ENVIRONMENT PROTECTION DEPARTMENT

MINISTRY OF TOURISM, CULTURE AND ENVIRONMENT, SABAH

GUIDELINES AND STANDARD OPERATING PROCEDURES (SOPs) FOR EARTHWORK ACTIVITIES IN SABAH

Guidelines and Standard Operating Procedures (SOPs) For Earthwork Activities in Sabah

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Preface

Earthwork is a component in most of the land development in Sabah. These activities are necessary for the construction of roads, driveways, building foundations, the preparation of land for development subdivisions and the maintenance and upgrading of infrastructure such as the Pan Borneo Highway project.

The aim of this document is to provide practical guidance to project proponents and any other stakeholders on the environmental considerations required in the preparation of a site for earthwork activities. At the same time provide guidance to practical application of mitigation measures to control and manage impacts due to earthwork activities.

Message

I wish to congratulate the Environment Protection Department (EPD) Sabah for their accomplishment in publishing this document entitled “Guidelines and Standard Operating Procedures (SOPs) for Earthwork Activities in Sabah”.

Maintaining a balance between development and a healthy environment is challenging. As emphasised in the Sabah State Policy on the Environment 2017, the State Government “recognises that the environment is an integral part of, as well as a strategic pillar of, sustainable development, which requires the adoption of appropriate policies incorporating environmental factors and standards into all development activities in order to maintain environmental and social sustainability”. Hence, a proper planning, effective strategies, and practical actions should be in place to control the impacts of development-related activities on the environment. One of the common activities in every development in Sabah is earthwork activities. Therefore, the establishment of these Guidelines and Standard Operating Procedures (SOPs) for Earthwork Activities is timely and provides the mechanism to guide project proponents in controlling and managing environmental impacts.

I look forward for Sabah to achieve a higher level of environmental achievements and sustainable development to meet the aspiration of the Sabah State Policy on the Environment that is “to maintain a healthy environment based on clean air, healthy rivers, vibrant forests, productive land, bountiful seas and cohesive communities contributing to the prosperity of the State and its people”.

DATUK SR. HAJI MOHD YUSRIE ABDULLAH
PERMANENT SECRETARY
MINISTRY OF TOURISM, CULTURE AND ENVIRONMENT

Foreword

The publication of the “Guidelines and Standard Operating Procedures (SOPs) for Earthwork Activities in Sabah” is part of the Environment Protection Department’s continuous efforts to enhance environmental management in Sabah specifically to provide guidance on how to minimise impacts of earthwork activities. These guidelines outline common environmental concerns related to earthwork activities and how these can be addressed through effective mitigation measures.

Section I introduces the purpose of the Guidelines, which is to provide practical guidance to project proponents and relevant stakeholders on the process involved in the preparation of a site for earthwork activities. It intends to provide a structured framework for the scope of environmental considerations required during the planning and implementation stages of earthwork activities. Integrated and holistic consideration of the site, soil characteristic, implementation schedule, practicality, etc. at the planning stage of development is essential for the selection of best mitigation measures. The significance of this approach will ensure that any earthwork activity will be carried out with minimal adverse residual environmental impacts. Section II presents the Standard Operating Procedures (SOPs), a clear and practical application of mitigation measures guidance for project proponents to control and manage impacts due to earthwork activities.

I greatly acknowledge all government agencies, organisations and individuals who provided valuable comments, feedback and input into the development and publication of these guidelines and SOPs. I sincerely hope this document will be utilised meaningfully and we encourage project proponents to implement environmental-self regulation (ESR) towards a more sustainable environment in Sabah.

VITALIS J. MODUYING
DIRECTOR
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ABBREVIATIONS

AEC	Agreement of Environmental Conditions
BMPs	Best Management Practices
DBKK	Kota Kinabalu City Council
DID	Drainage and Irrigation Department, Sabah
DP	Development Plan
DRP	Drainage Plan
EIA	Environmental Impact Assessment
EP	Earthwork Plan
EPD	Environment Protection Department, Sabah
ESCP	Erosion and Sediment Control Plan
L&S	Land and Survey Department, Sabah
PMM	Proposal for Mitigation Measures
MD	Mitigation Declaration
SOPs	Standard Operating Procedures

TERMINOLOGIES

Waterbodies	Sea, river, lake, drainage system, stream

Section I: Guidelines

1 Introduction

The aim of this guideline is to provide standard operating procedures (SOPs) applicable for earthwork activities at site in the state of Sabah, with a focus on prevention, mitigation and control of discharge from development area containing the major pollutant resulting from earthwork activities.

This guideline should serve as an operating manual and guide for the stakeholders in the implementation of the mitigation procedures. All the mitigation measures shall be designed, constructed, installed and maintained in accordance with good practices and applicable design specifications endorsed by the local authorities. For example, the Earthwork Plan and Drainage Plan endorsed by the local authorities, guidelines or manuals from the DID as well as the approved environmental conditions endorsed by the Environment Protection Department.

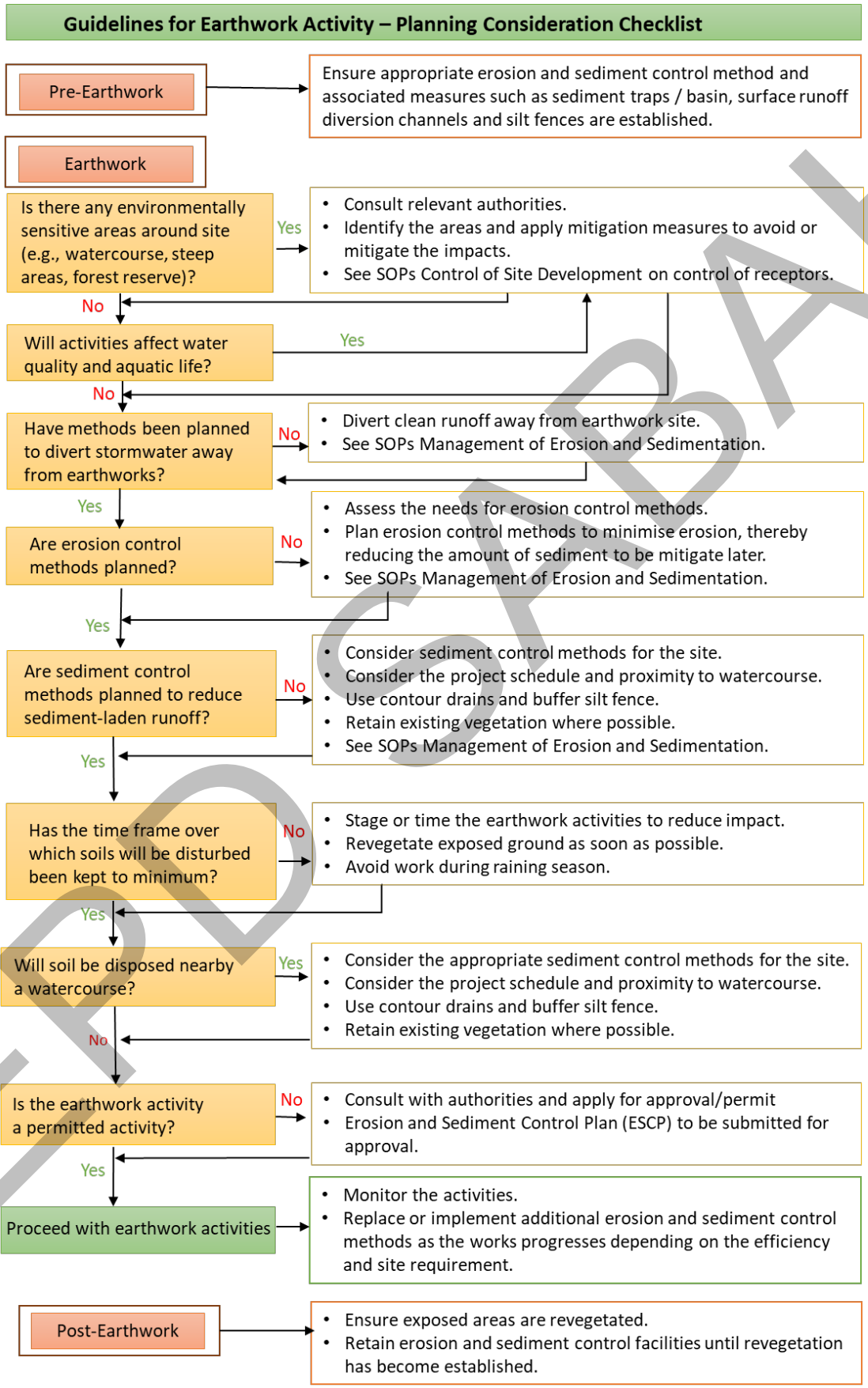
1.1 Earthwork Strategy

The Project developer should have the following earthwork strategies in all earthwork activities:

No	Strategy	Description
1	Minimise disturbance	Clear areas required for structure development or site access only.
2	Phase & Stage construction	Phase and stage out the earthworks on site to smaller scale / units to allow progressive revegetation and minimise erosion.
3	Protect steep slopes	Minimise clearing of existing steep slopes.
4	Protect waterbodies	Determine existing and future drainage patterns. No clearing adjacent to waterbodies.

No	Strategy	Description
5	Stabilise exposed areas rapidly	Revegetate disturbed soils after each stage of earthworks.
6	Install perimeter controls	Prevent runoff out of the worked area. Controls must be able to retain or direct the runoff within the site.
7	Implementing control measures	Ensure control measures used are site appropriate and adequately protect the receiving environment.
8	Technical capability	Technical capability is crucial to oversee the implementation and maintenance of the control measures.
9	Updating control measures	Adapting and modifying the control measures based on the project progression needs.
10	Assess and adjust	To check, examine and maintain or improve the control measures.

1.2 Planning Consideration Checklist



1.3 Application to these Guidelines

The type of project and site condition are crucial in determining the BMPs to apply when mitigating the impacts from earthwork activities. To ensure the right BMPs are applied at the right site condition and time, these factors will need to be considered as shown in Figure 1. The factors are further elaborated in the following subsections.

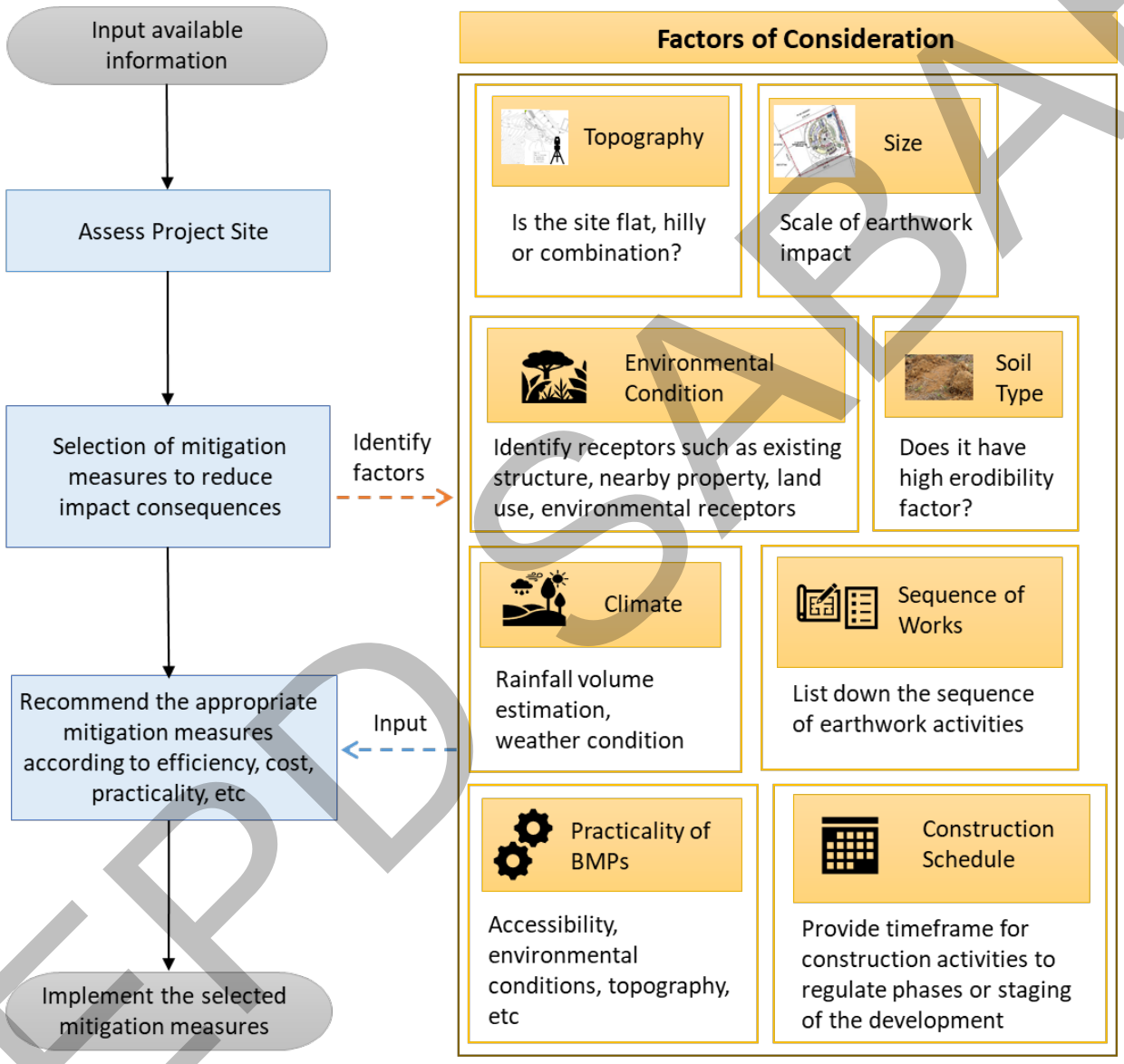


Figure 1 Factors of consideration for the appropriate mitigation measures process.

1.3.1 Topography

Ground topography plays an influencing factor when deciding on the staging, as it will affect the movement of the surface runoff. By understanding the ground topography, the site or earthwork staging can control the surface runoff to be contained within a particular work area through implementing the right mitigation measures.

1.3.1.1 Slope stability

When natural or man-made slopes found around and within the project site may be affected due to earthwork activities, additional geotechnical investigation on slope condition should be carried out. The investigation should show sufficient detail to adequately define the geologic conditions of the slopes, groundwater conditions, slope stability analysis covering factor of safety (F.O.S), slope gradient, slope classification, climate, etc. to allow slope risk assessment or potential slope failure against any nearby structure, life and property, to be carried out by the respective authority.

Understanding the slope condition in the area provides critical inputs to the planning of staging, sequence of works as well as deciding on the right mitigation measures to be implemented.

1.3.2 Project size / footprint

The project size / footprint will determine the scale of the earthwork impact and contribute to the earthwork planning to ensure impact scale is kept to a minimum. The core principles to be considered regardless of the project size and keeping the impacts to manageable levels are:

- Reducing the working area to be less than the plan area of the building and
- Regulate phases / staging of development (i.e., all clearing, grading and stabilisation operations shall be completed before moving into the next phase).

When considering the staging of the earthwork activities, other contributing factors such as topography of the site and / or existing conditions of the site also play a role in determining the staging process.

1.3.3 Existing environmental conditions

The existing condition of the site, such as land use and sensitive areas within or surrounding a project area, will also determine how the earthwork activities should be planned out and the suitable BMPs to reduce the amount and duration of the impact to the receiving receptors.

1.3.4 Soil Characteristics

Soil characteristics will also determine the type of mitigation measures to be installed on site. The effectiveness of the mitigation measures installed on the site are influenced by the ease of soil materials being dislodged from earthwork activities to capturing eroded materials.

1.3.5 Climate

Climatic condition of the area also plays a role in deciding the type of earthwork that should be carried out. As Sabah is a tropical climate with dry and wet seasons all year round, it is prudent to adjust the type of site activities that are needed against the season of the year. Where possible, all major earthworks shall be scheduled during the dry season, to minimise open ground surface exposed to the elements of rain and wind during wet seasons.

1.3.6 Sequence of Works (Phasing and Staging of earthwork activities)

Large scale earthwork activities will incur large scale environmental impacts such as erosion, surface runoff, etc. Therefore, phasing and staging based on the sequence of works and understanding the environmental conditions on site are to be considered. The extent of staging for a site will depend heavily on the sequence of earthwork activities that might occur in the construction sequence. For example, phasing the site into several smaller work parcels helps to manage the impact to the environment if the site is high in sensitivity.

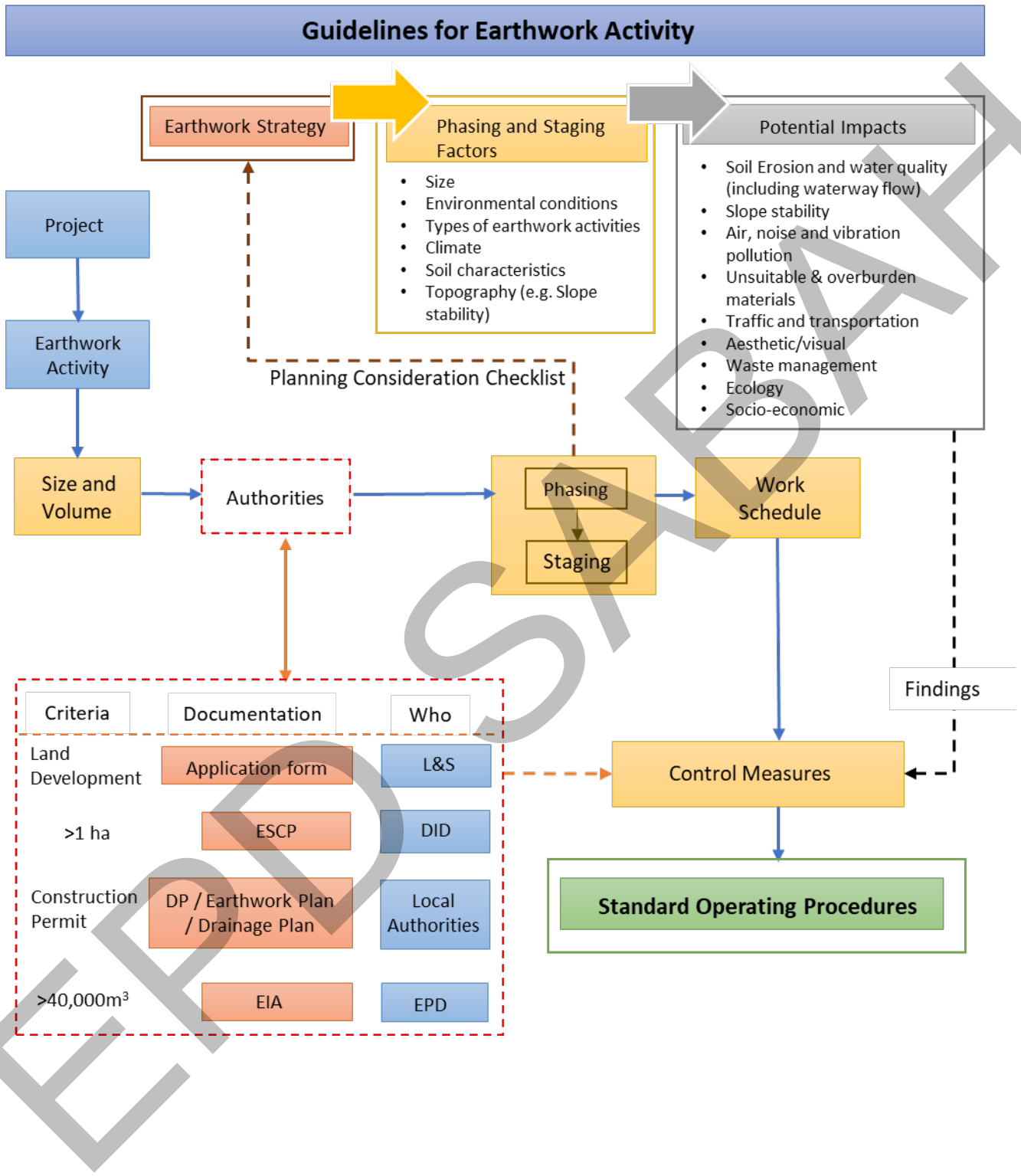
1.3.7 Practicality of Best Management Practices (BMPs) installations

Understanding the practicality and applicability of the mitigation measures, in this case the best management practices, to be installed on the site is crucial to ensure the success of the mitigation measures in mitigating the issues. Considerations such as accessibility, environmental conditions, topography, etc. are necessary to ensure the effective BMPs are installed.

1.3.8 Construction Schedule

The earthwork activities scheduled on site can determine the best management practices to be installed as well as plan for phasing and staging of the development. If there is only a short duration for the earthwork activities, then the selected mitigation measures need to be practical and effective to address the need. For example, the installation of the mitigation measures must be completed before the earthwork activities starts, as the measures are to address the impact from the earthwork activities.

1.4 Overview of the flow of the Guidelines



Section II: Standard Operating Procedures (SOPs)

All mitigation measures to contain the environmental impacts within the earthwork site shall be designed, constructed, installed, and maintained in accordance with good engineering practices and applicable design specifications. Developments involving earthwork will be controlled to ensure that they do not increase the risk of landslides and / or flooding by blocking flood water flow paths and culverts and diverting flood water to other sites. Situations such as landslides or sediment filling in an existing channel or overflow path must be carefully managed to avoid the risk of flooding.

The extent and scale of the earthworks may necessitate the creation of an adequate 'secondary flow path' in the event that a primary flow path / channel is blocked. Any control measures used to address this issue must be effective in avoiding significant impacts. Therefore, application of all mitigation measures installed at the earthwork site shall be in accordance with standards and specifications indicated, specified, stated, depicted and set forth in all the existing guidelines, laws and regulations in Malaysia.

1 Control of Site Development

Prior to any earthwork activities, legal documentation such as permit, permission or approval to develop the land must be obtained to avoid conflicts to the neighbouring landowners.

Apart from the site boundary, setback or buffers for sensitive and protected areas identified such as forest reserves, mangroves, waterbodies, hill sites, private lands and properties must be allocated to allow sufficient protection of the area from receiving any impacts due to the earthwork activities.

Target	Earthworks activities within the approved site boundary
Standard Operating Procedures	**1.1 Applicable Documents** Refer to relevant documents, such as approved EIA, PMM, AEC, MD, EP, ESCP, site plan, approved land development permits, earthwork Schedule B (Land Ordinance Cap 68), earthwork by-law, etc. for the approval conditions and required mitigation measures to be implemented in establishing the development site area. The mitigation measures outlined in the above-mentioned documents shall be referred to and take precedent to the requirement / standard procedures outlined here when preparing the site for earthwork activities. **1.2 General Procedures** 1.2.1 Site Plan 1.2.1.1 Appoint a licensed surveyor to carry out a site survey and submit for the approval process to the relevant authorities. 1.2.1.2 Carry out a site survey. The survey shall extend 500 m beyond the site boundary or as requested by the relevant agencies.

	1.2.1.3 Site plan to be prepared in Rectified Skewed Orthomorphic (R.S.O) system of rectangular coordinates. Standard of survey Class II or as requested by the relevant agencies. 1.2.1.4 Site plan to be plotted at scales 1:500 / 1:1,000 / 1:2,500 / 1:12,500 / 1:25,000 or as requested by the relevant agencies. 1.2.1.5 The site plan should show the following information: • Topography; • Limits of construction; • Conceptual project layout; • Surface waterbodies, known wetlands, springs, and wells; • Locations of final drainage discharge outlets; • Existing land use; • Existing vegetation; • Steep or unstable slopes; • Areas used to store soils and wastes; • Areas of cut and fill; and • Existing and planned paved areas and buildings.

1.2.2 Site Boundary Marking

1.2.2.1 Mark the site boundary with visible boundary marker tools made from sturdy materials such as painted wooden stakes, signboards, PVC pipes, and hoarding.

1.2.2.2 Demarcate working site and surrounding receptors that might be affected by the earthwork activities such as public road, drains, river, forest, residential / commercial buildings, etc. with visible markers such as red tape, signboards, fences, hoarding, etc.

1.2.2.3 Erect signboards or notification boards showing the site boundaries and demarcated area at visible height level.

1.3 General Sequence of Works

1.3.1 Per the site plan, mark every corner of the site boundary and earthwork phases with visible markers.

1.3.2 Identify receptors surrounding the site and demarcate the receptors with sufficient buffer / setback to ensure receptors are not affected by the earthwork activities.

1.3.3 Notify all workers, including contractors, agents, or personnel that are appointed in carrying out the earthwork activities on the boundary marker used on the site to avoid damaging, tampering or relocating them. Examples of notification methods are:

- Clearly state boundary marker tools in the approved map;
- Erect signboards at site boundaries;
- Conduct periodic awareness training on boundary markers used onsite; and

	• Display boundary marker tools used on-site with a notice / sign board. 1.3.4 Inspect and monitor marking tools at the site to ensure markers remain in their initial position without disturbance and / or damages. 1.3.5 Earthwork activities should not be conducted outside the marked boundary. Each phase of earthwork shall be conducted within the boundaries and any earthwork outside the boundaries without approval is prohibited.

Photo 1 Example of hoarding used to demarcate the active working area within a site.

Photo 2 Example of fencing used to surround the site boundary.

Photo 3 Example of signages installed at the visible marker demarcating the site boundaries.

Photo 4 Example of boundary marker / boundary stone used for land surveying.

Photo 5 Example of a marked buffer zone to protect mangrove forest.

2 Phased Development

Proper earthwork staging / phasing and work sequencing shall be adopted to ensure that bare / erodible surfaces are properly mitigated as soon as possible. Doing so shall minimise the earthwork impacts to the environment to a manageable level.

Uncontrolled or unplanned earthwork activities may result in environmental degradation, which affects the surrounding communities negatively via water pollution due to uncontrolled runoff, flash flooding due to blocked drains or sedimentation in the nearby river system, landslides due to land clearing, etc.

Target	• To reduce the impacts from earthwork activities to a manageable level. • To allow progressive revegetation and minimise erosion. • To facilitate the implementation of the best management practices sequentially or systematically.
Standard Operating Procedures	**2.1 Applicable Documents** Refer to documents such as approved EIA, PMM, AEC, MD, EP, ESCP, site plan, earthwork Schedule B (Land Ordinance Cap 68), earthwork by-law etc., to determine the phasing of the site. **2.2 General Procedures** 2.2.1 When establishing phasing and sequence of works for earthwork activities, criteria to be considered are (refer Section I: Subsection 1.3): • Existing environmental conditions; • The sequence of earthwork activities; • Topography;

- Climate;
- Soil Characteristics;
- The practicality of BMP installations; and
- Construction Schedule.

2.3 General Sequence of Works

2.3.1 Mark the phases and working zone to show the limit of active areas. Refer to SOPs for Control of Site Development on how to demarcate the site phases / working zone.

2.3.2 Conduct earthwork activities according to the phases.

2.3.3 Notify the relevant authorities of any changes to the earthwork phasing plan / sequence of the phasing.

2.3.4 Implementation of best management practices must be according to the submitted earthwork plan and sequence of works indicated.

3 Management of Erosion and Sedimentation

Earthwork activities lead to soil erosion, which degrades water quality by increasing turbidity levels and total suspended solids as well as sedimentation. Temporary drainage systems, as well as erosion and sediment control structures, shall be provided to control and provide effective retention and discharge of sediment runoff.

Target	Protection of water quality by managing the surface runoff, erosion, and sedimentation impacts.
Standard Operating Procedures	**3.1 Applicable Documents** Refer to documents, such as approved EIA, PMM, AEC, MD, EP, ESCP, mitigation maps, earthwork Schedule B (Land Ordinance Cap 68), earthwork by-law, etc. for the control measures to be implemented to mitigate erosion and sedimentation impacts. The control measures outlined in the above-mentioned documents shall be referred to and take precedent to the requirement / standard procedures outlined here when managing the impact of erosion and sedimentation due to the earthwork activities. **3.2 General Procedures** 3.2.1 Phased out active working area. 3.2.2 No direct discharge of surface runoff from the disturbed area into public drains or waterbodies. 3.2.3 No construction of surface runoff structures and sediment control measures in waterbodies. 3.2.4 Silt trap / sediment basin and temporary perimeter earth drain shall be constructed at a minimum of 20 m, or as specified in the report, away from the edge of the waterbodies.

	3.2.5	Where earthwork activities are to take place next to waterbodies, attempts should be made to maintain a vegetated buffer strip of sufficient width to trap sediment.
	3.2.6	Conduct earthworks at the targeted phase of the project site based on the earthworks schedule to reduce the period of exposed surfaces.
	3.2.7	Avoid conducting earthwork activities during rainy days.
	3.2.8	Temporary stabilisation period for exposed areas shall not exceed fourteen days after final formation level is reached on any portion of the site.
	3.2.9	Install soil stabilisation measures to protect exposed surface areas such as covering exposed surfaces area with temporary plastic sheets, geotextile mat, re-vegetating the surface area, backfill the areas, construct slope embankments, and applying road base.
	3.2.10	Conduct maintenance (sediment removal or de-siltation by excavation) on sediment control measures such as temporary earth drains, check dam, and sediment basin periodically with increasing frequency after each rain event.
	3.2.11	Plant cover crops on exposed surfaces such as *Mucuna bracteata, Brachiaria ruziziensis*, etc. or deep rooting plants to reduce soil erosion.
	3.2.12	Refer to SOPs contained in Slope Stabilisation if cover crops are not suitable due to slope surface type, such as rocky slopes.
	3.2.13	Refer to SOPs in Stockpiling of Earth Materials on the placement and management of stockpiles.

3.2.14 No disposal of earth, biomass waste, sediment, solid waste, sewage or scheduled waste into waterbodies.

3.3 General Sequence of Work

Construct runoff management and sediment control measures at the site prior to carrying out earthwork activities. Below are general sequences for installation of the mitigation measures:

i. Identify and mark sensitive receptors as well as site and / or buffer boundaries such as forested areas, mangroves, residential / settlement areas, and waterbodies based on SOPs outlined for Control of Site Development;

ii. Implement surface runoff, erosion and sediment control measures such as silt trap / sediment basin / sediment pond / sump and temporary perimeter earth drains prior to carrying out earthwork activities;

iii. Construct silt trap / sediment basin / sediment pond / sump at a location where practical and effective to control sediment runoff. The water from the silt trap / sediment basin / sediment pond / sump to be discharged through the prepared temporary discharge outlet (for example, earth drain or pipe culvert) that connects into existing drainage system or waterbodies; and

iv. Construct temporary earth drains according to the runoff flow direction (i.e., typically from higher to lower elevation) in order to ensure the surface runoff is diverted into stabilised area or into silt trap / sediment basin / sediment pond / sump before discharge.

Standard Operating Procedures	3.3.1 Flat Land Refer to Figure 2 to Figure 5 for the general sequence of works in installation of best management practices (BMPs) for earthwork activities at a typical site involving land clearings and sensitive receptors like rivers, mangroves, settlements, etc. 3.3.1.1 Sufficient buffer / setback to be provided to ensure receptors are not affected by the earthwork activities. 3.3.1.2 Silt trap / sediment basin / sediment pond / sump and temporary perimeter earth drains shall be constructed at a minimum of 20 m (or as specified in the report), away from the edge of the waterbodies.

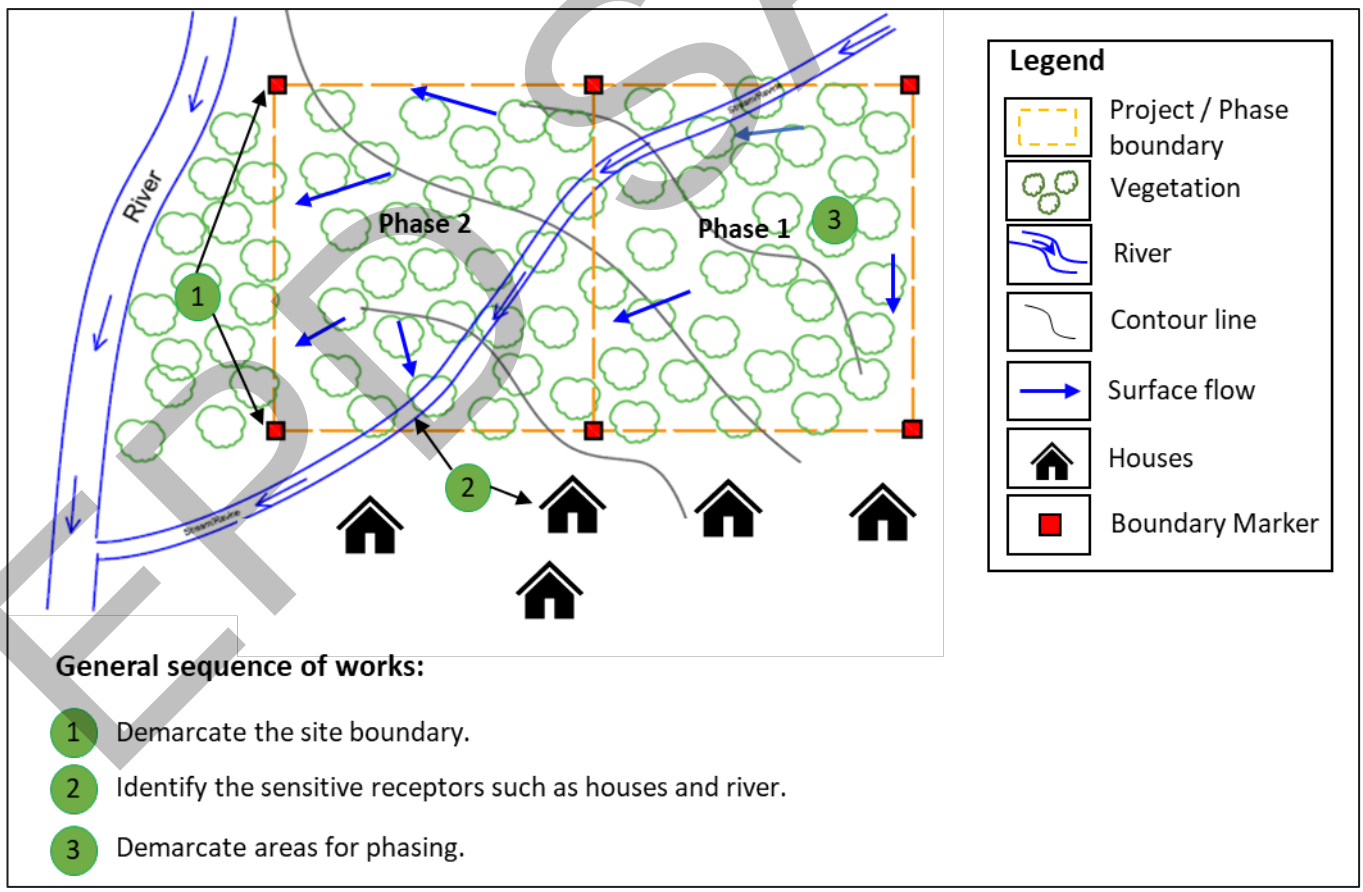


Figure 2 Illustration of demarcation of site boundary, phasing and identification of sensitive receptors.

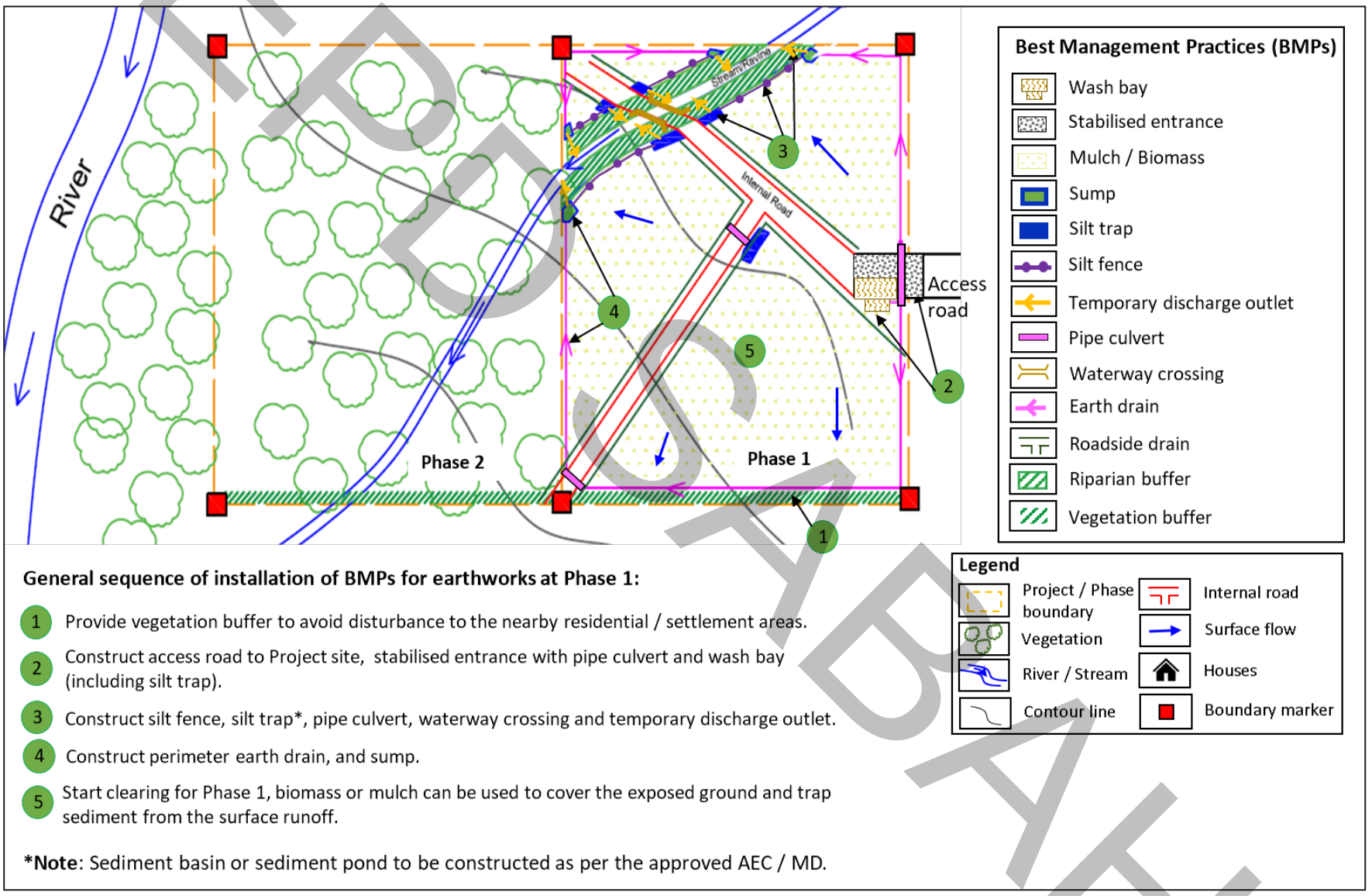


Figure 3 Illustration of best management practices for Phase 1.

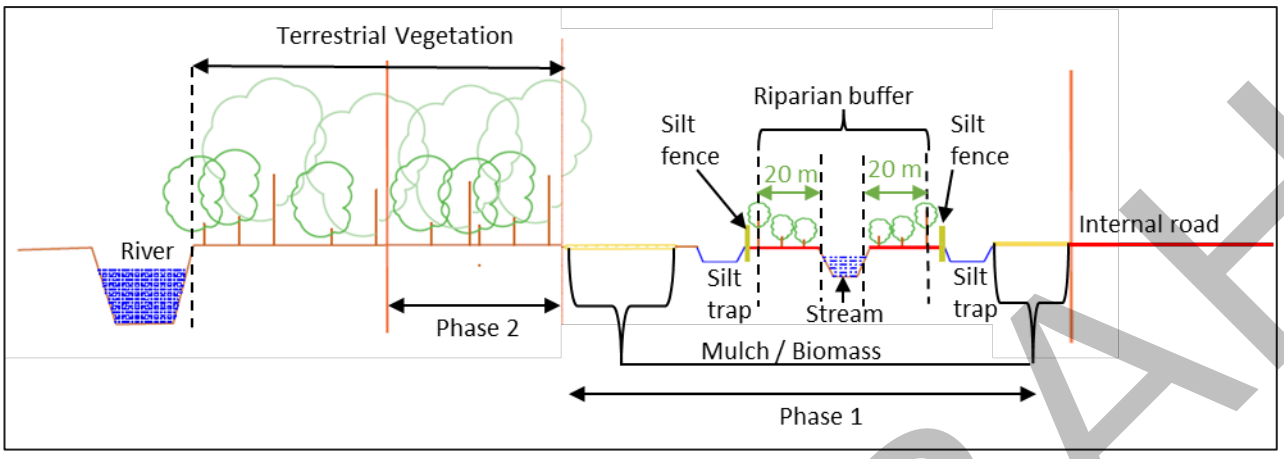


Figure 4 Illustration of the cross-section at stream area of Phase 1 layout.

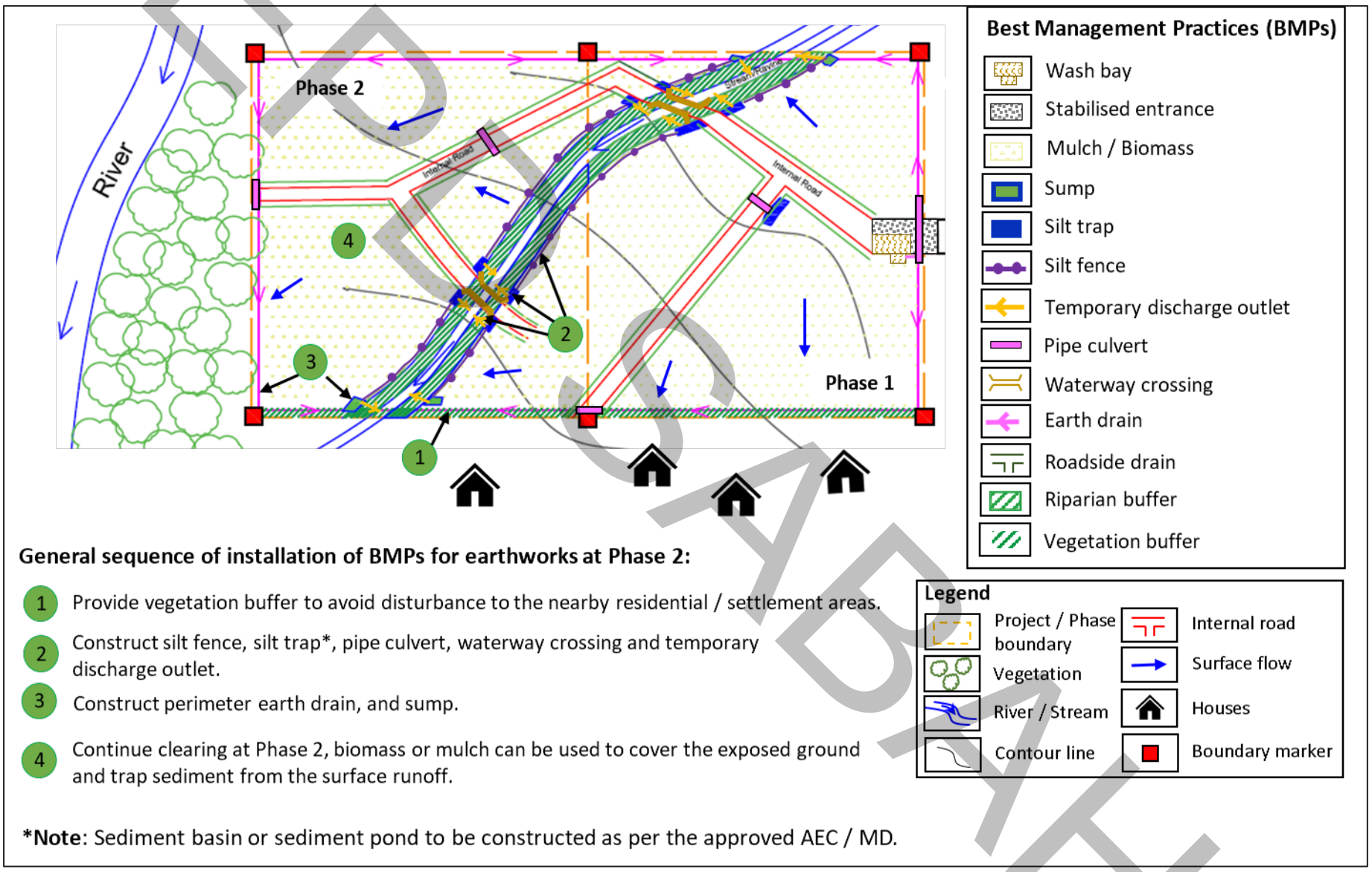


Figure 5 Illustration of best management practices for Phase 2.

Photo 6 Biomass or mulch can be applied on exposed soil ground to reduce erosion runoff at site.

Photo 7 Example of temporary perimeter earth drain constructed to divert runoff or channel water to silt trap / sediment basin / sediment pond / sump.

Standard Operating Procedures	3.3.2 Slope / Hilly Area Refer to Figure 6 to Figure 10 for the general sequence of works in installation of best management practices (BMPs) for earthwork activities at a slope site involving land clearing, cut and fill. 3.3.2.1 Sufficient buffer / setback to be provided to ensure receptors are not affected by the earthwork activities. 3.3.2.2 Provide sufficient setback (as specified in the design) from the edge of the slope when constructing the berm / cut off drain. 3.3.2.3 Temporary perimeter earth drain shall be constructed at the base / toe of the slope to channel the slope runoff to the sediment basin. 3.3.2.4 In case of landslide events or at critical areas, soil stabilisation BMPs can be implemented to obtain immediate results. The BMPs include active treatment systems, geogrid / geotextiles reinforcement, reinforced concrete retaining structure, reinforced fill structure, hydro-seeding, hydro-mulching, etc. 3.3.2.5 Refer to SOPs for Slope Stabilisation for more information on slope stabilisation measures.

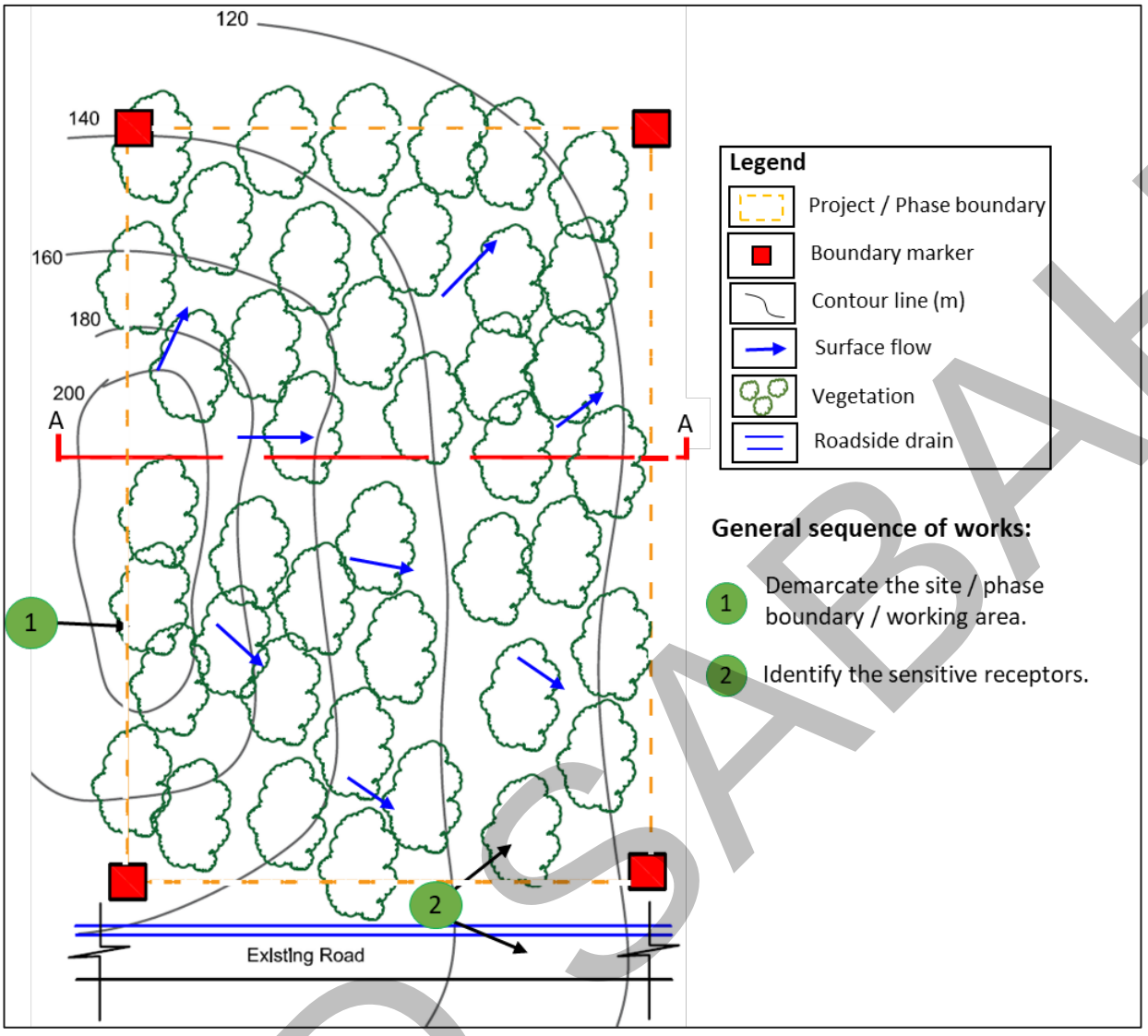
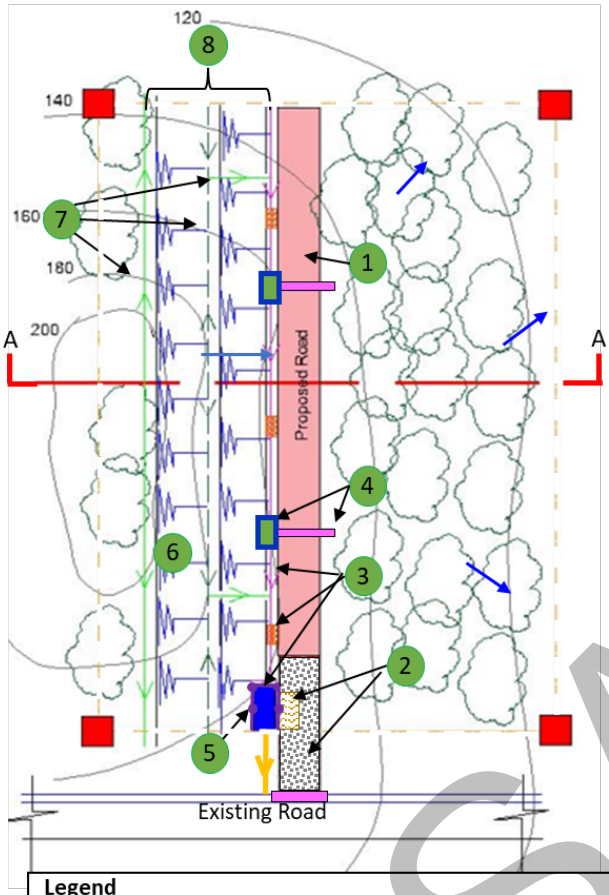


Figure 6 Illustration of demarcation of site boundary / phasing and sensitive receptors with slope or hilly topography earthwork site.

Example: Construction of proposed road development at slope area



Earthwork Activity

- Cut Slope
- Fill Slope

Best Management Practices (BMPs)

- Wash bay
- Stabilised entrance
- Sump
- Silt trap
- Silt fence
- Temporary discharge outlet
- Pipe culvert
- Check dam
- Earth drain
- Cut Off drain
- Berm drain
- Cascade drain
- Rolled erosion control blanket

Legend

- Project / Phase boundary
- Boundary marker
- Vegetation
- Roadside drain
- Contour line (m)
- Surface flow

General sequence of works for installation of BMPs for cut slope activities:

1. Tree cutting / vegetation removal at the cut slope area and along the proposed road alignment. Suitable biomass or mulch can be used to cover exposed ground temporarily to mitigate erosion impact.
2. Construct access road and stabilised entrance to site. Then, construct wash bay with silt trap.
3. Construct perimeter earth drain, silt trap* and check dam. Install geotextile and riprap at the end of the earth drain to filter the surface runoff before flowing into the silt trap.
4. Install pipe culvert together with the construction of sump. Additional measures to direct surface water to stabilised area by discharging through the pipe culvert.
5. Install silt fence around silt trap to control surface sediment runoff coming from the cut slope activities.
6. Start slope cutting and removed earth materials to be used as fill materials for the proposed road construction. Transfer earth materials to temporary stockpile (Refer to SOPs for Stockpile Management)
7. When slope cut has been completed, construct cut off drain, berm drain and cascade drain to direct the surface flow.
8. Stabilised cut slope with rolled erosion control blanket.

***Note**: Sediment basin or sediment pond to be constructed as per the approved AEC / MD.

Figure 7 Illustration of best management practices for cut slope activities.

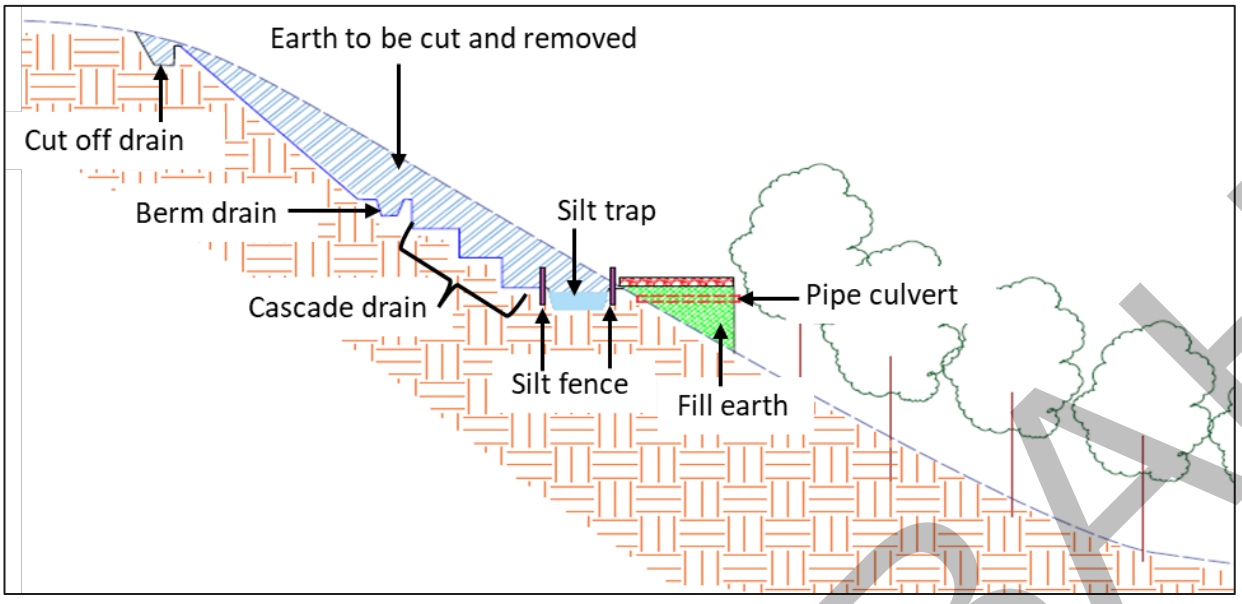
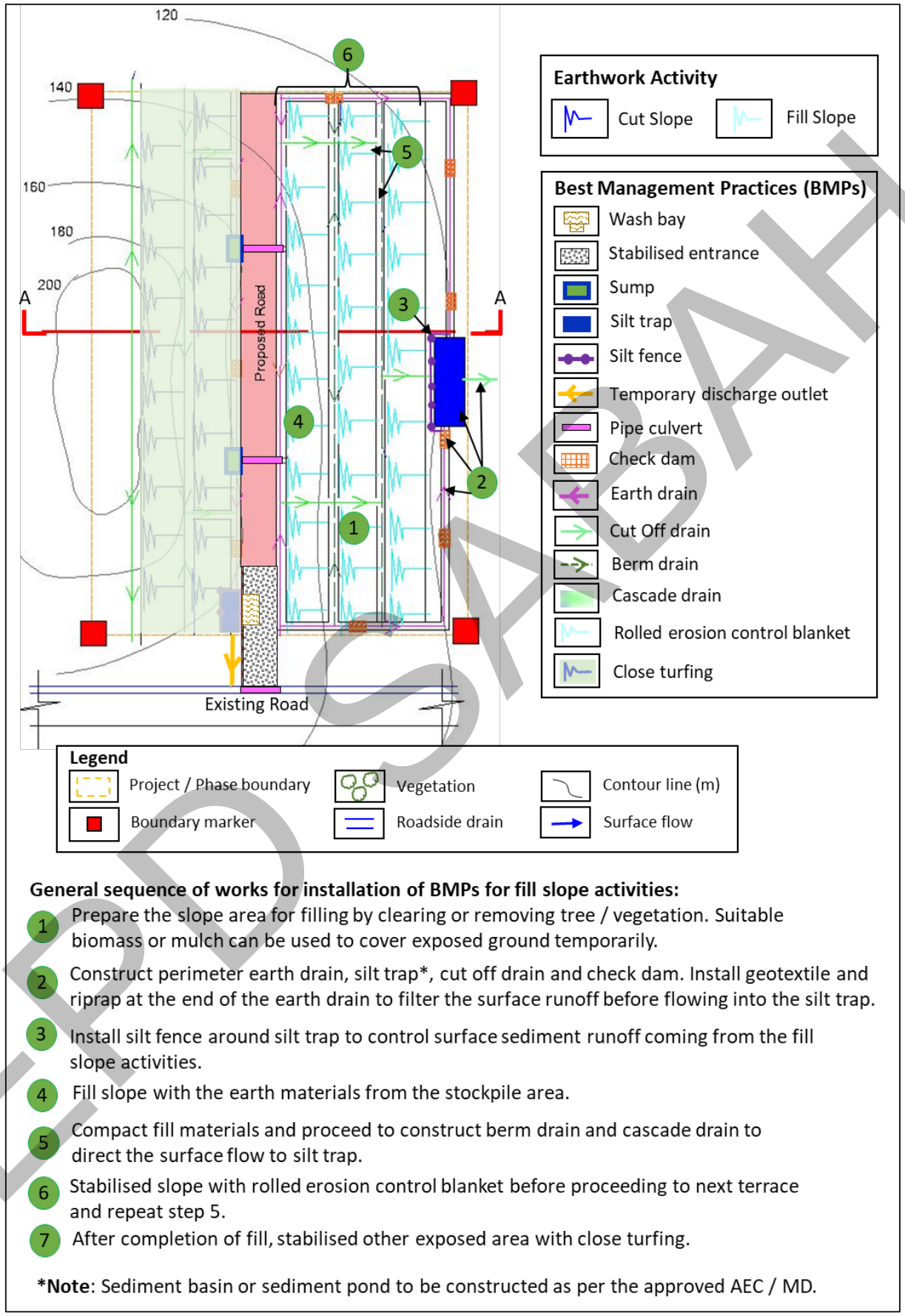


Figure 8 Illustration of cross section at A of the cut slope layout.



General sequence of works for installation of BMPs for fill slope activities:

1. Prepare the slope area for filling by clearing or removing tree / vegetation. Suitable biomass or mulch can be used to cover exposed ground temporarily.
2. Construct perimeter earth drain, silt trap*, cut off drain and check dam. Install geotextile and riprap at the end of the earth drain to filter the surface runoff before flowing into the silt trap.
3. Install silt fence around silt trap to control surface sediment runoff coming from the fill slope activities.
4. Fill slope with the earth materials from the stockpile area.
5. Compact fill materials and proceed to construct berm drain and cascade drain to direct the surface flow to silt trap.
6. Stabilised slope with rolled erosion control blanket before proceeding to next terrace and repeat step 5.
7. After completion of fill, stabilised other exposed area with close turfing.

***Note**: Sediment basin or sediment pond to be constructed as per the approved AEC / MD.

Figure 9 Illustration of best management practices for fill slope activities.

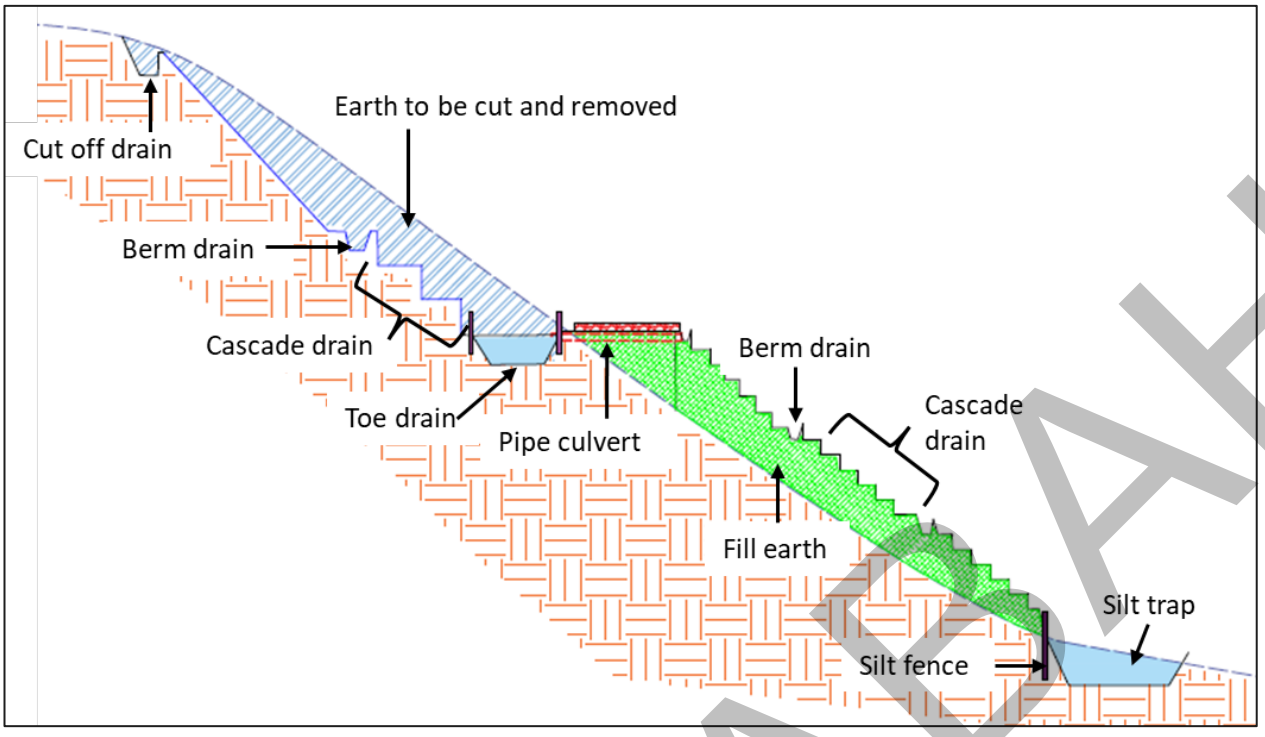


Figure 10 Illustration of cross section at A of the fill slope layout.

Photo 8 Example of silt fence installed at the edge of the slope.

Photo 9 Example of hydro-seeding practice carried out for soil stabilisation on slope.

Photo 10 Turfing practice on slope surface using vegetation mat

Photo 11 Example of usage of geotextile blanket to cover exposed slope and reduce runoff.

Photo 12 Example of plastic sheet covering exposed slopes and secured with wooden pegs.

Photo 13 Example of roll erosion control blanket (Organic mulch materials) anchored on the slope surface to control erosion and stabilise slope.

Standard Operating Procedures	3.3.3 River Refer to Figure 3 for the general sequence of works in installation of best management practices (BMPs) for earthwork activities at a typical site involving land clearings and sensitive receptors like rivers, mangroves, settlements, etc. 3.3.3.1 Setback for riparian buffer shall be applied for both sides of the riverbank. 3.3.3.2 A minimum of 20 m (or as stated in the report) setback of the riparian buffer to be provided.

Photo 14 Example of riparian buffer signage along a river (Source: EPD SOPs for Palm Oil Plantation).

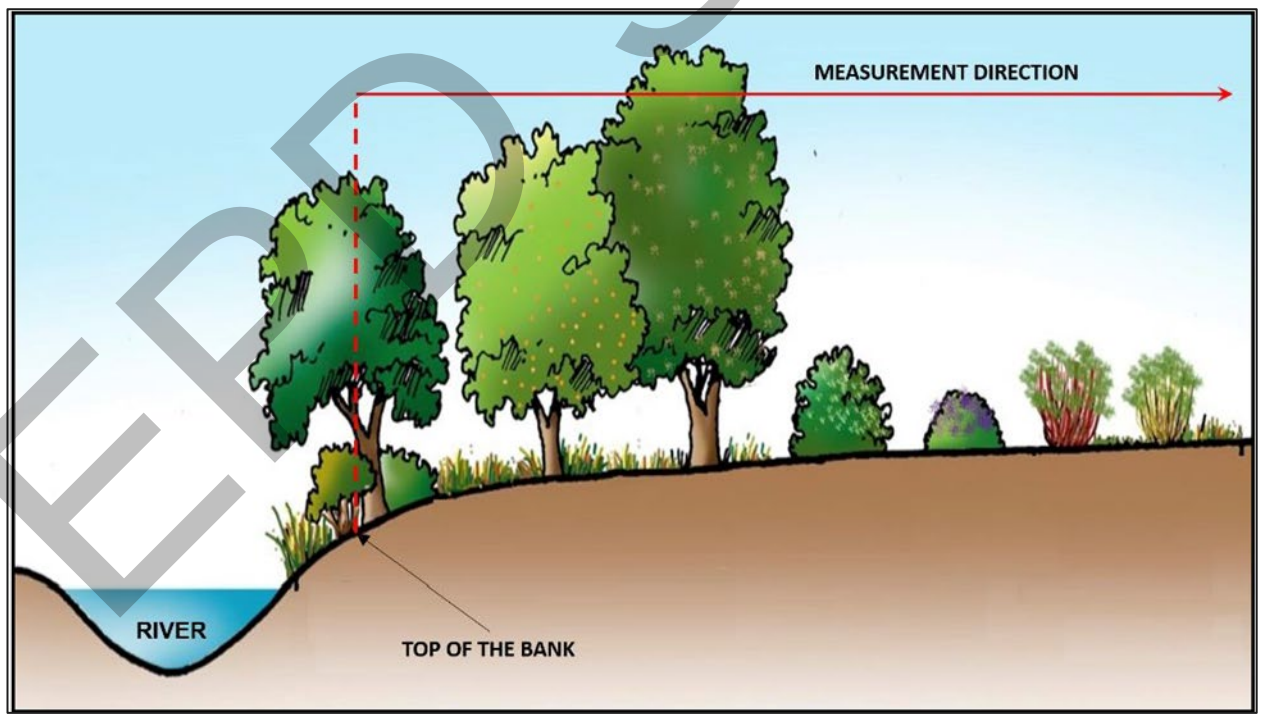


Figure 11 Width of the riparian buffer is measured in a horizontal distance from top of the river (Source: EPD SOPs for Palm Oil Plantation)

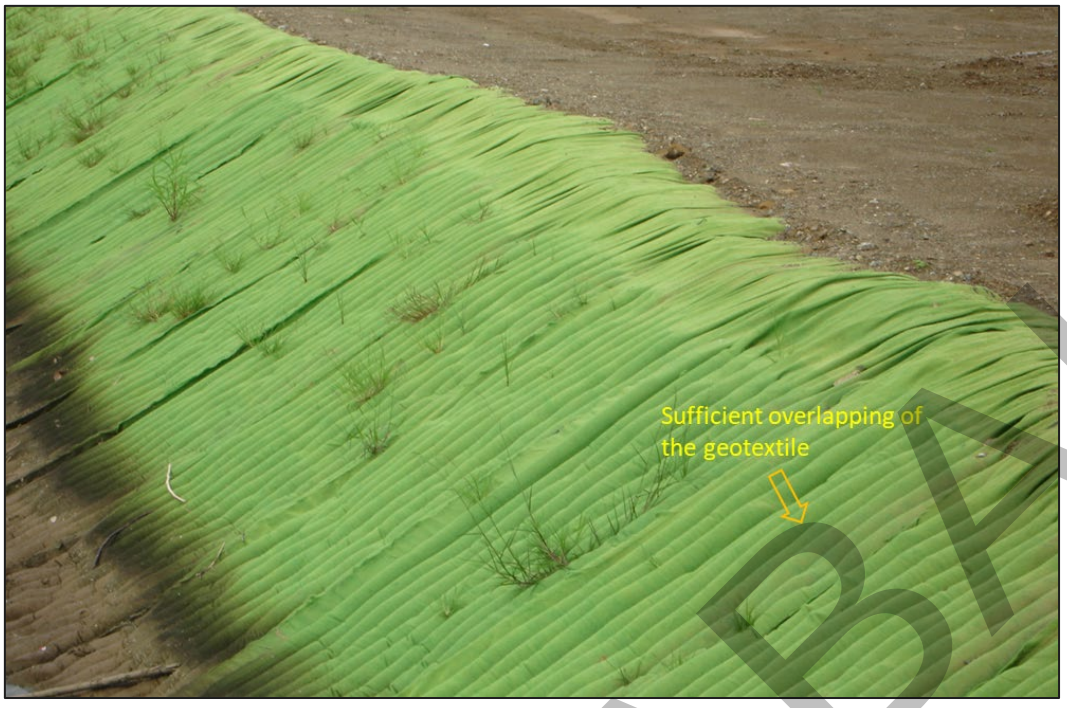


Photo 15 Example of application of geotextile blanket to stabilise riverbank.

Standard Operating Procedures	3.3.4 Sea Refer to Figure 13 to Figure 15 for the general sequence of works in installation of best management practices (BMPs) for earthwork activities adjacent to or at coastal areas. 3.3.4.1 Sufficient buffer / setback to be provided to ensure receptors are not affected by the earthwork activities. For example, for unprotected coastline or natural coastline, a coastal setback of 60 m from Mean High Water Line (MHWL) or as stated in the report shall be provided (see Figure 12).

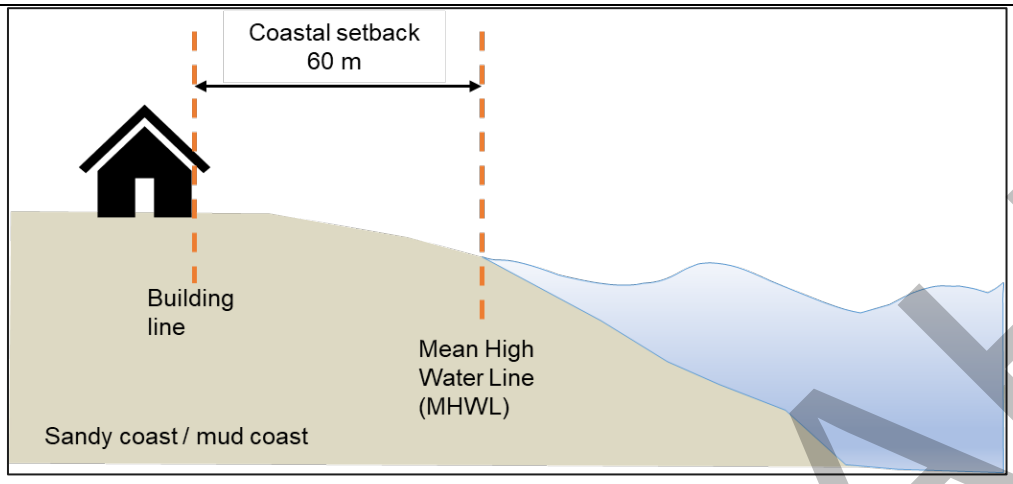


Figure 12 Illustration of coastal setback.

3.3.4.2 Silt curtains shall be installed in the shallow water environment (subjected to minimal wave action) along the site boundary adjacent to the coastline (see Photo 16).

Photo 16 Example of a silt curtain installed at shallow area long the site boundary.

3.3.4.3 The silt curtain shall be installed parallel to or at an angle to the direction of flow (see Photo 17).

Photo 17 Example of silt curtain application.

3.3.4.4 Perform inspections regularly and after every rainfall and heavy wind event to determine whether maintenance is required such as:

i. Check whether the silt curtain is twisted;

ii. Replace worn or broken anchor lines;

iii. Remove any solid waste / dirt caught on the silt curtain;

iv. Check the buoys / floatation devices; and

v. Check the efficiency of the silt curtain and reassess the location.

3.3.4.5 Silt curtain shall be removed during calm weather and low flows. It shall be removed by pulling it toward the construction area to minimise the release of trapped sediment. Both the top and bottom lines shall be pulled together like a parachute to pull the sediment ashore. Alternatively, the silt curtain may be furled and then removed using a boat.

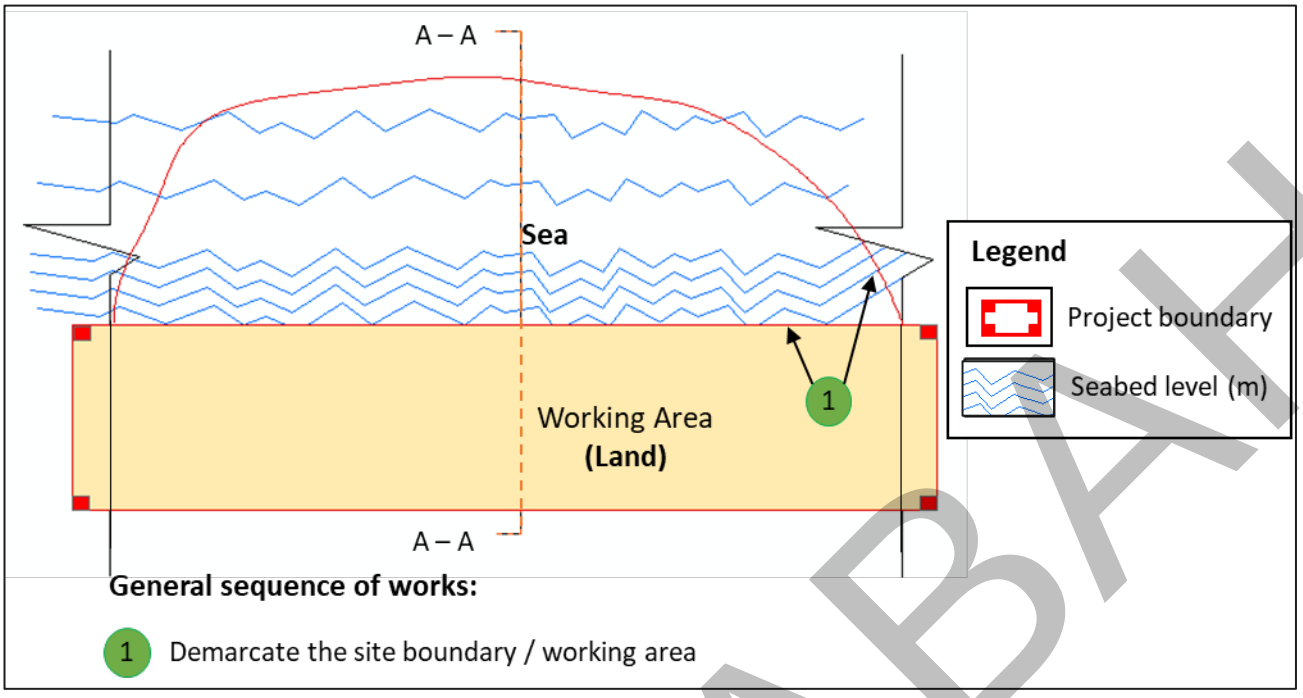


Figure 13 Illustration of demarcation of site boundary on land and at sea.

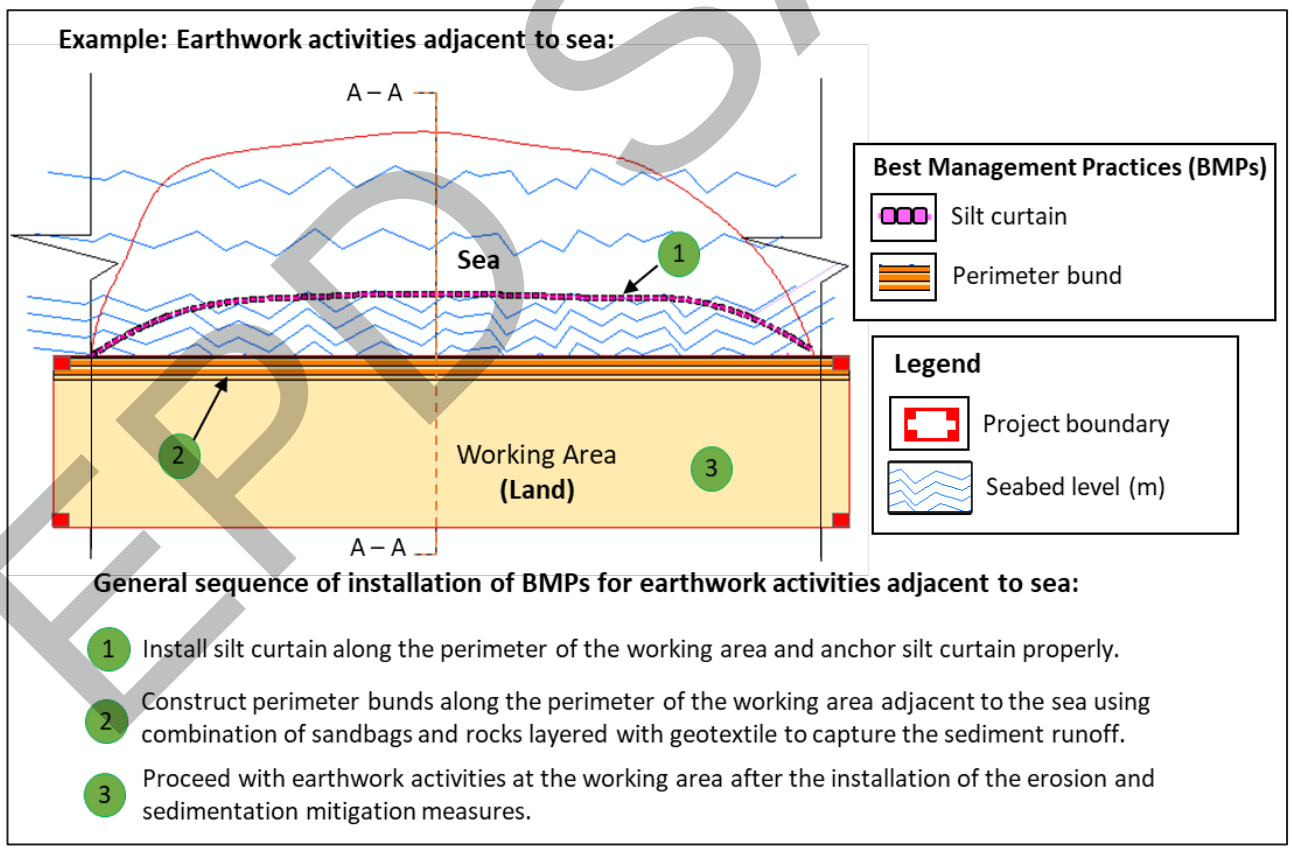


Figure 14 Illustration of typical best management practices for earthwork site nearby sea or coastal areas.

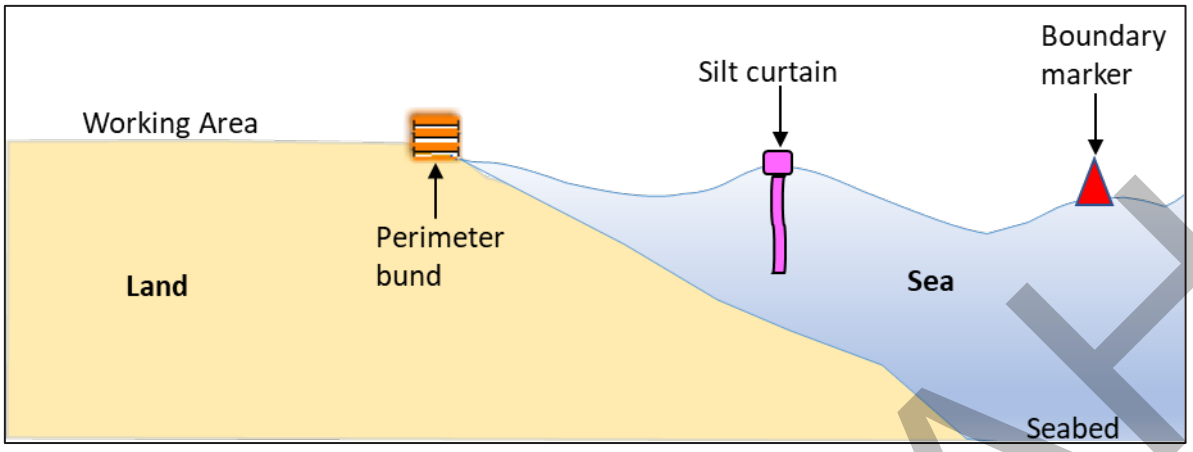


Figure 15 Illustration of cross-section A-A of the earthwork site adjacent to sea.

Photo 18 Example of a typical operating silt curtain.

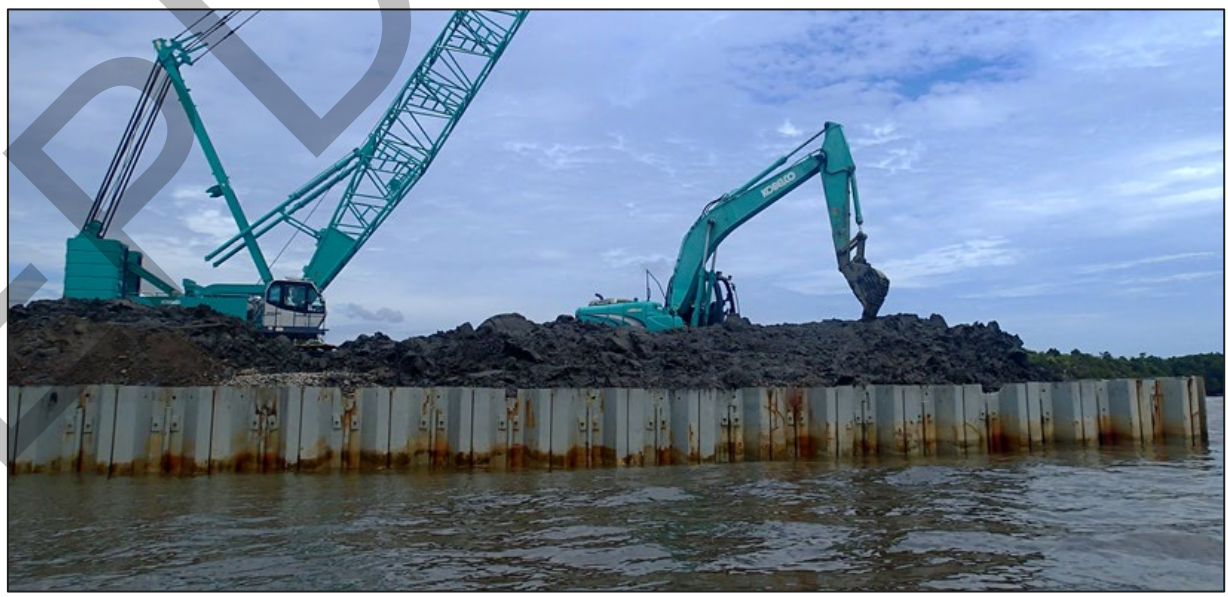


Photo 19 Example of the installation of sheet piles before earthwork activities.

Photo 20 Example of application of perimeter bund using combination of sandbags, rocks layered with geotextile before carrying out earthwork activities.

Standard Operating Procedures	Refer to Figure 16 to Figure 18 for the general sequence of works in installation of best management practices (BMPs) for earthwork activities at a typical site involving land clearings and sensitive receptors like wetlands / lakes, forests, mangroves, etc. 3.3.5 Wetland 3.3.5.1 Sufficient buffer / setback to be provided to ensure receptors are not affected by the earthwork activities. For example, i. For riparian buffer reserve / flora protection, a setback minimum of 20 m or as stated in the report shall be provided. ii. For wildlife protection, a buffer zone is to be provided as stated in the report.

	3.3.6 Lake 3.3.6.1 Buffer zone of a minimum of 20 m or as stated in the report shall be provided. 3.3.6.2 Maintain a vegetation strip around the lake.

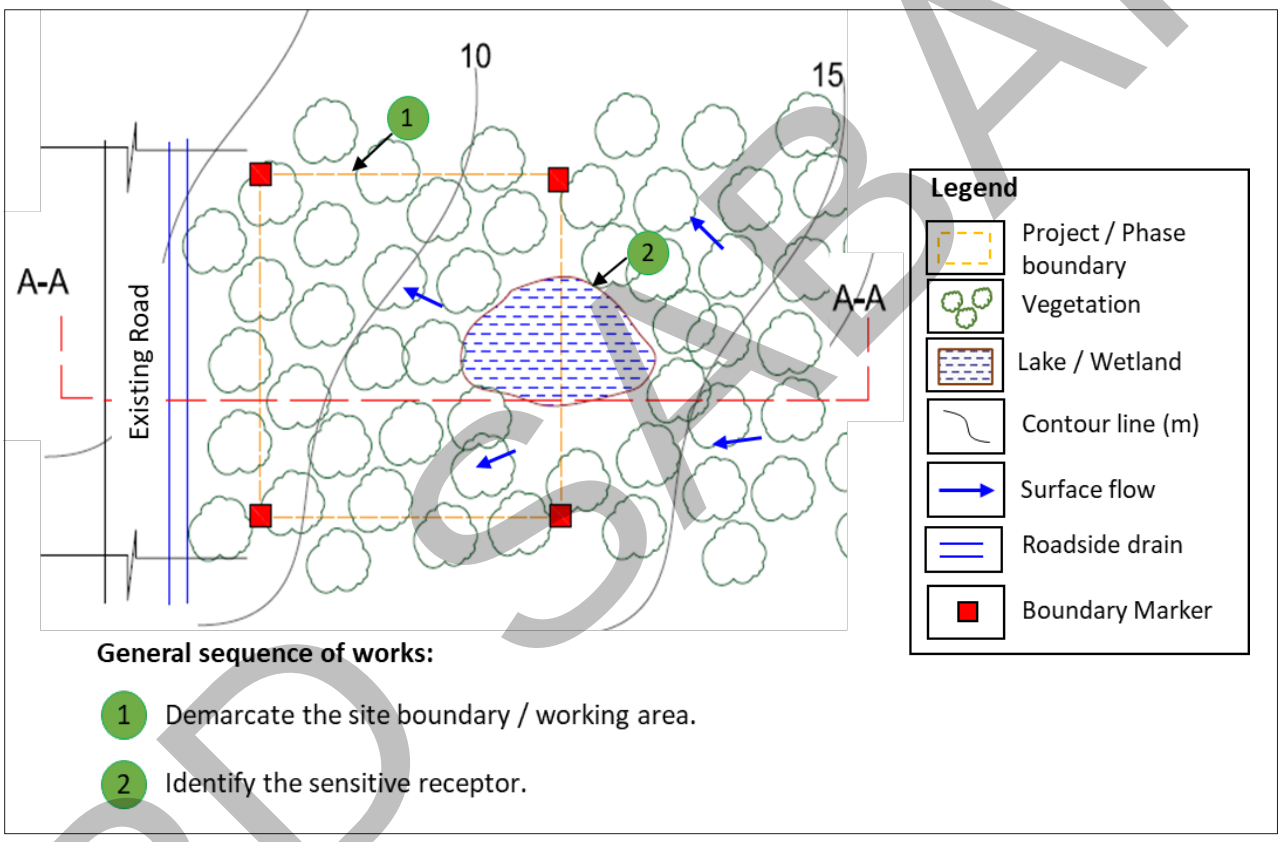


Figure 16 Illustration of a typical earthwork site with receptors such as a lake or wetland.

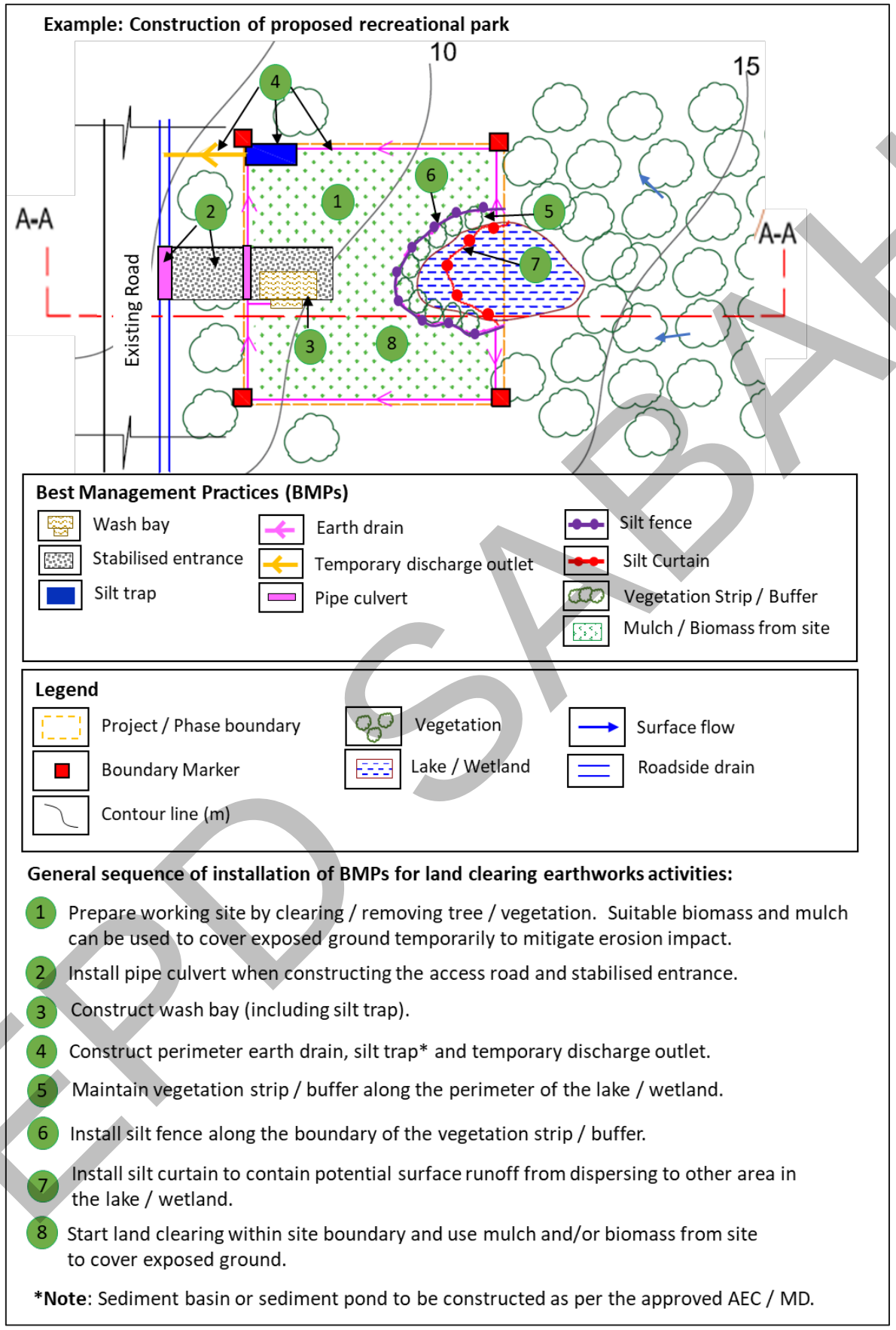


Figure 17 Illustration of best management practices with receptors such as lake.

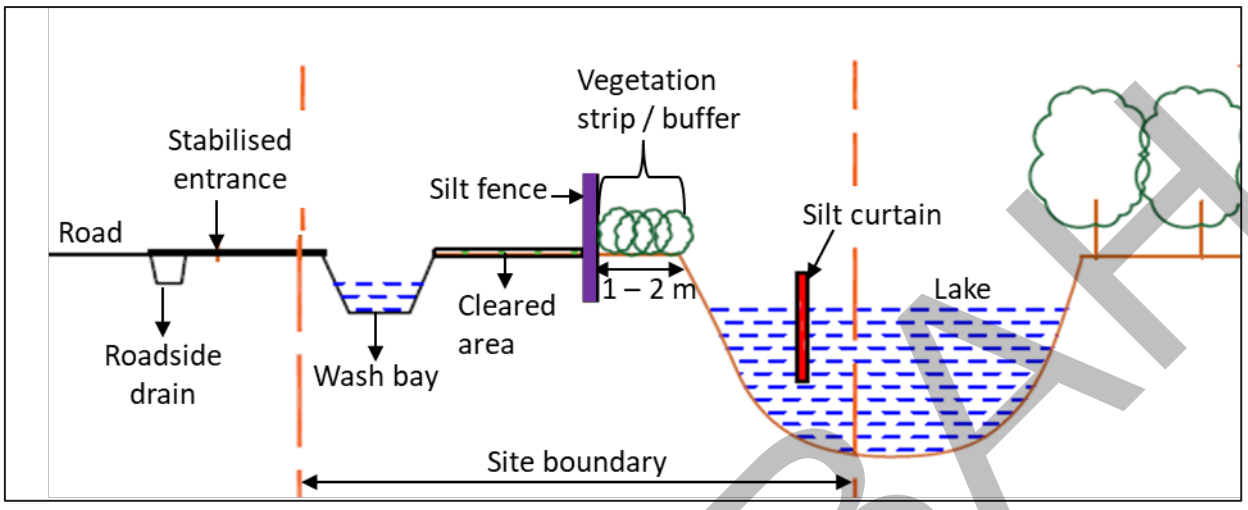


Figure 18 Illustration of the cross section at A-A of the Figure 17.

Photo 21 Example of a silt fence installed along the perimeter of a lake.

Photo 22 Example of riprap installed at the edge of a lake to trap sediment carried by surface flow.

4 Management and Disposal of Overburden / Excess Earth Materials

Soil erosion, water pollution, and dust dispersal are expected to occur at overburden disposal sites if earthwork control measures are not implemented properly. Impacts on traffic and transportation, such as damage to public roads, contamination of roads with dirt, road congestion, etc. can be anticipated during the transport of earth materials from the earthwork site to the overburden disposal area.

Target	To control overburden disposal / excess earth material activities to minimise air and water pollution, traffic, and transportation impacts, as well as impacts to the neighbouring land.
Standard Operating Procedures	**4.1 Applicable Documents** Refer to documents, such as approved EIA, PMM, AEC, MD, EP, ESCP, site plan, land development permits, earthwork Schedule B (Land Ordinance Cap 68), earthwork by-law license, mitigation maps, etc. for managing and disposal of overburden / excess earth materials. The mitigation measures outlined in the above-mentioned documents shall be referred to and take precedent to the requirement / standard procedures outlined here when carrying out disposal of overburden / excess earth materials for earthwork site to another site either within the working (or project) area or outside of the site. **4.2 General Procedures** 4.2.1 Construct surface runoff, erosion, and sediment control measures at the disposal site. Reference can be made to SOPs for Management of Erosion and Sedimentation for the installation of best management practices (BMPs) or typical mitigation measures implemented. Below are the general sequences of installation of BMPs:

	i. Identify and mark sensitive receptors as well as disposal site boundaries; ii. Implement the surface runoff, erosion, and sediment control measures such as sediment traps and temporary perimeter earth drains before carrying out site clearing, disposal activities and turfing to stabilise the exposed ground; iii. Construct silt trap / sediment basin / sediment pond / sump at a location where practical and effective to control sediment runoff. The water from the silt trap / sediment basin / sediment pond / sump to be discharged through the prepared temporary discharge outlet (for example, earth drain or pipe culvert) that connects into existing drainage system or waterbodies; and iv. Construct temporary earth drains according to the runoff flow direction to ensure the surface runoff is diverted into stabilised areas or sediment traps / basins before discharge. 4.2.2 No direct discharge of surface runoff from the disturbed area into public drains or waterbodies (e.g., sea, rivers, lakes, wetlands). 4.2.3 No construction of surface runoff structures and sediment control measures in waterbodies. 4.2.4 Retain or preserve existing vegetation around public drains or waterbodies. 4.2.5 Conduct site clearing and disposal activities within the active working area only. 4.2.6 No disposal of overburden into any waterbodies, over a slope or within the riparian buffer. 4.2.7 Erect suitable speed limit and safety signs at the disposal site entrance to notify public road users.

	4.2.8 Construct a wash bay with a silt trap / sediment basin / sediment pond / sump based on approved Drawing design at the entry / exit point of the site or at locations shown in the approved EIA / PMM and AEC / MD. 4.2.9 Clean tyres and undercarriage of transportation vehicles at the wash bay before leaving the disposal site to avoid formation of bulky deposited dirt and earth on public road surfaces. 4.2.10 Refer to requirements from the Local Authorities for transportation routes and / or Public Works Department for access involving road reserves (application of wayleave). 4.2.11 Obtain consent from private landowners if access through their land is required. 4.2.12 Cover transported overburden materials with canvas or tarpaulin sheets. 4.2.13 Avoid off-site transportation activities during peak traffic hours. **4.3 General Sequence of Works** 4.3.1 Lay down disposal materials in alternating layers of biomass and covered with excess fill materials. 4.3.2 Level and compact the area using compacting / levelling equipment to stabilise the ground surface. 4.3.3 Re-vegetate / turf the area to prevent erosion or movement of soils.

5 Stockpiling of Earth Materials

Part of the earthwork activities is stockpiling of excess / topsoil materials to be used at a later stage or overburden materials for disposal at a later stage. Unplanned stockpiling without implementation of control measures may cause water pollution to nearby waterbodies or drainage systems and airborne dust nuisance to neighbouring areas.

Target	To control stockpiling activities to minimise water pollution and airborne dust impacts.
Standard Operating Procedures	**5.1 Applicable Documents** Refer to documents, such as approved EIA, PMM, AEC, MD, EP, ESCP, mitigation maps, earthwork Schedule B (Land Ordinance Cap 68), earthwork by-law, etc. for the mitigation measures to be implemented for stockpiling of earth materials activities. The mitigation measures outlined in the above-mentioned documents shall be referred to and take precedent to the requirement / standard procedures outlined here when managing the impact due to stockpiling of earth materials. **5.2 General Procedures** 5.2.1 Implement surface runoff, erosion, and sediment control measures at the identified stockpiling location. Below are the general implementation sequences: i. Identify and mark stockpiling boundaries based on the SOPs for Control of Site Development; ii. Construct the surface runoff, erosion, and sediment control measures such as earth banks / drains, silt fences and others prior to carrying out site clearing and stockpiling activities; and iii. Construction of temporary earth drains must be according to the runoff flow direction in order to ensure the surface runoff is

diverted to stabilise the area or into sediment traps / basins before discharge.

5.2.2 No direct discharge of surface runoff from the disturbed area into public drains or waterbodies.

5.2.3 Stockpile location to be located away or a sufficient distance from the edge of slopes, drains, or waterbodies.

5.2.4 Adequate preventive measures, including the provision of proper and stable barricades or screens where necessary, shall be provided.

5.2.5 Conduct stockpiling activities by stages and avoid activities during rainy days.

5.2.6 Stockpile perimeter controls can be removed once all the materials from the stockpile have been removed.

5.3 General Sequence of Works

5.3.1 Stockpiles should be located at locations that will remain undisturbed for the longest period of time as the phases of the earthworks progress. Below are the general sequences in preparing a site for stockpiling (Refer Figure 19 and Figure 20):

i. Construct sediment control measures around the perimeter of the stockpile such as silt fences or sandbags;

ii. Sufficient buffer from the edge of the stockpile to the control measures to be provided for safety purposes;

iii. Construct earth banks to divert surface runoff from flowing through the stockpile; and

iv. Provide a stabilised access point to the stockpile.

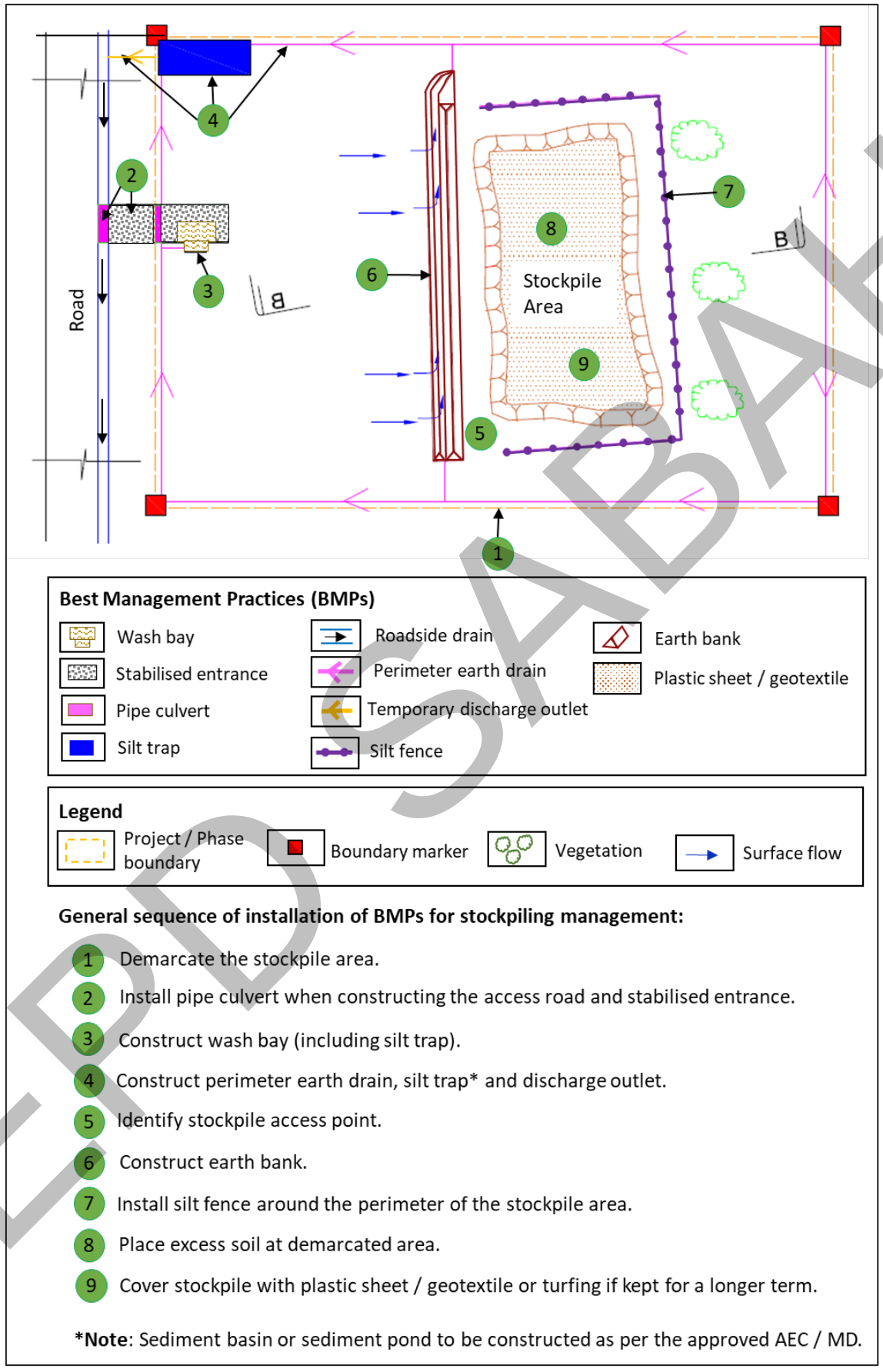


Figure 19 Illustration of stockpile management.

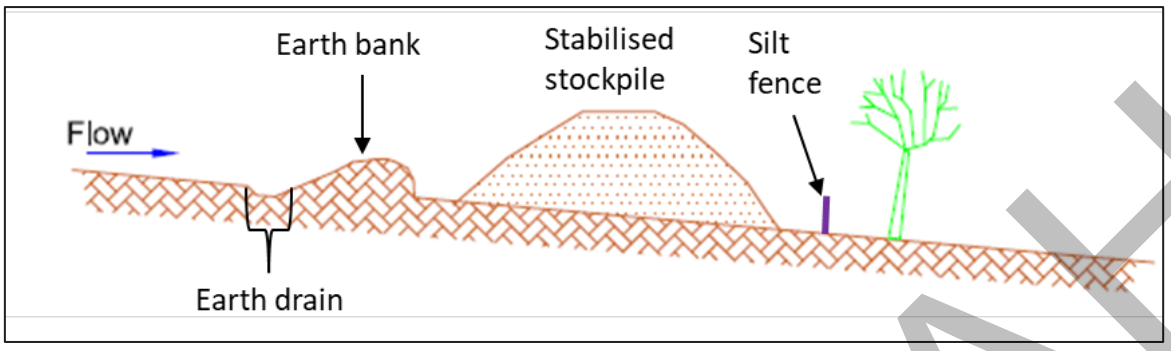


Figure 20 Illustration of cross section at B-B of the stockpile management.

6 Slope Stabilisation

Earthworks involving slope alteration by cutting or filling embankments can trigger slope failures or landslides within the site or to neighbouring areas, especially in the event of major rainfall and / or improper slope protection measures and slope drainage.

Target	Control of slope cutting activities to mitigate erosion and landslides.
Standard Operating Procedures	**6.1 Applicable Documents** Refer to documents (if any), such as approved EIA, PMM, AEC, MD, EP, ESCP, mitigation maps, earthwork Schedule B (Land Ordinance Cap 68), earthwork by-law, slope assessment study approved by relevant Local Authorities, etc. for the mitigation measures to be implemented for slope stabilisation activities. The mitigation measures outlined in the above-mentioned documents shall be referred to and take precedent to the requirement / standard procedures outlined here when implementing the slope stabilisation works. **6.2 General Procedures** 6.2.1 Refer to SOPs for Management of Erosion and Sedimentation for earthworks involving cut and fill at slope areas for the general sequences in the installation of best management practices (BMPs). Below are the general sequences of works: i. Identify and mark sensitive receptors / critical areas as well as the working area of the slope boundaries based on the buffer requirement; ii. Implement surface runoff, erosion, and sediment control measures such as silt trap / sediment basin / sediment pond / sump, temporary perimeter earth drains, earth banks or berm

drains at the toe of the slope before commencing cutting or filling works;

iii. Construct silt trap / sediment basin / sediment pond / sump at a location where practical and effective to control sediment runoff. The water from the silt trap / sediment basin / sediment pond / sump to be discharged through the prepared temporary discharge outlet (for example, earth drain or pipe culvert) that connects into existing drainage system or waterbodies; and

iv. Construct temporary earth drains and berm drains according to the surface runoff flow direction in order to divert the runoff to cascade drains that flow into stabilised areas or into silt trap / sediment basin / sediment pond / sump before discharge.

6.2.2 Commence slope cutting immediately after the area is cleared.

6.2.3 Conduct slope cutting in stages and in a controlled manner.

6.2.4 No stockpiling materials should be on slopes, slope crests or any probable locations susceptible to landslides or which endangers the public or adjacent properties.

6.2.5 Implement approved recommended slope stabilisation measures.

6.3 General Sequence of Works

6.3.1 Conduct slope cutting in stages and in a controlled manner. The berm width and height shall be based on the approved slope assessment study. Refer to approved construction methods outlined in the report. The general sequence of work for cut and fill slopes are:

	i. Implement erosion control measures such as temporary earth drains, temporary earth bunds, etc. prior to excavating / cutting; ii. Start slope benching activities to excavate / cut unsuitable materials. iii. After excavating / cutting / benching has been completed, start the filling of platforms and slopes from the lower level. Trim back to the final fill slope profile and stabilise the slope with re-vegetation activities such as close turfing. iv. Construct surface runoff measures such as toe drains at the toe of the slope. v. Continue to fill platforms and slopes of the upper level. Immediately compact the filled area and stabilise the slope with re-vegetation activities such as close turfing and construct surface runoff measures such as berm drains. 6.3.2 Minimise removal of existing vegetation to aid slope and soil zone stabilisation. 6.3.3 Apply roll erosion control blankets, plastic sheets or geotextile blankets / mats to cover the exposed slopes until actual turfing is carried out. 6.3.4 Cover plants to be established on the slopes of the platforms and walls of the terrace immediately after the start of earthworks. 6.3.5 Close turfing using grasses sourced from the site, as such species are more tolerant to the soil type of the area. Groundcover plants such as Blanket grass (*Axonopus compressus*), blue couch grass (*Digitaria didactyla*) and Manila

	grass (*Zoysia matrella*) may be used to protect the ground surface from rain splash and gully erosion. 6.3.6 Apply rock dissipater at the end point or at the toe end of the incomplete adjoining permanent drainage lines constructed along sloping areas. 6.3.7 For the monitoring of the slope stabilisation measures (if such requirement is stated in the approved report): i. Appoint a geotechnical engineer and professional geologist to jointly draw up the slope rehabilitation and stability monitoring plan (if such requirement is stated in the AEC / MD) even after the project has commenced. The general content of the slope rehabilitation and stability monitoring plan should include slope stability analysis, monitoring and rehabilitation plan. ii. Submit slope rehabilitation and stability monitoring plan to Department of Mineral and Geoscience for approval; and iii. Submit approved slope rehabilitation and stability monitoring plan to the EPD. 6.3.8 In addition, conduct the following steps for stabilised slopes: i. Refer to the slope maintenance programme and slope maintenance manual prepared by the Submitting Engineer; ii. Conduct visual inspection of all stabilisation structures. Record any defects in the stabilisation structures or any undeveloped slopes adjacent to the cut slope. These include special structures, such as drains, to ensure slopes are stable; iii. Install instruments, such as inclinometers and ground / building settlement markers, to monitor slope movement, if specified in the slope maintenance programme; and

	iv. If there are signs of slope movement on reinforced concrete stabilised structures, engage a geotechnical engineer and professional geologist to study the causes in detail, and take immediate action.

Photo 23 Soil stabilisation features using gabion structure to retain the soil.

Photo 24 Example of riprap slope protection after a landslide event.

Photo 25 Example of soil retention structure / reinforced concrete retaining walls using the soil nail method.

Photo 26 Example of retaining wall structure on hill slope.

Photo 27 Example of re-vegetation such as turfing and cascading drain measures to stabilise the slope.

Photo 28 Example of on-going construction of rock slope stabilisation protection (i.e., soil nail and netting method) to stabilise slope after landslide event.

7 Management and Extraction of Borrow Pit Area

Soil erosion, water pollution, dust dispersal and slope failure are expected to occur at borrow pits if no proper earthwork management and demarcation controls are implemented.

Impacts on traffic and transportation such as damage to public roads, contamination of roads with dirt, road congestion, etc. can be anticipated during transportation of earth materials from the borrow pit to the development site.

Target	Control of earth extraction activity at the borrow pits to control soil erosion, water pollution, dust dispersal, and slope failure as well as traffic and transportation impacts.
Standard Operating Procedures	**7.1 Applicable Documents** Refer to documents, such as approved EIA, PMM, AEC, MD, EP, ESCP, site plan, approved land development permits, earthwork Schedule B (Land Ordinance Cap 68), earthwork by-law, etc. The mitigation measures outlined in the above-mentioned documents shall be referred and take precedent to the standard procedures outlined here when establishing and carrying out earthwork activities at borrow pits for earth / soil extraction. **7.2 General Procedures** 7.2.1 Construct runoff management and sediment control measures such as temporary earth drains, silt fences, silt trap / sediment basin / sediment pond / sump, etc. at the borrow pit based on the specification, location and sequence of installation as listed in the approved documents. Refer to SOPs for Management of Erosion and Sediment and SOPs for Slope Stabilisation in the installation of best management practices (BMPs) to mitigate erosion impact at

	earthwork site. Below are the general sequences when establishing the borrow site: i. Mark the borrow pit and / or buffer boundaries based on the SOPs detailed in SOPs for Control of Site Development; ii. Construct temporary perimeter earth drains, silt trap / sediment basin / sediment pond / sump prior to carrying out extraction activities; and iii. Connect temporary earth drains to the silt trap / sediment basin / sediment pond / sump to divert all surface runoff into it. 7.2.2 Sediment traps / basins and temporary perimeter earth drains shall be constructed away from the edge of the waterbodies or drainage system. 7.2.3 No direct discharge of surface runoff from the disturbed area into public drains or waterbodies. 7.2.4 Conduct extraction activities by phases and avoid activities during rainy days. 7.2.5 Prohibit extraction of earth outside the borrow pit boundary. 7.2.6 Establish slope protection measures as stated in the report approved by the relevant Local Authorities. 7.2.7 Install suitable speed limit within the active working of the borrow pit area to ensure safe working condition. 7.2.8 Erect suitable speed limit and safety signs at the borrow pit entrance to notify public road users of incoming or outgoing transportation trucks.

	7.2.9	Construct a wash bay with a silt trap / sediment basin / sediment pond / sump based on the specification and location outlined in the approved plan.
	7.2.10	Clean tyres and undercarriage of transportation vehicles at the wash bay before leaving the borrow pit to avoid formation of bulky deposited dirt and earth on public road surfaces.
	7.2.11	Refer to requirements from the Local Authorities for transportation routes and / or Public Works Department for access involving road reserves (application of wayleave).
	7.2.12	Obtain consent from private landowners if access through their land is required.
	7.2.13	Cover transported earth materials with canvas or tarpaulin sheets.
	7.2.14	Avoid off-site transportation activities during peak traffic hours.

8 Management of Noise Level

It is expected that during the peak of earthwork activities, high noise levels will be generated. Increments of surrounding noise levels due to earthwork activities may cause nuisance and discomfort to the surrounding community. It is therefore crucial for the project proponent to take action to minimise noise level generated (to prevent any public conflicts from arising).

Target	Minimise noise generation from earthwork activities
Standard Operating Procedures	**8.1 Applicable Documents** Refer to documents, such as approved EIA, PMM, AEC, MD, EP, ESCP, mitigation maps, earthwork Schedule B (Land Ordinance Cap 68), earthwork by-law, etc. for the mitigation measures to be implemented to manage noise impacts. The mitigation measures outlined in the above-mentioned documents shall be referred to and take precedent to the requirement / standard procedures outlined here when managing the impact of noise pollution due to earthwork activities. **8.2 General Procedures** 8.2.1 Conduct earthwork activities within the approved time frame by the Local Authorities or as specified in the report. 8.2.2 Carry out maintenance on vehicles and machinery and keep maintenance records as evidence for submission to the authorities, if required. 8.2.3 Erect physical noise barriers at either: i. Along the boundary of the earthwork site; ii. At locations where high noise generation is expected; or

iii. At locations specified in the report.

8.2.4 The barrier height should be as specified in the report. Materials commonly used to erect the physical noise barrier are sheet metal panels (zinc hoarding). Other than that, composite panels can also be considered for constructing the noise barrier. Refer to Photo 29 to Photo 31 for examples of noise barriers.

8.2.5 Consider installing movable noise barriers when it is anticipated that high noise-emitting machinery such as excavation or drilling machines are used on-site.

Photo 29 Example of temporary noise barrier using zinc hoarding.

8.2.6 Install the movable noise barrier as close as possible to either the noise source or the receiver, with no gaps or openings at the barrier joints to minimise noise disturbance to adjacent land users. Refer to Photo 31 for example of a movable noise barrier.

Photo 30 Example of temporary noise barrier using composite panels (Source: Guidelines for Environmental Noise Limits and Control, Third Edition, 2019 (p. 103), DOE)

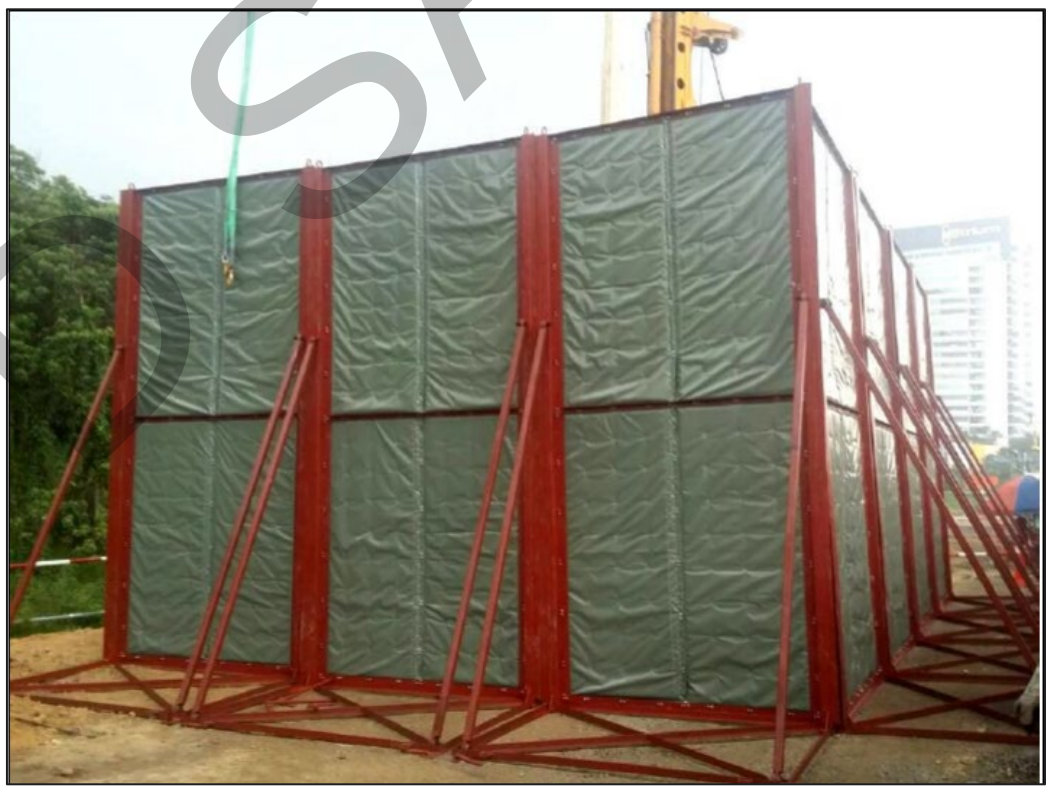


Photo 31 Example of movable noise barrier used to mitigate noise at source (Source: Guidelines for Environmental Noise Limits and Control, Third Edition, 2019 (p. 104), DOE)

9 Management of Air Quality

Airborne dust generated during earthwork activities may cause nuisance and discomfort to the surrounding community. It potentially affects respiratory systems, visual, and aesthetic factors due to the settling of dust on the surface of structures. Proper measures should be taken to minimise airborne dust generation.

Target	Minimise generation or release of airborne dust to the surrounding community.
Standard Operating Procedures	**9.1 Applicable Documents** Refer to documents, such as approved EIA, PMM, AEC, MD, EP, ESCP, mitigation maps, earthwork Schedule B (Land Ordinance Cap 68), earthwork by-law, etc. for the mitigation measures to be implemented to manage air quality impacts. The mitigation measures outlined in the above-mentioned documents shall be referred to and take precedent to the requirement / standard procedures outlined here when managing the impact of airborne dust due to earthwork activities. **9.2 General Procedures** 9.2.1 No “open burning” activities on-site. 9.2.2 Maintain original vegetation cover at non-working areas instead of clearing the entire site to minimise exposed soil surfaces. 9.2.3 Restrict public access to the site to limit movement of vehicles within the site thus reducing generation of airborne dust. 9.2.4 Reduce speed limit within working site to control generation of airborne dust from vehicle movement on exposed ground. 9.2.5 Erect speed limit signages at easily visible locations within the site to remind workers of the speed limits.

	9.2.6 Stabilise access roads and / or frequently travelled paths within the working site (see Photo 32).  Photo 32 Example of stabilisation of a frequently used route within the working site. 9.2.7 Access roads preferably to be built away from the existing waterbodies. Access roads to be paved (for a minimum distance of 10 m or as specified in the report) from where these access roads join existing roads. The construction stabilisation access can be made from aggregates, asphaltic concrete and concrete based on longevity, required performance and site condition (see Photo 33).

Photo 33 Example of stabilised access road using asphalt concrete.

9.2.8 Unpaved roads shall be sprayed with water to reduce dust pollution during dry periods.

9.2.9 Implement water storage and water spraying measures such as water browser trucks, handheld hoses, or sprinklers at site.

9.2.10 Conduct water spraying activities on dry and exposed soil areas (such as within working site, along the haul / access roads, existing roads and nearby settlement zone or other affected areas) a minimum three times a day especially during dry / hot and windy weather and with less frequency during rainy season.

9.2.11 A vehicle carrying a water tank using a sprinkler system is preferable to avoid over spraying to the extent that sediment-laden water is formed (see Photo 34).

Photo 34 Example of water tanker with sprinkler system to dampen the road access.

9.2.12 Ensure all construction vehicles drive through the wash bay whenever entering or exiting the working site (see Photo 35). Alternatively, hose down the tyres (or wheel wash) of the vehicles at the wash bay to prevent sediments from being transported out from the working site. A wheel wash at the exit point from the temporary access road manages the transportation of mud onto roads where it can be hazardous to other road users, pollute water ways and generate dust. The overflow from the wheel wash will be directed into silt trap / sediment basin / sediment pond / sump.

Photo 35 Example of wash bay at the entrance of the construction site.

9.2.13 Conduct street cleaning either by sweeping or using machinery to collect and remove sediments that have been transported out from the perimeter of the working site either through vehicle tracks or deposited runoff, at public or private roads especially at ingress and egress points.

9.2.14 Cover all transportation carrying loads with canvas or tarpaulin sheets.

10 Waste Management

Waste generated from earthwork activities can be categorised into the following:

- Biomass waste such as trees, stumps, logs, bushes, undergrowth, long grasses, crops, and vegetation;
- Solid and domestic waste such as leftover food for site workers, excess soil, construction debris (demolished concrete structures, terraces, ditches), etc.; and
- Scheduled waste such as contaminated soil, construction debris contaminated with chemicals, mineral oil or scheduled wastes such as rags, plastics, papers or filters, containers, bags or equipment, etc.

Improper waste management may lead to deterioration of water quality and potential risks of pest infestation and disease transmission to site workers as well as to the surrounding community.

Target	• Proper management of solid and biomass waste. • Ensure good housekeeping within the earthwork site. • Protect the water quality of nearby water bodies.
Standard Operating Procedures	**10.1 Applicable Documents** Refer to documents (if any), such as approved EIA, PMM, AEC, MD, EP, ESCP, mitigation maps, earthwork Schedule B (Land Ordinance Cap 68), earthwork by-law, local waste collectors, etc. for the mitigation measures to be implemented to manage waste generated from earthwork activities. The mitigation measures outlined in the above-mentioned documents shall be referred to and take precedent to the requirement / standard procedures outlined here.

10.2 General Procedures

10.2.1 Prohibit burning and indiscriminate disposal of waste.

10.2.2 Practice 4R concept (Reduce, Reuse, Recycle and Recover).

10.2.3 Provide adequate waste collection centres, and several strategic designated areas around the site for collecting waste.

10.2.4 Locate all waste collection facilities away from and if possible, downstream, of all critical and sensitive areas and traffic.

10.2.5 Ensure waste collection centres are covered or sheltered to avoid generation of leachate and prevent wind-blown waste.

10.2.6 Prepare and label all collection bins to ensure waste is placed in the correct bins for easy collection and transfer to the centralised collection centre (see Photo 36).

Photo 36 Example of labelled waste bins provided at a construction site.

10.2.7 Locate the centralised waste collection centre at an area that can be easily accessible by waste collection / haul trucks.

10.2.8 Appoint a contractor licensed by Local Authorities to collect waste generated from the earthwork activities and dispose of it at an approved disposal ground.

10.3 General Sequence of Works

10.3.1 Biomass Waste

10.3.1.1 Biomass waste can be reduced by reusing it as mulch on exposed ground at project site.

10.3.1.2 Bio-degradable waste such as organic waste can be reduced by composting. Refer to Ministry of Local Government and Housing Sabah for suitable composting methods.

10.3.2 Solid and Domestic Waste

10.3.2.1 Refer to the general procedures set by the Local Authorities for the disposal of domestic and construction debris waste.

10.3.2.2 Refer to SOPs for Management and Disposal of Overburden / Excess Earth Materials for the disposal of unsuitable earth materials.

	10.3.3 Scheduled Waste Refer to the requirements of Department of Environment (DOE) on handling and management of scheduled waste. 10.3.3.1 Construct or prepare a containment wall or embankment constructed with concrete or prefabricated metal that fences around any petroleum base products with the containment capacity of 110 % the capacity of the said vessel or tank. 10.3.3.2 Construct a scheduled waste storage facility to store hazardous waste such as petroleum products including fuel, hydraulic fluid or any liquid, used oil and grease, etc. 10.3.3.3 The waste storage facility should have a firm concrete base or impermeable material with concrete lined bund walls raised up to at least 0.5 m high to allow for retention of any spilled material and prevent seepage into the ground. 10.3.3.4 Soil contaminated by fuel and oil must not be washed with water. The contaminated soil should be removed and stored in waste storage drums and labelled accordingly. 10.3.3.5 Containment walls and scheduled waste storage can be built permanently or temporarily to act as a backup for primary containment vessels or for storage purposes. 10.3.3.6 Inspect the storage facilities weekly for any leakages or damage and keep a logbook for reference.

11 Management of Traffic and Transportation

Increased traffic volume is expected during earthwork activities. The presence of heavy and slow-moving vehicles may obstruct the movement of other vehicles plying public roads especially during disposal of overburden or excess soil at another location outside the earthwork site.

Target	Ensure traffic and transportation activities are carried out in a safe and efficient way.
Standard Operating Procedures	**11.1 Applicable Documents** Refer to documents (if any), such as approved EIA, PMM, AEC, MD, EP, ESCP, mitigation maps, earthwork Schedule B (Land Ordinance Cap 68), earthwork by-law, traffic management plan, traffic impact assessment report, etc. for the mitigation measures to be implemented to manage traffic and transportation impacts. The mitigation measures outlined in the above-mentioned documents shall be referred to and take precedent to the requirement / standard procedures outlined here when managing the impact of traffic and transportation due to the earthwork activities. **11.2 General Procedures** 11.2.1 Land 11.2.1.1 Impose speed limit and safety signs at the site entrance and within site to notify road users (see Photo 37 and Photo 38).

Photo 37 Example of speed limit sign installed at construction site.

Photo 38 Example of safety signs.

11.2.1.2 Strictly obey speed limits and other road traffic regulations.

11.2.1.3 Stabilise and pave all entrance / exit roads to the site for a minimum distance of 10 m or as specified in the report from where these access roads join existing paved or public roads.

11.2.1.4 Construct a wash bay with a silt trap / sediment basin / sediment pond / sump based on approved Drawing design at the location shown in the approved report.

11.2.1.5 Conduct periodic maintenance on the silt trap / sediment basin / sediment pond / sump. Prohibit disposal of sediment removed from the silt trap / sediment basin / sediment pond / sump into drainage or waterbodies.

11.2.1.6 Refer to requirements from the Local Authorities for transportation routes and / or Public Works Department for access involving road reserves (application of wayleave).

11.2.1.7 Obtain consent from private landowners if access is required across their land.

11.2.1.8 Clean tyres and undercarriage of transportation vehicles at the wash bay before leaving the earthwork site to avoid formation of bulky deposited dirt and earth on public road surfaces.

11.2.1.9 Remove sediment or mud deposited on public roads at the end of the same workday by sweeping, shovelling or hosing (see Photo 39).

11.2.1.10 Avoid off-site transportation activities during peak traffic hours.

Photo 39 Example of cleaning tyres and public roads.

	11.2.2 Sea 11.2.2.1 Install and use navigation lighting on vessels. 11.2.2.2 Install navigational lights and beacons at the marine working area. 11.2.2.3 Strictly adhere to the marine traffic risk assessment report as approved by Sabah Ports and Harbour Department in relation to working vessels / boats / barges travel route or marine activities. 11.2.2.4 Comply with navigation restrictions for all working vessels that are enforced by relevant authorities. 11.2.2.5 Refer to Sabah Ports and Harbour Department regarding the navigation and allowable anchorage area.

12 Closure and Abandonment

Visual and aesthetic values are subjective to individual receptors and relative to its surrounding landscape. In general, the exposed area due to abandonment would likely increase erosion and sedimentation due to surface runoff. Re-vegetation and site rehabilitation closest to its original conditions shall be carried out on the abandoned land in the event of possible site abandonment.

Target	• All exposed area due to abandonment to be vegetated as soon as possible. • Proceed immediately to the next phase of construction after the closure / completion of earthwork to reduce the duration of the exposed ground.
Standard Operating Procedures	**12.1 Applicable Documents** Refer to documents (if any), such as approved EIA, PMM, AEC, MD, EP, ESCP, mitigation maps, earthwork Schedule B (Land Ordinance Cap 68), earthwork by-law, etc. for the actions to be taken at the time of closure and / or abandonment of the earthwork site. The mitigation measures outlined in the above-mentioned documents shall be referred to and take precedent to the requirement / standard procedures outlined here. Alternately, implement the best management practices to minimise erosion and sedimentation impact due to exposed grounds. **12.2 General Procedures** 12.2.1 Remove all construction parts or structures used during earthwork activities which are not degradable, and which pose environmental risks.

	12.2.2	Clear all debris originating from earthwork activities that may block waterbodies such as overburden or unsuitable materials.
	12.2.3	Unclog all drainage that may cause water ponding or blockage.
	12.2.4	Fill up or rehabilitate unused sediment basin.
	12.2.5	Rehabilitate all exposed areas or cut slopes, which may cause further erosion or landslides, by re-vegetating these areas with cover crops native to the surrounding area.
	12.2.6	All procedures to be completed as soon as possible (or as specified by the relevant authorities).
	12.2.7	Submit a notification of closure or abandonment of earthwork activities as required by the relevant authorities.

13 Reference

Environmental Impact Assessment (EIA) Guidelines for Earthwork Activities, 2012, by Environment Protection Department (EPD), Sabah

Environmental Impact Assessment (EIA) Guidelines for Construction on Hill Slopes. 2012 by Environment Protection Department (EPD), Sabah

Guidelines on Land Disturbing Pollution Prevention and Mitigation Measures (LD-P2M2), 2017, Department of Environment (DOE), Malaysia

Standard Specification for Road Works Section 2: Earthworks, 2013, by Public Works Department (PWD), Malaysia

Standard Specification for Building Works, 2014, by Public Works Department (PWD), Malaysia

Guidelines for Slope Design, 2010, by Public Works Department (PWD), Malaysia

Hillsite Development Guidelines from Dewan Bandaraya Kota Kinabalu

Garis Panduan Perancangan Pembangunan Di Kawasan Bukit & Tanah Tinggi Negeri Selangor, 2010, by Kerajaan Negeri Selangor

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Safety Guidelines for Hill Site Development 2nd Edition, 2020 by State Government and Local Authority of Penang

Guideline for Erosion and Sediment Control in Malaysia, 2010, by Department of Irrigation and Drainage (DID) Malaysia

Guidelines on Erosion Control for Development Projects in The Coastal Zone, 1997, by Department of Irrigation and Drainage (DID) Malaysia

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Garis Panduan Pembangunan Pertanian Di Tanah Bercerun, 2020, by Department of Agriculture (DOA), Malaysia

Dealing with Construction Permit Submission Manual, 2017, by Kota Kinabalu City Hall (DBKK)

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ENVIRONMENT PROTECTION DEPARTMENT

MINISTRY OF TOURISM, CULTURE AND ENVIRONMENT, SABAH