Affidavit of Mark Chernaik

On the likely impacts if relief is not granted to petitioners in G.R. No. 197754 with respect to the issuance of mining licenses and tenements in Zamboanga Peninsula.

Qualifications

I earned a B.S. in Biochemistry from the University of Massachusetts at Amherst in 1984, a Ph.D. in Biochemistry from Johns Hopkins University in 1990, and a law degree from the University of Oregon in 1993 with an emphasis in environmental law. Since 1993, I have served as Staff Scientist for the Environmental Law Alliance Worldwide, providing scientific guidance to public interest environmental lawyers on a wide range of environmental topics, including the impacts of mining projects. My opinions on environmental matters have been relied upon in decisions of the Supreme Courts of India, Pakistan and Belize and in two landmark judgments of the European Court of Human Rights.[1]

I have special expertise regarding the environmental impacts of mining. I am the principal author of the "Guidebook for Evaluating Mining Project EIAs," published in 2010.[2] I have evaluated environmental impact assessments (including environmental impact statements) for more than twenty proposed large-scale mining projects around the world.

It is my opinion that if relief is not granted to petitioners in G.R. No. 197754 with respect to the issuance of mining licenses and tenements in Zamboanga Peninsula, then the following impacts are likely to occur.

1. Impacts on water quality in the Zamboanga Peninsula

Mining projects can significantly impair water quality and the availability of clean water over a large area. Surface and groundwater supplies may be rendered unfit for human consumption, the quality of surface waters in the project area may no longer be adequate to support native aquatic life and terrestrial wildlife. Two water quality impacts are of high concern on the Zamboanga Peninsula: acid mine drainage, and the erosion of soil and wastes into surface waters. These impacts are discussed further below.

1.1 Acid mine drainage

As elsewhere in the world, gold, copper and other mineral deposits on the Zamboanga Peninsula of Mindanao, contain significant levels of sulfide minerals.[3] When sulfide minerals in mined materials (such as the walls of open pits and underground mines, tailings, waste rock, and heap

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[1] *M.C. Mehta v. Union of India*, 1999-(003)-CLJ 0361–SC; *Shehla Zia v. WAPDA*, PLD 1994 (SC) 693. *Belize Institute for Environmental Law (BELPO) v. Department of Environment* (DOE), Supreme Court of Belize (30 June 2008) (Claim No. 302 OF 2007) , *Fadeyeva v. Russia* 55723/00 [2005] ECHR 376 (9 June 2005); *Dubetska and others v. Ukraine*, 30499/03 (10 February 2011)

[2] https://www.elaw.org/mining-eia-guidebook

[3] "Jimenez Jr. F.A., et al (2002) "Gold and Base-Metal Sulfide Mineralogy and Paragenesis of the Lalab Orebody, Sibutad, Zamboanga del Norte, Philippines: Clues to the Fluid Composition and Formation of Gold-Rich Zones," International Geology Review, 44(10):956-971

and dump leach materials) are excavated and exposed to oxygen and water, acid drainage can form if there is an insufficient amount of neutralizing material to counteract the acid formation. The acid drainage will, in turn, leach or dissolve metals and other contaminants from mined materials and form a solution that is acidic, high in sulfate, and metal-rich (including elevated concentrations of cadmium, copper, lead, zinc, arsenic, etc.)

Acid drainage and contaminant leaching can cause severe and irreversible water quality impacts as described below:

> "HOW DOES IT FORM? Acid mine drainage is a concern at many metal mines, because metals such as gold, copper, silver and molybdenum, are often found in rock with sulfide minerals. When the sulfides in the rock are excavated and exposed to water and air during mining, they form sulfuric acid. This acidic water can dissolve other harmful metals in the surrounding rock. If uncontrolled, the acid mine drainage may runoff into streams or rivers or leach into groundwater. Acid mine drainage may be released from any part of the mine where sulfides are exposed to air and water, including waste rock piles, tailings, open pits, underground tunnels, and leach pads.
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> "HARM TO FISH & OTHER AQUATIC LIFE: If mine waste is acid-generating, the impacts to fish, animals and plants can be severe. Many streams impacted by acid mine drainage have a pH value of 4 or lower – similar to battery acid. Plants, animals, and fish are unlikely to survive in streams such as this.
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> "TOXIC METALS: Acid mine drainage also dissolves toxic metals, such as copper, aluminum, cadmium, arsenic, lead and mercury, from the surrounding rock. These metals, particularly the iron, may coat the stream bottom with an orange-red colored slime called yellowboy. Even in very small amounts, metals can be toxic to humans and wildlife. Carried in water, the metals can travel far, contaminating streams and groundwater for great distances. The impacts to aquatic life may range from immediate fish kills to sub-lethal, impacts affecting growth, behavior or the ability to reproduce.
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> "Metals are particularly problematic because they do not break down in the environment. They settle to the bottom and persist in the stream for long periods of time, providing a long-term source of contamination to the aquatic insects that live there, and the fish that feed on them.
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> "PERPETUAL POLLUTION: Acid mine drainage is particularly harmful because it can continue indefinitely causing damage long after mining has ended. Due to the severity of water quality impacts from acid mine drainage, many hardrock mines across the west require water treatment in perpetuity. Even with existing technology, acid mine drainage is virtually impossible to stop once the reactions begin. To permit an acid generating mine means that future generations will take responsibility for a mine that must be managed for possibly hundreds of years."[4]

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[4] Earthworks Fact Sheet: Hardrock Mining and Acid Mine Drainage. http://www.earthworksaction.org/pubs/FS_AMD.pdf

1.2. Erosion of soil and wastes into surface water

For most mining projects, the potential of soil, wastes and eroding into and degrading surface water quality is a serious problem, especially in places such as the Zamboanga Peninsula which experiences episodes of torrential rain and where the topology consists of steep hills. According to a study commissioned by the European Union:

> "Because of the large area of land disturbed by mining operations and the large quantities of earthen materials exposed at sites, erosion can be a major concern at hardrock mining sites. Consequently, erosion control must be considered from the beginning of operations through completion of reclamation. Erosion may cause significant loading of sediments (and any entrained chemical pollutants) to nearby waterbodies, especially during severe storm events and high snow melt periods.
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> "Sediment-laden surface runoff typically originates as sheet flow and collects in rills, natural channels or gullies, or artificial conveyances. The ultimate deposition of the sediment may occur in surface waters or it may be deposited within the floodplains of a stream valley. Historically, erosion and sedimentation processes have caused the build-up of thick layers of mineral fines and sediment within regional flood plains and the alteration of aquatic habitat and the loss of storage capacity within surface waters. The main factors influencing erosion includes the volume and velocity of runoff from precipitation events, the rate of precipitation infiltration downward through the soil, the amount of vegetative cover, the slope length or the distance from the point of origin of overland flow to the point where deposition begins, and operational erosion control structures.
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> "Major sources of erosion/sediment loading at mining sites can include open pit areas, heap and dump leaches, waste rock and overburden piles, tailings piles and dams, haul roads and access roads, ore stockpiles, vehicle and equipment maintenance areas, exploration areas, and reclamation areas. A further concern is that exposed materials from mining operations (mine workings, wastes, contaminated soils, etc.) may contribute sediments with chemical pollutants, principally heavy metals.
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> "The types of impacts associated with erosion and sedimentation are numerous, typically producing both short-term and long-term impacts. In surface waters, elevated concentrations of particulate matter in the water column can produce both chronic and acute toxic effects in fish.
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> "Sediments deposited in layers in flood plains or terrestrial ecosystems can produce many impacts associated with surface waters, ground water, and terrestrial ecosystems. Minerals associated with deposited sediments may depress the pH of surface runoff thereby mobilising heavy metals that can infiltrate into the surrounding subsoil or can be carried away to nearby surface waters. The associated impacts could include substantial pH depression or metals loading to surface waters and/or persistent contamination of ground water sources. Contaminated sediments may also lower the pH of soils to the extent that vegetation and suitable habitat are lost.

"Beyond the potential for pollutant impacts on human and aquatic life, there are potential physical impacts associated with the increased runoff velocities and volumes from new land disturbance activities. Increased velocities and volumes can lead to downstream flooding, scouring of stream channels, and structural damage to bridge footings and culvert entries. In areas where air emissions have deposited acidic particles and the native vegetation has been destroyed, runoff has the potential to increase the rate of erosion and lead to removal of soil from the affected area. This is particularly true where the landscape is characterised by steep and rocky slopes. Once the soils have been removed, it is difficult for the slope to be revegetated either naturally or with human assistance."[5]

1.3 Contamination released from open pits tailing impoundments, waste rock, heap leach and dump leach facilities

If large-scale mining projects are permitted on the Zamboanga Peninsula, then these projects would include wet tailings impoundments, waste rock piles, and heap leach, and dump leach facilities that can cause severe water quality impacts. These impacts include contamination of groundwater beneath these facilities and surface waters. Toxic substances can leach from these facilities, percolate through the ground, and contaminate groundwater, especially if the bottom of these facilities are not fitted with an impermeable liner.

Tailings (a by-product of metallic ore processing) is a high-volume waste that can contain harmful quantities of toxic substances, including arsenic, lead, cadmium, chromium, nickel, and cyanide (if cyanide leaching is used). Although it is rarely the environmentally-preferable option, most mining companies dispose of tailings by mixing them with water (to form a slurry) and disposing of the slurry behind a tall dam in a large wet tailings impoundment. Because the ore is usually extracted as a slurry, the resulting waste contains large amounts of water, and generally forms ponds at the top of the tailings dams that can be a threat to wildlife. Cyanide tailings in precious metals mines are particularly dangerous.

During periods of heavy rain, more water may enter a tailings impoundment than it has the capacity to contain, necessitating the release of tailings impoundment effluent. Since this effluent can contain toxic substances, the release of this effluent can seriously degrade water quality of surrounding rivers and streams, especially if the effluent is not treated prior to discharge.

1.4. Contamination of water caused by mine dewatering

As elsewhere in wet and semi-wet tropical areas, groundwater levels (water tables) on the Zamboanga Peninsula are likely to intersect mineral deposits. When an open pit mine intersects the water table, groundwater flows into the open pit. For mining to proceed, mining companies must pump and discharge this water to another location. Pumping and discharging mine water causes a unique set of environmental impacts that are described below:

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[5] MINEO Consortium (2000) "Review of potential environmental and social impact of mining" http://www2.brgm.fr/mineo/UserNeed/IMPACTS.pdf

> "Mine water is produced when the water table is higher than the underground mine workings or the depth of an open pit surface mine. When this occurs, the water must be pumped out of the mine. Alternatively, water may be pumped from wells surrounding the mine to create a cone of depression in the ground water table, thereby reducing infiltration. When the mine is operational, mine water must be continually removed from the mine to facilitate the removal of the ore. However, once mining operations end, the removal and management of mine water often end, resulting in possible accumulation in rock fractures, shafts, tunnels, and open pits and uncontrolled releases to the environment.
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> "Ground water drawdown and associated impacts to surface waters and nearby wetlands can be a serious concern in some areas.
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> "Impacts from ground water drawdown may include reduction or elimination of surface water flows; degradation of surface water quality and beneficial uses; degradation of habitat (not only riparian zones, springs, and other wetland habitats, but also upland habitats such as greasewood as ground water levels decline below the deep root zone); reduced or eliminated production in domestic supply wells; water quality/quantity problems associated with discharge of the pumped ground water back into surface waters downstream from the dewatered area. The impacts could last for many decades. While dewatering is occurring, discharge of the pumped water, after appropriate treatment, can often be used to mitigate adverse effects on surface waters. However, when dewatering ceases, the cones of depression may take many decades to recharge and may continue to reduce surface flows."[6]

2. Impacts on wildlife and biodiversity in the Zamboanga Peninsula

The Zamboanga Peninsula provides habitat to numerous critical wildlife species. Some of these habitats have been designated as protected areas.[7] If allowed on the Zamboanga Peninsula, large-scale mining projects would adversely impact critical wildlife species by causing loss and fragmentation of wildlife habitat.

2.1 Habitat loss

Wildlife species live in communities that depend on each other. Survival of these species can depend on soil conditions, local climate, altitude, and other features of the local habitat. Mining causes direct and indirect damage to wildlife. The impacts stem primarily from disturbing, removing, and redistributing the land surface. Some impacts are short-term and confined to the mine site; others may have far-reaching, long-term effects.

The most direct effect on wildlife is destruction or displacement of species in areas of excavation and piling of mine wastes. Mobile wildlife species, like game animals, birds, and predators, leave

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[6] Ibid.

[7] Ong, P.S., Afuang, L.E. & Rosell-Ambal, R.G. 2002. Philippine Biodiversity Conservation Priorities: a Second Iteration of the National Biodiversity Strategy and Action Plan. Manila, Philippines: DENR, Biodiversity Conservation Program-UP Center for Integrative and Development Studies, & Conservation International.

these areas. More sedentary animals, like invertebrates, many reptiles, burrowing rodents, and small mammals, may be more severely affected.

If streams, lakes, ponds, or marshes are filled or drained, fish, aquatic invertebrates, and amphibians are severely impacted. Food supplies for predators are reduced by the disappearance of these land and water species.

Many wildlife species are highly dependent on vegetation growing in natural drainages. This vegetation provides essential food, nesting sites and cover for escape from predators. Any activity that destroys vegetation near ponds, reservoirs, marshes, and wetlands reduces the quality and quantity of habitat essential for waterfowl, shore birds, and many terrestrial species.

The habitat requirements of many animal species do not permit them to adjust to changes created by land disturbance. These changes reduce living space. The degree to which animals tolerate human competition for space varies. Some species tolerate very little disturbance. In instances where a particularly critical habitat is restricted, such as a lake, pond, or primary breeding area, a species could be eliminated.

Surface mining can degrade aquatic habitats with impacts felt many miles from a mining site. For example, sediment contamination of rivers and streams is common with surface mining.

2.2 Habitat fragmentation

Habitat fragmentation occurs when large areas of land are broken up into smaller and smaller patches, making dispersal by native species from one patch to another difficult or impossible, and cutting off migratory routes. Isolation may lead to local decline of species, or genetic effects such as inbreeding. Species that require large patches of forest simply disappear.

3. Social and health impacts on the communities in the Zamboanga Peninsula

More than 2.5 million people reside on the Zamboanga Peninsula, which includes the Provinces of Zamboanga del Norte. Zamboanga del Sur, and Zamboanga Sibugauy. Agriculture is the main economic activity within the Zamboanga Peninsula. Many of the residents of the Zamboanga Peninsula have strong ties to the land.

If allowed on the Zamboanga Peninsula, large-scale mining projects could adversely impact the health and social well-being of communities in the following ways.

3.1 Human displacement, resettlement and migration

Mineral deposits often lie beneath lands where communities reside. When they do, mining projects force communities off lands they have resided for decades. According to the International Institute for Environment and Development:

> "The displacement of settled communities is a significant cause of resentment and conflict associated with large-scale mineral development. Entire communities may be

> uprooted and forced to shift elsewhere, often into purpose-built settlements not necessarily of their own choosing. Besides losing their homes, communities may also lose their land, and thus their livelihoods. Community institutions and power relations may also be disrupted. Displaced communities are often settled in areas without adequate resources or are left near the mine, where they may bear the brunt of pollution and contamination. Forced resettlement can be particularly disastrous for indigenous communities who have strong cultural and spiritual ties to the lands of their ancestors and who may find it difficult to survive when these are broken."[8]

3.2. Lost access to clean water

According to scientists at the University of Manchester (UK) and the University of Colorado(U.S.):

> "Impacts on water quality and quantity are among the most contentious aspects of mining projects. Companies insist that the use of modern technologies will ensure environmentally friendly mining practices. However, evidence of the negative environmental impacts of past mining activity causes local and downstream populations to worry that new mining activities will adversely affect their water supply. ...
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> "There are major stakes in these conflicts, affecting everything from local livelihood sustainability to the solvency of national governments. Fears for water quantity and quality have triggered numerous and sometimes violent conflicts between miners and communities."[9]

3.3. Diminished livelihoods in the agricultural and tourism sectors

When mining activities are not adequately managed, the result is degraded soils, water, biodiversity, and forest resources, which are critical to the subsistence of local people. When contamination is not controlled, the cost of the contamination is transferred to other economic activities, such as agriculture and fishing. The situation is made worse when mining activities take place in areas inhabited by populations historically marginalized, discriminated against, or excluded.

3.4 Increased public safety risks associated with tailings dam failures

Dozens of dam breaks at wet tailings impoundments have created some of the worst environmental consequences of all industrial accidents. When wet tailings impoundments fail, they release large quantities of toxic waters that can kill aquatic life and poison drinking water supplies for many miles downstream of the impoundment.

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[8] International Institute for Environment and Development (2002) "Breaking New Ground: Mining, Minerals and Sustainable Development: Chapter 9: Local Communities and Mines. Breaking New Grounds." http://www.iied.org/pubs/pdfs/G00901.pdf

[9] Bebbington, A., & Williams, M. (2008) "Water and Mining Conflicts in Peru." Mountain Research and Development. 28(3/4):190-195 http://snobear.colorado.edu/Markw/Research/08_peru.pdf

4. Impacts on global climate change

Large-scale mining projects have the potential to alter global carbon in at least the following ways:

Lost CO2 uptake by forests and vegetation that is cleared. Many large-scale mining projects are proposed in heavily forested areas of tropical regions that are critical for absorbing atmospheric carbon dioxide (CO2) and maintaining a healthy balance between CO2 emissions and CO2 uptake. Some mining projects propose long-term or even permanent destruction of tropical forests.

CO2 emitted by machines (e.g., diesel-poweredheavy vehicles) involved in extracting and transporting ore.

CO2 emitted by the processing of ore into metal (for example, by pyro-metallurgical versus hydro-metallurgical techniques). For example, CSIRO Minerals of Australia used a Life Cycle Assessment methodology to estimate the life cycle emissions of greenhouse gases from copper and nickel production, including mining. This assessment found that Life Cycle greenhouse gas emissions from copper and nickel production range from 3.3 kilograms (kg) of CO_2 per kg of metal for copper produced by smelting to 16.1 kg of CO_2 per kg of metal for nickel produced by pressure acid leaching followed by solvent extraction and electrowinning.[10]

The bottom line is that metal mining generates more than 1 kg of greenhouse gas for every 1 kg of metal that is produced, and this does not take into account lost carbon uptake of cleared forests.

October 3rd, 2011

Mark Chernaik

Date

[10] T. E. Norgate and W. J. Rankin (2000) "Life Cycle Assessment of Copper and Nickel Production, Published in Proceedings, Minprex 2000, International Conference on Minerals Processing and Extractive Metallurgy, pp133-138. http://www.minerals.csiro.au/sd/CSIRO_Paper_LCA_CuNi.htm