papers, and industry best practices from around the world.

Photo provided by Sociedad Minera Cerro Verde S.A.A., a corporate affiliate of Freeport McMoRan Inc.

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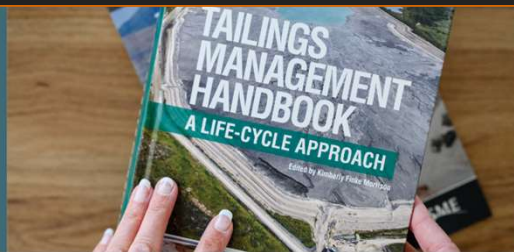
SME Tailings Portal – Consolidated Resources

The Tailings Information Portal, offering a curated database of resources, aligns with SME's values of promoting qualified personnel development and transparent information dissemination, crucial for mining industry success. <https://www.smenet.org/tailings>



SME

Opportunity to Sponsor Spanish Translation and Update of SME's **Tailings Management Handbook: A Life-Cycle Approach**



<p>Featured Resources</p> <p>Featured publications focused on the most relevant tailings regulations and standards.</p>	<p>Background</p> <p>Resources regarding background information and best practices.</p>	<p>Case Studies</p> <p>A collection of tailings storage facility design, construction, and safety case studies.</p>
<p>Closure & Reclamation</p> <p>A collection of resources for closure planning and reclamation strategies.</p>	<p>Design & Construction</p> <p>Technical literature supporting facility design and construction.</p>	<p>Governance</p> <p>Resources highlighting key elements pertaining to tailings governance framework.</p>
<p>Operations & Monitoring</p> <p>Publications focused on the operations and monitoring of tailings and related facilities.</p>	<p>Planning</p> <p>Documents supporting tailings planning, site selection, and management.</p>	<p>Technology & Innovation</p> <p>Resources relevant to technological advancements in tailings management.</p>



Questions?