WHAT ARE TAILINGS AND TAILINGS DAMS?


Mine Tailings, Ontario, Edward Burtnyski

To extract minerals like copper or gold out of rock, it must go through a range of treatments, including crushing, grinding, flotation, cyanidation or acid leaching. Tailings are the finely ground waste materials left over from these treatments. Many of these methods require water, so tailings are usually in the form of a slurry.

Tailings vary but may contain or produce cyanide, radiation, alkalinity (high pH) or acidity (low pH), arsenic, high salinity in pore water (pore water is in the spaces between particles of sand, rock or tailings). It can also produce sulphides which can create acid which dissolves any heavy metals in the tailings, like mercury, lead or arsenic. When dissolved, these heavy metals can be washed away into rivers or streams.

Toxic gases may be released off the tailings due to chemicals within the tailings. Colloidal clays in the tailings can affect the way the tailings settle and their strength. Tailings that separate after storage can form "slime ponds" which are hazardous for stability in the long-term.

WHAT IS A TAILINGS STORAGE FACILITY (TSF)?

These are built to contain tailings waste, and include a dam or other structure, plus anything used to transport tailings to the dam. It may include one or more tailings dams.

Once waste in a tailings dam is sufficiently stable with all water removed, the dam can be "decommissioned" to make it safer. **However, there are long-term impacts from storing contaminated tailings, with some tailings remaining highly contaminated for at least 1000 years. Some facilities may need a longer time to be considered safe.**

Tailings dams need to be built as far as possible away from waterways and neighbouring property. In Australia, **TSFs cannot be built on a natural drainage line or waterway,** as it increases the risk of contaminating water flow.

TAILINGS DAM DESIGN

Wet deposition TSFs, also called sub-aqueous deposition, are when wet tailings creates a pond behind the embankment. This is similar to the kinds of dams at Samarco. The Department of Economic Development, Jobs, Transport and Resources (Victoria, Australia) suggests this type of dam should be avoided. **Mining companies operating internationally often do not keep to the same rules and regulations they need to comply with in their own country.**

"For a dam-style TSF the initial embankment should form a substantial part of the final structure with lifts kept to a minimum."

"Technical Guideline – Management of Tailings Storage Facilities" Dept of Economic Development, Jobs, Transport and Resources, VIC, Australia

The high incidence of tailings dam failures is due to "the fact that tailings dams are most often constructed in sequential 'lifts' over several years that make quality control more challenging relative to water supply dams that are constructed all at once".

Chambers and Higman, 2 October, 2011


Red Chris Mine, British Columbia, Garth Lenz

Yet the Fruta del Norte Tailings Dam plan says: **"The TSF dam will be raised continuously throughout the service life until reaching the ultimate elevation. Each dam raise will be completed at least one year before the maximum tailings pond elevation required each year; currently dam raises are contemplated at Years 0, 2, 5, 10 and 14 (ultimate)."**

Storing mine waste underground, or using "dry stacking" which stores dry, compacted mine waste is "safer". The Mount Polley independent engineering review panel recommends tailings ponds have dry soil covers to stop oxygen reaching mining waste and creating sulfide oxidation.

WHAT ARE THE RISKS?

Contamination of land, groundwater and surface water with cyanide, sulphide, arsenic, cadmium, chromium, copper, lead, mercury, fluoride, tin and other heavy metals. Waterlogging and land salinisation are also risks.

Acid mine drainage is one of the biggest hazards mining can cause to waterways. If excavated rock containing sulphides is exposed to water and air, it reacts creating sulphuric acid. **Any part of the mine where sulfides are exposed to air and water is at risk of acid drainage, including waste rock piles, tailings, open pits, underground tunnels and leach pads.**

"The acid will leach from the rock as long as its source rock is exposed to air and water and until the sulphides are leached out – a process that can last hundreds, even thousands of years. The acid is carried off the mine site by rainwater or surface drainage and deposited into nearby streams, rivers, lakes and groundwater."

protectecuador.org

AMD from abandoned mine, protectecuador.org

High rainfall and/or earthquake risk put extra pressure on tailings dams. This extra pressure can result in a tailings dam collapse like that of Samarco or Brumadinho.

If tailings or waste water have high levels of heavy metals and colloidal clays, or it is an area at risk of earthquakes, floods or extended extreme weather, the area is considered a "consequence category of high or extreme", and the TSF will need higher standards of design and operation.

If there is a **flood or extended extreme weather period**, this extra water can be too much for the dam to cope with, and **contaminated water can enter the local rivers and streams**. Most tailings dams are only designed to carry runoff from 1:100 year storm events.

Marcopper mining disaster, Phillipines

The Intergovernmental Panel on Climate Change (2014) states that the frequency and intensity of extreme weather events like heavy rain and flooding are likely to increase as a result of climate change.

A study by Vincenti, Ruiz and Bersosa, found that some areas in Ecuador may get between 42 and 10 times more rain in these extreme weather events.

Preparing only for 1:100 year storm events is not enough.

TAILINGS DAM COLLAPSE

Tailings dam collapses can be due to earthquake, flooding, internal erosion, liquefaction, foundation failure or a combination of factors. The overall number of annual tailings dam failures has declined in recent years, however the number of serious failures has increased. (Bowker and Chambers 2015)

The Samarco dam collapse in 2015 which killed 19, and polluted hundreds of kilometres of river, was as a result of liquification triggered by an earthquake measuring only 2.6 on the Richter scale.

On the 5th of November 2015 the Fundao iron tailings dam collapsed at the Samarco iron ore mine upstream of the village of Bento Rodrigues. Nineteen people were killed, 50 injured, and 90% of Bento Rodrigues's homes were destroyed. 670 kilometres of the Doce River was devastated from tens of millions of cubic metres of tailings.

Samarco disaster

Brumadinho failure

The Brumdinho Disaster (Brazil)

On 25 January 2019, the tailings dam at Córrego de Feijão mine near Brumadinho collapsed killing 186. At least 122 people are still missing. Most of the victims were company Vale's employees. Three locomotives and 132 wagons were buried. The mud also struck and destroyed two sections of railway bridge and about 100 metres of railway track. Agriculture in the area was affected or totally destroyed.

The collapse released 12 million cubic meters of tailings into the river system. Experts say the metals in the tailings will affect the region's whole ecosystem.

In both instances, company directors were aware that the dam was vulnerable to collapse, yet did nothing about it.

At Samarco, sirens that were supposed to warn of collapse had never been installed. At Brumdinho, there was also no siren alert.

Three years after the Samarco dam collapse, BHP and Vale have only paid 3.4% of 400 million in fines. They settled a $7 billion lawsuit (which has yet to be paid), and still face a $55 billion lawsuit. To date, the townspeople have received no compensation.

Brumadinho clean up begins

LOOMING ISSUES - THE MIRADOR MINE

The more a country relies on mining to reinforce its GDP, the less likely it will be to impose strict environmental and health and safety regulations on companies extracting local metals and minerals. (The Ecologist, 6 March 2019)

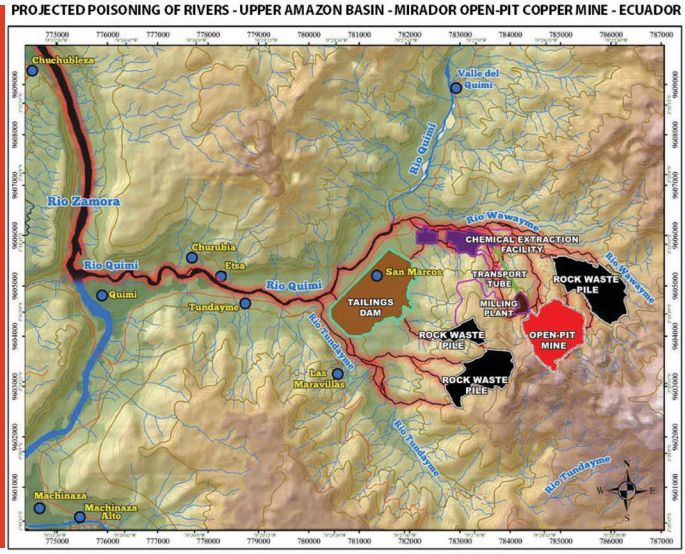
The low percentage of copper in the Mirador deposit means that "they will have to remove a very large amount of rock to obtain a very small amount of mineral," says Geologist Pablo Duque, Escuela Politecnica Nacional University, Quito. Chinese-owned EcuaCorriente plans to build a 200-hectare tailings facility, directly above the Rio Quimi.

Dr Emerman noted that the first dam under construction was being built in a manner which did not comply with the Environmental Impact Study of 2014 and was being built at a "critical" angle, in engineering terms at the "edge of collapse". This dam will be 63 meters tall. (The Ecologist, 18 February 2019)

"According to E-Tech International, EcuaCorriente itself gave the tailings impoundment a Very High risk rating, with potential for 'adverse environmental impacts and loss of life' if the dams holding back the waste fail. EcuaCorriente's studies state that, in the case of a dam rupture, the tailings would only spill into the Rio Quimi, and would not enter the Rio Zamora at its confluence only several kilometers downstream. But independent models show that the toxic waste would definitely enter the Zamora and travel quickly to the Rio Santiago, some 80 kilometers downstream."

(Mongabay, 21 December 2015)

PROJECTED POISONING OF RIVERS - UPPER AMAZON BASIN - MIRADOR OPEN-PIT COPPER MINE - ECUADOR



"The greatest threat posed by the Mirador Mine is the 99% certainty of the failure of the Tailings Dam, at present under construction." (David Dene, Rights of Nature conference)

EcuaCorriente has no plans for the collapse of the tailings dam or to lessen the risk of acid forming. "The mine plans that we have seen for the Mirador mine include leaving the waste on the surface of the ground. We have to assume that these materials will be left on the surface forever and that contaminants will be leaching from them at least for centuries."
Dr. Ann Maest said that she saw "no plans for construction of a treatment plant, and it is not included in the financial assurance (for mine closure). This is essential at a mine like this, with the high potential for contaminated water and high rainfall." (Dr. Ann Maest, scientist, E-Tech International)

The mine is expected to produce 60,000 tons of mining waste tailings every day. An earthquake could liquify the tailings or the foundations. If this happened at Mirador, hundreds of millions of tons of toxic waste would be released into the river systems of the Upper Amazon Basin.

"In the case of a high rainfall event leading to collapse, the fastest-moving mine tailings would reach the next major confluence where the River Zamora meets the River Santiago, (about 88 km downstream from the Rio Quimi –Rio Zamora confluence), within 5 hours." (David Dene, Rights of Nature)

The Tundayme dam in the valley of the Tundayme River is slated to be the tallest tailings dam in the world at 260 meters high, with slopes which are steeper than generally used, thus creating a greater danger of collapse.

"The consequences of the Tundayme collapse will be much greater than that experienced in other tailings dam failures simply because the proposed dam is higher, the highest in the world, meaning that the released tailings will travel a greater distance at a greater speed."

David Dene, Rights of Nature