Coal Mines Polluting South Kalimantan’s Water
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ABBREVIATIONS

AMD Acid mine drainage
AMDAL Environmental impact assessment procedure
ANDAL Environmental assessment report
ASM Artisanal and small-scale mining
BAPELAL Indonesian Environmental Impact Management Agency
BLHDD Badan Lingkungan Hidup Daerah (Provincial Environmental Protection Agency)
BLT Biro Lingkungan dan Teknik, Bureau of Environment and Technology
BOD Biochemical Oxygen Demand
CCoW Coal Contract of Works
COD Chemical Oxygen Demand
CoW Contract of Works
DGM Directorate General of Mines
DO Dissolved Oxygen
DTPU Directorate of Technical Mining
EIA Environmental Impact Assessment
EPA Environmental Protection Agency (Badan Lingkungan Hidup Daerah)
ha hectares
ICP-AES Inductively coupled plasma atomic emission spectroscopy
IUP Izin Usaha Pertambangan (which are the new mining permits being implemented)
KP Kuasa Pertambangan (coal concessions)
MEMR Ministry of Energy and Mineral Resources
mg/l milligrams per litre
MOF Ministry of Forestry
Mt Million tonnes
NGO Non governmental organisation
pH measures the acidity or basicity of an aqueous solution
PT Perseroan Terbatas (company incorporated in Indonesia)
RKL Rencana Pengelolaan Lingkungan, Environmental management plan
RPL Rencana Pemantauan Lingkungan, Environmental monitoring plan
TSS Total Suspended Solids
μg/l Micrograms per litre
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Greenpeace Investigation: South Kalimantan Sampling Sites

**PT. Arutmin Indonesia**

- **PT. Karya Caraka Mula**
  - An acid pond (pH 2.38) right beside a public road in a valley of paddy fields. It leaks the discharge limit to Manganese.

**PT. Adaro Indonesia**

- **PT. Jorong Barutama Greston**
  - A breach in the bank of an abandoned mine pit is leaking acid water (pH 3.74) into a stream used by the community.

**NOTES:**

- The comparison to regulatory limits for discharge of coal wastewater: Manganese (Mn) = 4mg/L = 4000 µg/L; Iron (Fe) = 7mg/L = 7000 µg/L
- Testing results from all 29 locations are available in Table: Concentration of Metals and Metalloids, Analytical Report 04-2014
- Source: Coal Map of South Kalimantan, Petromindo, August 2013, Indonesia Basemap 1:250.000, Badan Informasi Geospasial, 2014
- River Area, Ditjen Sumber Daya Air - Kem PU, Map Analysis

**SOURCE:**

- Ministry of Environment (MOE) Decree No. 113 on Wastewater Quality Limit for Coal Mining Activities

**IMAGE:**

- Erik Wirawan, Richi Raimba, DigitalGlobe, 2012-12-01 up to 2014-03-18, resolution spectral 60 x 60
Greenpeace has uncovered evidence that the intensive coal mining activities in Indonesia’s South Kalimantan province are discharging toxic pollution into rivers, and in some instances, violating national standards for wastewater discharges from mines. Local environmental authorities have failed to stop or prevent the violations. Due to the large amount of coal mining, almost half of the province’s rivers are at risk of being affected by water pollution from the mines.

In this report, Greenpeace is publishing findings from our first field-investigation on the impacts of large-scale coal mining on water quality in South Kalimantan.Coal mining changes the landscape of South Kalimantan.

Coal mining has transformed South Kalimantan over the previous fifteen years, as the province has seen a 2013 government water quality report correlating with a 2013 government water quality report. The investigation team visited South Kalimantan three times and collected 29 samples from five mining companies’ concessions; PT. Arutmin Indonesia, PT. Joring Baru Dharma Geotris, PT. Tanjung Alam Jaya, PT. Karya Cakara Mulia, PG. Barumanta and several smaller concessions in the districts of Singki, Banjar and Serah Laut, as well as conducting field pH measurements in additional mining concessions. The report reviewed publicly available data on the subject, with a focus on government data provided by the South Kalimantan provincial environmental protection agency, Badan Lingkungan Hidup Daerah (BLHD), and data from the Ministry of Energy and Natural Resources Department of Mining. Data published by the Indonesian Coal-Mining Association, along with other corporate data from coal companies, were also crucial to our desk review.

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Twenty years ago, Indonesia was a marginal player in the world of coal. Between 2000 and 2009, a new era emerged, of massive expansion of coal alongside decentralisation: Indonesia developed the world’s fastest growing coal sector, with coal production increasing by 460% since 2000. Today Indonesia is the world’s largest thermal coal exporter and the second largest coal exporter overall, reaching this dominant position in a remarkably short period of time. In 2012, Indonesia supplied 39% of global seaborne thermal coal exports, up from 14% merely 10 years earlier in 2002. In just two decades, Indonesia’s rampant deforestation and coal mining boom has driven the nation to become the world’s third largest climate polluter, behind China and the US. Some action is being taken to address deforestation, in order to honour outgoing President Susilo Bambang Yudhoyono’s 2009 voluntary commitment to reduce Indonesia’s emissions by up to 41% by 2020. However, the projected 460 million tonnes increase in carbon emissions from coal mining expansion completely undermines this emissions reduction target.

Indonesia’s coal production began to increase rapidly from 1989 to 1999, “during which time coal production grew from only 4.43 million tonnes (Mt) (1989) to 80.89 Mt (1999), a compound annual growth rate of 30 percent.” The spectacular boom in Indonesia’s coal production in the ‘90s heralded the government’s ever-greater dependence on coal. The 90s also saw Indonesia’s major coal producers embark on serious exploration projects, with commercial production skyrocketing.

In 1998, with the fall of Suharto, the Indonesian reform era began, and radically altered Indonesia’s political and administrative system - from highly centralised administration to decentralisation and towards a more democratic system. It also brought Indonesian coal companies to the fore and squeezed out international mining corporations.

Increased autonomy devolved to the district/ municipal level, power to the provincial level became limited, and central government authority was curtailed. With political and administrative powers shifting to sub-national governments, the mining sector changed completely.

Local authorities’ new regulatory power over the coal mining sector proved profitable, especially from the issuing of new mining licenses, exploration permits, or production permits (known at the time as Kuasa Pertambangan or KPs). Quickly, the issuing of local permits proliferated. The system of KPs is already in disarray and the local governments had granted over 10,000 permits. Many of these permits were overlapping or unmapped. As Indonesian corporations rose to unprecedented prominence, previously powerful international actors were sidelined and some of the world’s largest extractives companies were gradually excluded. Majority ownership of the biggest coal companies’ shifted to Indonesian investors, who rapidly became industrial giants.

This was an era when tremendous amounts of money were made and lost, with Indonesian companies engaged in titanic struggles for dominance. Indonesia’s most highly respected, weekly investigative news magazine ‘Tempo’
Coal Mines Polluting South Kalimantan’s Water

reported a proliferation of “Coal mafias” and “coal wars”; thugs were hired; transparency lessened; corruption expanded; illegal mining operations mushroomed; government coordination diminished; and from the sky, much of Kalimantan, the Indonesian part of the island of Borneo, began to look more and more ravaged. By 2008 there were three enormous, legal coal mining contractors in South Kalimantan - but hundreds of illegal, unlicensed small-scale coal miners. “Almost every district of South Kalimantan Province contains several illegal coal mines, and their numbers are growing. In 1997, 157 individuals or businesses of this type were recorded, rising to 445 in 2000 and 842 in 2004.” While large-scale concessions pollute more because of their size, smaller concessions may be worse in the intensity of their pollution, given the near total lack of environmental and other oversight in many cases. Some experts believe that “Artisanal and small-scale mining (ASM) in Indonesia is undertaken with little or no environmental care.”

Figure 3.1. Indonesia Coal Production 1981-2013

Source: BP Statistical Review of World Energy 2014
South Kalimantan: A Major Player in Indonesia’s Coal Industry

Today, Indonesia’s coal production is geographically concentrated in Kalimantan.\(^\text{12}\) Kalimantan accounts for over 40% of the country’s reserves.\(^\text{13}\) Most Indonesian coal comes from East Kalimantan, but production in South Kalimantan is becoming a massive part of the Indonesian coal story, and is still growing. South Kalimantan produced roughly 79 Mt in 2008\(^\text{14}\) rising to 118 Mt in 2011 (33% of national output).\(^\text{15}\) Reports estimated in 2009 that two-thirds of Indonesia’s coal exports were produced by around two dozen mines in East Kalimantan, while most of the remainder came from South Kalimantan.\(^\text{16}\)

In 2008, there were 26 mining permits from the central government and 430 mining permits from local government in South Kalimantan.\(^\text{17}\) A 2013 map from the Indonesian Coal Association, included at the beginning of this report, listed 480 legal mining companies in South Kalimantan (within that list, each company can have more than 1 concession).\(^\text{18}\) According to Greenpeace’s spatial analysis (see chapter 4), official mining concessions (illegal concessions excluded) cover approximately 1 million hectares (Mha) of South Kalimantan’s total area of 3.7 Mha. When factoring in the small-scale illegal coal miners that abound, almost a third of South Kalimantan has been given over to mining.

South Kalimantan is more than just a major player in Indonesia’s coal industry. South Kalimantan’s burgeoning coal output and resulting huge increase in carbon emissions contributes to global climate change, given the dominant and growing role of Indonesian coal in the international coal market.\(^\text{19, 20}\)
Coal mines polluting South Kalimantan’s water

Figure 3.2. South Kalimantan Coal Production

Source: Indonesia Mineral and Coal Statistics 2012

Additional companies

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1) Real numbers may be higher since local governments have not shared all their data.
### Purpose and Scope

In order to understand how extensive mining activities impact South Kalimantan, Greenpeace has undertaken an in-depth geo-spatial analysis to attempt to answer 3 questions:

1. How much land area of South Kalimantan is given to coal mining, and what is the current status of each concession based on latest available information?
2. Of the areas assigned to mining concessions, what important natural resources are being impacted – forest and major river catchment areas?
3. Water system affected by coal mining - how much of the river system is downstream of coal mines and thus exposed to mining wastewater discharge?

### Map Sources

- **Coal Map of South Kalimantan** (production, exploration, construction, feasibility study both for KP & PKP2B permits by Petromindo August 2011 (scale 1: 250,000)
- **The coal maps contain boundaries of coal concessions with 8 classifications; Production PKP2B, Production KP, Exploration PKP2B, Exploration KP, Feasibility Study PKP2B, Feasibility Study KP, Construction PKP2B, Construction KP (scale 1: 250,000).** Scanned copies of these coal maps were digitised using ArcGIS software.
- **Land Cover Map (2011)** from Republic of Indonesia Ministry of Forestry, (scale 1: 250,000). GIS digital data: From the land cover map, we included 6 classifications of forest cover; Primary Dry land Forest, Primary Mangrove Forest, Secondary Dry Land Forest, Primary Swamp Forest, Secondary Mangrove Forest, Secondary Swamp Forest.
- **Topographic Map (2010)** by Geospatial Information Agency (scale 1: 250,000). GIS digital data: The map contains administrative boundaries, river networks, roads, land countours, rail networks and important places. River networks are used as the base for the potential river pollution analysis.
- **South Kalimantan River Area Map (2010)** from Republic of Indonesia Ministry of Public Works. Scanned copies of the river area map were digitised using ArcGIS software. South Kalimantan province contains 4 river basins: Barito, Cengal-Batulicin, Kendilo and Pulau Laut. River areas, which extended beyond the South Kalimantan provincial border, were excluded from the map and the analysis.
Definition of Mine Concession Stages for Licensing:

According to the Ministry of Mining and Energy Resources Law No. 4/2009

1. Exploration:
The stage of mining activities that aims to obtain accurate and detailed information about the location, shape, dimension, distribution, quality and measured resource of minerals, as well as information about the local social and environmental situation.

2. Feasibility Study:
The stage of mining operations to obtain detailed information on all aspects that relate to the economic and technical feasibility of mining. This includes the analysis of the environmental impacts as well as post-mining planning.

3. Construction:
The stage of mining activities that covers the construction of all facilities related to production operations, including environmental impact control.

4. Production:
The stage of mining activities that includes construction at the mining site, processing, refining, including transportation and sales, as well as a means of controlling environmental impacts in accordance with the results of the feasibility study.

Data analysis: Using the spatial data from the above source maps, the area of each coal concession was calculated and aggregated. The area of river catchment areas and forest cover areas in each coal concession were also calculated using an overlay analysis and tabular analysis process. The length of rivers and streams that are within or downstream of the concessions was also calculated using an overlay analysis and tabular analysis process. The results are presented below:
Geo-Spatial Analysis Results

Figure 4.1. Coal Mining Concessions in South Kalimantan 2013
a) Coal Mining Concessions
This analysis is based on the Coal Map of South Kalimantan (production, exploration, construction, feasibility study both for KP & PKP2B permits), by Petromindo August 2011 (scale 1: 250,000).

Result:
official mining concessions (illegal concessions excluded) cover approximately 1 million hectares (Mha) of South Kalimantan's total area of 3.7 Mha. When factoring in the small-scale illegal coal mines that abound, almost a third of South Kalimantan has been given over to mining.

Table 4.1. Coal Mining Concessions in South Kalimantan 2013

<table>
<thead>
<tr>
<th>Row Labels</th>
<th>BARITO</th>
<th>CENGAL-BATU LICAN</th>
<th>KENDILO SOUTH KALIMANTAN</th>
<th>PULAU LAST</th>
<th>KENDILO EAST KALIMANTAN*</th>
<th>TOTAL (Ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sum in Ha</td>
<td>%</td>
<td>Sum in Ha</td>
<td>%</td>
<td>Sum in Ha</td>
<td>%</td>
</tr>
<tr>
<td>PRODUCTION (PKP2B)</td>
<td>81,363</td>
<td>9.93%</td>
<td>109,774</td>
<td>2.11%</td>
<td>153</td>
<td>88.24%</td>
</tr>
<tr>
<td>PRODUCTION (KP)</td>
<td>40,443</td>
<td>35.44%</td>
<td>114,275</td>
<td>56.22%</td>
<td>530</td>
<td>4.34%</td>
</tr>
<tr>
<td>EXPLORATION (PKP2B)</td>
<td>0</td>
<td>0.00%</td>
<td>16,176</td>
<td>2.53%</td>
<td>--</td>
<td>0.00%</td>
</tr>
<tr>
<td>EXPLORATION (KP)</td>
<td>97,083</td>
<td>8.34%</td>
<td>59,930</td>
<td>4.07%</td>
<td>75,197</td>
<td>0.00%</td>
</tr>
<tr>
<td>CONSTRUCTION (PKP2B)</td>
<td>27,199</td>
<td>16.59%</td>
<td>13,495</td>
<td>17.88%</td>
<td>417</td>
<td>5.51%</td>
</tr>
<tr>
<td>FEASIBILITY STUDY (PKP2B)</td>
<td>22,638</td>
<td>28.70%</td>
<td>28,623</td>
<td>17.18%</td>
<td>8478</td>
<td>1.91%</td>
</tr>
<tr>
<td>Grand Total</td>
<td>273,928</td>
<td>100%</td>
<td>639,844</td>
<td>100%</td>
<td>9508</td>
<td>100%</td>
</tr>
</tbody>
</table>

* As the GIS digital data that we extracted from the maps is based on coal concession boundaries, we have included some coal concessions that extend across the provincial border into East Kalimantan. However, as only small portions of these concessions extend across the border, we are confident that South Kalimantan level data is not distorted as a result.

Figure 4.2. South Kalimantan, Coal Mining and Forests
b) Forest Cover Within Coal Concessions

This analysis is made by overlaying the Coal Map of South Kalimantan (production, exploration, construction, feasibility study both for KP & PKP2B permits by Petromindo August 2011 - scale 1: 250,000), with the Land Cover Map in 2011 from the Ministry of Forestry.

<table>
<thead>
<tr>
<th>COAL MINING TYPE</th>
<th>BAHITO</th>
<th>CENGAL-BATULICIN</th>
<th>BENGSEL SOUTH KALIMANTAN</th>
<th>PULAU LAUT</th>
<th>RENGAS EAST KALIMANTAN</th>
<th>GRAND TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOREST</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PRIMARY</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction (PKP2B)</td>
<td>3150.032018</td>
<td>13.05%</td>
<td>3665.837295</td>
<td>8.49%</td>
<td>5463.892094</td>
<td>50.86%</td>
</tr>
<tr>
<td>Secondary Dry Land Forest</td>
<td>3150.032018</td>
<td>13.05%</td>
<td>5964.703899</td>
<td>6.94%</td>
<td>6453.867684</td>
<td>82.98%</td>
</tr>
<tr>
<td>Exploration (KP)</td>
<td>12265.119704</td>
<td>10.15%</td>
<td>4804.644057</td>
<td>20.40%</td>
<td>28245.665292</td>
<td>53.44%</td>
</tr>
<tr>
<td>Primary Mangrove Forest</td>
<td>–</td>
<td>0.00%</td>
<td>1015.916602</td>
<td>1.29%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Secondary Dry Land Forest</td>
<td>12265.119704</td>
<td>10.15%</td>
<td>41195.372143</td>
<td>52.79%</td>
<td>247.796623</td>
<td>3.04%</td>
</tr>
<tr>
<td>Secondary Mangrove Forest</td>
<td>–</td>
<td>0.00%</td>
<td>2545.817667</td>
<td>3.27%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Secondary Savanna Forest</td>
<td>–</td>
<td>0.00%</td>
<td>61.18774253</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Exploration (PK)</td>
<td>–</td>
<td>0.00%</td>
<td>7305.471391</td>
<td>22.26%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Primary Mangrove Forest</td>
<td>–</td>
<td>0.00%</td>
<td>664.4329414</td>
<td>0.90%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Secondary Dry Land Forest</td>
<td>–</td>
<td>0.00%</td>
<td>427.768938</td>
<td>0.50%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Secondary Mangrove Forest</td>
<td>–</td>
<td>0.00%</td>
<td>667.225479</td>
<td>0.85%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Feasibility Study (PKP2B)</td>
<td>816.059472</td>
<td>2.32%</td>
<td>389.974299</td>
<td>0.77%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Primary Mangrove Forest</td>
<td>–</td>
<td>0.00%</td>
<td>166.1254457</td>
<td>0.23%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Secondary Dry Land Forest</td>
<td>816.059472</td>
<td>2.32%</td>
<td>–</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Secondary Mangrove Forest</td>
<td>–</td>
<td>0.00%</td>
<td>432.5769933</td>
<td>0.55%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Feasibility Study (PK)</td>
<td>7565.346118</td>
<td>30.87%</td>
<td>10236.49909</td>
<td>23.41%</td>
<td>528.360282</td>
<td>7.25%</td>
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<tr>
<td>Primary Dry Land Forest</td>
<td>–</td>
<td>0.00%</td>
<td>124.860123</td>
<td>0.16%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Primary Mangrove Forest</td>
<td>–</td>
<td>0.00%</td>
<td>247.3818328</td>
<td>0.32%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Secondary Dry Land Forest</td>
<td>7565.346118</td>
<td>30.87%</td>
<td>15946.82989</td>
<td>20.29%</td>
<td>528.360282</td>
<td>7.25%</td>
</tr>
<tr>
<td>Secondary Mangrove Forest</td>
<td>–</td>
<td>0.00%</td>
<td>665.7676364</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Secondary Savanna Forest</td>
<td>–</td>
<td>0.00%</td>
<td>141.9008533</td>
<td>1.81%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Production (PK)</td>
<td>443.9102897</td>
<td>1.71%</td>
<td>7284.140077</td>
<td>28.62%</td>
<td>1.51910471</td>
<td>0.55%</td>
</tr>
<tr>
<td>Primary Dry Land Forest</td>
<td>–</td>
<td>0.00%</td>
<td>345.108283</td>
<td>0.44%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Secondary Dry Land Forest</td>
<td>443.9102897</td>
<td>1.71%</td>
<td>6309.724309</td>
<td>8.13%</td>
<td>1.51910471</td>
<td>0.55%</td>
</tr>
<tr>
<td>Secondary Mangrove Forest</td>
<td>–</td>
<td>0.00%</td>
<td>633.8434835</td>
<td>1.07%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Grand Total</td>
<td>24931.5511</td>
<td>100.00%</td>
<td>7017.472472</td>
<td>100.00%</td>
<td>902.3777684</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

**Table 4.2. Areas of Forest Cover within Coal Mining Concessions**

*As the GIS digital data that we extracted from the maps is based on coal concession boundaries, we have included some coal concessions that extend across the provincial border into East Kalimantan. However, as only small portions of these concessions extend across the border, we are confident that South Kalimantan level data is not distorted as a result.

**Result:**
Approximately 14% of total forested area in South Kalimantan is in coal mining concessions. Approximately 4% of the total primary forest in South Kalimantan is in coal mining concessions. Another 73% of forested area in Pulau Laut and 18% in Cengal-Batulicin is in coal concessions.
Coal Mines Polluting South Kalimantan’s Water

Figure 4.3. Potential River Pollution in South Kalimantan
Table 4.3. Potential River Pollution in South Kalimantan

<table>
<thead>
<tr>
<th>RIVER POLLUTION</th>
<th>BARITO</th>
<th>CENGAL - BATULICIN</th>
<th>KENDILO</th>
<th>PULAU LAUT</th>
<th>GRAND TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>River at risk of mining activities</td>
<td>1532</td>
<td>1413</td>
<td>234</td>
<td>72</td>
<td>3250</td>
</tr>
<tr>
<td>Not directly impacted by mining activities</td>
<td>2821</td>
<td>729</td>
<td>339</td>
<td>45</td>
<td>3935</td>
</tr>
<tr>
<td>GRAND TOTAL</td>
<td>4353</td>
<td>2142</td>
<td>573</td>
<td>117</td>
<td>7185</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RIVER POLLUTION</th>
<th>BARITO</th>
<th>CENGAL - BATULICIN</th>
<th>KENDILO</th>
<th>PULAU LAUT</th>
<th>GRAND TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>River at risk of mining activities</td>
<td>31.18%</td>
<td>65.96%</td>
<td>40.82%</td>
<td>61.39%</td>
<td>45.23%</td>
</tr>
<tr>
<td>Not directly impacted by mining activities</td>
<td>64.82%</td>
<td>34.04%</td>
<td>59.18%</td>
<td>38.61%</td>
<td>54.77%</td>
</tr>
<tr>
<td>GRAND TOTAL</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

**Result:**

Approximately 3,000 km of South Kalimantan’s rivers - around 45% of all rivers in the province - are downstream from coal mines and hence potentially at risk of toxic pollution from coal mining activities. Careful analysis of multiple maps from the coal industry and government authorities indicates that several of South Kalimantan’s watersheds are at risk due to the high concentration of coal mining operations there. According to Greenpeace mapping calculations, 33% of the coal production concessions in the province lie in the Barito watershed and 58% in the Cengal-Batulicin watershed, making these the most coal affected areas (see Table 4.1).

c) River Catchment Area/Waterways Downstream of Coal Concessions

The river area map analysis is based on overlaying the Coal Map of South Kalimantan (production, exploration, construction, feasibility study both for KP & PKP2B permit by Petromindo August 2011 (scale 1: 250,000), with the River Area Map from the Ministry of Public Works.

For the potential river pollution analysis, we calculated the length of river (km) flowing through coal mining concessions and traced the flows downstream using the Topographic Map by the Geospatial Information Agency (scale 1: 250,000) and the Coal Map of South Kalimantan, Petromindo August 2011 (scale 1: 250,000). The map may not show all the tributaries due to its scale. Our analysis only includes rivers, or sections of rivers, in the province of South Kalimantan.
ENVIRONMENTAL IMPACTS OF COAL MINING IN INDONESIA

Open Cast Coal Mining

Indonesia permits “open cast” mining, sometimes also called “strip mining” or “surface mining,” as well as “mountaintop removal mining”. Broadly speaking this is mining whereby all the soil and rock, which lie on top of the mineral being mined, are removed, often by bulldozing or blasting. Open cast mining is different from underground mining, where the surface is left more or less in place and where miners must remove minerals via shafts or tunnels.22

Open cast mining methods used to extract shallow coal reserves are common. In Indonesia generally, and in Kalimantan specifically, open cast mining is responsible for extreme and sometimes irreversible environmental destruction within the area mined, and with especially detrimental impacts on local water resources. Groundwater needs to be pumped out of the mine pits in order to access the seams, lowering groundwater levels over a large area. Forests need to cleared, and fertile topsoil is removed in order to access the coal. In the process, open cast coal mining can destroy valuable underground aquifers, streams and rivers.

Moreover, barren lands are easily eroded, degrading the water quality and clogging up rivers downstream, leading to increased flooding risks. JATAM, the lead NGO for mining advocacy in Indonesia, estimates that for every tonne of coal extracted, 7 - 10 tonnes of soil need to be removed. According to JATAM, “in East and South Kalimantan… a great number of plantations and paddy fields that used to be productive have been turned into gaping mining holes.” 23

Coal Mining and Deforestation

Massive land clearance for coal mining threatens forests, contributing to the critical deforestation brought about by palm oil plantations, logging, and other threats. When it comes to forests threatened by coal mining, dry land forests may be most at risk. Based on Greenpeace analysis of mining concession and land cover maps, see Tables 4.1 and 4.2, approximately 14% of total forested area in South Kalimantan is in coal mining concessions. According to Greenpeace mapping calculations, 33% of the coal production concessions in the province lie in the Barito watershed and 58% in the Cengal-Batulicin watershed, making these the most coal affected areas.

From the map below, looking at Kalimantan as a whole, Greenpeace mapping shows 0.13 million hectares being deforested in coal mining concessions between 2009 and 2011 – we estimate that around one-quarter of the total deforestation in Kalimantan between 2009 and 2011 appears to be attributable to coal, contributing 0.13 million to the total 0.44 Mha of forest cut down in Kalimantan.

Coal mining could do far more damage in the future than we have already seen in the past two years. **Coal mining could be a deforestation time bomb waiting to happen. With 3.45 Mha of forests designated as coal mining concessions throughout the whole of Kalimantan in 2011, Indonesia stands to lose hundreds of thousands more hectares of forest if coal companies are permitted to mine them.**
Open cast coal mining creates extreme changes in landscape. The rich topsoil is lost and may never be fully recovered. Coal mining potentially changes the landscape, creates erosion, and alters natural waterways.
Figure 5.1. Kalimantan, Coal Mining and Deforestation

Total Forest cover 2009 = 28.56 million hectare
Total Forest cover 2011 = 28.12 million hectare
Deforestation 2009 - 2011 = 0.44 million hectare
Forest Coal Mining concessions 2009 = 3.58 million hectare
Forest Coal Mining concessions 2011 = 3.45 million hectare
Deforestation in Coal Mining concessions 2009 - 2011 = 0.13 million hectare

Acid Mine Drainage

Acid mine drainage (AMD) is the flow or runoff of polluted, acidic, metal-rich water from operating or old abandoned coal mines and areas with surface deposits of mine waste such as rock piles, tailings, open pits, underground tunnels, and leach pads. Depending on the area, the contaminated water may contain high levels of salts, sulphate, iron, aluminium, and toxic heavy metals such as cadmium and cobalt. AMD occurs when metal sulfides, common in rock surrounding the coal seams, come into contact with water, generating acidity. Water quality is further degraded because this acidic water is capable of dissolving harmful metals in the surrounding rocks. AMD can have a direct impact on the quality of drinking water drawn from impacted surface water, on animal or plant life, and even cause the corrosion of equipment or structures. As mentioned above, AMD is often linked to an increase in heavy metals in water bodies or rivers, dissolved iron oxides, sulphates, as well as increased acidity. Many heavy metals bio-accumulate in tissue, and if they reach high enough concentrations they can cause health and reproductive problems in wildlife and humans.

This is true not only now but for the long term future as well. Even if Kalimantan’s coal mining companies cleaned up their operations and complied with the regulations, their past operations would still threaten human health and the environment for many years to come. This is partly because metals can cause problems over many years, since they do not break down in the environment, but rather settle and persist in bottoms of streams. This creates long-term contamination for aquatic insects and any animals that feed on them. Existing technology does not enable us to stop acid mine drainage once the reactions have started. Indeed, coal mines that contaminate neighbouring streams with AMD will pose problems that future generations may have to address and manage for hundreds of years. Ideas and prognostications about how to manage such waste in the long run remain speculative.
A study of AMD in South Kalimantan by the College of Technology Geological Department at STTNAS Yogyakarta found considerable sources of AMD and examples of low pH. The study revealed that in Binuang area, South Kalimantan Province, coal mining produced waste dumps and AMD in many settlement ponds with a very low pH (of 2.8 to 4.4), with metals among others magnesium, manganese, iron and lead. AMD in the study area was found to be affected by local geological conditions, such as basin topography, weathering, occurrence of sulfide minerals (predominantly pyrites) and geological phenomena such as joints and minor faults (that increased permeability of rocks so that rain water could filter through more freely”), as well as rainfall and high temperatures. Around Binuang, at Tarungin, Simpangempat and Pakan, ponds contaminated with AMD varied in size from a few square metres to an area of more than

INFOBOX:

**South Africa: AMD is now “the greatest environmental challenge”**

In South Africa, the Department of Water and Sanitation told the Parliament that AMD is “the greatest environmental challenge ever” 32, as it impacted water security and had emerging impacts on drinking water. Emergency intervention was required in three basins - Western, Eastern, Central basins. At the hearing, the Chamber of Mines (industry association) pointed out that the liability and mitigation costs of AMD from mining legacies are the responsibility of the state.
The study found that mining wastewater had mixed with groundwater, surface water, and rain water. Since mining activities at this site are ongoing, the study concluded that the mine would continue to produce AMD in years to come, posing problems that needed to be overcome.

A further study also found AMD from a PT. Berau mine in East Kalimantan, and found a low pH (3.96 to 4.49) at almost all monitoring points in 11 sub-catchments of the Ukud river downstream. It also found metals such as iron, aluminum, and manganese. The study found that “in the past operation there was no segregation between potentially acid forming material and non-acid forming material when dumping the overburden in this catchment.”

Further afield, in Sumatra, similar problems of coal mines contaminating rivers with AMD have been identified as well – raising the possibility that what happens in South Kalimantan may not be an exception but rather the norm. One such study by Riza et al, surveyed and analysed water quality from April to November 2011 in several tributaries of the Singingi river, to understand the effect of coal mines in Kuantan Singingi Regency, Riau Province. Water samples contaminated by mines effluents were collected from four Singingi river tributaries, Sepuh river, Geringgiging river, Keruh river, and Tapi river. The study concluded that Geringgiging river and Keruh river were heavily polluted, and Sepuh and Tapi rivers were moderately polluted.

The Indonesian government has a responsibility to test all of the potentially AMD affected waterbodies in Kalimantan that may be impacted by coal mining, and to examine samples for: low pH, an increase in total suspended solids (TSS), total dissolved solids (TDS), biological oxygen demand (BOD), and heavy metal concentration.

### Health Impacts from Coal Mining Wastewaters on Humans, Other Animals, Fish, and Plants

Wastewater from coal mines can include elevated levels of aluminium, arsenic, cadmium, chloride, copper, fluoride, hydrogen sulphide, iron, lead, manganese, nickel, nitrate, nitrite, phosphate, potassium, sodium, sulphate, zinc and other contaminants.

Different toxic pollutants, which typically emerge from coal mines, can potentially cause a variety of health problems, can harm crops when used for irrigation, as well as affect fisheries and freshwater ecosystems (see box below).

#### Figure 5.2. US EPA Organism Response to pH

<table>
<thead>
<tr>
<th>pH</th>
<th>6.5</th>
<th>6.0</th>
<th>5.5</th>
<th>5.0</th>
<th>4.5</th>
<th>4.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>TROUT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BASS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PERCH</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FROGS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SALAMANDERS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLAMS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CRAYFISH</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SNAILS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MAYFLY</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

United States Environmental Protection Agency
Acid waste from coal mines can severely harm or kill fish, animals and plants, reducing or even eliminating fish populations. A pH of around 7 is healthy, neutral, and natural for most water bodies (although rainwater and upland water often has a pH below 7 through completely natural processes). Many streams that are affected by AMD from coal mining have pH values of around 4 or even less than 4. At such low pH levels, plants, fish, and other animals can have trouble surviving. When water pH drops to 4 or 5, fish reproduction is affected and most fish eggs are not able to hatch; and adult fish can die at levels of 3 to 4:

The US EPA also noted that all biological organisms are interdependent and interrelated to each other and to the environment in which they live. Thus, even if frogs are able to tolerate higher levels of acidity than mayflies, if they need to eat insects like the mayfly in order to survive, frogs may die when mayflies die – simply because their food supply has critically dwindled. “Thus, as lakes and streams become more acidic, the numbers and types of fish and other aquatic plants and animals that live in these waters decrease.”

Besides pH, metal contamination of water can have significant impacts on fish and other aquatic life, and the Indonesian authorities must investigate these impacts in and around South Kalimantan’s coal mines, to assess the magnitude of damage done. Aluminium, arsenic, manganese, nickel, cobalt and chromium are known to be harmful (and occasionally even lethal) to aquatic organisms at the concentrations detected in Greenpeace samples (see box below). Water pollution from coal mines can have impacts far downstream, especially given the very large number of coal mines in the catchments of South Kalimantan’s main rivers. When not just one tributary but the entire river is polluted, dilution cannot be counted on to lower contaminant concentrations to safe levels.

As previously noted, acid water releases metals from soils into lakes and streams; some metals are highly toxic to many species of aquatic organisms. Many aquatic organisms are extremely sensitive to copper, particularly in soluble forms, which are generally far more bioavailable and toxic to a wide range of aquatic plants and animals, with some effects occurring even at very low concentrations. Increased copper levels cause chronic stress that may not kill individual fish, but leads to lower body weight and smaller size and makes fish less able to compete for food and habitat. Greenpeace found copper at high concentrations in some waters (up to 1880 micrograms per litre or μg/l). Background concentrations of soluble copper in uncontaminated surface waters can vary significantly, but levels are typically below 10 μg/l, and often far lower.

Table. 5.1. Compilation of studies on Indonesian Fish Species Response to pH

<table>
<thead>
<tr>
<th>Fish Species in Indonesia</th>
<th>Respon to pH*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ikan Nila (Nile Tilapia) <em>Oreochromis niloticus</em></td>
<td>At pH 4 -5 only 30% survived (red strain); other strains died with various gill damages.</td>
</tr>
<tr>
<td>Ikan Gabus (snakehead fish) <em>Channa striata</em></td>
<td>At pH 5 only 72% survived.</td>
</tr>
<tr>
<td>Ikan Mas <em>Cyprinus carpio</em></td>
<td>pH 6.5 - 8.5 - optimum.</td>
</tr>
<tr>
<td>Ikan Lele (Catfish) <em>Clarias gariepinus</em></td>
<td>pH 6.5 - 8.6 - optimum.</td>
</tr>
</tbody>
</table>

*Compilation of studies, each measured under different testing conditions, including various environmental parameters and life’s stages.

The box above illustrates clearly how different aquatic species in the United States are affected by low pH, and although there is no comprehensive equivalent for Kalimantan, some information does exist on how a few popular fish that are widely consumed in Indonesia, respond to different levels of pH.
Coal Mines Polluting South Kalimantan’s Water

Potential Impacts of the Heavy Metals Detected in South Kalimantan Coal Mining Wastewaters

Very few studies have been carried out on toxicity of heavy metals to Indonesian freshwater species and ecosystems. This box highlights findings from other parts of the world that clearly indicate that the detected levels of heavy metals can have serious impacts in Indonesia as well – and that groundwater flowing through active or abandoned coal mines often has depressed pH levels and elevated levels of dissolved metals such as arsenic, iron, copper and zinc, which can affect health of plants or animals.

Aluminium has greater toxicity in acidic water (pH 5.5 and below). Concentrations of 0.1-0.3 mg/l have been found to reduce survival of fish eggs and hamper growth in acidic water. Concentrations of 0.7-3.3 mg/l are reported to be chronically toxic in neutral water with effects including weight loss & impaired swimming and feeding ability (this relates to chronic or long term toxicity rather than acute toxicity). At higher concentrations, effects include damage to gills, clogging and disturbance of gill function; changes in internal organs and reproduction.

Manganese concentrations of around 1 mg/l can cause toxic effects on organisms in streams, rivers and lakes, as shown by both laboratory tests and field observations. Effects include inhibition of growth & photosynthesis of algae; survival and hatching of crab embryos; can kill some fish and fish embryos, as well as amphibian embryos, already at concentrations well below the Indonesian discharge standards. Other documented effects include shell disease in crabs and discoloration in the gills of lobsters. Manganese is also toxic to some terrestrial plants, with toxicity varying widely with species; effects include marginal chloroses, necrotic lesions, and distorted development of the leaves.

Iron: Dissolved iron is toxic at high concentrations, such as those which can occur in acidic water lacking oxygen, such as mine discharge. Studies have suggested that dissolved iron concentrations in fresh water should be below 0.2-0.4 mg/l, based on impacts on freshwater fish, clams, insects and plants. Particulate iron can settle on the bottom of water bodies, destroying plants, bottom-dwelling invertebrates and fish eggs. For every species that locals notice have been affected, there may be many more that slip under the radar. Indeed, although biodiversity appears to be heavily affected, there is no reliable study on the exact extent of the loss of flora and fauna in coal-mining affected forests.

Greenpeace calls on the authorities to conduct such a study, as a matter of urgency. The need for such a study is all the more pressing given that studies in other countries’ mining affected areas revealed clear negative impacts of coal pollution on flora and fauna. One such report about streams in the Central Appalachian Coalfields in the US assessed the state of the science on environmental impacts of mountaintop coal mines and “valley fills” by coal companies (namely dumping so much mining waste into valleys that they were completely filled up and disappeared). The study concluded that mining harmed stream ecosystems in numerous ways. Springs and small streams had been completely lost due to mountaintop removal or burial under fill; concentrations of major chemical ions were found downstream; water quality was at “levels that are acutely lethal to standard laboratory test organisms”; selenium concentrations were so high that they “have caused toxic effects in fish and birds”; and “macro-invertebrate and fish communities are consistently degraded.”
Coal Mines Polluting South Kalimantan’s Water

Land Erosion Leading to Water Quality Degradation and Flooding Risks

Many of South Kalimantan’s coal mines and concessions are located in flood prone areas. Greenpeace investigators witnessed a flash flood while they were investigating coal mines in Kabupaten Tanah Laut, recognised as a flood prone area by the local government. Based on an analysis of the last five years by the local disaster management agency, there are 939 flood points in South Kalimantan, which are located in the districts of Banjar, Tanah Laut, Tanah Bambu and Hulu Sungai Utara. Coal mining contributes to flooding because land clearance destroys the water retention capacity of the soil, leading to quick runoff after rainfall, and because large amounts of sediment discharges clog waterways. Those waterways then overflow more easily when heavy rains come. Coal mining also exacerbates flooding because it is typically preceded by logging and, during mining, no trees are allowed to grow back in key areas. Logging trees increases the flood risk in the long term because trees soak up vast amounts of water. Without these forests there is nothing to soak up heavy rainfall, and it frequently leads to flash floods.

Nickel: In freshwater ecosystems, nickel can inhibit algae growth and harm the survival of the embryos of some fish species. Nickel can inhibit growth of crops. Besides inhibiting plant growth, other symptoms of nickel toxicity in plants include chlorosis, stunted root growth and brown interveinal necrosis.

Cobalt: causes reduced survival and growth of fish embryos in some species, and it is lethal to toad larvae and sensitive invertebrate species. Cobalt is also toxic to a variety of food crops.

Chromium can cause allergic dermatitis through both skin contact and drinking. The condition is characterised by dryness, erythema, fissuring, papules, scaling, small vesicles, and swelling of skin. The U.S. EPA has proposed to classify chromium-6 as likely to be carcinogenic to humans when ingested, and an assessment is currently ongoing. In freshwater ecosystems, chromium decreases in survival and growth rates of aquatic animals; can cause DNA damage and effects on fertilization and blood composition in some species.

Post-Mining Reclamation and Long Term Recovery

The wholesale destruction of vegetation and soil over large areas, as well as mine tailings and toxic pits left behind by mining, affect ecosystems and water resources for decades. Mining companies have an obligation to alleviate the impacts to the extent possible through post-mining reclamation, but in reality this poses terrible problems. In many cases, reclamation in South Kalimantan is completely neglected. When mining companies have removed all the coal they want, they often abandon giant pits, which fill with toxic water, leaving behind lagoons that are especially dangerous for fish, amphibians, other animals, and local communities.

In many cases, post-mining reclamation in Kalimantan is done very poorly – although Greenpeace posits that “there is no truly good way to conduct reclamation, which is precisely one of the crucial reasons why strip mining should not be allowed. With bad reclamation, loss of topsoil, failure to save and reinstate original topsoil, re-planting with homogenous plantations of acacias, the land and its original biodiversity will never fully recover.”

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There are severe limits to what can be achieved through reclamation. A University of California study by Karen Holl, University of California, reviewed the long-term effects of reclamation efforts on plant conservation to determine whether vegetation of reclaimed mines approximated the surrounding forest after a long period of reclamation. The study also evaluated "how intensive reclamation practices used to address short-term erosion and water quality concerns affect long-term recovery." The hardwood forest reference sites in southwestern Virginia had not recovered. It was found that changes persisted, even on lands that had been reclaimed for over 35 years. This study’s results showed that planting with aggressive non-native ground cover species to minimize short-term erosion in highly disturbed sites may have slowed long-term recovery on the sites studied. This is particularly relevant because what reclamation there is in Kalimantan is often done on the quick and on the cheap, with inadequate soil replacement and planting of aggressive non-native ground cover species such as acacia.

East Kalimantan:
Environmental Devastation from Coal Mining

East Kalimantan is Indonesia’s most significant coal export region. Over 200 million tonnes of coal was shipped out in 2011. If it was a country, it would be the eighth biggest coal producer in the world.

Land erosion from deforestation and mining has dramatically increased the risk of flooding in the region. From 2010 to 2012, the city of Samarinda has recorded a total of 218 floods and has now acquired the reputation of “Kota Banjir”, or flood city.

The coal mining boom in the past 15 years has also caused widespread water pollution in the Makaham river, which flows through rainforests and is home to 147 indigenous freshwater fish species.
rather than with any attempt to replant the species common to the original forest.

A study for a PhD thesis by D. Setiawan from the Bogor Institute of Agriculture in Indonesia, conducted on the PT. Adaro concession at four different locations, reported that reclamation was ineffective in terms of a striking loss of macrofauna biodiversity (including a dearth or absence of worms, which play an important role in soil fertility). Setiawan examined the effectiveness of reclamation with Sengon (Paraserianthes falcatoria) and Acacia (Acacia mangium), which are typical plants most commonly used for reclamation of mining sites in Kalimantan. Setiawan’s analysis examined the lack success of land rehabilitation. The study also examined soil characteristics such as bulk density, aggregate stability, porosity, pH, and organic carbon. Setiawan found that although several indicators showed that reclamation had improved the stability of soil aggregates, no significant improvements could be noted in the ability of the soil to retain water for plants or in other key indicators during the period of observation.

Another study conducted in 2012 on reclamation land owned by PT. Arutmin Batulicin in South Kalimantan (where typical Acacia and Sengon plantations were chosen due to their fast growing nature), observed loss of biodiversity by comparing these plantations with the surrounding unharmed forest with vegetation such as Eusideroxylon zwageri/the famous kayu Ulin, Shorea lepidota (damar putih), which is protected by Agriculture Ministry Decree No. 54/Kpts/Um/II/1972.

In 2013, the South Kalimantan Environment Protection Agency released a statement acknowledging that surface mining would leave damaged land that might not fully recover. It found that even when previous topsoil had been piled and set aside to be reused for final covering of abandoned mining pits during land reclamation, the land would be different from the original state. The piled topsoil that was reserved to go back as the final layer of topsoil was already mixed, clearly different from its original state, and had suffered structure damage, with lower bulk density, worse permeability, and worse aeration.

Reclamation of post mining land with inadequate soil replacement and acacia plantations cannot be called reclamation, and is not restoring the original biodiversity of Kalimantan. Post mining land characteristically loses its rich topsoil, limiting re-vegetation. Today many local communities in Kalimantan have been left with – at worst – a moonscape of bare dry land with ponds of acid waste or – at best – homogenous plantation forest with no economic, biodiversity, or historical value.
Coal Mines Polluting South Kalimantan’s Water

An acid pond from coal mining activities
**Purpose and Scope**

The purpose of this report is to explore and explain the release of hazardous materials into the environment due to some specific coal mining activities and to reveal how the Indonesian government has failed to protect the public’s right to clean water. Greenpeace’s sampling of mine discharge aimed to provide a snapshot of the situation and to complement extensive desk research and prior investigations into the overall situation of coal mining in South Kalimantan. It is not a survey of every discharge point in all coal mining activities in South Kalimantan nor a survey of all coal mining companies in the area.

After, extensive desktop research, analysis of Google Earth and satellite maps, and a preliminary round of scouting in the field, Greenpeace teams returned to the field and collected water samples from coal concessions in South Kalimantan.

**Sampling Results**

29 samples of wastewater or surface water were collected and were sent to the Greenpeace Research Laboratories in Exeter, UK, in two separate batches, in July and August 2014. All samples were collected from locations associated with coal mining activities, with the first set collected between 19th-23rd July 2014, and the second set collected between 11th-14th August 2014.

All samples were collected in pre-cleaned glass, screw-capped bottles and kept cold and dark before shipment to our laboratory in the UK for analysis. Samples were analysed quantitatively for metals. The pH of each wastewater was measured both in the field using a number of calibrated hand-held devices for cross-checking and also upon receipt of the samples at the laboratory. (See Appendix for the full report: Greenpeace Research Laboratories Analytical Report 04 – 2014)

All samples were analysed quantitatively for the presence of a range of metals. Concentrations of metals in both whole and filtered water were determined in order to distinguish between metals associated with suspended matter and those present in dissolved form in the water.

For the majority of samples, the metal concentrations in the filtered sample were very similar to those in the whole (unfiltered) sample, indicating that these metals were present in these samples almost exclusively in dissolved forms rather than bound to suspended particles within the water.

Wastewaters generated by coal mining activities are subject to regulation in Indonesia which sets maximum permissible limits for certain parameters, including iron (7 milligrams per litre or mg/l = 7000 μg/l), manganese (4 mg/l = 4000 μg/l) and pH (between 6-9).76

18 of the cases (see Table 6.2) were sampled from wastewater being discharged at the moment of investigation, or from water outside man-made pits and pools, which constitutes a direct violation of Indonesian regulation. In other cases, a violation is committed if the water is discharged without substantial treatment.

For 22 of the 29 samples (76%), all of which were wastewater samples, the pH was below 6. In the
Coal Mines Polluting South Kalimantan’s Water

Table 6.1. Wastewater Quality Limit for Coal Mining Activities

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Indonesian Standard</th>
<th>World Bank Group Guidelines</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>6–9</td>
<td>6–9</td>
</tr>
<tr>
<td>TSS (Suspended Solids)</td>
<td>400 mg/l</td>
<td>50 mg/l</td>
</tr>
<tr>
<td>Iron (Fe) total</td>
<td>7 mg/l</td>
<td>2 mg/l</td>
</tr>
<tr>
<td>Mn total</td>
<td>4 mg/l</td>
<td>--</td>
</tr>
<tr>
<td>Chromium</td>
<td>None</td>
<td>0.1 mg/l</td>
</tr>
<tr>
<td>Nickel</td>
<td>None</td>
<td>0.5 mg/l</td>
</tr>
<tr>
<td>Zinc</td>
<td>None</td>
<td>0.5 mg/l</td>
</tr>
<tr>
<td>Copper</td>
<td>None</td>
<td>0.3 mg/l</td>
</tr>
</tbody>
</table>

(Indonesian standards are much weaker than those recommended by the USA or the World Bank Group guidelines). *World Bank safeguards are stronger than Indonesian regulation and practice.

Wastewaters from many of the locations sampled in this study did not comply with these regulations at the time of sampling, due to elevated concentrations of manganese and iron, and/or due to high acidity (pH below 6).

The concentrations of manganese exceeded the permissible limit for wastewater discharges in 17 of the 27 wastewater samples (63%), in both the filtered and whole sample in all cases, with concentrations in the whole sample ranging from 5350 μg/l (5.35 mg/l) to 40 200 μg/l (40.2 mg/l). The highest concentration, in sample IDN14029, exceeded the limit by 10 times. For all but one (IDN14001) of these 17 samples, the pH was also outside the allowed range (pH 6-9), and the highest manganese
Coal Mines Polluting South Kalimantan’s Water

concentration (40.2 mg/l) was found in sample IDN14029, which had the lowest pH (2.32).

Of these 17 samples, 7 also had concentrations of iron that exceeded the maximum permissible level, with similar levels in both the filtered and whole sample in all cases. Concentrations of total iron in whole samples were in the range 9740 μg/l (9.74 mg/l) to 280 000 μg/l (280 mg/l), with the highest concentration exceeding the limit by 40 times. The highest iron concentration was also found in a sample with one of the lowest pH values (IDN14015, pH 2.34). These findings are consistent with the high acidity of many samples solubilising iron and manganese from minerals in the local environment.

Three samples (IDN14015, IDN14017 and IDN14029) had notably higher concentrations of aluminium (94 700-184 000 μg/l, or 94.7-184 mg/l), nickel (1360-1690 μg/l), zinc (3210-3880 μg/l) and copper (100-1890 μg/l) compared to other wastewaters. Two of these samples (IDN14015 & IDN14029) had the lowest pH of all wastewater samples and also contained the highest concentration of either iron (IDN14015) or manganese (IDN14029). To a lesser extent, concentrations of chromium, cobalt, mercury and vanadium were elevated in some wastewater samples, particularly for IDN14015 and IDN14017. These additional metals may also be present in the samples at elevated concentrations as a result of having been solubilised from minerals in the local environment.

Overall, the data indicate a strong link between high acidity (low pH) in wastewaters (particularly for those below pH 4) and elevated concentrations of metals (especially iron, manganese and aluminium), predominantly in soluble forms (see Figure 1). The data also indicate that there is commonly a link between high concentrations of iron and/or manganese in wastewaters and higher concentrations of other metals.

The relevant regulation sets parameters only for pH, two metals (iron and manganese), and total dissolved solids. Nevertheless, the data and correlations apparent from the current study suggest that wastewaters from other similar locations which have been reported by others also to exhibit low pH may also have high concentrations of metals, particularly iron and manganese, and also that high concentrations of iron and manganese in wastewaters may also indicate high concentrations of other metals.

Figure 6.1. Relationships between pH and the dissolved concentrations of three metals in samples of water and wastewater collected in the vicinity of coal mining operations in Indonesia

Source: Greenpeace Research Laboratories (University of Exeter, UK)
What does the Sampling Mean? Breaking It Down

The low pH in 22 of Greenpeace’s samples (pH 4.66 to 2.32) means that the water we tested could harm or kill fish, insects, other living beings, and even plants – as well as harm people coming into direct contact with it. If this water and/or similar water from holding ponds and nearby water puddles were to leach or overflow or trickle into rivers and lakes downstream, it could harm flora and fauna there too (some samples were taken from waters which were leaching/overflowing at the time).

As explained in the Acid Mine Drainage section, when water pH drops to 5 or 4, fish reproduction is affected, most fish eggs cannot hatch at pH 5 or below, and adult fish often die at levels of 4 to 3 or below. Other living organisms besides fish would also be affected by streams contaminated from runoff of ponds with such low pH, as would plants.

When testing for metals, Greenpeace found very high levels of iron and manganese in many of the water samples, and in some also high levels of toxic heavy metals including nickel, zinc, and copper. The levels of iron and manganese that Greenpeace found in the water was often far above the legal limit set by the government for coal water discharge - with one case 40 times above the legal limit. There are legal limits for discharge from coal mines in Indonesia, and if the water is above those limits, and is being discharged or had been discharged without treatment into the environment and/or into rivers, this is a violation of the law.

In addition, none of the ponds containing highly acidic water or high metal concentrations where Greenpeace collected its samples were lined or appeared designed to prevent seepage into neighbouring water bodies. Made of earth, they are vulnerable to seepage as well as overflow in the rainy season. Some were leaking when the samples were collected.

Poor and Non-Existent Signage May Indicate Inadequate Monitoring

During their investigations, Greenpeace staff saw very few signs anywhere, for warning or monitoring. Even worse, there were no signs at
Coal mines polluting South Kalimantan’s water

Greenpeace Southeast Asia – Indonesia

all at sites that we subsequently found to have the worst sampling results – lowest pH and highest heavy metal contamination.

Greenpeace investigators identified two distinct kinds of settling ponds – a small number of official settling ponds with signage, which are treated and monitored, and a moonscape of abandoned mine pits with few or no signs and no evidence of being treated or monitored.

The lack of signage may indicate that there is lack of monitoring and surveillance around the issuance of Wastewater Discharge Licenses (Ijin pembuangan limbah). In order to properly monitor wastewater, and to adequately track change over time, government compliance officers must use specific compliance points. The 2003 Ministry of Environment Decree No. 113 on Wastewater Quality Limits for Coal Mining Activities, Article 1.7 states that: “A Point of Compliance is one or more location that is the reference for monitoring compliance over wastewater limit.” According to articles 8, 9 and 11, the Regent or Mayor must issue licenses for wastewater discharge, which specify the location of the Compliance Points. If there are changes in business location or activity, the company must report to get approval of new Compliance Points. Greenpeace saw poor evidence of Compliance Points, given the lack of appropriate signage.

Greenpeace challenges the government to prove transparently what routine monitoring has been done, both by companies and by the government, by publishing dates, locations, and findings of its monitoring online for the public. Moreover, as many rural communities in South Kalimantan do not have internet access, it is also crucial for monitoring results to be published in local newspapers and posted on village noticeboards.
Three In-Depth Case Studies: The Fuller Picture of What We Found

a) Top toxic trouble – Arutmin

The Arutmin concession in Asam Asam district was the worst of all the sites that Greenpeace sampled, with its scarred barren landscape, dead trees, lurid coloured toxic ponds, and abandoned pits.

One sample (IDN14029) taken from the Arutmin concession had the lowest pH of all our samples: pH 2.32 As a comparison, the regulation on coal wastewater quality limits (MoE, No. 113, 2003) specifies that the pH should be between 6 and 9. The sample also recorded the highest manganese concentration: 10 times the legal limit for permissible discharges from coal mines. The Greenpeace investigation team documented clear evidence that the dirty, contaminated settling ponds were flowing into the broader water system. In this sample area Greenpeace field investigators were able to clearly identify tracks left from water overflowing from a holding pond. Water was overflowing at the time in some places. Moreover, in other places there was evidence of previous overflow events: additional dry traces of previously overflowing water were unmistakable, although at the time of sampling it was the middle of the dry season. It was clear that one pond had recently overflowed into a puddle, and was 1-2 cm below the point of overflowing again. The dirty, contaminated settling ponds were observed at the time of sampling to be flowing into the broader water system.

Moreover, the ponds, overflow puddle and the course taken by the contaminated water were all less than 20 metres from a public road that was frequently used by local villagers. In the same concession, but at a different location from where Greenpeace was able to sample, our field investigators documented a leak into a creek that flows into a river. There is a risk, therefore, that contaminated water from this Arutmin concession may be affecting the residents of neighbouring Salaman village.
Coal Mines Polluting South Kalimantan’s Water

At another site in the same Arutmin concession (IDN14016), contaminated water flowed not only from one to a second, then to a third settling pond, but also flowed into a small creek, away from the official ponds. It then flowed under a road, then further away on the other side of the road, into a large yellow puddle, then into a greenish yellow puddle, and ultimately into a swamp. Almost all the trees in the swamp were dead. At the yellowish puddle at the head of the swamp the pH was very low (3.56). At the edge of the last pond above the road – the leaking pond (source of all the contaminated water), the pH was 3.43 (IDN14013).

The contaminated swamp was a mere 200 metres away from a small creek. This small creek led 4.7 km away to Asam Asam river.

Greenpeace investigators found an even more contaminated pond very close to the contaminated swamp (IDN14017), with a pH of 3.43 and high concentrations of copper, nickel, and zinc, which also contained chromium, cobalt, vanadium and mercury. This contaminated pond, which was a brown colour, was not only near the swamp but was also elevated relative to the swamp – posing a risk of potential leakage especially with heavy rainfall. It also appeared not to be an official settling pond at all, but rather an abandoned mining pit, which had been allowed to fill up with rainwater.

Whereas mining companies must post signs over their settling ponds detailing the results of routine monitoring and measurements, Arutmin had no such signs visible to Greenpeace investigators, recording any measurements. The only sign Greenpeace found was a lone sign proclaiming “no fishing or bathing” over an official settling pond above the road – nothing below the road, along the swamp, or at the abandoned mining pit.

The third contaminated hotspot in Arutmin (IDN14015) had extremely low pH at 2.34 and the highest iron contamination of all samples, up to 40 times the legal limit. Also high were zinc and nickel concentrations, as well as elevated concentrations of copper, chromium, cobalt, and mercury. This pond was located less than 3 metres from a public road to Salaman village.

Figure 7.1. Field sketch : Sampling Point ID/IDN 14029

Sketch is an illustration of field conditions; it doesn’t reflect the real scale.
Drinking water should not exceed 0.3 mg of iron per litre (mg/l) according to the Indonesian authorities.\textsuperscript{80} The other heavy metals found in high concentrations in this third contaminated hotspot – zinc, nickel, copper, chromium, cobalt and vanadium – may also be of concern in relation to human health if they contaminate drinking water.

\textbf{b) Banpu – Environmental threat}

Banpu and its fully owned subsidiary Jorong Barutama Greston have a concession that Greenpeace also investigated.

The Greenpeace investigation revealed that the mine has a massive acid mine drainage problem. We found a large abandoned mine pit 200 m x 2 km (visible in a Greenpeace drone video) with acidity and manganese levels well above discharge standards (IDN14026). Yet there was an uncontrolled and unregulated discharge of acid water right next to the large pit (IDN14025). Moreover, smaller ponds tested by Greenpeace all around the large pit were all revealed to be acidic, with pH ranging from 3.15 to 4.66.

Even if they are weaker than in many other countries, Indonesia has legal limits on discharges of polluted water from coal mines. These regulations require that wastewater from mining is discharged through regulated discharge points and, in most cases, the water must be treated in settling ponds before discharge. Yet the team witnessed several cases where contaminated water was being discharged outside of the mine area past settling ponds and the monitoring points. The Banpu - JBG case was among the worst of these cases. Water in the large 200 m x 2 km pit that Greenpeace tested had a pH of 3.74 at the time of sampling, and the leaked or spilled water outside the mine had a pH of 4.48. Moreover, concentrations of manganese clearly exceeded regulatory levels.

In 2010 the entire concession was closed by the authorities due to permit violation in a protected forest area. Later on the matter was resolved.\textsuperscript{81} The concession received a “red” ranking (meaning: it failed) in the government environmental ranking system called “PROPER” from 2009 and 2010.\textsuperscript{82} Details of Banpu’s compliance were not made public. Within the

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure7.2.png}
\caption{Field sketch: Sampling Point ID/IDN 14013, 14016, 14017}
\end{figure}

\textsuperscript{80} Even if they are weaker than in many other countries, Indonesia has legal limits on discharges of polluted water from coal mines. These regulations require that wastewater from mining is discharged through regulated discharge points and, in most cases, the water must be treated in settling ponds before discharge. Yet the team witnessed several cases where contaminated water was being discharged outside of the mine area past settling ponds and the monitoring points. The Banpu - JBG case was among the worst of these cases. Water in the large 200 m x 2 km pit that Greenpeace tested had a pH of 3.74 at the time of sampling, and the leaked or spilled water outside the mine had a pH of 4.48. Moreover, concentrations of manganese clearly exceeded regulatory levels.

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PROPER system, rankings are issued by the Ministry of the Environment. A red ranking means that the company has broken the law and failed to protect the environment. PROPER, which has been long criticised by NGOs for leniency, weakness, lack of transparency, and enabling corporate greenwashing, is not considered widely to have stringent criteria. Yet even PROPER has found this concession to be failing, in the past.

Greenpeace was physically prevented by security forces from testing further ponds and potentially contaminated creeks and rivers all around the giant 2 km-long pit, including by one individual wearing an army uniform.

Nonetheless, Greenpeace aerial footage from a drone indicates that many rivulets and creeks could well be contaminated by the many apparently toxic ponds in the Banpu-Jorong concession. These findings appear to be corroborated by an analysis of satellite imagery.

NGOs and local parliamentarians representing the area around the Jorong concession have repeatedly complained about the lack of adequate reclamation. A local NGO in South Kalimantan, MERAH PUTIH, also questioned Jorong’s reclamation, since it only planted acacia trees. (Acacia trees are known for being especially able to withstand low quality land with poor nutrients, drought, and are thought to be resilient to pollution). Greenpeace joins the call for Jorong to fulfil its legal responsibilities and to implement effective large-scale reclamation as a matter of urgency.

c) Tanjung Alam Jaya – contaminating a nearby farm

Our third case study concerns Tanjung Alam Jaya, which was acquired by state owned tin mining company PT Timah’s subsidiary PT Timah Investasi Mineral in 2003. When Greenpeace sent investigators to sample in the Tanjung Alam Jaya concession, sampling sites revealed numerous problems. At one site, the west side of an abandoned pit had a pipe leading to a creek. Testing upstream and downstream of the pipe in the creek, Greenpeace found that the pH before the pipe was 7.45, which is considered neutral or natural, whereas the pH downstream was 3.74.

Figure 7.3. Field sketch : Sampling Point ID/IDN 14004

Sketch is an illustration of field conditions; it doesn’t reflect the real scale
Coal Mines Polluting South Kalimantan’s Water

(IDN14004), which is highly acidic and toxic to many fish or other aquatic species.

The contaminated acidic water flowed through the creek down to a pond. Two additional pipes led to that pond as well. Their origin point was unknown. That pond was very close to a public road.

Worse yet, along the right side of the creek was a small plantation where a local farmer grew cassava, banana, and other crops. His “pondok” (a plantation hut) was less than 20 metres from the creek, which he used for bathing and drinking. Without the right equipment, it was not possible for Greenpeace to conduct tests on his crops, but the potential for contamination of soils and crops in the area is clear.

Below the abandoned pit on the south side, a leak appeared to be leading to a swamp, which appeared, in turn, to be connected to the local water system. The location at which Greenpeace tested the creek was approximately 500 metres from the Mangkaok river, a tributary of the Martapura river.

Greenpeace is not alone in noting problematic issues in this concession. In 2010, Tanjung Alam Jaya was sanctioned by Indonesia’s Minister of Environment – for polluting water. In 2010, a settling pond in the Tanjung Alam Jaya concession leaked into Riam Kiwa River, Banjar regency. This created high turbidity, with high levels of suspended solids that surpassed the pollutant discharge limit for coal mines of 400 mg/l). “It was reported that turbidity levels… [were] threatening the death of fish in the river and also causing human health problems due to the water being used for bathing and daily consumption.”

Due to this scandal, Tanjung Alam Jaya was subjected to administrative sanctions from the Environmental Ministry, alongside 4 other companies in South Kalimantan. They were given 6 months to clean up and fix their environmental management systems. Greenpeace now questions to what extent Tanjung Alam Jaya has truly cleaned up and improved its performance.

The Indonesian Coal Mining Association reported that Tanjung Alam Jaya will be shut down in 2014, raising the question of reclamation. If operations are truly slated to end in 2014, why has reclamation still not been rolled out comprehensively throughout the entire concession?
Greenpeace is not alone in finding substantial contamination of water by coal companies in Indonesia. Government agencies confirmed serious degradation of water quality around numerous coal mines across Indonesia; and acknowledged that coal mining plays a significant role. This section outlines government studies of how coal is polluting waterways in South Kalimantan, as well as in several other regions to indicate the severity and scope of this problem nationwide.

a) Government Acknowledgment in South Kalimantan

Greenpeace’s analyses, laying out data about pollution that indicts the coal companies, affirms the findings of the local Environment Protection Agency (Badan Lingkungan Hidup Daerah or BLDH) for South Kalimantan Province.

Key conclusions of the ‘Annual Report: Regional Environment Status South Kalimantan Province 2013’

- The testing results from several government sampling stations shows acidity (low pH), high Total Solid Solution (TSS), high Manganese (Mn) and high Iron (Fe). One sample even reaches 1,000% the allowed limit for Iron (according to Governor’s decree No. 05 from 2007). These indicators shows hazards that are posed to aquatic life; and show lower water quality due to intense land erosion, responsibility for which the government specifically attributes to the mining sector, naming coal mining as the culprit.

- Open cast coal mining creates extreme changes in landscape. Coal mining creates gaping pits that can never be fully reclaimed or covered. The rich topsoil, even if preserved on the side for later reclamation, undergoes mixture that eventually leads to earth with structure damage, lower bulk density (Bobot is/BI), smaller porosity, worse permeability and aeration, and which is unfertile. Coal mining potentially changes the landscape, creates erosion, and alters natural waterways.

- Further potential land damage in coal mining areas is the destruction of natural drainage in water bodies due to landscape changes, erosion, and landslides. In general, mining activity can create water pollution and leave behind unproductive land that can no longer be used for farming.

In addition, the South Kalimantan government EPA report listed a number of key findings regarding the Barito river and coal:

- The Barito river is impacted by the massive volume of coal transport on the river, amounting to approximately 65 million tons (±63,170,000 metric tonnes).

- The transport takes place using barges with a capacity of around 5,000 tons (±4,500 metric tonnes), implying 13,000 loaded barges and the same amount of [returning] empty barges per year.

- The barges and tug boats pulling them cause coal dust pollution, spread coal into the river (with spills and scattering of bits of coal from coal barges and tugboats), and cause turbulence.
The physical condition of the riverside has degraded dramatically. It is impacted by the high frequency of coal transport by barges on a large scale. Heavy traffic from various activities, including coal transportation, has caused landslides.

• Damage to and destruction of the many mangrove forests can be seen on the riverbank in Laut Kuala Lupak, Tabunganen District.

• 252,677 people live along the riverside.

• Government water quality measurement:
  1. pH: low pH was due to the condition of the catchment area of the Barito watershed that receives wastewater from the mining sector. Low pH may determine the overall water quality especially since water acidity increases the dissolution of metals into the water. Low pH threatens the aquatic ecosystem as only certain fish can withstand higher acidity.
  2. TSS: The highest TSS reached 117 mg/l in August 2013, surpassing the allowed limit of 50 mg/l in accordance with the Governor's decree No. 05 Year 2007 on river water quality. TSS rises due to mud and fine sand that are mostly caused by land erosion, that impacts the water body. The many measurements of TSS surpassing limits in the Barito river are due to inputs from rivers where coal mining persists.
  3. The watershed destruction and destruction of critical land in Kalimantan reaches 3 million hectares.
  4. Fe (Iron): In almost every month of testing, Fe measurement results surpassed the allowed limit set by the Governor decree No. 05, 2007. The Government claimed that one measurement even reached 1000% above the limit.
  5. Manganese (Mn): The highest measurement in 2013 was 0.5697 mg/l in the Alalak floating market, which was more than 5 times the allowed limit.
  6. These indicators highlight hazards that are posed to aquatic life, and problems for the community water supply, and the government specifically points to the mining sector – especially coal – as the culprit.

The South Kalimantan government EPA report also listed a number of key findings regarding the Martapura river and coal:

• The Martapura river withstands the dumping of waste and numerous activities linked to various riverine industries including plywood, glue, rubber, sand mining, and coal mining (PT. Baramarta). Some of the monitoring points receive a burden of waste from the coal mining sector.

• TSS: At many times and many station points, the measurement of TSS surpasses the allowed limit of 50 mg/l (Governor’s decree No. 05 Year 2007) on river water quality limit, for example 494 mg/l in October 2013. TSS rises due to mud and fine sand that are mostly attributed by the government to land erosion that was carried by the water body. The many measurement of TSS surpassing limit in the Martapura are found to be due to inputs from rivers where coal mining persists and that eventually flow into the Martapura. The government thus highlights
coal mining as a contributor to the unusually and unacceptably high TSS in this river. Water with high TSS has lower clarity and less sunlight, an ingredient important for vegetation to conduct photosynthesis, which supports the entire aquatic ecosystem.

- Fe (Iron): All measurements taken in 2013, measured 5 times at 5 control stations, surpassed the allowed limit of 0.3 mg/l in accordance with the Governor’s decree No. 05 Year 2007. Fe levels in the Martapura river even reached 45 times the limit, due to the peat and mining sectors upstream.

- Manganese (Mn): The presence of Manganese in the Martapura may be due to the mining sector. Measurements in April and March surpassed the water quality limit because of the rainy season, when the acid mine drainage cannot be managed, and enters the Martapura.

- The report focuses on a residential area, 6000 ha of farmland, as well as the aforementioned industries.

b) Government Acknowledgment in Other Regions of Indonesia

Various government documentation has been obtained by Greenpeace investigators, confirming that the official government acknowledgements that coal is also a source of water pollution in other regions of Indonesia. Excerpts and summaries of some of these reports are included below, in order to highlight the possible scope and severity of the problem nationwide. These reports also underscore that governmental acknowledgment of coal’s role in water pollution is not an isolated phenomenon, limited to one single report, but rather repeated acknowledgments by different agencies at different times.

The East Kalimantan Environmental Status Reports prepared by the provincial government 68 show that the Mahakam river in East Kalimantan has been “heavily polluted” for as long as samples have been taken, since 2003. Total suspended solids, BOD (biochemical oxygen demand) and COD (chemical oxygen demand) have been high throughout, but towards 2012 there was a significant increase in COD. Overall water quality degraded significantly from 2011 to 2012, and riverbottom (benthic) fauna downstream of Samarinda died entirely. The Environmental Status report by the provincial government attributes the worsening of water pollution and the die-off to water pollution from sludge or wastewater discharges into the river, and to water transport. Both impacts are dominated by coal mining, and the increase in COD without corresponding increase in BOD would be consistent with coal dust or other inorganic pollution, rather than organic matter from land erosion. Land erosion is also a major factor in the pollution of the river and coal mining is one of the main drivers.

In March 2013, the head of the parliament of the East Kutai regency Legislative Council heavily criticized KPC for discharging coal mining wastewater into the Sangatta river. The discharges have destroyed and polluted the river that 10,000 people rely on as their source of water. 89

In 2009, the South Kalimantan environmental authorities told the local people downstream of Adaro’s Tutupan coal mine not to consume the water in the Balangan river, because of discharges of polluted water from the settling pond of the mine. They ordered the company to distribute clean water to the affected communities. 90

According to the East Kalimantan Environmental Status Report 2012 by the East Kalimantan Environmental Agency (BLH Kaltim), flooding increased in Samarinda from 2009 through 2012. Samarinda has become known as the “Flood City” (“Kota Banjir”). There is also a saying highlighting how flood-prone the city has become: “if it rains without flooding, the name of the city cannot be Samarinda” (“kalau hujan tidak banjir, itu bukan Samarinda namanya”). The government report says that (coal) mining contributes to flooding by destroying the water retention capacity through land clearance, and by clogging the waterways and drainage systems through sedimentation.

Academic studies of other rivers regarding the impact of coal pollution on Indonesia’s
rivers, have findings quite similar to government reports. A survey and analysis of water quality was carried out in several rivers to assess the effect of coal mines in the district of Singingi, in Kuantan Singingi Regency, Riau Province. This is an area nationally renowned for its coal mining activity. The results of water quality compared with the Government Regulation No. 82/2001 and refers to the Ministerial Decree No.115/2003 on Guidance of Water Quality Status, laying out a water quality index, show “that Geringging river and Keruh river were heavily polluted. While other tributaries are moderately polluted, these two rivers show high levels of TSS, pH, BOD5, COD, and dissolved oxygen (DO) compared to standards. Coal mining in Kuantan Singingi Regency is open cast mining, a practice that removes the surface land or soil to tap into coal resources…[which] eventually creates acid mine drainage…Open cast mining removes the upper layer of land to another place and creates hills and valley that are deep enough to create small creeks in the surrounding areas, which eventually carry waste to the main river.” 91
Conclusion

Greenpeace’s investigation in South Kalimantan has found that the coal mining sector poses a serious and long-term threat to the province’s water resources.

Hazardous Wastewater from Coal Mining

Samples were collected from ponds associated with mining activities within five coal concessions. In comparison to the national standard for coal waste water discharge, results from the 29 samples analysed showed:

- 22 samples had pH below 6, with lowest pH 2.32.
- 17 samples exceed Manganese limit; 7 samples exceed Iron limit, with the highest concentration up to 40 times the limit.

The investigation uncovered mine discharge above standards in form of, seepage and leakage from settling ponds and abandoned coal mine pits. Some of the storage sites will likely flood during the rainy season, releasing highly toxic mining wastewater into the environment. Satellite image analysis also revealed that some mines placed their tailing ponds in close proximity to waterways, further increasing the risk of chronic seepage of toxic substances, and risk of large wastewater spills.

The coal mining company Arutmin was found to have among the worst results – all wastewater samples showed low pH and levels of metals that is above the regulated limits; samples containing the highest concentration of iron (40 times the limit) and Manganese (10 times the limit) are from Arutmin mines. Combined with on-site observations, the investigation clearly shows Arutmin’s poor management of on-site and offsite environmental effects including failure to prevent the formation of acid mine drainage and subsequent pollution of waterways and failure to prevent erosion of topsoil.

Serious Risk of Acid Mine Drainage (AMD) in the Long-Term

The most serious threat to water resources is the formation of acid mine drainage, which will continue to impact the rivers decades after mine closure and are notoriously difficult and expensive to manage.

In the investigation we have uncovered evidence that shows some of the mines already shows signs of AMD.

Recommendations:

To the government of South Kalimantan, in particular the Provincial Environmental Protection Agency (Badan Lingkungan Hidup Daerah) of South Kalimantan:

And, to the Ministry of Environment of Indonesia:

1. Immediate public investigation of coal mines’ water pollution in South Kalimantan

In light of the findings and the threat to water quality and public health, Greenpeace calls on the Provincial Environmental Protection Agency (Badan Lingkungan Hidup Daerah) of South Kalimantan and the Ministry of Environment
An acid pond (pH 2.34) from Coal Mining activities, right beside the main road used by villagers of Salaman, South Kalimantan.
Coal Mines Polluting South Kalimantan’s Water

Greenpeace Southeast Asia – Indonesia calls on the Ministry of the Environment (MoE) of Indonesia to conduct an immediate and thorough environmental investigation of coal mines operating in South Kalimantan. The investigation should cover on-site and offsite environmental effects including water pollution, wastewater treatment, site selection of mine waste ponds, preservation of topsoil and steps taken to prevent the formation of acid mine drainage. The MoE should publicly release the investigation findings, as well as records of the mandatory environmental audits undertaken by all coal mining companies since 2012.

Under Indonesian laws and regulation, the Ministry of the Environment holds responsibility for environmental policy and its implementation is conducted by BAPEDEL, the provincial environmental offices. According to the environmental license (Government Regulation 27/2012) companies are required to conduct mandatory environmental audits periodically, and if a company fails to carry out an environmental audit, the Minister for the Environment is authorised to carry out or appoint a third party to undertake the audit. The regulation also sets out that, “if the environmental license is revoked, the relevant business and or activities permits, which allow the business to operate, will also be revoked.”

Greenpeace calls on the MoE to publish the environmental audits of all coal mining companies since 2012 (when the regulations came into force) and reveal if any regulatory actions have been taken where violations were found. Local and or Central Government must revoke mining permits of violators.

2. Ensure strong environmental accountability in the mining licenses allocation process

Greenpeace recommends that the mine license allocation process includes a much stronger consideration of company track records on environmental performance, to strengthen environmental accountability of the process and penalise companies that are repeat offenders.

To protect the water quality and public health, the following need to be assessed as part of the licensing process and audit, with clear conditions:

- Licensing agency should assess the proximity to conservation forests and headwaters. The siting of mine wastewater ponds: a wide buffer zone from rivers must be set in order to reduce flooding and spilling risks.
The conditions should be that there is no overlap between mine development and conservation zone, no mining in headwater regions and all possible efforts to avoid any releases from wastewater ponds, including through siting, design (e.g. lining), maintenance, monitoring and restriction of access to such ponds.

• Licenses of coal concessions overlapping with conservation forests must be revoked.

3. Security fund for long term AMD management and liability

GR 27/2012 also mandates the environmental license holder to set aside funds (an environmental bond) that will be used for environmental rehabilitation and recovery. Greenpeace calls for the MoE to disclose details of the security fund set up for South Kalimantan, and whether this is set at the sufficient rate to prevent long-term public liability from acid mine drainage after mine closure.

4. Greater transparency and public information

The Provincial Environmental Protection Agency (Badan Lingkungan Hidup Daerah) of South Kalimantan and the Ministry of Environment of Indonesia to publish water discharge violations on a regular basis. This helps investors, central government mining permitting body and NGOs to track company performance and provides a strong incentive for companies to improve their practice. This should be published on a regular basis.

The Provincial Environmental Protection Agency (Badan Lingkungan Hidup Daerah) of South Kalimantan and the Ministry of Environment of Indonesia to make river quality reports publicly available – the Greenpeace investigation could only source the report after making several personal visits to the MoE and the local EPA; and only the most recent year is available.

The new government of Indonesia can and must do better in terms of monitoring, enforcing the existing laws, holding polluters accountable, and protecting its people and environment.

Greenpeace looks forward to working with the Central and South Kalimantan governments to seriously tackle these problems and find real solutions.
Appendix 1


3 Greenpeace International, Point of No Return: The massive climate threats we must avoid, p.45. http://www.greenpeace.org/international/point-of-no-return/

4 Ibid.


7 Lucarelli B. (2010).

8 Tempo magazine, 14 June, 2010, ‘Pengar Mafya Emas Hitam (Mafia Wars; Black Gold).’ (subscription).


16 “Indonesian coal” Donald L. Ewart, Jr., and Robert Vaughn, Marstonne & Marstonne Inc. US, review the Indonesian thermal coal industry. Reprinted from May 2009 World Coal Asia Special. www.WorldCoal.com

17 Lutfi Fatah (2008): The “majority of the large-scale coal industries operated with a permit called the Coal Mining Exploration Project Agreement (CMPEA), which is in Indonesian is called a PKP2B (Perjanjian Karya Pengusahaan Pertambangan Batubara) permit. The small-scale coal industries included small firms as well as individuals and cooperatives. These operated with Mining Authorization (MA) permits, which in Indonesia are called KP (Kuasa Pertambangan) permits.”

18 2013 map of South Kalimantan Coal Concessions from the Indonesian Coal Association issued by Petromindo – on file with Greenpeace

19 The World Energy Council declared in 2011 that Indonesia’s coal reserves were over 5.5 billion tonnes, or 0.6% of the world’s total coal reserves. [See, ICRA Indonesia Rating Feature September 2012. Rating Methodology for Coal Mining Companies” Overview] The figures for 2011 are a substantial increase from the 2010 BP Statistical Energy Survey, which found that in 2009, Indonesia had “coal reserves of 4.328 million tonnes, 0.2% of the world total [and] coal production of 252.47 million tonnes, 4.55% of the world total.” [See, Sourcewatch, Coal Mining in Indonesia - Overview, “Indonesia and coal”. http://www.sourcewatch.org/index.php/Indonesia_and_coal]

20 Zacks investment research has estimated that over 90% of the estimated coal demand growth in Asia, which is 3.5 billion metric tonnes, is expected to come from Indonesia over the next 20 years: Zacks Investment Research, “Peabody’s New Coal Backup,” 21 December 2010. http://www.zacks.com/stock/news/44950/peabody-s-new-coal-backup


Ghirmw M. Naja and Bohumir Volesky, 2009. Toxicity and Sources of Pb, Cd, Hg, Cr, As, and Radionuclides in the Acid Mine Drainage, p.35: http://biosorption.mcgill.ca/publication/HandB-Ch2.pdf


Ibid.


Department of Water and Sanitation of South Africa, briefing to the National Assembly Committee on Water and Sanitation on Acid Mine Drainage (AMD) and its implications to ground water, rivers and dams, 5 November, 2014. Summary of the hearing and the briefing papers can be accessed at: http://www.pm.org.za/node/48027


Ibid.


M. Sonny Abertiaiwan, Rudy Sayoga Gautama, Ginting Jalu Kusuma, Arief Wedhartono, Firman Gunawan, “The Challenges in Acid Mine Drainage Management in Lati Coal Mine Operation, East Kalimantan” (authors based at PT Berau Coal, and the Indonesia and Department of Mining Engineering, Faculty of Mining and Petroleum Engineering, Institut Teknologi, Bandung, Indonesia) http://www.academia.edu/6968715/The_Challenges_in_Acid_Mine_Drainage_Management_in_Lati_Coal Mine_Operation_East_Kalimantan


Coal Mines Polluting South Kalimantan’s Water

42 Impacts of pH on fish species were extracted from the US EPA Acid Rain study, other chemical components of acid rain were excluded. United States Environmental Protection Agency, “Effects of Acid Rain - Surface Waters and Aquatic Animals” website.  
http://www.epa.gov/acidrain/effects/surface_water.html

43 Ibid.
44 Ibid.
48 Ahmad, H. Iskandar & Kurniawati, N. 2012. Addition of Probiotic in Commercial Feed to Growth of Sangkuriang Catfish (Clarias gariepinus) on Nursery II. University of Padjadjaran, Indonesia. Jurnal Perikanan dan Kelaatan Vol. 3 No. 4. Refering to Indonesian SNI.
Coal Mines Polluting South Kalimantan’s Water


69 Characteristic post mining land has lost its rich topsoil, limiting re-vegetation options. Sengon (Paraserianthes falcatoria) and Acacia (Acacia mangium), are typically used in post-coal mining reclamation plantations in the region. They are chosen due to their resilience. [Environment Protection Agency (Badan Lingkungan Hidup Daerah) South Kalimantan Province. Annual Report: Regional Environment Status South Kalimantan Province 2013.] They can live in various types of land, including dry land with minimal nutrients, with good or bad drainage and even land with salinity problems [Arista TH, B. 2012. Carbon prediction in Acacia mangium and Paraserianthes falcatoria in post reclamation area of PT Arutmin Batulicin Kalimantan Selatan. Original title: Pendugaan kandungan karbon pada tegakan Akasia (Acacia mangium) dan tegakan Sengon (Paraserianthes falcatoria) di lahan reclamation pasca tambang batubara PT Arutmin Batulicin Kalimantan Selatan. Thesis, Bogor Institute of Agriculture, Indonesia]. However, Acacia is also associated with allelopathy that inhibits other plants from growing. [Nourni, Z. & Chaeib, M. 2011. Allelopathic Effects of Acacia Tortills (Forssk.). Hayne subsp. Raddiana (Savi) Brenan in North Africa. Pak. J. Bot., 43(6): 2801-2805.]


71 Setiawan, D. 2004. The change of soil characteristics at coal mine reclamation area which is revegetated in one, two, three and four years with Sengon and Acacia Plant. (Original title: Penubahan karakter tanah pada kawasan reklamasi bekas tambang batubara yang ditevegatasi selama satu, dua, tiga dan empat tahun dengan sengon dan akasia. Thesis. Bogor Institute of Agriculture.

72 Ibid


76 Indonesia Ministry of Environment (MenLH). 2003. Decrease No. 113 on Wastewater Quality Limit for Coal Mining Activities (Baku Mutu Limbah Bagi Usaha dan atau Kegiatan Pertambangan Batu Bara).

77 Ibid

78 The monthly limits in the U.S. are more stringent than the Indonesian limits.Cornell University Legal Information Institute, “40 CFR 434.35 - New source performance standards (NSPS),” http://www.law.cornell.edu/clr/text/40/434.35:


81 Setiawan, D. 2004. The Change of soil characteristics at coal mine reclamation area which is revegetated in one, two, three and four years with Sengon and Acacia Plant. (Original title: Penubahan karakter tanah pada kawasan reklamasi bekas tambang batubara yang ditevegatasi selama satu, dua, tiga dan empat tahun dengan sengon dan akasia. Thesis. Bogor Institute of Agriculture.


84 The Indonesian Coal Mining Association, Indonesian Coal Book 2012/2013, June 2012.


86 The Indonesian Coal Mining Association Report... Indonesian Coal Book 2012/2013, June 2012. Tanjung Alam Jaya entry showing that the concession will end in 2013-2014, page 427.

87 Environment Protection Agency (Badan Lingkungan Hidup Daerah or BLDH) for South Kalimantan Province, ‘Annual Report: Regional Environment Status South Kalimantan Province 2013.


89 BLH (Badan Lingkungan Hidup) East Kalimantan Environmental Status Report 2009
BLH (Badan Lingkungan Hidup) East Kalimantan Environmental Status Report 2010
BLH (Badan Lingkungan Hidup) East Kalimantan Environmental Status Report 2011
BLH (Badan Lingkungan Hidup) East Kalimantan Environmental Status Report 2012

90 “DPRD: KPC bertanggung jawab atas pencemaran Sungai Sangatta” (Parliament holds KPC responsible for pollution of the River Sengata) 18 March 2013. http://www.antaranews.com/berita/3693941/dprd-kpc-tanggung-jawab-atas-pencemaran-sungai-sangatta (According to this article, the Chairman of Commission III DPRD in East Kutai in East Kalimantan, member of parliament Kasmidi Bulang, asserted that PT Kaltim Prima Coal (KPC) was responsible for the pollution and damage to the Sengata River as a result of coal mine waste disposal into the river. Moreover, local legislator Palinggi Piter said that KPC must take responsibility for the waste stream flowing from the coal mine into the Sengata River and flowing into residential areas; and added that KPC should be responsible for cleanup operations. Officials reported having taken water samples at different points, and documenting varying levels of turbidity and quality, with a testing laboratory in Samarinda revealing very high turbidity, i.e. above 200 NTU.)


APPENDIX 1

Metals in Coal Mining & Processing Wastewaters from Indonesia, September 2014

Kevin Brigden, David Santillo & Paul Johnston
Greenpeace Research Laboratories Analytical Report 04-2014

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1. Introduction

29 samples of surface water or wastewater were received from Greenpeace Indonesia for analysis at the Greenpeace Research Laboratories in two separate batches, the first on the 29th July 2014 and the second on 21st August 2014. According to documentation supplied, all samples were collected from locations associated with coal mining activities, with the first set collected between 19th - 23rd July 2014, and the second set collected between 11th - 14th August 2014. The samples were composed of 27 wastewater samples, one sample of water from a creek (IND14008) and one sample from a pond (IND14020). Details of the samples received are provided in Table 1a (description) and Table 1b (GPS locations). All samples were analysed quantitatively for the presence of a range of metals. Concentrations of metals in both whole and filtered water were determined in order to distinguish between metals associated with suspended matter and those present in dissolved form in the water.

### TABLE 1A: DETAILS OF SAMPLES RECEIVED AND ANALYSED AT THE GREENPEACE RESEARCH LABORATORIES

<table>
<thead>
<tr>
<th>Sample Code</th>
<th>Company/District</th>
<th>Date (dd/mm/yy) ; Time</th>
<th>Sample Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IDN14001</td>
<td>Tanjung Alam Jaya/ Banjar</td>
<td>19/07/2014; 10.27</td>
<td>Wastewater</td>
<td>Collected from a small pond, an outfall ± 258 m downstream from a pit mine and ±370 m upstream from Mangkaek river, a tributary to Martapura river.</td>
</tr>
<tr>
<td>IDN14002</td>
<td>Tanjung Alam Jaya/ Banjar</td>
<td>19/07/2014; 11.05</td>
<td>Wastewater</td>
<td>Collected from an abandoned pit mine. Pit mine is ±628 m from Mangkaek river.</td>
</tr>
<tr>
<td>IDN14003</td>
<td>Tanjung Alam Jaya/ Banjar</td>
<td>19/07/2014; 10.27</td>
<td>Wastewater</td>
<td>Collected from an abandoned pit surrounded by plantation. The pit is ± 310 m from Mangkaek river.</td>
</tr>
<tr>
<td>IDN14004</td>
<td>Tanjung Alam Jaya/ Banjar</td>
<td>19/07/2014; 11.05</td>
<td>Wastewater</td>
<td>Collected from a leak at a land wall of an acid abandoned pit mine, the leak flows into a small creek, ± 478 m from Mangkaek river.</td>
</tr>
<tr>
<td>IDN14005</td>
<td>Tapin District</td>
<td>20/07/2014; 10.24</td>
<td>Wastewater</td>
<td>Collected from the discharge of a mine water treatment pond. Discharge from this pond can overflow to the irrigation channel, in parallel with Tapin river.</td>
</tr>
<tr>
<td>IDN14006</td>
<td>Tapin District</td>
<td>20/07/2014; 13.04</td>
<td>Wastewater</td>
<td>Collected from a leach from the edge of a mine waste pond.</td>
</tr>
<tr>
<td>IDN14007</td>
<td>Tapin District</td>
<td>20/07/2014; 17.07</td>
<td>Wastewater</td>
<td>Collected from a leach from the edge of a mine waste pond.</td>
</tr>
<tr>
<td>IDN14008</td>
<td>Baramarta/ Banjar</td>
<td>21/07/2014; 10.56</td>
<td>Creek water</td>
<td>Collected from a small creek, ±0.05 km upstream from Riamikawa river.</td>
</tr>
<tr>
<td>IDN14009</td>
<td>Baramarta/ Banjar</td>
<td>21/07/2014; 12.20</td>
<td>Wastewater</td>
<td>Collected from a mining wastewater treatment pond. The water flows to the direction of Riamikawa river.</td>
</tr>
<tr>
<td>IDN14010</td>
<td>Baramarta/ Banjar</td>
<td>21/07/2014; 13.04</td>
<td>Wastewater</td>
<td>Collected from a pond with wastewater being pumped out of a pit mine, water flows to the direction of Riamikawa river.</td>
</tr>
<tr>
<td>IDN14011</td>
<td>Baramarta/ Banjar</td>
<td>21/07/2014; 16.20</td>
<td>Wastewater</td>
<td>Collected from a leak at a mine waste treatment pond. Water flows in the direction of a swamp located ± 1.4 km from the Riamikawa river.</td>
</tr>
<tr>
<td>IDN14012</td>
<td>Kadja Caraka Mula/ Banjar</td>
<td>21/07/2014; 18.00</td>
<td>Wastewater</td>
<td>Collected from an abandoned pit mine beside a main road, with sandy fields on the other side of the road.</td>
</tr>
<tr>
<td>IDN14013</td>
<td>Arutmin/Asam-asam</td>
<td>22/07/2014; 11.18</td>
<td>Wastewater</td>
<td>Collected from the edge of a mine wastewater pond from which water flows to a swamp. A river is located nearby (± 0.78 km) which is a tributary to Asam-asam river (± 4.7 km).</td>
</tr>
<tr>
<td>IDN14014</td>
<td>Jonong Barutama Greston/ Tanah Laut</td>
<td>22/07/2014; 12.14</td>
<td>Wastewater</td>
<td>Collected from a mining wastewater pond, adjacent to a villages road (Besa Salaman), the pit leaks to a nearby creek (IND14019) which connects to Asam-asam River (± 7.6 km).</td>
</tr>
<tr>
<td>IDN14015</td>
<td>Arutmin/Asam-asam/ Tanah Laut</td>
<td>23/07/2014; 13.09</td>
<td>Wastewater</td>
<td>Collected from the edge/an opening at a mining wastewater pond, adjacent to a villages road (Besa Salaman).</td>
</tr>
<tr>
<td>IDN14016</td>
<td>Arutmin/Asam-asam/ Tanah Laut</td>
<td>11/08/2014; 11.55</td>
<td>Wastewater</td>
<td>Collected from a mining wastewater pond. The water flows to a swamp, towards a nearby river (± 0.15 km). A tributary to Asam-asam river (± 4.7 km).</td>
</tr>
<tr>
<td>IDN14017</td>
<td>Arutmin/Asam-asam/ Tanah Laut</td>
<td>11/08/2014; 12.38</td>
<td>Wastewater</td>
<td>Collected from a mining wastewater pond. The set of ponds are at a higher position than an adjacent swamp, separated by a high pile of land.</td>
</tr>
<tr>
<td>IDN14018</td>
<td>Arutmin/Asam-asam/Tanah Laut</td>
<td>11/08/2014; 13.27</td>
<td>Wastewater</td>
<td>Collected from the edge/an opening of a mine wastewater pond which discharges waste water to an adjacent swamp, towards Asam-asam river (± 5.44 km).</td>
</tr>
<tr>
<td>IDN14019</td>
<td>Jonong Barutama Greston/ Tanah Laut</td>
<td>11/08/2014; 14.50</td>
<td>Wastewater</td>
<td>Collected from a leak of a mine wastewater pond which flows to a small creek, a tributary to Asam-asam River (7.6 km).</td>
</tr>
<tr>
<td>IDN14020</td>
<td>Tanah Laut District</td>
<td>11/08/2014; 15.32</td>
<td>Pond water</td>
<td>Collected from a leak at a land wall of an acid abandoned pit mine, the leak flows into a small pond, an outfall ± 258 m downstream from a pit mine and ±370 m upstream from Mangkaek river, a tributary to Martapura river.</td>
</tr>
<tr>
<td>IDN14021</td>
<td>Jonong Barutama Greston/ Tanah Laut</td>
<td>11/08/2014; 18.37</td>
<td>Wastewater</td>
<td>Collected from a mining wastewater pond. This pond is part of a cluster of ponds, ±1-2 km from a nearby creek, a tributary to Asam-asam River (± 7.6 km).</td>
</tr>
<tr>
<td>IDN14022</td>
<td>Asutmin/ Batulicin</td>
<td>13/08/2014; 16.51</td>
<td>Wastewater</td>
<td>Collected from the edge of a mine wastewater pond that flows to a swamp, in the direction of a nearby creek (± 0.95 km), a tributary to Batulicin River (± 14 km).</td>
</tr>
<tr>
<td>IDN14023</td>
<td>Asutmin/ Batulicin</td>
<td>13/08/2014; 16.51</td>
<td>Wastewater</td>
<td>Collected from the edge of a mine wastewater pond that flows to a swamp, in the direction of a nearby creek (± 0.95 km) a tributary to Batulicin River (± 14 km).</td>
</tr>
<tr>
<td>IDN14024</td>
<td>Jonong Barutama Greston/ Tanah Laut</td>
<td>14/08/2014; 10.40</td>
<td>Wastewater</td>
<td>Collected from an abandoned pit within a concession area which is generally barren.</td>
</tr>
<tr>
<td>IDN14025</td>
<td>Jonong Barutama Greston/ Tanah Laut</td>
<td>14/08/2014; 11.18</td>
<td>Wastewater</td>
<td>Collected from a mine wastewater pond which flows to the surrounding area.</td>
</tr>
<tr>
<td>IDN14026</td>
<td>Jonong Barutama Greston/ Tanah Laut</td>
<td>14/08/2014; 11.57</td>
<td>Wastewater</td>
<td>Collected from a very large abandoned pit ± 2 km in length.</td>
</tr>
<tr>
<td>IDN14027</td>
<td>Jonong Barutama Greston/ Tanah Laut</td>
<td>14/08/2014; 12.24</td>
<td>Wastewater</td>
<td>Collected from an abandoned pit.</td>
</tr>
<tr>
<td>IDN14028</td>
<td>Jonong Barutama Greston/ Tanah Laut</td>
<td>14/08/2014; 14.13</td>
<td>Wastewater</td>
<td>Collected from a mine wastewater treatment pond. After treatment, the water flows to a swamp area.</td>
</tr>
<tr>
<td>IDN14029</td>
<td>Arutmin/Asam-asam/Tanah Laut</td>
<td>14/08/2014; 16.46</td>
<td>Wastewater</td>
<td>Collected from the edge/an opening of a mine waste pond with leaks which flow to a lower plantation.</td>
</tr>
</tbody>
</table>

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2. Materials and Methods

All samples were collected in pre-cleaned glass, screw-capped bottles and kept cold and dark before shipment to our laboratory in the UK for analysis. Samples were analysed quantitatively for metals. The pH of each wastewater was measured both in the field using a number of calibrated hand-held devices for cross-checking and also upon receipt of the samples at the laboratory.

Metal concentrations were determined for all samples by ICP atomic emission spectrometry (AES) following acid digestion and using appropriate intra-laboratory standards. Both the total concentrations in the whole (unfiltered) sample and the concentrations of dissolved forms in a filtered sample were determined separately for each sample. More detailed descriptions of the sample preparation and analytical procedures, including pH measurements, are presented in the Appendix 1. a.

3. Results and Discussion

The concentrations of metals and metalloids in filtered (dissolved metals) and in whole waters (dissolved and suspended metals) are reported in Table 2, together with pH measurements recorded in the field. The pH measurements from the field were in close correlation with pH measurements of samples received at the laboratory.
**Table 2: Concentrations of Metals and Metalloids (µg/L) in Whole and Filtered Samples of Wastewater (WW), Water from a Creek or from a Pond. *Limits for Wastewaters Generated by Coal Mining Activities (MOE 2003)*

<table>
<thead>
<tr>
<th>Sample Code</th>
<th>Type</th>
<th>pH Value</th>
<th>Aluminium (Al)</th>
<th>Arsenic (As)</th>
<th>Cadmium (Cd)</th>
<th>Chromium (Cr)</th>
<th>Copper (Cu)</th>
<th>Lead (Pb)</th>
<th>Mercury (Hg)</th>
<th>Nickel (Ni)</th>
<th>Selenium (Se)</th>
<th>Vanadium (V)</th>
<th>Zinc (Zn)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EN1401</td>
<td>WW</td>
<td>&lt;50</td>
<td>&lt;100</td>
<td>&lt;10</td>
<td>&lt;10</td>
<td>&lt;10</td>
<td>&lt;10</td>
<td>&lt;10</td>
<td>&lt;20</td>
<td>&lt;50</td>
<td>&gt;50</td>
<td>&lt;50</td>
<td>&lt;50</td>
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Limit* 6-9

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Nickel (Ni) 797 211 698 12500 16500 28000 6490 12500 27000 713 32 1790 35000 35000
Selenium (Se) 283 40 698 12500 16500 28000 6490 12500 27000 713 32 1790 35000 35000
Vanadium (V) 268 40 698 12500 16500 28000 6490 12500 27000 713 32 1790 35000 35000
Zinc (Zn) 94 53 56 90 5280 5280 5280 5280 5280 5280 5280 5280 5280 5280

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Coal Mines Polluting South Kalimantan’s Water
For the majority of samples, the metal concentrations in the filtered sample were very similar to those in the whole (unfiltered) sample, indicating that these metals were present in these samples almost exclusively in dissolved forms rather than bound to suspended particles within the water.

The exceptions, for which the whole (unfiltered) sample contained a notably higher concentration of one or more metal compared to the equivalent filtered sample, were predominantly those samples of wastewater (IND14001, IND14005, IND14009, IND14010, IND14011), creek water (IND14008) and pond water (IND14020) which had pH above 6.

Wastewaters generated by coal mining activities are subject to regulation in Indonesia which sets maximum permissible limits for certain parameters, including iron (7 mg/l = 7000 μg/l), manganese (4 mg/l = 4000 μg/l) and pH (between 6-9) (MOE 2003)¹.

Wastewaters from many of the locations sampled in this study did not comply with these regulations at the time of sampling, either due to elevated concentrations of manganese and iron, or due to high acidity (pH below 6).

For 22 of the 29 samples (76 %), all of which were wastewater samples, the pH was below 6. In the case of these 22 samples, pH values ranged from pH 4.66 (IND14007) to pH 2.32 (IND14029), with 7 samples having a pH below 3.

The concentrations of manganese exceeded the permissible limit for 17 of the 27 wastewater samples (63 %), in both the filtered and whole sample in all cases, with concentrations in the whole sample ranging from 5350 μg/l (5.35 mg/l) to 40 200 μg/l (40.2 mg/l). The highest concentration, in sample IND14029, exceeded the limit by 10 times. For all but one (IND14001) of these 17 samples, the pH was also outside the allowed range (pH 6-9), and the highest manganese concentration (40.2 mg/l) was found in sample IND14029, which had the lowest pH (2.32).

Of these 17 samples, 7 also had concentrations of iron that exceeded the maximum permissible level, with similar levels in both the filtered and whole sample in all cases. Concentrations of total iron in whole samples were in the range 9740 μg/l (9.74 mg/l) to 280 000 μg/l (280 mg/l), with the highest concentration exceeding the limit by 40 times. The highest iron concentration was also found in a sample with one of the lowest pH values (IND14015, pH 2.34). These findings are consistent with the high acidity of many samples solubilising iron and manganese from minerals in the local environment.

The creek water (IND14008) also had a concentration of iron in the whole sample which exceeded the limit for wastewaters (12 200 μg/l, or 12.2 mg/l), though the concentration in the filtered sample was far lower (below detection limit of 20 μg/l), indicating that iron in this sample was predominantly present in forms bound to suspended particles within the water rather than in dissolved form.

No maximum permissible concentrations are set for other metals within such wastewaters. However, it is noteworthy that a number of other metals were present at relatively high concentrations in many samples, considerably above concentrations typically found in uncontaminated surface waters, especially aluminium (up to 184 000 μg/l, or 184 mg/l), and also nickel (up to 1690 μg/l, IND14017), zinc (up to 3880 μg/l, IND14015) and copper (up to 1890 μg/l, IND14017).

Three samples (IND14015, IND14017 and IND14029) had notably higher concentrations of aluminium (94 700-184 000 μg/l, or 94.7-184 mg/l), nickel (1360-1690 μg/l), zinc (3210-3880 μg/l) and copper (100-1890 μg/l) compared to other wastewaters. Two of these samples (IND14015 & IND14029) had the lowest pH of all wastewater samples and also contained the highest concentration of either iron (IND14015) or manganese (IND14029). To a lesser extent, concentrations of chromium, cobalt, mercury and vanadium were elevated in some wastewater samples, particularly for IND14015 and IND14017. These additional metals may also be present in the samples at elevated concentrations as a result of having been solubilised from minerals in the local environment.

Overall, the data indicate a strong link between high acidity (low pH) in wastewaters (particularly for those below pH 4) and elevated concentrations of metals (especially iron, manganese and aluminium), predominantly in soluble forms (see Figure 1 below). The data also indicate that there is commonly a link between high concentrations of iron and/or manganese in wastewaters and higher concentrations of other metals.

The relevant regulation set parameters only for pH, two metals (iron and manganese), and total dissolved solids. There may be other locations equivalent to those investigated in this study for which data are available for wastewaters from coal mining from other studies which are limited to these four parameters. The data from this study indicate that it is likely that wastewaters at other equivalent locations with low pH may also have high concentrations of metals, particularly iron and manganese, and also that high concentrations of iron and manganese in wastewaters may also indicate high concentrations of other metals.

Coal Mines Polluting South Kalimantan’s Water

Appendix 1.a:
Details of methodologies

Preparation
To obtain total metal concentrations, a representative portion of each whole water sample was acidified by the addition of concentrated nitric acid to give a final concentration of 10% v/v. Separately, a portion of each whole sample was filtered through a 0.45 micron filter and then acidified in the same way to enable determination of dissolved metal concentrations. 50 ml of each acidified sample was digested firstly overnight at room temperature, then using microwave-assisted digestion with a CEM MARS Xpress system, with a temperature ramp to 180ºC over 15 minutes followed by holding at 180ºC for a further 15 minutes. Cooled digests were filtered and made up to 50 ml with deionised water.

Analysis
Prepared sample digests were analysed by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES) using a Varian MPX Simultaneous Spectrometer. Multi-element standards at concentrations of 0.5, 1.0, 2.5 and 5.0 mg/l respectively, and matrix matched to the samples, were used for instrument calibration. Any sample exceeding the calibration range was diluted accordingly, in duplicate, and re-analysed. Analysis of the arsenic, mercury and selenium content in the samples was carried out separately using cold vapour generation ICP-AES through reaction of the sample with sodium borohydride (0.6% w/v), sodium hydroxide (0.5% w/v) and hydrochloric acid (10 molar) with the resulting vapour carried in a stream of argon into the spectrometer. Two calibration standards were prepared, at 10 μg/l and 100 μg/l (mercury) and at 100 μg/l and 500 μg/l (arsenic & selenium), matrix matched to the samples.

Quality Control
Three samples were prepared for ICP analysis in duplicate and analysed to verify method reproducibility, along with a blank sample (10% v/v nitric acid in deionised water), and two mixed metal quality control solutions (4 mg/l and 0.4 mg/l for each metal respectively, other than mercury at 0.8 mg/l and 0.2 mg/l). All control samples were prepared in an identical manor to the samples.

Calibration of the ICP-AES was validated by the use of quality control standards at 4 mg/l and 0.4 mg/l prepared in an identical manner but from different reagent stocks to the instrument calibration standards. For cold vapour generation arsenic, mercury and selenium analysis, the calibration was validated using quality control standard at 80 μg/l (mercury) and 400 μg/l (arsenic and selenium), prepared internally from different reagent stock.

pH Measurement
The pH of each water sample was determined in the field at the time of sample collection. In addition, the pH of each wastewater was measured upon receipt of the samples at the laboratory. In both cases the measurement was recorded using a Hanna Instruments HI98129 pH meter calibrated using pH 4.01 and pH 7.01 Hanna buffer solutions, rinsing well with deionised water between samples.
Cover Photo:
© greenpeace/Yudhi Mahatma
Acid pond left by coal mining activities, Asam-Asam,
South Kalimantan

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