Tailings dams: Fact sheet

Produced by John Boscawen with Diana Salazar (2024)

1. What are tailings?

Tailings are waste materials left over after a target mineral is extracted from an ore.

They consist of crushed rock, water, traces of other minerals (such as cobalt, zinc, lead, mercury and so on), and additives used in processing (such as cyanide, sulphuric acid, petroleum byproducts).

Tailings are typically made up of both larger particles (sand) and finer particles (mud or slurry).

TSF stands for tailings storage facility. The most common method for storing tailings is to collect them behind a large earthworks, known as a tailings dam.

2. How many TSFs are there in the world?

The Global Tailings Portal documents over 1,900 tailings sites.[1]

Estimates as to the total number of active and retired TSFs vary from 3,500 to 35,000 tailings dams.[2]

Thus, it is not known how much mining waste there is stored in TSFs worldwide. Some estimate that 13 billion tonnes of the potentially toxic waste is produced per year, the majority of which is stored behind tailings dams.[3]

3. What types of TSF are there?

Deposit into watercourse – historically, mining waste has been allowed to flow directly into rivers and seas with huge environmental costs. In 2018 alone, large mining companies dumped over 220 million tonnes of mining waste directly into watercourses. [4]

Dams – tailings dams use embankments to contain tailings slurry so that it has less impact on the environment, but there are huge risks of both gradual pollution and catastrophic collapse. The largest tailings dam in the world has a planned storage capacity of 350 million cubic metres.[5]

Dry stack – a less common method due to its very high costs, but a safer method of tailings storage involves dehydrating tailings and forming the waste into “cakes” that can then be stacked and moved. This method reduces the risk of contamination.[6]

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[1] Global Tailings Portal (https://tailing.grida.no/)
[2] World Mine Tailings Failures - from 1915 (https://worldminetailingsfailures.org/)
[3] Hudson-Edwards et al. (2024) “Tailings storage facilities, failures and disaster risk,” *Nature Reviews Earth & Environment*
[4] Earthworks (2024) “Dumping by the Numbers” (https://earthworks.org/resources/ocean-dumping-numbers/)
[5] Syncrude Tailings Dam (https://en.wikipedia.org/wiki/Syncrude_Tailings_Dam)
[6] Metso (2024) “How to reshape the future of tailings?” (https://www.metso.com/insights/blog/mining-and-metals/how-to-reshape-the-future-of-tailings/)

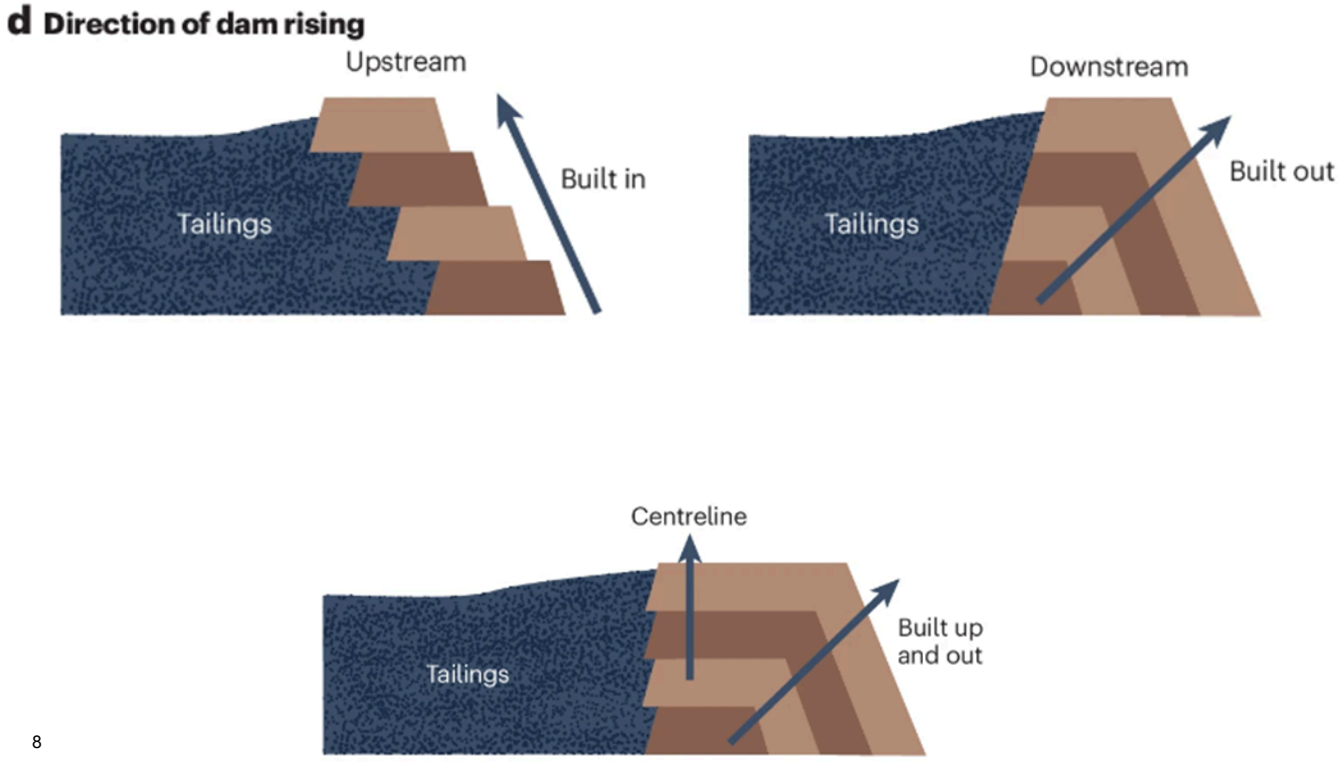
Mine refilling – it is also possible to use tailings as the basis for concrete (for use as a building material or to refill mine cavities).[7]

4. What's the difference between upstream, downstream and centreline tailings dams?

Upstream: where new levels of the raises of the dam are built on top of previously-deposited tailings. This method is particularly dangerous because the underlying tailings can liquify unexpectedly and collapse, giving way for the whole structure to topple. This is the cheapest method of tailings dam construction.

Downstream: where new levels of the raises of the dam are built outward from the tailings and on top of previous raises. Each new level is structurally independent of the tailings and therefore considered safer than upstream dams.

Centreline: where new levels of the raises of the dam are built on top of tailings as well as the existing embankment. This method is a combination of both upstream and downstream techniques and is the most expensive to build.



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[7] Gou, Zhou & Wei Ying Then (2019) "Utilization of tailings in cement and concrete: A review" (https://www.researchgate.net/publication/336668147_Utilization_of_tailings_in_cement_and_concrete_A_review)

[8] Hudson-Edwards et al.

5. What happens when TSFs collapse?

Tailings dams vary greatly in size, construction, toxicity and proximity to human activity.

Environmental impacts of dam collapse can include erosion, sedimentation of watercourses, and destruction of downstream channel and floodplain environments. They can also contribute to water contamination both by releasing large quantities of contaminant-bearing slime and liquids into water systems, and by disturbing contaminated alluvium on riverbeds (where there is historic mining in the catchment).

Human health impacts include loss of life due to submersion in the wave of slurry. The stress and negative change in material circumstances occasioned by displacement and loss of livelihood likely also have adverse effects on the health of affected people. Exposure to metals and metalloids through dust inhalation, drinking water, accidental ingestion, and contamination of the food chain has been connected with various health problems.

Profound and long-lasting socio-economic impacts ensue from human deaths and injury, destruction of property and livelihoods, loss of economic activity and public revenue owing to suspension or closure of mines, general disruption of infrastructure and amenity, litigation through criminal and civil proceedings, fines and penalties, and reputational damage to the mining industry and affiliated sectors. Cultural identity loss, recognition of affected Indigenous communities and impacts on ecological tourism are additional factors that warrant exploration but are often overlooked.[9]

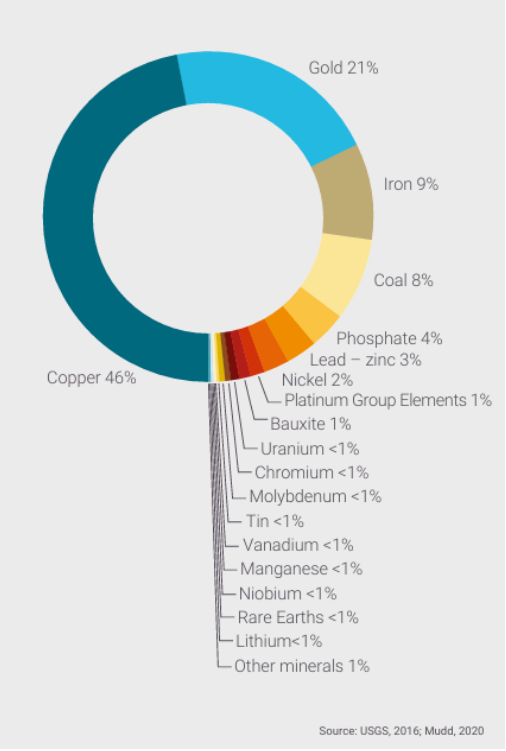
6. How often do tailings dams fail? Is the problem getting worse?

By one estimate, TSF failures have released a total of ~250 million m3 of tailings, destroying areas up to ~5,000 km2, directly killing an estimated 2,650 people and impacting ~317,000 people through displacement, property damage, and risks to livelihoods and health.[10]

119 of ~260 TSF collapses have occurred since the turn of the millennium.[11]

The problem isn't just the mining waste that has already been produced. The amount of tailings being created each year is set to rise dramatically as economies around the world pursue electrification under the banner of the energy transition, which, according to mining companies, will require large quantities of cobalt, nickel, iron, aluminium, lithium and, especially, copper.

Increasing demand has led to the mining of ever-lower grades across all minerals. This is directly responsible for a rise in the production of mining waste in real terms and as a



[9] Hudson-Edwards et al.
[10] Hudson-Edwards et al.
[11] WISE Uranium Project, "Chronology of major tailings dam failures" (https://www.wise-uranium.org/mdaf.html)

proportion of minerals extracted. For each tonne of pure copper produced today, ~740 tonnes of rock have to be blasted from the ground and at the end of the process over 400 tonnes of toxic waste need to be disposed of. It is believed that 46% of tailings produced worldwide are waste from copper production.[12]

In the first 24 years of the 21st Century, we have extracted more minerals and fuels from the earth's surface than we did in the entire 20th Century.[13]

The average size of a tailings reservoir has now grown to 17 million cubic metres. As the volumes of tailings held behind dams increases, the scale of the catastrophe when they fail will potentially become greater.

7. What are the environmental impacts of tailings dams when they function as intended?

Even when a tailings dam does not fully or partially collapse, there are nevertheless significant environmental risks associated with this method of tailings storage.

a. Ongoing **pollution of water** by leaching, seeping, pipeline leaks, overtopping of TSFs and airborne particulate matter, with consequences for biodiversity, agriculture and human health.
b. Airborne particles also cause **air pollution**, which can cause respiratory problems for humans and animals, as well as contaminating soil.

These two problems are exacerbated by climate change, which is causing heavier rainfall, more frequent floods, and very dry seasons.

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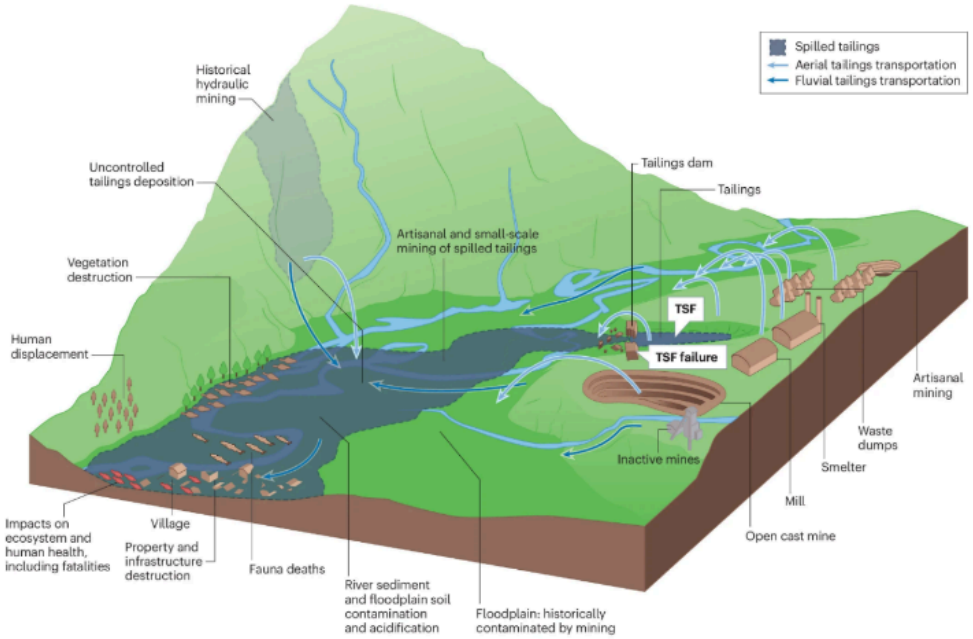

[12] Baker et al. (2020) Mine Tailings Facilities: Overview And Industry Trends, *Towards Zero Harm – a compendium compiled for the global tailings review*
[13] United Nations Environment Programme (https://www.unep.org/)
[14] Hudson-Edwards et al.