ENVIRONMENTAL BEST MANAGEMENT PRACTICES

GRID DEVELOPMENT'S PROJECT SITE

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Disclaimer

This handbook is the outcome from collaboration between TNB and DOE. The information provided in this book is for informational purposes only and intended for reference and guidance of all stakeholders especially contractors that involved in Grid Development. This handbook cannot be used or referred to by any other party for other purposes without prior consent from TNB and DOE. Information contained here is protected and confidential.

Acknowledgement

The completion of Environmental Best Management Practices Grid Development،s Project Site handbook would not have been possible to be accomplished without the support of DOE, TNB, and TNBR Team.

We would like to express our deepest gratitude for their commitment and hard work towards the successful completion of this handbook. The team members are as following:

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Lastly, to the people whose names are not mentioned above for their valuable support, contributions, and ideas in preparing the contents of this handbook.

Contents


1
Introduction


2
National Policies
& Environmental Laws


3
Environmental Aspects
& Impacts


4
Environmental Mitigation
Measures For Project Sites


5
Summary


6
References

Table of Contents

Foreword from Chief Grid Officer Tenaga Nasional Berhad

Tenaga Nasional Berhad fully recognizes that economic growth, sustainable development, and quality of life goes hand in hand. Our current daily activities might cause an inevitable impact to future of environmental sociology. Thus, to protect the environment, we are committed to continually improve our environmental management performance whilst responsibly providing safe, efficient, and reliable supply of electricity. We have set ourselves a high environmental management standard in achieving sustainable development in our project development and maintenance activities which in line with our Reimagining TNB (RT) core value (Mindfulness) - we are emphatic, respectful, and compassionate to others and the environment. In this handbook, we share our experiences and practices as well as learn from others embarking on the sustainable environmental journey. We thank DOE & TNBR for the opportunity to support us to develop this handbook and we hope that this will help our contractor and staff to be more environmentally friendly society.

Ir. Dev Anandan
Chief Grid Officer

Message from Director General Department of Environment (DOE), Malaysia

The Department of Environment, DOE would like to express its appreciation to TNB for its support and commitment in developing the Environmental Best Management Practices Grid Development.s Project Site.

This handbook is meant to assist any stakeholders that are involve with the construction of grid development. Apart from information about the compliance requirements to the Environmental Quality Act 1974, this handbook provide depth guidance through the hands-on illustrations and explanations on the best management practice for the grid development.

I believe that the technical input provided by DOE, TNB and TNBR in this handbook will provide the best guidance for reference to all stakeholders especially contractors involved in Grid Development. The Department hopes that all grid developments will emphasize and continue the best environmental management and become an example for other developments.

YBrs. Encik Wan Abdul Latiff bin Wan Jaffar
Director General, Department of Environment (DOE)

Introduction

This handbook was established as one of TNB Grid initiative towards self-regulatory commitment under Environmental Quality Act (EQA) 1974. The main objective of this handbook is to serve as a guidance to all staff in TNB Grid Development project including contractors and all relevant parties on the best management practices (BMPs) in relation to environmental management during construction stage at project site. Content of this handbook is based on the current best practices that had been implemented in TNB.

TNB had established Health, Safety and Environment Management System (HSEMS) to assist TNB as an employer and their employees to comprehend and embrace HSE matters and risks associated with their daily operations at their workplaces. HSEMS conforms to ISO standard including environmental management system which is ISO 14001:2015.

Consistent with HSE policies, the purpose of HSEMS is to provide the respective Division, Department or Subsidiaries of TNB with framework to minimize the impact to environment while ensuring all activities are in compliance to all legal requirements related to the environment. TNB Grid also is in support of TNB's environmental stewardship through Grid Green Code of Conduct (GGCC) focusing on Green House Gas Reduction, Forestation Control and Pollutant Management Initiatives.

TNB Grid had established internal procedures in managing the environmental aspects and impacts in compliance to Environmental Quality Act (EQA) 1974 and to meet the ISO14001:2015 standard requirements. There are two types of projects in term of environmental concerns namely prescribed activities under section 34A, EQA 1974 and non-prescribed activities. All projects will implement the best management practices (BMPs) accordingly at site, ensure all requirements in EQA 1974 and ISO14001:2015 are met. TNB had established an environmental policy to describe TNB's commitment in ensuring effective environmental management.

For generating the electricity, the direction is under purview of government through Suruhanjaya Tenaga (ST). Grid rules is to transmit bulk power from power stations to the distribution network and high voltage customers safely, securely, and economically.

RENEWABLE

Solar

Hydro

NON-RENEWABLE

Coal

Gas-Fired

BULK SUPPLY CONSUMER

Existing transmission system network that interconnected to our large power consumers (LPC) who sourced their electricity directly from the national grid system.

Generation Division to develop, operate and maintain TNB's portfolio of power generating units

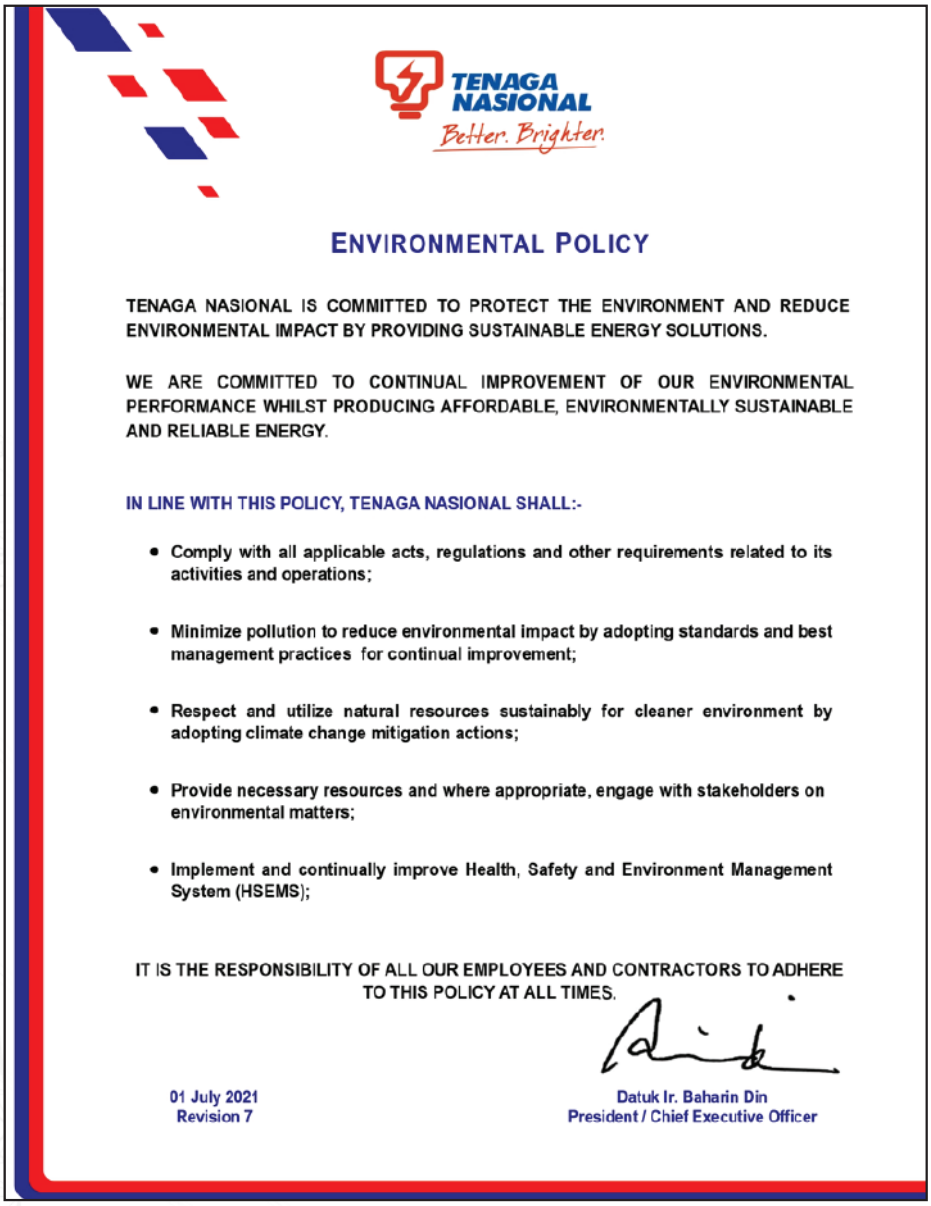
Grid Transmission Division is to plan, develop and maintain TNB's 132kV, 275kV and 500kV electricity transmission network known as the National Grid in Peninsular Malaysia

Distribution Division Conduct two value chain business activities on behalf of TNB, which are the Distribution Network Operations & Electricity Retail Operations

Commercial Consumer is not limited to operating office block & etc. Industrial Consumer means a consumer engaging in manufacturing & etc.

GENERATION **TRANSMISSION** **DISTRIBUTION** **CONSUMER**

Figure 1.1: Power Flow from Generation to consumers



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ENVIRONMENTAL POLICY

TENAGA NASIONAL IS COMMITTED TO PROTECT THE ENVIRONMENT AND REDUCE ENVIRONMENTAL IMPACT BY PROVIDING SUSTAINABLE ENERGY SOLUTIONS.

WE ARE COMMITTED TO CONTINUAL IMPROVEMENT OF OUR ENVIRONMENTAL PERFORMANCE WHILST PRODUCING AFFORDABLE, ENVIRONMENTALLY SUSTAINABLE AND RELIABLE ENERGY.

IN LINE WITH THIS POLICY, TENAGA NASIONAL SHALL:-

- Comply with all applicable acts, regulations and other requirements related to its activities and operations;
- Minimize pollution to reduce environmental impact by adopting standards and best management practices for continual improvement;
- Respect and utilize natural resources sustainably for cleaner environment by adopting climate change mitigation actions;
- Provide necessary resources and where appropriate, engage with stakeholders on environmental matters;
- Implement and continually improve Health, Safety and Environment Management System (HSEMS);

IT IS THE RESPONSIBILITY OF ALL OUR EMPLOYEES AND CONTRACTORS TO ADHERE TO THIS POLICY AT ALL TIMES.

01 July 2021
Revision 7

Datuk Ir. Baharin Din
President / Chief Executive Officer

Figure 1.2: TNB Environmental Policy

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GRID DIVISION
TENAGA NASIONAL BERHAD

QUALITY, HEALTH, SAFETY AND ENVIRONMENT (QHSE) POLICY

We aim to be the leading grid entity and grid system operator in ASEAN & amongst the best in the world. We are committed in providing quality services and products, ensuring safe & healthy working condition and protection of the environment.

To achieve the above, we shall;

1. Implement and continually improve QHSE Management System through PDCA concept.
2. Fulfill customer and stakeholder requirements.
3. Prevention of pollution, work related injury and ill health.
4. Eliminating hazards, reducing QHSE risks and continually improve our QHSE performance.
5. Encourage consultation and participation of workers in QHSE activities.
6. Comply with relevant legislations and other requirements.
7. Provide education and training programs to enhance QHSE skills and competencies.
8. Reporting and investigating of workplace and environmental accidents, and taking corrective measures to prevent recurrence.

Ir. Dev Anandan
Chief Grid Officer
Grid Division
TENAGA NASIONAL BERHAD
26th January 2023

Figure 1.3: TNB QHSE Policy

National Policies & Environmental Law

The National Policy on the Environment (NPE) was formulated in 2002 with the aim of providing policy directions for the protection and sustainable management of the environment. The Policy is based on eight principles which inter-alia are intended to harmonize economic development goals with environmental protection agenda. A key objective of the Policy is the integration of environmental considerations through the project planning.

2.1 Relevant National Policies and Plans

Relevant national policies and plans that shall be considered during planning the TNB Grid Project are as follows:

1. National Policy on the Environment
2. Malaysia,s National Policy on Biological Diversity
3. National Climate Change Policy
4. National Physical Plan
5. Sustainable Development Goals
6. Development Plan
   a. Structure Plan - Rancangan Struktur Negeri
   b. Local Plan - Rancangan Tempatan Daerah
   c. Rancangan Kawasan Khas
7. Special Management Area
   (Garis Panduan Tanah Tinggi)
8. Integrated Shoreline Management Plan (ISMP)
9. Grid Green Code Conduct 2021-2050

NPE 8 Principles

Figure 2.1: NPE 8 Principles

2.2 Environmental Legislation

The Environmental Quality Act (EQA) was formulated in 1974 to prevent, abate, and control pollution and to enhance the environmental quality in Malaysia. Regulations and Orders have been made under the EQA to control and manage various environmental aspects. The administration of the EQA is entrusted to the Department of Environment (DOE) Malaysia. The DOE, is the authority established under the EQA and plays a key role in the enforcement of the provisions of the Act and its subsidiary regulations. TNB Grid is committed in ensuring compliance with this Act and its regulations. TNB Grid will ensure a proper understanding of policies and legislations related to environmental protection and management in all its project planning. Thus, Table 2.1 shows the relevant regulations and orders under EQA with respect to TNB Grid Project.

Table 2.1: The Relevant Regulations and orders under EQA with respect to TNB Grid Project

No.	Environmental Regulations & Orders
1	Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order, 2015
2	Environmental Quality (Clean Air) Regulations 2014
3	Environmental Quality (Scheduled Wastes) Regulations, 2005
4	Environmental Quality (Motor Vehicles Noise) Regulations, 1987
5	Environmental Quality (Control of Emission from Diesel Engines) Regulations, 1996
6	Environmental Quality (Control of Emission from Petrol Engines) Regulations, 1996

Environmental Impact Assessment (EIA) is a statutory requirement for activities which have been prescribed under Section 34A of the EQA. Section 34A(2) of the Act stipulates that any person intending to carry out any of the prescribed activities is required to conduct an EIA study and submit a report to the Director General of Environment for prior approval. The main highlights of EIA provisions in the EQA 1974 include as stated in Table 2.2:

Table 2.2: EIA provisions in EQA 1974

Section	EIA Provision in EQA 1974
34A (1)	The Minister may prescribe any activity which have significant environmental impacts as prescribed activity
34A (2)	Appointment of qualified person to conduct EIA
34A (2A)	Director General shall maintain a list of qualified persons
34A (2B)	Qualified person shall be responsible for the EIA
34A (2C)	EIA report shall be in accordance with the guidelines
34A (3)	Director General can approve the EIA report with conditions and inform relevant approving authority
34A (4)	Director General may not approve the EIA report if not consistent with physical plan or fulfil the guideline

Section	EIA Provision in EQA 1974
34A (5)	Director General can require the submission of additional reports other than the EIA report
34A (6)	Activity is not to be carried out until EIA report is approved
34A (7)	Responsibility of the proponent to provide proof of compliance with conditions of approval
34A (8)	Fine not exceeding five hundred thousand or imprisonment for contravening section 34A
34AA	Director General may issue prohibition or stop work order

Any person who contravenes the requirement under Section 34A shall be guilty of an offence and shall be liable to a fine not exceeding RM 500,000.00 or to imprisonment for a period not exceeding 5 years or to both and to a further fine of RM1,000.00 for every day that the offence is continued after a notice by the Director General.

Referring to the EIA Order 2015, construction of transmission line is listed as one of the prescribed activities that required EIA as follows:

Activity	Schedule 1	Schedule 2
11	**POWER GENERATION AND TRANSMISSION** (a) Construction of steam generated power station using fossil fuels (other than coal) and having the capacity of 10 megawatts or more, with or without transmission line. (b) Construction of combined cycle power station, with or without transmission line. (c) Construction of transmission line in environmentally sensitive area.	**POWER GENERATION AND TRANSMISSION** (a) Construction of coal fired power station and having the capacity of 10 megawatts or more with or without transmission line.

Other than Activity 11, Activity 5 and Activity 13 could be applicable to TNB Grid Project as follows:

Activity	Schedule 1	Schedule 2
5	**FOREST** (a) Conversion of forest at 300 meters or more above mean sea level to other land use covering an area of 20 hectares or more but less than 100 hectares. (b) Logging, or cutting or taking of timber for the purpose of conversion from forest to other land use covering an area of 100 hectares or more but less than 500 hectares. (c) Logging, or cutting or taking of timber from forest at less than 300 meters above mean sea level covering an area of 100 hectares or more, outside permanent reserved forest. (d) Conversion of an area of— (i) mangrove forest; (ii) peat swamp forest; or (iii) freshwater swamp forest For industrial, housing, or agricultural use covering an area of 20 hectares or more but less than 50 hectares.	**FOREST** (a) Conversion of forest at 300 meters or more above mean sea level to other land use covering an area of 100 hectares or more. (b) Logging or conversion of forest to other land use within i. A catchment area of reservoirs used for municipal water supply, irrigation or hydro-power; ii. An area adjacent or near to any state park, national park or national marine park; iii. Any state park, national park, or national marine park; or iv. An area gazetted as water catchment forest under the National Forestry Act 1984 [Act 313]. (c) Logging or cutting or taking of timber from forest at 300 meters or more above mean sea level covering an area of 100 hectares or more, outside permanent reserved forest. (d) Logging, or cutting or taking of timber covering an area of 500 hectares or more. Clearing of mangrove forest, peat swamp forest or freshwater swamp forest on islands adjacent to any national marine park.

Activity	Schedule 1	Schedule 2
13	**DEVELOPMENT IN SLOPE AREA** Development or land clearing less than 50 percent of an area with slope greater than or equal to 25° but less than 35°.	**DEVELOPMENT IN SLOPE AREA** (a) Development or land clearing of 50 percent or more of an area with slope greater than or equal to 25° but lesser than 35°. (b) Construction of road, tunnel or bridge traversing an area with slope greater than or equal to 35°.

Adherence to DOE Guidelines

During the project implementation, all the requirements and specifications stipulated in the following guidelines issued by the DOE shall be adhered to requirement and specification as stated in Table 2.3.

Table 2.3: Requirement and specifications

No.	Requirement and Specifications
1	Environmental Impact Assessment Guideline in Malaysia, 2016
2	EIA Guidelines Power Generation & Transmission Projects 2021
3	Guidance Document for the preparation and submission of Environmental Management Plan (EMP)
4	Guidance Document for the preparation of the document on land disturbing pollution prevention and mitigation measures (LD-P2M2)
5	Manual Panduan Pemeriksaan BMPs* (BMPs: Best Management Practices) Untuk Kawalan Hakisan dan Sedimen
6	Guidance Document for addressing soil erosion and sediment control aspect in EIA Report.
7	Contaminated Land Management and Control Guidelines
8	Other documents issued by the DOE from time to time related to TNB Grid project.

Environmental Aspects & Impacts

In ensuring effective environmental management, environmental aspect and impact need to be identified and managed properly. Proper mitigation measures for the identified environmental aspects need to be determined to reduce its impact to the environment as in Figure 3.1.

The Grid has established a procedure on the environmental aspects & impacts register (GRID-MGMT-612-01) to ensure all environmental aspects & impacts are taken into consideration in each of its activities.

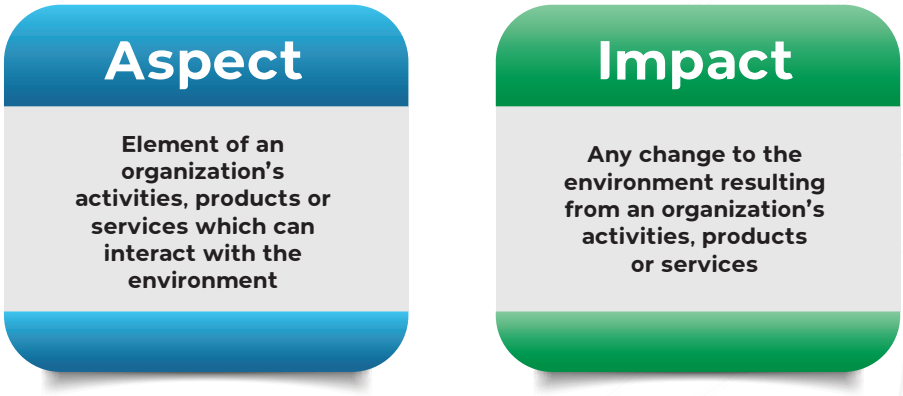


Figure 3.1: Definition of Environmental Aspect and Impact

3.1 Evaluations of Impacts in Project Activities

In order to ensure successful implementation of grid development project, the following procedures must be followed:

a. Identify the environmental sensitive area that affected by the project.
b. Describe the project activities that may have beneficial & adverse impacts on the environment.
c. Determine sensitive receptor might be impacted.
d. Assess the importance of significant impact.

The identification of critical project activities should begin during the scoping phase. Despite the fact that the activities are diverse, their environmental repercussions are very much the same. When assessing and summarizing the existing environment, as well as the project،s impact on it, the issues must be addressed, with a focus on the environment،s components.

The potential impacts which may arise from the project development were initially identified based on the findings of the Environmental Scoping Information (ESI) on the nature of the project. When it comes to establishing actual mitigating measures, such as contract terms, the focus switches back to the activities because it is by controlling activities that environmental consequences can be mitigated the most cost-effectively. The project activities serve as the foundation for evaluating the potential consequences. Figure 3.2 shows a summary of typical project activities at each project stage.

The list comprises the majority of the important activities related to substations and transmission lines constructions.

Figure 3.2 Summary of typical project activities at each project stage.

The potential impacts which may arise from the project development were initially identified based on the findings of the Environmental Scoping Information (ESI) on the nature of the project. Table 3.1 below are the sample on the potential impacts arising from project development:

Table 3.1: Aspects and Impacts based on key of project activities

Key of Project Activities	Aspects	Impacts	Source/ Project Activity
Pre-Constructions	• Soil • Water Quality • Waste • Air Quality	• Nil	• Site Survey
Constructions	• Soil • Water Quality • Waste • Air Quality • Noise & Vibrations • Ecology • Socioeconomic • Geology	• Soil erosion and sedimentation • Landslides • Water pollution • Air pollution • Noise pollution • Waste management • Loss of trees • Wildlife Conflicts • Job Opportunities	• Site Clearing • Earthwork • Surface run-off • Oil/Chemicals spillage • Vehicle and machinery movement • Construction & Domestic Waste • Employment opportunity • Rentice & Site Clearing • Seismic Activity
Operations & Maintenance	• Water Quality • Waste • Air Quality • Socio-economic • Electromagnetic fields • Geology	• Water pollution • Waste management • Air pollution • Maintenance and usage of transmission line • Transmission Line • Seismic Activity	• Maintenance and usage of transmission line • Transmission Line • Seismic Activity • Water pollution • Waste management • Air pollution
Decommissioning & Abandonment	• Waste • Land	• Waste management • Land Rehabilitation Program	• Structural Dismantling

Environmental Mitigation Measures for Project Sites

Grid Development has established an implementation guideline involving the environment, in line with Environment Quality Act 1974 which covers all work processes from planning to commissioning. The responsibilities, processes and checklist are clearly mentioned in internal work instruction that are appended in Appendix 2a & 2b known as Grid Development Project Environmental Management Guideline.

4.1 Introduction and Activities Related to Project Construction in Grid

Project Construction in Overhead Lines (OHL)

Overhead Lines (OHL) in the Grid Development Department consists of 132kV, 275kV and 500kV throughout the Peninsular of Malaysia. Land acquisition and/or wayleave is required to secure a timely legal entry to route alignment for the development of Grid Division transmission lines projects. Mode of procurements of these lands depends significantly on the policy adopted by each state authority as land is under state jurisdiction. Other than using the provisions under Electricity Supply Act (ABE) 1990, legal rights into the lands are obtained primarily using the provision under Clause 3.1(b) of the Land Acquisition Act 1960 where TNB requests state government to acquire land from private landowners which is needed for the development of Grid projects which is a purpose beneficial to the economic development of Malaysia. Where the transmission lines passing through forest reserve area, both acts or enactments governing TNB and Forestry Department will be applied to ensure security and compliance of legal requirement in the forest reserve. Where the transmission lines cross over other utilities such as highways, railways, river; specific prior approval process under each utility governing law and regulation is required.

Where the transmission lines cross over other utilities such as highways, railways, river; specific prior approval process under each utility governing law and regulation is required.

In general, main activities involved in construction of OHL can be categorized such as survey works, soil investigation works, rentice clearing works, foundation works, erection works and stringing works.

Followings are the general description of Overhead Line Construction activities.

Flow Project Construction in Overhead Lines (OHL) Related to EMS

1. Check Survey

Check survey works shall be conducted by Licensed Surveyor appointed by Contractor to confirm the survey done earlier by TNB's surveyor.

2. Soil Investigation

Soil investigation (SI) is to obtain soil properties in order determine the right design and type of foundation at the proposed location.

3. Rentice Clearing Works

Rentice clearing means clearing transmission line reserves any obstructions such as trees, tall shrubs, structures & etc. shall be carried out to the full widths of the Right of Way (ROW) measured horizontally as per the route plan and as specified in the Contract. Clearing work inside Forest Reserve shall be complied with requirements of State Forestry Department.

4. Best Management Practices (BMP)

Approved Best Management Practice (BMP) shall be carried out upon commencement of prescribed physical earthworks i.e. access road (either by contractor or logger) foundation works.

5. Normal Foundation Works

Construction of normal foundation is based on the drawing which is endorsed by Proffesional Engineer and reviewed and approved by TNB.

Process of foundation generally consists of following: Excavation, temporary shoring installation, stub setting, concreting, backfilling, compacting, turfing, drainage and slope protection (if required).

Competent Professional Erosion and Sediment Control (CPESC) and Professional Engineer (PE) to endorse drawings related to BMP implemetation at site.

6. Tower Erection

Lattice tower members consist of steel structures which need to be assemble on the ground and erected using derrick (pulley system).

7. Stringing Works

Stringing works is an activity to paying out conductor from tower to another tower using puller and tensioiner method.

To prevent any incidents during stringing works to properties and human, scaffoldings or netting or crane are used where cross over roads, highway, power lines, railways and other sites (approval by relevant authorities for crossing).

Figure 4. 1 (1) -(7): General description of overhead line structure

Project Construction in Substation (PMU)

Transmission Main Intake is the interconnection point of 500kV/275kV /132kV to the distribution network.

Land procurement is required to secure a timely legal entry to PMU site for the development of Grid Division transmission projects.

In general, main activities involved in construction of PMU can be categorized such as survey works, soil investigation works, site clearing works, building & road works, switchyard works, equipment erection works & testing. Typically, the general flow for construction of PMU as Figure 4.2:

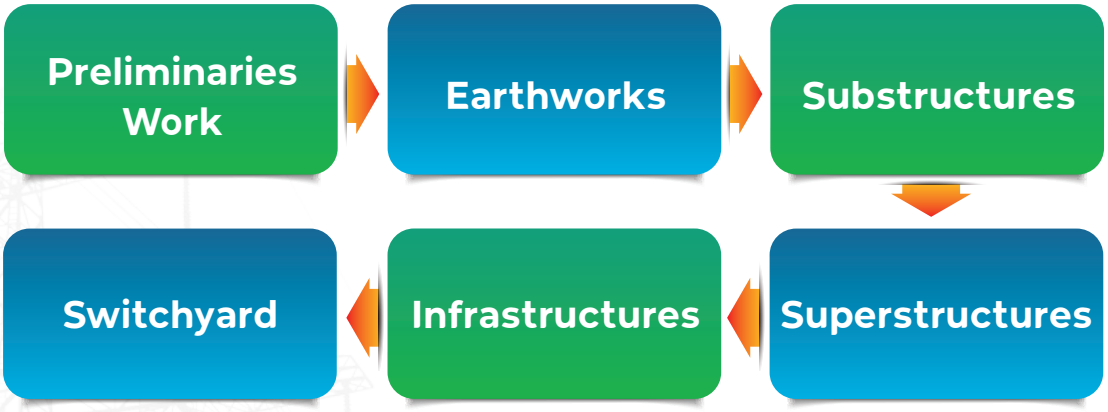


Figure 4. 2: The construction phase in substation

Followings are the general description of PMU substation Construction activities.

1. Survey Works

Survey works shall be conducted by Licensed Surveyor appointed by Contractor to start the design works.

2. Soil Investigation

Soil investigation (SI) is to obtain soil properties in order to determine the right design and type of foundation at the propose location or the needs for ground improvement.

3. Site Clearing Works

Site clearance must take place within the project area. Project team need to ensure that cleared materials are properly disposed according to the approved disposal site.

4. Building Works

Construction of substation building is based on the drawing is endorsed by Professional Engineer and reviewed and approved by TNB. Process of building works generally consists of following works:
Substructure works, superstructure works and M&E works.

5. Perimeter Road Works

Roads shall be made of Tarmac and must comply to the TNB design specifications and BOMBA requirements.

6. Equipment Erection

Electrical equipments consist of indoor and outdoor equipments. Primary equipments are erected at the switchyard. The secondary equipment are installed in the substation building.

7. Testing

Site acceptance test, inspection and OEM test shall be performed before commisioning of the substation.

8. Switchyard

Switchyard consist of plinths, steel structures, primary equipments, stone chipping, blast wall, earthing system, transformers. One of the important structure such as oil pit at the transformer plinth in switch yard is used to protect the environment from oil spillage from transformer equipment.

Figure 4. 3 (1)-(8): General description of Substation Activities

4.2 Environmental Measures and Implementation at Site

i) Pollution Prevention and Mitigation Measures

Any works involved to land disturbing shall make the most of the following **six (6) principles** in every stage of development when implementing the pollution prevention and mitigation measures. The **six (6) principles** are as follows:

Bill No.	Principles	Description
1	Run-off management	Before land-disturbing activities executed, key run-off control measure shall be first constructed and made operational. The run-off control measure shall include but is not limited to temporary earthdrain, diversion channel and discharges from and within the site.
2	Erosion control	To protect the soil surface from rain and to divert run-off from an expose area.
3	Sediment Control	To maintain effluence water quality by capturing eroded soil particles on the site before entering watercourse.
4	Protection	To protect the bare area (flat or steep terrain), inlet.
5	Preservation	To preserve the following but not limited to: 1. Slope > 25 degree 2. Water bodies reserved (river, monsoon drain) 3. Forestry reserved 4. Right of Way (ROW) 5. Mean sea level (MSL) elevation > 1000m
6	Maintenance	Maintenance shall begin as soon as the first BMP is installed or applied and shall continue through all the succeeding activities until the permanent control measure are established and functioning. Maintenance method shall be in accordance to design specification.

ii) Introduction of BMP's components

Best management practices (BMPs) describe ways to manage land disturbing activities to mitigate pollution on surface and groundwater near the project site. The BMP.s components are as follows:

Bill No.	Control Measure	Example of BMPs
1	Run off/on control	1) Drainage (earthdrain, cascade drain, berm drain) 2) Water bar (berm) 3) Slope drain pipe 4) Bridge and culvert 5) Check dam 6) Riprap – inside earthdrain or perimeter drain
2	Erosion Control	1) Gravel – for access road 2) Hydroseeding and Erosion Control Blanket (ECB) 3) Close turfing 4) Silt curtain 5) Sandbag barrier
3	Sediment Control	1) Silt trap 2) Sediment basin 3) Sump 4) Silt fence 5) Baffle – inside earthdrain 6) Active Treatment System (ATS) 7) Tyre Washing Facilities (Wash Trough) 8) Brush Barrier 9) Fiber rolls, coirlog or wattles
4	Engineering Control	Permanent slope stabilization (where required): 1) Soil nailing 2) Gunite 3) Steel grid netting
5	General Construction Control	1) Dust Control and street cleaning 2) Scheduled Waste Management 3) Construction Waste 4) Spill prevention and secondary containment 5) Sanitary Waste Management

iii) Detail work stages for construction activities

Detail work stages for construction of overheadlines and substation for Grid project as brief in chapter 4.1 Introduction and Activities Related to Project Construction in Grid. The implementation of BMPs is mainly focused on works as specified below:

i. Access Road

Access road is required prior to harvesting logs (taken out) or/and construction works.

During construction of access road, cut and fill slope are mainly required. Upon the construction, all the six (6) principles as per item 2 to be taken into consideration.
*Notes: For forestry area, the selection of access road to be initiated by Forestry Department (Pelan Jalan Hutan).

BMPs components during construction of access road and to be maintained periodically. The proposed BMPs along access road are as follows:

Bill No.	Control Measure	Proposed BMPs for access road
1	Run off/on control	1) Drainage system - earthdrain 2) Water bar (berm) 3) Watercourse crossing – culvert, temporary bridge and drain pipe 4) Check dam 5) Riprap – inside earthdrain or perimeter drain 6) Silt fence
2	Erosion Control	1) Outlet protection 2) Gravel for access road 3) Turfing 4) Hydroseed and Erosion Control Blanket (ECB) 5) Sandbag 6) Slope drain pipe
3	Sediment Control	1) Silt trap 2) Sediment basin 3) Sump 4) Baffle – inside earthdrain 5) Silt curtain - downstream 6) Wash through/tyre washing facilities 7) Active Treatment System (PAM Blocked Polymer) 8) Brush Barrier/Matting/biomass

*The implementation of BMPs is subjected to actual site condition

ii. Tower Construction

BMPs components is required during construction of tower foundation and to be maintained periodically during tower erection and conductor stringing. The proposed BMPs upon the foundation works are as follows:

Bill No.	Control Measure	Proposed BMPs for foundation works
1	Run off/on control	1) Drainage system – earthdrain, cascade drain, berm drain, perimeter drain 2) Silt fence
2	Erosion Control	1) Close turfing 2) Hydroseed and Erosion Control Blanket (ECB)
3	Sediment Control	1) Sump 2) Silt fence 3) Silt trap
4	Engineering Control	Permanent slope stabilization (where required): 1) Soil nailing 2) Gunite 3) Steel grid netting
5	General Construction Control	1) Dust Control and street cleaning 2) Scheduled Waste Management 3) Construction Waste 4) Spill prevention and secondary containment

*The implementation of BMPs is subjected to site condition

iii. Earthwork of Substation

BMPs components is required during earthwork for substation. The proposed BMPs upon the foundation works are as follows:

Bill No.	Control Measure	Proposed BMPs for earthwork
1	Run off/on control	1) Drainage system – earthdrain, cascade drain, berm drain, perimeter drain 2) Silt fence
2	Erosion Control	1) Close turfing 2) Hydroseed and Erosion Control Blanket (ECB)
3	Sediment Control	1) Sump pond 2) Silt fence 3) Sediment basin
4	General Construction Control	1) Dust Control and street cleaning 2) Scheduled Waste Management 3) Construction Waste 4) Sanitary Waste Management 5) Spill prevention and secondary containment

*The implementation of BMPs is subjected to site condition

A) RUN-OFF/ON Control

There are several types of BMPs components can be implemented as follows:

1. DRAINAGE

a) Definition	b) Purpose
Earthdrain - Temporary excavated channel or a combination of ridge and channel. **Cascade drain** - Concrete steps catch drains laid on the steep terraced slope. **Berm drain** - A narrow shelf, path, or ledge typically at the top or bottom of the slope.	**Earthdrain** - To direct run-off away from disturbed area. **Cascade drain** - To control and manage the flow of water from an elevated area to downhill. **Berm drain** - Prevent off-site sedimentation by diverting run-off to a sediment trapping control and can be used to divert a clean water from entering a disturbed area.

c) Application

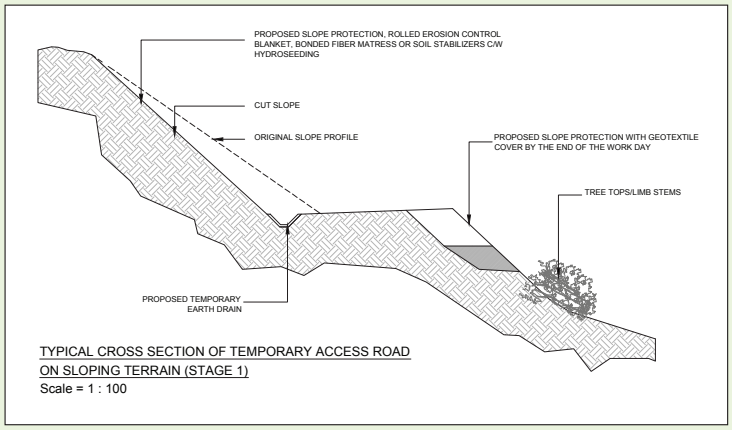
Earthdrain
- Along access road where there is a need to channel run-off surface.

Cascade drain
- Any cut and fill slope at construction site where there is a need to channel concentrated flow down slopes.

Berm drain
- Transport concentrated run-off from the top of the slope directed to a collection point (sediment basin, sump).

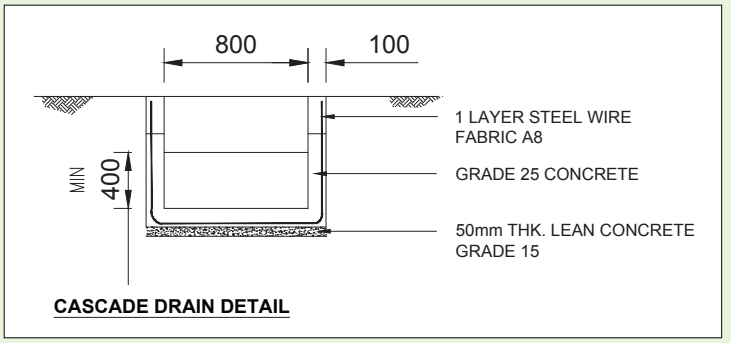
d) General/typical guidelines

Earthdrain

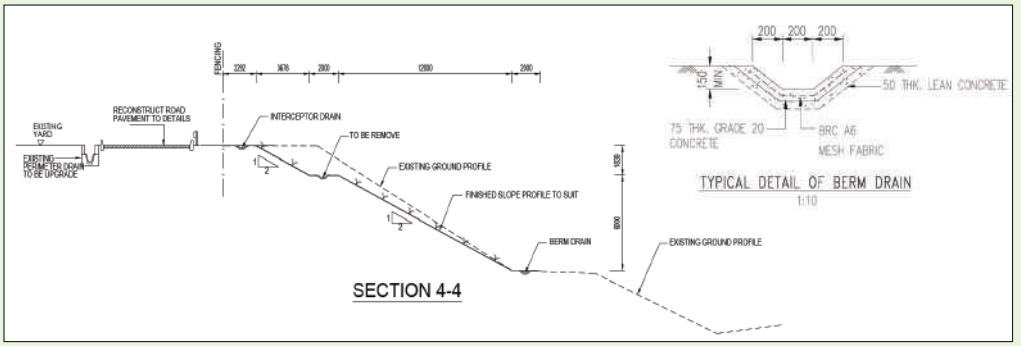


d) General/typical guidelines

Cascade Drain



Berm Drain



e) Site Photos

i. Earthdrain

ii. Cascade Drain

e) Site Photos

iii. Berm Drain

Inspection and Maintenance

Earthdrain need to be maintained periodically by inspection on the following items:

1. Earthdrain in place functioning to prevent muddy water from being discharged into sediment basin or silt trap or encroach public road.
2. To repair rills and gullis occur in the earthdrain (if necessary).
3. Regular desilting of earth drain, cascade drain, berm drain.
4. The size and capacity of the drains must be sufficient to cater at least a storm of 10 year Average Rainfall Intensity (ARI) event.
5. Cascade and berm drain need to be maintained periodically.

2. WATER BAR (BERM)

a) Definition

- Temporary structural/drain utilized to intercept and divert run on/off site water and off site runoff to a stabilized outlet.

b) Purpose

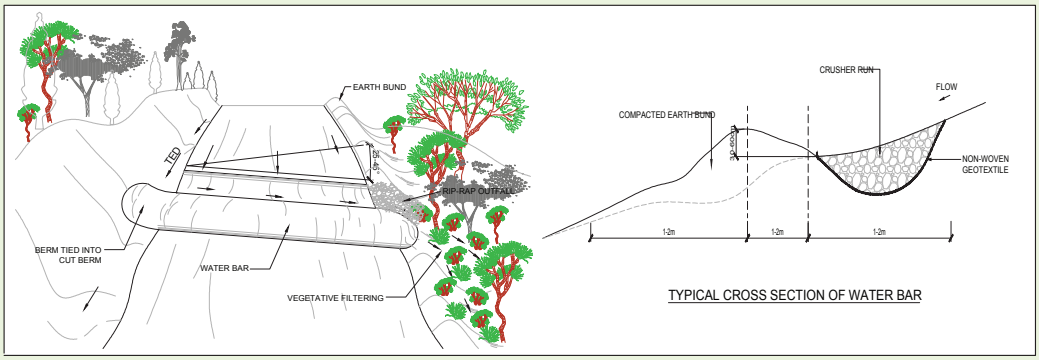
- To reduce the concentrated flows and the volume of run on/off water and divert the run on/off to stabilized areas.

c) Application

- Installation at sloping access road without introducing a wide-open gap.
- A cross drain with v-shaped cross section.
- The cross drain should be strong enough to withstand the load of any traffic that expected to use the access road.
- Water bar can be made from rocks or logs.
- Armouring of fill at the outlet is often needed to prevent gullying.

d) General/typical guidelines

Water bar (Berm)



e) Site Photos

Water Bar

Water Bar crossing the access road.

Inspection and Maintenance

Water bar/berm need to be maintained periodically by inspection on the following items:

1. Ensure water bar/berm size are appropriate to withstand runoff velocity force.
2. Regular inspection to water bar/berm structure and maintain the structure if there is gullying formation.

3. SLOPE DRAINPIPE

a) Definition

- Slope drain pipe structure placed from the top of a slope to the bottom of a slope. A heavy duty flexible pipe or conduit such as non-perforated, corrugated plastic pipe or specially designed flexible tubing should be used.

b) Purpose

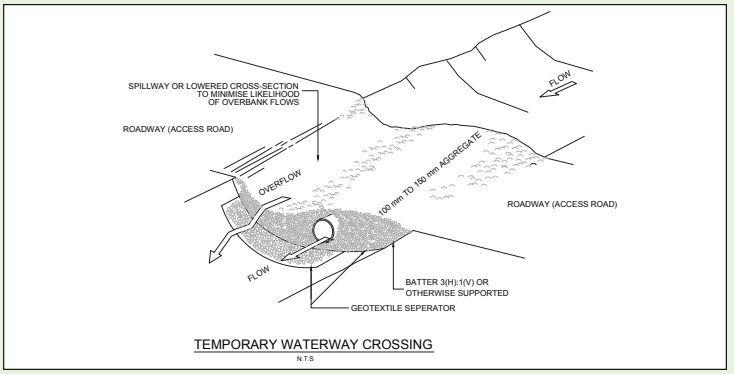
- To convey storm water runoff down the face of a cut or fill slope without causing erosion on or below the slope.

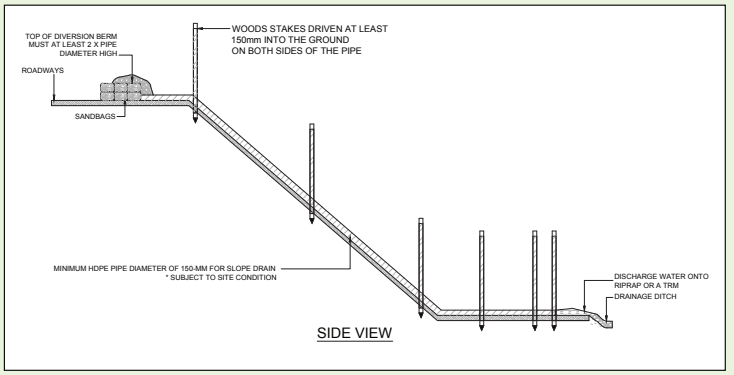
c) Application

- Temporary slope drains are used where stormwater runoff above a cut or fill slope will cause erosion if allowed flow over the slope.
- Temporary slope drains are generally used in conjunction with diversion to convey runoff down a slope until permanent water disposal measures can be installed.

d) General/typical guidelines

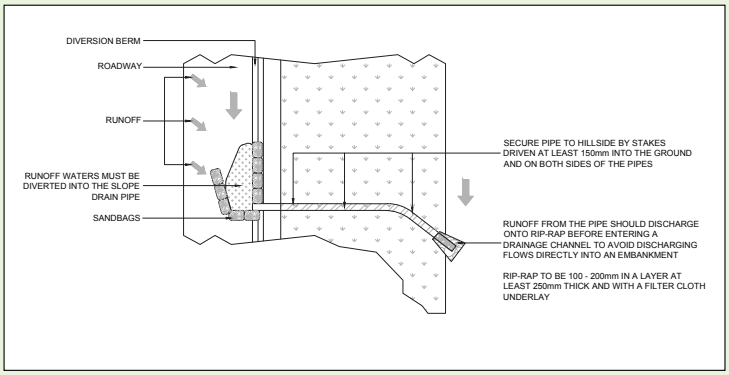
Slope Drain Pipe





d) General/typical guidelines

Slope Drain Pipe



e) Site Photos

Slope Drain Pipe

i. Installation of slope drain pipe using corrugated plastic pipe

ii. Discharge pipe from silt trap covered with on the inlet point

e) Site Photos

iii. Slope drain pipe

Inspection and Maintenance

Slope drain pipe need to be maintained periodically to ensure the BMPs performance by inspection on the following items:

1. Inspect the slope drain after each rainfall to determine whether it exceeded capacity, no lockages no leakages developed.
2. To ensure the anchoring is secure and positioning is appropriate for the site.
3. Inspect inlet and outlet structures for undercutting. To perform repairing works immediately if required.

4. BRIDGE AND CULVERT

a) Definition

- A temporary stream crossing is a structure placed across a waterway, which allows vehicles to cross the waterway during construction without entering the water, eliminating erosion and downstream sedimentation caused by the vehicles.

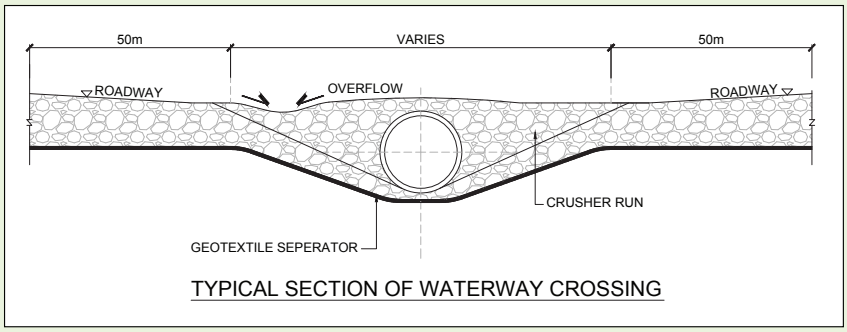
b) Purpose

- To provide safe, environmentally sound access across a waterway for construction equipment.
- To prevent construction equipment from damaging the waterway, blocking fish migration, and tracking sediment and other pollutants into the waterway.

c) Application

- Where heavy construction must be moved from one side of a stream channel to the other and equipment and construction vehicles will cross the stream repeatedly during construction.

d) General/typical guidelines



TYPICAL SECTION OF WATERWAY CROSSING

e) Site Photos

Bridge and Culvert

i. Installation of culvert crossing in progress

i. Bridge installation for river crossing

iii. Culvert installation

iv. Culvert installation

Inspection and Maintenance

Bridge and culvert to be maintained periodically to ensure the BMPs performance by inspection on the following items:

1. To maintain incoming BMP components through the mainstream such as earthdrain, check dam, silt trap and silt fence.
2. Periodically check on the physical condition of the bridge structure (culvert, span pile, etc.) especially during heavy monsoon season.
3. To ensure there is no blockage at culvert for smooth water flow.
4. Sufficient culvert size to cater the channeled water flow.

5. CHECK DAM

a) Definition

- A check dam is a small temporary device constructed of rock, sandbags, or fiber rolls, placed across a natural or man-made channel or drainage ditch.

b) Purpose

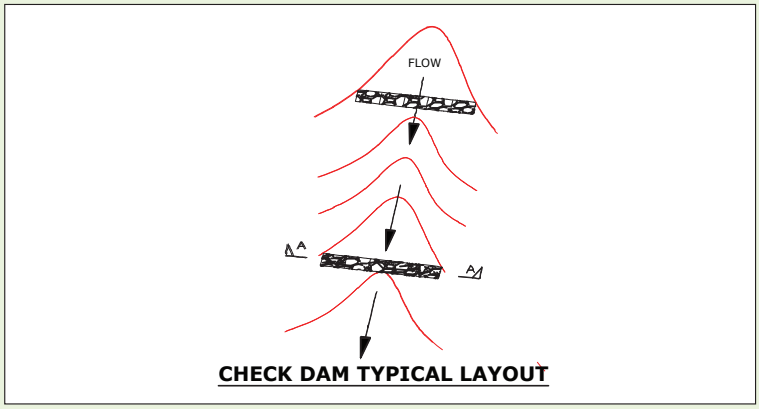
- To reduce the velocity of concentrated stormwater flows.
- To trap small amounts of sediment generated in the conveyances.
- To reduce scour and channel erosion.
- To encourage sediment dropout.

c) Application

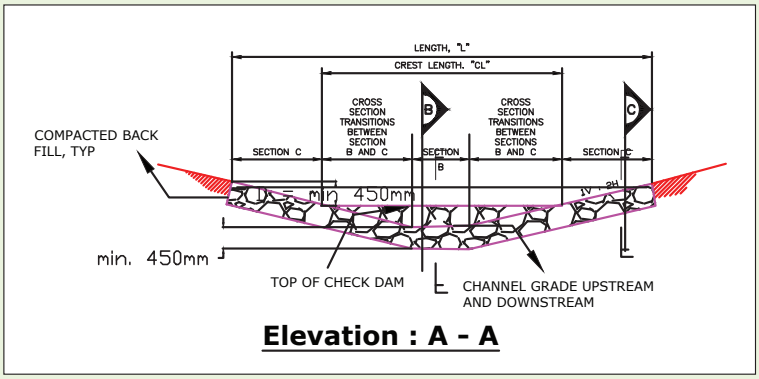
- Any stormwater conveyances having concentrated flow.
- To use natural resources (mulching/biomass protection) inside rentice e.g., by using branch of tree for wood.

d) General/typical guidelines

Check Dam



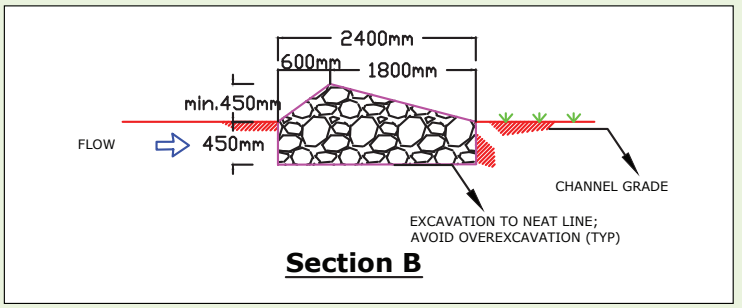
CHECK DAM TYPICAL LAYOUT



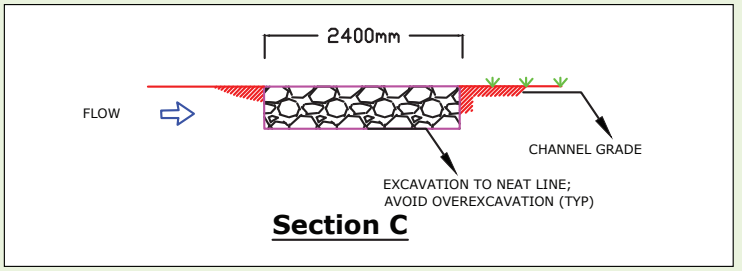
Elevation : A - A

d) General/typical guidelines

Check Dam



Section B



Section C

e) Site Photos

Check Dam

i. Check dam along the earthdrain with wood stack as anchoring mechanism at steep slope area

ii. Check dam installation along the earthdrain

Inspection and Maintenance

Check dam need to be maintained periodically to ensure the BMPs performance by inspection on the following items:

1. Inspect after each rainfall event.
2. Remove sediment accumulation.
3. Check structure and abutments for erosion or rock displacement and repair immidiately if required.
4. Ensure center of check dam is lower than the edges.
5. Inspect if there is scour underneath the check dam and bypasses on the sides.
6. Observe erosion of ditch segments between check dam-downcutting and side scour.

6. RIP RAP

a) Definition

- Riprap is a layer of large stones, angular stones, cobbles, or boulders laid onto slopes and channels/drain beds.

b) Purpose

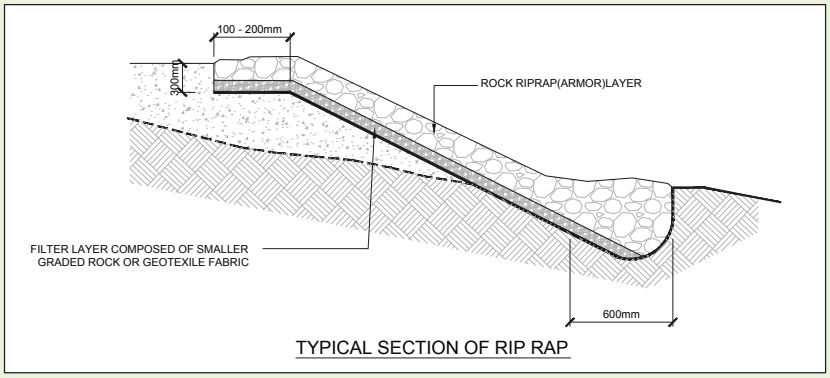
- To protect, armor and stabilize soil from erosion and scour in areas of concentrated runoff.

c) Application

- Riprap used to stabilize cut and fill slopes with 1:2 slope; channel side slopes and bottom inlets and outlet for culverts, drains, slope drains, grade stabilization structures and storm drains; and streambanks and grades.

d) General/typical guidelines

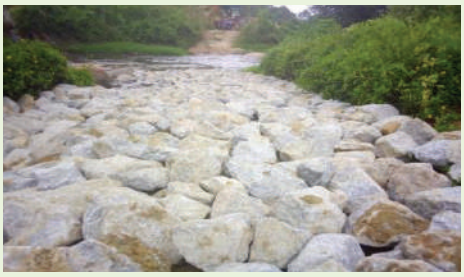
Rip Rap



Riprap design for streambanks

e) Site Photos

Rip Rap



i. Riprap installation inside the river crossing

ii. Riprap installation inside the discharged outlet

B) EROSION CONTROL

There are several types of BMPs components can be implemented as follows:

1. GRAVEL FOR ACCESS ROAD

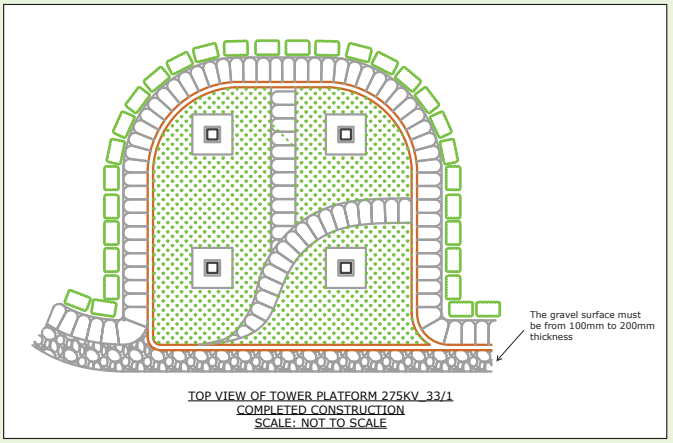
a) Definition	b) Purpose
- A stabilized construction roadway is a temporary access connecting existing public roads to a remote construction area.	- To provide a fixed stable route for the heavy construction traffic. - To reduce erosion and subsequent re-grading of permanent roadbeds between time of initial grading and final stabilization. - To stabilize soils on which a travel way is constructed of which may severely eroded and rutted created by vehicular tracking.

c) Application

- Applicable whenever travel ways are needed around poor soils area in a construction site of which the exposed soil is continually disturbed which eliminating the possibility of stabilization with vegetation.
- At waterways crossing is advisable to install geotextile sheet as a base before installation of the gravel to ensure the gravel is intact to the road surface.

d) General/typical guidelines

Gravel



Example of gravel installation for tower location

e) Site Photos

Gravel

i. Gravel at access road

ii. Gravel installation at waterways crossing required geotextile sheet

Inspection and Maintenance

Gravel for access roads need to be maintained periodically to ensure the BMPs performance by inspection on the following items:

1. Inspect stabilize construction roadways periodically and before and after every rainfall events.
2. Keep all temporary access roads ditches clear.
3. When no longer required, remove stabilized construction roadway and re-grade and repair slopes.

2. HYDROSEEDING AND EROSION CONTROL BLANKET

a) Definition

Hydroseeding
- Hydroseed is the process where a slurry of seed, fertilizer, mulch, binder, and water is sprayed on a prepared surface.

Erosion Control Blanket (ECB)
- ECB is used to stabilize channel floors or to protect seeding on planted slopes until they become established.

b) Purpose

Hydroseeding
- To temporarily protect exposed soils from erosion.

Erosion Control Blanket
- Stabilizing and maintaining ground structure and minimize soil erosion.

c) Application

Hydroseeding
- Hydroseeding is applied on any cleared soil surface where vegetative cover is needed which includes diversions berms and embankment, dams, temporary sediment basins, temporary road banks, and topsoil stockpiles. It also applied on areas that need temporary stabilization before final stabilization is installed and disturbed areas that will be re-disturbed after a period of extended inactivity.

Erosion Control Blanket
- ECB is applied on any bare and/or disturbed area subject to next intended construction activities to proceed in more than 30 days. It also is applied on any seeded area to promote growth.

d) General/typical guidelines

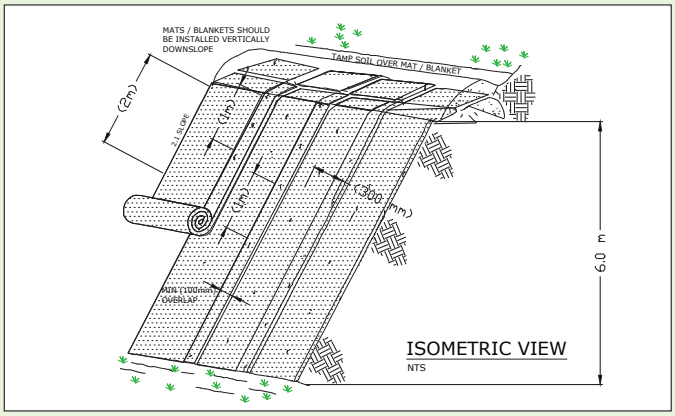
Hydroseeding
1. Hydroseeding should not be used in places with compacted soils, degraded surfaces, or ponding. Roots, branches, weeds, pebbles, ruts, and ridges should all be removed from the soil.
2. Hydroseeding should be installed upon completion of earthwork and foundation. As construction continues, it should be finished in stages. It should not be done when there is a lot of rain or wind.
3. Vertical grooves shall be absent from the final trimmed slope and to provide horizontal grooving.
4. Hydroseed composition consist of word fiber, seed, fertilizer, and stabilizing emulsion. During the early stage of installation, hydroseed need to be watering frequently until fully vegetated.

Steel Grid Netting
1. Should be installed after the installation of hydroseeding.

d) General/typical guidelines

Erosion Control Blanket (ECB)

1. ECB is made of natural agricultural straw and fibers that stitched together with degradable thread to a double layer photodegradable polypropylene netting.
2. ECB reduces soil erosion losses after installation thus effective grass establishment is achieved by hydroseeding.
3. ECB is a great absorbing and dissipating energy release by heavy rainfall. Therefore, hydroseeding is protected from being washed away.
4. Slope protection mat/blanket shall be used on exposed slope/surface where potential surface runoff to occur.
5. Slope surface shall be free of rocks, sticks and plants. Mats/Blankets shall have good soil contact.
6. Apply permanent seeding before placing blanket.
7. Lay blankets loosely and stake or staple to maintain direct contact with the soil. Do not stretch.



e) Site Photos

Hydroseeding & Erosion Control Blanket

i. Horizontal groove before hydroseeding

ii. Hydroseeding & ECB

Inspection and Maintenance

Hydroseeding & Erosion Control Blanket need to be maintained periodically by inspection on the following items:

1. Ensure all the grass is fully grown and function as a slope protection.
2. Additional drainage shall be constructed to discharge surface water away from the site quickly.
3. During monitoring if there are series of slope failures still occur upon reimplementation of the same methods, permanent slope protection shall take place i.e soil nailing, guniting and etc.

3. CLOSE TURFING

a) Definition

- Planting of grasses or ground cover (grass plant without gap between each other) to provides long-term stabilization of soil.

b) Purpose

- To reduce storm water runoff velocity and maintain sheet flow.
- To protect the soil surface from erosion.
- To promote infiltration of runoff into the soil.

c) Application

- Any completed or stabilized graded area such as bare area, flat surface area and area meant to be vegetated permanently.

d) General/typical guidelines

Close Turfing

1. Application at gentle slope (less than 30 degree).
2. The sod shall cut into strips not less than 250mm x 300mm in size.
3. The best grass for turfing scutch grass Cydon dactylon, doob grass, lepia grass.
4. If the slope is steeper than 25 degree wooden pegs should be hammered through the turf to stop sliding.

e) Site Photos

Close Turfing

Inspection and Maintenance

Close turfing need to be maintained periodically by inspection on the following items:

1. Planting the grasses or the ground cover plant without gap to ensure full protection to the stabalized and graded area.
2. To water the grasses or the ground cover plant regularly until the grasses fully growth.
3. Regular inspect to the grasess and ground cover plant growth and replanting the dead portion if necessary.
4. During monitoring, if there are series of slope failures still occur upon reimplementation of the same methods, permanent slope protection shall take place (eg. soil nailing, guniting, and etc.).

4. SILT CURTAIN

a) Definition

- A flexible floating permeable fabric or geotextile materials namely silt curtain/barriers installed in watercourse and is placed parallel or perpendicular to the direction of flow.
- This curtain does not extend to the bottom and weighted and anchored down to achieve closure while supported at the top through a floating system.

b) Purpose

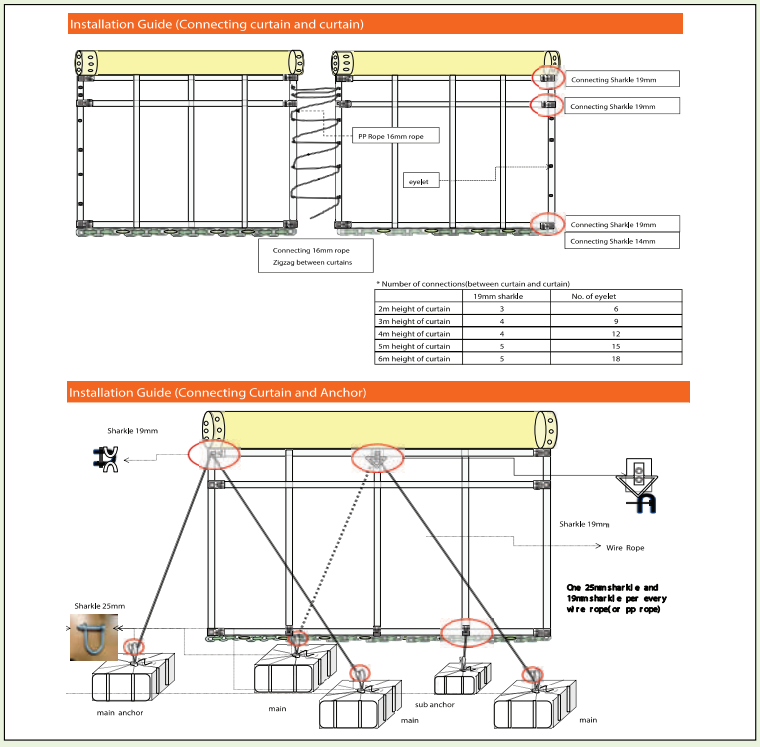
- To provide sediment containment or sediment protection for a watercourse.
- To prevent the migration of silt from a work site in a water environment into the larger body of water.
- To reduce or eliminate debris and minimize sediment transport from a disturbed area adjacent to or within a body of water.

c) Application

- Where construction activities occurs within a water body or along its shoreline or directly adjacent to a waterway or waterbody and is of short duration.
- The activities included but its not limited to bridge construction, rip rap replacement, utility work, stream bank restoration and dredging.
- Silt curtains are use in clam water surface.
- In most situations, silt curtains should not be installed across channel flows or flowing watercourse.

d) General/typical guidelines

Silt Curtain



	19mm sharkle	No. of eyelet
2m height of curtain	3	6
3m height of curtain	4	9
4m height of curtain	4	12
5m height of curtain	5	15
6m height of curtain	5	18

e) Site Photos

Silt Curtain

Example of silt curtain installation.

Inspection and Maintenance

Silt curtain need to be maintained periodically to ensure the BMPs performance by inspection on the following items:

1. Installation as per LD-P2M2 approved drawings.
2. Silt curtain should always be inspected after experiencing severe weather conditions.
3. Inspect the silt curtain for marine growth, sediment or debris.
4. Inspect the anchoring system and placement of the anchors. Adjust and/or repair the anchoring system if found out of place.
5. Ensure the silt curtain has not moved into shallower water whereby the bottom of the curtain is resting on bottom.
6. Inspect if any turbid water is escaping into the larger water body.

5. SANDBAG BARRIER

a) Definition

- A temporary linear sediment barrier constructed of stacked sandbags around site perimeter and active worksite.

b) Purpose

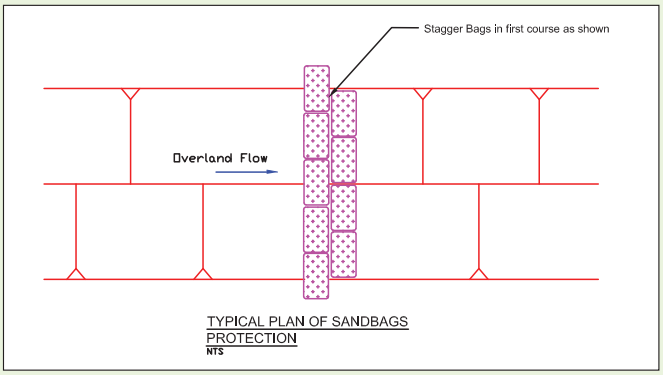
- To intercept and slow storm water sheet flow runoff.
- Allow sediment in runoff to settle before the water leaves the construction site.
- To divert and detain moderately concentrated flows associated with ditches, swales and storm drain inlets.

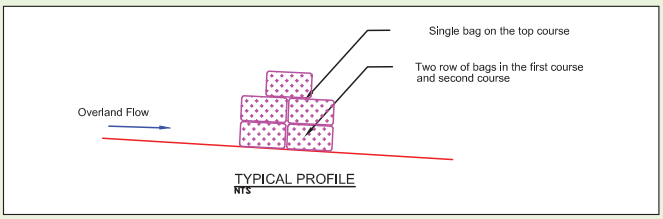
c) Application

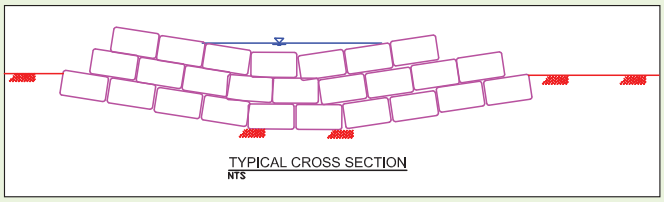
- Along the perimeter of a site.
- Below the toe of slopes required.
- Down slope of exposed soil areas.
- Around temporary stockpiles as required.
- Parallel to a roadway to keep sediment from paved areas.
- To divert or direct flow.

d) General/typical guidelines

Sandbag Barrier







e) Site Photos

Sandbag Barrier

i. Sandbag covered with geotextile sheet around and inlet/outlet of silt trap

ii. Sandbag barrier

Inspection and Maintenance

Sandbag barrier need to be maintained periodically to ensure the BMPs performance by inspection on the following items:

1. Ensure that all perimeter controls are maintained and protected from activities that reduce their effectiveness.
2. Sandbag barrier need to be inspected periodically and prior to and after rainfall events during rainy season.
3. Repair or replace sandbags as needed.
4. Remove accumulated sediment when it reaches 2/3 the barrier height.
5. Repair washouts and other damages as needed.
6. When no longer needed, remove the barrier and accumulated sediment then clean, re-grade, and stabilize the area.

C) SEDIMENT CONTROL

There are several types of BMPs components can be implemented as follows:

1. SEDIMENT CONTAINMENT SYSTEM (SCS)

a) Definition	b) Purpose
Silt Trap - Hydraulic controls that function by modifying the storm-runoff hydrograph and slowing water velocities to treat runoff from 2.0 ha or less. It works by providing containment storage volume for incoming runoff waters to capture sediment from runoff waters. **Sediment Basin** - Hydraulic controls that function by modifying the storm-runoff hydrograph and slowing water velocities to treat runoff more than 2.0 ha. It works by providing containment storage volume for incoming runoff waters to capture sediment from runoff waters. **Sump** - Low space that collects and manage surface runoff.	- To create conditions for sedimentation by allowing the deposition of suspended particles by gravity.

c) Application

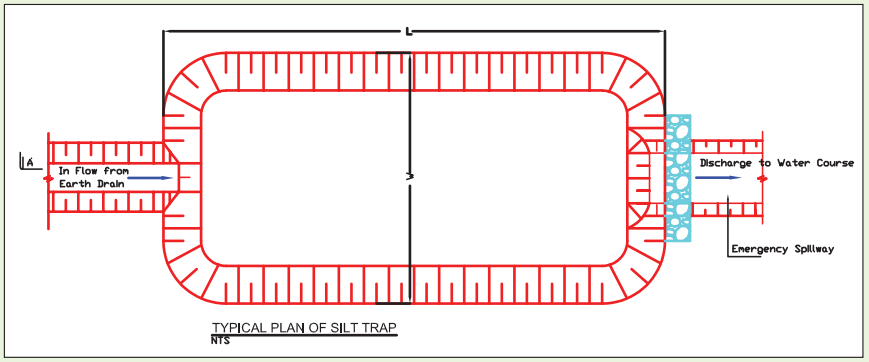
Silt Trap
- Used for smaller disturbed areas of less than five acres to intercept sediment-laden runoff for a sufficient period to allow majority of the sediment to settle before being released from the site.
- Constructed prior to disturbance of upslope areas, if possible, and continue functioning until the contributing drainage area is fully stabilized.

Sediment Basin
- Used to handling larger disturbed area (>5 acres).
- Placed near the perimeter of the site.
- Constructed prior to disturbance of upslope areas, if possible, and continue functioning until the contributing drainage area is fully stabilized.

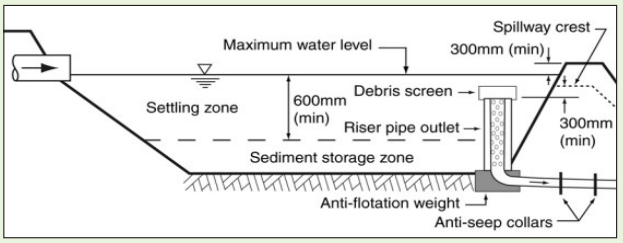
Sump
- To be located along drainage at a site constrain area where silt trap are not able to be constructed as per required size in order to cater the runoff volume and avoid overflow in silt trap.

d) General/typical guidelines

Silt Trap



Sediment Basin



e) Site Photos

Silt Trap

Sediment Basin

e) Site Photos

Sump

Inspection and Maintenance

Sediment containment system (SCS) need to be maintained periodically by inspection on the following items:

1. Ensure SCS adequately size to cater the surface run off during rains.
2. SCS in place and functioning to prevent muddy water from being discharged into nearby waterways/ drain or encroach public road.
3. To inspect the embankments are protected against erosion.
4. Regular desilting of the SCS before reaching 2/3 of SCS capacity.
5. To inspect during any storm event that threatens to exceed the available capacity in SCS and permanent water quality control structures.

2. SILT FENCE

a) Definition

- A silt fence is a temporary sediment barrier made of woven, synthetic filtration fabric stretch or geotextiles across and attached to supporting wood or steel post and entrenched.

b) Purpose

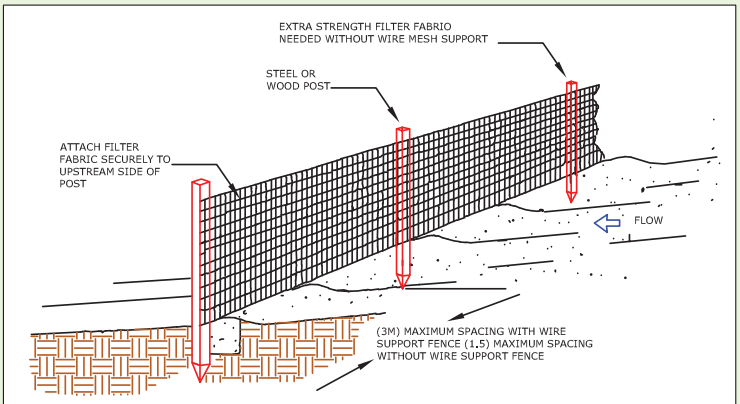
- To prevent sediment carried by sheet flow from leaving the site and entering natural drainage ways or storm drainage system by slowing storm water runoff and causing the deposition of sediment at the structure. Silt fencing encourages sheet flow and reduces the potential for development of rills and gullies.

c) Application

- Whenever to intercept, divert and capture sediment from sheet flow runoff.
- Below the toe of exposed and erodible slopes.
- Down-slope exposed soil areas.
- Around temporary stockpiles.
- Along streams and channels.
- Do not place the fence on a slope, or across any contour line.
- To use natural resources (mulching/biomass protection) inside rentice e.g. by using branch of tree for wood stack.

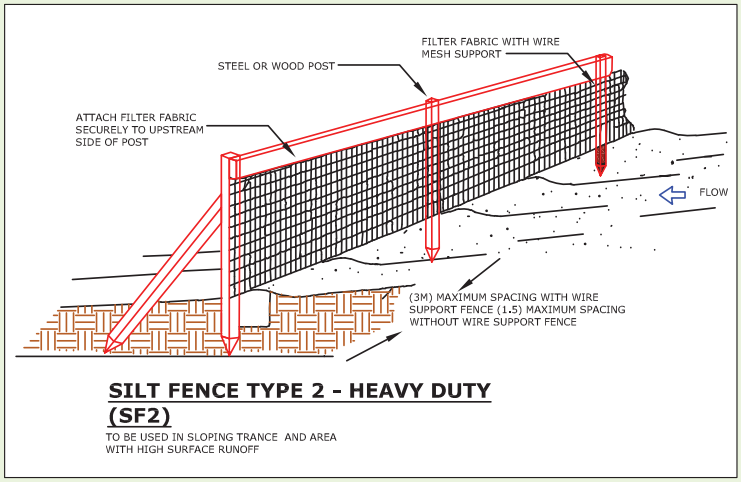
d) General/typical guidelines

Silt Fence

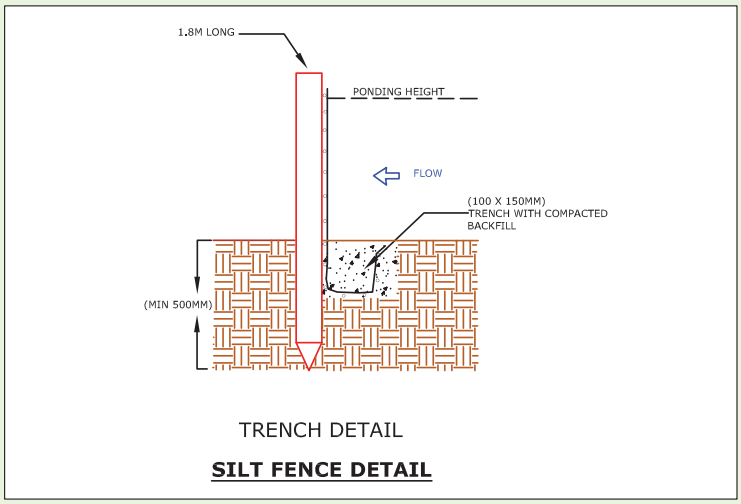


SILT FENCE TYPE 1 - NORMAL FLOW (SF1)

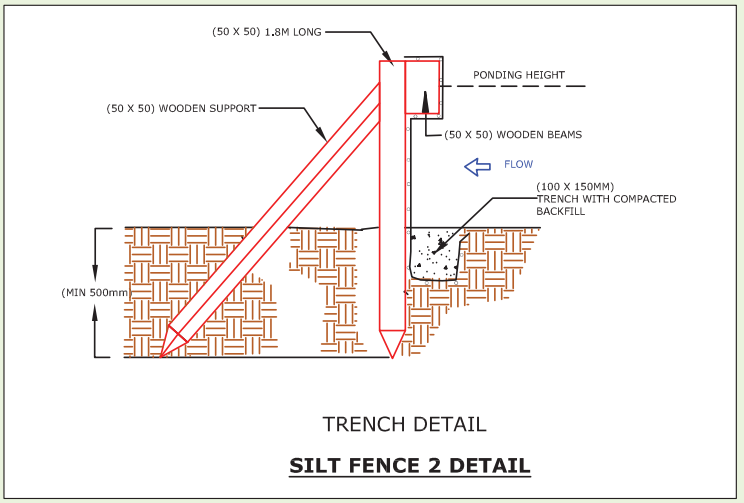
d) General/typical guidelines



Silt Fence



d) General/typical guidelines



TRENCH DETAIL

SILT FENCE 2 DETAIL

e) Site Photos

Silt Fence

Inspection and Maintenance

Silt Fence need to be maintained periodically to ensure the BMPs performance by inspection on the following items:

1. Support post must be placed at maximum 2 meter spacing.
2. Bottom of geotextile must be anchored to prevent wash-outs.
3. Support post must facing down slope of the geotextile.
4. Fabric buried at least 100mm.
5. Sediment fences should remain in place until the disturbed area is permanently stabilised.
6. Inspection daily and after rainfalls.
7. Repair whenever silt fence its damage.
8. Remove sediment frequently or when it reach 2/3 of the silt fence height.
9. Silt fence shall be maintain periodically.

3. BAFFLE

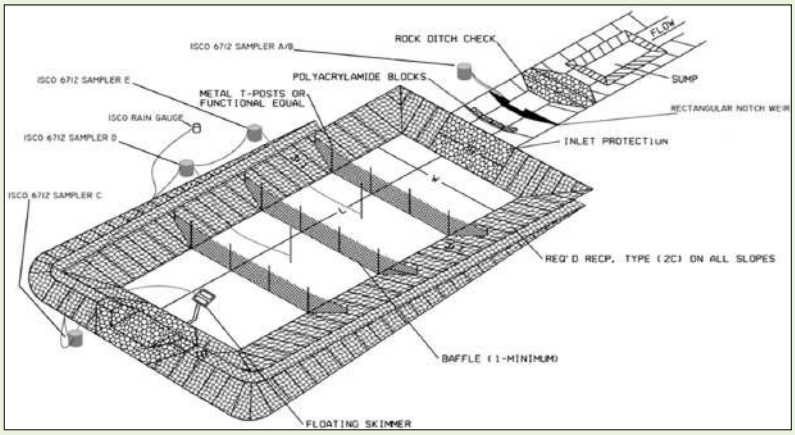
a) Definition	b) Purpose
- Baffles are barriers of porous and nonporous materials installed within the pooling areas of Sediment Trap/Basin to enhance sediment deposition.	- To extend the flow-path length of a suspended particle within a sediment containment system to overcome deficiencies associated with basin shape and inflow location characteristics and improve the basin،s sediment trapping efficiency by increasing the residency time for sediment to settle out.

c) Application

- Apply/install within the sediment trap/basin with high inflow of runoff to greatly improving their performance.

d) General/typical guidelines

Baffle



e) Site Photos

Baffle

Inspection and Maintenance

Baffle need to be maintained periodically to ensure the BMPs performance by inspection on the following items:

1. Inspect prior to anticipated significant rain events and restore any practice element as needed to maintain practice function.
2. At a minimum, inspect baffles within 24 hours of a rain event.
3. Baffles must be maintained to minimize failures since baffles can be difficult to repair. Remove sediment from baffle areas when it as accumulated to 1/2 the height of the barrier.
4. Re-anchor baffles to basin bottom and sides if water is observed flowing underneath or around them.
5. Maintain access corridors for basin and baffle maintenance and sediment removal.
6. Ensure that inflow areas are stable and not excessively eroding.
7. When permanent stormwater basins have been modified to function as a temporary sediment basin and the contributing watershed has been permanently stabilized, remove temporary baffles and sediment from the pooling area to meet the basin design requirements.
8. When baffles are a feature of a post-construction basin remove accumulated sediment once the basin watershed has been permanently stabilized.

4. ACTIVE TREATMENT SYSTEMS, ATS - (ANIONIC POLYACRYLAMIDE (PAM) BLOCK POLYMER)

a) Definition

- A system that is used to control discharges that require a chemical additive. It reduce turbidity of construction site runoff by introducing chemicals to stormwater. Coagulants and flocculants are used to enhance settling and removal of suspended sediments and generally include inorganic salts and polymers.

b) Purpose

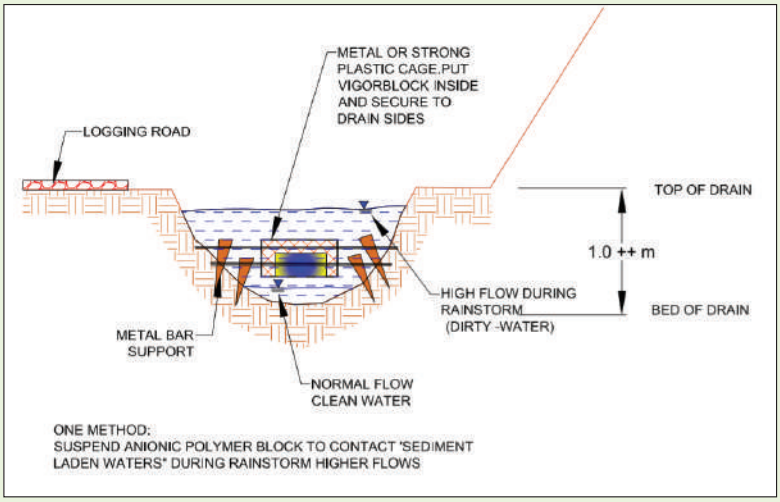
- To enhance flocculation, coagulation, and settling of the suspended sediment.

c) Application

- Before SCS where percentage of clay at that area exceeds 10% (LDP2M2 Guidelines 2017)
- Turbid discharges to sediment and turbidity sensitive waters cannot be avoided using traditional BMPs
- Site constraints inhibit the ability to construct a correctly sized sediment basin
- When the site has very steep or long slope lengths.
- It is advisable to install the ATS at the water-crossing used by the villagers

d) General/typical guidelines

PAM Block Polymer



e) Site Photos

PAM Block Polymer

i. PAM Block Polymer at sediment basin

ii. PAM Block Polymer at culvert

Inspection and Maintenance

Active Treatment System (ATS) need to be maintained periodically to ensure the BMPs performance by inspection on the following items:

1. Inspect and conduct regular discharge turbidity monitoring to allow for identifcation of any decline in performance over time that may be associated with PAM Block application.
2. Blocks may over time become coated with a layer of sediment and associated contaminants, which will compromise their ability to dissolve into the water. When this occurs, the sediment should be wiped off of the blocks so that their surface is again exposed.
3. The blocks can be used until there is no product remaining, provided that the expiry date has not passed and that they have been stored properly, in accordance with manufacturer guidance.

5. TYRE WASHING FACILITIES

a) Definition

Wash Trough

- Tyre washing facilities at construction site to prevent sediment being tracked onto public roads.

b) Purpose

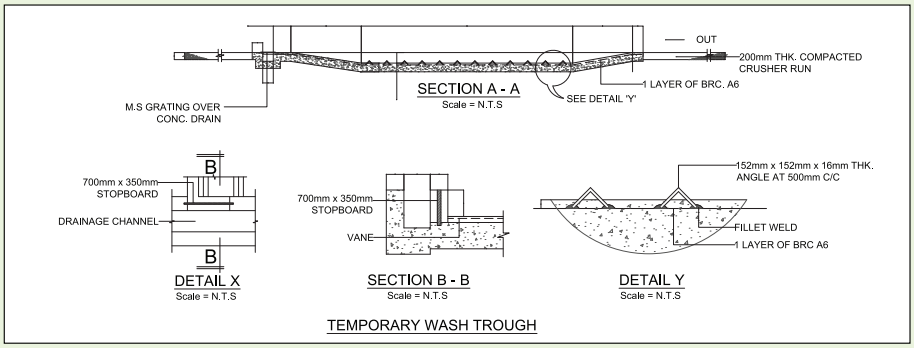
- To keep the public road clean from the dirt from the construction site.

c) Application

- Installed on construction sites entrance/exit to enable the wheels of plant, trucks, and other vehicles to be cleaned before leaving the site.

d) General/typical guidelines

Wash Trough



e) Site Photos

Wash Trough

Inspection and Maintenance

Wash trough need to be maintained periodically to ensure the BMPs performance by inspection on the following items:

1. Inspect wash through prior to forecast rain, daily during extended periods of rainfall,.
2. Inspect for sediment being tacked onto the road. If sand, soil, sediment or mud is tracked or washed onto the adjacent sealed roadway, then such material must be physically removed.
3. Ensure any associated drainage control measures are maintained in accordance with their desired operational condition.
4. Ensure overflows are directed to a suitable sediment trap

6. BRUSH BARRIER

a) Definition

- Brush barriers are a temporary sediment barrier constructed at the perimeter of a disturbed area, using residue materials (e.g., small tree branches, root mats, stone, or other debris left over from site clearing and grubbing).

b) Purpose

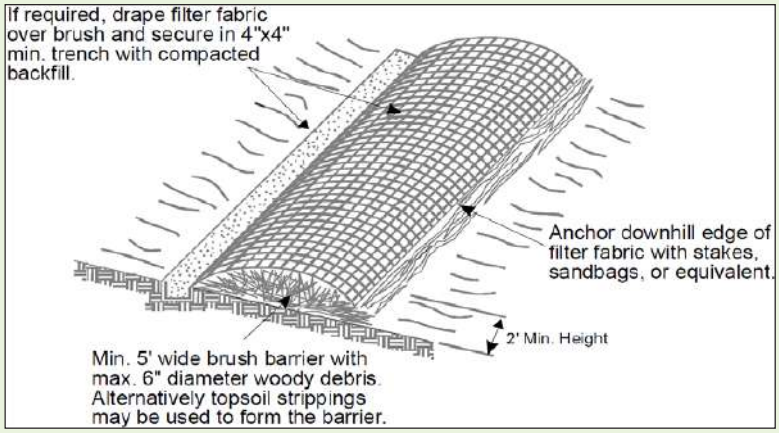
- To reduce the transport of coarse sediment from a construction site by providing a temporary physical barrier to sediment and reducing the runoff velocities of overland flow.

c) Application

- At sites where there is adequate brush from the clearing and grubbing of the construction site to construct an effective brush barrier.
- To be located below disturbed drainage areas of less than 0.25 acre per 100 feet of barrier length. The drainage slope leading down to a brush barrier must be no greater than 2:1 and no longer than 100 feet. This practice is not intended for areas of concentrated flow or substantial amounts of sheet flow.

d) General/typical guidelines

Brush Barrier



e) Site Photos

Brush Barrier

Inspection and Maintenance

Brush barrier need to be maintained periodically to ensure the BMPs performance by inspection on the following items:

1. Heavy deposits of sediment may need removal.
2. Occasionally, if filter fabric is used, tearing of the filter fabric may occur, replace and properly secure it, as needed.
3. When the barrier is no longer needed the fabric can be removed to allow natural establishment of vegetation within the barrier. The barrier will rot over time.

7. FIBRE ROLLS, COIRLOG OR WATTLES

a) Definition

- A fiber roll consists of straw, flax, coconut husk or other similar materials that are rolled and bound into a tight tubular roll and placed around the worksite perimeter and is referred to as wattles when placed on the face of slopes at regular intervals.

b) Purpose

- To intercept runoff.
- To reduce runoff flow velocity.
- To release the runoff as sheet flow.
- To provide some removal of sediment from the runoff.

c) Application

- May be used along the top, face and at the grade breaks of exposed and erodible slopes to shorten slope length and spread runoff as sheet flow.
- Install on disturbed areas that require immediate erosion protection.
- Can be used along the perimeter of a project.
- Unlined ditches as a check dam.
- Around temporary stockpiles.

d) General/typical guidelines

Fiber Rolls, Coirlog or Wattles

Fiber rolls, coirlog or wattles shall be installed as per the following steps:

1. Clear the installation area of any debris, trees, rocks, or large obstructions. Fiber rolls, coirlog or wattles are designed to come in contact with the soil, so any stumps or potential obstructions should be removed.
2. Dig a small trench in the location where the fiber rolls, coirlog or wattles need to be placed.
3. Place the coir logs in the trench and backfill with soil so that the fiber rolls, coirlog or wattles are tightly packed against the slope. Adjacent coir logs should be positioned so that the ends fit tightly against each other. Ends should be joined/secured together with coir twine or other suitable ties. Mattress coir fiber may be used to fill spacing between log ends.
4. Stake/anchor the fiber rolls, coirlog or wattles into position. fiber rolls, coirlog or wattles should be anchored according to site requirements or specifications.
5. For slope stabilization, the fiber rolls, coirlog or wattles shall be installed perpendicular to soil movement and parallel to the slope contour.

e) Site Photos

Fiber Rolls, Coirlog or Wattles


Coirlog installation

Inspection and Maintenance

Fiber Rolls, Coirlog or Wattles need to be inspected on the following items:

1. To check displacement of the logs.
2. To check for soil erosion at adjacent of the logs.

D) ENGINEERING Control

There are several types of BMPs components can be implemented as follows:

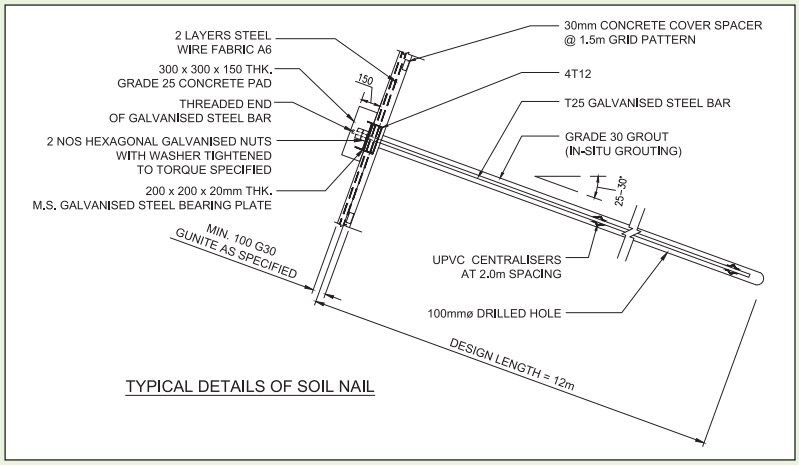
1. SOIL NAILING, GUNITE, STEEL GRID NETTING

a) Definition	b) Purpose
Soil Nailing - Soil nailing is a ground stabilisation technique used to reinforce and strengthen existing ground. It can be used on either natural or excavated slopes. It involves drilling holes for steel bars to be inserted into a slope face which are then grouted in place. It applicable in seismic zones. Increases shear strength of overall soil mass and can be used in wide soil types. **Gunite** - Gunite is a mixture of cement, sand or aggregate and water that produced a dense homogenous protective layer when projected at high velocity to the slope. **Steel Grid Netting** - The steel wire mesh essentially serves as an additional protective layer to avoid further occurrence of erosion by trapping the soil debris between the steel mesh and slope surface.	- A remedial permanent slope protection to treat unstable soil slopes.

c) Application
Soil Nailing - The soil nail slope is constructed top down as the soil fronting. The designed slope profile is removed stages. Nails are installed and grouted at each level after slope cutting is completed. The exposed soil shall be protected with steel mesh and reinforced short crete facing. - For soil nailing, drill 12m length of nail into ground, grouting of grade 30. - Spray concrete of grade 30 with thickness of 100mm with double layer of reinforcement A6. **Gunite** - Guniting shall only be carried out from top or upslope downwards to ensure no ingress or runoff below such gunite and direct the nozzle perpendicularly to the surface to be gunited. **Steel Grid Netting** - Consist of netting anchored to slope to resist the loads and retain the material in situ. - Reduce velocity and surface runoff.

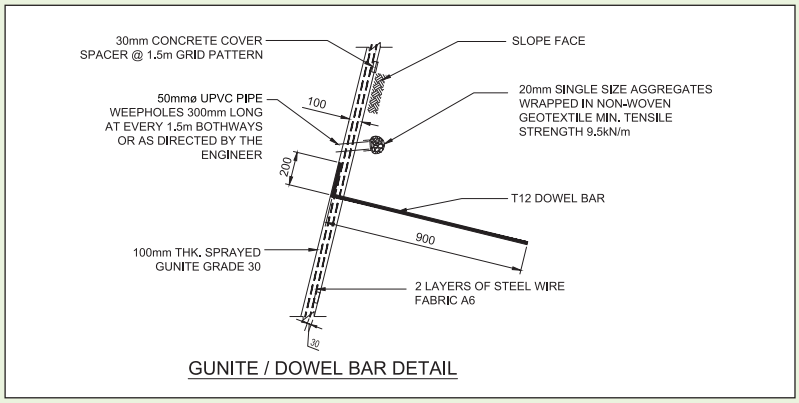
d) General/typical guidelines

Soil Nailing



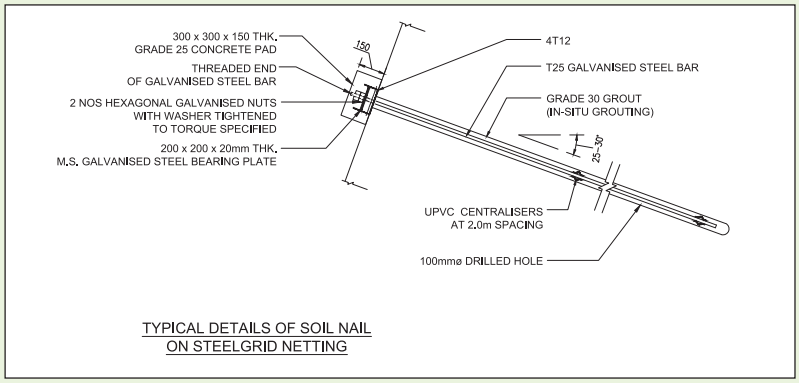
TYPICAL DETAILS OF SOIL NAIL

Gunite



GUNITE / DOWEL BAR DETAIL

Steel Grid Netting



TYPICAL DETAILS OF SOIL NAIL
ON STEELGRID NETTING

e) Site Photos

i. Soil Nailing works

ii. Guniting works

iii. Steel Grid Netting with Soil Nail Head

iv. Steel Grid Netting

Inspection and Maintenance

Soil Nailing

This area need to be maintained periodically by inspection on the following items:

1. Until the nail installation, reinforced short crete placement, attachment of bearing plates, nuts and nail testing are completed, do not excavate the next lift.
2. To ensure the nail grout and short crete have been cured for 72 hours.

Gunite

This area need to be maintained periodically by inspection on the following items:

1. Gunite shall be cured continously for 7 days by curing compund.

Steel Grid Netting

This area need to be maintained periodically by inspection on the following items:

1. Cover the metal surface with a protective layer to isolate the surrounding corrosive medium to prevent corrosion.

E) GENERAL CONSTRUCTION CONTROL

There are several types of BMPs components can be implemented as follows:

1. DUST CONTROL & STREET CLEANING

a) Definition	b) Purpose
- Practices to collect and remove tracked sediments that have escaped the perimeter of the construction site.	- To prevent the sediment from entering a storm drain or watercourse as well as to prevent dust blowing and movement on construction sites and roads.

c) Application

- Anywhere sediment is tracked from the project site onto the public or private paved roads, typically at points of ingress and egress.

d) Site Photos

Dust Control & Street Cleaning

i. Water tanker lorry to prevent dust blowing

ii. High pressure water jet to remove and clean the sediments

2. SCHEDULED WASTE MANAGEMENT

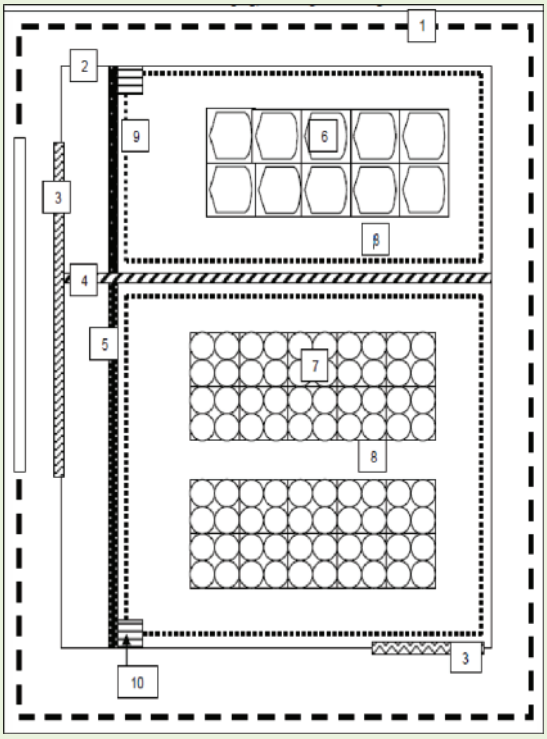
a) Definition	b) Purpose
- Any waste falling within the categories of waste listed in the First Schedule under Environmental Quality (Scheduled Wastes) Regulations 2005.	- To ensure schedule waste from construction site is being monitored, recorded, segregated & kept in designated container, labeled based on its category, or recycled whenever required.

c) Application

- Scheduled waste store (small cabin) with good air ventilation.
- Designated container and proper label to segregate scheduled waste.

d) General/typical guidelines

Scheduled Waste Store

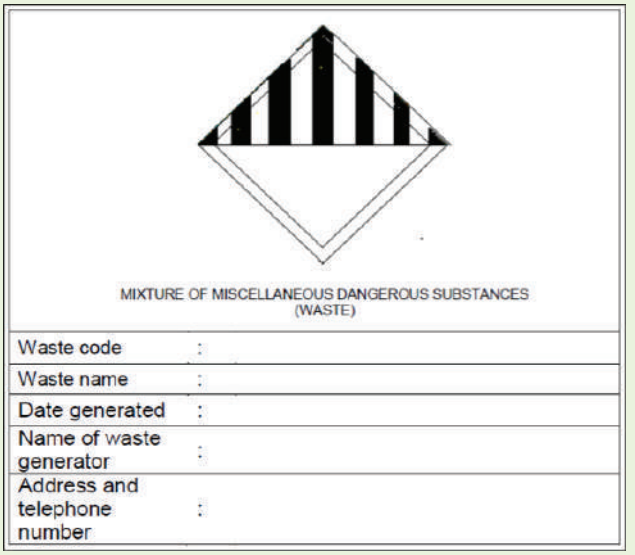


Legend:

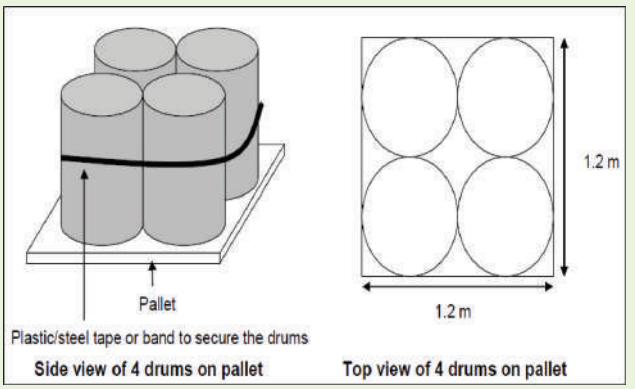
1. The entire storage area must be fenced in.
2. The storage place is sheltered or roofed or covered with suitable covering material and equipped with ventilation system for volatile wastes.
3. Entrance / emergency exit.
4. Separate compartments for different groups of incompatible wastes.
5. The storage area is surrounded by a concrete dyke or other equivalent structure to contain any spillage.
6. A jumbo bag containing scheduled wastes is placed on a pallet. The pallet is placed in rows by two pallets wide.
7. 4 drums containing scheduled wastes is placed in rows by two pallets wide.
8. Containers should be stored with an ample aisle space between groups of containers.
9. Perimeter drains.
10. The storage area should be graded to a sump.

d) General/typical guidelines

Scheduled Waste Label



Schedules Waste Packaging



e) Site Photos

Scheduled Waste Management

Inspection and Maintenance

Scheduled Waste Store need to be maintained periodically by inspection on the following items:

1. Ensure scheduled waste stored not more than 180 days or 20 metrics tonnes.
2. Containers observed free of leakage, hole, dent, bulge or corrosion.
3. Containment system free of water or other liquids.
4. All containers dated and labelled properly.

3. CONSTRUCTION WASTE

a) Definition	b) Purpose
- Construction solid waste means any solid waste generated from any construction or demolition activity, including improvement, preparatory, repair or alteration works.	- To ensure construction waste is being monitored, recorded, segregated & dispose properly, or recycled whenever required.

c) Application

- Roll-On Roll-Off (RORO) bins with adequate volume.
- Designated temporary storage for construction waste with proper demarcation.

d) Site Photos

Inspection and Maintenance

Construction Waste Storage area need to be maintained periodically by inspection on the following items:

1. Ensure no surplus on the construction waste stored at site.
2. Maintain good practice in housekeeping of the storage area.
3. Ensure all demarcation marking / tools are in good condition.

4. SPILL PREVENTION AND SECONDARY CONTAINMENT AREA

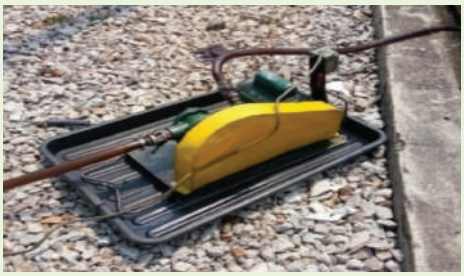
a) Definition	b) Purpose
Spillage - Any contact from chemical liquid that cause a condition which is hazardous or potentially hazardous to public health, safety or welfare or flora & fauna.	- To prevent potential environmental pollution that may cause from oil spillage. Ensure that oil spillage is control by the usage of designated container such as spill tray, bund wall & oil trap from polluting the environment.

c) Application

- A spill tray is placed under the machine to prevent oil from leaking.
- Bund wall is enclosed around the portable genset & transformers to prevent any oil spillage on the ground.
- Designated oil trap under grid size transformer to collect any oil spillage from polluting the environment.
- Construction of bund wall at the grid size transformer compound to avoid oil spillage into the surrounding area.

d) Site Photos

Spill Prevention and Secondary Containment Area



i. Spill tray located under the machine

ii. Bund wall enclosed around the portable genset

iii. Oil trap around the transformers

iv. Oil trap around the transformers

Inspection and Maintenance

Spill prevention and secondary containtment need to be maintained periodically by inspection on the following items:

1. Spill Tray, Bund Wall and Oil Trap is in good condtion without potential leakage.
2. Regularly check the flow of the oil trap.

5. SANITARY WASTE MANAGEMENT

a) Definition	b) Purpose
- The use of temporary toilet at construction site approved by the authority procedures and practices.	- To eliminate the discharge of construction site sanitary/ septic waste materials directly to the storm drain system or to watercourses without firstly treated to a standard requirement and compliance.

c) Application

- Sanitary/septic waste management practices are implemented on all construction sites that use temporary or portable sanitary/septic waste systems. Temporary sanitary facilities shall be located away from drainage facilities, watercourses, and from traffic circulation.

d) Site Photos

Sanitary Waste Management

i. Site Cabin Toilet

ii. Temporary site cabin toilet

4.3 Environmental Monitoring Quality

Environmental Monitoring Quality shall be implemented as per approved EMP such as Water Quality Monitoring, Air Quality Monitoring, Noise Level Monitoring and Vibration Level Monitoring. Environmental monitoring can be divided into three (3) main components as follows:

Bill No.	Main Component of Monitoring	Description	Parameter
1	Compliance Monitoring	1) To ensure works conducted to ensure the EIA condition approval (CoA) have complied. 2) Involves monitoring of discharge and emission from the pollution control facilities on site.	As per approved EIA condition approval (CoA) and Environmental Management Plan (EMP).
2	Performance Monitoring	1) To ensure certain characteristic that would indicate a BMP is functioning in optimal manner. 2) Involve preventive and corrective maintenance of the BMP to maintain their optimal performance.	Final discharge • Total suspended solid (TSS). • Turbidity.

Bill No.	Main Component of Monitoring	Description	Parameter
3	Impact Monitoring	1) To ensure works to measure the impact of the project on the surrounding environment. 2) Involves monitoring of ambient level.	Water quality • pH, temperature DO, BOD, COD, TSS, AN, Total coliform etc.  (a) Water sampling for water quality  (b) Water sampling for water quality Noise • LA_{eq}, L_{min}, L_{max}  (c) Noise measurement kit Air quality • PM_{10} 

4.4 Implementation Of Best Management Plan (BMP's) Do's And Don't

BMPs	Do	Don't
Silt Fence		
		
	 Silt fence well erected along the disturbed area	 Improper installation and poor maintenance of silt fence

BMPs	Do	Don't
Hydro-seeding & Erosion Control Blanket (ECB)		 i. ECB shall be installed fully cover the upslope ii. Lay ECB is loose without adequate stake and staple
	 Good practice of horizontal grooving prior to hydroseeding	 The ECB should be installed vertically downslope

BMPs	Do	Don't
Silt Trap	 Silt trap with protection	 No protection provided for silt trap spillway
Silt Trap Maintenance	 De-silt material from silt trap was dump onto a lorry before transport to stockpile area 	 De-silt material from silt trap dumped onto the access road

BMPs	Do	Don't
Scheduled Waste	 Containment bund provided	 Improper handling of schedule waste

BMPs	Do	Don't
Culvert and Crossings	 Culvert outlet protection provided	 No culvert outlet protection provided
Stockpile	  Stockpile covered with plastic sheet	

Summary

All mitigation measures identified shall be implemented at site to minimize the environmental impact during construction/ operation activities, as per stipulated in the Environmental Quality Act 1974. We are committed to continuously monitor and safeguard the environment.

"We do not inherit the earth from our ancestors, we borrow it from our children."

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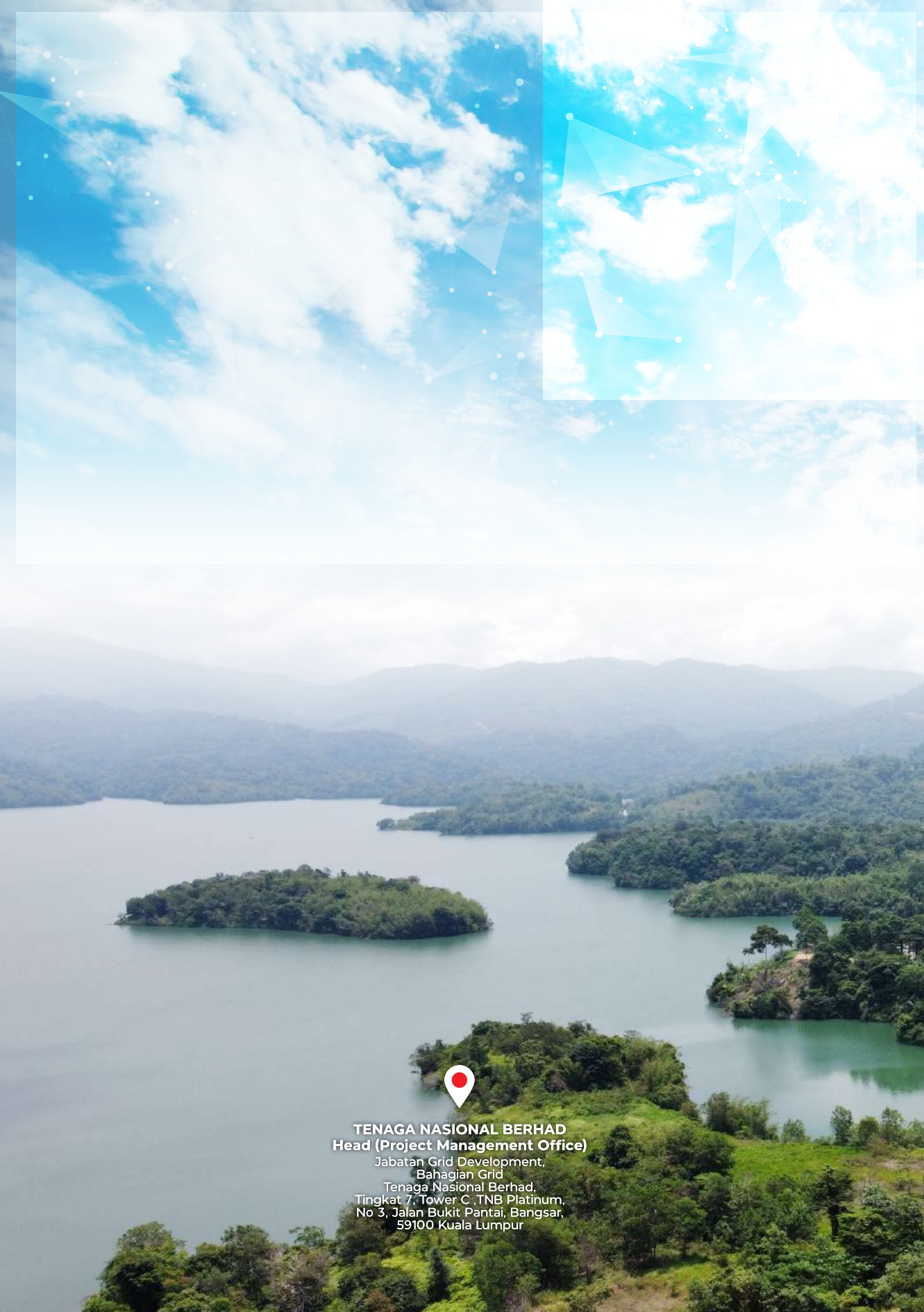

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