



# IAIA 21

VIRTUAL EVENT

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# Tailings Dams – Not Your Normal Dam Hazard

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# Not Normal Dams

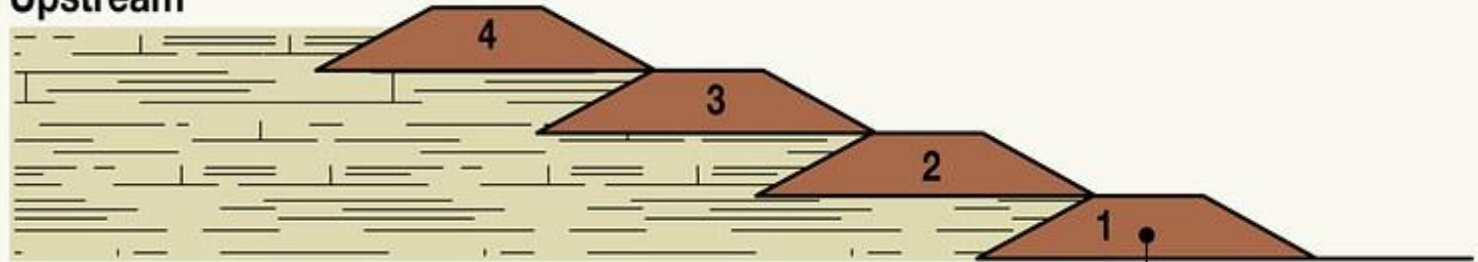
- Mining tends to have a low product to waste (tailings) ratio – lots of tailings for the reasons for the mining
- Tailings often stored above ground level, behind dams
- Delivery of tailings is often through a water slurry
- But - tailings dams **not** generally designed to hold significant quantities of water, on the surface or within the tailings
- Tailings need to be dewatering via drainage or evaporation
- Tailings water may be contaminated and hard to treat



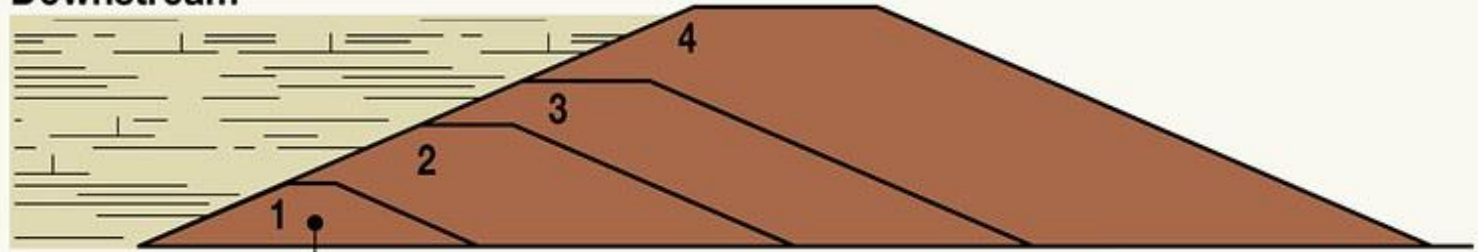
# Different Types of Tailings Dams

## Types of sequentially raised tailings dams

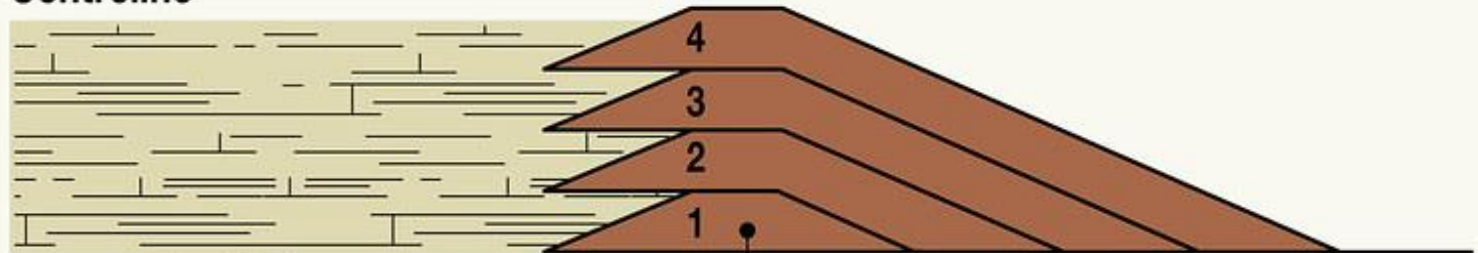
### Upstream



### Downstream



### Centreline



### Starter dyke: 1.

The dam design terms, upstream, downstream and centreline, indicate the direction in which the embankment crest moves in relation to the starter dyke at the base of the embankment wall.

### Dyke: 2 to 4 or more

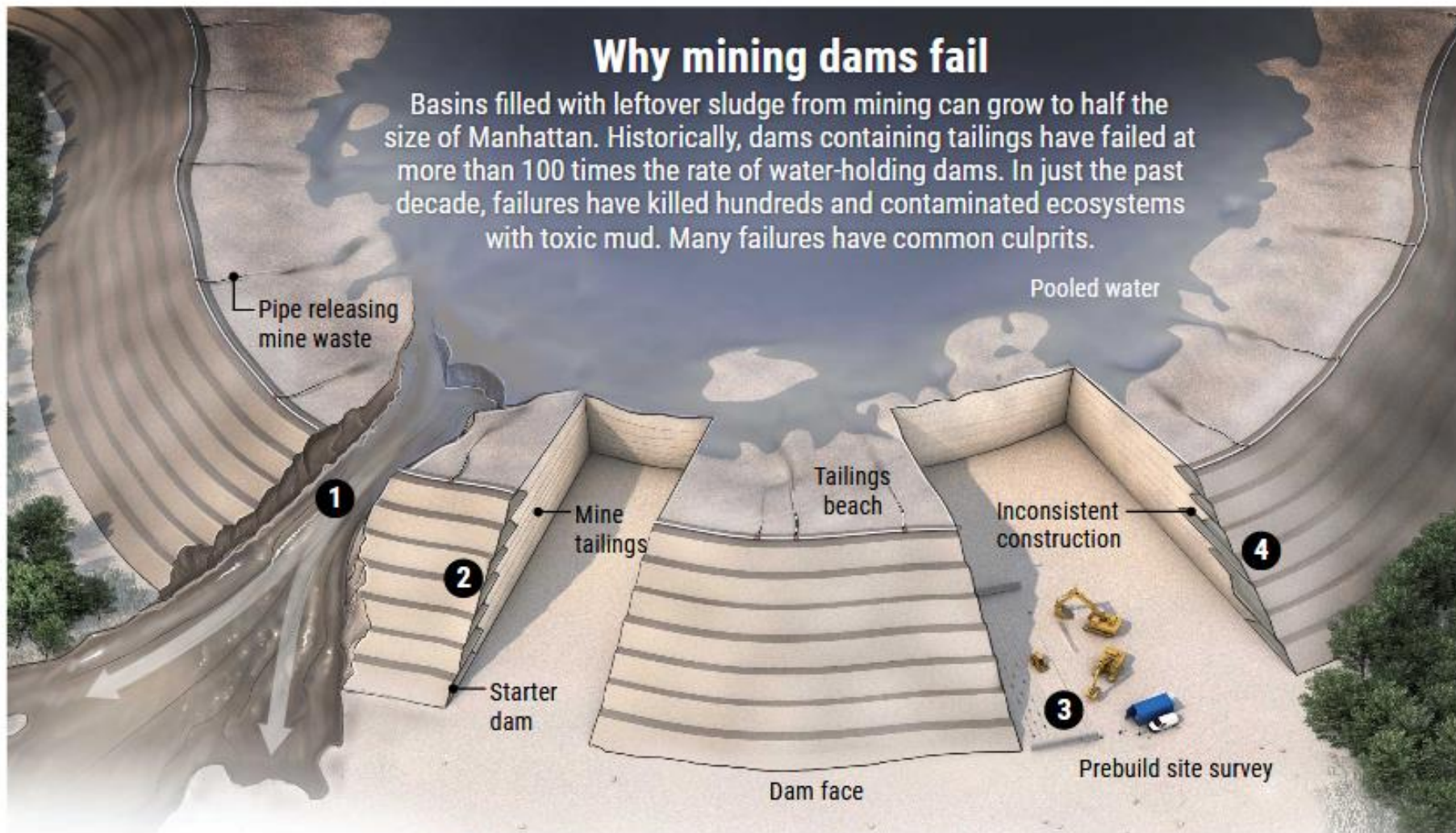
Dykes are added to raise the dam wall. This continues throughout the operation of the mine.





# Why mining dams fail

Basins filled with leftover sludge from mining can grow to half the size of Manhattan. Historically, dams containing tailings have failed at more than 100 times the rate of water-holding dams. In just the past decade, failures have killed hundreds and contaminated ecosystems with toxic mud. Many failures have common culprits.



## 1 Liquefaction

Infiltration of water into the dam is a chief source of failures. In extreme cases, water combined with stress such as an earthquake can cause an earthen dam to suddenly turn to liquid.

## 2 A risky design

Upstream construction is a common but failure-prone approach. The dam is raised gradually, as tailings accumulate. With each new level, the dam tilts upstream, relying on tailings below to help carry the load.

## 3 Shaky ground

Geologic weaknesses in the ground below a dam can leave it vulnerable. In one of the biggest recent failures, dam builders didn't drill deep enough to discover a weak layer left by receding glaciers.

## 4 Piecemeal changes

Unlike water dams, tailings dams evolve. They are built bit by bit over decades as mine waste piles up. This creates more potential for errors.



# Tailing Dam Failure Hazard and Consequences

- Estimated 29,000-35,000 active/inactive tailing dams  
(<https://worldminetailingsfailures.org/>)
- Tailing dam failures reported to be much more frequent than water dams
- Issue of legacy tailings dams – from closed facilities or abandoned mines – even when no longer being used, tailings dams need maintenance
- Recent major failures:
  - Samarco collapse – 2015: 19 fatalities, ecological and built infrastructure damage
  - Brumadinho collapse – 2019: 270 fatalities, ecological and built infrastructure damage
  - Piney Point Creek, Florida – 2021: so far, more a public concern than direct impact.



# The Prospect

- More tailing dams, as resource extraction increases with economic growth
- Bigger, and incrementally expanded, tailing dams
- More legacy dam risks
- Possible trend lines
  - Increased # failures due to more dams
  - Increased # failures of old, retired or abandoned dams due to lack of maintenance
  - Reduced # failures due to better design and management; better legacy site management





# Looking Forward

- Industry good practice for tailings dam management, **A Guide to the Management of Tailings Facilities**, overlaps with environmental impact assessment elements focusing on
  - Failure consequences
  - Social impact
  - Ecological, physical infrastructure impact
  - Risk management (EMMP)
- Given tailing dam failure rate, EIAs need to better anticipate failure modalities and risk management
- Mechanism needed for EIAs for legacy tailing dam – likely a very long term threat

1. Introduction .....	
2 Tailings Management Framework.....	
2.1 Overview .....	
2.2 Overarching Principles.....	
2.2.1 Risk Assessment and Management .....	
2.2.2 BAT and BAP for Tailings Management .....	
2.2.3 Independent Review .....	
2.2.4 Designing and Operating for Closure .....	
2.3 Managing Throughout the Life Cycle of a Tailings Facility .....	
3 Policy and Commitment.....	
4 Planning .....	
4.1 Risk Management .....	
4.2 Performance Objectives .....	
4.3 Accountability and Responsibility .....	
4.4 Management Process .....	
4.4.1 Conformance Management.....	
4.4.2 Change Management.....	
4.4.3 Controls.....	
4.4.4 Resources.....	
5 Implementing the Tailings Management Framework.....	
5.1 Operation, Maintenance and Surveillance Manual .....	
5.2 Emergency Preparedness .....	
5.2.1 Emergency Response Plans .....	
5.2.2 Emergency Preparedness Plans.....	
5.2.3 Other Considerations for ERPs and EPPs.....	
5.2.4 Integration with Crisis Management and Communications Planning.....	
5.3 Checklists .....	
6 Performance Evaluation.....	
7 Management Review for Continual Improvement .....	
8 Assurance .....	





# *Let's continue the conversation!*

Post questions and comments via chat in the IAIA21 platform.



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