Does your mine need remote sensing?

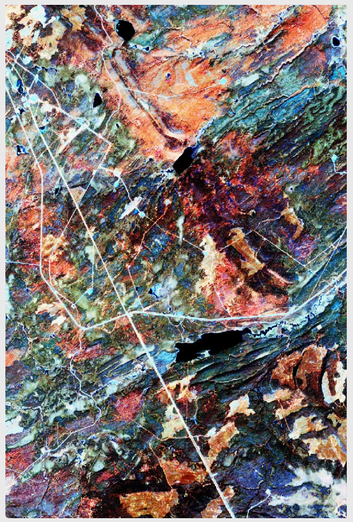
How will a best practice program of mine site rehabilitation monitoring look in 2020 and beyond?
Ecological monitoring of a rehabilitated site - assessment of attributes such as soil stability, vegetation and species diversity - isn't immune to digital disruption. Ecological monitoring benefits from consistent methods, used repeatedly, to interpret long-term trends. So, when digital tools like remote sensing come along, should we use them? While remote sensing is no longer new, it has yet to be fully integrated into monitoring best practices. No doubt there's widespread acceptance of its efficacy, but it's not always easy to adopt.

So, should remote sensing be a standardised approach alongside traditional, on the ground ecological monitoring methods? There's no binary response; it depends on the project - the mine's state, planned length of monitoring, vegetation, predicted outcomes, what's being monitored, if monitoring is already underway and for how long, budget, and traditional ecological monitoring methods that will be or have already been used. When discussing options there's no one-size-fits-all program: we look first at the mine's needs, the needs of their community, and of course the budget.

TRADITIONAL ON-GROUND REHABILITATION MONITORING IN THE PILBARA BIOREGION OF WESTERN AUSTRALIA (STANTEC)

READ MORE FROM OUR EXPERTS ON REMOTE SENSING:

- Which remote sensing technology is right for you?
- Underwater remote sensing
- Next steps for artificial intelligence in the remote sensing digital evolution



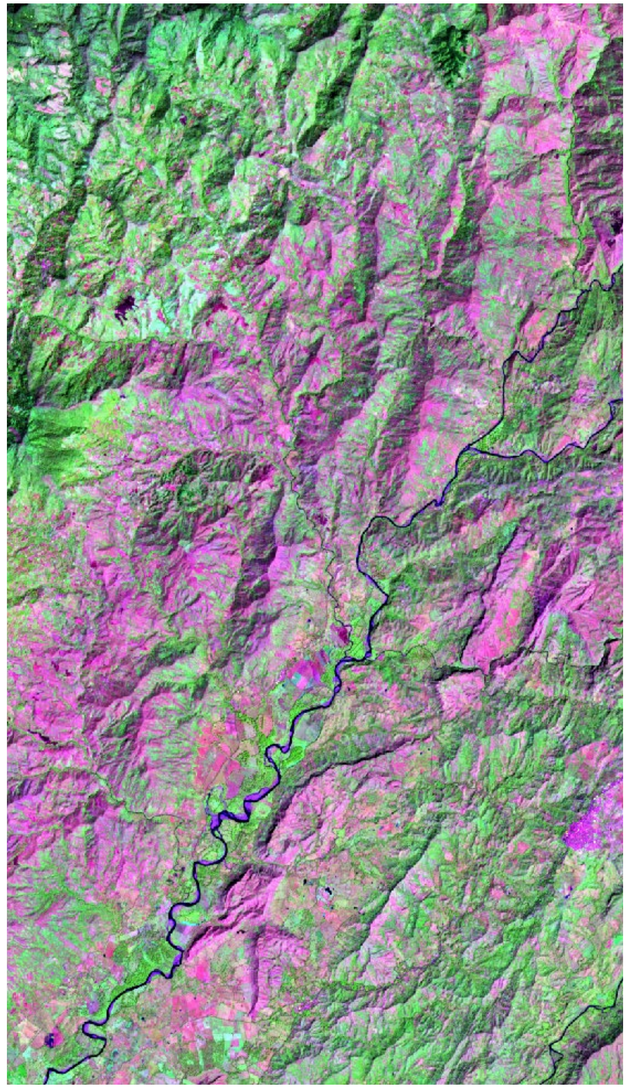
Remote sensing: What's it all about and why promote it?

Remote sensing is simply the science of obtaining information on an area of the earth without physically being there, typically using data acquired from satellites, aircraft or UAVs (unmanned aerial vehicles)

Remote sensing can:

- Dramatically improve the spatial scale of rehabilitation monitoring, by providing access to a range of image capture options and continually improving imagery resolution
- Improve the accuracy and reproducibility of monitoring data
- Minimise health and safety risks related to on-ground monitoring of remote or difficult to access areas
- Reduce costs by decreasing the field survey effort required
- Help keep a mining company up to date - many mining companies in Australia have implemented some form of remote sensing into their rehabilitation monitoring programs
- Complement traditional rehabilitation monitoring methods

For example, the use of remote sensing to assess erosion and stability over time on rehabilitated landforms



is highly beneficial compared to traditional transect assessments, as the whole landform can be assessed with accurate metrics derived for gully erosion (length, width, depth and volume) or landform subsidence.

Roadblock: species diversity

As with any technology, benefits come with risks or potential roadblocks. The good news is there is little risk to replacing on-ground erosion assessments with remote sensing provided the appropriate data is collected, and the approach adjusts to the extent of vegetation present.

For vegetation assessments, remote sensing currently cannot assess species diversity as comprehensively as on-ground methods. Even so, there are many examples of key native or introduced species being detected remotely. For example, in collaboration with Chevron Australia we've developed a robust monitoring protocol, using remote sensing, for key species of Triodia (spinifex) in semi-arid northern Australian grasslands.

Future development in species delineation within multi-spectral imagery is likely to be rapid but will require ground-truthing, with potentially repeated ground-truthing under different seasonal and climatic conditions. It isn't clear whether this approach will work for complete vegetation community diversity, structure, and fauna habitat suitability assessments because the specific detection of some species—for example introduced grasses such as buffel grass—has proved challenging to date, and there are limitations on the visibility of juveniles or small under-storey species in aerial or satellite imagery.

> *"REMOTE SENSING IS SIMPLY THE SCIENCE OF OBTAINING INFORMATION ON AN AREA OF THE EARTH WITHOUT PHYSICALLY BEING THERE, TYPICALLY USING DATA ACQUIRED FROM SATELLITES, AIRCRAFT OR UAVS (UNMANNED AERIAL VEHICLES)."*

Will regulation development mean increased reliance on remote sensing?
In time, government regulators of mine site rehabilitation, closure and relinquishment (in Western Australia) will likely expect whole-of-landform erosion assessments, rather than transect-based assessments, in order to demonstrate stability. However, the cost of using this approach may present a roadblock for some companies.

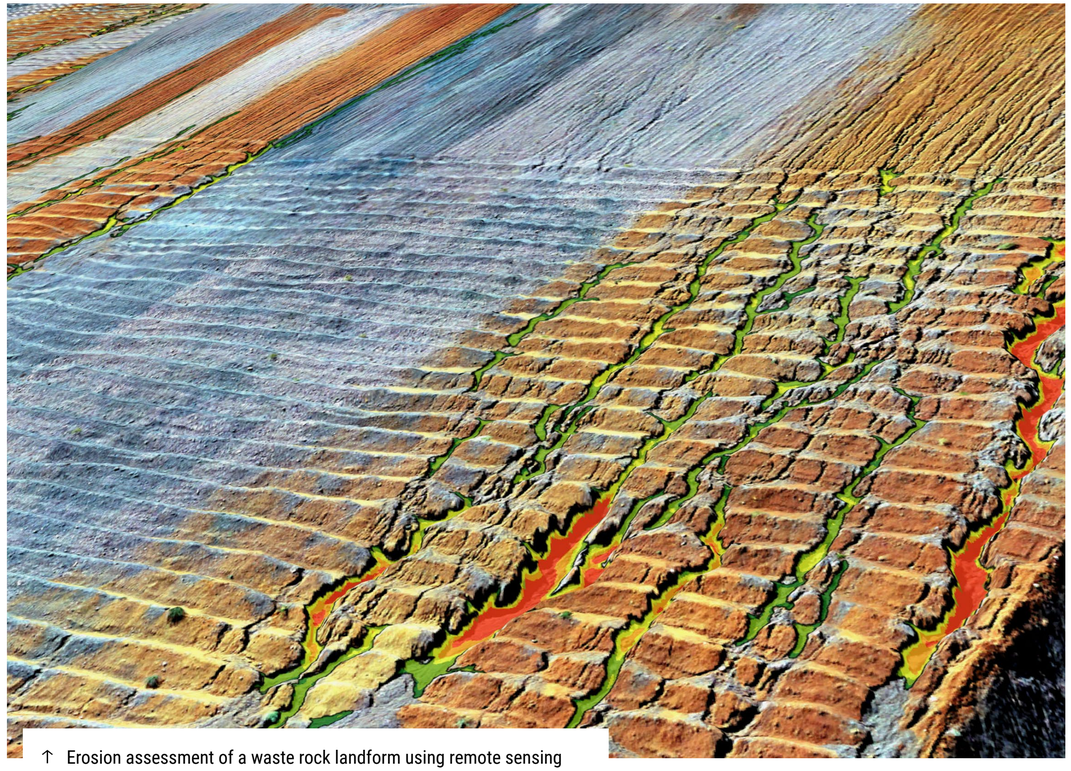
Regulatory requirements for sites that involve restoring functional ecosystems often focus on the return of reproductive capacity and biodiversity values. But if the focus of completion criteria used in closure planning shifts in favour of increased spatial scale of monitoring rather than detailed community composition data, do we risk losing information on the functional capacity and resilience of rehabilitated ecosystems?

Detailed soil assessments that can aid in predicting future rehabilitation outcomes and sustainability of vegetated ecosystems are also at risk of being lost in a shift to monitoring by remote sensing. While the obvious risk control measure is to combine remote sensing with detailed on-ground monitoring, escalating costs can be a roadblock.

AWARENESS OF SHARED CASE STUDIES AND EVOLVING TECHNOLOGIES WILL ALLOW MONITORING TO FACILITATE THE BEST ENVIRONMENTAL OUTCOMES AND MINIMISE RISKS ASSOCIATED WITH MINE CLOSURE INTO THE FUTURE.

Developing a tailored best practice monitoring program
There are options for developing cost-effective monitoring programs that utilise a combination of on-ground and remote methods. Many professionals within the mining industry are developing approaches tailored to specific sites and regulatory expectations.

Approaches may involve:
- Modification of existing aerial imagery capture programs to include multi-spectral data capture or to extend the area captured to include rehabilitated and surrounding areas in a cost-effective manner
- Alternating remote sensing with on-ground assessments, or when both are required concurrently the length of the fieldwork time needed may be substantially reduced
- Using satellite imagery collected in previous years to ‘go back in time’ and use change detection analysis to demonstrate trends
- Using whole-site remote sensing in the early stages of rehabilitation, which can aid detection of problem areas early on and ultimately save closure costs at the end of mine life



↑ Erosion assessment of a waste rock landform using remote sensing

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