



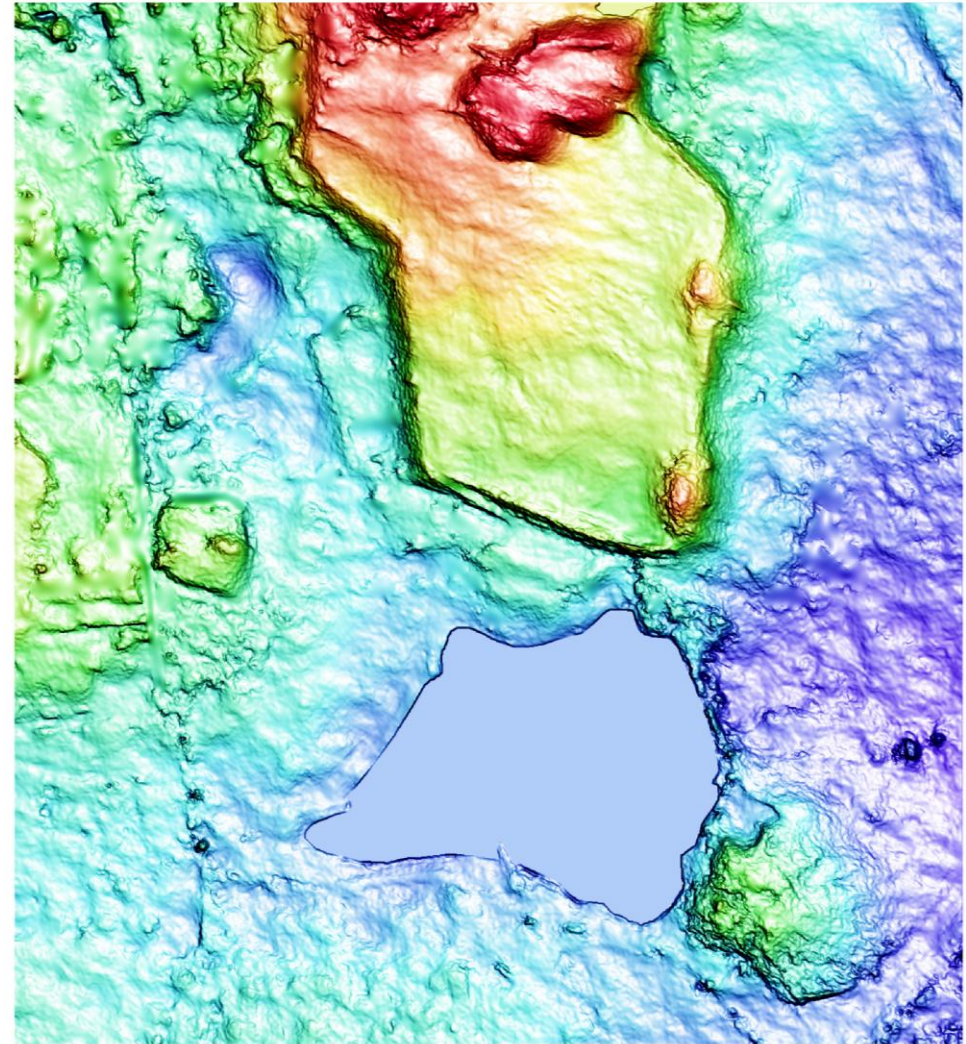
PhotoSat – Brad Forrest

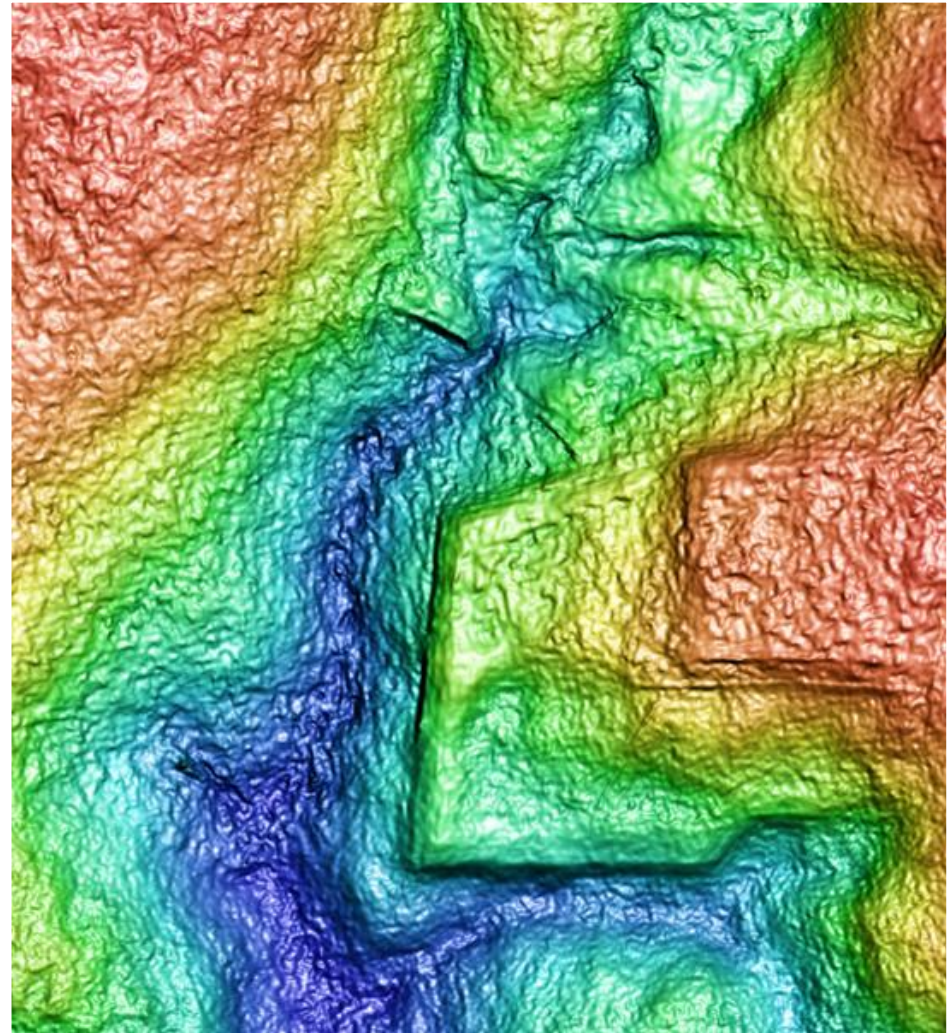
Session 7: Monitoring

A new tool for tailings storage facility management:
Insights from archived satellite imagery

Incomplete Records and New Standards

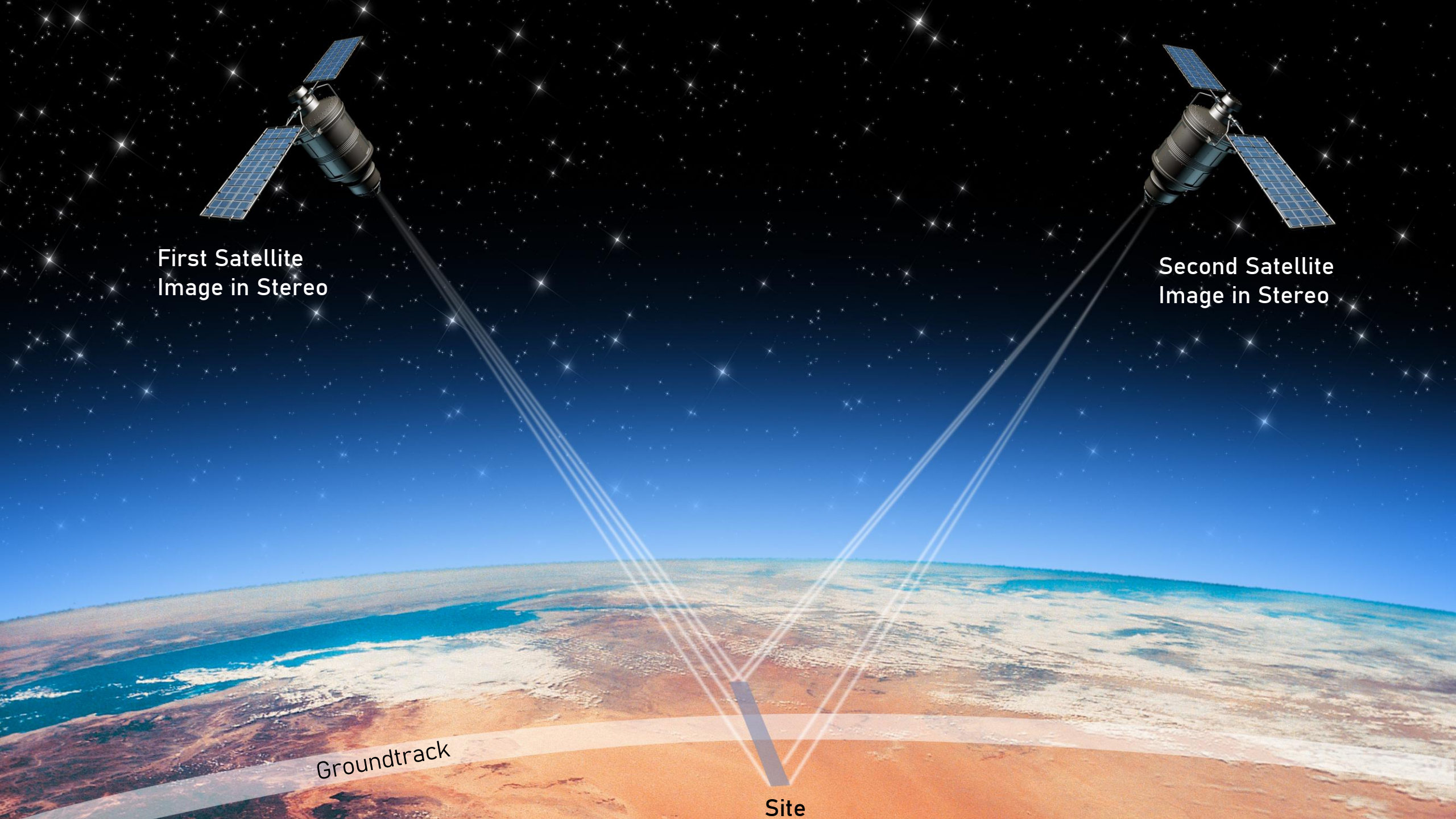






A Wealth of Archived Imagery





The diagram illustrates the process of capturing stereo images from space. Two satellites, each with two solar panels, are shown in orbit against a starry background. The left satellite is labeled 'First Satellite Image in Stereo' and the right one 'Second Satellite Image in Stereo'. Both satellites have light beams directed towards a specific point on the Earth's surface, labeled 'Site'. The Earth's surface is depicted with a blue ocean, a white sandy beach, and a reddish-brown desert. A semi-transparent grey band, labeled 'Groundtrack', follows the path of the satellites across the desert. The background transitions from a deep blue sky to a black space filled with stars.

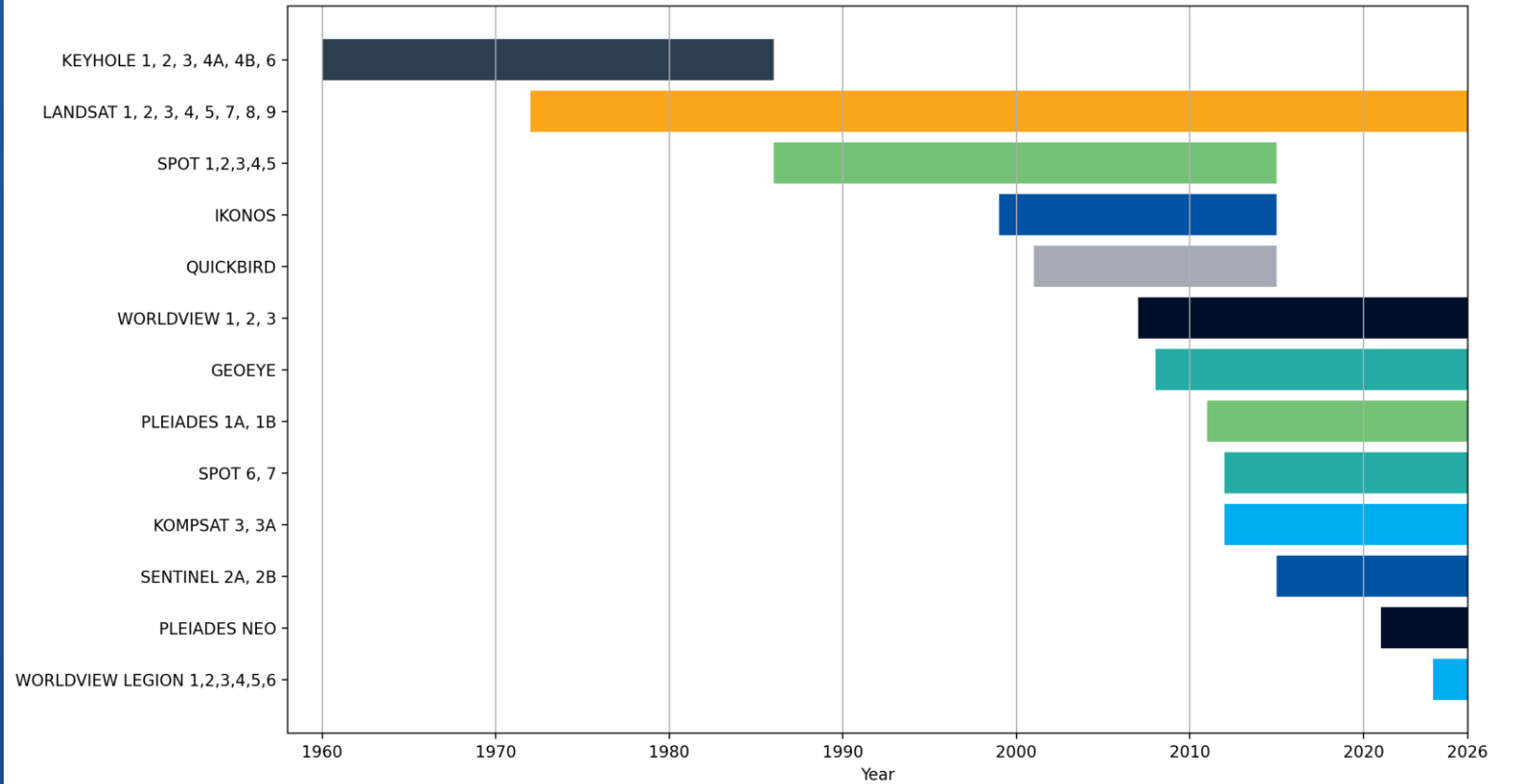
First Satellite
Image in Stereo

Second Satellite
Image in Stereo

Groundtrack

Site

Satellite Data Going Back Six Decades





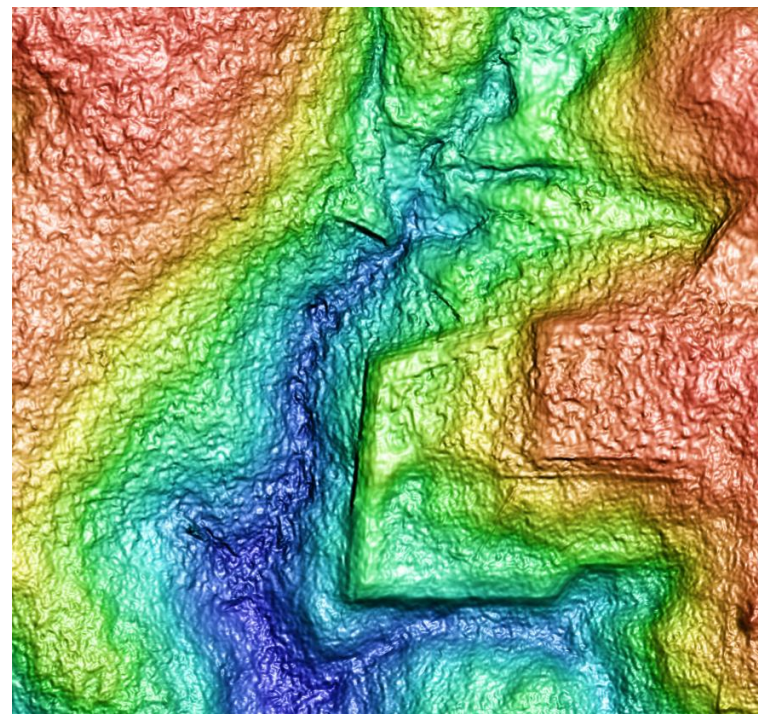
315 cloud free archive satellite photos from 1967 to 2020

[illegible]

Extracting Topography

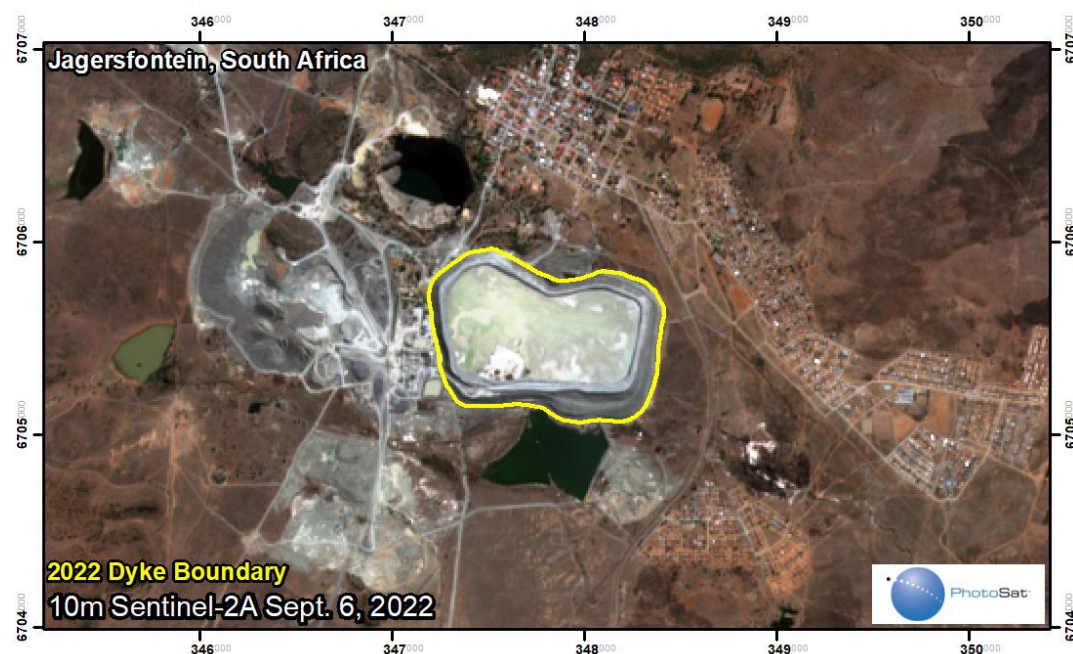


1967 Keyhole Ortho



1967 Keyhole Survey

Surface Reconstruction



2022 Pre-failure mono

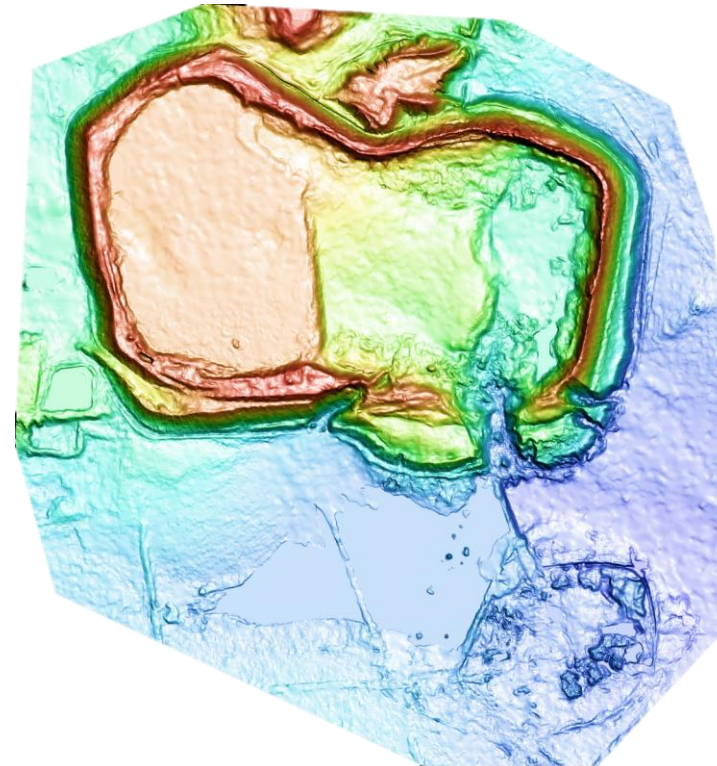


2022 Post-failure stereo

Reconstructed Surface



2022 Pre-failure reconstruction



2022 Post-failure from stereo

Filling Data Gaps

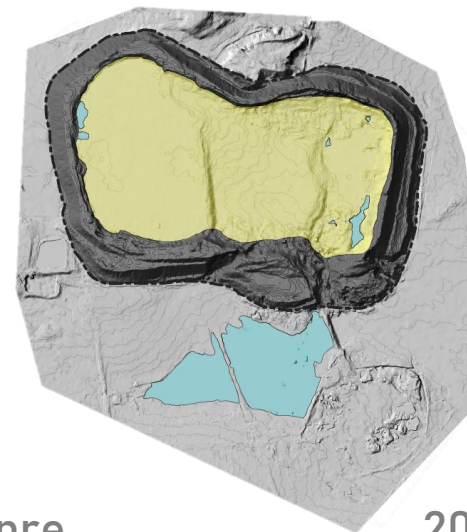
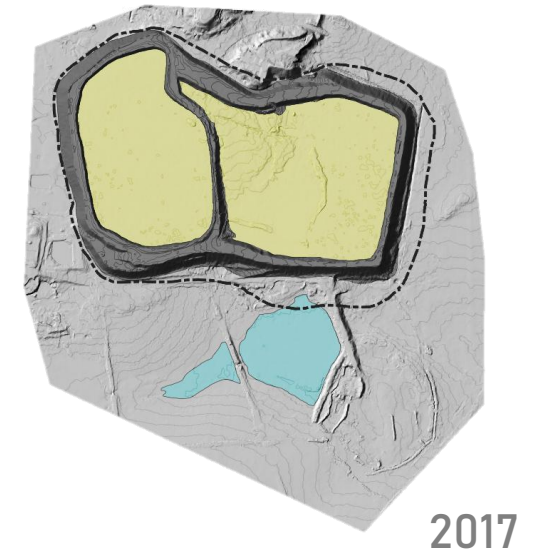
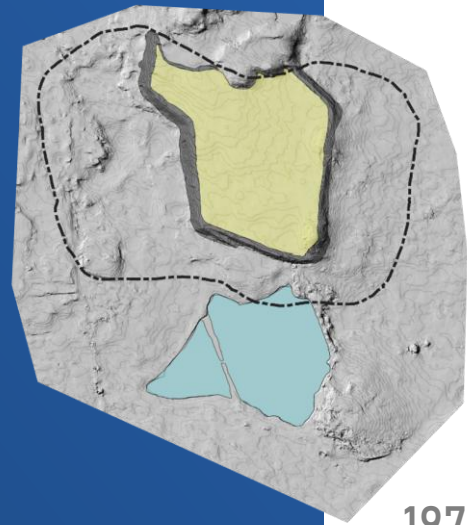


Consistent. Time Stamped. Defensible.



Component Mapping

Jagersfontein



 2022 Post-Failure
Dyke Footprint

 1m Contours

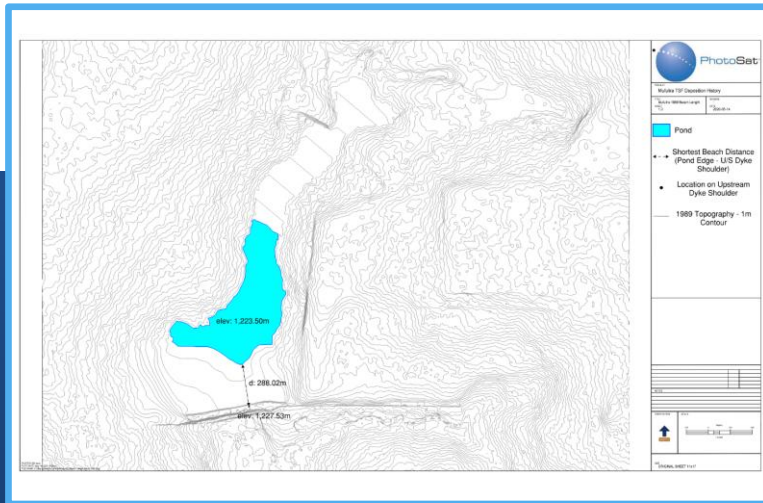
Geotechnical Feature

 Dyke/Wall

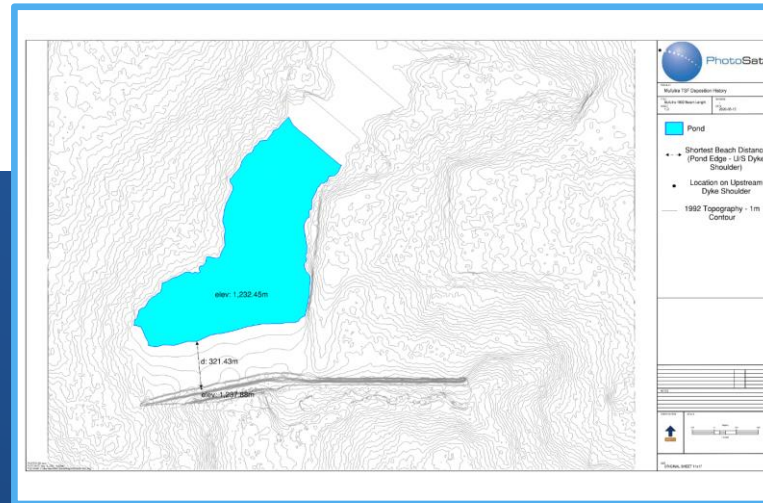
 Tailings

 Waterbodies

Pond Outline and Beach Length Maps



1989

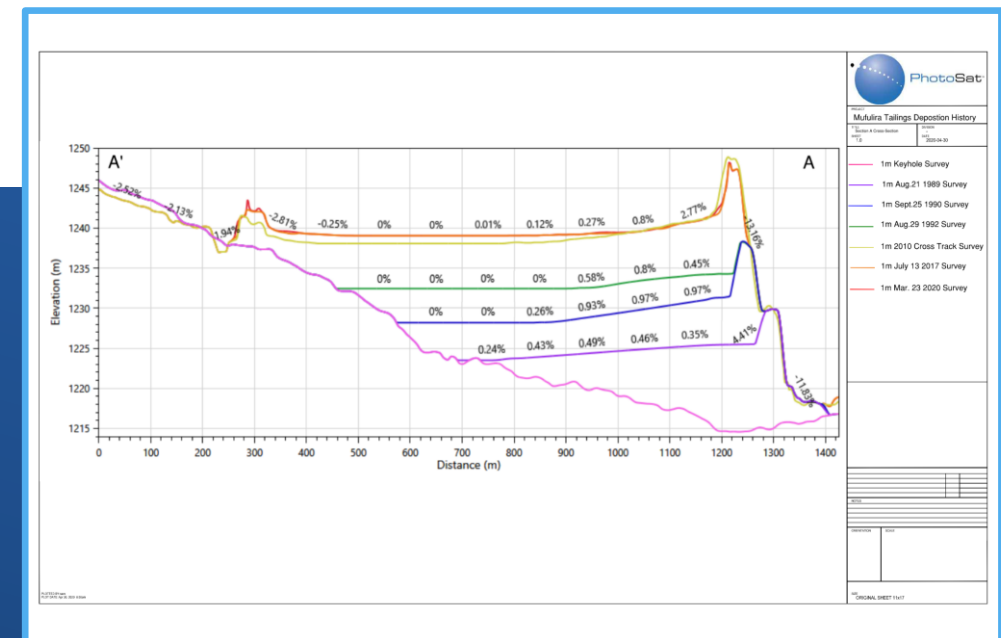
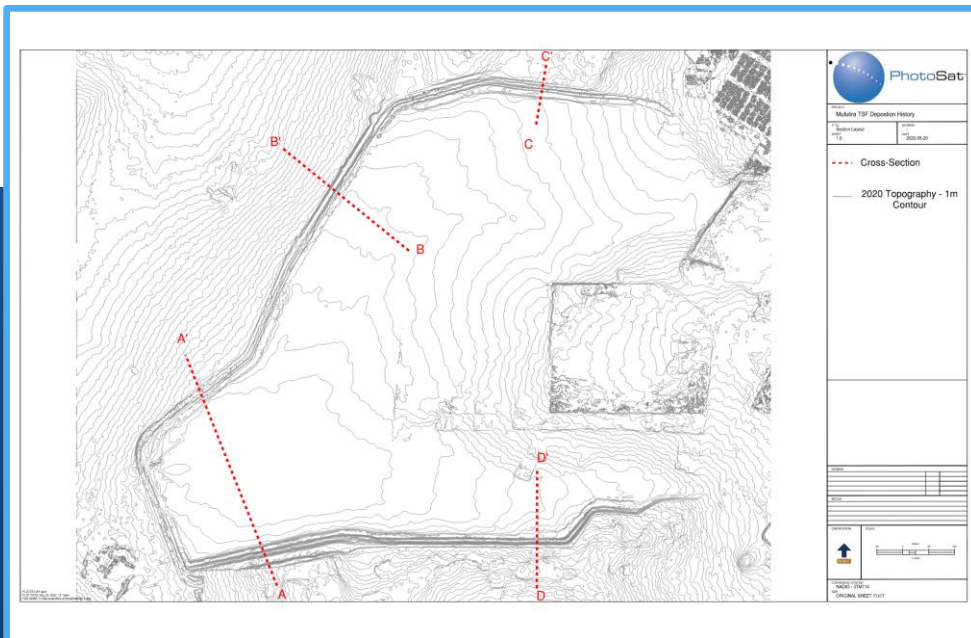


1992



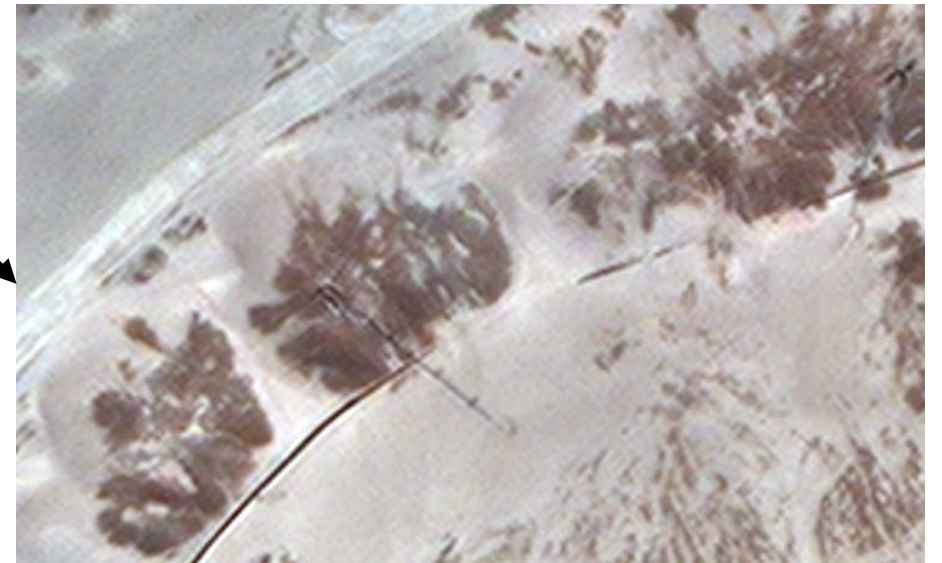
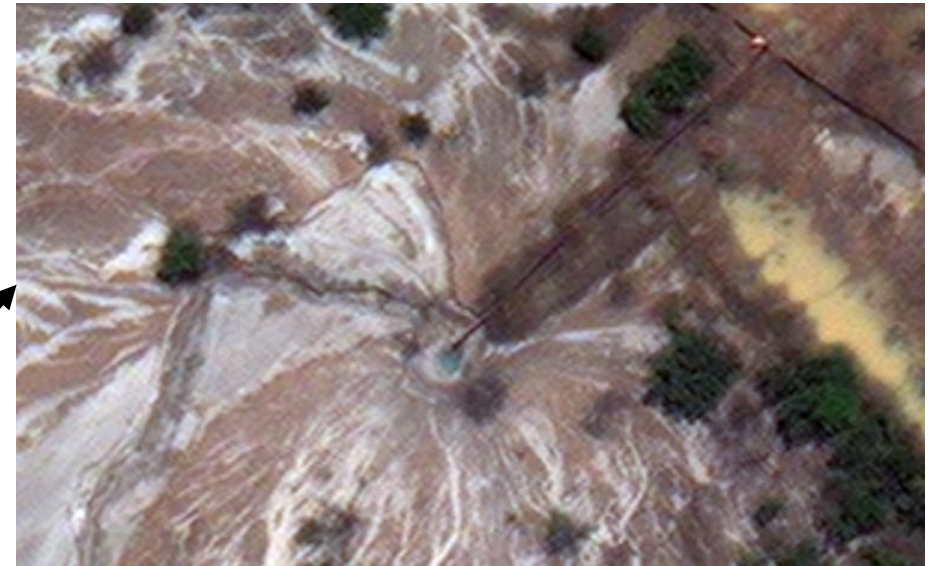
2020

Cross Sections



Pour Points

Mufulira



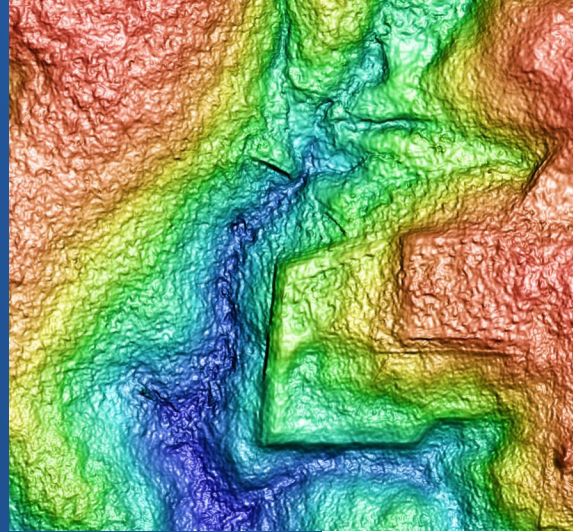
Cut and Fill

Mufulira

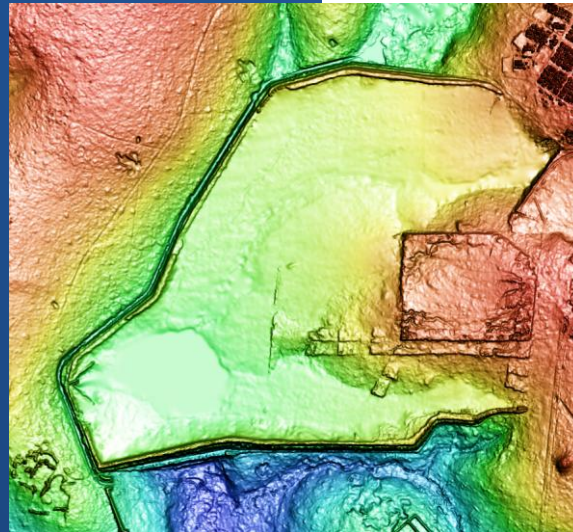
March 2020:

- Tailing thickness = 29m
- Tailings volume = $50,000,000\text{m}^3$

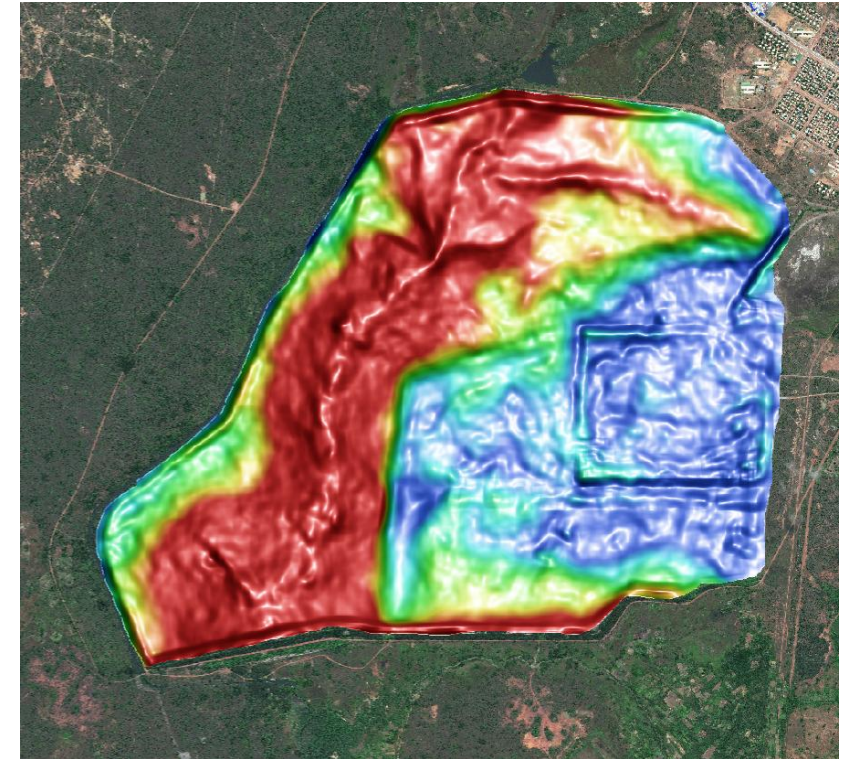
1967



2020

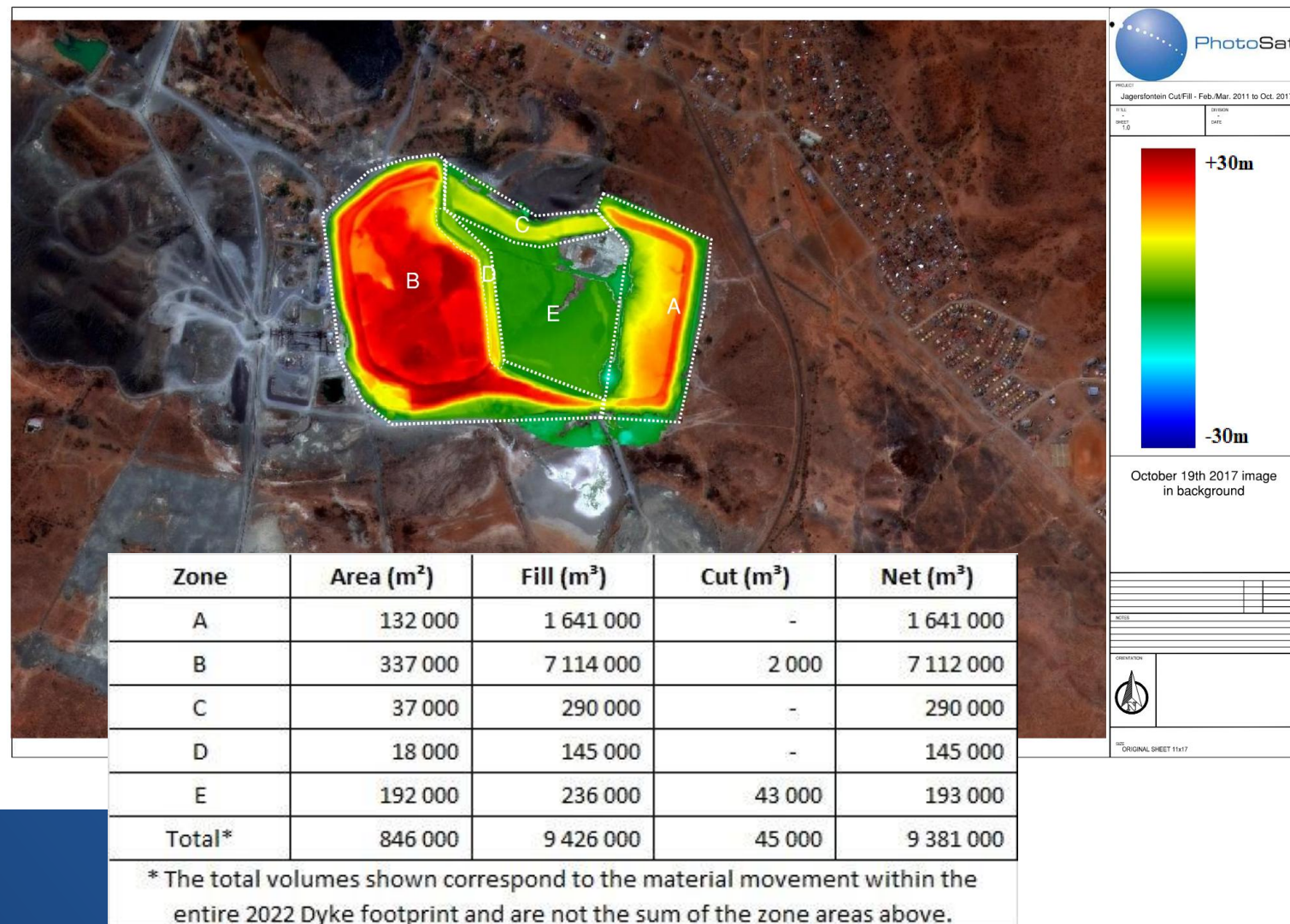


1967 to 2020



Volume Calculations

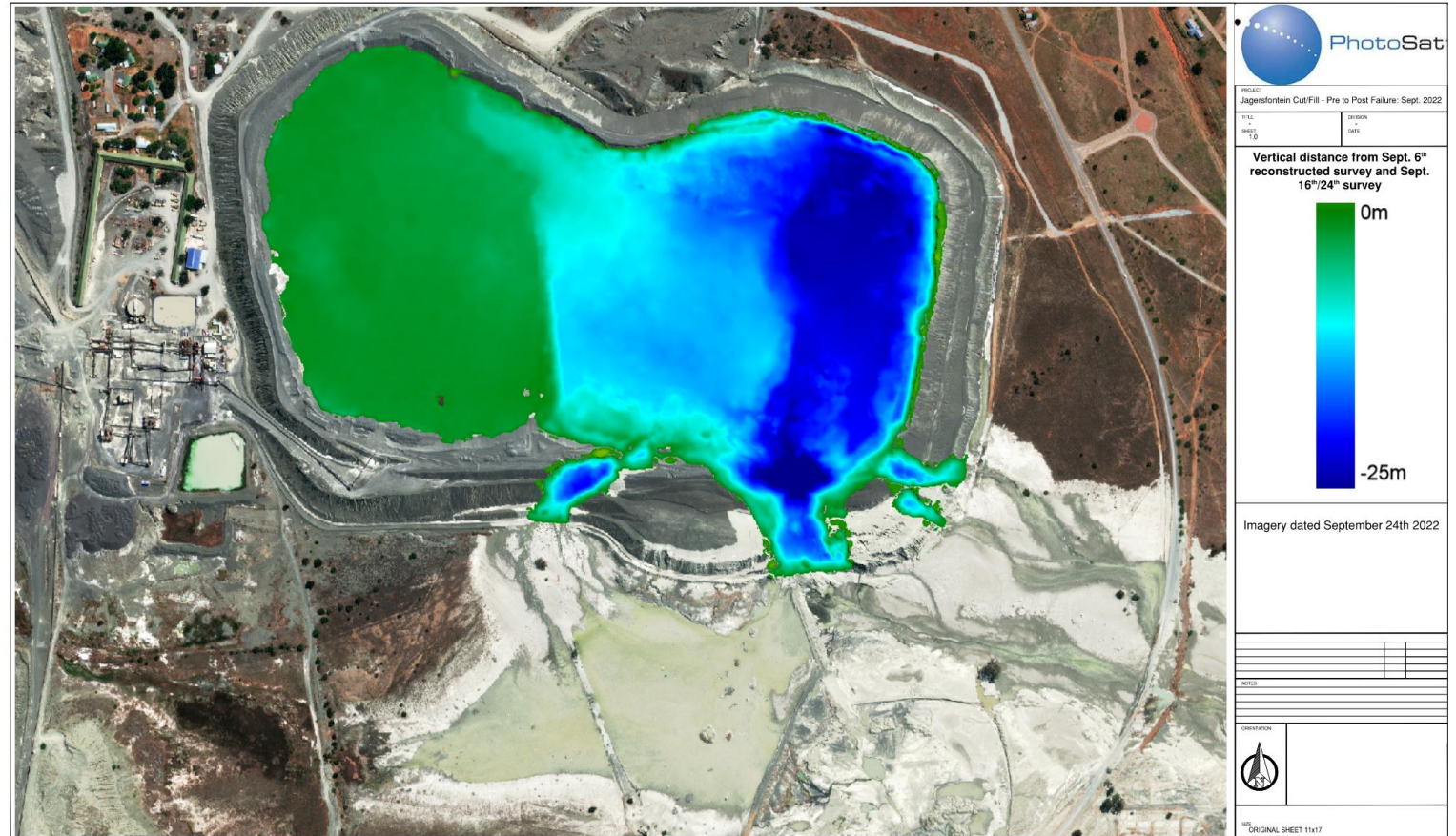
Jagersfontein



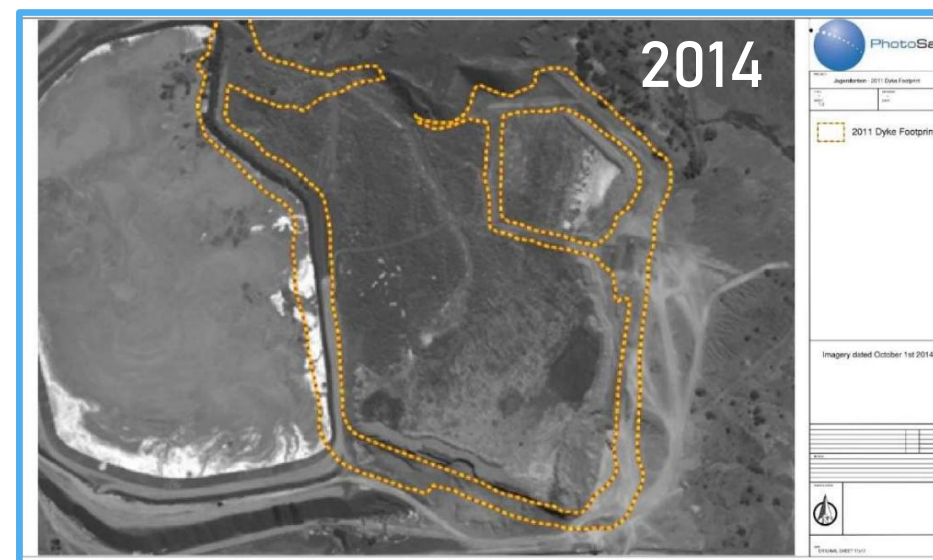
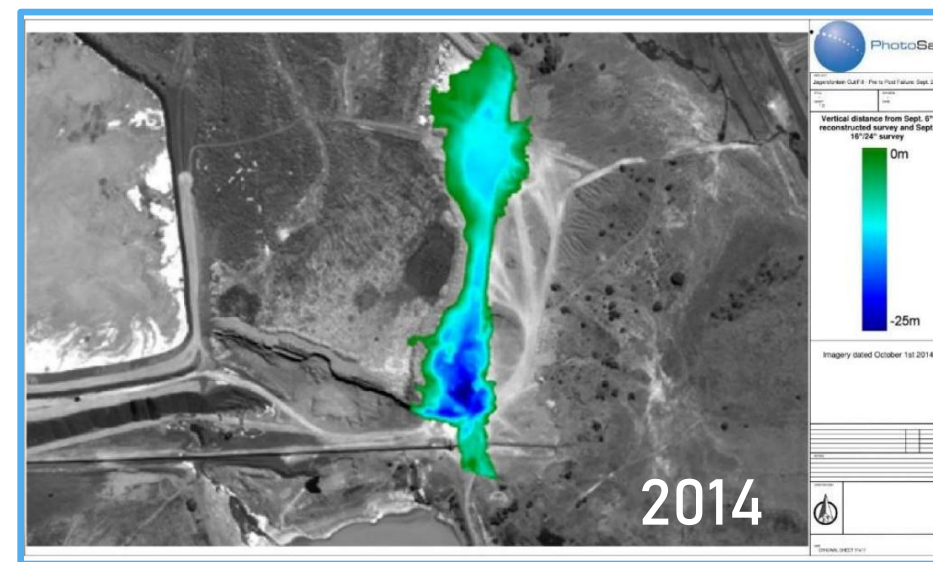
Volume Calculations

Jagersfontein

2022 pre-failure to 2022
post-failure



Zone	Area (sq.m)	Fill (cu. m)	Cut (cu.m)	Net (cu.m)
Embankment Structure	80,000	10,000	660,000	-650,000
Tailings	475,000	-	4,390,000	-4,390,000
TOTAL	555,000	10,000	5,050,000	-5,040,000



Dam Crest Height

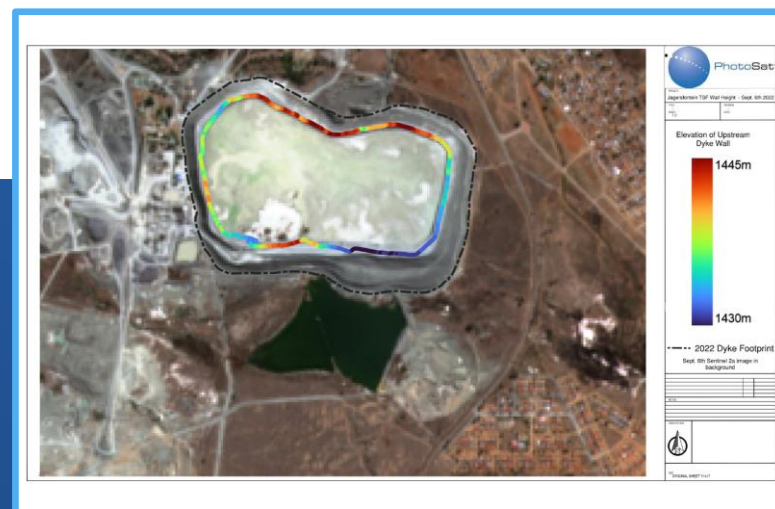
Elevation above sea level of the embankment wall.



2011



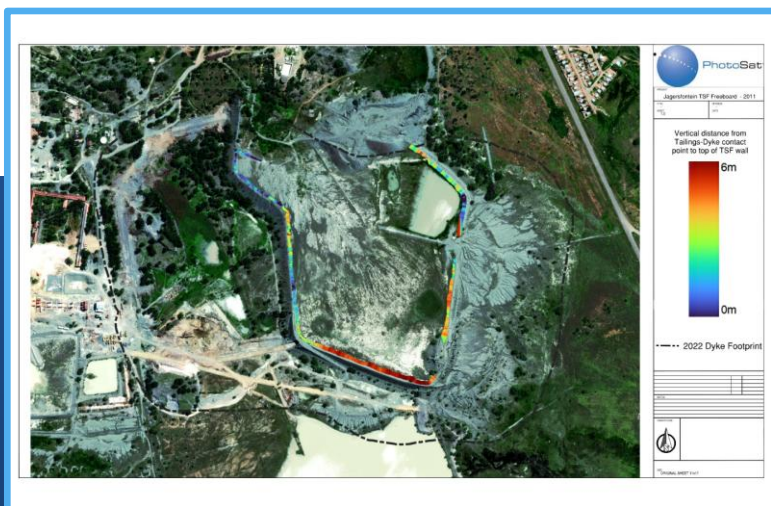
2017



2022

Freeboard

Vertical distance from the tailings to the top of the embankment wall at the point of contact.



2011



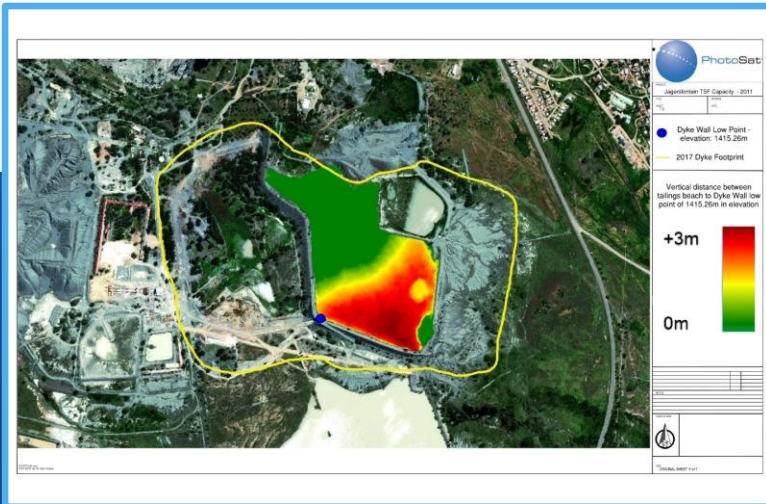
2017



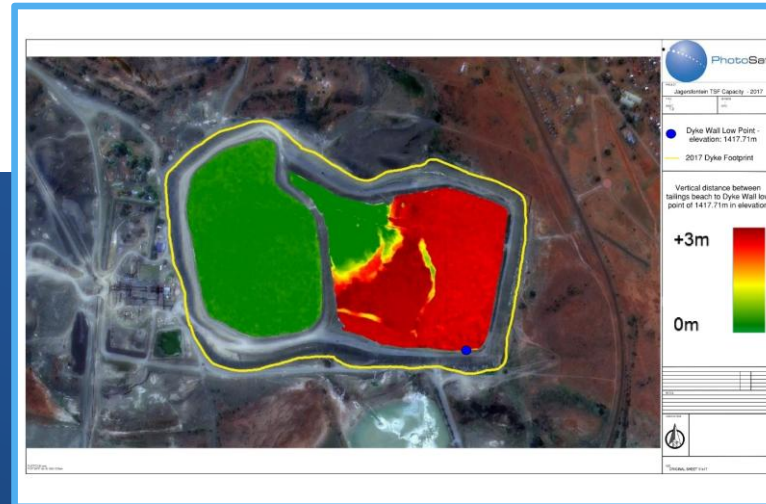
2022

Capacity Maps

Vertical distance between the tailings surface at a specific point and the lowest point on the dam crest.



2011

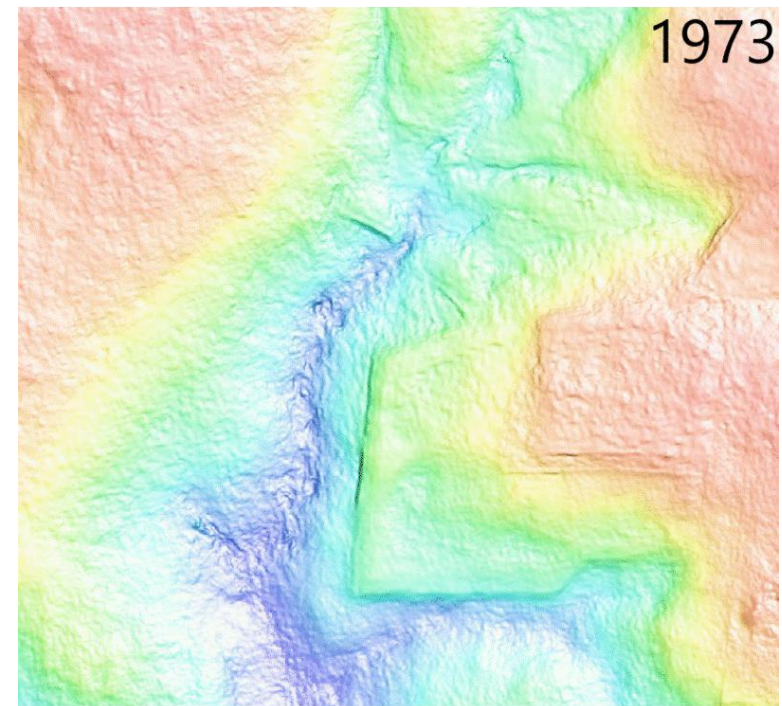
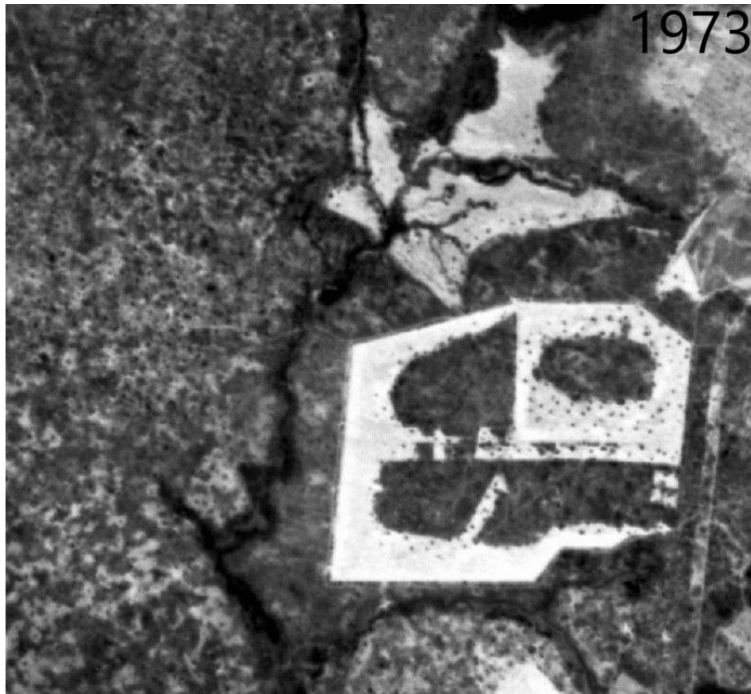


2017



2022

Going Back In Time



THANK YOU



Brad Forrest
Africa Account Executive
078 800 1499
brad.forrest@photosat.ca