Guidelines for Minimising Impacts of Sand Mining on Quality of Specific Rivers in Sabah

August 2011
GUIDELINES FOR MINIMISING IMPACTS OF SAND MINING
ON QUALITY OF SPECIFIC RIVERS IN SABAH

Published by

Environment Protection Department
Ministry of Tourism, Culture and Environment
Kota Kinabalu, Sabah
Preparation and printing of the guidelines is funded by the Federal Government through Sabah Economy Development and Industry Authority

First Edition: August 2011

FOREWORD

The 'Guidelines for Minimising Impacts of Sand Mining on Quality of Specific Rivers in Sabah' has been produced by the Environment Protection Department, Ministry of Tourism, Culture and Environment, Sabah, as part of the project on 'Impact Study of Palm Oil Mills, Oil Palm Plantations and Other Pollutants on the Quality of Selected Rivers in Sabah', which focused on five rivers in Eastern Sabah.

These guidelines aim to provide guidance to government agencies, the sand mining operators and relevant stakeholders on how to minimize impacts on rivers by the sand mining activities and subsequently enhance the water quality of rivers in Sabah. These guidelines take a multi-pronged approach and tackle issues like regulatory/institutional requirements, development planning/site selection, Best Management Practices (BMPs) for sand mining operators, appropriate extraction methods, monitoring and community engagement as well as undertaking closing plans and rehabilitation works. The best management practices promoted are based on industry experience throughout Malaysia and elsewhere. We believe that the implementation of best management practices will not only minimise pollution but will also enhance performance and productivity of the sand mining operators – resulting in a win-win situation.

I would like to record my gratitude and appreciation to all agencies and individuals for their invaluable contribution and continued support.

Yabi Yangkat
Director of Environment Protection Department, Sabah
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<tr>
<td>ACLR</td>
<td>Assistant Collector Land Revenue</td>
</tr>
<tr>
<td>BMP</td>
<td>Best Management Practices</td>
</tr>
<tr>
<td>DID</td>
<td>Department of Irrigation and Drainage</td>
</tr>
<tr>
<td>EIA</td>
<td>Environmental Impact Assessment</td>
</tr>
<tr>
<td>EPD</td>
<td>Environment Protection Department (State of Sabah)</td>
</tr>
<tr>
<td>GIS</td>
<td>Geographic Information System</td>
</tr>
<tr>
<td>HQ</td>
<td>Headquarters</td>
</tr>
<tr>
<td>JMG</td>
<td>Mineral and Geosciences Department (Jabatan Mineral dan Geosains)</td>
</tr>
<tr>
<td>JUPEM</td>
<td>Department of Survey and Mapping Malaysia (Jabatan Ukur dan Pemetaan Malaysia)</td>
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<tr>
<td>LSD</td>
<td>Lands and Surveys Department</td>
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<tr>
<td>MASMA</td>
<td>Manual Baru Saliran Mesra Alam</td>
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<tr>
<td>OSC</td>
<td>One Stop Centre</td>
</tr>
<tr>
<td>PMM</td>
<td>Proposal for Mitigation Measures</td>
</tr>
<tr>
<td>PVC</td>
<td>Polyvinyl Chloride</td>
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<tr>
<td>TOL</td>
<td>Temporary Occupation License</td>
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INTRODUCTION

1.1 PURPOSE

The purpose of this guideline is:

- To guide government agencies and local authorities in minimizing and monitoring impacts of river sand mining on the quality of specific rivers in Sabah; and

- To guide sand mining operators in implementing Best Management Practices (BMPs) and appropriate extraction methods, carrying out monitoring and community engagement as well as undertaking closing plans and rehabilitation work.

The geographic scope is focused on the middle reaches of the Segama River in Eastern of Sabah.

1.2 BACKGROUND

The study on the impact of polluting activities on water quality of specific rivers in Sabah has identified sand mining as one of the important pollution sources contributing to the degradation of the water quality of the Sg. Segama one of the specific rivers studied. Most of the sand mining activities were located in the middle stretch of the river at the time of the study.

In Sabah, river sand mining is carried out mainly for two purposes, namely, development requirements for road construction, building materials as well as channel deepening for flood control and ensuring adequate flow for water intake.
points. In-stream sand mining is the only method used in the targeted rivers. However, this practice has become an environmental issue as the demand for sand has increased for industry and construction activities in recent years.

In-stream sand mining can adversely impact water quality of the particular river extraction point as well as causing indirect adverse impacts to the aquatic habitats. Excessive removal of sand may significantly distort the natural equilibrium of a stream channel. By removing sediment from the active channel bed, in-stream mining interrupts the continuity of sediment transport through the river system, disrupting the sediment mass balance in the river downstream and inducing channel adjustments (usually incision) extending considerable distances (commonly 1 km or more) beyond the extraction site itself.

1.3 ISSUES

Several common issues derived from the sand mining activities are as follows:

**Channel erosion** – In-stream mining has been known to alter the geometry of the river channel thus promoting scouring and erosion. Although erosion of riverbanks is naturally occurring phenomena, it is known that sand mining activities accelerate the problem. Extraction of bed material in excess of replenishment by transport from upstream causes the bed to lower (degrade) upstream and downstream of the site of removal. Bed degradation can also undermine bridge supports, pipelines or other structures. Degradation may change the morphology of the riverbed, which constitutes one aspect of the aquatic habitat.

**Water quality** – Mining activities impact water quality through increased turbidity by re-suspension of sediment as well as through oil spills due to leakages from machinery used in the activities. Thus water quality may be adversely impacted particularly for downstream beneficial users. Loss of areas to be used as fishing, navigation, eco-tourism and leisure can also an issue.

**Ecological impact** – Mining activities can alter the ecology of a stream by disrupting the food chain or by destroying habitats of affected areas. The photosynthetic abilities of benthic organisms may also affected when turbidity due to the mining increases. If a floodplain aquifer drains to the stream, groundwater levels can be lowered as a result of bed degradation. Lowering of the water table can destroy riparian vegetation.
Nuisance factors – Mining activities are also associated with problems related to transportation of materials from site resulting in dust dispersion, noise, increased traffic density and damage to roads.
Although the sand mining activity is governed by the State Enactments as listed below, up till now there have been problems with implementation, partly driven by the increasing demand for sand and river stone used for construction activities. In Sabah, water quality protection is exercised by a combination of Federal, State and local Government authorities. However, the Federal agencies only focus on selected point sources of pollution while the state agencies focus on land management and non-point sources. The applicable State legislations are described in the following sections:

2.1 SABAH LAND ORDINANCE 68

The Sabah Land Ordinance (Section 23) and Sabah Land Rule 3, has highlighted that any extraction activities (to occupy and extract any timber or other forest produce or any earth, gravel, stones, coral, shell, guano, sand, loam or clay, or any bricks, lime, cement or other commodities manufactured from the materials aforesaid) need to obtain license(s) from the State Government. The relevant State agencies which are involved in the issuance of approvals and licenses are the EPD, DID and LSD respectively. The LSD issues a license through the Assistant Collector Land Resources (ACLR) to an applicant for the removal of stone, earth and river sand from State land and alienated land under Section 23 (A) of Land Ordinance 1930 and land rule 3 (2). The EPD requires an EIA approval prior to project commencement as it falls under the Second Schedule of the Environment Protection (Prescribed Activities) (Environmental
Impact Assessment) Order 2005. The Director of DID may issue a written approval for the removal of materials from a river or river reserve under Section 41 of the Water Resources Enactment 1998.

2.2 ENVIRONMENT PROTECTION ENACTMENT 2002

This Enactment makes provisions relating to the protection of the environment. It allows for the State to impose the need to prepare and obtain approval for an Environmental Impact Assessment (EIA) Report or a Proposal for Mitigation Measures (PMM) for any activity (non-prescribed) that has or likely to have an adverse impact on the environment. Any Government authority can also insist on an EIA to be carried out for an activity under their jurisdiction for the same purpose. The control of pollution-causing activity or one likely to cause pollution can also be controlled via the issuance of a license. Thus, the State is able to impose any measure or condition necessary for the protection of the environment in connection with any activity including:

‘Item 20 (d): excavation or dredging in water courses or altering the source and course of banks or streams’.

Item 32 of the Enactment also adds that ‘no person shall discharge any pollutant into the water or any pollutant onto or into any land that can result in pollutant entering the water in a manner that has or is likely to have a significant adverse impact on the environment’.

The Enactment also provides for the State to provide rules for an activity such as sand mining in the State, thus, making such an activity able to be governed effectively by law. Penalties can range from prohibition notices to fines to imprisonment to compounds.
2.3 ENVIRONMENT PROTECTION (PRESCRIBED ACTIVITIES) (EIA) ORDER 2005

Under the Second Schedule of the Environment Protection (Prescribed Activities) (Environmental Impact Assessment) Order 2005, this activity is listed as a prescribed activity under ‘item 9 (iii): Excavation or dredging of sand or rock materials from water courses, streams, rivers, coastal area or sea for commercial or construction purposes’, whereby an EIA study should be carried out by the applicants and approval from the Department is required prior to the commencement of the proposed Project.

2.4 SABAH WATER ENACTMENT RESOURCES, 1998

This Enactment provides for the sustainable management of water resources in the State of Sabah to promote orderly, equitable and efficient use of water and to maximize its economic, social and environmental benefits for the future. The establishment of river reserves is provided for in Section 40 of this Enactment which states that ‘river reserves are to be established on land which is within 20m of the top of the bank of every river, including its estuary, where the channel is not less than 3m wide’. River reserves can also be established in river channels less than 3m wide for the purpose of protection of volume and flow of water in water bodies which prevents the degradation of the quality of the water resources. Section 41 of the Enactment then states that ‘it is an offence to undertake any activity that involves the removal of natural vegetation or the removal or deposition of materials and the carrying out of commercial or agricultural activity without the approval of the State’. This is directly applicable in governing the operations of sand mining activities in the State and also allows the State to cease or relocate such activities if it degrades the water quality of the water body. Penalties imposed on the person carrying out such activity include fines, imprisonment and prohibition orders.

Recognising the need to better govern the activity, the LSD has recently formulated new application procedures (Figure 2.1) incorporating the requirements of EPD and JMG for application of sand mining in Sabah. The application procedures clearly state the processes for sand mining under TOL or Short Term Lease on State Land and application for sand mining on titled land. Both the procedures are similar, whereby applications shall be made in writing to the LSD for a license to remove stone, earth and sand from State land or alienated land through the ACLR in accordance to Section 23 of Land Ordinance.
and Sabah Land Rule 3(2). For sand mining within State land, draft approval of the land application is given to the applicants as the right to occupy. However, for the issuance of the TOL, the applicants must meet the aforesaid requirements. The Temporary Occupation License (T.O.L.) shall only be granted when applicants meet the requirement to conduct an EIA study and obtain the approval from the EPD.

(Source: Lands and Surveys Department, Sabah)

Figure 2.1: Procedure for River Sand Mining Licence Application

With the new procedures, it is anticipated that the TOL can be issued within 6 – 12 months. The duration is to provide sufficient time for the applicants to meet the EIA requirements for approval. A One Stop Centre (OSC) meeting conducted at the Headquarters (HQ) level weekly will help to expedite the approval process.
3

SITE SELECTION AND ASSESSMENT

3.1 INTRODUCTION

In determining suitable sites for sand mining extraction the following factors should be considered:

- The site must be at least 500 m away from the nearest sensitive receptor such as water intake points, fish breeding areas, irrigation areas and river sections used for navigation, recreational areas or riverine settlement including the following:
  - High risk channel erosion area;
  - Sites known to be important fish breeding grounds;
  - Gazetted environmentally-sensitive areas;
  - Water supply intake-points for potable or irrigation water; and
  - Proximity to burial reserves.

- The extraction rate of the sand must not exceed the replacement rate of the accreting channel and may not be more than the determined maximum extractable depth.

- Shallow and fast flowing river sections with steep channel slopes should be avoided.

- Avoid interference with human activities.

- Avoid sections of the river used for navigation, recreation or fishing.
• Avoid any areas with settlements along riverbanks (within 500 m of the bank or assessed as high erosion risk areas).

• Extraction should not be carried out in fast flowing river sections and must be confined to the designated and demarcated areas.

• The Processing areas must be away from the river reserve.

3.2 SAND MINING POLICY AND GUIDELINE

The following policies should be taken into consideration before approving sand mining permits:

• Ensure conservation of the river equilibrium and its natural environment.

• Avoid inducing erosion at the downstream reaches especially in areas with hydraulic structures such as jetties, water intakes etc.

• Ensure the rivers are protected from bank and bed erosion beyond its stable profile.

• Avoid interference with the river maintenance work by Department of Irrigation and Drainage (DID) or other agencies.

• No obstruction to the river flow and water transport.

• Avoid pollution of river water leading to water quality deterioration.

The general guidelines for sand and gravel mining are as follows:

• Parts of the river reaches that experience deposition or aggradation shall be identified first. Operators may be allowed to extract the sand deposits in these locations to lessen siltation or aggradation problems.

• The distance between sites for sand mining shall depend on the replenishment rate of the river. Sediment rating curve for the potential sites shall be developed and checked against the extracted volumes of sand.

• Sand may be extracted across the entire active channel during the dry season (June to November).
• Layers of sand which could be removed from the river bed shall depend on the width of the river and replenishment rate of the river (refer Figure 3.1).

• Sand shall not be allowed to be extracted where erosion may occur, such as at the concave bank.

• Sand and gravel shall not be extracted within 1,000 meter from any crucial hydraulic structure such as pumping station, water intakes, bridges, buildings and such structures.

• Sand mining could be extracted from the downstream of the sand bar at river bends. Retaining the upstream one to two thirds of the bar and riparian vegetation is accepted as a method to promote channel stability.

• Flood discharge capacity of the river could be maintained in areas where there are significant flood hazards to existing structures or infrastructure. Sand mining may be allowed to maintain the natural flow capacity based on surveyed cross-section history.
Figure 3.1 outlines the process required in determining the locations, periods and quantity for sand and gravel mining.

Figure 3.1: Volume Extraction Determination Using Sediment Rating Curve
Guidelines issues by The Federal Department of Irrigation and Drainage (DID) specify setbacks and mining envelopes for in-stream mining.

The excavation must be setback for distance with a minimum of 10 m from the main channel bank toward the flow channel. The stockpile must be located beyond 30 m from the main channel bank.

The minimum depth of the excavation or the maximum allowable mining depth is 1.5 m from the sand surface and may not be deeper that the specified redline which must be at least 1 m above the natural channel thalweg or base level elevation as determined by the survey approved by DID as shown in Figure 3.2.

(Source: River Sand Mining Guidelines, DID)

Figure 3.2: Setback, “redline” and Maximum Allowable Mining Depth for In-Stream Mining by the National DID, Malaysia
3.4 SETBACKS AND MINING ENVELOPE LEVELS FOR IN-STREAM MINING BY THE DID SABAH (STATE)

Sabah State DID in its guidelines for river sand mining has mentioned that extraction of sand can only be carried out on 1/3 of the river and the allowable portion of extraction is the middle third of the river (refer Table 3.1 and Figure 3.2).

The depth of extraction from the base of the river is dependent on the width of the river and the amount to be extracted as well as the replenishment rate of the sand. Figure 3.3 illustrates the width of river in relation to its allowable depth of extraction.

Table 3.1: Allowable Depth of Sand Extraction

<table>
<thead>
<tr>
<th>Width of River</th>
<th>Allowable Depth of Sand Extraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 10 metres</td>
<td>Not Allowed</td>
</tr>
<tr>
<td>Between 10 and 20 metres</td>
<td>0.5 metres</td>
</tr>
<tr>
<td>Between 20 and 50 metres</td>
<td>1.0 metres</td>
</tr>
<tr>
<td>More than 50 metres</td>
<td>1.5 metres</td>
</tr>
</tbody>
</table>

(Source: Sabah State DID, Guidelines for River Sand Mining)

Figure 3.3: Setback, Allowable Mining Portion for In-Stream Mining by the State DID, Sabah
It should be noted that the State DID Sand Mining guidelines are more stringent than those of the Federal DID and so should generally take precedence over the federal guidelines.

The following Figure 3.4 illustrates the typical layout of river sand mining operation.

(Source: EIA for proposed Sand Mining at Sg. Segama, Envsolve, 2011)

Figure 3.4: Typical Layout Plan of River Sand Mining Operations
4

RECOMMENDED MANAGEMENT PRACTICES

4.1 INTRODUCTION

This chapter outlines best management practices and addresses good operational elements to minimise impacts for the following aspects in sand mining operations:

- Operational practices;
- Stockpiling management;
- Processing Site/Maintenance yards;
- Appropriate Transportation Methods;
- Fuel storage/solid waste; and
- Practical BMPs and their effective implementation.

The most common method of river sand mining in the east coast region of Sabah is the suction dredging method. Other methods, i.e. dredger, excavators or manual removal may not be appropriate due to the dynamic of the river flow, current and size of the river itself. Methods with high capital investment may not be popular amongst the operators.

Suction dredging is commonly used due to its operation size, and the life span of the activities, which is rather short and periodical depending on the demand of sand. The sand extracted is normally for supply within the east coast region,
where development is not as robust as the west coast therefore sand extraction is relatively active when there is demand. This method however promotes environmental degradation; generally polluting the river by increasing the total suspended solids and in some cases oil contamination.

A typical illustration of River Sand Mining Operation in East Coast Region of Sabah is shown in Plate 4.1 – Plate 4.3.

Plate 4.1: Suction dredging is a common practice for river sand mining in the Eastern Sabah.

Plate 4.2: Dredged material is pumped into a pit for washing.

Plate 4.3: Sand is washed using water from river, segregating sand from pebbles, organic matter and debris. Silted run-off may pass through a pond prior to discharge into the river.

The following subsections illustrate the best management practices that can be adhered to in order to minimise the impacts.
4.2 OPERATIONAL PRACTICES

- Mining must be confined to one side of the river and should avoid the concave (i.e. erosion prone) side of the river;
- The use of river reserve as dumping area must be prohibited; the river itself should not be used as dumping area;
- Machinery and transportation vehicles used in the operations must be maintained well and be free of any leakages;
- Mining activities should be avoided after heavy rain events and at night times;
- Impacts on river water quality must be minimised by construction of sedimentation ponds with adequate peak run off control;
- De-silted materials must be placed away from the riverbank;
- Dry stockpiles must be covered;
- Vehicles transporting washed sand must maintain speed to not more than 30km/hr, be covered to avoid spilling on public roads and should travel on non-peak hours;
- Site office and workers quarters must be equipped with proper sanitation facilities. No direct discharge of sewage or sullage must be allowed into the river course;
- Proper waste collection bins must be provided; and
- Working areas must be made good after operations.

4.3 STOCKPILING MANAGEMENT

- Sand stockpiles must be located more than 30m away from the river bank to prevent the sand stockpile from being washed away if the river water level rises or during heavy rain;
- Organic matter, debris, pebbles stockpile must be located more than 30m away from the river bank, to prevent it from being washed away when the river rises;
- The Stockpile area should be screened with zinc hoarding or any other appropriate materials, with an approximate height of 2-2.5 m; and

- Sand should be washed using water from river, segregating sand from pebbles, organic matter, and debris. The washing water should be stored in a pond prior to discharge into the river.

Case 1: During the project period - assessments of sand mining along the Segama River observed that in most cases stockpiles of both sand and waste material (pebbles, debris, and organic matter) are normally placed near to the edge of the river. There is a danger that such stockpiles will be washed away during floods or heavy rainfall periods.

Plate 4.4: Good practice with sand stockpile more than 30m from the river bank.

Plate 4.5: Sand is dredged and piled up on the riverbank.

Plate 4.6: Poor practice with sand stockpiled too close to the edge of the river.
4.4 PROCESSING SITE AND MAINTENANCE YARD

- No discharge of oily wastewater directly into the river;

- Wherever skid tank is used for fuel storage, it should be surrounded by a bund and underlain with concrete flooring to prevent any spillages reaching the river;

- Equipment, machinery and transportation leaving the site should always be clean and if applicable, provision made for a wheel washing facility to clean tyres prior to entering public roads;

- A maintenance yard should be concreted with perimeter drainage to collect oily waste; and

- Overburden from mining activities is not allowed to be dumped on the riverbank or riverine reserve (not less than 30m from the bank of the river).

Plate 4.7: Skid tank properly bunded and with concrete flooring.

Plate 4.8: Workshop/maintenance yard is concreted with perimeter drainage to collect oil residue.
4.5 CONTROLLING RUN-OFF AND DISCHARGE

River sand mining activities currently result in silt run-off and discharge into the river. This silted run-off water contributes to higher total suspended particulates in the river thereby increasing its turbidity. In the Eastern of Sabah, most of the sand mining operators do not have ponds to contain their wash-out water or proper drainage to channel their run-off.

4.5.1 Construction of Sediment Pond

The impacts on water quality can be mitigated by means of appropriate working procedures such as provision for sediment pond and proper drainage ways. Construction of sediment ponds at the processing site will be able to regulate run-off and trap sediments prior to discharge via drainage ways (network of perimeter and feeder drains).

Sedimentation ponds and siltation structures are used to minimise sediment contributions to surface waters. Sedimentation ponds retain water and slow the velocity so that sediment can settle to the bottom of the structure. They can be excavated or may be constructed with an embankment of earthen materials.

It is recommended the ponds be located outside of natural drainages but if the site is located in a drainage area, the water-produced up-gradient from the site should be routed through an adequately sized culvert under the disturbed area and sedimentation pond or around the disturbed area. One of the primary concerns in developing a sediment pond is to create it so that required future maintenance can be done effectively and economically.
Figure 4.1: Cross-Section of Sediment Pond

(Source: MASMA Guidelines, DID 2000)
Typical illustration of sediment pond with silt trap.

Plate 4.9: Illustration of sediment pond with silt trap.

Case 2: Typical scenario along Sg. Segama where silt run-off from sand washing goes into a shallow pit and then is immediately discharge into the river. The small pit is to enable some settlement of sand which is then extracted by an excavator. It is not able to retain any of the washing water because it is too small.

Plate 4.10: Poor practice without Holding or Sediment Pond. Note the silted water discharges immediately back to the river.

For effective sediment ponds, the following criteria are applicable:-

- Ponds should be maintained by removing sludge at the bottom of the pond at regular interval;
- Sludge removed from the ponds should not be disposed near the ponds or any waterways;
- Two ponds should be built in parallel to allow cleaning operations;
- Ponds should not be constructed on top of natural waterways or streams.
Effective sediment ponds to control silted run-off depend largely on the size of the operation and the amount of water used for sand washing. The ponds should be able to hold sufficient amount of wastewater and run-off, with appropriate retention time prior to final discharge point. The following Table 4.1 provides guidance on pond specifications.

<table>
<thead>
<tr>
<th>Category</th>
<th>Capacity</th>
<th>Holding volume</th>
<th>Pond size</th>
<th>Proposed No. of ponds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
<td>&lt; 1,000 mt/month</td>
<td>40m³</td>
<td>6m x 2.5m x 1.5m</td>
<td>2</td>
</tr>
<tr>
<td>Medium</td>
<td>1,000 – 5,000 mt/month</td>
<td>40 – 200m³</td>
<td>6m x 2.5m x 1.5m</td>
<td>3</td>
</tr>
<tr>
<td>Large</td>
<td>&gt; 5,000 mt/month</td>
<td>200m³</td>
<td>10m x 3.5m x 2.0m</td>
<td>3</td>
</tr>
</tbody>
</table>

(Source: EIA Guideline for River Sand and Stone Mining by EPD)

4.5.2 Construction of Drainage Ways

Provision for good drainage systems as part of the mining operation ensures that silted run-off will be controlled prior to discharge into river. In the east coast of Sabah, most of the operations discharge their sand washout water straight into the river, contributing to increased level of turbidity.

The following are applicable for provisions of drainage at the processing site:

- Outfall of the drainage should be placed with riprap to prevent scouring of river bank;
- Perimeter drainage should be lined with geotextile and sand bag, and with check dam to slow the sediment transport;
- Periodic maintenance of the drainage ways is needed to remove deposited silt therefore deepening and widening the channel; and
- Design of drainage has to take into account the topography of the processing site and the drainage ability to accommodate peak surface run-off.
Plate 4.11: Provision for check dam to reduce velocity of the water and to retain sediment flow.

Plate 4.12: Placement of riprap rock under the outfall to prevent scouring on the riverbank.

Case 3: Examples of sand washout from river sand mining operation in east coast of Sabah. In the absence of a holding pond, which holds silted water prior to discharge, washout water is discharged into a drain and channel directly into the river.

Plate 4.13: Washout water is drained using concrete drain, but in some cases utilising earthen drainage.

Plate 4.14: Discharge of washout water using PVC pipe straight back into the river.
4.6 APPROPRIATE TRANSPORTATION METHODS

Sand from the project site will be transported mainly via land and possibly by river transportation. Land transportation involves lorries of various sizes. Impact of this type of transportation will be fugitive dust from the sand itself and the gravel road on which the lorries travel. Appropriate measures such as covering the lorries with canvas or plastic sheets can prevent dust nuisance to road users and local residents. Provision for wheel washing facilities can reduce earth from soiling public roads.

Transportation of sand via river may be by barges. This method of transportation is normally utilized for projects which have no road access or only accessible via river. Impact from this method of transportation will be oily wastes due to leakages, boat traffic hazards and disturbance to the riverbed. Regular maintenance on barges is recommended to prevent oil leakages, which may contaminate the river. Safety of other river users should also be a priority to sand mining operators, therefore employment of personnel to regulate traffic flow is recommended. Disturbance on the riverbed on the other hand can be minimised by only allowing barge movement during periods of high water levels.

Land Transportation using Vehicles

Plate 4.15: Plastic sheet is used to cover sand material to prevent sand fall out and fugitive dust.
River Water Transportation via Barge

Plate 4.16: Barge with containment and raised wall to prevent sand fallout.

4.7 MODIFYING OPERATIONAL PRACTICES WORKING TIME

Environmental impacts can be minimised by improvement and improvisation in the working time. By operating at certain particular times, impact on the environment can be minimised. The following can be used as guidelines for mining operations.

There should not be any mining activities on the following periods:

- Where there is a water intake point is downstream of the mining site, no operations should be carried out when the plant is taking in water.
- During breeding periods of fish and other aquatic inhabitants (the operator should verify with the Fisheries Department).
- During low water level due to dry season or low tide (data from DID).
MONITORING AND COMMUNITY ENGAGEMENT

5.1 INTRODUCTION

This chapter outlines monitoring programs and due processes for continuous community engagement as well as awareness programs with operators and includes the following issues:

- Monitoring parameters, frequency and locations;
- Impact monitoring;
- Reporting Mechanism;
- Periodic sediment transport and hydrology assessment; and
- Affected communities and modes of effective engagement.

5.2 MONITORING PLAN

Monitoring will provide data to evaluate the upstream and downstream effects of sand and gravel extraction activities, and long-term changes. A brief report summarizing the annual results of the physical and biological monitoring should document the evolution of the sites over time, and the cumulative effects of sand and gravel extraction. The summary should also recommend any maintenance or modification of extraction rates needed to minimise impacts of extraction (PWA, 1996).
5.2.1 Sand Replenishment, Geomorphology and Hydrology

Physical monitoring requirements of sand extraction activities should include surveyed channel cross-sections, longitudinal profiles, bed material measurements, geomorphic maps, and discharge and sediment transport measurements. The physical data will illustrate bar replenishment and any changes in channel morphology, bank erosion, or particle size. In addition to local monitoring for replenishment at specific mining sites, monitoring of the entire reach to the estuary will provide information on the cumulative response of the system to sand extraction. For example, it is important for downstream bars and the estuary to receive sufficient sand to maintain estuarine structure and function. Because the elevation of the bed of the channel is variable from year to year, a reach-based approach to monitoring will provide a larger context for site-specific changes.

If long-term monitoring data show that there is a reach-scale trend of bed lowering (on bars or in the thalweg), the extraction should be limited.

a) Cross-sections

Surveyed channel cross-sections should be located at permanently monitored sites upstream, downstream and within the extraction area. Cross-sections intended to show reach-scale changes should be consistently located over geomorphic features such as at the head of riffles, across the deepest part of pools, or across particular types of channel bars. Cross-section spacing should be close enough to define the morphology of the river channel. Cross-section data should be surveyed after the flood season to evaluate changes that may have occurred. Cross-section data should be collected over the reach to the estuary, and locally upstream, downstream, and within each mining site.

b) Reach Scale Cross-sections

- One long-term monitoring set to include the existing cross-sections to illustrate long-term changes over the scale of the reach to the estuary.

- Cross-sections surveyed by other government agencies should be incorporated into this programme.

- Additional cross-sections could be added to the set to aid in answering specific questions that arise.
• Cross-section spacing should range from about 100 m to 250 m depending on the local channel morphology.

• At least 10 survey points to be measured for each cross-section.

• It is advantageous to locate new cross-sections at the head (upstream end) of riffles, where changes in bed elevation are most likely representative of larger scale trends.

• This long-term monitoring data should be collected and analyzed even if no mining occurs in order to understand the trends of the river.

c) Mining Site Cross-sections

• One set of cross-sections at each extraction site to illustrate local changes related to specific in-stream extraction activities.

• At least 10 survey points to be measured for each cross-section at 20 to 30 m interval.

• Cross-sections should illustrate the upstream, mid-, and downstream portion of the site being excavated, and at least one cross-section upstream and one cross section downstream of the bar.

• Thus, at least five (5) cross-sections should be located at every extraction site to illustrate local changes. Cross-sections should be oriented perpendicular to the channel, extend from the top of bank to the opposite top of bank, and show the morphology of the channel (including the portion below the water surface).

• Survey notes should describe geomorphic features including top and base of bank, edges of bars, thalweg (the deepest part of the channel) and sediment characteristics.

• All cross-section elevations should be tied into a benchmark referenced to Department Survey and Mapping Malaysia (JUPEM)’s benchmark.

• By standardizing the horizontal and vertical reference datum, data can be used in a watershed data base, or GIS which could be used to address issues related to river stability, flood control, bed load transport, and the cumulative effects of sand and gravel extraction.
• A standard format for recording cross-section data should be provided to operators by DID to ensure that cross-section data is repeatable, and usable as part of the long-term record.

d) **Longitudinal Profile**

A longitudinal profile should extend through a reach extending from upstream of the project area to downstream of the project area. Profile points should be surveyed in the thalweg and be detailed enough to illustrate the channel morphology (riffle-pool sequences). Profile elevations should reference to JUPEM's benchmark.

e) **Geomorphic Maps**

Geomorphic maps may be constructed using a tape and compass for the project to illustrate channel morphology. Maps should illustrate bed and bank characteristics of the channel and particle size.

f) **Photo-documentation**

Photographs of the project sites should be taken prior to excavation to document the baseline conditions, and again during each monitoring session. Local field photographic station locations should be mapped on the geomorphic map and staked in the field in order to establish permanent photo stations.

g) **Hydrology and Sediment Transport**

Discharge and bed material measurements including suspended and bed load transport measurements taken by DID should continue in order to provide a statistically significant data base. Long-term data taken over a range of flows will add to our knowledge of river processes and aid in objectively evaluating the long-term trends in the river.

h) **Groundwater Level**

Monitoring wells should be established adjacent to any off-channel floodplain excavation to record changes in ground water levels. Measurements should be taken monthly.
5.2.2 Riparian Habitat

a) Extent and Quality of Riparian Vegetation

Document the extent and quality of riparian vegetation, including successional status, and any increase in disturbance indicators (non-native plants). The extent of riparian habitat can be determined utilizing aerial photos or satellite images. Habitat quality data, i.e., successional status and species composition, must be determined through field reconnaissance.

b) Riparian Vegetation Maps

Develop yearly maps of the sensitive habitat areas and document their aerial extent over time. These maps may be combined with the geomorphic maps. Monitor sites identified as sensitive for disturbance in excess of expected geomorphic trends - i.e., massive bank wasting up or downstream from an active mine site. Monitor sand mining impacts which may translate up and downstream, causing accelerated erosion of sensitive zones and impacting the ability of new habitat to form due to excessive scour or sedimentation.
A closing plan or a rehabilitation programme should be undertaken by the sand mining operators at the end of their project operation. The rehabilitation checklist is appended in Annex A.1. The following measures can be undertaken to rehabilitate the site:

### 6.1 SAND WASHING AREA

- Any pit/holes/ponds should be back-filled and compacted.
- The site should be cleared of any machinery, equipment and structures.
- Any access routes, especially if they are not beneficial to the local community would need to be ploughed and replanted with native species.
- River bank should be stabilized by means of compaction and then planting with vegetation.
- Close and restore river bank where access ramps have been restored. Ensure river channel is not obstructed and that repaired banks are adequately fortified.

### 6.2 STOCKPILE AREA

Any sand and organic stockpiles be taken out of the mining site to enable the rehabilitation process to take place.

The stockpile area should be re-vegetated with indigenous plant species.
6.3 REVEGETATION

- Tree species endemic to the area should be planted.
- Re-vegetate with indigenous plants which were removed from areas for the mining of sand as far as is reasonably practical.
- Plant trees along the riverbanks with no or minimal vegetation, irrespective of signs of erosion or not (ensure that species selected are indigenous species).

6.4 IMPROVEMENT OF RIVERBANKS

Channel erosion often occurs on riverbanks with no or minimum vegetation cover. Secondary rehabilitation measures could include:

- Plant trees along the riverbanks with no or minimal vegetation, irrespective of signs of erosion or not. However, careful selection of species is required to ensure that trees are suitable for banks improvement as well as not interfering with the existing species.

- Construction of artificial walls such as sheet piling or gabions to protect riverbanks with vegetation and with signs of erosion. Approval from DID is required for the design and construction of this engineering works.

Plate 6.1: Planting of Vetiver grass on riverbank.
REFERENCES


## Annex A.1

**Rehabilitation Inspection Checklist**

<table>
<thead>
<tr>
<th>Objective</th>
<th>Indicators</th>
<th>Improvements</th>
<th>Required comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mining proceeded in line with rehabilitation plan?</td>
<td>Rehabilitation Plan approved before mining commences.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface reshaped to obtain stability</td>
<td>Land stability restored</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface reshaped to provide for adequate drainage</td>
<td>Drainage restored</td>
<td>Surface not prone to erosion</td>
<td></td>
</tr>
<tr>
<td>Surface reshaped to give suitable slopes for targeted land use.</td>
<td>Surface suitable for future intended use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long term visual impacts Minimised</td>
<td>Surface blends into surrounding environment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All waste removed to licensed landfill</td>
<td>Lease area free of waste</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reclaim Access and haul roads</td>
<td>i) Roads reclaimed where not needed for future access.</td>
<td>ii) Access ramps removed</td>
<td></td>
</tr>
<tr>
<td>Site restored to a safe condition</td>
<td>Site safe to humans and animals</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Objective</td>
<td>Indicators</td>
<td>Improvements</td>
<td>Required comments</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Overburden and spoil restored to pit</td>
<td>Overburden and spoil restored</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fences removed, and in such a way as to permit revegetation</td>
<td>Fences removed, and in such a way as to permit revegetation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Signed: Inspector: ………………………..

Holder: Name: ………………………..

Designation: ………………………..

Signature: ………………………..
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental impact assessment report</td>
<td>A report or series of reports which provides a detailed assessment in quantitative and qualitative terms the likely impact of the activity on the environment, the measures on mitigation and the monitoring programme needed to ensure compliance.</td>
</tr>
<tr>
<td>&quot;Bank &quot; in relation to water body</td>
<td>Any bank, whether naturally or artificially formed.</td>
</tr>
<tr>
<td>&quot;Bed&quot; in relation to a water body</td>
<td>The land under the water body bounded by the banks closest to the water body subject to tidal influence, means the land under the water body extending to the highwater mark of ordinary spring tides.</td>
</tr>
<tr>
<td>Dredge</td>
<td>Is a device for scraping or sucking the river/seabed, used for dredging. A dredger is a barge or ship or boat equipped with a dredge. The terms are sometimes interchanged.</td>
</tr>
<tr>
<td>Floodplain</td>
<td>The area of a river valley which is covered with water when the river overflows during floods.</td>
</tr>
<tr>
<td>In-stream</td>
<td>Refers to water use taking place within a stream or river channel.</td>
</tr>
</tbody>
</table>
Material

Includes sand soil, gravel, stones, vegetation whether alive or dead, roots and other matter.

Pebble

A class of rock with a particle size of 4 to 64 millimetres based on the Krumbein phi scale of sedimentology. Pebbles are generally considered to be larger than granules and smaller than cobbles.

Riprap

Also known as rip rap, rubble, shot rock or rock armour — is rock or other material used to armour shorelines, streambeds, bridge abutments, pilings and other shoreline structures against scour, water or ice erosion.

River

A continually or intermittently flowing body of water, and includes a stream or modified watercourse but does not include any artificial watercourse unless it is a declared channel.

River reserve or shore reserve

A reserve established along the banks of a river to maintain natural vegetation or control development activities.

Water body

A river, estuary, lake, lagoon, swamp, marsh or other wetland.

Water body alteration activity

An activity which involves or is likely to have the effect of-

- Excavating material from the bed, bank or shore of a water body, or from a river or shore reserve;

- Obstructing, diverting or detrimentally affecting the flow or movement of water in a water body;
- Changing the course of a water body;
- Reducing the capacity of a water body to contain water by filing or other means; or
- Reclaiming land within a water body.

**Sediment**

Is naturally-occurring material that is broken down by processes of weathering and erosion, and is subsequently transported by the action of fluids such as water.

**Stockpile**

Is a pile or storage location for bulk materials, forming part of the bulk material handling process.

**Thalweg**

In hydrological and fluvial landforms, the thalweg is a line drawn to join the lowest points along the entire length of a stream bed or valley in its downward slope, defining its deepest channel.