


Tailings Dams: *A Disaster Waiting to Happen*

PREPARED BY

2021 CAPSTONE TEAM



<https://sipa.campusgroups.com/PCG/>



*This Capstone Project was conducted by students from
Columbia University's School of International and
Public Affairs, in partnership with the Government of
Peru and the Ministry of Energy and Mines under the
supervision of Mr. Jenik R. Radon.*

2021 CAPSTONE TEAM

Jie Deng

Rachael Eplee

Monica Yrrarazabal Grados

Xinwei He

Jessica Hernandez

Alexia Karpen

Emmanuel Roigest

Tenzin Thargay

CONTENTS

03

LETTER FROM THE TEAM

04

ACKNOWLEDGEMENTS

05

ABOUT THE CAPSTONE

06

SUMMARY OF RECOMMENDATIONS

07

EXECUTIVE SUMMARY

08

CONTEXT AND CURRENT EVENTS

12

CASE STUDY: PERU

13

DEFINING TAILINGS DAMS

17

CASE STUDY: BRAZIL

CONTENTS

24
CASE STUDY: UNITED STATES

25
CASE STUDY: CANADA

26
LEGAL AND POLITICAL STRUCTURE

35
ANALYSIS AND RECOMMENDATIONS

45
INCLUSIVE COMMUNITY PARTNERSHIP

49
CONCLUSIONS AND NEXT STEPS

51
WORKS CITED

LETTER FROM THE TEAM

As Peru confronts one of the most controversial moments in its political history alongside tackling the COVID-19 pandemic, our teAM has had the opportunity to observe as the Ministry of Energy and Mines (MINEM) continues its diligent work in aligning the goals of the mining industry with the development goals of the country. Recognizing that the Ministry's Mining Vision 2030 is central to that pursuit, our team has sought to build from seven years of consultations with MINEM and focus on the overlooked danger of tailings dams in the mining industry.

With this project, we hope to elevate the issue of tailings dams as one of the greatest looming threats to the long-term sustainability of the mining industry and the people living near mining sites. We recognize that at the heart of a sustainable future for the mining industry is proper engagement with local communities, whose ability to survive and develop are inherently linked to local mining activities and the proper management of natural resources

The Peruvian Ministry of Energy and Mines has the opportunity to head off devastation before it happens. Throughout the world, breakage and seepage from tailings dams are coming to light as a serious and looming threat to the environmental and social sustainability of the mining industry. Now is the moment to foresee and act in favor of better wastewater management by recognizing the critical nature of prioritizing tailings dams on the political agenda. We hope that the information we've provided in the following report is just the beginning.

THE 2021 CAPSTONE TEAM

ACKNOWLEDGEMENT

We extend our most sincere thanks to those professionals and experts who took the time to speak with and guide us through this process;

Evelyn Contreras, *Ministry of Energy and Mines, Peru*

Luis Augusto Ducassi Helguero, *Director General of Mining Promotion and Sustainability, Ministry of Energy and Mines, Peru*

Vinny Floris, *Inter American Development Bank*

Chris Bareither, *Colorado State*

Jan Morrill, *International Mining Campaigner at Earthworks*

Dr. Steven Emerman, *Malach Consulting*

Ugo Lapointe, *Canada Program Coordinator at Miningwatch Canada*

Ariana Melchor, *Independent Expert*

Ana Leyva, *Cooperación*

Dionel Martínez, *Cooperación*

Serena Chiang, *BASIS International School, Park Lane Harbor*

Kasei Oma, *BASIS International School, Park Lane Harbor*

Yingle Su, *Duke University*

Members of the RIMAY *Dialogo Multiactor* process

Translation services from, *NaTakallam*

About the Capstone

This year's project progresses previous capstone work on sustainable mining practices in Peru. As such, this report focuses on tailings dams - and often overlooked danger in the mining industry.

Tailings dams are wastewater retention ponds associated with mining activities. Hundreds of thousands of these long-term storage facilities exist worldwide, many without proper management and monitoring plans. Even as hundreds of lives are lost, public health in major cities is threatened, and critical ecosystems are destroyed, the maintenance of these dams remains overlooked.

Our recommendations tie the socioeconomic implications of dam failure to technical considerations for how they can be improved. The project team met with a wide variety of stakeholders to understand tailings dams in the context of how water management is addressed in the Mining Vision 2030, in community consultations and through technical working groups.

This report is complementary to the work already underway by RIMAY, the arm of MINEM responsible for the implementation of the Vision. Several key case studies of global dam failures mentioned in the report provide a foundation for legal recommendations for regulatory measures that hold parties accountable and ensure proper long-term management.

In an effort to make our information, and that of previous Capstones, accessible to all mining industry stakeholders, we have consolidated all of previous Capstone reports and information onto a website, which can be accessed in both English and Spanish. Our website will serve as an online archive and resource for future work.

PAST PROJECTS

2014

Colombia: Extractives for Prosperity

2015

Mining in Peru: Benefitting from Natural Resources and Preventing the Resource Curse

2016

The Peruvian Mining Sector: Exploring Issues Related to Social Licenses, Corruption and the Trans-Pacific Partnership Treaty

2017

Mining, Social License and Conflict Prevention

2018

Community Partnership Agreement: Securing Community Consent in Mining Areas in Peru

2019

Mining Vision 2030: Making it a Reality

2020

Colombia and Peru: Securing Community Acceptance in Natural Resource Rich Areas



<https://sipa.campusgroups.com/PCG/>

KEY RECOMMENDATIONS

01

Consider **IRMA** standards as baseline requirements for social and environmental standards.

02

Set the **global standard** for monitoring and maintenance of tailings dams, from EIA to post-project closure

03

Be a global leader in **Environmental Impact Assessment reform**.

04

Ensure that legislation and contracts hold mining companies both **civily and criminally responsible** for tailings dams failures to incentivize best practices in construction.

05

Continue to push for community consultation as the backbone of fair mining practice with **cultural, social, and economic benefits** at the center.

06

Encourage and facilitate the full integration of Mining Companies with local communities to ensure **effective and accurate information channels**.

07

Prioritize **family-level outcomes** for community benefits such as education and public health over more aesthetic improvements through modernization of infrastructure.

Executive Summary

The Peruvian Ministry of Energy and Mines has the opportunity to head off devastation before it happens. Throughout the world, breakage and seepage from tailings dams is coming to light as a serious and looming threat to a country's environmental and social sustainability as well as that of its mining industry.

As Peru confronts one of the most controversial moments in its political history alongside tackling the Covid-19 pandemic, the Ministry of Energy and Mines (MINEM) continues its work in aligning the mining industry with the development goals of Peru. The Ministry's Mining Vision 2030 is central to that pursuit, providing a framework for progressive mining regulation that fully incorporates social and environmental wellbeing and targets revenues to sustainable development. Building from seven years of consultations with MINEM, this report will focus on a particular and pressing issue that is too often overlooked in the mining industry.

Tailings dams are wastewater retention ponds associated with mining activities. There are an estimated 18,000 tailings dams globally, about 3,500 of which are active and without comprehensive and regular monitoring and maintenance plans. Even as hundreds of lives are lost, public health in major cities is threatened, and critical ecosystems are destroyed, the maintenance of these dams remains overlooked. This project seeks to elevate the issue of tailings dams as one of the greatest looming threats to the long-term sustainability of the mining industry and the people living near mining sites. Our recommendations tie the socioeconomic implications of dam failure to technical considerations for how they can be improved. In this, the project team met with a wide variety of stakeholders to understand tailings dams in the context of how water management is addressed in the Mining Vision 2030, in community consultations and through technical working groups. The report seeks to position itself as complementary to the work already underway by RIMAY, the arm of MINEM responsible for implementation of the Vision. It builds from several key case studies of dam failures to build a case for legal recommendations for regulatory measures which can hold parties accountable and ensure proper long-term management.

Beyond the technical and regulatory aspects, we recognize that at the heart of a sustainable future for the mining industry is proper engagement with local communities. Where rural mining communities are simultaneously reliant upon and subject to mining activities and their impacts, the proper management of natural resources is inherently linked to their ability to survive and develop. Our report insists that, now is the moment to foresee and act in favor of better wastewater management, and positioning the issue as critical to all Peruvian citizens. We hope that our Report elevates the issue within the Government of Peru and in the eyes of all stakeholders. As is popularly said, an ounce of prevention is worth a pound of cure and that requires preventive action now.

This approach builds directly from the work of the 2020 Capstone Group which drafted a recommended Community Partnership Agreement. In an effort to elevate its effectiveness, our group has sought and won funding from SIPA to translate this document from English to Spanish, and will include it as an addendum for the review of MINEM. Furthermore, our team recognizes the uniqueness of our project, which has spanned seven years. In celebration and support of this strong relationship between Columbia University and the Government of Peru, our team has begun the process of concentrating the collective information produced by Capstone groups since 2014 into a website which can serve as an online archive and resources for future work (website link: <https://sipa.campusgroups.com/pcg/home/>).

Current events, Peru's Mining Industry and the Mining Vision 2030

2020 was a global year of reckoning. As millions died from the COVID-19 pandemic, the global economy was halted, and political systems were challenged to enforce unprecedented public health safety measures while maintaining essential economic activities. Peru was no exception, quickly showing high infection rates, the country imposed one of the earliest and strictest lockdowns in Latin America. Despite these efforts, infection rates remained difficult to control and the country consistently showed some of the highest numbers of excess deaths in the world. Over crowded markets and homes combined with an ill-prepared healthcare system made the pandemic particularly hard to manage in Peru, and social unrest unfortunately followed.

On November 10, 2020 President Martin Vizcarra was removed from office by the Congress who cited his “moral incapacity” to run the country based on accusations of corruption in his former position as Governor of the southern Moquegua region from 2011-2014. Beyond these accusations, the two years of his Presidency saw significant clashes between the Executive and Legislative branches, and many Peruvian's saw this action as a sort of coup from the opposition party. Per the Constitution, upon the removal of Vizcarra, the Speaker of Congress Manuel Merino took on the power of the Presidency, but the social response was sharp from citizens who saw this as a seizure of power and protested for the protection of democracy. Their calls were met and just five days after entering office, Merino submitted his letter of resignation on November 15th, but not before the confrontation became violent, resulting in the deaths of two young protestors. Due to a lack of provision in the constitution, Peru was then left for a night without a President or Vice President before congress approved Francisco Sagasti as the interim President¹.

On April 11, 2021 general elections were held under record levels of political distrust. In a surprise last-minute surge, Pedro Castillo, who has been described as a far-left candidate, won the first round of elections and is currently showing 41.5% support in polls by the Peruvian Studies Institute (IEP). On June 6th Castillo will face Keiko Fujimori, his conservative opponent who is

¹ Sonneland, Holly. AS/COA Online. Peru's Presidential Crisis: A Timeline. 18 November 2020. <https://www.as-coa.org/articles/perus-presidential-crisis-timeline>

currently showing 21.5% support according to the same poll². The outcome of this election will greatly affect the role of MINEM and the rollout of the Mining Vision 2030 as the candidates support vastly different viewpoints; Castillo calling for the nationalization of the sector, and Fujimori who supports free markets and private sector engagement.

Despite the COVID-19 lockdowns and political unrest, mining has remained critical to national economic stability, but not without impact. Considering the importance of mining for the Peruvian economy, large-scale open-pit operations and construction of projects of particular significance to national interest resumed in May 2020 -while other activities remained closed- and all other mining activities were reactivated in August 2020. Reviving, stabilizing, and growing the industry is a top priority for both political candidates, but the means of achieving this goal are yet to be determined. In this, MINEM continues its efforts to innovate the sector and implement the Mining Vision 2030, with the goal of a stronger and more sustainable mining sector. This report seeks to contribute to that mission and support the process of placing the Mining Vision 2030 at the top of the agenda of the incoming administration. It does so as a part of the long standing relationship between Columbia University and Peru's MINEM, and this year's report will build from past year's analyses of the social and environmental impacts of the mining industry to focus particularly on the issue of wastewater storage in tailings dams.

The Mining Vision 2030 was developed between September 2018 and February 2019 by RIMAY (the name given to the Ministry of Energy and Mines' Centro de Convergencia y Buenas Prácticas Minero Energéticas), and assisted by the Inter-American Development Bank. With the goal that, "by 2030, mining in Peru [will be] inclusive, socially, environmentally and territorially integrated, within a framework of good governance and sustainable development framework. It [will be] consolidated as a competitive and innovative activity and be valued by all of society [globally]." The Vision is being implemented in a two-phase approach; through technical working groups which seek to provide concrete technical recommendations and multi-stakeholder dialogue

² IEP Informe de Opinion - Abril 2021 - Encuesta telefonica a nivel nacional. Lima, Peru. April 11, 2021.
<https://iep.org.pe/wp-content/uploads/2021/04/Informe-IEP-OP-Abril-II-2021-Segunda-vuelta-intencion-de-voto-v2.pdf>

taking place in selected mining territories around the country³. Our team engaged with both of these processes in order to understand where the issue of tailings dams could best be addressed.

Mr, Vinio Floris is leading the IDB and RIMAY's efforts to provide the most comprehensive technical and scientific recommendations for water management to the mining industry and the Government of Peru as the industry continues to expand. According to Floris, technical recommendations regarding tailings dams will be confronted as a part of their investigations and reporting and the group will work with technical tailings dam expert Christopher Bareither from Colorado State University. The goal of their work is to observe best practices from the perspective of structural engineering and natural resources management, but not to position the urgency of the issue from a socio-economic standpoint. With this understanding, our report seeks to supplement and compliment the efforts of Floris and his team to position tailings dams as a particularly pressing issue in water management for the mining sector as well as Peru.

Our team also had the opportunity to participate in RIMAY's ongoing multi actor dialogue for the Moquegua Region. In this effort, RIMAY and its community partners are developing a living document - called *Memoria Viva* - which documents and prioritizes the needs and opinions of key stakeholders in the region. Our report recognizes this process as a best practice in community consultation, and uses it to look more deeply into best practices in community partnership.

Though our recommendations are not technical, it is important to first provide a brief technical definition of tailings dams and their potential impacts on surrounding natural environments and the health of people living nearby. The report will then examine the socio economic implications of improper tailings dam management, drawing upon critical examples from Peru around the world. From this base, we provide a legal analysis of tailings dams as they stand in Peruvian law in order to provide a general list of recommendations for the regulatory measures which could be taken to more comprehensively address the threat posed by tailings dams to vulnerable mining communities.

³ <https://perusupportgroup.org.uk/2020/10/government-relaunches-its-vision-for-mining-development-rimay/>

Peru

Huancavelica; Cobriza Mine Tailings Dam Failure

Background

On July 10th 2019, Doe Run Peru's Cobriza copper mine in Huancavelica, Peru, spilled as a result of liquidation processes being conducted, in addition to poor maintenance. The dam failure released around 67 thousand cubic meters of dam residue that eventually reached the Mantaro River. According to OEFA, the spill affected 41,574 square meters of area, impacting the mine's electrical station, Cobriza II, and its maintenance units before reaching the Mantaro River, one of the country's most important rivers. The dam failure occurred as a result of static liquefaction and poor maintenance.



Photo by SPDA Actualidad Ambiental

Causes and Impacts of Dam Failure

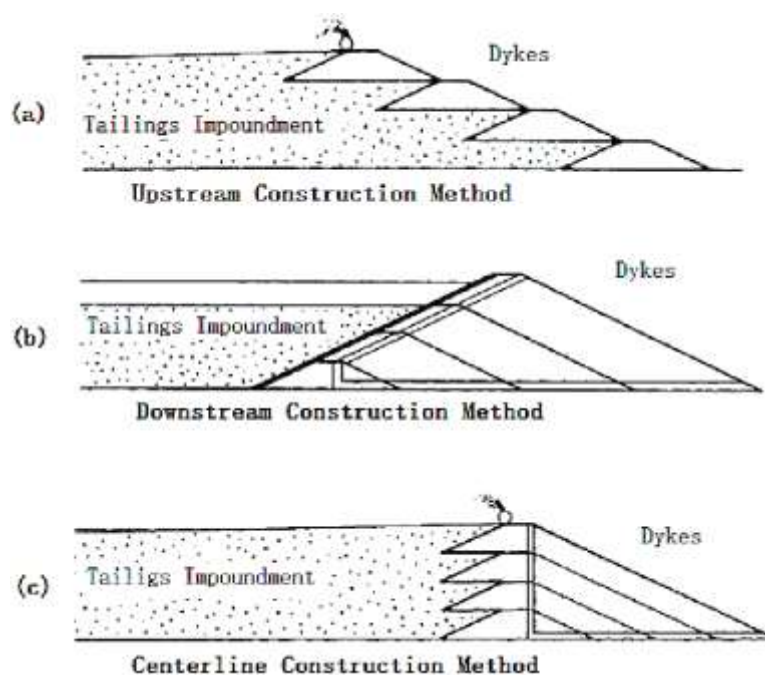
Reports found that the incident was a direct result of the poor maintenance of the wells containing the highly contaminated dam residues. OEFA revealed that since 2011, Doe Run Peru has received numerous fines for failing to comply with environmental protection regulations and for exceeding the maximum quantity of residue allowed to be held within a dam of its size. The company has paid an estimated 32 million soles, or \$8.8 million USD in fines related to its activities.

Interviews conducted with local populations after the spill revealed a strong sense of frustration amongst community members, who have repeatedly reiterated their continued support for mining activities in their area, under the condition that they are done in a responsible manner, both with respect to workers' conditions and the environment. OEFA ordered Doe Run Peru to oversee the immediate cleanup of waste, tailings and residue matter from the spill, as well as the restoration of the soil, and riverbank of the Mantaro River wherever possible.

Defining Tailings Dams

Tailings are mixtures of crushed rocks and processing fluids from washeries, mills, or concentrators that remain after the extraction of economic minerals, metals, coal, or mineral fuels from the mine resource. The ratio of tailings to concentrates varies around 200:1⁴. Generally, tailings' chemical composition depends on the mineralogy of the ore body, proficiency during the mining process, and the extent of weathering during storage in the blockaded impoundment.

Tailings dams feature house water and waste by-products from the mining process.⁵ Mining companies often use these earth-filled embankment dams to store large volumes of commercially worthless materials in mining operations that involve separating the ore. The mining of valuable components often produces large volumes of waste. More often than not, this waste is a combination of several things such as sand, chemical reagents, rocks, and water used to extract the commodity.



Tailing dams are the most effective technology known for wastewater storage where the contaminated water is stored for a long period of time where it settles and separates. These retention ponds. Extensometers and contract meters are used to monitor water and moisture within the structure for safety purposes. Ordinarily, tailing dams are retained using earth and rock as opposed to reinforced concrete, allowing the dam to be raised to accommodate more waste over the project lifecycle.

⁴ Kossoff, D., Dubbin, W.E., Alfredsson, M., Edwards, S.J., Macklin, M.G. and Hudson-Edwards, K.A., 2014. Mine tailings dams: Characteristics, failure, environmental impacts, and remediation. *Applied Geochemistry*, 51, pp.229-245.

⁵ Wills, B.A. and Finch, J., 2015. *Wills' mineral processing technology: an introduction to the practical aspects of ore treatment and mineral recovery*. Butterworth-Heinemann.

Tailing dams could negatively impact the community, especially when there is a leakage of toxic substances that can cause damage to the immediate environment. Moreover, tailing dams pose risks to local wildlife that usually bathe or drink from contaminated water coming from dam seepage.

There are three types of tailing dams: upstream, downstream, and centerline.⁶ Regular upkeep is central to their sustainability, but as with any dam, there is significant risk to the unnatural retention water. Downstream and centerline tailing dams are generally preferred over upstream as they are less stable under static loading and natural disasters such as earthquakes; however, upstream tailing dams are easier and cheaper to construct.

Analysis of tailing dams failures at Brazil's Brumadinho, an upstream mine which failed in 2019 [Box 1], and Canada's Mount Polley Dam, a centerline dam which failed in 2014 [Box 2], underscore the risks of poorly managed dams and their potential to break and have catastrophic consequences for human and environmental health. Regular maintenance and surveillance of tailing dams operation functions ensure sufficient drainage and that the dam can withstand the pressure from the mining wastes.⁷

The regulatory framework in Peru does not allow upstream tailing dams due to the country's vulnerability to earthquakes and other natural disasters. Furthermore, regulations such as the Supreme Decrees No. 040-2014 and 059-2005 prohibit tailings disposals.⁸ The fact that the metal extraction process within tailings dams is not 100% efficient requires further refining. After mining, there are still several metal and metalloid elements left in tailings dams. The main elements are: arsenic, copper, lead, zinc, mercury, cyanide, iron, barium, and aluminum. These elements will have huge negative impacts on the nearby ecosystem, environment, and the health of the local

⁶ Wills, B.A. and Finch, J., 2015. *Wills' mineral processing technology: an introduction to the practical aspects of ore treatment and mineral recovery*. Butterworth-Heinemann.

⁷ Lyu, Z., Chai, J., Xu, Z., Qin, Y. and Cao, J., 2019. A comprehensive review on reasons for tailings dam failures based on case history. *Advances in Civil Engineering*, 2019.

⁸ Lyu, Z., Chai, J., Xu, Z., Qin, Y. and Cao, J., 2019. A comprehensive review on reasons for tailings dam failures based on case history. *Advances in Civil Engineering*, 2019.

communities after the collapse of tailings dams. Heavy rain after tailings dams collapse will also exacerbate erosion, remobilization, and transport of contaminated particles.⁹

Environmental Effects

The amount of toxic chemicals injected into nearby rivers is huge. A tailings dams collapse at Baia Mare and Baia Borsa, Romania in 2000 spilled 120 tonnes of cyanide and metals into nearby rivers. The speed was fast. After the failure of the Bolivian San Ildefonso dam, 19 tons of Hg was detected in a nearby drainage basin two hours away from the dam.¹⁰ The impacts of tailings dams are also far-reaching. The Porco dam failure in Bolivia witnessed contamination seepage reaching 500km downstream.¹¹ The effects of contamination from subsequent failures also are usually irreversible, especially for the communities and rivers close to the failure.¹² Recent studies have also found that these negative outcomes may happen even when the dams do not fail.¹³

These toxic chemicals will decrease water quality and oxygen content. After water sources are polluted, the concentration of these elements are much higher than standard for irrigation and drinking. For example, The World Health Organization standard for magnesium in drinkable water is 0.4 mg L⁻¹. After a tailings dam failure, the magnesium concentration in nearby areas was 2.15 mg L⁻¹. Similarly, the World Health Organization standard for zinc is 3.0 mg L⁻¹. The zinc in nearby areas after tailings dams failure is 72.12 mg L⁻¹. The PH value of water will fall to around 3. The PH value for drinkable water is around 7. Subsequently, oxygen levels will decrease to 0.5-1g.

For nearby plants, these toxic chemicals cause loss of vegetation and nursery habitats. The following diseases have been reported after tailings dams failures: oxidative stress, effects on

⁹ <https://www.nature.com/articles/s41598-017-11143-x>

¹⁰ Kossoff, D., Dubbin, W. E., Alfredsson, M., Edwards, S. J., Macklin, M. G., & Hudson-Edwards, K. A. (2014). Mine tailings dams: Characteristics, failure, environmental impacts, and remediation. *Applied Geochemistry*, 51, 229-245.

¹¹ M.G. Macklin, P.A. Brewer, K.A. Hudson, Edwards, G. Bird, T.J. Coulthard, I.A. Dennis, P.J. Lechler, J.R. Miller, J.N. Turner A geomorphological approach to the management of rivers contaminated by metal mining *Geomorphology*, 79 (2006), pp. 423-447

¹² M. Olías, F. Moral, L. Galván, J.C. Cerón Groundwater contamination evolution in the Guadiamar and Agrio aquifers after the Aznalcóllar spill: assessment and environmental implications *Environ. Monit. Assess.*, 184 (2012), pp. 3629-3641

¹³ <https://theconversation.com/mine-waste-dams-threaten-the-environment-even-when-they-dont-fail-130770>

fluorescence, stomatal resistance, chlorophyll and photosynthesis, reproductive processes, seed germination, seed morphology and seed physiology.¹⁴

For agriculture, the toxic chemicals lead soil loss of regenerative capacity. For fishery, these low oxygen levels and low PH value decreased populations of aquatic species. For example, on April 25 1998, after the breach at the Aznalcóllar tailings dam at the Boliden Los Frailes, thirty-seven tons of fish died in a nearby river and all the crabs and shellfish disappeared into the contaminated mud.¹⁵ A tailings dams collapse in Romania in 2000 caused the death of fish not only in Romania but also in Hungary, Serbia, and Bulgaria.¹⁶

For animals, both small and large mammals are vulnerable to these toxic chemicals. In 2012, after the Mid-Wales floods, the concentration of Pb increased in silage, which resulted in poisoning and death of cattle.¹⁷ Another tailings dams collapse increased concentration of As from 17mg/kg to 48 mg/kg, which was fatal to birds.¹⁸

In the long term, these separate negative consequences will accumulate. It will alter species composition, change vegetative structure, decrease ecosystem connectivity and increase bank/bed erosion.

¹⁴ Chibuike GU, Obiora SC. Heavy Metal Polluted Soils: Effect on Plants and Bioremediation Methods. *Applied and Environmental Soil Science*. 2014;2014:12

¹⁵ J.O. Grimalt, M. Ferrer, E. Macpherson The mine tailing accident in Aznalcollar Sci. Total Environ., 242 (1999), pp. 3-11

¹⁶ M.G. Macklin, P.A. Brewer, D. Balteanu, T.J.Coulthard, B. Driga, A.J. Howard, S. Zaharia

The long term fate and environmental significance of contaminant metals released by the January and March 2000 mining tailings dam failures in Maramures County, upper Tisa Basin, Romania Appl. Geochem., 18 (2003), pp. 241-257

¹⁷ S.A. Foulds, P.A. Brewer, M.G. Macklin, W.Haresign, R.E. Betson, S.M.E. Rassner

Flood-related contamination in catchments affected by historical metal mining: an unexpected and emerging hazard of climate change Sci. Total Environ., 476-477 (2014), pp. 165-180

¹⁸ Eisler R. Arsenic hazards to humans, plants, and animals from gold mining. *Reviews of environmental contamination and toxicology*

Background

On January 25th 2019, the tailings dam of Vale S/A's iron ore mine failed catastrophically, ravaging the city of Brumadinho in Brazil's Minas Gerais State. An estimated 12 million cubic meters of mining waste spread downhill into the Paraopeba River, a river home to large, sand-extraction operations and situated near highly populated areas with extensive iron mining activities. The upstream tailing dam model used to construct the Brumadinho dam, which has since been banned in Brazil, has been largely considered to be the more dangerous of the two tailing dams models, but its cheaper cost and more easily attainable licensing process made it more appealing the mining giant, Vale S/A, who owns and operates 133 iron ore dams in the country.



Photo by panoramas.pitt.edu

Causes and Impact of Dam Failure

The official report on the Brumadinho tailings dam failure found that it occurred as a result of static liquefaction, a phenomenon of deformation and collapse alleged to be caused by a “triggering event” and collapsible materials. The investigation conducted found that the failure initiated near the crest of the dam but quickly progressed through the entire structure, allowing a comparatively shallow failure to develop, which was then followed by a series of retrogressive failures that eventually released the large volume of mine waste. Perhaps the most devastating fact about the disaster is that it could have been prevented. Six months after the dam collapsed, evidence emerged revealing that the German firm charged with certifying the safety of the dams' structure knew it was vulnerable before it collapsed. A report provided to the dam's owner by local inspectors showed that they had found flaws in the ability to monitor crucial water concentrations and drainage, inhibiting the inspectors from fully being able to assess the dam's stability.

Impact of Brumadinho Dam Failure

The Brumadinho dam failure had an immediate, devastating impact on the ecosystem and human health, primarily because of the toxic composition and velocity of the mud that engulfed neighboring areas. After devastating the area of land immediately surrounding the dam, 73% of which was covered by trees, grass and agricultural tracts, the mud tailings reached the Paraopeba River, increasing the water's suspended particulate matter, or SPM. The water turbidity of the Paraopeba River was also recorded at 3,000 NTU, a figure that is thirty times greater than the standard recommended by the Brazilian Resolution for Water Quality. The surrounding vegetation is said to have been the most affected by the mud tailings, comprising 49% of the affected area. The impacts on local flora and fauna created a tremendous loss of the ecosystem, and the devastation of agricultural land had significant ramifications for the local agricultural economy, an important economic activity in the area.

Health Effects

The effect of toxic chemicals from tailings dams leaks also have huge influences for the health of nearby communities. People will get exposure to these toxic chemicals through dermal contact, incidental inhalation, ingestion of particles and ingestion of crops. The following diseases have been found related to the past tailings dams failures: skin damage, kidney disease, lung and nasal irritation and damage, fragile bones, nervous disorder cardiomyopathy, ulceration of stomach and small intestines, nausea, and decreased sperm count.¹⁹Also, many metals, such as arsenic, nickel, cadmium, chromium, and lead are carcinogens. For example, exposure to uranium will increase carcinogenic risk as $1.01 * 10^{-3}$ ²⁰. For these potential cancer-related diseases, the risk for children is much higher than adults.

Exposure to these metals and metalloids can also compromise the immune system and a dangerous intersection arises between tailings dam exposures and HIV. HIV rates in South Africa's informal settlements are much higher than in formal settlements. One explanation for this is that a lot of tailings dams are located at informal settlements. People living there get greater exposure to toxic metals than people living in formal settlements. Thus, increased possibility of getting infectious HIV arises from exposure to metals via the tailings dams which can compromise immune systems.²¹

Last but not the least, one health consequence has not been given much attention is mental health. Exposure to these toxic metals and metalloids will not only impact people's skeletal, nervous, respiratory, excretory, and digestive systems but also impair people's cognitive ability.²² Linkages between tailings dams failures, negative health outcomes, and significant social impact expose this issue as disproportionately affecting populations which are already subject to significant socio-economic hardship, often in rural regions with limited economic resources and

¹⁹ ATSDR. *Toxic substances portal. toxicological profiles*: ATSDR; 2016.

²⁰ Njinga RL, Tshivhase VM. Lifetime cancer risk due to gamma radioactivity in soils from Tudor Shaft mine environs, South Africa. *Journal of Radiation Research and Applied Sciences*.

²¹ Socio-economic and demographic factors related to HIV status in urban informal settlements in the Eastern Cape, South Africa. *Steenkamp L, Venter D, Walsh C, Dana P Afr J AIDS Res. 2014 Sep; 13(3):271-9.*

²² Ngole-Jeme, V. M., & Fantke, P. (2017). Ecological and human health risks associated with abandoned gold mine tailings contaminated soil. *PloS one, 12(2)*, e0172517.

low resilience. The next section will explore the socioeconomic impacts of the improper or insufficient management of tailings dams.

Social Impact

Tailing dams, their failures, and mining projects in general have severe social impacts on communities, mainly pertaining to water management and access. In 2019, the Peruvian Ombudsman's Office noted that from a total of 202 social conflicts in Peru in 2018, about 63 percent involved social-environmental issues and, of those, 65 percent were related to mining.²³ Two of the most pressing issues resulting from the mining ventures are land use and contamination of local water sources.

A notable example of community opposition comes from the residents of Tambogrande. In 2002, the people of Tambogrande passed non-binding referendums banning mineral development fearing that excavation would displace half of the residents and impact the community's traditional livelihood.²⁴ In 2021 the Ministry of Energy and Mines submitted a report seeking to overturn certain mineral exploration rights granted to Nuevo Arcoiris S.A.C, a subsidiary of Canada's Tesoro Minerals Corp (TSXV: TES) which initially conducted mining in Tambogrande.²⁵ The Ministry's action represents a major step in the right direction for the community and government to reestablish community focused land use and suspend subsequent mining in the area to preserve a predominantly agricultural community.

A second notable community opposition to mining company's land use comes from the Las Bambas mine. Opposition to MMG mining, a subsidiary of the Chinese state-owned

²³ Agencia EFE. 2018. "Report Warns of Possible Toxic Leaks from Mining into Lima Water Supply | World | English Edition | Agencia EFE." December 13, 2018. <https://www.efe.com/efe/english/world/report-warns-of-possible-toxic-leaks-from-mining-into-lima-water-supply/50000262-3841214>.

²⁴ Wilson, Scott. 2002. "A Life Worth More Than Gold." *Washington Post*, June 9, 2002. <https://www.washingtonpost.com/archive/politics/2002/06/09/a-life-worth-more-than-gold/e7edc7f8-9685-466e-ba2b-8d33ed1dde18/>.

²⁵ Leotaud, Valentina Ruiz. 2021. "Canadian Company's Exploration Rights in Peru Hanging by a Thread." MINING.COM. January 10, 2021. <https://www.mining.com/canadian-companys-exploration-rights-in-peru-hanging-by-a-thread/>.

Minmetals Corp, dates back to 2015 when workers and community members gathered to express concern over the environmental degradation the project would inflict and the need for MMG to hire more local workers.²⁶ This protest of 15,000 people resulted in 3 people getting killed.²⁷ The conflict between the mining community of the Las Bambas mine and MMG, tragically and unfortunately, still continues today. In January 2020, locals lodged a three-week-long roadblock protest that prevented the export of approximately 189,000 tons of copper concentrate.²⁸ The local community has frequently used roadblocks as a form of protest to push MMG to confer greater local benefits. This has proved effective as in September 2020, MMG agreed to give spot benefits to families impacted by COVID-19 and finance sustainable developments for up to 1.25 million soles (\$348,000) over two years.²⁹

Contamination of water sources represents the second pressing social issue arising from tailings dams and mining projects. In particular, tailings dams are known to leak toxic tailings into water streams. Tailings from the Ariana mining project in 2019 are understood to have leaked toxic materials into the Rimac River basin that supplies Lima's drinking water.³⁰ Furthermore, Peruvian government data indicates that 25% of the 101 current conflicts in Peru's southern copper mining corridor stem from water access and quality.³¹ As dams age, the likelihood of undetected seepage drastically increases. A most recent example of this can be seen even in a developed country as the United States in the 2021 Piney Point phosphate pond leak in Florida [Box 2] where a state of emergency was declared after contaminated water was mixed with public sources.

²⁶ BBC News. 2015. "Peru Anti-Mining Protest Sees Deadly Clashes." *BBC News*, September 29, 2015, sec. Latin America & Caribbean. <https://www.bbc.com/news/world-latin-america-34389803>.

²⁷ *ibid.*

²⁸ Cervantes, Maria. 2021. "Protest Blocks \$530 Mln Worth of Copper from MMG's Las Bambas Mine in Peru - Association." *Reuters*, January 5, 2021. <https://www.reuters.com/article/peru-copper-bambas-idUSL1N2JG1ML>.

²⁹ *ibid.*

³⁰ Agencia EFE. 2018. "Report Warns of Possible Toxic Leaks from Mining into Lima Water Supply | World | English Edition | Agencia EFE." December 13, 2018. <https://www.efe.com/efe/english/world/report-warns-of-possible-toxic-leaks-from-mining-into-lima-water-supply/50000262-3841214>.

³¹ Miller, Ben, and Emilie Sweigart. 2019. "How Countries Manage Water: Peru." *Americas Quarterly* (blog). October 15, 2019. <https://www.americasquarterly.org/article/how-countries-manage-water-peru/>

Economic Impact

Tailing dams failures also carry major impacts on Peru's economy. Since 2016 Peru's mining industry has accounted for roughly 10%³² of the country's GDP but yet accounts for more than half of foreign direct investment (FDI) in the country.³³ Additionally, the industry provides a significant amount, about 22.8%, of Government revenue.³⁴

Over the past 20 years, Peru has experienced some of the most rapid economic growth in Latin America, increasing the number of high-return investment opportunities, many of which were in extractive industries. The rapid growth in FDI generated a surge of service jobs, largely in urban centers which have seen massive growth as people abandon rural regions in search of greater economic opportunity in cities. This economic growth has been effective in reducing poverty. Between 2004 and 2015 moderate poverty fell from 58 to 22 percent, extreme poverty fell from 16 to 4 percent, and the middle class grew by an impressive 18 percent.³⁵ Much of this success came as a result of policy reform which prioritized macroeconomic stability and higher fiscal revenues and accordingly reduced investment uncertainty. Investment in mining projects boomed in the early 2000s when the commodity price for minerals grew rapidly, but along with it, it also had serious adverse consequences as the black market for precious metals soared, mainly in the remote Amazonian regions of the country.

Peru has approximately 200 to 220 operational approved rare metal earth mines in operation in addition to hundreds of closed, abandoned, or illegal artisanal mines.³⁶ While these unreported mines may not appear in the calculation of gross domestic product (GDP) for Peru, the country still has to bear the consequences if these illegal mines fail.³⁷

³² <http://proyecta.minem.gob.pe/#>

³³ World Bank, Bolivia, Chile, Ecuador, and Venezuela Country Management Unit. Systematic Country Diagnostic, Peru. 2017.aa

³⁴ UK Space Agency and the Global Challenges Research Fund, HR Wallingford. 2019, "A review of the risks posted by the failures of tailing dams" <https://damsat.org/wp-content/uploads/2019/01/BE-090-Tailings-dams-R1-Secured.pdf>

³⁵ World Bank, Bolivia, Chile, Ecuador, and Venezuela Country Management Unit. Systematic Country Diagnostic, Peru. 2017.

³⁶ BNamericas <https://www.bnamericas.com/en/news/higher-mining-output-fails-to-stem-slower-peru-gdp-growth>

³⁷ BNamericas News. 2018. "Peru posts sluggish July GDP growth", September 18 2018. <https://www.bnamericas.com/en/news/peru-posts-sluggish-july-gdp-growth>

From the macroeconomic point of view, GDP of a country is calculated by adding the consumption, investment, government purchase and exports minus imports. In the case of Peru, as Peru being a traditional agricultural and mining country, the economy is at the middle level among Latin American countries. Thus, the dimensions such as investment, government purchase and exports in the calculation of GDP are highly related to the mining industry. This means that a series of significant tailings dams failures will directly impact the economy of the whole country. One of the most direct consequences of the tailing dams failure would be an increase in the unemployment rate. If the unemployment rate rises significantly, it can unleash a chain reaction where the Peruvian government has to provide sufficient jobs in a short period of time. Another way to address this issue would be the government pressing the central bank to inject capital in the market, affecting printing money. However, this would cause other economic problems such as inflation, and with the further consequence that the value of Peruvian Sol would decrease and create a potential economic crisis.

In 2014, a Chinese consortium led by China Minmetals Resources spent US \$7 billion to buy the Las Bambas copper mine from Glencore GLEN. Las Bambas is expected to become the third largest copper mine in the world. Minmetals Resources weighed, when participating in the acquisition negotiations, that there was enough profit from this venture to face huge risks to the timetable and cost of the overseeing production at the Las Bambas copper mine.

Risks included possible reduction in skilled workers, possible changes in tailings dam design, and higher-than-expected resettlement costs for residents on the original copper mine site. In addition to residents' relocation and resettlement issues, tailings dams leakage into water sources has caused the project to be shelved and capital expenditures increased. In 2018, Peru's mining industry produced 207,700 tons of copper in concentrates, breaking through the 200,000 tons mark for the first time.³⁸ The copper recovery rate increased by 3.15% compared with 2017. Concentrate impurity control achieved a substantial breakthrough, which was the best since commercial operation.

³⁸ Greenovation Hub 2014. "China's Mining Industry at Home and Overseas: Development, Impacts and Regulation", December 01, 2014. http://www.ghub.org/en/wp-content/uploads/sites/2/2019/07/case-study_CN-mining_2014.pdf

In conclusion, the reason tailing dams failures can cause such a dramatic impact in the economy is because most of the Peruvian GDP comes from the mining industry with its huge international capital investments.³⁹ The economics of tailings dams and mining projects are also tightly tied to social acceptance as well. Cases of local opposition resulting in road blockades, with respect to the case of the Las Bambas, can impact the mining industry to indicate that tailings dams and mining projects cannot come at the expense of local community's livelihoods and ways of living.

³⁹ Greenovation Hub 2014. "China's Mining Industry at Home and Overseas: Development, Impacts and Regulation", December 01, 2014. http://www.ghub.org/en/wp-content/uploads/sites/2/2019/07/case-study_CN-mining_2014.pdf

United States of America

Piney Point's Phosphate Pond Leak in Florida

Background

On April 3rd, 2021, the State of Florida declared a state of emergency, after an old phosphate mine's tailings pond began leaking. Piney Point mine's reservoir, located in the Tampa Bay area, is said to primarily contain salt water mixed with wastewater and storm water, according to the Florida Department of Environmental Protection, but officials could not rule out that a full breach could destabilize the walls of nearby ponds which do contain higher levels of toxic materials.



Photo by Channel 8 News Aerial Live Stream

Causes and Impacts of Failure

Piney Point bought the site after it was abandoned by the Mulberry Corporation, which had operated the plant for over 40 years, and reports issued in 2003 claimed that the reservoirs walls were already beginning to crumble. Since declaring a state of emergency, officials have evacuated over 300 homes in the local area, and closed off a highway near the mine's reservoir. Officials are removing 28 million gallons of water from the pond every day, which contains roughly 258 million gallons, while 178 million gallons have been discharged into Port Manatee. Water samples taken from areas surrounding the discharge point in Port Manatee have revealed elevated levels of phosphorous, according to Florida officials.

The Mount Polley Tailings Storage Facility Failure

Background

On August 14th, 2014, the perimeter embankment at the Mt. Polley copper mine in south-central British Columbia failed catastrophically. The dam failure released at least 25 million cubic meters of a combination of mine tailings and mine effluent mixed with stormwater into surrounding bodies of water. The mine tailings spread into Polley Lake, then Hazeltine Creek and finally stopped when they reached Quesnel Lake, a known salmon-rich lake.



Photo by The Narwhal Canada

Causes and Impacts of Dam Failure

The panel of experts assigned to review the dam failure concluded that the primary reason for the failure was the dam's design, which did not adequately consider the complexity of the sub-glacial and pre-glacial geological environment upon which the Perimeter Embankment foundation was built. The design failed to recognize that it was susceptible to undrained failure when subjected to the stresses associated with the embankment. This case offers a unique lesson for Peru in particular, because its failure was in its design—a design that did not adequately consider the complexity of the sub-glacial and pre-glacial geological environment upon which the Perimeter Embankment foundation was built. Given that the Peruvian Andes are home to about 70% of the world's tropical glaciers, most of which has started retreating at an alarming pace, Peruvian mining companies near glacial sites must consider what added risks their dams are exposed to when subjected to the stresses associated with the geological environment upon which their dams are built. Particularly considering that that environment can and will change over the dam's lifetime due to climate change.

The Cariboo Regional District declared a state of emergency in nearby communities immediately following the failure. The Interior Health Authority ordered drinking water bans due to water contamination concerns and the Department of Fisheries and Oceans closed the recreational salmon fisheries on the Quesnel and Cariboo Rivers. While there were fortunately no casualties recorded following the failure, the 350 people living in the Likely community remain wounded, concerned and divided about the tailings dam breach.

Legal and Political Structure

Peru has an investor-friendly legal framework that governs the mining sector, both for local and foreign investors, which have the same rights and obligations⁴⁰. The legal system has been designed to attract foreign and local capital in hopes of bringing work and development for communities in the mining regions. However, mining activities do not only generate benefits, and they come with a severe risk of side effects that could potentially lead to environmental disasters. Tailing dams, unfortunately, could become an example of this hypothesis.

We need to keep in mind that the 1993 Political Constitution of Peru stipulates that everyone has the right to enjoy a balanced and adequate environment for the development of their life. Accordingly, Article I of the General Environmental Law establishes that everyone has the inalienable right to live in a healthy, balanced and adequate environment for the full development of life, and the duty to contribute to effective environmental management and to protect the environment, as well as its components, particularly ensuring the health of people individually and collectively, the conservation of biological diversity, the sustainable use of natural resources and the sustainable development of the country.

In this section, we will briefly analyze the Peruvian mining legal framework to understand its importance and function when facing environmental challenges related to the mining industry and tailings dam. Specially in order to assess if this legal framework needs a reform aimed to prevent, monitor and avoid environmental deterioration and the depletion of natural resources related to tailings dams.

Peruvian Regulators and Administrative Agencies

The mining industry is regulated by the central government through the Ministry of Energy and Mines (MINEM). MINEM is responsible for issuing most of the environmental regulations

⁴⁰ However, the Political Constitution of Peru states that foreign investors may not, under any title, directly or indirectly acquire or hold mines, terrain, forests, waters, fuel or power plants within 50 km of the borders.

applicable to mining activities, as well as formulating and promoting policies for the development and promotion of sustainable mining activity.

The Ministry of Environment (MINAM) was created in May 2008, with the objective of designing, establishing, implementing and supervising national and sector environmental policy. MINAM is responsible for monitoring, supervising and controlling environmental quality standards. Additionally, MINAM has the duty of review (on a random basis⁴¹) EIAs approved, for large projects.

In 2012, the National Service of Environmental Certification for Sustainable Investments – SENACE, was created, as part of the SEIA⁴². SENACE is an agency with technical autonomy whose core functions include (i) the review and approval of the Detailed-EIAs (EIA-d); (ii) the management of the National Registry of Environmental Consultants; (iii) the management of the Administrative Register of Environmental Certifications; (iv) the coordination with other environmental authorities; (v) the formulation of proposals for the continuous improvement of the EIA process; and (vi) the implementation of a new Proceeding for the Approval of the Environmental Certification ("*Ventanilla Única de Certificación Ambiental*") in the proceedings for approving detailed environmental impact assessments classified as Category III.

Additionally, there is the Organization of Supervision and Environmental Assessment – OEFA, which is a public, technically specialized institution, under MINAM. It has the responsibility of monitoring and controlling environmental regulations compliance.

Finally, the Supervisory Body of Private Investment in Energy and Mines – OSINERGMIN, is the regulatory, enforcement and oversight body for the activities undertaken

⁴¹ According to Supreme Decree No. 019-2009-MINAM

⁴² The National System of Environmental Impact Assessment (SEIA), include procedures for classification of investment projects, implementation of environmental impact studies, procedures for reviewing EIAs, and issuing environmental certification. MINAM's role as lead and administrator of the SEIA has taken the first steps in articulating national, regional, and local government levels, as well as in coordinating actions with line ministries, in order to develop common denominators and procedures for EIA. Under the SEIA regulations, MINAM must provide favorable technical opinion before sectoral environmental regulations are approved.

(such as safekeeping measures within mines) by internal public or private law legal entities and individuals in the electricity, hydrocarbons and mining sub-sectors.

Obtaining and Mining Concession

A mining concession grants their holders (private parties) the right to explore, use and exploit mineral resources to an unlimited depth, bound by vertical planes corresponding to the sides of a square, a closed traverse rectangle or one whose vertices refer to Universal Transversal Mercator (UTM) coordinates.⁴³

Mining concessions constitute a different right from owners of surface land. Those owners of surface are not authorized to perform mining activities on them, unless they have a valid mining concession title granted by the Geological, Mining and Metallurgical Institute - INGEMMET.

Types of mining concessions:

- A mining concession grants rights to execute mining activities of exploration and exploitation - it has the nature of an immovable right.
- A processing concession grants the right to perform physical, chemical and physical-chemical processes to concentrate minerals or to purify, smelt or refine metals, including the following stages: (i) mechanical preparation, (ii) metallurgy and, (iii) refining.
- A general work concession grants the right to perform ancillary mining services or activities such as ventilation, sewage, hoisting or extraction to mining activities; and
- A mining transport concession grants the right to provide massive and continuous bulk transport of mineral products by unconventional methods.

A private party can submit an application (*petitorio*) for a mining concession to INGEMMET or the competent Regional Government, as applicable, and if it complies with the

⁴³ Sociedad Nacional de Minería, Petróleo y Energía, *Peru Mining Investment Handbook* prepared. Available at <https://resourcegovernance.org/sites/default/files/Mining%20investment%20handbook%20ENGLISH.pdf>

appropriate requirements, such as publication of legal notices and favorable technical and legal opinions, a resolution granting the concession shall be enacted. Once a concession is granted, an environmental study must be approved before the development of a mining project.

Environmental Impact Assessments (EIA)

In 1990, Legislative Decree No. 163 introduced environmental impact assessments (EIAs) to the management structure of the Peruvian mining industry. It required that the EIA be approved before the implementation of investment projects and that the information contained in the EIA shall be accessible to the public, with some exceptions. This approach was strongly challenged by the private sector that perceived environmental protection as an obstacle to economic growth⁴⁴.

Nevertheless, by the late-2000s EIA became the key instrument for environmental policy in Peru, covering all economic activities at the national, regional and local levels. In this regard, the holders of concessions that have completed the exploration and plan to initiate the mining exploitation must submit the corresponding EIA.

Based on their environmental risks, investment projects are classified as follows:

- Category I. Projects that do not have significant negative impacts on the environment.
- Category II. Projects that may have moderate negative impacts on the environment.
- Category III. Projects that may cause significant negative impacts on the environment.

Therefore, holders must do the following:

⁴⁴ Mariano Castro, Ernesto Sánchez-Triana, Fernando Loayza, Juan Albarracín-Jordan, and Ana Luisa Lima, *Environmental impact assessment reform in Peru*. Available at <https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.568.841&rep=rep1&type=pdf>

- Category I. Submit a simplified environmental impact statement (*Declaración de Impacto Ambiental*) (DIA) before the corresponding authority of the relevant sector.
- Category II. Submit a semi-detailed environmental impact assessment (EIASd) before the corresponding authority of the relevant sector.
- Category III. Submit a detailed environmental impact assessment (EIAAd) before the corresponding authority of the relevant sector.

EIAs are studies carried out by the mining company -and its consultants- that must be prepared for starting activities in mining. They must assess, identify and describe the physical-natural, biological, socio-economic and cultural aspects corresponding to the project's area of influence. In this sense, it is more like a map that indicates the existing conditions of the environment (before mining activities), such as water springs, canals, monitoring stations, and archeological sites, soil types, air quality, underground and surface water flows, and other features of the landscape. In addition, these studies must include an inventory of the area's natural resources, animal and plant species (identifying sensitive habitats and vulnerable or endangered species, if the case), and local communities.

This map will help to predict any environmental disaster arising from mining activities, and more important, to take internal control measures to mitigate and monitor the biophysical, social, and other effects of the mining activities; and in this sense, to achieve a harmonic balance between the mining activities and the environment.

The second function of an EIA is to identify the impacts that the mining activity, duly described, may have. In this sense, the EIA will help to elaborate a strategy for environmental management, monitor and control plans, which includes:

- I. The contingency plan.
- II. The compensation plan.

- III. The closure plan: mining companies must prepare, submit to MINEM for its approval and execute a closure plan, including technical and legal actions that the titleholder must perform to establish all measures in order to remediate the area used for mining activity and recondition, reduce and eliminate, where possible, all the contaminant effects that would harm the population and the ecosystem.

The titleholder must also grant environmental guarantees to secure the compliance with the closure plans and to cover the costs of rehabilitation measurements for the periods of final closure and post-closure of the mining activity.

- IV. The community participation plan: MINEM, through the General Bureau of Mining Environmental Matters - DGAA, is the competent authority to guide, direct and carry out processes of citizen participation related to the mining activities of medium and large mining.

Once the EIA is presented to MINEM, the DGAA is in charge of convening a public hearing in order to present the results. The public hearing must be announced at least 40 days in advance via press and radio, and open access to EIA documents must also be provided. Within 30 days of the hearing, the public is able to present observations and recommendations to MINEM.

EIAs are prepared by authorized entities, which are qualified and registered in the Registry of Entities Authorized to Conduct Environmental Impact Assessments in the Energy and Mining Sector. It is worth mentioning that for the elaboration of EIAs, these entities must follow parameters and guidelines established by regulations.

The approved environmental study must be updated by the mining company in every fifth year, counted from the start date of project execution and consecutively in equal periods, in the components that require it, in accordance with the provisions of the SEIA.

EIAs and Tailings Dams

One of the most important measures taken by the Peruvian government is that the construction of tailings dams with the upstream method is prohibited. Additionally, in 1997 technical guidelines were issued for tailings dams. Beyond those legal provisions there are not many rules and regulations specifically designed for tailings dams.

In this sense, an EIA is the key document which considers the management and control of tailings dams, if a company plans to build one.

For the operation of tailings, pads, leach heaps and waste rock deposits (dumps), the holder is obliged to have permanent professional supervision by a specialized engineer with experience in geotechnics⁴⁵. Tailings must be illuminated and signposted, and accesses must be blocked and prohibited from entering to unauthorized persons.

Likewise, the following measures must be implemented for a tailings dam to be approved:⁴⁶

- A. The control and management of particulate matter emissions in the different stages of the process.
- B. The control and handling of reagents.
- C. Prioritize the use of solids contained in tailings to optimize the final disposal area.
- D. Prioritize the recirculation of the water contained in the tailings to the beneficiation process.
- E. The use of impermeable materials and leakage control systems in the area of the dam and tailings deposits.
- F. Control and maintain the water balance technically established in the tailings deposit.
- G. Use filters for drying concentrates when appropriate.
- H. The control of spills in general and their cleaning.

⁴⁵ According to Supreme Decree No 024-2016-EM.

⁴⁶ According to Supreme Decree No. 040-2014-EM

Finally, as mentioned before, according to Supreme Decree No. 040-2014, the aquatic or underwater disposal of wastelands, tailings and other solid waste from mining activity for the implementation of a mining project is not allowed. A minimum safety radius -safety area- must be defined according to the type of installation or component of the mining project (pipeline, tailings dam, pit or others) within which there should be no dwellings. If productive systems are located within the security area (cultivation areas, pastures or others), the restrictions and security measures of the case should be considered.

When a mining company wants to build and use a tailing dam, the specifications and treatment shall be included in the EIA documentation of the project.

As previously indicated, the EIA is an instrument through which all risks of a mining project are analyzed and presented to surrounding communities, regulators, among others. The government then uses this report to determine if a project can receive an authorization to begin construction. However, there is a lack of consideration of the effects of cumulative impact of mining activities -which should be detailed in the EIA- in EIAs, which have failed to predict environmental and social disasters as a result of mining operations. One can conclude that the current system for EIAs has the potential to misunderstand the full extent of the threat posed by tailings dams.

Hence, there is currently a lack of trust and credibility of EIAs, due to frequent interrogates about EIAs already approved by the Government. Due to poorly designed EIAs, that ended up in environmental contamination and company's breaches of obligations or promises, community believe that companies only disclose certain information, and that has originated social conflicts. This issue and surrounding dynamics are explored in the second half of this report.

For example, in the Las *Bambas* project, the local community showed opposition that led to five modifications to the EIA.⁴⁷ Likewise, the *Conga*'s EIA included "*much useful information,*

⁴⁷ *Peru must revise Las Bambas environmental impact study, say experts.* Available at <https://dialogochino.net/en/extractive-industries/3859-peru-must-revise-las-bambas-environmental-impact-study-say-experts/>

*but left out inconvenient details and contained half-truths and incorrectly interpreted opinions.*⁴⁸”

Recently, there have been controversies regarding the *Ariana* project which some experts think that the dam should not be constructed because of a threat of contamination to water sources close to the project (due to the characteristics of the soil, and other factors). However, the EIA of this project was approved by Directorate Resolution No. 127-2016-MEM/DGAAM, dated April 29, 2016.

In this regard, the introduction of mechanisms of accountability such as the EIA, despite including public participation and community consultation, have not addressed specific, clear, structured and easily accessible legislation about the design, construction, management, supervision and accountability regarding tailings dam, which could increase tensions between mining companies and communities. *“In communities affected by mining, some people argue that the EIA only provides them with an opportunity to ask questions and make comments, which may lead to some modifications in the company's environmental mitigation plans, but cannot stop a proposed project from being approved. Conflicts still surface repeatedly in communities around the Yanacocha mine, and critics continue to fault the company's lack of transparency, inadequate processes of community consultation, and the absence of the state.*⁴⁹”

These examples show that there is a misunderstanding of the importance of the EIA, and that some companies may use EIA as a public relation document that intends to complete a checklist in order to start operations in the mine. This use of EIA can cause a huge problem specially for tailings dams because, as we have seen, there is no much regulation about tailings dams; in this sense EIA become critical when approving the design, construction and maintenance of tailings dams. In this sense, mining companies, communities and regulators need to be sure that

⁴⁸ Robert E. Moran, *The Conga Mine, Peru: Comments on the Environmental Impact Assessment (EIA) and Related Issues*. Available at:

<https://media.business-humanrights.org/media/documents/files/media/documents/peru-conga-rem-rept-english-march-8-2012.pdf>

⁴⁹ Fabiana Li, *Documenting Accountability: Environmental Impact Assessment in a Peruvian Mining Project*. *Political and Legal Anthropology Review*, November 2009, Vol. 32, No. 2 (November 2009), pp. 218-236. Available at

<https://anthrosource.onlinelibrary.wiley.com/doi/full/10.1111/j.1555-2934.2009.01042.x>

this document contains the appropriate infrastructure of the dam and details the conditions of the environment that surrounds a dam, in order to prevent any disaster.

Analysis and Recommendations

After a project is commenced and operational, tailings are an inevitable side-effect. Accordingly, it is important to consider the management of tailings throughout the project life-cycle, but even more importantly after project closure which leaves the waste material on-site in a storage facility intended to last for an indefinite period, theoretically forever.

For example, according to MINEM, 325 out of 7956 “*pasivos ambientales*” are related to tailings dams, which 49 are labeled as “very high risk” -with 7 being reused- and 80 as “high risk” -with 18 being reused.⁵⁰

This shows that tailings dams are a real threat in Peru. That is why the government issued a Regulation for Environmental Emergency Reports, which aims to regulate the technical-legal analysis of environmental emergency reports -such as tailing dams failures- presented in activities such as mining, whose environmental control is in charge of OEFA.

An environmental emergency has been defined as a sudden or unpredictable event generated by natural, human or technological causes that affect the activity of the company and that generate or may generate deterioration to the environment, which must be reported to OEFA. By way of example, the cases of environmental emergencies that must be reported are the following: fires; explosions; floods; hydrocarbon spills and/or leaks in general; dumping of tailings, toxic substances or hazardous materials; extraordinary discharge of production or waste water; among others.

⁵⁰ http://www.minem.gob.pe/minem/archivos/ANEXO_RM238.pdf

To sum up, considering that Peruvian regulations do not have many dispositions, obligations and prohibitions regarding tailings dam, mining companies are the ones who propose the location, the type of dam, and design its characteristics and management through the appropriate EIA, which under the lack of proper supervision (ex-ante and/or ex-post) may become a major problem for Peruvians.

General regulatory standards

In the following sections, we make recommendations for possible legislative changes in Peru's legal framework regulating tailings dams based on general standards and provide examples of legislative frameworks in other jurisdictions.

Several general standards have been developed with respect to the management of mines and tailings dams in particular.

Some of the most practical and progressive standards for mining have been developed in the Initiative for Responsible Mining Assurance (IRMA)⁵¹ standards. Under this initiative, environmental and human rights organizations worked together with mining companies, labour unions, community organizations and downstream users of mining products to produce standards that mining companies must meet if they want to be certified by the IRMA. The aim is to create an independently verified responsible mining assurance system that improves social and environmental performance.

For example, on the identification, characterization and evaluation of possible environmental and socioeconomic impacts in environmental studies, the standards provide that such studies should preferably be quantitative and should allow the relevant authority and the stakeholders to have a clear understanding of the impact of the mining project on the environment.

⁵¹ See the IRMA website at <https://responsiblemining.net/>.

Since Article 42⁵² of Supreme Decree No. 040-2014-EM allows international and national standards to be used, we consider that the inclusion of these IRMA standards could positively impact and strengthen the Peruvian regulation on water quality and tailings dam construction and maintenance. This measure that relies on a third party certification can also help the Peruvian Government in the assessment of EIAs.

Additionally, in 2015, Mining Watch Canada joined Fair Mining Collaborative and Northern Confluence in detailing how Canadian mining laws should be updated to prevent future tailings storage facility disasters. These recommendations form a good summary of the type of legislative changes that could be implemented in Peru⁵³.

RECOMMENDATION: We recommend that Peru enacts legislation requiring all mining companies to comply with the IRMA standards and certification.

Regulatory Standards for Tailings Dams

Governments should enact rules concerning the construction of tailings dams in order to mitigate, as much as possible, the risks identified in the previous sections.

In general, governments should force the industry to move away from using technologies that pose a significant threat of failure, that allow too much room for human error and that are known to have a detrimental impact on communities and ecosystems.⁵⁴ These regulations should require, amongst others, the use of “filtered tailings” (tailings that have been desaturated and do not present the risk of flowing downstream), and should prohibit the construction of dams upstream of local communities. Additionally, it should be required that financial feasibility studies conducted for proposed mines and waste disposal systems take into account the full long-term life cycle costs of

⁵² Article 42 of DECRETO SUPREMO No. 040-2014-EM

⁵³ Stano, Maya, P.Eng. LL.M. Lehrer, Emma, B.Sc.LL.B. *Fair Mining Practices: A New Mining Code for British Columbia*. Commissioned by the Fair Mining Collaborative. March 2013.

⁵⁴ See Earthworks website at <https://www.earthworks.org/campaigns/preventing-mine-waste-disasters/protecting-communities-from-tailings-disasters/>.

facilities and include externalities such as long-term costs/risks to the environment, industry and taxpayers, and public safety.⁵⁵

REQUIREMENTS IN OTHER JURISDICTIONS: *In most jurisdictions, mining companies are required to design their operations in a way that minimizes environmental risks such as leakages from tailing dams. These design requirements must generally be accounted for in the mining companies' environmental impact assessment submission.*⁵⁶ For example:

- *In British Columbia and New Mexico, mining companies must provide a detailed description of how they will manage tailings and give justification for their approach. In British Columbia, the Health, Safety and Reclamation Code for Mines in British Columbia was recently updated to increase design standards for tailing storage facilities. These updates included the introduction of new criteria for steepness of dam slopes, earthquake and flood design; additional responsibilities for the engineer of record, and the establishment of an Independent Tailings Review Boards.*⁵⁷
- *In other jurisdictions, the tailings design is addressed in the discharge permits, or in a separate permit. For example, in Arizona, plans for the disposal of waste water must be submitted for approval with the state wastewater disposal permit, whereas in Nevada, a permit is required before the construction or modification of any tailing impoundments.*
- *Other jurisdictions, such as South Africa and Chile for example, just provide specific requirements for the technical design of tailings.*

RECOMMENDATIONS:

- Require environmental assessments for all mines and for major expansions of existing mines⁵⁸ and reform the existing EIA framework, taking into account the issues identified above

⁵⁵ BC Mining Law Reform, *Water Disposal and Management*, University of Victoria Environmental Law Centre, p. 6.

⁵⁶ Sophie Thomashausen, Nicolas Maennling*, Tehtena Mebratu-Tsegaye, *A comparative overview of legal frameworks governing water use and waste water discharge in the mining sector*, Resources Policy, 55, 2018, p. 147.

⁵⁷ BC Mining Law Reform, *Water Disposal and Management*, University of Victoria Environmental Law Centre, p. 9.

⁵⁸ BC Mining Law Reform, *A Plan of Action for Change*, p. 5.

- Although Peruvian law already bans upstream tailings dams, however, we consider that other measures regarding the design and construction of dams, aiming to limit the negative impact on communities and the environment should be implemented.

Regulation on the Operation of Tailings Dams

With respect to the operation of tailings dams, the government should ban the disposal of tailings into lakes, rivers or oceans, as this can damage aquatic life and ecosystems, and threaten drinking water and human health. A number of jurisdictions have already acted to restrict or prohibit the direct disposal of mine waste into natural water bodies. Additionally, the IRMA should not certify mine sites that use river, submarine and lake disposal of mine waste materials.⁵⁹

Additionally, monitoring of mining companies' management of tailings dams is crucial. Hence, strict monitoring of tailings management should be established by the government. It is essential in this regard that the information collected from regular visual inspections and available monitoring instrumentation is reviewed by an assessor with knowledge of the behaviour of tailings dams.⁶⁰

REQUIREMENTS IN OTHER JURISDICTIONS:

- *In Poland and Hungary for example, annual inspections of tailings dams are to be performed;*⁶¹
- *The Swedish dam safety guidelines, which are also applicable to tailings dams, require that all tailings facilities have appropriate instrumentation to control the operation of the facility, check the stability and evaluate the status of the dam;*⁶²
- *Similarly, in Finland for example, tailings dams are inspected every five years by a competent expert and annual inspections must be performed by maintenance.*⁶³

⁵⁹ BC Mining Law Reform, *Water Disposal and Management*, University of Victoria Environmental Law Centre, p. 8.

⁶⁰ *A review of the risks posed by the failure of tailings dams*, 2019, p. 18.

⁶¹ *A review of the risks posed by the failure of tailings dams*, 2019, p. 19.

⁶² *A review of the risks posed by the failure of tailings dams*, 2019, p. 20.

⁶³ *A review of the risks posed by the failure of tailings dams*, 2019, p. 20.

RECOMMENDATIONS:

- Considering that Peru already prohibits the direct disposal of mine waste into natural water bodies, it is recommended that Peru strengthen its legal framework to require better and more consistent monitoring of tailings dams. Depending on the available financial means, this monitoring can either be conducted by the government, or the government can mandate mining companies to conduct such monitoring themselves by appointing independent experts. Also, annual inspections should be conducted.

Regulation on Tailings Dam Failure

One of the main problems with tailings dams worldwide is handling the environmental liabilities that are left unresolved after mining companies abandon a mining site. The main challenges in this regard are related to identifying who is responsible for the site after its closure.⁶⁴ It is therefore essential to develop mechanisms that enable the identification, maintenance and/or restoration of abandoned or ‘orphaned’ facilities.⁶⁵

REQUIREMENTS IN OTHER JURISDICTIONS: *The legal frameworks in most jurisdictions require mining companies to take measures to mitigate the environmental impact of a mine after it ceases to operate. More specifically, in most jurisdictions, as a condition for the approval of a mining permit, a post-mine closure plan must be submitted. That plan should set out how the company intends to minimize water contamination at the end of a mine operation's life.*⁶⁶

In some jurisdictions, mining companies are required to prepare a budget for the implementation of the post-mine closure plan, and/or to submit a financial security or bond to cover the anticipated cost of post-mine closure activities. Jurisdictions differ on who is required to certify the anticipated cost, the extent to which such amount is negotiable, and for how long the security or bond must be maintained. For example:

⁶⁴ *A review of the risks posed by the failure of tailings dams*, 2019, p. 34.

⁶⁵ Global Industry Standard on Tailings Management, August 2020, p. 4.

⁶⁶ Sophie Thomashausen, Nicolas Maennling, Tehtena Mebratu-Tsegaye, *A comparative overview of legal frameworks governing water use and waste water discharge in the mining sector*, Resources Policy, 55, 2018, p. 147.

- *In South Africa and China, any security or bond submitted may be released or refunded in full when the mine site is certified as having implemented all required post-closure actions, typically before a mine is fully decommissioned.*
- *By contrast, in the U.S., reviewed mining authorities may refund portions of the bond posted as segments of the post-mine closure plan are successfully implemented. In Nevada and New Mexico, where the closure requirements include a 5-year and 12-year monitoring period, respectively, after the mine has ceased operating, the financial assurance may only be refunded in full at the end of the monitoring period. Few jurisdictions outside of the United States require any active monitoring of the mine site post-mine closure.⁶⁷*

RECOMMENDATIONS:

- Peru's legislation should ensure that mining companies (managers, CEOs etc.) can be held both civilly and criminally liable for the damages caused by tailings dams failures, both during the mining operations and for a certain period of time after the closure of a mine;
- An important question to consider with respect to civil liability is the burden of proof. As it cannot be expected that the victims of a tailings dam failure bear the burden of proving the existence of a fault committed by the mining company at issue, a form of objective or "faultless" liability should apply to these cases.

Complaints and Grievance Mechanism

In addition to the possibility for legal action mentioned in the previous section, it is crucial for legislators to provide accessible and effective means for affected communities and individuals to raise and resolve mine-related complaints and grievances at the mine operational level, while not limiting their ability to seek remedy through other mechanisms.⁶⁸

⁶⁷ Sophie Thomashausen, Nicolas Maennling*, Tehtena Mebratu-Tsegaye, *A comparative overview of legal frameworks governing water use and waste water discharge in the mining sector*, Resources Policy, 55, 2018, p. 147.

⁶⁸ IRMA Standard, p. 31 and following.

The General Environmental Law currently allows citizen participation to help OEFA's supervision through community participation, through the following forms:

- a. Inspection and visual control of pollution processes.
- b. Inspection and control through measurements, sampling or environmental monitoring.
- c. Supervision and control via the interpretation or application of environmental studies or evaluations carried out by other institutions.

The results of the inspection and control actions carried out as a result of citizen participation may be made known to the local, regional or national environmental authority, for the purpose of their registration and corresponding complaint. If the authority decides that the complaint is not appropriate, it must be notified, with expression of cause, to whoever provides the information, saving their right to resort to other instances.

RECOMMENDATIONS:

- We recommend more promotion of the existing measures in order for them to become popular and better used by the communities; and
- We recommend that Peru mandates mining companies to elaborate internal grievance mechanisms enabling stakeholders to address any issues arising out of mining operations as a preliminary and simple step before having to undertake legal action.

Improving and Cultural Considerations in the Mining Industry Respecting Human Rights

The intersection of water, mining and human rights meets where the operational needs of mining conflicts with local populations' right to water. A culturally inclusive mining industry hence necessitates a government that complies with its international obligations to protecting the human rights of its citizens. Access to water is not only considered to be a precondition for the fulfilment of human rights, but is also recognized as being indispensable for leading a life with dignity.⁶⁹ Fundamental to International Human Rights Law are the obligations set out in the

⁶⁹ Kemp, D., Bond, C. J., Franks, D. M., & Cote, C. (2010). Mining, water and human rights: Making the connection. *Journal of Cleaner Production*, 18(15), 1553–1562. <https://doi.org/10.1016/j.jclepro.2010.06.008>

International Covenant on Economic, Social and Cultural Rights, which calls on its member states to ensure the progressive realization of its citizens economic, social and cultural rights. As a signatory to the Covenant, Peru is bound by the obligations set out in the Covenant, requiring it to guarantee three of its core provisions: the right to health, the right to an adequate standard of living and the right to life. While one's access to water is not recognized under the law as a distinct right in itself, it is considered to be intrinsic to the afore-mentioned rights. One's right to water and to sanitation, on the other hand, impose specific legal obligations on signatories. The interdependence amongst one's right to water, right to health, and right to housing requires intersectoral, holistic policy approaches to be embedded in any decision-making processes relating to climate change or water management.⁷⁰

Upholding human rights at both the national and community level must be viewed as a prerequisite for the desired social cohesion in and around mining projects. Threats to human rights at the local level have a greater propensity to escalate into conflict where governance frameworks are particularly weak.⁷¹ According to Mining Vision 2030, a good governance framework is one that is committed to a decentralized, democratic system through which development agreements are designed and implemented with the participation of all relevant stakeholders. An inclusive governance framework, must thus consider:

Gender Gap: Water Security & Water Governance

While men and women will be exposed to the same threat to water brought on by climate change, they are expected to experience such risks in different ways. As primary caretakers, and often those in charge of providing water to their households or caring for family members suffering from waterborne diseases, women and girls will be disproportionately affected by water insecurity. Such responsibility may keep young girls from school, women from being able to maintain employment, and exposes them to potential physical injury, as accessing water often means carrying heavy loads over long distances. Though they are actively engaged in water management, women only make up an estimated 15% of water utility employees in Peru, 7% of executive-level

⁷⁰ de Albuquerque, C., 2009a. Climate Change and the Human Rights to Water and Sanitation. Position Paper of the Independent Expert on the Issue of Human Rights Obligations Related to Access to Safe Drinking Water and Sanitation.

⁷¹ https://eiti.org/files/documents/peru_mining_vision_15_july_draft.pdf

positions in water user groups and only 6% of general manager positions in water utilities.⁷² The gender gap in decision-making is attributed to the disparities in land ownership in Peru, as holding water rights and participating in water user groups are directly contingent upon land ownership. Given that women only hold about 22% of the country's agricultural land titles, the disparity in land ownership is inevitably reflected in women's employment in the sector. Women are therefore not only the one's in charge of accessing water, but are simultaneously the least likely to receive it and have a role in managing it.

Strengthening Institutional Capacities

The Peruvian government must seek to lead the charge on strengthening the capacities of not just the institutions involved in the territorial, environmental and social development of communities, but those responsible, at the regional level, for holding such institutions accountable. Mining companies should work in tandem with the government to undertake due diligence efforts in order to ensure that security and law enforcement personnel are adequately educated and trained in matters that may affect the rights of populations living near mining sites.⁷³

Community engagement

Communities must have the power to decide whether or not they accept the long lasting and potentially disastrous consequences associated with tailings storage. Governments and mining companies should therefore allow for a transparent consent process that gives affected communities the ability to veto a project if they decide it is too dangerous.⁷⁴

For indigenous peoples in particular, international law recognizes that Free, Prior and Informed Consent (FPIC) must be in place in order for a mine to be developed, operated and closed. If a

⁷² Moss, S., & Gammie, G. (2019, November 14). Peru's leading Water Institutions commit to increasing women's role in water management. <https://www.forest-trends.org/blog/perus-leading-water-institutions-commit-to-increasing-womens-role-in-water-management-at-first-of-its-kind-national-forum/>

⁷³ See https://eiti.org/files/documents/peru_mining_vision_15_july_draft.pdf

⁷⁴ See Earthworks website at <https://www.earthworks.org/campaigns/preventing-mine-waste-disasters/protecting-communities-from-tailings-disasters/>.

community deems that a mine can-not safely and responsibly dispose of waste, the mine should not move forward.⁷⁵

Please note in this regard that the 2020 Columbia Capstone team developed an agreement putting communities on a comparable, if not equal, footing with mining companies and the government: the Community Partnership Agreement (report addendum).

Assessment and Recommendations for Inclusive Community Partnership

One of the core tenants of Peru's Mining Vision 2030 is that the country's mining industry be inclusive, and socially and territorially integrated. The fulfillment of that aim is largely dependent on the public participation procedure, which has revealed a series of challenges that have prevented or slowed the mining industry's ability to successfully roll out their projects or peacefully integrate into local communities. Such challenges were seen in the cases of Cerro Quilish, Conga and Rio Blanco, for instance, where an inability to obtain a social license stemmed from a combination of common elements which included either:

- (i) Activists who mobilized populations into challenging the rolling out of the mining project by promoting or inciting social conflicts on the basis of negative preconceptions regarding the implications and effects of mining activities, or⁷⁶
- (ii) Local authorities that either instigated or failed to anticipate the social conflict, and chose to resolved it by demanding that the mining company assume greater obligations⁷⁷

Given that the majority of mining projects tend to be located in areas with high poverty rates, mining companies tend to undertake state-like functions in order to obtain social licenses with these communities. This inevitably gives mining titleholders a state-like image, causing confusion amongst local populations about what obligations and commitments correspond to the state's responsibility, and those that fall under the purview of mining companies. This confusion translates into a misconception that mining companies have an obligation to build public facilities like

⁷⁵ See Earthworks website at <https://www.earthworks.org/campaigns/preventing-mine-waste-disasters/protecting-communities-from-tailings-disasters/>.

⁷⁶ Prado, L. R. (2019, November 29). Mining Projects in Peru: Community Relations, Indigenous Rights and the Search for Sustainability.

⁷⁷ Prado, L. R. (2019, November 29). Mining Projects in Peru: Community Relations, Indigenous Rights and the Search for Sustainability.

hospitals and schools, and provide public services, like electricity, drinking water and public health programs.⁷⁸ While many mining companies invest in communities by providing such facilities and services through corporate social responsibility, they do not have the legal obligation to do so. In an effort to mitigate the false narrative and sense of expectation around mining companies' obligations to local communities, it is important that the government, the mining company and the community establish a clear and inclusive multi-stakeholder approach which may include:

Considering Community-Specific Issues

Mining companies who have had success in building relationships with communities may realize that using the same approach to earn the consent of a neighboring community may look entirely different. The Database of Indigenous or Native Peoples (BDPI) recognizes the existence of 55 Indigenous Peoples in Peru, who together speak a total of 47 different indigenous languages.⁷⁹ Furthermore, the estimated 27% of Peruvian territory covered by mining concessions is located on 47.8% of indigenous territory.⁸⁰ This reality emphasizes the need for each community-based approach to be context specific, recognizing that communities, even within the same region, may have different cultures, speak different languages and identify in different ways.

Greater Representation

One of the key recommendations outlined in the Report of the Independent High-level Panel of Peace Operations, which aimed to improve the United Nations' Peacekeeping operations, emphasized the important role of "inclusive and equitable development practices"⁸¹ in conflict prevention and stressed that "UN mediators should work with relevant actors in the country and regions concerned, including community, religious leaders, and civil society representing women, youth and others."⁸² A similar approach can be taken in Peru's mining context, as the fortification of inclusive development plans could bring actors most representative of local communities to the discussion table, establishing a more accurate and credible voice for the people.

⁷⁸ Ariana

⁷⁹ *INDIGENOUS WORLD*. (2020). IWGIA. https://iwgia.org/images/yearbook/2020/IWGIA_The_Indigenous_World_2020.pdf

⁸⁰ *INDIGENOUS WORLD*. (2020). IWGIA. https://iwgia.org/images/yearbook/2020/IWGIA_The_Indigenous_World_2020.pdf

⁸¹ *Report of the High-Level Independent Panel on United Nations Peace Operations: Uniting Our Strengths for Peace- Politics, Partnership and People*. 16 June 2015. Pg. 19.

⁸² **Ibid, Pg. 20**

Clear Messaging

A multi-stakeholder approach brings a number of ideas, voices, opinions and concerns to the table, enriching the decision-making process. Such an approach also makes room for confusion, however, as the number of actors engaged in the process will inevitably demand for greater coordination and alignment, particularly between the national government and the different levels of government at the regional and city level. Aligning the priorities and positioning of the government, at every level, will facilitate the planning and implementation of development priorities, and lend to a more credible image. Such coordination will also reveal any semblance of corruption within government bodies, particularly at the sub-national level, allowing the weak accountability mechanisms exploited by such individuals to be identified and strengthened.

Understanding the Needs and Capacities of Communities

Nueva Fuerabamba was built by MMG Ltd., a Melbourne-based unit of China Minmetals Corporation, to house the ~1,600 people displaced to make room for the company's open-pit copper mine.⁸³ The new residential area boasts paved streets and new homes with electricity and indoor plumbing, luxuries that the mine operator believed would be well received by the indigenous people who now call it home. Nueva Fuerabamba is widely considered one of the most generous mining settlements ever negotiated in Peru, and while it provided luxuries and benefits that the community voted for in the 2009 deal, its provisions proved to be too foreign for the indigenous population.⁸⁴ A Reuters study interviewed two dozen residents in the area, many who said they missed their old, simple lives and who still struggled to navigate the new suburban-style amenities three years later. Farmers have had difficulty adjusting to the loss of their traditions, and some have misspent the cash settlements granted to them. The new farming and grazing land provided to them are too far away, many residents say, forcing them to leave their crops and livestock behind. The jobs promised by the MMG proved to require skill sets that most members

⁸³ Taj, M. (2017, December 07). Displaced by mining, Peru VILLAGERS spurn shiny new town. <https://www.reuters.com/article/us-mm-g-peru-insight/displaced-by-mining-peru-villagers-spurn-shiny-new-town-idUSKBN1E10JG>

⁸⁴ Taj, M. (2017, December 07). Displaced by mining, Peru VILLAGERS spurn shiny new town. <https://www.reuters.com/article/us-mm-g-peru-insight/displaced-by-mining-peru-villagers-spurn-shiny-new-town-idUSKBN1E10JG>

of the community lacked, making them incapable of maintaining or participating in such work. A more people-centered approach can better expose the community's histories, skill sets, and strengths and allow mining companies to make more informed, community-specific investments. This would not only give way for communities to capitalize on the amenities and benefits granted to them, but it would also give mining companies a more human-like image, one that is genuinely invested in their growth. Such efforts would help the companies establish a transparent and trusting relationship with the people, which is crucial for the successful and peaceful implementation of any mining project.

RECOMMENDATIONS:

- Ensure that no mineral tenure, mining exploration, siting, or other activities occur without the free, prior, and informed consent of affected indigenous communities, including the implementation of a Community Partnership Agreement;
- Considering that under Peruvian law EIAs already include a community participation plan, we strongly believe that mining companies and the government should focus their attention on tailings dams. In this sense, MINEN and/or SENACE could prepare some guidelines regarding the approach that mining companies shall perform in order to provide specific sessions in which they assess tailings dams with the community. These sessions should be especially important to hear the concerns and problems that dams could create in the future for communities and to provide the tools that communities need in order to be secure against possible dam failures.

Conclusion and next steps

With full understanding of the current political, economic, and public health crises that Peru is facing today, the aspiration of this report is to provide a foundation of evidence and justification for the prioritization of tailings dams in the implementation of Mining Vision 2030. COVID-19 has reminded the world of the unanticipated disasters that lie among us, but through proper regulation, engineering best practices, and strict liability, tailings dams do not have to be one of them. With this in mind, our team recommends that the Ministry of Energy and Mines consider the following as they continue to position the Mining Vision 2030 as the leading example of environmentally and socially responsible mining practice.

International standards provide a framework for the highest social and environmental standards, and although general, can provide a vital validation of Peru's mining practice. By implementing and becoming IRMA certified, Peru's mining sector stands to further fortify their place as a leader in mining standards. Worldwide the effectiveness of Environmental and Social Impact Assessments is in question, and calls for reform are being made as they continue to fail to predict cumulative environmental and social impacts of mining projects. Through deeper consideration of the requirements for a and role of Environmental and Social Impact Assessments, Peru stands to benefit a great deal through helping set a new global standard for risk analysis. Our team is recommending that the next Capstone project examine this potential more deeply. More specifically to tailings dams, stricter standards for monitoring and maintenance under the threat of both civil and criminal liability can incentivize companies to improve the overall standards for waste management. When considering improvements to current environmental legislation, we support the call for stronger accountability for multinational companies working in Peru to avoid the burden falling to the state and local communities.

Finally, we consider deeply the efforts currently underway by RIMAY in community consultation, and seek to promote them as a global best-practice. Continuing the push for equitable and inclusive community consultation is the backbone of fair mining practice with cultural, social, and economic benefits at the forefront. This effort can be further strengthened by facilitating the full integration of a company into the mining community to ensure that effective and accurate lines of communication are established through mutual accountability. This encourages the prioritization of family-level benefits of mining revenues, like education and public health, over

more aesthetic improvements through the modernization of infrastructure or construction of new commercial facilities.

In this research we have come to understand the intensely complex issues that face Peru in this moment. We have had the opportunity to witness MINEM in a moment of transition and uncertainty continue to work diligently to position the role of the mining industry in such a way that benefits the country's most vulnerable people and preserves its vital ecosystems. Though tailings dams are just one small aspect of the complex issues facing the sustainability of the industry, we hope this report can serve as a foundation for future research and reform to set a new global standard for handling these inevitable yet looming threats.

Works Cited

CASE STUDIES:

Brazil:

Sato, Y. & Godinho, H.P, 2003. Migratory fishes of the Sao Francisco River. Migratory Fishes of South America. World Fisheries Trust/The World Bank/International Development Research Centre, Ottawa. Pp. 195-232.

Kossoff, D., Dubbin, W.E., Alfredsson, M., Edwards, S.J., Macklin, M.G., Hudson-Edwards, K.A., 2014. Mine Tailing Dams: Characteristics, Failure, Environmental Impacts and Remediation. Appl. Geochem. 51, 229-245

Robertson, P.K., de Melo, L., Williams, D.J. and Ward Wilson, G. Report of the expert panel on the technical causes of the failure of Feijão Dam I, 12 December, 2019

De Sa, Gabriel. (2019, January 29). Brazil's deadly dam disaster may have been preventable. *National Geographic*. <https://www.nationalgeographic.com/environment/article/brazil-brumadinho-mine-tailings-dam-disaster-could-have-been-avoided-say-environmentalists>

The National Council of the Environment (CONAMA 357/2005)

Rotta, L., Alcântara, E., Park, E., Negri, R., et. al. (2020, April 10). The 2019 brumadinho tailings DAM collapse: Possible cause and impacts of the worst human and environmental disaster in Brazil. <https://www.sciencedirect.com/science/article/pii/S0303243420300192>

United States:

Jamasmie, C. (2021, April 05). Florida Faces Imminent Collapse of Giant Phosphate Mine Pond. <https://www.mining.com/florida-faces-imminent-collapse-of-giant-phosphate-mine-pond/>

Cohen, L. (2021, April 08). Florida Lawmakers Budget \$3 million to Clean up Piney Point and HELP "put it behind us once and for all". <https://www.cbsnews.com/news/florida-wastewater-leak-piney-point-200-million-amendment/>

Canada:

Meissner, D. (2019, August 04). Mount Polley mine disaster 5 years LATER; emotions, accountability unresolved | CBC News. <https://www.cbc.ca/news/canada/british-columbia/mount-polley-mine-disaster-5-years-later-emotions-accountability-unresolved-1.5236160>

Chambers, David. Report on Mount Polley Tailings Storage Facility Breach, Independent Expert Engineering Investigation and Review Panel (2015). <https://www.savetheboundarywaters.org/sites/default/files/attachments/45-chambers-mt-polley-tailings-dam-failure-report-summary-feb15.pdf>

Peru:

SPDA Actualidad Ambiental. *Desastre ambiental: 67 mil metros cúbicos de relave minero afectaron al río Mantaro*. 22 de Julio, 2019. <https://www.actualidadambiental.pe/desastre-ambiental-67-mil-metros-cubicos-de-relave-minero-afectaron-al-rio-mantaro/>

Main text body:

Agencia EFE. 2018. “Report Warns of Possible Toxic Leaks from Mining into Lima Water Supply | World | English Edition | Agencia EFE.” December 13, 2018. <https://www.efe.com/efe/english/world/report-warns-of-possible-toxic-leaks-from-mining-into-lima-water-supply/50000262-3841214>.

ATSDR. *Toxic substances portal. toxicological profiles*: ATSDR; 2016.

A review of the risks posed by the failure of tailings dams, *January 2019*. Available at: <https://damsat.com/wp-content/uploads/2019/01/BE-090-Tailings-dams-R1-Secured.pdf>

BBC News. 2015. “Peru Anti-Mining Protest Sees Deadly Clashes.” *BBC News*, September 29, 2015, sec. Latin America & Caribbean. <https://www.bbc.com/news/world-latin-america-34389803>.

BC Mining Law Reform, *A Plan of Action for Change*, p. 5.

BC Mining Law Reform, *Water Disposal and Management*, University of Victoria Environmental Law Centre.

BC Mining Law Reform, *Water Disposal and Management*, University of Victoria Environmental Law Centre, p. 8.

BC Mining Law Reform, *Water Disposal and Management*, University of Victoria Environmental Law Centre, p. 9.

BNamericas Available at: <https://www.bnamericas.com/en/news/higher-mining-output-fails-to-stem-slower-peru-gdp-growth>

BNamericas News. 2018. “Peru posts sluggish July GDP growth”, September 18 2018. <https://www.bnamericas.com/en/news/peru-posts-sluggish-july-gdp-growth>

Cervantes, Maria. 2021. “Protest Blocks \$530 Mln Worth of Copper from MMG’s Las Bambas Mine in Peru -Association.” *Reuters*, January 5, 2021. <https://www.reuters.com/article/peru-copper-bambas-idUSL1N2JG1ML>.

Chibuike GU, Obiora SC. Heavy Metal Polluted Soils: Effect on Plants and Bioremediation Methods. *Applied and Environmental Soil Science*. 2014;2014:12

Christopher S. & Julian D. Olden. Mine waste dams threaten the environment, even when they don't fail. February 24, 2020. Available at: <https://theconversation.com/mine-waste-dams-threaten-the-environment-even-when-they-dont-fail-130770>

de Albuquerque, C., 2009a. Climate Change and the Human Rights to Water and Sanitation. Position Paper of the Independent Expert on the Issue of Human Rights Obligations Related to Access to Safe Drinking Water and Sanitation.

Eisler R. Arsenic hazards to humans, plants, and animals from gold mining. *Reviews of environmental contamination and toxicology*

Fabiana Li, *Documenting Accountability: Environmental Impact Assessment in a Peruvian Mining Project*. Political and Legal Anthropology Review, November 2009, Vol. 32, No. 2 (November 2009), pp. 218-236. Available at <https://anthrosource.onlinelibrary.wiley.com/doi/full/10.1111/j.1555-2934.2009.01042.x>

Government Relaunches its “vision” for mining development (Rimay), October 24, 2020. Available at: <https://perusupportgroup.org.uk/2020/10/government-relaunches-its-vision-for-mining-development-rimay/>

Global Industry Standard on Tailings Management, August 2020, p. 4.

Greenovation Hub 2014. “China’s Mining Industry at Home and Overseas: Development, Impacts and Regulation”, December 01, 2014. http://www.ghub.org/en/wp-content/uploads/sites/2/2019/07/case-study_CN-mining_2014.pdf

Hatje, V., Pedreira, R. M., de Rezende, C. E., Schettini, C. A. F., de Souza, G. C., Marin, D. C., & Hackspacher, P. C. (2017). The environmental impacts of one of the largest tailing dam failures worldwide. *Scientific reports*, 7(1), 1-13.

IEP Informe de Opinion - Abril 2021 - Encuesta telefonica a nivel nacional. Lima, Peru. April 11, 2021. <https://iep.org.pe/wp-content/uploads/2021/04/Informe-IEP-OP-Abril-II-2021-Segunda-vuelta-intencion-de-voto-v2.pdf>

INDIGENOUS WORLD. (2020). IWGIA. https://iwgia.org/images/yearbook/2020/IWGIA_The_Indigenous_World_2020.pdf

J.O. Grimalt, M. Ferrer, E. Macpherson The mine tailing accident in Aznalcollar Sci. Total Environ., 242 (1999), pp. 3-11

Judith Marshall, *Tailings dam spills at Mount Polley and Mariana, Chronicles of Disasters Foretold*, August 2018, p. 43.

Kemp, D., Bond, C. J., Franks, D. M., & Cote, C. (2010). Mining, water and human rights: Making the connection. *Journal of Cleaner Production*, 18(15), 1553–1562. <https://doi.org/10.1016/j.jclepro.2010.06.008>

- Kossoff, D., Dubbin, W.E., Alfredsson, M., Edwards, S.J., Macklin, M.G. and Hudson-Edwards, K.A., 2014. Mine tailings dams: Characteristics, failure, environmental impacts, and remediation. *Applied Geochemistry*, 51, pp.229-245.
- Leotaud, Valentina Ruiz. 2021. "Canadian Company's Exploration Rights in Peru Hanging by a Thread." MINING.COM. January 10, 2021. <https://www.mining.com/canadian-companys-exploration-rights-in-peru-hanging-by-a-thread/>.
- Lyu, Z., Chai, J., Xu, Z., Qin, Y. and Cao, J., 2019. A comprehensive review on reasons for tailings dam failures based on case history. *Advances in Civil Engineering*, 2019.
- Mariano Castro, Ernesto Sánchez-Triana, Fernando Loayza, Juan Albarracín-Jordan, and Ana Luisa Lima, *Environmental impact assessment reform in Peru*. Available at <https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.568.841&rep=rep1&type=pdf>
- Miller, Ben, and Emilie Sweigart. 2019. "How Countries Manage Water: Peru." *Americas Quarterly* (blog). October 15, 2019. <https://www.americasquarterly.org/article/how-countries-manage-water-peru/>
- Moss, S., & Gammie, G. (2019, November 14). Peru's leading Water Institutions commit to increasing women's role in water management. <https://www.forest-trends.org/blog/perus-leading-water-institutions-commit-to-increasing-womens-role-in-water-management-at-first-of-its-kind-national-forum/>
- M.G. Macklin, P.A. Brewer, D. Balteanu, T.J.Coulthard, B. Driga, A.J. Howard, S. Zaharia
The long term fate and environmental significance of contaminant metals released by the January and March 2000 mining tailings dam failures in Maramures County, upper Tisa Basin, Romania Appl. Geochem., 18 (2003), pp. 241-257
- M.G. Macklin, P.A. Brewer, K.A. Hudson, Edwards, G. Bird, T.J. Coulthard, I.A. Dennis, P.J. Lechler, J. R. Miller, J.N. Turner A geomorphological approach to the management of rivers contaminated by metal mining *Geomorphology*, 79 (2006), pp. 423-447
- M. Olías, F. Moral, L. Galván, J.C. Cerón Groundwater contamination evolution in the Guadimar and Agrio aquifers after the Aznalcóllar spill: assessment and environmental implications *Environ. Monit. Assess.*, 184 (2012), pp. 3629-3641
- Ngole-Jeme, V. M., & Fantke, P. (2017). Ecological and human health risks associated with abandoned gold mine tailings contaminated soil. *PloS one*, 12(2), e0172517.
- Njinga RL, Tshivhase VM. Lifetime cancer risk due to gamma radioactivity in soils from Tudor Shaft mine environs, South Africa. *Journal of Radiation Research and Applied Sciences*.
- Dialogo Chino. *Peru must revise Las Bambas environmental impact study, say experts*. October 26, 2015. Available at <https://dialogochino.net/en/extractive-industries/3859-peru-must-revise-las-bambas-environmental-impact-study-say-experts/>
- Prado, L. R. (2019, November 29). Mining Projects in Peru: Community Relations, Indigenous Rights and the Search for Sustainability.

Robert E. Moran, *The Conga Mine, Peru: Comments on the Environmental Impact Assessment (EIA) and Related Issues*. Available at: <https://media.business-humanrights.org/media/documents/files/media/documents/peru-conga-rem-rept-english-march-8-2012.pdf>

Report of the High-Level Independent Panel on United Nations Peace Operations: Uniting Our Strengths for Peace- Politics, Partnership and People. 16 June 2015. Pg. 19.

S.A. Foulds, P.A. Brewer, M.G. Macklin, W.Haresign, R.E. Betson, S.M.E. Rassner
Flood-related contamination in catchments affected by historical metal mining: an unexpected and emerging hazard of climate change *Sci. Total Environ.*, 476–477 (2014), pp. 165-180

See Earthworks website at <https://www.earthworks.org/campaigns/preventing-mine-waste-disasters/protecting-communities-from-tailings-disasters/>.

Socio-economic and demographic factors related to HIV status in urban informal settlements in the Eastern Cape, South Africa. *Steenkamp L, Venter D, Walsh C, Dana P Afr J AIDS Res. 2014 Sep; 13(3):271-9.*

Sociedad Nacional de Minería, Petróleo y Energía, *Peru Mining Investment Handbook* prepared. Available at <https://resourcegovernance.org/sites/default/files/Mining%20investment%20handbook%20ENGLISH.pdf>

Sonneland, Holly. AS/COA Online. Peru's Presidential Crisis: A Timeline. 18 November 2020. <https://www.as-coa.org/articles/perus-presidential-crisis-timeline>

Sophie Thomashausen, Nicolas Maennling*, Tehtena Mebratu-Tsegaye, *A comparative overview of legal frameworks governing water use and waste water discharge in the mining sector*, *Resources Policy*, 55, 2018, p. 147.

Stano, Maya, P.Eng. LL.M. Lehrer, Emma, B.Sc.LL.B. *Fair Mining Practices: A New Mining Code for British Columbia*. Commissioned by the Fair Mining Collaborative. March 2013.

Taj, M. (2017, December 07). Displaced by mining, Peru VILLAGERS spurn shiny new town. <https://www.reuters.com/article/us-mmg-peru-insight/displaced-by-mining-peru-villagers-spurn-shiny-new-town-idUSKBN1E10JG>

Towards a Vision for Mining in Peru in 2030. July 2016. Available at: https://eiti.org/files/documents/peru_mining_vision_15_july_draft.pdf

UK Space Agency and the Global Challenges Research Fund, HR Wallingford. 2019, "A review of the risks posed by the failures of tailing dams" <https://damsat.org/wp-content/uploads/2019/01/BE-090-Tailings-dams-R1-Secured.pdf>

Wills, B.A. and Finch, J., 2015. *Wills' mineral processing technology: an introduction to the practical aspects of ore treatment and mineral recovery*. Butterworth-Heinemann.

Wilson, Scott. 2002. "A Life Worth More Than Gold." *Washington Post*, June 9, 2002.
<https://www.washingtonpost.com/archive/politics/2002/06/09/a-life-worth-more-than-gold/e7edc7f8-9685-466e-ba2b-8d33ed1dde18/>.

World Bank, Bolivia, Chile, Ecuador, and Venezuela Country Management Unit. Systematic Country Diagnostic, Peru. 2017.aa