

Weda Bay Nickel Review Report

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Preface

Dr. Robert Moran has more than thirty-eight years of domestic and international experience in conducting and managing water quality, geochemical and hydrogeologic work for private investors, industrial clients, tribal and citizens groups, NGO's, law firms, and governmental agencies at all levels. Much of his technical expertise involves the quality and geochemistry of natural and contaminated waters and sediments as related to mining, nuclear fuel cycle sites, industrial development, geothermal resources, hazardous wastes, and water supply development. In addition, Dr. Moran has significant experience in the application of remote sensing to natural resource issues, development of resource policy, and litigation support. He has often taught courses to technical and general audiences, and has given expert testimony on numerous occasions. Countries worked in include: Australia, Greece, Mali, Senegal, Guinea, Gambia, Ghana, South Africa, Iraqi Kurdistan, Oman, Pakistan, Kazakhstan, Kyrgyzstan, Mongolia, Romania, Russia (Buryatia), Papua New Guinea, Argentina, Bolivia, Chile, Colombia, Guatemala, Honduras, Mexico, Peru, El Salvador, Canada, Great Britain, United States.

These review efforts were performed at the request of Bank Information Center (www.bicusa.org) and EARTHWORKS (www.earthworksaction.org), both based in Washington, D.C.

Note: All references to page numbers are the numbers in the electronic versions shown at top of computer screen.

Executive Summary.

This technical review of the Weda Bay Nickel mine project examined the publicly-available documents and information related to environmental assessment and mining and mineral processing plans for the project on Halmahera in Indonesia. The review applies to the declared “Exploration and Feasibility” stage as well as later stages of the project proposed by Eramet, Mitsubishi, and PT Antam.

1-The WBN AMDAL / ANDAL documents lack the necessary reliable, technical data to make informed judgments on supporting the WBN application to MIGA. The ESRS describes numerous phases of studies and due diligence, but most significant conclusions are based on **inadequate testing [geochemical and metallurgical] and inadequate baseline data. [Performance Standard 1, 3]**

2-**Chemical Compositions.** The ANDAL fails to provide basic data on the *detailed* chemical composition of the WBN ores, solid and liquid wastes, etc. Those details provided in the ANDAL are totally inadequate to evaluate environmental risks. **[Performance Standard 1, 3]**

3-**Sampling & Handling Methods.** The ANDAL provides no specific information on the **sampling and handling methods** employed for water quality (fresh and sea water) monitoring [preservation, filtration, transportation, success at meeting lab holding times, etc.] Given the remoteness of the site, such details are fundamental. **All WBN analytical data should be considered of questionable quality until demonstrated otherwise. [Performance Standard 1, 3]**

4-**Feasibility studies** to evaluate the metallurgical and geochemical properties of the ores and wastes have already been performed. **However, this and other feasibility reports have not been released to the public, nor have detailed testing results been included in the ANDAL. Such detailed data are fundamental for realistically evaluating the effluent characteristics and project impacts. Without such data, claims about the benign nature of the effluents are pure speculation. [Performance Standard 1, 3]**

5-**Baseline data are totally inadequate** to define past and future impacts. This is true for water quality (fresh water and marine), surface and ground water resources, ground water flow directions, hydrogeologic interactions between surface and ground waters, aquatic organisms (fresh water and marine), soils, and river and marine sediments. Baseline data on long-term rainfall and seismic history are inadequate. **[Performance Standard 1, 3]**

6-**RSF.** Approximately **202 million tons of process waste residues** will be generated over the first 30 years of operation and stored in the Residue Storage Facility (RSF). Most similar residues contain high concentrations of metals,

metalloids, non-metals, and remnant process chemicals. These **residues will remain on site forever. Incorrect testing** is cited to demonstrate that the residues will be chemically-stable, long-term. Experience from numerous similar mine sites report that similar residues do release soluble and particulate contaminants into the environment, long-term. [**Performance Standard 1, 3**]

7-Asbestos. Scientific literature suggests a relationship between unusual incidences of lung cancers in populations near lateritic cobalt-nickel sites in the Pacific, and possible connections to the presence of **asbestos-like minerals** in the rock. The ANDAL presents no mineralogic data to show that the WBN ores and wastes do not contain such asbestos-like minerals. Such testing should be performed. [**Performance Standard 1**]

8-Residues / Waste Maintenance. The WBN site is subject to strong **seismic events, torrential rains**, etc. As stated, the waste residues will remain onsite forever. Forever is not simply 100 to 1000 years. This means risk of release of the waste contents into the environment continues FOREVER. **To ensure long-term waste containment under such adverse rainfall and seismic conditions these facilities will require continuous maintenance *in perpetuity*.**

9-Toxic Substances. The WBN operation will use and produce massive quantities of potentially-toxic process chemicals, fuels, explosives, pesticides, herbicides and rodenticides, etc., which are likely to generate significant releases to the environment with contamination impacts to the surrounding biosphere inevitable over the long-term.

10-Liquid Effluent. WBN proposes to discharge roughly 288,000 m³ / day, of liquid process wastes into Weda Bay. The pipeline orifice would discharge at about 400 to 500 meters from the shore at shallow depths (about 15m). After 30 years this would equal 3,153,600,000 m³ of effluent discharged to Weda Bay. [**Performance Standard 1, 3**]

11-WBN has failed to provide the actual, detailed test data that would substantiate the claim that these effluents are non-toxic to marine life, long-term. The few effluent data that are presented are incomplete, have used detection limits that are too high to be meaningful for environmental purposes, lack some of the most important parameters, such as pH, ammonia, nitrate, arsenic, antimony, selenium, mercury, uranium, etc., and are misleadingly presented.

12-It seems all but certain that currents will disperse effluent components widely and will cause significant negative impacts to the marine life (fish, invertebrates, benthos, and coral reefs) and collective ecosystem in Weda Bay over the 30 to 50 year life of the operation.

13-Such disposal of massive volumes of **potentially-toxic liquid mine process wastes into a near-shore, shallow marine environment would likely not be permissible in E.U. countries, the U.S.A., or Canada.**

14-**Predictions.** The “predictions” and computer simulations presented in the ANDAL are likely to have little *quantitative* validity, based on the findings of numerous researchers and the poor quality of the data presented. They should be largely ignored. **[Performance Standard 1]**

15-**The preponderance of “Significant negative impact” rankings in the ANDAL indicates clearly the long-term risks inherent in supporting this project.** Table VI-1 summarizes the **significant project impacts** and reports 95 of 120 aggregate rankings to be **“Significant negative impact”** for all but the Post-Operation Stage.

16-Given that WBN plans to expend \$4 billion + on this project, approval of this Contract of Guarantee by MIGA would likely ensure actual operation of the mine, not simply support for the Exploration & Preconstruction Phase and all phases should be included in the assessment. **[Performance Standard 1]**

17- **Water Quality Guidelines.** All project activities [effluents, wastes, air, sediments and waters] should be required to comply with both WBG guidelines and appropriate international standards / guidelines, not simply Indonesian water quality regulations.

18-**Overly-Optimistic Impact Predictions.** Most WBN impacts are portrayed as largely benign and manageable. Experience at numerous large-scale mining and other industrial projects indicates that it is not possible to operate a massive project like this for 30 to 50 years, without having some significant accidents and significant long-term impacts. The present B.P. oil spill in the Gulf of Mexico is a classical example of having tons of “happy talk” by industry and regulators, but a much darker reality. **[Performance Standard 1]**

19-Several fundamental **procedural flaws** are also identified. MIGA relied excessively on client-provided information that appears to have not been adequately verified for accuracy and comprehensiveness. **Independent data** are needed.

Conclusion. At Weda Bay, as with so many developing-world projects, the local citizens will be faced with a common trade-off: increased economic opportunities for some individuals versus significant degradation to parts of their environment and negative impacts to various aspects of their present way of life. There is no free lunch.

The ESRS and ANDAL are technically inadequate to provide the MIGA Directors with a reasonable basis on which to vote on MIGA’s support for the Contract of

Guarantee. Given the inadequacies in the assessment documents for all phases, given the violations of MIGA Performance Standards, and given the large number of probable significant negative impacts of the project relative to the limited positive impacts, a precautionary approach dictates that this project not proceed under current conditions.

1-Introduction.

Purpose and Scope. These comments represent a review of the PT Weda Bay Nickel (WBN) documents supporting their application for a MIGA Contract of Guarantee. My review has focused on the quality of data presented in the WBN documents and the potential impacts which may occur within the framework of the MIGA / IFC Performance Standards. My comments are based on:

- review of the following documents:
 - Environmental and Social Review Summary (ESRS) for the Weda Bay Nickel Project, prepared by MIGA, (2010), 23 pg.;
 - Eramet-PT Weda Bay Nickel Exploration and Development Environmental and Social Impact Assessment (ESIA) by ERM, (Feb. 2010), 315 pg;
 - ANDAL, Weda Bay Nickel Project, ERM & WBN (2009), 566 pg.
- more than 38 years of applied hydrogeologic and geochemical experience at hundreds of mines and other industrial and resource facilities around the world. This experience has been gained working for private investors, industrial clients, tribal and citizens groups, NGOs, law firms and governmental agencies at all levels.

These efforts were performed at the request of Bank Information Center (www.bicusa.org) and EARTHWORKS (www.earthworksaction.org), both based in Washington, D.C.

2-Technical Comments.

Note. Despite specific statements regarding proposed activities in the AMDAL / ANDAL documents, many of the activities actually implemented will change through the 30 to 50 year life-of-mine. Often what is stated in EISs is altered or simply not performed.

Note. When discussing the process plant and various waste handling / storage processes, the ANDAL frequently mentions that these are “closed” systems, implying that no reactants or products will be released. Unfortunately, in real-world mining projects no facilities are truly “closed systems” long-term.

2.1-Sampling. The ANDAL provides no specific information on the sampling and handling methods employed for water quality (fresh and sea water) monitoring [preservation, filtration, transportation, success at meeting lab holding times, etc.] In addition, no quality assurance data are provided or discussed. Given the remoteness of the site, such details are fundamental. Many of the water quality

analyses obviously fail internal quality checks. **This inadequacy for all phases of the project represents a violation of MIGA Performance Standard 1** requiring that an Assessment be adequate and accurate.

It is non-professional to simply state methods “complied with guidance”. In such remote locations, sampling and sample handling mistakes generate the largest part of errors in the data. **All WBN analytical data should be considered of questionable quality until demonstrated otherwise.**

2.2-Composition Data. The ANDAL fails to provide basic data on the *detailed* chemical composition of the WBN ores, solid and liquid wastes, etc. Those details provided in the ANDAL are totally inadequate to evaluate environmental risks. Instead WBN has substituted optimistic promises and “predictions” (generally providing insufficient technical support) rather than descriptions and quantification of the existing environment. In the rare instances where some chemical composition data have been provided [i.e. the chemical composition of the leachates from the process waste solids, and the composition of the liquid effluents to be discharged to Weda Bay], results from only one, technically-inadequate analysis has been provided for each. We are never told the original sources of these data, or shown the original data.

This represents a violation of MIGA Performance Standard 1 requiring that an Assessment be adequate and accurate.

-The ANDAL, ESIA and ESRS fail to adequately characterize the geochemical compositions and mineralogic characteristics of the WBN ores, waste rock, and solid process residues. It is standard practice for such detailed data to be presented in mining EISs in developed countries. **This is a problem for all phases of the WBN project and represents a violation of MIGA Performance Standard 1 requiring that an Assessment be adequate and accurate.**

To identify potential environmental contaminants, chemical analyses of these solids should include a broad range of inorganic and organic compounds. Such data should include: aluminum, antimony, arsenic, barium, cadmium, copper, chromium, cobalt, iron, lead, manganese, mercury, molybdenum, nickel, selenium, silver, thallium, tin, titanium, tungsten, vanadium, zinc, calcium, magnesium, sodium and potassium, boron, phosphorus, silica, natural radioactive constituents (uranium, thorium, potassium-40, gross alpha and beta, in general), rare earth elements, etc.

-Asbestos. Detailed mineralogic analyses of these solids should also be conducted, specifically investigating the presence of asbestos-like minerals. Several scientific papers have reported unusual incidences of lung cancers in populations near lateritic cobalt-nickel sites in the Pacific, and possible connections to the presence of **asbestos-like minerals** in the rock. The ESIA, page 66 (III-4) states: "A potential safety hazard specific to this project site is

related to a suspected asbestos-containing geologic unit at the bedrock surface below the saprolite in the ore bodies. Risk analysis is in process, as there is believed to be a chance this material has been or will be incorporated into building materials used in local residences. Samples were taken in late December 2009 and sent to France for analysis, but no reports have been received as yet." The ANDAL presents no mineralogic data to show that the WBN ores and wastes do not contain such asbestos-like minerals. Such testing should be performed and the results made available to the public and regulators. One must assume that WBN already possesses such routinely-collected data, but has chosen not to make them public.

For all phases of the project, this represents a violation of MIGA Performance Standard 1 requiring that an Assessment be adequate and accurate and include public disclosure.

2.3-Feasibility Studies. It is obvious that Feasibility studies to evaluate the metallurgical and geochemical properties of the ores and wastes have already been performed. **However, original, detailed testing results from these studies are not included in the ANDAL. Also, the Feasibility reports have not been released to the public. Such detailed testing data are fundamental for realistically evaluating the characteristics of any effluents and risk of impacts from this project. Without such data, all claims about the benign nature of the effluents is pure speculation and meaningless.**

For all phases of the project, this lack of disclosure also represents a violation of MIGA Performance Standard 1 requiring disclosure of adequate information.

2.4-RSF. Approximately **202,000,000 tons of process waste residues** will be generated over the first 30 years of operation and stored in the Residue Storage Facility (RSF). The ANDAL provides no detailed chemical composition or mineralogic data for typical WBN residues. Most similar residues contain high concentrations of metals, metalloids, non-metals, and remnant process chemicals. The proposed RSF will be constructed without any synthetic / engineered liner or dam. Natural silts in the RSF area will be compacted, forming a liner, which is alleged to be impermeable. However, WBN provides **no geotechnical or long-term hydrogeologic testing** to substantiate that leachates will not pass through the silt layer of the RSF into the local ground water. **These conditions not only represent a violation of Performance Standard 1, but the lack of an adequate liner, and additional pollution management uncertainties, indicate a failure to adequately avoid and minimize pollution in accordance with Performance Standard 3.**

Dewatering of the process solids makes storage safer than for normal tailings, and it minimizes risks from catastrophic failure. However, the greater problem in such a high-rainfall environment, is likely **chronic seepage into the [ground**

water and overall environment, long-term. International literature from metal-mine sites around the world report that similar residues do release soluble and particulate contaminants into the environment, long-term.

-Geochemical Testing. The ANDAL, ESIA and ESRS fail to present useful **geochemical testing data** of the RSF process residues [i.e. static (acid-base-accounting) and / or long-term kinetic testing]. Such test data would allow realistic evaluation of the chemical quality of leachates from the solid residues (in the RSF) over the long-term.

The ANDAL presents the results from one TCLP [Toxicity Characteristic Leaching Procedure] leach test to argue that the residues are chemically stable and will not release significant concentrations of any contaminants. TCLP testing is used to simulate leaching through **landfill soils**. Such TCLP tests were never intended to be used to evaluate mine waste leachates and are not suitable to reliably demonstrate the long-term chemical stability of such mining wastes. International literature from metal-mine sites around the world report that similar residues do release soluble and particulate contaminants into the environment, long-term. Consistent with the rest of the chemical testing in the ANDAL / ESIA, the authors provide no details on the specific methods employed in these tests. **This represents a violation of MIGA Performance Standard 1 requiring that an Assessment be adequate and accurate.**

Other RSF Uncertainties.

- The projected height of the RSF is not defined in these documents.
- WBN should have described the long-term experience with such RSF design at other worldwide facilities and provided specific examples.
- The ANDAL states that cell runoff will be diverted to a sediment pond before release (p. 59). To where would these waters be released---surface waters? It is possible that such waters may be toxic to freshwater aquatic organisms.
- Project documents fail to describe the character of the bedrock beneath the RSF, or the depth to the water table in these areas. They fail to provide any geologic cross-sections showing what lithologies are present below the compacted silts of the RSF.
- Because RSF residues may be used to back-fill mined areas, it is imperative that the detailed geochemical composition and leachability of these residues be reliably determined.

These **residues will remain on site forever**. The WBN site is subject to strong **seismic events, torrential rains**, etc. The baseline **rainfall data** is quite limited in areal coverage and historically, but it is clear that the region receives, on average, at **2000 to 3000 mm per year**, with much higher number likely. In addition, the whole region receives frequent **earthquakes**, but the historical record and magnitude data presented in the ANDAL & ESIA **goes back only to 1990, and too limited to define the real risks.**

As stated, the waste residues will remain onsite forever. Forever is not simply 100 to 1000 years. Even simple roads constructed in such unstable environmental conditions require continual maintenance. The most common risk to the RSF will be simple, long-term erosion. This means the risk of release of the waste contents into the environment continues forever. **To ensure long-term waste containment under such adverse rainfall and seismic conditions these facilities will require continuous maintenance *in perpetuity*. Normally, funds for such perpetual maintenance and monitoring are not available following mine post-closure.**

In accordance with MIGA Performance Standard 3, the proponent must consider such ambient conditions and potential for cumulative impacts with irreversible consequences, which the project plans do not adequately accomplish.

Disposal of waste residues in an unlined facility without a dam in a high-seismic, high rainfall area would routinely not be acceptable in most developed countries.

Water quality impacts are likely to be much more severe than projected in the ANDAL and ESIA, long-term, in all project phases and post-closure---based on past experiences at hundreds of mine sites.

2.5-Baseline Data. Baseline data are totally inadequate to present a statistically-valid picture of pre-project conditions and to define past and future impacts. This is true for water quality (fresh water and marine), surface and ground water resources, ground water flow directions, hydrogeologic interactions between surface and ground waters, aquatic organisms (fresh water and marine), soils, and river and marine sediments. Baseline data on long-term rainfall and seismic history are inadequate.

For all phases of the project, this represents a violation of MIGA Performance Standard 1 requiring that an Assessment be adequate and accurate.

This situation masks the impacts that may have already occurred during the previous 14+ years of site activity and makes it impossible to realistically evaluate impacts from on-going and future activities---from all project phases. The inadequate baseline data also fail to define past / present impacts from artisanal miners, which WBN claims have occurred, and which will likely become contentious. Such an inadequate baseline data set will prevent regulators and citizens from ever being able to define / prove that future impacts have actually occurred.

The ESIA discusses some new data for marine and freshwater baseline, which apparently were not included in the ANDAL. However, it does not appear that the old and new data have been integrated in the ESIA discussions.

Other baseline data inadequacies include:

-Ground waters (GW): the presence, directions of flow, and detailed water quality are inadequately defined. Such data are especially lacking in areas near proposed operation facilities. The chemical constituents determined are inadequate. Analyses need more metals, non-metals, natural radiochemical constituents, organics.

-GW water levels: in the Highlands data were reported for only 2 piezometers over a single 6-month period. In coastal areas, only data from 2 piezometers over a single 6-month period were reported. This is inadequate to characterize hydrogeologic conditions.

-Inadequate surface area coverage for a usable GW baseline.

-No details were provided on well construction, total well depths or the producing zones.

-GW water quality: ANDAL, pg 157: 10 samples; all were collected in Dec. 2008. Hence the data reflect no temporal / seasonal variability. The numbers of samples (n) are inadequate to perform reliable statistical evaluations. Hence these data are not representative of a reliable GW water quality baseline.

-Quality assurance / quality control (QA/QC) checks (i.e. ion balances, replicates, laboratory spikes) were not performed / reported.

-**Un-filtered** (Total) samples should be collected and analyzed, in addition to filtered samples—for both surface and ground waters. Humans and other organisms (aquatic, etc.) in such settings do not drink filtered water!

Community Wells: 6 were sampled; 2 only once; 4 twice. Hence these data are **useless to define seasonal or statistical variability.**

-Sampling dates are not consistent / comparable (i.e. Aug. 07, Dec 06, Aug, 08);

-Many samples appear not representative when the field specific conductance (SC) is compared to the sample TDS. Acceptable ratios are known from the literature (i.e. Hem, 1985) and these data show many instances where ratios are too low. Data from site SWL are obviously in error.

Human Water Use: ANDAL, p. 392-394

Many local citizens still use river water for bathing, washing and even **cooking and drinking.** Most encountered in the ANDAL surveys used wells or springs for cooking & drinking. **Thus, it is imperative that baseline water quality sampling include data from unfiltered samples from all water sources.**

-No seep / spring survey was conducted. Hence it will not be possible to demonstrate changes or impacts to spring yields (or the presence of springs) in the future. If water levels local wells decline, there will be no way to demonstrate that any such impacts were due to project or other activities.

The same criticisms apply to the surface water quality and river sediment baseline sampling:

- data are inadequate to compile statistically-valid baseline data set. Hence one cannot discriminate recent impacts from pre-project conditions.
- no info. on sampling / handling / holding times.
- no QA checks

2.6-Water Data Interpretation: Data are explained naively in the text. The focus is mostly on what is allowable, rather than describing the hydro-geochemical significance presented by the data. [i.e. high TSS concentrations: elevated examples often indicate well construction problems, but such explanations are not provided.]

-Specific Conductance (SC): some indicate sample instability (i.e. HG-04, PPG-001) when SC is compared to TDS—which authors fail to do.

- The list of constituents is inadequate to understand actual geochemical / contamination issues: additional metals / metalloids, natural radiochemicals, organics, asbestos, etc. needed.

For all phases, this violates Performance Standard 3: pollution prevention and abatement.

2.7-Process Effluent Disposal:

[Note. Technically liquid effluents will not be discharged to the sea during the Exploration and Preconstruction stages. However, these data must be included as part of an adequate baseline. It is misleading to disregard such data when evaluating the overall project.]

WBN proposes to discharge roughly 288,000 cubic meters / day, of liquid process wastes into Weda Bay. The pipeline orifice would discharge at about 400 to 500 meters from the shore at shallow depths (about 15m). After the proposed mine life of 30 years this would equal 3,153,600,000 cubic meters of effluent discharge to Weda Bay.

Limited details regarding this effluent disposal are presented in only one location in the ANDAL, ESIA, OR ESRS, that is, only in the ANDAL, pg. 479 (V-66-67)---**“hidden” in the Prediction section. To my knowledge they appear nowhere else.**

On p. 480 (V-67), the ANDAL states that: -"The relevant constituents of the effluent meet the Indonesian standards for nickel ore processing industry effluent shown previously in **Table V-6.**" **No such table is presented in the report.** The Table of Contents states the following: Table V-6 Quantities of Ore and Overburden to be Mined in Initial 30-Year Period.

WBN has failed to reveal the actual, detailed test data that would substantiate this claim. The list of chemical constituents presented lacks many of the most important constituents necessary to evaluate the potential toxicity of the effluent. This represents a violation of MIGA Performance Standard 1 requiring that an Assessment be adequate and accurate.

Effluent chemical composition details are presented disingenuously and misleadingly. These data present several significant “inadequacies” which include:

- The reader has no way of knowing what is the source of the data--it's not stated. We can assume it comes from one of the Feasibility Studies already conducted, but the source is not presented, nor are the original data. [It must be assumed that these data were extracted from the metallurgical testing conducted at the Eramet research facility in France (ESIA, p. I-6). Metallurgical testing is normally conducted by outside, independent testing labs.]
- No information is presented about how the samples were **collected and handled** [containers / preservation / kept on ice? / filtration / holding times before analysis, etc.]
- These reported data apparently result **from only one analysis, but that is unclear**. Numerous similar analyses would be required to draw useful conclusions about the chemical compositions and its potential toxicity.
- The results report **only dissolved metals**, but the effluent will contain some fraction of colloidal and particulate material. Plus, once the effluent mixes with the seawater, chemical reactions are likely to create additional particles. Thus, **total** determinations (from unfiltered samples) should also have been reported for the effluent.
- Many of the important results are reported in g/L (grams per liter), which would be totally confusing to the average reader / regulator or the non-technical MIGA reviewer. [Throughout the rest of the ANDAL, such results are reported in the usual mg/L, milligrams per liter]. Thus, they report the TDS (Total Dissolved Solids) of the effluent as 35 g/L, which more routinely would be 35,000 mg / L.
- The effluent analysis fails to report the concentrations of many of the major constituents, such as chloride, sodium, (despite mentioning their importance on the next page), Other important anions are also missing, such as ammonia, nitrate, potassium, etc. [Early test data for the proposed Ramu Nickel project effluents reported 900 mg/ L ammonia---which would be extremely toxic to marine organisms.] Sulfate in the effluent, when converted to mg / L = 57,000 mg/L; magnesium = 14,500 mg / L.
- The authors disingenuously neglect to specify the effluent pH, reporting only that it will be between 6 and 9. The effluent pH is one of the most fundamental pieces of information—yet it is not included. One can be sure they know the pH and detailed chemistry based on the previous detailed metallurgical testing, but have chosen not to report these data.

- The limited trace element data presented are reported using **detection limits that are too high to be meaningful for environmental purposes.** Hence, most are reported as < some value, which reveals little of environmental significance to the reader. Detection limits suitable for comparison to international drinking water and aquatic life uses should have been used. [Adjustments for the interferences due to the high effluent TDS are routinely made.]
- Some of the environmentally most important parameters, such as pH, ammonia, nitrate, arsenic, antimony, selenium, mercury, uranium, etc., and are not included.
- Because the process plant uses many organic compounds to extract the cobalt and nickel, these effluents should also have reported, as a minimum, total organic carbon, etc. Note that an analysis of an effluent from process waste solid residues [Table V-7 (P. 475 / V-62)] includes an **extensive list of organic constituents.** These TCLP results are largely useless quantitatively, but show that WBN considered the presence of organic compounds to be relevant.
- The effluent analyses should also have checked for the presence of natural radioactivity: gross alpha and beta, etc. and rare earth elements.

The effluent is expected to be warm, about 40 degrees C., which may cause impacts to local marine organisms / populations.

On pg.V-67 (p. 480), we are told several revealing tidbits that raise red flags: -"No significant levels of suspended sediment are projected to be in the effluent". Any competent consultant having these effluents analyzed would have used the actual, reported data for total suspended solids (TSS), rather than speculate. Also, once the effluent waters mix with the waters of the Bay, chemical reactions could cause sediment particles to form.

"Based on water quality results from the **pilot effluent treatment plant.....**" Clearly such detailed data were generated, probably as part of the metallurgical feasibility study---but are not revealed to the public. Instead of showing the actual detailed test data, the ANDAL states that various computer simulations were conducted—to allay the fears of the public.

WBN should be required to have whole effluent toxicity tests [WET tests] performed by an independent party, using these effluent solutions. In addition, long-term toxicity testing should also be conducted on local marine species---prior to award of any MIGA Guarantee.

Effluent Disposal. The ANDAL (p.92) states that Deep Sea Tailings Placement (DSTP) conflicts with Eramet policy and Indonesian Government expectations. It seems inconsistent for these policies to then propose marine disposal of liquid process effluents. Clearly the distinction relies on WBN demonstrating via detailed metallurgical and toxicity testing that such effluents are not toxic to the

relevant marine organisms in the long-term. This has not been done in the existing documents.

It seems all but certain that discharge of these effluents will cause significant negative impacts to the marine life (fish, invertebrates, benthos, and coral reefs) and collective ecosystem in Weda Bay over the 30 to 50 year life of the operation.

Such disposal of massive volumes of **potentially-toxic liquid mine process effluents into a near-shore, shallow marine environment would likely not be permissible in E.U. countries, the U.S.A., or Canada.**

2.8-Water Quality Guidelines: Project documents assume that WBN project activities would be required to comply with Indonesian water quality regulations--- both general environmental and nickel industry regulations. Such regulations are far too weak to minimize environmental impacts. **All project activities [effluents, wastes, air, sediments and waters] should be required to comply with both WBG guidelines and appropriate international standards / guidelines.**

2.9-Use of Potentially-Toxic Chemicals. The WBN operation will use and produce massive quantities of potentially-toxic process chemicals, fuels, explosives, pesticides, herbicides and rodenticides, etc., which are likely to generate significant releases to the environment with contamination impacts to the surrounding biosphere inevitable over the long-term.

For example, the ANDAL reports that the following chemical compounds will be used, and in some cases quantities / volumes are provided or have been calculated from the ANDAL data. The list that follows is partial.

Sulfuric Acid: 4,642,800 Tons / yr = 4,211,877,310 kg / yr

: 139,284,000 Tons / 30yrs. = 1,206,356,319,326 kg / 30yrs.

Sulfur = 1.4 million tons per year

Soda ash (Na₂CO₃) 22 tons per hr = 528 t / d; = 192,720 t / yr. (ANDAL, p.82)

Caustic soda (NaOH) = ?

Sodium sulfide (solid & liquid) = ?

Iron sulfate = ?

Flocculants (synthetic; specific flocculants not identified) = about 2400 to 3900 tons per yr.

Solvents (specific solvents not identified) = ?

Catalyst V₂O₅) = ?

Hydrocarbon Fuels: (ANDAL, p.85):

Industrial Fuel: 58,700 tons / yr.

Diesel oil: 25,100 tons / yr.

Gasoline: 3000 tons / yr.

Marine Diesel Oil: 5200 tons / yr.

Kerosene: 160 tons / yr.

Environmental documents should include tables summarizing all chemical compounds to be used per year throughout the life of the mine—especially potentially toxic chemicals. These tables should include the chemical names (in addition to commercial names) and quantities. Such tables are **not provided in the WBN reports**. These should include all process plant reagents including flocculants, etc., explosives, fuels, oils and greases, herbicides, pesticides, fertilizers, anti-fouling compounds, water-treatment chemicals, etc. **It is not realistically possible to evaluate future impacts if such data are not provided.**

2.10-Project Water Use: The project will use **massive quantities of water over the 30-50 year life of the operation**. Such water extractions may create conflicts with other surface water users during “dry” seasons (ANDAL, p.506). This may also negatively-impact water levels in shallow wells.

The ANDAL, p.506 (V-93), reports that the project water required will be:

-Fresh water extraction rate = $3,380 \text{ m}^3/\text{hr} = 29,608,800 \text{ m}^3/\text{yr}$
= $888,264,000 \text{ m}^3 / 30\text{yrs.}$
= $29,608,800,000 \text{ L / yr}$
= $888,264,000,000 \text{ L / 30yrs.}$

-Sea water extraction rate = $5,150 \text{ m}^3 / \text{hr.} = 45,114,000 \text{ m}^3/\text{yr}$
= $1,353,420,000 \text{ m}^3/ 30\text{yrs.}$
= $45,114,000,000 \text{ L / yr}$
= $1,353,420,000,000 \text{ L / 30yrs.}$

2.11-Security: Project quarrying will require use of about 443 tons per year of explosives. Such explosives leave residues of nitrate, ammonia and organic compounds on the rock, which then washes into the environment. These compounds, especially the ammonia, can be extremely toxic to aquatic organisms.

Because the project will routinely store onsite massive quantities of dangerous chemicals and explosives, it is imperative that these materials be stored and guarded in a totally secure manner. Such stores could be targets for insurgent or other violent groups.

2.12-Experience at Other Co-Ni Mines. These reports would have been much more meaningful if they had discussed the long-term impacts from marine disposal of similar liquid wastes and overall environmental and social impacts from similar cobalt-nickel projects. **No such detailed discussions are included.** All discussion in these MIGA documents is theoretical, and has not been related to actual, applied experiences.

2.13-Predictions. The “predictions” and computer simulations presented in the ANDAL are likely to have little *quantitative* validity, based on the findings of numerous researchers and the poor quality of the data presented. They should be largely ignored.

This represents a violation of MIGA Performance Standard 1 requiring that an Assessment be adequate and accurate.

Studies by Kuipers and Maest (2006) and Moran (1997, 2000) confirm that mine-related water quality computer simulations are largely useless for making reliable quantitative predictions of future water quality concentrations. They also confirm that most such predictions made by consultants to mining companies are generally too optimistic. Pilkey & Pilkey (2007) confirms that these shortcomings occur in most other disciplines where environmental predictions are attempted.

2.14-Impact Rankings. ANDAL tables summarizing the **significant project impacts** (Table VI-1) report 95 out of 120 aggregate rankings to be “**Significant negative impact**” for the first 6 pages. The 7 aggregate rankings on the last page should be **disregarded** because these Post-Operation Stage reclamation activities will occur more than 30 to 50 years in the future. Actual post-closure impacts are often much less benign than has been assumed here. **This preponderance of “Significant negative impact” rankings indicates clearly the long-term risks inherent in supporting this project.**

Following mine closure, numerous metal mine regions actually experience **significant negative impacts** because local governments no longer have the funds necessary to continue operating schools, health facilities, electrical and water treatment plants, and other infrastructure previously funded by the mining corporation. These real-world factors seem not to have been considered in the ANDAL impact rankings.

2.15-Overly-Optimistic Impact Predictions. Much of the language in the ANDAL and ESIA describe, at least in the texts, environmental impacts that are portrayed as largely benign and manageable. Experience at numerous large-scale mining and other industrial projects indicates that it is not possible to operate a massive project like this for 30 to 50 years, without having some significant accidents and significant long-term impacts. The present B.P. oil spill in the Gulf of Mexico is a classical example of having tons of “happy talk” by industry and regulators, but a much darker reality.

This represents a violation of MIGA Performance Standard 1 requiring that an Assessment be adequate and accurate.

3-Procedural Comments.

-The various WBN reports present the information in a totally disjointed way so that the overall perspectives (the “big picture”) are lost. For example, there is no **integrated** discussion of all water resources aspects that integrate the rainfall,

surface water, ground water (including springs and seeps), surface-water-ground water interactions, and water quality issues. The main consequences are that reviewers can seldom obtain a comprehensive picture of the issues and the impact assessment ends up being totally artificial.

Hence, the EIS / ANDAL efforts become predominantly a book-keeping exercise that appears to be focused on obtaining the needed permits. Any real scientific insight is largely lost.

-This AMDAL / MIGA process suffers from severe inherent **conflicts of interest**. As with most mining projects, the consultants are paid and directed by the project proponent, WBN. [These consultants receive essentially all their income from industrial clients.] Thus, all project data are generated by parties that have a financial stake in the regulatory outcome. No truly independent sources of data were used in generating these documents. Worse, these consultants will never be hired again by any mining companies if they do not provide “favorable” conclusions.

- It seems obvious that, if the Contract of Guarantee is approved by MIGA, the project will go forward to the operational stage. That is, this MIGA decision effects more than simply the Exploration and Preconstruction stages. **Additionally, MIGA Performance Standard 1 requires assessment of risks and impacts of “key stages of the project cycle, including the pre-construction, construction, operations, and decommissioning or closure.” The incompleteness of the assessment on all stages represents a violation of that Performance Standard.**

-Perceptions Towards Mining Activities (ANDAL, p. 386-87). The ANDAL reports that the local citizens had some negative perceptions about mining based predominantly on experiences at Buyat Bay, Lapindo’s mud disaster, and extreme poverty on Gebe Island. However, the technical and socioeconomic details of these situations were not discussed.

The ANDAL further states that citizens’ views on mining are tied to their perceptions of possible negative impacts---**which are defined by the company and their consultants. This is clearly a circular process.**

-Many parts of the ANDAL and ESIA sound like public relations documents, i.e. Sect. 1.2: Objectives and Benefits, where there is no mention of corporate profit. The same tone is followed in the overly-optimistic descriptions of many of the long-term impacts in the technical sections. It seems likely that none of these authors ever actually witnessed the full life of a mine, from exploration through many years post-closure.

-None of MIGA / WBG site inspection team appear to have applied experience in mining, mineral processing, or hydrogeology. As such, they are especially

dependent on the opinions supplied by WBN their consultants. This might explain some of the extreme discrepancies between the opinions about possible project impacts from WGN / ERM and myself. It also indicates that the ESRS was developed without adequately experienced persons as required by Performance Standard 1.

-WBN has obviously completed a metallurgical Feasibility study, which would be required to attract investors / lenders. These studies contain FUNDAMENTAL technical details on characteristics of ores, wastes, discharges to sea, etc. None have been made available to public. It seems imperative that such information should be publicly available prior to MIGA approval of the Guarantee. The same is true for any other feasibility studies. **For all phases of the project, this lack of disclosure also represents a violation of MIGA Performance Standard 1 requiring disclosure of adequate information.**

-The ranking of impacts clearly undervalues environmental & resource impacts relative to economic factors. When one reviews the tables summarizing the **significant project impacts** (Table VI-1), it is evident that the majority of aggregate rankings are **“Significant negative impact”**. Through the first six pages of the table, 95 out 120 rankings were “significant negative impact”. The seven rankings on the last page all deal with Post-Operation Stage reclamation and were all “significant positive impact”. Given that these reclamation activities would all occur more than 30 to 50 years in the future it seems foolish to assume any ranking for these items; this approach biases the outcomes. **This preponderance of “Significant negative impact” rankings indicates clearly the long-term risks inherent in supporting this project.**

-ANDAL vs ESRS & ESIA: There are often very different interpretations of data and impacts between these documents. The ANDAL, Ch. 5 & 6, describes MANY strongly negative impacts in most phases, yet the weight of these rankings seems to be lost when one reads the ESRS.

-The Extractive Industries Review (EIR) report prepared for the World Bank Group specifically recommends against the disposal of mine process wastes into marine environments. Ironically, this EIR effort was directed by the former Indonesian Minister of Environment, Dr. Emil Salim.

One of the primary conclusions of the EIR was that the WBG should not support mining (and other extractive industry) projects in countries where adequate governance is lacking. The WBN ANDAL reflects a lack of openness with respect to sharing specific, detailed environmental / test data and indicates inadequate transparency. **This project is likely to be largely self-regulated with dominant self-enforcement.**

-The ANDAL and ESIA fail to present any detailed chemical composition data for the WBN ores. Therefore it is not possible to ascertain whether the cobalt and

nickel concentrates, which will be processed elsewhere, contain economic quantities of precious metals such as gold, silver, platinum, palladium, rare earth elements, or other valuable byproducts. As such, it is not possible for the Indonesian regulators or the public to know whether additional sources of revenue might exist, on which royalties should be paid. In that vein, WBN should state where the concentrates will be shipped and refined.

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5.0-Appendices [supporting details]

- **Other Baseline Data: Air Quality: (p. 119):** In addition to the parameters above, and to provide a baseline for future operations, the study also investigated the total metals content (Ca, Mg, Ni, Fe, Co, Al, Mn, Cr, and Cu) in the TSP and Dust Fall. It should be noted that GR41 1999 does not regulate trace metals in the TSP and Dustfall. Why were metals done here? **Will they be monitored later? They should be.**
- **Rainfall:** few yearly data presented. Inadequate baseline.
- **Seismicity: very short-term data. Only have data for Halmahera region since 1990 (p.134). Where is the earthquake hazard map described on p. 136? Data are inadequate to evaluate true long-term risks.**

- **Streambed Sediment: This data set is presently inadequate.** No description of sampling / handling methods are provided. Seasonal coverage inadequate; some data too old to reflect recent conditions.
- **Soil Sampling (geochemical) near Proposed Facilities?** None noted. Not possible to evaluate possible future air (etc.) contamination.
- **Marine / Oceanography: ANDAL, p. 184**
Oceanography: p. 186: no cross-sections
-Marine WQ: p. 189:
4 samples only; all from one date. Totally inadequate for baseline.
 -Sampling Location map fails to show locations of facilities.
 -No information on sampling methods, depths, sampling / handling procedures.
 -Specific names, affiliations and experience of individuals who collected samples are not provided.
 -No data from total samples (non-filtered samples) provided.
 -Radchemicals and organics inadequate
-Marine Bottom sediment samples? None found.
- **Sagea Lagoon WQ:** 3 sampling episodes. Why separate section from rest of marine?
 -Sample locations unclear; not on map stated. Depths?
 -Facility locations not shown on sampling maps.
 -Samples are too old: Mar. 06, Dec. 06, Aug. 07.
 -Unclear whether metals data are from Dissolved or Total samples.
 -No radiochemical or organic constituent data.
 -No bottom sediment samples.
- **FW Aquatic Life Baseline: ANDAL, p. 245**
 -sampled 18 locations (Map 3-19); no sampling dates;
- baseline data are inadequate to define changes through time.
- **FW Benthos: ANDAL, p. 258**
-no dates provided; no depths provided.
- **Fish (FW): ANDAL, p. 264.**
 -no dates provided
- **Metals in Fish Tissue (FW): ANDAL, p. 265**
 -No locations or dates provided.
- **Marine Benthos: ANDAL, p. 276**
 -only 4 locations sampled;
 -no depths or dates provided;
-data are inadequate to define marine benthos baseline and future

changes.

- **Coral Reefs & fish (marine): ANDAL, p. 279**
 - Corals: 3m and 10m depths only.
 - Performed in 2001, by Dames & Moore; too old and too limited in number to supply adequate baseline.
- **Demersal & Pelagic Fish: ANDAL, p.294**
 - sampled one time only in Dec. 2007;
 - inadequate number and temporal / areal coverage for reasonable baseline.
- **Fish tissue metals analyses.** Pb, Cu, Zn, Hg and As (for concentration of metals in fish flesh).
 - (same for fish tissue data from Sagea Lagoon)
 - one sampling date;
 - inadequate number and temporal / areal coverage for statistically-useful baseline.