



Satellite Remote Sensing for Mining Facility Management

SIERRITA MINE AND TAILING POND • Green Valley, Arizona • March 18, 2022

A FREEPORT-MCMORAN CASE STUDY



OVERVIEW

Freeport-McMoRan (FCX) has a strong commitment to safety performance, environmental management, and local communities where it operates. It is committed to zero catastrophic failures or unplanned discharges from its Tailings Storage Facilities (TSFs). New remote sensing technologies play an important role in meeting this goal and help the Tailings, Crushed Leach and Water (TCLW) team make the right decisions while monitoring TSFs efficiently, holistically, and safely.

CHALLENGE

A MATTER OF TIME

Perhaps the most public-facing mining process, tailings storage facility management, is also the most heavily scrutinized. At FCX, the TCLW team works to manage these large facilities responsibly. Interdisciplinary teams of water resource and geotechnical engineers, geospatial scientists, metallurgists, geophysicists, and data scientists work together using an array of public and commercial remote sensing datasets— Sentinel-2,, Landsat, UAS, etc. – to monitor TSFs.

As COVID-19 spread across the world, the team had to operate at a reduced capacity. Governmental stay-at-home orders in various regions also meant they couldn't have the usual number of inspections on the ground. Vigilance in remote inspections was more crucial than ever. The team recognized that they needed an extra layer of satellite monitoring. And as they soon found out, this additional monitoring helped with other challenges too, from onsite work safety to water model calibration.

About Freeport-McMoRan

Freeport-McMoRan Inc. (FCX) is a leading international mining company with headquarters in Phoenix, Arizona. FCX operates large, long-lived, geographically diverse assets with significant proven and probable reserves of copper, gold and molybdenum. FCX has a strong commitment to safety performance, environmental management and the local communities where it operates. FCX is a founding member of the International Council on Mining and Metals (ICMM) and is committed to implementation of the ICMM Sustainable Development Framework.

About Planet Labs

Planet is the leading provider of global, near-daily satellite imagery data and insights. Planet is driven by a mission to image all of Earth's landmass every day, and make global change visible, accessible and actionable. Founded in 2010 by three NASA scientists, Planet designs, builds, and operates the largest earth observation fleet of satellites, and provides the online software, tools and analytics needed to deliver data to users. To learn more visit www.planet.com and follow us on Twitter at [@planet](https://twitter.com/planet)

SOLUTION

A (NEAR) DAILY REVISIT TIME

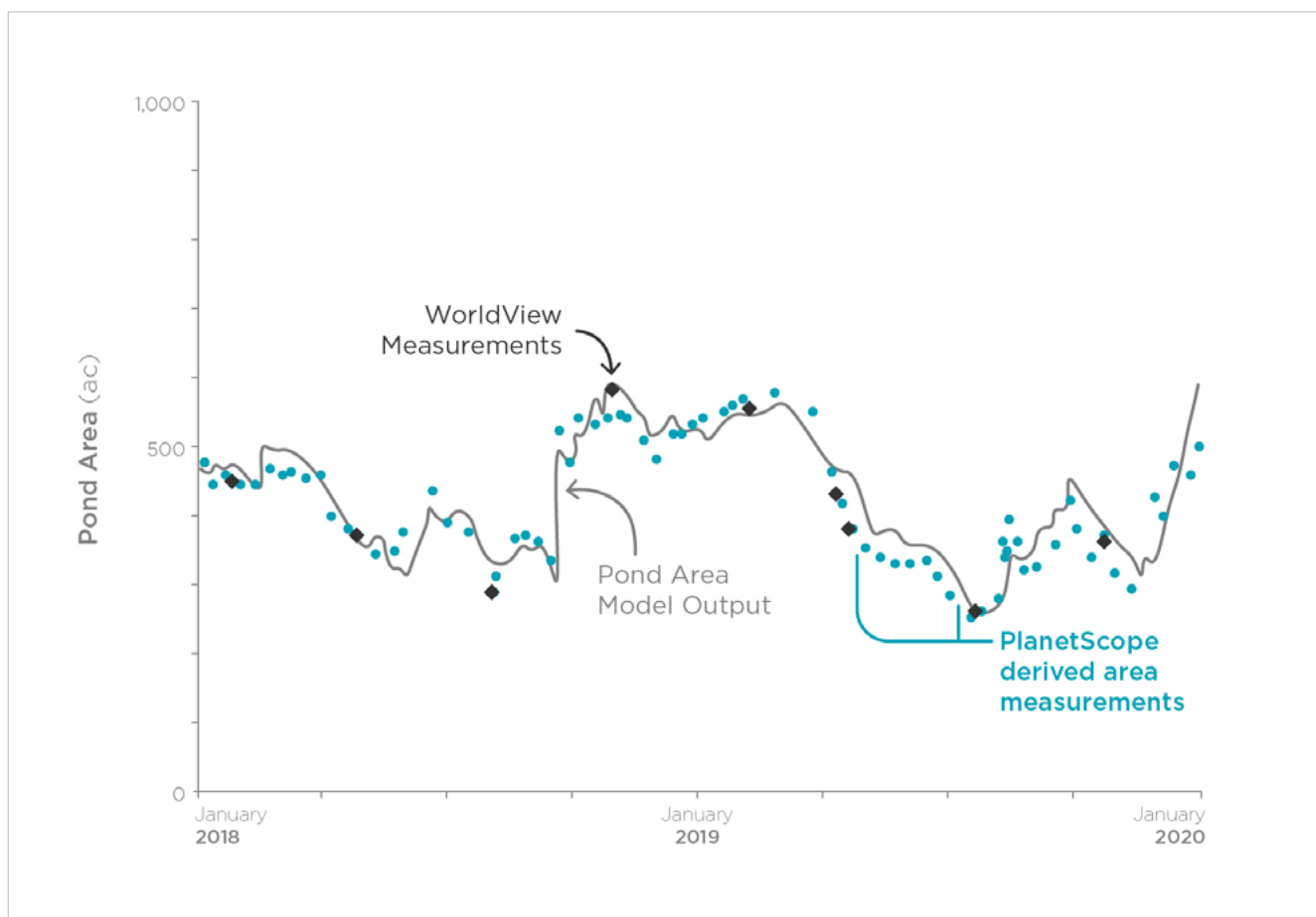
The team added PlanetScope to the existing pipeline for Sentinel-2 data in order to reduce time between observations. “We leveraged near-daily Planet imagery to map water in our facility and built online maps and dashboards so that operations and crew could adapt their processes. This increased visibility for engineers, operators, and other decision-makers, both on- and off-site,” shared Leland Sutter, Geospatial Analyst at FCX.



Near daily remote inspection of beach width to understand water location in Planet Explorer.



Mapping a weekly NDWI index in the browser to look at water body trends.



More-frequent measurements with PlanetScope imagery lead to improvements in Freeport-McMoRan’s water area model compared to quarterly WorldView imagery. Quarterly imagery captured seasonal trends but not the weekly variations in pond extent necessary for model calibration.

Planet's daily imagery allows engineers to monitor the area of the tailings ponds to more efficiently plan their daily work. Without remote sensing technology, someone must measure water at these extensive facilities on the ground with markers and range finders. Instead of physically walking the miles-long dam crest- which can be dangerous – engineers can remotely gain a better understanding of water location and stay safe while doing so.

Water management plays an important role in managing tailings, with an entire team dedicated to water management, modeling, and accounting at Freeport McMoRan. The models created by this team rely on pond areas derived from satellite imagery to aid in model calibration. Historically, water model calibration has relied on 50-centimeter WorldView imagery, delivered quarterly. But by leveraging near-daily imagery from Planet, the water management team can more robustly calibrate and validate their water models. Utilizing this imagery, they derive pond area outlines with multispectral analysis and machine learning techniques.



Pond area outlines calculated from PlanetScope imagery.

“PlanetScope imagery is a great solution for high temporal, medium spatial resolution imagery.”

LELAND SUTTER

Geospatial Analyst, Freeport-McMoRan

The more intricate peaks and valleys inferred from the water models can be validated with pond areas derived from frequent revisit times of PlanetScope. Then, pond outlines and water models can be shared with site operations teams using simple-to-use web maps to inform upstream and downstream processes. Barge locations, beach width, and deposition, among other variables, can also be tracked.

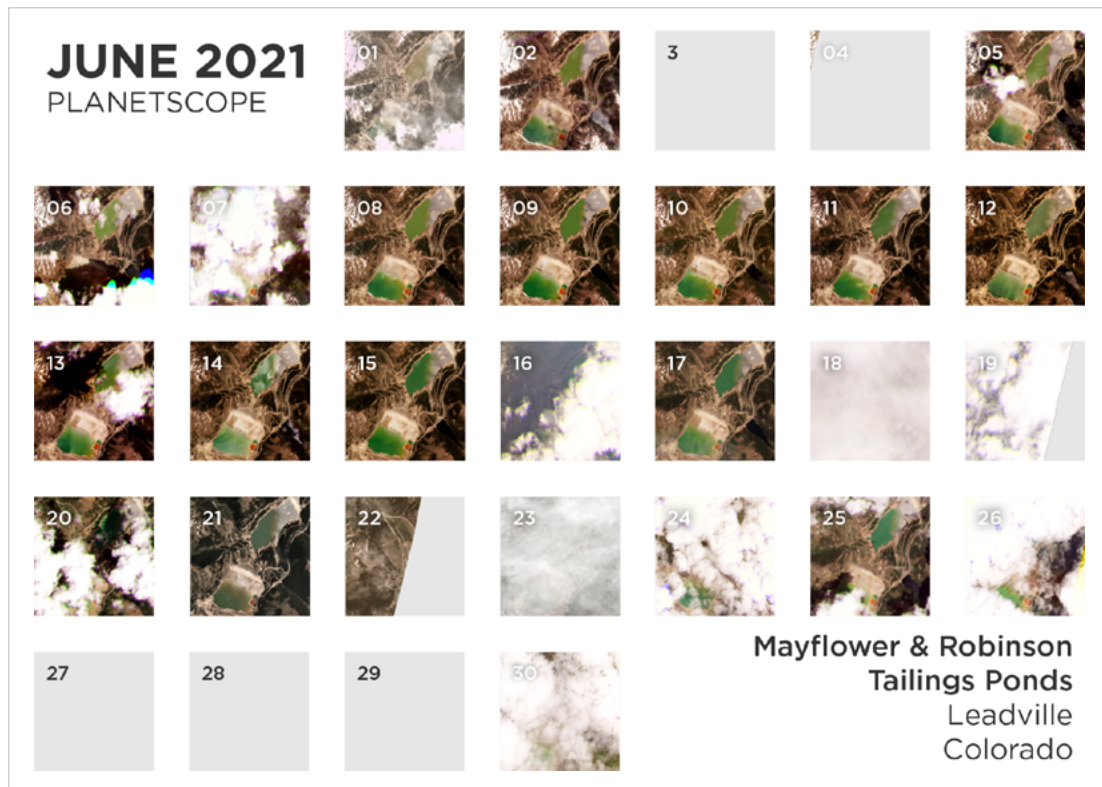
RESULTS

AN EXCITING FUTURE

Though the initial focus for PlanetScope imagery was on water and operations of TSFs (above), FCX soon found other uses. FCX has made Planet imagery available in their GIS system for general mapping needs. With frequent imagery collections, they are able to ensure there is recent imagery of mine sites without cloud cover. Additional use-cases have been found for dust control and air quality permitting. Areas with less moisture are more likely to be a source of dust which can lower air quality and can be prioritized for dust suppression. Other sites have also taken to online imagery for monitoring their tailings ponds.

With a company-wide commitment to safety, FCX uses an array of public and commercial remote sensing data sets. Though no one tool can provide all the information they need and use, Planet is crucial for its revisit times. And Sutter sees no end to Planet's usefulness.

“We see many future opportunities with Planet. Web development and the introduction of cloud computing have been positive, with an eventual goal of minimal downloads for on-the-fly visualizations. And the expected increase of spatial resolution of SkySat will give even greater flexibility for imagery needs on our sites,” said Sutter. He continued, “Working with Planet’s software developers and product owners, FCX has seen a huge improvement in online visualizations. Online visualizations minimize the amount of data that must be downloaded while improving the speed at which users can make decisions. Development is continuously ongoing, so you’re always excited to see what’s next.”



Despite cloud-cover, Planet managed to collect an image over the Mayflower and Robinson Tailings Ponds outside of the Climax Mine in Leadville, Colorado almost every day in June 2021.

Learn more about Freeport-McMoRan

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