



Tata Steel Optimizes Water & Environmental Management with ArcGIS and GeoAI

Customer

Tata Steel

Industry

Manufacturing

Use Case

Natural Resource Mining

Product Used

ArcGIS Pro, ArcSWAT, GeoAI, World Imagery Wayback, ArcGIS Living Atlas

Organization Detail

Tata Steel group is among the top global steel companies with an annual crude steel capacity of 35 million tonnes per annum. It is one of the world’s most geographically diversified steel producers, with operations and commercial presence across the world.



Culvert Location Identified using Super Resolution (SR3) tool in ArcGIS Pro

Project Summary

Tata Steel, one of the world’s most geographically diversified steel producers, is committed to sustainable mining and responsible environmental stewardship. To strengthen its water resource management, hydrological modelling, and land-use monitoring, Tata Steel’s Natural Resources Division (NRD) adopted Esri India’s advanced geospatial and GeoAI-driven capabilities.

With ArcGIS as the core of their digital initiative, the NRD team conducts highly accurate land-use analysis, sediment evaluation, culvert identification, and rainfall–runoff modelling to enable adaptive water management, driving quicker, data-backed decisions across mining operations.

Challenges

Earlier environmental and catchment assessment methods relied on field surveys and time-intensive processes, with varying levels of detail across large mining areas. Data from multiple sources and differing image resolutions made it challenging to consistently analyse sedimentation trends, culvert conditions, and hydrological behavior.

Tata Steel identified the opportunity to adopt a unified, intelligent geospatial platform that could streamline analysis, provide high-accuracy insights, and enable teams to monitor and understand landscape changes over time.

Solution

To advance its approach to water and environmental risk management, Tata Steel’s Natural Resources Division began modernizing how mining landscapes are analyzed and monitored. Central to this shift was the implementation of an integrated ArcGIS and GeoAI-powered geospatial framework that maps the terrain and uncovers how it evolves, functions, and responds over time.

1. Understanding the Landscape: The initiative began with developing a consistent, high-resolution view of land use and surface conditions across extensive and complex mining catchments. Using ArcGIS Pro, the NRD team performed detailed land-use and land-cover classification along with multi-temporal change analysis. This enabled a clear view of how surface conditions were evolving and how those changes could influence water flow and sediment movement. With this approach, analyses that previously took significant time could now be completed more efficiently and with greater precision, creating a strong foundation for informed environmental planning.

2. Predicting Water Behavior: With improved visibility into surface conditions, the focus shifted to understanding how water moved across the landscape. By implementing Arc SWAT, Tata Steel began simulating rainfall–runoff behavior across its mining catchments. These hydrological models helped the team anticipate how different rainfall scenarios would impact runoff, sediment transport, and catchment health. This shift from reactive analysis to predictive modelling enabled faster and more confident planning of catchment interventions, supporting adaptive water management practices.

3. Identifying Hidden Infrastructure Risks Remotely: Drainage infrastructure, such as culverts, plays a critical role in managing runoff, yet identifying blockages across vast mining areas had traditionally required extensive field surveys. To address this, Tata Steel applied GeoAI models to enhance satellite imagery and automatically detect culverts and potential obstructions with high precision. The super-resolution capability significantly improved visibility into infrastructure conditions. For the first time, teams could remotely identify drainage risks with ~1-metre accuracy, reducing dependence on time-intensive on-ground inspections and enabling earlier intervention.

4. Using Historical Insights to Inform Future Planning: Understanding how sedimentation patterns evolved over time was essential for sustainable water management. Using ArcGIS World Imagery Wayback, the NRD team analysed historical satellite imagery to track sediment accumulation and drainage changes across seasons and years. This temporal perspective helped distinguish natural sedimentation cycles from mining-related impacts. With these insights, Tata Steel NRD could plan targeted desilting activities, avoid unnecessary dredging, and reduce operational costs.

5. Scaling Insights with Trusted, Ready-to-Use Data: To ensure consistency and scalability, Tata Steel NRD integrated ArcGIS Living Atlas of the World into its workflows, gaining seamless access to Sentinel imagery and authoritative land-cover datasets. This eliminated data fragmentation and allowed analyses to be quickly extended across new mining areas without delays caused by data sourcing or preparation.

Outcome

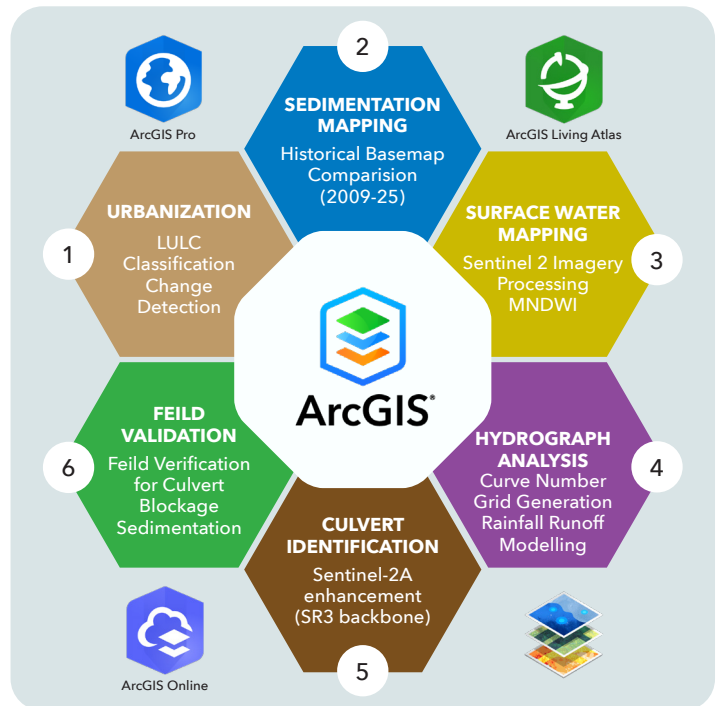
By bringing together ArcGIS, GeoAI, historical imagery, and authoritative datasets into a single intelligent system, Tata Steel NRD (Natural Resources Division) transformed its environmental and hydrological assessments from manual and reactive processes to an automated, predictive, and scalable approach. The result was significantly faster analysis and the creation of a repeatable model for mining-related water and environmental monitoring, enabling smarter operational decisions, optimized costs, and stronger environmental stewardship.

Key Outcomes:

- **Operational Efficiency:** Reduced manual mapping efforts by 60%, accelerating analysis and decision-making timelines.
- **Cost Optimization:** Avoided unnecessary dredging activities through targeted sediment analysis, resulting in significant cost savings.
- **Workforce Productivity:** Enabled remote infrastructure assessment, reducing the need for extensive field deployment and improving manpower utilization.

“ Esri India’s advanced geospatial and AI-driven tools have transformed how we understand and respond to spatial challenges. The ability to visualize, analyze, and act on high-resolution data has significantly improved our decision-making, operational efficiency, and long-term planning.

- Santosh Bhadra, Head – Geospatial & Mine Mapping Analyst, NRD, Tata Steel Ltd. ”



Workflow for Dimna Catchment Analysis