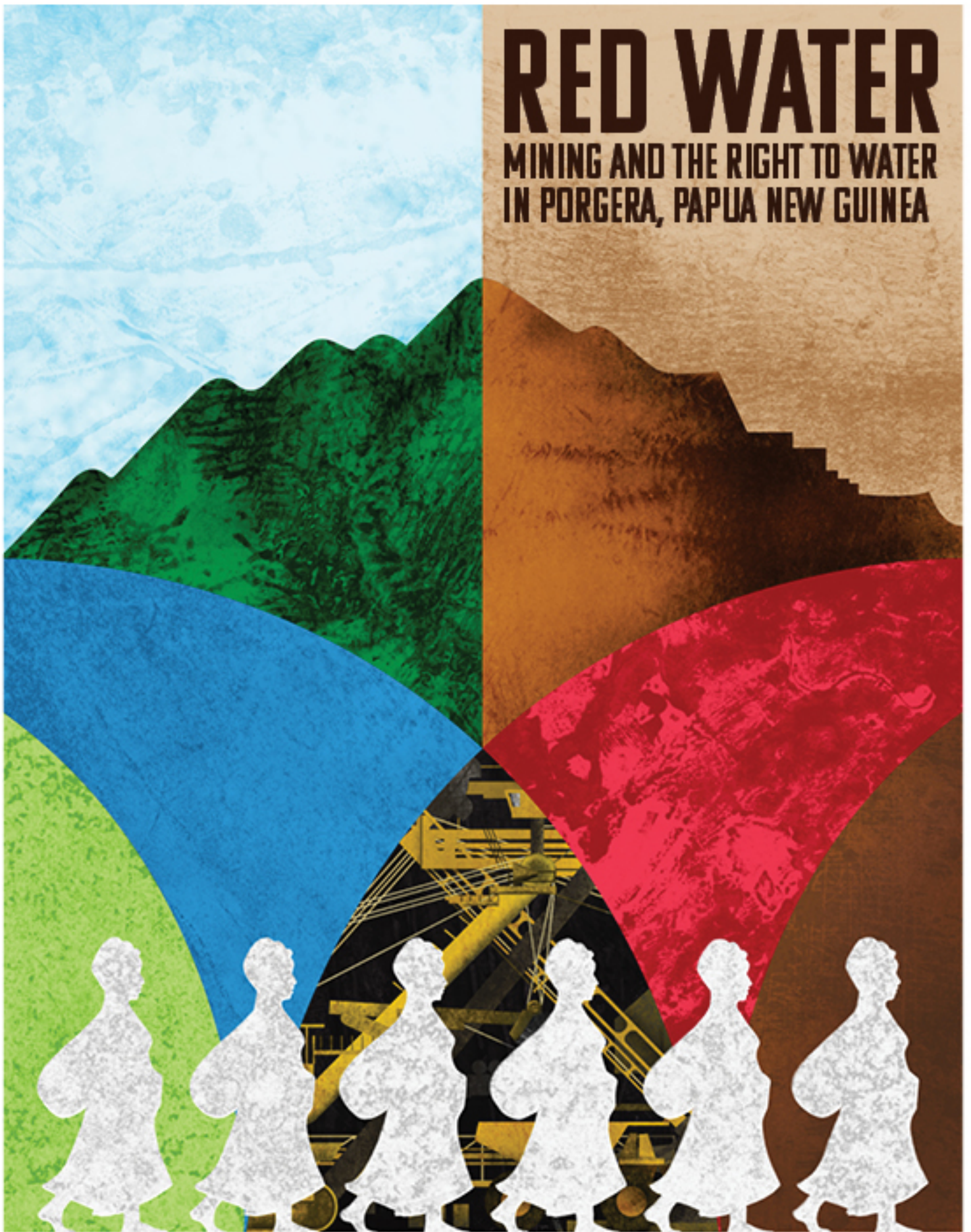


RED WATER

MINING AND THE RIGHT TO WATER
IN PORGERA, PAPUA NEW GUINEA



Columbia Law School Human Rights Clinic & AC4, Earth Institute, Columbia University



COLUMBIA LAW SCHOOL

HUMAN RIGHTS CLINIC



Advanced Consortium on
Cooperation, Conflict, and Complexity
EARTH INSTITUTE | COLUMBIA UNIVERSITY

**Red Water:
Mining and the Right to Water in Porgera, Papua New Guinea**

(February 2019)

About the Authors

The [Columbia Law School Human Rights Clinic](#) works to advance human rights around the world, and to train the next generation of strategic advocates for social justice. The clinic works in partnership with civil society organizations and communities to carry out human rights investigations, legal and policy analysis, litigation, report-writing, and advocacy.

The [Advanced Consortium on Cooperation, Conflict and Complexity \(AC4\)](#) at Columbia University's Earth Institute works to bring sustainable solutions to the issues of violent conflict, peace, and sustainable resource management. The Earth Institute, founded in 1995, leverages the expertise of its research centers, scientists, postdoctoral fellows, and staff at Columbia University to generate solutions for sustainable development. This unique institute brings together the intellectual, practical and theoretical resources needed to address some of the world's most difficult problems including environmental sustainability, climate change and poverty.

Acknowledgements

This report is part of an ongoing human rights investigation and advocacy project regarding the impacts of gold mining operations in Porgera, Papua New Guinea. Since 2006, researchers from the human rights clinics of Harvard Law School, New York University School of Law, and Columbia Law School have investigated allegations of human rights violations at the site of the Porgera Joint Venture mine. Prior work has addressed allegations of widespread abuses by security forces at the mine – including arbitrary detentions, physical assaults, sexual violence, and killings – in violation of the rights of local residents. This report, jointly prepared by the Columbia Law School Human Rights Clinic and the Advanced Consortium on Cooperation, Conflict and Complexity (AC4) of Columbia University’s Earth Institute, analyzes the impacts of the mine on the environment and communities immediately surrounding the mine, with a particular focus on local water sources, the right to water, and the extent to which the government of Papua New Guinea and the mining companies have met their international human rights obligations and responsibilities.

The Human Rights Clinic and AC4 would like to express their profound gratitude to the many people in Porgera whose experiences and demands for justice are the foundation for this report. The Clinic and AC4 would also like to thank the interpreters who provided their invaluable expertise in ensuring the careful relay of Porgerans’ important narratives. The Clinic and AC4 would also like to acknowledge and express gratitude for the external reviewers who provided invaluable feedback on drafts of this report.

This report’s lead authors are Sarah Knuckey, Lieff Cabraser Associate Clinical Professor of Law, Director of the Human Rights Clinic and Faculty Co-Director of the Human Rights Institute, Columbia Law School; Benjamin Hoffman, Deputy Director, Columbia Law School Human Rights Clinic; Joshua Fisher, Director of the Advanced Consortium on Cooperation, Conflict, and Complexity (AC4) at the Earth Institute, Columbia University; and Tess Russo, Adjunct Associate Research Scientist, Columbia Water Center at the Earth Institute, Columbia University and formerly RL Slingerland Early Career Professor of Geosciences, Pennsylvania State University, Department of Geosciences.

Contributing Authors and Research Team

Beth Hoagland, Ph. D. '18, Pennsylvania State University
Alison Borochoff-Porte, J.D. '15, Columbia Law School Human Rights Clinic
Stephanie Persson, J.D. '15, Columbia Law School Human Rights Clinic
Holly Stubbs, J.D. '15, Columbia Law School Human Rights Clinic
Genevieve Taylor, LL.M '15, Columbia Law School Human Rights Clinic
Whitney Hood, J.D. '16, Columbia Law School Human Rights Clinic
Gulika Reddy, LL.M '16, Columbia Law School Human Rights Clinic
Lizzie O'Shea, LL.M '16, Columbia Law School Human Rights Clinic
Candy Ofime, J.D. '17, Columbia Law School Human Rights Clinic
Su Anne Lee, LL.M '17, Columbia Law School Human Rights Clinic
Doreen Ivy Bentum, J.D. '18, Columbia Law School Human Rights Clinic
Rachel LaFortune, J.D. '18, Columbia Law School Human Rights Clinic

Oyinkan Muraina, J.D. '19, Columbia Law School Human Rights Clinic
Kamilah Moore, J.D. '19, Columbia Law School Human Rights Clinic
Nia Morgan, J.D. '19, Columbia Law School Human Rights Clinic
Lara Wallis, LLM '19, Columbia Law School Human Rights Clinic
Laura O'Brien, LLM '19, Columbia Law School Human Rights Clinic
Tessa Baizer, J.D. '20, Columbia Law School Human Rights Clinic

Additional Acknowledgements

The authors would additionally like to acknowledge and thank the following individuals who reviewed and commented upon earlier drafts of this report:

Fola Adeleke, Clinical Advocacy Fellow, Harvard Law School International Human Rights Clinic
Abigail Greg, MSc., Graduate Research Assistant, The Earth Institute
Amanda Klasing, Senior Researcher, Women's Rights Division, Human Rights Watch
Margaret Satterthwaite, Faculty Director and Professor of Clinical Law, Center for Human Rights & Global Justice
Inga Winkler, Lecturer in Human Rights, Institute for the Study of Human Rights, Columbia University

The authors would also like to acknowledge the research and cite-checking assistance of the following individuals:

Anna Clare Pogson, LLM '16, Columbia Law School
Jacob Bogart J.D. '18, Columbia Law School
Laura Pond, J.D. '18, Columbia Law School
Sami Cleland, J.D. '19, Columbia Law School
Mari Zaldivar, J.D. '19, Columbia Law School

Daniel Greenfeld designed the cover. Emily McDuff designed and formatted the body of the report.

This report does not represent the institutional views of Columbia Law School or Columbia University.

Funding

This project was funded by (a) Columbia Law School's Human Rights Clinic, and (b) a Cross-Cutting Initiative grant from Columbia University's Earth Institute from December 2013-December 2016.

Table of Contents

About the Authors	iii
Acknowledgements	iv
Executive Summary.....	1
Recommendations	10
Methodology	19
Chapter I: Background: Water, Extractive Industries in Papua New Guinea, and Industrial Mining in Porgera.....	28
Chapter II: Life Near a Mine: Social and Environmental Concerns	36
Chapter III: Legal Framework: The Right to Water and Interrelated Rights	44
Chapter IV: Water in Porgera: Findings from an Interdisciplinary Study	54
Part A: Analysis Of Water Sources In Porgera	56
Part B: Access To Information And Participation.....	91
Chapter V: Legal Analysis of the Realization of the Right to Water in Porgera	110
Conclusion	118
Annex I	120
Annex II.....	127
Endnotes	138

EXECUTIVE SUMMARY

Porgera gold mine in PNG . . . is a world-class gold mine project, with an annual gold production of 15 tonnes.¹

- Zijin Mining Group, co-owner of Porgera Mine, 2015

With these assets, Barrick will have access to over 5,300 square kilometers of contiguous ground for exploration in one of the world's most highly endowed, under-explored gold and copper regions, which is also home to the world-class Porgera mine.²

- Barrick Gold Corporation, co-owner of Porgera Mine, 2007

People say it is a world-class mine, but the environment tells a different story.

- Resident of Yarik Village, Porgera, January 5, 2015

Many indigenous residents of Porgera, Papua New Guinea express deep fear that their lands, water sources, and very bodies are being “poisoned” by the gold mine operating at the heart of their traditional lands. Upon entering the Porgera Valley, it is immediately apparent that industrial gold mining has brought profound physical changes to the landscape. The mine’s open pit has replaced an entire mountain. Fences topped with razor wire crisscross the land. Giant piles of waste rock create new, craggy terrain, across which the rumbling of trucks, helicopters, and dynamite blasts echo. An enormous “red river” of warm tailings waste flows out from the mine, charting a course through the valley until it meets with river systems downstream. A constant plume of white vapor wafts from a mill where gold is separated from rock, rising above local villages. Interspersed in this altered landscape are tens of thousands of people, living in cramped villages just minutes away from the mine’s operations.

The Porgera Joint Venture (PJV) gold mine in the highlands of Papua New Guinea (PNG) has been one of the world’s highest producing gold mines over the course of its quarter-century history, and has accounted for a considerable percentage of PNG’s economic income. Yet many Porgeran residents live in deplorable conditions and feel trapped by the mine. Where they once farmed vegetables and collected fresh water from natural streams, they now see ever-expanding waste dumps. For years, security guards at the mine physically abused many residents, including sexually assaulting and gang-raping Porgeran women.³ Residents feel the earth shake with recurring explosions from the mine operations, and worry about landslides threatening their homes and gardens. They see the rivers change color with the addition of mine waste and chemicals, smell the strong odor of industrial chemicals permeating their environment, and worry about the impact of these chemicals on their environment and health. Porgerans watch the white vapor from the mill join the clouds and have concerns about its impact on the rain that they collect to drink and water their gardens. They also hear the noise and feel the dust from trucks moving massive quantities of rock and waste at all hours of the day. The expectations of socio-economic development originally associated with the establishment of the mine have not been met for much of the Porgeran

population, fostering feelings of injustice and disillusionment. With limited jobs available for Porgerans from the mine itself, and few other employment opportunities present, many residents struggle to earn enough money to survive. Many try to make a living by searching in the mine's waste for scraps of gold left over from mine processes, or entering the open pit and risking serious injury.

Porgeran residents have expressed grave concerns regarding the mine's impact on their environment, culture, and way of life. Among the myriad, interconnected social, economic, environmental, and health concerns of the Porgeran people, access to clean water is one of the most urgent. Porgeran residents have often expressed fear and doubt about the availability and quality of water sources, and fear that the water they drink, and with which they bathe, cook, and wash, is a vector of harmful "chemical" emissions from the mine.

The PNG government acknowledges that access to water is a basic human right and that the government has an obligation to ensure that basic water and sanitation facilities are available for the benefit of all. It has made important commitments to improve water, sanitation, and hygiene service delivery as a vital component of long-term sustainable development in PNG in its first Water, Sanitation and Hygiene Policy (WaSH Policy) (2015-2030).⁴ The government has also committed to sustainable and responsible development, fostering economic development while protecting natural resources and the environment, in its National Strategy of Responsible Sustainable Development (StaRS) (2014).⁵ The government acknowledges that it is currently not meeting its national water and sanitation targets, and that, to date, its attempts to improve access to water and sanitation across the country have been inadequate.⁶

Barrick Gold Corporation (Barrick Gold) acknowledges human rights norms as "legal requirements." Its Human Rights Policy states that Barrick "will not tolerate violations of human rights committed by employees, affiliates or any third parties acting on [Barrick's] behalf or related to any aspect of a Barrick operation."⁸ Zijin Mining Group (Zijin Mining) has stated that it is committed to international human rights standards everywhere that it operates.⁹ Both companies have committed to pursuing socially and environmentally sustainable mining.¹⁰ Barrick Gold additionally has adopted a company-wide Water Management Framework aligned with the International Council on Mining and Metals Position Statement on Water Stewardship.¹¹ However, the mining companies do not have a right to water policy for the PJV gold mine.

This report seeks to support Porgeran communities in their efforts to secure their human rights, and the PNG government in its commitment to advancing the human right to water and its efforts to sustainably improve the quality of life in PNG through improved access to water. This report also seeks to support the mining companies to fulfil their responsibilities to respect the right to water and in meeting their goals as sustainable development partners in PNG.

This report is the product of an interdisciplinary and mixed-methods investigation of the right to water and interrelated rights in the residential areas adjacent to the PJV gold mine. The study was carried out in response to serious concerns expressed by residents over many years about the adequacy and safety of water in their area, and about the mine's impacts on their environment.

Drawing upon the research and analysis of environmental scientists and human rights law experts, the report concludes that the residents of Porgera do not have continuous supplies of adequate and accessible safe water or appropriate information about their water sources.

The PNG government and the mining companies Barrick Gold and Zijin Mining, and their jointly controlled operator of the mine, Barrick (Niugini) Limited (BNL), should provide emergency access to safe water, meeting minimal basic needs during periods of low rainfall, and promote consistent access to adequate amounts of water for households in Porgera. The PNG government should immediately pledge to carry out an Independent Environmental and Social Audit of the PJV mine examining all social, environmental, and health effects of the mine, and release, publicly respond to, and implement the Constitutional Law Reform Commission's *Review of Environmental and Mining Laws Relating to the Management and Disposal of Tailings*. The mining companies should immediately pledge to create a Human Right to Water Policy for the PJV mine through a rights-based, multi-stakeholder process, and fully support the Independent Environmental and Social Audit of the PJV mine. To address the root causes of the lack of adequate safe water and interrelated impacts, longer-term steps are needed, including: progressively improving water infrastructure in Porgera; adopting regulatory reforms to prevent or mitigate environmental harms that threaten water resources; and, if core human rights requirements cannot be met, resettling Porgeran residents away from the mine in a manner that meets strict international human rights standards.

WATER IN PORGERA: STUDY FINDINGS

This report is primarily focused on the right to water in Porgera, including an assessment of the availability, accessibility, quality, and acceptability of water resources, as well as the community's rights to access information about water and their environment, and to participate in decision-making that affects their environment. The report assesses whether the right to water has been realized, and the extent to which the government of PNG has met its human rights obligations and the mining companies Barrick Gold and Zijin Mining, and their jointly controlled operator of the mine, BNL, have met their human rights responsibilities. The findings are the result of a four-year study carried out by experts in land use, hydrology, geochemistry, environmental conflict, and human rights, following multiple site visits, water and soil sampling and analysis, household and focus group interviews, interviews with civil society leaders and government officials, and review of company and government documents.

A. Key findings of fact: Porgerans do not have consistent access to sufficient, acceptable, and safe water, and do not have access to adequate information about their water resources.

Residents of Porgera do not have consistent access to sufficient, acceptable, and safe water for personal and household purposes, and do not have adequate access to necessary, specific, and understandable information about water quality and any risks to health.

- 1. Water infrastructure in Porgera is poor, and collected rainwater is too frequently inadequate to meet household needs.** The PNG government has not built even basic infrastructure for supplying households in the area with running, potable water, and the mine has not yet made adequate efforts to address community water needs exacerbated by the mine's environmental impact, particularly during dry periods. The mine has repurposed empty industrial chemical barrels and provided them to households so that residents can collect rainwater. These plastic barrels generally have no lids and lack any filtration or treatment system. Residents have reasonable concerns about the quality of collected water due to the presence of dust, debris, and micro-organisms. While residents express serious concerns about whether the mine's mill contaminates rainwater, the Research Team found no evidence of heavy metals above World Health Organization (WHO) Drinking-water Quality Guidelines in tested rainwater. Nonetheless, the quantity of collected rainwater is too often insufficient to meet household needs, and, especially during dry periods, families are forced to ration water, go without, or spend many hours searching for alternative sources, some of which can be difficult to access or may be of poor quality. In interviews with the Research Team, Porgerans stated that they had not received deliveries of water, even during prolonged dry periods. The mine has more recently introduced "Tuffa tanks," large covered water containers, in an increasing number of villages. These are an improvement, but also are presently inadequate to guarantee basic water needs for all village residents, particularly during dry periods. Further, company-documented bacterial contamination of Tuffa tank taps raises concerns about the cleanliness of Tuffa tank water.
- 2. Tailings waste, rivers, and certain creeks near the mine present serious quality and safety concerns, although direct health impacts have not been adequately studied and risks depend upon the specific uses of the different sources by Porgeran residents.** The mine discharges tailings waste directly into the river system, effectively converting water sources relied upon by thousands of people into a "mixing zone" of contaminants. Runoff from the solid waste dumps and open pit, and discharge from the underground mines, may also be contributing to the contamination of the major rivers in the area. Water samples collected by the Research Team and separately by the mine reveal high concentrations of heavy metals such as cadmium, lead, nickel, arsenic, and zinc, often exceeding one or both of the WHO Drinking-water Quality Guidelines and the PNG Drinking Water Standards, in three major rivers running through the Porgera Special Mining Lease (SML), as well as in five creeks and the "Red River" of tailings waste, thus confirming Porgerans' deep concerns about river, creek, and tailings waste quality. While most residents do not rely on these sources for drinking water, many do spend hours wading in the rivers or tailings waste each day while panning for gold, or while washing their bodies and clothes in the rivers and creeks. Their use of rivers and creeks increases during periods of low rainfall. Some residents describe experiencing a burning feeling on their skin after contact with tailings waste. Some residents report occasionally drinking from rivers and creeks in periods of extreme drought, and many parents fear that their children may ingest polluted water, especially because children frequently play and swim in the tailings waste and rivers. Residents say that they do not receive sufficient information or warnings about water quality and any health risks posed by contact or ingestion of river and creek water. Any human health impacts of the water have yet to be adequately studied by the mining companies or

the PNG government, despite the serious concerns presented, and despite Barrick Gold's own acknowledgement of risk posed to those exposed to the tailings waste.¹²

3. **Alternative sources of water believed to be of acceptable quality can be too distant, costly, or risky for many residents.** When rainwater fails to meet needs, and residents wish to avoid turning to nearby rivers or creeks believed to be of poor quality, Porgerans often seek out more distant water sources. While some residents have access to nearby springs that they believe to be of good quality, similar springs are not equally available to all residents living in and around the mine, and some springs reduce or dry up during prolonged periods without rain. Long-term residents state that several of their traditional water sources, including springs and creeks, have been covered by waste dumps or significantly depleted since the advent of industrial mining, thus requiring residents to venture further away from their homes to obtain water. These journeys can present physical security risks, especially when involving hikes over difficult terrain, crossing fast-flowing rivers and waste dumps, or entering land owned by other clans. The longer journeys also decrease the amount of water that can be carried, and present additional burdens on some members of the population, including women, children, older persons, and persons with disabilities. While some residents hire vehicles to take them to distant sources, or buy commercially bottled water, these means of accessing water are cost prohibitive for many Porgeran residents.

4. **There is a lack of reliable information about water quality in Porgera by which residents can assess risks and make informed decisions about their water use.** The PNG government conducts limited testing to verify the PJV mine's compliance with its environmental permit. The government does not conduct broader water, environmental, and health studies in the villages near the PJV mine or educate the residents about the quality of water from various sources in the area. The mine has made progress since 2010 in publishing information online related to its environmental monitoring—ending a multi-year period where little to no information was shared online. However, available information indicates that the mine does not regularly test all the sources of water that Porgeran residents interact with, nor does it adequately test for related human health impacts. Further, inadequate steps are taken to make the information adequately accessible and understandable to Porgeran residents who lack internet connectivity, specialized expertise, and/or literacy. Neither the mine nor the government engages in sufficient face-to-face communication tailored to individual needs—such as those of children, women, and girls of reproductive age—to adequately convey information regarding water quality and risks. Lack of information contributes to residents living in uncertainty and fear, unsure how to best mitigate risks, discounting safe sources of water due to negative perceptions, and it undermines their ability to meaningfully participate in important decisions impacting their right to water.

B. Key legal findings: The PNG government has not met its human rights obligations to respect, protect, and fulfill the right to water in Porgera. The mining companies are in breach of their human rights responsibilities to respect the right to water, and could do more to support the realization of Porgerans' right to water.

The right to water means that every person has the right to available, accessible, safe, and acceptable water for personal and household uses such as drinking, washing clothes, food preparation, and hygiene. Individuals have the right to have access to information regarding their water sources and to participate in decision-making regarding water provision. The full realization of the human right to water is “essential to the full enjoyment of life and all human rights,” including the rights to life, health, food, housing, and an adequate standard of living.¹³ The PNG government has the primary obligation to respect, protect, and fulfill the right to water, which includes a core obligation to ensure the satisfaction of minimum essential amounts of water. Barrick Gold, Zijin Mining, and the jointly controlled operator of the mine, BNL, each have the responsibility to respect the right to water, including to engage in human rights due diligence to assess and take action on the mine’s impact on the right to water, as well as to prevent and mitigate adverse human rights impacts linked to their operations.

- 1. The residents of Porgera do not have consistent access to sufficient acceptable and safe water, particularly during periods of low rainfall. Adequate information about water safety is lacking for communities, undermining their ability to make informed decisions about water use and to participate meaningfully in decisions about water.** The unfulfilled right to water raises additional concerns for interrelated human rights, including the rights to health, food, sanitation, and adequate housing.
- 2. The PNG government has not met its obligations to respect, protect, and fulfill the right to water in Porgera.** The PNG government acknowledges the basic human right to water and its obligation to ensure equitable access to safe, convenient, and sustainable water for all. It has made important commitments toward improving access to water in its WaSH Policy, such as establishing an improved service delivery and monitoring framework, and supporting proposed changes in existing government policies. The government has also pledged a “renewed emphasis on sustainable and responsible development” and on the value of the country’s natural environment and large biodiversity, including its “clean and abundant water” in its National Strategy of Responsible Sustainable Development (StaRS),¹⁴ marking a policy shift in long-term planning towards achieving its goals of promoting economic growth, responsible stewardship of the environment, and social well-being.

However, the PNG government has not met its core obligation to ensure the satisfaction of, at the very least, the basic components of the right to water in Porgera, including: ensuring non-discrimination, monitoring the right to water, ensuring access to “the minimum essential amount of water, that is sufficient and safe for personal and domestic uses to prevent disease,” and ensuring that people’s personal security is not threatened when they access water.

The government also currently does not meet its national water and sanitation targets, particularly in rural areas where lack of access to improved water sources and safe

sanitation persists. The situation in Porgera is a manifestation of national policies and budgetary priorities that have, to date, failed to adequately address needs for water, sanitation, and hygiene in rural areas.

While the government itself recognizes the harm caused by mine-generated river and water pollution in PNG,¹⁵ it has failed to respect the right to water of the people in Porgera by approving the plans for the mine despite its foreseeable impacts on access to clean water for the residents that were relocated only a short distance away from the operations. The government's failure to introduce a regulatory framework that sufficiently monitors and protects water resources from contamination and exploitation constitutes a failure to protect the right to water from interference from third parties. Further, the government's current lack of adequate monitoring and regulation of the PJV's contamination of water sources, coupled with the government's failure to provide affected communities with the information necessary to understand and mitigate risk of harm, amounts to a failure to adequately protect the right to water, and also risks undermining the right to health.

Under such circumstances, and particularly as minimum essential amounts of water are not ensured in Porgera, the PNG government is *prima facie* violating its obligation to fulfill the right to water of Porgeran residents, and has the affirmative burden of demonstrating why it cannot meet its obligations. Until the government works with the mining companies to develop infrastructure for the provision of adequate, accessible, safe, and acceptable water, or resettle villages to areas with safe and reliable water sources, it will continue to fail to meet its obligation to fulfill the right to water of the people in Porgera.

- 3. Barrick Gold, Zijin Mining, and BNL are in breach of their responsibilities to respect the right to water and could do substantially more to support the realization of Porgerans' right to water.** The companies do not have an operational-level human right to water policy for the Porgera mine. The mine discharges contaminants into water sources relied upon by local communities and has failed to adequately monitor and share with communities the environmental and human health risks of such practices so that communities might adopt appropriate mitigation measures. Available evidence also suggests that the mine has covered or reduced numerous local creeks and springs. These activities have contributed to adverse impacts on water availability, accessibility, acceptability, and quality. While the PJV has taken some positive steps—including the provision of blue plastic barrels and the introduction of “Tuffa tanks” in some villages—these steps have not sufficiently mitigated the mine's negative impacts on water resources.

Additionally, the mining companies have not adequately studied and publicly reported on water uses in Porgera and the health impacts of the mine. Available reports of water quality are often inaccessible or not sufficiently functional so as to enable residents to assess risk, and there is inadequate face-to-face communication tailored to uniquely impacted groups. Recent company water initiatives have included some positive steps toward community consultation and participation, and the mine should build upon such measures to increase the scope and breadth of residents' participation in major decisions affecting water security.

Beyond their responsibility to respect the right to water, the companies could do substantially more to support greater advancement of the right to water in Porgera,

including through working with the PNG government and local landowners to provide water during times of low rainfall and building improved infrastructure to make safe water more accessible at the village and household levels.

NEXT STEPS TO RESPECT, PROTECT, AND FULFILL THE RIGHT TO WATER IN PORGERA

In order to achieve its national goals of promoting responsible and sustainable development, and meet its human rights obligations to respect, protect, and fulfill the right to water in Porgera, the PNG government should work with the mining companies to ensure that residents have emergency access to safe water to meet, at minimum, basic personal and household needs during periods of low rainfall, and progressively improve water infrastructure in Porgera. The government must also adopt regulatory reforms to prevent or mitigate environmental harms that threaten water resources relied upon by communities, including a review of its environmental and mining laws relating to the management and disposal of tailings waste. It should pledge to commission an Independent Environmental and Social Audit of the PJV mine examining all social, environmental, and health effects of the mine, and ensure the provision of information to communities about water quality and risks. The PNG government, with the assistance of international donors, should also fully implement its national WaSH Policy, particularly in Porgera, and build long-term water security for rural communities in accordance with its obligations to progressively fulfill the right to water. Where it has been determined that the safety, health, and enjoyment of human rights of the Porgeran communities demand resettlement away from the mine site, the government should participate in its planning and implementation process, ensuring that it is carried out in full accordance with human rights standards.

As an urgent matter, Barrick Gold, Zijin Mining, and BNL should make a public pledge to advance the human right to water and interrelated rights, and commit to create a Human Right to Water Policy through a multi-stakeholder process involving the meaningful participation of Porgeran communities. The mining companies should promote consistent access to adequate amounts of clean water for residents in Porgera by providing or funding water delivery to households in times of low rainfall, and working with the government and Porgeran communities to continue to progressively improve water infrastructure for households through the introduction of more sophisticated water harvesting methods. As part of their corporate responsibility to conduct human rights due diligence, Barrick Gold, Zijin Mining, and BNL should assess, mitigate, and remedy mine impacts on water and human health, including through support for an independent environmental and social audit of the PJV mine, and improved assessment of the variety of water sources used in or of concern to each village in Porgera. The companies should also ensure that Porgeran communities have access to information about water quality and health risks or impacts. The companies should ensure that Porgerans' right to participate in decision-making about water and their environment is advanced, and promote transparency concerning permits, policies, and monitoring related to the mine, as well as water and environmental issues. Where the safety, health, and enjoyment of human rights of the Porgeran communities require, the mining companies should work with the PNG government and the Porgeran communities to plan and implement resettlement so that it is carried out in a just and equitable manner, in full accordance with human rights standards.

The right to water is “indispensable for leading a life in human dignity”¹⁶ and necessary for the realization of other human rights, including the rights to life,¹⁷ health,¹⁸ and an adequate standard of living.¹⁹ Through working in concert with the full participation of Porgeran communities, the PNG government and the mining companies are well placed to ensure Porgerans are able to experience improved enjoyment of these rights. This study offers guidance for the government and companies as they work toward this goal.

RECOMMENDATIONS

RECOMMENDATIONS FOR BARRICK GOLD CORPORATION, ZIJIN MINING GROUP, AND BARRICK NIUGINI LIMITED

1. **Publicly commit to advance the human right to water in Porgera.**
 - a) Publicly announce a pledge to advance the human right to water in Porgera.
 - b) Publicly announce a commitment to initiate a multi-stakeholder process to create a Human Right to Water Policy for the Porgera Joint Venture (PJV) mine, and commit to a process that will respect a human rights-based approach, including the principles of participation, empowerment, transparency, and accountability.
2. **Ensure that measures to advance the human right to water in both the short and long-term are included as a component of any dialogue process regarding the future of mining in Porgera, including current and ongoing discussions related to the renewal of the mining lease.**
3. **Work with the government of PNG to promote consistent access to adequate amounts of clean water for household uses in Porgera.**
 - a) Provide or fund the delivery of water directly to households when necessary to meet household water needs during periods of low rainfall. To be effective and responsive to community needs, this will require the company to work with communities to establish a monitoring and reporting process for water availability at the household level.
 - b) Work with the PNG government, and in consultation with Porgeran communities, to improve infrastructure to provide adequate sources of safe water at the household level through the introduction of more sophisticated water harvesting methods. These could include, at a minimum: (i) installing an increased number of large “Tuffa tanks” in each village; (ii) providing covers and filters for current, widely used open water containers; (iii) ensuring that water taps in villages are regularly monitored and fixed; (iv) constructing public taps for water piped in from Waile Creek Dam, and directing Waile Creek water to villages; and (v) in some locations, exploring the construction of wells. To be effective, this will require the company to work with communities in monitoring the efficacy of water infrastructure improvements. Improved water infrastructure is necessary immediately, even if resettlement is planned in the longer-term.
 - c) Ensure that the mine closure plan includes close attention to promoting the right to water.

4. **Publicly pledge full support for an Independent Environmental and Social Audit of the Porgera Joint Venture mine.**
 - a) To address longstanding concerns about the environmental, social, and human health effects of the PJV mine, immediately express full support and cooperation with a comprehensive independent government audit of the mine's impacts. This audit should address impacts in the immediate surrounding areas, as well as impacts for downstream communities, and cover all issues of concern to residents, including, for example, land access, food security, housing, health, sanitation, and impacts to flora and fauna.
 - b) As part of the corporate responsibility to conduct human rights due diligence and assess all impacts of the mine on human rights, offer to wholly or partially fund the audit.
 - c) To ensure the audit's effectiveness and relevance to impacted communities, it must have a defined scope prepared in consultation with impacted communities, be adequately funded, have clear timelines, and its results must be published and shared with residents in an accessible and functional format and language, consistent with the principle of non-discrimination.
5. **Improve ongoing company human rights due diligence to fully assess, mitigate, and sustainably remedy mine impacts on water and human health.**
 - a) Improve water assessments by regularly conducting the following: (a) assessments of the extent and nature of creek and spring water sources impacted by the mine; (b) water sampling and analysis of all water sources used in or of concern to each village in Porgera; (c) source-by-source analysis of how residents use and perceive water, including seasonal variations in uses, and gender-specific use and exposure to water in the region.
 - b) On an ongoing basis, ensure funding for independent assessments of any risks or impacts on human health in Porgera connected to water use, chemicals or dust in the air, and other potential industrial mine concerns. This should include ongoing assessments of the presence of heavy metals in the bodies of Porgeran residents, with special consideration for women and children.
 - c) Assessments should be coordinated with relevant government agencies, conducted by a University-based center, and the researchers should be jointly agreed upon by the mining companies and Porgera landowners.
 - d) Ensure the findings of impact assessments are acted upon swiftly and meaningfully. Where actual and/or potential human rights harms have been identified, publicize those findings, and consult the community to find suitable remediation, prevention, and/or mitigation measures, including medical care where needed; and accordingly undertake policy and operational changes at all levels of the business structure to cease and remedy current harms, and prevent future harms.

- e) As part of ongoing consultation and engagement with the impacted communities, track responses to the remediation, prevention, and/or mitigation measures in order to continually stay informed about effectiveness of strategies, and be able to adjust where necessary. Tracking should be done by seeking feedback from the impacted communities and all other relevant stakeholders, using appropriate qualitative and quantitative indicators. Publicly report progress on effectiveness of the steps taken by the company.
- 6. Ensure that Porgeran communities and the general public have access to information about water quality and health risks or impacts.**
- a) Publish accessible and functional information, consistent with the principle of non-discrimination, about the results of all water, environment, and health testing. This information should be made available to all members of the community, beyond the community participants in the mine's participatory water testing program. It should be published in English and Tok Pisin and hardcopies should be delivered to each household, and posted throughout Porgera, including at Barrick's Community Affairs Office, in stores, markets, churches, schools, and in Piam and Porgera Station. To ensure that the information is accessible, the meaning of each test result, and the implications for flora, fauna, and human health should be carefully explained. Human health impacts unique to women, such as potential reproductive health impacts, should be specifically detailed. Where the test results indicate a risk, appropriate mitigation measures should be suggested.
 - b) Post water source-specific information, such as about the quality and safety of a particular spring or creek, at the site where residents access the water.
 - c) Send company representatives to each village, regularly through the year, to share, orally and in an open, public meeting, information about the quality of water and health risks or safety levels in Porgera. Advance outreach will be necessary to ensure that community members know about the planned information meeting, and that groups such as women, children, the elderly, and persons with disabilities are not excluded from these meetings. Information should be shared in Tok Pisin, Engan, and Ipili.
 - d) To ensure adequate outreach, send company representatives to provide water quality and health information to other locations and groups, including the Porgera health center, Piam hospital, schools, churches, and local organizations including women's organizations. Additional outreach, such as house visits, may be necessary to reach older persons and persons with disabilities.
 - e) Continuously update the manner of water and health information provision, on the advice of members of Porgeran communities.

7. **Ensure that Porgerans' right to participate in decisions about water and their environment is advanced.**
 - a) Ensure that programs or initiatives to improve water and human rights in Porgera include regular, broad, and meaningful community participation in design, development, and implementation. Dedicated measures should be included to facilitate the participation of all Porgerans, including women, the elderly, and persons with disabilities.
 - b) On the advice of Porgerans, offer trainings to residents to enable them to fully participate in deliberations about their water and environment.
8. **Promote transparency concerning permits, policies, and monitoring related to the mine and water and environmental issues.**
 - a) Make public and accessible all environmental, water use, and waste discharge permits related to the PJV mine and its Environmental Management and Monitoring Program.
 - b) Make public and accessible all environmental and public health monitoring results and studies prepared by, or on behalf of, the PJV, including, but not limited to: reports by the Porgera Environmental Advisory Komiti (PEAK); the 2013-2014 "Drinking Water Study" prepared in response to the 2011 complaint to the Organization for Economic Cooperation and Development (OECD);¹ the Centre for Environmental Health Pty Ltd.'s "Longitudinal Health Risk Assessment" study commissioned by PJV in 2003; the 1996 "Porgera Gold Mine, Review of Riverine Impacts" study conducted by the Commonwealth Scientific & Industrial Research Organization (CSIRO) addressing potential health and environmental effects of mine discharge;² the 2012-2013 study conducted by PJV comparing two villages that engage in panning for gold in the tailings discharge at the Anawe erodible dump with two control villages in the Porgera valley;³ the annual environmental reports produced prior to 2009, and the mine closure plan.
 - c) Ensure that all the mine's activities related to water service provision are recorded and reported to the National Water, Sanitation and Hygiene Authority for entry into the central WaSH Monitoring Information System.
9. **Pledge to attend and actively participate in Extractive Industries Transparency Initiative (EITI) meetings in Papua New Guinea.**
10. **Where the safety, health, and enjoyment of human rights of the Porgeran community requires, plan and implement resettlement so that it is carried out in a just and equitable manner, in full accordance with human rights standards.**
 - a) Ensure that the planning, implementation, monitoring, and evaluation of resettlement activities: have the free, prior, and informed consent of the Porgeran communities; respect and advance all human rights, including the rights to adequate standard of living, education, health, work, water and sanitation, housing, and food; and respect and advance the human rights principles of transparency, equality, non-discrimination and impartiality, dignity, accountability, participation, and access to information.

- b) Conduct due diligence during the selection of resettlement locations, considering the full range of real and potential social and environmental risks and benefits that could be faced by both the resettling and receiving community.
- c) In accordance with the right to remedy, institute an effective grievance mechanism to process and address any grievances that may arise in the course of resettlement.

RECOMMENDATIONS FOR GOVERNMENT ACTORS IN PAPUA NEW GUINEA

11. Work with the PJV to provide emergency access to safe water meeting minimal basic needs during periods of low rainfall, and progressively improve water infrastructure in Porgera.

- a) Allocate increased funds in national budgets for the provision of emergency water supplies to rural communities facing water shortages.
- b) Obtain commitments from the PJV to either fund or provide emergency water supply to households in Porgera during periods of low rainfall.

Work with the PJV to develop infrastructure to provide adequate sources of safe water at the household level, through, at a minimum, (i) installing an increased number of large “Tuffa tanks” in each village; (ii) providing covers and filters for current, widely used open water containers; (iii) ensuring that water taps in villages are regularly monitored and fixed; (iv) constructing public taps for water piped in from Waile Creek Dam, and directing Waile Creek water to villages; and (v) in some locations, exploring the construction of wells.

12. Immediately release, publicly respond to, and implement the Constitutional Law Reform Commission’s Review of Environmental and Mining Laws Relating to the Management and Disposal of Tailings (2015), including the following recommendations:

- a) Reform the *Mining Act 1992* to completely ban riverine tailings disposal for all future mining projects.
- b) Reform the *Mining Act 1992* to make it the singular legislative framework governing all mining projects.
- c) Update the *Environment Act 2000* so that it is in conformity with principles of international environmental law by: amending Section 7 to expressly mention the precautionary principle; and amending Section 4(g) to reflect the “polluter pays” principle.
- d) Reform the *Environment Act 2000* to make the submission of misleading and false information a punishable offense within the context of the environmental impact assessment process.

- e) Amend the *Mining Act 1992* to include Health Impact Assessments (HIAs) and baseline studies of the chemical burden on human beings and their environment as a pre-condition to the grant of mining licenses.

13. Adopt other necessary regulatory reforms to prevent or mitigate environmental harms caused by mining operations that threaten water resources relied upon by communities.

- a) Strengthen the *Environmental Act 2000* to require governmental monitoring of changes to the quality and quantity of all water sources affected by mining operations, and to require public disclosure of the results, including assessments of safety for each water source.
- b) Reform all legislative instruments related to mining to require awareness-building among impacted communities (by both government and companies) around the risks associated with the discharge of waste from permitted mining activities. Legislation should set specific indicators to monitor and assess awareness-building activity, particularly with concern for accessibility for all people regardless of factors such as physical ability, gender, age, literacy, or location.
- c) Legally require all mines, present and future, to prepare and implement a Human Right to Water policy through a multi-stakeholder process in order to operate in PNG.

14. Immediately pledge to carry out an Independent Environmental and Social Audit of the PJV, including its effects on the environment and communities in the Special Mining Lease (SML) areas, Lease for Mining Purpose (LMP) areas, and down the Strickland River to the Murray Basin.

- a) The audit must be a full audit examining all social, environmental, and health effects of the mine, including on water, land, flora, fauna, human health, etc., and not a mere compliance audit. Results of the study must be made public and accessible, especially for potentially impacted communities.

15. Ensure the provision of education and trainings to communities about safe water use.

- a) Direct the Department of Health to collaborate with the Conservation and Environment Protection Authority to conduct village-level education and trainings on how to mitigate the risks of exposure to waterborne pollutants, and how to safely handle, store, and use drinking water.

16. Fully implement the new national Water, Sanitation and Hygiene Policy across all levels of government and in Porgera and other rural areas, and work with international donor countries to ensure that it is adequately funded.

- a) Provide funding to help meet the 302-million-kina financial investment in infrastructure, operations, and maintenance needed for PNG to meet its 2030 water and sanitation targets.⁴ As highlighted by the Department of National Planning and Monitoring in the 2015-2030 National WaSH policy, this can be addressed by substantially increasing

government funding to the WaSH sector through the government's annual Development Budget, and from donor partners in the form of grants and loans.

- b) Ensure that recurrent development budget funds are allocated to the Department of Health, specifically for rural WaSH, beyond those services made available in hospitals and clinics.

17. Promote transparency about permits, policies, and monitoring related to mining and water and environmental issues.

- a) Direct the Mineral Resources Authority to release all PJV mining contracts and make them freely available online.
- b) Direct the Conservation and Environment Protection Authority to release all environmental studies undertaken around the PJV mine in Porgera, and make them freely available online.

18. Where the safety, health, and enjoyment of human rights of the Porgeran community requires, plan and implement resettlement so that it is carried out in a just and equitable manner, in full accordance with human rights standards.

- a) Ensure that the planning, implementation, monitoring, and evaluation of resettlement activities: have the free, prior, and informed consent of the Porgeran communities; respect and advance all human rights, including the rights to adequate standard of living, education, health, work, water and sanitation, housing, and food; and respect and advance the human rights principles of transparency, equality, non-discrimination and impartiality, dignity, accountability, participation, and access to information.
- b) Require and scrutinize the companies' due diligence during the selection of resettlement locations, considering the full range of real and potential social and environmental risks and benefits that could be faced by both the resettling and receiving community.

RECOMMENDATIONS FOR THE GOVERNMENT OF CANADA

19. Adopt necessary laws and regulations to ensure that Canadian corporations respect human rights in their extraterritorial activities, and that there is access to remedy where such activities breach international human rights.

20. Ensure that the newly established Canadian Ombudsperson for Responsible Enterprise (CORE) has robust investigatory capacity, including by ensuring CORE has adequate resources and power.

21. The CORE should take the findings of this report regarding Barrick Gold Corporation under consideration and communicate with the company about the concerns raised in this report and monitor how it acts to address them.

RECOMMENDATIONS FOR INTERNATIONAL DEVELOPMENT PARTNERS

22. Direct loans or grants specifically toward the implementation of the new PNG National Water, Sanitation and Hygiene Policy.
23. Provide financial and/or logistical support to the PNG government's Independent Environmental and Social Audit of the PJV mine.
24. Provide funding to PNG civil society groups, such as the Center for Environmental Law and Community Rights Inc. (CELCOR), to provide community legal education work about environmental, water, and health issues in Porgera and elsewhere in PNG.
25. Direct special funding to the Department of Health and the Conservation and Environment Protection Authority to undertake WaSH awareness trainings in Porgera.
26. Support communities and local government officials financially, technically, and logistically to monitor and improve safe water access in Porgera.

RECOMMENDATIONS FOR THE PORGERA LANDOWNER'S ASSOCIATION AND ALL CIVIL SOCIETY ORGANIZATIONS IN PORGERA

27. Share accessible information regarding mining operations, waste discharge, environmental impacts, and monitoring results with Porgeran residents in regular village-community gatherings.
28. Where the mining companies and the government establish rights-respecting participatory processes for a new Human Right to Policy, water and health assessments, and other issues, actively participate and ensure the views of all Porgerans are fairly represented.

RECOMMENDATIONS FOR THE INTERNATIONAL BUSINESS AND HUMAN RIGHTS COMMUNITY

29. Provide materials and trainings for community-based human rights impact assessments to communities in Porgera and elsewhere in PNG affected by the environmental and social consequences of extractive industries and mega-development projects, including specialized training for affected women who experience disproportionate impacts of extractive projects.
30. To promote effective right-based multi-stakeholder processes for the creation of Human Right to Water Policies across mining sites, exchange experiences, lessons learned, and best practice guidance.
31. Commit to and publicize a set of standards and best practices based on international human rights principles to guide corporations in making water, environmental, health, and other information accessible to the communities in which corporations operate.

RECOMMENDATIONS FOR UNITED NATIONS SPECIAL PROCEDURES, ESPECIALLY THE WORKING GROUP ON THE ISSUE OF HUMAN RIGHTS AND TRANSNATIONAL CORPORATIONS AND OTHER BUSINESS ENTERPRISES, THE SPECIAL RAPPOREUR ON THE HUMAN RIGHTS TO SAFE DRINKING WATER AND SANITATION, THE SPECIAL RAPPOREUR ON THE ISSUE OF HUMAN RIGHTS OBLIGATIONS RELATING TO THE ENJOYMENT OF A SAFE, CLEAN, HEALTHY AND SUSTAINABLE ENVIRONMENT, THE SPECIAL RAPPOREUR ON THE RIGHTS OF INDIGENOUS PEOPLES, AND THE SPECIAL RAPPOREUR ON THE IMPLICATIONS FOR HUMAN RIGHTS OF THE ENVIRONMENTALLY SOUND MANAGEMENT AND DISPOSAL OF HAZARDOUS SUBSTANCES AND WASTES

32. Communicate with Barrick Gold Corporation, Zijin Mining Groups, Barrick Niugini Limited, and the PNG government about the concerns raised in this report, seek information on what they are doing to address them, and provide guidance on the human rights obligations and responsibilities of governments and businesses to protect and respect human rights, and remedy human rights violations to which they have contributed.

METHODOLOGY

This report is the product of an interdisciplinary study of the right to water in Porgera, Papua New Guinea. The study focuses on whether the right to water of indigenous communities living near an industrial gold mine is being respected, protected, and fulfilled. This study combines site visits and observation, water sampling and analysis, interviewing, and analysis of scientific, policy, government, and legal materials. The Research Team includes experts in land use, hydrology, geochemistry, environmental conflicts, and human rights.

The research methodology was designed to promote a human rights-based approach to water and to fact finding. The adoption of a rights-based approach advances international human rights principles in the research methodology itself, making accountability and rights fulfillment not only end goals, but part of the research process.¹ The key principles of a human rights-based approach include recognizing the universality, indivisibility, and interrelatedness of rights; identifying all stakeholders, including both rights-holders and duty-bearers, and the underlying causes for the non-realization of rights; ensuring respect for equality, equity, and non-discrimination, with particular attention given to those experiencing vulnerability or marginalization; seeking the participation and empowerment of rights-holders; and implementing protocols for accountability, transparency, and respect for the rule of law.²

The Research Team sought to integrate a rights-based approach through each of the components of its methodology, including by seeking to understand the right to water in relation to other rights as well as the economic, social, cultural, and geographic context; centering Porgeran residents as rights-holders; assessing the role of multiple duty-bearers, including the mining companies, the Papua New Guinea government, and other countries; seeking to understand the different experiences of those within the rights-holder communities, and giving particular attention to groups which can experience vulnerability, such as women, children, older persons, non-landowners, and those with disabilities; and actively seeking the informed participation and consent of rights-holders in the study's design and implementation, including by piloting interview guides with focus groups and key civil society leaders, selecting sample locations with the participation of community leaders, and conducting meetings in each community to discuss the study, share knowledge, discuss recommendations, and report results in an accessible way that empowers local civil society.

1. SITE VISITS AND OBSERVATION

The research and analysis for this report was carried out over a four-year period between March 2014 and November 2018 and included five visits to Papua New Guinea. An initial scoping assessment in March 2014 was designed to discuss planning for the study with Porgeran community members. During a two-week investigation from December 2014 to January 2015, the Research Team collected water and soil samples and carried out interviews. During a two-week investigation in July 2015, additional data was gathered on water sources, further interviews were conducted, and investigation updates were provided to community members. During a three-week assessment from December 2015 to January 2016, the Research Team conducted further

interviews, collected additional water and soil samples, and also extensively discussed preliminary findings from the first sampling with Porgeran communities. In addition to conducting water sampling and interviews, the Research Team also gathered evidence through observation of each village in Porgera, including of river and stream appearance, local water collection methods, the condition of household water containers, and general living conditions. The Research Team collected photographic and video evidence during each site visit. The team also travelled to Port Moresby in March 2017 to share initial findings with and seek further information from civil society and government officials in the capitol, and again in March 2018 to discuss draft recommendations with members of civil society.

2. WATER SAMPLING AND ANALYSIS

Overview. The Research Team’s water sampling was designed to provide independent measurements of heavy metal concentrations in the major water sources in and around the mine site. The sampling sites were selected to test for the presence of chemicals of potential concern in waters that: (a) are used by local residents for various purposes, such as drinking, recreation, washing, and/or gold panning; and (b) make contact with or are located in different parts of the mine site. At each sampling site, the team measured water pH, dissolved oxygen, temperature, alkalinity, and electrical conductivity. These field parameters provide a first order assessment of water quality and are relevant for estimating the likelihood that heavy metals will be found dissolved in the water. Certain collected water samples were later tested at the Pennsylvania State University Materials Characterization Lab for heavy metals typically found in water sources near industrial mines, including arsenic, aluminum, cadmium, chromium, cobalt, copper, lead, manganese, nickel, and zinc. Additionally, these particular metals were chosen for analysis given the health risks they can pose to aquatic species and humans if present at elevated concentrations.

Type and amount of water samples analyzed. During the December 2014 to January 2015 investigation, the Research Team took field measurements at 64 sites, including:

- Water from ten covered water tanks and 21 open barrels (“blue buckets”) widely used in Porgeran villages in and around the mine to collect rainwater;
- Water from 22 points along various waterways locally referred to as “creeks,” including the Waile Creek Dam;
- Water from three springs;
- Water from seven points along the Kakai, Pongema, Kaiya, Anjolek, and Kaiya/Anjolek Rivers in Porgera; and
- Water from two points along the mine’s tailing waste release, locally referred to as the “Red Water” or “Red River.”

The Research Team collected thirteen water samples from a subset of these sites for more extensive laboratory testing.³ The thirteen samples were collected from:

- Two open barrels used for rainwater collection;
- Two creeks,
- Two control sites (upstream of the mine);
- Two springs;
- Three rivers (including two samples from the same point along one river—one taken before a rain event and the other after); and
- One point along the mine’s tailing waste release.⁴

During the December 2015 to January 2016 investigation, the Research Team again collected samples for laboratory analyses from the same barrels, creeks, and control sites from the previous year’s site visit, as well as from two different springs identified by community members as of particular interest. The team also took field measurements at thirty sites, including at two points above the confluence of the Red River and the Pongema River, and at the Yuyan Bridge.

The results of the laboratory analyses performed on the samples from the 2014-2015 and 2015-2016 field visits are presented in Annex I of this report. The complete data from both field visits, including sample analyses as well as field measurements, will be published separately as an open access dataset and are available upon request from the authors of this report.

Measuring heavy metal concentrations in water. In any given water sample, heavy metals can be present, either dissolved in the water, or in “particulate” form, where metals are attached to solid materials suspended (and not dissolved) in the water. While metals in either form in water used by humans may pose a risk, dissolved metals are generally more likely to be absorbed into the human body, both because dissolved metals are more likely to be consumed (metals in particulate form can be removed using a filter or allowed to separate if heavy enough to settle to the bottom of a container) and because dissolved metals are more likely to be absorbed through human tissue (“bioavailable”). As a result, the Research Team aimed to measure dissolved metal concentrations in order to provide a conservative risk assessment for potential negative human health impacts. However, measurements of the “total concentration” of a given heavy metal in a water sample—which is the combination of the dissolved *and* the particulate concentrations—may also provide an indication of health risks, particularly where water is consumed without filtration, or where individuals have prolonged exposure to the water source, such as in Porgera.

To measure the dissolved concentration of metals, water samples are first filtered to remove particulates, leaving only what is dissolved in the water.⁵ To measure the total concentration of a given heavy metal in a water sample, all the metals in particulate form need to first be chemically dissolved into the water sample before the concentration is measured. This is usually done by applying one or multiple acids to the sample (a process called “digestion”), which breaks down the particulates and allows the particulate metals to become dissolved in the water. Total metal concentrations will always be greater than or equal to the concentration of just the dissolved metals, because dissolved metals are a subset of the total.

With the exception of water samples from the Kakai and Anjolek Rivers, the Research Team filtered all water samples in the field in order to remove particulates and measure only dissolved metals. The Research Team was not able to fully filter samples from the Kakai and Anjolek Rivers in the field, because the water was too “turbid,” meaning the concentration of particulates (such as soil) was so high that field filtering could not fully remove particulates with the equipment brought to the field. As a result, for the Kakai and Anjolek River samples, the Research Team partially “digested” the remaining particle matter. These measurements offer an underestimate of total metal concentrations but are likely greater than dissolved concentrations.

Barrick’s Annual Environmental Reports and a study by the mine on drinking water⁶ report both dissolved and total metal concentrations. In these reports, total concentrations are generally ten to a thousand times higher than the dissolved concentrations alone (see Figure C-13 and Figure C-14 below for an illustration⁷). The Research Team has presented our measurements alongside the mean total concentrations obtained from the 2015 Barrick Annual Environmental Report, the most recent data that Barrick has made publicly available, in order to provide as much information as available. Because residents of Porgera have reported drinking water without filtering or treating it, and may have prolonged physical exposure to the various water sources, the total concentrations measured by the mine are relevant to understanding the full scope of potential harm.

Assessing the risks of exposure to heavy metal concentrations in water. The Research Team’s water testing and analysis provide a useful independent data source that can be compared to the mine’s reports and help identify sources of potential health risks that warrant further research and assessment.

In order to assess health risks, we compare the concentrations of heavy metals in the tested water to the World Health Organization (WHO) Guidelines for Drinking-water Quality and Papua New Guinea’s *Public Health (Drinking Water) Regulation* (1984).⁸ The WHO Guidelines provide reference points above which metal concentrations could negatively impact human health.⁹ The PNG Drinking Water Regulation presents modified WHO Guidelines standards meant to address variations in the country’s natural geochemistry.¹⁰ In addition to drinking, there are other pathways by which harmful contaminants can enter the body, such as physical contact with contaminated water. Contact can result in metals being absorbed through the skin and soft tissues, as well as through open wounds. In light of the variety of uses of local water sources reported by communities living near the mine—such as drinking, bathing, recreation, and gold panning—there are multiple pathways of possible exposure. This study thus helps identify public health concerns that warrant further study due to contaminants measured in these waterways. Further study, including measurements of metal concentration in human tissue, would be required for a comprehensive public health assessment.

Understanding the range of and variations in testing results. Chemical concentrations in samples taken at different times from the same location can vary because of changes in environmental conditions or industrial processing, and other factors. For example, a sample collected downstream of the mine’s open pit during rainfall may have elevated metal concentrations due to increased runoff compared to a sample collected from the same site during a dry period.¹¹

3. SOIL AND SEDIMENT SAMPLES COLLECTED FOR FUTURE STUDY

While conducting on-site water testing and collecting water samples, the Research Team also collected 45 samples of streambed sediments from streams adjacent to the PJV gold mine, and 25 soil samples from local residents' household gardens. While water samples provide a single snapshot of potential metal contamination used to assess the risk of such contamination at that time, soil and sediment samples can provide information on the accumulation of metals over longer periods of time. Streambed sediment samples in particular can be used to predict how metals that have accumulated in the soil along the banks of a stream may be released back into stream water over time, enabling an assessment of future risk. The streambed sediment samples will be analyzed for the same metals as the water samples as part of a future study on risks to residents after mine closure. The garden soil samples, based on a first order assessment, did not reveal elevated levels of heavy metals and thus will not be subject to further testing to ascertain health risks.

4. INTERVIEWS, FOCUS GROUPS, AND CONSULTATIONS

Over the course of four years, the Research Team conducted over 177 interviews and meetings. These included: numerous pre-study meetings, including initial consultation about the focus and scope of the study, and five meetings to pilot the semi-structured interview guide; 63 semi-structured household interviews in Porgera; 21 focus groups in Porgera; 25 key informant interviews in Porgera; 23 government and civil society meetings in Port Moresby; two information sharing sessions with Porgeran civil society representatives in Canada and New York; and six teleconferences with representatives from the mining companies. The Research Team also visited each village multiple times and held 32 large open village meetings to discuss the study, answer questions, explain results, and provide opportunities for information sharing.

Interviews were conducted in English, or with interpreters in Engan, Pidgin (*Tok Pisin*), or Ipili. The language of the interview depended on the preference of the interviewee.

The Research Team conducted all interviews in accordance with core human rights fact-finding principles including accuracy, confidentiality, sensitivity, impartiality, independence, integrity, and professionalism.¹² Interviewee security and confidentiality were central concerns and researchers followed strict informed consent guidelines in all interviews. This included discussing voluntary participation, potential risks, limitations, and the purpose of the study. Researchers did not record names or other individually identifying information during household interviews. All interviewees were asked how they would like to be referred to in the report, with most selecting identification based on their gender and village affiliation. The study received IRB approval from the Columbia University IRB Review Board.

The Research Team also maintained robust communications with the mining companies, and engaged with mine representatives to share initial results of the investigations and to solicit information held by the companies.

a. Community Consultation and Scoping

The study on water was requested by numerous community members over the course of many years of work in Porgera by members of the Research Team on other human rights issues.¹³ During the initial design of the study, the Research Team sought the views of civil society and community members about focus areas and about drafts of a semi-structured interview guide. In Porgera, prior to beginning village-based household interviews, two large meetings were convened with local residents to discuss the purposes of the investigations and to canvas a range of issues relating to the environment in Porgera. The Research Team then conducted a series of focus groups with participants from the meetings, speaking to groups of between five and forty-five individuals, to pilot the semi-structured interview guide.

b. Semi-Structured Household Interviews

Through the study, the Research Team sought to assess community perceptions regarding water quality and interaction with potential environmental hazards among the target population—households in villages in and around the PJV mine. The team visited villages within the Special Mining Lease (SML) area and other villages very close to the mine: Panadaka, Yarik (including Timorope and Top Yarik), Apalaka, Yunarilama, Alipis, Kulapi, Mugalep, Pakien Camp, and Anawe.

Within each village, the Research Team conducted semi-structured interviews in a subset of households selected through a “Random Walk Sampling” method. Due to the lack of a comprehensive and accurate census of the area, the Research Team chose not to attempt a random sample of households across the entire area in and around the mine. Instead, the Research Team adopted a “two-stage cluster” sampling approach of visiting individual villages and sampling households at the village level. The Research Team’s decision to visit *all* SML villages and the additional villages adjacent to the mine, rather than a smaller sub-set of the villages, was based on an assessment from numerous prior visits to Porgera that each village has unique geographical features and a unique interaction with the mine, and feedback from community members that all SML residents would want to see their villages represented in the study.

Due to the logistical challenges of interviewing an adult from *every* household within each of the villages, the Research Team adopted the Random Walk Sampling method to select a subset of the households for interviews in a way that minimized sampling bias caused by factors such as convenience.¹⁴ Through this method, the Research Team first identified a geographic reference point in each village—the central meeting place—and then identified roads or pathways radiating outwards from that reference point, as often as possible seeking paths corresponding to cardinal directions. The Research Team then selected every third or fifth household to interview, depending on the geographic reach of each village, with the twin goals of conducting multiple interviews along each tangent and reaching individuals living on the outskirts of the villages.¹⁵ In addition to reducing bias, this approach ensured that the sampled households showed maximum variation in elevation and distance to the mine’s hard rock waste dumps, primary liquid tailings discharge locations, and/or other channels of waste and contaminant discharge.

The interview questionnaire was jointly designed by human rights and water science experts based upon extensive legal and policy research on the right to water, and included questions about personal and household water collection, use, and perceptions; exposure to mine tailings and hard rock waste; air quality; land use and availability; food; health; housing; culture; sources of economic income, including alluvial mining; and participation in environmental decision-making, access to information, and access to justice. Its content was informed by the years of experience by members of the Research Team working on Porgera issues, input from Porgeran civil society members, and focus group review.

The semi-structured interview method allowed interviewers to systematically collect information from Porgeran residents, while providing them flexibility to collect broader and more detailed responses than would have been possible through a standardized questionnaire alone.

Prior to commencing household interviews in each village, the Research Team held open, public information meetings with all present residents of the village. During these meetings, the Research Team explicitly asked residents whether the team could conduct individual interviews, explained the purpose of the research and the proposed methods of water and soil testing and interviews, and sought community consent, questions, and feedback from those present.

c. Additional Meetings, Interviews, Focus Groups, and Consultations

In July-August 2015, a member of the Research Team returned to Porgera to conduct additional interviews and meetings in the villages. In each village, the Research Team member provided residents with an update on the progress of the study and sought additional information regarding a recent dry period. Further, residents were informed that members of the Research Team would return in December 2015-January 2016 to share the preliminary results of the scientific water analysis.

In December 2015-January 2016, the Research Team returned to Porgera. In each village, the Research Team presented the findings of the scientific analysis via visual and participatory methods. Residents were shown color-coded satellite maps of Porgera, indicating water quality in the area. Following the presentations, the Research Team organized focus group interviews, usually divided based on gender, to gather additional information regarding community water use and management strategies during the recent drought, and to seek residents' views about recommendations and next steps. The Research Team also held additional meetings with local leaders and key informants, including village or clan leaders, council members, members of the Akali Tange Association (ATA, an NGO based in Porgera), members of the Porgera Landowners Association (PLOA), a local government official, local health care workers, Porgeran women's groups, and Barrick community relations personnel.

In March 2017, members of the Research Team visited Port Moresby to share information with national civil society and government officials, and to seek further information about the national context for water policy in PNG and about PNG government activities in Porgera. The Team met with representatives of governmental departments and bodies, the United Nations, non-governmental organizations, political party staff members, university professors, and the United States Embassy. The team held a total of 12 meetings with officials of organizations including: the

Center for Environmental Law and Community Rights Inc. (CELCOR), the Conservation and Environment Protection Authority (CEPA), the Constitutional Law Reform Commission (CLRC), the Department of Health (DOH), The Department of National Planning and Monitoring (WaSH Unit), the UN Office of the High Commissioner for Human Rights (OHCHR), The PNG Extractive Industries Transparency Initiative (PNGEITI), University of Papua New Guinea science and law professors, and WaterPNG Ltd. The Team also subsequently conducted conference calls from New York with officials from ActNow PNG and the Oxfam International PNG office.

In November 2017, two Porgeran women's rights advocates visited the Research Team in New York for two weeks. Numerous meetings were held to discuss in-depth the gendered impacts of mining, particularly as it relates to access to water. We strive to highlight this gendered lens in this report. In November 2018, members of the Research Team provided technical support to four Porgeran women's rights advocates in making a submission to the United Nations Working Group on the issue of human rights and transnational corporations and other business enterprises on the disproportionate impact of mining on women, including the impact on access to water.¹⁶

In March 2018, members of the Research Team travelled to Port Moresby to share information with representatives of Porgeran civil society, and to seek feedback on this report's then draft recommendations.

d. Company Engagement

The Research Team has engaged with Barrick Gold throughout the study and the preparation of this report, and this report has benefited from in-person meetings, calls, and written exchanges with Barrick representatives, who have made themselves available at the request of the Research Team.

The Research Team met with the mine's Senior Manager of Community Relations and the mine's Environmental Manager in Porgera in January 2015 and January 2016, to discuss the mine's environmental monitoring and community outreach efforts and to request access to mine environmental and health impact studies. In response, the mine shared an overview of the mine's "Longitudinal Health Risk Assessment," as well as information about the mine's closure plan, pilot resettlement project, and Tuffa tank installation project. The Research Team also met with the mine's Executive General Manager in January 2016 to discuss water supply issues in Porgera and the need for relocation.

In February 2017, the team also engaged with Barrick representatives by phone and in writing. In February 2017, the Research Team requested information about right to water issues in Porgera. The company responded on Friday, April 21, 2017. The company's written responses are referenced throughout this report and are included as Annex II.

During February-November 2018, the Research Team engaged by telephone and email with Barrick representatives to discuss the major findings of this report and to see if Barrick would be providing any update or additional information building upon the information shared in April of the previous year. On April 9, 2018, a Barrick representative informed the Research Team that no formal update would be provided at that time. The Research Team held a total of four telephone conversations with Barrick representatives between May 3 and October 9, 2018 to discuss the

major findings of this report and potential steps to address those findings moving forward. The Research Team shared the sections of the report detailing the water findings with the mining company representatives (specifically Chapter 4: Water in Porgera). On November 1, 2018, BNL provided the Research Team with a written response to the draft sections of the report, which they had been provided. The company's written response is included in Annex II.

5. DESK RESEARCH

This report also relies on extensive desk research, including research on human rights law, environmental law, domestic PNG law, anthropological and environmental data, government reports, as well as on reports and other documents made public by the PJV and Barrick Gold.

CHAPTER I: BACKGROUND

Water, Extractive Industries in Papua New Guinea, and Industrial Mining in Porgera

This Chapter provides background about water in Papua New Guinea (PNG) at the national level. It includes data about the lack of access to improved drinking water sources across the country, especially in rural areas. It discusses key causes of the lack of rural water and sanitation initiatives, including the historical lack of a single governing water body, inadequate policies, inadequate budgeting to implement water policies, and the prioritization of urban projects over those in rural areas. This national backdrop has contributed to the absence of meaningful government intervention with respect to water infrastructure in the rural area of Porgera, and has heightened the vulnerability of Porgeran residents to changes in water access and quality related to mine operations. Recently, the government published a new Water, Sanitation and Hygiene Policy that, if funded and implemented well, holds much promise for improved water access in PNG broadly, and in rural areas such as Porgera specifically.

This Chapter also briefly summarizes the role of extractive industries generally in PNG, and describes industrial mining specifically in Porgera, including the Porgera Joint Venture mine's history, ownership, scale, and industrial processing methods. In particular, the mine's water use, as well as solid and liquid waste disposal methods, are discussed as a means of providing necessary background for understanding the links between mining operations and the primary human rights and environmental findings of the report.

1. WATER IN PAPUA NEW GUINEA: CONCERNS, POLICIES, PROGRAMS, AND NEW INITIATIVES

Lack of access to improved drinking water sources—water sources that, through some form of intervention or construction, are protected from contamination¹—is a significant problem across Papua New Guinea (PNG). A 2016 WaterAid report analyzing the state of access to water around the world found that PNG was “worst in the world for percentage of population without safe water.”² With 60 percent, or 4.5 million people, without safe water, and high costs associated with acquiring water for basic domestic use, PNG lags behind the rest of the world in its population's access to a safe water supply.³ Diarrhea, linked to lack of access to dependable, clean water sources and toilets, is thus one of the leading reasons for inpatient and outpatient visits to health facilities in PNG.⁴

The lack of access to safe water supply is especially felt by those living in rural areas. PNG has a total population of roughly 8 million.⁵ Its rural areas—mostly remote geographic areas with poor access to roads and basic services—are home to 87 percent of PNG's total population; the rest, 13 percent, live in urban areas.⁶ Studies conducted on access to improved drinking water sources in PNG show a wide gap between rural and urban households. In 2010, the Joint Monitoring Programme (JMP) of the United Nations Children's Fund and World Health Organization found

that 77 percent of Papua New Guineans living in urban areas had access to improved drinking water sources, while only 33 percent of those living in rural areas had similar access.⁷ Updated statistics from JMP, similarly disaggregated along rural-urban lines, show that this wide disparity continues to persist, with only minimal gains in access to improved water sources in PNG through 2015.⁸

There are several causes behind the persistence of this disparity. The top reason identified by the World Bank, a major PNG development partner, has been the absence of a single governing body to oversee water and sanitation service delivery nationally.⁹ There are two state-owned enterprises (SOEs) in charge of the provision of water in PNG: Eda Ranu and Water PNG.¹⁰ Both Eda Ranu and Water PNG operate on a commercial basis.¹¹ Eda Ranu is responsible for water and sanitation exclusively in the capital, Port Moresby.¹² Water PNG on the other hand, has “the duty of coordinating planning, design, construction, management of, and charging for, water supply and sewerage services *throughout the country*.”¹³ Its mandate, however, is defined differently for urban and rural areas: while it must “*provide* water supply . . . to meet the reasonable needs of the *urban* population,” it is only charged to “*promote* water supply . . . in *rural* areas and urban fringe areas through community participation on self-help bases and where necessary with the help of loans, grants, or aid.”¹⁴ Thus, for rural areas, there is no government entity specifically charged with ensuring the *provision* of water supply, and, according to PNG’s Department of National Planning and Monitoring, the commercial function of Water PNG has contributed to the prioritization of urban initiatives over the broad rural goals defined in its mandate, resulting in the neglect of rural communities.¹⁵ Water PNG currently operates in only fourteen provincial and six district towns, with no clear plan for how it will reach rural settlements like Porgera.¹⁶ PNG’s National Health Plan (2011-2020) tasks the Department of Health with planning and managing “safe community water supplies and waste disposal systems,” but the Department faces a dearth of resources to undertake this mandate.¹⁷

PNG’s Department of National Planning and Monitoring also identifies the inadequacy of government budgeting toward water services in general as a major cause of the stark rural-urban disparity in access to improved drinking water sources.¹⁸ Lack of funding has the effect of undermining any plans the PNG government has developed to improve water in PNG.¹⁹ Table 1 reveals water’s low priority level in budgetary decisions: budgetary allocation for water and sanitation together represented no more than 0.4 percent of the country’s GDP at any time between 2006 and 2012. In addition, historically, there have been no specific earmarks for WaSH initiatives in rural areas.²⁰ The Department of Health has taken on certain components of this responsibility, without any clear national strategy or specific financing.²¹

Table 1: Allocation of Development Expenditures for Water and Sanitation in PNG,
2006-2012 (in US\$ millions)²²

	2006	2007	2008	2009	2010	2011	2012
Total development budget allocated for water and sanitation	19	6	22	21	40	31	34
Government Direct financing	5	4	4	3	16	17	21
Loans	9	2	5	11	13	4	4
Grants	5	1	12	7	12	11	10
Proportion of GDP (%)	0.3	0.1	0.3	0.3	0.4	0.3	n/a

Source: Derived from PNG National Budgets for 2011 and 2012; WSP-World Bank, Water Supply and Sanitation in Papua New Guinea: Turning Finance into Services for the Future 15 (2013), https://www.wsp.org/sites/wsp.org/files/publications/WSP_EAP_SDA_PNG_Report.pdf (currency conversions completed by the Research Team for the “Red Water” report).

PNG has relied significantly on international aid for funding water services and programs. However, while loans and grants from development partners (particularly the World Bank, the European Union, the Japan International Cooperation Agency, and the Asian Development Bank) have increased the total budget allocation to the sector in recent years, the majority of development partner funding is given to only a few urban WaSH initiatives, such as the Port Moresby sewerage upgrade and District Town Water Supply projects.²³ Financing for the two SOEs, whether from the government Development Budget or from donor partners in the form of grants and loans, is insufficient to enable the SOEs to adequately expand their services. Currently, the SOEs have difficulty even maintaining existing service quality through revenue from tariffs.²⁴

The PNG-EU Rural Water Supply and Sanitation Programme (RWSSP) is the only significant source of funding for rural WaSH projects.²⁵ It provides financing for the “construction of water systems, linked closely to sanitation and hygiene education and technical, management and community development training.”²⁶ While the RWSSP works with the Department of Health as its main counterpart, the program primarily operates by funding non-governmental organizations, community-based organizations, churches, and communities.²⁷ The projects of these non-state actors remain largely uncoordinated with government planning.²⁸

The efforts of a multi-agency Task Force (convened in 2012)—comprising governmental agencies (such as the Department of Treasury and the Department of Health), non-governmental organizations (such as Water Aid), and the World Health Organization—led to the creation of PNG’s first Water, Sanitation and Hygiene Policy.²⁹ This document lays out a detailed plan for PNG to, among other goals, achieve access to a “safe, convenient and sustainable water supply” for 70 percent of the population in rural areas.³⁰ The document is intended to be used as a coherent framework for “national, provincial and local governments, [SOEs], development partners, non-government organizations, private sector and community stakeholders that are involved in

regulating, planning, financing, implementing, operating, facilitating or monitoring [WaSH] improvement programs and activities.”³¹

The new policy is based on the principle that “access to sufficient safe water and sanitation facilities is a human right.”³² It outlines: targets disaggregated for rural and urban areas; standards and definitions; core ethics for service delivery; the foundational, systemic problems and strategies related to the provision of water; and a plan for the harmonization of an entire sector.³³ It anticipates that an annual investment of 302 million kina (approximately US\$95 million) for infrastructure, operations, and maintenance will be required to meet the policy’s objectives.³⁴ Also critical for water improvement is the policy’s proposal for the establishment of a National Water, Sanitation and Hygiene Authority (NWSHA) to centralize and oversee national, urban, and rural efforts towards water accessibility and sanitation.³⁵ The policy gives a breakdown of the NWSHA’s role nationally, as well as its work for urban and rural areas.³⁶

While it is still too early to assess progress on implementation of the policy, the government’s commitment to a coordinated and strategic national approach, and the specific plans for increasing both national and international funding for WaSH, could mean greater accessibility to safe water in rural communities throughout the country if implemented consistently.

2. EXTRACTIVE INDUSTRIES IN PAPUA NEW GUINEA

As the paucity of rural WaSH initiatives in PNG indicates, it is essential that the country find sustainable means of generating financial resources for investment in economic and social rights programming. Despite its wealth of natural resources with high earning potential, PNG continues to grapple with the “resource curse,” performing poorly on a variety of economic and social indicators.³⁷

Mineral deposits, such as gold, copper, and oil, account for over 60 percent of national export earnings in PNG,³⁸ leaving the country acutely vulnerable to shifts in commodity pricing. For example, while PNG’s economy grew 9.9 percent in 2015, the growth rate dropped to 4.3 percent in 2016 due in part to weaknesses in global commodity prices and cuts in government capital expenditures.³⁹ Such shifts can undermine investment in essential governmental programs and activities.

Additionally, while mineral extraction has certainly contributed to economic growth in PNG, many segments of the population have not shared in the benefits of the economic growth rate and vast natural resource reserves. No significant reduction in income poverty occurred between 1996 and 2010.⁴⁰ In 2011, roughly 36 percent of the population lived below the basic needs poverty line.⁴¹ Over half of the population continues to live on less than US\$1 per day.⁴²

As the Porgera case illustrates, the dependence on extractive industries for economic growth has, at times, also exacerbated social conflicts and environmental degradation. Recently, the government of PNG has recognized that the current paradigm of economic development has been destructive for the environment and human rights.⁴³ This paradigm has, according to one government report, resulted in “more and more pressure . . . on the government to over exploit nonrenewable resources to pay for the cost of basic development whilst conveniently down playing the

seriousness of the critical and finite nature of such natural resources and the environmental damage they are causing to the ecology of the country,” including for example “mine generated river and water pollution.”⁴⁴ Importantly, the government has expressed a commitment to building a new sustainable development model that promotes “responsible stewardship for the environment, and promotion of social wellbeing.”⁴⁵ The model of sustainable development espoused by the government seeks to meet “the basic needs and aspirations of the present and future generations without jeopardizing the ability of the environment to provide the necessary ecosystem services, including clean water, clean air, clean energy and healthy food, and processes such as the absorption of pollution and decomposition of wastes.”⁴⁶ This report seeks to support the government in this goal.

3. INDUSTRIAL MINING IN PORGERA

This section discusses the history, ownership structures, and scale of mining operations in Porgera since 1989. It also describes the mineral extraction and waste disposal methods employed by the mine, including its rare and highly controversial practice of riverine tailings waste disposal.

a. The Porgera Joint Venture: Ownership and Mining Area

The Porgera gold mine, which began operations in 1989, has long been contentious, and has generated global attention for both violence by security personnel and allegations of environmental degradation. Located in the Porgera Valley of the Porgera District of Enga Province in the PNG highlands, the mine operates at an altitude of 2,200 to 2,700 meters.⁴⁷ The area is populated by the indigenous cultural and linguistic group known as the Ipili,⁴⁸ as well as by thousands of others from the Enga Province (and sometimes beyond), attracted to the area by economic opportunities associated with the mine.

The mine is owned by the Porgera Joint Venture (PJV). A 95 percent share of the PJV is currently held by Barrick (Niugini) Limited (BNL),⁴⁹ the manager of the mine, with the remaining 5 percent interest held by Mineral Resources Enga Limited, and divided equally between the Enga Provincial Government and local landowners.⁵⁰ BNL was previously a wholly-owned subsidiary of the Canadian company, Barrick Gold Corporation (Barrick Gold). In May 2015, Barrick Gold announced that Chinese company, Zijin Mining Group, acquired a 50 percent ownership of BNL.⁵¹ Barrick Gold acquired its share in the PJV in 2006, when it purchased Canadian mining company Placer Dome, the previous majority owner of the joint venture.⁵²

The PJV has exploration rights to over 5,300 square kilometers in the region,⁵³ and operates under multiple leases. A Special Mining Lease (SML) was granted to the PJV in 1989 and currently extends through 2019.⁵⁴ In 1989, a Mining Development Contract (MDC) was executed between the PNG national government and the PJV to govern the relationship and obligations of each party.⁵⁵ Those with special mining leases legally own minerals on the designated land and possess the sole right to enter and occupy the land.⁵⁶ The SML granted to the PJV encompasses roughly 2,350 hectares of land that comprise the mine area and related infrastructure.⁵⁷ The operation also occupies areas in the Porgera Valley under Leases for Mining Purposes (LMP) for additional mining operations requirements, including waste dumps, campsites, and water supplies.⁵⁸ Porgera

residents often describe their geographic residence as existing within either the SML or LMP areas.

b. Mine Operations and Waste Disposal

The PJV conducts open pit and underground mining. As the mine site has developed, the projected life of the mine has been extended numerous times, and as of 2014, was projected to continue until as late as 2026.⁵⁹ Ore processing from stockpiles—where low-grade material from the mine can be stored for later processing—may continue years longer.

Mine water use. The PJV operations require large quantities of water. Metal mines such as gold mines use over fifteen times more water for their processes than non-metal mines such as coal or salt.⁶⁰ In 2014, the PJV mine processed 5.86 million tons of ore, using an average of 5,660 liters of water per ton of ore processed (suggesting the use of approximately 33 billion liters of water in total in 2014).⁶¹ While the Research Team was unable to find publicly available information regarding total water usage for the PJV, according to a permit issued by the PNG government (recently shared by BNL with the Research Team upon request), the mine has permission to extract over 42 billion liters of water per year.⁶² According to a recent Barrick Gold Annual Environmental Report, water use efficiency has improved since 2012.⁶³ At the same time, the company reports a trend to increasing ore production over the same time, so water use may have remained relatively stable. The Porgera gold mine's main water supply comes from the Waile Creek Dam, and some water is also extracted from Kogai Creek.⁶⁴ The mine possesses four water treatment plants and five sewage treatment plants.⁶⁵

Mechanical and chemical processes are used to extract gold and other metals from the harvested ore, generating substantial liquid and solid wastes as by-products. The PJV disposes of the waste from these processes in several ways. The PJV disposes of the liquid wastes or “tailings”—which can include crushed rock, heavy metals, and chemical reagents used during processing—by releasing them into the PNG river system. The PJV generally stores solid wastes including excess hard rock in erodible waste dumps.

Liquid tailings waste and riverine disposal. The PJV releases tailings from the mine facility into the area of the Anawe dump. The tailings form a stream which runs for five kilometers before flowing into the Pongema River at an average rate of over 14,000 tons per day.⁶⁶ The tailings discharge forms what local residents refer to as the “Red River,” which dominates the landscape, and which Porgeran residents interact with on a daily basis. In Porgera, residents are exposed to the tailings waste in its concentrated form before it reaches the Pongema River. Children from nearby villages play in the tailings and swim in pools of stagnant water in the bed of the Red River. These issues are discussed in detail in Chapter IV.

Riverine tailings disposal is contrary to international best practices, and has been denounced by the World Bank and the International Finance Corporation.⁶⁷ A 2013 study of tailings disposal methods worldwide found that because of the “catastrophic environmental consequences experienced by the discharge of mine tailings to rivers,” riverine disposal is generally no longer used.⁶⁸ The study noted that of the approximately 2,500 industrial-size mines in the world, only four mines—three of them in Papua New Guinea—were found to rely on riverine tailings disposal.⁶⁹

Barrick Gold has committed to making efforts to avoid using riverine tailings disposal in the future.⁷⁰

When the method of riverine tailings disposal was first proposed by the PJV,⁷¹ it was initially rejected by PNG's Minister of Environment and Conservation as "totally unacceptable," but the PNG government approved the plans nonetheless.⁷² The mine has argued that its use of the method was a result of the high risk of failure for a tailings dam due to seismic activity in the area.⁷³ Tailings are treated to reduce the dissolved concentrations of heavy metal contaminants.⁷⁴ The mine reports that since its purchase by Barrick Gold, it has taken additional steps to improve tailings processing prior to discharge, such as commissioning a new cyanide destruction plant in December of 2008.⁷⁵

In March 2009, based on the recommendation of its Council on Ethics, the Norwegian government's pension fund divested from Barrick Gold after finding that the method of riverine tailings disposal risked "long-term and irreversible damage,"⁷⁶ especially due to heavy metal contamination, and because people "are undoubtedly exposed to arsenic, heavy metals and other harmful substances found in the tailings, which may inflict serious and long-term health effects."⁷⁷ Exposure to heavy metals such as zinc, lead, cadmium, and arsenic—even at low levels, if exposure is sustained—can lead to severe, negative health impacts on nearly every part of the human body, such as: kidney and liver failure, brain damage, damage to the nervous system, skeletal damage, digestive and urinary ailments, abnormal heart function, reproductive dysfunction (birth defects and miscarriages), skin lesions, and cancer.⁷⁸ Children are particularly at risk of severe health impacts from exposure.⁷⁹

Solid waste and rock waste dumps. The mining process also produces a substantial amount of solid waste. It can take many tons of rock to produce just one ounce of gold.⁸⁰ A portion of the Porgera mine waste is placed in four separate waste dumps, two stationary dumps for long-term storage of hard waste rock (Kogai stable dump and Anawe North stable dump), and two erodible dumps (Anjolek dump and Anawe dump)⁸¹ that allow soft rock waste to gradually wear away through exposure to wind, water, and other natural processes, releasing sediments and chemicals into the Pongema and Kaiya Rivers, which in turn flow into the Porgera River.⁸²

Environmental monitoring program. The PJV maintains an environmental monitoring program, and releases Annual Environmental Reports on its activities, including information such as tailings chemistry, hydrology and water use, energy efficiency, ore processing, and chemistry in waterways near the mine site. These reports are technical documents, and are publicly available on the company's website for the years 2009 through 2015. Monitoring and reporting issues are discussed in depth in Chapter IV.

Human rights and environmental policy commitments. Barrick Gold's human rights policy states that the company "strives to act in accordance with the [United Nations'] Guiding Principles on Business and Human Rights,"⁸³ and it considers "human rights norms to be legal requirements, and thus mandate[s] their adherence in the same vein as [Barrick Gold] mandate[s] compliance with other international and local regulatory requirements that apply to [its] business."⁸⁴ Barrick Gold has signed the UN Global Compact⁸⁵ and is a member of the International Council on Mining and Metals (ICMM),⁸⁶ both of which set out principles for corporate best practice in the areas of human rights and environmental responsibilities.⁸⁷ The ICMM has identified specific principles of

“environmental and socially sustainable water management,”⁸⁸ which it takes to mean “operating in an environmentally responsible way at all times,” making sure to “protect local water systems and use water wisely.”⁸⁹ The ICMM’s Position Statement on Water Stewardship requires companies to “apply strong and transparent water governance,” “manage water at operations effectively,” and “collaborate to achieve responsible and sustainable water use.”⁹⁰ Barrick Gold states that its company-wide Water Management Framework is aligned with the ICMM Position Statement.⁹¹

Zijin Mining does not have a formal, standalone human rights policy, but affirms several human rights and corporate social responsibility commitments in its “Sustainability” statement. In addition to pledging to uphold “international human rights standards everywhere [it] operate[s],” Zijin emphasizes a commitment to “sustaining harmonious relationships with local communities while reducing [its] ecological footprint.”⁹² Regarding environmental policy, Zijin asserts, “We pursue gold and silver, but care more about clear water and green mountains.”⁹³ Further, “[Zijin’s] senior management commit themselves to durable environmental protection.”⁹⁴ However, Zijin has not signed the UN Global Compact and is not a member of the ICMM.

Revenue transparency. Since 2013, BNL has been member of the PNG Multi Stakeholder Group (PNGMSG)—a convening of government actors, civil society organizations, mining and petroleum companies, and private citizens—to develop a PNG-specific implementation plan for the global Extractives Industries Transparency Initiative (EITI) in order to promote “revenue transparency and accountability in the country’s mining and petroleum sectors.”⁹⁵ According to public records, the last meeting of the PNGMSG that BNL attended was in December 21, 2015.⁹⁶

CHAPTER II: LIFE NEAR A MINE

Social and Environmental Concerns

After facing these struggles and hardships, our only wish is to be isolated from Barrick. We want to live in a good area, where the air is fresh, where there is good water, just like other people in the world. We don't want to struggle and lose many lives in this place. We wish to live a good life. If only Barrick would take us and relocate us. If we continue to live like this, then I think we are not human beings.

- Resident of Mugalep, January 4, 2015

This Chapter presents an overview of the principal human rights and daily life concerns voiced by Porgeran residents about living in close proximity to an industrial gold mine. While this report focuses on concerns related to water, water is just one of many serious, complex, and interconnected concerns in Porgera.

The mine has made a number of important positive contributions in Enga Province. As noted in prior reporting by the Columbia Law School Human Rights Clinic, communities now have “greater access to new infrastructure, educational facilities, a hospital, and roads. The mine also has provided opportunities in the form of scholarships, employment, and increased government revenues. Additionally, the mine has provided revenue streams to local communities in a variety of ways, including through compensation payments for mining impacts, and royalty payments for access to mineral resources. The company has also provided funds for some civil society groups.”¹

Yet residents report a significant number of interconnected concerns, fears, and adverse impacts on their lives. While each of the villages in Porgera—depending on its location, proximity to mine operations, and relocation history—has its own unique experience with the mine and mine-related impacts, residents share many common and interdependent concerns. These concerns include: overcrowding; lack of land and food security; resort to unsafe, small-scale mining for subsistence; blasts, noise, and chemical odors from the mine; and lack of water security. Porgerans describe living near the mine as “grim,”² “unsafe,”³ and “dangerous.”⁴ Many state that they are living like “animals.”⁵ These concerns have led to the widespread belief that community resettlement away from the mine is the only appropriate long-term solution.

1. OVERCROWDING

Porgeran residents raise serious concerns about overcrowded villages and homes, including its effects on community and familial conflict, farming land and food availability, adequate housing, and health and sanitation.

When the initial mining contract was signed in 1989, the communities that lived close to the mine were not relocated to new land far from mining areas. Instead, they were moved a short distance away, often just feet from mine operations and waste disposal.⁶ The population has since increased dramatically,⁷ placing increased strain on land for farming and on other natural resources, including

water, a point emphasized by BNL in its communication of November 2018 with the report authors.⁸ As the mining operations and waste areas have expanded, people are living and farming on ever-shrinking plots of land, much smaller than their traditional lands, and at the edge of an active mine. Residents commonly use terms such as “island”⁹ or “desert”¹⁰ to describe where they live. In Yarik village, for example, one man explained that on “one side, they are doing the blasting. On the other side, there is Anjolek dump There is nowhere to go.”¹¹

Community members are concerned about the crowding of multiple generations of families into small homes. Without land to move onto, numerous families are concentrated in small areas, and more people are forced to share living spaces than would traditionally be the case.¹² This can contribute to familial conflict,¹³ and exacerbate concerns for health and hygiene. Many live with their entire extended families—grandparents, parents, children, in-laws, cousins—all sharing a few small rooms.¹⁴ Depending on a variety of factors such as village location, economic resources, and status, families may live with ten, fifteen, or more family members, sleeping in every available space¹⁵ of homes of one or two small rooms.¹⁶



Photo 1: In most villages, neighbors' homes are situated within extremely close proximity to one another, with little space for agriculture or latrines.

2. LACK OF LAND AND POOR FOOD SECURITY

For many residents, subsistence agriculture, once a primary means of providing food,¹⁷ has become difficult or impossible because of the lack of land and the difficulty of farming on the steep hills onto which some have been relocated.¹⁸ The lack of land for subsistence agriculture contributes to food insecurity. Many Porgerans report that the land they now have available for growing food, if any, is not sufficient to support their family's basic food needs.¹⁹ Many report having no gardens, or only being able to grow a few plants directly around their home, where traditionally, such families would have numerous garden areas.²⁰ Some Porgerans interviewed by the Research Team also noted that they have been deprived of access to more fertile valley land, and instead are forced to rely on less productive land.²¹

Clan land ownership and boundaries limit the extent to which families might move away and find additional land for subsistence agriculture. Members of one clan cannot simply utilize another clan's land, without connection to that land, such as through marriage, or permission of the landowner clan.²² Residents often report feeling that they have little access to alternative places to live.²³ When asked why he did not use other land, one man responded: "I have no other place to go. Those are other peoples' lands. Some of those other people are my enemies."²⁴

Apart from subsistence agriculture, hunting animals and gathering plants were traditional means of supplementing diets. Now, however, many residents report that there is less bush available in which they can hunt, collect firewood, or find ferns, watercress, or other plants.²⁵ Interviewees attributed this in part to the fact that they were relocated to areas that had previously served as their bush areas,²⁶ and to the presence of the waste dumps and the mine. Residents report that animals that were traditionally hunted are no longer easily found, or are never found at all.²⁷ A man from Yarik stated, "We did have all these possums and birds and cassowaries in the mountain before, but now our bushes have been all taken by the company and they are all gone, but people that live in the other mountains still hunt their food, but we don't."²⁸

Because of the limitations on subsistence farming, hunting, and gathering, it is common for people to buy food from local stores and markets, when they have the funds to do so.²⁹ But with limited incomes, interviewees frequently voiced concern about not having enough food, skipping meals, or having imbalanced and inadequate meals, such as plain rice alone.³⁰

3. RESORT TO UNSAFE SMALL-SCALE MINING FOR SUBSISTENCE

Without sufficient land for farming and subsistence, families that otherwise would have used alluvial mining as supplemental income now turn to it as the primary means of survival.³¹ There are insufficient employment opportunities at the mine to provide an adequate alternative source of income for families—while local employees constitute a significant proportion of the mine's workforce (64 percent),³² this still only amounts to approximately 3 percent of the local population.³³ Small-scale mining is thus extraordinarily common in Porgera, and Porgerans of all ages and backgrounds participate. Gold can easily be sold to traders at Porgera Station for small amounts of cash.³⁴ Many Porgerans' daily lives are characterized by a cycle of collecting rock and gold, processing it through small-scale alluvial processes, and converting it to cash to buy food for the following day or week. The alluvial process involves grinding the rock into powder, combining it

with mercury, and burning the mercury off from the compound that is formed. Most residents take little to no precaution against the dangers of mercury use,³⁵ which is seen as a necessary risk for daily survival.³⁶

In order to find enough gold to survive,³⁷ many in Porgera feel forced to turn to the mine's hard rock waste dumps and riverine tailings, exposing themselves to the risks of chemical emissions³⁸ and possible arrest or retaliation by mine security personnel for trespassing on mine property.³⁹ Many people expressed concerns that they were exposing themselves to health risks by spending long hours and entire days partially submerged in the mine's tailings waste collecting gold,⁴⁰ mentioning that the water burns their skin at times or makes it "itchy" or "dusty."⁴¹ Children accompany older family members to the "Red River" of tailings waste, and women spend significant amounts of time in the water.⁴² (See Chapter IV for more detail on uses of the Red River). The mine's open pit attracts many people from other parts of Enga, including those who engage in violent criminal acts in and around the mine, but locals also use the pit as a source of income. The pit offers promise of higher profits, yet comes with a greater potential to clash with armed mine security forces.⁴³ A man from Apalaka described how his ten-year-old son commonly went into the open pit with other boys of roughly the same age, despite the father's warnings and pleas.⁴⁴

Although many people fear that looking for gold near the industrial mining operations exposes them to serious risks, providing food for the immediate needs of their families often outweighs the perceived risks.⁴⁵ Porgeran residents often refer to the Red River and other sources of gold as the "garden" of the community.⁴⁶ When asked why he went to the Red River, a man from Panadaka answered, "I think of my stomach. I don't have a garden and I don't have firewood, so when I think of my stomach I go to the Red River. . . . When I think about my stomach, I don't care about the chemicals."⁴⁷ The man mentioned that he and his family would go to the Red River when they were close to the bottom of their bag of rice. This pattern, of going to the Red River or other sources of gold when hungry or when families ran out of food, was echoed in many interviews.⁴⁸

4. BLASTS, LANDSLIDES, NOISE, AND CHEMICAL ODORS

Frequent use of explosives at the mine site triggers fears for Porgeran residents about the structural integrity of residents' nearby homes and the stability of the surrounding land.⁴⁹ Interviewees told the Research Team that blasts from the open pit and underground mine operations are strong enough to shake homes, move objects, and crack glass.⁵⁰ A distinct fear for those living above the underground mine is that their homes will one day suddenly sink into the mine following a blast.⁵¹ One woman from Apalaka told the Research Team, "When the company does the blasting out there, I feel the house shaking Sometimes [I] fear that the ground will open and I'll fall inside—that it will open up while I'm asleep."⁵² The high frequency of blasting means that these fears manifest often.

Porgera residents also fear landslides and erosion. In order to accommodate mining operations, houses and garden plots were relocated from the lower valley land to hillsides and sloped terrain. People in especially vulnerable villages such as Apalaka and Yarik attribute landslides and erosion around their homes to the blasting at the mine and to erosion caused by the waste dumps next to their villages.⁵³ Interviewees report having lost gardens to landslides, and erosion is clearly visible

near waste dump areas.⁵⁴ The effects of unstable land and housing create daily feelings of insecurity. People in Yarik, for example, fear that their village is being squeezed from all sides.⁵⁵

In addition to blasting and landslides, residents are impacted by persistent and loud sounds emanating from the active mine. In numerous villages, the sound of clamorous trucks and other vehicles operating throughout the day and night can be heard, which disturbs residents' sleep, conversation, and study.⁵⁶ These concerns are particularly pronounced for those living in villages close to Anawe dump and the pit areas, in particular Panadaka, Pakien Camp, Alipis, and parts of Kulapi. For some residents, the noise is so disruptive to sleep and study that they have sent their young children to other villages to live.



Photo 2: In the distance, the mine's lights can be seen. Operations often continue throughout the night, interrupting the quiet of the surrounding landscape.

Another prominent concern for residents is the mine's emissions into the air. In a number of villages, and especially Kulapi, a village close to the mine's processing facilities, a white plume can be seen rising from the processing plant, and people in various villages told the Research Team that they could often smell the chemicals from the mine.⁵⁷ People also believe that emissions in the air condense and combine with rainwater, impacting the quality of rainwater collected for drinking. (See Chapter IV for an examination of this concern). Many residents reported that they perceive a dusty residue accumulating on their roofs and plants, which they attribute to mine activity.⁵⁸ Members of the Research Team also experienced chemical smells when travelling near the mine's processing operations and the Yunarilama outlet from the underground mine.⁵⁹ These smells, and the sight of the white plume, lead to the widespread belief among residents, and prominently in Kulapi and Yarik, that the air is being polluted, and that direct inhalation of it is harming residents

and affecting their health.⁶⁰ Similar feelings were apparent in Anawe, where odors from the Red River waft across the village.⁶¹ Many residents also complained about dust in the air that they breathe, or that lands on their plants or in their water drums.⁶²

The mine monitors concentrations of arsenic, cadmium, mercury, and lead, as well as sulfuric acid, in emissions from stationary sources at the mine site.⁶³ The data reported by the mine in recent publicly available Annual Environmental Reports (measurements of metal concentrations taken in 2013, and of sulfuric acid concentrations taken in 2014), showed concentrations in compliance with relevant Australian standards.⁶⁴ Air quality monitored in 2014 at Panadaka and Kulapi—two villages very close the mine site—did reveal concentrations of particulate matter (with inputs from “wood burning, organics and wind-blown dust”) in excess of the Australian standards, with concentrations significantly higher at Kulapi, the village located closer to the open pit.⁶⁵

5. LACK OF WATER SECURITY

Residents are very concerned about the lack of water security in Porgera, and about the mine’s possible impacts on water in the area. Because the mine dumps its waste into the local river system, residents fear the effects when they bathe and wash. Without basic water supply infrastructure, residents draw water from their environment either through harvesting rainwater or using local surface or ground waters—but water supply is too often inadequate to meet basic needs, especially during dry periods. Residents believe that some of their streams have been covered by or decreased because of the mine, and that other streams are contaminated upstream either by the mine or by other villages. They are left dependent primarily on collected rainwater, but access to rainwater is not consistent, and residents fear that the rain is contaminated by emissions from the mine’s mill and from dust and dirty buckets. Porgerans have received little or no scientific information about the safety or risks of accessing different sources of water, and attribute numerous health problems in the villages to consuming or bathing in potentially contaminated waters. Obtaining trusted, reliable water, or any water at all for household use, is a struggle for many residents of Porgera. These problems are exacerbated during dry periods. These water issues are the focus of this report and are examined in much greater detail in Chapter IV.

6. THE DESIRE FOR RESETTLEMENT

Given the extremely poor general living conditions in Porgera, residents repeatedly and clearly express their strong desire for resettlement away from the mine.⁶⁶ Porgeran leaders describe the current situation as a “crisis.”⁶⁷ The basis for the desire for resettlement is clear. In one mother’s words:

When the mining started, the mining activity destroyed my creek forever, and my river that I used to get everything from was destroyed, and my life is in danger now. Now all my children, all my brothers’ and sisters’ children, everyone drinking, washing, cooking, in this water. All my good environment is spoiled, a lot of my kids have illness, a lot of mucous with cough, a lot are born mentally affected, a lot are born with no legs and arms, so I’m wishing that Barrick would resettle us.⁶⁸

Another man stated:

We are in a desperate situation. Our environment is not in a good condition. We are about to die. You better move us somewhere else, relocate us. If you were Barrick, that is what I would say. I want to move. Relocate us.⁶⁹

Another male resident emphasized concerns about unsanitary conditions:

There are houses everywhere here, there are not enough good toilets to go. We cook and eat and go to the toilet in the same area. The flies come to our uncovered food. I am thinking, the company should relocate me to a good place. Why is the company fencing me [in]?⁷⁰

Porgerans have stated their preference for resettlement for many years, as clearly noted in surveys carried out by consultants for the mining company.⁷¹ In the Human Rights Clinic and Earth Institute Research Team's interviews, focus groups, and village consultations, residents of Porgera also clearly and consistently explained their desire for resettlement. Indeed, in numerous household interviews, and in every village where the Research Team reported back water sampling results in January 2016, communities stated that resettlement was a top priority.⁷²

While some of the Porgeran residents' concerns can and should be addressed through emergency measures (for example, the provision of potable water), minor adjustments to basic services in and around the mine area will not solve the underlying problems. Porgerans note that the root cause of the intolerable living conditions for their families is living in and around an industrial mine, and that the only long-term solution is resettlement:

For us, the best result is relocation. We are really suffering here. We also need doctors to come to check to see if we are chemically affected. And if not relocated, we would want a water supply. Make us safe in this situation. But relocation is the only permanent solution. Everything else is temporary.⁷³

Resettlement of entire villages is a drastic step, entailing the uprooting of clans from their lands, and significant disruption to the lives of thousands of people. However, the daily, appalling living conditions in Porgera have resulted in residents feeling compelled to leave their own homes and traditional lands.

At various points in the mine's history, the mine owners have explored the possibility of resettlement. In 2007, for example, the mine commissioned URS Corporation consultants to explore the conditions of the SML and identify replacement land.⁷⁴ However, in 2008, the mine decided not to work toward resettlement, apparently due to high costs and implementation complexities.⁷⁵ The mine reached this decision despite acknowledging the gravity of the situation and the need for resettlement of hundreds of households "impacted by mining activities to an unacceptable degree."⁷⁶ Some of the company's own managers have expressed that the situation is unacceptable and morally wrong.⁷⁷ The community is aggrieved by the resettlement delay and what they take as repeated false promises.⁷⁸

Resettlement is currently being discussed anew. In 2013, the mine began to develop a pilot resettlement project in response to the ongoing demands for resettlement.⁷⁹ The current proposal is to begin resettlement starting with two communities in the mine lease area, Pakien Camp and Panadaka. Such resettlement will be an extraordinarily challenging task and one with no specific successful precedents in the mining sector in PNG.⁸⁰ The mine currently expresses a desire for resettlement,⁸¹ but questions its feasibility,⁸² and the PNG government has not yet committed any resources to this endeavor.⁸³ While analyzing the suitability of the pilot framework in an assessment commissioned by the mine, the Centre for Social Responsibility in Mining at the University of Queensland stated that the mine needs to undertake more preparation and planning before the pilot can move from its current concept stage to a draft plan.⁸⁴ The assessment also found that the risks associated with resettlement have not been fully examined.⁸⁵

It is essential that any resettlement initiative be designed and implemented in accordance with international human rights standards.⁸⁶ These include the active participation of Porgeran residents in, and their free, prior, and informed consent to, the design and implementation of a program, and assurances that resettlement will meet the human rights to, and Porgeran desires for, an adequate standard of living, education, health, work, housing, food, water, and sanitation.

CHAPTER III: LEGAL FRAMEWORK

The Right to Water and Interrelated Rights

This Chapter provides an overview of the right to water under international law, setting out the main elements of that right—availability, quality, acceptability, and accessibility—as well as its procedural dimensions, including access to information and participation. This Chapter also sets out interrelated rights, including the rights to life, health, food, and housing. It then explains the state obligations and corporate responsibilities with respect to the right to water.¹ It also discusses the domestic law and regulations that govern water use and quality and waste disposal in Papua New Guinea, and how they relate to the right to water.

1. INTERNATIONAL LEGAL FRAMEWORK

a. Overview

The right to water is a fundamental human right, and is “essential for the full enjoyment of life and all human rights.”² It is “indispensable for leading a life in human dignity”³ and necessary for the realization of other human rights, including the rights to life,⁴ health,⁵ and an adequate standard of living.⁶ The right to water requires “sufficient, safe, acceptable, physically accessible and affordable water for personal and domestic uses.”⁷ Those uses include drinking, washing of clothes, food preparation, and personal and household hygiene.⁸ When ensuring the realization of the right to water, states must also give specific attention to the rights of vulnerable or marginalized groups.⁹

The importance of the right to water and its interdependence with other rights has been recognized in UN General Assembly and Human Rights Council resolutions,¹⁰ international treaties,¹¹ and reports by UN Special Rapporteurs and the UN High Commissioner for Human Rights.¹² It has also been recognized in regional treaties and instruments,¹³ by regional human rights commissions and courts,¹⁴ national courts,¹⁵ and scholars.¹⁶ The right has now been examined in numerous contexts,¹⁷ and is the subject of a growing guidance and best practice literature.¹⁸

The full realization of the right to water requires that water resources be available, accessible, socially and culturally acceptable, and of a safe quality free from substances that threaten human health. The right to water also includes procedural elements, including the requirement that individuals and communities have access to adequate information regarding water resources and any risk of exposure to hazardous substances, as well as an opportunity to participate in relevant decision-making about water resources.

States are obliged to respect, protect, and fulfil the right to water. This means that they have obligations to avoid interfering with the right to water, to prevent third parties (such as corporations) from interfering with the right to water, and to take positive measures to ensure that the right to water is fulfilled. Corporations have the responsibility to respect the right to water, which includes avoiding causing or contributing to adverse impacts; seeking to prevent or mitigate adverse impacts; implementing an ongoing human rights due diligence process to identify, prevent,

mitigate, and account for how impacts are addressed; reporting in an accessible way any risks and impacts and company responses; and remedying any adverse impacts.¹⁹

a. Elements of the Right to Water

i. Accessibility

Water must be physically accessible.²⁰ It must be “within, or in the immediate vicinity, of each household,” and in areas that do not threaten a person’s physical security.²¹ World Health Organization guidelines state that “basic access” requires a water source be *both* within one kilometer *and* within a thirty minute round-trip from the household, including travel and collection time, in order to ensure that the minimum quantity of water necessary can be collected.²² If the water source is more than one kilometer away, the volume of water collected is likely very low.²³ Even where “basic access” is achieved, the right to water is not necessarily realized. Apart from the time and distance, individuals must also be able to access water safely, without facing threats to their physical security.²⁴ Further, water must be economically accessible, meaning it must be affordable for everyone.²⁵ Costs and charges associated with water should not force people into using unsafe alternative sources of water,²⁶ or compromise the realization of other rights such as food or housing.²⁷ In addition, water must be accessible to all sections of society,²⁸ without discrimination based on age, gender, race, or other grounds.²⁹ Therefore, assessment of the right to water must also take into account the needs of particular groups—including persons with disabilities,³⁰ children, older persons, and women—and address the ways in which accessibility concerns may disproportionately affect such groups.³¹

ii. Availability

The supply of water must be sufficient for personal and domestic uses,³² including drinking, washing of clothes, food preparation, and personal and household hygiene.³³ A minimum of fifty liters per person per day is necessary to meet most basic consumption and hygiene needs.³⁴ This supply of water must be “continuous,”³⁵ and not disrupted by seasonal variation, or other fluctuations in supply that lead to reduced availability and the need to store water in the household.³⁶

iii. Quality

Water must be safe for human consumption as well as personal and domestic hygiene.³⁷ It must be “free from micro-organisms, chemical substances and radiological *hazards* that constitute a threat to a person’s health.”³⁸ Water that is used by communities must therefore be protected from a degree of contamination that would present a significant risk to human health over a lifetime of consumption.³⁹ Benchmarks of exposure for a range of contaminants are recorded in the World Health Organization’s Guidelines for Drinking-water Quality.

The UN Special Rapporteur on the implications for human rights of the environmentally sound management and disposal of hazardous substances and wastes has indicated that water is the

resource most affected by the unsound management of hazardous substances and waste from extractive industries.⁴⁰ Such contaminants can seep, leech, and drain into water systems, polluting the water sources of those living near a mine and communities downstream.⁴¹ Exposure to such contaminants can have a disproportionate impact on children, women, and girls of reproductive age.⁴² The UN Special Rapporteur has reported on how exposure of children and pregnant mothers has resulted in a “silent pandemic” of disability and disease,” the effects of which often may not manifest until years or decades after exposure.⁴³

iv. Acceptability

The principle of acceptability requires that the odor, color, and taste of drinking water be socially and culturally acceptable from a user’s perspective, particularly as these are the primary means by which most individuals evaluate the quality and safety of water resources.⁴⁴ Water that is technically potable but not perceived by local users as clean or safe still presents a human rights concern, as it can drive people to access other less accessible or less safe sources of water.⁴⁵ Therefore, individual and community perceptions of palatability, the availability of information, and the degree of community participation in decision-making about water are of particular importance in assessing the acceptability of the water supply.⁴⁶

v. Access to Information and Participation

The right to have access to information concerning water issues, including full access to information held by public authorities or third parties concerning water services and the environment,⁴⁷ is a component of both the right to water⁴⁸ and the right to participation⁴⁹ and an independent right in and of itself.⁵⁰ The right to information is particularly important in relation to the possible presence of hazardous materials in water supplies, as “information on risks, mitigation measures and safer alternatives can help prevent harm and save lives,” implicating the rights to water, health, and life.⁵¹ In this context, the UN Special Rapporteur on the implications for human rights of the environmentally sound management and disposal of hazardous substances and wastes has found that “the right to information on hazardous substances and wastes would require that relevant information be available, accessible and functional, in a manner consistent with the principle of non-discrimination.”⁵²

Available means that “current reliable information has been generated and collected in a manner adequate to assess the magnitude of potential adverse impacts on the rights of people.”⁵³ The “necessary information” to meet this standard can include: the hazardous properties of substances, their “actual and potential uses and releases,” “the amounts of substances present in people and their environments compared with risks,” “the prevalence of adverse impacts” including particular health effects, and “protective measures and regulations.”⁵⁴

Accessible means that “everyone can seek, obtain, receive and hold available information,” that the information is provided “in a timely manner,” and that any costs associated with accessing the information are “kept at a minimum.”⁵⁵

Functional means that the information “works to prevent harm, to enable democratic decision-making, and to ensure accountability, access to justice and an effective remedy.”⁵⁶ Technical language must be “translated into a language that is functional, to enable individuals and groups of individuals to make informed choices,” and the “underlying data from which conclusions are drawn” must be accessible.⁵⁷

Consistent with the principle of non-discrimination means that information must be “disaggregated and specialized” to “understand and prevent disproportionate implications and impacts of hazardous substances and wastes on individuals and specific population groups, including different ages, incomes, ethnicities, genders as well as minorities and indigenous peoples.”⁵⁸

Provision of information is necessary to facilitate the individual’s *right to participate* in decision-making processes that affect their exercise of the right to water,⁵⁹ and in the case of indigenous communities, their right to free, prior, and informed consent with respect to projects implicating the use of water resources.⁶⁰ Participation is a continuous process,⁶¹ and it must be “active, free, and meaningful.”⁶² The types of participation that are required in the context of the right to water include the right to participate in decision-making about, first, financing and budgeting of water services,⁶³ and second, service provision, including the type, location, and improvement of water service provision as well as whether to involve the private sector.⁶⁴ The UN Special Rapporteur on the human right to safe drinking water and sanitation notes that participation is particularly important where access to water is affected by a mining project,⁶⁵ as “[s]uch situations are often marked by an atmosphere of mistrust and power imbalances.”⁶⁶ The right to participate can be advanced by undertaking social and environmental impact assessments collaboratively with the community, and at a minimum, disclosing the findings of such assessments.⁶⁷

The right of participation extends to children. The UN Special Rapporteur on the implications for human rights of the environmentally sound management and disposal of hazardous substances and wastes stresses, “[e]very child capable of forming his or her own views has the right to be heard and to influence decision-making processes that may be relevant in his or her life.”⁶⁸ Thus, children must “have access to environmental health information that is ‘understandable and appropriate to children’s age and educational level’.”⁶⁹

b. Interrelated Rights: The Rights to Life, Health, Food and Housing

The right to water is linked to other rights, which are intertwined to such an extent that conditions affecting the fulfilment of one right are likely to enhance or deteriorate the enjoyment of other rights. Water is required to produce food, ensure proper hygiene, secure livelihoods, and participate in cultural life.⁷⁰ The UN Committee on Economic, Social and Cultural Rights notes that the human right to water is a “prerequisite for the realization of other human rights,” particularly the right to life and human dignity (as “one of the most fundamental conditions for survival”), the right to the highest attainable standard of health, and the right to an adequate standard of living, including the rights to adequate food and housing.⁷¹

The right to water is particularly and inextricably related to the right to the highest attainable standard of physical and mental health, which includes both the freedom to control one’s health and body as well as the entitlement to a system of health protection.⁷² The right to health

“embraces a wide range of socio-economic factors that promote conditions in which people can lead a healthy life, and extends to the underlying determinants of health, such as food and nutrition, housing, access to safe and potable water . . . and a healthy environment.”⁷³ A violation of the right to water can result in critical health conditions such as severe dehydration or waterborne diseases that impact the right to health of affected individuals.⁷⁴ The right to health is also threatened by “unsafe and toxic water conditions,” and respecting the right to health requires steps to “ensure that natural water resources are protected from contamination by harmful substances.”⁷⁵ Thus, the fulfilment of the right to health requires “an adequate supply of safe and potable water” and “the prevention and reduction of the population’s exposure to harmful substances . . . or other detrimental environmental conditions that directly or indirectly impact upon human health.”⁷⁶

Access to water is also linked to the right to food,⁷⁷ which requires “regular, permanent and unrestricted access, either directly or by means of financial purchases, to quantitatively and qualitatively adequate and sufficient food corresponding to the cultural traditions of the people to which the consumer belongs.”⁷⁸ The UN Committee on Economic, Social and Cultural Rights has thus called for specific attention to the situation of “disadvantaged and marginalized farmers,” and stressed the need for “adequate access to water for subsistence farming and for securing the livelihoods of indigenous peoples” as part of the realization of the right to food.⁷⁹

Access to water is further linked to the right to housing,⁸⁰ which entails the “right to live somewhere in security, peace and dignity.”⁸¹ Inherent in that right is the availability of “certain facilities essential for health, security, comfort and nutrition,” including “safe drinking water” and “sanitation and washing facilities.”⁸²

c. State Obligations and Corporate Responsibilities with Respect to the Right to Water and Interrelated Rights

i. State Obligations

States have the primary obligation for ensuring that the right to water is realized for everyone within their territory or jurisdiction, and must respect, protect, and fulfil the right to water.⁸³ Additionally, states must regulate the extraterritorial operations of their corporations, and by investigating and providing access to remedy where such corporations infringe the right to water.

Respect. The obligation to respect requires that states refrain from interfering, directly or indirectly, with the enjoyment of the right to water.⁸⁴ The World Health Organization articulates the related duty of non-retrogression, which requires states to maintain existing water access and infrastructure or social assistance for the purchase of water.⁸⁵ The UN Special Rapporteur on the human right to safe drinking water and sanitation cites pollution, depletion, and diversion of water resources as a common threat to the right to water. Such activities can amount to a violation of a state’s obligation to respect if they are the result of state-backed efforts, such as state-controlled extractive industries, and state-issued licensing of projects that are predicted to result in human rights violations.⁸⁶

Protect. The obligation to protect requires that states prevent third parties, including corporations, from interfering “in any way” with the right to water and interrelated rights.⁸⁷ This obligation

includes “adopting the necessary and effective legislative and other measures to restrain, for example, third parties from denying equal access to adequate water; and polluting and inequitably extracting from water resources” where such actions would threaten the realization of the right to water.⁸⁸ Relatedly, states are required to prevent the population’s exposure to “harmful chemicals or other detrimental environmental conditions that directly or indirectly impact upon human health.”⁸⁹ The UN Special Rapporteur on the implications for human rights of the environmentally sound management and disposal of hazardous substances and wastes emphasizes that states should, in particular, “[p]revent childhood exposure to pollution and toxic chemicals” and “ensure the same protection to women and girls of reproductive age,”⁹⁰ as these groups are uniquely subject to long-term health impacts.⁹¹ The UN Special Rapporteur on the human right to safe drinking water and sanitation has stated that violations of the obligation to prevent exposure occur when a state fails to regulate excessive exploitation or contamination by third parties,⁹² noting that many such violations occur in the context of large-scale development projects.⁹³ When water services are operated or controlled by third parties, states must regulate to “prevent them from compromising equal, affordable, and physical access to sufficient, safe and acceptable water.”⁹⁴ In particular, states should take steps to ensure that “[i]ndigenous peoples’ access to water resources on their ancestral lands is protected from encroachment and unlawful pollution.”⁹⁵

Fulfill. The obligation to fulfill requires, as a starting point, that states ensure access to minimum essential amounts of water.⁹⁶ The state must take positive measures to assist individuals to realize their right to water, and directly provide water when people are unable to realize the right themselves.⁹⁷ States must adopt a national water strategy or “plan of action” to realize the right to water,⁹⁸ ensuring that water is affordable and accessible, particularly in rural and deprived urban areas.⁹⁹ The UN Special Rapporteur on the human right to safe drinking water and sanitation has found that violations occur when the state fails to: raise, allocate, and utilize necessary resources for water allocation; prioritize “comprehensive strategies and plans” to ensure minimum levels of access; prioritize steps to ensure “minimum essential levels of access to water;” and provide “adequate services.”¹⁰⁰

Human rights law provides for progressive realization of the right to water where a state lacks resources,¹⁰¹ but also includes certain “core obligations” that are of “immediate effect.”¹⁰² Core obligations include, for instance, ensuring non-discrimination, monitoring the right to water, ensuring access to “the minimum essential amount of water, that is sufficient and safe for personal and domestic uses to prevent disease,” and ensuring that people’s personal security is not threatened when they access water.¹⁰³ Where a state does not have the capacity to ensure access to basic water needs, the law requires that the state accord water rights “the highest priority,” and “where minimum essential levels are not ensured, the State is, *prima facie*, violating human rights, and it bears the burden of proof to demonstrate that it lacks the capacity to do so.”¹⁰⁴ The duty to fulfill requires states with limited resources to take concrete and targeted steps using their maximum available resources,¹⁰⁵ prioritizing essential levels of access to the most marginalized¹⁰⁶ and exercising due diligence to assess the impacts of their actions to ensure sustainable realization of human rights.¹⁰⁷

In order to respect, protect, and fulfill human rights, states must also “regularly and systematically” “generate, collect, assess and update information on hazardous substances and wastes”¹⁰⁸ — including the hazardous properties of substances, likelihood of exposure, risk of harm, and options available to prevent harm¹⁰⁹—and ensure that such information is “available, accessible and

functional for everyone,”¹¹⁰ with or without request, and particularly for those communities that are most vulnerable.¹¹¹

ii. Regulation by States of the Extraterritorial Actions of Their Corporations

In order to meet their obligation to protect economic, social, and cultural rights, states must “take steps to prevent and redress infringements of Covenant rights that occur outside their territories due to the activities of business entities over which they can exercise control.”¹¹² Entities expressly included under this obligation include “corporations incorporated under [the state’s] laws, or which have their statutory seat, central administration or principal place of business on [the state’s] national territory.”¹¹³ States should require parents of foreign subsidiaries, or corporations with foreign partners, “to act with due diligence to identify, prevent and address abuses to Covenant rights by such subsidiaries and business partners, wherever they may be located.”¹¹⁴ The UN Committee on Economic, Social and Cultural Rights has noted that “particular due diligence is required with respect to projects in mining” in light of the “well-documented risks associated with the extractive industry.”¹¹⁵ In exercising this obligation, states must put into place “effective monitoring, investigation and accountability mechanisms” to “ensure accountability and access to remedies, preferably judicial remedies, for those whose Covenant rights have been violated in the context of business activities.”¹¹⁶ Remedies must be “available, effective and expeditious,” and states must “remove substantive, procedural and practical barriers to remedies.”¹¹⁷

iii. Corporate Responsibilities

Corporations have responsibilities to respect human rights, including the right to water. To meet this responsibility, corporations must “[a]void causing or contributing to adverse human rights impacts through their own activities,” “[s]eek to prevent or mitigate adverse human rights impacts that are directly linked to their operations . . . by their business relationships, even if they have not contributed to those impacts,” and where they have “caused or contributed to adverse human rights impacts, they should provide for or cooperate in their remediation through legitimate processes.”¹¹⁸ Businesses’ responsibilities to respect human rights are independent of states’ obligations and are “over and above compliance with national laws and regulations protecting human rights.”¹¹⁹

In order to meet these responsibilities with respect to the right to water, corporations are required to, for example, establish a policy commitment to human rights and embed respect for the right in all activities and business relationships; engage in human rights due diligence to assess and take action on the corporation’s impact on the right to water; and establish concrete processes to remedy any adverse impact of their operations on the right to water.¹²⁰ With regard to toxic chemicals, corporations must seek to actively prevent contamination. The UN Special Rapporteur on the implications for human rights of the environmentally sound management and disposal of hazardous substances and wastes notes, “[a]t its most basic, [corporate] human rights due diligence . . . consists of identifying potential adverse impacts from businesses’ activities and business relationships and taking active measures to prevent such impacts from materializing.”¹²¹ At every step, companies must pay particular attention to the rights and needs of marginalized groups.¹²²

As part of their human rights due diligence obligations, corporations also have specific responsibilities to share information with affected communities. The OECD Guidelines for Multinational Enterprises provide that businesses should adopt a system of environmental management, and make information available to the public and to workers about “potential environment, health and safety impacts of the activities of the enterprise.”¹²³ Additionally, corporations should “engage in adequate and timely communication and consultation with the communities directly affected by the environmental, health and safety policies of the enterprise and by their implementation.”¹²⁴ The UN Special Rapporteur on the implications for human rights of the environmentally sound management and disposal of hazardous substances and wastes has found that, especially for “local communities in high-risk areas,” it is not sufficient for companies to “simply identify the name of the hazardous substance,” rather “[i]t is essential to explain and create awareness about what harm may result.”¹²⁵

2. DOMESTIC LEGAL FRAMEWORKS

a. Papua New Guinea

In addition to the state obligations and corporate responsibilities set out in international human rights law, water use and quality and mine waste disposal in Papua New Guinea are governed by a combination of broad national goals identified in the Constitution, a set of national laws and regulations, and mine-specific water use and discharge permits. None of these domestic legal instruments explicitly codify the elements of the international human right to water, but they do provide some protections.

National goals and basic rights. At the constitutional level, to guide national policy-making, Papua New Guinea has identified national goals and basic rights. The national goals include:¹²⁶ that every person be free from domination or oppression and have equal opportunity to participate in and benefit from development; that the standard of public health be improved; that foreign investments be strictly controlled; and that “natural resources and [the] environment ... [be] conserved and used for the collective benefit of us all, and be replenished for the benefit of future generations.”¹²⁷ The Constitution also calls on the government “to control major enterprises engaged in the exploitation of natural resources.”¹²⁸ Basic rights identified in the Constitution include, among others, the rights to life, liberty, and security of person, and the right to take part in political activities.

Regulation of environmental protection and water resources. The *Environment Act 2000* (Papua New Guinea) provides a broad regulatory framework for environmental protection, generally prohibiting all persons from causing environmental harm and imposing a duty to take all reasonable and practicable measures to prevent or minimize environmental harm.¹²⁹ This general duty does not give rise to legal liability, but breaches of the duty may be addressed by orders of the executive government.¹³⁰ The availability and use of water resources is regulated by the *Environment Act 2000* (Papua New Guinea) and the *Water Resources Act 1982* (Papua New Guinea). The *Environment Act 2000* establishes that while “the right to the use, flow and control of water is vested in the State,”¹³¹ citizens have an overarching right to take water for domestic purposes.¹³² The Act empowers the Director of Environment to take measures to ensure availability of water resources during drought conditions, with legislative priority given to domestic purposes.¹³³

The *Water Resources Act 1982* establishes the Water Resources Board, and empowers the Board to examine problems concerning, and make plans regarding, the allocation and quality of water and the conservation of water.¹³⁴ Neither law expressly guarantees the provision of water or water infrastructure to citizens of Papua New Guinea, nor do they establish requirements for water accessibility, or acceptability for domestic purposes. The *Public Health (Drinking Water) Regulation 1984* (Papua New Guinea) sets out water quality standards for untreated water and treated water intended for drinking purposes.¹³⁵

Regulation of mining activities. The *Mining Act 1992* (Papua New Guinea) empowers the government to enter into mining contracts with mining developers and grant exploration licenses and various mining leases and easements.¹³⁶ Mining leases granted under this Act broadly empower mining companies to “do all things necessary or expedient for the undertaking of mining or treatment operations,” including removing rock, taking or diverting water resources, and constructing waste dumps.¹³⁷ The *Mining Act 1992* does not prohibit riverine tailings disposal, nor does it require health impact assessments or baseline studies as a condition for the grant of mining licenses.

Water and environment permits and licenses. The *Water Resources Act 1982* sets out the process of applying for water use permits.¹³⁸ Permits allow the holder, such as a mining company, to take water for the purpose specified in the permit and discharge water or waste in accordance with prescribed conditions and standards.¹³⁹ The *Environmental Act 2000* and the *Environmental Contaminants Act 1978* (Papua New Guinea) set out the process for applying for permits and licenses to undertake certain activities that can cause environmental harm, including releasing contaminants into the environment.¹⁴⁰ The *Environment (Water Quality Criteria) Regulation 2002* (Papua New Guinea) largely defers to the terms of those permits, and expressly allows “mixing zone[s]” or bodies of water “into which waste is discharged and where the prescribed water quality criteria are not required to be met and the protection of aquatic life may not be guaranteed.”¹⁴¹

Access to information. Various legislative arrangements provide that there should be at least some access to information relevant to the regulation of water and environmental matters. The *Environment Act 2000* requires that a register of relevant information be kept by a director and “shall be made available for inspection by any person at all reasonable times.”¹⁴² Under the *Environmental Planning Act 1978*, the Director of the Office of Environment and Conservation must keep a register of all Environmental Plans.¹⁴³ The *Environmental Contaminants Act 1978* requires that the Minister for Environment keep the original of each license and each license application and make copies of any license or license application available to the public.¹⁴⁴ None of these legislative instruments, however, require the government or mining companies to take affirmative steps to raise awareness among communities of environmental risks associated with the discharge of wastes.

b. Canada and China

Neither Canada nor China has robust measures to ensure respect for, and remedy violations of, human rights by their corporate citizens operating abroad. Currently, Canada does not have any specific legislation to directly regulate Canadian extractive companies’ overseas operations.¹⁴⁵ Instead, Canada relies on some limited access to civil tort claims and remedies at the provincial

level,¹⁴⁶ and a non-binding policy initiative aimed at encouraging corporate social responsibility and compliance with international human rights standards when Canadian corporations act abroad.¹⁴⁷ Similarly, China does not have specific legislation to regulate the environmental and human rights impacts of Chinese extractive companies overseas, but instead relies on host country regulation, and more recently on non-binding guidelines to encourage good corporate social responsibility and compliance with international human rights standards.¹⁴⁸ Most of China's guidelines do not impose binding obligations, nor do they have grievance mechanisms through which affected individuals and groups might challenge non-compliance.¹⁴⁹ Such limited measures as have been adopted by Canada and China have been criticized as insufficient to meet their international legal obligation to prevent and redress infringements of human rights that occur outside a state's territory due to the activities of business entities over which the state can exercise control.¹⁵⁰

CHAPTER IV: WATER IN PORGERA

Findings from an Interdisciplinary Study

Before the mine, there were creeks and springs, but now it is hard for me. Where will I get water?

- Resident of Alipis Village, January 6, 2016

If it is rainy season, we drink water. But if it is dry season, we don't have water.

- Resident of Panadaka Village, January 3, 2015

INTRODUCTION

Residents of Porgera lack a continuous supply of adequate, safe, and acceptable water to meet their personal and household needs throughout the year. Basic water-supply infrastructure is severely lacking in villages in and around the Porgera gold mine, and many naturally occurring water sources, such as creeks and rivers, are perceived as contaminated by mining or upstream human use exacerbated by overcrowding. Some residents have access to springs perceived to be safe to drink, but many others report that certain customary water sources, including springs and creeks, have been covered or depleted since the advent of industrial mining. Residents of some villages access water piped from a reservoir to the mine, filling buckets under a pressure release valve located near their village, but this is inaccessible to many and was not designed for residents' use. Most residents across the valley generally rely on rainwater for drinking and household purposes, usually collecting it in open, plastic containers placed outside their homes, with some residents more recently benefitting from larger, covered tanks installed by the mining company. Residents are concerned that rain is polluted by harmful chemicals from gaseous emissions produced by the mine's processing facilities, and that mine dust and bacteria contaminate water during collection and storage. The Research Team found no evidence of heavy metals above World Health Organization (WHO) Guidelines for Drinking-water Quality or PNG Drinking Water Standards in collected rainwater. However, biological growth in water containers and bacterial contamination on tank taps are serious concerns, and requires further efforts to study and mitigate risk.

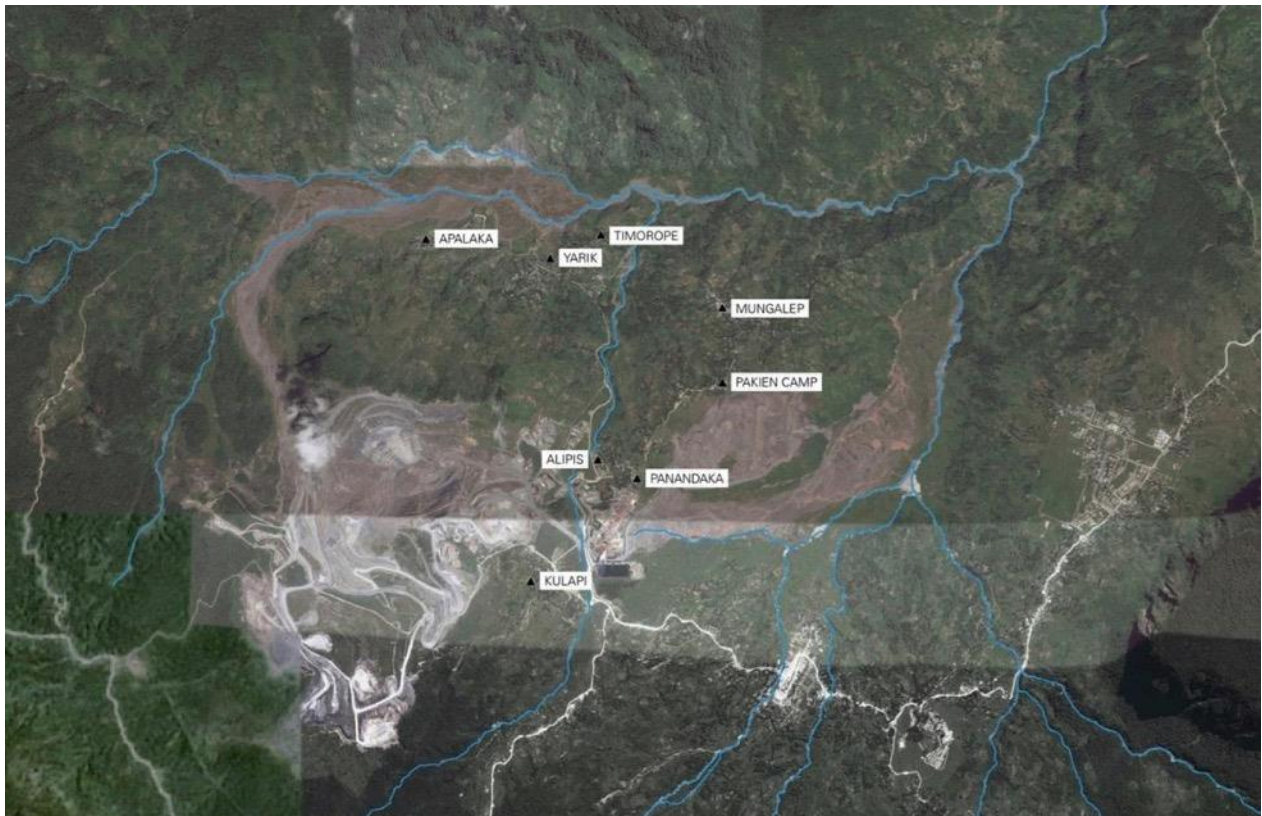
Importantly, the amount of rainwater collected is too often inadequate to meet all household needs. Residents report rationing water, sometimes going without during periods of very low rainfall, or seeking water from alternative sources, such as creeks and springs, which may be far away, expensive, or present physical security or health risks. Longer journeys to sources farther from the mine severely limit the amount of water a family can collect, can present risks to physical security when they necessitate crossing fast-flowing rivers and waste dumps, and can limit access by some, including children, older persons, and persons with disabilities. Water scarcity undermines food preparation and impacts personal hygiene, particularly for women in Porgera who at times face difficulties finding clean water for washing during menstruation. Although water is available for purchase at Porgera Station and sometimes from neighbors, for many families, purchasing water is very difficult or cost prohibitive, and would mean sacrificing the purchase of food or other necessities. While BNL has stated that the mine has in the past provided water to residents in

response to requests for emergency water supplies, residents interviewed for this study reported no knowledge of the mine supplying water to villages near the mine during the times of prolonged drought which occurred during the period of this study.

Residents do not typically drink from rivers or from most creeks, because they perceive the water to be of poor quality. However, some residents report drinking from rivers or creeks during extreme drought. And residents frequently use the rivers and creeks for bathing or washing clothes and dishes. No residents reported drinking from the mine tailings waste, known locally as the Red River. However, many Porgerans expressed concern about whether the waste might harm those who spend hours each day panning for gold or children who frequently play in the tailings. Based on the Research Team's analysis and information reported by the mine, heavy metals are present in concentrations above WHO Guidelines for Drinking-water Quality in three major rivers in Porgera, as well as the "Red River" of tailings waste, and five creeks, confirming Porgerans' deep concerns about river and some creek water close to the mine. More studies need to be conducted to assess any risk to human health arising from interaction with the tailings waste, rivers, and creeks.

Porgerans' lack of adequate information about water resources, and the failure of corporate and state actors to conduct sufficient outreach to communities, has led to a general feeling of insecurity and fears of adverse health impacts. The failure of the mine to effectively respond to communities' uncertainties has engendered feelings of distrust and a sense of helplessness about the prospect of an improved standard of living.

Map 1: Villages in and around the mine



PART A: ANALYSIS OF WATER SOURCES IN PORGERA

This Part describes the primary sources of water in Porgera, and each source's uses, accessibility, availability, acceptability, and quality, drawing upon detailed interviews, site visits, and water quality analysis. Sources described include rainwater (as well as the various methods used to collect it); springs or *ipa kendos*; creeks; mine tailings waste; rivers; the Waile Creek Dam and the mine's pressure release valves; and commercially bottled water. Water quality results are compared to WHO Guidelines for Drinking-water Quality and PNG Drinking Water Standards. Part B of this chapter sets out residents' access to information and participation concerning water.

1. RAINWATER

Summary of Findings. *Porgerans rely on rainwater as their main source of water for drinking and other household purposes, generally collecting it in uncovered plastic containers provided by the mine, and, more recently, via large covered "Tuffa tanks" in some areas. The mine's recent support for the installation of Tuffa tanks in various villages has improved water availability, but more measures are needed to guarantee basic water needs for all village residents. Even in villages that have benefited from the installation of Tuffa tanks, some families report that they must at times strictly ration collected rainwater, are sometimes forced to go without adequate water, and go to great lengths during dry periods to find other sources of water to meet basic needs. In addition to availability issues, Porgerans are concerned that collected rainwater may be contaminated by the mine's mill, which residents see releasing a white, cloud-like substance into the air. As a result, many residents continuously fear potential negative health effects from consuming rainwater or, sometimes, choose not to drink it. However, the Research Team's analysis of collected rainwater did not reveal heavy metal concentrations exceeding WHO Guidelines for Drinking-water Quality or PNG Drinking Water Standards. The government and the mine should improve outreach efforts to convey this important health information to Porgerans. Porgerans are also concerned that the presence of dust, debris, and micro-organisms in rainwater collection and storage containers may be harmful, a concern shared by the Research Team. Mitigation measures, such as regular container cleaning and the continued installation of improved rainwater collection infrastructure, are needed.*

a. Accessibility and Availability

Rainwater is the primary source of drinking water for Porgerans and is often used for other household purposes, including cooking and washing. Many residents report that collected rainwater amounts do not provide a continuous supply of water. Residents express concern that the number and capacity of containers is insufficient for household size and village population density, especially during periods of low rainfall. During longer periods of low rainfall, containers can completely dry up.

Company-supplied, plastic "blue barrels" are inadequate to meet even basic water needs: For many years, families living near the mine have relied primarily on open "blue barrels" to collect rainwater. The containers are generally placed next to homes and beneath roofs to collect run-off.

Despite the mine's positive, although very belated introduction of larger, covered tanks at the village level (discussed below), many families continue to rely on open plastic containers. Households generally have one, or occasionally two, blue barrels, which the mine has distributed to villages. According to information provided to the Research Team by BNL, the containers originally contained hydrochloric acid used in the mine's processing plant, and were washed and tested prior to distribution to village residents.¹ Each blue barrel has the capacity to collect up to 200 liters (approximately 50 gallons) of rainwater.² Some families also use a variety of found or, occasionally, purchased containers, such as bowls or garbage bins, to collect additional rainwater. Many of the containers the Research Team observed did not have covers or filtration systems, although some households placed screens on top of the barrels in an effort to keep out larger debris (See Photo 8). Collected water is accessed by scooping out water by hand or with plastic cups or other objects.

While some families have had the resources to buy additional containers to supplement the blue barrels distributed by the mine, for many years, numerous families have relied on the one or two plastic containers given to them by the company. Because of their value and scarcity, competition and conflict has arisen when the company distributed the containers.³

Some households reported that even during rainy periods when water is most plentiful, the water collected in the blue barrels is not enough to consistently meet all household needs.⁴ In Porgera, blue barrels are often used communally by large families or multiple families, resulting in inadequate supplies. For example, a woman from Kulapi village reported that one blue barrel did not supply enough water for the ten members of her household.⁵ A government official with responsibility for monitoring mines, interviewed for this report, stated, "I don't think one of those blue tanks is enough for one household," noting that the blue barrels were brought in by the company as chemical storage and repurposed for community use. "This is one way of getting rid of them," he added.⁶

The water in one blue barrel, if not replenished by continued rainfall, does not supply enough water to meet basic human needs for the average Porgeran family for even one day. The United Nations High Commissioner for Human Rights has emphasized that "between 50 and 100 liters of water per person per day are needed to ensure that all health concerns are met."⁷ A minimum of 25 liters of water per person per day is the lowest threshold to "maintain life," yet even "this amount raises health concerns because it is insufficient to meet basic hygiene and consumption requirements."⁸ In Porgera, one blue barrel full to maximum capacity (200 liters) would not supply a family of 13 (the mean number for Porgeran villages according to one mine-sponsored study)⁹ with enough water for even one day.

In an effort to make collected rainwater last as long as possible, Porgerans often ration it, using rainwater primarily just for drinking and cooking.¹⁰ According to the WHO Guidelines for Drinking-water Quality, the average person requires at minimum 7.5 liters of water per day just to meet basic drinking water and certain cooking needs.¹¹ If a typical Porgeran family rationed water for only drinking and certain limited cooking purposes, one full blue barrel would only meet around two days' worth of need.¹²

To supplement inadequate rainwater supplies for all household uses, Porgerans are forced to turn to rivers or creeks—many of which residents consider polluted—to wash their clothes, dishes, and

bodies.¹³ Water shortages are especially severe during periods of low rainfall, when containers for rainwater collection run dry. The Porgera Valley does not have distinct, regular wet and dry seasons,¹⁴ and Porgerans often use the phrase “dry season” to refer to periods of limited rainfall that can last anywhere from a few days to several months.¹⁵ Cycles of high and low rainfall alternate regularly in the Valley, and water shortages can be frequent. One dry period in 2015 was so severe that the mine itself was forced to shut down production because of water shortages.¹⁶ For some residents of Porgera, even a day without rain could affect access to water, resulting in drinking water shortages. Periods lasting several consecutive days without rain can create serious problems for families and for villages, particularly for families that do not have access to other sources of safe drinking water nearby. One woman from Panadaka told us, “If it is rainy season, we drink water. But if it is dry season, we don’t have water.”¹⁷

New company-installed tanks are beneficial, but insufficient: When the mine first opened and relocated villagers to “company houses,” it provided some large metal tanks to collect rainwater.¹⁸ Now, many of these metal containers are rusted or broken, and sit dilapidated and unused next to homes (see Photo 5).¹⁹ In recent years, the mine has installed “Tuffa tanks”—large, covered containers used in Porgera for communal water collection and often shared at the village level or by multiple households—as part of the mine’s “Supplemental Water Project.”²⁰ Tuffa tanks are either 1000, 5000, or 9000 liters in size.²¹ According to information provided to the Research Team by BNL, as of April 2017, the mine had installed 73 tanks in Panadaka, Alipis, Apalaka, Timorope, Pakien Camp, and Mugalep villages, with additional tank installation planned for Upper Yarik village.²²

According to BNL, “following the introduction of the Supplemental Water Project,” requests from community members for emergency water supplies became “very infrequent,” and “[n]o such requests have been received since 2015.”²³ While the installation of Tuffa tanks is a beneficial step toward improved water accessibility and availability at the village level, available information suggests that the efforts to date have not been adequate:

- First, during interviews conducted for this study in villages where tanks had been installed, residents expressed concerns about access to water. Residents indicated that the current supply of Tuffa tanks cannot consistently meet the demands required of supplying multiple homes, and that tanks can be distant from certain households and can run out during periods of low rainfall. When the Research Team visited Porgera in 2015 and 2016, numerous residents of Panadaka—a village where the mine reports that the Supplemental Water Project was piloted and completed in 2013²⁴—reported continued water scarcity concerns.²⁵ With respect to the Tuffa tanks, one woman noted, “[E]very one of us gets down there to drink it, so sometimes it runs out.”²⁶ Another man indicated that there were not enough Tuffa tanks in the village to meet the demand, and noted that “when it is dry there is no water in the tanks.”²⁷ Other residents of Panadaka reported that the Tuffa tanks are either too far away or on other families’ land where they cannot access them.²⁸ Similar concerns were raised in 2016 focus groups in other villages where Tuffa tanks had been, or were being, installed.²⁹ In Alipis village—where the tanks are located inside the company’s community affairs office, and the water is accessed via public taps in the village—the taps do not consistently function. For example, they were not functioning when inspected by the Research Team in

January 2016. According to residents contacted in February 2018, the taps were functioning again at that point.³⁰

- Second, residents interviewed for this study reported that their requests for water have often gone unanswered. Numerous individuals reported begging the company to fill up small containers of water without success. “I go to Barrick and ask them to supply water. They don’t listen to me,” explained a man from Timorope.³¹ A similar sentiment was echoed by a man from Mugalep: “So many times, I have written a letter requesting for water. But nothing had been done.”³² “We go and ask [the mine to fill up containers during the dry periods] at Community Affairs. But the security guards don’t allow us in. The security guards chase us,”³³ reported a woman from Alipis. An employee from the PJV Community Affairs office, an office located near Alipis and Panadaka villages that has various large water tanks on site, explained to our team: “I want to give water out, but Barrick tells us not to or we will lose our job. Barrick employees can take water from the mine site, but they don’t allow us to take more water for other people. They only allow us to take one container, a transparent one, like the one-liter bottles. They are worried we would steal gold.”³⁴ Where residents had relationships with company staff, water is sometimes provided. “We go and request water from the securities [guards] at the Community Affairs office,” said a man from Alipis. “If we know them, they will bring us some.”³⁵ A woman from Panadaka explained, “Sometimes they deny us water. It is only the nice employees that let us fetch water.”³⁶
- Third, despite reported water availability concerns at both Yunarilama and Kulapi villages, BNL has not yet installed Tuffa tanks there,³⁷ and there is no information available about whether they will do so. In November 2018, BNL stated to the report authors that the “extension of this program into other communities on the Special Mining Lease may assist in providing additional water supply,” and has committed to “continue to work with relevant communities to determine where the installation of supplemental water supplies may be required.”³⁸
- Fourth, it is unclear whether or how BNL is scientifically and comprehensively assessing water needs at the village and household levels. BNL tests for water *quality*,³⁹ and says it consults with local leaders, but for the company to determine whether water needs are being met and to assess rights fulfilment, it is necessary for BNL to carry out regular, proactive, thorough assessments of water *availability* and *accessibility* for households across Porgera. Relatedly, there is no information available about whether the company based the number and location of installed Tuffa tanks on a needs assessment in the densely populated villages of Porgera. To make conclusions about water availability, it is not sufficient to rely on complaints made by residents. This is especially so because some residents report not requesting water from the mine despite their strong needs. In Yunarilama, when asked whether residents ever go to the PJV’s Community Affairs office to request emergency water supply during dry periods, one woman replied, “[W]e don’t go there because the security is very strict. They only allow personnel with ID cards. Without an ID card, you cannot have access to Community Affairs office.”⁴⁰ Another woman from Yarik stated, “We used to go see Barrick . . . but they don’t listen, they don’t take notes.”⁴¹

Need for company to deliver water during dry periods: The mine’s original environmental plan explicitly provided for emergency water provisioning, noting: “During prolonged drought periods potable water will be supplied to conveniently located tanks by the mine water tanker.”⁴² In communications with the Research Team, the mine acknowledged that “[r]equests for emergency water supplies have occasionally been made by individuals within SML communities, typically coinciding with extended dry or drought conditions.”⁴³ The mine has stated that, in response to such requests in the past, it “ported [treated water] to the site in question on an ‘as-needs’ basis when necessary.”⁴⁴ However, in numerous focus group interviews with residents across the villages near the mine, many Porgerans stated that they do not receive deliveries of water, even during prolonged dry periods.⁴⁵ A government official interviewed for this report stated that the company was supposed to supply water, but had only followed through on this obligation during construction of the mine.⁴⁶ Indeed, in recent agreements between BNL and village landowners as part of the Supplemental Water Project, the mine has made explicit that the company will not provide water, noting with respect to its installation of Tuffa tanks that the “maximum amount of water available to the Landowners from the Water Tanks will be the amount received from natural rainwater. Barrick will not be obliged to fill the Water Tanks from water carts or by other means.”⁴⁷

Residents are forced to resort to extreme measures to reach alternate water sources during dry periods: Water insecurity becomes grave during dry or low rainfall periods lasting multiple weeks or months. During such times, residents devote significant time and resources to finding water for basic uses. As explained below (Sections 2 on creeks, 3 on springs, and 5 on rivers), Porgerans travel long distances, sometimes facing security threats and financial hardship to access springs on other clans’ land; use river and creek water they consider polluted and unsafe for washing, bathing, and sometimes drinking; and often simply go without adequate quantities of drinking water, while reducing their cooking and limiting or forgoing washing and bathing.

When households run out of rainwater, some residents also report having to steal rainwater from others, including neighbors and the mining company. A man from Panadaka, where Tuffa tanks have been installed since 2013, reported, “Sometimes when we need water, we jump the fence into the mine area. Security guards throw tear gas at us. The only people who have money, with a vehicle, or to hire transportation, can go get water from a far distance. If we don’t have money, we have to jump the fence and cut a hole in the [company] tank, [but sometimes] security comes and spills our water out so we don’t get any.”⁴⁸ During one site visit, members of the Research Team also observed equipment discretely installed by villagers for syphoning off water from company tanks to redirect it into villages. Interviewees also reported that they sometimes resorted to stealing water from neighbors who had larger or fuller containers. “When everyone is sleeping, the little boys go up and try to steal [our neighbor’s] water. He chased us,” one father said.⁴⁹ Another woman reported that when she was desperate for water, she stole from family members or from the church pastor’s large water tank.⁵⁰ One man from Timorope explained that during dry periods, he became so concerned about rationing water, he restricted his own family’s access to his tank: “I lock the tank,” and “I tell [my family] the water is only for cooking.”⁵¹

Lack of rainwater negatively impacts personal hygiene and food access, particularly for women: Lack of rainwater significantly impacts access to acceptable water for washing and personal hygiene. A man from Panadaka stated: “If you come to this village, you will not see clean people. We need water so we do not wash.”⁵² Many residents reported not being able to rinse their bodies with clean water when they return home after panning for gold in the tailings of the mine and described dry

skin and skin rashes.⁵³ When rainwater runs out, residents frequently wash in rivers they consider unclean, and where bathing can present privacy concerns, especially for women. Porgerans also use rivers for washing while rationing limited rainwater, saving the rainwater for drinking (see further below, Section 5 on rivers). One woman from Alipis noted that during dry seasons, stored rainwater would be rationed for drinking, not washing: “We don’t want to waste it on washing. We store the drum water for drinking.”⁵⁴ A woman from Mugalep stated, “The blue container, it isn’t a big one. It is little. We only store water when it rains. So if I see a little water, that water is for cooking, and drinking. Why would I waste that small water to wash myself?”⁵⁵ A man from Timorope explained that during “the dry season . . . we don’t use [rainwater] for washing our bodies or clothes. We don’t wash. We wear dirty clothes.”⁵⁶

Women also stated how difficult it was for them when they could not adequately wash during menstruation.⁵⁷ For some, even rainwater was deemed too suspect for intimate hygiene. One woman from Apalaka explained, “When we have our periods, we can’t wash in our *kendos* [springs] or blue drums. We don’t know [whether] chemicals might come into us.”⁵⁸ Another woman from Alipis added, “We have monthly periods. You can see it is unhygienic. We need to wash our body. We don’t have any place to wash.”⁵⁹

Prolonged low rainfall also adversely impacts Porgerans’ ability to cook and thus access adequate food. “[W]e need water to cook so we eat biscuits instead of cooking food,”⁶⁰ explained a woman from Mugalep, describing how low rainfall affected the food she and her family ate. A woman from Panadaka similarly reported: “If we don’t have water to drink or cook, we go to the shops, buy coke and a scone.”⁶¹



Photo 3: Children stand by their blue barrel, now almost empty of water.



Photo 4 (above, left): One barrel's label reveals its past use as a storage container for Hydrochloric Acid.

Photo 5 (above, right): An old metal tank no longer used for water storage.

Photo 6 (below): Homes near the mine do not have running water inside them. This woman has brought her dishes to a Tuffa tank to wash them.



b. Acceptability

Most Porgerans report fearing that rainwater is contaminated by the mine.⁶² They express concern that emissions, forming a white, cloudy plume rising from the mine’s mill and processing facilities, might contain chemicals that enter the atmosphere, polluting rainwater.⁶³ Residents also express concern that dust from mine operations mixes with rain, or collects on their roofs, dirtying rainwater as it collects in plastic containers.⁶⁴

Those living closest to the mine’s mill, including residents of Kulapi and Panadaka, express particular concern about rainwater pollution. “The mine produces smoke just below the clouds and when the cloud comes down in the rain, the smoke becomes part of the water I drink,” observed one woman from Panadaka.⁶⁵ “We think when it comes down, it comes down with the chemicals, so we are drinking chemical,” explained another resident.⁶⁶ One man from Alipis stated that he refused to drink rainwater out of his blue bin at all because of this perception of smoke “coming down as rain.”⁶⁷



Photo 7: A man rests as white emissions billow from the mine behind him, joining the cloud cover overhead.

Residents also perceive the containers in which they collect rainwater as being frequently dirty—containing leaves, dust, and micro-organisms—and expressed concern about the safety of drinking from the buckets.⁶⁸ One woman from Kulapi, for example, noted that she does not drink from her blue barrel because she can see “things growing inside [it].”⁶⁹ Panadaka residents have heightened concerns about mine dust, as dust from trucks and operations at the active Anawe Waste Dump is

regularly seen blowing near their village. One young father from Panadaka described his worries for his children when dust, which he sees rising from nearby mine operations, gets in the family's drinking water.⁷⁰ Some residents with access to Tuffa tanks also expressed doubt as to whether tank covers are adequate protection against dust and other debris.⁷¹

Residents raised varied concerns about the smell, color, and taste of the water collected in buckets. Some described the water as tasting rusty at times,⁷² others described how the water would change color and would begin to look yellow, particularly during dry periods with less rain.⁷³ When asked to describe the smell, one woman from Panadaka explained that it smelled "like when you are soaking clothes in the bucket, and you don't wash them for a long time, and then you take them out, and smell it."⁷⁴

Not all residents had strong concerns about rainwater quality, and some had more positive perceptions of their collected rainwater. "We continuously replace the water in the blue tank. So it is usually clean," said one resident from Yarik.⁷⁵ A woman from Yarik also remarked that the water is "all right" to drink "when the rain comes . . . but if it stays there for a week it is old and mells and tastes different. The water smells like it is dead water."⁷⁶

c. Quality

The Research Team conducted visual observation of rainwater collection containers and methods, reviewed studies by the mine, and tested rainwater in Porgerans' plastic barrels to ascertain whether rainwater showed evidence of unsafe heavy metal contamination from the mine.

No evidence of unsafe levels of heavy metals in rainwater: The Research Team conducted field tests and collected samples for laboratory testing of heavy metal concentrations. In the field, the Research Team tested collected rainwater from ten covered tanks, including Tuffa tanks, and 21 open barrels. In each village, the Research Team conducted between four to ten tests. At each sampling site, the Research Team measured water pH (acidity), dissolved oxygen, temperature, and electrical conductivity using a YSI Sonde (Sontek) measuring instrument, and alkalinity using a field alkalinity kit. These field parameters provide a first order assessment of water quality and are relevant for estimating the likelihood that heavy metals will be found dissolved in the water.

To ascertain whether collected rainwater contained concentrations of heavy metals above WHO Guidelines for Drinking-water Quality, water samples were collected from two of the open barrels and taken to Penn State University for heavy metal analysis. Collected water samples were tested for heavy metals typically found in water sources near industrial mines, including arsenic, aluminum, cadmium, chromium, cobalt, copper, lead, manganese, nickel, and zinc. The Research Team's chemical analyses of collected rainwater in January 2015 did not indicate the presence of heavy metals exceeding WHO Guidelines for Drinking-water Quality or the PNG Drinking Water Standards (see Table 1 in Annex I for full results).

Some trace metals were present at low concentrations in rainwater. These likely originated from a combination of natural and human sources, including local mine emissions, dust and wind-blown particles not associated with the mine, and materials used to collect and store rainwater, such as metal roofs. The low concentrations of trace metals in collected rainwater do not exceed WHO

Guidelines for Drinking-water Quality or the PNG Drinking Water Standards and thus likely do not pose a risk to human health.

The field tests conducted on collected rainwater reveal near-neutral pH and electrical conductivity, and most had acceptable levels of dissolved oxygen. This suggests that the stored rainfall is not acidic, contains minimal salts, and in most cases had low levels of biological activity.

In November 2014, the Porgera Environmental Advisory Komiti (PEAK) (an organization funded by the mine) and the PJV conducted a study of drinking water in Porgera. The study came in direct response to a complaint filed by the Porgeran Land Owners Association (PLOA) with the Organisation for Economic Cooperation and Development (OECD) National Contact Point in Canada. The complaint stated that the PJV failed to share environmental monitoring information with impacted communities (See Part B of Chapter IV on access to information).⁷⁷ The PEAK/PJV study found concentrations similar to those the Research Team found for each of the physical and chemical parameters tested, and also found that heavy metal concentrations in collected rainwater were below WHO Guidelines for Drinking-water Quality. The PEAK/PJV study concluded that elevated concentrations of some metals, such as zinc, likely result from roof contamination during water collection.⁷⁸

The PEAK/PJV report, and our Research Team's test results, sharply contrast with the concerns of many Porgerans that rainwater is polluted by the mine—a concern formed based on daily observation of emissions rising from the mine's mill, together with a lack of information provided by the company or government (See Part B of Chapter IV on access to information).

The Research Team shared these results with Porgerans in July 2015, and December 2015-January 2016. In response to some Porgerans' continued concerns, the Research Team conducted a second round of sampling and analysis, which produced similar results. These findings will be reported in a later, peer-reviewed study.

Concerns about drinking water quality in storage containers: The Research Team's study was focused on heavy metals. However, interviews with Porgeran residents, together with the Research Team's observations of water containers and prior studies by PEAK, raise concerns about the cleanliness of the blue barrels and the quality of water for drinking. These issues require further study and attention. The blue barrels provided by the mine do not have covers or filters and often collect dirt or dust, leaves, and other debris. The Research Team observed algae growth, leaves, and sediment in barrels, including dirt at the bottom and along the sides of many buckets.⁷⁹ In 2014, two of the Tuffa tanks analyzed by the PEAK and the PJV showed total coliform contamination in excess of the PNG Raw Drinking Water Quality Standard.⁸⁰

Some residents reported cleaning their barrels more often than others did, which is likely to affect the persistence of biological growth or dirt within the barrel.⁸¹ However, cleaning the barrels can be a difficult task, particularly during periods of low rainfall. In focus groups and individual interviews, residents also reported that the amount of dust or other material apparent in containers is higher in periods of low rainfall.⁸² A man from Panadaka explained: "We need to wash the tanks but we cannot, so sometimes this [not washing] makes us sick. The blue tanks are not clean but how can you collect water to clean the tanks?"⁸³ When blue barrels are cleaned, residents generally only use water to rinse the interior after emptying the barrel of accumulated debris.⁸⁴ The frequency of such

cleanings, and the techniques used, are likely insufficient, given Porgerans' and our Research Team's observations of biologic material inside barrels and dirty, brown or green colored water.

Many residents observe that organisms—such as mold or insects—grow or live in and around the blue barrels.⁸⁵ They described seeing small moving organisms that they call “germs.”⁸⁶ A mother from Timorope stated: “I see tiny, white things. They are in the water. There are plenty. When they are there, we push them to the sides of the tank, and then put our cups in the middle [to collect water].”⁸⁷ Others resorted to similar water collection methods, attempting to scoop “good water” and avoid visibly dirty areas of the barrels.⁸⁸ The presence of organic matter was confirmed visually by the Research Team in numerous drinking water containers in Porgera.

Residents also noted that cleaning the larger Tuffa tanks presented particular difficulties: some reported not cleaning the Tuffa tanks, or only infrequently cleaning the tanks.⁸⁹ One man from Apalaka observed, “It is very high. It is on high posts. I don't want to go up there and break the post. There is no big opening on top where I could look down and clean it.”⁹⁰ According to information provided to the Research Team by BNL, water quality in select Tuffa tanks installed through the Supplemental Water Project is periodically tested, and mine staff work with tank “custodians” to identify and address sources of any contamination identified.⁹¹ There was no indication in the information provided to our Research Team by the mine that similar outreach is conducted to all community members with such tanks, or that any outreach at all is conducted outside the four villages where the mine analyzed water quality samples. By the terms of the Memorandum of Agreement signed at the time the tanks are installed, village landowners are responsible for maintenance and repairs of the tanks.⁹² The difficulties of this arrangement were highlighted in 2015, when the mine reported bacterial contamination of 13 Tuffa tanks.⁹³ The mine attributed this high level of contamination to drought conditions, which decreased water flow and enabled bacteria to accumulate on taps:

The poor water quality is considered to be related to the drought conditions and very low water levels in the tanks, with some at or near empty during sampling in September. This restricted the ability to flush the taps adequately before sample collection and bacteria on the tap surface is likely a significant source of contamination.⁹⁴

While the company pledged to “investigate this issue and . . . ensure that the taps are sterilized before sample collection for bacteriological analysis,” the company made no comment on how low water levels were being or would be addressed, nor did the company indicate whether or how this bacterial contamination risk would be mitigated or communicated to community members given the evident risk of bacterial contamination from the taps.⁹⁵

While collected rainwater is within acceptable quality standards for the heavy metals analyzed in this study, issues of biological growth, insects, or other types of contaminants may present health concerns and require both further study to ascertain risk, and coordinated company and government efforts to provide training and education to villages in Porgera. Short-term mitigation measures to improve water quality could include the provision of information to Porgerans about safe water storage, regular container cleaning, and the installation of improved rainwater collection infrastructure.

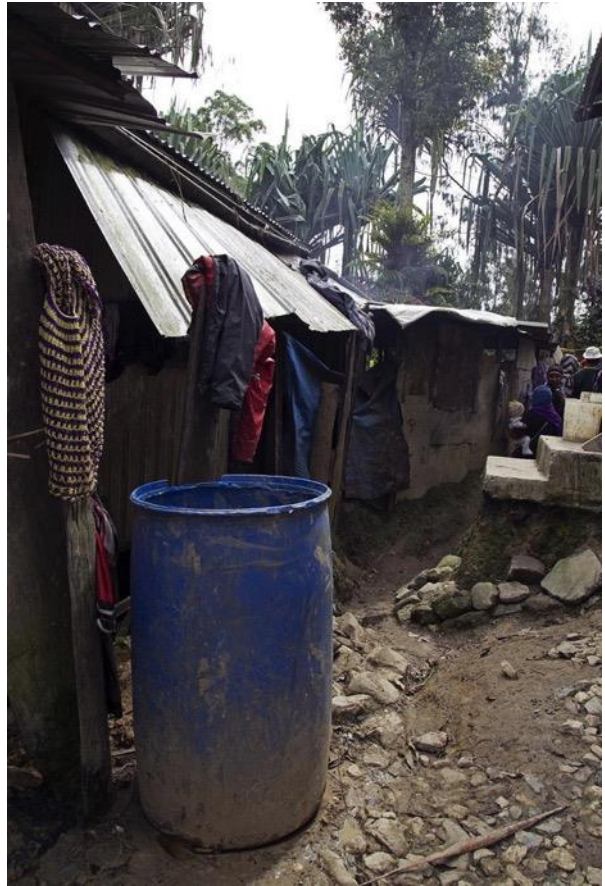


Photo 8 (above, left): One family has tried to improvise a screen to keep debris out of their blue barrel.

Photo 9 (above, right): Blue barrels are typically found under roofs in order to best collect rainwater run-off.

2. CREEKS

Summary of findings. Numerous creeks run through the Porgera Valley. “Creek” is used here to describe small streams—flowing surface water of a few inches to a few feet wide—and distinguished from a “river” (larger surface waters in the Valley) and from a “spring” (water derived from a groundwater source). Residents use the Valley’s creeks in a variety of ways, depending on their accessibility, perceptions of cleanliness, and rainfall. Perceptions of contamination or cleanliness vary from creek to creek, but residents report that many are used for washing rather than drinking because of concerns about both upstream village use and mine pollution. Some residents reported drinking creek water when other sources are not available, despite concerns about quality. Residents in some villages reported that access to creeks can be reduced during dry periods, and that some creeks now have reduced flow or have disappeared altogether beneath mine waste dumps or near the underground mine. This reported decrease in creek flow is in line with predictions made by the mine’s original environmental plan regarding the mine’s impact on local water supply. The Research Team found concentrations of arsenic and lead above WHO Guidelines for Drinking-water Quality in the two SML creeks that were tested, a result likely linked to mine activity. Barrick Gold and the PEAK assess heavy metal concentrations in almost a dozen creeks in the region of the mine, including the two creeks tested for this study. The Annual Environmental Reports and the PEAK/PJV Drinking Water Study also report findings of concentrations sometimes exceeding WHO Guidelines for Drinking-water Quality and/or the PNG Drinking Water Standards for a subset of the measured chemicals in certain creeks, although Barrick Gold’s and the PEAK/PJV’s reports do not explicitly compare the measured concentrations to the WHO Guidelines or the PNG Standards.

a. Accessibility and Availability

Accessibility to and availability of creek water for household purposes varies significantly from village to village. Some villages have creeks running through or near them, others require a longer walk. Residents in some villages reported that access to creeks can decrease during dry periods, and that some creeks have reduced flow or have disappeared altogether beneath mine waste dumps or near the underground mine.

Multiple uses of creek water: Creek water can be used for multiple, and sometimes conflicting purposes, simultaneously serving as a latrine, washing site, and a source of drinking water. Taro Creek is one such creek, used by Apalaka residents for personal and household hygiene, cooking, and sometimes drinking.⁹⁶ Many residents of Yarik report using Yawana Creek, particularly during dry seasons, to wash clothes⁹⁷ and at times their bodies,⁹⁸ although the creek is also used as a latrine.⁹⁹ Some residents of Anawe (particularly those without access to vehicular transportation) report using Li Creek for drinking water and washing.¹⁰⁰ Some residents of Yunarilama reported using certain creeks for drinking, and washing clothes as well as their bodies.¹⁰¹ Kulapi residents report using several creeks, including Kulapi Creek, for washing, recreational use for children, and sometimes for drinking water during periods of drought.¹⁰²

Residents of Panadaka, Pakien Camp, and Alipis reported little to no use of creek water for household purposes due to access difficulty.¹⁰³ Some residents use Yakatabari Creek, but mainly for gold-panning.¹⁰⁴

Concerns about depletion of some existing creeks since commencement of mining operations:

Long-term residents report that before industrial mining operations began in Porgera, they frequently accessed a range of creeks for household water use.¹⁰⁵ The mine's original environmental plan confirms this variable use of smaller surface waters, noting, "Village water supplies . . . are usually taken from small tributaries and only from the main streams . . . during prolonged drought periods."¹⁰⁶ Residents state that some of their water sources have either disappeared or been significantly depleted.¹⁰⁷ These reports are consistent with forecasts made by the mine's original environmental plan, which predicted that "the abstraction of water for hydro-electric power generation and domestic water supply will *reduce stream discharges downstream* of the weirs, and *during the drier periods flow may be eliminated altogether*."¹⁰⁸ To address this impact, the plan proposed that "if no alternative reliable sources are available, [the mine operator should] provide clean water along the sections of river likely to become dry and/or heavily sedimented."¹⁰⁹

Reduced access to creek water has been particularly serious for residents of Panadaka and Pakien Camp (also sometimes referred to as Mugalep), which are located adjacent to Anawe dump, an area where the mine dumps hard rock waste. Residents reported that previously accessible creeks have been covered up by rock waste.¹¹⁰ Residents attribute the disappearance and decreased flow of some creeks, such as the Kawadube, to the mine's waste dump.¹¹¹

In other villages, such as Apalaka, located on a steep hill behind the open pit and above the mine's underground mining areas, some residents report that creeks have become much smaller or dried up and disappeared.¹¹² Some locals hypothesize that this is because "[t]he underground mining has pulled all the water underground."¹¹³ "My children haven't seen those streams," a man from Apalaka told us.¹¹⁴ Residents of Yunarilama also noted that creeks have disappeared, or dry up or have reduced flow during dry seasons.¹¹⁵

Because little detailed information is available on the number and location of creeks prior to mining operations (the mine's initial environmental impact assessment did not go into this level of detail), it is difficult to conduct a creek-by-creek pre- and post-mine analysis. However, residents' views and experiences align with the mine's initial assessment that creeks would be impacted.

Residents face difficulties in collecting creek water: It can be particularly difficult to use creeks for household water, as this use requires residents to collect and carry full water containers back to the home or carry clothes and dishes to a creek.¹¹⁶ Creeks can be located far away from some households, and residents fetching water from local creeks reported carrying 10 to 30 liters per person, daily.¹¹⁷

b. Acceptability

Many Porgerans fear or assume that their local creeks are polluted by the mine or by upstream human use. A number of families reported that they only use creek water for washing or bathing, and not for drinking due to fears about the safety of the water.¹¹⁸ Others stated that, although they are worried about pollution levels, they are forced to drink creek water when they run out of water from other sources.¹¹⁹ Residents reported that creek water can have an abnormal color and poor taste.¹²⁰ Perceptions of the severity of these problems, and the impact of these perceptions on the

use of certain water sources, varies between villages, as well as sometimes between individuals within villages:

- **Panadaka:** Residents of Panadaka generally reported that they do not have access to creeks near their homes, as previous creeks, such as the Kawadube, were covered by the dump.¹²¹
- **Kulapi:** Residents generally describe their creek water as “dirty.”¹²² One man from Kulapi said, “They all smell because they have the dump up there, and now the water smells dirty. It smells like chemicals.”¹²³ Several residents expressed fear that one main creek, the Yoleyope, has been contaminated.¹²⁴ One hypothesized that this contamination was caused by the company diverting a river upstream.¹²⁵ One man described drinking this water in spite of his fear of pollution.¹²⁶ Another man from Kulapi noted that fear of mine contamination prevented him from drinking from the Yoleyope any longer: “The Yoleyope [Creek] we used to drink from. But the company dumps up there, and now the Yoleyope [Creek] is very dirty.”¹²⁷ The Kulapi, on the other hand, is favorably perceived by some residents, who describe it as “clean,” “good,” or “fresh.”¹²⁸ Others, however, perceive the creek as unclean,¹²⁹ and only fit for washing or cooking purposes due to upstream human use and fears of mine dump contamination.¹³⁰ One man in Kulapi explained, “A lot of people [...] sleep above and they urinate and wash their clothes and do dishes, so I think it is unsafe for me to drink. Also at the top, there is another [mine] dump.”¹³¹ Nevertheless, some residents of Kulapi report drinking from the Kulapi Creek during extremely dry periods.¹³²
- **Alipis:** Residents see their creeks as dirty, and express concern about up-stream contamination. Several would not drink creek water because of potential human pollution.¹³³ A young man from Alipis also expressed fear of mine contamination: “There are creeks here, but we don’t get water from there. We are scared to drink it because of the chemicals from the mine.”¹³⁴ The Yakatabari, described as “very smelly,”¹³⁵ evoked particular concerns for one woman who described gold-panning in this creek: “I put my two legs into the water and put my bottom in the water and sit on a big rock. I feel that it is bad, it is not good for my health. [But] I don’t think about my health. I think about my food, my clothing. I sacrifice my life to get the gold for money.”¹³⁶
- **Apalaka:** Residents of Apalaka (as well as Yarik) expressed concern about the quality of Taro Creek, reporting that Taro Creek looked “yellow, pinkish, brown.”¹³⁷ Some attributed this contamination to mining;¹³⁸ others observed that it was sullied by upstream human use, from individuals washing¹³⁹ or using the creek environs as a latrine.¹⁴⁰ Some described the water as tasting bad and explained, “[A]fter washing in Taro Creek . . . we see dust on our skin; we don't feel clean.”¹⁴¹
- **Yarik:** In addition to their concerns regarding Taro Creek, residents of Yarik consistently described the Yawana as dirty. “Yawana is not pure clean, it comes with some dirt,” explained one woman from Yarik.¹⁴² “The Yawana Creek is used as a toilet and a dump. So I don’t wash myself there,” a man from Yarik observed, before adding

that he was sometimes forced to use the creek to wash during times of drought.¹⁴³ Another man from Yarik added, “[T]he creek has a terrible smell. It smells like rubbish, like a heap of rubbish.”¹⁴⁴ One resident described Yawana Creek as “gray, or brown,” adding, “[Y]ou will see this same color everywhere around here. All the creeks have the same color.”¹⁴⁵ One woman from Yarik refused to use water from the Yawana because of perceived chemical contamination.¹⁴⁶

- **Anawe:** Residents described their main creek, the Li, as unacceptable for use. One resident observed, “[T]he water is soapy. We know that it is not good.”¹⁴⁷ Some no longer drank from the Li because of concerns related to human use and the mine’s presence.¹⁴⁸ Others reported sometimes drinking from the Li out of need. One woman from Anawe, for example, remarked that she thought the creek was contaminated by the mine, but was compelled to make use of it regardless: “Sometimes it is brown, sometimes it is white, and sometimes it is clear,” she observed. “I know it is unsafe, but there is no other source.”¹⁴⁹ One man from Anawe also reported drinking from Li Creek despite suspecting mine contamination, but remarked that the water tasted bad and made him “feel like vomiting.”¹⁵⁰
- **Yunarilama:** Residents report using some creek water despite concerns regarding water quality.¹⁵¹ Residents observed the changing color of creek water, which could turn “milky”¹⁵² or brown.¹⁵³ Residents also noted that creek water had poor taste.¹⁵⁴ Residents did not report using Yunarilama Creek, expressing fear of mine discharge from the Yunarilama mine portal, which drains from the underground mine into Yunarilama Creek.¹⁵⁵ For example, many worried that fumes from the portal contaminated the air they breathe.¹⁵⁶ One resident observed, “The dam there, the waste water and the things coming down there, we breathe those into our nose and we feel sick.”¹⁵⁷ One man from Yunarilama also feared that the waste from the portal might contaminate nearby water storage.¹⁵⁸

c. Quality

To determine whether small surface waterways contain concentrations of heavy metals above WHO Guidelines for Drinking-water Quality, the Research Team tested water in 22 creeks across the Porgera SML. At each sampling site, the team measured water pH (acidity), dissolved oxygen, temperature, and electrical conductivity using a YSI Sonde (Sontek) and alkalinity using a field alkalinity kit. These field parameters provide a first order assessment of water quality and are relevant for estimating the likelihood that heavy metals will be found dissolved in the water. Most of the creeks showed a near-neutral or slightly basic pH (7 to 8.4 pH) and high dissolved oxygen, both of which indicate, but do not guarantee, healthy streams. The near neutral pH, for instance, likely results from the mine artificially controlling the pH of its tailings by adding lime,¹⁵⁹ while high dissolved oxygen is typical in small, turbulent streams and therefore not surprising to see in Porgera, despite other water quality issues.¹⁶⁰ Yunarilama and Yakatabari Creeks had notably higher conductivity than the control sites, suggesting high levels of dissolved salts potentially harmful to human health and calling for further study.

Because of limited testing capacity, the Research Team prioritized taking creek water samples for metal analysis lab work from creeks identified in the mine's environmental reports and by local residents as likely to be contaminated by mine discharge. The mine, in its own environmental reporting, identifies Yakatabari and Yunarilama as "creeks within the mine lease area that are potentially contaminated by drainage from the mining operation."¹⁶¹ The Research Team tested Yunarilama and Yakatabari, as well as two control sites located upstream from the mine. Water samples from these creeks were taken back to Penn State and tested for heavy metals typically found in water sources near industrial mines, including arsenic, aluminum, cadmium, chromium, cobalt, copper, lead, manganese, nickel, and zinc. The Research Team filtered all samples to measure dissolved concentrations of metals in creeks. As explained in the chapter on Methodology, dissolved concentrations offer an underestimate of the total concentration of metals that may be absorbed in human bodies when unfiltered water is consumed. In addition to dissolved concentrations, Barrick's 2015 Annual Environmental Report and the PJV/PEAK Drinking Water Study report total metal concentrations (the combination of dissolved and particulate matter found in water), where total concentrations are generally one to several orders of magnitude higher than the dissolved concentrations alone. The Research Team's analysis of water samples, coupled with reporting from Barrick Gold's 2015 Annual Environmental Report, reveals:

- Based on analysis of water samples collected by the Research Team, the two control sites upstream of the mine do not have metal concentrations that exceed the WHO Guidelines for Drinking-water Quality or the PNG Drinking Water Standards, except for zinc in Aipulunga Creek, which is likely due to natural sources.
- Water from Yakatabari Creek may pose a public health concern to communities. In Yakatabari Creek, the Research Team found dissolved concentrations of lead and arsenic above WHO Guidelines for Drinking-water Quality. In addition, according to the mine's data, lead, arsenic, cadmium, chromium, copper, iron, nickel, zinc, and sulfate, exceed one or both of the WHO Guidelines for Drinking-water Quality and the PNG Drinking Water Standards.
- Water from Yunarilama Creek may pose a public health concern to communities. In Yunarilama Creek, the Research Team found dissolved concentrations of arsenic above WHO Guidelines for Drinking-water Quality. In addition, according to the mine's data, the total concentrations of arsenic, cadmium, chromium, copper, iron, lead, nickel, zinc, and sulfate, exceed one or both of the WHO Guidelines for Drinking-water Quality and the PNG Drinking Water Standards.

Residents' perceptions that some of the creeks are unsafe to drink are thus supported by scientific testing (see Tables 2(a) and 2(b) in Annex I for full results). Fortunately, no residents reported drinking from Yakatabari or Yunarilama Creeks. However, residents are exposed to heavy metals via gold-panning and other contact. Given the potential for very serious health impacts from exposure, further study is needed to understand the extent of any resulting risk.

The elevated levels of arsenic and lead, which are natural components of the gold host rock, found in Yakatabari and Yunarilama Creeks are likely caused by mining activity, including excavation and processing, in which waste is deposited onsite in solid waste dumps and released as liquid tailings.

The mine's "28 Level" underground water discharge drains into Yakatabari Creek, which flows into the Kakai River, which subsequently joins the Kaiya River.¹⁶² The Yunarilama Creek receives discharge from the Yunarilama portal, the underground and open pit drainage tunnel.¹⁶³

The PEAK/PJV Drinking Water Study Update provides additional geochemical measurements from other creeks based on measurements conducted in 2014 (see Tables 2(a) and 2(b) in Annex I for full results). Comparing data from this study against WHO and PNG drinking water quality measures reveals several areas of concern:

- In Taro Creek, the dissolved (and total) concentrations of iron and lead, and the total concentrations of arsenic, cadmium, chromium, copper, nickel, and zinc exceeded one or both of the WHO Guidelines for Drinking-water Quality and PNG Drinking Water Standards.
- Yawana and Yoloyope Creeks had total concentrations of lead exceeding WHO Guidelines for Drinking-water Quality.
- Dissolved (and total) iron concentrations exceeded the "Highest Desirable Level" PNG Drinking Water Standard in Kulapi, Taro, Yoloyope, and Yawana Creeks.

In light of the uses of the different creeks for cooking, washing, bathing, and sometimes drinking, the high concentration of multiple metals in Taro Creek, the high concentrations of lead in Yawana and Yoloyope Creeks, and the high concentration of iron in Kulapi, Taro, Yoloyope, and Yawana Creeks, warrant further studies as to the degree of health risks posed to residents.

The gray and brown color observed in many creeks across Porgera is likely due to large concentrations of suspended sediment (high turbidity), which occurs naturally in mountain systems. The relatively high total metal concentrations reported in Barrick Gold's Annual Environmental Reports¹⁶⁴ suggest that metals may be adsorbed to (that is, be part of the structure of) the particles that make the water appear turbid. The health implications of the form of the metal will depend on the type of exposure (contact or ingestion). Further investigation is required to determine the health impact of contact or ingestion of turbid creek water.

As described in the Methodology chapter of this report, water chemistry can vary at a given site according to changes in



Photo 10: Many creeks in Porgera have a gray or brown color. Residents often fear such creeks to be polluted by the mine or by upstream use.

atmospheric, hydrological, physical, and human use conditions. Despite such fluctuations, the Research Team's results are similar to the ranges of concentrations reported annually by the mine. At the time of our sampling, some of the concentrations measured in Yakatabari and Yunarilama Creeks were higher than the median reported by Barrick Gold for 2014 (e.g., arsenic), and some of the concentrations were lower (e.g., nickel). This is likely due to differences in the conditions at the testing sites over time.

3. SPRINGS

Summary of findings. Springs (also known as “bush water” or “ipa kendos”) are present in a number of villages close to the mine. However, not all households can easily access springs, and residents report that some springs have been buried or covered by the mine site. When accessible and available, springs are frequently used as a source of drinking water. During dry periods when rainwater is no longer available, residents from villages without springs will sometimes travel long distances to villages with running springs, and are generally required to pay access fees to the clan that owns the spring; inter-clan conflict has at times arisen over access to springs. During dry periods, spring discharge can decline, and residents must then turn to other sources. While some residents report concerns about spring water quality, spring water is generally thought to be cleaner than other sources. The Research Team collected samples from three springs. Analysis did not reveal concentrations of heavy metals above WHO Guidelines for Drinking-water Quality or the PNG Drinking Water Standards. The PEAK and the mine have reported results from water quality testing for two springs. These studies did not find contaminants above WHO Guidelines or PNG Drinking Water Standards for measured chemicals, but did find faecal coliform contamination at one spring.

a. Accessibility and Availability

The accessibility and availability of water from springs varies from village to village, and also varies within villages depending on rainfall. Porgerans often collect spring water by inserting a thick leaf or short pipe into the side of a hill to channel the water into a stream under which a plastic container can be placed.¹⁶⁵ Depending on the spring and the amount of water flowing, this water collection method can take anywhere from a few minutes to several hours to fill one container.¹⁶⁶

For many residents living near the mine, springs are scarce and not easily reachable: Panadaka, Pakien Camp, Kulapi, and Alipis have few springs available, and are especially vulnerable to prolonged episodes of low rainfall.¹⁶⁷ Some residents attribute the scarcity of springs to the mine.¹⁶⁸ Residents of Mugalep have some springs, but residents reported that they can dry up,¹⁶⁹ and some are a long walk away.¹⁷⁰ A man from Mugalep described the process of collecting water from Anawe: “We use five liter containers. We carry at least two on our back. And sometimes we carry a saucepan of about three liters in our hand.”¹⁷¹ In Yarik, numerous households access the Tuyuba and Kapia springs,¹⁷² but residents also report traveling to Wangima Spring during dry periods, which can be an hour or more each way on foot¹⁷³ or 10 to 15 minutes by bus:¹⁷⁴ “Sometimes we walk, sometimes we take PMV [local bus]. We stay for half a day, then come back. During the hot days.”¹⁷⁵ Residents of Porgera emphasize the need to travel every day or every other day to fill up their water containers, and that the springs are “not enough for everyone.”¹⁷⁶

Wangima Spring is an important water source for many Porgerans, even those who must walk long distances or drive to access it. One woman from Panadaka said, “It is too far to go to Wangima for dishes and laundry. I use it for drinking only.”¹⁷⁷ For Alipis residents, Wangima is the most commonly used spring when rainwater receptacles have dried up.¹⁷⁸ The spring is about a 30-minute walk each way from the main Alipis area.¹⁷⁹ Sometimes, access to the spring’s water is made more difficult by damage to the water access point, as was the case when the Research Team visited in July 2015.¹⁸⁰

Travel to reach springs can be dangerous and challenging for some residents: Traveling long distances to access springs can pose physical dangers. For Yarik and Apalaka residents, for example, people accessing springs located beyond the mine’s waste dump must cross the often fast-moving waters of the Kaiya/Anjolek Rivers. A woman from Yarik described such a day spent seeking spring water: “You wake up at seven o’clock. Walk over to Anjolek. It is muddy, and you struggle. So we walk over it, over to the bush. And then we come back after four o’clock.”¹⁸¹ One man from Apalaka described obtaining spring water as an all-day affair in which his entire family participated:

When my tank water finishes in the dry season, me, and my wives and my children, we take plastic containers and we cross Anjolek dump and over to that mountain range, and we make our own springs in the bush. From here to that mountain, it is a three-hour walk. After three hours of walking from here to the bush, I cut down Pandanus leaves, and I push the end into the dirt. I wait for the dirt to come out, and I wait. When I see the water is clean, then I fetch it. It takes one hour to fill each container.¹⁸²

Such arduous travel poses particular difficulties for older persons and persons with disabilities.

Seeking access to springs can impose a financial burden and expose individuals to inter-clan conflict: Clan boundaries and land ownership make the water accessibility landscape complex. Conflict between clans and village residents can arise over access to spring water, particularly during dry periods.¹⁸³ Women from Yarik observed that spring water collection has triggered fights.¹⁸⁴ During periods of low rainfall, some *ipa kendos* progressively dry up and accessing springs can require traveling farther afield,¹⁸⁵ with residents describing walks of at least one hour walking each way, in addition to collection time.¹⁸⁶

Many residents will not travel to get spring water from another clan’s land at all,¹⁸⁷ or they need to negotiate and pay for access. Residents reported that it was unacceptable at certain times to cross into another clan’s land to collect water.¹⁸⁸ Where residents were able to travel and allowed access to another clan’s *ipa kendo*, interviewees reported having to pay a fee varying from 1 kina (approximately \$0.31 USD) to 10 kina (approximately \$3.08 USD) depending on the source and size of container.¹⁸⁹ A woman from Alipis reported: “People charge us. If we don’t give money, people will break our containers and bash us. We are scared.”¹⁹⁰ A father from Apalaka described the uncertainty of being able to access springs to provide for his four children: “Sometimes, the people over there stop us from going But sometimes they let us.”¹⁹¹ A man from Pakien Camp observed, “Water is life so we argue for the water.”¹⁹² Another man, from Mugalep, explained:

[First,] [w]e cannot go onto other people's land. We cannot approach their area. Two, we can make enemies out there. Third, it takes us long hours out there. Fourth, we are afraid of getting taxed. Lastly, it is more dangerous for women and children. They could be raped, or beaten up. It is too risky. But some people who are partly related to those clans will go up there. They have access. But it is just a few of us that can do that.¹⁹³

Crossing clan boundaries to fetch water can present specific risks for women and children. "In the night it is scary because the boys who own [the *ipa kendo*] try to rape and hit women,"¹⁹⁴ confided a woman from Mugalep. Another woman from Apalaka explained, "[T]he owners of the land are asking us to pay for the water, they tried to break our containers if we don't pay, the young girls they threaten them and want to rape them."¹⁹⁵

One spring in particular, Wangima, is at the crossroads of multiple villages and accessed by many clans.¹⁹⁶ Many report having to pay for access,¹⁹⁷ and some report being completely blocked from accessing this spring at certain times.¹⁹⁸ Women from Panadaka explained that they "don't get [water from Wangima] for free,"¹⁹⁹ reporting that it costs 5 to 10 kina for one container that will last only one day.²⁰⁰ Women from Alipis reported facing similar obstacles to accessing Wangima: "It is owned by another clan," one woman explained, adding "[S]ometimes they charge us for fetching, and sometimes they tell us no."²⁰¹ "Sometimes we fight to fetch the water," another woman said.²⁰² "Sometimes we go during the night, when everyone has gone to their house," said one resident.²⁰³



*Photo 11 (above, left): A woman collects spring water from an improvised leaf sprout, inserted into the side of a hill.
Photo 12 (above, right): The washing has been gathered at a spring source, rather than transport water back to the home.*



*Photo 13 (above, left): Men gather by a local spring, funnelled from a pipe.
Photo 14 (above, right): Washing with spring water, it can take significant time to collect adequate water for this task.*

b. Acceptability

Many Porgerans perceive springs to be a clean and safe source of drinking water, stating that the water is fresh and tastes “sweet” (good).²⁰⁴ Some springs, however, were thought to be unsafe to drink.²⁰⁵ One man from Kulapi noted that he stopped going to one area he had previously used to find spring water because he feared pollution from overcrowding.²⁰⁶ Residents of Mugalep generally report that a spring they access near Anawe dump is not as good quality as other springs. A man from Mugalep observed that its “[t]aste is different from our *ipa kendos*. The color is also different. The taste is [bad].”²⁰⁷ Residents from several villages also reported that some springs may periodically, such as after heavy rains, run “muddy,”²⁰⁸ or “milky,” with a “kerosene rainbow.”²⁰⁹

Still, where available, residents often favor spring water to other sources, and sometimes travel significant distances, including to other villages or across the mine’s dump areas and outside the SML, to collect it (See Section 3 on spring “Accessibility and Availability”).

c. Quality

The Research Team collected samples from three springs: Wangima Spring, accessed by residents of Alipis, Panadaka, Mugalep, and Timorope when rainwater is scarce; Yawena Spring in Yarik; and Anawe Spring, near the Anawe Dump. Analysis did not reveal heavy metal concentrations above WHO Guidelines for Drinking-water Quality or the PNG Drinking Water Standards in any of these three springs.

Barrick Gold's Annual Environmental Reports and the PEAK/PJV 2014 Drinking Water Study Update contain data on one spring, which they refer to as "Kendo Spring," located near Yogone Creek to the west of Apalaka.²¹⁰ The mine reports safe concentrations of all metals tested in the spring, with the data showing that the spring water has slightly high alkalinity, which is expected given the local geology.²¹¹ In 2014, the PJV also began reporting on "Wendako Spring," located on the edge of the Anawe dump. In 2015, the mine reported safe dissolved and total concentrations of all metals tested in this spring. The mine also reported elevated alkalinity, and faecal coliform contamination, confirming some residents' fears that springs may be contaminated by human waste.²¹²

We present our measurements alongside the mine's in Table 3 in Annex I.

4. TAILINGS WASTE

***Summary of findings.** Liquid tailings from the mine, known colloquially as the "Red River," contain various heavy metals at concentrations above WHO Guidelines for Drinking-water Quality. Porgeran residents perceive the Red River to be polluted, and none reported drinking from it. However, many residents pan for gold in the Red River, spending many hours in it every day, and a number of residents reported using the Red River on open wounds, as the water is believed to dry out sores. Children also frequently play and swim in it. The mine has confirmed that the Red River poses public health risks for those who come into physical contact with the tailings. Further efforts are needed to mitigate the risks, regularly share health information with residents, and study any health effects, including to determine if contaminants could be accumulating in the bodies of people who interact regularly with the tailings waste.*



Photo 15 (above): The Red River is a vibrant red against the lush green of the Porgeran horizon.



Photo 16 (above, left): Children play in the Red River.

Photo 17 (above, right): Children playing by the Red River, the water's residue evident upon their skin.

a. Accessibility and Availability

The “Red River” of tailings waste flows east from the mine facilities next to Anawe dump and discharges into the Pongema River. Approximately one kilometer downstream, the Pongema joins with the Kaiya and Kakai Rivers, forming the Lower Porgera River. The Red River is primarily used by Porgerans for economic and recreational purposes. Accessibility varies across the Valley, often depending on village proximity.

Residents regularly use the tailings to pan for gold: Residents often spend many hours a day wading or sitting in the mine tailings that make up the Red River. One woman from Panadaka explained her panning schedule: “From six in the morning to six o’clock in the afternoon. When I’m hungry, I come out for a little while, then I return. I wash myself off in the pools of water in the waste dump, and then I come home.”²¹³ Other women from Panadaka echoed this all day use of the tailings.²¹⁴ During numerous visits to Porgera, members of the Research Team have observed many Porgerans using the tailings for gold panning.

Children regularly use the tailings: Children accompany their mothers or other relatives on gold-panning trips. “Every family goes down to the tailings,” a woman from Mugalep reported. “We sit there by the tailings and feed our children. When we stop and get hungry, we drink and eat, we don’t wash our hands.”²¹⁵ A woman from Panadaka explained, “All of my grandchildren go to the red water with me. They play in the water. I take them to wash in the water in the waste dump. Then I take them home.”²¹⁶ The Research Team observed that groups of young children play in the tailings for hours each day (See Photos 16 and 17).²¹⁷

b. Acceptability

The Red River is perceived by many Porgerans as the new “garden” or source of employment and income. “If I don’t go down to the river to the panning then I will have no place to make my living. That is my garden, that is my life down there,” said one resident.²¹⁸ Some residents report that they use the Red River water to dry out their open sores, as it is believed to quicken the drying process.²¹⁹ Some also believe the Red River acts as fertilizer for plants.²²⁰ For many others, however, the Red River is seen merely as a source of chemical contamination, and one that can result in physical injury, such as chemical burns.²²¹ One local NGO, the Akali Tange Association, compiled documentation in 2010 of numerous alleged cases of skin ailments among those using the Red River, including burns.²²² A man from Kulapi associated exposure to the tailings with the premature death of middle aged women who had panned for gold in the Red River many times: “We don’t go to there now. We are scared because our mothers died in that place. We don’t want to die too.”²²³

c. Quality

The Research Team tested water in the tailings waste at points above and below the confluence with the Pongema River. The tailings waste above the confluence of the Pongema is the waste

directly discharged by the mine. At each sampling site, the team measured water pH (acidity), dissolved oxygen, temperature, and electrical conductivity using a YSI Sonde (Sontek) and alkalinity using a field alkalinity kit. These field parameters provide a first order assessment of water quality and are relevant for estimating the likelihood that heavy metals will be found dissolved in the water. Samples were also taken to Penn State and tested for heavy metals typically found in water sources near industrial mines, including arsenic, aluminum, cadmium, chromium, cobalt, copper, lead, manganese, nickel, and zinc.

The Research Team found dissolved concentrations of arsenic, cadmium, iron, lead, nickel, sulfate, and zinc above either WHO Guidelines for Drinking-water Quality or PNG Drinking Water Standards in the Red River before it is diluted by the Pongema River (see Table 4(a) in Annex I). As explained in the chapter on Methodology, dissolved concentrations offer an underestimate of the total concentration of metals that may be absorbed in human bodies. Barrick Gold's 2015 Annual Environmental Report, which presents total concentrations (the combination of dissolved and particulate matter found in water), found levels of arsenic, cadmium, chromium, copper, iron, lead, nickel, and zinc exceeding WHO Guidelines for Drinking-water Quality in the liquid tailings. These findings indicate that tailings waste is not suitable for consumption and could pose a public health concern for the communities that come into physical contact with the waste. Indeed, in 2015 the mine reported that “[r]isk is posed to people exposed through dermal contact with undiluted tailings as a result of low pH and elevated concentrations of dissolved cadmium, iron, nickel and zinc.”²²¹ Further study is needed to determine the nature and extent of any harm caused by contact with the tailings, including whether contaminants are accumulating in the bodies of people who interact with tailings waste or the surrounding environment.

For testing results on water quality after the confluence point of the Red River and the Pongema, see Section 5 on rivers.

5. RIVERS

Summary of findings. The Kakai, Anjolek, and Kaiya/Anjolek Rivers running through Porgera contain various heavy metals at concentrations above WHO Guidelines for Drinking-water Quality. Most residents rightly believe the rivers to be polluted and unsafe to drink. The main uses of the rivers are economic (wading in them for many hours while panning for gold), household (washing bodies, clothes, dishes), and recreational (swimming, especially by children). During dry periods, however, some residents report drinking from several of the rivers as a last resort. Some company information about river use before the mine started suggests that that major rivers were too turbid to be used for regular consumption, and residents only rarely used them for drinking. Current use of the rivers for personal bathing and washing clothes and dishes is especially frequent during periods of low rainfall, when residents lack or must strictly ration water from other sources. Parents also expressed fear that their children may sometimes drink from the rivers while they are playing in them. Because many people often interact with the rivers, there are public health concerns requiring further study. Health studies of the Porgeran population are needed to assess any impacts on human health, and the company and the government should provide warnings and accessible information to residents about river quality and risks.

a. Overview of River System in Porgera

Three main, natural rivers run through the SML area: the Kakai, the Kaiya, and Anjolek:

- The Kakai River flows from the south to the north of the SML, and is used primarily by residents from the villages of Panadaka, Yunarilama, and Alipis.
- The Kaiya and Anjolek Rivers are located in the northern part of the SML, with the Anjolek originating from the north-west of the SML. The Kaiya and Anjolek flow down from the mountains through the mine's Anjolek erodible dump, where the Anjolek River joins the Kaiya. The Kaiya/Anjolek River is used primarily by residents from the villages of Apalaka, Yarik, and Timorope.
- The Kakai flows into the Kaiya/Anjolek River before flowing toward the Strickland River, which eventually empties into the Pacific Ocean.

The mine's tailings waste (the "Red River") flows first into the Pongema River, which flows from the south to the north. The tailings and Pongema then join the Kaiya/Anjolek and Kakai to form the Lower Porgera River.



Photo 18: Children play and families wash their clothes in the Kakai River near Alipis village.

b. Accessibility and Availability

River accessibility and use varies across the Valley. The rivers are used for economic, recreational, and household purposes. Residents often sit in the rivers for hours each day, panning for gold. Children in particular frequently use rivers for playing and swimming. The rivers, particularly the Kakai, are also often used for bathing and washing clothes and dishes. Residents report generally not drinking from the rivers, but some reported occasional drinking use during long dry periods when other sources became unavailable.

Many residents of Alipis readily access the Kakai River, generally using it for washing and swimming. Panadaka residents also access the Kakai, although it is at least a 10 to 15 minute walk from the center of the village.²²⁵ Yunarilama residents access the Kakai further downstream. Pakien Camp and Mugalep residents face longer traveling distances, making the trek difficult for residents carrying dishes and clothes to be washed, and therefore use the Kakai less often. Residents of Apalaka, Timorope, and Yarik are closer to the Kaiya, which they use for gold panning and sometimes washing, but it can be a long and dangerous walk due to erosion and the steepness of the valley from their villages down to the river.



Photo 19: The Anjolek River flows down from the Anjolek dump, later joining the Kaiya River.

Residents regularly use the Kakai and Kaiya Rivers to pan for gold: Some residents of Alipis describe spending all day gold-panning in the Kakai River.²²⁶ “In the morning I go, and I come back in the afternoon,”²²⁷ one man explained. Another elaborated, explaining that he gold pans from “[s]ix o’clock in the morning to five o’clock at night.”²²⁸ The Research Team has also regularly observed residents gold panning in both the Kakai and Kaiya Rivers during research visits.

Children are frequent users of the rivers: Children frequently wash, play, and swim in small “pools” in both the Anjolek and Anawe waste dumps, as well as in the Kakai River (See Photo 18). “In your place, in America or other parts of the world, children have swimming pools. Our Kakai River is like our swimming pool. Children splash it into their mouth and nose,”²²⁹ reported a woman from Alipis.

Rivers are regularly used for personal and household hygiene: The rivers are primarily used for washing and other household purposes other than drinking. The rivers are frequently used for washing purposes, especially during dry periods when many residents can be observed washing clothes, dishes, and themselves in the rivers.²³⁰ In dry periods, residents of Alipis, Panadaka, and Yunarilama very frequently rely on the Kakai River, which they consider polluted, for washing.²³¹

Women and children interact frequently with river water: Women make use of the rivers with particular frequency for personal bathing, and because they are often responsible for bathing children and washing the family's clothes and dishes.²³² One man from Panadaka noted that women in particular "walk to the big river [Kakai], washing clothes, body, cooking utensils."²³³ Women also experience unique difficulties when carrying out daily washing needs during times of low or no rainfall. As one woman from Yunarilama explained: "During the dry season, we had a very difficult time. It's okay to wash clothing in the rivers but the very thick blankets, we had difficulty to wash them. We've been using the same dirty blankets for sleeping."²³⁴

Babies and young children are also washed in these rivers.²³⁵ One woman from Kulapi noted, "Mothers, we face problems with little babies. In dry season, it is hard to wash babies out here. We wash the babies in the big rivers here. They get dirty, scabies, they cough, and their skin gets dusty."²³⁶

Rivers are sometimes used as emergency drinking water during drought: Numerous residents reported to the Research Team that the main rivers are polluted, and they do not drink from them. "We cannot drink from these big rivers, they have chemicals," one man from Timorope said.²³⁷ Residents of Yunarilama stated: "Before mining started, we drank it. Now we don't. Nobody drinks from it."²³⁸

However, some residents reported that occasionally, and as a last resort during very dry periods, some residents drink from the rivers. Some residents of Panadaka and Alipis report drinking from the Kakai when springs and other sources run dry or are difficult to reach.²³⁹ One man from Alipis noted that springs were "too far. So we just go to the Kakai."²⁴⁰ A woman from Panadaka observed, "We drank from Kakai River [during the drought]."²⁴¹ Some residents of Apalaka and Yarik also report drinking from the Kaiya River during dry periods.²⁴² One man from Apalaka stated, "We go to the Kaiya River in the dry season. We boil the water in the Kaiya river. We drink it after we cool it. . . . Yes, I think it is polluted. The chemical mixed with water and we don't normally drink it. We only drink it in the dry season. Our ancestors drank fresh water from [it], but now it is spoiled."²⁴³ Some residents of Mugalep also noted that river water might be consumed during times of extreme need. "We try to avoid drinking from the two rivers, but we need water," one man from Mugalep said.²⁴⁴ Another added, "[I]f I don't have any money, I have to drink whatever water is available."²⁴⁵ A woman from Mugalep noted, when springs dry up, "If we don't have money, we have to go down to the Kakai River."²⁴⁶

c. Acceptability

Porgerans do not consider the rivers acceptable for any use, although they frequently use them for washing, panning, and recreation anyway, because they have limited alternatives. Porgerans generally believe that water from the main rivers is polluted and unsafe to drink, because of the

mine as well as upstream village use. They are concerned about using the waters and are often not sure if there is a “safe” level or type of use. In interviews, Porgerans reported having rashes, or dusty, itchy skin after washing in the big rivers.²⁴⁷

Many Porgerans believe that the mine dumps waste, sewage, and chemicals into the Kakai.²⁴⁸ Residents told the Research Team that the Kakai River water often smells of “rust” or “chemicals.”²⁴⁹ Residents of Panadaka emphasized that water from the Kakai River is “always dirty,”²⁵⁰ describing it as “green or brown” in color²⁵¹ and “greasy.”²⁵² The Kakai water was therefore considered too polluted to safely drink.²⁵³ One man from Yunarilama explained nonetheless that when forced to drink from the Kakai, which he referred to as “the dirty chemical water,” he would try to imagine it was clean water: “I don’t care about the color or the smell, I definitely know it’s poisonous water, but in my mind I create my own images that it is a beautiful clean river from before the mine.”²⁵⁴ Because of limited access to other water sources, many residents also use the river water for bathing and for washing dishes and clothing, even though they consider the water dirty.²⁵⁵ Some of these residents complained that after bathing or washing clothing in the Kakai River, their skin felt itchy and described “dust” on their skin or clothing.²⁵⁶ A few interviewees refused to use the water from the Kakai River for any purpose at all, including for washing or bathing.²⁵⁷

The Kaiya/Anjolek River is described as similarly “dirty.”²⁵⁸ “I myself see that basically they throw all the waste, grease, and dirt from the mine, they wash down to the Kaiya, so I know that it is unsafe,” said one man from Yunarilama. “Before the mining, they’ve got fish and frogs in the water, but now after the mining, they’ve thrown the waste down into the Kaiya and the color itself has turned brown. Now that there is no fish and frogs I know that it is unsafe.”²⁵⁹ Some individuals reported avoiding using the water from the Kaiya.²⁶⁰ Some residents of Apalaka reported using the Kaiya for washing, despite pollution fears.²⁶¹

Women also expressed particular hygiene concerns, especially during menstruation when they report using river water they consider polluted to wash internally.²⁶² A woman from Alipis said, “I am talking on behalf of all the females. We have monthly periods. You can see it is unhygienic. We need to wash our body. We don’t have any place to wash. We go to the Kakai River to wash bodies. The chemicals must have come to our body.”²⁶³ Some women expressed fear that the resulting exposure to the river water has resulted in the interruption of normal menstrual cycles.²⁶⁴ Women also expressed fears that the water exposure had induced miscarriages or led to child deformities.²⁶⁵

d. Quality

The Research Team tested water in the Kakai, Pongema, Kaiya, Anjolek, and Kaiya/Anjolek (where the two rivers have joined) Rivers. At each sampling site, the team measured water pH (acidity), dissolved oxygen, temperature, and electrical conductivity using a YSI Sonde (Sontek) and alkalinity using a field alkalinity kit. These field parameters provide a first order assessment of water quality and are relevant for estimating the likelihood that heavy metals will be found dissolved in the water.

At a subset of the sites, water samples were collected and taken back to Penn State and tested for heavy metals typically found in water sources near industrial mines, including arsenic, aluminum, cadmium, chromium, cobalt, copper, lead, manganese, nickel, and zinc. For water collected from the confluence of the liquid “Red Water” tailings and the Pongema, the Research Team filtered samples to measure dissolved concentrations of metals, providing an underestimate of the total concentration that may be absorbed in human bodies. For water collected from the Kakai and Anjolek Rivers, which was too turbid at the time of sampling to allow for filtration in the field, the Research Team partially digested (that is, chemically dissolved) the particulate matter. These measurements offer an underestimate of total metal concentrations (the combination of dissolved and particulate matter) but are likely still greater than dissolved concentrations. We present our measurements alongside the mean total concentrations obtained from the 2015 Barrick Annual Environmental Report in Tables 4(a) and 4(b) in Annex I. For more information on our water sampling and testing methods, see the chapter on Methodology.

The Research Team’s observations of the water in the Kakai and Kaiya/Anjolek Rivers supported local perceptions of water appearance. The water in these rivers was often opaque, and varying shades of brown or gray, with high levels of suspended sediment.

Based on the Research Team’s analysis and information reported in Barrick’s 2015 Annual Environmental Report:

- **The Kakai River** is not suitable for consumption and could present a public health concern for residents who interact with this water. Median total concentrations reported by the mine in 2015 for cadmium, iron, lead, and zinc exceed either the WHO Guidelines or the PNG Drinking Water Standards. The 2014 report also found levels of arsenic above WHO Guidelines. In addition, the Research Team’s partial digestions, which represent an underestimate of the total concentration, show that the concentrations of iron and lead exceed the PNG Drinking Water Standards and the WHO Guidelines, respectively. Concentrations measured by the Research Team were higher after a rain event compared to before. Thus, residents may be at higher risk of exposure if they drink from the Kakai River during or after rains. Further study is needed to determine the extent of any risk that these chemicals pose for the local communities.
- **The Anjolek River** is not suitable for consumption and could pose a public health concern for residents who interact with this water. The Research Team’s partial digestions, which represent an underestimate of the total concentration, revealed cadmium, iron, lead, nickel, and zinc levels exceeding either the WHO Guidelines for Drinking-water Quality or the PNG Drinking Water Standards. Downstream of the confluence with the **Kaiya River**, the mine reports that median total concentrations exceed either the WHO Guidelines or the PNG Drinking Water Standards for arsenic, cadmium, chromium, iron, lead, nickel, and zinc. Further study is required to determine the extent of any risk that these contaminants pose for the local communities.

- **The confluence of the liquid “Red Water” tailings and the Pongema River** was also tested by the Research Team. The analysis found dissolved concentrations of sulfate and fluoride exceeding PNG Drinking Water Standards. The Research Team did not measure total concentrations, nor were total concentrations reported by the mine for this location.

6. WAILE CREEK DAM & PRESSURE VALVE WATER ACCESS

Summary of findings. Waile Creek Dam, created by the PJV and located approximately 15 kilometers above the mine, supplies water to the mine-site. The water is pumped through company-built pipes that run past Aumbi and Kulapi villages to the mine-site. The company has not created any purpose-built infrastructure to direct this water to villages. However, residents of nearby villages can often access the pumped water via pressure valves. Residents use this source for drinking and other household purposes. During dry periods, some residents from other villages also travel to the pressure valves or Waile Creek itself to collect water, but accessibility can be difficult due to distance, expense, and clan boundaries. The water is generally perceived by Aumbi residents to be of good quality, although Kulapi residents had more mixed views of the water at their local valve.

a. Accessibility and Availability

Waile Creek Dam water, piped to the mine-site, is primarily accessible to and used by residents of Aumbi and Kulapi (especially Kulapi 4), where pressure valves are located. Water flow varies depending on the mine’s management of gold processing and tends to be continuous, except during extreme dry periods.

The company designed the piping to supply water to the mine site. It was not designed to also provide water to villages, and drinking water taps have not been constructed along the piping route. No pipes were constructed to pipe water to village centers. The water supply to Porgeran residents is incidental. The valve at Kulapi 4 has become a frequently used source of water for residents of that village,²⁶⁶ although some residents, such as the elderly, find it difficult to collect the water themselves.²⁶⁷ Some cannot even make the attempt.²⁶⁸ The valve at Kulapi is small, and appears to only release water because it was broken;²⁶⁹ it shoots water straight into the air and requires villagers to construct informal channeling devices, such as a cut coca cola can,²⁷⁰ to funnel water into plastic bottles.²⁷¹ (See Photos 20, 21, and 22 of the Kulapi valve).

The water released from the pressure valves is far less accessible for residents of other villages, especially Apalaka, Yarik, Timorope, and Mugalep, which are not in easy walking distance and would generally require vehicular transportation. In addition, families reported not feeling comfortable collecting water from another clan’s land, or not being able to pay clan access fees for the water. Some stated that they could not get water from Aumbi because it is “someone else’s land.”²⁷² A woman from Kulapi explained, “We don’t go there. At Aumbi, those people get a tax for the water. Depending on the container, 5 kina or 10 kina. People who live there, they seem to own that water.”²⁷³

Direct access to Waile Creek Dam itself is largely limited to the few Porgerans who can access vehicles, as it is approximately 15 kilometers from the SML. “Only those with vehicles go to Waile Creek. They collect water for their families, and any extra they sell,” explained a man from Mugalep.²⁷⁴ Some interviewees also expressed concerns about collecting water directly from Waile Creek. A woman from Alipis told us: “Waile Stream isn’t our land. If we go, someone might chop our necks.”²⁷⁵



Photo 20: A family collecting water from the pressure valve at Kulapi, directing the water by hand.

b. Acceptability

Porgerans generally perceive Waile Creek water, which is far upstream of the mining operations areas, to be cleaner and safer than streams or rivers running through the SML, and some expressed that they felt it was better than rainwater collected in buckets.²⁷⁶ Residents who accessed the water via the Aumbi pressure valve generally stated that it was of good quality.²⁷⁷

Residents of Kulapi had more varied opinions regarding the quality of the water collected from the Kulapi 4 pressure valve: some described it as “cold and fresh,”²⁷⁸ but others referred to it as “chemical water,”²⁷⁹ and some expressed uncertainty.²⁸⁰



Photo 21 (above, left): Attaching a hose allows this resident to direct the flow of water from the pressure valve at Kulapi. Photo 22 (above, right): The pressure valve at Kulapi shoots water straight into the air unless residents improvise collection methods (See Photos 20 and 21). An entire village relies heavily on this one source. Photo 23 (below): A young boy stands beside a pressure valve for a pipe channelling water from the Waile Creek dam.



c. Quality

The Research Team tested the water at Waile Creek Dam for pH, alkalinity, conductivity, and temperature. The Research Team similarly tested the water released from the valves at Aumbi and Kulapi 4 Villages.

The Team found all measured parameters to be at acceptable levels. Because of limited resources and residents' lack of general concern about heavy metals in Waile Creek, the Research Team did not conduct tests for heavy metals.

Barrick Gold's testing results reported for Waile Creek do not indicate any unsafe metal contamination, although pH and sulfate have increased over the life of the mine.²⁸¹

7. COMMERCIALY BOTTLED WATER

Summary of findings. During dry periods, some Porgerans supplement water supplies by buying commercially bottled water from local stores for drinking and cooking purposes. While bottled water is perceived to be safe and of good quality, most families do not purchase it because it is unaffordable. Purchasing bottled water can mean sacrificing other basic necessities.

a. Accessibility and Availability

During dry periods, some Porgerans buy commercially bottled water from local stores for drinking and cooking purposes, although costs are prohibitive for most families. Most Porgerans have extremely limited financial resources, and only a few interviewees reported purchasing bottled water.²⁸² Bottled water is prohibitively expensive for many Porgerans.²⁸³ "The small bottles are three kina [US\$1.12] each," said one man from Yarik, "It is four kina [US\$1.49] bus fare to Porgera Station. And four kina back. Eight kina [US\$2.98] is a lot for me . . . it is painful for me to buy water."²⁸⁴ A man from Anawe similarly commented, "I don't buy it because I don't have three kina to spend on water."²⁸⁵ Another woman rhetorically asked, "Where would I get the money to buy [water]?"²⁸⁶ The Research Team found no evidence that the company or the government supplied commercially bottled water to Porgeran residents in times of drought.

b. Acceptability

Porgerans did not express concerns about bottled water quality, but infrequently accessed it for financial reasons.

c. Quality

The Research Team did not test commercially bottled water given the lack of concern expressed by residents and limited resources for sampling.

PART B: ACCESS TO INFORMATION AND PARTICIPATION

We always go to community affairs, complaining. Sometimes we protest. We rub our bodies in mud, we tell them we aren't drinking water. But they have no ears.

- Resident of Yarik Village, January 5, 2015

White people like this never come and sit and talk with us like this. Barrick white people come talk with leaders and government. They don't talk with women and grassroots.

- Resident of Mugalep Village, January 6, 2016

INTRODUCTION

Under international human rights law, the PNG government has the obligation, and the mining companies have the responsibility, to make information about the mine's impacts on human rights available, accessible, functional, and consistent with the principle of non-discrimination. They also have the obligation and the responsibility to facilitate participation of Porgeran residents in decision-making processes about water resources.

The mining companies and the PNG government do not currently make necessary information about the mine's impacts on the environment and human health adequately available, accessible, or functional, and they could do more to promote community members' participation in decision-making impacting their right to water.

For many years, little information was available to the public about water quality in villages near the mine, and it was unclear what, if any, water and health testing the mine or the government were conducting in this area. Starting in 2010, the mine began to take positive steps to make some environmental impact information more publicly available. However, some reports remain unpublished, some important issues remain inadequately studied, and available reports often fail to present information in a way that is adequately accessible and functional, given limited internet and the lack of specialist expertise and literacy among the Porgeran population. The significance of the available reports for human behavior and health can be difficult to interpret, and there is a substantial gap in studies directly addressing potential health impacts. Many Porgerans report a lack of information about water, a lack of sufficient dialogue with the companies and the PNG government over many years, and a lack of sufficient participation by community members in decision-making about water issues. There is a dearth of effective face-to-face communication with impacted communities regarding health and environmental issues, and information is rarely provided in a form appropriate to the local context and tailored to the specific needs and experiences of those uniquely impacted, such as women and young children. The government conducts some testing, but only to verify the mine's own results. The government does not undertake testing to assess concerns about the full range of water sources relied upon by residents or any risks they may pose to human health.

1. AVAILABILITY OF INFORMATION

The availability of information (meaning the generation and collection of reliable information) about water and environmental issues has improved over the life of the mine, but available information remains inadequate and studies undertaken to date by the mining companies and the PNG government have not addressed all necessary issues.

The PNG government only tests for compliance with the mine's permits, without conducting much needed additional assessment of environmental and health impacts: Pursuant to its operating license, the PJV mine is required to demonstrate that it is in compliance with its permits and with PNG water quality regulations. In practice, as the *Environmental Act 2000* expressly allows riverine tailings disposal and mixing zones,¹ the PJV's discharge permits do not require that the mine demonstrate compliance with domestic water quality standards until a compliance point located approximately 165 kilometers downstream from the mine. The government's role has primarily been to verify PJV testing to ensure compliance with permits, without expanding upon the type of information available or more fully assessing mine impacts. This practice has resulted in significant gaps in the availability of information regarding water quality and health in villages potentially impacted by the mine.

A government official interviewed for this report explained that while the Conservation and Environmental Protection Agency (CEPA) tests water and sediment twice a year to verify the mine's own reports, the CEPA does not test water sources that fall outside of the PJV's reporting requirements, including sources that people closely rely upon and interact with, such as river water in the mixing zone, springs, or rainwater. The official acknowledged that such testing is limited and inadequate. The official stated that the government's testing should not be limited merely to permit conditions, but should extend to the waters people drink and interact with, and should assess the overall social, health and environmental conditions around the mine.

In interviews with the Research Team, key PNG government officials noted that the government is not doing enough to make information about the mine's impact on health and the environment available to Porgerans.² While there are numerous departments and agencies in the PNG government with the authority to conduct needed studies and community outreach—including the CEPA,³ the Mineral Resources Authority,⁴ the Department of Health,⁵ as well as Water PNG⁶—officials interviewed for this report cited many obstacles to government efforts to conduct studies to supplement the PJV's reporting, including: unclear division of labor and inadequate inter-departmental cooperation;⁷ inadequate funding for significant studies or field work, as well as a general lack of resources; and gaps in access to technical knowledge or equipment.⁸ Some departments were also simply unaware of the need for further studies. One official noted that the Department of Health, for example, had not received any notice of concern or complaint about the mine's impact on health.⁹ Another official noted that Water PNG has difficulty accessing information about rural water needs and relies on active outreach from villages, local government representatives, or mining companies.¹⁰

The PNG government has not responded to concerns about lack of mine impact information: The Constitutional Law Reform Commission (CLRC) has raised the issue of inadequate mine impact information with the PNG government, but the government has not yet taken action to address

these concerns. In September 2015, the CLRC submitted a groundbreaking report to the government: *Review of Environmental and Mining Laws Relating to the Management and Disposal of Tailings*. The report made several recommendations regarding availability of information on tailings disposal impacts, including that environmental and human health impact assessments, as well as social impact assessments, be made a pre-condition for the grant of a mining lease.¹¹ The CLRC also recommended that the “CEPA, in collaboration with the PNG Water Board [now known as Water PNG], develop and maintain a nation-wide water monitoring office with monitoring sites all over the country, including mining project . . . sites, collecting data on the quality and quantity of PNG’s water resources.”¹²

The CLRC report also highlighted that the Department of Health acknowledged the need for health impact assessments in its submissions to the CLRC. The CLRC observed:

Despite the fact that mining and oil and gas projects have profound . . . impacts on community health, PNG does not currently require project proponents and stakeholders to systematically consider potential health impacts of proposed projects prior to licensing and operation, nor to demonstrate appropriate planning for the Department managing those potential impacts.¹³

Although the CLRC report was submitted in September 2015, the CLRC’s report has not been tabled in Parliament, and the government has not substantively responded to it, or explained how it will implement the CLRC’s important findings and recommendations.

Before 2010, the availability of company information regarding the PJV’s impacts on water and the environment was highly inadequate: Civil society and ethical investment groups have raised many concerns about the dearth of studies and the lack of transparency about water and environmental issues around the PJV mine. The Norwegian Council on Ethics, which reviewed the PJV’s riverine tailings disposal practices in 2007, expressed concern about the PJV’s lack of transparency and openness in environmental reporting,¹⁴ particularly noting the lack of information on the environmental and health impacts of the PJV’s riverine tailings disposal method.¹⁵ At the time, the Norwegian Council also noted that the most comprehensive independent environmental assessment of the mine was conducted over ten years prior.¹⁶ The Norwegian Council’s own independent assessment found cause for concern, noting a risk of deteriorating water quality and increasing heavy metal concentrations that could result in “substantial effects on *human life and health*.”¹⁷ The Norwegian Council recommended that Barrick Gold be excluded from future investments of the government’s pension fund, as the Porgera mine’s tailings disposal method posed “an unacceptable risk of extensive and irreversible damage to the natural environment.”¹⁸

The Norwegian Council also noted specific concerns regarding the lack of health impact information. The Council was unable to ascertain whether the PJV had undertaken systematic investigations to evaluate any long-term health risks faced by local residents due to mine pollution and waste.¹⁹ Barrick Gold referred the Council to a 1996 study that addressed potential health and environmental effects of mine discharge.²⁰ According to the Council, this report assessed risks to the population located in the mixing zone (i.e., the zone between the discharge point and the first compliance point) as low, because villagers reportedly did not live near the water at the time and so faced minimal exposure.²¹ The 1996 study called for detailed risk assessments “for all people living downstream of the mine.”²² This call, in the Council’s opinion, had not been heeded by the mine.²³

The Council quoted Barrick Gold as asserting that “health risk assessments and medical assessments of downriver populations” had been conducted, with “interim reports . . . posted from time-to-time.”²⁴ In this regard, Barrick Gold referenced the website of the Porgera Environmental Advisory Komiti (PEAK), a committee created in 1997 by Placer Dome, Barrick Gold’s predecessor, in response to the 1996 study recommendations.²⁵ However, the Council stated that it was unable to find such reports on the PEAK website.²⁶ Only one 2001 study was available on the website, offering “a limited health assessment of a small sample of residents in nine villages above SG3.”²⁷ The PEAK website also noted the existence of a Community Health Study, but this report was not available according to the Council.²⁸ Our Research Team has also been unable to assess these reports as the PEAK website is no longer functioning.²⁹ The company reported to our Research Team that the website was closed as a result of the PEAK being disbanded in early 2016, and the company stated that it was still discussing “whether and how” to make PEAK reports available.³⁰

Human Rights Watch has also noted that until “September 2010, Barrick consistently refused to make public key data that could allow for independent assessment of its claims regarding the likely impacts of riverine tailings disposal at Porgera, especially its periodic environmental reports to the Papua New Guinea government.” Human Rights Watch stated that “[a]lternative independent sources of data do not exist.”³¹

When our Research Team requested access to the PJV’s Annual Environmental Reports published or produced by the mine prior to 2009, BNL refused to share them, stating only that “[t]hese documents are not currently available.”³²

Online publication of company Annual Environmental Reports from 2010 beneficial, but important data gaps remain: The mine first made its Annual Environmental Reports publicly accessible in 2010.³³ According to these reports, now accessible for the years 2009-2015 (the 2016 and 2017 Annual Environmental Reports were inaccessible online at the time of publishing this report), a selection of local creeks and rivers within the SML³⁴ are monitored on a monthly basis for dissolved and total metals, pH, sulphate, and alkalinity.³⁵ The Annual Environmental Reports additionally cover monitoring of heavy metal concentrations in water and aquatic life downstream of the mine. The 2013, 2014, and 2015 Annual Environmental Reports also report the results of water testing at select drinking water sites, namely water tanks and two springs in four SML villages, with a fifth village added in 2015.³⁶ The 2013-2015 reports also include air quality measurements from several locations near the mine.³⁷ While the Annual Environmental Reports improve information availability by reporting concentrations of trace metals found in some locations of the environment and river system downstream of the mine, there are significant gaps in the information contained in the reports, which renders them inadequate to fully assess risks to the environment and human health.

In particular, the reports fail to provide detailed information on the mine’s impact on the availability of water resources, and on the potential negative human health impact from contact or ingestion of local water. The company does not regularly conduct comprehensive assessments of human use of water sources in the area, including of how use shifts with variations in rainfall. They do not present water sampling and analysis for many of the water sources with which residents frequently interact, and they do not assess bioaccumulation of metals and trace elements in the human population. While reporting testing results from drinking water sites in four, and, most

recently, five villages between 2013 and 2015 represents an important improvement, such testing is not extended to all villages, nor to the diversity of water sources with which residents interact (discussed in more detail below with respect to the village drinking water study).³⁸ The Annual Environmental Reports analyze heavy metal concentrations in aquatic food sources such as prawns and fish as an indication of bioaccumulation of heavy metals and one vector of potential negative human health impact, but these studies only begin miles downstream of the mine with the upper Strickland River,³⁹ and thus are an insufficient measure of the risks faced by SML residents who live within and next to the mine.

An important addition to the 2013 Annual Environmental Report is the reporting of dissolved and total concentrations of certain heavy metals in “contact water”—rivers and creeks deemed potentially contaminated due to “mine contact runoff”—which are compared to “trigger values” set by the mine to analyze degrees of risk.⁴⁰ However, the mine does not compare the measured concentrations to PNG Raw Drinking Water Standards or WHO Guidelines for Drinking-water Quality, and does not indicate how any of the mine contact runoff sources are used by Porgerans.⁴¹

In 2015, the company made an important addition to its Annual Environmental Report, including a section on “water-based activities” that made an effort to assess potential health risks to communities who interact with water through contact, such as through gold panning, bathing, fishing and swimming. Positively, in this section, the mine reports pH and dissolved (but not total) concentrations for certain metals, comparing findings to both Australian recreation water guidelines (ANZECC/ARMCANZ (2000)) and the PNG Raw Drinking Water Quality standards. Unfortunately, this section offers limited information for communities living in and around the SML, as out of the six testing sites documented, only one, the tailings waste (“Red River”), is located in the SML. The next closest testing site is the mine’s first compliance point, SG1, located 8 km downstream from the mine. The Annual Environmental Report offers no further clarification on the nature of this risk nor does it detail any mitigation efforts the mine is undertaking given the fact that many Porgerans rely on gold-panning in the mine tailings as a source of sustenance (See Chapter IV, Section 4 on the tailings waste).

Village drinking water study a further positive step, but more is needed: In 2011, the Porgera Landowners Association and Porgeran NGO, the Akali Tange Association, filed a complaint with the Organization for Economic Cooperation and Development (OECD) National Contact Point of Canada, asserting that the PJV failed to provide impacted communities with “Adequate and Timely Environmental, Health and Safety Information.”⁴² Following subsequent mediation through the OECD, the mine committed to and then conducted a study of select water sources used for drinking and other household purposes in and near four SML villages in 2013 and 2014.⁴³ The full results of this study are presented in the 2013 “Water Sampling & Analysis Report for SML Villages”⁴⁴ (covering the 2013 testing) and the 2014 “Drinking Water Study Update”⁴⁵ (covering the 2014 testing), and some of the data is additionally discussed in the Annual Environmental Reports for those years. This study was a step forward, because it represented a concrete effort to measure the concentrations of contaminants in the primary water sources relied upon by some village residents for drinking and other household needs. However, the study was limited in scope in certain key respects, and the information collected is insufficiently analyzed, such that the study does not adequately assess or convey risks to the environment and to individuals who interact with various village water sources.

While the documents reporting the details and full results of this study are not currently publicly accessible online (see the discussion of “accessibility” below), the Research Team was able to obtain the 2013 “Water Sampling & Analysis Report for SML Villages” by direct request to BNL, and accessed the 2014 “Drinking Water Study Update” from the PEAK website before it was taken offline. According to these reports, sampling locations were selected in or near Yarik, Apalaka, Panadaka, and Kulapi villages, at drinking water sites and creeks “commonly used by local inhabitants for laundry, bathing, panning for gold or recreational activities.”⁴⁶ In 2013, water samples were collected at one spring, twelve drums or tanks used to collect rainwater, and nine creeks.⁴⁷ In 2014, samples were collected at the same sites as the previous year, with the exception of Panadaka, where samples were collected from 15 then recently installed Tuffa tanks rather than the three drums sampled the previous year.⁴⁸ Water samples were then assessed for a variety of contaminants, including heavy metals.

While this study is certainly an important contribution to information availability, it is significantly limited in scope. First, the study only addresses questions of water quality and does not address issues of water availability, or offer any assessment of water needs, despite that being one of the study’s stated aims.⁴⁹ Second, the study only looked at water sources relied upon by Yarik, Apalaka, Panadaka, and Kulapi villages, rather than all SML villages, despite the often-significant difference in water sources accessed by, and water needs of, other villages. Third, by focusing primarily on testing rainwater as the primary drinking water source, the study failed to assess numerous springs and small creeks that are occasionally relied upon for drinking water, and frequently relied upon for other household uses. Fourth, by testing only once a year, the study is unable to reach any conclusions about seasonal variations in water quality based on differences in rainfall, and how that affects which sources residents rely upon.

Additionally, the results from the study, and in particular the creek testing, are inadequately analyzed in the mine’s reports. The results are presented in tables without comparison to any water quality standard and without any description of the potential risks of exposure to, or ingestion of, such water sources across the variety of their uses.⁵⁰ When the Research Team performed this comparison for several of the creeks, the measured concentrations of certain heavy metals exceeded WHO Guidelines for Drinking-water Quality standards as well as PNG Raw Drinking Water standards.⁵¹ In the mine’s reporting, rather than analyzing any potential risks from such data, the company focuses its attention only on assessing risks of the rainwater samples and the one spring that is identified as a drinking water source, having reached the conclusion that creeks are not used for drinking water.⁵² The study also lacks any recommendations for improving water quality and access. The 2014 update indicated the need for future analysis of results, specifically the comparison of 2014 data against PNG drinking water quality guidelines,⁵³ but the Research Team was unable to verify whether any follow-up studies have actually been undertaken.

According to information BNL provided to the Research Team, drinking water from the 2014 sampling sites is sampled and analyzed annually.⁵⁴ BNL did not provide the Research Team with the results of such testing for any year following 2014, and such information does not appear to be publicly accessible, although BNL stated that results are “provided and explained to the community representatives” that participate in sampling.⁵⁵ The list of annual sampling sites identified by BNL does not include the creeks that were tested in 2013 and 2014, nor does it extend to drinking water supplies outside of Apalaka, Yarik, Panadaka, and Kulapi.⁵⁶

The mining companies report that additional studies exist, but they do not cover all necessary issues, and their precise scope and contents cannot be independently verified: According to information that BNL provided to the Research Team, or documents the companies have made accessible online, additional studies on the environmental and health impacts of the mine have been, or are being, conducted. However, these studies do not fill all necessary gaps in information availability, and because the studies are not publicly accessible, the Research Team cannot assess whether and how they would contribute to improved information availability:

- ***Studies on how local residents use water sources:*** In response to the Research Team’s request for company reports on local use of various water sources, BNL responded that such surveys “were undertaken during mine planning,” and that “copies may still exist in pre-digital archives.”⁵⁷ The Research Team assumes from this response that the mining companies have conducted no studies on this topic since mine planning over twenty years ago, despite significant changes to the local landscape and population size.
- ***Studies on whether or how the mine has impacted the availability of water:*** In response to the Research Team’s request for company reports on the mine’s impact on the availability of water sources, BNL responded that such surveys “were undertaken during mine planning and development,” and that “copies may still exist in pre-digital archives.” The Research Team assumes from this response that the mining companies have conducted no studies on this topic since mine planning and the early stages of development.
- ***Studies on how the mine has impacted human health:*** According to a document that BNL provided to the Research Team, which summarizes some of the PJV’s health monitoring efforts, the mine has completed several studies analyzing various vectors of possible exposure to contaminants.⁵⁸ None of these studies, however, have been made publicly accessible to independently verify their content, although the mine indicated that they would be made public in 2017 as part of a singular, finalized “Longitudinal Health Risk Assessment.”⁵⁹ At the time of publishing this report, this assessment was not available online. The studies include:
 - A 2003 study by the Centre for Environmental Health Pty Ltd, “which monitored contaminant metal and essential micronutrient concentrations of the main drinking water sources, recreational waters, air, village soil, natural sediment and floodplain sediment at mine-affected and control villages in [20 villages in the Porgera, Lagaip, Strickland, and Lake Murray districts].”⁶⁰ Contaminant concentrations were not measured in human bodies. It is unclear from the information BNL provided whether the study included a village within the SML itself. According to BNL, the assessment found that the mine’s impact on health is minimal,⁶¹ but this study is not publicly available for independent review, and the lack of direct assessment of human health is a significant gap.
 - A 2004-05 study of village diet, measuring “the types and quantities of food consumed by households at the control and mine-affected locations,” and assessing “the contaminant metal and essential micronutrient concentrations in a

range of basic foods.” BNL did not provide the Research Team a summary of the results of this study.

- A 2010-11 study which, according to BNL, improved the accuracy of the previous diet study by completing “a survey of individual food consumption in mine-affected and control villages in the five regions,” which, together with the previous study, could be used to assess exposure to contaminants through food sources. According to BNL, while food consumption “differed widely for all age and gender groups between the five regions,” the study found that “consumption patterns and amounts were quite similar between the two mine-affected and control survey villages in each region.”⁶² Because the Research Team was not provided a copy of the study itself, it is unable to independently assess the results.
- A 2010 “human time-activity pattern survey,” intended to measure how much time village residents spend engaging in certain activities as a means of estimating villagers’ exposure to contaminants. According to BNL, “[f]ood was the overwhelming contributor to contaminant metal exposure . . . at all of the surveyed villages,” accounting for “90-99 per cent of aggregated maximum exposure for all ages and gender groups.”⁶³ Because the Research Team was not provided a copy of the study itself, it is unable to independently assess the results.
- A 2012-13 study (involving “time-activity monitoring, a survey of individual food consumption . . . and sampling of food, drinking water, recreational water, air quality and soil at food gardens and village areas for contaminant metals”) assessing exposure risks faced by residents of two villages involved in panning for gold in mine tailings compared with the risks faced by residents of two control villages within the Porgera Valley.⁶⁴ The study did not directly measure contaminants in human bodies (e.g. through blood, hair, or tissue sampling). According to BNL, the study found that levels of contaminant metal exposure and intake “are not significantly different” between “gold-worker” and control villages, and did not generally represent a threat to human health.⁶⁵ However, because the Research Team was not provided a copy of the study itself, it is unable to independently assess the results.
- ***Additional community “health impact assessments”:*** In its 2011 Responsibility Report, Barrick Gold stated its intention to complete health impact assessments (HIAs) “in the communities surrounding the Porgera mine” in order to “assess community health issues and risks and to map out mitigation strategies.”⁶⁶ It is unclear if this reference to HIAs refers to additional studies beyond the Longitudinal Health Assessment, and the Research Team has been unable to ascertain the progress of Longitudinal Health Assessment’s implementation, or any results of such additional studies if that is the case.

2. ACCESSIBILITY AND FUNCTIONALITY OF AVAILABLE INFORMATION

Both the mine and the government have collected important environmental and health information that they have not made publicly accessible. Although various studies exist, some are not publicly accessible at all, and many others are not readily accessible to those without internet access, specialist expertise, or high levels of literacy. Much of the public reporting is not made accessible and functional for the most important stakeholders, the residents of Porgera.

Some available government information is not made publicly accessible: The PNG government has not made the Conservation and Environmental Protection Agency (CEPA) water studies accessible online. While the results are reportedly presented at quarterly review meetings with representatives from the provincial government and landowners, among others, they are not made accessible to a more general audience. The Constitutional Law Reform Commission (CLRC) made note of this type of concern in its tailings report and recommended that the *Environmental (Permits) Regulation 2002* be amended to require CEPA to:

[M]aintain an official website containing, amongst other requirements, up to date publication of all approved tailings management systems, all tailings compensations agreements, all environmental reports submitted by the mining proponent as well as the CEPA's comments on them, any independent audits carried out by the CEPA, all environmental impact assessment related guidelines and all independent studies on tailings management mandated by the CEPA.⁶⁷

The PNG government has yet to address this recommendation.

Further, according to the CLRC, while official mine documents, such as environmental permits and environmental impact statements, are “public” information, they are not obtainable in practice.⁶⁸ For example, when the Research Team attempted to obtain a copy of the PJV's mine closure plan, the Mineral Resource Authority, a government agency responsible “for regulating all mineral exploration and mining activities in the country,”⁶⁹ insisted that the plan could not be shared because it contained proprietary information.

The mining companies do not make public all the available information collected by the mine: The mine has not made the results of various studies publicly accessible, including the full results of its annual testing of village water sources,⁷⁰ the completed portions of what BNL has labeled its “Longitudinal Health Risk Assessment,” despite some of its components having been completed for over a decade,⁷¹ and its 2016 and 2017 Annual Environmental Reports. Furthermore, the PJV's environmental permits are not publicly accessible (at the request of the Research Team, BNL shared water use and waste discharge permits).

While the mine has slowly modified its annual environmental reporting over the years, including new information collected that may not be shared in any other public document, not all of the environmental information collected by the mine is conveyed in its public annual reports. In particular, the mine has not included the results of water sampling and analysis conducted by the mine in 2013 and 2014 at creeks in and around Yarik, Apalaka, Panadaka, and Kulapi villages. As noted above, the mine committed to this additional testing in response to a complaint from village

residents and landowners that the mine was not doing enough to provide them with environmental and health information. While the 2013 and 2014 Annual Environmental Reports report the results of testing completed at certain identified drinking water collection sites (select springs, drums, and larger tanks),⁷² neither reports the results of the testing that was conducted at nine creeks “that are commonly used by local villagers for laundry, bathing, panning for gold or other recreational activities.”⁷³ The results of the 2013 and 2014 creek testing are not currently accessible online.

The mine also added statistical trend analysis to its Annual Environmental Reports starting in 2013—which aids in characterizing multi-year trends of metal concentrations—however, in 2013, “[i]n order to reduce the size of the [annual report],” the statistical summary tables of data were not included.⁷⁴ The report authors indicated the intent to prepare “a separate volume containing the statistical summary tables, details of sampling methods and QA/QC data, which would accompany the more concise [report],”⁷⁵ but the Research Team has not been able to establish whether such a volume was ever produced.

The mine has not yet made the most recent testing results, Annual Environmental Reports for 2016 and 2017, publicly accessible. No explanation for the delay has been provided.

Much information is not accessible or functional to those without internet, literacy, or specialist expertise: While the mine increased transparency by making its Annual Environmental Reports for 2009-2015 available online for independent review, these reports are not written so as to easily draw conclusions regarding risks to human health and the environment, and are largely not accessible or functional to those without internet access, specialist expertise, and advanced English literacy. The annual reports contain valuable information, but the information is frequently communicated as raw data rather than in functional terms or easy-to-understand graphics, and it is often not presented alongside relevant standards so as to assist the reader in interpreting the data and reaching determinations as to any risks. Targeted efforts by the mine and PEAK to make certain information more accessible have represented improvements, but were short-lived, limited in scope, and still insufficiently clear as to the particular risks posed by the environmental conditions reported.

- ***Annual Environmental Reports are difficult to understand without specialist expertise:*** When reporting on water quality, the Annual Environmental Reports often present raw data in a difficult to interpret form. For example, the reports present the concentrations of heavy metals as “box plots,”⁷⁶ which show the range of measurements made during the study year, and the range of measurements made from 1991 to the study year (See, our above Chapter, “Methodology,” for an example of a “box plot” graph). The box plots show the median average concentration and range of concentrations during the study periods, but do not communicate to the average reader the significance of the concentrations for the environment, local fauna, and human health, and require specialist expertise or training to interpret. The 2009-2012 reports also provide data tables of mean average annual water quality for some local rivers and creeks, such as Yunarilama and Yakatabari, below mine discharge or waste dump contact points.⁷⁷ These data tables present monthly average concentrations for the tailings and annual summary statistics (including the average concentrations and standard deviation, as well as the minimum and maximum concentrations measured) for the tailings and some

local water sources. This raw data is not communicated in a way that allows a non-specialist reader to easily interpret the data.

Starting in 2013, the reports use a more advanced framework meant to identify potential risks of mine-related environmental impact through the introduction of “trigger values,” which indicate whether an adverse impact to the environment may be occurring.⁷⁸ In this formatting, the company reports some of its data in color-coded tables where measurements that indicate “potential risk” of environmental impact are shaded yellow and measurements that indicate “low risk” are shaded green. However, in the 2013 and 2014 reports, the company’s use of trigger values only begins at the SG1 monitoring site, located 8 km downriver from the mine. In a positive step in 2015, the company began to apply a similar form of reporting to water sources within the SML, marking measurements that indicate “potential risk” in yellow. While this formatting marked an improved method of conveying potential environmental risk to lay readers, it provides no clarity on human health risks.

- ***Majority of testing results are not compared to relevant water quality standards:*** The Annual Environmental Reports fail to present all water data alongside relevant standards that assist in comparative interpretation. Water quality measurements from local streams are presented in tables that do not include reference to WHO Guidelines or other such benchmarks of water quality.⁷⁹ This lack of a baseline against which to compare the data makes it difficult for non-specialists to understand whether or not concentrations are elevated or unsafe. Only the measurements from drinking water tanks are compared to the PNG drinking water standards, despite the diversity of uses to which residents use many of the other sources tested. Innovations in the reports from 2013 through 2015, such as the use of trend analysis that indicates changes in concentrations of metals and other chemicals over time,⁸⁰ remain difficult to interpret from a health or environmental perspective without comparison to water quality standards, as it is impossible to know if the magnitude exceeds recommended limits. The data presentation could be improved, for example, by explaining in a narrative form any risks to the environment or human health and indicating clearly how the measures comply with or exceed WHO Guidelines for Drinking-water Quality. Porgerans should be able to clearly determine the nature and extent of any impacts or risks and be informed of such risks in direct and clear language.
- ***Reports aimed at community members are an improvement, but inadequately communicate potential risks:*** There have been two reports that attempt to address water quality issues in more functional terms, but even these reports remain difficult to understand for most audiences and fail to adequately convey any risks. The first such report is an annual “Report Card” on the health of the Porgera/Strickland river system, published by PEAK in 2010 with the assistance of the International Water Centre (Australia). It does not appear that any similar Report Cards were produced in subsequent years. Based on data from the 2007 and 2008 Annual Environmental Reports, the Report Card attempted to identify how well the mine protected “important environmental values” such as water quality, health, abundance of marine life, biodiversity, and ecosystem productivity in the Strickland river system, while highlighting areas of concern, and, according to the Report Card authors, enabling

“large and often complex amounts of technical information to be communicated to a broad range of people.”⁸¹ While this Report Card distils much of the annual reporting data for the environment downstream of the PJV, it does not provide a similarly detailed assessment of water sources *in* the SML. The Report Card assists in communication by outlining levels of concern—low, median, and moderate—but it does not offer context for the ramifications of these levels or explain the risks to human health that they may present. Nor does the report offer a way to interpret the “poor scores” recorded in the Upper River near the mine, and SG1 in particular (where the report documented a high level of concern due to poor water quality, with elevated dissolved copper levels and elevated levels of arsenic, lead, silver, and zinc for sediment-bound metals). The Report Card does not adequately explain to Porgerans what the score means for whether or how they should interact with different water sources.

A second targeted study presents results from water testing conducted by the mine in 2013 and 2014 in four SML villages. The results of this study are presented in two documents: the 2013 “Water Sampling & Analysis Report for SML Villages”⁸² (covering the 2013 testing) and the 2014 “Drinking Water Study Update”⁸³ (covering the 2014 testing). While concise and containing useful photographs, these documents remain written in technical language, consisting mostly of raw data with only sparse conclusions on “alkalinity,” “turbidity,” “faecal coliform,” and “dissolved and total metal concentrations.”⁸⁴ The practical implications of these results for water quality and access, and human health, are not explained. Despite the presence of concerning concentrations of heavy metals in creeks, the results are not compared to any water quality standard by which risk might be assessed or highlighted. Further, there is no mention in either document of plans for reporting at the community level, although BNL has stated that, at least for testing of drinking water in recent years, results are “provided and explained to the community representatives” that participate in sampling.⁸⁵ Neither document is currently publicly accessible online.⁸⁶

Because the government has failed to put its testing results online or otherwise make them publicly accessible, the Research Team is unable to determine the functionality of CEPA’s data communication.

Information is not communicated adequately at the village level in Porgera: Neither the government nor the mine takes sufficient steps to communicate environmental risks at the village level in Porgera. The government does not play a meaningful role in conveying environmental information to Porgeran residents. A government official told our Research Team that officials do not visit SML villages in Porgera to share the government’s testing results.⁸⁷ The mine plays a more active role in providing information, but the steps it has taken are inadequate. The incremental steps the mine has made toward improving access to environmental and health impact information online have not adequately translated into improved access to information for impacted communities, who remain afraid of potential environmental contamination and uncertain of what water sources are safe to use.

- ***Company program to include Porgeran community members in water testing a positive step, but more must be done:*** The mine most directly provides information to communities in the context of annual drinking water testing conducted in Apalaka, Yarik, Panadaka, and Kulapi villages. As of 2015, another two villages were to be added, according to the PJV’s Annual Environmental Report.⁸⁸ According to information BNL provided to the Research Team, the results of this testing are “provided and explained to the community representatives” involved in the sampling (who are either representatives from the PLOA or from “Village Water Committees”), with “mine staff available to further explain or discuss the results.”⁸⁹ Where the results indicate that a drinking water source has concentrations of contaminants in excess of PNG Raw Drinking Water Quality Standards, BNL states that “mine staff work . . . with the supply custodians to identify and mitigate” the potential sources of contamination, explaining “preventative measures” such as keeping roof catchments clean.⁹⁰ There was no mention, however, of any reporting or trainings by the mine directly and broadly to village communities themselves, and it is unclear if the village representatives identified by the mine share the results of testing with the broader community. It is also unclear what information, if any, is provided by the mine to villages beyond those selected for annual water sampling and analysis, nor what steps are taken to conduct tailored outreach to particular groups, such as women, children, or older persons. In a November 2018 communication with the report authors, BNL expressed a commitment to “continue to engage with the community participants in the participative water-testing program to discuss practical steps that testing program participants, including company representatives, can take to help ensure that test results are communicated as widely as possible.”⁹¹

One way to provide water information to community members would be through the posting of warning signs at water sources. However, the Research Team has never observed any form of company or government sign or posting near any water source conveying information about risk or appropriate use, despite having extensively visited water sites in the SML, including hiking alongside creeks and rivers.

- ***Porgerans report lack of awareness of company and government water testing and lack of communication:*** Numerous Porgerans interviewed for this report stated that they are unaware of the results of any environmental monitoring that either the mine or the PNG government is conducting. Some residents state that they have never seen someone from the government or the company testing their water sources.⁹² One man, when asked if the company conducted testing or did any outreach, stated, “No one ever comes here. They treat us like pigs and dogs. They never come.”⁹³ Others report that they have seen testing carried out by company or government officials, but that they have not learned the results.⁹⁴ One man in Yunarilama explained, “Sometimes they come and check and test the tank water, and send the test to Australia. And they said they would bring back the results, and we waited so long, but they never came back.”⁹⁵ Another told a similar story in Anawe, “They go in a chopper and test in the red water and the dump site . . . They don’t tell people but they go and do their jobs.”⁹⁶ A man from Kulapi added, “Some came, we showed them the places that we fetch water and drink water, and they went away. They took our information but never brought back the results.”⁹⁷

When our Research Team reported back the preliminary results of our water study to communities living in the SML in July 2015, and then in a more comprehensive report-back in December 2015 and January 2016, many residents said it was the first time “experts” were sharing information about water quality at the community level. Many people in Porgera maintain they have no knowledge of the company reaching out to explain the potential impact of chemicals on water quality.⁹⁸ In Mugalep, a woman reported, “They have never informed us about any of the chemicals.”⁹⁹ People who did report that they had received briefings from the mine’s Community Affairs Office stated that the outreach was ineffective, and did not alleviate community fears about water safety issues.¹⁰⁰ For example, in Yunarilama, a resident explained that some “expats” had tested a water source and told him that there were “chemicals inside,” and that they shouldn’t drink the water, “but there is nowhere else to get water, so we drink it.”¹⁰¹ A woman from Apalaka explained that she had seen mine employees collecting samples before, but reported:

They don’t walk like this. They come on choppers, at the dump there, they take samples but we don’t know the results of the testing, they don’t ask us like this. They only fly through the helicopters, take water and soil and take it back. They don’t ask us these questions (do you drink/wash here)—they take samples and go.¹⁰²

Some residents of the SML are thus aware that the mine conducts environmental testing of their environment, but lament that “Barrick (...) does not give us report.”¹⁰³

The PEAK—which, when it still existed, was fully funded by the mine—reportedly attempted some community communications initiatives. PEAK had the stated purpose of communicating “relevant information . . . to the target communities in Porgera.”¹⁰⁴ A researcher sponsored by PEAK in 2010 also noted the need for improved face-to-face communication between the mine and impacted communities:

The people, not just their community leaders or representatives, living in the villages around the SML area and elsewhere - require accurate information about pollution caused by the mine. Clear face-to-face explanations would help allay fears about poisons and toxins with a community liaison worker who consistently and regularly travels to villages and discusses these and other environmental issues, face to face, with educational resources and information.... There is also a need for information about the tailings disposal and explanations about ‘Acid Rain’ so that misconceptions do not flourish.¹⁰⁵

According to information provided to the Research Team by BNL, the PEAK was disbanded in 2016 following a review that determined “that the organization was becoming less effective in meeting important foundational objectives.”¹⁰⁶ In 2017, BNL reported that, as a priority for that year, a process was underway to develop a replacement body with “formal and transparent terms of reference” that will be “tasked with developing an information policy that will govern what assessments are undertaken, what information will be published, and how to increase the reach of

published information to all stakeholders, and in particular, the SML communities,” including whether and how previous information will be made accessible.¹⁰⁷ At the time of publication, the Research Team was unable to ascertain whether any such steps had been taken. BNL additionally noted that “community leaders and organizations [would] be consulted during the design process on their views about how best to meet their information needs,” but no information was shared about whether community members would directly participate in the design or operations of the new entity.¹⁰⁸ Such community engagement would be important, given community members’ valuable knowledge about information needs and unparalleled insight on best practices for reaching community members.

3. CONSISTENCY OF INFORMATION WITH THE PRINCIPLE OF NON-DISCRIMINATION

Available information made accessible to Porgeran residents is generally not tailored to the specific needs and experiences of those uniquely impacted.

According to Barrick Gold, environmental and social impact assessments (or equivalent studies)—which are completed at each of its mining projects prior to development and during major expansions of existing operations—allow the company to uphold the participation and consultation of “marginalized and vulnerable community members.”¹⁰⁹ However, the available and accessible environmental studies for the PJV do not contain information that disaggregates according to any effects on those who may be uniquely impacted, such as children, women, persons with disabilities, older persons, or those with less access to socio-economic resources. Further, the Research Team has not found evidence of attempts by the company to ensure that groups experiencing vulnerability or marginalization, including persons who have not had access to education to obtain literacy, are provided with information in a way that addresses their unique circumstances.

The Research Team was only able to find one report that addressed issues faced by a particular group: a PEAK-sponsored study from 2011 that examined the mine’s impact on women’s lives. The report highlights the disproportionately negative effect of the mine on women—whose traditional source of income and social independence, gardening and subsistence agriculture, has been significantly reduced since the mine began operation.¹¹⁰ According to this report, the benefits of the mine greatly favor men as employees and landowners,¹¹¹ contributing to social inequality and instability. The report notes some small steps taken by the PJV to collaborate with the (PJV-created and funded) Porgera District Women’s Association (PDWA) to communicate directly with women in and around the SML, but notes that these efforts have been inconsistent and under-resourced.¹¹² In fact, the report highlights that an unfortunate effect of the PJV’s work with the PDWA—whose offices are located on the PJV mine site—has been that many women perceive the PDWA as a “PJV Women’s Association,” with some under the impression that it is only for PJV employees, or only for women in the SML, reducing its legitimacy in the community.¹¹³ The report concludes that “consistent social monitoring should be undertaken by PEAK or PJV or independent researchers - or perhaps a combination of the three,”¹¹⁴ and notes the need for direct communication with women on the impact of the riverine tailings disposal method,¹¹⁵ the dangers of mixing chemicals in gold production,¹¹⁶ the reduction of royalty payments and plans for mine closure,¹¹⁷ and the logistics of the relocation program.¹¹⁸ The Research Team has been unable to find any public response by the mine to these recommendations.

4. PARTICIPATION

Residents of Porgera report not having adequate opportunities to participate in decision-making about water issues in Porgera. A mine Community Affairs Office and other outreach processes exist, but the mine's relations with local residents are poor, and many residents report feeling a lack of power to participate in decisions. Because information provision to communities is so inadequate, individuals' and communities' abilities to participate in environmental decision-making are adversely impacted. The mine's recently introduced Supplementary Water Project includes some positive steps toward community consultation and participation in the installation and testing of Tuffa tanks in certain SML villages. The company should build upon this participation to increase its scope and to ensure participatory structures exist for major decisions affecting water security and the design of mitigation measures in Porgera.

Community perceptions of the mining company are strongly negative: The PJV operates a Community Affairs Office in Porgera, but it is generally negatively perceived by local communities. The office, which is PJV's public face in the community and most residents' only method of communication with the company, is located behind ten feet of fences and razor wire and is patrolled by guards. A woman from Yarik explained the process of registering complaints:

We go up with our village leaders. The community workers come to the gate and ask why we are there. Our community leaders tell them: we have no good water to drink. We complain about our land. They say, they'll go to a meeting, and come back and give us an answer. They go inside their office and never come back. We have been going since the mining started. We gave up going there ourselves. We tell our community leaders and husbands to go. They try to be rough on them. They go in strong. But nothing happens.¹¹⁹

Another woman shared a common disillusionment regarding engaging with the mine: "The company tells us they will look into our problem but then they lock gates and chase our men out, so we don't talk to them at the mine anymore."¹²⁰

Barrick Gold notes the existence of some outreach programs for community participation,¹²¹ but these initiatives have proven insufficient to overcome community members' perceptions of both lack of participation and the futility of participation. Overall, Porgerans report a negative relationship between their communities and the mine.¹²² Some report feeling that the company treats them like "animals,"¹²³ and many report feeling powerless to have meaningful engagement and participation in company decisions that impact their environment and water.¹²⁴ One woman stated that "Barrick is a deaf person and a dumb person. He can't speak. When we request something they never give it to us. When he wanted things he came as a good person. Now he closes his ears. When we go for grievance, and we complain, they don't listen to us and they don't respond to us."¹²⁵ This sentiment is not unique, and many Porgerans stated that the mine does not adequately respond to their complaints and appears to them as indifferent to the impact of the mine on their lives.¹²⁶ Some stated that they continued to reach out to the company, only to be persistently turned away. One young man explained, "So many times, I have written a letter requesting for water. But nothing had been done."¹²⁷ Another person explained, "If the company does not listen to us we will still complain because we do not have enough food."¹²⁸

Bureau Veritas, an organization hired by Barrick Gold to provide an assessment of Barrick Gold's Responsibility Reports covering all operations around the world, has highlighted concerns about community participation at the company's mines. In its 2010 recommendations, Bureau Veritas noted: "Site level stakeholder communications could be improved to include more information about material issues, community support, and how Barrick uses stakeholder feedback in the planning, development and operation of mining activities."¹²⁹ The agency further recommended "[i]ncreas[ing] the visibility and value of stakeholder input to the risk assessment process at all levels."¹³⁰ Similar concerns were echoed in the 2015 review, which noted a need for "additional communication with stakeholders regarding mine expansion plans, life-of-mine, and eventual mine closure plans."¹³¹ The agency emphasized that Barrick Gold should "[c]ontinue to seek and consider local stakeholder input on community development and education projects, especially at mature mines to align more closely with community member expectations for post-closure sustainable development."¹³²

New water project participation a step forward, and should be continued and extended: Mine initiatives since 2013 to conduct annual water sampling and analysis of drinking water sources in four villages, and to install Tuffa tanks in most SML villages, have provided important opportunities for certain community members to participate in decision-making regarding water quality and security. The mine should build on these efforts, ensuring that as many community members as possible are meaningfully consulted, and extend these efforts to all villages near the mine.

Village-level water sampling and analysis starting in 2013 represents a positive step in community participation and information provision, and should be expanded in scope and coverage. According to information in the 2013-2015 Annual Environmental Reports, and according to information provided to our Research Team by BNL, the mine has introduced a program of "participatory sampling" of local village water supplies, conducted in consultation with representatives of the PLOA or representatives of "Village Water Committees."¹³³ Due to community advocacy through the OECD in 2012, the company was forced to conduct village-level testing.¹³⁴ The company notes that sampling locations in four villages were set "at sites nominated by the community during discussions about drinking water supplies that formed part of the Canadian Government OECD NCP process in 2012," with additional sites added as Tuffa tanks were installed in villages through the mine's Supplementary Water Project.¹³⁵ As an additional positive step for community participation, during the initial study conducted in 2013, the PJV consulted the PLOA in two meetings, and requested that a PLOA representative be present during the sample collection for purposes of transparency, along with the village representatives who had selected the sample sites.¹³⁶ BNL has stated that the results of such testing are then provided and explained to the community representatives,¹³⁷ although the company provided no information to suggest that such results are directly shared with the full communities. The company should work to ensure that participatory sampling is as broad and inclusive as possible, including all segments of the population, such as women, who often bear the burden of household water provisioning. Particularly where testing results show contamination in excess of PNG Raw Drinking Water Quality Standards and WHO Guidelines, mine staff should work to ensure broad involvement. According to information provided to the Research Team by BNL, currently in cases of contamination, mine staff work with the "custodian" of the tank from which the sample was taken to ensure treatment and preventative measures.¹³⁸ It is unclear how such information is then shared with the larger community. Further, the company provided our Research Team no information to

suggest that similar outreach is conducted to other community members with similar rainwater collection methods, nor in villages outside the four selected for this study.

Community participation in the Supplementary Water Project (the mine's Tuffa tank installation project), represents another positive step, and should be expanded to more members of the community in order to lead to greater community roles in high-level decision-making regarding water security measures. According to the 2013 and 2014 Annual Environmental Reports and information BNL provided to the Research Team, the mine piloted a rainwater supply project at Panadaka Village in 2013, meant "to improve the availability and reliability of safe drinking water for local communities."¹³⁹ According to both Annual Environmental Reports, the project "received strong community support."¹⁴⁰ Building upon this pilot program, the mine has now implemented the Supplementary Water Project in the SML, seeking to: "increase community access to potable water" through community collaboration in installing and maintaining additional water tanks in SML villages; "promote engagement, participative decision-making and governance amongst community groups in terms of access to potable water;" and "improve general hygiene in the community."¹⁴¹ BNL reports that tank installations have been completed for Panadaka, Alipis, Apalaka, Timorope, Pakien, and Mugalep villages, with additional work planned for Upper Yarik Village.¹⁴² BNL reports that new tank sites were selected in consultation with village leaders, and the maintenance of the tank turned over to "pre-established Village Water Committees (VWC) consisting mainly of village leaders and Councillors."¹⁴³ According to BNL, "[l]ocal participation was considered essential to the project, both in terms of planning and development, and in the construction and maintenance of water infrastructure," with the intention that the program additionally "help develop skill sets within the community and provide avenues for future employment."¹⁴⁴ All labor and trade work for the tank construction was to be sourced from within each village to ensure "local ownership," training was provided to allow community members to undertake work related to installation, and before work commenced, a memorandum of agreement would be explained in both Tok Pisin and Ipili.¹⁴⁵ These measures increase participation of some community members in certain village-level water decisions. However, based on the information provided by BNL, it is unclear how residents were consulted in the design phase of the project itself (in which the decision to install Tuffa tanks was reached in the first place). Further, the information provided by BNL does not explain whether or how the company sought to include the participation of all segments of the population, and significant perspectives may have been overlooked, such as those of women.

Porgerans report little assistance from the PNG government in addressing concerns about mine impact: Some Porgerans report seeking assistance from the government, but community members report a lack of positive outcome. A man from Yarik stated, "When we see that we are like a lion in a cage, we ask the company: please come and see us. We are dying. We gave you our precious land with gold. Can you relocate us? But no feedback from Barrick. We cried and plead and protested to the government. But the government has no ears. They haven't helped us."¹⁴⁶

Under the Memorandum of Agreement between the national government of PNG and the PLOA, the national government agreed to "ensure that the Department of Environment [DEC, now known as the CEPA] provides competent experts to respond promptly to landowner concerns regarding environmental issues."¹⁴⁷ However, while Porgeran residents have raised concerns of environmental pollution in the past, the CEPA has not taken adequate action in response.¹⁴⁸ The mine has also noted the CEPA's lack of engagement in Porgera. Charlie Ross, the PJV's

environmental manager, informed the Constitutional Law Reform Commission (CLRC) that there had been little involvement of government environmental monitors in Porgera since 2012 and expressed disappointment that the Mineral Resource Authority had not coordinated any meetings between the PJV and the DEC in that time. The mine also informed the CLRC that, although the Provincial Mine Advisor conducted checks at the mine, there was no longer a DEC representative in the Porgera/Paiam Township.¹⁴⁹

During the CLRC consultations in Porgera, conducted as part of its research for its important report on tailings disposal, Porgeran stakeholders informed the CLRC of the need for government assistance in facilitating community participation, including through an “independent office” to represent and advise landowners in negotiations with the government and the mine. Porgeran stakeholders also expressed that “District and LLG [“Local-Level”] Governments should have a role in discussions relating to the mine tailings waste and their impacts,” and that the CEPA “must be more active with community complaints and have its complaint process made public and easily accessible by impacted communities.”

Drawing upon the concerns expressed by Porgeran stakeholders, the CLRC recommended that the National Executive Council create “a separate body, independent of the State regulatory bodies,...to advise, assist and represent the land owners and impacted communities in negotiating Memorandum of Agreements and any Business Engagement Plan between the land owners, the developer and the State, as well as in holding the developer, the State and regulatory authorities to account.”¹⁵⁰ At the time of publication, the Research Team was unable to find any public information about whether such a step had been taken.

CHAPTER V:

Legal Analysis of the Realization of the Right to Water in Porgera

Porgerans living in and around the Porgera Joint Venture gold mine do not have consistent access to sufficient, acceptable, and safe water for personal and household purposes. They also do not have sufficient access to necessary, specific, and understandable information about water quality and any risks to health. The Papua New Guinea government has not met its obligations to respect, protect, and fulfill the right to water; including its core obligation to ensure the satisfaction of minimum essential levels of the right to water in Porgera. Barrick Gold, Zijin Mining, and Barrick (Niugini) Limited have not fulfilled their responsibilities to respect the right to water. Additionally, the companies could do more, beyond their responsibilities to respect rights, to support the advancement of Porgerans' rights to water. These circumstances also raise concerns for the interrelated human rights to sanitation, health, food, and adequate housing.

1. MANY RESIDENTS LIVING NEAR THE PORGERA MINE DO NOT HAVE ACCESS TO SUFFICIENT ACCEPTABLE AND SAFE WATER, AND DO NOT HAVE ACCESS TO ADEQUATE INFORMATION ABOUT THEIR WATER RESOURCES.

Water resources in Porgera do not consistently satisfy the availability, accessibility, acceptability, and quality elements of the right to water, particularly during dry periods. Necessary information about water quality, wider environmental impacts, and any human health risks is lacking or not adequately reaching communities, undermining Porgerans' abilities to understand and mitigate risks and participate meaningfully in decisions about water.

Accessibility and Availability. Rainwater is a primary source of water for basic consumption and hygiene in Porgera but current quantities collected do not consistently meet the minimum accessibility and availability requirements of the right to water. The primary limits on rainwater collection are tank number and capacity, rudimentary harvesting methods, and fluctuations in rainfall, all operating to undermine the ability of residents to continuously access the minimum amounts necessary to meet most basic consumption, hygiene, and household needs. While many of the relocation houses originally provided to landowners by the mine had large metal tanks that collected rainwater runoff from the metal roofs of the houses, the vast majority of these tanks have long-since corroded and become unusable, and many residents report lacking the resources to replace or repair them.¹ Rainwater is instead commonly harvested using 200-liter blue barrels. These are placed in the open or are used to collect water running off from household roofs, and many residents report that they are simply not large enough to supply sufficient and continuous water for all members of their household, even during periods of rainfall. This forces many families to ration rainwater or use it exclusively for drinking. Residents report severe shortages during periods of low rainfall. Since 2013, an increasing number of villages have benefited from the communal use of larger "Tuffa" tanks, installed by the mine, which have more sophisticated harvesting methods that can help alleviate the limits of rainwater harvesting at the household level. However, available information indicates that such tanks have not yet been installed in all villages,

are not within the immediate vicinity of all households, and can be insufficient to meet the demands required of supplying multiple households with all their water needs. They are thus presently inadequate to guarantee basic water needs for all village residents, particularly during dry periods.

Because rainwater can be insufficient to supply residents in Porgera with enough water to meet their needs, most households need to supplement their rainwater collection with water collected from other sources. Yet sources of water of acceptable quality to supplement the lack of rainwater are too often “inaccessible” under the legal standard of the right to water due to distance, cost, or security risks. Long-term residents state that some streams and creeks they traditionally relied upon for drinking water have dried up, disappeared, or been covered up as a consequence of mine operations and waste disposal. Many of the creeks or bush water to which individuals now turn are located beyond the one-kilometer/30-minute roundtrip accessibility criterion of the right to water, sometimes even requiring multiple hours of travel, and sometimes under strenuous hiking conditions. These factors combine to undermine both the amount of water that can be collected for daily use, and the time individuals can devote to other activities of daily subsistence. The difficulties in accessibility disproportionately impact older persons, persons with disabilities, women, and children. Further, accessing certain water sources can pose unacceptable risks to physical security, because residents, as part of their journey, may need to cross fast-moving rivers, waste dumps, or trespass on another clan’s land where they become vulnerable to physical or sexual violence. Certain sources of adequate and potable water, such as Waile Creek Dam or Wangima spring can be *economically* inaccessible as well for some residents, requiring prohibitively expensive hiring of private vehicles or public transport, or paying access fees when the sources are located on another clan’s land. Bottled water is similarly too expensive for most residents to serve as a replacement.

Acceptability. Residents have concerns about the acceptability of their rain, creek, and river water. Many residents live with a daily concern that their rainwater is contaminated by mine emissions. The Research Team’s water testing analysis found no evidence of unacceptable levels of heavy metals in rainwater. Yet residents’ reasonable concerns impact their experience of water security and acceptability and affects behavior, and the government and the mine have not addressed these concerns through adequate information and outreach.

Beyond concerns regarding rainwater, many residents find the water nearest their households to be of unacceptable quality. Only the communities of Aumbi and Kulapi have access to Waile Creek Dam water piped in near their communities, and only through the mine’s pressure relief valves, rather than through infrastructure designed to meet village needs. Members of communities without access to this piped-in water often cannot easily turn to nearby rivers or creeks because of concerns about the odor, appearance, and taste of these sources. Some households can readily access spring water considered acceptable, but others must spend hours seeking out water sources. Many residents use water sources they consider dirty, contaminated, and unacceptable for household purposes like washing and bathing because they have no alternative.

Quality. There are serious concerns about the quality of water sources relied upon by the residents of Porgera. In particular, the disposal or drainage of mine tailings and waste in creeks and the major rivers of Porgera has led to the presence of heavy metals in levels exceeding WHO Drinking-water Guidelines in the Kaiya/Anjolek and Kakai Rivers, the Yakatabari and Yunarilama

Creeks, and the “Red River” of tailings waste. The mine additionally reports concerning concentrations of heavy metals in Taro, Yoloyope, and Yawana Creeks. While most residents of Porgera report only using the main rivers and certain of these creeks for bathing or washing clothes, some residents reported drinking such water during times of prolonged drought, raising serious concerns about negative health impacts implicating both the right to water and the right to health. In addition, some residents spend full days sitting in the creeks, rivers, and tailings waste while panning for gold, including with open wounds; women use river water to wash during menstruation; and children swim and play in these sources. These uses present serious concerns requiring further efforts to mitigate risks, regularly sharing health information with residents, and studying any human health effects, including to determine if contaminants could be accumulating in the bodies of people who interact regularly with the tailings waste. While rainwater and water in certain other creeks did not similarly contain evidence of mine-related contamination in excess of the WHO Drinking-water Guidelines, the Research Team observed signs of biological growth in the blue barrels, which may present other health concerns undermining the rights to water and sanitation, health, and housing. Relatedly, the mine’s documentation of bacterial contamination on Tuffa tank taps raises concerns about the quality of water accessed from these sources, especially during periods of low rainfall.

Access to Information and Participation. Despite the serious concerns regarding human health raised by certain water sources, there is a lack of reliable information about water quality and human health affects in Porgera that undermines the ability of residents to avoid and mitigate risks. Individuals use contaminated water without appropriate precautions, and discount relatively safe sources of water out of perceptions of unacceptable quality. This problem is particularly concerning for children and women and girls of reproductive age in light of their particular vulnerability to long-term health impacts. The PNG government and the mining companies have not adequately studied and publicly reported on water uses in Porgera and the health impacts of the mine. Available reports of water quality are often inaccessible to those without internet access, and even when such information is made accessible, it is not sufficiently functional so as to enable residents to assess risks to human health and the environment. There is inadequate face-to-face communication with impacted communities regarding water quality, tailored to the needs of uniquely impacted groups. The mine’s recently introduced Supplementary Water Project involves some positive steps toward community consultation and participation in the installation and testing of Tuffa tanks in certain SML villages, but more could be done to share information on the variety of water sources with which residents interact, and to ensure that all residents are included in key decisions impacting their right to water.

2. THE PAPUA NEW GUINEA GOVERNMENT HAS NOT MET ITS OBLIGATIONS TO RESPECT, PROTECT, AND FULFILL THE RIGHT TO WATER.

While the PNG government acknowledges the basic human right to water and has made important commitments toward improving access to water in recent national policies and strategies, it has not met its core obligation to ensure the satisfaction of minimum essential levels of the right to water in Porgera. By licensing the Porgera gold mine without sufficient protections and mitigation measures in place—despite the predicted impacts on water—the government failed to meet its obligation to respect the right to water. Its failure to enact a legal and regulatory regime to monitor, prevent, and mitigate the mine’s adverse impacts on water, as well as its failure to ensure that communities have

access to information about water, constitutes a failure to protect the right to water. In addition, by failing to provide a system to ensure consistent access to sufficient, acceptable, good quality water to meet basic personal and household needs, the PNG government is failing to meet its obligation to fulfill the right to water.

Positive commitments made to human rights and sustainable development. The PNG government acknowledges its obligation to ensure equitable access to safe, convenient, and sustainable water for all. It has made important commitments toward improving access to water in its new Water, Sanitation and Hygiene (WaSH) Policy, such as establishing an improved service delivery and monitoring framework. The government has also pledged a “renewed emphasis on sustainable and responsible development” and on the value of the country’s natural environment and large biodiversity, including its “clean and abundant water” in its 2014 National Strategy of Responsible Sustainable Development (StaRS),² marking a policy shift in its long-term planning toward achieving its goals of promoting economic growth, responsible stewardship of the environment, and social well-being. However, the PNG government does not currently meet its national water and sanitation targets, particularly in rural areas such as Porgera, and has acknowledged that “historically, WaSH has not had the attention from government that is required to help ensure targets are met.”³ According to its own WaSH Policy, access to improved water sources and safe sanitation has been declining in recent years, and this is reflected in the health of the nation: PNG currently ranks at the bottom of Pacific countries for all WaSH related health statistics.⁴

Failure to respect the right to water. The PNG government failed to meet its obligation to respect the right to water by approving the plans for the Porgera gold mine despite the mine’s foreseeable impact on the availability and quality of water resources, as outlined in the mine’s initial environmental impact assessment. The proposed geographic footprint of the mine anticipated the physical covering of numerous traditional water sources used by the surrounding communities, and the riverine tailings disposal method adopted by the project necessarily implicated the contamination of rivers used by local populations. It was additionally foreseeable that the project would cause a population influx and a decrease in available land for housing, sanitation, and subsistence agriculture, exacerbating existing tensions related to scarce resources. In these circumstances, the government should have foreseen that, in the absence of adequate regulation of the mine’s interaction with existing water sources, or the relocation of communities a safe distance away from the project with adequate water resources, the right to water and related rights of the people that lived around the mine site was threatened by the project. The government’s actions, in approving the mine and granting a Special Mining Lease with inadequate safeguards to protect human rights and the environment, did not accord enough respect to communities’ enjoyment of the right to water and interrelated rights.

Failure to protect the right to water from business impacts. The PNG government has acknowledged that the destruction of river systems by tailings from mining operations is a “major black mark” against the country’s environmental record.⁵ However, while the government recognizes the harm caused by mine generated river and water pollution in PNG, its ongoing failure to enact and implement a regulatory framework that sufficiently monitors and protects water resources from contamination and exploitation by private actors in Porgera represents a failure to meet its obligation to protect the right to water. The current regulatory and permitting regime for the PJV allows the mine to discharge tailings waste directly into the river system, and only requires compliance with water quality standards 165km downstream of the mine, effectively converting

water sources relied upon by thousands of people into a “mixing zone” of contaminants. Runoff from the solid waste dumps and open pit, and discharge from the underground mines, may also be contributing to the contamination of the major rivers in the area. The Research Team’s analysis revealed the presence of heavy metals in these rivers exceeding WHO Drinking-water Quality Guidelines, and such contamination presents a potential risk to human health, particularly during times of drought, that requires urgent and regular assessment. The government’s current lack of adequate monitoring and regulation of the PJV’s contamination of water sources, coupled with the government’s failure to provide affected communities with the information necessary to understand and mitigate risk of harm, amounts to a failure to adequately protect the right to water, and also risks undermining the right to health.

Failure to fulfill the right to water. The PNG government has not met its core obligation to ensure the satisfaction of, at the very least, minimum essential levels of the right to water in Porgera including: ensuring non-discrimination, monitoring the right to water, ensuring access to “the minimum essential amount of water, that is sufficient and safe for personal and domestic uses to prevent disease,” and ensuring that people’s personal security is not threatened when they access water.⁶ The PNG government’s failure to establish any system to ensure consistent access to minimum essential amounts of water for residents in and around the mine, particularly in dry periods, is an ongoing violation of its obligation to fulfill the right to water. Based on interviews and the Research Team’s observations, it appears that neither the national nor the provincial government has taken measures to establish adequate infrastructure to provide potable water to residents in Porgera, despite residents’ inability to meet the right to water themselves. The government has not built a rainwater harvesting system, or pipes extracting water from streams or springs in the area. The government has built no communal facilities, such as secure tanks or taps, which could enable communities to realize the right to water. The Research Team could find no evidence that the government delivered bottled water or filled household containers during emergency dry periods in Porgera. The PNG government conducts limited testing to verify the PJV mine’s compliance with its environmental permit, but does not conduct broader water, environmental, and health studies in the villages near the PJV mine or inform the residents about the quality of water from various sources in the area or how to access or treat water to minimize health risks. The situation in Porgera is a manifestation of national policies and budgetary priorities that have, to date, failed to adequately address needs for water, sanitation, and hygiene in rural areas. Under such circumstances, and particularly as minimum essential water levels are not ensured in Porgera, the PNG government is *prima facie* violating its obligation to fulfill the right to water of Porgeran residents, and has the affirmative burden of demonstrating why it cannot meet its obligations. While the government’s own WaSH policy cites insufficient funding as a reason for the lack of any real progress in improving access to water and sanitation, it also acknowledges the inadequacy of government budgeting toward water services in general. Addressing the obligation to fulfill will require both immediate actions in accordance with its core obligations, and longer-term planning for the progressive realization of the right to water in Porgera and nationally. The PNG government’s new WaSH Policy is an important step toward the long-term goal of meeting the human right to water in rural areas throughout the country, and the government must ensure that the policy is fully implemented across all levels, particularly in Porgera and other rural areas, and work with international donors to ensure that its initiatives are fully funded.

3. BARRICK GOLD, ZIJIN MINING, AND BARRICK (NIUGINI) LIMITED ARE IN BREACH OF THEIR RESPONSIBILITIES TO RESPECT THE RIGHT TO WATER, AND COULD DO SUBSTANTIALLY MORE TO SUPPORT THE ADVANCEMENT OF PORGERANS' RIGHT TO WATER.

The companies have failed to create and implement an operational-level human right to water policy for their Porgera mine. The mine's activities have contributed to adverse impacts on water availability, acceptability, and quality, and the companies have not taken sufficient steps to mitigate these impacts. The companies have also failed to implement adequate ongoing human rights due diligence by not implementing an effective program to assess water uses and human health risks. The companies are failing to keep local communities adequately informed of water quality risks and available mitigation measures. Finally, beyond their corporate responsibilities to respect rights, the companies could do more to support the advancement of the right to water in Porgera.

Lack of operational-level human right to water policy. While Barrick Gold has expressed a broad policy commitment to human rights, Zijin Mining does not have an official human rights policy, and none of the companies has established an operational-level human right to water policy for the Porgera mine.

Infringement on access to acceptable and safe water sources and insufficient steps to mitigate adverse impacts. The mine's operations contribute to adverse impacts on the availability, accessibility, and quality of water resources, and while the companies have taken certain steps to mitigate those impacts, these steps are insufficient. Available evidence suggests that the mine's operations and waste dump areas, as predicted in its initial environmental impact assessment, have resulted in some local creeks and springs being covered up or reduced. This can contribute to difficulties for some residents in accessing adequate amounts of water for drinking and general household purposes. In addition, the mine's discharge of tailings and other waste water contaminates major rivers and creeks upon which residents are frequently forced to rely, despite finding such sources unacceptable for household use. The mine has distributed repurposed blue plastic barrels to households, but they are too small and insufficient in quantity to collect adequate amounts of rainwater. In addition, their introduction, without proper covers and filtration or instructions, has created a rainwater collection infrastructure that results in water that is visibly dirty and susceptible to issues of biological growth, insects, or other types of contaminants which may present health concerns. The more recent introduction of "Tuffa" tanks in some of the villages has been important, but is also insufficient, because information available to the Research Team indicates that tanks have not been installed in all villages, and tanks are not within the immediate vicinity of all households, and can be insufficient to meet the demands required of supplying multiple households. While the mine reports that it has in the past provided emergency water supplies in response to requests, many residents report that their households have not received water supplies during recent dry periods, despite acute need.

Failure to implement adequate ongoing human rights due diligence to identify, assess, and track actual and potential water concerns and related impacts. The mining companies are failing to adequately meet their responsibilities to engage in ongoing human rights due diligence. They do not adequately study the mine's impact on the availability of water resources, nor how Porgeran residents perceive and use each water source—steps that are necessary to ascertain the extent of any

risks to human health and also to identify water accessibility impacts. The companies have not carried out and made publicly available sufficient public health studies to assess human health risks and impacts, particularly as related to the mine's tailings waste, which, as the company highlighted in 2015, poses a risk to people who come into contact with it. The mine discharges contaminants into water sources relied upon by communities. Of particular concern, the Research Team's water testing indicates concentrations of heavy metals, including arsenic, cadmium, lead, nickel, and zinc, in excess of WHO Drinking-water Quality Guidelines in the major rivers downstream of the mine facility—concentrations that are directly linked with mine activity and waste discharge. As these major rivers are used by local communities—often for general household purposes, and occasionally for drinking—particularly during dry periods, the companies need to carefully assess risks to human health. While the mine has a program of ongoing monitoring of water quality to ensure compliance with applicable permits granted by the PNG government, it does not similarly monitor community use of the affected water sources or the actual or potential health consequences of such use. There is also no evidence that the companies have specifically assessed risks faced by particular groups that may be uniquely impacted, such as older persons, or persons with disabilities.

Failure to adequately publicly account for any impacts and to communicate water information to communities in Porgera. Tied to the failure to adequately monitor community use of water sources and public health is the companies' need to do more to ensure that Porgeran communities have sufficient access to information and participate fully in decisions regarding water security. While the mine has stated that it recognizes its responsibility to communicate water management issues to local communities,⁷ the information it does collect often does not reach or is not understood by local communities. Generally, the mine's public environmental reporting does not clearly indicate for communities which sources of water to avoid in light of unsafe levels of chemicals or heavy metals, which sources are safe to use, or what measures should be taken when accessing certain water sources to reduce any residual risk. Nor does the mine provide specific guidance to communities regarding the unique vulnerabilities faced by children and women and girls of reproductive age when accessing various water sources. The companies also fail to make information accessible: water testing results and mitigation information is not adequately conveyed to the village and household level through regular in-person outreach, and the companies do not install signs at water sources informing residents of any risks or safety levels. This lack of information contributes to misinformation regarding the acceptability of different water sources, with negative implications for accessibility and safe water use. The lack of information also undermines residents' abilities to meaningfully participate in decision-making about water issues in Porgera. The mine's Supplementary Water Project includes some positive steps toward community consultation and participation, and the mine should build upon such measures to increase the scope and breadth of residents' participation in major decisions affecting water security.

More could be done to support the advancement of Porgerans' rights to water. Barrick Gold, Zijin Mining, and BNL could feasibly take additional steps to support Porgerans' rights to water, beyond the business responsibility to "respect" the right to water. Periods of low rainfall contribute to water scarcity for Porgeran residents, and the companies could support fulfillment of the right to water by working with the local, provincial, and national governments and Porgeran landowners and residents to deliver or otherwise provide water during such periods. The companies could also improve how they provide information to Porgerans about safe water storage, regular container

cleaning, and the installation of improved rainwater collection infrastructure. In addition, the water the mine uses from Waile Creek Dam could be more carefully shared with residents through installing pipes at the village level, with multiple points of access to taps.

CONCLUSION

Thousands of residents of Porgera live in cramped and overcrowded villages in and around an industrial gold mine, with the deep fear that the mine is poisoning their land, air, water, food, and bodies. The situation is so stark that for most residents, resettlement away from the mine seems the only viable solution. Access to safe water, a chief concern of the residents and a human right, has not been adequately respected, protected, or fulfilled by the principal duty-bearers: the mining companies and the government.

A red river of mine tailings discharge as well as runoff from waste dumps and open pits, has led to widespread pollution of Porgera's rivers. Most residents limit their use of the most heavily contaminated sources to gold panning, bathing, or washing clothes, rather than drinking. Many spend full days in the rivers and mine tailings panning for gold, and are forced to rely more heavily on rivers for household purposes during periods of low rainfall when other water sources can become scarce. There is a lack of information available to communities in Porgera about any impacts of this water use on human health.

Although many Porgerans fear that the mine pollutes their rainwater, our Research Team did not find high concentrations of heavy metals in collected rainwater—the main drinking water source in Porgera. However, poor company and government information-sharing and education has resulted in widespread fear, which at times causes some people to avoid rainwater. Importantly, current rainwater harvesting and storage methods, despite recent improvements supported by the mine, are inadequate to consistently meet household needs. Families in Porgera too often simply do not have enough water for personal and household use, and are at times forced to ration rainwater, limiting its use to drinking and cooking alone. The lack of covers or filters on most water collection buckets also presents water safety concerns. The lack of a consistent safe drinking water source forces residents to seek out alternative sources further away, often requiring long, difficult journeys which undermine the amount of water that can be collected, present concerns for physical security, and can have a disproportionate impact on women, children, older persons, and persons with disabilities.

The government of Papua New Guinea, and the mine over its years of operation, have not done enough to promote access to safe water for residents of the villages surrounding the mine. Nor have they done enough to ensure that residents have critical information regarding the quality of the water sources on which they rely, or any related human health impacts and risks. Porgeran residents depend on water for nearly every facet of their daily lives—drinking, cooking, farming, bathing, and gold panning—and it is incumbent on the principal duty-bearers, namely the PNG government and the mining companies, Barrick Gold Corporation, Zijin Mining Group, and Barrick Niugini Limited (BNL), to take immediate and sustained action to ensure that the grave concerns regarding the right to water are comprehensively addressed.

In order to address the breach of the right to water in Porgera, these actors should work cooperatively and with shared responsibilities to:

- Provide emergency access to safe water to households to meet minimal basic needs during periods of low rainfall and promote consistent access to adequate amounts of water for households in Porgera;
- Progressively improve water infrastructure to guarantee stability in water access and quality through the introduction of more sophisticated water harvesting methods;
- Fund and undertake environmental, social, and health impact assessments of the mine's surrounding villages with the consent and participation of community members including through improved company due diligence and a government-led Independent Environmental and Social Audit of the PJV mine and ensure the provision of information to communities about water quality and risks;
- Establish comprehensive and effective monitoring and reporting processes to track implementation of measures; and
- If core human rights requirements cannot be met, pursue resettlement of the Porgeran communities away from the mine, carried out in just and equitable manner and with strict adherence to international human rights standards.

The government and the companies should also engage in policy reform to advance the right to water. The PNG government should adopt regulatory reforms to prevent or mitigate environmental harms that threaten water resources relied upon by communities, including in particular through its response to the Constitutional Law Reform Commission's Review of Environmental and Mining Laws Relating to the Management and Disposal of Tailings. The PNG government, with the assistance of international donors, should also fully implement its national WaSH Policy (2015-2030), particularly in Porgera, increasing funding for WaSH initiatives, reforming water service delivery systems, and building long-term water security for rural communities in accordance with its obligations to progressively fulfill the right to water. As an urgent matter, Barrick Gold, Zijin Mining, and BNL should make a public pledge to advance the human right to water and interrelated rights, committing to create a Human Right to Water Policy through a multi-stakeholder process involving the meaningful participation of Porgeran communities. The companies should also ensure that Porgerans' right to participate in decisions about water and their environment is advanced, and promote transparency concerning permits, policies, and monitoring related to the mine, water, and environmental issues. The openness of representatives from the mining companies to engage on these issues through multiple conversations during the preparation of this study is a positive and encouraging step.

The PNG government acknowledges that access to safe water is a human right, and that human rights harms have been caused and continue to occur within the current extractives-focused development model. The government's commitment to building a new sustainable development model that promotes responsible stewardship for the environment and promotion of social wellbeing is essential, and, if effectively pursued, can mean a future where the right to water is truly respected, protected, and fulfilled in Porgera and throughout the country. Working with government, and in full consultation with Porgeran community members, the companies should support these efforts as sustainable development partners in PNG and in fulfilment of their responsibilities to respect the right to water.

ANNEX I

Table 1: Chemistry of water sources near the PJV mine. Dissolved concentrations are reported from our measurements made in 2015. SPC represents specific conductance and Total Alk represents total alkalinity as mg/L CaCO₃. All elements are recorded as ppb, except sulfate, chloride, fluoride, and nitrate (ppm).

	SPC	pH	Total Alk	As	Cd	Cr	Cu	Fe	Pb	Ni	Zn	SO ₄	Cl	F	NO ₃
<i>Yunarlama Collected Rainwater</i>	10.90	7.69	71.00	0.16	< 2	0.10	0.77	< 10.0	0.20	< 2.0	41.63	1.14	0.59	0.04	0.46
<i>Kulapi Collected Rainwater</i>	7.00	6.30	25.00	0.23	0.12	0.03	5.28	< 10.0	0.45	< 2.0	181.9	1.64	0.34	0.04	0.98
<i>WHO Guidelines</i>	--	--	--	10	3	50	200	--	10	20	300	--	--	--	50
<i>PNG Raw Water Standards</i>	--	--	--	50	10	--	--	1000	100	--	--	400	--	5	0
<i>PNG Drinking Water Standards</i>	--	0-8.5 (5-9.2)*	200 (600)*	50	10	--	50 (5000)*	100 (0)*	100	--	0 (15000)*	200 (400)*	200 (1000)*	0 (5)*	0

* “Highest desirable concentration” given, with “maximum permissible concentration” in parentheses.

The PNG Drinking Water Standards lists the ‘highest desirable concentration’ for iron (Fe) as 100 ppb, which exceeds their listing of the “maximum permissible concentration” for Fe at 0 ppb. Due to this inconsistency, we will only refer to concentrations that exceed the higher concentration, 100 ppb. The PNG Drinking Water Standards list a maximum permissible concentration of 0 ppm nitrate, which we cannot find support for in the literature; as a result, we use the less conservative standard set by the WHO Guidelines.

Table 2(a): Chemistry of water sources near the PJV mine. Dissolved concentrations are reported from our measurements made in 2015. SPC represents specific conductance and Total Alk represents total alkalinity as mg/L CaCO₃. All elements are recorded as ppb, except sulfate, chloride, fluoride, and nitrate (ppm). Bold numbers indicate values over WHO Guidelines for Drinking-water Quality limits or PNG Drinking Water Standards.

	SPC	pH	Total Alk	As	Cd	Cr	Cu	Fe	Pb	Ni	Zn	SO ₄	Cl	F	NO ₃
<i>Yunarlama Portal</i>	3800	8.1	--	11.5	< 2.0	0.15	< 3.0	< 10.0	< 10.0	< 10.0	10.2	705	627	0.22	28.7
<i>Yakatabari Creek</i>	1310	8.4	205	19.2	1.25	2.25	17.8	3550	39.6	0.90	138	473	14.6	0.89	10.4
<i>Control Site - Aipulunga Creek</i>	247	8.4	116	4.8	< 2.0	11.9	17.6	< 10.0	9.30	15.00	432	3.87	0.95	0.08	0.79
<i>Control Site - Wanbel Creek (2015)</i>	99	7.8	87	0.15	< 2.0	0.47	0.58	100	0.13	< 2.0	24.9	3.67	0.39	0.08	0.90
<i>Control Site - Wanbel Creek (2016)</i>	649	7.2	35	0.3	0.1	0.4	< 3.0	88	1.1	1.5	15.6	4.05	0.39	0.2	0.7
<i>Kulapi Creek **</i>	185	7.7	126	1	0.2	0.5	1.2	210	0.55	1	7.8	1.0	6.6	--	--
<i>Taro Creek **</i>	247	7.0	72	8.4	0.2	0.5	1.9	360	18	1	15	55	5.9	--	--
<i>Yawana Creek **</i>	326	7.0	149	1	0.2	0.5	1.5	420	0.86	1	2.2	29	5.9	--	--
<i>Yoloyope Creek **</i>	221	6.9	88	1	0.2	0.5	1	640	1.2	1	3.6	1.0	10	--	--
WHO GUIDELINES	--	--	--	10	3	50	200	--	10	20	300	--	--	--	50
PNG Raw Water Standards	--	--	--	50	10	--	--	1000	100	--	--	400	--	5	0
PNG Drinking Water Standards	--	0-8.5 (5-9.2)*	200 (600)*	50	10	--	50 (5000)*	100 (0)*	100	--	0 (15000)*	200 (400)*	200 (1000)*	0 (5)*	0

* "Highest desirable concentration" given, with "maximum permissible concentration" in parentheses.

** Measurements from the PEAK Drinking Water Study Update, 2014.

For comparison, the following table presents the total concentrations of the same elements reported by Barrick Gold and PEAK. Both PEAK and Barrick Gold's measured total concentrations for several elements are notably higher than WHO guidelines and PNG standards.

Table 2(b): Total concentrations interpreted from Barrick Gold's 2015 Annual Environmental Report,¹ and from the 2014 PEAK Drinking Water Study Update. Values exceeding WHO Guidelines or PNG Drinking Water Standards are in bold. Concentrations are given in µg/L except for SO₄ which is mg/L.

	As	Cd	Cr	Cu	Fe	Pb	Ni	Zn	SO ₄
<i>Yunarilama</i> **	1165	59	920	865	92.3 x 10 ⁵	2850	790	10500	515
<i>Yakatabari</i> **	415	28	195	335	1.6 x 10 ⁵	2000	170	5460	393
<i>Kulapi</i>	1	0.2	0.6	1	300	0.65	1	1.3	--
<i>Taro</i>	190	25	130	220	1.2 x 10 ⁵	3900	110	3600	--
<i>Yawana</i>	3.5	0.2	16	16	1.3 x 10 ⁴	15	10	33	--
<i>Yololope</i>	5.6	0.3	12	7.9	2 x 10 ⁴	23	9.1	67	--
WHO GUIDELINES	10	3	50	200	--	10	20	300	--
PNG Raw Water Standards	50	10	--	--	1000	100	--	--	400
PNG Drinking Water Standards	50	10	--	50 (5000) *	100 (0) *	100	--	0 (15000) *	200 (400) *

* "Highest desirable concentration" given, with "maximum permissible concentration" in parentheses.

** Measurements from the PJV's 2015 Annual Environmental Report.

Table 3: Chemistry of water sources near the PJV mine. Dissolved concentrations are reported from our measurements made in 2015, or, where noted, from the mine's data. SPC represents specific conductance and Total Alk represents total alkalinity as mg/L CaCO₃. All elements are recorded as ppb, except sulfate, chloride, fluoride, and nitrate (ppm). Bold numbers indicate values over WHO drinking-water quality limits or the PNG Drinking Water Standards.

	SPC	pH	Total Alk	As	Cd	Cr	Cu	Fe	Pb	Ni	Zn	SO ₄	Cl	F	NO ₃
<i>Anawe Spring (2015)</i>	2785	7.9	155	0.4	0.25	0.15	< 3	73.7	0.15	<10	46.3	1293	26	0.9	25.7
<i>Wangima (2016)</i>	139	6.3	44	--	< 2	< 2	< 3	< 1	< 10	<10	5.8	11	2.4	0.2	3.0
<i>Yawena (2016)</i>	649	7.2	220	--	< 2	< 2	< 3	12.4	< 10	<10	8.1	55	1.0	0.2	9.0
<i>Kendo Spring**</i>	580	6.9	23	1	0.2	0.5	1	5	0.5	1	2.3	19	23	--	--
<i>Wendako Spring***</i>	360	7.3	216	0.1	0.1	--	0.5	--	0.1	0.5	5.7	5.0	3.4	--	--
<i>WHO Guidelines</i>	--	--	--	10	3	50	200	--	10	20	300	--	--	--	50
<i>PNG Raw Water Standards</i>	--	--	--	50	10	--	--	1000	100	--	--	400	--	5	0
<i>PNG Drinking-water Standards</i>	--	0-8.5 (5-9.2)*	200 (600)*	50	10	--	50 (5000)*	100 (0)*	100	--	0 (15000)*	200 (400)*	200 (1000)*	0 (5)*	0

* "Highest desirable concentration" given, with "maximum permissible concentration" in parentheses.

** Concentrations reported in Barrick Gold's 2014 Annual Environmental Report.

*** Concentrations reported in the PJV's 2015 Annual Environmental Report.

Table 4(a): Chemistry of water sources near the PJV mine. Concentrations are reported from our measurements made in 2015. SPC represents specific conductance and Total Alk represents total alkalinity as mg/L CaCO₃. All elements are recorded as ppb, except sulfate, chloride, fluoride, and nitrate (ppm). Bold numbers indicate values over WHO drinking water quality limits.

Site ID	SPC	pH	Total Alk	As	Cd	Cr	Cu	Fe	Pb	Ni	Zn	SO ₄	Cl	F	NO ₃
<i>Kakai River - Pre Rain</i>	554	8.4	135.00	2.20	1.60	3.80	12.35	6570	81.3	1.90	336	22.5	7.68	0.84	9.65
<i>Kakai River - Post-Rain</i>	561	8.4	250.00	11.10	2.75	6.45	8.15	8270	172	5.35	1000	22.4	8.14	0.85	11.6
<i>Anjolek River</i>	406	8.4	--	5.70	8.95	32.50	38.35	114740	318	52.3	1010	105	10.8	0.88	9.49
<i>Tailings Waste Upstream of Pongema Confluence</i>	4900	7.0	--	32.00	55.20	10.00	146.00	20090	27.6	521	4560	3700	20.7	1.14	9.30
<i>Pongema downstream of Tailings Confluence</i>	568	8.0	95	0.9	2.9	0.2	2.6	<10	0.1	4.3	73.8	433	22	6.9	16.4
<i>WHO Guidelines</i>	--	--	--	10	3	50	200	--	10	20	300	--	--	--	50
<i>PNG Raw Water Standards</i>	--	--	--	50	10	--	--	1000	100	--	--	400	--	5	0
<i>PNG Drinking-water Standards</i>	--	0-8.5 (5-9.2)*	200 (600)*	50	10	--	50 (5000)*	100 (0)*	100		0 (15000)*	200 (400)*	200 (1000)*	0 (5)*	0

* "Highest desirable concentration" given, with "maximum permissible concentration" in parentheses.

For comparison, the following table presents the total concentrations of the same elements reported by Barrick Gold. For some testing sites, Barrick Gold's 2015 Annual Environmental Report provides box plots rather than specific values, thus limiting the precision of interpreting their reported measurements. For those measurements which are only presented as box plots, the Research Team estimated the values visually and reports here the lower bound value on the median concentration. Barrick Gold's measured total concentrations for several elements are notably higher than WHO Guidelines and PNG Standards.

Table 4(b): Total concentrations interpreted from Barrick Gold's 2015 Annual Environmental Report,¹ and from partial digestions conducted by the Research Team on a subset of samples². Values exceeding WHO Guidelines for Drinking-water Quality or PNG Drinking Water Standards are in bold. Concentrations are given in µg/L except for SO₄ which is mg/L.

Site ID	As	Cd	Cr	Cu	Fe	Pb	Ni	Zn	SO ₄
<i>Kogai Toe (Kakai)</i>	4.8	3.1	4.6	6.1	4.3 x 10 ³	28	5.8	490	622
<i>Red River¹</i>	>30500	>500	>8000	>10000	>5 x 10 ⁶	>50000	>5000	>110000	NA
<i>Kaiya at Yuyane Bridge¹</i>	>50	>3	>50	>50	>1.5 x 10 ⁵	>300	>100	>500	>50
<i>Kaiya D/S Anjolek</i>	81	3.8	100	75	1.9 x 10 ⁵	370	104	895	59
<i>Kakai pre-rain²</i>	2.20	1.6	3.8	12.4	6573	81.25	1.90	336	22.5
<i>Kakai post-rain²</i>	11.10	2.8	6.5	8.2	8272	172	5.35	1006	22.4
<i>Anjolek²</i>	5.70	9.0	32.5	38.4	1 x 10 ⁵	52.3	318	1010	105
WHO GUIDELINES	10	3	50	200	--	10	20	300	--
<i>PNG Raw Water Standards</i>	50	10	--	--	1000	100	--	--	400
<i>PNG Drinking Water Standards</i>	50	10	--	50 (5000)*	100 (0)*	100	--	0 (15000)*	200 (400)*

¹ These values were estimated visually from Barrick Gold's 2015 Annual Environmental Report box plots.

² Partial digestions on samples collected in 2015. These values may underestimate total concentrations.

ANNEX II

April 2017

Village water supply – water sampling and analysis

Drinking water supplies at a number of locations in and around the four principal SML settlements are sampled and analyzed each year (See also **Attachment 1 – Map of drinking water source sampling sites**, and **Table 1 – Sampling Sites – Participatory Sampling of Local Village Water Supplies**).

The samples are taken in conjunction with community representatives from the Porgera Land Owners Association (“PLOA”) or representatives of Village Water Committees, at sites nominated by the community during discussions about drinking water supplies that formed part of the Canadian Government OECD NCP process in 2012, and at other sites that are part of the PJV Supplementary Water Project (See also below **Supplemental Water Project**).

The samples are sent for analysis by two independent, reputable laboratories:

- Microbiological analyses examining total and faecal coliforms are undertaken by SGS Laboratories in Port Moresby;
- Trace metal tests are undertaken by the Australian Government National Measurement Institute in Sydney, Australia.

PJV’s Environment Department also undertakes physico-chemical analyses of the samples in the mine’s onsite laboratory.

Sampling results and data are provided and explained to the community representatives once the analyses are completed, and mine staff are available to further explain or discuss the results once they are received.

Treatment of non-compliant water supplies

Where sampling results show any non-compliance with the PNG Raw Drinking Water Quality Standard, immediate steps are taken to correct the non-compliance. An example of this occurred in the 2014 sampling study, where two of the sample sites returned data showing total coliform contamination.

The water supplies were investigated, and mine staff worked with the supply custodians to identify and mitigate possible vectors for total coliform contamination, and to explain the treatment and preventative measures, such as ensuring that roof catchments are kept clean from leaf litter and other materials.

Following corrective action, previously non-compliant water supplies are re-tested to ensure compliance with the PNG Raw Drinking Water Quality Standard.

Sites	Name on map	Easting	Northing
Kendo Spring	Kendo Spring	9397744	731458
Apalaka H1 Tank	AP_H1	9397663	731732
Apalaka H2 Tank	AP_H2	9397668	731751
Yarik H1 Tank	YR_H1	9397172	732549
Yarik H2 Tank	YR_H2	9397157	732803
Yarik H3 Tank	YR_H3	9397392	732845
Yarik School Tank	Yarik School	9397325	733329
Panadaka 1 Jack Inji Tank	PA_V1H1	9395455	733689
Panadaka 1 Catholic Church Tank	PA_V1H2	9395447	733689
Panadaka 1 Panda Ekepa Tank	PA_V1H3	9395508	733674
Panadaka 1 Bus David Yandapa Tank	PA_V1H4	9895578	733584
Panadaka 1 John Pokean Tank	PA_V1H5	9395598	733582
Panadaka 1 Bilip Aile Tank	PA_V1H6	9395610	733666
Panadaka 1 Roselyn Pokean Tank	PA_V1H7	9395618	733682
Panadaka 1 Joseph and Rueben Kiala Tank	PA_V1H8	9395580	733706
Panadaka 1 Joseph Kiala Tank	PA_V1H9	9395509	733541
Panadaka 1 United Church Tank	PA_V1H10	9395573	733761
Panadaka 1 Neslon Nai Tank	PA_V1H11	9395447	733606
Panadaka 2 Akena Pawa Tank	PA_V2H1	939577	733837
Panadaka 2 Nickson Yambu Tank	PA_V2H2	9395857	733795
Panadaka 2 Tomson Kuna Tank	PA_V2H3	9395786	733792
Panadaka 2 Timothy Kerene Tank	PA_V2H4	9395743	733784
Wendako Spring	Wendako Spring	9394941	734120
Kulapi V1 H1 drum	KL_V1H1	9394334	733261
Kulapi V2 H 1 tank	KL_V2H1	9394495	733045
Kulapi V4 H1 tank	KL_V4H1	9394700	732772

Table 1 – Sampling Sites – Participatory Sampling of Local Village Water Supplies

Mine Waste Discharge

The mine is permitted to discharge treated mine tailings, treated domestic sewage, rainfall runoff and rainwater drainage from the mine lease areas into the Strickland River system.

No other mining-derived waste is discharged into the river system.

Dewatering

Surface rainfall run-off occurs from the Open Pit complex, as well as from the Underground complex, where surface water has seeped into mining areas. This run-off is free-draining.

Rates of surface water run-off vary according to prevailing weather conditions.

Testing of the mine contact water that drains from these areas is undertaken on a monthly basis to ensure that no mine-derived chemical contaminants, such as hydrocarbons, are entering the natural water systems.

“Blue Barrel” water storage containers

Blue plastic containers were provided to some communities to allow the collection of rainwater as a water resource prior to the development of the later Supplemental Water Project.

The containers originally contained simple hydrochloric acid (HCl + H₂O) used in the mine’s processing plant.

Prior to any further use of these containers beyond their original purpose, they were subject to a rigorous rinsing and testing process, where each container was rinsed three times and pH tested, to ensure that they were safe for use.

Dilute solutions of hydrochloric acid have a range of domestic uses, including cleaning and de-scaling of kettles and other cooking vessels, and as a means of increasing the acidity of swimming pools. Hydrochloric acid is also naturally produced by the human gastric system.

Porgera Environmental Advisory Komiti (PEAK)

The company commissioned an external review of the form and functions of PEAK in 2015, which showed that the organization was becoming less effective in meeting important foundational objectives.

A decision was made in early 2016 to disband PEAK in its then form, and to undertake a process to develop a new body that would meet those objectives more effectively. The closure of the former PEAK website was consequent on the disbanding of the PEAK entity.

The new entity will have formal and transparent terms of reference, and will be tasked with developing an information policy that will govern what assessments are undertaken, what information will be published, and how to increase the reach of published information to all stakeholders, and in particular, the SML communities.

Work to design and develop a new entity is considered a priority for 2017, and community leaders and organizations will be consulted during the design process on their views about how best to meet their information needs.

Once a new entity has been formed to perform these functions, it will make decisions regarding whether and how to publish previous information. Developing a new Internet portal for the provision of information will likely be a priority for the entity.

Requests for emergency water supplies

Requests for emergency water supplies have occasionally been made by individuals within SML communities, typically coinciding with extended dry or drought conditions.

Following assessment of the request, emergency water supplies were typically provided through the use of portable water containers, such as the “blue barrels”, and treated water was ported to the site in question on an “as-needs” basis when necessary.

These requests became very infrequent following the introduction of the Supplemental Water Project, which aims to provide permanent supplemental water sources to SML communities. No such requests have been received since 2015.

Supplemental Water Project

In 2013, in response to community concerns regarding access to potable water in some SML villages, the Porgera Joint Venture (PJV) designed a supplementary water project involving the installation of water tanks in a pilot location – Panandaka village – located on the Porgera SML.

The principal development objectives of the project were as follows:

- Increase community access to potable water
- Promote engagement, participative decision making and governance amongst community groups in terms of access to potable water
- Improve general hygiene in the community

It was also hoped that training provided through the program would help develop skill sets within the community and provide avenues for future employment.

The program focused upon forming and partnering with a Village Water Committee (VWC) to help design, construct and manage rainwater catchment and reticulation systems to help improve community access to potable water. Local participation was considered essential to the project, both in terms of planning and development, and in the construction and maintenance of water infrastructure.

Training was provided to community members and organizations to allow them to undertake contractual work during the installation of the water infrastructure.

The pilot project started in September 2013 and was completed in December 2013. It was considered to be a success by all participants, and mine management agreed to extend the project to all SML communities.

The program has led to the installation of 73 potable water tanks in SML communities to date, and remains ongoing. Attachment 2 provides a map of drinking water tank installation sites relevant to this project.

The following Table provides a summary of tank installations to date across SML villages.

Site	SML village location	Number of tanks	Tank sizes
1	Panandaka village	15	<ul style="list-style-type: none"> ▪ 6 x 9000L tuffa tanks ▪ 6 x 5000L tuffa tanks ▪ 3 x 1000L tuffa tanks
2	Alipis village	4	<ul style="list-style-type: none"> ▪ 4 x 9000L tuffa tanks ▪ Nil x 5000L tuffa tanks ▪ Nil x 1000L tuffa tanks

3	Apalaka village	10	<ul style="list-style-type: none"> ▪ 3 x 9000L tuffa tanks ▪ 7 x 5000L tuffa tanks ▪ Nil x 1000L tuffa tanks
4	Timorope village	14	<ul style="list-style-type: none"> ▪ 5 x 9000L tuffa tanks ▪ 3 x 5000L tuffa tanks ▪ 6 x 1000L tuffa tanks
5	Pakien village	13	<ul style="list-style-type: none"> ▪ 6 x 9000L tuffa tanks ▪ 3 x 5000L tuffa tanks ▪ 4 x 1000L tuffa tanks
6	Mungulep village	17	<ul style="list-style-type: none"> ▪ 5 x 9000L tuffa tanks ▪ 4 x 5000L tuffa tanks ▪ 8 x 1000L tuffa tanks

Table 2 – Drinking Water Tank Installations – SML Villages

The next stage of this project will involve the following installations.

Site	SML village location	Number of tanks	Tank sizes
7	Upper Yarik village	41	<ul style="list-style-type: none"> ▪ 9 x 9000L tuffa tanks ▪ 10 x 5000L tuffa tanks ▪ 22 x 1000L tuffa tanks

Table 3 – Planned 2017 Drinking Water Tank Installations – SML Villages

Procedures for Supplementary Water Tank Project planning and installation

The Supplementary Water Project forms part of the mine’s 3---year Community Development Plan, which outlines target sites for supplementary water supplies, and the procedures that apply to water supply projects.

Under the current Community Development Plan, the following internal procedures are applied to the design and development of a supplementary water supply.

- 1.1. Community Projects (CP) and Community Development (CD) teams conduct site inspection/assessments to assess and confirm tank installation location suitability, accessibility, catchment surface sizes and appropriate tank capacity
- 1.2. CP develops an installation project scope and budget based on the inspection/assessment results.
- 1.3. CD develops a project proposal including results of the scope/cost.
- 1.4. CD management reviews the project proposal and provides an approval to proceed.
- 1.5. Approved proposal is sent to CP to place order from suppliers.
- 1.6. CD & CP work with the community to form a village water committee (VWC) if one does not already exist for that community.
- 1.7. A standard MOA is drafted for PJV EMD and the VWCs to sign that specifies the roles and responsibilities of the project partners.
- 1.8. CP & CD selects local contractor with the condition that contractor is from the locality of the tank installation area and that local laborers are engaged to ensure everyone is given a chance to earn a form of revenue and avoids employment related concerns.

- 1.9. The scope is discussed with contractor.
- 1.10. Contractor is inducted on the job with tools like job hazard analysis (JHA) and relevant safety procedures.
- 1.11. Once materials are on site, contractor plus CP starts moving to site to implement.
- 1.12. Any grievances all managed by the local team in conjunction with the VWC.
- 1.13. CD provides oversight over the project whilst CP supervises the project execution.
- 1.14. After completion, members of the management team are invited to hand over the project.
- 1.15. Project progress and closure reports are prepared and submitted to management by CP.
- 1.16. Environment team and CD conducts periodical water quality tests as part of the monitoring and evaluation process.
- 1.17. All maintenance and repairs of the installations are the responsibility of the tank owners – covered in the MOA.
- 1.18. Through the project cycle, regular updates are provided to the management on progress.

Ongoing participatory sampling and monitoring of the water quality of water collected and stored under this program is undertaken by the mine Environment Department, in conjunction with members of the Village Water Committee (See also above – **Village Water Supply – Sampling and Analysis**).

The following Attachments provide samples of project documents mentioned in the procedures above, using the 2015 Pakien Village Supplementary Water Project as an example.

Attachment 3 – Pakien Village Supplementary Water Supply Project Proposal

Attachment 4 – Pakien Village Supplementary Water Supply Project Memorandum of Understanding

Attachment 5 – Sample Pakien Village Supplementary Water Supply Project Progress Report

Other documents requested

Any reports or documents regarding local use of water sources

Surveys regarding this subject were undertaken during mine planning – copies may still exist in pre-digital archives, and will be forwarded when located.

Any reports or documents regarding the impact on the mine on the availability of water

Surveys regarding this subject were undertaken during mine planning and development – copies may still exist in pre-digital archives, and will be forwarded when located.

Any reports or documents on the actual impact of the mine on human health, or on any risks to human health that the operation of the mine might present

The principal research being undertaken on this subject is the Longitudinal Health Study, which is due to be completed this year. No preliminary draft is available.

When the study commenced, Barrick committed to communicating any preliminary findings that showed a risk to human health to affected communities. No such finding has been made during this study to date.

Current Water Use Permit

Provided

Current Environmental Discharge Permit

Provided

2013---2014 Drinking Water Study (ex OECD NCP recommendations)

Provided

Centre for Environmental Health --- "Longitudinal Health Risk Assessment" 2013

See previous note

CSIRO --- Porgera Gold Mine – Review of Riverine Impacts" 1996

This is a large document, and will be provided via an FTP or DropBox mechanism.

2012---2013 Health Study – exposure to tailings comparative study

This study forms part of the Longitudinal Health Study, which is due to be completed this year. No preliminary draft is available.

When the study commenced, Barrick committed to communicating any preliminary findings that showed a risk to human health to affected communities. No such finding has been made during this study to date.

Annual Environment Reports published or produced by the mine prior to 2009

These documents are not currently available.

Barrick Niugini Limited – Response to Draft CLS Water Study Draft Report

Thank you for the opportunity to provide feedback on Parts A and B of Chapter 4 of your draft Study Report.

We note that due to time and resourcing constraints, we are not able to provide a fully comprehensive response to the Draft Study findings and recommendations, and can only provide a relatively general response at this time.

Consultative Approach

We acknowledge the consultative approach adopted by the Study authors to discuss certain draft findings and recommendations arising from the Study with the company prior to publication, and appreciate the opportunity to participate in the three consultative sessions held between the research team and company representatives in September and October of this year.

We feel that these were useful discussions, and see the dialogue as an important first step towards achieving effective outcomes to the challenges identified during the Study.

We would be willing to continue engaging on these matters following the publication of the final study Report, and in particular to continue discussions about processes that could bring together other stakeholders, such as public sector agencies, to consider the issues and recommendations raised in the Study report

Social and Environmental Context

While we note that the Draft Report does provide significant background information regarding the environmental and social conditions within the Porgera Valley, there is very little information provided to allow a comparison of the Porgera context with other similarly remote areas where reticulated water is not available.

For example, the Study does not provide comparative information on how people living in other similarly remote communities with similar rainfall conditions access, store or use water for personal and household purposes, and whether they experience similar difficulties in accessing water in times of scarcity to those reported by Study respondents.

The inclusion of comparative information would assist in identifying whether these difficulties are unique to the Porgera context, or are more commonly experienced by remote-area communities.

We also note that the Chapter does not detail the average annual rainfall for the region – estimated to be between 400 – 450cm per year – a point that would provide a useful contextual point when considering water availability.

Similarly, we feel that it would be useful for the report to provide further context on the social environment in Porgera, and whether and how changes to the community profile over time have contributed to the challenges identified during the Study.

For example, significant inward migration into the Porgera Valley has occurred over the past two decades, with some estimates indicating that the local population has grown by more than 1000% over the life of the mine to date.

This has placed significant pressure on the availability of natural resources for the use of legitimate Porgera SML Landowners, including on the availability of reliable water supplies, but is a matter that is entirely beyond the ability of the company or Government to control or influence.

Community Consultation on Water Issues and the Supplemental Water Program

We note that Porgera SML Landowners raised the issue of village water supplies during OECD NCP proceedings conducted in 2015 following a Request for Review submitted to the Canadian OECD National Contact Point pursuant to the OECD Guidelines for Multinational Enterprises in 2014.

As noted in the draft Study report, those discussions resulted in an agreed regime of participative water testing of community-selected water sources, intended to provide certainty to local residents that local water sources are safe to use (which, in turn, would have the effect of increasing locally “available” water supply).

We acknowledge that while some individual community members still hold concerns regarding the quality of community water sources, and note that it is extremely challenging to achieve full and uniform understanding of such matters within any community, even where community-determined representatives are active participants in the testing process.

Despite this, we will continue to engage with the community participants in the participative water-testing program to discuss practical steps that testing program participants, including company representatives, can take to help ensure that test results are communicated as widely as possible.

As noted in the Study report, we have previously discussed the mine supplemental water program, undertaken in close consultation with communities, which seeks to provide additional reliable water supplies within SML communities.

We note that the jointly-agreed objectives of that project are to:

- Increase community access to potable water
- Promote engagement, participative decision making and governance amongst community groups in terms of access to potable water
- Improve general hygiene in the community

The program focuses upon forming and partnering with a Village Water Committee (VWC) to help design, construct and manage rainwater catchment and reticulation systems to help improve community access to potable water. Local participation is considered essential to the project, both in terms of planning and development, and in the construction, responsible usage and maintenance of water infrastructure.

While some limited reference is made to the detail of this program in the draft report, we think the Study report may benefit from a more detailed description of this program, including its stated objectives, details of community consultations and participation, and specific detail around the numbers and locations of water tank installations completed under the program. This information was previously provided to the research team in April of 2017.

The extension of this program into other communities on the Special Mining Lease may assist in providing additional water supply, and we will continue to work with relevant communities to determine where the installation of supplemental water supplies may be required.

“Mapping” of Responsibilities

While we note that Study authors acknowledged in recent conversations held between researchers and representatives of the mining company that tackling the challenges identified through the Study was not solely a responsibility of the company, the actual phrasing of the draft report often suggests that the company is the responsible entity.

The company noted this during the recent discussions, and suggested that it would be a useful task for the report to include a “map” outlining the respective responsibilities and obligations of the various stakeholders involved in this issue – whether the mining company, public institutions and officials, or individual community members.

In our view, developing a common understanding of the nature of these responsibilities among all relevant stakeholders would be a critical first step in proposing and developing joint approaches to overcoming many of the issues identified during the study.

>>

ENDNOTES

EXECUTIVE SUMMARY

¹ ZIJIN MINING GRP. CO. LTD, Senior Managers of Porgera Gold Mine Visit Zijinshan Copper Mine (Nov 21, 2015) (on file with authors).

² BARRICK GOLD CORP., ANNUAL REPORT 2007 9 (2008), <http://www.barrick.com/files/annual-report/Barrick-Annual-Report-2007.pdf>.

³ See COLUMBIA L. SCH. HUM. RTS. CLINIC & HARVARD L. SCH. INT'L HUM. RTS. CLINIC, RIGHTING WRONGS? BARRICK GOLD'S REMEDY MECHANISM FOR SEXUAL VIOLENCE IN PAPUA NEW GUINEA: KEY CONCERNS AND LESSONS LEARNED (2015).

⁴ PAPUA N.G. DEP'T OF NAT'L PLAN. & MONITORING, *PNG National Water, Sanitation, and Hygiene WaSH Policy 2015-2030*, http://www.inapng.com/pdf_files/WaSH%20Policy%202015-2030.pdf.

⁵ PAPUA N. G. DEP'T OF NAT'L PLAN. & MONITORING, *National Strategy of Responsible Sustainable Development for Papua New Guinea (StaRS)* (2nd ed. 2014), <http://www.planning.gov.pg/images/dnpm/pdf/StaRS.pdf>.

⁶ PAPUA N. G. DEP'T OF NAT'L PLAN. & MONITORING, *PNG National Water, Sanitation and Hygiene (WaSH) Policy 2015-2030* 3 (2015) http://www.inapng.com/pdf_files/WaSH%20Policy%202015-2030.pdf

⁷ BARRICK GOLD CORP., HUMAN RIGHTS COMPLIANCE PROGRAM 3 (undated).

⁸ BARRICK GOLD CORP, HUMAN RIGHTS REPORT 2017, <https://barrick.q4cdn.com/788666289/files/responsibility/Barrick-Human-Rights-Report.pdf> at 17.

⁹ *Social Responsibility*, ZIJIN MINING GRP. CO. LTD, <http://www.zijinmining.com/sustainability/Social-Responsibility.jsp> (last visited November 19, 2018).

¹⁰ BARRICK GOLD CORP., RESPONSIBILITY REPORT 2013: RESPONSIBLE MINING 35 (2013); ZIJIN MINING, *Social Responsibility*, <http://www.zijinmining.com/sustainability/Social-Responsibility.jsp>; ZIJIN MINING, *Our Approach*, <http://www.zijinmining.com/sustainability/Our-Approach.htm>.

¹¹ BARRICK GOLD CORP, HUMAN RIGHTS REPORT 2017, <https://barrick.q4cdn.com/788666289/files/responsibility/Barrick-Human-Rights-Report.pdf> at 40-42.

¹² PORGERA JOINT VENTURE, ANNUAL ENVIRONMENTAL REPORT 2015 at viii (June 2016) (noting that “[r]isk is posed to people exposed through dermal contact with undiluted tailings as a result of low pH and elevated concentrations of dissolved cadmium, iron, nickel and zinc”).

¹³ G.A. Res. 64/292, The Human Right to Water and Sanitation, ¶1 (July 28, 2010). See also Part III: Legal Framework, *infra*.

¹⁴ The PNG government designed and launched its National Strategy of Responsible Sustainable Development in 2014 as part of its Development Strategic Plan 2010-2030 in recognition of the need to “lead the way back to a new paradigm” of sustainable development and economic growth that is socially and environmentally responsible. *National Strategy of Responsible Sustainable Development for Papua New Guinea*, *supra* note 5, at 9 and 25.

¹⁵ PAPUA N. G. DEP'T OF NAT'L PLAN. AND MONITORING, *National Strategy of Responsible Sustainable Development for Papua New Guinea (StaRS)* 27 (2nd ed. 2014), <http://www.planning.gov.pg/images/dnpm/pdf/StaRS.pdf>

¹⁶ Comm. on Econ., Soc. and Cultural Rts., General Comment No. 15: The Right to Water, U.N. Doc. E/C.12/2002/11, ¶ 1 (Jan. 20, 2003) [hereinafter General Comment No. 15: The Right to Water]; see also *id.* ¶ 3 describing water as “one of the most fundamental conditions for survival.”

¹⁷ International Covenant on Civil and Political Rights, art. 6, Mar. 23, 1976, S. Exec. Doc. No. E, 95-2, 999 U.N.T.S. 171. See Catarina de Albuquerque (Independent Expert), *Rep. of the Independent Expert on the Issue of Human Rights Obligations Related to Access to Safe Drinking Water and Sanitation*, U.N. Doc. A/HRC/12/24 (July 1, 2009) (recognizing that states cannot guarantee the right to life without providing access to water and sanitation).

¹⁸ International Covenant on Economic, Social, and Cultural Rights, art. 12, Jan 3, 1976, 993 U.N.T.S. 3. See Human Rights Council Res. 27/2, ¶ 1, The Human Right to Safe Drinking Water and Sanitation (Oct. 2, 2014).

¹⁹ G.A. Res. 217 (III) A, art. 25, Universal Declaration of Human Rights, (Dec. 10, 1948). See Human Rights Council Res. 15/L.14, ¶ 3, Human Rights and Access to Safe Drinking Water and Sanitation (Sept. 24, 2010) (stating that “the human right to safe drinking water and sanitation is derived from the right to an adequate standard of living and inextricably related to the right to the highest attainable standard of physical and mental health, as well as the right to life and human dignity”) and Human Rights Council Res. 27/2, ¶ 1, The Human Right to Safe Drinking Water and Sanitation (Oct. 2, 2014) (stating that the human right to safe drinking water and sanitation is essential for an adequate standard of living and the right to health).

RECOMMENDATIONS

¹ Cited in BARRICK GOLD CORP., PORGERA JOINT VENTURE LONGITUDINAL HEALTH RISK ASSESSMENT STUDY (on-file with authors) [hereinafter PJV LONGITUDINAL HEALTH RISK ASSESSMENT STUDY].

² Cited in COUNCIL ON ETHICS, THE NORWEGIAN GOV'T PENSION FUND—GLOBAL, RECOMMENDATION OF 14 AUGUST 2008 TO THE MINISTRY OF FINANCE 2 (2008), https://www.regjeringen.no/globalassets/upload/fin/etik/r/recommendation_barrick.pdf.

³ Cited in PJV LONGITUDINAL HEALTH RISK ASSESSMENT STUDY, *supra* note 1.

⁴ INDEPENDENT STATE OF PAPUA NEW GUINEA: DEPARTMENT OF NATIONAL PLANNING AND MONITORING, PNG National Water, Sanitation and Hygiene (WaSH) Policy (2015-2030) 12 (2015), http://www.planning.gov.pg/images/dnpm/pdf/WaSH_POLICY04.03.2015.pdf.

METHODOLOGY

¹ See *The Human Rights Based Approach to Development Cooperation: Towards a Common Understanding Among UN Agencies*, United Nations Dev. Grp. (2003), <http://hrbaportal.org/the-human-rights-based-approach-to-development-cooperation-towards-a-common-understanding-among-un-agencies>.

² *Id.*

³ A YSI Multiparameter Pro Plus sensor was used to measure pH, electrical conductivity, dissolved oxygen, and temperature at each testing site.

⁴ Samples were collected according to standard sampling protocols (i.e. samples were filtered (0.45µm) in the field, acidified with nitric acid, and kept cold until analysis). See AM. PUB. HEALTH ASSOC., AM. WATER WORKS ASSOC., & WATER POLLUTION CONTROL FED'N., STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTEWATER (19th ed. 1995). ICP-Mass Spectrometry was used to analyze the samples for trace elements.

⁵ Filtration also leaves particulates smaller than 0.45 µm.

⁶ See PAULUS BAK, SIMON APTE, CHARLIE ROSS & AUGUSTINE MUNGKAJE, PEAK, DRINKING WATER STUDY UPDATE 13 (Nov. 2014).

⁷ As a reference point, the WHO Guidelines for Drinking-water Quality set the acceptable limit for cadmium at three micrograms per liter. The boxplots reported by Barrick demonstrate that, in 2014 (Figure C-13), dissolved cadmium approaches that level in at least one site, and total cadmium concentration (by comparison) exceeds that level in multiple sites. Concentrations exceeding three micrograms per liter were similarly observed over the entire range of data (Figure C-14).

⁸ Public Health (Drinking Water) Regulation 1984 (Papua N.G.).

⁹ While there are water quality guidelines meant to address recreational water use, as opposed to drinking water, such as the WHO Guidelines for Safe Recreational Water Environments, such guidelines provide only minimal guidance, generally measuring potential health hazards based on the assumption that an individual will ingest a small percentage of water during recreation. The WHO recreational guidelines, for example, assume a contribution from swimming

equivalent to 10 percent of drinking-water consumption. As a result, “a substance occurring in recreational water at a concentration ten times that stipulated in the drinking-water guidelines may merit further consideration,” according to the WHO recreational guidelines. WORLD HEALTH ORGANIZATION, GUIDELINES FOR SAFE RECREATIONAL WATER ENVIRONMENTS, VOLUME 1: COASTAL AND FRESH WATER 170-171, (2003) http://www.who.int/water_sanitation_health/bathing/srwg1.pdf. Similarly, the Australian recreational water guidelines premise acceptable levels of toxic chemicals based on the assumption that “no person will ingest more than a maximum of 100mL water during a normal swimming session.” AUSTRALIAN AND NEW ZEALAND GUIDELINES FOR FRESH AND MARINE WATER QUALITY, VOLUME 1, 5-8 (2000) <http://www.agriculture.gov.au/SiteCollectionDocuments/water/nwqms-guidelines-4-voll.pdf>. Such benchmarks of exposure do not track with the ways in which Porgerans interact with contaminated water sources, for example sitting in rivers and tailings waste for full days, and as some individuals do report drinking from rivers during extended periods of low rainfall, the Research Team uses the WHO Guidelines for Drinking-water Quality to benchmark potential risk to human health.

¹⁰ The PNG Standards generally allow higher concentrations of heavy metals (such as Arsenic and Lead), but also provides limits for elements that are not regulated by the WHO Guidelines (such as Iron and Chloride).

¹¹ For an example of how heavy metal concentrations can differ over time, see Barrick’s reporting of cadmium concentrations in water sources near the PJV mine site in Barrick’s 2014 Annual Environment Report. BARRICK GOLD CORP., PORGERA, ANNUAL ENVIRONMENT REPORT 2014, 172 (2015), <http://www.barrick.com/files/porgera/2014-Porgera-Annual-Environmental-Report.pdf>. The box plots show both the range of cadmium concentrations measured at 11 monitoring locations in 2014 (Figure C-13), and the entire range of data published by Barrick from 1991-2014 (Figure C-14). These graphs show that, for any location, the range of concentrations varies inside a single year as well as across years. *Id.*

¹² See, e.g. RAOUL WALLENBERG INST. OF HUMAN RIGHTS & HUMANITARIAN LAW, GUIDELINES ON INTERNATIONAL HUMAN RIGHTS FACT-FINDING VISITS AND REPORTS (2009); INT’L INST. OF HIGHER STUDIES IN CRIMINAL SCIS., SIRACUSA GUIDELINES FOR INTERNATIONAL, REGIONAL AND NATIONAL FACT-FINDING BODIES (2013); *Code of Conduct for Special Procedures Mandate-holders of the Human Rights Council*, Human Rights Council Res. 5/2. U.N. Doc. A/HRC/RES/5/2 (June 17, 2007); INT’L NON-GOV’T ORGS., INTERNATIONAL NON-GOVERNMENTAL ORGANIZATIONS ACCOUNTABILITY CHARTER (2005); U.N. OFFICE OF THE HIGH COMM’R FOR HUMAN RIGHTS, TRAINING MANUAL ON HUMAN RIGHTS MONITORING, U.N. Doc. HR/P/PT/7 (2001); Navanethem Pillay, U.N. High Comm’r for Human Rights, Lecture: Human Rights Investigations and their Methodology (Feb. 24, 2010).

¹³ COLUMBIA LAW SCHOOL HUMAN RIGHTS CLINIC & HARVARD LAW SCHOOL INTERNATIONAL HUMAN RIGHTS CLINIC, RIGHTING WRONGS? BARRICK GOLD’S REMEDY MECHANISM FOR SEXUAL VIOLENCE IN PAPUA NEW GUINEA: KEY CONCERNS AND LESSONS LEARNED (Nov. 2015).

¹⁴ See UNITED NATIONS SECRETARIAT DEPT. OF ECON. AND SOC. AFFAIRS, DESIGNING HOUSEHOLD SURVEY SAMPLES: PRACTICAL GUIDELINES (2005); Jermiah Ngondi et al., *The epidemiology of trachoma in Eastern Equatoria and Upper Nile States, southern Sudan*, 83 BULL. OF THE WHO 904, 905-906 (2005). At the village level, as at the SML level, the Research Team chose not to attempt a simple random sample due to the lack of a comprehensive and accurate census of the area, which would be necessary to develop a randomization model. While the Random Walk Sample approach does not produce a random sample, each household in the village had an equal (non-zero) probability of being included in the sample, reducing the introduction of bias. Because the total population of the SML was not known, it was not possible to generate a statistically representative sample size to know how many interviews to conduct in each village. Rather, the team conducted interviews in villages for similar periods of time, generating similar sample sizes across villages. This hybrid approach did not generate statistically representative data, however it did reduce sampling bias.

¹⁵ Where an adult resident of the selected household was not present at the time the household was selected, the interviewers moved to the next third or fifth household to conduct an interview. The interviewer would then return immediately following the interview to determine whether an adult resident had returned. If the household was still “absent” at the time the interviewer returned, the household was omitted from study.

¹⁶ EVERLYN GUAPE, LELY KESA, CRESSIDA KUALA & JOYCELYN DAVID MANDI, DISPROPORTIONATE IMPACTS OF BUSINESS ACTIVITIES ON WOMEN: LESSONS FROM PAPUA NEW GUINEA TO INFORM GENDER GUIDANCE TO THE UN GUIDING PRINCIPLES ON BUSINESS AND HUMAN RIGHTS, Submission to the Working Group on Issue of Human Rights and Transnational Corporations and Other Business Enterprises (Nov. 5, 2018) (on file with authors).

CHAPTER I: BACKGROUND

Water, Extractive Industries in Papua New Guinea, and Industrial Mining in Pongera

¹ WORLD HEALTH ORGANIZATION AND UNITED NATIONS CHILDREN'S FUND JOINT MONITORING PROGRAMME FOR WATER SUPPLY AND SANITATION (JMP), PROGRESS ON DRINKING WATER AND SANITATION: SPECIAL FOCUS ON SANITATION 22 (2008) ("The category 'improved drinking water sources' includes sources that, by nature of their construction or through active intervention, are protected from outside contamination, particularly faecal matter").

² WATERAID, WATER: AT WHAT COST? THE STATE OF THE WORLD'S WATER 2016 8 (2016), http://www.wateraid.org/uk/~media/Publications/Water_at_what_cost.pdf?la=en-GB [hereinafter "WATERAID BRIEFING"].

³ WATERAID BRIEFING, *supra* note 2, at 8.

⁴ INDEPENDENT STATE OF PAPUA NEW GUINEA: NATIONAL DEPARTMENT OF HEALTH, PNG National Health Plan (2011-2020): Vol. 1 Policies and Strategies 11-13 (2010), http://www.wpro.who.int/health_services/papua_new_guinea_nationalhealthplan.pdf [hereinafter PNG HEALTH PLAN 2011-2020].

⁵ THE WORLD BANK, *Country Profile: Papua New Guinea*, <http://www.worldbank.org/en/country/png>.

⁶ WSP-WORLD BANK, *Water Supply and Sanitation in Papua New Guinea* 42 (2013), https://www.wsp.org/sites/wsp.org/files/publications/WSP_EAP_SDA_PNG_Report.pdf [hereinafter WSP-WORLD BANK REPORT].

⁷ WSP-WORLD BANK REPORT, *supra* note 6, at 3.

⁸ WHO/UNICEF JOINT MONITORING PROGRAMME (JMP) FOR WATER SUPPLY AND SANITATION, TRENDS IN DRINKING WATER COVERAGE (GRAPH), PAPUA NEW GUINEA: ESTIMATES ON THE USE OF WATER SOURCES AND SANITATION FACILITIES, <https://washdata.org/data#!/png>.

⁹ WSP-WORLD BANK REPORT, *supra* note 6, at 11.

¹⁰ THE WORLD BANK, *Water, Sanitation and Hygiene Policy Development in Papua New Guinea*, Report No. ACS8481 (May 30, 2014), <http://documents.worldbank.org/curated/pt/849191468285072764/text/ACS84810WP0P1448230Box385243B00PUBLIC0.txt>.

¹¹ INDEPENDENT STATE OF PAPUA NEW GUINEA: DEPARTMENT OF NATIONAL PLANNING AND MONITORING, PNG National Water, Sanitation and Hygiene (WaSH) Policy (2015-2030) 12 (2015), http://www.planning.gov.pg/images/dnpm/pdf/WaSH_POLICY04.03.2015.pdf [hereinafter PNG WASH POLICY 2015-2030].

¹² PNG WASH POLICY 2015-2030, *supra* note 11, at 3.

¹³ GOVERNMENT OF PAPUA NEW GUINEA, National Water Supply and Sewerage Act 1986, Part I, §1 (emphasis added).

¹⁴ GOVERNMENT OF PAPUA NEW GUINEA, National Water Supply and Sewerage Act 1986, Part II, §§ 5(a) and (b) (emphasis added).

¹⁵ *See* PNG WASH POLICY 2015-2030, *supra* note 11, at 12 ("This commercial responsibility means that (perceived) non-commercial peri-urban and settlement areas as well as many district towns remain unserved. Indeed, Water PNG is currently operating in only 14 provincial and 6 district towns.")

¹⁶ PNG WASH POLICY 2015-2030, *supra* note 11, at 12; Interview with Government Officials in Port Moresby, Papua New Guinea (Mar. 2017).

¹⁷ PNG WASH POLICY 2015-2030, *supra* note 11, at 12.

¹⁸ PNG WASH POLICY 2015-2030, *supra* note 11, at 14.

¹⁹ While the government of PNG has drafted a number of multi-decade plans outlining ambitious goals for improving water access, *see, e.g.*, GOVERNMENT OF PAPUA NEW GUINEA, Medium-Term Development Strategy: 2005-2010 (2004) (identifying plans and costs for developing new programs in water supply and sanitation); GOVERNMENT OF PAPUA NEW GUINEA, National Health Plan 2011-2020, Volume 1: Policies and Strategies 28 (2010), http://www.wpro.who.int/health_services/papua_new_guinea_nationalhealthplan.pdf, these plans have not received sufficient budgetary allocations to be adequately implemented. *See* PNG WASH POLICY 2015-2030, *supra* note 11, at 12 (acknowledging that the Department of Health “lacks resources to implement WaSH programmes on any scale”).

²⁰ WATERAID, *WaterAid PNG Country Program Evaluation* 9, (2015), <http://www.wateraid.org/~media/Publications/programme-evaluations/Papua-New-Guinea-Evaluation-Report-2015.pdf>.

²¹ PNG WASH POLICY 2015-2030, *supra* note 11, at 3.

²² PAPUA NEW GUINEA: DEPARTMENT OF TREASURY, The National Budget (2011), http://www.treasury.gov.pg/html/national_budget/national_budget_2011.htm; PAPUA NEW GUINEA: DEPARTMENT OF TREASURY, The National Budget (2012), http://www.treasury.gov.pg/html/national_budget/national_budget_2012.htm; WSP-WORLD BANK REPORT, *supra* note 6, at 15.

²³ PNG WASH POLICY 2015-2030, *supra* note 11, at 14.

²⁴ PNG WASH POLICY 2015-2030, *supra* note 11, at 14.

²⁵ JULIET WILLETTS, DANIELLE PEDI, NAOMI CARRARD, BRONWYN POWELL & INGRID DE LACY, INT’L WATER CTR. & THE INST. FOR SUSTAINABLE FUTURES AT UNIV. OF TECH. SYDNEY, NGO PARTNERSHIPS AND CAPACITY DEVELOPMENT IN THE WATER SANITATION AND HYGIENE SECTOR 44 (2008).

²⁶ *Id.*

²⁷ GOVERNMENT OF PAPUA NEW GUINEA, Medium-Term Development Strategy: 2011-2015 (2010).

²⁸ WSP-WORLD BANK REPORT, *supra* note 6, at 11.

²⁹ *See* PNG WASH POLICY 2015-2030, *supra* note 11.

³⁰ PNG WASH POLICY 2015-2030, *supra* note 11, at 8.

³¹ PNG WASH POLICY 2015-2030, *supra* note 11, at 5.

³² PNG WASH POLICY 2015-2030, *supra* note 11, at 9.

³³ *See* PNG WaSH Policy 2015-2030, *supra* note 11.

³⁴ PNG WASH POLICY 2015-2030, *supra* note 11, at 4.

³⁵ PNG WASH POLICY 2015-2030, *supra* note 11, at 16.

³⁶ PNG WASH POLICY 2015-2030, *supra* note 11, at 16-23.

³⁷ *See* UNITED NATIONS DEV. PROGRAMME, 2014 NATIONAL HUMAN DEVELOPMENT REPORT: PAPUA NEW GUINEA 11-12 (2014), http://www.pg.undp.org/content/dam/papua_new_guinea/docs/Publications/FINAL%20PNG%20NHDR_low%20res_compressed.pdf (noting that poverty rates, conflict, and inequality are higher and Human Development Index scores are lower in resource-dependent nations than in non-resource-dependent nations, and that extractive industries generate few jobs).

³⁸ *The World Fact Book: Papua New Guinea—Economy*, UNITED STATES CENTRAL INTELLIGENCE AGENCY, <https://www.cia.gov/library/publications/the-world-factbook/geos/pp.html> (last updated Jan. 12, 2017).

³⁹ ASIAN DEV. BANK, ASIAN DEVELOPMENT OUTLOOK 2016 UPDATE: MEETING THE LOW CARBON GROWTH CHALLENGE xxi, 172 (2016), <https://www.adb.org/sites/default/files/publication/197141/ado2016-update.pdf>.

⁴⁰ John Gibson, *Two Decades of Poverty in Papua New Guinea*, Presentation at Crawford School (June 12, 2014), <http://devpolicy.org/presentations/2014-PNG-Update/Day-1/Two-decades-of-poverty-in-PNG-John-Gibson.pdf>.

⁴¹ UNITED NATIONS DEV. PROGRAMME, 2014 NATIONAL HUMAN DEVELOPMENT REPORT: PAPUA NEW GUINEA, *supra* note 37, at 29.

⁴² OXFAM AUSTRALIA, *Papua New Guinea*, <https://www.oxfam.org.au/about-us/countries-where-we-work/papua-new-guinea/>.

⁴³ PAPUA N. G. DEP'T OF NAT'L PLAN. AND MONITORING, *National Strategy of Responsible Sustainable Development for Papua New Guinea (StaRs)* 26-27 (2nd ed. 2014), <http://www.planning.gov.pg/images/dnmp/pdf/StaRS.pdf> [hereinafter StaRs Report]; Stuart Kirsch, *An Incomplete Victory at Ok Tedi*, CARNEGIE COUNCIL (Apr. 6, 2000), https://www.carnegiecouncil.org/publications/archive/dialogue/2_02/articles/614.

⁴⁴ StaRs Report, *supra* note 43, at 27.

⁴⁵ See StaRs Report, *supra* note 43, at 29.

⁴⁶ StaRs Report, *supra* note 43, at 31.

⁴⁷ BARRICK GOLD CORP., *Form 40-F (2011 Annual Report (foreign private issuer))* 67, (Mar. 28, 2012).

⁴⁸ Susan Bonnell, *Social change in the Porgera Valley*, in *DILEMMAS OF DEVELOPMENT: THE SOCIAL AND ECONOMIC IMPACT OF THE PORGERA GOLD MINE 1989-1994* 88, 96-97 (Colin Filer, ed., 1999).

⁴⁹ BARRICK GOLD CORP. 2011 Form 40-F, *supra* note 47, at 66.

⁵⁰ BARRICK GOLD CORP. 2011 Form 40-F, *supra* note 47, at 67.

⁵¹ BARRICK GOLD CORP., "Barrick Announces Strategic Partnership with Zijin Mining Group" <http://www.barrick.com/investors/news/news-details/2015/Barrick-Announces-Strategic-Partnership-with-Zijin-Mining-Group/default.aspx>.

⁵² BARRICK GOLD CORP. 2011 Form 40-F, *supra* note 47, at 67.

⁵³ BARRICK GOLD CORP., *Form 40-F (2013 Annual Report (foreign private issuer))*, 110 (Mar. 31, 2014).

⁵⁴ Mining leases are issued for durations of either twenty or forty years, with options for ten or twenty-year renewals, respectively. See NORTON ROSE LLP, *Mining in Papua New Guinea: Ten things to know* (2012), <http://www.nortonrosefulbright.com/files/mining-in-papua-new-guinea-ten-things-to-know-october-2012-72443.pdf>.

⁵⁵ BARRICK GOLD CORP. 2011 Form 40-F, *supra* note 47, at 67.

⁵⁶ Kym Livesley & Daniel Murnane, *Papua New Guinea*, in *MINING: IN 31 JURISDICTIONS WORLDWIDE* 144, 145 (Michael Bourassa & John Turner, eds., 2013), <http://www.gadens.com/News/Documents/GTDT%20Mining%202013%20-%20Papua%20New%20Guinea.pdf>.

⁵⁷ BARRICK GOLD CORP. 2011 Form 40-F, *supra* note 47, at 67.

⁵⁸ BARRICK GOLD CORP. 2011 Form 40-F, *supra* note 47, at 67.

⁵⁹ See BARRICK GOLD CORP. 2011 Form 40-F, *supra* note 47, at 68; BARRICK GOLD CORP., *Form 40-F (2014 Annual Report (foreign private issuer))*, 143 (Mar. 30, 2015).

⁶⁰ ENV. CANADA & NAT'L WATER RESEARCH INST., *THREATS TO WATER AVAILABILITY IN CANADA* 68 at tbl. 1 (2004), http://www.ec.gc.ca/inre-nwri/0CD66675-AD25-4B23-892C-5396F7876F65/ThreatsEN_03web.pdf.

⁶¹ BARRICK GOLD CORP.: PORGERA, ANNUAL ENVIRONMENTAL REPORT 2014 79 (July 2015) [hereinafter BARRICK 2014 ENVIRONMENTAL REPORT].

⁶² Environment Permit issued to Barrick (Niugini) Limited under Section 65 of the Environment Act 2000, Permit No. WE-L3(91), 4 (Nov. 29, 1988) (listing "Total Annual Extraction Volume" from seven extraction points at 42,201,300 m³/year).

⁶³ BARRICK 2014 ENVIRONMENTAL REPORT, *supra* note 61, at 82.

⁶⁴ BARRICK 2014 ENVIRONMENTAL REPORT, *supra* note 61, at 121-122; see also BARRICK GOLD CORP. 2011 Form 40-F, *supra* note 47, at 70.

⁶⁵ BARRICK GOLD CORP. 2011 Form 40-F, *supra* note 47, at 70.

⁶⁶ PORGERA JOINT VENTURE, ENVIRONMENTAL MONITORING 2011 ANNUAL REPORT ES-2 (June 2012), <http://www.barrick.com/files/porgera/2011-Porgera-Annual-Environmental-Report.pdf>.

⁶⁷ EXTRACTIVE INDUSTRIES REVIEW, STRIKING A BETTER BALANCE: VOLUME I: THE WORLD BANK GROUP AND EXTRACTIVE INDUSTRIES 31, 56 (2003), <https://openknowledge.worldbank.org/bitstream/handle/10986/17705/842860v10WP0St00Box382152B00PUBLIC0.pdf?sequence=1> (stating agreement—in a report published by the World Bank and written by a consultancy group—with “the call for a ban on riverine tailings disposal,” and suggesting that “[n]o [World Bank Group]-supported mining project should use riverine tailings disposal.”); INT’L FIN. CORP., WORLD BANK GROUP, ENVIRONMENTAL, HEALTH AND SAFETY GUIDELINES FOR MINING 7 (2007), <http://www.ifc.org/wps/wcm/connect/1f4dc28048855af4879cd76a6515bb18/Final+-+Mining.pdf?MOD=AJPERES> (“Riverine...tailings disposal is not considered good international industry practice.”).

⁶⁸ INT’L MAR. ORG., INTERNATIONAL ASSESSMENT OF MARINE AND RIVERINE DISPOSAL OF MINE TAILINGS 8 (2013), <http://www.imo.org/en/OurWork/Environment/LCLP/newandemergingissues/Documents/Mine%20Tailings%20Marine%20and%20Riverine%20Disposal%20Final%20for%20Web.pdf>.

⁶⁹ *Id.* at 8-9.

⁷⁰ BARRICK GOLD CORP., *2015 Responsibility Report* 46 (2016), <http://www.barrick.com/files/responsibility/Barrick-2015-Responsibility-Report.pdf> (“in the future, Barrick will build mines that rely on other methods of disposal of mining and processing material, and avoid riverine tailing disposal methods.”).

⁷¹ RICHARD JACKSON & GLENN BANKS, IN SEARCH OF THE SERPENT’S SKIN: THE STORY OF THE PORGERA GOLD PROJECT 111-14 (2002).

⁷² HUMAN RIGHTS WATCH, GOLD’S COSTLY DIVIDEND: HUMAN RIGHTS IMPACTS OF PAPUA NEW GUINEA’S PORGERA GOLD MINE 74 (2011) (citing Euralia Pane, *in* Papua New Guinea Post Courier 1 (Feb. 16, 1988), “Porgera gold waste plan is rejected”).

⁷³ PORGERA JOINT VENTURE, *Riverine Tailings and Waste Rock Management* 1-3, <http://www.barrick.com/files/porgera/Porgera-Riverine-Tailings-and-Waste-Rock-Management.pdf>. A tailings dam is a physical structure that stores the liquid waste from mining operations.

⁷⁴ *See* PORGERA JOINT VENTURE, *Riverine Tailings and Waste Rock Management*, *supra* note 73, at 3.

⁷⁵ PORGERA JOINT VENTURE, *Riverine Tailings and Waste Rock Management*, *supra* note 73, at 5, 7.

⁷⁶ COUNCIL ON ETHICS, The Norwegian Gov’t Pension Fund—Global, Recommendation of 14 August 2008 to the Ministry of Finance 1, 25 (2008), https://www.regjeringen.no/globalassets/upload/fin/etikkk/recommendation_barrick.pdf (regarding investments in Barrick Gold Corp.).

⁷⁷ COUNCIL ON ETHICS, The Norwegian Gov’t Pension Fund—Global, Recommendation of 14 August 2008 to the Ministry of Finance, *supra* note 76, at 18.

⁷⁸ *See, e.g.* Lars Järup, *Hazards of heavy metal contamination*, BRIT. MED. BULL. 68 (2003) and J. O. Duruibe, M.O.C. Ogvuegbu, and J.N. Egwurugwu, *Heavy metal pollution and human biotoxic effects*, INT’L J. OF PHYSICAL SCI. 2(5), 112-116 (May 2007).

⁷⁹ *Id.*

⁸⁰ Sam Ro, *Here’s How Many Tons of Rock You Have to Mine Just for an Ounce of Gold*, BUS. INSIDER (Apr. 24, 2013), <http://www.businessinsider.com/tons-of-rock-for-an-ounce-of-gold-2013-4>.

⁸¹ BARRICK GOLD CORP., 2011 Form 40-F, *supra* note 46, at 71; *see also* PORGERA JOINT VENTURE, *Riverine Tailings and Waste Rock Management*, *supra* note 73, at 10.

⁸² *See* PORGERA JOINT VENTURE, *Riverine Tailings and Waste Rock Management*, *supra* note 73, at 10; INT’L INST. FOR ENVTL. AND DEV., MINERALS, MINING AND SUSTAINABLE DEV., *Mining for the Future: Porgera Riverine Disposal Case Study* 8 (2002), <http://pubs.iied.org/pdfs/G00562.pdf>.

⁸³ BARRICK GOLD CORP., HUMAN RIGHTS POLICY 2 (June 22, 2016).

⁸⁴ BARRICK GOLD CORP., HUMAN RIGHTS COMPLIANCE PROGRAM 3 (undated).

⁸⁵ See UNITED NATIONS GLOBAL COMPACT, *Our Participants*, <https://www.unglobalcompact.org/what-is-gc/participants>.

⁸⁶ See INT'L COUNCIL ON MINING & METALS, *Our Members: Member Companies* (2016), <http://www.icmm.com/members/member-companies>.

⁸⁷ See UNITED NATIONS GLOBAL COMPACT, *The Ten Principles of the UN Global Compact*, Principles 1, 2, 7 and 8, <https://www.unglobalcompact.org/what-is-gc/mission/principles>; INT'L COUNCIL ON MINING AND METALS, *Ten Principles* (2015), <https://www.icmm.com/en-gb/about-us/member-commitments/icmm-10-principles>.

⁸⁸ BARRICK GOLD CORP., RESPONSIBILITY REPORT 2013: RESPONSIBLE MINING 35 (2013).

⁸⁹ BARRICK GOLD CORP., RESPONSIBILITY REPORT 2013: RESPONSIBLE MINING 35 (2013).

⁹⁰ INT'L COUNCIL ON MINING & METALS, *Position Statement on Water Stewardship*, <https://www.icmm.com/water-ps>.

⁹¹ BARRICK GOLD CORP., HUMAN RIGHTS REPORT 2017, 40-42, <https://barrick.q4cdn.com/788666289/files/responsibility/Barrick-Human-Rights-Report.pdf>.

⁹² ZIJIN MINING, *Social Responsibility*, <http://www.zijinmining.com/sustainability/Social-Responsibility.jsp>.

⁹³ ZIJIN MINING, *Our Approach*, <http://www.zijinmining.com/sustainability/Our-Approach.htm>.

⁹⁴ *Id.*

⁹⁵ THE PNG EXTRACTIVE INDUSTRIES TRANSPARENCY INITIATIVE (PNGEITI), *What is PNGEITI?*, <https://www.pngeiti.org.pg/about-us/what-is-pngeiti/>.

⁹⁶ PNGEITI National Secretariat, Meeting Minutes from Multi-Stakeholder Group Meeting #8 (Dec. 21, 2015), <http://www.pngeiti.org.pg/wp-content/uploads/2016/07/2015.12.21-MSG-Meeting-8-Minutes.pdf>.

CHAPTER II: LIFE NEAR A MINE

Social and Environmental Concerns

¹ See Columbia Law School Human Rights Clinic & Harvard Law School International Human Rights Clinic, *Righting Wrongs? Barrick Gold's Remedy Mechanism for Sexual Violence in Papua New Guinea—Key Concerns and Lessons Learned* 23-24 (2015) (and extensive sources cited therein).

² Interview with a woman from Timorope 2 (YK9) (Jan. 5, 2015) (“It is very grim here. The conditions are not good. I think a lot about whether I will ever move to a better place, or whether I will die here. It is like a trauma.”).

³ Interview with a woman from Tamando (AW6) (Jan. 10, 2015) (“We are unsafe sleeping close to the dump. The company should relocate us to a place where we can have a proper life. We are waiting and waiting and waiting but we never know what the company will do. It is a terrible life here. I strongly recommend that the company should relocate us.”).

⁴ Interview with a man from Yarik Timorope (YK4) (Jan. 5, 2015) (“In other mines in PNG, I have seen when they want to mine, they relocate all the human beings, to some 8-10 kilometers away from the mine itself. In Porgera, when they did the MOU, that is the time they destroyed us... But now, we, human beings, and animals, and mining are living together. That is how they spoiled us. The government and the company put our lives in danger.”).

⁵ Interview with a woman and mother from Timorope 2 (YK9) (Jan. 5, 2015) (“We are living like animals. Toilets are nearby. The place for getting water is not safe enough, and we have no garden to feed ourselves. They are using our land and mining our gold. They should have relocated us somewhere else.”); Interview with a man from Mugalep (MG2) (Jan. 4, 2015) (“We are always drinking water here that is not safe to drink, the mine should relocate us somewhere else, the company thinks that we are primitives. There is no one who will back us up, they treat us as animals.”).

⁶ See Susan Bonnell, *The landowner relocation programme, in* DILEMMAS OF DEVELOPMENT: THE SOCIAL AND ECONOMIC IMPACT OF THE PORGERA GOLD MINE 1989-1994 128-129 (Colin Filer ed., 1999) (stating that the company preferred a relocation program where “people moved house but remained on their own land.”). For information on the original relocation plan, see Mary Anderson, Doug Fraser & Luc Zandvliet, COLLABORATIVE FOR

DEV. ACTION, *Corporate Options: Constructive Engagement in Conflict Zones* 10 (2001), <http://cdacollaborative.org/wordpress/wp-content/uploads/2016/01/Placer-Dome-Asia-Pacific-Porgera-Joint-Venture-PJV-Gold-Mining-Operation.pdf>.

⁷ BARRICK GOLD CORP., *RESPONSE TO PORGERA ALLIANCE REPORT “Landowners in Porgera Demand Urgent Resettlement”* (2012), <http://www.facing-finance.org/wp-content/blogs.dir/16/files/2012/03/barrickgold-response-porgera-mine-28-feb-2012.pdf> (the company notes, “When the mine originally began operating there were about 5,000 people in the area. In-migration has brought that number to about 50,000 today.”).

⁸ BARRICK (NIUGINI) LTD., *Response to Columbia Law School – Water Study* (Nov. 2018). See *infra* Annex II.

⁹ Interview with a woman from Mugalep (MG7) (Jan. 4, 2015); Interview with a male landowner from Yarik Timorope 2 (YK3) (Jan. 5, 2014); Interview with a man from Yarik Timorope (YK4) (Jan. 5, 2015); Interview with a woman from Panadaka (PD2) (Jan. 3, 2015).

¹⁰ Interview with Man from Mugalep (MG3) (Jan. 4, 2015).

¹¹ Interview with a man from Yarik Timorope (YK4) (Jan. 5, 2015); Interview with a male landowner from Yarik Timorope 2 (YK3) (Jan. 5, 2014) (“You can see that there is not enough land. You can see that this house is on a rock. We don’t build houses on a rock normally. We only built here because there is not enough space.”).

¹² Bonnell, *The landowner relocation programme*, *supra* note 100, at 139 (describing how men customarily had separate houses for wives that did not get along and that grown children also had their own homes).

¹³ See, e.g., Interview with a woman from Panadaka (PD4) (Jan. 3, 2015) (complaining that she has to “share [her] house with [her] husband’s two wives.”); Interview with a woman from Kulapi 1 (KP8) (Jan. 9, 2015) (explaining the complicated living arrangement: “The first generation (my father and mother in law, and my husband) lives with the second generation in the same house. Where will the second generation go to build their house? There is no land.”). See also Bonnell, *The landowner relocation programme*, *supra* note 100, at 139-140 (detailing that in 1993-94, impact assessment of the relocation effort from the mine, up to 20 family members were documented living in a single home, and that overcrowding contributed to family disputes, possible increase in communicable diseases, and strain on already limited water, food, and gardening land).

¹⁴ See, e.g., Interview with a woman and landowner from Yarik (YK2) (Jan. 5, 2015) (explaining that the woman is living in very crowded conditions, with two houses and “a lot of family”); Interview with a male landowner from Timorope 2 from Tiyini Clan (YK6) (Jan. 5, 2015) (explaining that overcrowding has increased due to the relocation of people from Alipis to Yarik. “My sister should have her own place with her own husband, but there is not enough land, so she is forced to live here with me.”).

¹⁵ See, e.g., Interview with man from Mugalep (MG3) (Jan. 4, 2015) (“We are too crowded. As you can see, here I sleep with my wife and some kids. In that other room, my mother’s first-born son and kids. And on the benches you are on, more sisters and brothers sleep.”); Interview with a woman from Yarik Timorope (YK1) (Jan. 5, 2015) (“Everybody sleeps here, my sister’s kids, her husband, look at all these beds.”).

¹⁶ See, e.g., Interview with a woman from Tamando (AW3) (Jan. 10, 2015); Interview with a woman from Paiari village (MG6) (Jan. 4, 2015); Interview with a woman from Yarik (YK7) (Jan. 5, 2015); Interview with a woman from Kulapi 2 (KP4) (Jan. 9, 2015); Interview with a woman from Kulapi 2 (KP3) (Jan. 9, 2015) (mentioning that she lived with her sisters in law and their children, over 20 people in total, in a relocation home); Interview with a woman from Kulapi 1 (KP8) (Jan. 9, 2015) (mentioning that over 30 people live together).

¹⁷ See HARVARD LAW SCHOOL INT’L HUMAN RIGHTS CLINIC & NYU SCHOOL OF LAW CTR. FOR HUMAN RIGHTS AND GLOBAL JUSTICE, Legal Brief regarding Bill C-300 before the Standing Comm. on the Foreign Affairs and Int’l Dev. at 5, House of Commons, Ottawa, Canada (Nov. 16, 2009); Glenn Banks, *The Economic Impact of the Mine, in DILEMMAS OF DEVELOPMENT: THE SOCIAL AND ECONOMIC IMPACT OF THE PORGERA GOLD MINE 1989-1994*, 88, 96-97 (Colin Filer ed., 1999).

¹⁸ See Glenn Banks, *Gardens and Wantoks, in DILEMMAS OF DEVELOPMENT: THE SOCIAL AND ECONOMIC IMPACT OF THE PORGERA GOLD MINE 1989-1994*, 160-189 (Colin Filer ed., 1999) (“The physical environment exercises a basic constraint on Porgeran agriculture. Soil fertility, slope angles, altitude and climate all act to inhibit the productivity of the gardening system. Recent changes, such as the massive in-migration and the loss of gardening land to the mine operation, have exaggerated the effect of these environmental factors.”).

¹⁹ Nearly every interviewee we spoke with stated that the land available for subsistence farming was insufficient to grow enough food to adequately feed his or her family. *See, e.g.*, Interview with a woman from Panadaka (PD4) (Jan. 3, 2015) (mentioning that she grows a few plants around her house but does not have space for a garden: “There are no gardens around here.”); Interview with a woman from Yarik Timorope (YK1) (Jan. 5, 2015) (mentioning that she only grows plants just around her house because there is no room to plant. She used to raise chickens, however sold them to purchase food for her family); Interview with a man from Yarik (YK5) (Jan. 5, 2015) (mentioning that he does not have bush or land to access for food); Interview with a man from Kulapi 3 (KP5) (Jan. 9, 2015) (mentioning that his only land was destroyed by a landslide roughly 10 years ago). Many mentioned that their former gardening—often the only land residents had—or bush land used for hunting and gathering wild plants, had been covered by the waste dumps, tailings, other mine facilities, or for relocation purposes. *See, e.g.*, Interview with a woman from Panadaka (PD2) (Jan. 3, 2015); Interview with a woman from Panadaka (PD5) (Jan. 3, 2015); Interview with a woman from Porgera (MG4) (Jan. 4, 2015); Interview with a male landowner from Yarik Timorope 2 (YK3) (Jan. 5, 2014); Interview with a man from Yarik Timorope (YK4) (Jan. 5, 2015); Interview with a woman and mother from Timorope (YK9) (Jan. 5, 2015); Interview with a woman from Yunarilama (YL3) (Jan. 6, 2015); Interview with a woman from Mugalep (MG8) (Jan. 4, 2015); Interview with a woman from Upper Yarik (YK10) (Jan. 6, 2015); Interview with a woman from Yarik (YK8) (Jan. 5, 2015); Interview with two chiefs from Kulapi 2 (KP2) (Jan. 9, 2015); Interview with a woman from Kulapi 1 (KP8) (Jan. 9, 2015).

²⁰ Bonnell, *The landowner relocation programme*, *supra* note 100, at 144. The Research Team observed that what residents referred to as one “garden” consisted of at least a few raised beds or “mounds” used for planting crops.

²¹ *See, e.g.*, Interview with two chiefs from Kulapi 2 (KP2) (Jan. 9, 2015) (claiming that their home and garden used to be in the valley, and now they live in what used to be the bush, where the soil is not as good for growing crops); Interview with a woman from Kulapi 2 (KP3) (Jan. 9, 2015) (stating that the company took over the fertile land where her home used to be, and that now they live in the area that used to be the bush where they hunted); Interview with a man from Mugalep (MG2) (Jan. 4, 2015) (“The fertile soil, this has been covered by the dump, and we don’t have any proper area.”). The situation in Kulapi is particularly acute, as individuals have had to clear primary rainforest land—marked by high altitude, poor soil, a high-water table, and high nitrogen content—as a substitute for their former gardening land, making it particularly difficult to grow sweet potatoes (“kau kau”), a staple of the Porgeran diet. *See* Bonnell, *The landowner relocation programme*, *supra* note 100, at 146; Interview with a woman from Kulapi 2 (KP3) (Jan. 9, 2015) (“When the company moved us here, I stopped planting sweet potato...I cannot grow my food here because water comes up from the ground and soaks the plants and they don’t grow well.”); Interview with a woman from Kulapi (KP9) (Jan. 9, 2015) (mentioning that water comes up from her garden and the plants do not grow well).

²² *See* Banks, *Gardens and Wantoks*, *supra* note 111, at 160 (noting that “[a]ccess to land at Porgera for an individual is derived from cognatic kinship links—that is, through rights to land acquired from either parent.”). The people in the Porgera valley are traditionally and culturally tied to the land. *See* Anderson, Fraser & Zandvliet, *supra* note 100 at 10 (explaining that “even if the land is sold, it is still considered to belong to the traditional clan.”).

²³ Many interviewees indicated that tribal land boundaries prevented them from moving to or utilizing nearby areas of land that may be less crowded. *See, e.g.*, Interview with a woman from Yarik (YK7) (Jan. 5, 2015) (explaining that she cannot go to the red river to pan for gold, because “[t]hat’s another man’s land”); Interview with a man from Yarik (YK5) (Jan. 5, 2015) (declaring that it is “forbidden to go to another person’s bush” to collect firewood or wild greens).

²⁴ Interview with a Man from Apalaka (AP1) (Jan. 11, 2015).

²⁵ *See, e.g.*, Interview with a man from Alipis (AL5) (Jan. 7, 2015) (blaming Barrick for destroying “all my bush”); Interview with two chiefs from Kulapi 2 (KP2) (Jan. 9, 2015) (stating that prior to the mine hunting was common, but that now “[t]he bush area has been covered by the dump...”); Interview with a man from Kulapi 3 (KP5) (Jan. 9, 2015) (mentioning that he has no place to hunt for birds because “[t]here is no bush...”); Interview with a woman from Kulapi 1 (KP8) (Jan. 9, 2015) (“Because of the mining, blasting, and dumping and stock[piles], all the bush has been destroyed, so there is no bush left. All the wild bush animals have run away. They no longer exist.”); *see also* Interview with a woman from Yarik Timorope (YK1) (Jan. 5, 2015); Interview with a man from Yarik (YK5) (Jan. 5, 2015).

²⁶ *See, e.g.*, Interview with a woman from Kulapi 2 (KP3) (Jan. 9, 2015) (“Here, where we live now, used to be a big bush area where we used to find pandanus nuts and hunt for animals.”).

²⁷ *See, e.g.*, Interview with a man from Alipis (AL5) (Jan. 7, 2015) (mentioning that he did not know where the animals have gone, but that Barrick destroyed “all my bush,” and reminiscing that when there was bush, they used to hunt animals). *See also*, PENNY JOHNSON, SCOPING PROJECT: SOCIAL IMPACT OF THE MINING PROJECT ON WOMEN IN

THE PORGERA AREA 51, PORGERA ENVIRONMENTAL ADVISORY KOMITI (2010) (on file with authors) (“Before the mine, food was supplemented with protein from fresh-water-fish, and hunting cuscus (possum) and cassowary and other birds and small animals. These wild animal food sources are now scarcer, having moved to new habitats away from the mine disturbance, blasting and population increase in the valley.”).

²⁸ Interview with a woman and landowner from Yarik (YK2) (Jan. 5, 2015).

²⁹ See Banks, *The Economic Impact of the Mine*, *supra* note 110, at 88, 112-114 (finding in 1993 that only 4% of household income comes from cash crops). See also Banks, *Gardens and Wantoks*, *supra* note 111, at 160-89 (detailing a case study of Apalaka and Kulapi, which indicated that the “subsistence system appeared to be under increasing stress” and that most households supplement their incomes with food bought from stores and that buying and selling crops was not a significant source of dietary nutrition). See also Interview with a woman from Yarik Timorope (YK1) (Jan. 5, 2015) (“I have no land. It’s like I am living in some kind of city in America or Australia, everything is money. Where will I get money?”); Interview with a woman and landowner from Yarik (YK2) (Jan. 5, 2015) (“before the company we had land and banana and sweet potato and cabbage, we have them all in here, but when the company came this all stopped and now we all depend on money to buy our food.”); Interview with a male landowner from Yarik Timorope 2 (YK3) (Jan. 5, 2014) (“My garden has been covered up by the dump. I have no garden. I get my money and I buy food from the market or the stores.”); Interview with a man from Yarik Timorope (YK4) (Jan. 5, 2015) (“We have no land left to plant. I have no garden. Sometimes when I get some money, I buy food from the Station.”); Interview with a man from Yarik (YK5) (Jan. 5, 2015) (“We only buy food, we don’t grow any. We buy food at the store and the market.”); Interview with a man from Alipis (AL2) (Jan. 7, 2015) (“There is no place to make gardens, so when I get money I go the station or Alipis to buy food.”); Interview with a man from Kulapi 3 (KP5) (Jan. 9, 2015) (stating that when he has money he buys his food from the Station market); Interview with a woman from Kulapi 3 (KP6) (Jan. 9, 2015) (stating that she has no land for a garden and she buys her food from the market when she has money); Interview with a man from Kulapi 3 (KP7) (Jan. 9, 2015) (stating that she does not grow her own food and that she buys her food from Porgera Station); Interview with a woman from Kulapi (KP9) (Jan. 9, 2015) (“I have no gardens. My gardens have been spoiled by the chemical water. I buy food from the market and the stores.”); Interview with a man from Mugalep (MG2) (Jan. 4, 2015) (claiming that people in Mugalep “live like people live in town,” as they don’t have proper gardens and they purchase their food with money.”); Interview with a woman from Upper Yarik (YK13) (Jan. 6, 2013) (mentioning that she obtains most of her food from the market and there are no nearby bushes for her to gather food from).

³⁰ See, e.g., Interview with a woman from Yarik (YK7) (Jan. 5, 2015) (stating that she was hungry at the time of the interview and that she has nowhere to hunt or plant food, that she is forced to “budget [her money] frugally,” and often goes without breakfast or lunch. She previously had a garden in which she would grow vegetables); Interview with a woman from Yarik (YK8) (Jan. 5, 2015) (stating that they sometimes “fast” when they don’t have food to eat); Interview with a woman and mother from Timorope (YK9) (Jan. 5, 2015) (mentioning that there is not enough food to feed her family, that her garden was covered by the dump, and that she does not have enough money to afford proper protein); Interview with two chiefs from Kulapi 2 (KP2) (Jan. 9, 2015) (mentioning that if they are “lucky” they eat, but otherwise go to sleep without eating); Interview with a man from Yunarilama (YL5) (Jan. 6, 2015) (stating that at approximately 2pm, he had only chewed gum that day, but would cook plain rice later in the day); Interview with a man from Kulapi 3 (KP5) (Jan. 9, 2015) (mentioning that he occasionally goes to sleep without dinner and purchases food when he is “lucky.”); Interview with a woman from Panadaka (PD6) (Jan. 3, 2015) (mentioning that she depends on money to buy food as there is no space to “plant greens,” and that if there is not enough money, “we do not eat and go to bed with no food”); Interview with Man from Mugalep (MG3) (Jan. 4, 2015) (stating that they only plant “some cabbage” because there is not enough land to plant, and that if the family doesn’t have money, “we don’t eat for one or two days”); Interview with a man from Yarik Timorope (YK4) (Jan. 5, 2015) (mentioning that his gardens were covered by the dump and he has nowhere else to plant and stating that if he and his wife have no money, “we live without food for a few days”); Interview with a man from Kulapi 3 (KP7) (Jan. 9, 2015) (mentioning that he only grows a few plants around his house and that if he is unable to find gold, he does not have food); Interview with a man from Anawe (AW2) (Jan. 10, 2015) (mentioning that his garden was covered by a dump and that he is left hungry even after panning for gold daily, and sometimes sleeps without eating).

³¹ Small-scale mining has been a historical part of the income in Porgera for many years, although its importance as a source of income varies based on availability, the price of gold, and alternative ways to survive such as subsistence farming and outside employment. See Jerry K. Jacka, *Whitemen, The Ipili, and The City of Gold: A History of Politics, Race and Development in Highlands New Guinea*, 54 ETHNOHISTORY 445, 461 (2007) (citing a patrol officer in the 1970s who noted that alluvial mining incomes have varied from “literally nothing to several thousands of dollars

each year”); *see also* Banks, *The Economic Impact of the Mine*, *supra* note 110 at 96 (noting a number of studies that indicated that alluvial gold mining had been an important part of the economy since the 1950s, and that between 15% and 30% of income came from alluvial mining, but that the majority of income before the mine came from subsistence agriculture). *See also* Interview with a woman from Kulapi 2 (KP3) (Jan. 9, 2015) (mentioning that her former fertile land was where the mine now is, and that she now lives where they used to gather pandanus nuts and hunt animals, and stating her concerns that her “children will suffer without gardens and food.” Also mentioning that she relies on illegal mining for food and cannot grow plants properly where she lives); Interview with a woman from Kulapi 2 (KP4) (Jan. 9, 2015) (mentioning that she must go to the “chemical river” in order to look for food, and that she has no garden and only grows a few plants); Interview with a man from Alipis (AL5) (Jan. 7, 2015) (mentioning that he used to have access to the bush to hunt before the mine, but now his land is gone and he goes gold panning for food); Interview with a woman and landowner from Yarik (YK2) (Jan. 5, 2015) (mentioning that prior to the establishment of the mine, the family had land to grow, but now “we all depend on money to buy our food.”).

³² BARRICK GOLD CORP. 2011 Form 40-F, *supra* note 47, at 67 (“The workforce at Porgera comprises approximately 2,600 employees...In addition, there are approximately 500 contractors. Of the total employee workforce, 94% are PNG citizens (64% local employees and 30% from other parts of PNG).”).

³³ Approximately 1,600 people out of a population of 50,000. *See* Johnson, *supra* note 120, at 17 (noting that the population has increased from 9,253 people in 1990, to around 50,000 in 2010).

³⁴ The amounts that people mentioned generally ranged from 15 to 60 kina per day, but were dependent on the source, with sources near and in the open pit generating the most money. *See, e.g.*, Interview with a man from Panadaka (PD1) (Jan. 3, 2015); Interview with a man from Alipis (AL4) (Jan. 7, 2015); Interview with a man from Alipis (AL5) (Jan. 7, 2015); Interview with a woman from Yarik Timorope (YK1) (Jan. 5, 2015) (describing how she makes 100 to 200 kina per week of panning); Interview with a man from Alipis (AL2) (Jan. 7, 2015); Interview with a man from Anawe (AW2) (Jan. 10, 2015) (describing that he gathers roughly one gram of gold after 12 hours in the red river, which generates 50 to 60 kina of compensation); Interview with a woman from Anawe (AW4) (Jan. 10, 2015) (stating that she makes roughly 15 kina per every five or six hours she spends in the red river). *Cf.* Interview with a woman from Apalaka (AP5) (Jan. 11, 2015) (stating that she can make around 150 kina per day by going to an area near the open pit). For additional context, one interviewee told the Research Team that one gram of gold received was equivalent to 50 kina in compensation. *See* Interview with a woman from Panadaka (PD5) (Jan. 3, 2015).

³⁵ *See, e.g.*, Interview with a Man from Panadaka (PD1) (Jan. 3, 2015) (mentioning that he allows some of his children to mix gold with mercury); Interview with a woman from Panadaka (PD2) (Jan. 3, 2015) (mentioning that she uses mercury with her bare hands, does not wear a mask or gloves, and thinks the mercury has harmed her body); Interview with a woman from Panadaka (PD4) (Jan. 3, 2015) (mentioning that she does not tell her grandchildren to leave when she cooks mercury); Interview with a woman from Panadaka (PD5) (Jan. 3, 2015) (mentioning that she held mercury for years and is concerned that it affected her child’s development); Interview with a man from Apalaka (AP4) (Jan. 11, 2015) (describing how he burns mercury inside the kitchen area and cooks food at the same time he cooks mercury); Interview with a woman and her daughter from Alipis (AL3) (Jan. 7, 2015) (mentioning that she (the daughter) uses mercury with her bare hands).

³⁶ *See, e.g.*, Interview with a woman from Yarik Timorope (YK1) (Jan. 5, 2015) (“One time I went to the hospital and a doctor told me mercury is not good to use, but what will I do, I have no other options and no other way to live.”).

³⁷ Some residents report that the mine has reduced the amount of gold they can find through panning in rivers, requiring longer hours and seeking gold in more dangerous locations. This perception is supported by the mining contract, which provided a one-time payment for the loss of income from alluvial mining, as well as additional compensation for some groups. *See* PETER JOHNSON, THE NATIONAL RESEARCH INSTITUTE, *LODE SHEDDING: A CASE STUDY OF THE ECONOMIC BENEFITS TO THE LANDOWNERS, THE PROVINCIAL GOVERNMENT, AND THE STATE, FROM THE PORGERA GOLD MINE 40* (2012), <https://pngri.org/portfolio/porgera-gold-mine/>; Interview with local government official (Jan. 9, 2015) (“Tailings payments are for loss of income from alluvial mining.”). *See also* Interview with a man from Yarik (YK5) (Jan. 5, 2015) (commenting that prior to the establishment of the mine, the Kaiya and Kaka Rivers used to have significantly higher gold output for local alluvial miners); Interview with a man from Alipis (AL4) (Jan. 7, 2015) (mentioning that before the opening of the mine, he could get 300 to 1,000 kina per day from panning, and that now he gets 30 to 60 kina per day).

³⁸ *See, e.g.*, Interview with a man from Yunarilama (YL1) (Jan. 6, 2015) (mentioning that he pans every day from 5am to 8pm in the Kaiya and Anjolek rivers, which are fast flowing and “very dangerous”); Interview with a woman and her daughter from Alipis (AL3) (Jan. 7, 2015) (mentioning that she (the daughter) goes panning from the morning until

5pm every day in the Kaka River, that the water is smelly, and that she feels that it is bad for her health); Interview with a man from Alipis (AL5) (Jan. 7, 2015) (stating that he sits in the Kaka River every day for 11 hours per day).

³⁹ For a comprehensive summary of abuses committed by PJV security personnel, see HARVARD LAW SCHOOL INT'L HUMAN RIGHTS CLINIC & NYU SCHOOL OF LAW CTR. FOR HUMAN RIGHTS AND GLOBAL JUSTICE, Legal Brief, *supra* note 110.

⁴⁰ *See, e.g.*, Interview with a man from Panadaka (PD1) (Jan. 3, 2015) (stating that he stays in the red river for 12 hours per day); Interview with a woman from Panadaka (PD2) (Jan. 3, 2015) (mentioning that she has gone to the red river nearly every day for 25 years, and thinks she is affected by the “chemicals”); Interview with a woman from Panadaka (PD4) (Jan. 3, 2015) (stating that she stays in the water for 12 hours per day, feels weak when she leaves the water, and does not know what type of risks she is exposed to); Interview with a woman from Panadaka (PD6) (Jan. 3, 2015) (mentioning that she spends 12 hours per day in the red river for three to four days at a time); Interview with a man from Alipis (AL7) (Jan. 7, 2015) (calling the red river a “dangerous place...But we think about food.”); Interview with a woman from Tamando (AW3) (Jan. 10, 2015) (“Sometimes I get worried about what is in the red river.”); Interview with a woman from Tamando (AW6) (Jan. 10, 2015) (mentioning that she feels the water is unsafe, but stays there “for the purpose of gold”); Interview with a resident of Tamando (AW7) (Jan. 10, 2015) (“We think that by breathing in the red tailings, we might get sick. We have that in our minds, but where would we get food from?”).

⁴¹ *See, e.g.*, Interview with a man from Panadaka (PD1) (Jan. 3, 2015) (mentioning that he has been burned by the red river water previously); Interview with a man from Alipis (AL7) (Jan. 7, 2015) (stating that sometimes his skin is itchy after panning in the red river); Interview with a woman from Tamando (AW3) (Jan. 10, 2015) (stating that sometimes the red river burns their skin and makes it dusty).

⁴² *See, e.g.*, Interview with a man from Panadaka (PD1) (Jan. 3, 2015) (explaining that the wife went to the red river while pregnant and brought her children with her); Interview with a woman from Panadaka (PD3) (Jan. 3, 2015) (mentioning that she went to the red river “many times” when she was pregnant); Interview with a woman from Panadaka (PD4) (Jan. 3, 2015) (mentioning that her grandchildren accompany her to the red river and play in the water); Interview with a woman from Panadaka (PD6) (Jan. 3, 2015) (mentioning that her child goes in the water at the red river).

⁴³ Interview with a man from Apalaka (APSK1) (Jan. 11, 2015) (stating that it is better to obtain gold from the pit than the Anjolek River, and that going to the Anjolek River involves wasting a lot of time and hard work); Interview with a man from Anawe (AW1) (Jan. 10, 2015) (stating that it is easier to get gold from the pit than the dump, and that even when security guards are present, he can make 200 to 300 kina per day. Also stating that sometimes security forces beat, and place trespassers in jail).

⁴⁴ Interview with a man from Apalaka (APSK1) (Jan. 11, 2015) (noting that his children tell him: “Will you provide everything for us? We need shoes and clothing for ourselves. Will you provide everything for us? We want to get money, we want to go.”).

⁴⁵ *See, e.g.*, Interview with a woman from Panadaka (PD5) (Jan. 3, 2015) (mentioning that she went to the dump to collect gold and mix it with mercury every day when she was pregnant: “If I don’t go, where would I get food?”); Interview with Man from Mugalep (MG3) (Jan. 4, 2015) (a couple mentioning that they go to the “smelly” “red cyanide water:” “We sit there by the tailings and we feed our children.”); Interview with a man from Yarik (YK5) (Jan. 5, 2015) (mentioning that despite knowledge of the health effects of mercury, “people need the gold to get money for food.”); Interview with a woman from Yarik (YK8) (Jan. 5, 2015) (mentioning that although there is a risk of drowning in the fast flowing river where she pans, “we take that risk, because we think of the food that we will get to eat.”); Interview with a man from Yunarilama (YL1) (Jan. 6, 2015) (stating that he has no land and thus must pan to purchase food for his family, despite the risk of going to the “strong and fast flowing streams” [the Kaiya and Anjolek] that have “carried away” women and children); Interview with a landowner from Kulapi 2 (KP1) (Jan. 9, 2015) (stating that with no land to farm on, and despite knowing that people have been shot going into the pit by security personnel, “knowing the risk and the danger, we will still go into the pit to buy our food”).

⁴⁶ *See, e.g.*, Interview with a woman from Panadaka (PD6) (Jan. 3, 2015) (stating that she has no other way to make a living and the river is her “garden,” her “life”); Interview with Man from Mugalep (MG3) (Jan. 4, 2015) (mentioning that there is nowhere else to get food and so the “red cyanide water” is their “garden”); Interview with a woman and mother from Timorope (YK9) (Jan. 5, 2015) (mentioning that she has no garden, but she has gold to support her family instead.). *See also* Interview with a woman from Paiari village (MG6) (Jan. 4, 2015); Interview with a woman from Yarik (YK7) (Jan. 5, 2015); Interview with a man from Yarik Timorope (YK4) (Jan. 5, 2015); Interview with a

woman from Panadaka (PD5) (Jan. 3, 2015); Interview with a man from Panadaka (PD1) (Jan. 3, 2015). Prior to the opening of the mine, locals used to view sources of gold as their “second garden.” It now appears that they view them as their first. *See* Bonnell, *Social change in the Porgera Valley*, *supra* note 48, at 25.

¹⁷ Interview with a man from Panadaka (PD1) (Jan. 3, 2015). Another woman from Yarik told us that, “I know that I will get sick, I think that if I die that’s okay but I think of the food I am going to eat tonight and I can stay there.” Interview with a woman and landowner from Yarik (YK2) (Jan. 5, 2015).

¹⁸ *See, e.g.*, Interview with a woman from Panadaka (PD3) (Jan. 3, 2015) (mentioning that she only goes to the red river “when I don’t have enough food.”); Interview with a woman from Mugalep (MG7) (Jan. 4, 2015) (mentioning that her family goes to the red river “when we think about food and money”; Interview with a woman from Kulapi 2 (KP3) (Jan. 9, 2015) (“I get food from the illegal mining. I have no options. We fight, struggle, live like this.”); *see also* Interview with a woman from Yarik (YK8) (Jan. 5, 2015); Interview with a woman from Upper Yarik (YK10) (Jan. 6, 2015); Interview with a landowner from Kulapi 2 (KP1) (Jan. 9, 2015).

¹⁹ *See, e.g.*, Interview with a Man from Apalaka (AP1) (Jan. 11, 2015) (mentioning that he feels unsafe in his house, is scared of living where he does, and that the house moves when there is blasting at the mine); Interview with a man from Yarik Timorope (YK4) (Jan. 5, 2015) (stating that when the blasts occur, “we are scared. I live with fear.”); Interview with a woman from Yarik (YK8) (Jan. 5, 2015) (expressing concern that her house will fall, and that she can feel it shaking); Interview with a woman from Yarik (YK11) (Jan. 6, 2015) (mentioning that during the blasts, they leave their house and wait outside until the blasting ends); Interview with a landowner from Kulapi 2 (KP1) (Jan. 9, 2015) (mentioning that he thinks his house will “fall down” when the blasting occurs); Interview with a woman from Kulapi 2 (KP3) (Jan. 9, 2015) (mentioning that when the blasting occurs, the house moves, and “[e]ven the children run closer to us. We hold them tightly.”); Interview with a woman from Kulapi (KP9) (Jan. 9, 2015) (stating that she feels scared to live close to the mine where explosions occur and people have died: “Sometimes, I feel that it might blow our houses up.”).

²⁰ *See, e.g.*, Interview with a woman from Yarik (YK12) (Jan. 6, 2015) (mentioning that their house shakes during the blasting); Interview with a Man from Apalaka (AP1) (Jan. 11, 2015) (mentioning that the house moves when the “big blasts” occur); Interview with a woman from Yarik (YK8) (Jan. 5, 2015) (stating that she can feel her house “shaking”); Interview with a man from Yarik Timorope (YK4) (Jan. 5, 2015) (reporting that during the blasting, he can feel his house moving and see the windows moving); Interview with a woman from Yarik Timorope (YK1) (Jan. 5, 2015) (stating that she can feel the house moving during the blasts); Interview with a man from Apalaka (APSK1) (Jan. 11, 2015) (stating that when the blasting occurs, “the cupboards move and the plates and cups make noise” and that in other homes, cooking pots move); Interview with a resident of Porgera (APSK2) (Jan. 11, 2015) (“We see tables shake. It takes 3 or 5 minutes...sometimes books fall off the table.”); Interview with a landowner from Kulapi 2 (KP1) (Jan. 9, 2015) (stating that his “windows crack and fall down”).

²¹ *See, e.g.*, Interview with a man from Apalaka (APSK1) (Jan. 11, 2015) (mentioning that when the blasting occurs she is scared that she might “sink into the underground mine”); Interview with a man from Alipis (AL7) (Jan. 7, 2015) (mentioning that “when the blast happens, it might sink everything down into the pit. That is a fear in our life.”); Interview with a woman from Upper Yarik (YK13) (Jan. 6, 2013) (mentioning that she used to think that when the blasting occurred, she “might sink with the house or the earth might open”); Interview with a woman from Yarik Timorope (YK1) (Jan. 5, 2015) (mentioning that when she first felt the shaking, that she thought the ground would move and “we would fall into a big hole”).

²² Interview with a woman from Apalaka (AP5) (Jan. 11, 2015).

²³ *See, e.g.*, Interview with a woman from Yarik (YK12) (Jan. 6, 2015) (mentioning that blasting occurs both underground and at the surface of the mine and that many landslides occur); Interview with a man from Mugalep (MG1) (Jan. 4, 2015) (explaining losing his land in Apalaka to a landslide, which he believed was caused by being so close to the “big mountain so when they blast it shakes the place,” and the “heavy” dump). *See also* Interview with a resident of Porgera (APSK2) (Jan. 11, 2015) (“We worry there will be a landslide and we’ll get washed down to the dump.” Also attributing “[t]he shaking and the blasting” to the cause of the landslide); Interview with a woman from Anawe (AW4) (Jan. 10, 2015) (responding to a question about whether he feels the blasts “all the trees, and houses move. Sometimes there are landslips. The whole valley moves.”).

²⁴ *See, e.g.*, Interview with a man from Apalaka (AP4) (Jan. 11, 2015) (claiming that most of his gardens have been lost due to landslides); Interview with a man from Yunarilama (YL2) (Jan. 6, 2015) (mentioning that he previously had a “lot of land” but that landslides have taken away the topsoil); Interview with a woman from Upper Yarik (YK13) (Jan.

6, 2013) (claiming that she lost land in a landslide and was not compensated by the company); Interview with a woman from Mugalep (MG8) (Jan. 4, 2015) (reporting a loss of the majority of her gardens and land to landslides).

⁵⁵ See, e.g., Interview with a man from Yarik Timorope (YK4) (Jan. 5, 2015) (“On one side, they are doing the blasting. On the other side, there is Anjolek dump. And that side [points downhill] is where the polluted river is. There is nowhere to go.”), (describing living a “few minutes” from the edge of a hill that leads to Anjolek dump and feeling unsafe being so close); Interview with a woman and mother from Timorope (YK9) (Jan. 5, 2015) (“I think the weight of the dump pulls the land. And when they do blasting, it moves the earth, and they are doing underground mining. This makes our land weak.”).

⁵⁶ See, e.g., Interview with a woman from Panadaka (PD2) (Jan. 3, 2015) (mentioning that she “cannot sleep at night because of the noise,” which she claims is “made by the big truck”); Interview with a woman from Panadaka (PD3) (Jan. 3, 2015) (mentioning that the machines [trucks] from the mine make noise so that it is “very hard to sleep at night”); Interview with a man from Mugalep (MG2) (Jan. 4, 2015) (mentioning as the first thing during a summary of what it is like to live in Mugalep, that “[t]he noise from the machine disturbs [him]”); Interview with Man from Mugalep (MG3) (Jan. 4, 2015) (mentioning that their sleep is often disturbed due to the “big machines”); Interview with a woman from Mugalep (MG7) (Jan. 4, 2015) (complaining that “[i]t is too noisy here when the mining is going every day and every night.”); Interview with a woman from Kulapi (KP10) (Jan. 9, 2015) (describing that “[t]here are strange noises from the machines”); Interview with a man from Kulapi (KP11) (Jan. 9, 2015) (mentioning at the very beginning of the interview that “[t]here are machines making a lot of noise [trucks loading and “moving back and forth”], 24 hours a day. I sleep a restless sleep in this house.”).

⁵⁷ See, e.g., Interview with a landowner from Kulapi 2 (KP1) (Jan. 9, 2015) (stating that he can smell the “smoke” from the mine 24 hours a day, and that it smells like chemicals, and sometimes it smells like “when you burn batteries”); Interview with two chiefs from Kulapi 2 (KP2) (Jan. 9, 2015) (mentioning that the smell comes with the wind, and smells like “tear gas,” and that when the smell is strong, “you can have a big headache”); Interview with a woman from Kulapi 2 (KP3) (Jan. 9, 2015) (mentioning that the smell is “very terrible,” and that they cover their faces); Interview with a man from Kulapi 3 (KP5) (Jan. 9, 2015) (mentioning that the “smoke” from the mine blows towards Kulapi and creates a “rubbish” smell and that the “gas” coming from the mine smells like chemicals); Interview with a man from Kulapi 3 (KP7) (Jan. 9, 2015) (mentioning that he can smell the “chemical gas” when the wind blows towards Kulapi, and that it smells like “when we roast pigs”); Interview with a woman from Kulapi 1 (KP8) (Jan. 9, 2015) (mentioning that she can smell the bad “chemical air” when the wind blows it from the mill).

⁵⁸ See, e.g., Interview with a man from Anawe (AW2) (Jan. 10, 2015) (explaining that he was afraid to eat vegetables from his garden after periods of no rain, due to what he saw as chemical gas accumulating on them). People in other villages noted residue accumulating on their roofs and plants, which they attributed to emissions from the mine. See, e.g., Interview with a landowner from Kulapi 2 (KP1) (Jan. 9, 2015); Interview with a woman and mother from Timorope (YK9) (Jan. 5, 2015); Interview with a man from Kulapi 3 (KP5) (Jan. 9, 2015); Interview with a man from Alipis (AL2) (Jan. 7, 2015); Interview with a woman from Paiari village (MG6) (Jan. 4, 2015).

⁵⁹ People living in Yunarilama also reported this phenomenon. See, e.g., Interview with a man from Yunarilama (YL4) (Jan. 6, 2015); Interview with a man from Yunarilama (YL2) (Jan. 6, 2015); Interview with a man from Yunarilama (YL1) (Jan. 6, 2015).

⁶⁰ See, e.g., Interview with a woman from Kulapi 3 (KP6) (Jan. 9, 2015) (“When we get sick, we think the sickness is from the bad air.”); Interview with a woman from Kulapi 1 (KP8) (Jan. 9, 2015) (stating the people in Kulapi face bad health conditions “because of the poisonous gas that we are breathing in from mining activity.” Also noting that the air is not good because the “chemical air” blows over from the mill and “[t]he children are sick all time. They have high fever and cough. That’s why we are thinking that we are breathing bad air.”); Interview with a woman from Yarik (YK11) (Jan. 6, 2015) (stating the belief that they are breathing air with “chemicals or acid from the mine”); Interview with a man from Yarik Timorope (YK4) (Jan. 5, 2015) (“I think the chemicals that they put in to mix the gold, are given off as gas. So the gas is mixing with the air, and when we breathe the oxygen, we are breathing oxygen and the dangerous chemicals.”); Interview with a man from Mugalep (MG1) (Jan. 4, 2015) (explaining that he thinks the air is bad because when he works at the mine site: “they used to issue us something that would block our noses [masks]...and when you go near the gate it smells really bad like chemicals so I know the smoke has a lot of chemicals and that it is bad for us to breathe.”).

⁶¹ Interview with a woman from Tamando (AW3) (Jan. 10, 2015) (describing the smell from the red river as “really strong”); Interview with a woman from Tamando (AW6) (Jan. 10, 2015) (“I smell the air and see the steam rushing from the red water.”).

⁶² See, e.g., Interview with man from Kulapi (KP11) (Jan. 9, 2015) (“And when it is dry season, dust created by the mine working area comes into our environment,” and “gets in the drum, we can see dust and colors From the dust, and air, we can’t breathe well. There is dust. It goes into our mouths. We cough. We are breathing dust air.”); Interview with a woman from Kulapi (KP9) (Jan. 9, 2015) (“In the dry season, sometimes I see there is dust on the vegetables”); Interview with a woman from Kulapi (KP10) (Jan. 9, 2015); Interview with a Man from Panadaka (PD1) (Jan. 3, 2015) (“we can clearly see that there is dust in the water,” “In this area, we are really living so close to the dump area. We have the dust.” “We think we are sick because of the water, and also because of the dust coming up this way.”); Interview with man from Mugalep (MG3) (Jan. 4, 2015) (“Today, I feel that the air I am breathing in is contaminated. Before, I used to breathe in from the bushes and trees. But now I am breathing the dust from the dump, the polluted air that is given off from the mining activity.”); Interview with a man from Alipis (AL1) (Jan. 7, 2015) (“every day in the afternoon, when the company blasts, the air comes down and it is full of dust. The kids breathe the air”).

⁶³ BARRICK 2014 ENVIRONMENTAL REPORT, *supra* note 61, at 115.

⁶⁴ BARRICK 2014 ENVIRONMENTAL REPORT, *supra* note 61, at 115 (comparing measured concentrations to New South Wales Protection of the Environment Operations (Clean Air) Regulation (2010) and the Victoria State Environment Protection Policy (Air Quality Management) (2001)).

⁶⁵ BARRICK 2014 ENVIRONMENTAL REPORT, *supra* note 61, at 137 (reporting concentrations of particulate matter over two times the limit in Panadaka, and over three-and-a-half times the limit in Kulapi).

⁶⁶ COLUMBIA LAW SCHOOL HUMAN RIGHTS CLINIC, Notes from reporting back (Jan. 4, 2016) (“Here, it is inhumane. It is like the mine is stealing our gold. We young ones think our fathers didn’t do the agreement well. Our land is spoiled. We want a strong recommendation for resettlement.”); COLUMBIA LAW SCHOOL HUMAN RIGHTS CLINIC, Notes from reporting back (Jan. 3, 2016) (“Before, we had a healthy life. We had crops. But now we have no land. We want you to make a recommendation about resettlement.”)

⁶⁷ PORGERA LAND OWNERS ASSOCIATION, *Landowners in Porgera Demand Urgent Resettlement* 14 (2011), <http://www.porgeraalliance.net/wp-content/uploads/2011/10/Urgent-Resettlement-Porgera-web.pdf>.

⁶⁸ Interview with a man from Alipis (AL4) (Jan. 7, 2015).

⁶⁹ Interview with a man from Kulapi (KP11) (Jan. 9, 2015).

⁷⁰ Interview with a man from Apalaka (AP2) (Jan. 11, 2015).

⁷¹ PORGERA LAND OWNERS ASSOCIATION, *supra* note 160, at 3. (“Despite the realisation that 96% of the Special Mining Lease (SML) landowners required urgent resettlement (as per a survey conducted by the URS Consultants of Canada in August 2006)”; HUMAN RIGHTS WATCH, GOLD’S COSTLY DIVIDEND: HUMAN RIGHTS IMPACTS OF PAPUA NEW GUINEA’S PORGERA GOLD MINE 33-34 (2011), <https://www.hrw.org/sites/default/files/reports/png0211webwcover.pdf> (citing the draft social impact assessment: “as a result of the development of mining operations and significant population growth since 1987, SML communities are currently living in overcrowded, unsanitary and potentially dangerous conditions, and have limited available land for family subsistence...Resettlement would have a generally positive impact by removing SML communities from existing difficult and potentially dangerous living conditions; by improving their quality of life; [and] providing access to essential services and opportunities to develop sustainable livelihoods in relocation areas.”); DEANNA KEMP & JOHN OWEN, THE UNIVERSITY OF QUEENSLAND, *A third party review of the Barrick/Porgera Joint Venture off-lease resettlement pilot* vii (2015), https://www.csr.uq.edu.au/publications?task=download&file=pub_link&id=1444 (“The pilot resettlement framework developed by Barrick PJV is a response to a number of stated problems. These include a shortage of land for both the operation and the community, congestion and overcrowding on the lease area that exacerbates safety and law and order issues, ongoing demands from landowners for off-lease resettlement, increasing levels of social impact from the mine’s activities. . .”).

⁷² Interview with a man from Panadaka (PD1) (Jan. 3, 2015); Interview with a woman from Panadaka (PD2) (Jan. 3, 2015); Interview with a woman from Panadaka (PD3) (Jan. 3, 2015); Interview with a woman from Panadaka (PD4) (Jan. 3, 2015); Interview with a woman from Panadaka (PD5) (Jan. 3, 2015); Interview with a man from Mugalep (MG1) (Jan. 4, 2015); Interview with a man from Mugalep (MG2) (Jan. 4, 2015); Interview with a man and woman from Mugalep (MG3) (Jan. 4, 2015); Interview with a landowning woman from Mugalep (MG5) (Jan. 4, 2015); Interview with a woman from Paiari Village (MG6) (Jan. 4, 2015); Interview with a woman from Timorope Yarik (YK1) (Jan. 5, 2015); Interview with a woman from Yarik Timorope (YK2) (Jan. 5, 2015); Interview with a man

landowner from Yarik Timorope 2 (YK3) (Jan. 5, 2015); Interview with a man from Yarik Timorope (YK4) (Jan. 5, 2015); Interview with a woman and mother from Yarik Timorope 2 (YK9) (Jan. 5, 2015); Interview with a woman from Yarik (YK12) (Jan. 6, 2015); Interview with a man from Yunarilama (YL2) (Jan. 6, 2015); Interview with a woman from Yunarilama (YL3) (Jan. 6, 2015); Interview with a man from Apalaka (AP1) (Jan. 6, 2015); Interview with a resident of Porgera (AP2) (Jan. 11, 2015); Interview with a resident of Porgera (AP3) (Jan. 11, 2015); Interview with a man from Apalaka (AP4) (Jan. 11, 2015); Interview with a woman from Apalaka (AP5) (Jan. 11, 2015); Interview with a man from Alipis (AL2) (Jan. 7, 2015); Interview with two women from Alipis (AL3) (Jan. 7, 2015); Interview with a leader from Alipis (AL6) (Jan. 7, 2015); Interview with a man from Alipis (AL7) (Jan. 7, 2015); Interview with a landowner from Kulapi 2 (KP1) (Jan., 9, 2015); Interview with a chief from Kulapi (KP2) (Jan. 9, 2015); Interview with a woman from Kulapi (KP3) (Jan. 9, 2015); Interview with a woman from Kulapi (KP4) (Jan. 9, 2015); Interview with a man from Kulapi 3 (KP5) (Jan. 9, 2015); Interview with a woman from Kulapi (KP6) (Jan. 9, 2015) Interview with a man from Kulapi (KP11) (Jan. 9, 2015); Interview with a man from Apalaka (AW2) (Jan. 10, 2015); , Interview with a woman from Anawe (AW4) (Jan. 10, 2015); Interview with a woman from Tamando (AW6) (Jan. 10, 2015); Focus Group Interview with men from Panadaka (PD FGM) (Jan. 5, 2016) (“The only thing I want is resettlement. I have no other options.”); Focus Group Interview with women from Panadaka (PD FGW) (Jan. 5, 2016) (“The main concern is relocation.”); Focus Group Interview with women from Mugalep (MG FGW) (Jan. 6, 2016) (“We need resettlement out of the mine.”); Focus Group Interview with women in Alipis (AP FGW) (Jan. 7, 2016) (“What we want is resettlement.”); Focus Group Interview with women from Kulapi (KP FGW) (Jan. 8, 2016) (“We want resettlement. They should give us fresh water in a different location.”); Focus Group Interview with men from Apalaka (AK FGM) (Jan. 10, 2016) (“For us, the best result is relocation. We are really suffering here.”); Focus Group Interview with women from Apalaka (AK FGW) (Jan. 10, 2016) (“we need relocation on this village.”); Focus Group Interview with women and men from Timorope (TP FGWM) (Jan. 11, 2016) (“we have no land, people are dying, if the company can’t feed us with food or water, then we need to be resettled.”); Focus Group Interview with women from Top Yarik (TY FGW) (Jan. 12, 2016) (“We want Barrick to relocate us somewhere else where there is good water.”).

⁷³ Focus Group Interview with women from Apalaka (AK FGW) (Jan. 10, 2016).

⁷⁴ DEANNA KEMP & JOHN OWEN, *supra* note 167, at 25.

⁷⁵ DEANNA KEMP & JOHN OWEN, *supra* note 167, at 25-26 (“As resettlement planning progressed, the cost and complexities of implementing a full scale off-lease resettlement project became increasingly evident. RAPs [Resettlement Action Plan] were drafted by URS in early 2008, but were not finalized. A series of budget estimates were also produced suggesting that the whole-of-lease resettlement proposal was unaffordable. One company interviewee said, “the price tag was just jaw dropping” and explained that the budget estimations changed the viability of the Stage 6 development. The combination of technical issues, haulage costs, capital expenditure against the price of gold, and level of cost and complexity associated with resettlement brought the whole Stage 6 expansion into question. By early-2008, a decision was reached by Barrick PJV not to progress with either the Stage 6 expansion or the proposed resettlement.”).

⁷⁶ HUMAN RIGHTS WATCH, GOLD’S COSTLY DIVIDEND: HUMAN RIGHTS IMPACTS OF PAPUA NEW GUINEA’S PORGERA GOLD MINE 34 (2011), <https://www.hrw.org/sites/default/files/reports/png0211webwcover.pdf>.

⁷⁷ DEANNA KEMP & JOHN OWEN, *supra* note 167, at 18 (One senior company manager said, “Morally, this is wrong. There are too many people crammed in there [on the SML]. People are exposed to too many hazards. Too many children are exposed to the mine.” Another manager said, “I don’t think the current situation is acceptable to the company anymore. The risks are too great and the impacts on the community are too significant.”).

⁷⁸ *See e.g.* Interview with a leader from Alipis (AL6) (Jan. 7, 2015) (“The company promised they would relocate us. They told me to go to Laigam, and clear my area, and they would relocate my people there. I went to Laigam, I organized my people, we killed pigs and celebrated that we would be relocated. But nothing happened.”); Interview with a landowner from Kulapi 2 (KP1) (Jan. 9, 2015) (“Company normally tells us that it was going to relocate us and we always thought this was true. A lot of our landowners from the area have been educated and have gone to school, and because of this they only think about their stomach and they don’t think about the illiterate ones and those of us who have never gone to school. When the company says it was going to relocate us we are happy, but when the people in charge of here take our request to the company they come back with negative answers. So we just stay like this.”).

⁷⁹ DEANNA KEMP & JOHN OWEN, *supra* note 167, at vii.

⁸⁰ DEANNA KEMP & JOHN OWEN, *supra* note 167, at 12 (“Moreover, there are few examples of successful ‘resettlement’ cases in PNG that developers can easily replicate. There are no precedents for resettlement in the mining sector specifically.”).

⁸¹ Interview with Porgera Mine Manager (March 2017).

⁸² DEANNA KEMP & JOHN OWEN, *supra* note 167, at 30, 31 (“One [mine] manager said, “Cost determines viability. This might be do-able, but if it’s not affordable, we won’t proceed further.” “Company interviewees were unanimous in stating that the pilot’s success was contingent on government involvement. Reflecting this common view, one senior manager said, “This would be very difficult to do without a good level input and commitment from the national government.”).

⁸³ DEANNA KEMP & JOHN OWEN, THE UNIVERSITY OF QUEENSLAND, *Porgera Joint Venture (PJV) off-lease resettlement pilot: Independent Panel of Observers annual monitoring report 13* (2017), <https://www.csr.uq.edu.au/publications/porgera-joint-venture-pjv-off-lease-resettlement-pilot-independent-panel-of-observers-annual-monitoring-report-march-2016-2017>.

⁸⁴ DEANNA KEMP & JOHN OWEN, *supra* note 167, at 34. In a 2017 update, Kemp and Owen note that “[e]fforts have been made during the monitoring period to improve knowledge and information systems,” but state that they will not be able to report on these efforts until the next monitoring period. DEANNA KEMP & JOHN OWEN, *supra* note 167, at 34.

⁸⁵ DEANNA KEMP & JOHN OWEN, *supra* note 167, at 35. In a 2017 update, Kemp and Owen note, “Some progress has been made during the monitoring period to identify resettlement risks. This includes understanding what some of the resettlement risks look like from the perspective of members of the [Local Resettlement Committee]. The Panel regards these efforts as positive and expects PJV to invest in additional workshops so that these risks can be examined in further detail. The Panel notes that greater attention will need to be given to the gender dimensions of the resettlement pilot, including risks to women and girls.” DEANNA KEMP & JOHN OWEN, *supra* note 178, at 32-33.

⁸⁶ *See, e.g.*, U.N. Office of the High Comm’r for Human Rights, Special Rapporteur on adequate housing as a component of the right to an adequate standard of living, Basic Principles and Guidelines for Development-based Evictions, U.N. Doc. A/HRC/4/18 (2007) (requiring appropriate notice to affected communities and participation in decision-making prior to resettlement; affirming “the right to alternative land of better or equal quality and housing that must satisfy the following criteria for adequacy: accessibility, affordability, habitability, security of tenure, cultural adequacy, suitability of location, and access to essential services such as health and education,” food, potable water, sanitation, etc. and “productive land” located “as close as possible to the original place of residence and source of livelihood”); U.N. Office of the High Comm’r for Human Rights, Guiding Principles on Internal Displacement, U.N. Doc. E/CN.4/1998/53/Add.2 (1998) (requiring that free, prior, and informed consent be sought prior to displacement, and that all displaced individuals receive an adequate standard of living in resettlement, including, *inter alia*, access to food, potable water, housing, clothing, health, sanitation, and education); Brookings Instit. & The United Nations’ Office for the Coordination of Humanitarian Affairs, Handbook for the Application of the UN Guiding Principles on Internal Displacement (1999); Committee on Economic, Social and Cultural Rights, General Comment No. 7 on the right to adequate housing (Art.11.1): forced evictions, UN Doc. E/1998/22 (1997).

CHAPTER III: LEGAL FRAMEWORK

The Right to Water and Interrelated Rights

¹ The failure to resettle villages far away from the mine, combined with a massive population influx, the loss of arable land to mine operations and waste dumps, the disposal of tailings waste into waterways, and the growing dependence on unsafe artisanal mining practices, have all contributed to a host of human rights concerns that implicate related legal frameworks. Here, and in the remainder of this study, we focus specifically on the impacts of mining operations on the right to water, and the implications for other interrelated human rights.

² G.A. Res. 64/292, ¶ 1, The Human Right to Water and Sanitation (July 28, 2010). *See also* the same language in Human Rights Council Res. 27/2, ¶ 1, The Human Right to Safe Drinking Water and Sanitation (Oct. 2, 2014).

³ Comm. on Econ., Soc. and Cultural Rts., General Comment No. 15: The Right to Water, U.N. Doc. E/C.12/2002/11, ¶ 1 (Jan. 20, 2003) [hereinafter General Comment No. 15: The Right to Water]; *see also id.* ¶ 3 describing water as “one of the most fundamental conditions for survival.”

⁴ International Covenant on Civil and Political Rights, art. 6, Mar. 23, 1976, S. Exec. Doc. No. E, 95-2, 999 U.N.T.S. 171 [hereinafter ICCPR]. *See* Catarina de Albuquerque (Independent Expert), *Rep. of the Independent Expert on the Issue of Human Rights Obligations Related to Access to Safe Drinking Water and Sanitation*, U.N. Doc. A/HRC/12/24 (July 1, 2009) (recognizing that states cannot guarantee the right to life without providing access to water and sanitation).

⁵ International Covenant on Economic, Social, and Cultural Rights, art. 12, Jan 3, 1976, 993 U.N.T.S. 3 [hereinafter ICESCR]. *See* Human Rights Council Res. 27/2, ¶ 1, The Human Right to Safe Drinking Water and Sanitation (Oct. 2, 2014). *See also* General Comment No. 15: The Right to Water, *supra* note 3, ¶ 3 (stating that the right to water was “inextricably related to the right to the highest attainable standard of health,” provided by art. 12).

⁶ G.A. Res. 217 (III) A, art. 25, Universal Declaration of Human Rights, (Dec. 10, 1948) [hereinafter Universal Declaration of Human Rights]. *See* Human Rights Council Res. 15/L.14, ¶ 3, Human Rights and Access to Safe Drinking Water and Sanitation (Sept. 24, 2010) (stating that “the human right to safe drinking water and sanitation is derived from the right to an adequate standard of living and inextricably related to the right to the highest attainable standard of physical and mental health, as well as the right to life and human dignity”) and Human Rights Council Res. 27/2, ¶ 1, The Human Right to Safe Drinking Water and Sanitation (Oct. 2, 2014) (stating that the human right to safe drinking water and sanitation is essential for an adequate standard of living and the right to health).

⁷ General Comment No. 15: The Right to Water, *supra* note 3, ¶ 2. *See also* WORLD HEALTH ORG., OFF. OF THE HIGH COMM’R OF HUMAN RTS., WATER AID, CTR. ON HOUSING RTS. AND EVICTIONS & THE CTR. FOR ECON., SOC. AND CULTURAL RTS., THE RIGHT TO WATER 12-16 (2003) (using the same criteria of sufficient, safe, acceptable, physically accessible and affordable water); U.N. High Comm’r for Human Rts., Rep. on the Scope and Content of the Relevant Human Rights Obligations Related to Equitable Access to Safe Drinking Water and Sanitation under International Human Rights Instruments, at ch. II, U.N. Doc. A/HRC/6/3 (Aug. 16, 2007) (listing the elements of the right to water as quantity, quality and equitable, physical and economic access); OFF. OF THE HIGH COMM’R FOR HUMAN RTS., U.N. HABITAT & THE WORLD HEALTH ORG., THE RIGHT TO WATER: FACT SHEET NO. 35 7-11 (2010).

⁸ General Comment No. 15: The Right to Water, *supra* note 3, ¶ 12; THE RIGHT TO WATER: FACT SHEET NO. 35, *supra* note 7, at 3.

⁹ *See, e.g.*, Convention on the Elimination of All Forms of Discrimination Against Women, art. 14(2), Dec. 18, 1979, 1249 U.N.T.S. 13 [hereinafter CEDAW] (state parties must “ensure to women the right...to enjoy adequate living conditions, particularly in relation to...water supply...”); Convention on the Rights of the Child, art. 24(2), Nov. 20, 1989, 1577 U.N.T.S. 3 [hereinafter CRC] (state parties “shall take appropriate measures...[t]o combat disease and malnutrition...through the provision of adequate...clean drinking water.”); Convention on the Rights of Persons with Disabilities, art. 28(2), Dec. 13, 2006, 2515 U.N.T.S. 3 [hereinafter CRPD] (requiring state parties to “ensure equal access by persons with disabilities to clean water services.”).

¹⁰ G.A. Res. 64/292, U.N. Doc. A/RES/64/292, ¶ 1, The Human Right to Water and Sanitation (July 28, 2010); G.A. Res. 68/157, The Human Right to Safe Drinking Water and Sanitation (Dec. 18, 2013); Human Rights Council Res. 15/L.14, ¶ 3, Human Rights and Access to Safe Drinking Water and Sanitation (Sept. 24, 2010). *See also* Human Rights Council Res. 16/2, The Human Right to Safe Drinking Water and Sanitation (Apr. 8, 2011); Human Rights Council Res. 18/1, The Human Right to Safe Drinking Water and Sanitation (Oct. 12, 2011); Human Rights Council Res. 21/2, The Human Right to Safe Drinking Water and Sanitation (Oct. 9, 2012); Human Rights Council Res. 24/18, The Human Right to Safe Drinking Water and Sanitation (Oct. 8, 2013); Human Rights Council Res. 27/2, ¶ 1, The Human Right to Safe Drinking Water and Sanitation (Oct. 2, 2014).

¹¹ CEDAW, *supra* note 9, art. 14(2)(h) (recognizing the right of women in rural areas to enjoy “adequate living conditions,” particularly in relation to water supply); CRC, *supra* note 9, art. 24(2)(c) (recognizing the provision of clean drinking water as necessary to achieve the highest attainable standard of health); CRPD, *supra* note 9, art. 28(2)(a) (recognizing the right of social protection which includes equal access to clean water). *See also* U.N. Water Conf., *Mar del Plata Action Plan*, 66 (Resolution II), U.N. Doc. E/CONF.70/29 (1977) (stating that all people “have the right to have access to drinking water in quantities and of a quality equal to their basic needs”); U.N. Conf. on Env’t and Dev’t, *Agenda 21*, ch. 18 (1992); U.N. Conf. on Human Settlements (Habitat II), *Habitat Agenda*, U.N. Doc.

A/CONF.165/14, ¶ 11 (Aug. 7, 1996) (recognizing water and sanitation as part of the right to an adequate standard of living).

¹² El Hadji Guissé (Special Rapporteur), *Final Rep. on the Relationship Between the Enjoyment of Economic, Social and Cultural Rights and the Promotion of the Realization of the Right to Drinking Water Supply and Sanitation*, U.N. Doc. E/CN.4/Sub.2/2004/20, ¶¶ 23–25 (July 14, 2004) (explicitly supporting the right to water as an independent right at international law). *See also* U.N. High Comm’r for Human Rts., *Rep. on the Scope and Content of the Relevant Human Rights Obligations Related to Equitable Access to Safe Drinking Water and Sanitation under International Human Rights Instruments*, U.N. Doc. A/HRC/6/3, ¶¶ 45–49 (Aug. 16, 2007). The independent expert on the issue of human rights obligations related to access to safe drinking water and sanitation was established by Human Rights Council Res. 7/22 (Mar. 28, 2008) and the title was changed to Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation to reflect recognition of the right to water in Human Rights Council Res. 16/2, ¶ 4 (Apr. 8, 2011). Explicit recognition of the right to water is evident in Catarina de Albuquerque (Independent Expert), *Rep. of the Independent Expert on the Issue of Human Rights Obligations Related to Access to Safe Drinking Water and Sanitation*, U.N. Doc. A/HRC/12/24 (July 1, 2009); Catarina de Albuquerque (Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation), *Rep. of the Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation: Addendum – Compilation of Good Practices*, U.N. Doc. A/HRC/18/33/Add.1 (June 29, 2011); Catarina de Albuquerque (Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation), *Rep. of the Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation*, U.N. Doc. A/66/255 (Aug. 3, 2011); Catarina de Albuquerque (Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation), *Stigma and the Realization of the Human Rights to Water and Sanitation*, U.N. Doc. A/HRC/21/42 (July 2, 2012); Catarina de Albuquerque (Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation), *Sustainability in the Realization of the Human Rights to Water and Sanitation*, U.N. Doc. A/HRC/24/44 (July 11, 2013); Catarina de Albuquerque (Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation), *Rep. of the Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation*, U.N. Doc. A/68/264 (Aug. 5, 2013); Catarina de Albuquerque (Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation), *Common Violations of the Human Rights to Water and Sanitation*, U.N. Doc. A/HRC/27/55 (June 30, 2014); Catarina de Albuquerque (Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation), *Rep. of the Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation*, U.N. Doc. A/69/213 (July 31, 2014). *See also* the recognition of the right to water in the context of the right to food, most recently *in* Jean Ziegler (Special Rapporteur on the Right to Food), *Rep. Submitted by the Special Rapporteur on the Right to Food, Jean Ziegler, in accordance with Commission on Human Rights Resolution 2003/25*, U.N. Doc. E/CN.4/2004/10; in the context of the right to health, *see* Paul Hunt (Special Rapporteur on the Right of Everyone to the Enjoyment of the Highest Attainable Standard of Physical and Mental Health), *Rep. of the Special Rapporteur on the Right of Everyone to the Enjoyment of the Highest Attainable Standard of Physical and Mental Health*, U.N. Doc. E/CN.4/2006/48, ¶¶ 5, 9 (Mar. 3, 2006); and as an “important element of adequate housing,” *see* Miloon Kothari (Special Rapporteur on Adequate Housing as a Component of the Right to an Adequate Standard of Living), *Rep. of the Special Rapporteur on Adequate Housing as a Component of the Right to an Adequate Standard of Living*, U.N. Doc. E/CN.4/2002/59, ¶¶ 55–56 (Mar. 1, 2002).

¹³ African Charter on the Rights and Welfare of the Child, art. 14(2), Nov. 29, 1999, OAU Doc. CAB/LEG/24.9/49; African (Banjul) Charter on Human and Peoples’ Rights, art. 24, June 27, 1981, OAU Doc. CAB/LEG/67/3 rev. 5; Protocol to the African Charter on Human and Peoples’ Rights on the Rights of Women in Africa, art. 15, July 11, 2003; Additional Protocol to the American Convention on Human Rights in the Area of Economic, Social and Cultural Rights, art. 11, Nov. 17, 1988; Arab Charter on Human Rights, art. 39, May 22, 2004 (recognizing the right of everyone to the enjoyment of the highest attainable standard of health, for which states should ensure the provision of “basic nutrition and safe drinking water for all” and proper sanitation systems); 14th Summit Conference of Heads of State or Government of the Non-Aligned Movement, *Final Document: Disarmament and International Security*, NAM2006/Doc.1/Rev.3, ¶ 226 (Sept. 16, 2006) (recognizing “the right to water for all”); First Africa-South America Summit, *Abuja Declaration*, ASA/Summit/doc.01(I), ¶ 18 (Nov. 26–30, 2006) (where heads of state declared that they would promote the right of their citizens to have access to clean and safe water and sanitation within their respective jurisdictions); Eur. Consult. Ass., *Recommendation 14 of the Comm. of Ministers to Member States on the European Charter on Water Resources*, ¶ 5, 769th meeting of the Ministers’ Deputies (Oct. 17, 2001) (stating that that everyone has the right to a sufficient quantity of water for his or her basic needs); Water Management in Developing Countries: Resolution on the Commission Communication on Water Management in Developing Countries and Priorities for EU Development Cooperation, EUR. PARL. DOC. P5_TA0377, ¶ 1 (2003) (stating that “access to drinking water in a sufficient quantity and of adequate quality is a basic human right”); *see also* 1st Asia-Pacific Water Summit, Beppu,

Message from Beppu (Dec. 3–4, 2007) (a group of Asia-Pacific leaders agreeing to recognize people’s right to safe drinking water and basic sanitation as a basic human right and fundamental aspect of human security).

¹⁴ See *Velez Loo v. Panama*, Preliminary Objections, Merits, Reparations and Costs, Judgment, Inter-Am. Ct. H.R. (ser. C) No. 218 (Nov. 23, 2010); *Xakmok Kasek Indigenous Community v. Paraguay*, Merits, Reparations, and Costs, Judgment, Inter-Am. Ct. H.R. (ser. C) No. 21 (Aug. 24, 2010); *Case of the Sawhoyamaya Indigenous Community v. Paraguay*, Merits, Reparations and Costs, Judgment, Inter. Am. Ct. H.R. (ser. C) No. 146 (Mar. 29, 2006); *Yakye Axa Indigenous Community v. Paraguay*, Merits, Reparations, and Costs, Judgment, Inter-Am. Ct. H.R. (ser. C) No. 125 (June 17, 2005); *Tadevosyan v. Armenia*, App. No 41698/04, Eur. Ct. H. R. (Dec. 2, 2008); *Riad and Idiab v. Belgium*, App. Nos 29787/03 and 29810/03, Eur. Ct. H.R. (Jan. 24, 2008); *Eugen Gabriel Radu v. Romania*, App. No 3036/04, Eur. Ct. H.R. (May 26, 2009); *Marian Stoicescu v. Romania*, App. No 12934/02, Eur. Ct. H.R. (July 16, 2009); *Butan and Dragomir v. Romania*, App. No 40067/2006, Eur. Ct. H.R. (Sept. 19, 2008); *Fedotov v. Russia*, App. No 5140/02, Eur. Ct. H.R. (Oct. 25, 2005); *Zander v. Sweden*, App. No. 14282/88, Eur. Ct. H.R. (Nov. 25, 1993); *Dubetska v. Ukraine*, App. No 30499/03, Eur. Ct. H.R. (Feb. 10, 2011); *Melnik v. Ukraine*, App. No 72286/2001, Eur. Ct. H.R. (Mar. 28, 2006); *Institute for Human Rights and Development in Africa v. Angola*, Communication 292/04, African Commission on Human and Peoples’ Rights (May 22, 2008); *Sudan Human Rights Organisation and Centre on Housing Rights and Evictions v. Sudan*, Communications 279/03 and 296/05, African Commission on Human and Peoples’ Rights (May 27, 2009). See also *European Roma Rights Centre v. Italy*, Complaint 27/2004, Decision on the Merits, European Committee of Social Rights, ¶ 35 (Dec. 7, 2005) (where the European Committee of Social Rights included access to safe drinking water as a requirement of the right to adequate housing, provided by article 31 of the Revised European Social Charter); *World Organisation against Torture, Lawyers’ Committee for Human Rights, Jehovah Witnesses & Inter-African Union for Human Rights v. Zaire*, Communications 25/89, 47/90, 56/91, 100/93, African Commission on Human and Peoples’ Rights, ¶ 47 (Mar. 1996) (stating that failure by the government to provide safe drinking water constituted a violation of the right to health); *Sudan Human Rights Organisation v. The Sudan and Centre on Housing Rights and Evictions v. The Sudan*, Communications 279/03 and 296/05, African Commission on Human and Peoples’ Rights, ¶¶ 206–212 (May 13–27, 2009).

¹⁵ *L. Mazibuko & Others v. The City of Johannesburg & Others*, 2009, 3 SA 592 (S. Afr.) (holding that pre-payment water meters used by the City of Johannesburg are unlawful, and the City is obliged to provide forty-two liters of free water to each Phiri resident who cannot afford to pay for water, in accordance with the right to water in Section 27(1) of the South African constitution). *Cámara de Apelaciones en lo Civil de Neuquén [CApel.CC Nqn.] [Civil Court of Appeals of Neuquén, Argentina]*, 19/05/1997, “Menores Comunidad Paynemil s/accion de amparo” (Expte 311-CA-1997), sala II (Arg.) (the Civil Court of Appeals of Neuquén, Argentina found that the exposure of indigenous children to lead and mercury in drinking water, through pollution by an oil company, was a violation by the Provincial authority to protect the community’s right to health and to a safe environment); *Charan Lal Sahu v. Union of India*, AIR 1990 SC 1489 (India); *Subhash Kumar v. State of Bihar*, AIR 1991 SC 420, 424 (India) (interpreting Article 21 of the Indian Constitution, which protects the right to life, as including the right to water); *Perumatty Grama Panchayat v. State of Kerala*, (1) KLT 2004 731 (Kerala) (finding that the state must protect water resources for the benefit of future generations, and a failure to do so amounts to a violation of the right to life, protected by the Indian Constitution). The Supreme Court of Chile found in a case involving the Pascua Lama mine in the Atacama region of Chile, that the right to water was indivisible with the right to health and the preservation of the nature, and ordered a cessation in the mining project until all works aimed to protect water resources had been completed. *Corte Suprema de Justicia [C.S.J.] [Supreme Court]*, 23 septiembre 2013, “Resolución n° 69037 de Corte Suprema,” Rol de la causa: 5339-2013, Sala Tercera (Constitucional) (Chile), https://www.escri-net.org/sites/default/files/Decision%20-%20Corte%20Suprema_0.pdf.

¹⁶ INGA T. WINKLER, *THE HUMAN RIGHT TO WATER: SIGNIFICANCE, LEGAL STATUS, AND IMPLICATIONS FOR WATER ALLOCATION* (2012); Amy Hardberger, *Life, Liberty, and the Pursuit of Water: Evaluating Water as a Human Right and the Duties and Obligations It Creates*, 4 NW. UNIV. J. INT’L HUM. RTS. 331 (2005); Peter H. Gleick, *The Human Right to Water*, 1 WATER POL’Y 487 (1998); Malcolm Langford, *The United Nations Concept of Water as a Human Right: A New Paradigm for Old Problems?* 21 INT. J. WATER RESOURCES DEV. 273 (2005); Takele Soboka Bulto, *The Emergence of the Human Right to Water in International Human Rights Law: Invention or Discovery?*, 12 MELB. J. INT’L L. 290 (2011).

¹⁷ CTR. FOR HUMAN RIGHTS AND GLOBAL JUSTICE ET. AL., *WÖCH NAN SOLEY: THE DENIAL OF THE RIGHT TO WATER IN HAITI* (2008); HUMAN RIGHTS WATCH, *Troubled Water: Burst Pipes, Contaminated Wells and Open Defecation in Zimbabwe’s Capital* (Nov. 2013); HUMAN RIGHTS WATCH, *Toxic Water, Tainted Justice: Thailand’s*

Delays in Cleaning Up Kitty Creek (Dec. 2014); AMNESTY INT'L, *Parallel Lives: Roma Denied Rights to Housing and Water in Slovenia* (Mar. 16, 2011); Elisabeth Koek, *Water for One People Only: Discriminatory Access and 'Water Apartheid' in the OPT*, AL-HAQ (Mar. 2013).

¹⁸ CEO WATER MANDATE, SHIFT & THE PACIFIC INST., *Guidance for Companies on Respecting the Human Rights to Water and Sanitation: Bringing a Human Rights Lens to Corporate Water Stewardship* (Jan. 2015); Catarina de Albuquerque & Virginia Roaf, *On the Right Track: Good Practices to Realising the Rights to Water and Sanitation* (Feb. 2012), http://www.ohchr.org/Documents/Issues/Water/BookonGoodPractices_en.pdf. See also Catarina de Albuquerque (Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation), *Rep. of the Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation: Addendum – Compilation of Good Practices*, U.N. Doc. A/HRC/18/33/Add.1 (June 29, 2011) (a guide to how states can implement the rights to water and sanitation); El Hadji Guissé (U.N. Special Rapporteur), *Economic, Social and Cultural Rights: Realization of the Right to Drinking Water Supply and Sanitation – Draft Guidelines for the Realization of the Right to Drinking Water and Sanitation*, U.N. Doc. E/CN.4/Sub.2/2005/25, ¶ 2.3(e) (July 11, 2004).

¹⁹ John Ruggie (Special Representative of the Secretary-General on the Issue of Human rights and Transnational Corporations and other Business Enterprises), *Guiding Principles on Business and Human Rights: Implementing the United Nations "Protect, Respect and Remedy" Framework*, Principles 11-22, U.N. Doc. A/HRC/17/31 (Mar. 21, 2011).

²⁰ General Comment No. 15: The Right to Water, *supra* note 3, ¶ 12(c). See also U.N. High Comm'r for Human Rts., Rep. on the Scope and Content of the Relevant Human Rights Obligations Related to Equitable Access to Safe Drinking Water and Sanitation under International Human Rights Instruments, ¶ 25, U.N. Doc. A/HRC/6/3 (Aug. 16, 2007).

²¹ General Comment No. 15: The Right to Water, *supra* note 3, ¶ 12(c)(i); see also THE RIGHT TO WATER: FACT SHEET NO. 35, *supra* note 7, at 10.

²² WORLD HEALTH ORG., GUIDELINES FOR DRINKING-WATER QUALITY 84 (4th ed. 2011) (noting that even at this level of basic access, hygiene may be compromised, leading to high public health risks).

²³ See *id.*

²⁴ See General Comment No. 15: The Right to Water, *supra* note 3, ¶ 12(c)(i); U.N. High Comm'r for Human Rts., Rep. on the Scope and Content of the Relevant Human Rights Obligations Related to Equitable Access to Safe Drinking Water and Sanitation under International Human Rights Instruments, ¶ 25, U.N. Doc. A/HRC/6/3 (Aug. 16, 2007).

²⁵ See General Comment No. 15: The Right to Water, *supra* note 3, at ¶¶ 12(c), 56 (stating that “[u]nder no circumstances shall an individual be deprived of the minimum essential level of water”). See also U.N. High Comm'r for Human Rts., Rep. on the Scope and Content of the Relevant Human Rights Obligations Related to Equitable Access to Safe Drinking Water and Sanitation under International Human Rights Instruments, ¶ 28, U.N. Doc. A/HRC/6/3 (Aug. 16, 2007) (the right to water does not require free water but nobody should be deprived of access because of an inability to pay); UNITED NATIONS DEV'T PROGRAM, HUMAN DEVELOPMENT REPORT 2006 – BEYOND SCARCITY: POWER, POVERTY AND THE GLOBAL WATER CRISIS 97 (2006) (water costs should not constitute more than three per cent of household income); WINKLER, *supra* note 16, at 137 (three to five per cent is the most common indicator).

²⁶ GUIDELINES FOR DRINKING-WATER QUALITY, *supra* note 22, at 85. See also U.N. Conf. on Env't and Dev't, *Agenda 21*, ¶ 18.8 (1992); (beyond the provision of safe drinking water for the satisfaction of basic needs, water users should be charged appropriately); Eur. Consult. Ass., *Recommendation 14 of the Comm. of Ministers to Member States on the European Charter on Water Resources*, ¶ 19, 769th meeting of the Ministers' Deputies (Oct. 17, 2001) (“[w]ithout prejudice to the right to water to meet basic needs, the supply of water shall be subject to payment in order to cover financial costs associated with the production and utilisation of water resources.”).

²⁷ General Comment No. 15: The Right to Water, *supra* note 3, ¶ 12(c)(ii).

²⁸ *Id.* ¶ 12(c)(iii).

²⁹ *Id.* ¶ 13. See also THE RIGHT TO WATER, *supra* note 7, at 10; U.N. High Comm'r for Human Rts., Rep. on the Scope and Content of the Relevant Human Rights Obligations Related to Equitable Access to Safe Drinking Water and Sanitation under International Human Rights Instruments, ¶ 22, U.N. Doc. A/HRC/6/3 (Aug. 16, 2007) (using the

concept of “equitable access” requiring “equal and non-discriminatory access” where no population group is excluded from access to water or disproportionately burdened with the costs of access).

³⁰ THE RIGHT TO WATER: FACT SHEET NO. 35, *supra* note 7, at 21–22 (noting that disabled people have historically suffered from marginalization and discrimination as a result of the inaccessible design of buildings, services and infrastructure, and that any water provision must be physically accessible to them, in accordance with CRPD, *supra* note 9, art. 28(2)).

³¹ U.N. High Comm’r for Human Rts., Rep. on the Scope and Content of the Relevant Human Rights Obligations Related to Equitable Access to Safe Drinking Water and Sanitation under International Human Rights Instruments, ¶ 25, U.N. Doc. A/HRC/6/3 (Aug. 16, 2007). Women and children do most of the water collecting if drinking water is not available on the premises, and therefore a lack of accessibility has a disproportionate burden on them, *see* THE RIGHT TO WATER: FACT SHEET NO. 35, *supra* note 7, at 19–21 (citing data from WÖCH NAN SOLEY: THE DENIAL OF THE RIGHT TO WATER IN HAITI, *supra* note 17, at 44 (showing that 20% of respondents in a household survey in Port-de-Paix “reported that having to collect water prevented or inhibited their children from attending school. Nearly three quarters also stated that safe drinking water was not available in schools and that many children had to carry water to school or purchase it there.”)).

³² General Comment No. 15: The Right to Water, *supra* note 3, ¶ 12(a).

³³ *Id.* (in this context, “drinking” means water for consumption through beverages and food. “Personal sanitation” means disposal of human excreta. Water is necessary for personal sanitation where water-based means are adopted. “Food preparation” includes food hygiene and preparation of food. “Personal and household hygiene” means personal cleanliness and hygiene of the household environment, *id.* ¶ 12(a) n.13).

³⁴ General Comment No. 15: The Right to Water, *supra* note 3, ¶ 12(a) refers to World Health Organization guidelines as the standard for determining what is a sufficient quantity of water. *See also* THE RIGHT TO WATER, *supra* note 7, at 13; GUIDELINES FOR DRINKING-WATER QUALITY, *supra* note 22, at 84; U.N. High Comm’r for Human Rts., Rep. on the Scope and Content of the Relevant Human Rights Obligations Related to Equitable Access to Safe Drinking Water and Sanitation under International Human Rights Instruments, U.N. Doc. A/HRC/6/3 (Aug. 16, 2007) (stating that between 50 and 100 liters of water per person per day are needed to ensure that most basic needs are met and few health concerns arise. Access to 25 liters per person per day represents a minimum).

³⁵ General Comment No. 15: The Right to Water, *supra* note 3, at n.12 (defining “continuous” as “the regularity of the water supply is sufficient for personal and domestic uses”). *See also* Catarina de Albuquerque (Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation), *Rep. of the Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation: Addendum – Mission to Tuvalu (17–19 July 2012)*, U.N. Doc. A/HRC/24/44/Add.2, ¶¶ 15–16 (July 1, 2013) (noting that the adequacy of rainwater sources will be determined by the capacity of a rainwater catchment system and whether fluctuations in rainfall interrupt the refilling of a tank, creating discontinuity in supply).

³⁶ GUIDELINES FOR DRINKING-WATER QUALITY, *supra* note 22, at 86 (stating that storing water can increase the risk of contamination and impact water quality).

³⁷ General Comment No. 15: The Right to Water, *supra* note 3, ¶ 12(b).

³⁸ *Id.* (emphasis in original). *See also* GUIDELINES FOR DRINKING-WATER QUALITY, *supra* note 22, at 1 (defining safe drinking water as that which “does not represent any significant risk to health over a lifetime of consumption, including different sensitivities that may occur between life stages.”).

³⁹ *See* General Comment No. 15: The Right to Water, *supra* note 3, ¶ 12(b) and n.15 (referring states to World Health Organization Guidelines for drinking-water quality as a means for determining the appropriate standards); GUIDELINES FOR DRINKING-WATER QUALITY, *supra* note 22, at 1 (defining safe drinking water as water that “does not represent any significant risk to health over a lifetime of consumption, including different sensitivities that may occur between life stages”).

⁴⁰ Calin Georgescu (Special Rapporteur on the Human Rights Obligations Related to Environmentally Sound Management and Disposal of Hazardous Substances and Waste), *Rep. of the Special Rapporteur on the Human Rights Obligations Related to Environmentally Sound Management and Disposal of Hazardous Substances and Waste*, U.N. Doc. A/HRC/21/48, ¶ 39, (July 2, 2012).

⁴¹ *Id.*

⁴² Baskut Tuncak (Special Rapporteur on the Implications for Human Rights of the Environmentally Sound Management and Disposal of Hazardous Substances and Wastes), *Rep. of the Special Rapporteur on the Implications for Human Rights of the Environmentally Sound Management and Disposal of Hazardous Substances and Wastes*, U.N. Doc. A/HRC/33/41, ¶¶ 5, 56, 70 (Aug. 2, 2016).

⁴³ Baskut Tuncak (Special Rapporteur on the Implications for Human Rights of the Environmentally Sound Management and Disposal of Hazardous Substances and Wastes), *Rep. of the Special Rapporteur on the Implications for Human Rights of the Environmentally Sound Management and Disposal of Hazardous Substances and Wastes*, U.N. Doc. A/HRC/33/41, ¶ 6 (Aug. 2, 2016) (citing Philippe Grandjean & Philip J. Landrigan, *Neurobehavioural effects of developmental toxicity*, 13 THE LANCET NEUROLOGY, no. 3 (2014)).

⁴⁴ See General Comment No. 15: The Right to Water, *supra* note 3, ¶ 12(b); GUIDELINES FOR DRINKING-WATER QUALITY, *supra* note 22, at 7–8, ¶ 1.1.6 (“Water should be free of tastes and odours that would be objectionable to the majority of consumers. In assessing the quality of drinking-water, consumers rely principally upon their senses.”).

⁴⁵ *Id.* at 8, ¶ 1.1.6.

⁴⁶ See Catarina de Albuquerque (Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation), *Realising the Human Rights to Water and Sanitation, A Handbook by the UN Special Rapporteur Catarina de Albuquerque: Legislative, Regulatory and Policy Frameworks*, 51 (2014) (“Participation is crucial to ensure that the technology and design of water and sanitation facilities will be acceptable to users, for example, in terms of allowing good hygiene practice. Including the concept of acceptability in laws is necessary but insufficient, as the only way to ensure genuine acceptability is with the full participation by users of the service in decisions about technology and design.”).

⁴⁷ General Comment No. 15: The Right to Water, *supra* note 3, ¶ 48. See also U.N. Econ. Comm’n for Europe, Convention on Access to Information, *Public Participation in Decision-Making and Access to Justice in Environmental Matters*, art. 5(1)(c) (June 25, 1998) (requiring immediate dissemination to potentially affected communities of all information that could enable the public to take measures to prevent or mitigate harm arising from environmental threats).

⁴⁸ See General Comment No. 15: The Right to Water, *supra* note 3, ¶ 12(c)(iv); THE RIGHT TO WATER: FACT SHEET NO. 35, *supra* note 7, at 16; Catarina de Albuquerque (Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation), *Rep. of the Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation*, U.N. Doc. A/69/213, ¶¶ 27–29 (July 31, 2014) (listing access to information as a criterion for active, free and meaningful participation).

⁴⁹ Catarina de Albuquerque (Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation), *Rep. of the Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation*, U.N. Doc. A/69/213, ¶¶ 9–17 (July 31, 2014) (describing the legal basis of the right to participation).

⁵⁰ See Baskut Tuncak (Special Rapporteur on the Implications for Human Rights of the Environmentally Sound Management and Disposal of Hazardous Substances and Wastes), *Rep. of the Special Rapporteur on the Implications for Human Rights of the Environmentally Sound Management and Disposal of Hazardous Substances and Wastes*, U.N. Doc. A/HRC/30/40, ¶ 22 (July 8, 2015) (noting that the right is derived from the right freedom of expression and the right to take part in public affairs, and encompasses “the right of individuals to request and receive information of public interest and information concerning themselves that may affect their individual rights”).

⁵¹ See *id.* ¶ 25. See also Comm. on Econ., Soc. and Cultural Rts., General Comment No. 14: The Right to the Highest Attainable Standard of Health, U.N. Doc. E/C.12/2000/4, ¶ 44(d) (Aug. 11, 2000) [hereinafter General Comment No. 14: The Right to the Highest Attainable Standard of Health] (identifying as a “core obligation” of states as part of the right to health, “[t]o provide education and access to information concerning the main health problems in the community, including methods of preventing and controlling them”).

⁵² Baskut Tuncak (Special Rapporteur on the Implications for Human Rights of the Environmentally Sound Management and Disposal of Hazardous Substances and Wastes), *Rep. of the Special Rapporteur on the Implications for Human Rights of the Environmentally Sound Management and Disposal of Hazardous Substances and Wastes*, U.N. Doc. A/HRC/30/40, ¶ 32 (July 8, 2015).

⁵³ *Id.* at ¶ 33.

⁵⁴ *Id.*

⁵⁵ *Id.* at ¶ 34.

⁵⁶ *Id.* at ¶ 35.

⁵⁷ *Id.* at ¶ 36.

⁵⁸ *Id.* at ¶ 37.

⁵⁹ See General Comment No. 15: The Right to Water, *supra* note 3, ¶ 48; Catarina de Albuquerque (Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation), *Common Violations of the Human Rights to Water and Sanitation*, U.N. Doc. A/HRC/27/55, ¶ 68 (June 30, 2014) (stating that violations of the right to participate can occur through “failure to take reasonable steps to facilitate participation, including by ensuring the right to access to information” and noting that the procedural dimension of the right to water stems from the right to participate in public affairs as guaranteed by ICCPR, *supra* note 4, art. 25(a)).

⁶⁰ See G.A. Res. 61/295, art. 32(2), Add.1, United Nations Declaration on the Rights of Indigenous Peoples (Sep. 13, 2007).

⁶¹ Catarina de Albuquerque (Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation), *Rep. of the Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation*, U.N. Doc. A/69/213, ¶ 2 (July 31, 2014) (also noting that participation should not reinforce inequalities or existing hierarchies, *id.* ¶ 3).

⁶² Catarina de Albuquerque (Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation), *Rep. of the Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation*, U.N. Doc. A/69/213, ¶¶ 18–31 (July 31, 2014) (defining “active, free and meaningful” as requiring the following steps: involving people in the terms of engagement; creating opportunities for participation from the beginning of deliberations; eliminating all barriers to accessing deliberative processes; free and safe participation without coercion, inducement, reprisals, or discrimination; access to information; ensuring people’s views are considered and are able to influence the decision; requiring more than simply obtaining consent). See also Catarina de Albuquerque (Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation), *Common Violations of the Human Rights to Water and Sanitation*, U.N. Doc. A/HRC/27/55, ¶¶ 68–69 (June 30, 2014) (supporting the concept of “meaningful engagement” established in *Occupiers of 51 Olivia Road, Berea Township and 197 Main Street, Johannesburg v. City of Johannesburg* 2008 (3) SA 208 (CC) ¶¶ 18, 21 (S. Afr.). See also WINKLER, *supra* note 16, at 220 (participation requires that “the specific decisions regarding water allocation within that framework are taken by including all relevant stakeholders”).

⁶³ Catarina de Albuquerque (Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation), *Rep. of the Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation*, U.N. Doc. A/69/213, ¶¶ 62–63 (July 31, 2014) (citing the example of Kenyan residents in Kayole-Soweto who were successful in negotiating a policy of spreading payment for water connection over two years).

⁶⁴ *Id.* ¶ 67.

⁶⁵ *Id.* ¶ 78 (stating that mining “can have serious consequences on both water quantity and quality that can extend across generations”).

⁶⁶ *Id.*

⁶⁷ *Id.*

⁶⁸ Baskut Tuncak (Special Rapporteur on the Implications for Human Rights of the Environmentally Sound Management and Disposal of Hazardous Substances and Wastes), *Rep. of the Special Rapporteur on the Implications for Human Rights of the Environmentally Sound Management and Disposal of Hazardous Substances and Wastes*, U.N. Doc. A/HRC/33/41, ¶ 23 (Aug. 2, 2016).

⁶⁹ Baskut Tuncak (Special Rapporteur on the Implications for Human Rights of the Environmentally Sound Management and Disposal of Hazardous Substances and Wastes), *Rep. of the Special Rapporteur on the Implications for Human Rights of the Environmentally Sound Management and Disposal of Hazardous Substances and Wastes*, U.N. Doc. A/HRC/33/41, ¶ 58 (Aug. 2, 2016) (quoting Comm. on the Rts. of the Child, General Comment No. 15 on the right of the child to the enjoyment of the highest attainable standard of health, art. 24, U.N. Doc. CRC/C/GC/15, ¶ 58 (Apr. 17, 2013)).

⁷⁰ General Comment No. 15: The Right to Water, *supra* note 3, ¶ 6.

⁷¹ *Id.* ¶¶ 1, 3.

⁷² See ICESCR, *supra* note 5, art. 12 (stating that “States Parties to the present Covenant recognize the right of everyone to the enjoyment of the highest attainable standard of physical and mental health” and noting that in realization of this right, state parties should take concrete measures, including the steps necessary for “[t]he improvement of all aspects of environmental and industrial hygiene”); General Comment No. 14: The Right to the Highest Attainable Standard of Health, *supra* note 51, ¶ 8. See also explicit recognition of the right to health *in* Universal Declaration of Human Rights, *supra* note 5, art. 25; CRC, *supra* note 9, art. 24.

⁷³ General Comment No. 14: The Right to the Highest Attainable Standard of Health, *supra* note 51, ¶ 4.

⁷⁴ See General Comment No. 15: The Right to Water, *supra* note 3, ¶¶ 2, 8.

⁷⁵ General Comment No. 14: The Right to the Highest Attainable Standard of Health, *supra* note 51, ¶ 8.

⁷⁶ *Id.* ¶ 15.

⁷⁷ ICESCR, *supra* note 5, art. 11(1) provides: “The States Parties to the present Covenant recognize the right of everyone to an adequate standard of living for himself and his family, including adequate food...”.

⁷⁸ United Nations Off. of the High Comm’r for Human Rts., *Special Rapporteur on the Right to Food*, <http://www.ohchr.org/EN/Issues/Food/Pages/FoodIndex.aspx>.

⁷⁹ General Comment No. 15: The Right to Water, *supra* note 3, ¶ 7.

⁸⁰ ICESCR, *supra* note 5, art. 11(1) provides “The States Parties to the present Covenant recognize the right of everyone to an adequate standard of living for himself and his family, including adequate...housing...”.

⁸¹ Comm. on Econ., Soc. and Cultural Rts., General Comment No. 4: The Right to Adequate Housing, U.N. Doc. E/1992/23, ¶ 7 (1991).

⁸² *Id.* ¶ 8(b).

⁸³ This “tripartite typology” of state obligations applies generally in the context of economic, social and cultural rights: see WINKLER, *supra* note 16, at 107; General Comment No. 15: The Right to Water, *supra* note 3, ¶ 20 (“The right to water, like any human right, imposes three types of obligations on States parties: obligations to respect, obligations to protect and obligations to fulfill.”) (emphasis omitted); THE RIGHT TO WATER, *supra* note 7, at 7. See also Catarina de Albuquerque (Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation), *Common Violations of the Human Rights to Water and Sanitation*, U.N. Doc. A/HRC/27/55, ¶ 16 (June 30, 2014).

⁸⁴ General Comment No. 15: The Right to Water, *supra* note 3, ¶ 21 (this obligation prohibits any practice that “denies or limits equal access to adequate water; arbitrarily interfering with customary or traditional arrangements for water allocation; unlawfully diminishing or polluting water...limiting access to, or destroying, water services and infrastructure as a punitive measure”); see also Catarina de Albuquerque (Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation), *Common Violations of the Human Rights to Water and Sanitation*, U.N. Doc. A/HRC/27/55, ¶ 17 (June 30, 2014) (identifying three common violations of the obligation as “(a) Direct interference with access to water or sanitation; (b) Pollution, diversion or depletion of water resources; (c) Criminalization of activities linked to water or sanitation and punitive measures”).

⁸⁵ THE RIGHT TO WATER, *supra* note 7, at 28–29.

⁸⁶ Catarina de Albuquerque (Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation), *Common Violations of the Human Rights to Water and Sanitation*, U.N. Doc. A/HRC/27/55, ¶ 20 (June 30, 2014).

⁸⁷ General Comment No. 15: The Right to Water, *supra* note 3, ¶ 23.

⁸⁸ *Id.*

⁸⁹ See also General Comment No. 14: The Right to the Highest Attainable Standard of Health, *supra* note 51, ¶ 15 (stating that “States are also required to adopt measures against environmental and occupational health hazards...For this purpose they should formulate and implement national policies aimed at reducing and eliminating pollution of air, water and soil, including pollution by heavy metals such as lead from gasoline.”) See also *id.* ¶ 36; “States should also refrain from unlawfully polluting air, water and soil, e.g. through industrial waste from State-owned facilities.” *Id.* ¶ 3). See also General Comment No. 15: The Right to Water, *supra* note 3, ¶ 44(a) (discussing violations of the obligation to respect as including “pollution and diminution of water resources affecting human health”).

⁹⁰ Baskut Tuncak (Special Rapporteur on the Implications for Human Rights of the Environmentally Sound Management and Disposal of Hazardous Substances and Wastes), *Rep. of the Special Rapporteur on the Implications for Human Rights of the Environmentally Sound Management and Disposal of Hazardous Substances and Wastes*, U.N. Doc. A/HRC/33/41, ¶ 110(a) (Aug. 2, 2016).

⁹¹ *Id.* ¶ 5.

⁹² Catarina de Albuquerque (Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation), *Common Violations of the Human Rights to Water and Sanitation*, U.N. Doc. A/HRC/27/55, ¶ 29 (June 30, 2014); General Comment No. 15: The Right to Water, *supra* note 3, ¶ 44(b) (listing common violations of the obligation to protect as “(i) failure to enact or enforce laws to prevent the contamination and inequitable extraction of water; (ii) failure to effectively regulate and control water services providers; (iv) failure to protect water distribution systems (e.g., piped networks and wells) from interference, damage and destruction”). *See also* THE RIGHT TO WATER, *supra* note 7, at 29 (listing examples of interference by third parties as pollution from factories, farming or sewage, a private individual denying access to a river needed for washing, or a corporation increasing prices for water services to unaffordable levels).

⁹³ Catarina de Albuquerque (Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation), *Common Violations of the Human Rights to Water and Sanitation*, U.N. Doc. A/HRC/27/55, ¶ 31 (June 30, 2014). *See also* The Social and Economic Rights Action Center and the Center for Economic and Social Rights v. Nigeria, African Commission on Human and Peoples’ Rights, Communication 155/96 (Oct. 27, 2001) (finding violations of the rights to life and health for failure of Nigeria to monitor water pollution by oil companies in the Niger Delta).

⁹⁴ General Comment No. 15: The Right to Water, *supra* note 3, ¶ 24 (stating that this regulatory system must include “independent monitoring, genuine public participation and imposition of penalties for non-compliance.”). *See also* El Hadji Guissé (U.N. Special Rapporteur), *Economic, Social and Cultural Rights: Realization of the Right to Drinking Water Supply and Sanitation – Draft Guidelines for the Realization of the Right to Drinking Water and Sanitation*, U.N. Doc. E/CN.4/Sub.2/2005/25, ¶ 2.3(e) (July 11, 2004) (directing states to “[e]stablish a regulatory system for private and public water and sanitation service providers that requires them to provide physical, affordable and equal access to safe, acceptable and sufficient water”, which includes “mechanisms to ensure genuine public participation, independent monitoring and compliance with regulations.”).

⁹⁵ General Comment No. 15: The Right to Water, *supra* note 3, ¶ 16(d).

⁹⁶ General Comment No. 15: The Right to Water, *supra* note 3, ¶ 37(a) (listed as the first of the state’s immediate “core obligations” with respect to the right to water).

⁹⁷ *See id.* ¶ 25 (describing the duty to fulfil as requiring states to facilitate, promote and provide: “The obligation to facilitate requires the State to take positive measures to assist individuals and communities to enjoy the right. The obligation to promote obliges the State party to take steps to ensure that there is appropriate education concerning the hygienic use of water, protection of water sources and methods to minimize water wastage. States parties are also obliged to fulfil (provide) the right when individuals or a group are unable, for reasons beyond their control, to realize that right themselves by the means at their disposal.”); WINKLER, *supra* note 16, at 110–111 (describing the obligation to ensure direct provision of water only as a “last resort,” typically in emergency disaster relief situations or where people do not have sufficient means to pay for water services). *See also* Case of the Sawhoyamaya Indigenous Community v. Paraguay, Merits, Reparations and Costs, Judgment, Inter. Am. Ct. H.R. (ser. C) No. 146 (Mar. 29, 2006), ¶ 230 (ordering the state of Paraguay to “supply sufficient drinking water for consumption and personal hygiene to the members of the [Sawhoyamaya Indigenous] Community,” as the lack of drinking water in the area, particular during times of drought, threatened the right to life).

⁹⁸ General Comment No. 15: The Right to Water, *supra* note 3, ¶ 28 (“Such strategies and programmes may include: (a) reducing depletion of water resources through unsustainable extraction, diversion and damming; (b) reducing and eliminating contamination of watersheds and water-related eco-systems by substances such as radiation, harmful chemicals and human excreta; (c) monitoring water reserves; (d) ensuring that proposed developments do not interfere with access to adequate water; (e) assessing the impacts of actions that may impinge upon water availability and natural-ecosystems watersheds, such as climate changes, desertification and increased soil salinity, deforestation and loss of biodiversity; (f) increasing the efficient use of water by end-users; (g) reducing water wastage in its distribution; (h) response mechanisms for emergency situations; (i) and establishing competent institutions and appropriate institutional arrangements to carry out the strategies and programmes.”). *See also id.* ¶¶ 28, 37(f) and 47; Catarina de Albuquerque (Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation), *Rep. of the Special Rapporteur on*

the Human Right to Safe Drinking Water and Sanitation: Addendum – Mission to Tuvalu (17-19 July 2012), U.N. Doc. A/HRC/24/44/Add.2 (July 1, 2013); Catarina de Albuquerque (Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation), *Rep. of the Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation: Addendum – Mission to Kiribati (23-26 July 2012)*, U.N. Doc. A/HRC/24/44/Add.1, ¶ 63(b) (June 28, 2013) (recommending the establishment of legal and institutional frameworks to protect the rights to water and sanitation, and an independent regulator for water and sanitation).

⁹⁹ General Comment No. 15: The Right to Water, *supra* note 3, ¶¶ 7, 26, 27 (to ensure that water is affordable states may adopt measures such as “(a) use of a range of appropriate low-cost techniques and technologies; (b) appropriate pricing policies such as free or low-cost water; and (c) income supplements,” *id.* ¶ 27. In addition, “[a]ttention should be given to ensuring that disadvantaged and marginalized farmers, including women farmers, have equitable access to water and water management systems, including sustainable rain harvesting and irrigation technology,” *id.* ¶ 7).

¹⁰⁰ Catarina de Albuquerque (Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation), *Common Violations of the Human Rights to Water and Sanitation*, U.N. Doc. A/HRC/27/55, ¶¶ 35-49 (June 30, 2014) (identifying several categories for violations of the failure to fulfil). *See also* Catarina de Albuquerque (Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation), *Rep. of the Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation: Addendum – Mission to Tuvalu (17-19 July 2012)*, U.N. Doc. A/HRC/24/44/Add.2, ¶¶ 15-16 (July 1, 2013) (finding a violation of right to water in light of rainfall fluctuations and limited harvesting capacity for small houses, even though each household on the main island of Tuvalu benefited from the provision of a 10,000-liter rainwater tank).

¹⁰¹ ICESCR, *supra* note 5, art. 2(1) (clarifies the responsibilities that accompany progressive realization: “to take steps, individually and through international assistance and cooperation, especially economic and technical, to the maximum of its available resources, with a view to achieving progressively the full realization of the rights recognized in the present Covenant.”). *See also* General Comment No. 15: The Right to Water, *supra* note 3, ¶ 17 (“While the Covenant provides for progressive realization and acknowledges the constraints due to the limits of available resources, it also imposes on States parties various obligations which are of immediate effect. States parties have immediate obligations in relation to the right to water, such as the guarantee that the right will be exercised without discrimination of any kind (art. 2, para. 2) and the obligation to take steps (art. 2, para.1) towards the full realization of articles 11, paragraph 1, and 12.”); *id.* ¶ 18 (stating that states have a “constant and continuing duty under the Covenant to move as expeditiously and effectively as possible towards the full realization of the right to water. Realization of the right should be feasible and practicable, since all States parties exercise control over a broad range of resources, including water, technology, financial resources and international assistance, as with all other rights in the Covenant.”); *id.* ¶ 37; Human Rights Council Res. A/HRC/15/L.14, ¶ 8(a), Human Rights and Access to Safe Drinking Water and Sanitation (Sept. 24, 2010) (calling on states to realize progressively the right to water and sanitation through “legislation, comprehensive plans and strategies”); *See also* Human Rights Council Res. 27/2, ¶ 11(a), The Human Right to Safe Drinking Water and Sanitation (Oct. 2, 2014).

¹⁰² General Comment No. 15: The Right to Water, *supra* note 3, ¶ 37.

¹⁰³ General Comment No. 15: The Right to Water, *supra* note 3, ¶ 37.

¹⁰⁴ Catarina de Albuquerque (Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation), *Common Violations of the Human Rights to Water and Sanitation*, U.N. Doc. A/HRC/27/55, ¶ 49 (June 30, 2014). *See also* Catarina de Albuquerque (Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation), *Rep. of the Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation*, U.N. Doc A/HRC/24/44, ¶ 58 (July 11, 2013) (stating that states must invest “maximum available resources” in the water sector). *See also* WINKLER, *supra* note 16, at 122 (stating that states must demonstrate that every possible effort has been made and that all available resources have been used to satisfy minimum needs with respect to water).

¹⁰⁵ Catarina de Albuquerque (Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation), *Rep. of the Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation: Addendum – Mission to Kiribati (23-26 July 2012)*, U.N. Doc. A/HRC/24/44/Add.1, ¶¶ 3, 63(a) (June 28, 2013); Catarina de Albuquerque (Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation), *Rep. of the Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation: Addendum – Mission to Tuvalu (17-19 July 2012)*, U.N. Doc. A/HRC/24/44/Add.2, ¶¶ 4, 54(a) (July 1, 2013). *See also* Catarina de Albuquerque (Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation), *Common Violations of the Human Rights to Water and Sanitation*, U.N. Doc. A/HRC/27/55, ¶ 49 (June 30, 2014) (stating that the state must “demonstrate that every effort has been made to use all resources that are at its disposition” to satisfy minimum obligations, with the state bearing the

“burden of proof” to demonstrate that it lacks capacity to provide minimum essential levels of water); Catarina de Albuquerque (Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation), *Rep. of the Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation*, U.N. Doc A/HRC/24/44, ¶ 58 (July 11, 2013) (stating that states must invest “maximum available resources” in the water sector). *See also* WINKLER, *supra* note 16, at 122 (stating that states must demonstrate that every possible effort has been made and that all available resources have been used to satisfy minimum needs with respect to water).

¹⁰⁶ Catarina de Albuquerque (Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation), *Rep. of the Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation*, U.N. Doc A/HRC/24/44, ¶ 58 (July 11, 2013). While “maximum available resources” is not expressly defined, the U.N. Special Rapporteur has suggested evaluating “the national allocation of funds to areas such as the military, bailouts for banks, and the construction of infrastructure for the hosting of mega-events, as well as the amount of funds lost due to the toleration of corruption.” *Id.* at ¶ 60. Another suggested benchmark is “[c]omparing per capita incomes against water and sanitation indicators among countries with comparable levels of development,” to determine whether all available resources have been effectively utilized. *Id.* at ¶ 61.

¹⁰⁷ Catarina de Albuquerque (Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation), *Rep. of the Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation*, *Rep. of the Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation*, U.N. Doc A/HRC/24/44, ¶ 16 (July 11, 2013) (“States must act with care and deliberation, exercise due diligence to assess the impacts of their actions and omissions on the realization of human rights, and adjust their policies and measures as soon as they become aware that current policies might lead to unsustainable results.”).

¹⁰⁸ Baskut Tuncak (Special Rapporteur on the Implications for Human Rights of the Environmentally Sound Management and Disposal of Hazardous Substances and Wastes), *Rep. of the Special Rapporteur on the Implications for Human Rights of the Environmentally Sound Management and Disposal of Hazardous Substances and Wastes*, U.N. Doc. A/HRC/30/40, ¶50 (July 8, 2015).

¹⁰⁹ *Id.* ¶¶ 50–51.

¹¹⁰ *Id.* ¶ 48.

¹¹¹ *Id.* ¶ 67.

¹¹² Comm. on Econ., Soc. and Cultural Rts., General Comment No. 24 on State Obligations under the International Covenant on Economic, Social and Cultural Rights in the Context of Business Activities, E/C.12/GC/24, ¶¶ 26, 30 (Jun. 23, 2017). *See also* MAASTRICHT PRINCIPLES ON EXTRATERRITORIAL OBLIGATIONS OF STATES IN THE AREA OF ECONOMIC, SOCIAL AND CULTURAL RIGHTS [hereinafter MAASTRICHT PRINCIPLES] at 6, 25, 27, http://www.etoconsortium.org/nc/en/main-navigation/library/maastricht-principles/?tx_drblob_pi1%5BdownloadUid%5D=23 (offering an expert opinion restating human rights law on State extra-territorial obligations and finding “[a]ll States have obligations to respect, protect and fulfil human rights, including civil, cultural, economic, political and social rights, both within their territories and extra-territorially”); the Legal Consequences of the Construction of a Wall in the Occupied Palestinian Territory, Advisory Opinion, 2004 I.C.J. 136 (July 9) (affirming state extraterritorial human rights obligations under the ICESCR and the ICCPR); Comm. on Econ., Soc. and Cultural Rts., Statement on the obligations of States parties regarding the corporate sector and economic, social and cultural rights, E/C.12/2011/1, ¶¶ 5-6 (July 12, 2011); John Ruggie (Special Representative of the Secretary-General on the Issue of Human rights and Transnational Corporations and other Business Enterprises), *Guiding Principles on Business and Human Rights: Implementing the United Nations “Protect, Respect and Remedy” Framework*, U.N. Doc. A/HRC/17/31, Principles 1 & 2 (Mar. 21, 2011) (“States must protect against human rights abuse within their territory and/or jurisdiction by third parties, including business enterprises” and “should set out clearly the expectation that all business enterprises domiciled in their territory and/or jurisdiction respect human rights throughout their operations.”).

¹¹³ Comm. on Econ., Soc. and Cultural Rts., General Comment No. 24 on State Obligations under the International Covenant on Economic, Social and Cultural Rights in the Context of Business Activities, E/C.12/GC/24, ¶ 31 (Jun. 23, 2017).

¹¹⁴ *Id.* ¶ 33.

¹¹⁵ *Id.* ¶ 32.

¹¹⁶ *Id.* ¶ 38. *See also*, MAASTRICHT PRINCIPLES, *supra* note 112, at 24 (“All States must take necessary measures to ensure that non-state actors which they are in a position to regulate, . . . such as . . . transnational corporations and other business enterprises, do not nullify or impair the enjoyment of economic, social and cultural rights. These include administrative, legislative, investigative, adjudicatory and other measures.”). *See also id.* at 37 (“Where the harm resulting from an alleged violation has occurred on the territory of a State other than a State in which the harmful conduct took place, any State concerned must provide remedies to the victim.”); Inter-American Comm’n on Human Rts., *Indigenous Peoples, Afro-Descendant Communities, and Natural Resources: Human Rights Protection in the Context of Extraction, Exploitation, and Development Activities* (Dec. 31, 2015), <http://www.oas.org/en/iachr/reports/pdfs/ExtractiveIndustries2016.pdf> (noting, “[States] should adopt appropriate mechanisms of supervision and regulation of the activities of their companies and nationals abroad in line with the relevant international human rights standards.”).

¹¹⁷ Comm. on Econ., Soc. and Cultural Rts., General Comment No. 24 on State Obligations under the International Covenant on Economic, Social and Cultural Rights in the Context of Business Activities, *supra* note 113, ¶¶ 41-44.

¹¹⁸ *Guiding Principles on Business and Human Rights: Implementing the United Nations “Protect, Respect and Remedy” Framework*, *supra* note 19, principles 13 and 22. *See also* ORG. FOR ECON. COOPERATION AND DEV’T, OECD GUIDELINES FOR MULTINATIONAL ENTERPRISES 19-20 (2008); Catarina de Albuquerque (Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation), *Common Violations of the Human Rights to Water and Sanitation*, U.N. Doc. A/HRC/27/55, ¶ 32 (June 30, 2014); U.N. CONF. ON ENV’T AND DEV’T, *Rio Declaration on Environment and Development*, art. 16, U.N. Doc. A/CONF.151/26 (Vol. I), annex I (Aug. 12, 1992) (“National authorities should endeavour to promote the internalization of environmental costs and the use of economic instruments, taking into account the approach that the polluter should, in principle, bear the cost of pollution, with due regard to the public interest and without distorting international trade and investment.”).

¹¹⁹ *Guiding Principles on Business and Human Rights: Implementing the United Nations “Protect, Respect and Remedy” Framework*, *supra* note 19, Principle 11 (commentary).

¹²⁰ *See id.* at Principle 15 (“In order to meet their responsibility to respect human rights, business enterprises should have in place policies and processes appropriate to their size and circumstances, including: (a) A policy commitment to meet their responsibility to respect human rights; (b) A human rights due-diligence process to identify, prevent, mitigate and account for how they address their impacts on human rights; (c) Processes to enable the remediation of any adverse human rights impacts they cause or to which they contribute.”); *id.* at Principle 19 (commentary); ORG. FOR ECON. COOPERATION AND DEV’T, OECD GUIDELINES FOR MULTINATIONAL ENTERPRISES Pt. II (A) (10) (2008) (Corporations should, “[c]arry out risk-based due diligence, for example by incorporating it into their enterprise risk management systems, to identify, prevent and mitigate actual and potential adverse impacts”); *see generally*, *Guidance for Companies on Respecting the Human Rights to Water and Sanitation: Bringing a Human Rights Lens to Corporate Water Stewardship*, *supra* note 18.

¹²¹ Baskut Tuncak (Special Rapporteur on the Implications for Human Rights of the Environmentally Sound Management and Disposal of Hazardous Substances and Wastes), *Rep. of the Special Rapporteur on the Implications for Human Rights of the Environmentally Sound Management and Disposal of Hazardous Substances and Wastes*, U.N. Doc. A/HRC/33/41, ¶ 75 (Aug. 2, 2016).

¹²² *Guiding Principles on Business and Human Rights: Implementing the United Nations “Protect, Respect and Remedy” Framework*, *supra* note 19, at 6.

¹²³ ORG. FOR ECON. COOPERATION AND DEV’T, OECD GUIDELINES FOR MULTINATIONAL ENTERPRISES, Pt. V (2)(a) (2008) (stating further that information must be in a form that is adequate, measurable, verifiable and timely, *id.* at Pt. V (1)(c) and (2)).

¹²⁴ *Id.* at 19, pt. V (2)(b). *See also* Baskut Tuncak (Special Rapporteur on the Implications for Human Rights of the Environmentally Sound Management and Disposal of Hazardous Substances and Wastes), *Report of the Special Rapporteur on the Implications for Human Rights of the Environmentally Sound Management and Disposal of Hazardous Substances and Wastes*, U.N. Doc. A/HRC/30/40, ¶ 89 (July 8, 2015) (“Businesses have a responsibility to provide any and all information necessary to respect human rights affected by hazardous substances.”).

¹²⁵ Baskut Tuncak (Special Rapporteur on the Implications for Human Rights of the Environmentally Sound Management and Disposal of Hazardous Substances and Wastes), *Report of the Special Rapporteur on the Implications for Human Rights of the Environmentally Sound Management and Disposal of Hazardous Substances and Wastes*, U.N. Doc. A/HRC/30/40, ¶ 92 (July 8, 2015).

¹²⁶ While the national goals are not judicially enforceable, “it is the duty of all governmental bodies to apply and give effect to them as far as lies within their respective powers.” CONSTITUTION OF THE INDEPENDENT STATE OF PAPUA NEW GUINEA Aug. 15, 1975, § 25(2).

¹²⁷ CONSTITUTION OF THE INDEPENDENT STATE OF PAPUA NEW GUINEA, Aug. 15, 1975, National Goal 4. Similar wording is used as part of a set of “Basic Social Obligations” also set out in the Constitution. *See id.* at *Preamble: Basic Social Obligations*, ¶ (d).

¹²⁸ CONSTITUTION OF THE INDEPENDENT STATE OF PAPUA NEW GUINEA, Aug. 15, 1975, National Goal 3.

¹²⁹ *Environment Act 2000* (Papua New Guinea) s 7(1).

¹³⁰ *Environment Act 2000* (Papua New Guinea) s 7(3). A Memorandum of Agreement between the State, Enga Provincial Government, and landowners additionally requires the national government to “ensure that the Department of Environment provides competent experts to respond promptly to landowner concerns regarding environmental issues.” Memorandum of Agreement Relating to the Development of the Porgera Gold Mine Project, Independent State of Papua New Guinea & Porgera Landowners, ¶ 12(b), (May 1989).

¹³¹ Environment Act 2000, § 79(1) (Papua N.G.).

¹³² *Id.* at §§ 79(2), (3), 80. *See also* Water Resources Act 1982, pt. III (Papua N. G.).

¹³³ *See* Environment Act 2000, §§ 95(2), (3) (Papua N.G.).

¹³⁴ Water Resources Act 1982, § 15(1) (Papua N.G.).

¹³⁵ Public Health (Drinking Water) Regulation 1984 (Papua N.G.).

¹³⁶ Mining Act 1992 (Papua N.G.).

¹³⁷ *Id.* at § 41 (Papua N. G.).

¹³⁸ Water Resources Act 1982, pt. V (Papua N.G.).

¹³⁹ Water Resources Act 1982, § 42 (e)(ii), (f) (Papua N.G.).

¹⁴⁰ Environment Act 2000, pt. 5 (Papua N.G.); Environmental Contaminants Act 1978, § 16(1) (Papua N. G.) (“[A] person shall not discharge, emit or deposit an environmental contaminant into the environment except in accordance with a licence held by him.”).

¹⁴¹ Environment (Water Quality Criteria) Regulation 2002, reg. 1.2 (Papua N. G.).

¹⁴² Environment Act 2000, § 131(2) (Papua N. G.).

¹⁴³ Environmental Planning Act 1978, § 26 (Papua N. G.).

¹⁴⁴ Environmental Contaminants Act 1978, § 29(1) (Papua N. G.).

¹⁴⁵ While numerous attempts have been made to enact legislative reform, none have been successful. Several Bills have been tabled in the House of Commons, but none have passed legislative review. *See* An Act Respecting Corporate Accountability for the Activities of Mining, Oil or Gas in Developing Countries, Bill C-300, 40th Parliament, 2nd Session (2009); An Act to Amend the Federal Courts Act (International Promotion and Protection of Human Rights), Bill C-492, 38th Parliament, 2nd Session (2007).

¹⁴⁶ *See, e.g.,* Araya v. Nevsun Resources Ltd., 2016 BCSC 1856 (Can.); *García v. Tahoe Resources Inc.*, 2017 BCCA 39 (Can.); *Choc v. Hudbay Minerals Inc.*, 2013 ONSC 1414 (Can.). In such cases, Canada’s civil courts have allowed claims of physical violence linked to operations of Canadian mining companies abroad to proceed to trial. For a discussion of limits on access to remedy in Canadian courts, *see, e.g.,* GWYNNE SKINNER, ROBERT MCCORQUODALE, & OLIVIER DE SCHUTTER, *THE THIRD PILLAR: ACCESS TO JUDICIAL REMEDIES FOR HUMAN RIGHTS VIOLATIONS BY TRANSNATIONAL BUSINESS* (2013).

¹⁴⁷ *See* OFF. OF CORP. SOC. RESP., *DOING BUSINESS THE CANADIAN WAY: A STRATEGY TO ADVANCE CSR IN CANADA’S EXTRACTIVE SECTOR ABROAD* 3-5, 12 (2014) (noting that “[t]he Government of Canada expects Canadian companies operating abroad to respect human rights and all applicable laws, and to meet or exceed widely-recognized international standards for responsible business conduct,” and summarizing the powers of the Office of the Extractive Sector CSR Counsellor to: offer guidance on CSR compliance, and coordinate with the Organization for Economic

Co-Operation and Development (OECD) National Contact Point (NCP) to review extraterritorial CSR practices of Canadian extractive sector companies through non-judicial processes.) Companies “found not to be embodying CSR best practices and who refuse to participate in dispute resolution processes” face the withdrawal of Government of Canada support in foreign markets).

¹⁴⁸ See INCLUSIVE DEVELOPMENT INTERNATIONAL, *SAFEGUARDING PEOPLE AND THE ENVIRONMENT IN CHINESE INVESTMENTS: A GUIDE FOR COMMUNITY ADVOCATES* 29 (2017) (describing, *e.g.*, the Guidelines for Social Responsibility in Outbound Mining Investments made by the China Chamber of Commerce of Metals, Minerals & Chemicals Importers & Exporters (CCCMC), a body under the authority of the Ministry of Commerce); GREENOVATION HUB, *CHINA’S MINING INDUSTRY AT HOME AND OVERSEAS: DEVELOPMENT, IMPACTS AND REGULATION* 9, 62, 65-66 (2014).

¹⁴⁹ INCLUSIVE DEVELOPMENT INTERNATIONAL, *supra* note 148, at 28 (noting that only the Asian Infrastructure Investment Bank includes a grievance mechanism with its guidelines); GREENOVATION HUB, *supra* note 148, at 66.

¹⁵⁰ See, *e.g.*, UN Human Rights Comm., Concluding observations on the sixth periodic report of Canada, CCPR/C/CAN/CO/6, ¶ 6 (Aug. 13, 2015) (expressing concern over “allegations of human rights abuses by Canadian companies operating abroad, in particular mining corporations, and about the inaccessibility to remedies by victims of such violations,” including “the absence of an effective independent mechanism with powers to investigate complaints alleging abuses by such corporations that adversely affect the enjoyment of the human rights of victims, and of a legal framework that would facilitate such complaints,” and calling on Canada to “enhance the effectiveness of existing mechanisms to ensure that all Canadian corporations, in particular mining corporations, under its jurisdiction respect human rights standards when operating abroad” and to “develop a legal framework that affords legal remedies to people who have been victims of activities of such corporations operating abroad”); Comm. on the Elimination of Racial Discrimination, Concluding observations of the Committee on the Elimination of Racial Discrimination (Canada) CERD/C/CAN/CO/19-20, ¶ 14 (Apr. 4, 2012) (expressing concern over the lack of “measures with regard to transnational corporations registered in Canada whose activities negatively impact the rights of indigenous peoples outside Canada, in particular in mining activities,” and calling on Canada to “take appropriate legislative measures to prevent transnational corporations registered in Canada from carrying out activities that negatively impact on the enjoyment of rights of indigenous peoples in territories outside Canada”); Comm. on Econ., Soc., and Cultural Rts., Concluding Observations on the Sixth Periodic Report of Canada, UN Doc. E/C.12/CAN/CO/6, ¶¶ 5-6, 15-16 (Mar. 23, 2016) (expressing concern over “the limited access to judicial remedies before courts in [Canada] by victims,” including indigenous peoples, and over the inefficacy of “existing non-judicial remedial mechanisms,” and calling on Canada to “strengthen its legislation governing the conduct of corporations registered or domiciled [in Canada] in their activities abroad,” as well as adopt “effective mechanisms to investigate complaints” and “legislative measures necessary to facilitate access to justice”).

CHAPTER IV: WATER IN PORGERA

Findings from an Interdisciplinary Study

PART A: Analysis of Water Sources in Porgera

¹ BARRICK (NIUGINI) LTD., *Response to Columbia Law School – Water Study* (Apr. 2017). See *infra* Annex II. .

² See PAULUS BAK, SIMON APTE, CHARLIE ROSS & AUGUSTINE MUNGKAJE, PEAK, DRINKING WATER STUDY UPDATE 13 (Nov. 2014) [hereinafter DRINKING WATER STUDY].

³ Interview with a man and woman from Mugalep (MG3) (Jan. 4, 2015) (“The blue bins are normally distributed from time to time. When they come, everyone rushes to get them.”).

⁴ Interview with a woman from Panadaka (PD5) (Jan. 3, 2015); Interview with two women from Alipis (AL3) (Jan. 7, 2015).

⁵ Interview with a woman from Kulapi (KP9) (Jan. 9, 2015) (“That blue tank is not enough for the families here. We are ten people. It is not enough. In dry season, we normally go up to the Kakai top.”). See *also* Interview with a woman from Panadaka (PD5) (Jan. 3, 2015).

⁶ Interview with Government Officials in Port Moresby, Papua New Guinea (Mar. 2017) [hereinafter POM Interview 2017].

⁷ Human Rights Council, Rep. of the United Nations High Commissioner for Human Rights on the scope and content of the relevant human rights obligations related to equitable access to safe drinking water and sanitation under international human rights instruments, U.N. Doc. A/HRC/6/3, at 15 (2007).

⁸ Human Rights Council, Rep. of the United Nations High Commissioner for Human Rights on the scope and content of the relevant human rights obligations related to equitable access to safe drinking water and sanitation under international human rights instruments, U.N. Doc. A/HRC/6/3, at 15 (2007).

⁹ PENNY JOHNSON, PORGERA ENVIRONMENTAL ADVISORY KOMITI, SCOPING PROJECT: SOCIAL IMPACT OF THE MINING PROJECT ON WOMEN IN THE PORGERA AREA 18 (2010) [hereinafter JOHNSON, WOMEN IN PORGERA] (“In a survey of homes in 1988, Robinson (1988) found that recent migration had helped increase household size to 13 members. A survey of 96 relocation homes conducted in 1993 found relocation houses with a mean household size of 8.1 persons (citing Susanne Bonnell, *The landowner relocation programme*, in *DILEMMAS OF DEVELOPMENT: THE SOCIAL AND ECONOMIC IMPACT OF THE PORGERA GOLD MINE 1989-1994* (Colin Filer ed., 1999)); Fritz Robinson, PORGERA JOINT VENTURE, *1988 Porgera Relocation Study* (1991). Our survey involved spot sampling of two households per village for 8 villages and recorded up to 25+ people living in some houses or compounds, with a mean size of 13.06.”).

¹⁰ *See, e.g.*, Interview with two women from Alipis (AL3) (Jan. 7, 2015) (“I have only the blue container, here, and I think that this one will finish, I reserve it only for drinking. “I wash my body in this dirty water. I wash my clothes in this dirty water. I wash my dishes in this dirty water.”).

¹¹ WORLD HEALTH ORG., GUIDELINES FOR DRINKING-WATER QUALITY Section 5.3.1 (2011), http://apps.who.int/iris/bitstream/10665/44584/1/9789241548151_eng.pdf.

¹² WORLD HEALTH ORG., GUIDELINES FOR DRINKING-WATER QUALITY Section 5.3.1 (2011), http://apps.who.int/iris/bitstream/10665/44584/1/9789241548151_eng.pdf.

¹³ Interview with a man from Alipis (AL2) (Jan. 7, 2015); Interview with a woman from Kulapi 1 (KP8) (Jan. 9, 2015); Interview with a woman from Kulapi (KP10) (Jan. 9, 2015); Interview with a man from Kulapi (KP11) (Jan. 9, 2015); Interview with a male landowner from Yarik Timorope 2 (YK3) (Jan. 5, 2015); Interview with a woman from Upper Yarik (YK13) (Jan. 6, 2013); Interview with a man from Panadaka (PD1) (Jan. 3, 2015); Interview with a woman from Panadaka (PD3) (Jan. 3, 2015); Interview with a woman from Panadaka (PD5) (Jan. 3, 2015); Interview with a woman from Panadaka (PD6) (Jan. 3, 2015); Interview with a man from Yumarilama (YL2) (Jan. 6, 2015); Interview with a man from Yarik Timorope (YL4) (Jan. 6, 2015); Interview with a man from Yumarilama (YL5) (Jan. 6, 2015); Interview with a man from Alipis (AL4) (Jan. 7, 2015); Interview with a man from Alipis (AL5) (Jan. 7, 2015); Interview with a man from Alipis (AL1) (Jan. 7, 2015) (“I budget the water that I have in the blue bin.”). *See also* Interview with two women from Alipis (AL3) (Jan. 7, 2015) (“I have only the blue container, here, and I think that this one will finish, [so] I reserve it only for drinking.”).

¹⁴ *See* Susanne Bonnell, *Social change in the Porgera Valley*, in *DILEMMAS OF DEVELOPMENT: THE SOCIAL AND ECONOMIC IMPACT OF THE PORGERA GOLD MINE 1989-1994* 22 (Colin Filer ed., 1999). *See also* Jerry Jacka, *Correlating Local Knowledge with Climatic Data: Porgeran Experiences of Climate Change in Papua New Guinea*, in *ANTHROPOLOGY AND CLIMATE CHANGE: FROM ACTIONS TO TRANSFORMATIONS* 192-193 (Susan A. Crate & Mark Nuttall eds., 2016) (identifying variable wet and dry periods in Porgera). Average annual rainfall in Porgera is approximately 3,500 millimeters per year. *See* *DILEMMAS OF DEVELOPMENT: THE SOCIAL AND ECONOMIC IMPACT OF THE PORGERA GOLD MINE* 22 (Colin Filer, ed., 2012).

¹⁵ *See* JERRY JACKA, *ALCHEMY IN THE RAIN FOREST: POLITICS, ECOLOGY, AND RESILIENCE IN A NEW GUINEA MINING AGE* 42 (2015) (addressing how Porgerans do not identify specific wet or dry periods).

¹⁶ Reuters Staff, *El Niño halts Papua New Guinea gold mine-Barrick*, REUTERS (OCT. 19. 2015), <http://www.reuters.com/article/barrick-gold-porgera-el-nino/el-nino-halts-papua-new-guinea-gold-mine-barrick-idUSL3N12J28720151019>.

¹⁷ Interview with a woman from Panadaka (PD3) (Jan. 3, 2015).

¹⁸ Metal tanks were mentioned in the following interviews, though in most cases are no longer utilized: Interview with a man from Yarik Timorope (YK4) (Jan. 5, 2015); Interview with a male landowner from Timorope 2 from Tiyini Clan

(YK6) (Jan. 5, 2015); Interview with a woman from Yarik (YK12) (Jan. 6, 2015); Interview with a man from Yarik Timorope (YL4) (Jan. 6, 2015); Interview with a man from Kulapi 3 (KP5) (Jan. 9, 2015); Interview with a woman from Kulapi 1 (KP8) (Jan. 9, 2015); Interview with a woman from Kulapi (KP9) (Jan. 9, 2015); Interview with a man from Apalaka (AP1) (Jan. 6, 2015); Interview with a resident of Porgera (AP2) (Jan. 11, 2015); Interview with a man from Apalaka (AP4) (Jan. 11, 2015); Interview with a man from Apalaka (AP6) (Jan. 11, 2015).

¹⁹ *See, e.g.*, Interview with a woman from Yarik (YK12) (Jan. 6, 2015). (“The tank is rusted away and it leaks. We don’t drink from there.”); Interview with a woman from Timorope Yarik (YK1) (Jan. 5, 2015) (“Before, Placer Dome gave metal tanks. But they rusted, so we stopped using them. We use the blue bins.”); Interview with a woman from Kulapi (KP9) (Jan. 9, 2015) (“There was a tank, a metal tank...It has rusted and leaks so we don’t get water from there anymore.”); Interview with a resident of Porgera (AP2) (Jan. 11, 2015) (“It got rusted, and got holes in it.”); Interview with a man from Apalaka (AP6) (Jan. 11, 2015) (“[N]ow the tanks are all rotten.”).

²⁰ According to information provided by BARRICK (NIUGINI) LTD., the “Supplemental Water Project” began with a pilot project in Panadaka in 2013. BARRICK (NIUGINI) LTD., *Response to Columbia Law School – Water Study* (Apr. 2017). *See infra* Annex II.

²¹ BARRICK (NIUGINI) LTD., *Response to Columbia Law School – Water Study* (Apr. 2017). *See infra* Annex II.

²² BARRICK (NIUGINI) LTD., *Response to Columbia Law School – Water Study* (Apr. 2017). *See infra* Annex II. *See infra* Annex II (noting the installation of 15 tanks in Panadaka (6 x 9000L, 6 x 5000L, 3 x 1000L), 4 in Alipis (4 x 9000L), 10 in Apalaka (3 x 9000L, 7 x 5000L), 14 in Timorope (5 x 9000L, 3 x 5000L, 6 x 1000L), 13 in Pakien (6 x 9000L, 3 x 5000L, 4 x 1000L), and 17 in Mungulep (5 x 9000L, 4 x 5000L, 8 x 1000L)).

²³ BARRICK (NIUGINI) LTD., *Response to Columbia Law School – Water Study* (Apr. 2017). *See infra* Annex II.

²⁴ BARRICK (NIUGINI) LTD., *Response to Columbia Law School – Water Study* (Apr. 2017). *See infra* Annex II.

²⁵ *See, e.g.*, Interview with a man from Panadaka (PD1) (Jan. 3, 2015), Interview with a woman from Panadaka (PD2) (Jan. 3, 2015) (both noting continued reliance on blue buckets and the need to use rainwater only for drinking during periods of low rainfall); Interview with a woman from Panadaka (PD3) (Jan. 3, 2015) (describing the need to collect water from Aumbi during times of water scarcity).

²⁶ Interview with a woman from Panadaka (PD3) (Jan. 3, 2015).

²⁷ Focus Group Interview with men from Panadaka (PD FGM) (Jan. 5, 2016).

²⁸ *See, e.g.*, Interview with a woman from Panadaka (PD4) (Jan. 3, 2015).

²⁹ *See, e.g.*, Focus Group Interview with women from Alipis (AP FGW) (Jan. 7, 2016) (“Just recently, they gave us water supply from the Tuffa tank. There are many of us living here. We use the water up.”; “If it doesn’t rain for a day, the tanks finish”); Focus Group Interview with men from Mugalep (MG FGM) (Jan. 6, 2016) (“A week ago, they gave us five Tuffa tanks. But the total population here in Mugalep is 5,000 people. These five Tuffa tanks cannot feed all of us. It has never been done before.”); Focus Group Interview with men from Apalaka (AP FGM) (Jan. 7, 2016) (“There are too many people living here. In the dry season, [the Tuffa tanks] are not enough. They last 2 or 4 days.”). Another woman from Yarik (where large Tuffa tanks have been installed outside of the mine’s “Supplemental Water Project”) observed, “The Tuffa tanks will end fast during the dry season.” Focus Group Interview with women from Timorope Yarik (TY FGW) (Jan. 12, 2016).

³⁰ The Research Team confirmed their current status through outreach to Porgeran community members, one of whom was able to share photos of the taps now in use.

³¹ Interview with a man from Yarik Timorope (YK4) (Jan. 5, 2015).

³² Interview with a man and woman from Mugalep (MG3) (Jan. 4, 2015).

³³ Focus Group Interview with women from Alipis (AP FGW) (Jan. 7, 2016).

³⁴ Focus Group Interview with women from Alipis (AP FGW) (Jan. 7, 2016).

³⁵ Interview with a leader from Alipis (AL6) (Jan. 7, 2015).

³⁶ Interview with a woman in Panadaka (PD4) (Jan. 3, 2015).

- ³⁷ BARRICK (NIUGINI) LTD., *Response to Columbia Law School – Water Study* (Apr. 2017). *See infra* Annex II. (noting the installation of 15 tanks in Panadaka (6 x 9000L, 6 x 5000L, 3 x 1000L), 4 in Alipis (4 x 9000L), 10 in Apalaka (3 x 9000L, 7 x 5000L), 14 in Timorope (5 x 9000L, 3 x 5000L, 6 x 1000L), 13 in Pakien (6 x 9000L, 3 x 5000L, 4 x 1000L), and 17 in Mugulep (5 x 9000L, 4 x 5000L, 8 x 1000L)).
- ³⁸ BARRICK (NIUGINI) LTD., *Columbia Law School Water Study Response* (Nov. 2018). *See infra* Annex II.
- ³⁹ BARRICK (NIUGINI) LTD., *Response to Columbia Law School – Water Study* (Apr. 2017). *See infra* Annex II.
- ⁴⁰ Focus Group Interview with women from Yunarilama (YM FGW) (Jan. 10, 2016).
- ⁴¹ Focus Group Interview with women from Yarik (TY FGW) (Jan. 12, 2016).
- ⁴² *See* PORGERA JOINT VENTURE, PORGERA GOLD PROJECT ENVIRONMENTAL PLAN VOLUME B 61 (Jan. 29, 1988) (hereinafter ENVIRONMENTAL PLAN).
- ⁴³ BARRICK (NIUGINI) LTD., *Response to Columbia Law School – Water Study* (Apr. 2017). *See infra* Annex II.
- ⁴⁴ BARRICK (NIUGINI) LTD., *Response to Columbia Law School – Water Study* (Apr. 2017). *See infra* Annex II.
- ⁴⁵ *See, e.g.*, Focus Group Interview with women from Panadaka (PD FGW SK) (Jan. 5, 2016); Focus Group Interview with women from Apalaka (AK FGW) (Jan. 10, 2016); Focus Group Interview with men from Apalaka (AK FGM) (Jan. 10, 2016); Focus Group Interview with women from Alipis (AP FGW) (Jan. 7, 2016); Focus Group Interview with women from Kulapi (KP FGW) (Jan. 8, 2016); Focus Group Interview with women from Yunarilama (FGW YM) (Jan. 10, 2016).
- ⁴⁶ POM Interview 2017.
- ⁴⁷ Memorandum of Agreement Between Barrick (Niugini) Limited (Barrick) As Manager of the Porgera Joint Venture (Barrick) And The Landowners of Pakiane Village (Nov. 19, 2015) (on file with authors).
- ⁴⁸ Focus Group Interview with men from Panadaka (PD FGM) (Jan. 5 2016).
- ⁴⁹ Interview with a man and woman from Mugalep (MG3) (Jan. 4, 2015). Another woman from Mugalep reported stealing water from family members or from the church pastor’s water tank when she was desperate. Interview with a woman from Porgera (MG4) (Jan. 4, 2015).
- ⁵⁰ Interview with a woman from Porgera (MG4) (Jan. 4, 2015).
- ⁵¹ Interview with a man from Yarik Timorope (YK4) (Jan. 5, 2015).
- ⁵² Focus Group Interview with men from Panadaka (PD FGM) (Jan. 5, 2016).
- ⁵³ Focus Group Interview with men from Panadaka (PD FGM) (Jan. 5, 2016).
- ⁵⁴ Focus Group Interview with women from Alipis (AP FGW) (Jan. 7, 2016). *See also* Interview with a woman from Panadaka (PD2) (Jan. 3 2015) (“At once when there is big crisis, I usually get a big container (the one you are sitting on) and I use the water wisely. To drink and not to wash.”).
- ⁵⁵ Interview with a man and woman from Mugalep (MG3) (Jan. 4, 2015).
- ⁵⁶ Interview with a man from Yarik Timorope (YK4) (Jan. 5, 2015).
- ⁵⁷ Focus Group Interview with women from Apalaka (AK FGW) (Jan. 10, 2016); Focus Group Interview with women from Mugalep (MG FGW) (Jan. 6, 2016); Focus Group Interview with women from Alipis (AP FGW) (Jan. 7, 2016); Focus Group Interview with women from Yunarilama (YM FGW) (Jan. 10, 2016).
- ⁵⁸ Focus Group Interview with women from Apalaka (AK FGW) (Jan. 10, 2016).
- ⁵⁹ Focus Group Interview with women from Alipis (AP FGW) (Jan. 7, 2016).
- ⁶⁰ Focus Group Interview with women from Mugalep (MG FGW) (Jan. 6, 2016).
- ⁶¹ Focus Group Interview with women from Panadaka (PD FGW SK) (Jan. 5, 2016).
- ⁶² Interview with a man from Panadaka (PD1) (Jan. 3, 2015); Interview with a woman from Panadaka (PD2) (Jan. 3, 2015); Interview with a woman from Panadaka (PD4) (Jan. 3, 2015); Interview with a woman from Panadaka (PD5) (Jan. 3, 2015); Interview with a woman from Panadaka (PD6) (Jan. 3, 2015); Interview with a man from Mugalep

(MG1) (Jan. 4, 2015); Interview with a man and woman from Mugalep (MG3) (Jan. 4, 2015); Interview with a woman from Porgera (MG4) (Jan. 4, 2015); Interview with a landowning woman from Mugalep (MG5) (Jan. 4, 2015); Interview with a woman from Mugalep (MG8) (Jan. 4, 2015); Interview with a woman from Yarik Timorope (YK2) (Jan. 5, 2015); Interview with a male landowner from Yarik Timorope 2 (YK3) (Jan. 5, 2015); Interview with a man from Yarik Timorope (YK4) (Jan. 5, 2015); Interview with a man from Yarik Timorope (YK5) (Jan. 5, 2015); Interview with a male landowner from Timorope 2 from Tiyini Clan (YK6) (Jan. 5, 2015); Interview with a woman from Yarik Timorope (YK7) (Jan. 5, 2015); Interview with a woman from Yarik Timorope (YK8) (Jan. 5, 2015); Interview with a woman and mother from Yarik Timorope 2 (YK9) (Jan. 5, 2015); Interview with a woman from Yarik (YK12) (Jan. 6, 2015); Interview with a woman from Upper Yarik (YK13) (Jan. 6, 2013); Interview with a man from Yunarilama (YL2) (Jan. 6, 2015); Interview with a landowner from Kulapi 2 (KP1) (Jan., 9, 2015); Interview with a chief from Kulapi (KP2) (Jan. 9, 2015); Interview with a man from Kulapi 3 (KP5) (Jan. 9, 2015); Interview with a woman from Kulapi (KP6) (Jan. 9, 2015); Interview with a man from Kulapi (KP7) (Jan. 9, 2015); Interview with a woman from Kulapi 1 (KP8) (Jan. 9, 2015); Interview with a woman from Kulapi (KP9) (Jan. 9, 2015); Interview with a woman from Kulapi (KP10) (Jan. 9, 2015); Interview with a man from Kulapi (KP11) (Jan. 9, 2015); Interview with a man from Apalaka (AW2) (Jan. 10, 2015); Interview with a woman from Anawe (AW4) (Jan. 10, 2015); Interview with a man in Anawe (AW5) (Jan. 10, 2015); Interview with a woman from Tamando (AW6) (Jan. 10, 2015); Interview with a man from Apalaka (AP1) (Jan. 6, 2015); Interview with a resident of Porgera (AP3) (Jan. 11, 2015); Interview with a woman from Apalaka (AP5) (Jan. 11, 2015); Interview with a man from Alipis (AL1) (Jan. 7, 2015); Interview with a man from Alipis (AL2) (Jan. 7, 2015); Interview with two women from Alipis (AL3) (Jan. 7, 2015).

⁶³ Interview with a woman from Panadaka (PD2) (Jan. 3, 2015); Interview with a woman from Panadaka (PD4) (Jan. 3, 2015); Interview with a woman from Panadaka (PD5) (Jan. 3, 2015); Interview with a man from Mugalep (MG1) (Jan. 4, 2015); Interview with a man and woman from Mugalep (MG3) (Jan. 4, 2015); Interview with a woman from Porgera (MG4) (Jan. 4, 2015); Interview with a landowning woman from Mugalep (MG5) (Jan. 4, 2015); Interview with an individual from Mugalep (MG7) (Jan. 4, 2015); Interview with a woman from Mugalep (MG8) (Jan. 4, 2015); Interview with a male landowner from Yarik Timorope 2 (YK3) (Jan. 5, 2015); Interview with a man from Yarik Timorope (YK4) (Jan. 5, 2015); Interview with a man from Yarik Timorope (YK5) (Jan. 5, 2015); Interview with a woman from Yarik Timorope (YK7) (Jan. 5, 2015); Interview with a woman from Yarik Timorope (YK8) (Jan. 5, 2015); Interview with a woman and mother from Yarik Timorope 2 (YK9) (Jan. 5, 2015); Interview with a woman from Yarik (YK12) (Jan. 6, 2015); Interview with a woman from Upper Yarik (YK13) (Jan. 6, 2013); Interview with a man from Yunarilama (YL2) (Jan. 6, 2015); Interview with a man from Alipis (AL1) (Jan. 7, 2015); Interview with a man from Alipis (AL2) (Jan. 7, 2015); Interview with two women from Alipis (AL3) (Jan. 7, 2015); Interview with a leader from Alipis (AL6) (Jan. 7, 2015); Interview with a landowner from Kulapi 2 (KP1) (Jan., 9, 2015); Interview with a chief from Kulapi (KP2) (Jan. 9, 2015); Interview with a man from Kulapi 3 (KP5) (Jan. 9, 2015); Interview with a woman from Kulapi (KP6) (Jan. 9, 2015); Interview with a man from Kulapi (KP7) (Jan. 9, 2015); Interview with a woman from Kulapi 1 (KP8) (Jan. 9, 2015); Interview with a man from Kulapi (KP7) (Jan. 9, 2015); Interview with a woman from Kulapi (KP9) (Jan. 9, 2015); Interview with a man in Anawe (AW5) (Jan. 10, 2015); Interview with a woman from Tamando (AW6) (Jan. 10, 2015); Interview with a man from Apalaka (AP1) (Jan. 6, 2015); Interview with a resident of Porgera (AP2) (Jan. 11, 2015); Interview with a woman from Apalaka (AP5) (Jan. 11, 2015).

⁶⁴ Interview with a woman and mother from Yarik Timorope 2 (YK9) (Jan. 5, 2015); Interview with a man in Anawe (AW5) (Jan. 10, 2015); Interview with a landowner from Kulapi 2 (KP1) (Jan., 9, 2015); Interview with a chief from Kulapi (KP2) (Jan. 9, 2015); Interview with a woman from Kulapi (KP3) (Jan. 9, 2015); Interview with a man from Kulapi (KP11) (Jan. 9, 2015); Interview with a man from Mugalep (MG1) (Jan. 4, 2015); Interview with a woman from Kulapi (KP4) (Jan. 9, 2015); Interview with a landowning woman from Mugalep (MG5) (Jan. 4, 2015) (When asked opinion on the rain water in blue tanks] “I don’t think it’s safe to drink, because it comes off the roof. Also, the smoke from the mine goes up and joins the clouds, then comes down as rain. So it is not good. That is what I think.”); Interview with a man from Apalaka (AP1) (Jan. 6, 2015) (“When it rains, the thick smoke comes down to my tank in the rain. I believe I am drinking chemical water.”).

⁶⁵ Interview with a woman from Panadaka (PD2) (Jan. 3, 2015).

⁶⁶ Interview with a woman from Panadaka (PD5) (Jan. 3, 2015).

⁶⁷ Interview with a man from Alipis (AL2) (Jan. 7, 2015).

⁶⁸ Interview with a man from Kulapi (KP7) (Jan. 9, 2015); Interview with a woman from Panadaka (PD2) (Jan. 3, 2015) (“I get my drinking-water from the blue containers...Whether it's good or bad I drink from that. Even if the water is polluted by mosquitoes I drink from there...When the mosquito larva comes, I stir the water so that I don’t drink the

larva and I can drink. Also sometimes there is green moss that grows, but we just remove it and drink.”); “I haven’t used my blue barrel to drink. I just use it for washing clothes...When I look into the bucket, I see some kind of red stuff, so I don’t want to drink from that.”); Interview with a woman from Kulapi 3 (KP6) (Jan. 9, 2015) ([water from the blue barrels] “has a bad taste. I don’t like drinking it. But where else can I drink water? Compared to the water supply, it is a little better. But it doesn’t taste good. After drinking it we feel like vomiting. We think that it is chemical water from the air that comes down as rain from the container. But we have no choice, so we just close our eyes and drink.”); Interview with a man from Kulapi (KP11) (Jan. 9, 2015) (“When it is dry season and dust gets into the drum, we can see dust and colors. Where will we go and drink?”).

⁶⁹ Interview with a woman from Kulapi 1 (KP8) (Jan. 9, 2015).

⁷⁰ Interview with a man from Panadaka (PD1) (Jan. 3, 2015) (“[W]hen the trucks are working down there, and dust comes up, we can clearly see that there is dust in the water.”).

⁷¹ Interview with a resident of Porgera (AP3) (Jan. 11, 2015) (“It might not be safe sometimes. I think the air we breathe is not safe. So the tank water is not safe.”); *cf.* Interview with a landowning woman from Mugalep (MG5) (Jan. 4, 2015) (“It has a cover, so I think it is safer.”).

⁷² Interview with a man from Alipis (AL1) (Jan. 7, 2015).

⁷³ Interview with a man from Yunarilama (YL2) (Jan. 6, 2015).

⁷⁴ Interview with a woman from Panadaka (PD3) (Jan. 3, 2015).

⁷⁵ Interview with a woman from Yarik (YK11) (Jan. 5, 2015).

⁷⁶ Interview with a woman from Upper Yarik (YK10) (Jan. 6, 2015).

⁷⁷ PORGERA LANDOWNERS ASS’N, AKALI TANGE ASS’N & MININGWATCH CANADA, *Request for Review Submitted to the Canadian National Contact Point Pursuant to the OECD Guidelines for Multinational Enterprises*, 7, 22 (Mar. 1, 2011), www.oecdwatch.org/cases/Case_210/929/at_download/file.

⁷⁸ DRINKING WATER STUDY, *supra* note 2.

⁷⁹ Interview with a man from Alipis (AL7) (Jan. 7, 2015) (“[L]eaves fall into the drum” a man from Alipis told us, “They are in the bottom [of the barrel].”).

⁸⁰ BARRICK GOLD CORP.: PORGERA, ANNUAL ENVIRONMENT REPORT 2014, 132-36 (July 2015), <http://barrick.q4cdn.com/808035602/files/porgera/2014-Porgera-Annual-Environmental-Report.pdf> [hereinafter ANNUAL ENVIRONMENTAL REPORT 2014].

⁸¹ *See* Focus Group Interview with women from Apalaka (AK FGW) (Jan. 10, 2016) (“We drink from the tuffa tanks, we don’t wash them when they have leaves so maybe the chemical dust gets in the water, the people get sick and have diarrhea typhoid.”); Interview with a woman from Panadaka (PD2) (Jan. 3, 2015) (“When the mosquito larva comes, I stir the water so that I don’t drink the larva and I can drink. Also sometimes there is green moss that grows, but we just remove it and drink.”); *see also* Interview with a man from Alipis (AL7) (Jan. 7, 2015) (“The leaves fall into the drum. They are in the bottom. We leave it as it is. We collect the top water and drink it. [*Do you ever empty out the bins and wash them?*] When it is very full and dirty, we turn it over, and let the water out, get the leaves and dirt out, and wash it with water. [*How often?*] [after some discussion, he says once a week, but I don’t consider this a very reliable answer.]”); Interview with a woman from Kulapi (KP6) (Jan. 9, 2015) (“I don’t smell anything. I wash the containers and make them clean so I don’t smell anything.”).

⁸² *See, e.g.*, Focus Group Interview with women from Panadaka (PD FGW SK) (Jan. 5, 2016); Focus Group Interview with women from Apalaka (AK FGW) (Jan. 10, 2016); Focus Group Interview with women from Kulapi (KP FGW) (Jan. 8, 2016); ; Focus Group Interview with women from Yunarilama (YN FGW) (Jan. 10, 2016); Focus Group Interview with men from Top Yarik (TY FGM) (Jan. 10, 2016); Interview with an individual from Mugalep (MG7) (Jan. 4, 2015) ([on water from the tanks] “When the water is full it doesn’t show any sign of spoiling, but when the water goes down it looks like kerosene has been put in the water and it look oily.”).

⁸³ Focus Group Interview with men from Panadaka (PD FGM) (Jan. 5, 2016).

⁸⁴ *See e.g.*, Interview with a man from Alipis (AL7) (Jan. 7, 2015).

⁸⁵ *See e.g.*, Interview with a woman from Panadaka (PD2) (Jan. 3, 2015) (“When the mosquito larva comes, I stir the water so that I don’t drink the larva and I can drink. Also sometimes there is green moss that grows, but we just remove it and drink.”).

⁸⁶ *See, e.g.*, Interview with a man from Yarik Timorope (YK4) (Jan. 5, 2015); Interview with a man from Yarik Timorope (YK5) (Jan. 5, 2015).

⁸⁷ Interview with a woman from Timorope Yarik (YK1) (Jan. 5, 2015).

⁸⁸ Interview with a man from Alipis (AL7) (Jan. 7, 2015) (“We try to get the good water from the blue bin, and push the other aside or dump it out. It’s bad, but we drink it.”; “The leaves fall into the drum. They are in the bottom. We leave it as it is. We collect the top water and drink it.”); Interview with a woman from Kulapi (KP4) (Jan. 9, 2015) (“We try to separate the water from the dust...We use a cup to separate the water from the germs.”).

⁸⁹ Focus Group Interview with women from Apalaka (AK FGW) (Jan. 10, 2016) (“We drink from the tuffa tanks, we don’t wash them when they have leaves so maybe the chemical dust gets in the water, the people get sick and have diarrhea typhoid.”); Interview with a landowning woman from Mugalep (MG5) (Jan. 4, 2015) (“The water in the tank is okay. It tastes nice. But now there is more dust in there, and it is not safe to drink the water from the tank. When we see dirt in the tank, we don’t drink it. When it is clean, we drink from there. It is only every once in a while that it is dirty.”).

⁹⁰ Interview with a resident of Porgera (AP2) (Jan. 11, 2015).

⁹¹ BARRICK (NIUGINI) LTD., *Response to Columbia Law School – Water Study* (Apr. 2017). *See infra* Annex II.

⁹² BARRICK (NIUGINI) LTD., *Response to Columbia Law School – Water Study* (Apr. 2017). *See infra* Annex II; Memorandum of Agreement Between Barrick (Niugini) Limited (Barrick) As Manager of the Porgera Joint Venture (Barrick) And The Landowners of Pakiane Village (Nov. 19, 2015) (on file with authors).

⁹³ PORGERA JOINT VENTURE, ANNUAL ENVIRONMENTAL REPORT 2015, 153 (June 2016), <http://www.porgerajv.com/BlankSite/media/PorgeraIV/Pdf%20files/2015-Porgera-AER-Final-1.pdf> [hereinafter ANNUAL ENVIRONMENTAL REPORT 2015].

⁹⁴ *Id.*

⁹⁵ *Id.*

⁹⁶ Focus Group Interview with men from Apalaka (AK FGM) (Jan. 10, 2016); Interview with a man from Apalaka (AP4) (Jan. 11, 2015).

⁹⁷ Interview with a woman from Timorope Yarik (YK1) (Jan. 5, 2015).

⁹⁸ Interview with a woman and mother from Yarik Timorope 2 (YK9) (Jan. 5, 2015); Interview with a male landowner from Timorope 2 from Tiyini Clan (YK6) (Jan. 5, 2015); Interview with a male landowner from Yarik Timorope 2 (YK3) (Jan. 5, 2015).

⁹⁹ Interview with a woman and mother from Yarik Timorope 2 (YK9) (Jan. 5, 2015); Interview with a male landowner from Yarik Timorope 2 (YK3) (Jan. 5, 2015).

¹⁰⁰ Focus Group Interview with women and men from Anawe (AW FGWM) (Jan. 8, 2016).

¹⁰¹ Interview with a woman from Yunarilama (YL3) (Jan. 6, 2015) (on Kalayu); Interview with a man from Yarik Timorope (YL4) (Jan. 6, 2015) (on cooking with water from Kalayu); Interview with a man from Yunarilama (YL5) (Jan. 6, 2015) (Ice Pari).

¹⁰² Focus Group Interview with men from Kulapi (KP FGM) (Jan. 8, 2016); Focus Group Interview with women from Kulapi (KP FGW) (Jan. 8, 2016); Interview with a landowner from Kulapi 2 (KP1) (Jan., 9, 2015); Interview with a chief from Kulapi (KP2) (Jan. 9, 2015).

¹⁰³ Focus Group Interview with men from Panadaka (PD FGM) (Jan. 5, 2016); Focus Group Interview with women from Panadaka (PD FGW SK) (Jan. 5, 2016); Interview with a man from Panadaka (PD1) (Jan. 3, 2015); Interview with a woman from Panadaka (PD2) (Jan. 3, 2015); Interview with a woman from Panadaka (PD3) (Jan. 3, 2015); Interview with a woman from Panadaka (PD4) (Jan. 3, 2015); Interview with a woman from Panadaka (PD6) (Jan. 3, 2015); Focus Group Interview with men from Mugalep (MG FGM) (Jan. 6, 2016); Focus Group Interview with women from Mugalep (MG FGW) (Jan. 6, 2016) (WH); Interview with a man from Mugalep (MG1) (Jan. 4, 2015);

Interview with a man from Mugalep (MG2) (Jan. 4, 2015); Interview with a man and woman from Mugalep (MG3) (Jan. 4, 2015); Interview with a woman from Porgera (MG4) (Jan. 4, 2015); Interview with a landowning woman from Mugalep (MG5) (Jan. 4, 2015); Interview with a woman from Paiari Village (MG6) (Jan. 4, 2015); Interview with a woman from Mugalep (MG8) (Jan. 4, 2015); Interview with a man from Alipis (AL1) (Jan. 7, 2015); Interview with a leader from Alipis (AL6) (Jan. 7, 2015).

¹⁰⁴ Interview with two women from Alipis (AL3) (Jan. 7, 2015); DRINKING WATER STUDY, *supra* note 2.

¹⁰⁵ Interview with a woman from Panadaka (PD4) (Jan. 3, 2015) (“We used to fetch water from streams when our ancestors lived here, but after the mine started, we cannot get water from the stream any more.”); *see also* Interview with a woman from Panadaka (PD2) (Jan. 3, 2015); Interview with a woman from Panadaka (PD5) (Jan. 3, 2015); Interview with a man from Mugalep (MG2) (Jan. 4, 2015); Interview with an individual from Mugalep (MG7) (Jan. 4, 2015); Interview with a woman from Mugalep (MG8) (Jan. 4, 2015); Interview with a man from Yarik Timorope (YK4) (Jan. 5, 2015); Interview with a man from Yarik Timorope (YK5) (Jan. 5, 2015); Interview with a woman from Upper Yarik (YK10 FI) (Jan. 5, 2015); Interview with a woman from Yarik (YK12) (Jan. 6, 2015); Interview with a man from Apalaka (AW2) (Jan. 10, 2015); Interview with a landowner from Kulapi 2 (KP1) (Jan., 9, 2015); Interview with a woman from Kulapi (KP3) (Jan. 9, 2015); Interview with a man from Kulapi 3 (KP5) (Jan. 9, 2015).

¹⁰⁶ ENVIRONMENTAL PLAN, at 44.

¹⁰⁷ Interview with a woman from Panadaka (PD2) (Jan. 3, 2015); Interview with a woman from Panadaka (PD3) (Jan. 3, 2015); Interview with a woman from Panadaka (PD4) (Jan. 3, 2015); Interview with a woman from Panadaka (PD5) (Jan. 3, 2015); Interview with a man from Mugalep (MG2) (Jan. 4, 2015); Interview with an individual from Mugalep (MG7) (Jan. 4, 2015); Interview with a man from Yarik Timorope (YK4) (Jan. 5, 2015); Interview with a man from Yarik Timorope (YK5) (Jan. 5, 2015); Interview with a man from Alipis (AL4) (Jan. 7, 2015); Interview with a man from Apalaka (AP1) (Jan. 6, 2015); Focus Group Interview with men from Yunarilama (YM FGM) (Jan. 10, 2016).

¹⁰⁸ ENVIRONMENTAL PLAN, at 61 (emphasis added).

¹⁰⁹ *See* ENVIRONMENTAL PLAN, at 61.

¹¹⁰ Interview with a woman from Panadaka (PD3) (Jan. 3, 2015) (“There’s no little streams here...They have been all covered up.”). *See also* Interview with a woman from Panadaka (PD5) (Jan. 3, 2015); Interview with a man from Mugalep (MG2) (Jan. 4, 2015); Interview with an individual from Mugalep (MG7) (Jan. 4, 2015); Interview with a woman from Panadaka (PD2) (Jan. 3, 2015) (“All the old rivers or streams have been covered by the dump and the water just disappeared into the soil. There is no water for us to drink.”).

¹¹¹ Interview with a man from Panadaka (PD1) (Jan. 3, 2015); Interview with a woman from Panadaka (PD2) (Jan. 3, 2015); Focus Group Interview with men from Panadaka (PD FGM) (Jan. 5, 2016).

¹¹² Interview with a man from Apalaka (AP1) (Jan. 6, 2015) (“*Where did you obtain your water before the mining?* From ipo yongonae, hupaka, akanda, enoyai. Those waters were very good. They were springs from the mountains. My ancestors drank from it. I drank from it. Mining came and destroyed it. They no longer exist now.”); Interview with a man from Apalaka (AP4) (Jan. 11, 2015).

¹¹³ Interview with a resident of Porgera (AP2) (Jan. 11, 2015).

¹¹⁴ Interview with a man from Apalaka (AP2) (Jan. 6, 2015) (“When I was young, I drank from those three creeks. Now that the mining started, the waters stopped existing. I don’t drink from them. My children haven’t seen those creeks. The creek has stopped.”).

¹¹⁵ Interview with a man from Yunarilama (YL1) (Jan. 6, 2015); Interview with a man from Yarik Timorope (YL4) (Jan. 6, 2015); Focus Group Interview with men from Yunarilama (YM FGM) (Jan. 10, 2016).

¹¹⁶ Interview with a woman from Timorope Yarik (YK1) (Jan. 5, 2015) (A: “If there is no water, during the dry season, we go to Yawana. Yawana is not pure clean, it comes with some dirt. We carry our clothes bags to Yawana, and wash there. Q: Are the clothes clean after Yawana? A: After washing them, the clothes turn dusty. But we have no other choice.”).

¹¹⁷ *See, e.g.*, Focus Group Interview with men from Apalaka (AK FGM) (Jan. 10, 2016); *see also*, Focus Group Interview with women and men from Anawe (AW FGWM) (Jan. 8, 2016).

¹¹⁸ In Kulapi, for example, people wash in the Ekano and Kulapi streams but think they are too polluted to drink. *See* Interview with a woman from Kulapi (KP10) (Jan. 9, 2015) (“Only washing our bodies, we don’t drink.”); *see also* Interview with a woman from Panadaka (PD5) (Jan. 3, 2015) (stating that she uses a small stream near her house for washing clothes, but that the “water isn’t safe to drink. People live up there, and they put their waste in it, so it isn’t safe to drink.”); Interview with a male landowner from Yarik Timorope 2 (YK3) (Jan. 5, 2015) (stating that they use the Tibuno Kendo and Yawana streams, but only for washing); Interview with a woman from Upper Yarik (YK13) (Jan. 6, 2013) (“We also go down to small streams and wash clothes and plates/cups there. Not to drink.”); Interview with a man from Anawe (AW2) (Jan. 10, 2015) (“The good big rivers that I used to wash my clothes are under the ground. Today I wash my clothes in the dirty water here [Kili].”); *see also* Interview with a man in Anawe (AW5) (Jan. 10, 2015).

¹¹⁹ Interview with a woman from Panadaka (PD4) (Jan. 3, 2015) (“There is an outlet creek near Yarik where we go if we have no other choice. Wingeema creek. It tastes awful because the water travels through mining valleys. The taste of it is awful, but we need water. It looks dull, like dust.”); Interview with a woman from Timorope Yarik (YK1) (Jan. 5, 2015) (“If there is no water, during the dry season, we go to Yawana [creek]. Yawana is not pure clean, it comes with some dirt.”).

¹²⁰ Interview with a man from Panadaka (PD1) (Jan. 3, 2015); Interview with a woman from Panadaka (PD2) (Jan. 3, 2015); Interview with a woman from Panadaka (PD3) (Jan. 3, 2015); Interview with a woman from Panadaka (PD4) (Jan. 3, 2015); Interview with a man from Mugalep (MG2) (Jan. 4, 2015); Interview with an individual from Mugalep (MG7) (Jan. 4, 2015); Interview with a woman from Mugalep (MG8) (Jan. 4, 2015); Interview with a man from Yarik Timorope (YK5) (Jan. 5, 2015); Interview with a woman from Yarik Timorope (YK8) (Jan. 5, 2015); Interview with a chief from Kulapi (KP2) (Jan. 9, 2015); Interview with a woman from Kulapi (KP3) (Jan. 9, 2015); Interview with a man from Kulapi 3 (KP5) (Jan. 9, 2015); Interview with a woman from Kulapi (KP6) (Jan. 9, 2015); Interview with a man from Apalaka (AP1) (Jan. 6, 2015); Interview with a resident of Porgera (AP2) (Jan. 11, 2015); Interview with a woman from Apalaka (AP5) (Jan. 11, 2015); Interview with a man from Alipis (AL4) (Jan. 7, 2015); Interview with a man from Alipis (AL5) (Jan. 7, 2015); Interview with a man from Alipis (AL8) (Jan. 7, 2015); Interview with a woman from Panadaka (PD5) (Jan. 3, 2015); Interview with a man and woman from Mugalep (MG3) (Jan. 4, 2015); Interview with a woman from Paiari Village (MG6) (Jan. 4, 2015); Interview with a woman from Timorope Yarik (YK1) (Jan. 5, 2015); Interview with a woman from Yarik Timorope (YK2) (Jan. 5, 2015); Interview with a male landowner from Yarik Timorope 2 (YK3) (Jan. 5, 2015); Interview with a man from Yarik Timorope (YK4) (Jan. 5, 2015); Interview with a male landowner from Timorope 2 from Tiyini Clan (YK6) (Jan. 5, 2015); Interview with a woman from Yarik Timorope (YK7) (Jan. 5, 2015); Interview with a woman from Yarik (YK12) (Jan. 6, 2015); Interview with a woman from Upper Yarik (YK13) (Jan. 6, 2013); Interview with a woman from Yunarilama (YL3) (Jan. 6, 2015); Interview with a man from Yarik Timorope (YL4) (Jan. 6, 2015); Interview with a man from Yunarilama (YL5) (Jan. 6, 2015); Interview with a man from Alipis (AL1) (Jan. 7, 2015); Interview with a leader from Alipis (AL6) (Jan. 7, 2015); Interview with a man from Alipis (AL7) (Jan. 7, 2015); Interview with a landowner from Kulapi 2 (KP1) (Jan., 9, 2015); Interview with a woman from Kulapi (KP4) (Jan. 9, 2015); Interview with a woman from Kulapi (KP9) (Jan. 9, 2015); Interview with a man from Kulapi (KP11) (Jan. 9, 2015); Interview with a man from Anawe (AW1) (Jan. 10, 2015); Interview with a man from Apalaka (AW2) (Jan. 10, 2015); Interview with a female from Tamando (AW3) (Jan. 10, 2015); Interview with a woman from Anawe (AW4) (Jan. 10, 2015); Interview with a man in Anawe (AW5) (Jan. 10, 2015); Interview with a woman from Tamando (AW6) (Jan. 10, 2015); Interview with a man from Apalaka (AP4) (Jan. 11, 2015).

¹²¹ Interview with a man from Panadaka (PD1) (Jan. 3, 2015); Interview with a woman from Panadaka (PD2) (Jan. 3, 2015); Interview with a woman from Panadaka (PD 3) (Jan. 3, 2015). Only one woman reported having access to a small creek near her house. Interview with a woman from Panadaka (PD 4) (Jan. 3, 2015).

¹²² Interview with a landowner from Kulapi 2 (KP1) (Jan., 9, 2015); Interview with a chief from Kulapi (KP2) (Jan. 9, 2015); Interview with a man from Kulapi (KP11) (Jan. 9, 2015).

¹²³ Interview with a landowner from Kulapi 2 (KP1) (Jan., 9, 2015).

¹²⁴ Interview with a chief from Kulapi (KP2) (Jan. 9, 2015); Interview with a landowner from Kulapi 2 (KP1) (Jan. 9, 2015).

¹²⁵ Interview with a landowner from Kulapi 2 (KP1) (Jan., 9, 2015).

¹²⁶ Interview with a chief from Kulapi (KP2) (Jan. 9, 2015).

¹²⁷ Interview with a landowner from Kulapi 2 (KP1) (Jan., 9, 2015).

- ¹²⁸ *See, e.g.*, Interview with a woman from Kulapi (KP6) (Jan. 9, 2015); Interview with a man from Kulapi (KP7) (Jan. 9, 2015); Interview with a man from Kulapi 3 (KP5) (Jan. 9, 2015).
- ¹²⁹ Interview with a man from Kulapi (KP11) (Jan. 9, 2015).
- ¹³⁰ Focus Group Interview with men from Kulapi (KP FGM) (Jan. 8, 2016); Focus Group Interview with women from Kulapi (KP FGW) (Jan. 8, 2016); Interview with a man from Kulapi (KP7) (Jan. 9, 2015); Interview with a woman from Kulapi 1 (KP8) (Jan. 9, 2015).
- ¹³¹ Interview with a man from Kulapi (KP7) (Jan. 9, 2015).
- ¹³² Focus Group Interview with women from Kulapi (KP FGW) (Jan. 8, 2016); Interview with a woman from Kulapi (KP3) (Jan. 9, 2015); Interview with a woman from Kulapi 1 (KP8) (Jan. 9, 2015).
- ¹³³ Interview with a man from Alipis (AL1) (Jan. 7, 2015) (“There is a small creek away from the Kakai River. It is called Ank. But I don’t drink from it. People live above it and drop rubbish and all that. So it is unsafe to drink?”); Interview with a leader from Alipis (AL6) (Jan. 7, 2015) (“We can’t drink from it, because there are too many people, people excrete, it is overcrowded.”).
- ¹³⁴ Interview with a man from Alipis (AL7) (Jan. 7, 2015).
- ¹³⁵ Interview with two women from Alipis (AL3) (Jan. 7, 2015).
- ¹³⁶ Interview with two women from Alipis (AL3) (Jan. 7, 2015).
- ¹³⁷ Focus Group Interview with men from Apalaka (AK FGM) (Jan. 10, 2016).
- ¹³⁸ Interview with a woman from Yarik Timorope (YK2) (Jan. 5, 2015) (“It is a dirty river, it comes from the company up there.”).
- ¹³⁹ *See e.g.*, Interview with a man from Apalaka (AP4) (Jan. 11, 2015).
- ¹⁴⁰ Focus Group Interview with men from Apalaka (AK FGM) (Jan. 10, 2016).
- ¹⁴¹ Focus Group Interview with men from Apalaka (AK FGM) (Jan. 10, 2016).
- ¹⁴² Interview with a woman from Timorope Yarik (YK1) (Jan. 5, 2015).
- ¹⁴³ Interview with a male landowner from Yarik Timorope 2 (YK3) (Jan. 5, 2015).
- ¹⁴⁴ Interview with a male landowner from Yarik Timorope 2 (YK3) (Jan. 5, 2015).
- ¹⁴⁵ Interview with a male landowner from Timorope 2 from Tiyini Clan (YK6) (Jan. 5, 2015).
- ¹⁴⁶ Interview with a woman from Yarik Timorope (YK7) (Jan. 5, 2015) (“I don’t go there. It is chemicals. Yawana is coming from the mine open pit. We know chemicals and oils come down. So we don’t drink from that.”).
- ¹⁴⁷ Focus Group Interview with women and men from Anawe (AW FGWM) (Jan. 8, 2016).
- ¹⁴⁸ Interview with a man in Anawe (AW5) (Jan. 10, 2015).
- ¹⁴⁹ Interview with a woman from Anawe (AW4) (Jan. 10, 2015).
- ¹⁵⁰ Interview with a man from Apalaka (AW2) (Jan. 10, 2015).
- ¹⁵¹ Interview with a man from Yunarilama (YL1) (Jan. 6, 2015); Interview with a woman from Yunarilama (YL3) (Jan. 6, 2015) (on Kalayu); Interview with a man from Yarik Timorope (YL4) (Jan. 6, 2015) (on cooking with water from Kalayu); Interview with a man from Yunarilama (YL5) (Jan. 6, 2015) (Ice Pari).
- ¹⁵² Interview with a man from Yarik Timorope (YL4) (Jan. 6, 2015) (“The Kaka River Creek is called *Ipo Kalayo* [Ipili name].”).
- ¹⁵³ Interview with a man from Yarik Timorope (YL4) (Jan. 6, 2015); Interview with a man from Yunarilama (YL5) (Jan. 6, 2015).
- ¹⁵⁴ Interview with a man from Yunarilama (YL5) (Jan. 6, 2015).

¹⁵⁵ ANNUAL ENVIRONMENTAL REPORT 2014, *supra* note 79, at 155; BARRICK GOLD CORP.: PORGERA, ENVIRONMENTAL MONITORING ANNUAL REPORT 2012, 187 (2013), <http://s1.q4cdn.com/808035602/files/porgera/2012-Porgera-Annual-Environmental-Report.pdf>.

¹⁵⁶ Interview with a woman from Yunarilama (YL3) (Jan. 6, 2015); Interview with a man from Yarik Timorope (YL4) (Jan. 6, 2015); Interview with a man from Yunarilama (YL5) (Jan. 6, 2015).

¹⁵⁷ Interview with a man from Yunarilama (YL2) (Jan. 6, 2015).

¹⁵⁸ Interview with a man from Yunarilama (YL5) (Jan. 6, 2015).

¹⁵⁹ BARRICK GOLD CORP., TAILINGS MANAGEMENT AT PORGERA, 3, <http://barrick.q4cdn.com/808035602/files/porgera/Tailings-Management.pdf> (“Tailings undergo significant precautionary treatment at the site before discharge to mitigate any potentially harmful effects. This includes a multi-step neutralization process in the mine’s treatment plant and a series of chemical processes that destroy cyanide and neutralize the pH of the water. . . . Slaked lime is also added to the tailings to raise pH prior to discharge.”).

¹⁶⁰ H. Guasch, J. Armengol, E. Martí & S. Sabater, *Diurnal variation in dissolved oxygen and carbon dioxide in two low-order streams*, WATER RESEARCH 32(4), 1067-1074 (1998).

¹⁶¹ ANNUAL ENVIRONMENTAL REPORT 2014, *supra* note 79, at 111.

¹⁶² PORGERA JOINT VENTURE, ENVIRONMENTAL MONITORING 2011 ANNUAL REPORT, 5-47 (2012), <http://www.barrick.com/files/porgera/2011-Porgera-Annual-Environmental-Report.pdf>.

¹⁶³ *Id.*

¹⁶⁴ *See, e.g.*, ANNUAL ENVIRONMENTAL REPORT 2014, *supra* note 79.

¹⁶⁵ *See, e.g.*, Interview with a woman from Yarik Timorope (YK7) (Jan. 5, 2015) (“They cut the leaves from the pandanus tree. They cut the sides, so it forms a half pipe. They push it in to the side of the hill, into the dirt. Brown water starts to come out. After an hour or so, it comes cleaner.”).

¹⁶⁶ Interview with a woman from Yarik Timorope (YK7) (Jan. 5, 2015) (“They cut the leaves from the pandanus tree. They cut the sides, so it forms a half pipe. They push it in to the side of the hill, into the dirt. Brown water starts to come out. After an hour or so, it comes cleaner. One of the plastic yellow containers can take about 2-3 hours, to get a few gallons.”); Interview with a man from Alipis (AL2) (Jan. 7, 2015) (“I collect [water] from an underground spring. I go down to fetch the water every afternoon. If I take plenty of containers, it takes me a long time. And it is heavy when I carry it back. It takes me at least one hour, 1.5 hours [to make the roundtrip]. Going down, with empty containers is quick. But coming back takes time. The water comes from the mountain. It comes from the stone, you move the mud, water starts to flow, then you stick in a leaf, and funnel it into the containers.”).

¹⁶⁷ *See* Focus Group Interview with men and women from Timorope (TP FGWM) (Jan. 11, 2016); Focus Group Interview with women from Panadaka (PD FGW SK) (Jan. 5, 2016); Focus Group Interview with men from Panadaka (PD FGM) (Jan. 5, 2016); Focus Group Interview with men from Pakien Camp (PC FGWM) (Jan. 6, 2016); Focus Group Interview with women from Kulapi (KP FGW) (Jan. 8, 2016) (where a woman noted, “Our kendos have already been covered by the dump. We don’t have kendos here at Kulapi.”); Focus Group Interview with men from Alipis (AP FGM) (Jan 7, 2016).

¹⁶⁸ Focus Group Interview with men and women from Timorope (TP FGWM) (Jan. 11, 2016); Interview with a man from Apalaka (AP1) (Jan. 6, 2015) (“From *ipo yongonae*, *hupaka*, *akanda*, *enoyai*. Those waters were very good. They were springs from the mountains. My ancestors drank from it. I drank from it. Mining came and destroyed it. They no longer exist now.”).

¹⁶⁹ Focus Group Interview with women from Mugalep (MG FGW) (Jan. 6, 2016) (WH) (where a man explained that “We have two ipa kendos. The whole community uses them. During the dry season, the ipa kendos dry up (it only takes few weeks for them to dry up). We have to go to Kakai.”).

¹⁷⁰ Interview with a man from Mugalep (MG1) (Jan. 4, 2015) (man from Mugalep travels 6 hours in total by car to get to Kumbi Piari spring); Focus Group Interview with women from Mugalep (MG FGW) (Jan. 6, 2016) (WH) (one hour walk to Kiligali ipo kendo, and about an hour to walk to ipa Pakena (for the latter, one woman noted: “A person says they own the kendo so when people go to fetch the water, people sit there for hours waiting for the water to fill up.”).

¹⁷¹ Focus Group Interview with men from Mugalep (MG FGM) (Jan. 6, 2016).

- ¹⁷² Focus Group Interview with men from Top Yarik (TY FGM) (Jan. 10, 2016); Focus Group Interview with women from Timorope Yarik (TY FGW) (Jan. 12, 2016).
- ¹⁷³ Focus Group Interview with men from Top Yarik (TY FGM) (Jan. 10, 2016); *see also* Focus Group Interview with women from Timorope Yarik (TY FGW) (Jan. 12, 2016); Interview with a woman from Upper Yarik (YK10 FI) (Jan. 5, 2015); Interview with a woman from Yarik Timorope (YK2) (Jan. 5, 2015).
- ¹⁷⁴ Interview with a woman from Upper Yarik (YK10 FI) (Jan. 5, 2015); Interview with a woman from Yarik (YK12) (Jan. 6, 2015).
- ¹⁷⁵ Focus Group Interview with men from Top Yarik (TY FGM) (Jan. 10, 2016).
- ¹⁷⁶ Focus Group Interview with men from Apalaka (AK FGM) (Jan. 10, 2016); Focus Group Interview with women from Apalaka (AK FGW) (Jan. 10, 2016); Interview with two women from Alipis (AL3) (Jan. 7, 2015); Interview with a man from Apalaka (AP1) (Jan. 6, 2015); Interview with a resident of Porgera (AP2) (Jan. 11, 2015); Focus Group Interview with men and women from Timorope (TP FGWM) (Jan. 11, 2016).
- ¹⁷⁷ Interview with a woman from Panadaka (PD4) (Jan. 3, 2015).
- ¹⁷⁸ Human Rights Clinic Research Team, COLUMBIA LAW SCHOOL, Observations from trip to Papua New Guinea (July-Aug. 2015) (14-1-1) (on file with authors).
- ¹⁷⁹ Human Rights Clinic Research Team, COLUMBIA LAW SCHOOL, Observations from trip to Papua New Guinea (July-Aug. 2015) (on file with authors).
- ¹⁸⁰ Human Rights Clinic Research Team, COLUMBIA LAW SCHOOL, Observations from trip to Papua New Guinea (July-Aug. 2015) (on file with authors).
- ¹⁸¹ Interview with a woman from Yarik Timorope (YK7) (Jan. 5, 2015).
- ¹⁸² Interview with a man from Apalaka (AP1) (Jan. 6, 2015).
- ¹⁸³ Focus Group Interview with men and women from Timorope (TP FGWM) (Jan. 11, 2016); Interview with a resident of Porgera (AP2) (Jan. 11, 2015).
- ¹⁸⁴ Focus Group Interview with women from Timorope Yarik (TY FGW) (Jan. 12, 2016).
- ¹⁸⁵ Interview with a man from Alipis (AL2) (Jan. 7, 2015); Interview with two women from Alipis (AL3) (Jan. 7, 2015); Interview with a man from Apalaka (AP1) (Jan. 6, 2015); Interview with a resident of Porgera (AP2) (Jan. 11, 2015).
- ¹⁸⁶ Interview with a resident of Porgera (AP2) (Jan. 11, 2015) (describing that it takes two hours round-trip); Interview with two women from Alipis (AL3) (Jan. 7, 2015) (stating that she travels one hour each way); Interview with a man from Apalaka (AP1) (Jan. 6, 2015) (travels three hours there, three hours back).
- ¹⁸⁷ *See, e.g.*, Interview with a man from Mugalep (MG1) (Jan. 4, 2015); Focus Group Interview with men from Mugalep (MG FGM) (Jan. 6, 2016); Focus Group Interview with women from Yunarilama (YM FGW) (Jan. 10, 2016) (“As a tradition, we are not allowed to go to other villages to collect water.”); Focus Group Interview with women from Apalaka (AK FGW) (Jan. 10, 2016) (“We don’t have any other places to go and get water. The bush up there is owned by different groups of people or clans.”); Focus Group Interview with women from Kulapi (KP FGW) (Jan. 8, 2016); (“We don’t go there. At Aumbi, those people get a tax for the water. Depending on the container, 5 kina or 10 kina. People who live there, they seem to own that water.”).
- ¹⁸⁸ The response questions about getting water from other places was often that that land was owned by a different tribe. *See* Focus Group Interview with women from Yunarilama (YM FGW) (Jan. 10, 2016) (“Q: Do you use ipa kendos from other villages? A: No. Q: Why? A: We don’t go there because the owners of those areas ask for money to fetch their water. As a tradition, we are not allowed to go to other villages to collect water.”).
- ¹⁸⁹ *See, e.g.*, Focus Group Interview with women from Mugalep (MG FGW) (Jan. 6, 2016) (WH); Focus Group Interview with men from Pakien Camp (PC FGWM) (Jan. 6, 2016); Focus Group Interview with men and women from Timorope (TP FGWM) (Jan. 11, 2016).
- ¹⁹⁰ Focus Group Interview with women from Alipis (AP FGW) (Jan. 7, 2016).
- ¹⁹¹ Interview with a resident of Porgera (AP2) (Jan. 11, 2015).
- ¹⁹² Focus Group Interview with men from Pakien Camp (PC FGWM) (Jan. 6, 2016).

- ¹⁹³ Focus Group Interview with men from Mugalep (MG FGM) (Jan. 6, 2016).
- ¹⁹⁴ Focus Group Interview with women from Mugalep (MG FGW) (Jan. 6, 2016) (WH).
- ¹⁹⁵ Focus Group Interview with women from Apalaka (AK FGW) (Jan. 10, 2016).
- ¹⁹⁶ Panadaka residents report that they do not have springs, and must walk to the Wangima spring (30-minute walk each way). *See* Focus Group Interview with men from Panadaka (PD FGM) (Jan. 5, 2016); Focus Group Interview with women from Panadaka (PD FGW SK) (Jan. 5, 2016); Interview with a man from Alipis (AL7) (Jan. 7, 2015); Interview with a man and woman from Mugalep (MG3) (Jan. 4, 2015); Focus Group Interview with men and women from Timorope (TP FGWM) (Jan. 11, 2016).
- ¹⁹⁷ Interview with a woman from Upper Yarik (YK10 FI) (Jan. 5, 2015); Focus Group Interview with women from Panadaka (PD FGW SK) (Jan. 5, 2016); Focus Group Interview with men from Alipis (AP FGM) (Jan 7, 2016).
- ¹⁹⁸ Interview with a man from Yunarilama (YL5) (Jan. 6, 2015) (“sometimes people up there don’t let us.”); Focus Group Interview with men and women from Timorope (TP FGWM) (Jan. 11, 2016); Focus Group Interview with men from Alipis (AP FGM) (Jan 7, 2016).
- ¹⁹⁹ Focus Group Interview with women from Panadaka (PD FGW SK) (Jan. 5, 2016).
- ²⁰⁰ Focus Group Interview with women from Panadaka (PD FGW SK) (Jan. 5, 2016).
- ²⁰¹ Focus Group Interview with men from Alipis (AP FGM) (Jan 7, 2016).
- ²⁰² Focus Group Interview with men from Alipis (AP FGM) (Jan 7, 2016).
- ²⁰³ Focus Group Interview with men from Alipis (AP FGM) (Jan 7, 2016).
- ²⁰⁴ Interview with a man from Apalaka (AP6) (Jan. 11, 2015); Interview with a woman from Kulapi (KP9) (Jan. 9, 2015); Interview with a woman from Yarik Timorope (YK7) (Jan. 5, 2015); *see also* Interview with a woman from Upper Yarik (YK13) (Jan. 6, 2013) (“like water in the fridge”); Interview with a man from Mugalep (MG2) (Jan. 4, 2015); Interview with a woman from Porgera (MG4) (Jan. 4, 2015).
- ²⁰⁵ Interview with a man and woman from Mugalep (MG3) (Jan. 4, 2015) (about Wendoko); Interview with a woman from Yarik Timorope (YK2) (Jan. 5, 2015) (about Wingima); Interview with a man from Yarik Timorope (YK4) (Jan. 5, 2015); Interview with a woman from Panadaka (PD4) (Jan. 3, 2015) (also about Wingima).
- ²⁰⁶ Interview with a man from Kulapi 3 (KP5) (Jan. 9, 2015) (“a lot of people are building their houses up there, I think it has been polluted by a lot of people, so I don’t drink there any more.”).
- ²⁰⁷ Focus Group Interview with men from Mugalep (MG FGM) (Jan. 6, 2016).
- ²⁰⁸ *See, e.g.*, Consultation with residents of Panadaka (July 6, 2015) (description of Larapia Kendo); *see also*, Consultation with residents of Panaka (July 16, 2015) (description of Wano Kendo).
- ²⁰⁹ *See, e.g.*, Consultation with residents of Top Yarik (July 14, 2015) (description of Koma and Pipe Kendos); *see also*, Interview with a woman from Yarik (YK12) (Jan. 6, 2015); Interview with a woman from Upper Yarik (YK13) (Jan. 6, 2013); *cf.* Interview with a woman from Yarik Timorope (YK2) (Jan. 5, 2015); Interview with a man from Alipis (AL5) (Jan. 7, 2015); Interview with a man from Alipis (AL7) (Jan. 7, 2015); Interview with a woman from Panadaka (PD4) (Jan. 3, 2015).
- ²¹⁰ *See, e.g.*, BARRICK ANNUAL ENVIRONMENTAL REPORT 2014, *supra* note 79, at 134-135; DRINKING WATER STUDY, *supra* note 2.
- ²¹¹ ANNUAL ENVIRONMENTAL REPORT 2014, *supra* note 79, at 134-135; DRINKING WATER STUDY, *supra* note 2.
- ²¹² ANNUAL ENVIRONMENTAL REPORT 2015, *supra* note 92, at 155-156.
- ²¹³ Interview with a woman from Panadaka (PD6) (Jan. 3, 2015).
- ²¹⁴ Interview with a man from Panadaka (PD1) (Jan. 3, 2015); Interview with a woman from Panadaka (PD3) (Jan. 3, 2015).
- ²¹⁵ Interview with a man and woman from Mugalep (MG3) (Jan. 4, 2015).
- ²¹⁶ Interview with a woman from Panadaka (PD4) (Jan. 3, 2015).

- ²¹⁷ Human Rights Clinic, COLUMBIA LAW SCHOOL, Observations from trip to Papua New Guinea (Jan. 16, 2017) (on file with authors).
- ²¹⁸ Interview with a woman from Panadaka (PD6) (Jan. 3, 2015).
- ²¹⁹ Focus Group Interview with women from Panadaka (PD FGW SK) (Jan. 5, 2016).
- ²²⁰ Interview with a man and woman from Mugalep (MG3) (Jan. 4, 2015).
- ²²¹ *See, e.g.*, Interview with a man from Panadaka (PD1) (Jan. 3, 2015).
- ²²² Jeffery Simon, PORGERA ALLIANCE, *Porgera: Barrick Poison Community*, <http://www.porgeraalliance.net/wp-content/uploads/2010/08/Tailing-Disposal.pdf>.
- ²²³ Interview with a landowner from Kulapi 2 (KP1) (Jan., 9, 2015).
- ²²⁴ ANNUAL ENVIRONMENTAL REPORT 2015, *supra* note 92, at viii (see also testing results at 157).
- ²²⁵ Sarah Knuckey, Lieff Cabraser Associate Clinical Professor of Law, Columbia Law School, Photographic log from Panadaka Village (July 13, 2015) (on file with authors).
- ²²⁶ Interview with a man from Alipis (AL4) (Jan. 7, 2015); Interview with a leader from Alipis (AL6) (Jan. 7, 2015).
- ²²⁷ Interview with a man from Alipis (AL2) (Jan. 7, 2015).
- ²²⁸ Interview with a man from Alipis (AL5) (Jan. 7, 2015).
- ²²⁹ Focus Group Interview with women from Alipis (AP FGW) (Jan. 7, 2016).
- ²³⁰ *See, e.g.*, Focus Group Interview with men from Kulapi (KP FGM) (Jan. 8, 2016); Focus Group Interview with women from Alipis (AP FGW) (Jan. 7, 2016); Focus Group Interview with men from Alipis (AP FGM) (Jan 7, 2016); Focus Group Interview with men from Pakien Camp (PC FGWM) (Jan. 6, 2016); Focus Group Interview with women from Panadaka (PD FGW SK) (Jan. 5, 2016); Focus Group Interview with men from Top Yarik (TY FGM) (Jan. 10, 2016); Focus Group Interview with women from Timorope (TP FGW) (Jan. 11, 2016); Focus Group Interview with men from Yunarilama (YM FGM) (Jan. 10, 2016).
- ²³¹ Focus Group Interview with women from Panadaka (PD FGW SK) (Jan. 5, 2016) (“We wash and drink in the Kakai.”); Focus Group Interview with men from Panadaka (PD FGM) (Jan. 5, 2016) (“Women walk to the big river [Kakai], washing clothes, body, cooking utensils...The water is not good. Even our clothes are dusty.”); Interview with a woman from Yunarilama (YL3) (Jan. 6, 2015) (“[I]n the dry season so I go to Kaka, the dirty chemical water. I don’t care about the color or the smell, I definitely know its poisonous water, but in my mind I create my own images that it is a beautiful clean river from before the mine. Barrick is dumping its waste into it so I automatically know that it’s polluted.”).
- ²³² *See, e.g.*, Focus Group Interview with women from Mugalep (MG FGW) (Jan. 6, 2016) (WH); Focus Group Interview with women from Yunarilama (YM FGW) (Jan. 10, 2016).
- ²³³ Focus Group Interview with men from Panadaka (PD FGM) (Jan. 5, 2016).
- ²³⁴ Focus Group Interview with women from Yunarilama (YM FGW) (Jan. 10, 2016).
- ²³⁵ *See, e.g.*, Focus Group Interview with women from Apalaka (AK FGW) (Jan. 10, 2016).
- ²³⁶ Focus Group Interview with women from Kulapi (KP FGW) (Jan. 8, 2016).
- ²³⁷ Focus Group Interview with men and women from Timorope (TP FGWM) (Jan. 11, 2016).
- ²³⁸ Focus Group Interview with men from Yunarilama (YM FGM) (Jan. 10, 2016).
- ²³⁹ *See* Focus Group Interview with women from Panadaka (PD FGW SK) (Jan. 5, 2016); Focus Group Interview with men from Alipis (AP FGM) (Jan 7, 2016).
- ²⁴⁰ Focus Group Interview with men from Alipis (AP FGM) (Jan 7, 2016).
- ²⁴¹ Focus Group Interview with women from Panadaka (PD FGW SK) (Jan. 5, 2016); *cf.* Focus Group Interview with men from Panadaka (PD FGM) (Jan. 5, 2016) (one man from Panadaka countered, “It’s dirty, how can we drink that? Only children drink it, we don’t know.”).

- ²⁴² Focus Group Interview with women from Apalaka (AK FGW) (Jan. 10, 2016); Focus Group Interview with men from Apalaka (AK FGM) (Jan. 10, 2016); Interview with a man from Apalaka (AP6) (Jan. 11, 2015); Interview with a woman from Apalaka (AP5) (Jan. 11, 2015); *see also* Focus Group Interview with women from Timorope Yarik (TY FGW) (Jan. 12, 2016) (women of Top Yarik also talk of drinking the Kaia).
- ²⁴³ Interview with a man from Apalaka (AP6) (Jan. 11, 2015).
- ²⁴⁴ Focus Group Interview with men from Mugalep (MG FGM) (Jan. 6, 2016).
- ²⁴⁵ Focus Group Interview with men from Mugalep (MG FGM) (Jan. 6, 2016).
- ²⁴⁶ Focus Group Interview with women from Mugalep (MG FGW) (Jan. 6, 2016) (WH).
- ²⁴⁷ *See, e.g.*, Focus Group Interview with women from Yunarilama (YM FGW) (Jan. 10, 2016); Focus Group Interview with women from Apalaka (AK FGW) (Jan. 10, 2016); Focus Group Interview with men from Kulapi (KP FGM) (Jan. 8, 2016); Focus Group Interview with women from Mugalep (MG FGW) (Jan. 6, 2016) (WH); Interview with a woman from Kulapi (KP4) (Jan. 9, 2015).
- ²⁴⁸ Interview with a man from Panadaka (PD1) (Jan. 3, 2015) (“The Kakai river there, it is a big river where the company normally puts chemicals so we don’t drink from this.”); Interview with a man from Alipis (AL1) (Jan. 7, 2015) (“The company operates up above. They do dumping and all this. Every day it is dirty. There is no option, so I go there to wash. Day and night. It is dirty every day. Big machines are up there. Waste from the mine is dumped in the river. But I have to use it.”). *See also* Interview with a woman from Panadaka (PD3) (Jan. 3, 2015); Interview with a woman from Panadaka (PD5) (Jan. 3, 2015); Interview with a woman from Panadaka (PD6) (Jan. 3, 2015).
- ²⁴⁹ Interview with a man from Alipis (AL1) (Jan. 7, 2015) (“It smells and stinks. Of oil. It doesn’t smell good.”); Interview with a man from Alipis (AL2) (Jan. 7, 2015) (“The smell is very different. It smells like chemicals. Different from normal rivers.”); Interview with a woman from Panadaka (PD5) (Jan. 3, 2015) (It smells like chemical or a waste from the gold. It smells like rust, or like water that has been kept for so long in a bucket); Interview with a man from Yarik Timorope (YL4) (Jan. 6, 2015) (“It smells really bad. It smells like chemicals”), *see also* Interview with a woman from Panadaka (PD6) (Jan. 3, 2015); Interview with a man from Yarik Timorope (YL4) (Jan. 6, 2015).
- ²⁵⁰ Interview with a woman from Panadaka (PD3) (Jan. 3, 2015); *see also* Interview with a woman from Panadaka (PD5) (Jan. 3, 2015).
- ²⁵¹ Interview with a woman from Panadaka (PD3) (Jan. 3, 2015).
- ²⁵² Interview with a man from Panadaka (PD1) (Jan. 3, 2015).
- ²⁵³ Interview with a woman from Panadaka (PD5) (Jan. 3, 2015) (“In dry season, we go to the Kakai River. It isn’t good water, it is dirty water. But we wash there. We don’t drink from it.”); *see also* Interview with a woman from Panadaka (PD6) (Jan. 3, 2015); Interview with a man from Yunarilama (YL2) (Jan. 6, 2015); Interview with a man from Yunarilama (YL1) (Jan. 6, 2015); Interview with a man from Yarik Timorope (YL4) (Jan. 6, 2015); Interview with a man from Alipis (AL1) (Jan. 7, 2015); Interview with a man from Alipis (AL2) (Jan. 7, 2015); Interview with two women from Alipis (AL3) (Jan. 7, 2015); Interview with a man from Alipis (AL5) (Jan. 7, 2015); Interview with a man from Panadaka (PD1) (Jan. 3, 2015); Interview with a woman from Panadaka (PD3) (Jan. 3, 2015). Of the twelve people interviewed who described the Kakai River, only one person told us that he would actually drink from the river water. *See* Interview with a man from Yunarilama (YL1) (Jan. 6, 2015).
- ²⁵⁴ Interview with a man from Yunarilama (YL1) (Jan. 6, 2015).
- ²⁵⁵ Interview with a man from Panadaka (PD1) (Jan. 3, 2015); Interview with a woman from Panadaka (PD3) (Jan. 3, 2015); Interview with a woman from Panadaka (PD5) (Jan. 3, 2015); Interview with a woman from Panadaka (PD6) (Jan. 3, 2015); Interview with a man from Yunarilama (YL2) (Jan. 6, 2015); Interview with a man from Yarik Timorope (YL4) (Jan. 6, 2015); Interview with a man from Yunarilama (YL5) (Jan. 6, 2015); Interview with a man from Alipis (AL1) (Jan. 7, 2015); Interview with two women from Alipis (AL3) (Jan. 7, 2015); Interview with a man from Alipis (AL4) (Jan. 7, 2015); Interview with a man from Alipis (AL5) (Jan. 7, 2015).
- ²⁵⁶ Interview with a woman from Panadaka (PD3) (Jan. 3, 2015) (“After we wash our clothes and dishes and bodies, you can see they are dusty.”); Interview with a woman from Panadaka (PD5) (Jan. 3, 2015) (“The water there is the waste from the pit. It comes with milky and white and dirty things, in the river. The water gets dirty. But during the dry season, we don’t have other water. So we wash our skin and our clothes there.”); Interview with a man from Alipis (AL1) (Jan. 7, 2015) (“After I bathe, and come out, my skin becomes dusty and itchy.”); *see also* Interview with a man

from Yunarilama (YL5) (Jan. 6, 2015); Interview with a man from Yarik Timorope (YL4) (Jan. 6, 2015); Interview with a man from Alipis (AL5) (Jan. 7, 2015); Interview with a woman from Panadaka (PD6) (Jan. 3, 2015).

²⁵⁷ Interview with a woman from Yunarilama (YL3) (Jan. 6, 2015); Interview with a man from Alipis (AL2) (Jan. 7, 2015).

²⁵⁸ Interview with a man from Yarik Timorope (YK5) (Jan. 5, 2015) (“Before, we drank it. It was clear water. Now with the mining, we can see the color is brown. It is dirty water. We don’t wash there either.”); Interview with a woman from Apalaka (AP5) (Jan. 11, 2015) (“It’s not good water. It comes with chemicals. When it rains, the Kaiya river would look white and it comes down with the diesel. When it’s dry the water turns a little bit green and clean a little bit.”).

²⁵⁹ Interview with a man from Yunarilama (YL2) (Jan. 6, 2015).

²⁶⁰ Interview with a male landowner from Yarik Timorope 2 (YK3) (Jan. 5, 2015) (“Previously we used the big river, the Kaiya river to wash ourselves. But when the mine started building the waste dump, the river became dirty.”); Interview with a man from Yarik Timorope (YK4) (Jan. 5, 2015) (“[the Kaiya-Anjolek] is dirty. Before, we drank it. It was clear water. Now with the mining, we can see the color is brown. It is dirty water. We don’t wash there either.”).

²⁶¹ Interview with a resident of Porgera (AP3) (Jan. 11, 2015); Interview with a woman from Apalaka (AP5) (Jan. 11, 2015); Interview with a man from Apalaka (AP6) (Jan. 11, 2015).

²⁶² Focus Group Interview with women from Mugalep (MG FGW) (Jan. 6, 2016) (WH).

²⁶³ Focus Group Interview with women from Alipis (AP FGW) (Jan. 7, 2016).

²⁶⁴ Focus Group Interview with women from Apalaka (AK FGW) (Jan. 10, 2016) (“Q: Does the dry season have any specific impact on women? A: In the dry season, I’ve been washing down there and I could not see my periods. I wash internally there. I stopped having my periods.” Another woman: “We are really concerned about our periods, it happened during the dry season and now our cycles have changed. When we have our periods, we can’t wash in our kendos or blue drums. We don’t know, chemicals might come into us.”); *see also* Interview with two women from Alipis (AL3) (Jan. 7, 2015); Focus Group Interview with women from Timorope Yarik (TY FGW) (Jan. 12, 2016) (“Commonly, women have menstruation overflowing for over 2 weeks, and sometimes for 2 months, no cycle. We don’t know.”); Focus Group Interview with women from Alipis (AP FGW) (Jan. 7, 2016) (“They are also affected by this chemical river. We wash in the Kakai river. Young girls have complicated flow of blood. We think they have period, but it keeps flowing. In our community, most women are affected. Some have complicated problems in their wombs.”).

²⁶⁵ Focus Group Interview with women from Alipis (AP FGW) (Jan. 7, 2016) (“I am talking on behalf of all the females. We have monthly periods. You can see it is unhygienic. We need to wash our body. We don’t have any place to wash. We go to the Kakai River to wash bodies. The chemicals must have come to our body. Sometimes the timing of our periods [are] wrong. Sometimes the blood keeps flowing. And some women give birth to deformed baby. There was a woman who gave birth to a baby with two heads. We women are really suffering here.”); (“We don’t have any other sources of water to wash ourselves. We sit in the Kakai and we thoroughly clean our internal parts. When we want to deliver, we go and do exercise and we wash in the river so the baby can come. We don’t go to the river to deliver baby. We can deliver at the river or at home. It must be dangerous for babies and ourselves.”); Focus Group Interview with women from Panadaka (PD FGW SK) (Jan. 5, 2016) (“I am pregnant and I go to the red river. There’s no other way to get food. I’ve had four miscarriages.”); Focus Group Interview with women from Mugalep (MG FGW) (Jan. 6, 2016) (WH) (“It’s very harmful when we have period[s], mothers give things to babies, we need water. I go and use unclean water, our secret parts are itchy. Previously in traditional times, our mother were here, going around washing themselves, totally, now we don’t have the chance to wash ourselves. We are walking around with dirty skin, most mothers are ill with womb cancer or STIs.”); (“A:...Pregnant mothers, when it is time for delivery, they have the best medical clinics in white place. In Porgera we try to make the babies come out ourselves and use the river we try to wash ourselves to release the baby out. Q: Do some women go to the red water or Kakai to deliver their baby? A: Yes, we just go and wash ourselves, we don’t go there to deliver, just wash ourselves but we don’t expect to deliver but sometimes we can anyway. Women who have babies and periods cannot go where the men are, this is our custom.”); Focus Group Interview with women from Apalaka (AK FGW) (Jan. 10, 2016) (“Most of our pregnant women wash their bodies in the big rivers, sometimes we give birth to children, there are crippled, paralyzed, double-headed, 2 hands, 4 hands. We are scared of them so we throw them.”).

- ²⁶⁶ Interview with a man from Kulapi 3 (KP5) (Jan. 9, 2015); Interview with a woman from Kulapi (KP6) (Jan. 9, 2015); Interview with a man from Kulapi (KP7) (Jan. 9, 2015); Interview with a woman from Kulapi (KP9) (Jan. 9, 2015); Interview with a woman from Kulapi (KP10) (Jan. 9, 2015); Interview with a man from Kulapi (KP11) (Jan. 9, 2015).
- ²⁶⁷ Interview with a woman from Kulapi (KP10) (Jan. 9, 2015).
- ²⁶⁸ Interview with a woman from Kulapi (KP3) (Jan. 9, 2015).
- ²⁶⁹ Focus Group Interview with women from Kulapi (KP FGW) (Jan. 8, 2016).
- ²⁷⁰ Interview with a man from Kulapi 3 (KP5) (Jan. 9, 2015) (“I am drinking from the company supply water [at Kulapi 4]. . . . There is no tap. It releases by pressure. When it comes out, we fetch water. . . . it is a big pipe that comes down from Wally Creek. It is hooked... I cut coca cola 500ml used to funnel the water into 1L bottles. For drinking water 3 containers. For cooking, I carry a bucket.”)
- ²⁷¹ HUMAN RIGHTS CLINIC RESEARCH TEAM, COLUMBIA LAW SCHOOL, Observations from trip to Papua New Guinea (Jan. 8, 2016) (on file with authors).
- ²⁷² Interview with a woman from Kulapi (KP9) (Jan. 9, 2015); Interview with a resident of Porgera (AP2) (Jan. 11, 2015).
- ²⁷³ Focus Group Interview with women from Kulapi (KP FGW) (Jan. 8, 2016).
- ²⁷⁴ Focus Group Interview with men from Mugalep (MG FGM) (Jan. 6, 2016).
- ²⁷⁵ Focus Group Interview with women from Alipis (AP FGW) (Jan. 7, 2016).
- ²⁷⁶ Interview with a man from Kulapi (KP7) (Jan. 9, 2015) (“It tastes differently from the barrel. The water from the pressure pipe tastes fresh and nice. The water from the container is tasteless.”).
- ²⁷⁷ Interview with a woman from Panadaka (PD3) (Jan. 3, 2015); Interview with a man from Mugalep (MG1) (Jan. 4, 2015); Interview with a man in Anawe (AW5) (Jan. 10, 2015); Interview with a man from Mugalep (MG2) (Jan. 4, 2015).
- ²⁷⁸ Interview with a woman from Kulapi (KP6) (Jan. 9, 2015) (stating that the water supply from Kulapi 4 “comes from Waile Stream, so it is okay”); Interview with an individual from Mugalep (MG7) (Jan. 4, 2015); Interview with a man from Mugalep (MG2) (Jan. 4, 2015) (describing Waile Stream as, “good, it comes from the woods...We feel the water in there is fresher than the water in the tanks.”); Interview with a chief from Kulapi (KP2) (Jan. 9, 2015).
- ²⁷⁹ *See, e.g.*, Interview with a man from Kulapi (KP11) (Jan. 9, 2015); *see also*, Interview with a man from Kulapi 3 (KP5) (Jan. 9, 2015) (describing water from the pressure valve: “doesn’t taste good. But I have nothing else to drink”); Interview with a woman from Kulapi (KP4) (Jan. 9, 2015) (describing it as tasting like “medicine” and being “mixed with chemicals”).
- ²⁸⁰ *See, e.g.*, Interview with a woman from Kulapi (KP10) (Jan. 9, 2015) (describing that water from pressure valves “comes from Waile Stream. I don’t know if it is good or bad.”); Interview with a man from Kulapi (KP7) (Jan. 9, 2015); (“That is supplied by the company, so we don’t know whether it is good or bad water.”).
- ²⁸¹ ANNUAL ENVIRONMENTAL REPORT 2014, *supra* note 79.
- ²⁸² *See, e.g.*, Interview with a woman from Yarik Timorope (YK2) (Jan. 5, 2015); Interview with a male landowner from Yarik Timorope 2 (YK3) (Jan. 5, 2015); Interview with a man from Yarik Timorope (YK4) (Jan. 5, 2015); Interview with a woman from Apalaka (AP5) (Jan. 11, 2015); Interview with a landowning woman from Mugalep (MG5) (Jan. 4, 2015); Interview with a woman from Upper Yarik (YK13) (Jan. 6, 2013); Interview with a man from Alipis (AL5) (Jan. 7, 2015); Interview with a landowner from Kulapi 2 (KP1) (Jan., 9, 2015); Interview with a woman from Kulapi (KP4) (Jan. 9, 2015); Interview with a woman from Tamando (AW6) (Jan. 10, 2015).
- ²⁸³ Interview with a man from Apalaka (AW2) (Jan. 10, 2015) (“We buy this sort of bottle for three kina with money, so I don’t buy it because I don’t have three kina to spend on water.”); *see also* Interview with a man from Panadaka (PD1) (Jan. 3, 2015); Interview with a man from Yarik Timorope (YK5) (Jan. 5, 2015); Interview with a man from Yunarilama (YL5) (Jan. 6, 2015); Interview with a man from Alipis (AL4) (Jan. 7, 2015).
- ²⁸⁴ Interview with a man from Yarik Timorope (YK4) (Jan. 5, 2015).
- ²⁸⁵ Interview with a man from Apalaka (AW2) (Jan. 10, 2015).

²⁸⁶ Interview with a landowning woman from Mugalep (MG5) (Jan. 4, 2015); Interview with a woman from Paiari Village (MG6) (Jan. 4, 2015).

CHAPTER IV: WATER IN PORGERA

Findings from an Interdisciplinary Study

PART B: Access to Information and Participation

¹ Environment (Water Quality Criteria) Regulation 2002, Reg. 1.2 (Papua N. G.) (bodies of water “into which waste is discharged and where the prescribed water quality criteria are not required to be met and the protection of aquatic life may not be guaranteed”).

² POM Interview 2017, *supra* note 2.

³ The CEPA, which grants environmental permits for extractive projects, is in charge of creating and implementing environmental policy and regulations. CONSTITUTIONAL & LAW REFORM COMM’N, REVIEW OF ENVIRONMENTAL MINING LAWS RELATING TO MANAGEMENT AND DISPOSAL OF TAILINGS, 53 (2013) [hereinafter CLRC Report].

⁴ The MRA is responsible “for regulating all mineral exploration and mining activities in the country.” However, it has limited power “to regulate, monitor and manage mine tailings in relation to environment matters,” as, under Section 43(1)(a)(ii) of the Mining Act, the MRA must take an environmental permit issued by the DEC as “conclusive evidence of protection of the environment.” CLRC Report, *supra* note 4, at 11.

⁵ POM Interview 2017, *supra* note 2.

⁶ POM Interview 2017, *supra* note 2.

⁷ POM Interview 2017, *supra* note 2.

⁸ POM Interview 2017, *supra* note 2; *see also* CLRC Report, *supra* note 4, at 45.

⁹ POM Interview 2017, *supra* note 2; Chief Secretary to the government, Sir Manasupe Zurenoc, noted to the CLRC that monitoring mechanisms already exist within various government agencies but there has been inconsistent performance of these required duties. CLRC Report, *supra* note 4, at 9.

¹⁰ POM Interview 2017, *supra* note 2.

¹¹ CLRC Report, *supra* note 4, Recommendations 11(a) and (12).

¹² CLRC Report, *supra* note 4, Recommendation 17.

¹³ CLRC Report, *supra* note 4, at 12.

¹⁴ COUNCIL ON ETHICS, THE NORWEGIAN GOV’T PENSION FUND—GLOBAL, RECOMMENDATION OF 14 AUGUST 2008 TO THE MINISTRY OF FINANCE [regarding investments in Barrick Gold Corp.] 1, 25 (2008) [hereinafter NORWEGIAN GOV’T PENSION FUND], https://www.regjeringen.no/globalassets/upload/fin/etikk/recommendation_barrick.pdf (“[n]either has the company been willing to present data to underpin its allegations that environmental and health damage does not occur.”).

¹⁵ NORWEGIAN GOV’T PENSION FUND, *supra* note 15, at 2 and 7 (“Barrick does not publish any figures relating to the discharges from the Porgera mine and provides little information in general on the environmental aspects of the operation”; “Barrick does not provide any information relating to waste management at the mine, neither with regard to tailings nor waste rock.”).

¹⁶ *Id.* at 2.

¹⁷ *Id.* at 13 and 22 (emphasis in original).

¹⁸ *Id.* at 25.

¹⁹ *Id.* at 19.

²⁰ *Id.* at 2.

²¹ *Id.* at 19 (summarizing CSIRO report from 1996, p. ES-6: “In the CSIRO report from 1996, the population’s health risk in the mixing zone was assessed as low. The reason for this, according to the report, was that the villagers did not live near the river and therefore had limited exposure to the water.”) (Today, through a combination of immigration and natural population growth, the population has expanded and many now live in close proximity to the mine tailings.).

²² *Id.* (quoting CSIRO 1996 report, p 3-17).

²³ *Id.* at 20 (“[T]he CSIRO recommendation regarding a comprehensive and detailed assessment of health risks encompassing the whole riverine population does not seem to have been carried out. Neither does the Council consider the other studies referred to by the company to provide a scientific basis for claiming that health risks do not occur.”).

²⁴ *Id.* at 19.

²⁵ *Id.* at 19 n. 98 (“Placer Dome established in 1997 a “multi-stakeholder committee called PEAK (Porgera Environmental Advisory Komiti) to oversee the implementation of the CSIRO recommendations.” The respected leader of the Foundation for People and Community Development in Papua New Guinea was appointed to chair the committee. In 2001, he withdrew from PEAK because, in his view, Placer Dome did little to implement the CSIRO’s recommendation and because he felt that he was used in the company’s CSR propaganda. According to his letter to the company: “Placer has now had four years to carry out these studies and implement their recommendations, yet nothing has changed from the situation in 1996 when the CSIRO report was started.”)

²⁶ *Id.* at 20.

²⁷ *Id.*

²⁸ *Id.*

²⁹ PORGERA ENVIRONMENTAL ADVISORY KOMITI, www.peakpng.org.

³⁰ BARRICK (NIUGINI) LTD., *Response to Columbia Law School – Water Study* (Apr. 2017). *See infra* Annex II.

³¹ HUMAN RIGHTS WATCH, *Gold’s Costly Dividend: Human Rights Impacts of Papua New Guinea’s Porgera Gold Mine* 76 (Feb. 2011), <https://www.hrw.org/sites/default/files/reports/png0211webwcover.pdf>.

³² BARRICK (NIUGINI) LTD., *Response to Columbia Law School – Water Study* (Apr. 2017). *See infra* Annex II.

³³ BARRICK GOLD CORP., *Tailings Management at Porgera 1* (2012), <http://www.barrick.com/files/porgera/Tailings-Management.pdf>.

³⁴ The Annual Environmental Reports list the following as mine contact monitoring sites within the SML: Anjolek starter dump ‘A’ (SDA) toe, Kaiya River downstream of Anjolek erodible dump, Kaiya River at Yuyane Bridge, Yunarilama at Portal for drainage tunnel, 28 Level (underground water discharge at adit), Yakatabari Creek downstream of 28 Level discharge, Kogai stable dump toe area, Kogai at culvert, Wendako Creek downstream of Anawe North stable dump, Aipulungu River at road bridge near Porgera Station, Lime plant discharge upstream of Aipulungu River (*See e.g.*, PORGERA JOINT VENTURE, ENVIRONMENTAL MONITORING 2009 ANNUAL REPORT, 5-50 -5-71 (June 2010), <http://barrick.q4cdn.com/808035602/files/porgera/Porgera-2009-Annual-Environmental-Report.pdf>). In 2015, the Aipulungu River at road bridge near Porgera Station and the Kaiya River at Yuyane Bridge testing sites were not included in the data, despite still being listed as testing sites. PORGERA JOINT VENTURE, ANNUAL ENVIRONMENTAL REPORT 2015, 68-75 (June 2016), <http://www.porgerajv.com/BlankSite/media/PorgeraIV/Pdf%20files/2015-Porgera-AER-Final-1.pdf>.

³⁵ PORGERA JOINT VENTURE, ENVIRONMENTAL MONITORING 2009 ANNUAL REPORT, 5-50 - 5-71 (June 2010), <http://barrick.q4cdn.com/808035602/files/porgera/Porgera-2009-Annual-Environmental-Report.pdf> [hereinafter ENVIRONMENTAL MONITORING 2009]; PORGERA JOINT VENTURE, ENVIRONMENTAL MONITORING 2010 ANNUAL REPORT, 5-46 - 5-68 (June 2011), <http://barrick.q4cdn.com/808035602/files/porgera/2010-Porgera-Annual-Environment-Report.pdf> [hereinafter ENVIRONMENTAL MONITORING 2010]; PORGERA JOINT VENTURE, ENVIRONMENTAL MONITORING 2011 ANNUAL REPORT, 5-47 - 5-69 (June 2012), <http://barrick.q4cdn.com/808035602/files/porgera/2011-Porgera-Annual-Environmental-Report.pdf> [hereinafter ENVIRONMENTAL MONITORING 2011]; BARRICK GOLD CORP.: PORGERA, ENVIRONMENTAL MONITORING ANNUAL REPORT 2012, 186-209 (Sept. 2013), <http://barrick.q4cdn.com/808035602/files/porgera/2012-Porgera-Annual-Environmental-Report.pdf> [hereinafter ENVIRONMENTAL MONITORING 2012]; BARRICK GOLD CORP.: PORGERA,

ANNUAL ENVIRONMENTAL REPORT 2013, 61-71 (Dec. 2014), <http://barrick.q4cdn.com/808035602/files/porgera/2013-Porgera-Annual-Environmental-Report.pdf> [hereinafter ENVIRONMENTAL REPORT 2013]; BARRICK GOLD CORP.: PORGERA, ANNUAL ENVIRONMENTAL REPORT 2014, 111-114 (July 2015), <http://barrick.q4cdn.com/808035602/files/porgera/2014-Porgera-Annual-Environmental-Report.pdf> [hereinafter ENVIRONMENTAL REPORT 2014]; PORGERA JOINT VENTURE, ANNUAL ENVIRONMENTAL REPORT 2015, 68-75 (June 2016), <http://www.porgerajv.com/BlankSite/media/PorgeraJV/Pdf%20files/2015-Porgera-AER-Final-1.pdf> [hereinafter ENVIRONMENTAL REPORT 2015].

³⁶ ENVIRONMENTAL REPORT 2013, *supra* note 36, at 135; ENVIRONMENTAL REPORT 2014, *supra* note 36, at 131; ENVIRONMENTAL REPORT 2015, *supra* note 36, at 152.

³⁷ ENVIRONMENTAL REPORT 2013, *supra* note 36, at 72; ENVIRONMENTAL REPORT 2014, *supra* note 36, at 115; ENVIRONMENTAL REPORT 2015, *supra* note 36, at 76.

³⁸ Additionally, as was earlier noted with respect to the accessibility of information, the Annual Environmental Reports fail to present the totality of the data collected as part of village-level water sampling and analysis, notably failing to include results of testing of creeks accessed by residents for a variety of purposes, including bathing and laundry.

³⁹ ENVIRONMENTAL REPORT 2013, *supra* note 36, at 178-213; ENVIRONMENTAL REPORT 2014, *supra* note 36, at 143-46; ENVIRONMENTAL REPORT 2015, *supra* note 36, at 140-141.

⁴⁰ ENVIRONMENTAL REPORT 2013, *supra* note 36, at 61-71; ENVIRONMENTAL REPORT 2014, *supra* note 36, at 111-114; ENVIRONMENTAL REPORT 2015, *supra* note 36, at 68-75.

⁴¹ ENVIRONMENTAL REPORT 2014, *supra* note 36, at 185-90.

⁴² PORGERA LANDOWNERS ASS'N, AKALI TANGE ASS'N & MININGWATCH CANADA, *Request for Review Submitted to the Canadian National Contact Point Pursuant to the OECD Guidelines for Multinational Enterprises*, 24 (Mar. 1, 2011), www.oecdwatch.org/cases/Case_210/929/at_download/file. *See also, id.* at 7, 22.

⁴³ *See Final Statement of the Canadian National Contact Point on the Notification dated March 1, 2011, concerning the Porgera Joint Venture Mine in Papua New Guinea, pursuant to the OECD Guidelines for Multinational Enterprises*, <http://www.international.gc.ca/trade-agreements-accords-commerciaux/ncp-pcn/statement-declaration.aspx?lang=eng> (last modified Jan. 16, 2014); *Barrick accepts Canadian National Contact Point recommendations on Porgera Joint Venture* (Dec. 2013), <http://www.barrick.com/files/porgera/Barrick-accepts-Canadian-National-Contact-Point-recommendations-on-Porgera-Joint-Venture.pdf>; PAULUS BAK, SIMON APTE, CHARLIE ROSS & AUGUSTINE MUNGKAJE, PEAK, DRINKING WATER STUDY UPDATE (Nov. 2014) (on file with authors) [hereinafter DRINKING WATER STUDY UPDATE].

⁴⁴ BARRICK GOLD CORP. PORGERA JOINT VENTURE, *Water Sampling & Analysis Report for SML Villages* (Aug. 20, 2013) (prepared by Paulus Bak, BARRICK PORGERA ENVIR. DEP'T) (on file with authors) [hereinafter Report for SML Villages].

⁴⁵ DRINKING WATER STUDY UPDATE, *supra* note 44.

⁴⁶ Report for SML Villages, *supra* note 45; DRINKING WATER STUDY UPDATE, *supra* note 44.

⁴⁷ *See* Report for SML Villages, *supra* note 45.

⁴⁸ *See* DRINKING WATER STUDY UPDATE, *supra* note 44.

⁴⁹ *See* DRINKING WATER STUDY UPDATE, *supra* note 44, at 3 (indicating with respect to “project scope” that the study aimed to “survey water availability in these communities...[r]ank the water supply needs of each settlement...[and] provide lasting solutions—not just ‘more rainwater tanks’”).

⁵⁰ Report for SML Villages, *supra* note 45.

⁵¹ According to the 2013 data reported by the company: for Yakatabari Creek, the dissolved (and total) concentration for arsenic and the total concentrations for cadmium, lead, nickel, and zinc exceed WHO Guidelines for Drinking-water Quality; for Taro and Yambu Creeks, the total concentrations for arsenic, cadmium, copper, lead, nickel, and zinc exceed WHO Guidelines for Drinking-water Quality; for Yawana Creek, the total concentration for lead exceeds WHO Guidelines for Drinking-water Quality; for Kogai and Yololope Creeks, the total concentrations for arsenic, cadmium, lead, nickel, and zinc exceed WHO Guidelines for Drinking-water Quality; for Wendako Creek, the

dissolved (and total) concentration for zinc exceeds WHO Guidelines for Drinking-water Quality. *See also* Chapter IV, Section 2, for a summary of the 2014 data.

⁵² DRINKING WATER STUDY UPDATE, *supra* note 44, at 3.

⁵³ *Id.*

⁵⁴ BARRICK (NIUGINI) LTD., *Response to Columbia Law School – Water Study* (Apr. 2017). *See infra* Annex II.

⁵⁵ *Id.*

⁵⁶ *Id.*

⁵⁷ *Id.*

⁵⁸ BARRICK (NIUGINI) LTD., *PJV Longitudinal Health Risk Assessment Study* (on-file with authors).

⁵⁹ BARRICK (NIUGINI) LTD., *Response to Columbia Law School – Water Study* (Apr. 2017). *See infra* Annex II.

⁶⁰ BARRICK (NIUGINI) LTD., *PJV Longitudinal Health Risk Assessment Study* (on-file with authors).

⁶¹ *Id.*

⁶² *Id.*

⁶³ *Id.*

⁶⁴ *Id.*

⁶⁵ *Id.*

⁶⁶ BARRICK GOLD CORP., 2011 Responsibility Report, 43 (2012), <http://barrick.q4cdn.com/808035602/files/responsibility-report/2011/Barrick-2011-Responsibility-Report.pdf>.

⁶⁷ CLRC Report, *supra* note 4, Recommendation 3(a), at 45.

⁶⁸ “The CLRC itself was not able to obtain an environment permit or an example of an environmental impact statement from the DEC despite these docs being ‘public.’” CLRC Report, *supra* note 4, at 44.

⁶⁹ CLRC Report, *supra* note 4, at 10.

⁷⁰ The full results from 2013 and 2014 sampling of village water sources are reported in two documents: BARRICK GOLD CORP. PORGERA JOINT VENTURE, *Water Sampling & Analysis Report for SML Villages* (Aug. 20, 2013) (prepared by Paulus Bak, BARRICK PORGERA ENVIR. DEP’T) (on file with authors) (covering the 2013 data) and PAULUS BAK, SIMON APTE, CHARLIE ROSS & AUGUSTINE MUNGKAJE, PEAK, *DRINKING WATER STUDY UPDATE 3* (Nov. 2014) (on file with authors) (covering the 2014 data). Neither of these documents is currently publicly accessible. The Research Team was able to obtain a copy of the 2014 document by visiting the PEAK website before that website was taken offline, and was able to obtain a copy of the 2013 document only by specific request to BNL. While the 2013 and 2014 Annual Environmental Reports report a portion of the information collected for that year from these two documents, the Annual Environmental Reports do not reports the full data set. As of the time of writing, no information is publicly accessible regarding village water sampling and analysis for the years 2016 or 2017.

⁷¹ With respect to the health assessment, BNL has stated that the complete assessment is “due to be completed this year [2017]” and that “[n]o preliminary draft is available.” BARRICK (NIUGINI) LTD., *Response to Columbia Law School – Water Study* (Apr. 2017). *See infra* Annex II.

⁷² In the 2013 Annual Environmental Report, the mine reported water quality results from one spring, eight tanks, and four drums, and in the 2014 Annual Environmental Report, the mine reported results from two springs, 23 tanks, and one drum, detailing whether water samples are compliant with the PNG Raw Drinking Water Standard for dissolved metals, faecal coliform, and acceptability measures (turbidity and color). ENVIRONMENTAL REPORT 2013, *supra* note 36, at 135-38; ENVIRONMENT REPORT 2014, *supra* note 36, at 131-36.

⁷³ ENVIRONMENTAL REPORT 2013, *supra* note 36, at 137-38; ENVIRONMENT REPORT 2014, *supra* note 36, at 131-36. In a separate section of the 2014 Annual Environmental Report, the mine reports the water quality testing results for “contact water.” ENVIRONMENT REPORT 2014, *supra* note 36, at 111-12. While some of these contact water sources tested in 2014 overlap with the creeks tested by the PJV and PEAK as part of their village water sampling and analysis, the testing sites are not identical, and the information reported is not as detailed.

⁷⁴ ENVIRONMENTAL REPORT 2013, *supra* note 36, at ii.

⁷⁵ *Id.* at ii.

⁷⁶ ENVIRONMENT MONITORING 2009, *supra* note 36, at 5-52-5-67; ENVIRONMENT MONITORING 2010, *supra* note 36, at 5-48-5-62; ENVIRONMENTAL MONITORING 2011, *supra* note 36, at 5-49-5-63; ENVIRONMENTAL MONITORING 2012, *supra* note 36, at 189-203.

⁷⁷ ENVIRONMENT MONITORING 2009, *supra* note 36, at 5-69-5-71; ENVIRONMENT MONITORING 2010, *supra* note 36, at 5-64-5-68; ENVIRONMENTAL MONITORING 2011, *supra* note 36, at 5-65-5-69; ENVIRONMENTAL MONITORING 2012, *supra* note 36, at 205-208.

⁷⁸ Temporal trends are also calculated and significance statistics are provided. Baseline and reference locations are used to establish water quality levels un-impacted by the PJV facility. These measurements are used to establish trigger values for assessing impact at sites influenced by the mine. The process of establishing trigger values is described in detail in BARRICK GOLD CORP.: PORGERA, ANNUAL ENVIRONMENT REPORT 2014, 16-20 (July 2015), <http://www.barrick.com/files/porgera/2014-Porgera-Annual-Environmental-Report.pdf>.

⁷⁹ ENVIRONMENTAL MONITORING 2013, *supra* note 36, at 63-70; ENVIRONMENTAL REPORT 2014, *supra* note 36, at 169-176.

⁸⁰ ENVIRONMENTAL MONITORING 2013, *supra* note 36, at 71; ENVIRONMENTAL REPORT 2014, *supra* note 36, at 114.

⁸¹ PORGERA ENVIRONMENTAL ADVISORY KOMITI, *Strickland River Report Card 2009* (2010), <http://barrick.q4cdn.com/808035602/files/porgera/PEAK-Porgera-Report-Card-2010.pdf>.

⁸² Report for SML Villages, *supra* note 45.

⁸³ DRINKING WATER STUDY UPDATE, *supra* note 44, at 3.

⁸⁴ *Id.*

⁸⁵ BARRICK (NIUGINI) LTD., *Response to Columbia Law School – Water Study* (Apr. 2017). *See infra* Annex II.

⁸⁶ While the 2014 “Drinking Water Study Update” was available on the PEAK website before the website was taken offline, the Research Team is unaware if the 2013 “Water Sampling & Analysis Report for SML Villages” was ever made publicly accessible online.

⁸⁷ POM Interview 2017, *supra* note 2.

⁸⁸ “PJV has implemented a supplementary water project involving the installation of a minimum of 10 tanks at each of six villages to improve the availability and reliability of safe drinking water for local communities.” ENVIRONMENTAL REPORT 2015, *supra* note 36, at 153.

⁸⁹ BARRICK (NIUGINI) LTD., *Response to Columbia Law School – Water Study* (Apr. 2017). *See infra* Annex II.

⁹⁰ BARRICK (NIUGINI) LTD., *Response to Columbia Law School – Water Study* (Apr. 2017). *See infra* Annex II.

⁹¹ BARRICK (NIUGINI) LTD., *Response to Columbia Law School – Water Study* (Nov. 2018). *See infra* Annex II.

⁹² Interview with a woman from Yunarilama (YL3) (Jan. 6, 2015) (stating that the mine doesn’t care about their environmental quality and so had not tested); Interview with a woman from Kulapi (KP6) (Jan. 9, 2015) (“No. I haven’t seen anyone come and test anything.”); Interview with a man from Kulapi (KP7) (Jan. 9, 2015) (stating that no one has come and tested the water, soil, or air); Interview with a man from Kulapi (KP11) (Jan. 9, 2015) (stating that he has never seen anyone doing testing); Interview with a man from Apalaka (AW2) (Jan. 10, 2015) (stating that he has never seen anyone doing any testing); Interview with a woman from Apalaka (AP5) (Jan. 11, 2015) (stating that she did not know of anyone doing any tests); Interview with a resident of Tamando (AW7) (Jan. 10, 2015) (stating that he had never seen anyone testing anything); Interview with a woman from Anawe (AW4) (Jan. 10, 2015); (“I haven’t seen anyone yet.”); Interview with a man from Alipis (AL2) (Jan. 7, 2015) (“No. Nobody has come.”).

⁹³ Interview with a man from Yarik Timorope (YK4) (Jan. 5, 2015).

⁹⁴ *See, e.g.*, Interview with a woman from Panadaka (PD2) (Jan. 3, 2015) (“Those men came and collected water, but they didn’t give us any information.”); Interview with a man from Mugalep (MG2) (Jan. 4, 2015) (stating that he had seen mine employees testing the water, but he had not heard the results); Interview with a male landowner from Yarik Timorope 2 (YK3) (Jan. 5, 2014) (“Sometimes I see the company’s environment people doing experiments. They

never tell us the results. They just say that they are coming to measure the area.”); Interview with a male landowner from Timorope 2 from Tiyini Clan (YK6) (Jan. 5, 2015) (“They fetch water and take samples. But the government doesn’t say any environmental representatives to come. They never share the results of their tests with us.”); Interview with a woman from Upper Yarik (YK10) (Jan. 5, 2015) (“Last year there was a man [PJV workers] and came here to collect water samples and collect soil samples. But I don’t know that was last year, they just collect and go away.”); Interview with a woman from Yarik (YK11) (Jan. 5, 2015) (stating that men from the company came but she did not know what they did or the results of the testing); Interview with a woman from Yarik (YK12) (Jan. 6, 2015) (“As far as I know, they haven’t shared their samples tests or whatever.”); Interview with a woman from Upper Yarik (YK13) (Jan. 6, 2013) (“The company used to come and test and used to drill, but they never say anything.”); Interview with a woman from Kulapi 1 (KP8) (Jan. 9, 2015) (“Barrick employees from environmental department came one time to take samples of the water. When they came, I questioned him. You have always come and take samples, but you never tell me the result”); Interview with a woman from Kulapi (KP9) (Jan. 9, 2015) (“Once they came and set up something for the air. The put it recently...They never told us anything.”); Interview with a man from Kulapi 3 (KP5) (Jan. 9, 2015) (“They took our information but never brought back the results.”); Interview with a man from Apalaka (AP6) (Jan. 11, 2015) (“Yes, but they don’t give us a feedback.”).

⁹⁵ Interview with a man from Yunarilama (YL5) (Jan. 6, 2015).

⁹⁶ Interview with a woman from Tamando (AW6) (Jan. 10, 2015).

⁹⁷ Interview with a man from Kulapi 3 (KP5) (Jan. 9, 2015).

⁹⁸ Interview with a woman from Mugalep (MG8) (Jan. 4, 2015) (“Nobody has told me anything”); Interview with a woman and mother from Yarik Timorope 2 (YK9) (Jan. 5, 2015) (“The company never explains to us about any safety precautions or our health.”); Interview with a man from Panadaka (PD1) (Jan. 3, 2015) (“None of these people from the company, have come around to talk to us.”); Interview with a woman from Paiari Village (MG6) (Jan. 4, 2015) (“No. No one has ever come to visit us. No one has come to educate us.”); Interview with a woman from Timorope Yarik (YK1) (Jan. 5, 2015) (“No, they’ve never come.”); Interview with a woman from Yarik (YK12) (Jan. 6, 2015) (“But today, Barrick has rejected everything ...We are just living like this. Ignorance.”); Interview with a woman from Upper Yarik (YK13) (Jan. 6, 2013) (stating that the company never provided information about water and soil quality); Interview with a man from Yunarilama (YL2) (Jan. 6, 2015) (stating that the community affairs had never contacted him); Interview with a woman from Yunarilama (YL3) (Jan. 6, 2015) (“Barrick doesn’t come to give awareness or notice that they are sending out water.”); Interview with a man from Alipis (AL1) (Jan. 7, 2015) (stating that no one has informed him about water or soil quality); Interview with a man from Alipis (AL4) (Jan. 7, 2015) (“They never come and talk to us.”); Interview with a chief from Kulapi (KP2) (Jan. 9, 2015) (In answer to a question about whether the mine has informed them about emissions: “No, the company is hiding everything.”); Interview with a woman from Kulapi (KP3) (Jan. 9, 2015) (“I am like a child. I live in this community where there is no leader, no government, and my people have agreed to have the company and it agreed to be my parent, but it doesn’t take care of my needs.”); Interview with a resident of Tamando (AW7) (Jan. 10, 2015) (“We are waiting and waiting and waiting but we never know what the company will do.”).

⁹⁹ Interview with an individual from Mugalep (MG7) (Jan. 4, 2015).

¹⁰⁰ Interview with a woman from Timorope Yarik (YK1) (Jan. 5, 2015) (stating that community affairs contacted them about the water being unsafe but did not provide them alternative safe water); Interview with a man from Yarik Timorope (YL4) (Jan. 6, 2015) (explaining that someone had told village leaders that a local tank was unsafe to drink but that they did not know why the tank was unsafe or who the people were).

¹⁰¹ Interview with a man from Yarik Timorope (YL4) (Jan. 6, 2015).

¹⁰² Woman Focus Group, Drought Interviews, Apalaka (Jan. 7, 2016).

¹⁰³ Focus Group Interview with women from Apalaka (AK FGW) (Jan. 10, 2016).

¹⁰⁴ See PORGERA ENVIRONMENTAL ADVISORY KOMITI, *About Peak*, <http://www.peakpng.org/about-peak/> (last visited Apr. 5, 2015, no longer accessible) (explaining Peak’s functions and roles).

¹⁰⁵ PENNY JOHNSON, PORGERA ENVIRONMENTAL ADVISORY KOMITI, SCOPING PROJECT: SOCIAL IMPACT OF THE MINING PROJECT ON WOMEN IN THE PORGERA AREA 83 (2010) [hereinafter JOHNSON, WOMEN IN PORGERA].

¹⁰⁶ BARRICK (NIUGINI) LTD., *Response to Columbia Law School – Water Study* (Apr. 2017). See *infra* Annex II.

¹⁰⁷ *Id.*

¹⁰⁸ *Id.*

¹⁰⁹ BARRICK GOLD CORP., Responsible Mining (2011 Responsibility Report) 43 (2011).

¹¹⁰ JOHNSON, WOMEN IN PORGERA, *supra* note 105 (“What is actually happening, then, is that those women who have lost their land, have lost their livelihoods and social (customary) insurance, and now rely on other more fragile forms of subsistence,” 4). Johnson also highlights the general loss of traditional knowledge around gardening and cultivation as over-crowding and reduced access to arable land means fewer and fewer women have garden space: “Since the mine has been around (20 years +) some young women from around Porgera Station and the SML have either forgotten or have never experienced how to make and maintain gardens.” *Id.* at 52.

¹¹¹ JOHNSON, WOMEN IN PORGERA, *supra* note 105, at 3.

¹¹² Johnson notes the possible existence of agricultural training for women co-sponsored by the PJV Social Development Office and the Porgera Women’s Association, and the existence of a small-scale gardening workshop program run by the Porgera Women’s Association: “The Social Development Office and Porgera District Women’s Association were responsible for organizing a woman agriculturalist from Port Moresby to come out to teach seed germination and plant management. The PDWA also run (and are presently running - May 2010) gardening workshops. The workshops are highly valued, but without sufficient land most people are planting meager vegetable beds in front of their house, a far cry from their original gardens. About 10-15 people access the present agricultural course, and more courses need to be sustained. It needs to be noted however, that many young women do not want to participate in the subsistence economy. They are intent on making their lives by other means.” (52); additionally “The PJV supports women through its Social Development division “Community Development”, that is among other things set up to organise women to participate in women’s development programs. Community Development was originally established to help relocated families into their new homes, and provided an avenue for women to air grievances, ultimately assisting social stability. They work alongside the Porgera District Woman’s Association, and serve as an advisory body to the PDWA. The Porgera District Women’s Association was originally established to promote the development of women’s groups and to provide assistance for project and program initiatives, and to organise training in the legal and social rights and responsibilities pertaining to women - it has not been (to date) able to live up to all of these expectations at the one time.” JOHNSON, WOMEN IN PORGERA, *supra* note 105, at 60.

¹¹³ JOHNSON, WOMEN IN PORGERA, *supra* note 105, at 61.

¹¹⁴ JOHNSON, WOMEN IN PORGERA, *supra* note 105, at 11.

¹¹⁵ JOHNSON, WOMEN IN PORGERA, *supra* note 105, at 83.

¹¹⁶ JOHNSON, WOMEN IN PORGERA, *supra* note 105, at 83 (“Women (directly) could also be clearly informed about the dangers involved in mixing chemicals in gold production, and the harm in washing these chemicals into streams and rivers. This information is needed first hand, given with respect and clarity and in language that is accessible and that is explained more than once, and not administered by someone (male) who adopts a language that is chastising or authoritarian, but rather by a person trained to give information graciously and respect-fully. Many studies have shown that if new information is not understood and consequently “owned”, behaviour changes will not occur. The logic of the extreme health costs would demonstrate the reasoning offset against financial gain.”).

¹¹⁷ JOHNSON, WOMEN IN PORGERA, *supra* note 105, at 84 (“PEAK could encourage Community Relations/Environmental Planning section of PJV to conduct a series of systematic information sessions with women in Porgera so that they have a clear understanding of the reasons for declines in royalty payments, and plans for closure and the ways that people need to adjust to these.”).

¹¹⁸ JOHNSON, WOMEN IN PORGERA, *supra* note 105, at 85 (“Women in the villages and communities in the SML area and remote wards require an understanding of the logistic problems that exist regarding relocation. Many need clear illustration about the constructive achievements being made regarding relocation land and houses in the mine area, and why it can be so slow and where government and land restrictions and other physical complexities exist because these barriers are sometimes unclear or unknown. If men are being informed about the situation, the information is not making it through to the women. A liaison worker could help clarify issues and assist in mediation between various parties. Women need to be involved and encouraged to participate in public debate, especially when it concerns their livelihood.”).

¹¹⁹ Interview with a woman from Yarik Timorope (YK7) (Jan. 5, 2015).

¹²⁰ Interview with an individual from Mugalep (MG7) (Jan. 4, 2015).

¹²¹ See, e.g., BARRICK GOLD CORP., 2011 Responsibility Report 44, 49 (2012), <http://barrick.q4cdn.com/808035602/files/responsibility-report/2011/Barrick-2011-Responsibility-Report.pdf> (describing a “Participatory Rural Appraisal (PRA) engagement methodology” to implement development programs, which in Porgera, involved visiting 21 villages in Porgera to begin a “dialogue on the issues of population, health and nutrition, education, sanitation and governance” with the aim of completing “formal community development plans, designed by the communities, the Porgera mine, local government and NGOs”; and discussing the creation of a “Community Issues Committee . . . comprised of representatives of the 24 local landholding clans, together with representatives of the mine,” which “meets regularly to deal with concerns and issues that arise within the mine-associated communities” and “assists in the development of agreements and contracts.”).

¹²² See, e.g.; Interview with a man from Kulapi (KP11) (Jan. 9, 2015); (“their [Barrick’s] promises are lies.”); Interview with a man from Apalaka (AP6) (Jan. 11, 2015) (“The company doesn’t care about us.”); Interview with a man from Apalaka (AP1) (Jan. 6, 2015) (“their [Barrick’s] promises are empty.”); Interview with a woman from Anawe (AW4) (Jan. 10, 2015) (“You [Barrick] are stealing from us.”); Interview with a man from Apalaka (AW2) (Jan. 10, 2015) (“Barrick is too big, after having complained for so long, he acts as if he doesn’t have ears to listen.”); Interview with a man from Yunarilama (YL2) (Jan. 6, 2015) (“But they don’t tell us that is caused by the polluted air, but all of this is hidden.”); Interview with a man from Alipis (AL2) (Jan. 7, 2015) (“When Placer left, Barrick took over. I’m not happy with either company. Neither has done anything good.”); Interview with a chief from Kulapi (KP2) (Jan. 9, 2015) (“I’m not happy with this agreement, the company is not following what we said in the agreement. He is just doing what he wants to do now.”); Interview with a woman from Kulapi (KP3) (Jan. 9, 2015) (“The company hasn’t done anything good for me.”).

¹²³ Interview with a man from Mugalep (MG2) (Jan. 4, 2015) (“There is no one who will back us up, they treat us as animals.”); Interview with a man and woman from Mugalep (MG3) (Jan. 4, 2015) (“Barrick classifies us as animals.”); Interview with a man from Yarik Timorope (YK4) (Jan. 5, 2015) (“They treat us like pigs and dogs. They never come”); Interview with a woman from Yunarilama (YL3) (Jan. 6, 2015) (“Barrick does not care about it. He thinks that we are animals, are waste, we mix the living with the waste that they are throwing down. We are not regarded as human beings, it has no concern about us.”).

¹²⁴ See, e.g. Interview with a woman from Paiari Village (MG6) (Jan. 4, 2015).

¹²⁵ Interview with a woman from Kulapi (KP3) (Jan. 9, 2015).

¹²⁶ See, e.g., Interview with a man from Alipis (AL2) (Jan. 7, 2015) (“The company never listens. I used to go and tell them our concerns. Every day we would meet to discuss what to say. But the company never listens.”); Interview with a man from Alipis (AL4) (Jan. 7, 2015) (“They pretend to listen, but they don’t respond to our questions.”); Interview with a landowner from Kulapi 2 (KP1) (Jan., 9, 2015) (“The company always responds okay, I will look into it, but they never did anything.”); Interview with a chief from Kulapi (KP2) (Jan. 9, 2015) (“He wants to keep smoke running all the time. He doesn’t care about us.”); Interview with a man from Apalaka (AW2) (Jan. 10, 2015) (“Barrick is too big, after having complained for so long, he acts as if he doesn’t have ears to listen. Barrick just keeps on going and doesn’t respond”); Interview with a man from Yarik Timorope (YK4) (Jan. 5, 2015) (“During the dry season, the tank and the blue bins finish. I go to Barrick and ask them to supply water. They don’t listen to me.”); Interview with a woman from Yarik Timorope (YK7) (Jan. 5, 2015) (“We always go to community affairs, complaining. Sometimes we protest. We rub our bodies in mud, we tell them we aren’t eating, we aren’t drinking water. But they have no ears to listen.”); Interview with a man from Apalaka (AP1) (Jan. 6, 2015) (“We go there to protest. We strike. We write letters. No response.”); Interview with a woman from Upper Yarik (YK10 FI) (Jan. 5, 2015) (“I would go see community relations officers. And they used to say okay, we will come and see you, and gave me a number. I went to see them 3-4 times but they never come.”); Interview with a man from Alipis (AL1) (Jan. 7, 2015) (“Company doesn’t listen to me when I complain.”); Interview with a man from Alipis (AL4) (Jan. 7, 2015) (“The office is right here, so we just go up and speak to them. The pretend to listen, but they don’t respond to our questions.”); Interview with a chief from Kulapi (KP2) (Jan. 9, 2015) (“they said they were going to come up and see and then they never came up.”); Interview with a woman from Kulapi 1 (KP8) (Jan. 9, 2015) (“They say they will come and visit, but they have never come.”); Interview with a man from Yarik Timorope (YK4) (Jan. 5, 2015) (“When we see that we are like a lion in a cage, we ask the company: please come and see us. We are dying. We gave you our precious land with gold, but no feedback from Barrick.”); Interview with a woman from Yarik (YK12) (Jan. 6, 2015) (“Barrick is still ignoring us, ignoring us, ignoring us.”).

¹²⁷ Interview with a man and woman from Mugalep (MG3) (Jan. 4, 2015).

- ¹²⁸ Interview with a man from Mugalep (MG1) (Jan. 4, 2015).
- ¹²⁹ BARRICK GOLD CORP., 2010 Responsibility Report 9 (2011), <http://www.barrick.com/files/responsibility-report/2010/Barrick-2010-Responsibility-Report.pdf>.
- ¹³⁰ *Id.*
- ¹³¹ BUREAU VERITAS NORTH AMERICA, 2015 Independent Assurance Statement (June 2016), <http://www.barrick.com/files/responsibility/Assurance-Letter-2015.pdf>.
- ¹³² *Id.*
- ¹³³ ENVIRONMENTAL REPORT 2013, *supra* note 36, at 135; ENVIRONMENT REPORT 2014, *supra* note 36, at 131; BARRICK (NIUGINI) LTD., *Response to Columbia Law School – Water Study* (Apr. 2017). *See infra* Annex II.
- ¹³⁴ *See Final Statement of the Canadian National Contact Point on the Notification dated March 1, 2011, concerning the Porgera Joint Venture Mine in Papua New Guinea, pursuant to the OECD Guidelines for Multinational Enterprises*, <http://www.international.gc.ca/trade-agreements-accords-commerciaux/ncp-pcn/statement-declaration.aspx?lang=eng> (last modified Jan. 16, 2014); *Barrick accepts Canadian National Contact Point recommendations on Porgera Joint Venture* (Dec. 2013), <http://www.barrick.com/files/porgera/Barrick-accepts-Canadian-National-Contact-Point-recommendations-on-Porgera-Joint-Venture.pdf>; DRINKING WATER STUDY UPDATE, *supra* note 44.
- ¹³⁵ BARRICK (NIUGINI) LTD., *Response to Columbia Law School – Water Study* (Apr. 2017). *See infra* Annex II.
- ¹³⁶ Report for SML Villages, *supra* note 45, at 1-2.
- ¹³⁷ BARRICK (NIUGINI) LTD., *Response to Columbia Law School – Water Study* (Apr. 2017). *See infra* Annex II.
- ¹³⁸ *Id.*
- ¹³⁹ ENVIRONMENTAL REPORT 2013, *supra* note 36, at 136; ENVIRONMENT REPORT 2014, *supra* note 36, at 132; .
- ¹⁴⁰ ENVIRONMENTAL REPORT 2013, *supra* note 36, at 136; ENVIRONMENT REPORT 2014, *supra* note 36, at 132.
- ¹⁴¹ PORGERA JOINT VENTURE, *Porgera Supplementary Water Project* (on-file with authors).
- ¹⁴² BARRICK (NIUGINI) LTD., *Response to Columbia Law School – Water Study* (Apr. 2017). *See infra* Annex II.
- ¹⁴³ PORGERA JOINT VENTURE, *Porgera Supplementary Water Project* (on-file with authors).
- ¹⁴⁴ BARRICK (NIUGINI) LTD., *Response to Columbia Law School – Water Study* (Apr. 2017). *See infra* Annex II.
- ¹⁴⁵ PORGERA JOINT VENTURE, *Porgera Supplementary Water Project* (on-file with authors); BARRICK (NIUGINI) LTD., *Response to Columbia Law School – Water Study* (Apr. 2017) (on file with authors).
- ¹⁴⁶ Interview with a man from Yarik Timorope (YK4) (Jan. 5, 2015).
- ¹⁴⁷ Memorandum of Agreement Relating to the Development of the Porgera Gold Mine Project, Independent State of Papua New Guinea & Porgera Landowners, ¶ 12(b), (May 1989) (on-file with authors).
- ¹⁴⁸ POM Interview 2017, *supra* note 2.
- ¹⁴⁹ CLRC Report, *supra* note 4, at 40.
- ¹⁵⁰ CLRC Report, *supra* note 4, Recommendation 16.

CHAPTER V:

Legal Analysis of the Realization of the Right to Water in Porgera

¹ Additionally, with the swelling population, those living in relocation houses are just a very small subset of the total population in Porgera.

² PAPUA N. G. DEP'T OF NAT'L PLAN. AND MONITORING, *National Strategy of Responsible Sustainable Development for Papua New Guinea (StaRS)* (2nd ed. 2014), <http://www.planning.gov.pg/images/dnppm/pdf/StaRS.pdf>.

³ *PNG National Water, Sanitation, and Hygiene WasH Policy 2015-2030*, at 13.

⁴ *PNG National Water, Sanitation, and Hygiene WasH Policy 2015-2030*, at 13.

⁵ *National Strategy of Responsible Sustainable Development for Papua New Guinea*, at 33.

⁶ Committee on Economic, Social and Cultural Rights, General Comment No. 15: The Right to Water, ¶ 1, U.N. Doc. E/C.12/2002/11 (Jan. 20, 2003).

⁷ See MEI SHELP, BARRICK GOLD CORP., *BLOG: How Barrick manages water* (Jan. 9, 2015), <http://barrickbeyondborders.com/blog/2015/01/every-drop-counts-how-barrick-manages-water/>.