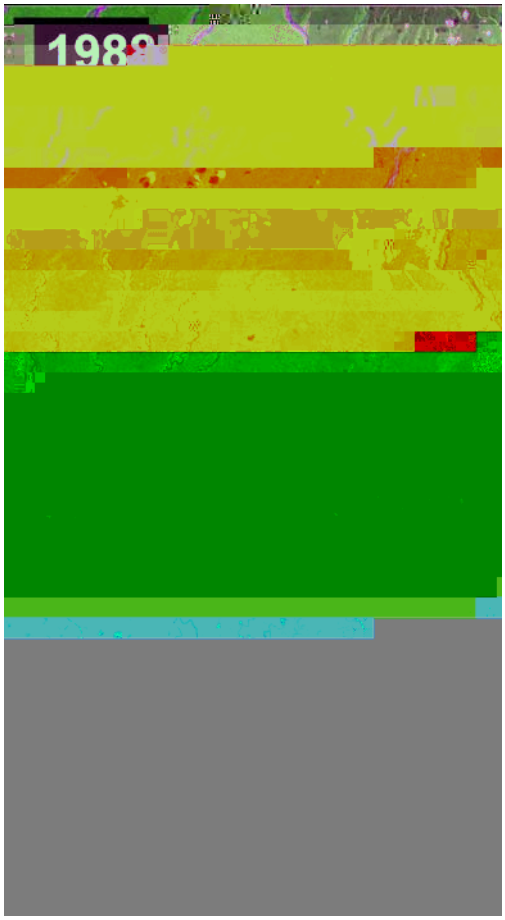
5 Environmental Impacts: Lowland

Before the levee system was constructed, tailings were carried from the highlands by the Otomona River, and deposition took place within the natural Ajkwa River channel. It was not long before the Ajkwa River channel was plugged with tailings. When this occurred, tailings


1988

5.1 Inadequate Tailings Containment

Since the levees were constructed in 1997, most tailings stay between the levee banks, so most of the future on-land impact of tailings will be within the 230km^2 ADA area. However, the jungle and the rivers just outside of the ADA have in the past and will occasionally receive tailings deposition, due to tailings building up within the ADA and overflowing levee banks, or due to levee slips and erosion (repairs noted in PTFI 2003, PTFI 2005b, PTFI 2005c). In its study of Landsat images in 2000, senior staff at the National Space and Aeronautic Institute identified locations where tailings had escaped the levee system, and during a ground truthing expedition, one such location was witnessed first-hand, where the eastern le

The ADA structure is raised up above the surface level of the plains around Timika, and throughout much of this area, the water table is at the surface of the deposited tailings. This is visible as the blue area within the ADA in the satellite photos shown in Figure 7 and Figure 24. Because of this difference in the height of the water table within the ADA and the water table on

there are still areas within the ADA undergoing the dieback process, as seen in Figure 26. After

the crumble structure of soil which results in disruption to root growth, and consequently a reduction in plant and animal diversity.

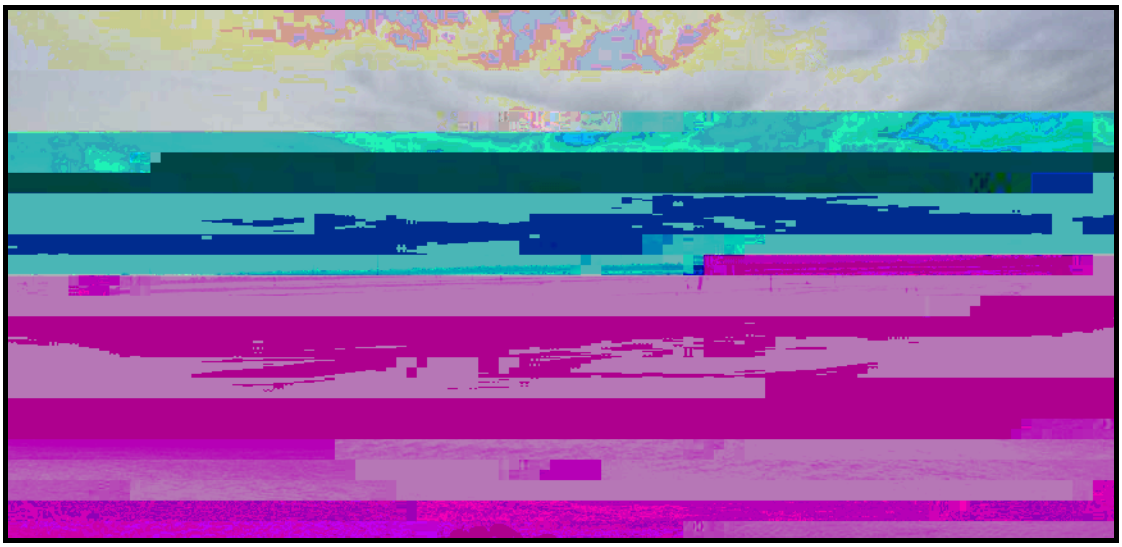
The problem of revegetation of the ADA is discussed in the post closure section below. However it is worth briefly noting that pure tailings, which will eventually comprise most of the 230 square kilometer ADA area, have elevated heavy metals concentrations, are lacking in organic carbon and other key nutrients, and do not have sufficient water holding capacity. Tests have shown pure tailings cannot support adequate germination or growth of native or garden plants

The Plant and Wildlife Risk Assessment showed that all of the plant species tested accumulate at least one heavy metal when grown in Freeport-Rio Tinto's mine

organisms such as bacteria, fungi and protozoa up to invertebrates such as ants and termites. These soil biota are crucial for soil fertility and ecosystem sustainability, particularly in rainforest

In the AERA, Parametrix created a more lenient species sensitivity distribution (SSD) for the estimation of the risk of chronic toxicity from dissolved copper. The SSD used in the AERA to calculate risks, reproduced below as Figure 33, uses estimated, not measured, chronic toxicity values, excludes outliers and is adjusted for reduced copper toxicity based on a 150 ppm hardness found in part of the Ajkwa River. Nevertheless, Parametrix's more lenient SSD still predicts that

Figure 34. The natural meanders, fringing rainforest and aquatic ecosystem of Ajkwa River have been replaced by the expansive Ajkwa Deposition Area. (photo: ELSHAM Feb 2006).



The process of diverting the waters of the Ajkwa River has been planned since the 1990s, (PTFI 1997) and was completed in 2005, as shown in Figure 17. The waters of the Ajkwa River, which

6 Environmental Impacts: Estuarine

The Ajkwa Estuary downstream from the ADA provides terrestrial and aquatic environments with superb habitat diversity, established in zones depending on height above mean sea level, salinity, soil type and drainage, among other factors (Figure 35).

The downstream end of the ADA consists of fresh water swamp forests (sago wetland). In the seawards direction, this fresh water plant community grades into brackish water of mixed mangrove / swamp forest and *Nypa fruticans* palm communities. Most of the remaining Ajkwa Estuary is a mature equilibrium mangrove ecosystem, covered by a tall forest with a 25 - 30m high canopy, comprised of two mangrove communities; one dominated by *Bruguiera* spp in the upper estuary, and the other by *Rhizophora*78

A conceptual food web diagram from the ERA is presented in Figure 36. The benthic invertebrate (aquatic) fauna of the estuarine area includes molluscs, crustaceans, and polychaetes such as oysters, crabs, barnacles, and worms. There are small fish species which are permanently

expected to be unable to adapt to tailings smothering and/or heavy metals toxicity. The reviewers

the Grasberg open pit operation is scheduled to close in 2015; the year 2034, selected because the ERA assumes mining will end around 2035; and the year 2068, which was chosen as the post mining recovery period.

In the ERA, these risks are summarised in tabular form (Table ES-1 in Parametrix 2002a), which combines risks from all the periods and does not provide any geographical cues showing which areas are impacted. In an attempt to present the issue more accessibly, this report illustrates the discussion of risks drawn from Parametrix's table ES-1 with several figures designed to give a

Figure 37. Ecological risk map of the Ajkwa Estuary based on sedimentation rate

- The upper main channel at CR02 has shallowed by about 80% from around 10 m depth in 2000 to only 2 m depth in 2005. This measured rate of shallowing is roughly in

Figure 35. Their results showed that as far back

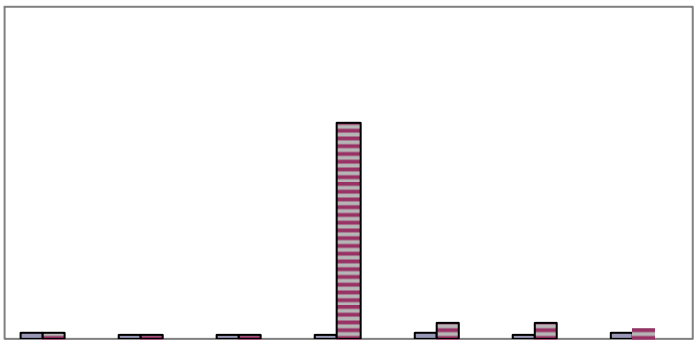
in the two figures below for measured TSS levels (Figure 40) and predicted future TSS levels (Figure 41), the whole Ajkwa Estuary is at risk, based on actual measurements made in 2000, and on future risks modelled in the ERA. Note that the upper estuary is at risk of 29% species loss based on the measured median TSS level of 503 mg/L (Parametrix comment, p.52 of ERA Review Panel, 2002). If this risk were one percent higher the upper estuary in the following figure would be shaded orange instead of yellow:

Figure 40. Ecological risk map of the Ajkwa Estuary based on measured TSS,

Figure 41. Ecological risk map of the Ajkwa Estuary based on <u>modelled TSS</u>, (from risks summarised in table ES-1 in Parametrix 2002a).

Besides risk of species loss through directly harmful effects on organisms, Freeport's tailings are likely to impact on the ecological productivity of the entire Ajkwa River system including the estuary. Tailings cause increased turbidity, which interferes with photosynthesis by algae,

Figure 42. Turbidity in Ajkwa Estuary compared to adjacent estuaries and ANZECC guidelines for tropical lowland rivers and estuaries. From data for July 2000 in Ilahude et al. 2004.



6.5 Copper Toxicity Risks in Mangrove Area

Figure 44. Ecological risk map of the Ajkwa Estuary based on measured dissolved copper

soil particles, thereby increasing the water holding capacity of the soil; (3) secreting

Figure 45. Species sensitivity distributions for acute and chronic toxicity of dissolved copper to saltwater organisms. Concentration of 23 µg/L high lighted as found in the water column of Ajkwa mangroves and crab burrow water. (Adapted from Parametrix 2002a).

The risks which are presented for the mangrove area in Figure 44 are based on sampling in the AERA studies which revealed that aquatic organisms were severely impacted by tailings in the mangrove area: All species of snails are missing from the Ajkwa Estuary mangroves whereas there are several types present in the Kamora Estuary reference mangroves. This represents the loss of an entire class of molluscs with an important ecological role. Furthermore, there was a 28 to 39% decline in the number of species of shellfish, crabs and polychaetes in the tailings-

These results indicate that biodiversity in the Ajkwa Estuary is somewhat lower than in other estuaries, but more importantly that the species currently found in the Ajkwa Estuary are significantly different from those in nearby unaffected estuaries. This indicates significant disruption to the ecology of the Ajkwa Estuary.

Figure 47. Plankton-derived carbon inputs to Ajkwa Estuary (Marine) ecosystem. (From Parametrix 2002a)

Figure 48. Plant-derived carbon inputs to

alternative input of detrital carbon into the food chain is also threatened, because of the Freeport mine's destruction of thousands of hectares of riverine rainforest within the tailings deposition area, and the predicted gradual smothering of a large area of mangroves by tailings. This risk was not considered in the Aquatic ERA modelling, which did not look at changes in detrital carbon.

Another risk related to the loss of rainforest and mangroves is that of a possible increase in the water temperature of the Ajkwa river and estuary. Aquatic communities can be very sensitive to changes in water temperature, and the Indonesian water quality standards reflect this by

has been severely disturbed and has lost significant biodiversity and ecological function, contrary to Freeport's claims. Furthermore, environmental risk modelling presented in the ERA predicts the Ajkwa Estuary environment is likely to further deteriorate as future tailings continue to have an impact over the next several decades. The impact is due to a combination of the risks quantified in the ERA and detailed in the sections above, including toxicity of copper from tailings, high TSS levels and high sedimentation rate.

7 Environmental Impacts: Outside Mining Concession Area

7.1 Arafura Sea

Two detailed sediment (tailings) transport models were developed for the Parametrix ERA. Unfortunately there are crucial errors in the basic assumptions upon which the modelling is based:

> "All models predicted what would happen to sediments and water quality assuming that PTFI generated **0.5 billion** metric tons of tailings over the life of mining, which has been assumed to conclude in **2034** (see Figure 2-5)." (Parametrix 2002a, emphasis added)

This figure of 0.5 billion tons much less than the amount of tailings actuallyssumptn e000 grarh ls freproduc-4.48

questions from parliament on 15 February 2005, company executives stated that mine closure will begin in 2040 (PTFI 2005a). The ERA sediment transport modelling of future impacts of mining, however, is based on mine waste input ending in 2034, seven years earlier than the expected date of 2041.

These large inconsistencies in quantity of tailings produced and the date of mine closure introduce crucial errors into the Sediment Transport Model. Both errors serve to underestimate the duration and scale of impacts of tailings input and hence the severity of future tailings

Carstensz Range, then following the Mawati River past the Amungme highland village of Tsinga, down to the Arafura Sea, incorporating the coastal area as shown in Figure 3.

The Lorentz protected area is one of Indonesia's conservation jewels, and its biological and

the coast in the direction of Kamora. The NW Monsoons (December to March) bring a south-eastward current along the coastline of Lorentz National Park (Brunskill 2004b).

The ERA quotes figures from the Institute of Technology Bandung sediment modelling that suggest around 3.5 - 5 cm of Freeport-Rio Tinto's tailings will be deposited in the Mawati and Otokwa mangrove ecosystems, part of the Lorentz National Park. Meanwhile, natural sedimentation will amount to as little as 1,5 cm which means copper-contaminated mine tailings may constitute up to 20% of the sedimentation in the Mawati and Otokwa mangroves. (Parametrix 2002a p.3-6).

Besides this modelling, biological monitoring produced results whic

metals can be released into the environment potentially affecting plants and animals. While there's no direct human impact, there is an impact on the river ecology.

…

The enthusiasm of miners, communities and governments to have development take place and gain its benefits can blind these stakeholders to the problems and difficulties development can bring, and leave behind. Without that full life cycle plan, when you come to closure the final legacy of the development project can be, or be seen to be, socially, economically and environmentally negative, like a long term hangover.

…

Freeport has responded to recent criticism in the New York Times of the environmental impacts of its riverine tailings disposal with the statement:

ADA will not be continuously immersed in water after mine closure, and hence will be exposed to oxidation:

- There is constant drainage of water from the downstream end of the ADA which is open to the Ajkwa Estuary,
- Once the Otomona River is diverted away from the upstream end of the ADA, after the year 2041, the only input of water will be rainfall within the ADA.
- The El Niño cycle brings drought conditions to Papua on an irregular, but inevitable basis.
- There is constant leakage through the aquifers underlying the ADA, and through the

“Fulvic, humic acids and water also form complexes. The major contribution played by complexation is in increasing metal solubilities by several orders of magnitude. Once in

within the dump (Neale et al 2003). Although Freeport's consultants say these issues are being addressed, the destabilising processes involved are difficult to prevent and are quite likely to disrupt the capping layer over the long term, requiring repairs.

Indeed, even with a team of geotechnical experts and geotechnical monitoring instruments located in the waste rock dumps, landslides at the Wanagon dump have proved impossible to prevent, and sometimes the best that can be hoped for is prior warning (PTFI 2005a). It is not feasible for all waste rock dumps at Freeport to be recontoured to a shallow slope because of the steep terrain in which some of the waste is placed, and any attempt to do so would require spreading the waste over an even broader area of fragile, rare mountain ecosystem.

Other structural risks for the stability of waste rock dumps over the long-term have been

Brunskill, Gregg J. Irena Zagorskis, John Pfitzner, Joanna Ellison. 2004; Sediment and trace element depositional history from the Ajkwa River estuarine mangroves of Irian Jaya (West Papua), Indonesia. Continental Shelf Research 24 (2004). The first three authors are from the Australian Institute of Marine Science, and the fourth is from the University of Tasmania.

Hardinsyah et al, IPB Bogor, Cenderawasih Un

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Parametrix 2002c. Vol. 3, Plant and Wildlife Risk Assessment. Prepared for PT Freeport Indonesia.

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WALHI Interviews. 2005, 2006. Interviews with several Kamoro and Amungme people from Kali Kopi village, Banti village, and Timika, November 2005, February 2006. Interviewees requested anonymity.

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