position paper

Sustainable Mining:
Case Study for Bauxite Mining in Pahang

bauxite

Position Paper on Sustainable Mining:
Case Study for Bauxite Mining in Pahang

ASM Task Force on Sustainable Mining

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Foreword

With the increasing demand for raw materials from a thriving global manufacturing sector, the mining industry is seeing a revival from its sunset days. However, this is not without several transformations as we see shifts towards creating a more sustainable industry. It is predicted that the future mining industry leaders in 20 – 30 years' time will be those who take action now to drive sustainable growth especially in view of these non-renewable resources and consumer demand for a more balanced economic, social and environmental impact.

Hence, in carrying out its mandate as a "Thought Leader" for matters related to science, engineering, technology and innovation, the Academy of Sciences Malaysia (ASM) has always endeavoured to address the nation's deepest concerns. ASM viewed seriously the sudden surge in bauxite mining occurring in the state of Pahang since 2015 and its negative impacts towards the environment and the Rakyat's well-being. As a result, the ASM Task Force on Sustainable Mining was established to highlight the importance of ensuring mining activities are conducted in a sustainable manner and provide recommendations for such sustainable practices.

Minerals could be a potential source of wealth creation for resource-rich nations, and mining is still the primary method of extraction. As for Malaysia, the mining sector has a huge potential to generate income and create employment with the mining and quarrying sector contributing to 8.8% of our GDP in 2016. Unless properly managed, mining activities could lead to environmental degradation adversely affecting societal well-being. The Second Mineral Policy (NMP2), introduced in 2009, places strong emphasis on environmental stewardship to ensure that the nation's mining sector is developed in an environmentally sound, responsible and sustainable manner.

This Position Paper reflects the convergence of ideas and inputs obtained through stakeholder consultations involving policy makers, academia, industry, and community. The publication of this Position Paper by ASM provides independent, evidence-based input for policy making and promotes the innovative use of Science and Technology (S&T) to solve national problems in the context of sustainable development. This is in support of Malaysia's commitment towards achieving the United Nations 17 Sustainable Development Goals (SDGs) for 2015-2030 and the United Nations Development Programme in encouraging sustainable practices in the mining industry by incorporating the relevant UN SDGs.

I would like to congratulate the Task Force for producing this Position Paper, aptly entitled Sustainable Mining: Case Study for Bauxite Mining in Pahang. This effort would not have been possible without the strong support and co-operation from the Task Force, co-chaired by Professor Dato' Dr Azizan Abu Samah FASc and Academician Datuk Fateh Chand FASc. I hope the highlighted issues and recommended action plans in this Position Paper would benefit policy makers, state governments as well as industry players to harness science, technology and innovation towards sustainable solutions for the mining industry.

Professor Datuk Dr Asma Ismail FASc
President
Academy of Sciences Malaysia

Preface

In 2014, the Indonesian government imposed a ban on unprocessed mineral ore exports which resulted in a shortage of bauxite supply especially in China. Benefitting from this situation, local bauxite producers increased their production by 20 times to fill in this gap for the high demand of bauxite in the global market. This heightened activity was observed in Kuantan, Pahang where the sudden and unregulated mining activity adversely affected the local communities and the environment particularly the air, river and marine quality resulting in an environmental disaster highlighted by red rivers and red sea along beaches and Kuantan port. Road safety and human health became a major issue and a moratorium on mining and export of bauxite was imposed to mitigate the environmental damage caused.

In view of this, the objectives of this position paper are to highlight issues as well as propose measures to remediate and mitigate problems arising from regulated and unregulated mining activities. This paper also advocates for more sustainable and environment friendly methods to be adopted for mineral mining, especially for bauxite.

This position paper comprises literature research along with information derived from several resourcing and advocacy activities such as a forum on sustainable mining, presentation and submission of a proposal paper to the Environment Quality Council (EQC) and several site visits. It is also a culmination of ideas from a series of meetings among the members of the ASM Task Force on Sustainable Mining. In addition, this will be a useful resource in assisting the government and private mining companies to mine and regulate mining activities in a sustainable manner.

Finally, we are grateful to all the Task Force members for providing views and ideas, all of which helped to develop a deeper understanding of the challenges and the potential action plan expressed in this position paper. It is hoped that this report will serve as a useful reference for sustainable mining in Malaysia.

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Acknowledgement

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List of Acrynoym

ASM - Academy of Sciences Malaysia
DMG - Department of Minerals and Geoscience
DOE - Department of Environment
EIA - Environmental Impact Assessment
EMP - Environmental Management Plan
ESCP - Erosion and Sediment Control Plan
IAI - International Aluminium Institute
JMG - Jabatan Mineral dan Geosains
NLC - National Land Code
NMC - National Mineral Council
NMP2 - National Mineral Policy 2
NRE - Ministry of Natural Resources and Environment
PTG - Pejabat Tanah dan Galian
SME - State Mineral Enactment
SPAD - Land Public Transport Commission
UMP - Universiti Malaysia Pahang
UNU-IIGH - UNU International Institute for Global Health
UTM - Universiti Teknologi Malaysia

Executive Summary

Introduction

Bauxite mining in Kuantan, Pahang started in early 2013 with small-scale mining in Balok and later expanded to Bukit Goh, Bukit Sagu and Sungai Karang. The rapid expansion, from 343,000 tonnes to 3.72 million tonnes from January to September 2015, coupled with uncontrolled and unsustainable legal and illegal mining activities has resulted in an environmental disaster. Government through the Ministry of Natural Resources and Environment first imposed a three-month moratorium on all bauxite mining activities in Pahang on 15 January 2016. However, the moratorium has been extended several times with the current period ending on 31 December 2017 (as of June 2017).

1. Objectives

a. To highlight the issues related to bauxite excavation/mining in Kuantan, Pahang;

b. To propose measures to remediate and mitigate the problems arising from bauxite excavation/ mining in Kuantan, Pahang; and

c. To propose sustainable and environmental friendly methods for bauxite excavation/mining activities for the future.

2. Issues and consequences of unregulated bauxite excavation/mining in Kuantan

a. Loophole in governance – Bulk of the mining activities were not conducted under the State Mineral Enactment (SME) but under the National Land Code (NLC). The SME has stringent conditions for exploration, mining, environment impact assessment, common mine rehabilitation fund, mine rehabilitation plan, royalty on minerals mined etc. Many of these safe guards are not found in the NLC.

b. Environmental Impact – Little or no consideration was given to managing the environment. This resulted in health issues (respiratory and skin rash problems), pollution of rivers, coastal beaches and port waters, elevated noise levels, damage to roads, excessive sediment erosion and a dusty environment.

c. Road Safety - There have been road accidents, including fatal ones, involving lorries.

d. River and Marine Water Quality - Besides polluting the Sungai Kuantan basin which is also a source for drinking water, unregulated bauxite mining can precipitate out heavy metals and other pollutants which can affect the health of the residents.

e. Aquatic Ecosystem – Unregulated mining has damaged the ecosystem. A high level of sediment can choke fishes by clogging their gills, bury invertebrates, and prevent photosynthesis.

f. Human Health Impact - Unregulated mining activities in Kuantan have resulted in severe health impact to the surrounding residents. Long term health impact can be expected due to dust and the presence of toxic heavy metals.

g. Respiratory Health – Generated dust is hazardous to the human respiratory system and measurements of dust levels show it is above the ambient level during mining.

h. Contamination of Human Food Chain - The heavy metal from bauxite mining may be taken up by aquatic organism that forms part of the human food chain.

Executive Summary

3. Remedial Action Plan

a. Regulation – Bauxite mining activities should be regulated under the State Mineral Enactment.

b. Clearance of the existing stockpile – Must be conducted with procedure based on best practices.

c. Effective Pollution, Erosion and Sediment Control - Effective control should be set up.

d. Environmental Monitoring - Monitoring should be conducted on a regular basis encompassing water and air quality and noise levels.

e. Transportation - Steps to be taken to ensure that lorries are relatively clean and in line with best practices or the SPAD guidelines.

f. Stockpiling – Set up a centralised stockpile yard with in-built environmental safe guards.

g. Community Awareness & Engagement – Local NGOs should be invited to assist in giving all stakeholders more exposure regarding issues on bauxite mining.

h. Rehabilitation strategy - A Mine Rehabilitation Plan should be thoroughly strategised.

4. Sustainable Mining for the Future

a. Royalty on Minerals in Pahang – As prescribed in the State Mineral Enactment, the rate of royalty payable on bauxite is 5%.

b. Future/Sustainable Mining - Mining operation must maintain the mining area according to global best practices.

c. Spillage – Need to invest in conveyer belt system to minimise spillage and pollution.

d. Dedicated Road – Need to look into the feasibility of a dedicated, specially gazetted route to transport bauxite to the stockpiles and port.

e. A proper environmental monitoring plan should be put in place and monitoring of surface and ground water levels, water quality, air quality, noise levels etc should be undertaken regularly.

f. A mine rehabilitation plan should be put in place as required under the SME. Miners have to contribute to a Common Rehabilitation Fund.

Conclusion

The bauxite mining industry in Kuantan had resulted in substantial financial benefits not only to the Government but has also elevated the livelihood of people associated with the industry in Kuantan. Nevertheless, it has also raised concern of wanton environmental damages and consequent health effects. Therefore, stringent and clear regulatory measures should be imposed to minimise the negative impacts of the bauxite mining industry. Regular enforcement will ensure that the bauxite industry remains relevant and safe.

1.0 Introduction

Introduction

Bauxite mining in Kuantan, Pahang started in early 2013. It began with small-scale mining in Balok and later expanded to other areas namely Bukit Goh, Bukit Sagu and Sungai Karang. In January 2014, the Indonesian government started to develop a domestic metal processing industry. As a result of this initiative, a bauxite ban was put in place. This incident has resulted in the shortage of bauxite worldwide, particularly affecting China. The state of Pahang, which has deposits of bauxite particularly in Kuantan district, has taken steps to fill in the gap to meet the high demand of bauxite in the market. The high demand of bauxite has resulted in the involvement of many unregulated or unscrupulous mining methods for mineral extraction. It was reported that irresponsible parties have conducted illegal mining activities generating profits of up to RM 1 million in less than 6 months (AFP, 23 Dec 2015).

The bauxite production in Malaysia was merely 208,770 tonnes in 2013 and 963,000 tonnes in 2014. However, in 2015 there was a sudden surge of bauxite mining up to 20 million tonnes. It has been reported that the bauxite produced was mainly exported to China. The export figure has grown exponentially from 343,000 tonnes to 3.72 million tonnes from January to September 2015. The bauxite deposit in Kuantan is expected to be exhausted in 2017 with the current trend of aggressive bauxite mining (The Star, 19 Dec 2015).

This rapid expansion coupled with uncontrolled and unsustainable legal and illegal mining activities has resulted in an environmental disaster which brings risk to public health and damage to the ecosystem. In order to address the impact of bauxite mining activities in Pahang, the Government through the Ministry of Natural Resources and Environment imposed the first three-month moratorium on bauxite mining activities on 15 January 2016 until 15 April 2016. This deadline was later extended until 15 July 2016, 15 September 2016, 31 December 2016, 31 March 2017, 30 June 2017 and 31 December 2017 (as of June 2017).

A Task Force was established by the Academy of Sciences Malaysia (ASM) to study the matter and make recommendations to the Government so that bauxite mining especially in Kuantan can be conducted in a sustainable way with minimal damage to the environment.

1.1 Objectives of this paper

The proposed Position Paper for bauxite excavation/mining in Kuantan is hinged on the following objectives:

a. To highlight the issues related to bauxite excavation/mining in Kuantan, Pahang;

b. To propose measures to remediate and mitigate the problems arising from bauxite excavation/mining in Kuantan, Pahang; and

c. To propose sustainable and environmental friendly methods for bauxite excavation/mining activities for the future.

1.2 Report Scope

This report covers information derived from the following resourcing and advocacy activities conducted by the Task Force:

a. Forum on Sustainable Mining: Case Study of Bauxite excavation/mining in Pahang (16 February 2016)
b. Presentation and submission of a Proposal Paper to Environment Quality Council 119th Meeting (12 April 2016)
c. Site visit to Kuantan, Pahang (18 May 2016)
d. Site visit to Pengerang, Johor (30 May 2016)

2.0
Mining Industry & Governance

Mining Industry & Governance

The mining industry comes under the purview of the NRE. However, mining involves land, which is a State matter. Thus, the approval of applications for prospecting/exploration and mining comes under the State Authority with technical inputs provided by the federal agencies under the purview of the NRE such as the DMG and the DOE. The Federal Government in 1988 established a NMC to coordinate mineral related matters, between the Federal and State Governments and to oversee the overall integrated development of the mineral industry. The Federal Government has been urging that abandoned mines be revived and also encouraging the States to open up more areas for exploration and mining.

2.1 Mining Industry

Malaysia is one of the largest economies in South East Asia, and one of the fastest growing. The population in Malaysia is estimated around 28 million today, making it a growing market with considerable potential. Malaysia has significant reserves of mineral deposits namely metallic, non-metallic and energy minerals. The mineral reserves are worth several billion dollars in economic potential. The Malaysian Mineral Statistics from 2009 to 2015 are tabulated in Appendix B.

2.2 Mining Governance

Mineral can be defined as any substance whether in solid, liquid or gaseous form. Mineral normally occur in or on the earth, in or under the sea or seabed. It is normally formed by or subjected to a geological process. In Malaysia, any activities related to mineral are governed by the Mineral Development Act, 1994 and the SME. In the Mineral Development Act 1994, provision of power has been given to the Federal Government for inspection and regulation of mineral exploration and mining and other related matters.

Rock materials have a very wide definition ranging from natural rocks, sand, clay, shell or guano and any bricks, lime, cement or other commodity manufactured from it. The activities related to rock materials in Malaysia are governed under National Land Code 1965, Section 14 which has provision for Quarry Rules.

Bauxite in Kuantan is being mined or excavated through two permitted activities, one through a mining permit issued by the PTG Pahang with inputs from JMG Pahang, and the other is through a permit for excavation of laterite soil issued by the Pejabat Daerah dan Tanah Kuantan. It is also believed that illegal mining activities are also being carried out on smaller plots of land.

In order to capitalise on the country's mineral resources, the Federal Government has formulated the NMP2 in 2009. NMP2 has provided the foundation for the development of effective, efficient and competitive regulatory environment for the mineral sector. The thrust of the policy is to expand and diversify the mineral sector through optimal exploration, extraction, and utilisation of resources using modern technology supported by Research and Development (R&D).

The salient features of NMP2 are the provisions for security of tenure, high land use priority for mining, uniform and efficient institutional framework, and regulations and guidelines for mining. Under NMP2, emphasis has been given to rehabilitation, environmental protection, sustainable development and the management of social impact. The environmental aspects of mines are regulated by the Environmental Quality (Prescribes Activities) (Environmental Impact Assessment) Order 1987, which is the subsidiary legislation to the Environmental Quality Act 1974. Under Order 1987, mining of minerals in new areas where the mining lease covers a total area larger than 250 hectares is a prescribed activity, and requires an approved Environmental Impact Assessment report by the Department of Environment.

2.2.1 Mineral Development Act (1994)

Under the Mineral Development Act 1994 Section 63 (2), provision has been made for the Minister in-charge of mining to regulate matters related to environmental protection and safety. The Mineral Development (Operational Mining Scheme, Plans and Record Books) Regulation 2007 were enacted to deal with information or proposal of mining scheme which includes environmental protection measures, monitoring and contingency plans and progressive rehabilitation and post mine closure. More regulations related to environmental and safety such as Mine Effluents (ME) Regulations, the Use of Explosives and Blasting Agent (UEBA) Regulations and the Safety in Surface Mines and Exploration (SSME) Regulations have been planned in different stages to provide more comprehensive enforcement in mining industry.

Environmental Impact Assessment

Bauxite mining activities in Kuantan started in 2013 and were not subject to Environmental Quality (Prescribed Activities) (EIA) Order 1987 since it is not categorised as a prescribed activity. Under the EIA Order 1987, only the "mining of minerals in new areas where the mining lease covers a total area in excess of 250 hectares" is categorised as a prescribed activity. However, all the mining leases or excavation permits issued seem to be of smaller sizes. Hence, none was subjected to an EIA.

Under the State Mineral Enactment 2001, mining operation is divided into two, large-scale and small-scale operation. The definition of large-scale and small-scale are further defined.

Large-scale operation is defined as operation with following condition as listed:

a. Which exceeds any of the following production limits:
   (i) In the case of extraction of minerals from alluvial deposits, annual throughput of 3.5 million cubic meters per year;

   (ii) In the case of underground mining operations, annual combined run-of-mine ore, waste and overburden production of 100,000 tonnes per year (waste material not exiting mine mouth to be excluded); or

   (iii) In the case of open cast mining operations; extracting minerals from primarily non-alluvial deposits, annual combined run-of-mine ore, waste and overburden production of 300,000 tonnes per year;

b. With a capital and infrastructure investment exceeding one hundred and fifty million ringgit;

c. With more than 250 employees or workers at the mine site on a typical day (including all shifts); or

d. Which uses any of the following mining practices;
   (i) Extensive and continued use of explosives;

   (ii) Continuous flotation circuits; or

   (iii) Extensive and continued use of toxic chemicals or agents.

On the other hand, a small-scale operation is defined as mining operation other than a large-scale operation.

Mine Rehabilitation Fund and Common Rehabilitation Fund

According to the State Mineral Enactment 2001 Part X 126, *every lessee authorising a large-scale operation shall submit to the Director a mine rehabilitation plan and upon application for a renewal of such lease, a modified mine rehabilitation plan for approval by the committee. The mine rehabilitation plan should include specific rehabilitation actions, inspections, annual reports, estimated total cost of rehabilitation, cost estimates for each specific rehabilitation action and a detailed timetable for the orderly and efficient rehabilitation of mining land.*

A large-scale mining operation lessee is required to submit a rehabilitation plan before mining commences and is obliged to establish a Mine Rehabilitation Fund (Table 1). The Mine Rehabilitation Fund shall be used for the implementation of the rehabilitation plan to which it relates and the Committee may, for the implementation of the mine rehabilitation plan, authorise payment from the Fund to the lessee, or other party designated in the rehabilitation.

Although small scale operation lessee is not required to submit rehabilitation plan, they are obliged to contribute to the Common Rehabilitation Fund (Table 1). The Common Rehabilitation Fund shall be used for the rehabilitation of mining land.

Table 1: Types of Rehabilitation Funds and Amount of Contribution

Types of Rehabilitation Funds	Duration of Lease	Contribution of Fund
Mine Rehabilitation Fund	Leases >10 years	An initial amount of 10% of the estimated total cost of rehabilitation is to be paid up before work begins but no later than one year after leasing commences. An amount equal to 1/10 of the estimated total for rehabilitation is to be paid annually.
	Leases <10 years	An initial amount equal to the estimated total cost of rehabilitation is to be paid up before work begins but no later than one year after leasing commences. An amount equal to the estimated total cost of rehabilitation divided by the term of the lease is to be paid annually.
Common Rehabilitation Fund	n/a	1% from gross sale or a fee determined, whichever is greater.

In either case, the respective state Authority is authorised to manage the funds. For better financial transparency, the committee should keep proper accounts and other records of the operation funds, prepare a statement of accounts of each financial year and have its accounts audited annually by the Auditor General.

2.2.2 State Mineral Enactment Pahang

According to the Mineral Enactment 2001 for the state of Pahang, 'to mine' is defined as intentionally to win minerals and includes any operation directly and indirectly and necessary therefore or incidental thereto, and 'mining' shall be construed accordingly. In order to administrate the state mineral resources, State Mineral Resources Committee needs to be established. In Part II Chapter 1 of the Mineral Enactment 2001, the committee shall consist of the following members:

a. A Chairman who shall be appointed by the State Authority;

b. The State Legal Advisor or his authorised representatives;

c. The Director who shall be the Secretary;

d. The Director General of Mineral and Geoscience or his authorised representative;

e. The Director General of Environmental Quality or his authorised representative;

f. The Director General of Forestry Peninsular or his authorised representative;

g. The Director of the State Economic Planning Unit or his authorised representative; and

h. Three other members who shall be appointed by the State Authority.

However, in practice for (d) through (f), the authorised representatives, namely, the State Directors, attend the committee meetings.

The functions of the committee shall include to:

a. Perform any function conferred or imposed upon under the State Mineral Enactment 2001; and

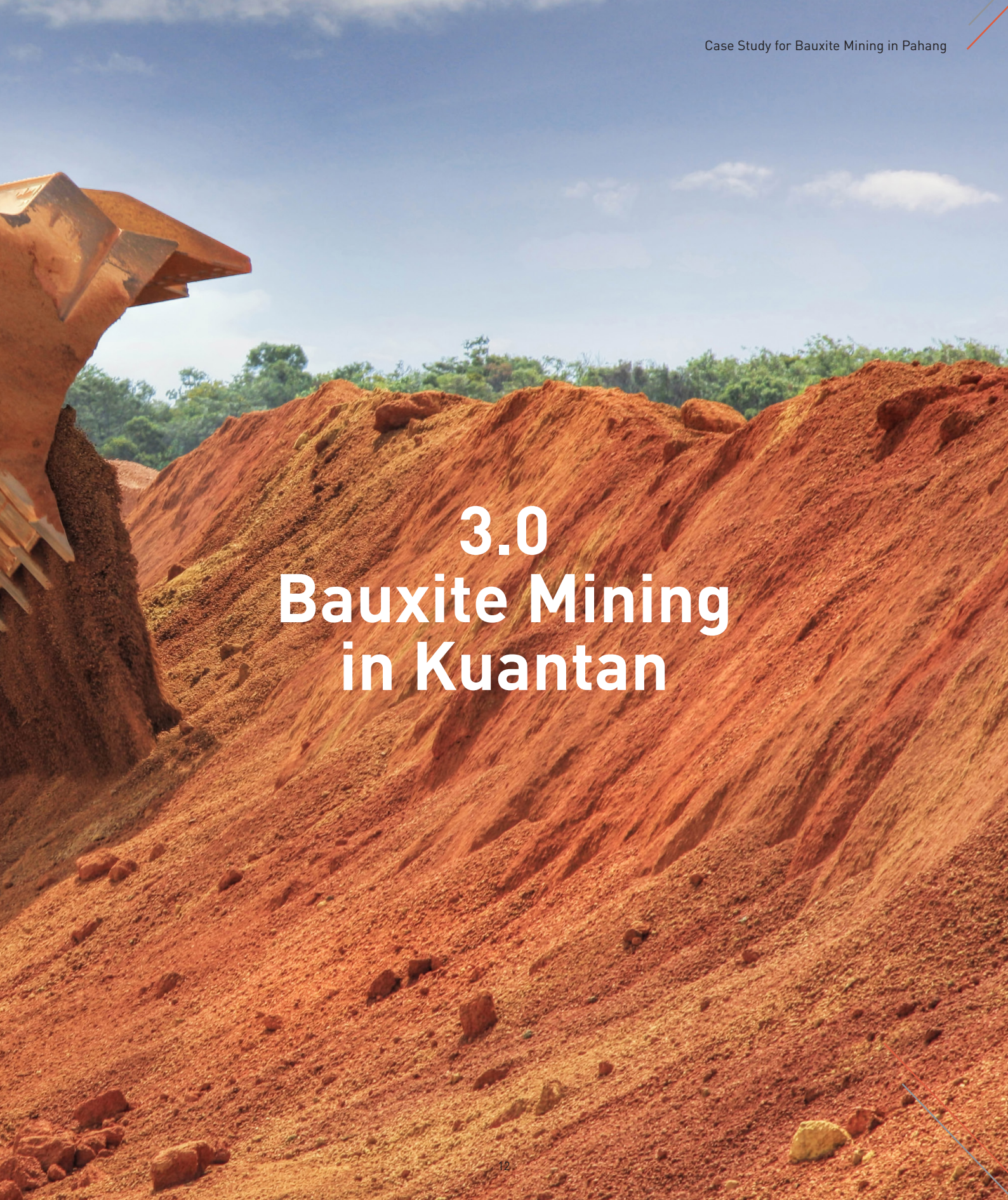
b. Perform any other function as the State Authority as determined from time to time.

Penalty for mining without a valid licence

According to Part XI 158, any person who conducts mining without a valid licence or lease issued under the State Mineral Enactment whether or not any mineral is won shall be guilty of an offence and shall on conviction be liable to a fine of not exceeding five hundred thousand ringgit or to imprisonment for a term not exceeding ten years or both.

Penalty for failure to pay into the Mine or Common Rehabilitation Fund

Any lessee who fails to pay the amount for Mine Rehabilitation or Common Rehabilitation Fund as the case shall be liable to a fine not exceeding twice any amount outstanding or to imprisonment for a term not exceeding six months or both.



3.0 Bauxite Mining in Kuantan

Bauxite Mining in Kuantan

In Kuantan, bauxite is mainly extracted through open cast methods. During the process, the topsoil and overburden layer will first be removed prior to bauxite extraction. Most of the mined out lands which are barren of vegetation are left abandoned without being rehabilitated. Therefore, they are subjected to wind action which generates windblown dust. The effect of dust can be worsened particularly during dry and hot season. Furthermore, when there is heavy rainfall over the unrehabilitated mined lands, landslides or flooding may happen, resulting in bauxite residue flowing into the river system.

After the mining of bauxite, the materials are then transported to the bauxite washing site to remove excess materials from bauxite ores. This refers to ore which contains less than 40% bauxite. Bauxite washing will increase the average grade of bauxite so that it can be sold at a higher price. Illegal bauxite washing conducted openly near rivers results in bauxite washings flowing back into the river giving rise to a 'red river'. Uncontrolled water extraction from the river for bauxite washing should be closely supervised. The wash water containing high heavy metals exceeding safe levels must be treated before being returned to the river system.

After washing, bauxite ores are transported to Gebeng Industrial Estate where they are temporarily stockpiled before being shipped off to China via Kuantan Port. Due to scarcity of space in Kuantan Port, the numbers of stockpiles have grown rapidly. Figure 1 shows stockpiles located at Kuantan Port while Figure 2 shows the stockpiles outside Kuantan Port.

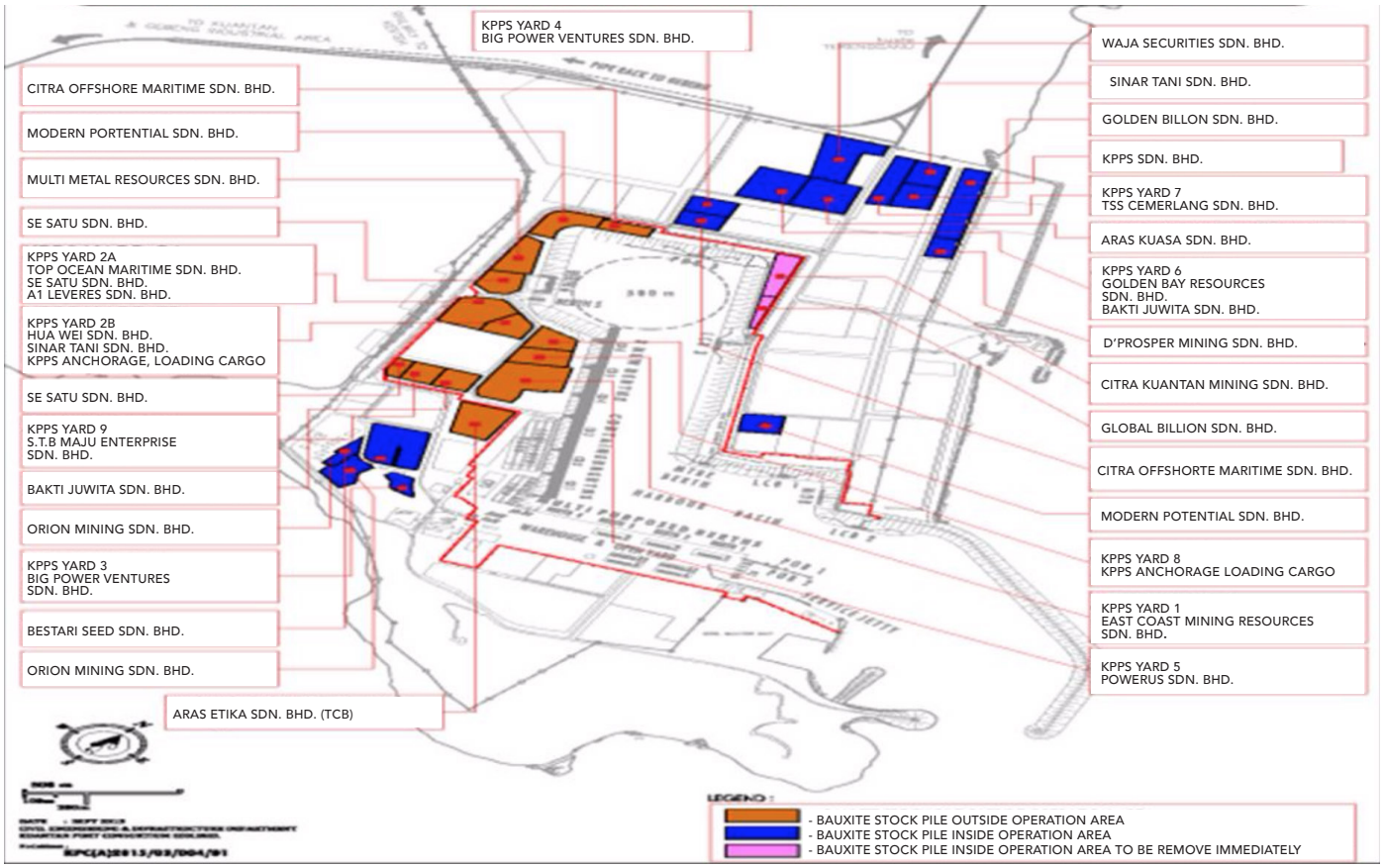


Figure 1: Stockpile within Kuantan Port (Kuantan Port Authority, 2016)

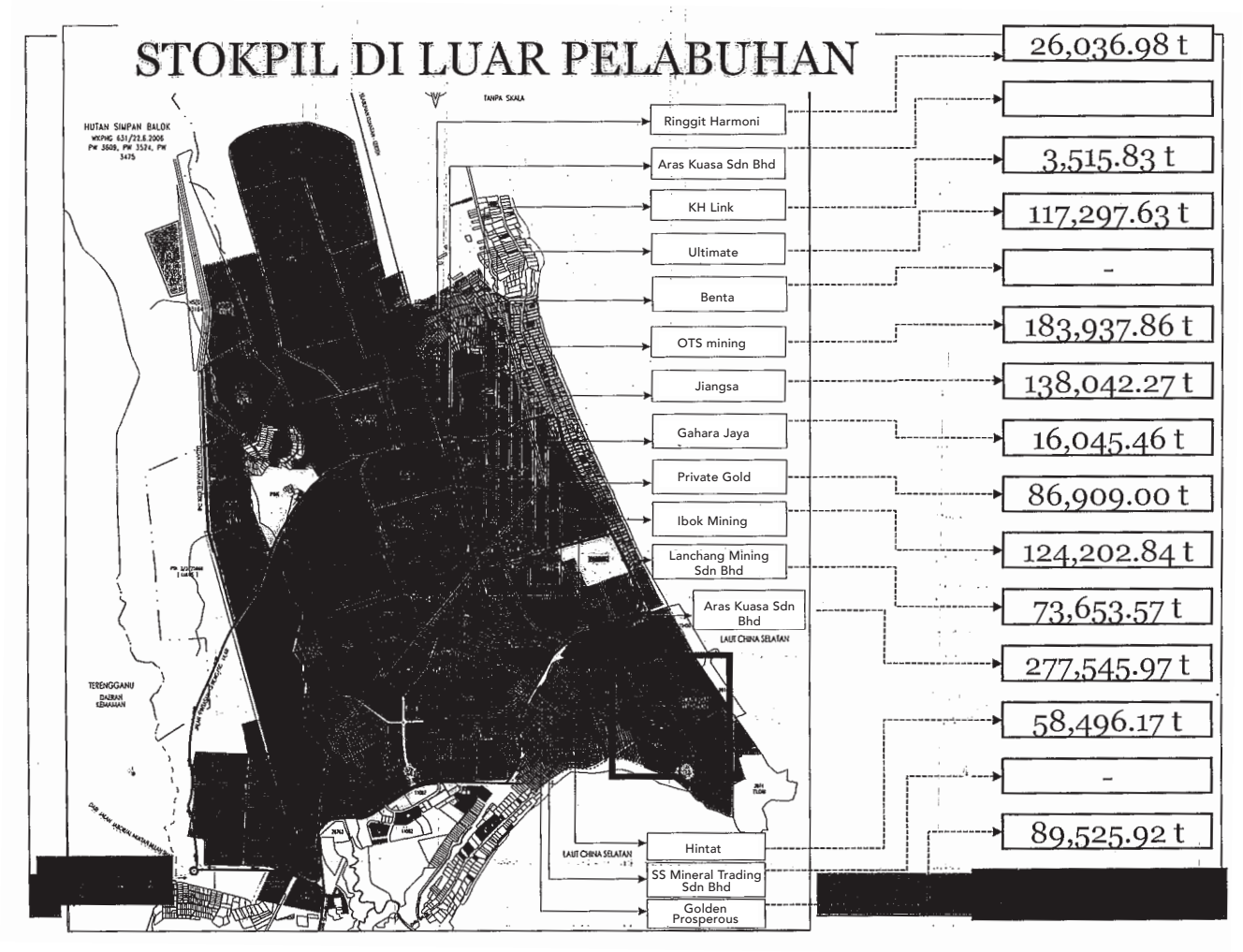


Figure 2: Stockpiles outside Kuantan Port (Kuantan Port Authority, 2016)

These stockpiles are not covered and thus are exposed to wind action generating windblown dust and erosion from heavy rainfall. Proper erosion and sediment control measures (drains, sediment ponds, etc.) should be in place in order to control sediment-laden runoff from flowing into the nearest waterways.

Bauxite ores are mainly transported from mining sites to the stockpiles or Kuantan Port by lorries. Most of the lorries used unpaved roads exiting into regular public roads. Many of these roads pass through residential areas particularly Felda Bukit Goh, Kota SAS, Semambu, Perumahan Damansara, Perkampungan Batu Hitam, Sungai Karang and Jabor. Most of the lorries are not cleansed using water jet or passed through tire washing area before leaving the mining site. Dirty or muddy lorries will worsen the air pollution along the route to the port. Since lorry drivers are paid according to the tonnage transported, most of the lorry drivers violated the guidelines for transporting soil by SPAD since strict enforcement is lacking or absent. In some cases, lorry drivers rush their loads to the port since they are paid according to the number of trips. Such irresponsible act poses a high rate of accidents on the road.

Bauxite Mining in Kuantan

Erosion and Sediment Control Plan (ESCP) at the mining site should ensure that such lorries only be loaded up with bauxite at a controlled location on the perimeter of the site. Lorries operating inside of the site should be confined inside the site, until mining operations are completed. Preferably, lorries should be loaded up at storage bins which are supplied by conveyor belts as this method would reduce the tendency of spillage on the lorries as compared to the present shovel and excavator method.

3.1 Port handling processes and transportation

Latest handling technologies for bauxite are a major concern, to achieve low operational costs for loading and unloading of lorries and vessels, as well as for the protection of the environment. The bauxite particle characteristics make its handling rather complex in order to attain optimum performances, in terms of quantity that can be conveyed, and the amount of dust and spillage that must be minimised during loading and unloading operations. At Kuantan Port, bauxite is handled via traditional loading and unloading methods, i.e., by grabs and simple hoppers on the quay and at the sea. This had resulted in major pollution on land and water.

4.0
Issues & Consequences of Unregulated Bauxite Exvacation/Mining in Kuantan

Issues & Consequences

4.1 Loophole in governance

One of the pressing issues that the Task Force discovered in preparing this Position Paper was that a large number of unregulated mining activities in Kuantan were not conducted under the State Mineral Enactment but it was conducted under the National Land Code on the pretext of excavating and transporting laterite or soil. As a result, requirements that govern proper mining such as mining plans, rehabilitation plans and rehabilitation funds are not applicable.

The Task Force also noted that both regulated and unregulated bauxite excavation/mining activities from mine to ship were not strictly adhered to the best practices in term of environmental and health control which led to the adverse environmental, health and safety impact of the mining activities to the public and ecosystem.

4.2 Impact of bauxite excavation/mining in Kuantan

4.2.1 Environmental Impact

Dust is a primary environmental problem caused by improper management of bauxite mining. Dust mainly covers large surrounding residential and agricultural neighbourhoods of the sites being exploited. From bauxite mines to the bauxite washing sites and finally to Gebeng Industrial Estate and Kuantan Port, bauxite ores are transported by lorries. Many of these lorries use regular public roads passing through residential areas. These residents are exposed to daily bauxite dust from lorries which when suspended in the air, permeates into their homes. There have been frequent complaints of respiratory and skin rash problems from residents living along these transportation roads.

In terms of radioactivity, bauxites contain very low levels of naturally occurring radioactive materials. The levels of uranium (^{238}U) and thorium (^{232}Th) in bauxite are normally in the mg/kg range and give rise to extremely low levels of radioactivity, at or below naturally occurring radioactivity found in granite rocks in many regions of the world.

4.2.2 Road Safety

Road safety is another issue that must be addressed for bauxite mining industries in Kuantan. There have been several road accidents involving lorries transporting bauxite, some of which were fatal. From site observation, lorry drivers are mainly paid according to either tonnage or trips. Lorry drivers who are paid by tonnage would tend to overload their lorries in order to get more pay.

Overloaded lorries will reduce the lifespan of road systems or damage the road. Those who are paid by trips would risk their life and the lives of other road users by speeding or driving recklessly in order to get more daily trips. Road safety is further risked when lorry drivers worked without adequate rest in order to earn more. Furthermore, there are also huge numbers of lorries that are not well-maintained. There are even lorry drivers who do not use the designated route to the port.

4.2.3 River and Marine Water Quality

Mining related activities are generally taking place upstream of Sungai Kuantan basin which is the main source of domestic water supply in Kuantan. Based on observation, unregulated mining activities have polluted Sungai Kuantan and its tributaries. Several water samples were taken at the downstream of the bauxite mines for water quality test. The result revealed that unregulated mining has polluted the river severely through increase in sediment load.

Sediments from the loose earth due to mining activities have increased the levels of suspended solids and turbidity particularly during rainy season. Besides, the sedimentation and siltation have also made the river shallower and particularly increase the chance for eutrophication for smaller streams. This will damage aquatic habitats, elevate flood risks and potentially disrupt operations of water treatment plants.

Figure 3: Visual yellowish color of an affected river situated near a bauxite mine in Kuantan

Bauxite mining can also precipitate out heavy metals such as arsenic, mercury, aluminium as well as other pollutants and these will enter the river during rain. Deposits on road surfaces during the transport of bauxite will also be picked up by runoff. The process of "bauxite washing" generates effluent which also enters the watercourses. These metals can adversely affect human health if consumed over an extended period of time. Monitoring data from the Department of Environment showed mercury levels at Bukit Goh intake to be at 0.0001 mg/L.

The permissible limit adopted by the Ministry of Health and DOE is 0.0010 mg/L. While mercury levels remained within permissible limits, preliminary results show the aluminium levels in samples taken from local residences in Felda Bukit Goh were at levels of 0.29 mg/L and 0.25 mg/L, thus exceeding the Health Ministry standard of 0.20 mg/L. Conventional water treatment systems are not specifically designed to effectively remove these metals, though "indirect" removal is plausible at the coagulation/flocculation and filtration stages. Hence, there is a risk that these metals will escape the treatment plant and enter the water distribution network, reaching potable water.

"Bauxite washing" activities have also resulted in several rivers to be barricaded/ dammed up with earth. The stability of these structures is questionable. If these structures fail, the impact towards the downstream areas would be monumental when mud and sediment come gushing down. This very real risk is amplified during rainy season as the volume of water increases.

4.2.4 Aquatic Ecosystem

The continuous degradation of water quality due to unregulated bauxite mining will pose a major impact to the biodiversity of aquatics in the river. Sungai Kuantan is the habitat for aquatic flora and fauna. A high occurrence of sediment in the river will not only increase the turbidity of water but also destroy the population of aquatic flora and fauna. A high level of sediment can choke fishes by clogging their gills, bury invertebrates that are an important part of the food chain, and prevent photosynthesis by cutting sunlight penetration. The presence of heavy metal will also poison aquatic flora and fauna.

Issues & Consequences

4.2.5 Human Health Impact

Unregulated mining activities in Kuantan have resulted in severe health impact to the surrounding residents. Bauxite ore contain metals that are hazardous to humans. It has been reported that bauxite contains toxic heavy metals, namely, aluminium, lead, mercury, arsenic, cadmium, nickel and chromium which may be carcinogenic. Low levels of radioactive may also be emitted from bauxite as soil materials are naturally-occurring radioactive materials.

4.2.6 Respiratory Health

Bauxite ore transportation from the mining site or from the stockpile to the port generates a large amount of dust which is hazardous to the human respiratory system. Respirable particles which have aerodynamic diameters of 10mm (PM10) and 2.5mm (PM2.5) respectively, pose damaging effects to the human respiratory system. PM10 has the ability to reach the lower respiratory tract while PM2.5 may penetrate the deeper part of the lungs called the alveolar region which is vital for gas exchange. In general, children and the elderly are the most vulnerable to dust pollution particularly those with respiratory issues such as asthma, chronic bronchitis and other cardiovascular problems.

During the peak of bauxite mining, 24-hour PM10 has been monitored in three locations namely Bukit Goh, Beserah and Gebeng Industrial Estate. The results revealed that 24-hour PM10 levels were 222.13 µg/m3 in Bukit Goh, 164.05 µg/m3 in Beserah, and 276.79 at the Kuantan Port. It can be concluded that the 24-hour PM10 in all locations exceeded 24-hour Malaysian Ambient Air Quality for PM10 which is 150 µg/m3.

4.2.7 Contamination of Human Food Chain

The heavy metal from bauxite mining may be taken up by fishes, shellfish and other aquatic organism that form part of the human food chain. Heavy metals can be accumulated up the food chain through bioaccumulation. Humans being the top of the food chain may be the most vulnerable to contamination of the aquatic environment.

The New Straits Times in 2015 have reported a high level of arsenic ranging from 70.8 to 104.5 g/kg in fish caught from Sungai Pengorak. This value exceeds the permissible level for arsenic in fish and fishery products of 1 mg/g for Malaysia (Food Act 1983; Food Regulations 1985) and 0.1-5.0 µg/g for FAO/WHO (Joint FAO/WHO Expert Committee on Food Additives 2000).

Despite the bauxite issue being highlighted regularly in media and warnings by environmental experts and scientists, some members of the public seem unaware of the danger of the bauxite-contaminated environment. The reason for this is assumed to be the failure and inaction of the regulatory agencies in issuing advisory information of impending danger to the public and denying that the environmental problem really exists. Risk communication has to be expedited. Many experts who are aware of the potential danger also held back for fear of being in conflict with the Federal and State authorities on the issue

Image Courtesy : NORWEGIAN HULL CLUB

5.0 Recommended Action Plan

Recommended Action Plan

In order to minimise the impact of bauxite mining in Kuantan, the State Government of Pahang should control mining operation at the source.

5.1 Remedial Action Plan

5.1.1 Regulating Bauxite Mining Activities

All bauxite mining activities must be regulated under the State Mineral Enactment. Loophole such as mining bauxite under the National Land Code on the pretext of soil transport activities must be plugged.

5.1.2 Clearance of the existing stockpile

During the Moratorium, directives to clear existing stockpiles including that of illegally mined bauxite were issued by the Ministry of Natural Resources and Environment. Operators required permits (AP) and must carry out procedure based on best practices to clear the stockpiles to transport out the ores to the nearest ports.

5.1.3 Effective Pollution, Erosion and Sediment Control

Effective pollution, erosion and sediment control should be set up particularly at the mining sites, stockpile yards, ports and from port to barge. It is important to ensure that proper filtration system is installed on the drainage system to ensure that pollution, erosion and sediment are well controlled. On top of that, filtration ponds should be constructed to control run off water from flowing into the river or sea.

ESCP for mining areas should be planned as part of an Environmental Management Plan (EMP) to be continuously supervised and updated. Such actions could ensure that sediments can be controlled at the site and not be freely allowed to run off into adjacent drains and streams and finally into the sea, as with the present case.

Washing of excavated material to increase the mineral content of the bauxite should be done on site. Under no circumstances should any miner be allowed to wash bauxite away from its own site, e.g., near existing rivers or streams, with the washed sediment being allowed to seep back into the river or stream. The ESCP must take into account of any such washing, should it be required by the mine concerned.

5.1.4 Environmental Monitoring

Proper environmental monitoring should be conducted on a regular basis. The environmental monitoring should include ground water levels and quality, water quality, air quality and etc. Operators must take responsibility for meeting performance standards set by government regulators and are expected to pursue continual improvement where practicable. Negative environmental impact on land, water, air and biota should be avoided where feasible, and any impact on environmental values should meet the approved outcomes.

Public health and safety should not be compromised. Rigorous monitoring and public reporting programs should be used to demonstrate progress towards, and achievement of, agreed environmental outcomes, such that it will be possible to take corrective or enforcement action if the environmental outcomes are not achieved. The facility responsible for the bauxite residue should demonstrate capability through implementation of suitable management systems (including contingency plans) with adequate training and resourcing to ensure best practice is implemented onsite.

Therefore, prior to lifting of the moratorium, it is essential for baseline data to be established and documented as follows:

a. Properties of surface and groundwater;

b. Impact of mining activities on freshwater uses (supplies of drinking water, fishing, irrigation, amusement, industry, household);

c. Baseline and impact assessment of terrestrial and aquatic flora and fauna;

d. Assessment of dust and noise level; and

e. Assessment of social impacts and community engagement.

5.1.5 Transportation

Air pollution is one of the main issues in bauxite mining. It is suggested that every mining site, stockpile and port should install a wheeler washer (Figure 4) to reduce the tendency of mud stuck on the wheels. On top of that, washing bays should also ensure that lorries are relatively clean while exiting either mining sites, stockpiles or port.

Figure 4: Wheeler Washer installed onsite

In addition, it is suggested that every bauxite industrial player follows strict SPAD guidelines while transporting bauxite from either the mining sites to the stockpiles or to the port. The vehicles should be properly covered to avoid the dispersion of loose bauxite along the route during transporting process. Overloading may also cause the loaded materials to spill and will make it difficult to be covered according to SPAD guidelines. Thus, a close container truck may be the transport vehicle of choice for bauxite.

In order to reduce air pollution in residential areas, a specially gazetted route for transporting bauxite to the stockpiles and port should be designed. Transportation route of lorries should bypass as many residential areas as possible. Besides that, it is advisable to impose conditions on controlled stockpile which should be as far away as possible from the residential area. A restriction of maximum height should be imposed to minimise the dispersion of bauxite dust to the surrounding area. Construction of airborne dust mitigation fence should be implemented around the port and mining sites to reduce the tendency of dust transmission from within to the surrounding residential areas.

The traditional method of using grabs and simple hoppers on the quay and when loading onto sea vessels at Kuantan Port has raised two major concerns, namely:

a. Kuantan Port is situated very close to urban dwelling; therefore, pollution is a serious problem. It is quite difficult to avoid pollution when using the grabs, as any moderate breeze will blow away the ore. As such, contaminated air and surrounding areas need to be continuously cleaned; and
b. A second major concern is the amount of spillage.

Two methods are proposed to address these concerns:

a. Loading via conveyer belt, in which case, pollution and spillage can be minimised; and
b. A pneumatic loader whereby the ore is handled in a totally enclosed system, pollution and spillage are almost totally eliminated.

For long-term planning, it is advisable to have a dedicated quay with effective pollution, erosion, and sediment control for the purpose of loading and unloading ore onto sea vessels.

Recommendation Action Plan

5.1.6 Stockpiling

While a huge stockpiling yard is not encouraged within the area of the port, a centralised stockpile yard complying with the specification approved by the State Government could be implemented. Effective through put system could be used to minimise the issue of stockpiling. Besides that, the height of stockpile should be restricted to less than seven meters high in the open area.

5.1.7 Community Awareness & Engagement

Local NGOs will be invited to give more exposure to all stakeholders regarding the issues of bauxite. The program can be successful when conducted incorporating:

a. The creation of a workable social adjustment strategy involving all stakeholders;

b. The establishment of an enduring relationship between the mine operation and the surrounding community;

c. The adequate provision of social, safety, health and educational services to the community;

d. The establishment of a joint consultative committee between the mineral operator and all stakeholders right from the planning stage; and

e. The implementation of Social Impact Assessment on mineral operations.

5.1.8 Rehabilitation strategy

Mine Rehabilitation Plan should be thoroughly strategised to ensure successful rehabilitation is conducted once mining ceases in the area. Proper planning will ensure that the mine is not left as an environmental disaster area once mining has stopped. Improper management of ex-mining area may pose safety and health hazards to the public and wildlife. It will also ensure that limits to the mine area and depth of excavation are clearly planned for and approved beforehand, instead of the present haphazard way of mining at breakneck speed purely to maximise profits, regardless of consequences to everyone and everything else.

Bank guarantee or insurance coverage (similar to the present requirement for a government contract) which will be utilised to rehabilitate the mine area should be forfeited if the company absconds after mining operations cease. The amount of coverage shall be equivalent to the estimated cost of rehabilitation.

Figure 5: 300 acres of land (ex-mining site) are dedicated for Acacia planting by Johore Mining and Stevedoring Company Sdn Bhd

Figure 6: A township is being developed on an ex-mining land in Pengerang, Johor

Mine operations should have a comprehensive mine rehabilitation plan to leave behind the mined-out land with realistic land-use options in place after mining activities have ceased. To this effect, a proper sediment and erosion control mechanism should also be in place.

5.2 Sustainable Mining for the Future

According to Pahang's Menteri Besar Datuk Seri Di Raja Hj. Adnan Hj. Yaakob, Pahang has the potential to earn up to RM24 million per month with the renewed rates for bauxite production (NST, 26 November 2015). Bauxite mining has increased the income of low-income earners as lorry drivers could earn up to RM8,000 monthly by transporting bauxite from mines to the collection points. Bauxite mining also increased the number of job opportunities for excavators, administrative, staffs, etc. Increased job opportunities result in elevated household income, which leads to improved social conditions.

5.2.1 Royalty on Minerals in Pahang

The rate of royalty payable on any mineral won shall be as prescribed in the First Schedule (Table 3).

Table 3: Schedule of Royalty for Metallic Items

No	Item	Rate
1	Tin	5% from the value
2	Gold	5% from the value
3	Silver	5% from the value
4	Bauxite	5% from the value
5	Ilmenite	5% from the value
6	Copper	5% from the value

Recommendation Action Plan

In general, the State Authority shall establish the methods of determining the market value of a mineral. The method of determining the market value of the minerals shall comply with the following methods

a. The sales revenue realised by the holder of the mineral tenement; or

b. Reference to a monthly price for the mineral determined by the Director General of Mineral and Geoscience; or

c. Reference to a published price series for the mineral that is widely recognised and used by the international mining community as a reference price.

The holder of a mineral tenement, required under the Enactment to pay royalty based on the value of the mineral, shall sell or transfer the mineral produced at prices reflecting world market conditions and in line with commercial mining industry practices.

The holder of a mineral tenement shall within seven days of the expiry of each month, forward to the Director the royalties and a report for the preceding calendar month showing in full the details required to calculate those royalties, including, where relevant:

a. The quantity of the mineral;

b. Terms and other parties involved, of any sale, transfer, shipment or other disposal of the mineral;

c. The market value of the mineral;

d. The method of calculating the market value of the mineral including details of any costs deducted to calculate the market value; and

e. Report any transaction, transfer, arrangement and dealing which involve affiliated enterprises along with relevant supporting documents.

5.2.2 Future/Sustainable Mining

A sustainable mining operation must maintain the mining area according to global best practices and this includes successful rehabilitation and environmental management that ensures that other long term land uses are not compromised.

According to the International Aluminium Institute (IAI), almost 80% of mines surveyed are ISO 14001 certified (IAI, 2008) and more than 80% of surveyed operations have a long-term or completion plan for their mining area, in order to establish a self-sustaining system with realistic land-use options in place after mining activities have ceased. The surveys also found over 80% of mines maintain an environmental consciousness and training programme for all employees and contractors who are involved in rehabilitation.

Environmental and social impacts are examined before commencement of mining. After the environmental impact assessment (EIA), precautionary measures are applied to prevent and limit impacts of the project on the natural environment.

Strategies to mitigate negative environmental and social impacts of bauxite mining include:

1. Monitoring and modelling noise levels, provision of buffer zones, altered timing of operations, modification of equipment, changes to mining and blasting methods;

2. Regulate dust levels by watering, road maintenance and vehicle speed limits;

3. Erection of settling ponds and other drainage control structures;

4. Rehabilitation of mined areas as immediate as possible after closure;

5. Regulate the spill of hydrocarbon and other spills; and

6. Resourcing of research and development projects.

Bauxite mining consumes a relatively small amount of energy and has low greenhouse gas emissions as compared to alumina refining and aluminium smelting processes. Most of energy required (95%) to extract and haul the mined ore are from diesel fuel and fuel oil combustion provides.

Global average energy consumption is around 150 MJ per tonne of bauxite, with each tonne of bauxite having to be transported on average 50 km from the point of extraction to the shipping point or local refinery stockpile.

Mine operators surveyed have also adopted a number of strategies to use energy more efficiently and to reduce emissions. These strategies include:

1. Purchase of larger, more energy efficient mining equipment and lorries;
2. Improved maintenance of mining and transport machinery;
3. More efficient use of equipment by optimising lorry cycle times and reducing idling and waiting times;
4. Reduction of haul distances for overburden storage;
5. Use of downhill regenerative cable belt conveyors to transport bauxite; and
6. Change to lower emission fuels such as natural gas, where possible.

Whole or parts of this self-sustaining system is recommended for Malaysian mine operators. Such a system is deemed feasible for adoption whereby for the most part mine operators can easily engage consultants to conduct training and assessments.

Image Courtesy : http://cleanmalaysia.com/

6.0 Conclusion

Conclusion

6. Conclusion

In conclusion, the bauxite mining industries in Kuantan had resulted in substantial financial benefits not only to the government but have also elevated the livelihood of people associated with the industries in Kuantan. However, the mining activities have also raised concern of consequent health effects to the residents of Kuantan and drew public's attention towards wanton environmental damages. Therefore, if the bauxite excavation/mining activities are to resume, stringent and clear regulatory measures should be imposed to minimise the negative impacts of the bauxite mining industry. Regular enforcement will ensure that the bauxite industry remains relevant and safe for the residents of Kuantan. It is suggested that proper planning and execution based on international and local best practices should be taken up prior to the imposed moratorium being lifted.

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Appendices

Appendix A

Bauxite

Bauxite is an amorphous, clayey rock containing aluminium hydroxide which is the principle ore of aluminium. The amorphous rock of bauxite consists of largely hydrated alumina with variable proportions of iron oxides. Generally, bauxite does not have specific composition. It is mainly the combination of hydrous aluminium oxides, aluminium hyroxides, clay minerals and insoluble materials namely quartz, hematite, magnetite, siderite and goethite. The aluminium minerals in bauxites includes gibbsite Al(OH)3, boehmite γ-AlO(OH) and diaspore α-AlO(OH).

Lateritic bauxites, or more popularly known as silicate bauxites, occur predominantly above carbonate rocks namely limestone and dolomite. Lateritic bauxite is formed by lateritic weathering and residual accumulation of intercalated clay layers. Lateritic bauxites are found mainly in tropical countries. The lateritic bauxites are formed through lateritization of various silicate rocks namely granite, gneiss, basalt, syenite and shale. The formation of bauxites depends mainly on the intensity of weathering conditions in location which have good drainage. Good drainage and high intensity of weathering conditions enable the dissolution of kaolinite and the precipitation of gibbsite. High aluminium content can be located below a ferruginous surface layer. The aluminium hydroxide in lateritic bauxite deposits is mainly gibbsite.

Physical Properties of Bauxite

Bauxites are typically soft with Mohs Hardness ranging from 1-3. The colour of bauxites varies according to content of the mineral in it. Generally, bauxites occur in colours ranging from white to gray to reddish brown with pisolitic structure, earthy luster and with relatively low specific gravity of 2.0-2.5. The physical properties of bauxites are tabulated in Table 1. Figure 1 shows the pisolites, which are normally found in bauxites. Physical properties vary widely according to the mine source. Granulations available include: 50 mm by down lumps, crushed coarse sizes (-3 mesh, -6 mesh, -8 mesh and -12 mesh) and ground powder sizes (-100 mesh, -200 mesh and -325 mesh).

Table 1: Physical properties of bauxite

	Properties	Description
1	Colour	White, grey, sometimes stained yellow, orange, red, pink, or brown
2	Streak	Usually white, but iron stain can discolour
3	Luster	Dull, earthy
4	Diaphaneity	Opaque
5	Cleavage	None
6	Mohs Hardness	1 to 4
7	Specific Gravity	2 to 5
8	Diagnostic Properties	Often exhibits pisolitic structure; colour
9	Chemical Composition	Variable but always rich in aluminium oxides and aluminium hydroxides
10	Crystal System	n/a
11	Uses	Primary ore of aluminium, also used as an abrasive

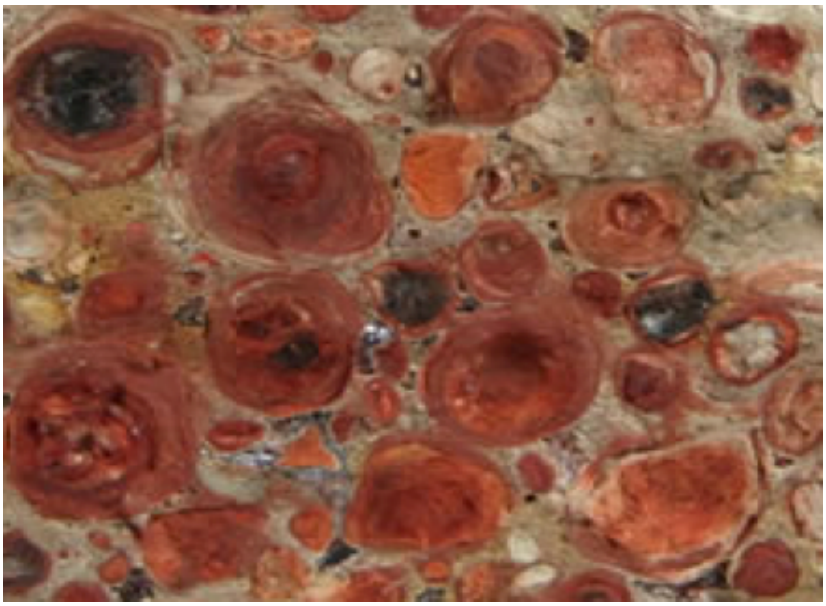


Figure 1: Pisolites in Bauxite

Chemical Properties of Bauxite

The main compositions of bauxite residue comprise iron oxides, titanium oxide, silicon oxides and undissolved alumina with a wide range of oxides mainly depending on the location or origin of the bauxite. High concentration of bauxite gives the by-product its red colour characteristic, hence, is commonly referred to as "red mud". A typical chemical composition range (%) for bauxite residue for main components is shown in Table 2 and mineralogical composition range for bauxite residues is shown in Table 3 .

Table 2: Chemical Composition Range (%) of Bauxite Residue for Main Components (IAI, 2015)

	Component	Typical Range (%)
1	Fe_2O_3	20-45
2	Al_2O_3	10-22
3	TiO_2	4-20
4	CaO	0-14
5	SiO_2	5-30

Table 3: Mineralogical Composition Range for Bauxite Residues (IAI, 2015)

	Component	Typical Range (%)
1	Sodalite (3Na2O.3Al2O3.6SiO2.Na2SO4)	4-40
2	Goethite (FeOOH)	10-30
3	Hematite (Fe2O3)	10-30
4	Magnetite (Fe2O4)	0-8
5	Silica (SiO2) crystalline and amorphous	3-20
6	Calcium aluminate (3CaO.Al2O3.6H2O)	2-20
7	Boehmite (γ-AlO(OH))	0-20
8	Titanium Dioxide (TiO2) anatase and rutile	2-15
9	Muscovite (K2O.3Al2O3.6SiO2.2H2O)	0-15
10	Calcite (CaCO3)	2-20
11	Kaolinite (Al2O3.2SiO2.2H2O)	0-5
12	Gibbsite (Al(OH)3)	0-5
13	Perovskite (CaTiO3)	0-12
14	Cancrinite (Na6[Al6Si6O24].2 CaCO3)	0-50
15	Diasopore (α-AlO(OH))	0-5

Table 4: Kuantan Bauxite Distribution and Quality (Rajah, 1986)

No.	Area	Alumina, %	Iron oxide, %	Silica, %	Titania %
1	Tanjong Gelang	33-44	21-30	1-17	3-4.6
2	Jabor Valley Estate	40-48	23-27	2-24	2-5
3	Jeram-Kuantan Estate	21-39	25-40	1.96-2.8	3-6
4	Bukit Goh Estate	26-49	22-26	1.4-25	2-5

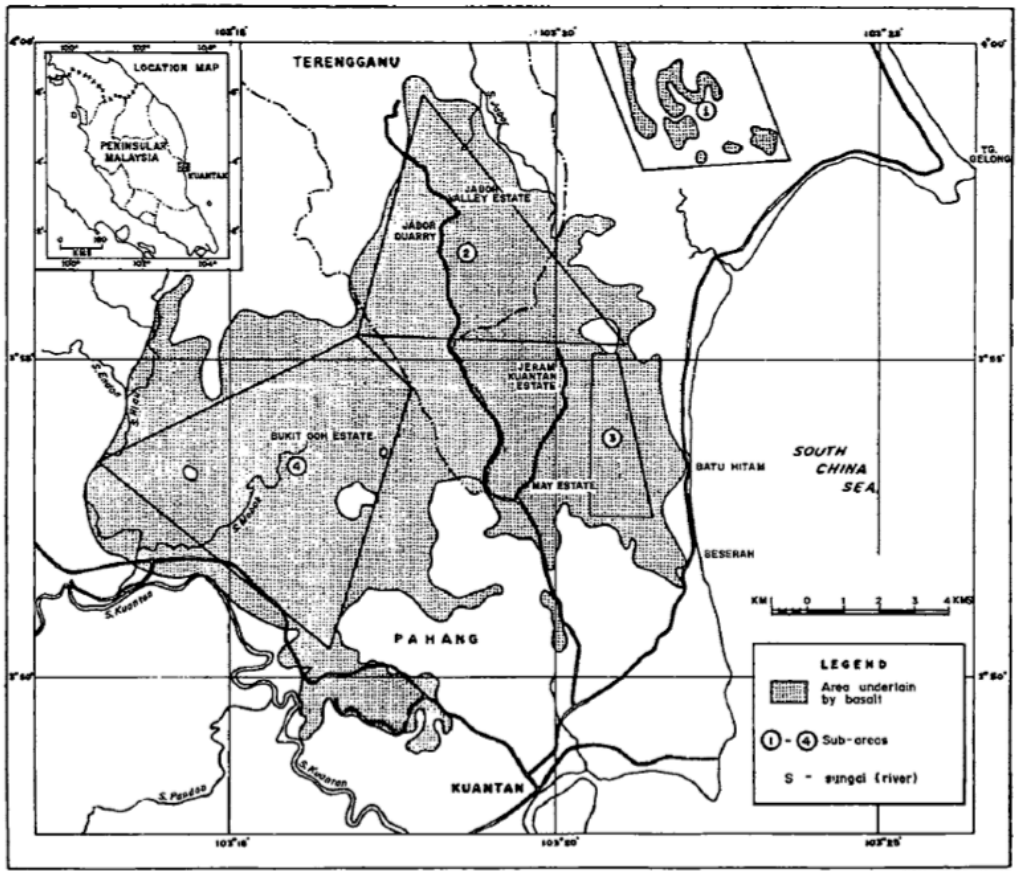


Figure 2: Map of the Kuantan area, Peninsular Malaysia

Note: By international standards these are low to medium grade bauxites (Rajah, 1986)

Common Industrial Applications of Bauxite

1. Aluminium production
2. Abrasive
3. Proppant

Sources: International Aluminium Institute (2015); Rajah (1986)

Appendix B

MALAYSIAN MINERAL STATISTICS (2009-2015)

2015*				
Mineral	Production (Tonnes)	Value (RM Million)	No. of Mines	No. of Workers
Metallic Mineral				
Tin	4,104	279,48	35 (x)	1,490
Bauxite	6,322,300	505.76	21	155
Gold (kg)	4,854	625.63	13	1,814
Ilmenite	6,177	3.09	N/A	N/A
Iron Ore	1,611,820	377.65	64	2,184
Manganese	515,288	51.53	9	311
Associated Minerals (+)	9,840	69.85	N/A	N/A
Non-Metallic Mineral/ Industrial Mineral				
Aggregates	156,585,912	2,805.57	N.Y.A	N/A
Clays	35,497,604	301/07	N.Y.A	N/A
Feldspar	340,777	25.78	5	75
Kaolin	261,574	24.85	8	299
Limestone	27,540,339	403.40	N.Y.A	N/A
Mica	4,833	3.38	2	13
Sand & Gravel	34,341,300	569.54	N.Y.A	N/A
Silica sand	2,211,305	114.80	N.Y.A	96
Barytes	16,624	17.17	-	-
Energy Mineral				
Coal	2,464,779	366.96	7	705

2014				
Mineral	Production (Tonnes)	Value (RM Million)	No. of Mines	No. of Workers
Metallic Mineral				
Tin	3,777	257.21	37 (x)	1,538
Bauxite	962,799	77.02	2	81
Gold (kg)	4,308	555.26	12	1,776
Ilmenite	8,159	4.08	N/A	N/A
Iron Ore	9,615,323	2,252.87	92	2,800
Manganese	835,429	83.54	20	409
Associated Minerals (+)	4.374	12.11	N/A	N/A
Non-Metallic Mineral/ Industrial Mineral				
Aggregates	136,161,663	2,439.63	355	N/A
Clays	30,867,482	261.80	1,541	N/A
Feldspar	378,446	28.63	4	74
Kaolin	207,694	19.73	17	283
Limestone	23,984,121	350.78	14	N/A
Mica	5,659	3.96	2	13
Sand & Gravel	29,862,000	495,25	915	N/A
Silica sand	1,922,874	99.83	35	69
Barytes	14,456	14.93	1	21
Energy Mineral				
Coal	2,687,764	400.16	5	838

2013				
Mineral	Production (Tonnes)	Value (RM Million)	No. of Mines	No. of Workers
Metallic Mineral				
Tin	3,697	258.79	36 (x)	1,532
Bauxite	208,770	16.70	1	46
Gold (kg)	3,823	535.18	10	2,098
Ilmenite	16,043	8.02 (r)	N/A	N/A
Iron Ore	12,134,258	1,698.80	98	2,965
Manganese	1,125,127	112.51	15	286
Associated Minerals (+)	367.641 (r)	12.70 (r)	N/A	N/A
Non-Metallic Mineral/ Industrial Mineral				
Aggregates	153,173,000 (r)	2,528.41	356	N/A
Clays	29,830,904	254.25	1,626	N/A
Feldspar	314,399 (r)	25.05 (r)	3	65
Kaolin	293,480 (r)	28.81 (r)	16 (r)	283
Limestone	18,068,782	314.73	14	N/A
Mica	4,363	3.49	2	13
Sand & Gravel	35,577,000 (r)	553.24	930	N/A
Silica sand	1,243,660	52.78	34	80
Barytes	500	0.25	1	21
Energy Mineral				
Coal	2,907,463	523.34	7	1,099

2012				
Mineral	Production (Tonnes)	Value (RM Million)	No. of Mines	No. of Workers
Metallic Mineral				
Tin	3,725	242.12	36 (x)	3,730 (r)
Bauxite	121,873	9.75	1	44
Gold (kg)	4,625	740.00	15	1,891
Ilmenite	22,275	15.59	N/A	N/A
Iron Ore	12,143,985	1,821.60	97	2,509
Manganese	1,099,585	109.96	13	382
Associated Minerals (+)	20,827	29.70	N/A	N/A
Non-Metallic Mineral/ Industrial Mineral				
Aggregates	110,339,369	1,863.37	312	N/A
Clays	30,689,951	261.39	1,678	N/A
Feldspar	482,906	37.13	5	76
Kaolin	438,923	41.87	27	283
Limestone	23,533,922	235.74	10	N/A
Mica	3,967	2.58	2	13
Sand & Gravel	28,592,007	460.01	970	N/A
Silica sand	931,880	62.39	5	163
Barytes	N/A	N/A	1	9
Energy Mineral				
Coal	2,951,124	441.24	7	1,006

2011				
Mineral	Production (Tonnes)	Value (RM Million)	No. of Mines	No. of Workers
Metallic Mineral				
Tin	3,340	233.80	36 (x)	3,321
Bauxite	188,141	18.81	2	44
Gold (kg)	4,219	649.78	17	1,569
Ilmenite	28,782	20.15	N/A	N/A
Iron Ore	8,007,879	1,615.58	80	2,197
Manganese	597,917	59.79	13	254
Associated Minerals (+)	13,176	28.23	N/A	N/A
Non-Metallic Mineral/ Industrial Mineral				
Aggregates	118,509,699	2,011.34	301	N/A
Clays	28,383,719	229.88	1,557	N/A
Feldspar	379,629	16.15	9	69
Kaolin	442,550	42.14	27	265
Limestone	21,832,159	203.40	9	N/A
Mica	4,245	2.33	3	13
Sand & Gravel	37,339,082	618.60	1,036	N/A
Silica sand	1,340,013	66.16	1,036	195
Barytes	N/A	N/A	1	9
Energy Mineral				
Coal	2,915,788	437.37	9	1,029

2010				
Mineral	Production (Tonnes)	Value (RM Million)	No. of Mines	No. of Workers
Metallic Mineral				
Tin	2,668	168.39	39 (x)	1,326
Bauxite	124,274	15.92	2	82
Gold (kg)	3,766	397.18	14	1,326
Ilmenite	19,306	4.72	N/A	N/A
Iron Ore	3,557,813	423.73	50	1,089
Manganese	899,703	143.84	9	210
Associated Minerals (+)	9,534	15.97	N/A	N/A
Non-Metallic Mineral/ Industrial Mineral				
Aggregates	101,809,657	1,637.10	299	N/A
Clays	27,543,322	195.24	1,545	N/A
Feldspar	455,497	21.13	6	69
Kaolin	530,331	41.67	26	390
Limestone	22,431,147	188.30	9	N/A
Mica	4,515	2.43	3	27
Sand & Gravel	30,698,267	448.91	1,051	N/A
Silica sand	932,159	35.89	28	191
Barytes	1,000	0.15	3	9
Energy Mineral				
Coal	2,397,340	261.66	9	996

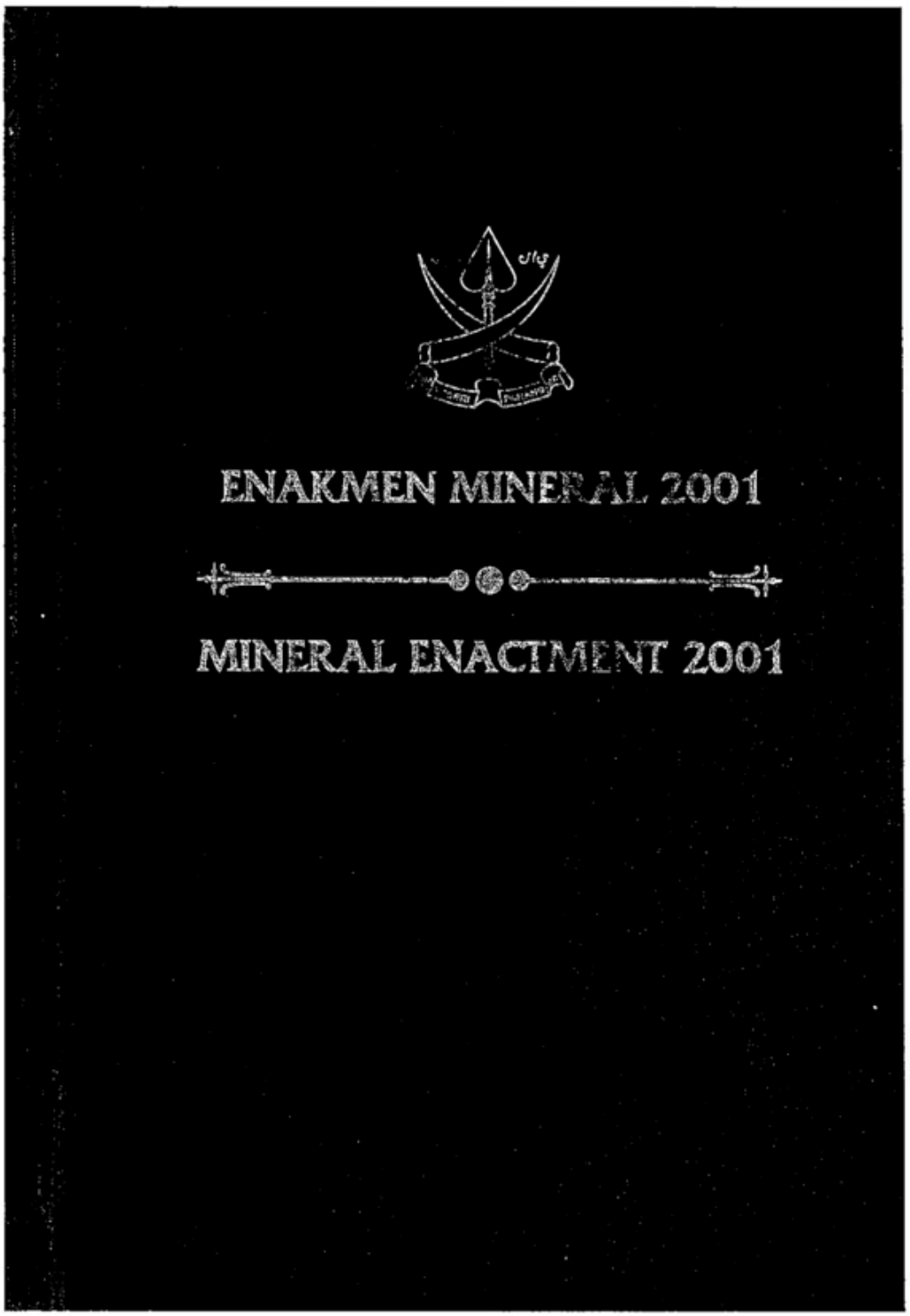
2009				
Mineral	Production (Tonnes)	Value (RM Million)	No. of Mines	No. of Workers
Metallic Mineral				
Tin	2,410	113.44	31 (x)	1,051
Bauxite	263,432	9.22	2	80
Gold (kg)	2,794	307.55	12	1,363
Ilmenite	15,983	4.00	N/A	N/A
Iron Ore	1,470,186	147.02	31	642
Manganese	468,963	98.48	7	173
Associated Minerals (+)	2,848	5.97	N/A	N/A
Non-Metallic Mineral/ Industrial Mineral				
Aggregates	86,497,394	1,381.00	296	N/A
Clays	22,966,036	158.70	1,333	N/A
Feldspar	410,053	33.91	3	81
Kaolin	487,632	36.77	16	365
Limestone	22,165,099	181.27	9	N/A
Mica	4,324	2.38	3	27
Sand & Gravel	17,382,050	246.45	847	N/A
Silica sand	630,394	26.79	3	158
Barytes	22,390	7.72	3	14
Energy Mineral				
Coal	2,138,390	320.76	10	584

2008				
Mineral	**Production (Tonnes)**	**Value (RM Million)**	**No. of Mines**	**No. of Workers**
Metallic Mineral				
Tin	2,605	132.49	36 (x)	882
Bauxite	275,069	25.58	2	60
Gold (kg)	2,489	172.73	7	900
Ilmenite	36,779	8.57	N/A	N/A
Iron Ore	981,932	117.83	17	357
Manganese	536,675	82.07	6	173
Associated Minerals (+)	3,267	6.35	N/A	N/A
Non-Metallic Mineral/ Industrial Mineral				
Aggregates	75,883,364	1,157.59	289	N/A
Clays	25,065,218	175.11	1,327	N/A
Feldspar	457,377	30.05	5	75
Kaolin	419,157	30.18	19	419
Limestone	23,852,825	176.28	9	N/A
Mica	5,593	3.08	3	35
Sand & Gravel	24,471,877	318.15	908	N/A
Silica	345,477	21.01	4	158
Energy Mineral				
Coal	1,166,524	160.34	6	545

Sources: Department of Minerals and Geoscience, Malaysia; Department of Statistics, Malaysia.

Appendix C

Pahang Mineral Enactment 2001



"environmental impact assessment" means a report made in accordance with guidelines published by the Director General of Environmental Quality appointed under section 3 of the Environmental Quality Act 1974 [*Act 127*], containing an assessment of the impact a mining operation will have or is likely to have on the environment and the proposed measures that shall be undertaken to prevent, reduce or control the impact on the environment;

"exploration area" means any land in respect of which an exploration licence is for the time being in force;

"exploration licence" means an exploration licence issued under section 41;

"explore" means to search for mineral deposits and includes prospecting;

"fossick" means to search for and to extract minerals by using simple implements and to remove the minerals as samples, specimens or lapidary work without any intention to sell the minerals;

"fossicking licence" means a fossicking licence issued under section 21;

"individual mining licence" means an individual mining licence issued under section 35;

"Land Administrator" means a Land Administrator appointed under section 12 of the National Land Code and includes an Assistant Land Administrator appointed thereunder; and in relation to this Enactment, references to the Land Administrator shall be construed as references to the Land Administrator, or any Assistant Land Administrator, having jurisdiction in the district or sub-district in which the mineral tenement apply;

"large scale operation" means a mining operation within a mining lease area—

(a) which exceeds any of the following production limits:

(i) in the case of extraction of minerals from primarily alluvial deposits, annual throughput of 3.5 million cubic metres per year;

(ii) in the case of underground mining operations, annual combined run-of-mine ore, waste and overburden production of 100,000 tonnes per year (waste material not exiting mine mouth to be excluded); or

(iii) in the case of open-cast mining operations extracting minerals from primarily non-alluvial deposits, annual combined run-of-mine ore, waste and over-burden production of 300,000 tonnes per year;

(b) with a capital and infrastructure investment exceeding one hundred and fifty million ringgit;

(c) with more than 250 employees or workers at the mine site on a typical day (including all shifts); or

(d) which uses any of the following mining practices:

(i) extensive and continued use of explosives;

(ii) continuous flotation circuits; or

(iii) extensive and continued use of toxic chemicals or agents;

"member" means a member of the Committee;

"mine", when used as a noun, means any place, excavation or working wherein, whereon or whereby any operation connected with mining is carried on together with all buildings, premises, erections, water reservoirs, tailing ponds, waste, other dumps and appliances belonging or appertaining thereto above or below the ground or in or below the sea for the purpose of winning, obtaining or extracting any mineral by any mode or method or for the purpose of dressing, treating or preparing minerals ores;

"mine rehabilitation plan" means a rehabilitation plan approved under section 126;

"mineral" means any substance whether in solid, liquid or gaseous form occurring—

(a) naturally;

(b) as a result of mining in or on the earth; or

(c) as a result of mining in or under the sea or sea bed,

"Settlement Officer" means the Settlement Officer appointed under section 12 of the National Land Code;

"small scale operation" means a mining operation other than a large scale operation;

"specimen" means a fraction of naturally occurring matter not necessarily representative of the mass of which it forms a part;

"State Authority" means the Ruler or the State Executive Council, as the case may be;

"Superintendent of Mines" means the Superintendent of Mines appointed under section 7;

"Survey Officer" means the Chief Survey Officer or any Survey Officer appointed under section 12 of the National Land Code;

"to mine" means intentionally to win minerals and includes any operation directly or indirectly and necessary therefor or incidental thereto, and "mining" shall be construed accordingly;

"to pan" means to wash or sift with a pan, dulang or rake for the purpose of obtaining minerals;

"treat" means to subject to any process whereby chemical or physical change takes place in the substance subjected thereto;

"waste" includes any discarded overburden material, tailing, any intermediate product from mining or mineral processing stockpiled for further operations, water treated or stored in mining or mineral processing, and any chemical substance temporarily or permanently withdrawn from such operations;

"water licence" means a water licence issued under section 100;

"water permit" means a water permit issued under section 101.

(2) Subject to subsection (1) and unless the context otherwise requires, all words and expressions used in this Enactment which are defined in the National Land Code shall be deemed to have the meaning assigned to them by that Code.

Minerals vested in the State Authority

3. There is and shall be vested solely in the State Authority all minerals within or upon any land, including so much of the bed of any river, and of the foreshore and bed of the sea, as is within the territories of the State or the limits of the territorial waters if they have not been specifically disposed of by the State Authority in accordance with the provisions of this Enactment or any other written law.

PART II

ADMINISTRATION

Chapter 1—State Mineral Resources Committee

Establishment of Committee

4. (1) There shall be established a committee to be known as the State Mineral Resources Committee.

(2) The Committee shall consist of the following members:

(a) a Chairman who shall be appointed by the State Authority;

(b) the State Legal Adviser or his authorised representative;

(c) the Director who shall be the Secretary;

(d) the Director General of Mineral and Geoscience or his authorised representative;

(e) the Director General of Environmental Quality or his authorised representative;

(f) the Director General of Forestry Peninsular Malaysia or his authorised representative;

(g) the Director of State Economic Planning Unit or his authorised representative; and

(h) three other members who shall be appointed by the State Authority:

Lease shall be indefeasible

123. The granting of a mining lease under this Enactment over State land to any person shall confer on the person a lease of the land which shall be indefeasible as provided in Part Twenty of the National Land Code.

Saving in respect of mining lease or certificate

124. Every mining lease or mining certificate subsisting at the commencement of this Enactment shall continue to be in force under the Mining Enactment Federated Malay States Chapter 147 under which it was issued until the expiration thereof.

Inspection of registers

125. Any person shall, upon payment of the prescribed fee, be permitted to inspect any register referred to in section 115 during the hours and on the days appointed by the Director or the Superintendent of Mines, as the case may be.

PART X

REHABILITATION

Rehabilitation plan for mining lease authorising large scale operation

126. (1) Every lessee of a mining lease authorising a large scale operation shall submit to the Director—

(a) a mine rehabilitation plan; and

(b) upon application for a renewal of such lease, a modified mine rehabilitation plan,

for approval by the Committee.

(2) The mine rehabilitation plan shall provide for specific rehabilitation actions, inspections, annual reports, estimated total cost for rehabilitation, cost estimates for each specific rehabilitation action and a detailed timetable for the orderly and efficient rehabilitation of the mining land.

(3) The Committee shall, within a reasonable time from the submission of the mine rehabilitation plan under subsection (1), approve or reject such plan, and shall notify the lessee of its decision.

(4) Any lessee whose mine rehabilitation plan has been rejected under subsection (3)—

(a) may submit such number of mine rehabilitation plans as may be necessary in order to obtain the approval of the Committee; or

(b) may appeal against the rejection, within sixty days of notification of the decision under subsection (3), to the State Authority whose decision thereon shall be final.

(5) Where the lessee intends to modify a mine rehabilitation plan approved under this section, the lessee shall submit the proposed modified rehabilitation plan to the Committee for approval.

(6) Where any mining lease authorising a large scale operations is renewed, no mining shall proceed until a modified mine rehabilitation plan has been approved under this section.

(7) Where a mining lease authorising a small scale operation is altered to authorise a large scale operation under section 63, no large scale operation shall commence on the land until a mine rehabilitation plan has been approved under this section.

Mine Rehabilitation Fund

127. (1) There shall be established a Mine Rehabilitation Fund for the purpose of rehabilitation of mining lands which are subject to mining leases authorising large scale operations.

(2) The Fund shall be administered by the Committee.

(3) The lessee shall pay into the Fund—

(a) where the term of the mining lease authorising large scale operations exceeds ten years—

(i) an initial amount of ten per cent of the estimated total cost for rehabilitation specified in the mine

rehabilitation plan before the commencement of development work but not later than one year from issuance of the lease:

Provided that where a mining lease authorising a small scale operation is altered to authorise a large scale operation, the initial amount shall be paid before the commencement of the large scale operation; and

(ii) annual payments, nine months thereafter, of one tenth of the estimated total cost for rehabilitation specified in the rehabilitation plan; or

(b) where the term of the mining lease authorising a large scale operation is less than ten years—

(i) an initial amount equal to the estimated total cost for rehabilitation specified in the rehabilitation plan divided by the term of the lease before the commencement of development work but not later than one year from issuance of the lease:

Provided that where a mining lease authorising a small scale operation is altered to authorise a large scale operation, the initial amount shall be paid before the commencement of the large scale operation; and

(ii) annual payments, each year thereafter, equal to the estimated total cost for rehabilitation specified in the rehabilitation plan divided by the term of the lease.

(4) Where at any time after the issuance of the mining lease the Committee determines that the estimated total cost to implement the approved mine rehabilitation plan is excessive or insufficient, it may—

(a) refund any excess amount to the lessee; or

(b) require the lessee to deposit an additional amount as it may specify,

as the case may be.

(5) Where the mining lease is renewed, the lessee shall pay into the Fund such annual amounts as may be specified in the modified mine rehabilitation plan.

(6) The Committee may specify the manner of collection of payments under subsection (3).

(7) The State Legislative Assembly may appropriate such sum as it deems necessary to be deposited into the Fund which sum shall be subtracted from the estimated total cost for rehabilitation payable by the lessee under subsection (3).

(8) Any sum deposited into the Fund under section 131 shall be subtracted from the estimated total cost for rehabilitation payable by the lessee under subsection (3).

(9) Any money paid into the Fund shall be deposited in any bank duly licensed under the Banking and Financial Institutions Act 1990 [*Act 312*].

(10) The Fund and any sum accruing therefrom shall be used only for the implementation of the rehabilitation plan to which it relates and the Committee may, for the implementation of the mine rehabilitation plan, authorise payments from the Fund to the lessee, or other party so designated in the rehabilitation plan.

(11) The Committee shall—

(a) keep proper accounts and other records in respect of the operations of the Fund;

(b) cause to be prepared a statement of accounts in respect of each financial year; and

(c) cause its accounts to be audited annually by the Auditor-General.

(12) The lessee shall implement and perform the obligations described in the mine rehabilitation plan during the term of the mining lease.

(13) Where the mine rehabilitation plan has been fully implemented and completed to the satisfaction of the Committee, any sum remaining in the Fund shall be refunded to the lessee.

(14) In this section, "Fund" means the Mine Rehabilitation Fund established under subsection (1).

Non-payment into the Mine Rehabilitation Fund

128. (1) Where the lessee fails to pay the sum payable into the Mine Rehabilitation Fund under subsection 127(3) within the time prescribed, the Committee shall—

(a) serve or cause to be served on the lessee a notice of demand in such form and in such manner as may be prescribed; and

(b) forward a copy of the notice to the Director who shall, upon receipt of the notice, cause a note of the service of the notice to be endorsed on the document of mining lease to which it relates.

(2) If the whole of the sum demanded under paragraph (1)*(a)* is paid to the Committee within the time specified therein—

(a) the notice shall thereupon cease to have effect; and

(b) the note endorsed pursuant to paragraph (1)*(b)* on the document of mining lease shall be cancelled accordingly.

(3) If by the end of the period specified in the notice of demand the whole of the sum demanded under paragraph (1)*(a)* has not been paid to the Committee, the Committee shall notify the State Authority of such default, and upon receipt of such notification, the State Authority shall by order declare the mining land in respect of which the mining lease has been granted forfeited to the State Authority and the provisions of sections 78 and 79 shall apply.

Common Rehabilitation Fund

129. (1) There shall be established a Common Rehabilitation Fund for the purpose of rehabilitation of mining lands which are subject to mining leases authorising small scale operations.

(2) The Fund shall be administered by the Committee.

(3) There shall be paid into the Fund—

(a) such sum as may be annually appropriated by the State Legislative Assembly for the purposes of the Fund;

(b) any loan or grant given to the State Authority by the Federal Government for the purposes of the Fund; and

(c) the rehabilitation fee payable under subsection (4).

(4) For the purposes of the Fund, every holder of a mining lease authorising a small scale operation shall pay into the Fund—

(a) an annual fee at the rate of one percent of the gross sales value of all minerals won during a calendar year from the mining land that is subject to the lease; or

(b) a prescribed annual fee,

whichever is greater.

(5) Subsection (4) shall not apply to any lessee who is permitted to alter mining operation from a large scale operation to a small scale operation.

(6) Any money paid into the Fund and any sum accruing therefrom—

(a) shall be deposited in any bank duly licensed under the Banking and Financial Institutions Act 1990; or

(b) may be invested in accordance with the provisions of the Trustee Act 1949 [*Act 208*].

(7) The Fund shall be used for the following purposes:

(a) the preparation by the Committee of rehabilitation plans for—

(i) any land, other than alienated land, affected by mining before this Enactment comes into force; or

(ii) any State land or reserved land affected by mining after this Enactment comes into force; and

(b) the implementation of any plan referred to in paragraph *(a)* that is approved by the Committee.

(8) The Committee shall—

(a) keep proper accounts and other records in respect of the operations of the Fund;

(b) cause to be prepared a statement of accounts in respect of each financial year;

(c) cause its accounts to be audited annually by the Auditor-General; and

(d) as soon as the accounts of the Fund have been audited, but not later than six months after the end of the financial year, cause a copy of the audited statement of accounts to be transmitted to the State Authority together with a copy of any observation made by the Auditor-General on the statement or the accounts.

(9) A copy of the statement and observations transmitted to the State Authority under paragraph (8) *(d)* shall be laid before the State Legislative Assembly as soon as practicable after its transmission.

(10) The Committee shall keep a record of the mining leases authorising small scale operation which are not in compliance with the provisions of subsection (4) and annually provide copies of such record to the State Authority and the Director.

(11) The fee payable under subsection (4) shall be payable in such manner as may be prescribed.

(12) In this section, "Fund" means the Common Rehabilitation Fund established under subsection (1).

Non-payment into the Common Rehabilitation Fund

130. (1) Where the lessee fails to pay the sum payable into the Common Rehabilitation Fund under subsection 129(4) within the time prescribed, the Committee shall—

(a) serve or cause to be served on the lessee a notice of demand in such form and in such manner as may be prescribed; and

(*b*) forward a copy of the notice to the Director who shall, upon receipt of the notice, cause a note of the service of the notice to be endorsed on the document of mining lease to which it relates.

(2) If the whole of the sum demanded under paragraph (1)(*a*) is paid to the Committee within the time specified therein—

(*a*) the notice shall thereupon cease to have effect; and

(*b*) the note endorsed pursuant to paragraph (1)(*b*) on the document of mining lease shall be cancelled accordingly.

(3) If by the end of the period specified in the notice of demand the whole of the sum demanded under paragraph (1)(*a*) has not been paid to the Committee, the Committee shall notify the State Authority of such default, and upon receipt of such notification, the State Authority shall by order declare the mining land in respect of which the mining lease has been granted forfeited to the State Authority and the provisions of sections 78 and 79 shall apply.

Rehabilitation requirements when altering mining lease authorising small scale operations to mining lease authorising large scale operations

131. Where a mining lease authorising small scale operations is altered to a mining lease authorising large scale operations under section 63—

(*a*) the provisions of sections 126 and 127 shall apply after the authorisation to conduct large scale operations is granted;

(*b*) the lessee shall have no further obligation under section 129; and

(*c*) the Committee may transfer to the Mine Rehabilitation Fund established under section 127 such sum as the lessee has paid into the Common Rehabilitation Fund under section 129.

Rehabilitation requirements when altering mining lease authorising large scale operations to mining lease authorising small scale operations

132. Where a mining lease authorising large scale operations is altered to a mining lease authorising small scale operations under section 63—

(a) the lessee shall submit a modified rehabilitation plan for approval by the Committee; and

(b) the lessee shall continue his obligation under section 127 in accordance with the modified rehabilitation plan.

PART XI

ENFORCEMENT, INVESTIGATION, EVIDENCE, OFFENCES AND PENALTIES

Chapter 1 - Enforcement and Investigation

Enforcement by authorised officer

133. An authorised officer may for the purpose of enforcing this Enactment—

(a) call for and examine any book, document, instrument or record and make copies of or take extracts from such book, document, instrument or record which is in the custody or control of any person pertaining to any matter under this Enactment;

(b) visit, enter, inspect and examine with or without previous notice any fossicking, panning, exploration or storage facility area or mine or mineral processing plant at any time but shall not unnecessarily obstruct or impede any work therein;

(c) investigate in respect of any fossicking, panning, exploration or storage facility area or mine or mineral processing plant concerning—

(i) the state and condition of any such area or plant;

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