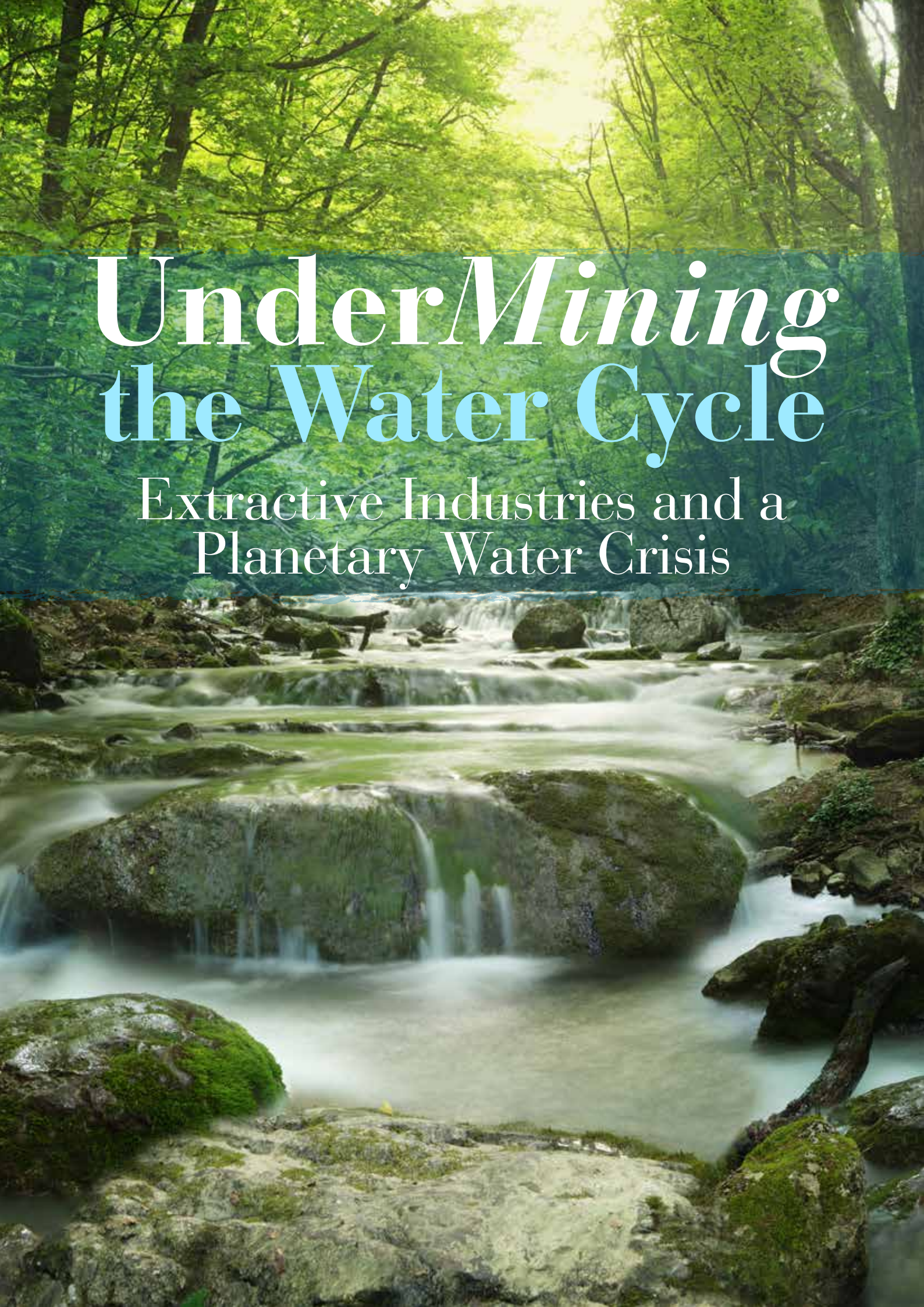

Under*Mining* the Water Cycle

Extractive Industries and a Planetary Water Crisis

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Extractive Industries and a Planetary Water Crisis

Throughout this report we use the terms 'mining' and 'extractive industries' interchangeably to refer to a broad array of extractive methods, including open pit mining, underground mining, drilling and fracking, used to extract minerals, metals and fossil fuels.

Download a copy of this report at:
www.gaiafoundation.org/UnderMiningtheWaterCycle

UnderMining the Water Cycle: Extractive Industries and a Planetary Water Crisis (2016)

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WATER IS LIFE

"The river moves from land to water to land, in and out of organisms, reminding us what native peoples have never forgotten: That you cannot separate the land from the water, or the people from the land."

- Lynn Noel, Author

Humans rely on clean fresh water to live and thrive, as do a great host of other species we share the land, water and air with. The great cycling of water through the different spheres of Earth sustains life as we know it.

Of all the water in the world, 98% percent is too salty to sustain life beyond the oceans. Just 2% of the water on Earth is fresh and only 0.5% of that is immediately available to us, the rest being locked up in ice caps, groundwater systems and soil.

Freshwater is renewed through a complex natural water cycle that connects oceans to mountains via the atmosphere and the land. This cycle facilitates the formation and movement of clouds, evapotranspiration in Earth's forests, the transfer of clean water through rivers, streams and lakes, filtration of pollutants by wetlands and the recharging of groundwater aquifers.

As long as water is allowed to observe this natural cycle, supplies of fresh water can renew and purify themselves in perpetuity. However, when the water cycle is disrupted and sources of fresh water are depleted, polluted and exploited faster than the rate they can regenerate, the amount of fresh water available to humans, other species and whole ecosystems can be drastically reduced and even extinguished.

In this sense, though the Earth's total supply of all water is constant, sources of fresh water are finite. We only have a certain amount to go around and cannot create more.

Despite this fact, around the world today we see countless examples of powerful economic and political forces treating fresh water as an infinite resource. These forces exploit fresh water, like so many of Earth's elements, to power industrial development and economic accumulation.

Seeing and using water as a means to make profit, rather than as a life-giving element we have a responsibility to protect, these powerful interests are gambling with our lives. They are simultaneously polluting and depleting Earth's precious sources of fresh water faster than they can recover, disrupting the water cycle and precipitating a global water crisis.

Michal Kravèik's cycle of a droplet

To complete the hydrological cycle, a drop of water must first evaporate from a plant, Earth surface, swamp, river, lake or the sea, then fall back down to Earth as precipitation. If the drop of water falls back onto a forest, lake, blade of grass, meadow or field, it cooperates with nature to return to the hydrological cycle. However, if the Earth's surface is paved over, denuded of forests and meadows, and drained of natural springs and creeks, the drop will not form part of river basins and continental watersheds, where it is needed by people and animals, but head out to sea, where it will be stored. It is like rain falling onto a huge roof, or umbrella; everything underneath stays dry and the water runs off to the perimeter. The consequent reduction in continental water basins results in reduced water evaporation from the Earth's surface, and becomes a net loss, while the seas begin to rise.

The mining industry is deeply complicit in the creation of this water crisis. This report's goal is to expose the industry as an increasingly prolific user, displacer and polluter of water on a global scale. In the context of a thirsty world facing a changing climate, the report shows how the impacts of mining disproportionately affect vital ecosystems and marginalised communities, reminding us that we ignore the integrity of the whole water cycle at our peril.

Securing clean fresh water for everyone, and for the ecosystems we depend on, is a matter of justice that requires us to challenge power structures, not simply dig wells.

Collecting water/africa/ Adobe Stock images

MINING AND THE PLANETARY WATER CRISIS

Globally more than a billion people, one in seven on the planet, now lack access to safe drinking water.[1] Global demand for water is predicted to exceed supply by 40% in 2030.[2]

There is no doubt that we are currently experiencing an unprecedented global water crisis. Unless drastic measures are taken, major global institutions agree that fresh water shortages and inequalities of access to fresh water will worsen in the near future. In 2015, nearly 900 experts who took part in the World Economic Forum's Global Risk Perception Survey rated water crises as the greatest risk facing our planet.[3]

Our changing climate and the growth of global population by approximately 85 million people a-year[4] are often cited as the main causes of the world's water crisis. But neither climate change nor population growth alone can adequately account for our present situation.

The consumption of global water supplies is doubling every 20 years, at more than twice the rate of human population growth.

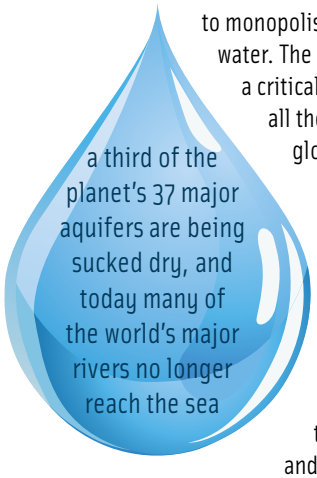
In addition, experts believe we ought to see climate change as a product and intensifier of our existing water crisis, as well as a contributing cause. Food & Water Watch Chair, Maude Barlow, explains:

> *"Major bodies of water have been destroyed from over extraction and water diversion, not climate change as we usually describe it. The destruction of watersheds and water–retentive land is causing rapidly growing desertification, which in turn warms the planet."*

Our human water crisis, which primarily affects Earth's poorest and most marginalised communities, is in large part driven by the ecological water crisis Barlow describes. Around the world people's ability to access enough fresh water to live and live well is threatened as sources of freshwater and the species that rely on them are devastated and depleted.

NASA reports that a third of the planet's 37 major aquifers are being sucked dry,[5] and today many of the world's major rivers no longer reach the sea.[6] As a result of pollution and destruction of water systems, between 1970 and 2010 fresh water species declined by 76%, more sharply than species in land or marine ecosystems.[7]

This destruction and depletion of water systems has predominantly been perpetrated by powerful industries that are using their wealth to monopolise access to, and control of, water. The impact of these industries is a critical missing piece in identifying all the factors contributing to our global water crisis.



The extractive industries are a key contributor to the global water crisis. Sustained by demand for minerals, metals and fossil fuels from new economic hubs in the Global South and the penchant for travel, luxury and high-tech products in the Global North, extractive operations are having uniquely wide-ranging impacts on the water cycle.

A Global Water Crisis

The US National Academy of Scientists says that by 2050, more than one billion urban slum dwellers will only have daily access to enough water to fill a small bathtub.

India: In 1951, the average water availability was 3,450 cubic metres per person, per year. By the late 1990s, this had fallen to 1,259 cubic metres per person, per year. By 2050 it is projected to fall to 760 cubic metres. The rate of water withdrawal has exceeded population growth by factor of 2.

Oceania: Over 3.2m of the region's 10.3m population have no access to surface water. Only 1 in 4 people have access to piped water.

USA: The 1,300 km wide High Plains Ogallala aquifer is being depleted eight times faster than nature can replenish it.

China: In Beijing, the water table has dropped 37 metres over the last four decades. In fact the water crisis is so severe that experts are considering whether China's seat of power will have to be moved.

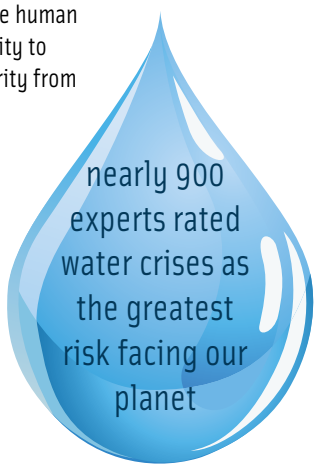
Mexico: In Mexico City, pumping exceeds natural recharge by 50-80% each year and experts predict the city might run out of water entirely in the next decade.

Middle East: The Arabian Aquifer System, a key water source for 60 million people living in arid conditions is the world's most overstressed aquifer.

These operations are water intensive and complicit in the destruction of ecosystems critical to the proper functioning of the water cycle. Mining is capable of polluting water bodies over vast distances. Even when a mine has closed its impacts on water may continue to worsen and spread for centuries, leaving a toxic legacy for future generations.

At a time when millions worldwide lack access to clean water, governments are clearly putting industry before people and the planet's interests in the allocation and protection of water. With full knowledge of the impact of their decisions, they are allowing industry to simultaneously exhaust, pollute, displace and privatise sources of freshwater faster than they can recover.

In 2010, the UN acknowledged that clean drinking water and sanitation are essential to the realisation of all human rights. They have also recognised that the global water crisis is growing. Yet today the profit motive that drives industries like mining continues to trump the human right to water and our responsibility to safeguard the water cycle's integrity from local to planetary level.



MINING'S IMPACTS ON WATER

The types of impact that extractive operations have on water systems depend to a large extent on the mineral, metal or fuel being mined and the method of mining used. However, all large-scale extraction - from hard-rock open pit mining to hydro-fracking- has the potential to negatively impact not just local water sources, but whole water systems.

Mines deplete, damage and pollute water systems at each stage of their lifecycle, from prospecting to closure and sometimes for centuries after. Around the world today there are many thousands of active and decommissioned mines impacting or capable of impacting water systems in these ways. In the USA, for example, one of the few nations where data is available, there are over 13,500 active and approximately 500,000 decommissioned mines.[8]

The multitude of mines worldwide and the potential of each to damage water systems across great stretches of both time and space, indicate why the industry warrants special attention in addressing the global water crisis.

This section will look in detail at the different kinds of impact various types of extraction have on water systems. It gives real examples of how the industry is abusing water systems and in turn violating people's human right to water and the rights of all species, on a planetary scale.

Though we examine mining's different impacts on water separately here, the reality is that mines produce these impacts simultaneously and in an interconnected way. For example, we explore how mining depletes local water sources, depriving communities of an adequate supply, separately from a discussion about how mining pollutes water. But pollution is also a form of deprivation, reducing the amount of clean fresh water available to communities and ecosystems.

A constant feature of mining's impacts on water is that they disproportionately affect already marginalised communities around the world, perpetrating a form of environmental discrimination. For example, half of all gold mines, known for polluting water with cyanide and other toxins, are located in the territories of indigenous peoples.[9] Many of these indigenous groups have little political voice and live in isolated regions considered to be expendable by decision makers. This is despite the fact that 80% of the planet's remaining biodiversity is also to be found in indigenous territories.[10]

Furthermore, the industry's impacts are often gendered, disproportionately affecting women and women's livelihoods. Samantha Hargreaves from WoMin, a regional platform unifying African women in the fight against destructive resource extraction, describes why:

> "When mining impacts local water sources, it is women and girls who have to walk further to fetch water from unpolluted sources. If people in a community become sick as a result of water pollution, it is often women that must care for the sick. Not only does this reduce the time women and girls are able to spend doing other livelihood activities or attending school, this unpaid labour by women acts as an invisible subsidy to companies who should guarantee and pay for communities' access to water where it is impeded as a result of mining.
>
> Where communities are displaced by mining, often because of impacts on water, women face increased risk of sexual and gender-based violence, AIDs and other threats to their safety and health. When women are affected and endangered in these ways, whole families and communities suffer."

Watergrabbing and Depletion

In 2012, The Water Disclosure Project – a corporate stewardship programme addressing the global water crisis - confirmed that mining is one of the world's most water intensive industries[11]. All types of mining and extraction, whether for metals, minerals, coal, shale gas or tar sands, use vast amounts of water. This water is used for processing, dust suppression, slurry transportation and waste disposal.

Open Pit Mines

Mir Diamond Mine, Russia. The Mir Mine is so deep that it creates a downdraft so strong that a no-fly zone is enforced around it. It takes over two hours to drive from the bottom of the mine to the top.

Bingham Canyon Mine, USA. Rio Tinto's Bingham Canyon Copper Mine is 1.2 km deep, almost 8km^2 in area, and can be seen from space.

Chiquicamata, Chile. CODELCO's copper-gold mine is the largest open pit copper mine in the world at 4.3km long, 3km wide and 900 metres deep.

Garzweiler Mine, Germany. The biggest mine on the planet by area, this shallow coal strip mine covers 48km^2. Vatican City would fit inside the mine one hundred times over.

Today many forms of extraction require larger amounts of water than ever before as minerals, metals and fossil fuels become more scarce and/or difficult to extract. This is particularly true in the case of 'extreme energy' extraction[12], such as hydrofracking and tar sands mining.

Companies mining tar sands in Canada siphon off approximately 370 million cubic metres of water every year from the Athabasca River alone, free of charge.[13] This quantity exceeds the amount of water that the city of Toronto, with a population of 2.8 million people, uses annually. The water extracted is used to process the tar sands into a useable fuel, helping separate the viscous oil, or bitumen, from sand formations.

A single hydraulic fracturing, or 'fracking' job requires 1 to 8 million gallons of water [14]. In Michigan, USA, Encana Corporation's planned fracking operations are predicted to require 4 billion gallons of groundwater, the equivalent of 16 days worth of the entire state's public water supply.[15] There are estimated to be over 500,000 fracking wells in the USA alone.[16]

Almost none of the water used in these extreme extractive processes can be recycled and returned to the water cycle as it is too toxic and expensive to treat.[17,18]

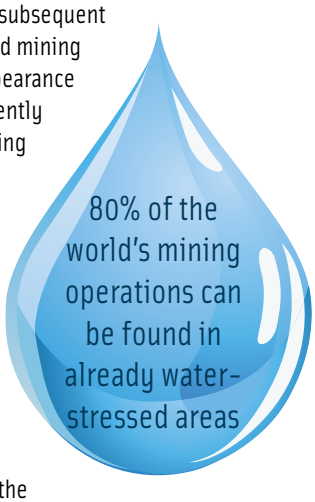
The intensity of the mining industry's water use often hits areas least able to sustain it. 80% of the world's mining operations can be found in already vulnerable, water-stressed areas.[19] In order to take control of the increasingly vast water supplies they need to operate, mining companies use their power and wealth to strike deals with national and local authorities to 'grab' water as well as land.

Grabbing and monopolising scarce local water sources, the mining industry is responsible for depriving already vulnerable communities around the world of a secure supply of clean fresh water to drink and to sustain their ecosystems and livelihoods.

This practice of 'watergrabbing'[20] for mining was recently brought to an abrupt end in El Salvador during a major clean water crisis, although this positive action has also come at a price. In 2008, after gold mining operations polluted the water supply of San Sebastian, the then-president of El Salvador, Antonio Saca, stopped issuing new mining permits. Saca's decision was popular with many local people battling to keep their gold in the ground and protect scarce fresh water supplies. However, it upset Canadian mining multinational Pacific Rim (now owned by Oceana Gold), which had been exploring for gold and was in line to receive extraction permits before the ban. The company is now suing the country for $301million in lost earnings. El Salvador has had to spend over $6 million in opposing the company's legal onslaught, as Oceana Gold demonstrates the power of multinationals to use wealth as a weapon.[21]

Watergrabbing is also a pressing concern in India, where a plan is currently being developed to build a cluster of 71 coal plants in the highly water stressed Vidarbha region in Central Maharashtra. In this region over 6,000 farmer suicides have been documented in the last decade in relation to the lack of water for irrigation.[22]

In some cases, the grabbing and subsequent depletion of water sources to feed mining operations can lead to the disappearance of entire water systems, permanently altering ecosystems and instigating mass migrations.



In Bolivia, Lake Poopó was once the country's second largest lake, but in December 2015, it was officially declared evaporated – the result of the disappearance of the Andean glaciers that fed it, an El Nino fuelled drought and the thirst of the mining industry.

Upstream of Lake Poopó, over 100 mines have been drawing large quantities of water from the lake's tributaries. As a result of the lake's exhaustion, thousands have lost their livelihoods and been forced to leave the region. Wildlife is also suffering - biologists say over 75 bird species have disappeared from the area completely.[23]

Disruption and Destruction of Water Systems

In some cases, the locations chosen for mining operations or the type of mining employed can directly disrupt and destroy lakes, rivers, forests and other interconnected parts of the water cycle.

As the concentrations of minerals and metals contained within mined ores decrease, companies must remove more rock and use more water to recover the same amount of gold, tin and so on. Today, producing a single gold ring can produce over 20 tonnes of mine waste[24] and it takes 24 bathtubs full of water to extract and wash one tonne of coal.[25]

Economically speaking, the cheapest way for companies to mine in these changing circumstances is often to dig vast open pits, destroying ever-larger swathes of ecosystem in the process, including rivers, lakes and wetlands.

Tailings pond in rural Utah/iofoto/ Adobe Stock images

In Colombia, mining company Cerrejon Coal plans to re-direct the Arroyo Bruno (a local river) to expand its open pit coal mining operations in the arid region of La Guajira. The indigenous Wayuu people, who call the region home, are already suffering a severe drought and researchers from the University of La Guajira have indicated the company's plans could effectively destroy the river.[26]

Open pit mines are often dug to a substantial depth, commonly extending below the water table. Breaching the water table causes the mine pits to fill with water, which must be pumped out for mining operations to continue.

In Australia's Galilee Basin, the predicted volume of groundwater that will need to be removed to enable coal mines to operate is 2,007 billion litres. That's four times the volume of water in Sydney Harbour.[27]

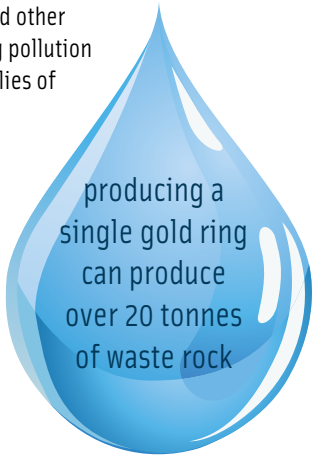
The process of pumping out this water depletes groundwater reserves, lowering the water table. This can severely disrupt ecosystems that are reliant on the water table at its existing levels, including human communities who become unable to access ground water by digging wells as they used to.

In the USA, the planned Rosemont Mine in Arizona's Santa Rita Mountains is predicted to lower the water table by at least 1000 feet, destroying marshlands, river systems, farmland and forest. The mining operation would last 20 years, but the draw down of water that may result is predicted to continue for hundreds of years and to expand outwards for miles.[28]

Pollution – Chronic and Disastrous

Water is never local or static. Its ability to transport nutrients throughout the water cycle also means that water can rapidly and invisibly spread pollution into neighbouring ecosystems and communities.

The pollution of water systems by mining affects a far greater area than the parameters of the mine site itself. Water's flowing nature means that, when released, containing this pollution can prove an impossible challenge. Unlike in other industries, water polluted by mining is often so toxified that it can never be returned to water systems or be used by humans and other species again. In this way, mining pollution permanently depletes finite supplies of fresh water.



The numerous processes involved in just one mining operation can create multiple sources of water pollution and toxic waste, affecting whole ecosystems and communities' ability to access water to drink, cook, wash, fish and grow food.

The types of pollution produced by these processes can be broadly split into two categories: Chronic and disastrous. As explained below, their different names refer to the manner in which the pollution is released into the wider environment rather than the severity of their effects. Both are capable of severely polluting water systems.

Chronic Pollution

Chronic mining pollution is persistently produced and released into wider ecosystems over relatively long periods of time as a result of mining activities.

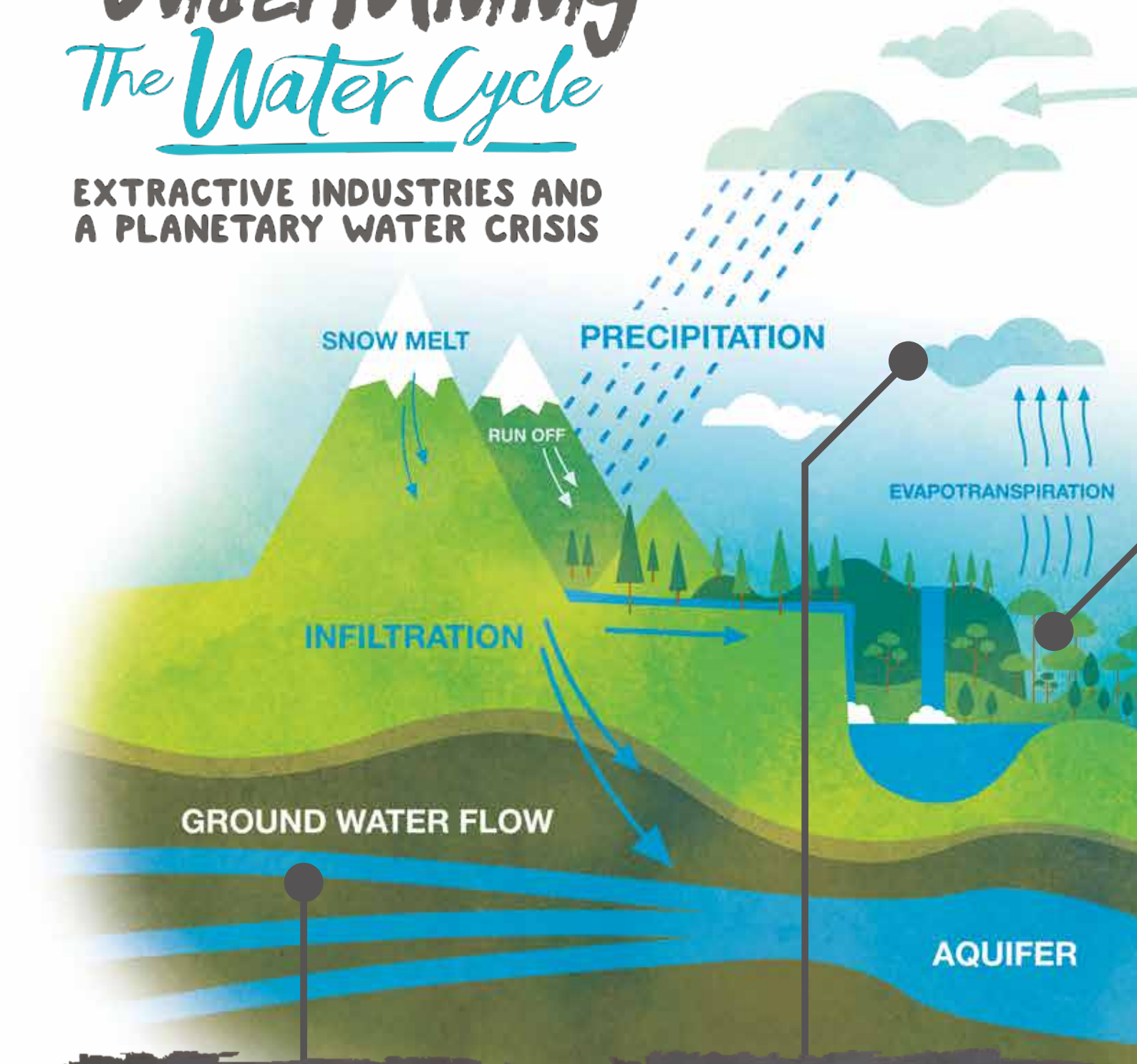
Mining produces many types of chronic pollution that differ according to the mining process and the target mineral, metal or fuel. The impacts of this pollution can slowly toxify and destroy whole ecosystems, posing a serious threat to the health of humans and other species.

Acid Mine Drainage

So called 'waste rock' that is dug up from deep underground during the mining process, especially for copper and gold, can contain sulphides that become sulphuric acid when exposed to air and water. This waste rock is usually left in open-air heaps of rubble in the vicinity of the mine site.

UnderMining The Water Cycle

EXTRACTIVE INDUSTRIES AND A PLANETARY WATER CRISIS



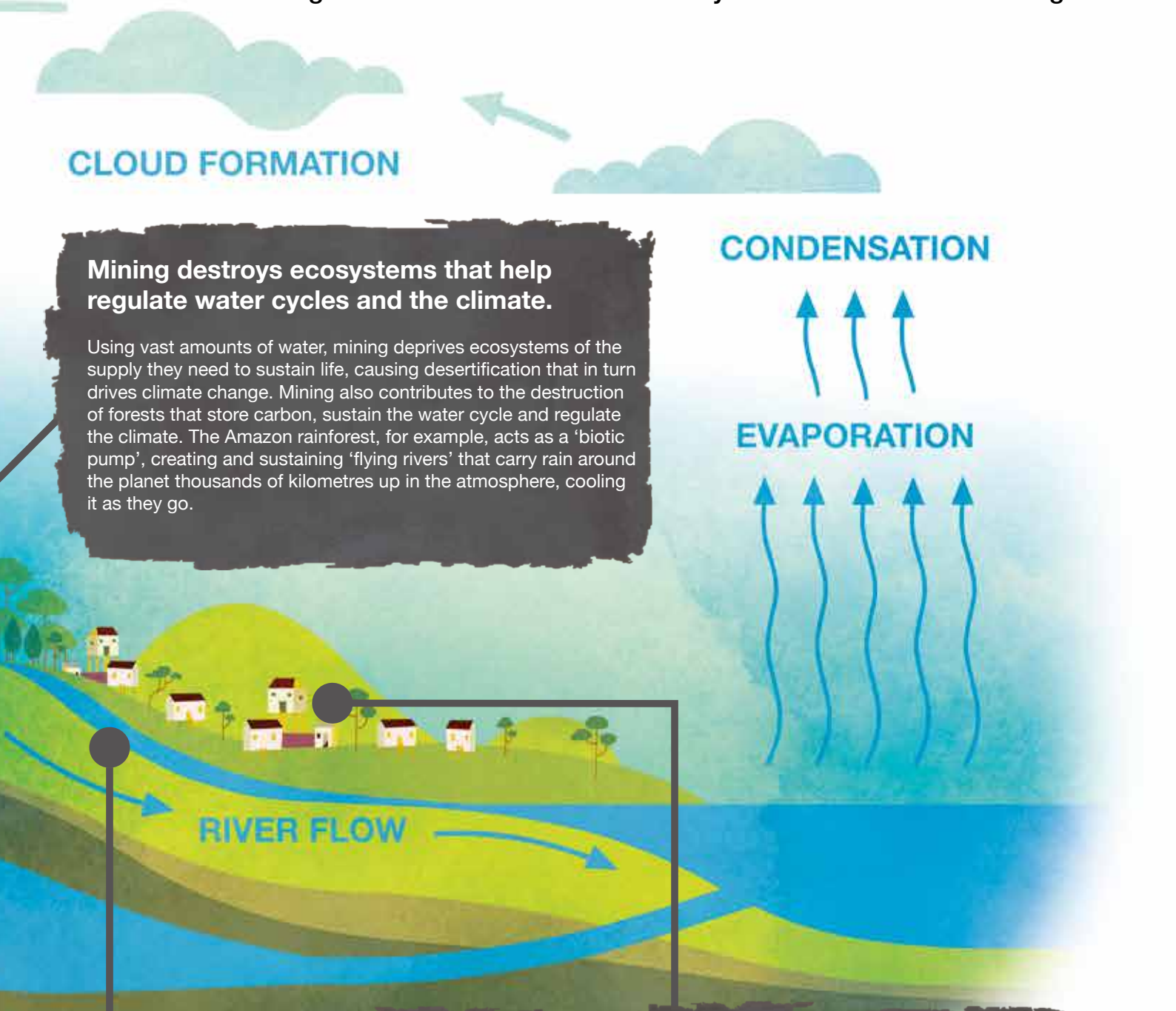
Mining depletes, pollutes and disrupts easily accessible sources of underground water faster than they can recover.

The mining industry extracts water from aquifers deep below the Earth's surface. These aquifers re-charge slowly, so demand from water intensive industries like mining are rapidly depleting these water sources world-wide. The physical construction of some mines also damages and pollutes groundwater systems, lowering the water table and depriving ecosystems, humans and other species of fresh water.

The mining industry drives climate change, both a cause and intensifier of the global water crisis.

The mining industry consumes and produces vast amounts of fossil fuels that contribute to climate change. Mining also alters water systems and destroys biodiversity, driving climate change and reducing the ability of ecosystems to adapt to a warming planet. Climate change destabilises the water cycle, increasing drought and flooding worldwide. The IPCC estimates that one billion people in dry regions face water scarcity as a result.

The extraction of minerals, metals and fossil fuels worldwide by the global mining industry is impacting every stage of the water cycle. Polluting, depleting and destroying sources of fresh water faster than they are able to recover, the cumulative impacts of mining are a key contributor to a global water crisis that is intimately connected to climate change.



Mining destroys ecosystems that help regulate water cycles and the climate.

Using vast amounts of water, mining deprives ecosystems of the supply they need to sustain life, causing desertification that in turn drives climate change. Mining also contributes to the destruction of forests that store carbon, sustain the water cycle and regulate the climate. The Amazon rainforest, for example, acts as a 'biotic pump', creating and sustaining 'flying rivers' that carry rain around the planet thousands of kilometres up in the atmosphere, cooling it as they go.

Mining depletes, pollutes and disrupts sources of easily accessible fresh water.

Mining companies extract water in vast quantities from rivers and lakes, interrupting their natural cycle. Mines, old and new, also pollute these water-ways with acid, cyanide, oil and heavy metals, sometimes for hundreds of years. Because water flows, this pollution spreads over large distances. The physical construction of mines can destroy water systems, while associated industrial processes produce acid rain that falls back to earth and further pollutes water.

Mining deprives communities of all species of adequate access to safe fresh water.

The impacts of mining on rivers and other fresh water sources reduce the ability of communities of all species to live a healthy life. 80% of mining operations are found in already water-stressed areas and mining's impacts disproportionately affect already marginalised communities. The mining industry uses its power and wealth to grab and control water, even when scarce, posing a serious threat to the Human Right to Water, the Rights of Water and all the life forms that depend on it.

Illustration by Ben Pearce (www.benpearce.com)

red polluted lake in Romania, Geamana/bereta/Adobe Stock image

Rainwater that passes through these rock heaps becomes acidic and then enters into soil and water systems, polluting them. This phenomenon is known as Acid Mine Drainage (AMD). AMD can continue long after a mine has closed, rendering water and ecosystems acidic and infertile for hundreds of years and leaving a toxic legacy for future generations to deal with.

In South Africa, the city of Johannesburg has been experiencing an AMD crisis as the result of leaky, century-old gold mines in the Witwatersrand area.[29] AMD has repeatedly threatened to flood parts of the city in recent years. Numerous connected water sources, including the Vaal and Crocodile Rivers, are now badly affected by AMD and the western basin of Witwatersrand has been declared an environmental disaster zone.[30]

Heavy Metal Leaching

Waste rock produced by mining may also contain heavy metals such as iron, nickel, copper, lead, arsenic and aluminium. AMD produced from sulphides in the same waste material dissolves and leaches these metals from the rock. These toxic metals then enter water systems and contaminate them, with serious potential impacts on the health of human communities, aquatic and land-based ecosystems and species.

These metals can continue to leach into water systems for as long as AMD takes place, which can be decades or even hundreds of years.

Pit Lake Plumes

When operations at open pit mines that have breached the water table stop and the pumps are turned off, the abandoned pits often fill up again to form a lake. The water in these lakes is typically unnaturally acidic or alkaline and contaminated with metals, metalloids, saline and other substances used or disturbed by the mining process.[31]

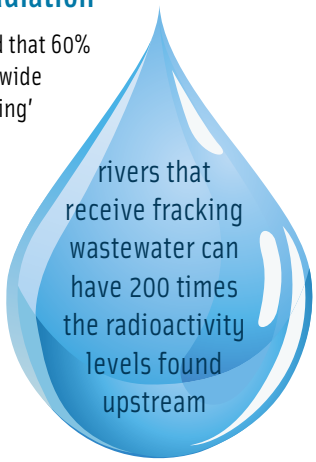
The formation of pit lakes not only produces large volumes of polluted water[32] but also draws adjacent unpolluted groundwater into a polluted system. Because of the connections between water systems, underground plumes of pollution from mine voids may extend large distances and affect nearby groundwater sources and ecosystems tens of kilometres away from the pit lake.[33]

The Pilbara Region in North Western Australia is the ancestral home of a number of Aboriginal groups and a global biodiversity hotspot for subterranean species that live in its deep groundwater systems. It is also the site of a recent mining boom. Today 92% of Pilbara is covered by live or pending mining concessions.[34]

An estimated 97 pit lakes already exist in the Pilbara Region and several hundred more are planned. The Australian Environmental Protection Agency reports that due to the connectivity of the region's water systems, there is a significant risk of pollution in surrounding landscapes as a result of these pit lakes. They note that pit lakes take hundreds of years to stabilise, with changes in water chemistry taking place over thousands of years.[35]

Fracking Chemicals & Radiation

As of 2010, it has been estimated that 60% of all new oil and gas wells worldwide use hydraulic fracturing or 'fracking' to extract shale gas or oil.[36] Each time a well is fracked, up to 40,000 gallons of chemical 'frack fluid' are combined with water and sand to shatter and dissolve shale rock, and to encourage methane or oil to migrate to the well to be collected. A well can be fracked up to 18 times.[37]



Operators keep the exact mix of chemicals used in their fracking processes a secret. However, over 600 different chemicals are known to be used in shale gas production, including radioactive, toxic and carcinogenic chemicals such as radium, methanol, hydrochloric acid, formaldehyde, lead, uranium, mercury and ethylene glycol.[38]

Studies show that the amount of frack fluid that is recovered from underground can be anywhere from 80%, to as little as 15%, while one report suggests that on average only 8% is recaptured.[39,40] The rest (up to 92%) is left underground, where it can contaminate the water table and local water systems.[41] Drinking water from water wells near fracking sites has been found to contain methane at concentrations 17 times higher than in unpolluted wells.[42]

Fracking wastewater, known as 'flowback', that does come up from underground should be kept in tanks or recycled. However, few water treatment facilities have the capacity to handle fracking wastewater and it is commonly left in tailings ponds, from where it can leak into local water systems. Rivers downstream from water treatment plants that receive fracking wastewater have been found to contain 200 times the radioactivity levels found upstream.[43]

Disastrous Pollution

Disastrous pollution is released rapidly into wider ecosystems and waterways, usually as a result of industrial accidents and human error. It can be the product of both active mining operations and mines that have long been shut down.

Active Mines

In recent years, the most glaring examples of disastrous pollution have occurred when tailings dams at active mines, designed to hold mining waste mixed with water, have burst. When this happens millions of litres of mining waste are released extremely rapidly, causing powerful floods that can and have washed away entire towns and ecosystems.

The liquid tailings released in these floods are typically contaminated with heavy metals, cyanide, sulphuric acid and other substances, depending on the substance being mined. Disastrous releases can simultaneously destroy and pollute large areas.

On the 4th August 2014, a tailings dam burst at Imperial Metals' copper-gold mine in Cariboo, British Colombia, releasing 24 million litres of toxic water and mud. In just four days, the spill – now known as the Mount Polley Mining Disaster - emptied the four square kilometre tailings pond into Lake Polley, causing the largest mining disaster in Canada's history.[44]

In the wake of the spill, a state of emergency was declared in the local area and more than 300 local residents were warned not to drink or bathe using household water.[45] Water systems famous for hosting salmon runs were found to contain elevated levels of selenium, arsenic, copper, iron and other metals.[46] The extent of the damage is likely to be unknown for sometime as toxins bioaccumulate in the environment. Despite all of this, in December 2015 it was revealed that no charges would be brought against Imperial Metals as a result of the spill.[47]

Just over a year later, on November 5th 2015, a tailings dam holding back waste from BHP Billiton and Vale's joint-owned Samarco iron-ore mine in Mariana, Brazil, burst, sending a tidal wave of red sludge down into the valley below. The dam failure released 60 million cubic metres of mine waste into the Rio Doce (Sweet River) killing at least 17 people,[48] decimating the town of Bento Rodrigues, forcing over 600 local residents to evacuate the area and cutting off water supplies to more than 250,000 people downriver.[49,50]

The spill polluted over 500km of the Rio Doce - which provides over 230 municipalities with water - with toxic substances including arsenic, lead and mercury. After 17 days, pollution from the tailings dam reached the Atlantic Ocean.[51] Since then, it has spread along Brazil's Espirito Santo coast, forcing beaches to close and posing a serious threat to marine reserves.

Leaked documents reveal that a senior engineering consultant warned Samarco, a joint venture between BHP and Vale, that the dam had severe structural problems.[52] The mining companies deny this, however.

Tailings dam disasters like these are on the rise. A 2015 study, by Bowker Associates Science & Research In The Public Interest and the Center for Science in Public Participation examining 100-years of tailings dam failures, revealed a trend towards more failures with greater consequences.[53]

Whilst the mining industry says it has made great strides in safety by applying new technologies, the study's authors contend that it is precisely these new technologies that are helping to cause disasters. New extractive technologies make mining minerals and metals at increasingly low concentrations profitable, but they also mean that mining operations are creating ever larger amounts of waste. Having to store more waste increases the likelihood of storage related disasters like those in Brazil and Canada.

There are thousands of mine waste facilities worldwide that are meant to stand and contain this waste in perpetuity. Yet there is no overseeing body or entity that regulates the safety of these sites.[54] This situation allows companies to both generate more waste and self-regulate tailings facilities. As long as this remains the case, the trend towards more and increasingly destructive mining pollution events will worsen and water, ecosystems and communities will pay the price.

Historic Mines

Unfortunately, disastrous pollution is not only a product of active mines. Mines that have been closed for decades, even centuries, can cause rapid and destructive pollution events that can poison waterways over large distances and for long periods of time.

On the 5th August 2015, Environmental Protection Agency personnel and staff from Environmental Restoration LLC accidentally released 3 million gallons of toxic water[55] from the tailings pond of the Gold King Mine near Silverton, Colorado in the USA. The acidic water, polluted with heavy metals,[56] entered the Animas and San Juan rivers and their tributaries, turning them bright yellow and travelling over 300km through the states of Colorado, New Mexico and Utah.[57]

The Gold King Mine itself was abandoned in 1923 and is one of 22,000 abandoned mines in Colorado.[58] Gold King and many other mines in the area have known problems with Acid Mine Drainage. Even before the spill, the upper reaches of the Animas River Basin had become devoid of fish and other forms of aquatic life as a result of chronic pollution caused by the region's abandoned metal mines.[59] Todd Hennis, owner of the Gold King Mine, says that the mine was already discharging waste water into surrounding water systems at a rate of 250 gallons-per-minute before the disaster.[60]

bull elk drinking from stream/natureguy/Adobe Stock images

Around the world mining leaves a toxic ecological legacy, putting water systems and the life they sustain at risk for hundreds of years. This is partly due to the inherent future risks mines pose as generators of waste, chemicals and pollutants. It is also a result of the irresponsible way that mining companies are able close their operations in many nations.

When a mine comes to the end of its productive life, established companies commonly sell off their operations to junior companies without the skills and resources to properly close operations. When these companies leave, local authorities, communities and ecosystems are generally left to cope with the economic, social and environmental costs of the clean up. Even in countries where companies are required to pay local and national authorities for clean up services, these payments aren't enough to cover the vigilant care of mine sites in perpetuity, as is required to avoid chronic and disastrous pollution events.

dirty drinking water/Abdelhamid Kalai/Adobe Stock images

MINING, WATER AND CLIMATE CHANGE

Climate change is already exacerbating the global water crisis and is set to worsen it. The overall effect of a warming climate on water is to intensify and destabilise the hydrological cycle, causing both more frequent and destructive droughts and floods.[61]

In the already dry subtropics, climate change is likely to lead to reduced rainfall and harsh droughts that will catastrophically impact on ecosystems and agriculture, causing hunger and thirst for humans and other species. In its special report on climate change adaption, the Intergovernmental Panel on Climate Change (IPCC) estimates that around one billion people in dry regions may face increasing water scarcity as a result of climate change.[62]

The ways in which mining impacts water systems and ecosystems simultaneously drives climate change and reduces the ability of communities and ecosystems to adapt to a warming planet.

Fossil Fuels

The mining industry plays a key role in driving climate change by both consuming vast amounts of energy in the extraction of fossil fuels and then selling those fuels in the knowledge they will emit greenhouse gases into the atmosphere.

From extraction to transportation to processing, mining operations require vast amounts of energy. In South Africa, the Department of Minerals and Energy (DME) estimates that the mining industry uses 6% of all the energy consumed in the country.[63] In Brazil, the largest single energy consumer is the mining giant Vale, which accounts for around 4% of all energy use.[64]

The majority of this energy is generated from fossil fuel sources, making the mining industry a significant contributor to global CO2 emissions through use. However, the most accurate way to visualise mining's actual contribution to climate change is by adding the carbon content of fossil fuels such as coal, oil, tar sands and natural gas mined by the industry to the CO2 emissions it creates in doing so.

If exploited, the Alpha and Kevin's Corner coal mines in the Galilee Basin, Australia, will release 3.7 billion tonnes of CO2 emissions.[65] This figure represents the CO2 that will be burned to provide energy to mine and transport the coal, plus the carbon content of the coal itself that will mostly be exported and burnt elsewhere to fuel manufacturing, agriculture and more. Greenpeace have calculated that if the Alpha Mine alone were a country, its annual carbon emissions would be higher that Colombia's.[66] If both mines were stopped, the carbon savings would be equivalent to making the United Kingdom carbon neutral for six years.[67]

Though largely responding to demand for fossil fuels from many other industries and the global economy, the mining industry is deeply complicit in driving climate change as the provider of these dirty fuels. As such, it is helping warm our atmosphere and throw the hydrological cycle out of its natural rhythms.

The impacts of this disruption are becoming increasingly obvious even today as droughts, floods and irregular weather patterns strike around the planet. If fossil fuel extraction and consumption, and thereby the mining industry, are not reigned in, the extremity and uncertainty of these events will only get worse; many more people and species will suffer a chronic lack of water, whilst others will suffer inundation. As the water cycle struggles to function, more and more communities and the ecosystems that sustain them will be deprived of life-giving fresh water.

Destruction of Biodiversity

Another way in which mining drives climate change is by directly destroying biodiverse ecosystems that help regulate water cycles and the climate.

Due to the industry's massive consumption of water, the large number of mines around the world and their prevalence in dry regions, mining has contributed to the desertification of dry lands.[68,69] The desertification process involves the release of CO2 into the atmosphere from soil and vegetation that dies as a result of water shortages and other human-driven causes.[70]

Though under-recognised, the release of this carbon from soil and plants is a significant contributor to climate change, which itself intensifies desertification, creating a vicious circle. According to the UN Convention to Combat Desertification, the world's soils hold more organic carbon than that held by the atmosphere.[71]

Mining also contributes to climate change by causing deforestation. Though industrial agriculture accounts for 70% of global deforestation, mining is also a contributor. For example, by destroying areas of the Amazon rainforest to create space to mine, lay roads and create settlements.[72] This deforestation is contributing to the disruption of the Amazon's vital role in the planetary water cycle.

The Amazon not only breathes in and stores vast amounts of CO2, it also acts as a biotic pump,[73] creating and sustaining 'flying rivers' that carry rain thousands of kilometres up in the atmosphere, cooling it as they go. Deforestation in the Amazon and the resulting disruption of the water cycle is a key factor driving the droughts being suffered in Sao Paulo, Brazil.[74] Scientists say deforestation of the Amazon may even be partially responsible for drought as far away as California and Texas.[75]

Reducing Resilience

Through its impacts on water and biodiversity, mining undermines the resilience[76] of communities and ecosystems and their ability to adapt to climate change.

Where mining destroys ecosystems, including water systems, the connectivity between species and ecological areas can be broken or damaged. A lack of ecological connectivity makes ecosystems more vulnerable to climate change[77] and can lead to their total breakdown, as seen in the case of desertification.

By using up and polluting local water sources as well as physically digging mines, companies frequently displace communities and in doing so increase their vulnerability to the impacts of climate change. These communities may be resettled or forced to move into urban areas where they experience poverty, loss of livelihood and further water shortages.[78]

In Zimbabwe, the people of Arda Transsau were forcibly relocated from their homes to make way for mining operations in the Marange diamond fields. Rather than provide a borehole for the community to pump their own water, mining company Anjin and the Zimbabwean Government installed a centrally controlled tap in the resettlement area, requiring the community to pay for their water.

The people of Arda Transsau could not afford the tapped water, however, and in June 2014 their supply was cut off due to non-payment. As a result, women and children have to make an arduous walk to get water from the Odzi River. Not only does this reduce the time children spend in school, it has cost lives. Since the relocation two children have drowned whilst collecting water.[79]

Without the ability to access clean water and practice their agricultural livelihoods, the people of Arda Transsau are unable to provide for themselves as they used to.[80] They have been made more vulnerable to climate change and tragedy than ever before as the result of mining relocation.

As water becomes more scarce in some areas as a result of the complex interaction between the destruction of water systems and climate change, the mining industry's thirst for water will have ever greater consequences for the communities and the ecosystems in which they operate.

CONCLUSION: A BRIGHT BLUE FUTURE?

"We call upon the waters that rim the Earth, horizon to horizon, that flow in our rivers and streams, that fall upon our gardens and fields, and we ask that they teach us and show us the way."

- Chinook Blessing, USA

The fact that mining is a key contributor to our planetary water crisis and to climate change is beyond dispute. But it is our response to this fact that will define the extent to which mining, and other industries, continue to perpetuate this crisis.

We have significant cause for hope as communities around the world are increasingly standing up to defend their waters and their lands from the extractive industries. Together with international allies, they are calling for change on numerous levels, from more stringent regulation of mining companies, to a deep turning in our thinking about the true nature and value of water.

The planetary water crisis is the by-product of a system of power in which multinational corporations and co-opted governments trample ecosystems and communities in order to grab and abuse water to facilitate capital accumulation and unfettered economic growth. We need to seek to change this system if we are to achieve justice - justice for communities of all species and their ability to enjoy their right to water, and justice for water itself- the uniting element on which all of life depends. There cannot be justice for one if there is not justice for all.

Mining companies must be made to take responsibility for their cumulative impacts on water over time and space. New regulations are required that strongly oblige companies to respect Free Prior Informed Consent and the rights of communities to both define consent and say no to mining; to make Environmental Impact Assessments (EIAs) more stringent; to hold mining companies financially and legally responsible for disasters, ecosystem destruction and violations of the human right to water; to shift the ecological and economic burden of abandoned mines from the shoulders of communities and governments onto mining companies and to redirect mining capital to regenerating healthy ecosystems where mining has left wastelands.

It is time to declare no-go areas for the extractive industries. This includes recognising key watersheds and water stressed areas - as well as food growing regions, primary forests, all protected and conserved areas, sacred natural sites and territories - as off-limits for any destructive industrial activity.

The creation of these no-go areas needs to be supported by a radical re-think of the role of the extractive industries in our societies. We need to responsibly and consciously use the minerals and metals we have already mined - changing the way we design, make and sell goods - and above all reduce our patterns of consumption. Likewise we need to reduce and redistribute our use of energy worldwide, ensuring equitable access to energy produced through localised renewable systems.

Ultimately this transition involves re-thinking and overhauling our dominant economic system that drives mining operations, and the growing global inequality that allows them to flourish. We cannot continue to push through planetary 'red lines' in the pursuit of material development and economic growth for the few. To think we can have infinite growth on a finite planet, is a folly. Instead, we must re-imagine the meaning of prosperity, cultivate an ethic of enough-ness and redefine development, so that we do not undermine the integrity of our planet and the living systems on which all of life depends.

In the words of Eduardo Gudynas, Uruguayan social and political ecologist, this new paradigm of development should:

"Ensure people's quality of life, in a broad sense that goes beyond material well-being (to include spiritual wellbeing) and the individual (to include a sense of community), as well as beyond anthropocentrism (to include Nature). This perspective aims to transcend the dualism that separates society from Nature, as well as breaking with the linear idea of history that assumes our countries must imitate the lifestyles and culture of the industrialised nations."[81]

Where water is concerned, this transcendence means coming to see water as much more than a resource to be commodified and used. As a common good for all species, water should never be privatised or treated as property.

Cultivating what Maude Barlow has called a 'new water ethic,' we must rediscover our sense of water's own rights and our responsibilities to it. According to this ethic, water has a right to fall from the sky, to flow through the land and fly over it, to remain clean and to course through its cycle constantly. We have a responsibility to ensure the integrity of this cycle is maintained and balance our activities accordingly, so that the cycles of water around our one and only planet can continue to sustain all of life, for generations to come.

By re-embedding ourselves in the web of life we reconnect with our inter-generational and inter-species responsibilities.

Water is life and we must stand up to defend it.

Salmon jumping waterfall Alaska/kcapaldo/Adobe Stock images

Endnotes

1 World Health Organisation http://www.who.int/water_sanitation_health/mdg1/en/

2 Water Resources Group (2012) http://www3.weforum.org/docs/WEF/WRG_Background_Impact_and_Way_Forward.pdf

3 World Economic Forum (2015) http://reports.weforum.org/global-risks-2015/press-releases/

4 G. Tyler Miller et al (2015) Environmental Science, P.14. Cengage Learning

5 NASA (2015) http://earthobservatory.nasa.gov/IOTD/view.php?id=86263

6 Earth Policy Institute (2006) http://www.earth-policy.org/books/out/ote6_3

7 WWF, Zoological Society of London (2014) Living Planet Index http://www.livingplanetindex.org/projects?main_page_project=LivingPlanetReport&home_flag=1

8 Abandoned Mine Lands Portal http://www.abandonedmines.gov/ep.html

9 Earthworks. http://nodirtygold.earthworksaction.org/impacts/indigenous_communities#.VuL3zxKLSL8

10 World Bank (2008) The Role of Indigenous People in Biodiversity Conservation. http://siteresources.worldbank.org/INTBIODIVERSITY/Resources/RoleofIndigenousPeoplesinBiodiversityConservation.pdf

11 Water Disclosure Project (2012) https://www.cdp.net/cdpresults/cdp-water-disclosure-global-report-2012.pdf

12 Corporate Watch (2014) To the ends of the Earth: A guide to unconventional fossil fuels https://corporatewatch.org/publications/2014/ends-earth-guide-unconventional-fossil-fuels

13 Munk Centre and University of Alberta (2007) http://www.ualberta.ca/~ersc/water.pdf

14 http://www.dangersoffracking.com/

15 TransNational Institute (2013) Fracking: Old story, new threat http://www.tni.org/sites/www.tni.org/files/download/fracking_old_story_new_threat_0. pdf

16 US Energy information Administration (2014) https://www.eia.gov/dnav/ng/ng_prod_wells_s1_a.htm

17 Environmental Defence Canada (2013) Water and Tar Sands http://climateactionnetwork.ca/wp-content/uploads/2014/02/WaterandTarSandsReport_FINAL.pdf

18 Natural Resource Defence Council (2012) http://www.nrdc.org/water/fracking-drinking-water.asp

19 Water Disclosure Project (2012) https://www.cdp.net/cdpresults/cdp-water-disclosure-global-report-2012.pdf

20 Transnational Institute (2014) The Global Water Grab: A primer https://www.tni.org/en/publication/the-global-water-grab-a-primer

21 Business and Human Rights, OceanaGold sues el Salvador for $301million http://business-humanrights.org/en/oceanagold-sues-el-salvador-for-301-million-because-govt-did-not-grant-it-a-mining-permit

22 Greenpeace (2012) Cluster of thermal power plants may escalate Vidarbha's existing agrarian crisis http://www.greenpeace.org/india/en/Press/Cluster-of-thermal-power-plants-may-escalate-Vidarbhas-existing-agrarian-crisis-Greenpeace/

23 The Guardian (2016) Bolivia's second largest lake dries up http://www.theguardian.com/world/2016/jan/22/bolivias-second-largest-lake-dries-up-and-may-be-gone-forever-lost-to-climate-change

24 Earthworks (2004) http://nodirtygold.earthworksaction.org/library/detail/how_the_20_tons_of_mine_waste_per_gold_ring_figure_was_calculated#.Vt8PZ5OLTxU

25 Transnational Institute (2014) The Global Water Grab: A primer https://www.tni.org/en/publication/the-global-water-grab-a-primer

26 https://ashajiraa.wordpress.com/2015/08/04/the-manmade-re-routing-of-a-precious-river-uniguajira-highlights-potential-risks-of-new-extraction-plans-written-by-doris-elin-salazar/

27 Lock the Gate Alliance (2013) Draining the Lifeblood http://www.lockthegate.org.au/draining_the_lifeblood

28 Sonora Institute (2012) Rosemont Mine may eliminate area's water resources http://www.sonoraninstitute.org/media-room/699-rosemont-mine-project-may-eliminate-area-water-resources.html

29 Bloomberg (31 July 2013) S.Africa to Start Pumping Acid Water from Johannesburg Mines http://www.bloomberg.com/news/2013-07-31/south-africato-start-pumping-acid-water-from-johannesburg-mines.html

30 Greenpeace Africa (2011) Acid mine drainage in Johannesburg http://www.greenpeace.org/africa/en/News/news/Acid-Mine-Drainage/

31 Dr Lu Zhao et al (2009) Mine Voids Management Strategy (I): Pit Lake Resources of the Collie Basin, p.25 http://www.water.wa.gov.au/__data/assets/pdf_file/0012/5601/96275.pdf

32 Earthworks (2013) Polluting the future http://www.earthworksaction.org/files/publications/PollutingTheFuture-FINAL.pdf

33 Lee Atkinson (2002) The Hydrology of Pit Lakes http://www.swhydro.arizona.edu/archive/V1_N3/feature2.pdf

34 MBS Environmental (2014) Pit lakes a legacy concern for the EPA http://mbsenvironmental.com.au/pit-lakes-a-legacy-concern-for-the-epa/

35 MBS Environmental (2014) Pit lakes a legacy concern for the EPA http://mbsenvironmental.com.au/pit-lakes-a-legacy-concern-for-the-epa/

36 Montgomery, Carl T.; Smith, Michael B. (2010) Hydraulic fracturing. History of an enduring technology. JPT Online (Society of Petroleum Engineers): 26–41

37 Jesse Jenkins (2013) Energy Facts: How Much Water Does Fracking for Shale Gas Consume? http://theenergycollective.com/jessejenkins/205481/friday-energy-facts-how-much-water-does-fracking-shale-gas-consume

38 US House of Representative Committee on Energy and Commerce (2011) Chemicals used in hydraulic fracturing https://democrats-energycommerce.house.gov/sites/default/files/documents/Hydraulic-Fracturing-Chemicals-2011-4-18.pdf

39 Earthworks. Hydraulic Fracturing 101.http://www.earthworksaction.org/issues/detail/hydraulic_fracturing_101#. UcAdL5x0SZ

40 Downstream Strategies (2013) Water Resource Reporting and Water Footprint from Marcellus Shale Development in West Virginia and Pennsylvania http://www.downstreamstrategies.com/documents/reports_publication/ marcellus_wv_pa.pdf

41 Earthworks. Hydraulic Fracturing 101.http://www.earthworksaction.org/issues/detail/hydraulic_fracturing_101#. UcAdL5x0SZ

42 Duke University. (2011)Methane levels 17 times higher in water wells near hydrofracking sites, study finds. www.sciencedaily.com/releases/2011/05/110509151234.htm.

43 Smith-Heavenrich, S. (2011) Expert: drilling impact two orders of magnitude bigger – with no regs http://newyork.sierraclub.org/SA/Vol41/impact.htm

44 The Guardian (2014) Mount Polley mine spill: a hazard of Canada's industry-friendly attitude? http://www.theguardian.com/environment/2014/aug/13/mount-polley-mine-spill-british-columbia-canada

45 CBC (2014) Mount Polley Mine tailings pond breach called environmental disaster http://www.cbc.ca/news/canada/british-columbia/mount-polley-mine-tailings-pond-breach-called-environmental-disaster-1.2727171

46 Vancouver Sun (2014). Mount Polley mine breach: Elevated levels of chemical elements near tailings pond http://www.vancouversun.com/business/Mount+Polley+mine+breach+Elevated+levels+chemical+elements/10161351/story.html

47 DeSmog Canada (2015) No Fines, No Charges Laid for Mount Polley Mine Disaster http://www.desmog.ca/2015/12/18/no-fines-no-charges-laid-mount-polley-mine-disaster

48BBC (2015) Brazil dam collapse death toll rises to 17, BHP says http://www.bbc.co.uk/news/business-35158646

49 Al Jazeera (2015) Dam burst at mining site devastates Brazilian town http://www.aljazeera.com/news/2015/11/dam-burst-mining-site-devastates-brazilian-town-151106022548631.html

50 Telesur (2015) Brazil's 'Mountain Tsunami': a Disaster Waiting to Happen www.teleSURtv.net/english http://www.telesurtv.net/english/opinion/Brazils-Mountain-Tsunami-a-Disaster-Waiting-to-Happen-20151127-0027.html

51 The Guardian (2015) Mining waste reaches Brazilian coast two weeks after BHP dam collapse http://www.theguardian.com/world/2015/nov/23/brazil-dam-collapse-mining-waste-reaches-ocean-rio-doce

52 Wall Street Journal (2016). Samarco Warned of Problems at Dam, Engineer Says http://www.wsj.com/articles/samarco-warned-of-problems-at-dam-engineer-says-1453093025

53 Bowker and Chambers (2015) The risk, public liability and economics of tailings storage facility failures http://csp2.org/files/reports/Bowker%20%26%20Chambers%20-%20Risk-Public%20Liability-Economics%20of%20Tailings%20Storage%20Facility%20Failures%20%E2%80%93%2023Jul15.pdf

54 Earthworks (2015) Brazil Mine Spill: Enough is Enough https://www.earthworksaction.org/earthblog/detail/brazil_mine_spill_enough_is_enough#.VuGippOLRYh

55 CNN (2015) By the numbers: The massive toll of the Animas River spill http://edition.cnn.com/2015/08/13/us/animas-river-spill-by-the-numbers/

56 The Denver Post. (2015) Animas mine disaster: Arsenic, cadmium, lead broke water limits http://www.denverpost.com/environment/ci_28614946/epa-taking-damage-claims-toxic-spill-animas-river

57 CNN (2015) By the numbers: The massive toll of the Animas River spill http://edition.cnn.com/2015/08/13/us/animas river-spill-by-the-numbers/

58 Washington Post (2015) What the EPA was doing when it sent yellow sludge spilling into a Colorado creek http://www.washingtonpost.com/news/morning-mix/wp/2015/08/10/what-the-epa-was-doing-when-it-sent-yellow-sludge-spilling-into-a-colorado-creek/

59 Washington Post (2015) What the EPA was doing when it sent yellow sludge spilling into a Colorado creek http://www.washingtonpost.com/news/morning-mix/wp/2015/08/10/what-the-epa-was-doing-when-it-sent-yellow-sludge-spilling-into-a-colorado-creek/

60 CNN (2015) Gold King Mine owner: 'I foresaw disaster' before spill http://edition.cnn.com/2015/08/13/us/colorado-epa-animas-river-spill-owner/

61 http://earthobservatory.nasa.gov/Features/Water/page3.php

62 IPCC. Working Group II: Impacts, Adaptation and Vulnerability http://www.ipcc.ch/ipccreports/tar/wg2/index.php?idp=180

63 Cleantech Magazine (2010) http://www.cleantechinvestor.com/portal/fuel-cells/6422-mining-and-energy.html

64 Cleantech Magazine (2010) http://www.cleantechinvestor.com/portal/fuel-cells/6422-mining-and-energy.html

65 The Guardian (2013) The whopping climate change footprint of two Australian coalmining projects http://www.theguardian.com/environment/planet-oz/2013/nov/07/climate-change-keystone-galilee-queensland-coal-mining

66 Greenpeace (2012) Cooking the Climate: Wrecking the reef http://www.greenpeace.org/australia/en/what-we-do/climate/resources/reports/Cooking-the-climate-Wrecking-the-reef/

67 The Guardian (2013) The whopping climate change footprint of two Australian coalmining projects http://www.theguardian.com/environment/planet-oz/2013/nov/07/climate-change-keystone-galilee-queensland-coal-mining

68 Harold E Dregne (1985) Desertification of Arid Lands. P 50. Harwood Academic Publishers, London.

69 UN http://www.un.org/en/events/desertificationday/background.shtml

70 Siri Eriksen (2001) Linkages between climate change and desertification http://ag.arizona.edu/oals/ALN/aln49/eriksen-part1.html#process-es

71 UNCCD http://www.unccd.int/Lists/SiteDocumentLibrary/Publications/Desertificationandclimatechange.pdf

72 The Guardian (2015) High gold prices causing increased deforestation in South America, study finds http://www.theguardian.com/environment/2015/jan/14/high-gold-prices-causing-increased-deforestation-in-south-america-study-finds

73 Anastassia M. Makarieva and Victor G. Gorshkov (2010) The Biotic Pump: Condensation, atmospheric dynamics and climate http://www.bioticregulation.ru/common/pdf/ijw10.pdf

74 CIFOR (2015) The science is clear: Forest loss behind Brazil's drought http://blog.cifor.org/26559/the-science-is-clear-forest-loss-behind-brazils-drought?fnl=en

75 NASA (2015) Tropical Deforestation Affects Rainfall in the U.S. and Around the Globe http://www.nasa.gov/centers/goddard/news/topstory/2005/deforest_rainfall.html

76 Stockholm Resilience Centre (2014) What is Resilience? http://www.stockholmresilience.org/download/18.10119fc11455d-3c557d6d21/1398172490555/SU_SRC_whatisresilience_sidaApril2014.pdf

77 M. Krosby et al (2010) Ecological Connectivity for a Changing Climate http://www4.ncsu.edu/~haddad/Publications/articles/Krosby_et_al_2010_ConsBio.pdf

78 Oxfam (2015) Mining, resettlement and lost livelihoods https://www.oxfam.org.au/wp-content/uploads/2015/04/mining-resettlement-and-lost-livelihoods_eng_web.pdf

79 Yes to Life, No to Mining (2015) Disaster strikes in Arda Transau mining relocation area http://www.yestolifenotomining.org/zimbabwe-disaster-strikes-in-arda-transau-mining-relocation-area/

80 Yes to Life, No to Mining (2015) Displaced villagers of Arda Transau told they must pay to farm http://www.yestolifenotomining.org/zimbabwe-villagers-of-arda-transau-displaced-by-mining-told-they-must-pay-to-farm/

81 Eduardo Gudynas. Transitions to post-extractivism (http://www.tni.org/files/download/beyonddevelopment_transitions.pdf

The report & animation can be downloaded from:

www.gaiafoundation.org/UnderMiningtheWaterCycle
www.gaiafoundation.org/WaterisLife

UnderMining the Water Cycle: Extractive Industries and a Planetary Water Crisis - reveals how the extractive industries are playing a key role in driving our planetary water crisis. Grabbing, destroying and polluting water systems, these industries are violating the UN Human Right to Water, denying all species the clean water they need to thrive and disrupting the water cycle itself. With a bold infographic, this report outlines the impacts mining has on water and climate change. It calls for a new water ethic that recognises water's own rights to remain clean, to flow and to follow its natural cycle.

The report is accompanied by the short film **Water is Life, Don't UnderMine it.** This beautifully illustrated animation, by Ben Pearce, takes us on two very different journeys through the water cycle. One shows the life-giving nature of water for everything from forests to frogs. The other reveals the ways in which mining is severely damaging and toxifying the water cycle, putting life itself in jeopardy.

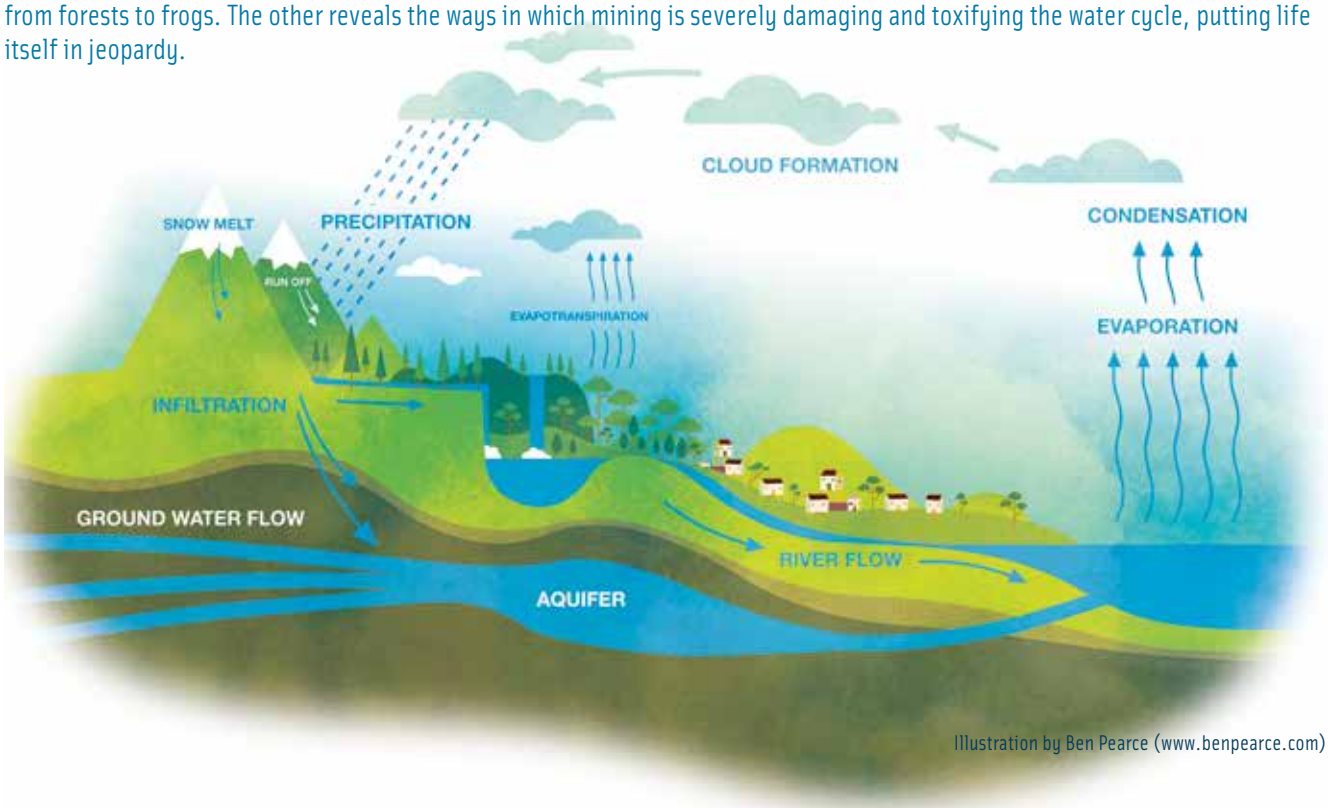


Illustration by Ben Pearce (www.benpearce.com)

RIGHTS OF NATURE

It widely recognized that a profound transformation of the dominant industrial system is required to deal with the multiple ecological, climatic, social, economic and political crises that now plague our planet. At the heart of this transformation, is the need to shift out of our human-centric worldview to embrace the reality that we are part of a dynamic living planet. This requires us to recognise that the Earth is lawful and ordered and human societies need to comply with the laws that govern nature, in order to ensure that the web of life is sustained. This is what has become known as Earth Jurisprudence, recognising the lawfulness of the Earth and deriving human governance systems from this principle.

Given the magnitude of destruction caused by the dominant extractive economy, there is a growing movement across the planet calling for the Rights of Nature to be recognised and respected. This recognises that every species and aspect of the Earth, has a right to be, a right to habitat and a right to participate in the evolutionary processes - by the very fact of existence. This is as true for humans as it is for everything else that exists on our planet.

In this report, we can see that fresh water anywhere on the Earth, is part of planetary-wide cycles of water - through the air, the sea and the land. The nature of water is that it flows, and needs to flow to stay healthy and clean, assisted by the millions of organisms living in its medium. In order to ensure that water is able to regenerate itself through its cycles, we need to find ways to stop the destructive, toxic activities undermining its integrity. This is our responsibility to water and to all the species which depend on water for life, including humans, for generations to come. Recognising the Rights of Water, wherever we are, and ensuring destructive forces are held back, is a vital task for all who care for life.

the Gaia foundation

MELCA-Ethiopia

NAPE-Uganda

African Biodiversity Network

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