Environmental Impact Assessment (EIA)

Guidelines for Shoreline Development Activities

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Foreword

The Environmental Impact Assessment (EIA) has been widely used as a critical tool in managing and clarifying the complex interrelationships between development and the environment. It provides assessment of the environmental consequences of development actions in a systematic, holistic and multidisciplinary way.

In Sabah, the Environment Protection Department is imposing two environmental impact assessment categories namely the EIA or the Proposal for Mitigation Measures (PMM) in managing any development listed as prescribed activities under the Environment Protection (Prescribed Activities) (Amendment) Order 2013.

The purpose of these Guidelines is to provide practical guidance to environmental consultants, developers, planning authorities and any other stakeholders on procedural aspects as well as the processes involved in the preparation of the EIA/ PMM report. It intents to provide a structured framework for the scope of environmental considerations required during the planning, implementation and maintenance stages of any prescribed development activity. Identification of potential environmental issues at the initial stage of development is essential for the selection of realistic mitigation measures. Significance of this approach will ensure that any development activity will be carried out with minimal adverse residual environmental impacts.

It is the Department's hopes that these Guidelines will result in greater consistency and understanding on the basic of environmental requirements, selection of alternatives, identification of environmental issues, preparation of mitigating measures as well as environmental compliance and monitoring to ensure sustainable and profitable activities are achieved.

The Department gratefully appreciate the valuable assistance from government agencies, organizations and individuals in their comments, feedback and inputs on these Guidelines. We welcome comments and suggestions for the continuous improvement of these Guidelines in future.

Yabi Yangkat
Director
Environment Protection Department

Contents

1 Introduction

1.1 Definitions

The aim of this EIA guideline is to provide a framework for the preparation of an Environmental Impact Assessment (EIA) and Proposal for Mitigation Measures (PMM) report for shoreline development activities in the State of Sabah, Malaysia. This EIA guideline should serve as an operating manual for the Project Proponents as well as a guide for environmental consultants.

The expression "Environmental Assessment" will in this document refer to either EIA or PMM as appropriate. The term "TOR" is likewise used generically to refer to either Terms of Reference (TOR) for EIA and Scoping Note for PMM as appropriate.

Within Sabah, certain development activities along the shoreline are categorised as a "prescribed activity" under the First and Second Schedule of the Environment Protection (Prescribed Activities) (Environmental Impact Assessment) Order 2005. This requirement therefore subjects the Project Proponent to appoint an environmental consultant registered with the Environment Protection Department (EPD), to conduct an Environmental Assessment report for submission to, and approval by the EPD Sabah prior to project commencement. The EIA report will only cover the site preparation and construction phases of these developments under the prescribed activity.

The term "shoreline development" is, in this guideline, defined as any development activity located within 200 metres of the high water mark. Examples of development activities that commonly occur in this zone are development of housing, commercial and industrial estates, resorts and recreational buildings and facilities, buildings for public purposes, jetties, port and marina facilities, infrastructure (roads, pipelines, communication towers and cables), breakwaters, sea protection walls and others (refer to Plate 1-1 and Plate 1-2).

Plate 1-1: Example of shoreline development - Sutera Harbour Resort's marina

Plate 1-2: Example of shoreline development – Sandakan Port

This EIA guideline focuses on the planning and control of shoreline development activities and management of impacts on adjacent areas. The main objective of this guideline is to provide environmental consultants, developers, contractors and government agencies involved in shoreline development activities with:

i. Information on how to avoid and minimise environmental impact, which is preferable to the more costly option of undertaking remedial action;

ii. Information on the likely impact of shoreline development activities on the environment and how this is to be assessed; and

iii. Suggested best practice environmental measures to meet the performance objectives.

This EIA guideline is not prescriptive or detailed. Each environmental assessment will require the environmental consultant to tailor their assessment to particular site conditions and make their own assessment of measures appropriate to the site.

The content of this EIA guideline may be amended from time to time in order to keep abreast with the latest developments and improvements in techniques and new understanding of the environmental impacts and risk. Such changes may be issued by EPD in a complete revision of this document, or in separate additional guidance notes which address specific issues.

This EIA guideline has been produced in consultation with relevant technical departments, stakeholder representatives, and other interested organisations. Printed copies of this and other EIA guidelines are available from EPD.

1.2 Assessment Procedure – A Quick Reference

The environmental assessment procedure may be divided into seven steps as described in Table 1-1. Of these steps, only steps 3 and 4 are dealt with in this guideline as these include issues particular to shoreline development. The remaining steps are standard procedures, common to all Environmental Assessment reports. These steps are described in detail in the Handbook on Environmental Impact Assessment in Sabah (November 2005) issued by EPD.

Table 1-1: Assessment Procedures

The Seven Steps	Summary of Main Required Activities
Step 1: **Project Screening**	**Project Proponent:** • Check Section 2.2 to see if the project is required to undertake an EIA or PMM • Consult with EPD as to whether the project should undertake an EIA or PMM • Consult with EPD whether planning documents are sufficient
Step 2: **Selection of Environmental Consultants**	**Project Proponent:** • Select EPD registered consultants to undertake preparation of TOR and the EIA; or Scoping Note and the PMM
Step 3: **Project Scoping and Preparation of Terms of Reference/ Scoping Note**	**Environmental Consultant:** • Undertake scoping activities • Assess initial project description and assist the Project Proponent to make amendments. • Perform initial site visit • Prepare a draft TOR or Scoping Note • Undertake the public hearing activities required for Special EIA • Participate in review meetings • Finalise the TOR for EIA or Scoping Note for PMM and obtain final approval from EPD
Step 4: **Undertaking the EIA/ PMM Study**	**Environmental Consultant:** • Assess the project details • Assess the existing environments

The Seven Steps	Summary of Main Required Activities
	• Assess the environmental impacts • Devise and propose mitigation measures • Devise and propose monitoring programmes
Step 5: **Preparation of the EIA/ PMM Report**	**Environmental Consultant:** • Adhere to the EPD requirements based on the approved TOR/ Scoping Note in the preparation of the EIA/ PMM report • Prepare the EIA/ PMM report in line with the EPD chapter by chapter recommendations • Discuss with the Project Proponent on the findings and content of the EIA/ PMM report
Step 6: **Submission of the EIA/ PMM Report**	**Environmental Consultant:** • Submit the EIA/ PMM report to EPD • Undertake the public hearing activities required for Special EIA • Participate in review meetings • Submit additional information if required and finalise the EIA/ PMM report
Step 7: **Preparation of the Agreement of Environmental Conditions/ Mitigation Declaration**	**Project Proponent:** • Review the draft Agreement of Environmental Conditions (AEC)/ Mitigation Declaration (MD) prepared by EPD • Signing of the Letter of Undertaking on AEC/ MD • Implement mitigation measures and monitoring programmes • Submission of periodic environmental compliance report as required in the AEC/ MD

2 Sabah Context

2.1 Geographical Overview

Development in the coastal zone is often concentrated near population centres to take advantage of the existing services, community, suppliers and labour sources. Numerous industries such as quarries, cement, wood, pulp and paper utilise existing ports and harbours for import and export. Along the coastline of Sabah, there are many small, government and privately owned, ports and jetties. Most of these jetties are piled while some are earth filled. In some resorts or clubhouses, there are marinas and/ or jetties e.g. Sutera Harbour Marina.

In recent years, there has been increased development along the coastal zone of Sabah, particularly for ports, harbours and marinas as well as housing, commercial and industrial development. Examples of commercial development along the shoreline in the State Capital include Anjung Senja fronting Wawasan Plaza and the Promenade hotel, and the Kota Kinabalu Waterfront, fronting Centre Point Sabah.

There is also pressure to expand tourism related development along the coastal beaches with small-scale resorts along the West Coast beaches from Kuala Penyu up to Tuaran and Kudat district.

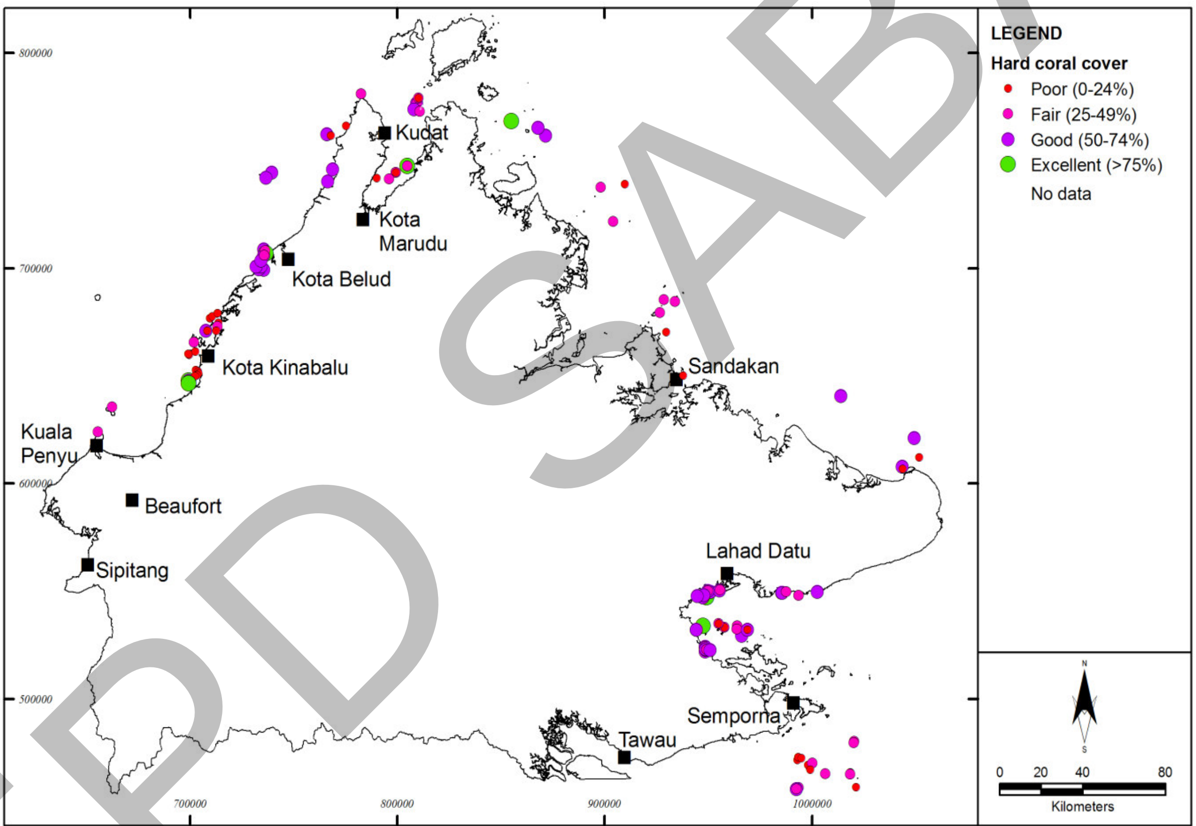
Natural coastal landscapes are varied; in Sabah they include features such as littoral beaches, rocky headlands, river outlets and deltas, tidal flats and tidal inlets, sand spits and mangrove swamps. The coastline is dynamic in nature, with some areas eroding and others building up, in response to sediment transport driven by hydrodynamic forces such as waves and currents.

Waves and currents together with sediment sources from rivers are the main drivers for sediment transport and morphology. The coastline of Sabah is exposed to three different "seas" with the west coast from Brunei Bay to Pulau Banggi facing the South China Sea, Pulau Banggi to the eastern tip of Borneo at Hog Point facing the Sulu Sea, and the remaining part of the coastline from Hog Point to Tawau facing the Sulawesi Sea. Current and wave exposure varies significantly, leading to different sediment transport patterns and morphology for each region.

Two important marine environments dominate the coastline of Sabah, namely, coral reefs and mangrove forests. Often associated with these reefs and mangroves are seagrass beds, which play an equally important role in ecosystem dynamics, but have a less extensive distribution along Sabah's coastline.

Coral Reefs

Coral reef growth and development are predominately in water depths of 1-12 m. The more extensive and least disturbed reefs are concentrated along the coast from Teluk Usukan to Teluk Ambong, in Tunku Abdul Rahman Park off Kota Kinabalu, around Pulau Dinawan and the Pulau Tiga Park, Darvel Bay and the islands off Semporna. Figure 2-1 illustrates data available from the Shoreline Management Plan (EPD, 2005). This is not comprehensive, and any environmental assessment for shoreline development activities with potential impacts to any reef areas should specifically address and assess potential impacts to the reefs.



Source: Sabah Shoreline Management Plan, 2005

Note: Data both primary and secondary is available. Reef areas with no data available are not shown

Figure 2-1: Location and quality of reefs around Sabah

Mangrove Forests

Mangrove forests have a patchy distribution along the West Coast of Sabah, occurring primarily along the shores of the Kudat and Bengkoka Peninsulas and the estuaries of the Klias and Padas Rivers. Mangroves also line the banks of the various tidal lagoons, for example, Teluk Sulaman and rivers such as Sg. Kinarut, and form a coastal fringe in protected bays such as Teluk Ambong and Teluk Sapangar. The most extensive mangrove habitats are on the east coast of Sabah, covering much of the coastline and forming large swamps, for example in Labuk Bay, Sandakan Bay, Kinabatangan and Tawau Bay (Cowie Harbour). In other areas, mangroves form a narrow fringe along the coastline, for example in Semporna where mangroves can be found growing in sand and limestone.

Direct habitat impacts through development in mangroves should be avoided wherever possible, while the Environmental Assessment study should also investigate other impacts which may affect nearby mangrove areas, such as sedimentation and erosion, changes in water quality and salinity, and changes in tidal prism.

Seagrass Beds

Seagrass distribution in Sabah has not been well documented. Known areas include extensive seagrass within the Sulaman and Mengkabong estuaries on the West Coast of Sabah, while a number of other areas have smaller, patchy seagrass beds. Along the east coast, scattered distributions of seagrass beds are found in many areas, such as in Darvel Bay and the Semporna islands. Seagrass beds were also observed and/ or reported around Jambongan and the Beluran area, as well as at Tambisan. Given the lack of information on seagrass, it is important to consider if the environmental conditions at the location would support seagrass habitats (which require relatively clear waters), and to carry out initial site investigations to verify the presence or absence of these habitats within the vicinity of the proposed development site.

2.2 Legal Requirements

Under the Environment Protection (Prescribed Activities) (Environmental Impact Assessment) Order 2005, the submission of PMM and EIA are mandatory requirements for shoreline development in Sabah under the First and Second Schedules of the Order, respectively. Specifically, the prescribed activities are:

First Schedule: List of Prescribed Activities Requiring Proposal for Mitigation Measures (PMM) Report

Item 3: Housing, commercial and industrial estates

Para (iii) — *Development of housing, commercial or industrial estates within 200 metres from the high-water mark of the coastal area*

Item 6: Resorts and recreational development

Para (ii) *Development of resorts, recreational or tourism facilities within 200 metres from the high-water mark of the coastal area*

Item 7: Any other activities which may damage or have an adverse impact on the quality of environment

Para (i) *Construction of buildings for public purposes within 200 metres from the high-water mark of the coastal area*

Para (ii) *Construction of open jetties with a length of 100 metres or more for commercial or public use along rivers or sea front*

Second Schedule: List of Prescribed Activities Requiring Environmental Impact Assessment (EIA) Report

Item 12: Any other activities which may damage or have an adverse impact on quality of environment

Para (ii) *Construction of major roads or upgrading of major roads involving realignment and widening through settlement, coastal areas or wetland forests, or on hills with slopes having gradient of 20 degrees or more*

Para (iii) *Construction of port facilities (including warehouses, container yards and cargo storage facilities) for commercial use along rivers or sea front*

Para (iv) *Construction of closed landing jetties for commercial or public use along rivers or sea front*

This EIA guideline differs somewhat from the other EPD EIA Guidelines in that it is site-specific rather than activity-specific; i.e. shoreline development activities are primarily prescribed owing to their location within 200 m of the shoreline.

There are also other prescribed activities that have an indirect connection to shoreline development activities. These include (but are not limited to):

First Schedule: List of Prescribed Activities Requiring Proposal for Mitigation Measures (PMM) Report

Item 3: Housing, commercial and industrial estates

Para (i) *Development of housing, commercial or industrial estates covering an area of 10 hectares or more but less than 50 hectares*

Para (ii) *Conversion of wetland forests into housing, commercial or industrial estates covering an area of 2 hectares or more but less than 30 hectares*

Item 4: Fisheries and aquaculture

Para (i) *Conversion of wetland forests into fisheries or aquaculture development covering an area of 10 hectares or more but less than 50 hectares*

Para (ii) *Creation of lakes or ponds for fisheries or aquaculture development covering an area of 10 hectares or more but less than 50 hectares*

Item 6: Resorts and recreational development

Para (i) *Development of resorts, recreational or tourism facilities covering an area of 10 hectares or more but less than 30 hectares*

Second Schedule: List of Prescribed Activities Requiring Environmental Impact Assessment (EIA) Report

Item 3: Housing, commercial or industrial estates

Para (i) *Development of housing, commercial or industrial estates covering an area of 50 hectares or more*

Para (ii) *Conversion of wetland forests into housing, commercial or industrial estates covering an area of 30 hectares or more*

Item 5: Land reclamation

Reclamation of land by the sea or along river banks for development of housing, commercial or industrial estates, construction of major roads, or other public purposes

Item 6: Fisheries and aquaculture

Para (ii)	*Creation of lakes or ponds for fisheries or aquaculture development covering an area of 50 hectares or more*

Item 9: Quarries

Para (ii)	*Earth work involving extraction, removal, filling or dumping of earth with a volume of 40,000 cubic metres or more*
Para (iii)	*Excavation or dredging of sand or rock materials from watercourses, streams, rivers, coastal area or sea for commercial or construction purposes*

Item 10: Resorts and recreational development

Para (i)	*Development of resorts, recreational or tourism facilities covering an area of 30 hectares or more*
Para (iii)	*Development of golf courses*

Under Section 12A of the Environment Protection Enactment 2002, amended in 2012, failure to comply to the requirement for an Environmental Assessment may result in a fine not exceeding fifty thousand ringgit (RM50,000) or imprisonment for a term not exceeding two years, or both a fine and imprisonment, under the First Schedule. Under the Second Schedule, failure to comply may result in a fine not exceeding one hundred thousand ringgit (RM100,000) or imprisonment for a term not exceeding five years, or both a fine and imprisonment.

An Environmental Assessment is an important technique for ensuring that the likely impacts of the shoreline development activities on the environment are fully understood and taken into account, before such a development is allowed to commence. The main objectives of an Environmental Assessment for shoreline development are:

- To assess and recommend the most appropriate shoreline development options (layout, methodology) based on existing site conditions, so as to minimise impacts to the environment;

- To identify, predict and wherever possible quantify the significance of any adverse impacts on the coastal and marine environments and communities that are likely to be affected by the shoreline development activities;

- To formulate and incorporate appropriate and cost effective mitigation and abatement measures into overall planning of shoreline development activities; and

- To determine a suitable and effective programme for ensuring environmental compliance and monitoring of residual impacts.

It is noted that some of the above prescribed activities may have project components that are discussed under other EIA Guidelines published by EPD. For example, the EIA Guidelines for Land Reclamation Activities, namely project components which extend into and potentially impact the littoral zone, which can be distinguished from the shoreline development activities which are prescribed by virtue of their location within 200 m of the shoreline, but with little to no anticipated impacts on the marine hydraulic processes. The activities that may potentially impact the littoral zone include closed jetties, causeways and breakwaters, and in some cases stockpiling and beach nourishment. Closed jetties, causeways and breakwaters will impact the shoreline in a similar way to reclamations and as such the impact prediction and evaluation methodologies for these developments are also similar.

Other legal requirements applicable to shoreline development activities, which should be referred to by the environmental consultant during preparation of the Environmental Assessment report are:

Legal Requirements	Relevance
Environmental Quality Act, 1974	– Restriction and prohibition of pollution (air emissions, noise pollution, inland waters, soil, waste, hazardous and scheduled substances) – Prohibition of open burning – Management of scheduled waste
Environmental Quality (Sewage) Regulations 2009	– Provision and proper operation of sewage treatment system – Sewage discharge quality
Environmental Quality (Scheduled Wastes) Regulations 2005	– Management and disposal of scheduled waste including storage and labelling
Wildlife Conservation Enactment 1987	– Protection and management of plants and animals

Legal Requirements	Relevance
Town and Country Planning Ordinance (Sabah Cap. 141)	– Preparation and approval of schemes for designated landuse of an area (zoning)
Land Ordinance (Sabah Cap. 68)	– Land matters, shore reserve.
Water Resource Enactment, 1998	– Water conservation areas – Flood plain management areas – River reserves – Shore reserves
Cultural Heritage (Conservation) Enactment 1997	– Preservation and conservation of cultural heritage sites
Explosive Act 1957 (revised 1978)	– Use, storage and transport of explosives
Local Municipal Rules including Earthwork By-Laws	– Requirements for planning submission including earthwork, drainage, construction and others.
Sabah Biodiversity Enactment, 2000	– License to access biological resources
Fisheries Act, 1985	– Conservation and development of maritime and estuarine fishing and fisheries in Malaysian waters – Protection of aquatic mammals and turtles and riverine fishing – Development of aquaculture
Ports and Harbours Enactment, 2002	– Issuance of ship/ vessel licence – Control and regulation of traffic flow by water in ports and harbours – Oil pollution by vessel within port limits or harbour

In addition to the legal requirements, there are several guidelines related to the environment which should be considered by all shoreline development applicants. These include (but are not limited to):

- Handbook on Environmental Impact Assessment in Sabah (Second Edition) (Environment Protection Department, November 2005);

- EIA Guidelines for Land Reclamation Activities (Environment Protection Department, 2012);

- EIA Guidelines for River Sand and Stone Mining Activities (Environment Protection Department, 2012);

- EIA Guidelines for Earthwork Activities (Environment Protection Department, 2012);

- Environmental Impact Assessment (EIA) Guidance Document for Sand Mining/ Dredging Activities (Department of Environment);

- Environmental Impact Assessment (EIA) Guideline for Coastal Resort Development (Department of Environment);

- Guidelines on the Prevention and Control of Soil Erosion and Siltation in Malaysia (Department of Environment, 1996);

- Sabah Shoreline Management Plan (Environment Protection Department, 2005);

- Guidelines for Public Safety and Health at Construction Sites (Department of Occupational Safety and Health, 2007);

- Urban Stormwater Management Manual for Malaysia (MSMA 2nd Edition) (Department of Irrigation and Drainage, 2011);

- National Landscape Guidelines (Department of Town and Country Planning, 1995);

- Guidelines on Erosion Control for Development Projects in the Coastal Zone (Department of Irrigation and Drainage, 1997); and

- Guidelines for Erosion and Sediment Control in Malaysia (Department of Irrigation and Drainage, 2nd Edition 2011).

These guidelines should be followed as appropriate (depending on the project concept and site specific issues) by the environmental consultant during preparation of the Environmental Assessment report for submission to EPD.

The guidelines and legislation above are correct as of November 2012. It is the duty of the environmental consultant at all times to update the list and to apply the latest regulations as issued by relevant government agencies.

2.3 Application and Approving Procedures

Any person who intends to undertake shoreline development activities in the State of Sabah is required to submit an Environmental Assessment report to the Director of EPD, Sabah for approval. The contact details for EPD are:

DIRECTOR

ENVIRONMENT PROTECTION DEPARTMENT

Tingkat 1 – 3, Wisma Budaya

Jalan Tunku Abdul Rahman

Beg Berkunci 2078

88999 Kota Kinabalu, Sabah, Malaysia

Telephone Number:	+60 (088) – 251 290/ 251 291/ 267 572/ 268 572
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Email Address:	jpas@sabah.gov.my
Website Address:	http://www.sabah.gov.my/jpas

In addition, written approval of the development report/ plan from the relevant City Council/ Municipal Council/ Local District Council is required but may not be limited to the previously mentioned approval requirement.

The procedure for submitting and obtaining approval for the development plan is shown in Figure 2-2 and summarised as follows:

- The applicant must submit a development proposal report or plan, prepared by a qualified person [generally an architect/ planner], to the relevant City Council/ Municipal Council/ Local District Council.

- The City Council/ Municipal Council/ Local District Council will refer the development report/ plan to the relevant departments (including EPD) for technical comments and acceptance. If the proposed development is categorised as a “prescribed” activity under the Environment Protection (Prescribed Activities) (Environmental Impact Assessment) Order 2005, an EIA/ PMM report is required for approval from the EPD.

- In the event that the proposed development involves a change in the land use, approval is required from the Central Town and Country Planning Board of the area where the construction works will be carried out, for rezoning of the land (change of land use). This is in accordance to Part I, Section 3 of the Town and Country Planning Ordinance 1950.

- The City Council/ Municipal Council/ Local District Council may approve the proposed development upon receiving approval from the Central Town and Country Planning Board for rezoning, approval of the EIA report from the EPD, and compliance with all technical comments and acceptance from the relevant departments on the application.

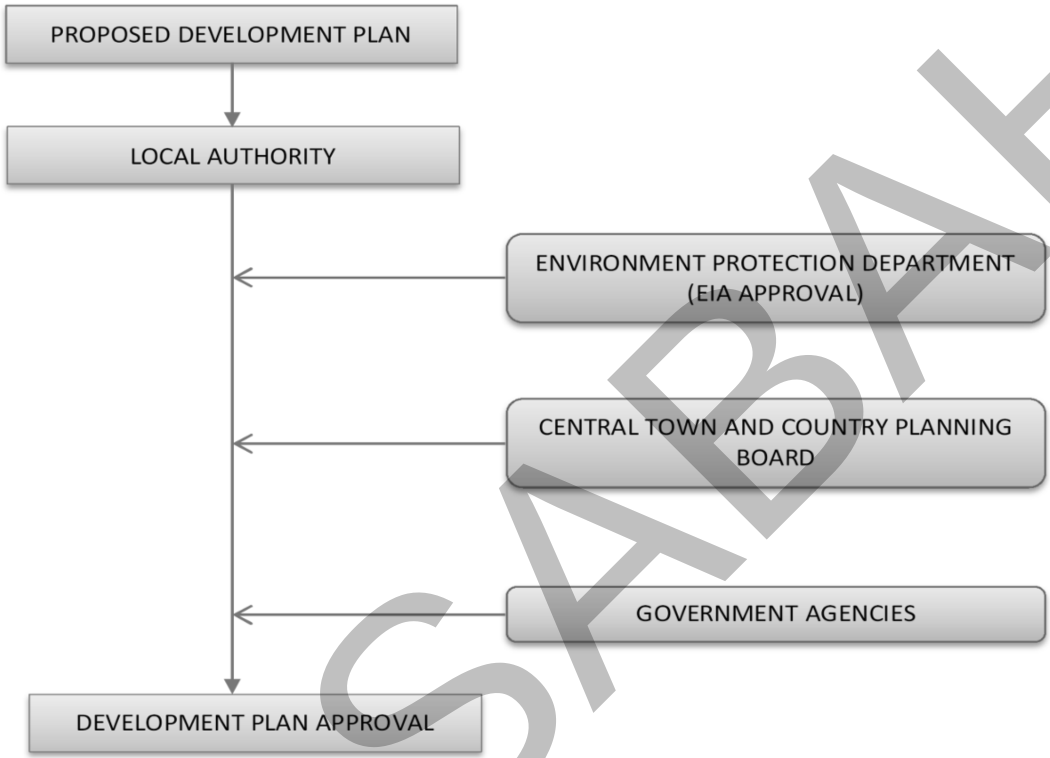


Figure 2-2: Procedure for processing of Development Plan

2.4 Key Stakeholders

As part of the environmental assessment procedure, EPD will seek technical comments from relevant departments with responsibilities for specific aspects relating to the shoreline development activities. The main responsibilities of these departments in relation to the Environmental Assessment are listed below. However, the departments may also comment on any other aspect of the assessment, if deemed relevant.

Department	Technical Role
Lands and Surveys Department	– Land titles/ ownership
District Office	– Local settlement issues, i.e. flooding, public complaints and others
Department of Irrigation and Drainage	– Rivers and drainage system, coastal zone management,

Department	Technical Role
	shoreline management, coastal protection works, water quality – Water resource issues
Town and Regional Planning Department	– Landuse planning, zoning
Municipal Council	– Municipality issues, i.e. waste management and others
Department of Environment	– General environmental concerns (air, effluent, water, scheduled waste and others)
Sabah Parks	– Development within or nearby marine parks
Sabah Forestry Department	– Forestry issues, in particular mangrove forest reserves
Sabah Wildlife Department	– Habitat and wildlife issues
Marine Department	– Shipping and navigation areas, vessel management
Ports and Harbours Department	– Oversee water traffic in all ports, harbours and rivers, boats/ ship licences under 15 NRT
Museum Department	– Cultural heritage, artefacts

The list of departments is not exhaustive and may vary depending on the development concept and sensitivity of the location.

EPD is responsible for overseeing the environmental assessment procedure in relation to the prescribed activities and at the same time, requires comments/ concerns/ advice from the key stakeholders for decision making.

3 Typical Project Activities

3.1 Project Plan

An environmental assessment is an assessment of an intent, i.e. the assessment of the potential impacts occurring from well described planned activities.

It is therefore important that all activities, which have potential environmental impacts, are planned properly and described in sufficient detail prior to an environmental assessment. After the initial project information, the Environmental Assessment report therefore concerns the project description or plan.

The Project Proponent must provide the environmental consultant with a detailed description of all activities; both the main construction activities and the supporting activities.

3.2 Project Stages

Generally, shoreline development will involve four (4) main stages, i.e. pre-development; site preparation; construction; and abandonment/ post-construction. The activities involved during these stages are listed below in Table 3-1.

Table 3-1: Typical Activities for Shoreline Development Projects

Stage	Activities
Pre-development	• Land acquisition and access - Acquire land - Relocation of existing occupants (if any) • Investigation - Detailed site surveying - Preparation of feasibility studies - Preparation of conceptual plan, geological and hydrological report and soil investigation report - Detailed design for Erosion and Sediment Control Plan (ESCP) and drainage plan - Detailed site preparation planning (earthwork and construction method, work sequence, disposal site/ borrow areas for dredge spoil or unsuitable materials and earth/ sand

Stage	Activities
	requirement) - Environmental Impact Assessment (EIA) study
Site Preparation	• Site clearing/ stripping - Construction of temporary access roads - Removal of existing vegetation cover - Demolition and removal of existing structures - Construction of temporary drainage system - Provision for operating equipment (chainsaws, front loader, bulldozers and other) • Temporary occupation - Establishment of site office, workers' quarters and any other temporary construction and lay-down areas - Provision for electricity, water, telecommunication, solid waste and sewage facilities - Employment of workers - Machineries and equipment servicing and maintenance • Earthwork - Earth cutting and filling works/ dredging/ reclamation - Transportation of materials (soil and waste) - Installation of erosion control measures/ close turfing
Construction	*Onshore Development (refer to Figure 3-1)* • Transportation of construction materials • Construction of development components and facilities • Installation of permanent drainage system • Landscaping *Marine Development (refer to Figure 3-1)* • Transportation of construction materials • Construction of access road • Construction of jetties, marinas and others • Construction of groynes, breakwaters, and solid (filled) jetties

Stage	Activities
	• Shoreline protection works • Landscaping
Abandonment/ Post-construction	In addition, there is also the possibility of abandonment during the implementation of proposed shoreline development activities. The types of activities involved during this stage are: - Unsuitable/ surplus material removal or stockpiling - Workers' quarters and site office removal - Solid waste disposal - Equipment and machineries removal - Liquid waste disposal - Site rehabilitation works, i.e. soil stabilization and other As for completion of the development, it involves: • Operations of ports, resort, commercial or industrial complex • Maintenance dredging

Some key development components and project operational activities that need to be considered and described are listed in Table 3-2.

Table 3-2: Key Shoreline Development Structures, Facilities and Associated Activities

Coastal Development Structures and Facilities	Major Development Activities associated with Development	Major Operational Activities
<u>Coastal Structures</u> - Jetty - Breakwater - Groyne - Revetment or seawalls - Marine outfall/ intake	Dredging Earthworks	

Coastal Development Structures and Facilities	Major Development Activities associated with Development	Major Operational Activities
Tourism-based Facilities - Hotels, tourism based facilities - Marina - Golf courses	Site clearing & earthworks Water use Sewage and waste water management	Yachting/ boating Water sports Fishing Snorkelling Scuba-diving Golfing, golf course management
Commercial Facilities - Shops - Restaurants	Site clearing and earthworks Waste management Sewage and waste water management	Waste management Sewage and waste water management
Industrial - Ports and harbours - Industrial complexes - Industries requiring access to seawater e.g. power stations	Site clearing and earthworks Waste management Sewage and waste water management	Berthing/ unberthing and loading/ offloading of product Product handling/ processing Maintenance activities Waste management Sewage and waste water management

Shoreline development activities can be divided into those which are located along the coastline (within the 200 m zone for the purpose of this guideline) but which do not have marine components and those which include coastal structures/ marine components as per Table 3-2). The key consideration in the sub-division of projects is whether or not they will impact the marine environment and coastal stability, either during construction, in the medium to longer term or permanently.

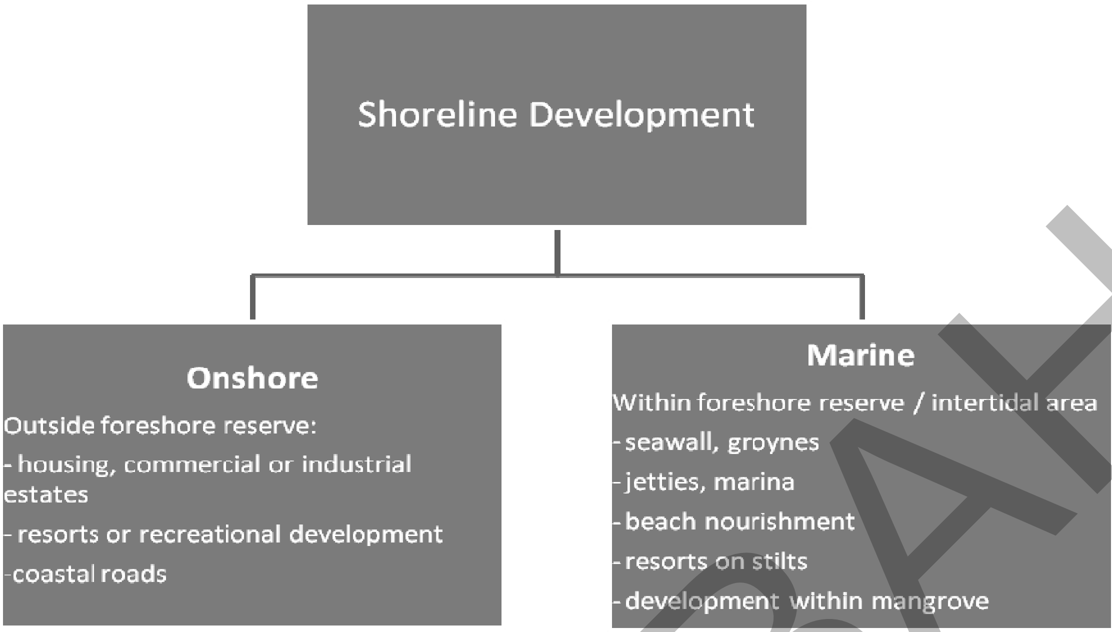


Figure 3-1: Types of Shoreline Development

Plate 3-1: Example of resort built on stilts

Plate 3-2: Example of jetty construction

Plate 3-3: Example of seawall and resort built outside the foreshore reserve

Plate 3-4: Development within mangrove area

4 Scoping

This chapter deals with the scoping stage which defines the work scope for preparation of the Environmental Assessment report (refer to Table 4-1).

Table 4-1: Assessment Procedures - Scoping

The Seven Steps	Summary of Main Required Activities
Step 3: Project Scoping and Preparation of Terms of Reference/ Scoping Note	Environmental Consultant: • *Undertake scoping activities* • *Assess initial project description and assist the Project Proponent to make amendments* • *Perform initial site visit* • *Prepare a draft TOR or Scoping Note* • *Undertake the public hearing activities required for Special EIA* • *Participate in review meetings* • *Finalise the TOR for EIA or Scoping Note for PMM and obtain final approval from EPD*

Scoping is the identification of potential environmental impacts and the predicted extent of the impacts. This exercise is an important early stage of the environmental assessment process to ensure that the assessment is carried out properly and appropriately, i.e. that the report is sufficiently comprehensive, while at the same time preventing the assessment from becoming unnecessarily protracted or expensive due to inappropriate focus on issues of only minor concern.

In general, the scoping process is outlined in the EPD's Handbook on Environmental Impact Assessment in Sabah. This section briefly outlines the main steps in scoping, but primarily focuses on providing specific guidance on:

- Identification and preliminary assessment of potential impacts with respect to certain shoreline development activities and with respect to specific project locations; and

- Selection of appropriate assessment methodologies, based on project sensitivities.

In order to carry out the above, a comprehensive description of the project in terms of location, activities and processes needs to be developed. This is described in the following section.

4.1 Project Information

The first step in scoping is to obtain as much relevant information about the project as possible, to ascertain the scale of the project and its component activities which may result in impacts to the environment.

4.1.1 Description

A description of the project location, activities and potential qualitative and quantitative impacts should be developed at this stage in order to identify the stages, activities or characteristics of the proposed project that are likely to give rise to environmental impacts.

A key assessment that has to be made for all shoreline development projects is whether it in the short or longer term will affect the local coastal morphology. This must cover both immediate impacts by coastal components and the potential for future impacts associated with exposure of the project through coastal erosion. An initial assessment of the coastal stability at the site is required during the scoping phase. Unless it can be clearly ascertained that the site is not subject to erosion that could potentially threaten the project and that the project will not affect the coastal stability within its lifetime, a more detailed assessment will be required as part of the environmental assessment.

Projects which can be classified as having marine components will have potential hydraulic impacts and hence, depending on the scale and nature of the project, will need some level of hydraulic impact assessment, including morphological impacts to the adjacent shorelines.

4.1.2 Project Location

A preliminary assessment of the baseline conditions shall be made to identify key sensitive receptors. Consideration should be given to the existing coastal/ riverine regime and features, bathymetric conditions, river estuaries, water quality and sensitive habitats and land uses.

A site visit and preliminary consultations with relevant regulatory authorities must be undertaken during the scoping exercise.

The Project Proponent and environmental consultant should also verify that the project is in line with the Sabah Shoreline Management Plan (EPD, 2005) when selecting sites to develop in order to avoid coastal sensitive areas. The SMP indicates areas where development should be prohibited or restricted and of particular relevance, the setback requirements for certain areas.

In most areas, a standard setback of 60 m from the shoreline (MHHW) is prescribed. However, the SMP does specify greater setback for some management units and the environmental consultant would need to refer to the management strategy description for each management unit.

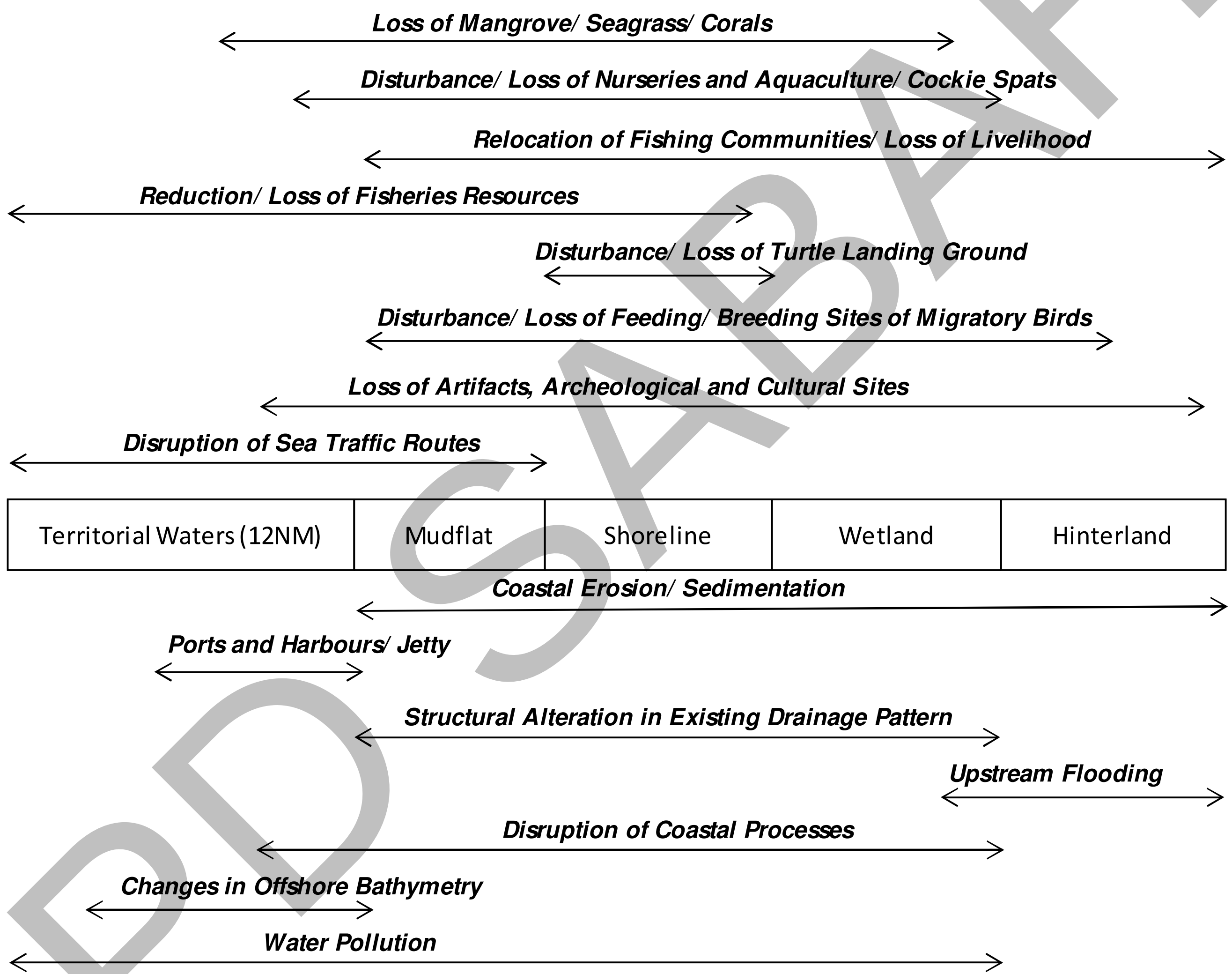
It is noted however, that the SMP is a plan at a regional scale, and hence any borderline cases should be reviewed in detail and any deviations from the SMP thoroughly explored and justified. It is recommended that such a review/ preliminary study be carried out prior to or at the TOR stage in order to allow the authorities to make a decision on the project before significant project development works, including the Environmental Assessment, are carried out.

4.1.3 Identification and Prioritisation of Impacts

Based on the previous steps, a list of all potential environmental impacts should be made with a preliminary estimate of their relative significance. The key impacts are those with the highest potential significance, considering both spatial scale, significance to stakeholders, potential impact severity and mitigation potential. EPD’s Handbook on Environmental Impact Assessment in Sabah is a useful resource for this assessment. A prioritised list of impacts shall thereby be established and clearly described.

For each key impact identified, the anticipated zone of impact should be estimated by the expert judgement of the relevant specialists, based on conditions at the site. The zone of impacts may differ depending on the environmental component; the zone of impact for noise pollution for example, may be much smaller than the potential water quality zone of impact, owing to properties of both the polluting and the dispersing agent and the conditions at the site.

Some potential impacts and their zone of impact for shoreline development projects are shown in Figure 4-1.



Source: Adapted from DOE Malaysia EIA Guidelines for Land Reclamation Projects, 2008

Figure 4-1: Main issues and extent of impacts for shoreline development projects

4.2 Types of Impacts

Whereas shoreline development activities can provide significant planning and development opportunities as well as benefits to the public if properly planned and executed, there are also numerous potential adverse impacts that have to be taken into account. The potential impacts are site and project specific, depending, among other factors on topography, drainage patterns, current and sediment transport conditions, nearby environmental receptors, size and layout.

Whereas the environmental assessment evaluates both positive and negative impacts, the positive impacts are generally site specific, related to the project objectives, whilst the negative impacts can be considered as generic impacts on the physical, ecological and socio-economic environments. A non-exhaustive list of main potential impacts related to shoreline development activities is given in Table 4-2 and Table 4-3 for onshore development and marine development activities, respectively. These are also listed in Section 5.3and Figure 4-1.

Table 4-2: Potential Issues to be considered for Onshore Development Activities

Activities	Potential Impact	Potential Sensitive Receptors
Construction Activities:		
• Construction of access road	• Soil erosion • Increased runoff • Increased turbidity into nearby water body • Loss of flora and fauna	• Flora and fauna • Recreational area
• Site clearing	• Soil erosion and siltation • Increase in suspended particulates • Increase in noise • Loss of flora and fauna	• Marine habitats • Flora and fauna • Adjacent community and business centres
• Setting up of site office & workers quarters • Building construction	• Increase in dirt and dust • Generation of sewage, sullage and garbage • Enhancement of employment and commercial opportunities • Increase in communicable and	• Adjacent community and business centres

Activities	Potential Impact	Potential Sensitive Receptors
	parasitic diseases	
• Landscaping	• Increased aesthetic value • Reduced erosion • Introduction of exotic species • Fertiliser and pesticide usage	• Adjacent shoreline land users • Native flora • Water quality impacts
Permanent/ Operational Activities:		
• Operations of resort, commercial or industrial complex	• Sewage discharges • Wastewater discharges	• Nearshore waters • Nearshore habitats • Water users - fishermen, recreational areas
	• Air emissions	• Coastal communities
• Development footprint	• Loss of habitat	• Coastal vegetation, mangroves • Coastal fauna, turtle nesting
	• Land use incompatibility • Aesthetic impacts	• Adjacent land users • Local community, tourists
	• Restriction of public accessibility	• Local villagers, • Fishermen • General public, tourists
• Alteration of hydrology/ drainage, e.g. construction of roads through streams and mangrove areas	• Upstream flooding • Changes in tidal flushing	• Residences, businesses • River/ stream users e.g. aquaculture activities • Aquatic habitats • Estuarine/ riverine mangroves

Table 4-3: Potential Issues to be considered for Marine Development Activities

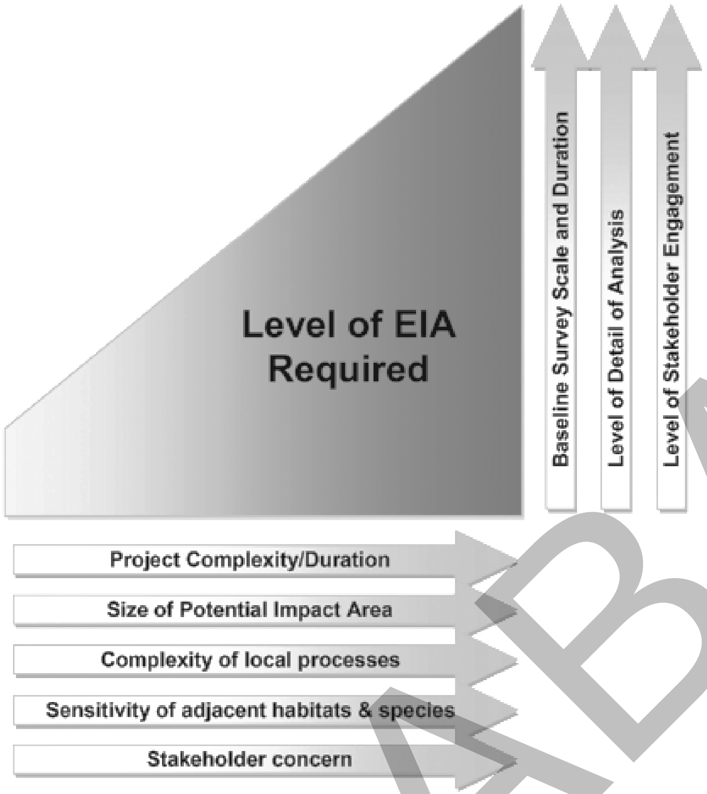
Activities	Potential Impact	Potential Sensitive Receptors
Construction Activities:		
• Construction of access road	• Soil erosion • Increased runoff • Increased turbidity into nearby water body • Loss of flora and fauna	• Flora and fauna • Recreational area
• Construction of jetties, marinas and others • Construction of groynes, breakwaters, and solid (filled) jetties • Shoreline protection works • Dredging	• Loss of habitat within footprint of structure • Reduction in littoral drift • Changes in wave refraction pattern • Changes in coastal current pattern • Impact on adjacent shorelines (erosion/ sedimentation) • Release of suspended sediments (sediment plumes) • Changes to flushing/ tidal exchange in river mouths • Impacts on upstream flooding	• Marine and intertidal habitats • Marine traffic users (impacts of changed current patterns on navigation safety) • Adjacent shoreline land users, coastal and beach habitats • catchment land uses and community
• Setting up of site office & workers quarters • Building construction	• Increase in dirt and dust • Generation of sewage, sullage and garbage • Enhancement of employment and commercial opportunities • Increase in communicable and parasitic diseases	• Adjacent community and business centres
• Landscaping	• Increased aesthetic value • Reduced erosion • Introduction of exotic species • Fertiliser and pesticide	• Adjacent shoreline land users • Native flora • Water quality impacts

Activities	Potential Impact	Potential Sensitive Receptors
	usage	
Operational Activities:		
• Vessel calls, berthing/ unberthing	• Navigation impacts • Sediment re-suspension from propellers	• Other commercial water users • Fishermen • Nearshore waters • Nearshore habitats
• Loading/ unloading of product	• Spills of product e.g. oil and chemical spills	• Marine and intertidal habitats • Water birds and marine fauna • Fishermen
• Change in drainage patterns	• Change in drainage patterns resulting in flooding impacts upstream	• Catchment land uses and community
• Operations of port, resort, commercial or industrial complex: - Waste and sewage discharges - Ballast water discharge - Process emissions such as cooling water	• Water pollution • Introduction of exotic plankton	• Nearshore waters • Nearshore habitats • Water users – fishermen, recreational areas
• Development footprint	• Land use incompatibility • Visual/ aesthetic impacts	• Adjacent landuses • Local communities
	• Loss of habitat	• Coastal vegetation, mangroves • Coastal fauna, turtle nesting
	• Restriction of public accessibility	• Local villagers, • Fishermen

Activities	Potential Impact	Potential Sensitive Receptors
		• General public, tourists
• Maintenance dredging	• Sediment plumes	• Marine and intertidal habitats

4.3 Terms of Reference

The TOR for the Environmental Assessment shall directly reflect the scoping exercise whereby the environmental consultant should address the identified impacts as fully as practicable. The level of analysis from baseline studies and the sophistication of prediction and evaluation methodologies, shall be tailored to the level of significance of the impacts and hence level of precision required for the evaluation as illustrated in Figure 4-2. Less attention should be given to those issues which have lesser significance. In practical terms, this means that the level of uncertainty may be higher for these issues.



Source: PIANC 2010

Figure 4-2: Key factors in determining the level of environmental assessment required

4.3.1 Data Collection Requirements

Collecting existing data is always the first step in the collection of baseline information. It must however be reviewed for its relevance to the proposed site, its accuracy, and use as a basis for determining what primary field investigations may be required to 'fill the gaps'.

Primary field surveys are almost always required for most aspects of the environment, such as: existing sediment characteristics, vegetation and habitats, water, air quality, noise levels, aquatic biology, currents and water levels, socio-economic and other factors. Field surveys are needed either because published information in Sabah often does not exist at a suitable scale, or is not generally applicable to the project being assessed.

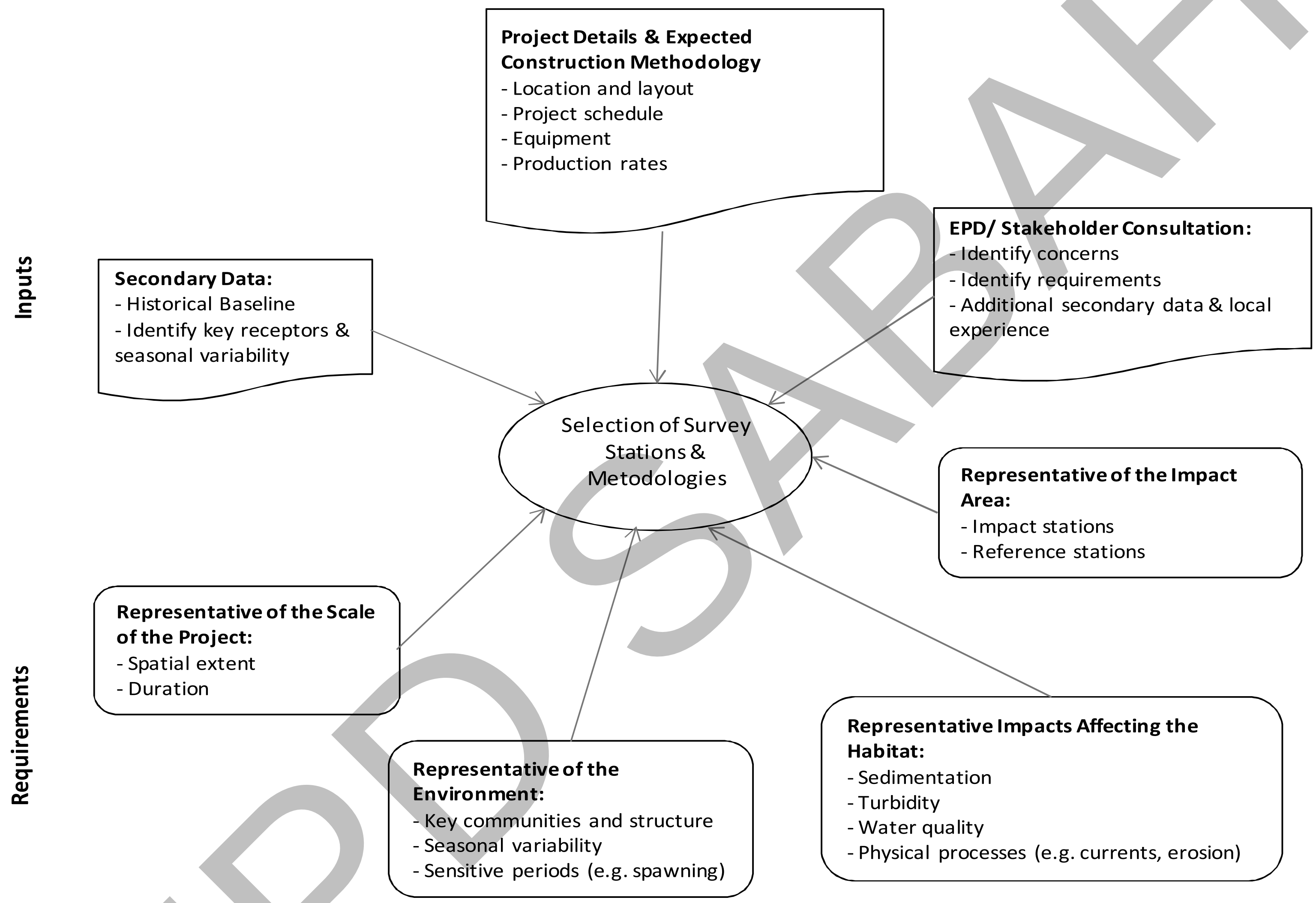
Existing (secondary) data should also be reviewed in terms of its validity, which includes considerations on the age of the data, the suitability of the methods used and a critical assessment of the results themselves. With respect to the age of secondary data, an assessment of the stability of the environment and parameter in question should be made. In a stable environment, data that is several years old may be adequate, whereas a highly dynamic environment would necessitate the use of recent data and supplementation by primary field data. For example, current patterns in an area are not likely to change significantly over the years in a natural environment. However, if there has been recent development in the area, such as the construction of a jetty or reclamation, then the currents would need to be reassessed.

Where primary field surveys are required, careful consideration must be given to the design of the field survey and sampling programme (refer to Figure 4-3). The data collection must focus on the key issues needed to be examined for the Environmental Assessment (identified during the scoping process), and should be collected at the appropriate time(s) of the year. In Sabah, this may include consideration of rainy and dry seasons, and on the coast, the monsoon and inter-monsoon periods.

It is important to address the temporal scale of the project when designing the baseline survey programme. A long-term project construction (e.g. one or more years) would require a baseline survey that captures natural seasonal variations within that period; while for a short project (e.g. 1-3 months construction phase), capturing a snapshot of the existing conditions can be sufficient.

In addition, the survey programme shall take into account the anticipated zone of impact for the issue in question to ensure that all potential sensitive receptors are included.

It should also be highlighted that a more detailed baseline, capturing seasonal variations, provides more security for the Project Proponent, in the event that natural variations are incorrectly perceived by stakeholders or regulators as project-derived impacts.



Source: Adapted from PIANC, 2010

Figure 4-3: Examples of criteria for selection of baseline survey stations and methodologies

5 Impact Prediction and Evaluation

This chapter deals with the assessment of the impacts that are likely to occur in the existing environment when the project activities are implemented (refer to Table 5-1).

Table 5-1: Assessment Procedures – Description of Impact Assessment

The Seven Steps	Summary of Main Required Activities
Step 3: Undertaking the EIA/ PMM study	Environmental Consultant: • *Assess the project details* - *Plan assessment* • *Assess the existing environments* - *Physical environment* - *Biological environment* - *Human environment* • *Assess the environmental impacts* - *Hydraulic/ morphological impacts to the shoreline* - *Flooding risk due to altered hydrology or impacts on flows of drain outlets and river mouths* - *Water quality deterioration from increase of suspended solids and discharges of other pollutants* - *Ecological impacts on marine and terrestrial habitats, flora and fauna* - *Conflict of land uses e.g. loss of coastal area used e.g. for fishing, leisure, eco-tourism or navigation* - *Air and noise pollution* - *Waste handling (biomass, solid waste, sewage and scheduled waste)* - *Impacts on existing land or marine traffic* - *Social economic concern/ benefits* - *Potential abandonment* • *Devise and propose mitigation measures* • *Devise and propose monitoring programmes*

This section outlines procedures for identifying the environmental impacts associated with shoreline development activities, as well as proposed methodologies for assessing the scale and extent of the environmental impact.

The magnitude of the impacts depends on the combination of existing conditions and the selected construction technologies and methodologies, while the zone of impact depends on existing environmental conditions such as coastal features, vegetation, biological features or nearby settlements. Adverse environmental impacts affect habitats and livelihoods outside the project area and hence the Project Proponent is responsible to minimise such impacts by adopting mitigation measures. As a general principle, mitigation measures should preferentially focus on addressing the impacts in order to eliminate/ minimise the residual impacts.

The assessment should consider site characteristics, the proposed shoreline development activities and the cumulative effects with other existing or proposed developments within close proximity to the site. The environmental consultant's approach to assessing these interrelated factors should be clearly described based on the TOR as approved by EPD.

5.1 Description of Plans and Site

Step 4 of the overall environmental assessment process may be divided into four (4) main parts:

i. Description of planned activities and existing environment conditions;

ii. Assessment of environmental impacts;

iii. Devising mitigation measures; and

iv. Formulation of monitoring programme.

This chapter deals with the description of plans and the existing conditions within the site and the zone of impact (refer to Table 5-2).

The assessment of the existing environment and thus the activities and associated mitigation will, to a large extent, be based on an analysis of topographic maps combined with knowledge of the field conditions. The actual delineation of areas and mitigation measures must be based on the verifiable conditions in the field, i.e. be based on field surveys.

Table 5-2: Assessment Procedures - Description of Plans and Existing Environments

The Seven Steps	Summary of Main Required Activities

Step 4:
Undertaking the EIA/ PMM study
	Environmental Consultant:
	• *Assess the project details*
	  • *Plan assessment*
	• *Assess the existing environments*
	  • *Physical environment*
	    - *Water*
	    - *Air and noise*
	    - *Soils and geology*
	    - *Meteorology*
	  • *Biological environment*
	    - *Flora and fauna*
	  • *Human environment*
	    - *Public administration*
	    - *Demography*
	    - *Livelihoods and economic activities*
	• *Assess the environmental impacts*
	• *Devise and propose mitigation measures*
	• *Devise and propose monitoring programmes*

The impact assessment is, as mentioned, based on a combined knowledge of the intent and the existing environment.

An assessment must therefore be made of the existing environment, its components and its sensitivity to impacts from the shoreline development activities. In order to provide a basis for comparison during later monitoring, it is important to have a set of baseline data, describing clearly the pre-project conditions. The description provided must be clear and direct to the point being discussed.

5.1.1 Project Options

Shoreline development activities particularly those involving marine development can have inherent risks. These risks are usually manageable, but involve increase costs, relative to alternative sites. The decision to develop on a shoreline should be assessed and justified through a discussion of alternative project options.

The justification needs to identify why the proposed functions or objectives of the development can only be achieved by locating the development on a shoreline area. This approach is aimed at preventing inappropriate shoreline development activities which can possibly cause irreversible environmental impacts in the long run.

5.1.2 Project Screening

Screening is recommended to be applied by environmental consultants to determine the aspects that should be covered in an Environmental Assessment report. The process of screening should be simple and rapid, but effective enough to eliminate major potential environmental impacts that have residual significance, such as destruction of environmentally sensitive areas or priority habitat.

Screening allows for focus on real environmental issues at an early stage of the assessment process and allows for environmentally sensitive planning and the early resolution of some issues. This will minimise the possibility of residual impacts. Project screening is conducted by assessing the project details in relation to the existing environment as described in Section 5.1.3 and Section 5.1.4.

5.1.3 Assess the Project Details

In order to be able to propose realistic mitigation measures, the following initial information should be obtained prior to embarking on any field surveys or assessments to be included in the Environmental Assessment report.

A more detailed description of the project concept, with all available technical data should be given in the EIA report, in terms of:

i. Project Location and Concept

- Exact location of the project site on a map with an appropriate scale and coordinate system;
- Description and illustration of the proposed project including all the related components (development plan and cross-sectional views);
- Minimum setback from high water mark (HAT);
- Implementation schedule for site clearing, earthwork and construction activities;
- Local structure plan for the area and its nearby surroundings;

- Components or activities below the MHHW (in the marine/ littoral zone); and

- Statement of need for the proposed project.

ii. Control of Earthwork and Construction

- Detailed site survey plan showing ground levels, rivers, existing structures and other features within the site;

- Estimated amount of earthwork (cut and fill) including location of proposed borrow pits/ disposal sites, layout plan and cross sections. The vertical and horizontal scales on all cross sectional **drawings must be 1:1**;

- Earthwork and construction methodology, schedule and equipment;

- Erosion and sediment control plan detailing out the erosion control measures to be implemented;

- Details on siting of temporary structures such as site office, workers' quarters, workshop, sanitary facilities, stockpile area, and others, including estimated number of workers to be employed (if available);

- Drainage plan showing plans for conveying surface and sub-surface water away from the site;

- Site access/ road construction;

- Traffic and transportation (marine or land based transport of construction materials); and

- Landscaping proposal for the proposed project, including vegetative restoration of portions of the site that were disturbed during construction.

iii. Handling and Disposal of Oils, Scheduled and Hazardous Substances and Waste

- Storage of oil and fuel;

- Disposal of scheduled waste; and

- Disposal of sewage.

iv. Solid Waste Management

- Disposal of solid waste;
- Disposal of biomass waste; and
- Disposal of earthworks/ overburden material.

v. Other Discharges or Emissions

Depending on the activity:

- Ballast water management (ports and jetties);
- Control of discharges/ emissions (e.g. anti-corrosives, biofouling chemicals, and others);
- Wastewater and sewage discharges; and
- Oil spill risk assessment (port and jetties).

vi. Other Operational Activities

- Marine traffic and navigation – consider navigation routes; number of additional vessel movements; and
- Type of recreational activities such as snorkelling or scuba diving.

5.1.3.1 List of Supporting Documents Required

The following reports/ details (plus other appropriate reference sources) should be made available and incorporated in the Environmental Assessment report, where relevant:

Report/ Study	Details Required
Geological/ Soil Investigation Report prepared by a registered geologist/ professional engineer	*For Marine Development* – Detailed marine geology, subsurface geological profile, coastal morphology and processes, bathymetry survey, reclamation materials (source – quarry or borrow areas) results *For Onshore Development* – Underlying soil properties (including strength and permeability), geological and slope features including slope failure areas (landslides), structural geology (rock types, landforms, terrain features, joints, bedding, faults, shear zone, etc.), degree of weathering, hydrogeological regimes (groundwater levels, aquifer characteristics)
Erosion and Sediment Control Plan (ESCP) as prepared by a competent party (latest as per submitted to the local authority)	– Layout and design details for erosion control facilities such as sediment basin, silt traps and temporary drainage network mainly for earthwork/ reclamation stage (compulsory) and construction stage (where applicable)
Drainage Report prepared by a professional engineer (latest as per submitted to the local authority)	– Drainage pattern onsite before and after development, water catchment areas, runoff flow direction
Reclamation/ Earthwork Plan (in phases) prepared by a professional engineer (latest as per submitted to the local authority)	– Earth cutting and filling areas, comparison between existing and finished ground levels, reclamation implementation in phases detailing out the activities involved in each phase

5.1.4 Assess the Existing Environment

It is necessary to provide sufficient information to give a brief but clear illustration of the existing environmental components. These components include, to the extent applicable (but are not necessarily limited to) the following:

- **Physical Environment**: bathymetry, wind, wave, current, coastal morphology, topography, soil, geology, hydrology, climate, water catchment areas, shore reserves, water and air quality and noise level.

- **Biological Environment**: wildlife, forest - mangrove, rare, protected or endangered species (both aquatic and terrestrial flora and fauna), fisheries, coastal vegetation, wilderness or protected areas, key conservation value habitats or species.

- **Human Environment**: population and communities (including numbers, locations, compositions, employment and other), land use, infrastructural facilities (including water supply, electricity, sewerage and others), institutions (such as schools, hospitals and places of worship), transportation (roads, navigation and other), archaeological, historical and cultural values and aesthetic values.

The baseline study for the Environmental Assessment should concentrate on identifying those environmental components that may be significantly impacted by the proposed project. These may be identified through ground observation, literature review and stakeholder consultation. The description can be presented in the form of mapping, listing or reports in the Environmental Assessment report.

5.1.5 Study Area and Zone of Impact

Generally, a study area for the preparation of an Environmental Assessment report covers a 3 km radius from the project site boundaries. However, the study area should focus on what the environmental consultant deems to be the zone of impact. A clear delineation of the study area based on actual ground survey conducted is important to define the area within which impacts should be considered.

There may be different zones of impact for the physical (such as marine water quality, coastal morphology, drainage pattern, and air emission/ noise nuisance), biological (such as wildlife species, habitat and diversity) and human (such as social issues affecting communities, cultural and aesthetic aspect and land use) environment. The environmental consultant should overlap these impact zones and decide which zone is particularly sensitive and where impacts are likely to be of some significance. Such zones may reach far downstream from the site, particularly if there are sensitive areas downstream or locality concerns. The zone of impact can be determined after understanding the concept of the proposed development and conducting ground observations to identify these sensitive areas.

The extent of the study area/ zone of impact must be mapped out, clearly defined and justified in the TOR document and agreed upon with EPD. This will particularly include human settlements that are to be included in the assessment surveys for the preparation of the Environmental Assessment report.

5.2 Impact Assessment

The Environmental Assessment for shoreline development activities will assist in the following:

- Planning of site preparation and subsequent construction works;
- Identification of environmental impacts and the risk of negative impacts;
- Exclusion or protection of sensitive or vulnerable areas; and
- Protecting environmental components in the immediate site area, in adjacent areas and in the broader environment.

Integrating environment protection at the project planning stage will ensure that measures to avoid and minimise pollution can be built into the project design and work schedule. The Environmental Assessment should not only consider the environmental impact on a site, but whether or not significant off-site effects are likely. An initial assessment of the site should be conducted to identify sensitive environmental areas or land-uses that require protection. These may include:

- Sensitive or endangered flora and fauna;
- Aquatic plants and animals, if a natural waterway is affected; and
- Historical buildings/ cultural areas that are considered as sensitive.

The first activity to be performed as part of the Environmental Assessment process is to identify environmental issues which are important and which will need to be studied in detail, and to identify and eliminate issues which are of little or no importance and therefore can be excluded from the Environmental Assessment study.

In addition to an assessment of the specific impacts related to the project, an overall assessment should be made based on the carrying capacity of a particular coastal area, and/ or river system to accommodate shoreline development activities, while still maintaining its geomorphic and ecological characteristics. In this respect, an assessment of the 'cumulative impacts' of the shoreline project being assessed, plus other existing and planned shoreline development activities on the same coastal area or river drainage system is important. Integrated assessment of the sensitivity of the broader coastline or river system to cumulative impacts of a number of shoreline projects will assist in managing the area and its resources in a way that is compatible with 'best practise' environmental protection.

5.2.1 EIA Matrix

Impact assessment is not an exact science. The assessment of impacts therefore requires a deep knowledge and understanding of the local environment and, in the case of marine development, of coastal hydraulics and coastal processes from the assessors. Therefore, different assessments are likely to come to similar but still somewhat different conclusions.

The environmental consultant should combine their personal experience with recent international and local research results, monitoring reports from neighbouring areas of active developments, new survey data and in some cases from the results of modelling.

Literature on the impacts of shoreline development activities already exists and in the first instance this should be consulted. A review of known impacts documented for similar environments is likely to provide a good foundation for the basis of the impact assessment.

Results obtained from computerised mathematical models need to be verified against field data. It should be recognised that for the results to be representative, the data requirements are high and limited by the quality of the input data. To enable verification by EPD, actual procedures should be made available. Before using computer models, prior consultation and approval with EPD is advisable.

It cannot be stressed enough that the environmental consultant should take a realistic and site specific view of the project. They shall neither promote nor criticise the proposed activities but realistically present, what in their professional opinion is realistic to expect as a result of the plans. In order to have an impact on the planning, the environmental consultant must focus on a limited number of significant key issues supported by literature review and project specific information. In addition to an assessment of the probability (risk) of the impact to occur, each issue shall be described with a view of:

- The magnitude of the projected impact.
- The permanence of the projected impact.

- The reversibility of the projected impact.
- Cumulative impacts over time of the projected impact.

This means that these four points must be represented as sub-headings for each description of each impact.

The summary of results shall be presented in an EIA Matrix, an example of which is shown in Table 5-3. To guide the reader of the Environmental Assessment report, this summary table is best placed before the descriptions of environmental impacts.

Table 5-3: EIA Matrix (Example)

Impacts	Magnitude	Permanence	Reversibility	Cumulative
Key Environmental Impacts				
Shoreline Morphology	2	3	3	3
Soil Erosion and Water Pollution	1	2	2	3
Air and Noise Pollution	1	2	2	2
Waste Management	2	2	2	2
Ecology	1	3	3	2
Other Environmental Impacts				
Traffic and Transportation	2	2	2	2
Socioeconomic	2	3	3	2
Visual/ Aesthetic	2	3	3	3
Abandonment	1	3	2	2

Legend	**Number**		
Criteria	**1**	**2**	**3**
<u>*Magnitude*</u> *Measure of the importance of the condition in relation to spatial boundaries*	Change/ effect within project site only	Change/ effect to local conditions and/ or to areas immediately outside	Regional/ national/ international change/ effect
<u>*Permanence*</u> *To define whether the condition is temporary or permanent*	No change/ not applicable	Temporary	Permanent
<u>*Reversibility*</u> *Measure of the control over the effect of the applied condition*	No change/ not applicable	Reversible	Irreversible
<u>*Cumulative*</u> *Measure of whether the effect will be a single effect or a cumulative effect over time or a synergistic effect with other conditions*	No change/ not applicable	Non-cumulative/ single	Cumulative

When scoring the level of impact, the environmental consultant should give justification on how the scoring has been done and what has caused very high or very low assessment scores. This can be done by repeating the table row at the end of each impact description. An example is given in Table 5-4.

Table 5-4: Activity Level EIA Matrix (Example for Shoreline Morphology Impact)

Criteria	Score	Justification
Magnitude of change/ effect	2	Erosion impacts predicted to adjacent properties.
Permanence of Impact	3	Proposed groynes is a permanent structure.
Reversibility of Condition	3	Irreversible (without mitigation).
Cumulative Impact	3	Cumulative as the erosion will likely continue over time until new equilibrium reached.

5.2.2 Use of Geographical Information System (GIS)

The representation of spatial data by means of a GIS provides an appropriate tool for representing and analysing spatial data sets, particularly for larger, more complex and sensitive projects. GIS therefore offer good opportunities to examine the environmental sensitivity of different environments.

It is a requirement to submit datasets directly to EPD. The GIS used by the environmental consultant should be able to export datasets in a format readable by the EPD's system. The environmental consultant should therefore consult the EPD before the analytic work begins in order to ensure such compatibility.

EPD may from time to time issue a list of map formats including standardised map symbols or spatial data requirement, which must be used in maps submitted as part of an Environmental Assessment.

5.2.3 Numerical Modelling

Many environmental impacts from shoreline development activities which involve marine construction projects are not easily quantifiable. Numerical modelling is a key tool to quantify hydraulic impacts as it provides spatial and temporal information about the existing environment and the ability to predict future changes in response to a project. Comparing model results for existing conditions with results that include the proposed project can be used to assess the potential impacts.

Except for small projects in areas with no, or very limited, sensitive receptors, where a lower level of certainty in the impact prediction may be accepted, hydraulic studies based on numerical modelling are considered a requirement to quantify potential impacts for shoreline development activities involving marine construction. For the small, non-sensitive projects, expert judgement based on an understanding of the site conditions may be sufficient for the evaluation of impacts.

Results obtained from computerised mathematical models need to be verified against field data. It should be recognised that for the results to be representative, the data requirements are high and limited by the quality of the input data. The environmental consultant is referred to the Department of Irrigation (DID)'s guidelines for numerical modelling which include guidelines on data collection, model calibration and validation.

5.2.4 Optimisation of Project Plan

The environmental consultant will at several points during the assessment, find that the plan description provided by the Project Proponent is suboptimal seen from an environmental point of view. There may be environmental management issues, which are not included in the plan description, there may be certain parts of the project scope, timing or lay-out, which are not seen as acceptable, or there may be suboptimal choices of technologies or methodologies. The environmental consultant will, when such flaws in the plan description become obvious, advise the Project Proponent on recommendable plan changes so the final plan, which is being assessed by the environmental consultant, is optimised for environmental management, i.e. negative environmental impacts are being minimised through proper choice of scope, technologies and methodologies.

It is unavoidable that the project activities will cause some residual impacts even when all activities are carried out in the best possible manner. The assessment by the environmental consultant will then concentrate on assessing the magnitude and effect of these residual impacts. There will be no more that the Project Proponent can do to minimise them. There will, however, be some mitigation in the form of compensation that can be implemented. Off-set planting or replacement of habitat conservation, cash compensation or substitutes for lost livelihoods or environmental services are among the options for mitigating unavoidable and thus residual, impacts.

Project optimisation options should be thoughtfully considered and reported in the Environmental Assessment report so that the maximum benefits of the project are clearly understood. These benefits should be considered against any residual impacts that may be identified in the Environmental Assessment.

5.3 Environmental Impacts

The key environmental impacts associated with shoreline development activities concern:

- Hydraulic/ morphological impacts to the shoreline (for marine development projects)
- Flooding risk due to altered hydrology or impacts on flows of drain outlets and river mouths
- Water quality deterioration from increase of suspended solids and discharges of other pollutants
- Ecological impacts on marine and terrestrial habitats, flora and fauna
- Conflict of land uses e.g. loss of coastal area used e.g. for fishing, leisure, eco-tourism or navigation

These key impacts are highlighted as they are primarily project-related impacts rather than process-related; i.e. they are mitigated through appropriate project siting and design optimisation, rather than through any construction or operational practice or activity. Project design addresses the key physical impacts, which generally results in a reduction of consequent biological and socio-economic impacts. Addressing the key physical impacts prior to design finalisation is essential to the sustainability of the overall design concept, as physical impacts are extremely difficult to mitigate once the development plan is fixed.

Impact prediction and evaluation methodologies for these key impacts are described in the following subsections. Other adverse environmental impacts of shoreline development activities include:

- Increased noise levels from construction activities.
- Dust and atmospheric pollutants from machinery and transport vehicles.
- Increase in traffic density from transportation activities.

Documented advice should be provided to Project Proponents at an early planning stage on best ways to improve the environmental sustainability of the project. For example, provide site location or design alternatives that reduce the risk of environmental impacts and improve the environmental performance and aesthetics of the project. This may require the environmental consultant to obtain specialist advice from technical specialists (i.e. designer or engineer/ architect) on such matters.

Different activities related to shoreline development projects cause different impacts, while technologies, methodologies and local, site specific conditions determine the extent of the impacts, i.e. the zone of impact and the severity. As a planning tool, it is important that the Environmental Assessment gives very clear recommendations to the Project Proponent on how activities should be implemented. The surrounding community, however, is more concerned on where, when and how, impacts will affect their livelihoods; less on why. The definition of impact, particularly residual impact, should therefore be clear and define impacts in terms of time, quantity and quality.

5.3.1 Hydraulic and Morphological Impacts

Alterations to the riverbank or shoreline configuration through the construction of structures such as jetties, marinas, groynes, breakwaters, sea walls, or other features within the littoral or intertidal zone may result in alterations in wave and current patterns. These changes in turn can cause the following cascading impacts:

- Coastal erosion (refer to Plate 5-1).
- Siltation of waterways at river mouths, rivers, navigation channels, ports and harbours, drains, outfalls and others, and at environmental receptors.
- Navigational impacts (from waves, eddies, cross-currents, tunnel-flow).
- Bathing safety (from waves, eddies, rip-currents).
- Flooding impacts (extension or siltation of waterways and drainage systems).
- Flushing impacts on corals, mangroves, embayed water bodies, water villages and others (from shadowing, changes in tidal prism and others).
- Changes in salinity concentrations in estuaries.

Plate 5-1: Example of coastline erosion at Kg. Kinarut Laut

The erosion and siltation impacts can be quantified if changes in the sediment transport patterns (which is a result of the combined wave and current climate) can be assessed.

Numerical models are often preferred as a tool to quantify hydraulic impacts as they provide spatial and temporal information about the hydraulic environment. The modelling for both existing conditions and with the proposed development can be compared to assess the potential impacts. The consultant is also referred to the Department of Irrigation (DID)'s guidelines for numerical modelling which include guidelines on calibration and validation of model.

Data Requirements:

Baseline information for the assessment of hydraulic impacts in coastal areas includes:

- Current measurements (if numerical modelling is to be carried out, DID guidelines specify a minimum of two locations for at least 3 days over spring and neap tides).

- Water level measurements (if numerical modelling is to be carried out, DID guidelines specify a minimum of 15 days of measurements simultaneous with current measurements).
- Bathymetry.
- Coastal profiles/ river cross-sections.
- Development plan detailing out the project components and extent of area involved.

For the assessment of morphological impacts, a comprehensive bottom sediment survey of the area surrounding the proposed marine construction components should be performed and analysed for grain size using appropriate techniques.

Assessment Methodology (Coastal Hydraulic Impacts):

In general, modelling of waves and currents is considered necessary for construction works encompassing structures which can significantly affect the transport of sediment in the littoral zone. This would apply to works involving groynes, breakwaters or solid filled jetties (causeways). Exception might be made for certain small projects in areas with no or very limited sensitive receptors, where a lower level of certainty in the impact prediction may be accepted. In these cases expert judgement based on an understanding of the site conditions may suffice for the evaluation of impacts.

To assess the potential impacts to the hydraulic regime and coastal environment from the proposed development, comparisons of the hydrodynamic simulations for both existing conditions and with the proposed development need to be carried out. Assessment should also include consideration of seasonal effects and project phasing.

Assessment Methodology (Morphological Impacts):

The hydraulic changes and associated changes in sediment transport patterns can result in morphological changes as mentioned above. The morphological changes induced by marine construction projects are often critical if realised as coastal erosion, bank erosion or siltation of waterways. Accretion of materials can be a problem if it increases erosion elsewhere, inhibits navigation or makes changes to the current velocities.

The existing coastal morphology at a site is not a static condition. An on-going process of erosion and deposition is fundamental to the natural environment.

The potential impacts relate to interventions that accelerate, reduce, or significantly change the pre-existing balance of morphological change.

The historical rate of morphological change, and the trajectory under existing conditions, can often be assessed by an examination and comparison of historical aerial photos, as well as on-site identification of changes in shoreline movement. However, care must be taken when using such historical data to form assumptions on the future trajectory. The processes shaping the historical patterns must be understood and reviewed to determine whether changes have occurred in the environment (e.g. catchment based changes that can modify historical sediment sources) that may alter or reverse historical morphological patterns.

Depending on the location, scale and configuration of the marine structures, the morphological impact assessment may require numerical modelling whereas in more simple cases, expert assessment may be carried out through an evaluation of the predicted changes in the current and wave conditions and its anticipated effect on morphology. Minor changes in hydraulic conditions would be expected to result in similarly minor morphological impacts.

However, if the scale of the project is large and larger scale changes in current and wave patterns are expected around the project site (for example large breakwaters or river training walls), or if there are particularly sensitive shoreline land uses or intertidal habitats in the area (nearby coral reefs, seagrass or mangrove areas), a more comprehensive approach would be required. Numerical modelling in these instances should be carried out to identify potential erosion and deposition areas and quantify changes in sediment budget and sediment transport capacities in these areas. Exact quantification of actual erosion and/ or sedimentation rates is however generally difficult without extensive and long-term data collection.

5.3.2 Hydrological Impacts/ Upstream Flooding

Prediction of sedimentation or changes in water levels should be used to assess the potential for flooding in upstream areas, in particular for projects where the marine structures extend or partially intrude into a river mouth. It is difficult to quantify impacts through, for example, prediction of actual flood levels during certain design flood events, as this would entail extensive baseline data collection of the flood plain or affected area in order to establish a terrain model of the area. It is therefore generally acceptable, for smaller projects, to predict changes in water levels in the rivers and based on the predicted changes in river water levels, to estimate the expected flood response.

Pre-existing drainage systems can be affected by new shoreline development if it becomes necessary to extend or divert the drainage outfall. In these cases the outfall may be more frequently inundated, resulting in a reduced outfall capacity. Engineering responses may require a drainage upgrade, or installation of pump facilities. These actions may require their own impact assessment.

Developments within estuaries may also affect mangrove areas beyond the direct impact area, for example, through the construction of access roads intersecting mangrove areas. This may affect the overall tidal prism or cut-off areas of mangroves from their normal tidal regime.

5.3.3 Water Quality

Marine works for shoreline development activities such as sand filling, general filling, dredging and pile driving in water may adversely affect the water quality of the neighbouring areas due to release and suspension of sediments and turbid water. In the case of dredging, the re-suspension of sediments in water may lead to the introduction of previously dormant heavy metals and other pollutants adsorbed by the sediments, possibly with toxic or harmful levels for humans and/ or aquatic fauna.

Marine structures around river mouths such as breakwaters and river training walls, with or without dredging works may disturb the saline balance of a river and the flushing capacity of embayed areas. Water quality deterioration arising from reduced flushing may be further exacerbated by routine discharges during the operations of the port/ commercial/ residential or resort development.

Marine structures such as reclamations, ports, harbours, marinas and aquatic based resorts may also suffer from water quality deterioration arising from reduced flushing.

Data Requirements:

The baseline water sampling programme should consider the following factors:

- Sampling locations should consider sensitive receptors.
- Samples to be collected from a representative depth. In the case of marine outfalls, sampling should be carried out to establish a water quality depth

profile, with a minimum of near bottom, mid-depth and sub-surface sampling. This is because the dispersion of the pollutant may be dependent on stratification within the water column and the location of the outfall in the water column (depth).

- Sampling needs to cover diurnal and tidal fluctuations. For example drainage and waste outfalls on the shoreline can be expected to show greater impacts during the working day and/ or on rising tides.
- Sampling parameters should reflect the parameters of concern to the sensitive receptors and the characteristics of the discharges/ emissions. (e.g. coliforms, nutrients for bathing water areas, TSS, metals for marine habitats and depending on the type of activities involved).
- When sampling near rivers and streams, the sampling shall be repeated a sufficient number of times to allow the determination of the pollution loading from these sources.

In addition, references should also be made to the following planning documents for a more complete assessment:

- Development plan
- Earthwork layout plan including erosion and sediment control components
- Soil investigation and/ or geological report (if applicable)
- Drainage layout plan

Suspended Sediment Plume Assessments

Increased amounts of suspended solids in the water column will increase the turbidity of sea water and will lead to a reduction of light penetration. This may in turn affect sensitive primary producer habitats such as corals and seagrasses as well as adjacent shoreline land uses such as resorts and recreational areas.

The extent of physical impacts will depend on the amount of suspended solids generated and velocities of currents that disperse the suspended sediments. Hence projects which involve significant dredging works (particularly in areas with fine sediments, as is often the case around harbour developments) within the vicinity of sensitive marine habitats or shoreline land uses (i.e. recreational uses), should in general carry out suspended sediment plume modelling to predict impacts to these sensitive areas. Modelling is often a suitable approach for testing the impacts associated with a given project under various climatic conditions. It can also be used to explore various dredging methodologies or scenarios.

Where sensitive receptors exist within the potential impact zone (and this may be more than 10 km from the project site, depending on met-ocean conditions), numerical modelling of suspended sediment plumes during dredging activity should be carried out. The requirement for modelling for other marine construction works should be assessed based on the scale of the project, the amount and type of fill or construction material to be used and site sensitivities.

Further information on suspended sediment plume modelling is given in Appendix 6; however, it is emphasised here that, due to the complexities in receptor responses to suspended sediment plume impacts, any modelling assessment is supplemented by an experience-based approach, drawing on:

- Expertise and experience with similar scale projects in similar proximity to relevant receptors and similar met-ocean environments.
- Local expertise and experience across multiple disciplines and locations in relation to the particular sensitive marine habitats/ communities found at the site.
- Assessment and analysis of trends and sensitivities in baseline data.

For shoreline development activities with none or minor marine construction works, a desktop assessment of potential erosion runoff and dispersion should be made, considering the following key factors:

- Type and volume of construction material (i.e. fine material will be highly dispersive compared to coarser material or rock.
- Construction methodology (erosion and runoff protection measures).
- Met-ocean environment at the project site (predominant wave and currents patterns).

Flushing

This component is related to shoreline development projects which involve marine construction. Marine structures around river mouths such as breakwaters and river training walls, with or without dredging works may disturb the saline balance of a river and the flushing capacity of embayed areas. This also applies to enclosed structures such as ports, harbours and marinas. If dredging or construction works are done inside the river or at the river mouth, the saline intrusion processes are altered which has a potential impact on various receptors (e.g. riverine mangroves which may extend significant distances upstream) and at locations relying on fresh-water intake. The saline wedge travelling up river typically is sensitive to river mouth dredging and construction works which may change the tidal prism.

The flushing capacity of rivers and estuaries may also change if they are embayed by the development works or when the works induce changes in the tidal prism. Flushing and salinity impacts should be assessed in detail if the river mouth or estuary is home to sensitive habitats such as mangroves or seagrasses which are accustomed to the existing tidal regime. Factors to be considered should include changes in salinity, frequency and height of tidal inundation.

Hydrodynamic conditions (the motion of water) in the sea govern the mixing of runoff water with ambient sea water. In a semi-enclosed bay or estuary the water exchange or mixing rate can be slow (long flushing times), which can cause problems from an accumulation of, and increased concentration of, vectors that affect water quality. Along an open straight coastline the water exchange and mixing can be much faster, which can minimise accumulation.

Some marine structures, depending on configuration, have the potential to influence water quality conditions by altering the flushing characteristics of the area, for example through the creation of semi-enclosed or more sheltered areas along the coastline. This may cause stagnant or poorly-flushed areas which can accumulate rubbish or pollutants, in particular where the feature is constructed nearby a source of pollutant discharge, such as a river and main drains.

Changes in flushing of an estuary or river may also impact estuarine habitats such as mangroves and seagrass beds, and fisheries activities such as aquaculture. Changes may affect the salinity regime in these areas and/ or result in accumulation of pollutants affecting the carrying capacity of the water body to assimilate inputs for example from aquaculture activities.

As mentioned above, flushing and salinity impacts should be assessed in detail if the proposed development is likely to affect a river mouth or estuary which supports sensitive habitats such as mangroves or seagrasses. Numerical modelling of flushing pre- and post-development should be carried out in these instances. The assessment should take into account various climatic and flow scenarios. Factors to be considered should include changes in salinity, frequency and height of tidal inundation, while the flushing simulations provide a general indication of residence times of various pollutants within the affected water body. However, if more detailed information is required, for example actual concentrations of a given pollutant of concern, water quality modelling should be carried out.

Water quality and ecological models including food web and explicit nutrient recycling (including loss processes such as denitrification) are now readily available. Many of these can couple directly to hydrodynamic models which fully resolve advection and dispersion of these processes (hydrodynamic as well as nutrients and others) in the water column at very high resolution. More specifically these models can also be used to determine eutrophication, contamination of organisms by heavy metals and specific seabed water column nutrient exchanges through mineralisation.

These models are generally data intensive and hence their use should be weighed against the study requirements.

Operational Discharges

The type and magnitude of routine discharges from a development project depends very much on whether it is of an industrial, commercial, and residential or tourism nature. For commercial, residential or tourism developments, discharges may be limited to treated sewage discharges, whereas discharges or spills from ports and industrial projects are likely to be greater in frequency and magnitude. Releases to the marine environment may involve routine, process-related discharges to the sea, such as cooling or heating water, wastewater discharge points and other marine outfalls. Associated pollutants with marine outfalls also include chlorine and other biocides which are applied to prevent bio-fouling in the water intake/ outfall systems. The likelihood of non-routine discharges, such as leaks of oil and grease, chemical products or oil spills are also higher.

For non-industrial shoreline development activity in an area of normal sensitivity, it may be sufficient to assess the impact of deteriorated water quality by considering the estimated volumes and concentrations of discharges from the site and the nature or behaviour of the pollutants against site conditions such as existing water quality and the level of water exchange (e.g. enclosed versus open coastline). A qualitative assessment of the level of dispersion in the nearshore areas and the carrying capacity of the receiving waters can then be made. Evaluation of the significance of the impact should also consider the number and type of water users in the near vicinity of the site.

For shoreline development of a more industrial nature, the assessment of water quality impacts may be coupled with numerical modelling. In general, for permanent impacts (i.e. throughout the project life-cycle), such as cooling water or other process/ wastewater discharge in the vicinity of sensitive areas (e.g. fishing grounds, marine habitats, recreational beaches), numerical modelling should be carried out to determine the spatial extent of the impact and the predicted magnitude (concentrations). The risk of oil spill or other spills of hazardous product should also be assessed for port developments located near sensitive marine habitats such as mangroves and coral reefs.

Numerical modelling of water quality can be carried out to varying levels of detail, depending on the scale of the project and site sensitivities. Basic modelling of advection and dispersion can be carried out to determine the maximum spread of a conservative tracer (i.e. to represent a pollutant with no breakdown) under the post development hydrodynamic conditions. For more precise predictions, water quality models including loss processes such as speciation, uptake and water-sediment interactions, coupled with hydrodynamic models are now readily available as described in the previous section. These models are generally data intensive and hence their use should be weighed against the study requirements. For example, if waste water discharges are to occur in an area where flushing and water quality is already an issue, then water quality modelling to quantify the potential increases in certain parameters may be required to evaluate actual concentrations against available standards or the tolerances of the identified sensitive receptor(s).

Models to be selected must be well proven and be satisfactorily calibrated and verified with field data. Some important model features that must be considered in the assessment include:

- Parameterisation of receptor tolerances to the pollutant in question (e.g. thermal stress, chlorine);
- Spatial resolution of the model in the potential impact area appropriate for the zone of impact and complexity of the flow;
- Vertical resolution dependent on the three-dimensional nature of the flow and the design of the discharge outfall in the potential impact area; and
- Simulations adequately covering both representative and worst-case climatic conditions and being sufficiently long to ensure that key tidal, wind and wave effects are captured.

5.3.4 Ecological Impact

Coastal developments may involve the direct removal of coastal or nearshore marine habitats either through the location of the development, dredging or indirect construction methods such as spillage from dredgers during transit and discharges during spoil dumping that may smother adjacent critical habitats. This impact has the potential to inflict a direct loss of the resource/ habitat, an indirect loss of economic and ecological value (e.g. fisheries, tourism and biodiversity) and may cause cumulative impact on adjacent habitats with interlinked functions.

Most organisms living in a water body are sensitive to any changes in their environment, whether natural (such as increased turbidity during floods) or unnatural (such as contamination arising from disturbance of sediments which can sometimes result in release of contaminants). Different organisms respond in different ways. The most sensitive of these are the primary producer benthic habitats, as these depend upon clear water to maintain sufficient light penetration for photosynthesis, while they are, at the same time, sessile and unable to move away from the affected area. These and other habitats/ communities are discussed further in the following subsections.

Primary Producer Benthic Habitats

Primary producer benthic habitats are those that require the sun’s light to photosynthesise and are thus particularly sensitive to increased turbidity. These include coral reefs, seagrass and algal communities.

Key impacts to these habitats include direct loss due to dredging or construction over the habitat (project impacts) and suspended sediment plume and sedimentation impacts during the dredging/ disposal and construction process.

Direct losses may be evaluated by totalling the area of habitat lost, the abundance or coverage of e.g. live coral within the area. Indirect effects are less easy to quantify, and depend on assumptions and available literature on tolerances to the various identified stressors and their predicted magnitude and duration.

Assessment Methodology:

In areas where coral reefs, seagrass or algae have been reported to occur (see Section 2.1), habitat mapping should be carried out to verify the presence or absence of these habitats. Coral reef and seagrass habitat mapping can be carried out through various methods such as underwater towed video camera transects, snorkelling or site surveys during low tides.

If such habitats are found to exist around the project site and within the potential impact zone, further investigations will be required.

The significance of impacts to coral or seagrass habitats can be evaluated by assessing the importance of the community, for example through taxonomic diversity indices, and the cover of live coral/ seagrass or algae as a percentage of the substrate. Generally higher percentage cover and higher diversity are given higher importance. Qualitative, semi-quantitative or quantitative survey methods may be employed to determine these variables. In addition, the distribution frequency of a particular habitat or community should also be taken into account when weighing its local and regional importance. If a certain habitat type (e.g. seagrass beds) are locally and regionally rare or patchy, the importance of this habitat to marine fauna may be significantly higher compared other areas where its distribution is more widespread and/ or continuous.

Generally for environmental assessment purposes, knowledge of the exact species of coral is not necessary for the impact evaluation. In known coral reef hotspots however, such as Darvel Bay where many endemic species may be found, species identification assumes more importance, as the impact significance would be higher if the stressor is predicted to affect areas supporting rare or endemic species.

In less sensitive areas, information on coral genera and lifeforms would suffice. Lifeform categorisation is important as the different lifeforms exhibit varying sensitivity to turbidity and sedimentation.

Seagrass, where they occur should be identified to species level, as the tolerances of different species to different sediment types, exposure and tidal/salinity regimes are more well-documented and can be used in the impact evaluation.

Impact Evaluation

Impacts both during the site preparation, construction phase and after the completion of the project should include the following:

- Effects of sediment plumes and sedimentation during the site preparation and construction phase.

- Effects of changed sedimentation and water turbidity due to changed currents and waves caused by the marine construction works.

- Effects of changed water turbidity or other water quality parameters due to discharges caused by the project.

- The area and condition of benthic communities and aquatic habitat directly covered by the project footprint.

For the analysis it may be necessary to use the results of the above mentioned numerical water quality, sediment plume and sedimentation modelling and in some cases flushing or water quality modelling.

Magnitude of Impacts

Predicting the severity of the stressor, such as suspended sediment plumes or thermal plumes over the coral reef or seagrass habitat is only the first step in the impact assessment. In order to evaluate the impact to the community, the responses of the organisms in question to these stressors must be established. This is done through determination of the tolerance limits to the stressor (i.e. turbidity, sedimentation, other water quality pollution).

Establishing biological tolerance limits is complex and should ideally be based on available site specific data. However, this is not yet available or seen as practical in Sabah at this stage, and hence the consultant must rely upon relevant literature values.

It is however important to select comparable studies (e.g. use of coral or benthic species from similar tropical regions rather than say temperate species). The tolerance limits should take into account both the magnitude and the duration of the impact (refer to Figure 5-1). Most coral reefs for example are adapted to short periods of high suspended sediment loading which occur naturally during storm events, such that thresholds should not be set as absolute values (e.g. 50 mg/L), but should also look at the duration of the loading (e.g. should not exceed 10 mg/L for more than 10% of the time). Unfortunately, much of the published data on tolerance limits provide only single absolute values, and hence the threshold durations should also consider site specific baseline conditions. For example, if a healthy reef is located in an area subject to periodic plumes from nearby rivers, the coral species and community as a whole could be assumed to be tolerant to turbidity thresholds on the high side compared to reefs that are only rarely exposed to turbidity plumes. Conversely, a poor quality reef located in a similarly turbid background environment may indicate that the community is already near the tolerance threshold for turbidity, and that community may have limited capacity to tolerate any further increases in magnitude or duration of turbidity.

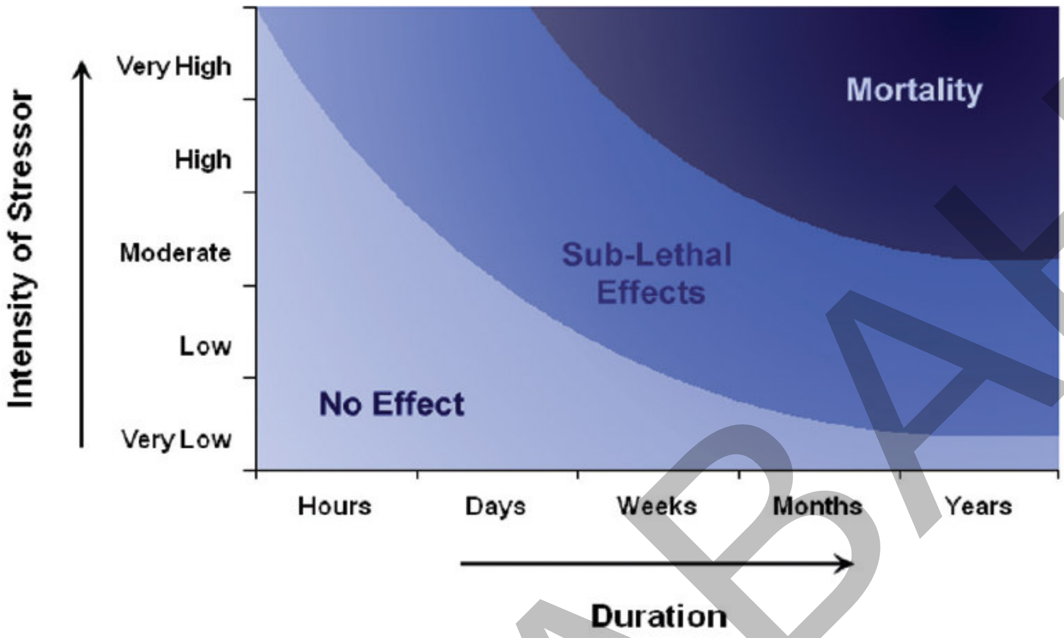


Figure 5-1: Conceptual relationship between the intensity and duration of a stress event and the risk of impacts to primary producer benthic habitats

Impact Significance

The significance of the impact is related to the importance of the habitat being affected. This may be based on a range of factors, some of which are listed below:

Ecological criteria, such as:

- Representativeness – are the species and communities in the potential impact area well represented in other parts of the region or country
- Rarity or conservation status – are any of the species rare or endangered
- Resilience – what is the pre-project level of impact and stress on these habitats
- Cumulative effects

Socio-economic criteria:

- Local significance – what is the cultural and socioeconomic significance of these habitats

- Stakeholder needs and perceptions

Other Biological Habitats and Communities

Further assessment on each specific type of ecological features related to shoreline development activities are as follows:

Mangroves

The baseline information should contain a description and assessment of the present distribution and condition of mangrove forests within the affected area. Mangrove mapping can be carried out through satellite imagery or aerial photograph interpretation, combined with ground truthing. Dominant species and overall observations of mangrove health can be made based on qualitative descriptions, semi-quantitative or quantitative surveys.

The impact assessment should consider impacts both during the construction phase and after the completion of the project, including:

- Effects of changed sedimentation and erosion patterns due to changed currents and waves caused by marine construction works.

- The area and state of mangrove vegetation directly impacted by the project footprint.

- Areas where mangrove vegetation is assessed to develop or disappear due to the project e.g. due to changes in tidal prism or salinity. This may arise from project components such as the construction of a road through a mangrove area or reduced salinity intrusion into a river owing to the project development.

- Risks to mangrove areas from oil spills.

Soft Bottom Macrobenthos

A description and assessment of the present distribution, species composition and richness of the macrobenthic community in the impact zone should be provided. Baseline data should include taxonomic identification to the lowest possible taxonomic level. In particular groups of organisms that are particularly tolerant or conversely intolerant to disturbance and water pollution should be identified, i.e. the baseline should consider life-forms, motility, and tolerance to various pollutants or stressors.

Impact assessments should include construction phase impacts, such as direct removal from the project footprint and dredging, as well as operational phase impacts, including the effect of routine discharges from the development.

Depending on the scale of the project and its emissions, it may be necessary to use the results of the above mentioned computerised sediment spreading and water quality modelling for the impact assessment.

Establishing biological tolerance limits is complex and should ideally be based on available site specific data. However, as for other habitats and communities, there is little available data on macrobenthic responses to pollution, dredging and sedimentation specific to Sabah at this stage, and hence the environmental consultant must rely upon relevant literature values. Some useful links are provided in the References section. However, it is important to select comparable studies (e.g. benthic species from similar sedimentary environments; species from tropical regions rather than say temperate species). The tolerance limits should take into account both the magnitude and the duration of the impact as illustrated in Figure 5-1 above.

Marine Megafauna

Marine megafauna relates to often endangered species such as sea turtles, dugongs, whales and dolphins. These are reported to occur around many areas of Sabah, however published data on distribution and frequencies is not readily available. Rarely is it possible to launch a full survey of marine mammals or turtle nesting for a single EIA project, owing to the duration and seasonality considerations when designing such surveys. It is therefore important for the baseline assessment to consult with local NGOs and institutions such as the Borneo Marine Research Institute of University Malaysia Sabah and WWF Malaysia, to obtain information on sightings at the project location. Consultation with local communities, in particular fishing communities is also an important source of local anecdotal information, and it is recommended that socio-economic surveys related to the Environmental Assessment include a line of questioning on sightings of marine megafauna in the area, their recentness and regularity.

An assessment of habitats in the area should also be made with respect to their potential to support such species. For example, turtle nesting occurs on sandy beaches, often without an extensive intertidal area in front of the beach. Feeding grounds may include coral reefs, algal and seagrass beds. Seagrass is also the primary food source for dugongs and hence information on seagrass distribution, coverage and species composition would provide key information to derive potential habitat suitability for this endangered species.

Impacts to be considered include loss of habitat type, disturbance such as underwater noise, lighting, water pollution from routine discharges as well as risks of accidental spills such as oil spill.

5.3.5 Fishery and Aquaculture

Fisheries play an important role in the economy of the coastal populace by providing food, employment and regular income. The two types of fisheries that need to be considered are capture fisheries and culture fisheries. The coastal and estuarine waters support a rich harvest of economically important invertebrates and marine fishes. Some aquaculture activities such as cage culture fisheries can thrive in naturally sheltered coastal and estuarine waters.

These areas may be directly or indirectly affected through loss of habitat (spawning, nursery and feeding grounds), deterioration of water quality through discharges from the project or due to accumulation of pollutants arising from reduced flushing capacity.

Assessment Methodology:

The assessment shall provide adequate and accurate baseline data of the proposed development site and its adjacent area of probable impact (the study area) for accurate prediction and evaluation of fisheries impacts. The baseline study shall include at least the following:

a) Review and Collation of Existing Information

Existing information regarding the study area shall be reviewed. Such information includes both published and unpublished materials. Useful information could also be obtained from consultation of local fishermen, non-government organizations and relevant government departments.

The accuracy and usefulness of the fisheries information obtained must be carefully evaluated before adopting it in the Environmental Assessment report. Aspects such as time of survey (to check whether secondary information is out of date or valid), methodology, and others shall be taken into account. If there are doubts, they shall be verified by on-site survey(s).

b) Field Surveys

Based on the results of (a) above, the study shall identify data gaps and determine if there is any need for field surveys. The primary aim of the field surveys is to fill the data gap and to gather adequate information for subsequent fisheries impact prediction and evaluation, formulation of proposed mitigation measures and monitoring requirements. If field surveys are considered necessary, the study shall recommend appropriate methodology, duration and timing for the field surveys. These may be limited to surveys of local fishermen or aquaculturists on the details of their catch such as amount, seasonality, type, or may involve actual fish stock or resource surveys. In the case of aquaculture activities, surveys of the farmers on the fish species reared, productivity and existing issues will generally suffice.

These surveys need to be carried out in conjunction with water quality surveys assessing key parameters of importance to fish fauna, such as dissolved oxygen, salinity, turbidity, nutrient and phytoplankton levels.

Fisheries and aquaculture are important resources and careful consideration of the impacts in this field are required, for both the construction phase and the operating phase of the project. The locations of present and planned aquaculture sites should be detailed, and the assessment of these should comprise, but need not be limited to:

- Description and assessment of the present fishery and aquaculture resources in the study area including type, catch and production, value, and others.
- Areas of nursery/ spawning or fishing grounds and aquaculture directly removed by the project and their importance to the local and regional socio-economy.
- Areas of fishing grounds and aquaculture indirectly impacted by the project either during the construction or operational phase due to suspended sediment plumes, pollutant discharges, changes in flushing capacity or salinity.
- Value of fishery and aquaculture impacted by the project.
- Employment in fishery and aquaculture impacted by the project.

5.3.6 Change in Land Use

Coastal land uses may include agriculture (farming and aquaculture), built-up areas which include townships, residential, commercial and industrial areas, open spaces, vegetation cover (including mangroves, terrestrial forests), water bodies, and recreational or tourism areas.

Assessment Methodology:

In addition to current land uses, it is also pertinent to verify whether the identified area has any parcel or parcels of land earmarked for future development (proposed land use), as well as those already earmarked for development (committed land use). This information is useful in identifying whether or not there is any conflict of uses or interests.

A comparison of land use compatibility is to be made against the existing land uses, in particular sensitive land use features as well as the structure or zoning plans for the specified area. Land use features that may be particularly sensitive to direct land use conflicts are tourism and recreational areas and villages. Cumulative impacts need to be considered when expanding industrial or port areas, particular with respect to sedimentation at nearby ports/ harbours, changes in hydraulic/ flushing regimes which may affect water intakes or outfalls of existing plants, and others.

5.3.7 Noise

The focus of noise assessment for shoreline development would largely be on point and line sources during the site preparation and construction phase. Noise generation during operation for residential, resorts and recreational development would be expected to be low; however operational noise may need to be assessed in more detail for commercial or industrial activities.

Assessment Methodology:

In general, noise level information and samples are to be collected and analysed as follows:

- Noise level data collected at the site.
- Parameters to be analysed include Equivalent Sound Level (L_{eq}), background or residual noise (L_{90}), Peak Sound Level (L_{10}), Maximum Noise Level (L_{max}) and Minimum Noise Level (L_{min}).
- Noise sources from existing activities.

Noise from specific sources, such as machineries and equipment used, may be assessed based on the strength of the noise sources and the attenuation factor for a given situation. A simple estimate of noise for a given distance from a generator, for example, may be based on a general assumption of a 6 dB(A) reduction for a doubling in distance from the source. Consideration may be given for excess attenuation due to variation in atmospheric conditions, physical environmental conditions (such as vegetation type) and physical barriers (such as trees and walls). Consideration should also be given with referencing noise levels to temporal ambient noise levels; e.g. lower noise level thresholds would apply at night when ambient noise levels are lower.

For line sources of noise, such as that from boat traffic, prediction of noise is best undertaken by actual noise measurements for areas which are exposed to similar noise conditions. Noise and vibrations from boat activity is particularly important with respect to marine turtles and fisheries. Underwater noise impacts should be considered for marine construction projects involving high noise emissions (such as marine pile driving, blasting) within areas where marine megafauna are known to occur.

5.3.8 Dust and Atmospheric Pollutants

Impacts of shoreline development on air quality are expected to occur mainly during the construction phase where dust may be generated from site preparation, transportation and construction activities.

Assessment Methodology:

Air quality baseline information should consider the following:

- Sampling location should be based on the potential zone of impact of the project as well as air-sensitive receptors in the area.
- Parameters to be analysed should be selected based on the expected air emissions throughout the project lifecycle.
- Seasonality of annual meteorological information. Data on temperature, rainfall, wind speed and direction as well as meteorological phenomena such as inversions should be compiled from sampling stations nearest and relevant to the project site.
- Air pollution sources from existing activities in the surrounding area.

Qualitative assessment of air quality is often considered to be adequate provided the development requires a clean environment such as resort and recreational development. Quantitative assessment of impacts, where required, may need to be undertaken with the use of computerised models for pollutant dispersion for industrial projects with emission sources.

5.3.9 Socio-Economic

The social and human environment outlines the commitment to social considerations in land use planning, and a requirement for all shoreline development projects to follow the guideline below in preparing social assessment reports as part of the environmental assessment study process.

<u>Assessment Methodology:</u>

<u>Description of Existing Socio-Economic Conditions:</u> This includes description of the following from field studies, ground surveys and published reports:

- *Existing and Proposed Land Use*

  This includes zoning for the area within and surrounding the proposed development and any designated receptors that are found during field visits.

- *Land Status/ Tenure*

  Land issues/ claims should be highlighted, if any.

- *Key Demographic and Economic Characteristics*

  This applies to the surrounding community within the zone of impact and includes:

  - Location of populations within and surrounding the project site (to be clearly illustrated in a map)
  - Population
  - Gender and age groups
  - Ethnic group and religion
  - Educational background
  - Socio-economic status (i.e. economic activities, income, employment, occupation)
  - Sensitive areas (i.e. burial ground, historical buildings/ artefacts, cultural sites, water catchments, archaeological sites, recreational sites and tourist attractions, and others) (to be clearly illustrated in a map).

- *Infrastructure/ Service/ Facilities*

  - Urban Areas – within 500 metres radius or 5 – 10 minutes walking distance (i.e. child care centre, kindergartens, schools, clinic or hospital, shops, public transport, recreation centres, and others (clearly illustrated in a map).

- Rural Areas – within 3 km radius from the site/ zone of impact.

- *Perception and Awareness/ Community Engagement*

  Consultation should, at the very early planning stage, provide the community with an opportunity to be informed and to influence decisions which may affect them. The Project Proponent must commit to this consultation by giving opportunity for the community to participate in the decision making process as the project may affect the way their local area is developed.

  A consultation plan document including the following should be prepared:

  - *Objective of the consultation process*

  - *Identification of zone of impact (receptors that will be impacted by the development)*

  - *Level of communication, i.e. door to door interview, questionnaire distribution, community dialogue, and others*

  - *Relevant questions that should be posed to the community can include (but are not limited to):*

    - *Have you heard about the new upcoming project?*

    - *What are your concerns related to the project?*

    - *What benefits do you perceive from this project?*

    - *What is your recommendation for improvement of the project?*

    - *What is your level of acceptance of the upcoming project?*

    The number of respondents to be consulted within the zone of impact must be determined and justified by the environmental consultant with **locations of those interviewed marked in a map**. Emphasis should be given on consultation with the village head/ local representative.

  - *How issues raised in the public consultation are to be handled in the Environmental Assessment report.*

Brief social survey notes describing the project concept and outlining the social consultation method including list of questionnaire must be prepared and documented in the Environmental Assessment report.

Prediction of social economic impacts is an inexact exercise. To assess the significance of the impacts, the following general concerns need to be addressed:

- *Nature of the Impact*

Probability of occurrence	-	Likelihood that an impact will occur as a result of the project
People affected	-	Percentage of population affected or how it will affect different demographic groups
	-	What is the likely population change as a result of the development
	-	Will the project likely to give rise to an increase or decrease in employment opportunity in the locality
Zone of Impact	-	The extent of impact in terms of area (show on map)
Duration	-	How long will the impact last, assuming no attempts to mitigate

- *Severity of the Impact*

Local sensitivity	-	To what extent is the local population aware of the impact? Is it perceived to be significant? Has it been a source of previous concern in the community?
Magnitude	-	How serious is the impact? Does it cause a large change over baseline conditions (e.g. will crime rate double)? Will local capacity be exceeded?
	-	Will the project generate demand for increased community services and facilities (schools, health care, road conditions, shops, public transport, parks, and others)?

- *Potential for Mitigation*

Reversibility	-	Is the impact reversible? Short or long term?
Institutional capacity	-	The current institutional capacity to address impacts;
	-	Existing legal, regulatory structure;
	-	Can local government deal with the impact or would it involve the private sector?

5.3.10 Land and Marine Traffic

Traffic and transportation activities within and due to the shoreline development activity may result in dust and noise pollution as well as increasing the existing traffic volume. The assessment needs to describe the current traffic condition along the route that will be used for transportation and estimate traffic generation attributed to the project, whether land or marine traffic.

Increased marine traffic can contribute to shoreline erosion as a result of wave action from boat wake and re-sedimentation of river and seabed materials. This is a function of the type of boat, volume of traffic, boat speed, and the shoreline characteristics (soil, vegetation, slope, protection provided).

Assessment Methodology:

The following information is important for the impact assessment on transportation and traffic:

- Existing transportation network (road, river or sea) in the vicinity of the proposed project.
- Existing transportation systems in the area – all modes, operational characteristics, public transport, terminals and others.
- Traffic flow characteristics (volumes, composition, speeds and others).

Description and assessment of the effect on the existing traffic and transportation activities must consider the effect on project traffic generation volume and distribution and potential for congestion.

Where the development entails a port or marina with significant marine traffic, or a jetty development in close proximity to existing ports or harbours, a marine traffic risk assessment or navigation study may be required. Such a study is to be submitted to the Ports and Harbours Department for approval, however the key findings should also be included in the Environmental Assessment study.

5.3.11 Aesthetic and Recreational Value

The study needs to consider the potential impacts on aesthetic and recreational values along the coastline which could be compromised as a result of the project. Aesthetic and recreational values relating to the extent of visible plume may affect land uses along the coast.

Coastal erosion and/ or siltation of fines can have severe impacts, for instance on the quality of recreational beaches, which may either erode away or transform a sandy to a silty/ muddy beach.

During site preparation, increased turbidity may impact aesthetic and recreational values relating, potentially affecting tourism along the coastline.

Assessment Methodology:

Description and assessment should include of the effect of the project on resources that are valued by the people (i.e. the ecological assets or resources such as beaches, coral reefs, rain forest, flora and fauna, mangrove, natural trails, recreational areas and facilities, and lifestyle in general); and on the visual impression of the shoreline, its interference with scenery and amenities that maintain the quality of life for the local population as well as the visiting tourists. The investigation shall cover, but need not be limited to:

- Computerised or artistic, visual impact assessment at important locations or facilities of public value for example existing hotels, beaches, residential areas, public parks and others;
- Polling of affected population using RRA or similar techniques to assess the perceived impacts of the project by the populace; and
- Of particular interest may be the loss of existing waterfront precinct to be replaced with a new development. Properties that become set back from the coastline in this way may suffer a loss in value, as well as in commercial activity, if that activity was based, in part, on the waterfront positioning (e.g. hotel, tourist facility).

Plate 5-2: Example of aesthetic value in the surroundings of a water village, Kg. Tg. Aru

5.4 Additional Impacts

The list of potential impacts above is non-exhaustive as the environmental consultant should extend or shorten the list of issues depending on local conditions. The discovery of particular key conservation value areas or particular sensitive habitats will require the inclusion of new issues while other issues may not be applicable for that particular project.

6 Mitigation Measures

This chapter covers identification of the major mitigation measures for the environmental impacts identified (refer to Table 6-1).

Table 6-1: Assessment Procedures – Description of Mitigation Measures

The Seven Steps	Summary of Main Required Activities
Step 4: Undertaking the EIA/ PMM study	Environmental Consultant: • *Assess the project details* • *Assess the existing environments* • *Assess the environmental impacts* • *Devise and propose mitigation measures* - *Minimise hydrodynamic and morphological impacts* - *Control sediment spill* - *Proposal for landscaping/ aesthetic features* - *Minimise air and noise pollution impact* - *Provision for habitat and wildlife protection/ conservation* - *Management of waste generated* - *Provision for land and marine traffic management* - *Reducing adverse impact on surrounding community* • *Devise and propose monitoring programmes*

The previous section included a description of methods for assessing planned activities and their impact on the environment. It also points out that there may be impacts from necessary and unavoidable activities, which were not included in the project plan and description. Mitigation measures therefore address three different scenarios:

- Proposals for improved technologies or methodologies for planned activities in order to minimise their negative environmental impact, e.g. site selection, site layout orientation; and earthwork/ construction implementation method. This is best addressed during the pre-feasibility stage.

- Proposals for management activities, which are not included in the Project Proponent's original plan of activities but which are necessary in order to control environmental degradation. This is mainly related to working practices such as earthwork/ reclamation and construction methodologies, limiting working hours and water pollution control measures. Control measures often result in limiting the impact, with a residual level of impact that has to be accepted.

- Proposals to compensate for unavoidable, residual impacts, e.g. community development programmes or a specific contribution towards local conservations of valuable marine or riverine ecological resources or offsets.

The environmental consultant should assess the adequacy of the measures to alleviate or mitigate negative environmental impacts planned by the Project Proponent. Where the Project Proponent's measures can be strengthened or where they are seen as insufficient, the environmental consultant should propose mitigation in the form of proposals for alternative technologies, methodologies or scope of work. Addressing the key physical impacts prior to design finalisation is essential to the sustainability of the overall design concept. For residual impacts, the environmental consultant should, where appropriate, propose mitigation measures to compensate for the effects of the impacts. It is important to note that the recommended mitigation measures for a project in the Environmental Assessment report must be based on the different stages of project implementation such as site preparation and construction.

The environmental consultant must for each foreseen impact and for each proposal for changes to scope, technology or methodology assess the risk level and magnitude of all expected residual impacts and state these clearly in the Environmental Assessment report.

In addition, there are requirements, which are imposed for administrative reasons. These include employment of an environmental officer, provision of maps and other information, which may be necessary for environmental monitoring.

It is, however, important that the Project Proponent and the environmental consultant together use the latest knowledge and development in the respective fields, in order to devise a project and site specific plan for environmentally sound management and associated mitigation. The pointers included in this guideline should not be seen as a complete, ready-made, direct solutions but rather as principles of mitigation.

At the same time, it must be stressed that any combination of site, technology and methodology will warrant a unique set of mitigation measures.

6.1 Key Mitigation Measures

6.1.1 Impacts to Coastal Hydrodynamics

For development projects involving marine construction works, careful site selection and design of the development layout will minimise changes in current patterns and other coastal hydrology. The key to the development of such a design is the numerical modelling of the physical impacts and the sound physical reasoning utilised in establishing alternatives and the selection of the final preferred project option, which results in minimum physical impacts and a reduction of consequent biological impacts.

This optimisation procedure for reduction of the physical impacts prior to design finalisation is essential to the sustainability of the overall design concept, as physical impacts (morphological impacts, flushing and upstream flooding) are extremely difficult to mitigate once the development plan is fixed.

Where some impacts cannot be mitigated, compensatory measures may be applied. For example in the case of predicted erosion impacts to adjacent shorelines, the Project Proponent may be required to construct coastal defence or carry out beach nourishment in these affected areas.

6.1.2 Sediment Spill Management Options

Various management options can be adopted to reduce, impede or control impacts of spills associated with dredging and other marine construction works. Management options can make use of anything from simple but creative technical installations to detailed impact prediction models; the latter as a way of supporting decision making (e.g. extrapolating sparse data in time and space, defining suitable environmental windows or delineating impact zones).

Various management options or a combination of options can be utilised to meet given environmental health criteria of identified receptors. Adopted mitigation techniques are mainly technical measures aimed at reducing the sediment release and thus reducing turbidity and sedimentation. Some of the more successful options include (but are not limited to):

- Control of production rate at the source of the spill (at-source control measures) by altering the number of trips, routing, pumping rates, limiting the dredging to one suction head only (e.g. rather than two), using smaller dredgers and others.

- Using high-accuracy dredging and measuring-techniques and by minimum over-depth dredging.
- Use of suitable dredging equipment including e.g. under-keel overflow, closed grab-dredge, ‘turtle excluding devices’ and/ or green valves. Submerged diffusers may reduce water column impacts because they release the dredged material lower in the water column and reduce the velocity of discharge.
- Prevention of leakage from equipment.
- Reduction of propeller wash and vessel wakes by establishing navigational restrictions (i.e. reduced speed near receptors, operating on shallow waters during higher tides only).
- Bund-walls to “seal” the construction site.
- Controlling sediment runoff by using temporary settling basins or overflowing at locations along the development frontage that generate minimum plumes.
- Use of silt curtains either at the source or at receptors (refer to Plate 6-1).
- Design of optimal schedules for the dredging operations (regarding distance and frequency of spill generating operations).
- Project timing: Altering the time of year of dredging to avoid critical life-cycle phases of sensitive environmental receptors.
- Temporal changes of dredging locations and/ or timing of dredging works with due consideration to marine factors (e.g. spawning periods) and hydraulic patterns (tidal and wind-induced flows).
- Treatment of sediments to reduce levels of e.g. contaminants.
- Temporary or permanent relocation (if possible) of the receptor (e.g. corals).
- Use of predictive modelling in the environmental assessment phase to test/ delineate potential impact zones from various potential climatic scenarios, sea-bed sediment compositions, geotechnical properties, dredging/ reclamation schedules, equipment and others.

- Use of adaptive management in the environmental monitoring phase.

Plate 6-1: Use of silt curtain to control sediment dispersal

It is emphasised that the use of silt curtains has to be considered carefully. Silt curtains are only effective in calm waters but their functionality becomes poor with high waves or in environments with currents of even mild strength. Silt curtains are also likely to be impractical in large-scale dredging-operations.

The preferred management plan for a given project needs to be tailored to meet the given environmental objectives typically using the above options or a combination of the options. If mitigation cannot reduce impacts to an acceptable level compensatory measures may be required to offset the impacts. However, compensation should not be seen as a substitute for prevention or mitigation, but as a supplement to best practice prevention and mitigation.

<u>**Construction Activities**</u>

To limit any potential problems from construction activities, the choice of material for fill and construction can be made to limit the amount of fines released into the water and speed up critical operations. The timing of construction operations may also play a key role in minimising, not only the release of sediments in the water but also in the control of noise, dust and sensitive periods of environmental and social importance.

Spill Budget

To limit potential impacts from dredging spills often a spill budget is defined, which gives the maximum amount of spill allowed for the dredging works (or a stage of the works). The spill budget is defined to meet the quality objectives at the project location, these are site specific and must be determined as part of the environmental assessment. For example, in dredging near coral reef areas, threshold limits at these coral reef areas must be defined, and the spill budget established to meet this threshold. At another project area, the sensitive receptor may be a public beach for example. The threshold at this area would be different, and the spill budget again should be tailored to meet the specified thresholds at this area. Further information on the spill budget is given in Appendix 6.

Runoff and Erosion Control

Water quality and siltation of waterways can occur as a direct result of erosion of soil from construction sites. Storm-water should not be allowed to run through the construction site into nearby waterways and the sea without appropriate silt and erosion control measures being in place. Another method is to control the timing on when vegetation can be cleared/ stripped from the site and the extent of clearance to ensure exposed areas are not subjected to surface water runoff. These clearance activities should be reviewed based on the construction programme so that exposed areas are protected as soon as possible. Further information on best practices for erosion and soil control upon the affected land can be obtained from the DID Guidelines for Erosion and Sediment Control in Malaysia (DID, 2010).

6.1.3 Ecological Impact

Impacts can be minimised by identifying, and zoning off, areas that are considered to have valuable ecological communities. This may require some adjustments to the siting and orientation of aspects of the project at the planning stage. For permanent, process related impacts, there is much less scope to reduce impacts by adjusting operational practices once the development is in place. The key to reducing impacts is careful site selection and design and the selection of appropriate technology that minimises emissions and discharges in the first place.

During the construction phase, the control of sediment spill is often the key mitigation measure to prevent impacts to marine habitats.

Where some impacts cannot be mitigated, compensatory measures may be explored, such as:

- Relocation of communities, such as corals or seagrass, to other, unaffected areas.
- Restoration of habitats upon completion of the dredging and marine construction phase (if site conditions are still suitable post-construction), e.g. mangrove, coral or seagrass replanting.
- Construction of artificial reefs or wetlands at appropriate locations.

6.1.4 Fishery and Aquaculture

The mitigation measures that can be considered for fishery and aquaculture impacts include (but are not limited to):

- Compensation package to those affected.
- Establish artificial reefs to create alternative fishing grounds.
- Relocate fish landing areas with provision of facilities.

6.1.5 Socio-Economic

The mitigation measures that can be considered for impacts on the socio-economic aspect include (but are not limited to):

Economy

- Preference for employment and business should be given to local population. This will provide some opportunities to the local people to participate in the development of the project, as well as providing them with an opportunity to earn extra income.
- Improve potential employment benefits, commerce and income for local people.

Social

- Reduce in-migration.
- Providing additional accommodation for the workforce.

Archaeology

- Any monumental remains must be first notified to the relevant authorities, studied and relocated in another area.
- Any work on site must be stopped if archaeological sites are discovered during construction.
- Efforts must be made to preserve the cultural remains and archaeological sites located outside the development area.
- Set up markings where cultural remains and archaeological sites are located before they are salvaged or moved.

6.1.6 Others

Water Quality

Contaminated runoff from the project site shall be controlled to minimise water pollution and biological impacts. The mitigation measures that can be considered for water pollution include (but are not limited to):

- **Construction of drainage network** – A network of drains can be installed to regulate runoff within the site and also prevent runoff from adjacent areas from flowing into the site. Perimeter and feeder drains should be designed to cater for peak surface runoff. These drains should be maintained by removing deposited silt at regular intervals. The network and location of drains as proposed in the ESCP should be assessed before and during construction stage (refer to Plate 6-2). Additional drains may be required to ensure proper regulation and control of runoff within the site. Particular attention needs to be paid to the drain outlets so that downstream impacts are not initiated or exacerbated. Capacity of receiving drains or waterways needs to be checked for increased flows and the flow concentration at the outlet.

Plate 6-2: Inspection of drainage system should be carried out periodically

- **Sediment ponds** – Runoff from work areas should be routed towards sediment ponds. These trap sediment and reduce suspended sediment loads before runoff is discharged from the project site. Sediment ponds should be designed based on runoff, retention time and soil characteristics.

- **Maintenance of drains** – Maintain local drains regularly. Remove silt or aggregates deposited in drains. Approval from Department of Irrigation and Drainage (DID) may be required.

- **Unsuitable material** – Unsuitable material from the project development shall not be disposed of directly into rivers, streams or onto low ground adjacent to waterways, but collected and disposed of on land, at approved disposal facilities.

- **Buffer strips** – the retention of riverine buffer strips adjacent to waterways can be a very effective measure to capture sediment before it enters the waterways. DID provide guidelines on buffer strip widths that should be adopted. Where existing vegetation is not already in place in the proposed buffer area, new vegetation should be planted. Re-vegetation should follow the pattern of local riverine vegetation in species mix, density and distribution.

- **Treat effluent discharges** - Any effluent discharges from development on the project site must be treated to Standard B (minimum) of the Environmental Quality (Industrial Effluent) Regulations 2009 while sewage should comply with Standard B (minimum) of the Environmental Quality (Sewage) Regulations 2009.

Noise

The mitigation measures that can be considered for noise pollution include (but are not limited to):

- **Working hours** - Proper planning for construction working hours. Activities should be planned to avoid working at night and on public holidays.

- **Inform communities** - Surrounding communities should be adequately informed of the proposed project's working hours, as awareness can reduce noise-related annoyance.

- **Maintenance of machinery** - Noisy semi-mobile and mobile machinery should be well maintained to reduce noise emission. Installation of silencers/mufflers should be considered.

- **Provide hoarding** - Where practical, site boundaries should be demarcated with attractive hoarding particularly where boundaries are adjacent to nearby communities. Alternatively, the boundaries could be planted with trees/ shrubs to screen visual and noise pollution from the construction site.

Dust

Dust management is an important environmental and public health issue on development sites during the dry season. The generation of dust is dependent on the soil conditions and on the local weather conditions. Dust must be managed so as not to create a nuisance and/ or health hazard. The mitigation measures that can be considered for dust pollution include (but are not limited to):

- **Minimising vegetation clearance** – As much as possible, vegetation clearing should only be limited to areas necessary for the project development.

- **Re-vegetation** - Re-vegetating areas that are no longer required for construction.

- **Water spraying** - Ensuring that unsealed roads and exposed areas are watered at all times.

- **Applying speed restrictions** – Reduce vehicles' speed to assist in reducing the dust generated.

- **Consideration of wind conditions** - Ensuring construction activities take into consideration of local wind conditions.

- **Wheel washing facility** - Provide a wheel washing facility at all site exit points to avoid dirt being carried out of the project area. Water from the washing facility should be changed regularly to ensure clean water (without silt) at all times. The facilities should be connected to the sedimentation basin to treat dirty water, prior to final discharge.

Land Traffic and Transportation

The mitigation measures that can be considered for impacts from land traffic and transportation include (but are not limited to):

- **Vehicle speed** - Transportation vehicles should maintain appropriate travelling speed along the access roads. Within the site, the speed limit of vehicles should not be more than 30 km/hour to reduce dust dispersion.

- **Traffic management** - During high traffic periods, traffic management should be used to ensure that local traffic is not unreasonably disrupted by construction traffic.

Marine Traffic

The mitigation measures that can be considered for impacts from marine traffic include (but are not limited to):

- **Navigation aids** - Installation and maintenance of navigation aids such as buoys, beacons, waterway markings and sign.

- **Signals** - Use necessary signals approved by the authority when working at night.

- **Warning signs** - Warning signs indicating that there is a hazard ahead should be established.

Aesthetic and Recreational Value

Mitigation measures for visual/ aesthetic features should include consideration of potential landscape visual enhancement besides reduction of damage caused by the proposed development.

Alternative designs that would avoid or alleviate the identified landscape impacts or that would make the project visually more compatible with the surrounding setting should be thoroughly examined before adopting other mitigating measures to reduce adverse impacts.

The mitigation measures that can be considered for aesthetic and recreational impacts include (but are not limited to):

- **Preservation** - Preservation of, e.g. trees, green belts, landscape/ ecological/ architectural features of high value. Any tree with good amenity value unable to be retained in its current location should be considered for transplanting to another suitable location onsite.
- **Architectural layout** - Modifying the architectural layout so that the development is compatible with the surrounding environment.
- **Remedial measures** - Remedial measures, e.g. facade treatment, colour scheme, texture of materials used, use of non-reflective material, screen painting and height, can be applied to improve compatibility to the surrounding environment.
- **Compensatory measures** - This may include, e.g. landscape treatment, compensatory planting, creation of interesting landscape or visual features to enhance the view and creation of green corridors along access roads.
- **Recreational areas** - Provide for new or enhance recreational areas.

6.2 Residual Impacts

It is unavoidable that there will be some adverse impacts from shoreline development activities even if these are carried out with every intention of avoiding or minimising such impacts.

These generally include permanent, project related impacts, such as the loss of habitat or land use within the project footprint itself, hydraulic impacts; and a certain magnitude of process-related impacts such as sediment plumes or other water quality impacts, land and marine traffic disturbance, noise disturbance and others. For such impacts, the risk and magnitude of these residual impacts must be evaluated as part of the assessment procedure.

6.2.1 Off-set of Residual Impacts

Residual impacts relating to the loss of biodiversity/ habitat may be countered by off-set activities elsewhere. Particular key conservation value habitats may be protected elsewhere. Such off-set activities may balance the impact in full or partially, but should in all cases be considered.

6.2.2 Mitigation of Residual Impacts

Residual impacts are already minimised through the choice of technologies or methodologies. Mitigation is therefore only possible through compensation or substitution. Compensatory measures in terms of replacement of habitat loss, re-vegetation, alternative access to livelihoods, and others are among the available options for mitigation of residual impacts.

7 Monitoring Programmes

This chapter covers the recommended monitoring programmes based on the mitigation measures highlighted for the identified environmental impacts (refer to Table 7-1).

Table 7-1: Assessment Procedures - Description of Monitoring Programme

The Seven Steps	Summary of Main Required Activities
Step 4: Undertaking the EIA/ PMM study	Environmental Consultant: • *Assess the project details* • *Assess the existing environments* • *Assess the environmental impacts* • *Devise and propose mitigation measures* • *Devise and propose monitoring programmes* - *Compliance monitoring* - *Impacts monitoring*

Environmental monitoring provides feedback on the actual environmental impacts of a project. Monitoring results will assist in the judgement of whether the environmental mitigation measures proposed are successful in reducing or eliminating negative environmental impacts. An environmental monitoring programme is also used to ensure compliance to the recommended mitigation measures and environmental standards stipulated by EPD, Sabah and other relevant agencies.

Generally, an environmental monitoring programme will involve collecting data for one or more of the following purposes (Everitt, 1992):

i. To establish a baseline, that is, gathering information on the basic site characteristics prior to development or to establish current conditions;

ii. To establish long term trends in natural undisturbed systems to establish natural baselines;

iii. To estimate inherent variation within the environment, which can be compared with the variation observed in another specific area;

iv. To make comparison between different situations (for example, pre-development and post development; upstream and downstream) to detect changes; and

v. To make comparisons against a standard or target level.

Without a monitoring system, there is no mechanism for ensuring that the specified mitigation measures are being implemented and for evaluating the success of the mitigation measures undertaken.

The environmental monitoring programme will generally comprise compliance and impacts monitoring. Compliance monitoring aims to ensure compliance to the recommended mitigation measures and environmental standards stipulated by EPD, Sabah and other relevant agencies whereas impacts monitoring provides feedback on the actual environmental impacts of a project in order to confirm that a project is meeting the agreed level of impact and that the predictions of impacts made during the environmental assessment have been accurate.

7.1 Compliance Monitoring

The environmental consultant should, in the Environmental Assessment report, propose means and schedules for monitoring whether the technologies and methodologies applied in the project comply with the recommended measures and methods. This compliance monitoring plan will then, by the EPD, be used as a basis for an Agreement of Environmental Condition (AEC) or Mitigation Declaration (MD), which is an agreement between the EPD and the Project Proponent on how environmental management of the project shall be optimised.

The environmental consultant must, for each of the mitigation measures proposed in relation to the environmental issues that have been identified, recommend how, when and where a monitoring can be implemented to verify that the recommendations have been followed.

EPD has also established a standardised monitoring system. The system is linked to a database within EPD. This database will store all future monitoring data from all monitoring of shoreline development activities.

The frequency of environmental monitoring and reporting may be varied depending on the sensitivity of the area and the stage of project development and is specified by EPD through the AEC/ MD issued with the Environmental Assessment approval.

There are requirements for submission of maps and photos to support compliance monitoring. Maps must follow standard cartographic requirements of showing geo-references, scale and north arrow, while photos must have dates and geo-reference.

7.1.1 Monitoring Techniques

Compliance monitoring will be undertaken primarily by means of the techniques listed below. This information should be submitted to EPD based on the agreed frequency of monitoring until the project is completed.

Photographs. Photographs to provide evidence of the implementation of the recommended mitigation measures. Photographs should, for example, be used to verify compliance with the following mitigation measures:

- Provision of sediment and erosion control measures such as silt curtains, sediment basins, silt traps and bund walls.
- Provision of noise and dust suppression facilities onsite, e.g. wheel washing facilities, hoarding, condition of access roads.
- Changes to the landscape and aesthetics of the area.
- Waste management or 'housekeeping' practices such as documentation of conditions at waste collection areas, oil storage areas, workshops, workers' quarters, and others.
- Phased clearing/ earthwork/ reclamation.

When photographs are submitted for compliance monitoring, the exact location should be clearly marked on a map together with a GPS reading and a direction bearing. The date and time should be noted.

Field checks. Periodic field checks at appropriate stages of the shoreline development activities should be undertaken in order to ensure compliance with the following mitigation measures:

- Earthwork and construction methodology (earthwork area; period and timing of operations; equipment and methods used).
- Improved working practices/ management procedures.
- Reducing dust and noise problems.
- Proper waste handling.
- Phased earthwork.
- Proper transportation management

Records. Records of earthwork and construction activities/ progress to ensure compliance with the following mitigation measures:

- Planned schedule and actual completion of construction e.g. for phased breakwater construction.
- Planned schedule of site clearance.
- Documentation of dredging location and volume.
- Documentation of spill from dredger.
- Maintenance of sediment plume control measures, e.g. bund wall, silt curtains and sediment basin.
- Maintenance of sediment traps.
- Daily working hours.
- Properties of dredge/ fill material used.

Maps/ layout plans. Maps/ layout plans to indicate locations of key mitigation measures during implementation. These should, for example, be used to verify compliance with the following mitigation measures:

- Location of installation of erosion control facilities such as bund walls, silt curtains, sediment basin and others.
- Provision of noise and dust suppression facilities onsite, e.g. wheel washing facilities, hoarding.
- Layout of development area.

Apart from these site inspection type monitoring techniques, a key monitoring requirement is compliance with the spill budget during the dredging works. Best practice spill budget monitoring involves both compliance and impacts monitoring. The basic compliance with the spill budget is outlined below, while best practice feedback monitoring which combines spill budget compliance with impact monitoring and feedback/ optimisation of the spill budget is discussed in Appendix 6.

Spill budget compliance monitoring involves the following:

- Continuous monitoring of dredger overflow water flow rates and time during dredging operations at site.

- Sampling of the overflow water from the hopper of the dredger at least four times during each dredging cycle at the project site, with the samples being analysed for TSS.

Based on the above parameters the spill from the dredger can be calculated and compliance with the spill budget verified.

Scheduling and responsibilities. As the Environmental Assessment report covers shoreline development activities (both site preparation and construction stages), therefore the need for images and other monitoring requirements should be planned accordingly. The monitoring programme should be formulated in advance by the environmental consultant in collaboration with the Project Proponent in accordance with the schedule of implementation, and be approved by the EPD through the AEC/ MD.

The Environmental Assessment should clearly state the responsibilities and actions to be taken in relation to compliance monitoring, as follows:

- Allocate institutional and administrative responsibilities for planning, management implementation and monitoring of the environmental requirements; and

- Allocate responsibilities to execute mitigation measures, including the detailed design of the mitigation measures.

Non-compliance will normally be followed by the issuance of an order to comply and a simultaneous and immediate compounding of the non-compliance offence according to the Environment Protection Enactment 2002.

The Project Proponent and/ or environmental monitoring consultant should consult the EPD for advice if there are difficulties in implementing the approved mitigation measures and monitoring programmes.

In some cases EPD may request a “re-assessment” of specific aspects of the operation related to the mitigation measures found to be in “non-compliance”.

7.2 Impacts Monitoring

Impacts monitoring is concerned with the monitoring of the residual impacts or the effectiveness of the mitigation measures. The Environmental Assessment report will have provided baseline data showing the situation before the construction activities took place. All subsequent impact monitoring will relate to this baseline data. It is therefore important that the environmental consultant plans sampling points and parameters for baseline sampling to coincide with points and parameters for impact monitoring.

This section focuses primarily on marine impacts monitoring, such as hydraulic impacts, water quality and aquatic ecology. Other impacts arising from general construction activities, such as air and noise impacts should also be considered, depending on the nature of the development in question.

7.2.1 General Considerations

The environmental consultant shall provide adequate baseline data for the variables that are suggested in the monitoring programme. In general, the Environmental Assessment report will have the required baseline data showing the situation as it was before the construction activities took place; however, it is important to reassess these against the predicted zone of impact determined during the impact assessment phase.

The programme that is expected to run during the construction of the project must be designed to make it possible for feed-back action in short time. The monitoring programme should comply with the following demands:

- It shall include variables that monitor the ecological and environmental status of features that have been identified to be potentially impacted by the project.
- It shall include variables that enable an immediate identification of situations where major environmental quality objectives or standards are exceeded.
- It shall include stations in the monitoring programme in areas that are outside the impact area of the project to provide a non-effect reference.
- It shall provide baseline data for the monitoring and control programme collected before the initiation of the project in order to enable comparison during the construction and after completion of the project.

7.2.2 Sediment Plume Monitoring

Suspended sediment monitoring should be carried out during the dredging and marine construction works phase. For larger scale dredging projects and those in sensitive areas, online turbidity monitoring at one or two locations should be considered. Fixed monitoring stations should be established around the project area and to target sensitive receptors. In addition, mobile stations should be sampled to capture TSS concentrations within the plume. These will move depending on the location of the active dredging/ construction area.

Care must be taken in capturing plume characteristics. A few typical examples of fixed monitoring station shortcomings are shown in Figure 7-1. The first figure shows a dredger moving at a speed of 1.0 m/s dredging a channel exposed to a cross current of 0.5 m/s. A monitoring station (M) that records turbidity every 15 minutes is installed near the channel. Although 15 minutes is often considered a high-frequency recording, the station has less than a 50% probability in picking up the plume, let alone its maximum intensity, under these conditions.

The second figure shows a stationary dredger with two monitoring stations installed (M1, M2) and clearly both stations are not capturing the main plume characteristics under the given current conditions.

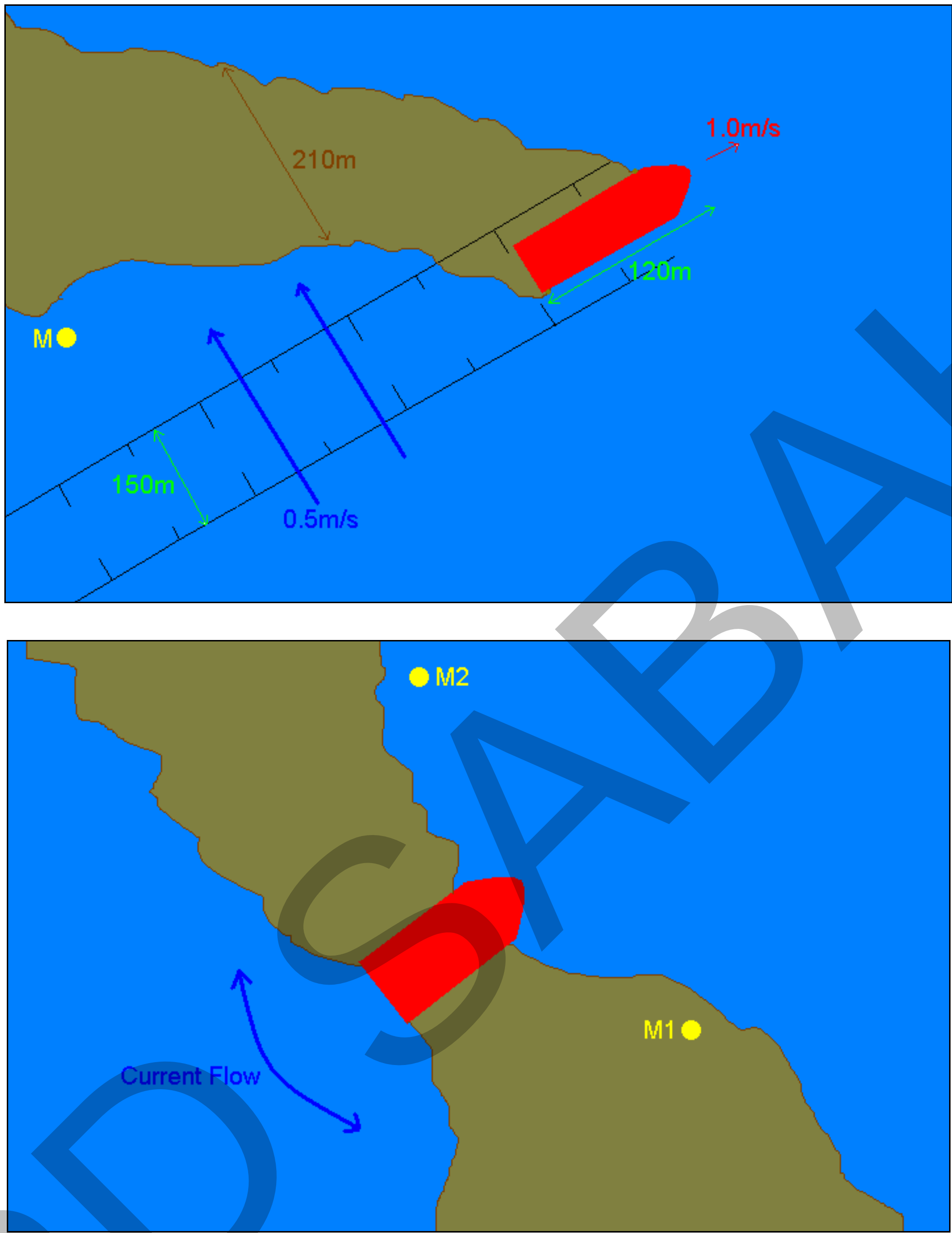


Figure 7-1: **Examples of non-representative feedback from monitoring stations for dredging operations**

Again, monitoring requirements are dependent on the scale of the project, the duration of the dredging and marine construction works and the site sensitivities, and can range from continuous monitoring, daily, weekly or up to monthly monitoring. Any frequency greater than monthly monitoring is not really valuable in establishing the actual impact of the works.

7.2.3 Morphological Impacts

For marine developments in the vicinity of high quality beaches or moderate quality open littoral beaches, there is a requirement to document the impact of the construction works on the shoreline and beach levels. This is generally carried out through coastal profile monitoring, with ground levels (land and/ or bathymetric survey) taken at regular intervals along a profile perpendicular to the shoreline at a defined spacing, with the survey points taken along the profile to pick up all the important features of the beach levels. Monitoring is generally undertaken every three to six months, depending on the predicted severity of the morphological impact. Alternatively, over a longer time frame, photo records, and/ or aerial photography of the shoreline or river can be surveyed at periodic intervals, and especially following storm or flood events.

7.2.4 Flooding and Water Levels

Where impacts to a main river or stream may occur (e.g. as a result of the construction of breakwaters fronting the river mouth), post construction monitoring of water levels inside the river is recommended by way of installation of water level gauge. Information on water levels and records of flood events should be monitored. If impacts are identified, remedial measures may be undertaken such as dredging of the river mouth or construction of bunds along the river banks.

7.2.5 Water Quality

During the construction phase, water quality monitoring (apart from sediment plume monitoring) is undertaken to determine actual impacts from release of contaminants (heavy metals) or nutrients from the dredge material and the release of other pollutants from the construction process, such as oil and grease, or pollution from workers' quarters. Additional parameters may be recommended depending on site characteristics.

The number of stations should be determined based on the predicted impact area, and, as mentioned above, also include at least one station outside the predicted impact area to act as a reference station.

The frequency of sampling will depend on the scale and duration of the construction works. Generally, a higher frequency should be included e.g. fortnightly to monthly sampling during the dredging and marine construction phase, which can be reduced for the remainder of the construction phase when the dredging activity has ceased and the works are limited to onshore works.

For projects with routine discharges into the sea during operations, regular monitoring should be carried out at the outfall to ensure that effluent discharges remain within stipulated limits. The frequency should be tailored to the magnitude of the discharge (pollutant loading and discharge rate) and the predicted impact zone, and may entail anywhere from continuous to weekly or fortnightly sampling. Sampling at potentially impacted sensitive receptors should also be carried out on a regular basis. In the case of biological or ecological receptors, the frequency of the water quality monitoring would need to be designed in conjunction with ecological monitoring requirements.

7.2.6 Ecology

Monitoring of mangroves, corals and seagrass may be required, depending on the predicted zone of impact and proximity of these sensitive areas to the project site.

These habitats should be monitored for signs of sedimentation and early signs of stress, such as coral bleaching, reduction in seagrass cover and shoot density. Measures of community variables such as species diversity are not generally relevant considering the time frames of most dredging projects and the response time of these organisms i.e. these changes may occur gradually over several months and years, rather than weeks and months.

The monitoring of marine habitats should be sufficiently frequent to identify changes in the habitat components between two monitoring rounds, whilst allowing for mitigating actions while construction work is still in progress. The frequency will depend on the habitats and parameters in question, but in general monthly monitoring during the dredging and marine construction phase can be expected. The type of monitoring stations could be (but are not limited to):

- Sedimentation – sediment traps
- Turbidity monitoring
- Light attenuation
- Suspended sediments
- Coral and seagrass health surveys and others

The number of stations will also depend on the extent of the zone of impact, but a sufficient number of stations and replicates should be established to account for natural variation within the habitat. The monitoring programme should also include stations in areas that are outside the area of impact to act as a non-effect reference.

Other biological monitoring that may be required depending on the site location includes:

- Fish stocks – fish catch surveys at affected fishing grounds;
- Turtles – in the event that the environmental assessment reveals the presence of turtle nesting within two (2) km of the development area, regular beach surveys should be carried out to establish the number of landings and to liaise with the relevant authorities for the protection of nesting sites; and
- Other identified marine flora and fauna of significant importance.

7.2.7 Monitoring Frequencies

Frequencies of monitoring depend upon the timing and schedule of project activities. The monitoring frequency can be varied. If the environmental consultant finds there is a particular parameter, which should be monitored more frequently due to increased activity levels, an increased monitoring frequency should be proposed in the Environmental Assessment report. On the other hand, if little activity is on-going, and the operation is in compliance over an extended period, the Project Proponent may request a less intensive monitoring schedule. Changes in the monitoring frequency will be decided on a case-by-case basis by EPD.

References

In addition to the relevant laws, regulations and guidelines, the following list includes general and specific literature, which may be useful for the reader.

1. Business and Biodiversity Offsets Programme (BBOP) (2009). The Relationship between Biodiversity Offsets and Impact Assessment: A BBOP Resource Paper. BBOP, Washington, D.C.

2. Business and Biodiversity Offsets Programme (BBOP) (2012). Guidance Notes to the Standard on Biodiversity Offsets. BBOP, Washington, D.C.

3. International Association of Dredging Companies (IADC) and Central Dredging Association (CEDA) (1998). Environmental Aspects of Dredging, Volume 4: machines, Methods and Mitigation. IADC/CEDA, the Netherlands.

4. Jabatan Pengairan dan Saliran Malaysia (1997). Garispanduan JPS 1/97: Guidelines on Erosion Control for Development Projects in the Coastal Zone. Published by the Coastal Engineering Section, JPS Headquarters.

5. PIANC (2010). PIANC Report No 108: Dredging and Port Construction Around Coral Reefs. PIANC Secretariat General, Belgium.

6. Department of Irrigation and Drainage (2010). Guideline for Erosion and Sediment control in Malaysia. Ministry of Natural Resources and Environment, October 2010.

Appendix 1: Glossary of Terms

Activity – basic element of a project or plan that has the potential to affect any aspect of the environment. Projects are composed of activities. Activities are often called actions.

Bathymetry – the water depths; shape of the sea bed.

Building – any building, erection or structure on any land and where the context so permits, includes the land on which the building is situated.

Central Board – the Central Town and Country Planning Board constituted under the provisions of Section 3 of the Town and Country Planning Ordinance.

Coastal Area – foreshore, inter-tidal and marine areas extending seaward up to 1.5 km offshore. The foreshore may be defined as 20 m inland of the high water mark. Refer also to definition for high water mark.

Development – any development that involves infrastructure and other structural construction activities together with related activities or changes the land and sea's natural condition.

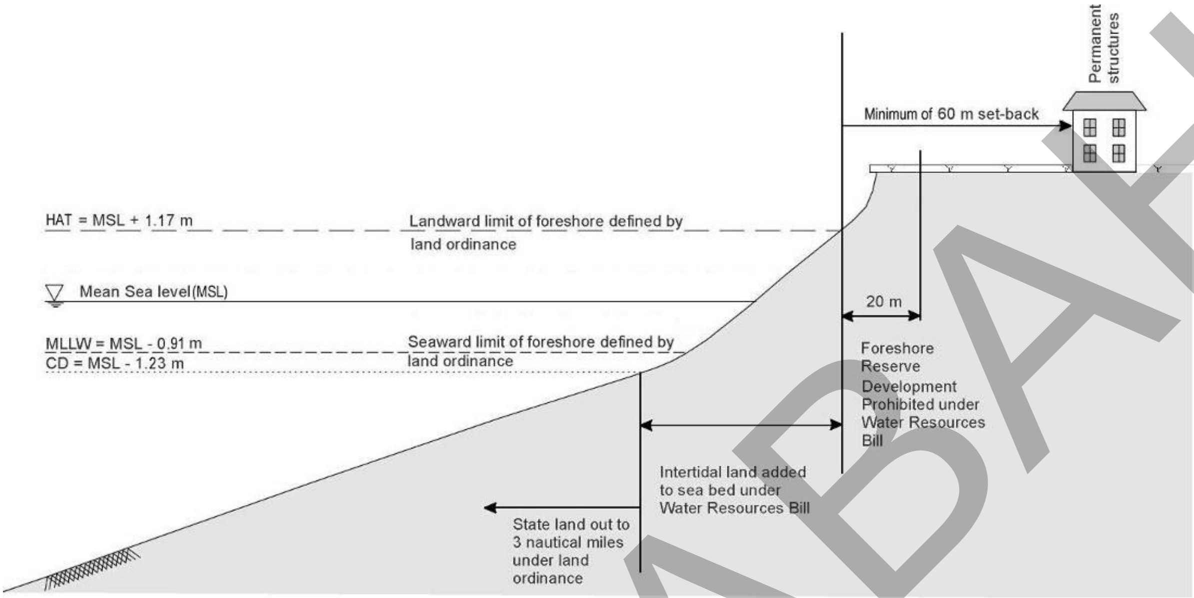
Effluent – any discharge either sewage or industrial effluent by an operation to the receiving environment.

Environment – physical factors of the surroundings of the human beings including land, water, atmosphere, climate, sound, odour, taste, the biological factors of animals and plants, and the social factor of aesthetics.

Environmental Impact – an estimate or judgement of the significance and value of environmental effects on physical, biological, social or economic environment.

High Water Mark - the top of a beach indicated by a debris line, i.e. the highest point on a beach where debris is deposited. It is not a well-defined level compared to a fixed datum as the debris line will vary with both tides (following the forth-nightly neap-spring tidal cycle) and wave exposure, with higher waves having the potential to move the debris line higher up on the beach. For the purpose of this guideline, the intent is to measure the distance from a line above which flooding will not occur under normal tide and wave conditions. The Highest Astronomical Tide (HAT) is a practical estimate of a fixed level that fulfils this. The HAT will not be exceeded by astronomical tidal elevations alone, and under most conditions has a small allowance for wave/ wind setup and wave run-up. HAT levels relative to Chart Datum for Standard Ports in Sabah (and Labuan due to its proximity) from the Malaysia Tide Tables are shown as follows:

Labuan	2.60 m	Felda Sahabat	2.95 m
Kota Kinabalu	2.40 m	Lahad Datu	2.54 m
Kudat	2.54 m	Semporna	2.59 m
Sandakan	2.89 m	Tawau	3.85 m



Definition sketch for foreshore and intertidal zones (with tidal variations representing Kota Kinabalu)

Matrix Method – identifies interaction between various project actions and environmental parameters and components.

Natural Resources – air, biological diversity of resources, oil, gas, forest and forest product, land, rocks, soils, animals, birds, plants, marine or aquatic life, and water of the State of Sabah.

Pollutants – any natural or artificial substances, whether in solid, semi-solid or liquid form, or in the form of gas or vapour, or in a mixture of at least two of these substances, or any objectionable odour or noise or heat emitted, discharged or deposited or is likely to be emitted, discharged or deposited from any source which can directly or indirectly cause pollution and includes any environmentally hazardous substances.

Pollution – any direct or indirect alteration of the physical, thermal, chemical, or biological properties of any part of the environment by discharging, emitting, or depositing wastes so as to affect any beneficial use adversely, to cause a condition which is hazardous or potentially hazardous to public health, safety or welfare, or to animals, birds, fish or aquatic life, or to plants.

Residual Impact – the potential environment impact remaining after mitigating measures have been adopted into a project plan.

Spill Budget – (relating to dredging and reclamation) maximum amount of spill that can be released into the environment for a given project (or stage of project).

Topography – shape of the ground, formed by highlands, slopes, rivers, swamps, coasts and river network which have their own aesthetic values.

Zone of Impact – an extent of area which will receive the greatest effect from an activity

Appendix 2: List of Abbreviations

ACLR	Assistant Collector of Land Revenue
AEC	Agreement of Environmental Conditions
BMP	Best Management Practice
CSD	Cutter Suction Dredger
DID	Department of Irrigation and Drainage
DOE	Department of Environment
EIA	Environmental Impact Assessment
EPD	Environment Protection Department
ESCP	Erosion and Sediment Control Plan
HAT	Highest Astronomical Tide
IUCN	International Union for Conservation of Nature
LAT	Lowest Astronomical Tide
LSD	Lands and Surveys Department
MD	Mitigation Declaration
MHHW	Mean High Higher Water
MSMA	Manual Saliran Mesra Alam
NRT	Net Registered Tonnage
NWQSM	National Water Quality Standards for Malaysia
PMM	Proposal for Mitigation Measures
RM	Ringgit Malaysia
SD	Suction Dredger
Sg.	Sungai (River)
SMP	Shoreline Management Plan
TOR	Terms of Reference
TSHD	Trailer Suction Hopper Dredger
TSS	Total Suspended Solids
WHO	World Health Organization
WWF	World Wildlife Fund

Appendix 3: Contact Details

Contact details for other key government agencies related to shoreline development activities are as follows:

Department	Address	Contact Details	
Lands and Surveys Department	Wisma Tanah dan Ukur, Jalan Perwira, Beg Berkunci No. 2044, 88576 KOTA KINABALU	Tel No.:	088 - 527600/ 527601
		Fax No.:	088 - 413626
		Email:	-
Sabah Wildlife Department	Tingkat 5, Blok B, Wisma MUIS, 88100 KOTA KINABALU	Tel No.:	088 - 215167/ 214515
		Fax No.:	088 - 222476/ 254767
		Email:	jhl@sabah.gov.my
Department of Irrigation and Drainage	Aras 5, Wisma Pertanian, Jalan Tasik, Luyang, Off Jalan Maktab Gaya, Beg Berkunci 2052, 88767 KOTA KINABALU	Tel No.:	088 - 280500
		Fax No.:	088 - 242770
		Email:	did@sabah.gov.my
Department of Fisheries	Aras 4, Blok B, Wisma Pertanian Sabah, Jalan Tasik, Luyang, Off Jalan Maktab Gaya, 88624 KOTA KINABALU	Tel No.:	088 - 235966/ 245489/ 245490
		Fax No.:	088 - 240511
		Email:	fish.dept@sabah.gov.my
Ports and Harbours Department	Ibu Pejabat, Peti Surat No. 80164, 87011 W.P. Labuan	Tel No.:	087 - 412966/ 412453
		Fax No.:	087 - 417531
		Email:	phdepts@sabah.gov.my
Town and Regional Planning Department	Tingkat 3, 4 dan 5, Blok B, Wisma Tun Fuad Stephens, KM 2.4, Jalan Tuaran 88646 KOTA KINABALU	Tel No.:	088 - 222336/ 222337/ 222031
		Fax No.:	088 - 222557
		Email:	-
Minerals and Geoscience Department Malaysia, Sabah	Jalan Penampang, Beg Berkunci 2042, 88999 KOTA KINABALU	Tel No.:	088 - 260311/ 252494/ 252496
		Fax No.:	088 - 240150
		Email:	jmgsbh@jmg.gov.my
Marine Department	No. 2, Kompleks Jabatan Laut, Teluk Salut, Jalan Sepanggar, 88450 KOTA KINABALU	Tel No.:	088 - 401111
		Fax No.:	088 - 401182
		Email:	pjlwsb@marine.gov.my
Department of Environment, Sabah	Aras 4, Blok A, Kompleks Pentadbiran Kerajaan Persekutuan Sabah, Jalan UMS-Sulaman, 88450 KOTA KINABALU	Tel No.:	088 - 488166
		Fax No.:	088 - 488177/ 488178
		Email:	sabah@doe.gov.my

Appendix 4: List of Environmental Consultants/ Study Team

The following list includes the expertise, which in most cases should form part of the assessment team for shoreline development EIAs depending on site characteristics and environmental issues identified. Some team members may cover two or more of these fields of expertise:

- Soil Erosion
- Hydrology
- Ecology/ Flora and Fauna
- Geology
- Air Quality and Noise
- Socio-Economic
- Waste Management

Each member of the team, involved for their specialist subject(s), should be involved in the entire environmental assessment cycle from scoping, baseline data collection, impact prediction and evaluation, and identification of mitigation measures.

The list of registered environmental companies related to environmental report preparation can be referred to on the website of EPD: http://www.sabah.gov.my/jpas/

Appendix 5: Standard List of Content

The content of the EIA report shall consist of the following:

CHAPTER 1:	**EXECUTIVE SUMMARY**
	Project Description
	Findings
CHAPTER 2:	**GENERAL INFORMATION**
	Project Title and Project Proponent
	Environmental Consultant
	Public Hearing (for Special EIAs)
CHAPTER 3:	**PROJECT DESCRIPTION**
	Statement of Need
	Concept and Phases
	Description of Location
	Project Status
CHAPTER 4:	**IMPACT PREDICTION AND EVALUATION**
	Significant Environmental Impacts
	EIA Matrix
	Impact Assessment
CHAPTER 5:	**RECOMMENDED MITIGATION MEASURES**
	Recommendations
	Additional Mitigation Measures
CHAPTER 6:	**RECOMMENDED MONITORING PROGRAMME**
	Compliance of Mitigation Measures
	Residual Impacts
ANNEXES	Annex 1: Baseline Environmental Data and Information
	Annex 2: Methodologies and Analysis of Data
	Annex 3: List of References
	Annex 4: Terms of Reference

Appendix 6: Additional Notes on Suspended Sediment Plume Impact Assessment of Projects involving Dredging Activity

Modelling

The accuracy of impact predictions from numerical models depends on the temporal and spatial coverage and validity of input data and the ability of the models (and modeler) to identify and simulate the key processes. The use of quantitative performance criteria for model calibration and validation against field measurements can help regulators assess the level of reliability achieved and improve stakeholder confidence in model results.

The suspended sediment plume modelling should be based on the project-specific variables (dredger type, number, production rate, properties of dredge/ fill material, placement methodology). Often, only limited project information is available during the environmental assessment stage, so a conservative, but realistic approach should be adopted. In particular, the timing, scheduling, equipment, content and characteristics of fines is typically not confirmed at the environmental assessment stage. In these cases the environmental assessment needs to clearly articulate any assumptions made, and the requirement for verification and/or review when more detail is available, or during the monitoring stage.

In order to be conservative, a range of timings and production rates should be assessed. A few variations of an assumed full reclamation/dredge log (spill budget) will generally not provide a good representation of the overall environmental risks associated with the project. Therefore, a modelling strategy that encapsulates these uncertainties at the environmental assessment stage is equally important for the accurate prediction of potential impacts. A scenario-based modelling approach that establishes a set of representative and conservative scenarios for key factors controlling the spill and plume dispersion and simulates all combinations of e.g. dredge/ disposal, climatic and spill scenarios can be adopted.

The model results will give the spatial extent of the plume as well as magnitude (concentrations) of suspended solids. In order to interpret these results so as to derive impacts for various sensitive receptors, the Malaysian water quality guidelines, or, depending on the type of sensitive receptor, literature-based information on tolerance limits should be referred to. These should generally take into account both the magnitude of the impact as well as the duration of exposure. Based on these tolerance limits, the potential zones of impact can be derived from the modelling of individual scenarios through established impact criteria for key environmental receptors, and the overall impact zones may be derived by combining all the individual scenarios.

The impact zones for different receptor types readily identifies receptors at risk, while a wealth of information that can be extracted from the individual scenarios forms a solid platform for taking environmental objectives into account in optimisation of the final dredging programme.

In terms of sediment plume modelling associated with dredging and other marine construction works, some important model features must be addressed in the assessment. They include, but are not limited to:

- Parameterisation of receptor tolerances to turbidity and sedimentation.

- Spatial resolution of the model in the potential impact area appropriate for the scale of plume generation and complexity of the flow.

- Vertical resolution dependent on the three-dimensional nature of the flow in the potential impact area.

- Simulations adequately covering both representative and worst-case climatic conditions and production rates and being sufficiently long (typically 28 days) to ensure that both key and cumulative tidal, wind and wave effects are captured.

- Taking into account that the plume is composed of different sediment fractions with different characteristics, which also depends on, amongst other things, the anticipated dredging technique to be utilized.

- Description of the spatial and temporal variability of plume generation, e.g.

  - Trailer suction hopper dredgers (TSHDs) generate a moving source of spill in the dredging area. The turnaround time depends on the sailing time between the dredging site and material placement site.

  - Grab dredgers generate a stationary source of spill, with periodic emissions during the lift phase.

The level at which the plume generation from dredging and construction operations is modelled will depend on the level of accuracy required. For example, a spill from a TSHD often carries on after dredging stops. This and other sources of sediment suspension such as propeller wash may result in turbidity generated outside the development area. In sensitive areas where plume generation is close to coral reefs for example, a high level of detail should be included in the modelling.

Mitigation Measures – Application of Spill Budget

At the environmental assessment stage such a budget most often relies on sparse information since the contractor has not yet been appointed and details of the operation is therefore often not finalised and available to the environmental consultant. Hence at the environmental assessment stage, the overall spill budget is generally estimated through the following main assumptions:

Assume total amount of fines in the dredged material. This is a function of:

- Total volume of dredging.
- Percentage of fines in dredge material. (adequate baseline information on sediment texture/ % fines to be obtained for the dredging site).

Assume the percentage of fines released into adjacent water bodies.

The spill rate is then obtained by parcelling out the total spill volume (estimated through the steps above) over the course of the project. The distribution of the total spill over the project life-time typically requires the following information:

- Location of dredge disposal site.
- Equipment and installation specifications (i.e. number of barges, sizes of barges, speed and others).
- Working schedule (e.g. 12 hour/day operation).
- Period of dredging/ construction works.
- Time required for loading and offloading of barge(s) or hopper.
- Sailing time between dredging and disposal site.

The assumptions above can be used to determine the spill events, i.e. providing the spill rates in a time-series, which in turn will provide the overall spill. At the environmental assessment stage the information listed above is typically not available since the contractor has not yet been appointed and details of the environment and the dredging operation are often not defined and available to the environmental consultant. Hence in most cases, resort must be made to sparse data, empirical formulations and/ or previous experience from similar projects either locally or in similar locations.

An example of calculated spill rates is provided in Figure A6-1 showing a one-day snap-shot of spills from combined cutter-head and barge operations. The operation involves two barges of different sizes that are rotating between dredging and disposal grounds and operating continuously over 24 hours.

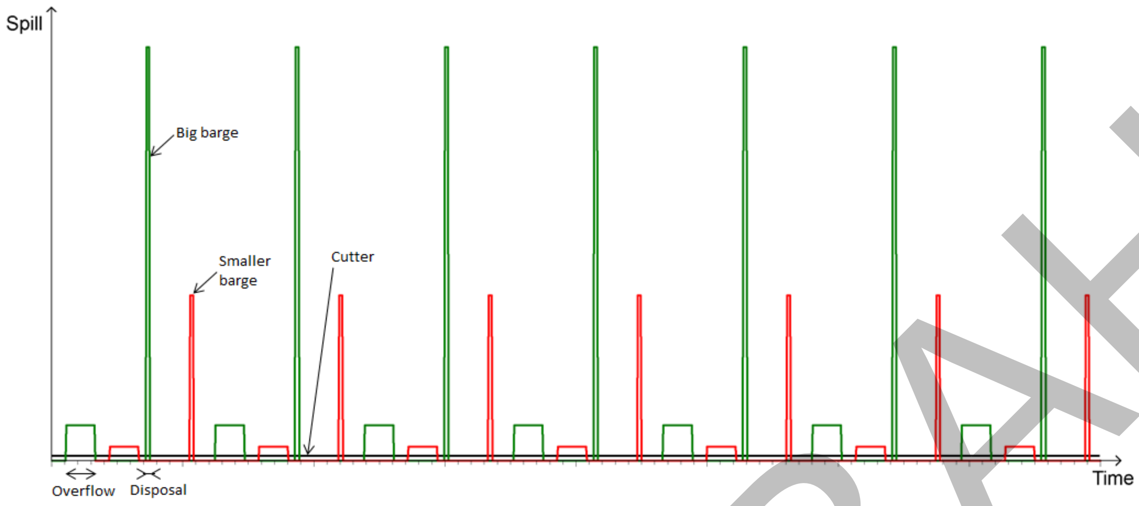


Figure A6-1: One-day snap-shot of spill from overflow, disposal and continuous cutter dredging

The spill budget can be significantly refined in the environmental monitoring programme stage. At this stage, the contractor has been appointed and the dredging operations, or at least parts of it, are better defined. Moreover, the spill can be monitored directly at-source providing more realistic spill rates.

This spill budget is an important component of the so-called feedback management (monitoring stage) which is described below.

Best Practice Monitoring

For large scale dredging works where sediment plume impacts are a key concern, the implementation of best practice monitoring should be considered. Fixed monitoring stations for suspended sediments usually cannot cover all potential impact areas. Furthermore, measurements from fixed stations do not distinguish between sediments from the actual project and other projects, let alone the background concentrations and furthermore introduce a certain risk of missing out on peak plume characteristics. Conventional monitoring campaigns are often stiff and reactive in the sense that they lack the flexibility to provide timely management responses. Introducing certain feedback in the monitoring campaigns and using numerical modelling in combination can often overcome such shortcomings.

The main idea of introducing feedbacks is to have a flexible management concept that ensures that health conditions and environmental protection criteria (objectives) are met throughout the project life. Note that the flexibility gained with such management approaches may have effects on production and is likely to have cost implications to the contractor and/ or consequences to the time schedule of the project. It is essential that the necessary provisions are included in the construction contract and that the project developer is committed to the economic and time schedule consequences. Feedback monitoring is considered best-practice.

The main strength in feedback management is its built-in adaptability to accommodate critical environmental responses related to the project. Main components in feedback management are numerical modelling, the spill budget and monitoring the spill-limit which is the component ensuring that environmental objectives are fulfilled.

The spill-limit is adaptive. The components are combined in the following sequence:

- At-source measurements of spill rates. As described above, the measurements are often taken directly from the overflow of the dredger (overflow sampling) at given frequency (f_1). The measured spill rates are then checked against the set spill-limit (at the onset of the monitoring campaign the spill-limit is taken from the spill budget given at the EIA stage). If the spill-limit is exceeded over a certain period of time (T_1) then the spill rates and the sediment budget are adjusted to compensate.

- Simulate the temporal and spatial plume excursions from the actual measured spill using modelling (at the onset of the modelling complex established during the EIA stage can be adopted but should be subject to continuous refinements in the course of the monitoring works as monitoring data become available). Modelling can enter the feedback management through:

  - Hindcast plume and impacts modelling: Compare model predictions with in-situ measurements of concentrations (fine-calibrate if necessary the model) and record predicted impacts against tolerance limits at receptors.

  - Forecast plume and impacts modelling. If tolerance limits at receptors are forecasted to be exceeded over a critical period of time (T_2) then spill may be adjusted accordingly.

Habitat/ receptor monitoring at given frequency (f_2). Based on observed health conditions the tolerance limits for each receptor are updated which may trigger an adjustment of the spill-limit (i.e. production method and rates).

Evaluate response times (T_1, T_2) and frequencies (f_1, f_2).

The principle mechanisms in the feedback management are illustrated in Figure A6-2. At the onset of the monitoring campaign, spill and tolerance limits and monitoring and modelling set-ups can be taken from the environmental assessment works. The response frequencies i.e. how often limits and models are updated depend on the nature of the project (project size and complexity, sensitivity, hydraulic variability, stakeholders concern and others). The complexity of feedback management is therefore scalable and can be tailored to meet any project.

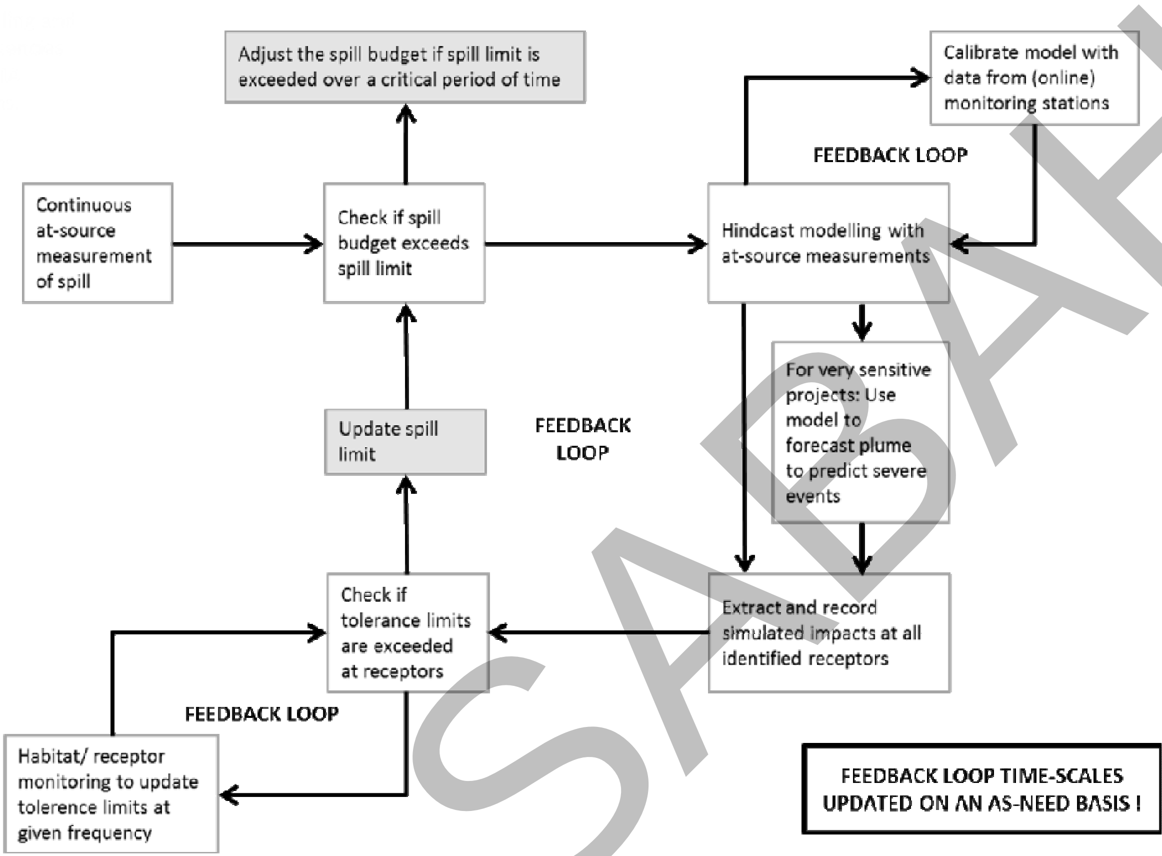


Figure A6-2: Overview chart of feedback management mechanisms

Feedback management is considered best practice as it provides the required flexibility and builds on various types of input in an integrated framework (modelling, monitoring and experience). The following main advantages can be identified:

- Spill budget control through at-source measurements forms a first level control of potential impacts. It allows segregation and management of individual work components, avoiding over-response while ensuring the tiered response targets those activities causing impacts.
- Predictive models are used extensively to hindcast the location of the plumes from the construction operations, thereby providing a complete temporal and spatial picture of potential impacts, filling in the gaps between monitoring stations (both instrumentation and coral health) and allowing clear segregation of the impacts arising from component activities.
- Tolerance limits are used to identify potential impacts before they occur, allowing implementation of management measures to avoid the impacts, rather than respond to them.

- Tolerance limits are updated based on monitoring data collected as the works progress.
- Results of on-line instrumentation at coral receptors and remote sensing are used to validate spill budget and numerical models, as well as proxies for potential coral health impacts.