GOVERNMENT OF BANGLADESH
MINISTRY OF LOCAL GOVERNMENT, RURAL DEVELOPMENT & CO-OPERATIVES
LOCAL GOVERNMENT ENGINEERING DEPARTMENT

Rural Transport Improvement Project

Environmental Codes of Practice

March 2003
Rural Transport Improvement Project

ENVIRONMENTAL CODES OF PRACTICE

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INTRODUCTION

A.1 OBJECTIVES OF ECP

The objectives of the Environmental Codes of Practice (ECP) for the improvement and maintenance works associated with the RTIP are to

- Provide both reasonable and practical information on environmental management aspects of design, improvement and maintenance of the sub-projects associated with RTIP,
- Minimise the adverse environmental impacts of the sub-projects associated with RTIP by responding to the environmental screening and management framework
- Encourage work practices consistent with good practice operating principles so as to maintain the natural values present along / at the projects site, during the design, improvement and maintenance of works

A.2 CONTEXT TO THE ECP

The Rural Transport Improvement Project (RITP) targets improvement of prioritised feeder roads, rural roads (RR1 category), growth centre markets (GCM), maintenance of feeder roads, and construction of river jetties (ghats) and structures on rural roads spread over 21 districts of Bangladesh. The planning, design and implementation of these roads are proposed to be carried out over a period of 5 years.

Although the potential environmental impacts associated with the proposed works are considered to be minimal, an Environmental Management Framework (EMF) has been prepared to define the strategy and action plans to satisfy the requirements of the safeguard policies of the World Bank and at the same time to meet the legislative and statutory requirements of the Government of Bangladesh. The EMF is directed toward the maintenance and enhancement of environmental resources, by introducing an environmental screening process to identify environmental issues and respond appropriately during design, construction and maintenance of the sub-projects. The EMF also provides the context and rationale for preparation of the Environmental Codes of Practice (ECP) to encourage adoption of environmentally sound and sustainable designs followed by good construction practices.

As per the requirements of the Environmental Conservation Act, 1995, an Initial Environmental Examination (IEE) has also been carried by the LGED. The ECP will address the compliance requirements of the conditions, if any, as stipulated by the Department of Environment in their letter of Environmental Clearance to the LGED. The policy is to undertake environmental screening and prepare additional IEE for any road subsequently included to the RITP.

The National Environment Policy of the Government of Bangladesh sets the policy framework for environmental management and sustainable development in the country. The Policy emphasizes inter alia

- Maintenance of the ecological balance and overall progress and development of the country through protection and improvement of the environment,
- Protection of the country against natural disasters,
- Identification and control of all types of activities related to pollution and degradation of environment,
- Environmentally sound development in all sectors,
- Sustainable, long term and environmentally sound use of all natural resources, and
- Active association with all environmental related international initiatives to the maximum possible level.

The Department of Environment (DoE) is the regulating agency for the protection and management of environment in Bangladesh in line with the National Environmental Policy, 1992. The Environment Conservation Act, 1995 provides the legal framework to implement the Policy.

Consistent with the stated objectives of the Policy, the LGED, as the Proponent and Executing Agency of the RTIP, will:

- Ensure that all sub-projects identified to be implemented under the RTIP be subjected to an environmental screening process as stipulated under the EMF,
- Encourage the use of Environmental Codes of Practice for works, as appropriate, for both sub-projects associated with the RTIP,
- Ensure that works are conducted in compliance with legislative and statutory requirements of the Government of Bangladesh and environmental safeguard policies of the World Bank. Appendix 3 is intended to assist in the identification of relevant legislation and policies relating to environmental management for sub-projects associated with RTIP in Bangladesh,
- Increase the knowledge and skills of staff, contractors, consultants and contract administrators of environmental management techniques through appropriate training; and
- Monitor compliance to this policy through implementation of the ECP, and as appropriate, review and modify the ECP and the Environmental Screening Checklist to ensure continual improvement of the good work practices for environmentally sustainable and socially responsible rural infrastructure development.

A.3 SCOPE AND CONTENTS OF THE ECP

The sub-projects associated with the RTIP design and implementation stage will have the following sequential key stages.

- Selection of sub-projects applying the selection criteria developed through participatory consultation during the project preparation stage
- Topographic surveys and other field investigation
- Inventorization of structures
- Preliminary designs - horizontal alignment, vertical alignment, cross-section, structures
- Environmental and Social Screening
- Integration of environmental and social concerns into the sub-project design
- Detailed engineering design including bid documents preparation incorporating appropriate applicable environmental specifications selected from the Environmental Codes of Practices
- Tendering and contract documentation
- Implementation and supervision, inspection, monitoring and auditing

Participatory consultation will continue to remain an integral part of the whole project process as documented under the stand-alone separate documentation on "Participatory Consultation".

The environmental screening and management process must respond to any environmental (or other) impact identified, prior to the commencement of works. It must indicate work practices and design and construction features, which are to be used to minimise environmental damage. For most of the Category C sub-projects, where there is a minimal or no environmental impact, the EMF advocates
use of the appropriate Environmental Codes of Practice (ECP). In this context, the ECP are intended to ensure that appropriate work practices are used and minimal environmental standards are met to minimise potential environmental impacts of the sub-projects associated with the RTIP. The ECP identify the activities and the potential environmental impacts a particular activity may create, recommend appropriate works practices, provide an outline of the reasons protective / mitigative measures are required (the "why?") and focus on proper construction, installation and maintenance of protection / mitigation measures (a "how to" approach). The ECP also specify the related environmental objective to be achieved.

Each of the stages of a sub-project, i.e. planning, design, construction, and operation and maintenance are interrelated and have differing potential to effect (either adversely or beneficially) the environment. As such, the ECP cover key activities associated with all stages of a sub-project such as planning, study, survey, design, tendering, contract documentation, implementation, and supervision, inspection, monitoring and auditing.

The ECP will be used by all parties involved with the improvement and maintenance sub-projects under the RTIP such as LGED Engineers (XEN / UE / AE / SAE), Technicians, Draftspersons, surveyors, Work Assistants, and Consultants (DSMC), and Contractors' personnel. It will be up to the LGED to demonstrate that the best practicable solution has been adopted in the project design, and that the particular solution will ensure that the environment will be protected to the best practicable standard.

The establishment of the environmental management unit (EMU) within the LGED will assume much of the responsibility for undertaking environmental screening of the sub-projects, ensuring that appropriate protection and mitigation measures are incorporated into the road designs, bidding and contract documents, establishing monitoring, and compliance systems, and ensuring that the functions of the LGED and its contractors generally meet the requirements of the Bank's safeguard policies and the GoB's legislative and regulatory requirements.

The ECP consist of simple and summarized best practice operating guidelines for various key sub-project activities which have potential to impact the environment (positively or adversely) or to enhance the environmental (and social) benefits.

These have been designed as a living document and will continue to be updated by LGED, as and when necessary, during the course of implementation of the RTIP.

The ECP has been presented in three parts and two appendices as outlined below:

Part I: comprises the ECP related to general guidelines and includes General Procedures, and Participatory Consultation.

Part II: includes common guidelines dedicated to main project activities that are applicable to all the sub-projects.

Part III: Guidelines, which are applicable to a particular type of sub-project, are presented as Additional Guidelines for Different Type of Sub-projects under Part III of the document.

Appendices: comprise 3 attachments providing definition and glossary of terms used in the document, environmental screening checklist and a tabulation of relevant environmental Acts and Rules.
A.4 Framework of the ECP

Each of the individual ECP should be read in conjunction with ECP 1 which sets out the general procedures for implementation, monitoring, review and approval of the codes. Some ECP are relevant to all aspects of a sub-project works and services, while others are only relevant to one or two stages of an overall sub-project cycle, as shown in Table 1 below. Similarly, some ECPs (Common) are relevant to all sub-projects associated with the RTIP.

Table 1 - ECP and Relevance to sub-project stages

<table>
<thead>
<tr>
<th>ID No</th>
<th>ECP Topics</th>
<th>Stages of a sub-project</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Planning</td>
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<td></td>
<td><strong>GENERAL GUIDELINES</strong></td>
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<tr>
<td>ECP 1</td>
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<tr>
<td>ECP 3</td>
<td>EA Process</td>
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<td>ECP 4</td>
<td>Minimising Construction Impacts</td>
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<td>Borrow Areas Development and Operation</td>
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<td>ECP 9</td>
<td>Material Storage Transport and Handling</td>
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<tr>
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<td>ECP 11</td>
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### ID No | ECP Topics | Stages of a sub-project
---|---|---
| | Planning | Design | Implementation |

#### ECP 12 Brick Manufacturing / Breaking Practices

#### ECP 13 Traffic Management During Construction

#### ECP 14 Occupational Health and Safety

### ADDITIONAL PROJECT COMPONENTS SPECIFIC GUIDELINES

#### Rural Road Improvement

- **ECP 15** Planning, Design and Construction
- **ECP 16** Drainage Structures

#### Feeder Road Maintenance

- **ECP 17** Planning, Design and Construction
- **ECP 18** Drainage Structures

#### Small Structures on Rural Roads (SRR)

- **ECP 19** Planning, Design and Construction

#### Growth Centre Market (GCM) and Ghat Improvement

- **ECP 20** Planning, Design and Construction
- **ECP 21** Drainage Structures
- **ECP 22** Solid Waste Management
- **ECP 23** Slaughtering Waste Management
- **ECP 24** Sanitation
### Table 2

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<td>Minimising River Bank Erosion</td>
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<td>Transportation</td>
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<tr>
<td>ECP 32</td>
<td>Water Supply</td>
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Table 2 overleaf provides an example checklist of the types of activities involved with the various activities related to sub-projects associated with RTIP works and services and the ECP, which will be referred to and incorporated into the corresponding activities.
### Table 2 - Improvement / Maintenance Works & Services Activities and Relevant ECP

| ACTIVITY                                               | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 |
|--------------------------------------------------------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|    |
| Road realignment                                       |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Vegetation clearance                                   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Land access for investigation and surveys              |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Community consultation and participation               |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Bridge design                                          |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Culvert design                                         |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Borrow areas                                           |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| River sand extraction                                  |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Batter stability                                        |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Spoil disposal                                         |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Road drainage                                          |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Stream or river crossings                              |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Protection of Cultural and properties including burial sites or graves |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| ACTIVITY                                      | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 |
|----------------------------------------------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Source of materials                           |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Chance finding of archaeological assets / relics |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Revegetation and landscape planting           |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Visual impact                                |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Materials stockpiles                         |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Site (sand extraction, borrow and brick-breaking yard) rehabilitation and reinstatement |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Erosion control                              |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Transport and storage of Materials           |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Occupational Health and Safety               |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Traffic management during construction       |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Storm water Drainage in market centre        |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Solid Waste in Market centre                 |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| ACTIVITY | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 |
|----------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Water supply in market centre |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Sanitation in market centre |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Transportation network in market centre |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Slaughtering waste |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Tree planting around market centres |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| River bank erosion control |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Water Supply at jetty / ghat |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Sanitation at Jeety/ghats |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Transportation at jetty / ghats |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
ECP 01: GENERAL PROCEDURES

1.1 INTENT OF THE ECP

The ECP have been prepared to define methods and/or procedures to be followed by LGED district and Upazila Engineers, Consultants, designers and contractors for the avoidance or mitigation of adverse environmental effects that may arise out of road projects. It is desirable that all people involved in the planning, design, and implementation of sub-projects associated with the RTIP are aware of the need for the ECP, practice the procedures established therein, and implement systems for the prevention or mitigation of adverse environmental effects of the sub-project interventions. The ECP shall be followed for the planning, design and implementation of all sub-projects works to be carried out under the RTIP.

Each of the ECP shall be read in conjunction with ECP 1 - General Procedures. The definitions of terms used in the ECP are as set out in Section 1.3 below and Appendix 1.

In addition, all works undertaken under any of the sub-projects associated with the RTIP must comply with the requirements set out in the Environmental Management Framework.

1.2 AUTHORITY FOR THE ECP

These codes have been prepared under the requirements of the RTIP Environmental Management Framework and the entire responsibilities related to its distribution, control, periodic revision, review and approvals rest with the Project Co-ordinator, RTIP, LGED, Dhaka.

The ECP shall be used as a guide for the planning, design, construction and supervision of the sub-projects associated with the RTIP.

1.3 DEFINITIONS OF KEY TERMS

"ECP" Environmental Codes of Practice for sub-projects associated with the RTIP.

"Project" IDA assisted Rural Transport Improvement Project (RTIP).

"Sub-Project" Any individual scheme such as a section of a rural road or a GCM selected for improvement under the Project.

"PIO" Project Implementation Office established as special purpose unit by LGED for management and administration of the RTIP.

"Engineer" The Executive Engineer of the respective sub-project’s district.

"Consultant" The firm or design team engaged by the client to undertake either the investigation or the design or the construction supervision of the sub-project and shall include DSMC.

"DSMC" The firm engaged by the Client (LGED) for design, supervision and monitoring of the sub-projects under the Project. It refers to Design, Supervision and Monitoring Consultant.

"Designer" The person, group or groups that undertake the sub-project preparation and/or construction supervision.

"Contractor" The firm engaged by the LGED to implement a sub-project works.


"EMF" Environmental Management Framework for the RTIP.

"EMU" The Environmental Management Unit established by the LGED under the RTIP.

"DOE" The Department of Environment and includes the Director of DOE.

Other relevant terms can be found in Appendix 1.
1.4 ECP FORMAT

The ECP are presented in the following format:

**GENERAL PROCEDURES**

As set out in ECP 1 and which shall be read in conjunction with each code of practice.

**ENVIRONMENTAL CODES OF PRACTICE**

Each code is identified by a reference number e.g., ECP 02 - Participatory Consultation.

Each code sets out its objective and contains a description of practices that are to be applied to the planning, design, construction, and maintenance phases of the sub-projects.

Where applicable, the ECP also present sample design guidelines for use by the Consultants or Designers for planning and design, and sample specification clauses for insertion in a sub-project’s construction contract specifications.

1.5 MONITORING AND REVIEW

1.5.1 Monitoring and Non-compliance

The Environmental Management Unit (EMU) of the RTIP shall monitor the implementation of these ECP. The EMU shall undertake all duties assigned under all codes of practice as per the Environmental Management Framework (EMF) for the project, and may take the assistance of DSMC’s Environmental Engineers to physically monitor the sub-projects implementation and compliance with the ECP.

Where the Environmental Engineers of the EMU or DSM Consultant observe activities or conditions on sub-projects implementation work sites or on adjoining sites that do not comply with the requirements of the ECP, as incorporated under the construction contract documents, it shall forthwith make a written report to the Engineer to the Contract endorsing a copy to the Executive Engineer (XEN) of the EMU. On no account shall the Environmental Engineers give directions to any contractor or its staff, employed under a Contract with the LGED, Government of Bangladesh, in relation to any non-compliance. The report shall define the non-compliance with the ECP and shall note the time, date, and place of the non-compliance. The XEN of the EMU shall request the Engineer to the Contract to issue instructions to the Contractor to forthwith instigate procedures to correct the non-compliance and to avoid any recurrence of such non-compliance. The Engineer to the Contract shall confirm in writing to the XEN - EMU as soon as practicable after correction of the non-compliance.

1.5.2 Review of ECP

The XEN of the EMU shall review these ECP annually during the project implementation period or at such time that circumstances require the revision of, or addition to the ECP. For the purposes of review, the XEN of the EMU shall consult the Project Director and the World Bank. The review would include, but not be limited to, the following:

(a) Review the attainment of the objectives of the ECP.

(b) Reassess the need for training for all levels of personal engaged in the RTIP design and implementation.

(c) Recommend any amendments to or additions to the ECP.

The XEN - EMU shall submit a report to the Project Director on the findings of the Environmental Audit Team within 15 days of completion of the audit findings with recommendations in regard to any amendments to or additions to the ECP. The Project Director may approve such amendments or additions with information to the IDA.

1.6 TRAINING

The Environmental Management and Capacity Building Training at RTIP level would be covered under EMF. However, at sub-project level, the training would be organised and convened by XEN / UEs at least one month prior to start of construction activities. The stakeholders for sub-project level training would include concerned Union Panchad Members, Purushova Members, Community Leaders, NGOs, concerned...
Government Stakeholders like Utility Service Providers, Inland Water Transport Authority, Bangladesh water Development Board etc., Member of Ghat Management and Market Management Committees, Boat Owners Association etc

1.7 ELIGIBILITY TO TENDER FOR ROAD IMPROVEMENT WORKS

After a period of two years from the date of commencement of RTIP, eligibility to tender for local competitive bidding (LCB) for any construction work to be undertaken under the RTIP could be made conditional upon attendance of at least one training session as outlined in section 1.6 above by the following contractor’s personnel:

- Construction Manager
- Quality Manager
- Overseer
- Foremen

Proof of attendance at a training session by the above personnel would be by inclusion of the appropriate attendance certificates or the tender may be declared invalid.

1.8 ENVIRONMENTAL SCREENING PROCESS

As early as possible in the preliminary design process for any sub-project, the Project Director shall arrange to undertake environmental screening as per the requirements and process established under the Environmental Management Framework (EMF). The participatory consultation shall be undertaken as an integral part of the road selection, planning, design, and implementation stages of the sub-projects as per the Participatory Consultation Framework established under the RTIP (refer ECP 03).

The EMU, through the concerned Executive Engineer, shall complete the Environmental Screening and will ensure incorporation of the relevant provisions of the ECP into design and construction practices to reduce potential environmental impacts. The concerns and issues of the stakeholders will be identified and where possible mitigated through measures incorporated into the design.

The Environmental Screening Report, in addition to documenting the process outlined above, shall identify potential impacts from both the construction phase and post-construction phase of the respective sub-projects. The report accompanying the matrix of impacts shall identify each significant impact, and include a statement identifying the protection, management and mitigation measures that will be included in design and construction to reduce any adverse impacts. These may be included as a sub-project specific Environmental Management Plan (EMP), if so required by the EMF. The screening report and the EMP will need to be forwarded to the World Bank for information.

After screening and the assessment of the suitability of mitigation measures (identified in the EMP, if any), the EMU may require the DSMC to amend designs to address the concerns raised during the consultation, or incorporate additional mitigation measures consistent with these ECP. If the EMU is satisfied with the Screening report and mitigation measures (identified in EMP, if any) the EMU shall advise the DSMC that the sub-project can be implemented without further assessment. The EMU then informs the Project Director and the World Bank, in writing, that the sub-project has been screened out of the EA process.

The person responsible for preparation of the contract documentation shall ensure that all recommendations of the Project Director and the EMU are incorporated into the final design and contract documentation.

Where the XEN of EMU is not satisfied that the effects identified can be mitigated through design or incorporation of other measures, or the Environmental Specialist indicates that there is not agreement to any aspect of the process, the matter shall be referred to the Project Co-ordinator.

The Project Co-ordinator may initiate further investigation or consultation to satisfy any aspect of the screening process, or require a detailed study or mediation. The process required for either a detailed study or mediation is set out in the Environmental Management Framework.

**Design Guidelines:** The Designer shall submit the preliminary design to the XEN of the EMU for identification of issues and preparation of the screening report. The preliminary design shall be amended by the DSMC to take into account comments from the XEN of the EMU regarding environmental or safety issues. An amended screening report identifying the changes in design and environmental impact shall be submitted to the Environmental Audit Team (section 1.9).
1.9 ENVIRONMENTAL AUDITING

The sub-projects associated with the RTIP shall be subjected to an environmental audit as recommended under the EMF. The environmental audit report shall be submitted to the World Bank and the XEN of the EMU at the stages as prescribed in the EMF. The ECP may be reviewed and revised, as necessary, based on the findings of the audit.

1.10 COST ESTIMATES

The cost for the sub-project level training program to be conducted by the concerned Executive Engineers will be met from the overall project management budget or the EMP budget.
2 ECP 02: PARTICIPATORY CONSULTATION

2.1 OBJECTIVE

To establish the process of community consultation for meaningful participation of stakeholders / affected communities in selection, design and implementation of the sub-projects associated with RTIP, and to set out how consultation should be undertaken with the local community, NGOs and Union Panoshad (Road User's Committee constituted under the recently completed RRMIMP II)

2.2 GENERAL PRINCIPLE

In all aspects of SRR sub-projects, it shall be the responsibility of the EMU /PIO (LGED headquarter) to ensure that

✓ The information sharing process about the proposed SRR component, its scope, selection criteria, approach and methodology for effective and meaningful participatory consultation and community contribution during the selection, planning, design and implementation stages. The community consultation process will be as per the Participatory Consultation Framework established for the RTIP

✓ Stakeholders and affected communities (positively of adversely) have timely and meaningful inputs to, and participation in, any phases or aspects of the sub-projects including environmental and social screening process

✓ The sub-projects are sustainable, by adequate consultation with all affected communities, Union Parishad (UP), Thana Engineer, Thana Nirbahi, Market Management Committee, and present and potential road user groups

✓ Convene the Road Users Committees and Market Management Committee early in the planning and design phase to ensure that all concerns and issues of stakeholders and affected communities can be addressed and/or reflected in the selection, planning and design of sub-projects

✓ Planning and implementation methodology for the SRR and structures on feeder roads incorporates the provisions of this ECP as well as those of World Bank approved EMF and Participatory Consultation Framework requirements of this component

✓ The LGED complies with all requirements of the Environmental Management Framework as they pertain to consultation during the environmental screening and management process

2.3 CONSULTATION PROCEDURE

Consultation Procedure for SRR, RR1 & RR2

The overall process for consultation shall include the steps set out in the RTIP Consultation Framework for the Construction of SRRs, RR1 and RR2 (Annexure 3.1).

Consultation Procedure for GCM

Prior to commencing the participatory planning process, a site survey is required to establish the market site boundary and existing structures and facilities at the site. The survey team should include the Thana Engineer, Thana Nirbahi, Union Parishad, and the Market Management Committee.
The participatory planning process is initiated and organised by the District Sociologist and Thana Community Organiser while the Thana Engineer takes the lead role in overseeing and supervising the implementation of the participatory planning activities at the Thana level. It is the responsibility of the EMU / PIO (LGED headquarter) to ensure that all works implemented for market improvement sub-projects under RTIP are carried out in accordance with this process.

The following ten steps outline the participatory activities required for the planning and design phase of growth centre market improvement:

1. Planning meeting at the Thana level
2. Information / Publicity campaign
3. Conduct social investigation
4. Initiate group discussions with each market group and local bodies
5. Consolidate outputs of group discussions and prepare maps
6. Prepare participatory planning session
7. Conduct participatory planning session
8. Prepare preliminary design / Master Plan
9. Check / confirm proposed Master Plan at the site
10. Finalise proposed Master Plan and prepare tender documents

Once the proposed Master Plan has been completed the participatory process for the implementation phase can be initiated. The following steps and process are involved:

11. Approval of the proposed Master Plan and preparation for pre-implementation meeting
12. Conduct pre-implementation meeting
13. Fund raising and depositing of 10-20% local counterpart by users / Union Parishad
   Formation of monitoring committees
   Tendering works / selection of contractors
   Formation and training of labor groups / Labor Contracting Society
14. Awarding of tender / issuance of work order and implementation of works
   Monitoring and supervision of progress and quality of works, site visits and meetings,
   preparation of progress reports
15. Thana Engineer to prepare and submit closure report once all improvement work has been completed satisfactorily.

**Consultation Procedure for Environmental Enhancement**

RTIP presents a number of opportunities for providing environmental enhancement and roadside rehabilitation measures. Some of these measures, which may be undertaken under this project, are described hereunder:

**Rehabilitation of Degraded Areas** Apart from replacing trees that are lost through construction activities there is an opportunity to provide supplementary plantings in areas without trees which have experienced environmental degradation (e.g., soil erosion and/or loss of tree cover), particularly in market or village areas or future road side rest areas devoid of trees and areas along the banks of the rivers / canal / drains

**Rehabilitation of Borrow pits/drainage ditches along the roads** : Poorly drained ditches along the roads lead to stagnant water bodies with risk of disease or
accidents for local residents. Roadside ditches in village and market areas are prone to disposal of solid, liquid and even toxic wastes. New borrow pits excavated in these areas will exacerbate the problem.

**Improved Access to Community Water Supply** : Opportunity exists to provide improved access to the local village ponds located adjacent to the project roads / GCMs so that the community can more easily collect water, bathe and wash. The location of bathing and washing ghats may be provided in consultation with the local villagers.

**Development of Extracted Borrow areas as Fish Ponds** : Some of the recommended potential quarry sites are close to villages. After extraction of the blue metal, these sites will be developed as water tanks for multipurpose uses or as cattle troughs in consultation with the landowner and local villagers. The associated cost is included as the restoration cost of the selected quarries.

**Improvements to Existing and Additional Bus stops** : Frequently, pavements are not widened for bus stops and in some locations the widening is utilised by waiting passengers. The result of these circumstances is that buses frequently stop in the travelled lane to load and unload passengers. Widening of pavement at bus stops to provide pull outs for the bus and delineating a passenger waiting area by using paving stones will provide more safety as well as improved traffic flow. Where possible, new bus stops with sitting benches and drinking water facility may be added.

The participatory consultation shall include all the concerned sub-project-wise-stakeholders for the above-mentioned environmental enhancement measures. The selection of sites, design, mode of action and responsibility for its maintenance shall be discussed and finalised in the proposed consultation.

### 2.4 COST OF PARTICIPATORY CONSULTATION

The cost of participatory consultation shall be estimated in sub-project specific BOQs as per the guidelines given in EMF.
ECP 03: DESIGN AND EA PROCESS

3.1 OBJECTIVE

The main objectives of this ECP are to provide guideline on the EA process during design stage of the sub-projects associated with RTIP and to facilitate in adopting an EA mechanism, which is required to identify, assess and incorporate the environmental safeguards measures in the design and implementation of sub-projects.

3.2 STEPS INVOLVED IN EA PROCESS

The EA shall follow the operational requirement and adopt good practices as per the requirements / guidelines of Bank’s OP 4 01 / GP 4 01 and as detailed in Environmental Management Frameworks (EMF). During planning and design of sub-projects, EA process shall involve the following stages:

- Environmental Screening
- Preparation of LEA or EIA as required
- Preparation of EMP
- Integration of EMF / EMP / ECP in design and contract document

3.3 ENVIRONMENTAL SCREENING

Environmental screening shall be undertaken for all the sub-projects associated with RTIP. The main objectives of the environmental screening are:

- to identify the key environmental issues in the sub-projects,
- to determine the magnitude of actual and potential impacts,
- to ensure that environmental considerations are given adequate weight in selection and design of proposed sub-projects,
- to categorize the sub-project, and
- to recommend the type of environmental analysis recommended for the sub-project.

The above objectives will be met thorough undertaking credible number of sample case studies under each project component, establishing environmental screening criteria for each project components so as to ensure categorisation all the future sub-projects, based on a limited number of parameters. Based on the scale, magnitude and severity of impacts, all the sub-projects shall be categorised either as Category-1, Category-2 or Category-3. The three environmental categories identified for the RTIP are described below in the increasing order of potential impacts and thus level of environmental assessment.

**Category 3:** Sub-projects that are likely to have minimal or short-term impacts on the environment and that can easily be addressed through standardized mitigation measures. Normally such sub-projects do not require special studies other than filling in an Environmental Screening Format. It is recommended to undertake an environmental screening and to incorporate relevant provisions of the Environmental Codes of Practice (ECP) in the designs and contract documents.

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1 Potential impacts that could be considered to be limited to construction period only
2 Environmental Screening refers to a preliminary level of EA. It does not require sophisticated or expatiate environmental expertise and can be adequately completed by the Upazila / Assistant Engineers
Category 2: Sub-projects that have some moderately significant environmental impacts, that are site-specific in nature, and do not significantly affect human populations or alter environmentally important resources such as wetlands, natural forests, prime agricultural area etc. Few, if any, of the impacts are irreversible and in most cases, mitigation measures can be easily designed and implemented. For the sub-projects under this category, a Limited Environmental Assessment (LEA) and associated Environmental Management Plan (EMP) is recommended. The recommendations of the sub-project specific EMP shall need to be incorporated in the design and implementation plans of the sub-project.

Category 1: Sub-projects that have potentially significant adverse impacts that are sensitive, diverse, or unprecedented, or that could affect an area broader than the sites subjected to physical works. These sub-projects may have potential to set off a chain of other environmental impacts. Sub-projects under this category will require a detailed EA or Environmental Impact Assessment including a sub-project specific EMP. In addition, the process and outputs of the EA shall be subjected to an independent review and all the relevant provisions of the EMP will need to be incorporated into the design and bidding and construction contract documents.

3.4 INTEGRATION OF ECP/EMP

The ECP/EMP so prepared should be incorporated into the design and contract documents of various sub-projects for its effective implementation.

3.5 PUBLIC CONSULTATION AND PARTICIPATION

The public consultation with the concerned stake holders and their participation is a very useful and effective tool for proper planning, design and implementation of any sub-projects. Public consultation should be part and parcel of EA process right from the project selection to implementation and operation. The road users committees, market committees, project-affected communities (either beneficial or adverse) and local communities shall be involved in selection of sites, planning and design of various sub-projects.
ECP 04: MINIMISING CONSTRUCTION IMPACTS

4.1 GENERAL

Adverse environmental impacts during construction can arise from increased sediment load and fuel/oil spillage from vehicles and machinery, water pollution from effluent disposal, disturbance to local communities from increased construction traffic, noise and dust pollution and potential destabilisation of the river bank through erosion.

4.2 OBJECTIVE

To provide guidelines to mitigate potential adverse impacts on the environment from the construction of various sub-projects. These guidelines should be read in conjunction with the best operating practices outlined in ECP 15, ECP 17, ECP 19, ECP 20, ECP 28 (Planning, Design and Construction).

4.3 PLANNING AND DESIGN

The designer shall follow the general guidelines for planning and design for construction of various sub-projects to minimise short and long term adverse environmental effects as set out in ECP 15, ECP 17, ECP 19, ECP 20, ECP 28 (Planning, Design and Construction).

4.4 IMPLEMENTATION

4.4.1 Condition of Plant and Machinery

All plant, vehicles or machinery used near water bodies, within the river or on access roads to the river or in working areas for stockpiling shall be in good condition with no leaking fuel and/or lubricants including oil and grease.

**Suggested Specifications:** The contractor shall ensure that all plant, vehicles and machinery used in construction works are in good condition with no leaking fuel and/or lubricants including oil and grease. If any leak of fuel, oil or grease occurs the contractor shall immediately remove any relevant item of plant, vehicle or machinery from the site of the works and may not return such item to the site until all leaks have been repaired.

4.4.2 Minimise Downstream Adverse Environmental Effects

All practicable steps shall be taken to prevent an increase in the level of turbidity downstream of construction works. Such steps may include the construction of diversion channels, bunds with upstream settling areas or other screening systems that will minimise increased downstream turbidity.

**Suggested Specifications:** The contractor shall take all practicable steps to prevent an increase in downstream turbidity arising from construction works adjacent to or in river. Such practices may include the use of sediment control fences around abutment areas to prevent exposed soils susceptible to erosion from being transported into the watercourse by surface run-off. After construction is completed, mulching and hydro-seeding graded material should be carried out to protect the stream bank around abutments from erosion. The contractor shall take steps from time to time as may be required by the Engineer.
4.4.3 Measures to Reduce Release of Pollutants

Accidental releases of wet concrete and other pollutants (such as fuels, paint, solvents, asphalt, etc) to the watercourse may have a toxic effect on fish and other aquatic organisms. Specific measures to reduce the risk of accidental releases include enhancing safety and inspection procedures, and improving materials safe handling.

**Suggested Specifications:** The Contractor shall safely handle and store hazardous materials in accordance with the following requirements:

- Hazardous materials shall be stored above flood level and at least 30m from any watercourse.
- Hazardous liquid substances (e.g., petrol, diesel, oils) shall be stored on top of sealed plastic sheets in a secure, flat enclosed area. Bunded walls shall be at least 25cm high.
- All empty containers and drums shall be returned to the maintenance depot. It shall be ensured that all drums and containers are closed and not tipped over and all waste oil, lubricants, and solvents shall be stored in closed containers.
- The Contractor shall have an emergency procedure and will seek directions from the Engineer/DSM Consultant regarding the disposal of hazardous materials. Used lubricants and oils shall be collected and disposed of or recycled without causing pollution or a hazard to worker safety. Spills of hazardous materials within or outside enclosed storage areas shall be cleaned up immediately.
- Contaminated and torn or worn plastic sheets shall be disposed of appropriately.
- At all times when products are being handled or transferred, the Contractor shall take all precautions to prevent any product from being spilled, misplaced, or lost and possibly entering and contaminating the soil or a natural waterway.
- The Contractor shall not wash out tankers near watercourses. The contractor shall refuel or service equipment and vehicles at least 30m away from any watercourse. Refuelling over liner material with an absorbent pad (e.g., sand bed) will help to contain potential spills. If refuelling is done from a bulk tanker, the hose/nozzle assembly shall be replaced to its proper position upon completion.

4.4.4 Potable Water Supplies

If town or village water supply intakes are located within 200m upstream or downstream of a construction site for jetty, ghat, bridge, etc., temporary measures shall be taken to protect water supply quality during the construction phase.

**Suggested Specifications:** The contractor shall ensure that where town or village water supply intakes are located within 200m upstream or downstream of a jetty, ghat, bridges, etc., construction site, appropriate measures shall be undertaken to protect water supply quality during construction. These measures will include temporary relocation of the water supply intake away from the construction site or treatment of water through filtration, etc.

4.4.5 Fuel Storage and Refuelling

No fuel storage area or refuelling of plant, vehicles or machinery shall be located within or adjacent to any river or within any river floodplain. All fuel storage areas shall be bunded to prevent the escape of spilled fuel or lubricants.

**Suggested Specifications:** The contractor shall ensure that fuel storage areas are located at an elevation above any likely flood level. All fuel storage areas and refuelling activity shall be undertaken within a bunded area to prevent the escape of spilled fuel or lubricants. Access to the bunded area shall be protected by an appropriate concrete lined drain which shall discharge through a purpose built oil or grease trap prior to discharge into a grassed swale that shall lead to a natural watercourse.
4.4.6 Air Pollution

Suitable precautions shall be taken to minimise the impacts on people and the environment from noise and dust pollution. Construction activities shall be confined to reasonable working hours, all machinery and plant shall be well maintained and operated within specifications and newly worked exposed soil surfaces shall be regularly watered to minimise dust pollution.

**Suggested Specifications:** With respect to air pollution from construction activities, the contractor shall ensure that:

- construction activities are confined to daylight hours where houses are located within 200m of a construction site;
- all machinery and plant are maintained and operated within manufacturer's specifications;
- newly worked exposed soil surfaces shall be regularly watered to minimise dust pollution;
- where the construction site is located adjacent to a market, construction activities are minimised on market "hat" (operating) days.

4.4.7 Site Restoration

At the completion of construction works, all plant, machinery and vehicles and any temporary structures will be removed from specifically where it is located in river bed immediately on completing operations.

4.4.8 Archaeological Sites

Should any archaeological sites be discovered during any stage of jetty construction such work shall cease immediately and the Directorate of Archaeology notified forthwith. On no account shall construction activities continue until authorised by the Directorate of Archaeology.

**Suggested Specifications:** If the contractor locates any archaeological site or suspected archaeological site he shall immediately cease operations and notify the Engineer forthwith. On no account shall construction work continue until authorised by the Engineer.
ECP05: VEGETATION MANAGEMENT

5.1 GENERAL
The potential for felling of roadside avenue trees is minimal due to the sub-projects associated with RTIP. However, in order to take care of any unforeseen eventuality and to promote good operating practices on works that ensures proper vegetation management, this ECP should be implemented to the extent applicable and practical.

5.2 OBJECTIVES
To provide best practice guidelines on protection, conservation and enhancement of vegetation cover during implementation of sub-projects associated with RTIP.

5.3 BEST PRACTICES
5.3.1 Vegetation - Only Do What You Have To Do
Objective: Protect existing trees, shrubs and groundcovers. Protection is more effective economically and environmentally than it is to replant them.

Remember:
- Healthy vegetation is an asset. The unnecessary disturbance of healthy vegetation, (trees, shrubs and ground layer species)
  - encourages weeds, which compete with native plants and increase maintenance costs,
  - can prevent the regeneration of native plants,
  - increases the risk of soil erosion and stream sedimentation,
  - increases cost of restoration,
- The fine feeder roots occur in the top 30-cm of soil and the larger, deeper roots act as ‘anchors’;
- Vehicle activity under trees or over vegetation can damage native vegetation and compact the soil, stopping air from reaching the roots;
- Fill material prevents water and air from reaching the roots, causing root death. It may also cause trunk rot. Where fill is unavoidable, try to retain the fill beyond the drip line;
- Cuts and trenches can damage the essential fine ‘feeder roots’ of the tree. Damage to roots can also make the tree unstable; and
- When root removal cannot be avoided, leave a clean-cut edge to the root. Roots greater than 50mm in diameter should be retained where possible.

Best Practices:
✓ Only disturb the minimum amount of soil and native vegetation that is required to do the works or activity.
✓ Work outside the drip line of a tree to reduce damage to the roots, trunk and limbs where possible.
✓ Store materials and equipment away from trees.
✓ Confine the driving or parking vehicles to within the designated work area.
✓ Fence off areas where identified native vegetation is threatened by vehicular activity or the storage of materials or equipment, by using woven mesh barriers, wire fencing or large logs.
✓ Place fill material outside of the drip line of trees and shrubs.
✓ Keep soil cuts and trenching away from the drip line of trees where possible.
5.1.2 Revegetation Program

Objective: To re-establish native vegetation through responsible revegetation program

Best Practices:
- Where works are likely to modify the existing vegetation, a management plan for the rehabilitation of that vegetation must form part of any sub-project design and must ensure that revegetation replaces and enhances the vegetation cover and species diversity that exists at the works site.
- Responsibility for rehabilitation after disturbance to a site rests with the LGED
- Maintenance of rehabilitated sites for up to two years post planting to be undertaken by the group performing the works or engaged LCS
- Encouraging natural regeneration as much as possible
- Plant vegetation in accordance with best horticultural practices

5.1.3 Stay Within the ‘Construction’ Zones

Objective: To limit all activities to a defined area, reducing disturbance to surrounding vegetation

Remember:
- The ‘Construction Zone’ is the area clearly marked where all construction activities take place (such as the area stripped for construction of sub-projects, stockpile areas, compounds, access routes, etc.)
- By carrying out activities from within the ‘Zone’ minimum disturbance to vegetation results

Best Practices:
- Stay within the defined construction zone and access tracks during construction works

5.1.4 Vehicle and Machinery Activity

Objective: To minimise disturbance to indigenous vegetation (trees, shrubs and groundcover) by using the appropriate type and minimum size of machine for the job, and confining vehicular activities to designated areas

Best Practices:
- Select the type and size of machinery appropriate for the task to minimise disturbance to vegetation
- Park machinery in a cleared area, in a designated wayside stop, parking lot or on private land (where permission has been granted).
- Site machinery compounds clear of trees, shrubs and ground covers. In no circumstances should vegetation be removed to provide for the siting of machinery compounds or storage of materials
- Service vehicles and machinery on the roadside at a designated location only when it is not possible to move to a more appropriate site. Great care must be taken to ensure that no spillage results from any servicing operation
- Confine machinery to the existing road formation, proposed alignment, access tracks or designated construction zone unless otherwise directed by the site supervisor
- Turn vehicles and machinery within the Construction Zone or on cleared sites or sites that have minimal indigenous vegetation.
- Avoid drip lines of trees to minimise root damage and soil compaction around tree root systems from machinery.

5.1.5 Vegetation Canopy Clearance above Roads

Objective To obtain minimum height clearance of vegetation overhanging roads with the least impact on the roadside vegetation
Best Practices:
- Retain a minimum height of 5 metres clearance height from the established road formation (roads surface and shoulders) to the vegetation overhang
- Remove only those limbs necessary to obtain the minimum clearance
- Prune trees carefully

5.1.6 Vegetation Management During Works

Vegetation Removal

Objective: Clear only the minimum amount of vegetation required

Remember:
A Vegetation Clearance Plan should be got approved from the Engineer before trees or vegetation are removed or pruned

Best Practices:
- Prior to commencing any works ensure that the Contractor has obtained the appropriate permissions.
- Consider the following points before any action is taken
  - Safety of staff, property and road users;
  - The effect of the tree removal on the appearance of the roadside, and
  - The historical and cultural significance of the tree
- Remove only vegetation required for construction (marked vegetation only) and for safety;
- Trees should be felled into the construction zone, not into undisturbed vegetation;
- Trees removed from outside of the construction zone must be felled by cutting off at ground level to minimise disturbance to the surrounding vegetation. Removal of trees complete with root systems causes unnecessary soil and vegetation disturbance
- Removed vegetation can be chipped for mulch and spread on exposed areas to assist with the spread the local seed,

5.1.7 Prune Trees Carefully

Objective: Selective, and careful, pruning of trees wherever possible can often reduce the need for tree removal, resulting in preservation of those trees and minimal soil disturbance.

Best Practices:
- Prior to commencing any works, and where required, ensure you have the appropriate permissions/Consents.
- To avoid damage to the bark below the cut, use the three cut method on all but the smallest branches
- Where possible hollow bearing trees should only have weight reduction of the crown so that minimal loss of tree hollows occurs

5.1.8 Avoid ‘Tidying Up’ Vegetation

Objective: To prevent the unnecessary removal of vegetation as sites are tidied up.

Remember:
- Thinning out of plants or plant removal causes unnecessary disturbance to the soil, vegetation, and wildlife habitat and spreads weeds
- Exposed soil can also be subject to erosion leading to siltation of drainage lines and damage to aquatic environments
- Minimal disturbance avoids costly ground repairs after construction
Best Practices:

- Do not grade or excavate beyond the site or spread topsoil into native vegetation
- Leave vegetation undisturbed wherever possible during construction
- Avoid leaving earth bare and subject to erosion
- Identify and mark out areas of intact (quality) native vegetation prior to commencing works

5.1.9 Weeds - Be Aware of Noxious Weeds

Objective: To identify the particular weed threat to the roadside on which an activity is to be undertaken

Remember:

Noxious weeds are plants that are declared to be a serious threat to agriculture and the environment. Noxious weeds can be spread during activities, which disturb vegetation or the soil.

Best Practices:

- Prior to the commencement of any construction activity identify existing weeds at the site.
- Ensure weed management is incorporated in contractor's EMP.
- Dispose of noxious weeds at a designated dumpsite, or burn on site in a cleared area.
- Monitor designated weed dumpsites and prevent weeds from spreading off the site.

5.1.10 Weed Control

Objective: To prevent the spread of weeds by vehicles and machinery

**Water Hyacinth:** One of the obnoxious plants, which occur in abundance in Bangladesh, is water hyacinth. It spreads very fast and replaces native plants and does substantial damage to agricultural lands and crops. While construction activities on the bridges, culverts, jetties, and ghats, weed control measures would need to be incorporated by the contractor.

Best Practices:

- Identify areas of weed prior to commencing any works.
- Work from weed-free (clean) areas into weed-affected areas of the works site.
- Before being transported to any new location, vehicles and machinery to be cleaned of all soil and washed down thoroughly at a designated washdown area (e.g., Depot).

**Suggested Specification:** The Contractor shall limit its area of work to the minimum possible and shall disturb a minimum amount of soil and vegetation that is required to do the works or activity. The Contractor shall work outside the drip line of a tree to reduce damage to the roots, trunk, and limbs where possible. The Contractor shall store materials and equipment away from trees and confine the driving or parking vehicles to within the designated work area. The Contractor shall fence off areas where identified vegetation is threatened by vehicular activity or the storage of materials or equipment, by using woven mesh barriers, wire fencing, or large logs. In case of any damage to the vegetation by the Contractor's acts of negligence, he shall have to re-vegetate the disturbed area to the entire satisfaction of the Engineer. The Contractor shall undertake the improvement works in such a manner that no obnoxious plants are spread to the areas free of such weeds.

5.1.11 Cost of Revegetation

The cost of revegetation shall be estimated for applicable sub-projects and included in BOQ for Environmental Management and Enhancement Budget.
ECP06: CONSTRUCTION CAMPS

6.1 OBJECTIVES
To provide guidelines on the selection, development, maintenance and restoration of construction camp sites in order to avoid or mitigate against significant adverse environmental effects, both transient and permanent.

6.2 SITING
During planning of the works consideration shall be given to the location of construction camps for the sub-project. Construction camps and areas identified that may be suitable for the development of such camps shall be raised in the course of public consultation. Areas that are not suitable for reasons such as environmental, cultural or social sensitivity shall also be identified.

Wherever possible construction camps shall be planned in areas that will have minimal adverse environmental effects. In identifying such areas particular care shall be taken to evaluate the adverse affects of water, noise and air pollution, which, although transient, will preclude the use of some areas as construction camp sites.

Suggested Design Guideline: The location of construction camps shall be considered during planning. As a result of public consultation a schedule of sites that are inappropriate for such use in terms of social or cultural values or in terms of their physical environment shall be identified. A schedule of such sites shall be prepared and supplied to the designer and contractor. Location of construction camps within floodplains shall be avoided.

6.3 LOCATION
Construction camp sites shall be located such that permanent adverse environmental effects can be avoided or mitigated against and transient adverse environmental effects are minimised. Camp sites shall not be located in areas identified during the planning stage as unsuitable for such use.

The site or sites shall be selected such that mitigation measures stipulated in this ECP can be implemented with reasonable facility.

Suggested Design Guideline: The consultant shall consider appropriate locations for construction camps during the design of work. The consultant shall also specify a schedule of sites identified during the planning stage as unsuitable as well as sites which are unsuitable in terms of topography, proximity to water courses, and environmental sensitive areas such as forests, wetlands, or other sensitive areas. The consultant may specify the actual site of the construction camp or he may specify the conditions that are to be met by the contractor in selecting, developing, maintaining and restoring such campsites.

6.4 PRIVATE LAND
Where construction camps are to be located on land outside the road reserve the contractor shall obtain the approval of the landowner to establish the camp site on such land and pay agreed compensation as per the RTIP Resettlement and Rehabilitation Framework. Environmental protection measures established by this ECP shall apply to all land regardless of ownership.

Suggested Specifications: Unless otherwise specified the contractor is at liberty to make his own arrangements with landowners to establish construction camps. Prior to the development of such camps, the contractor shall submit to the Engineer the signed authority of the landowner for the contractor to establish the construction camp on any land, after proceeding as per the RTIP Resettlement Framework.

The contractor shall also submit to the Engineer the following information signed by the landowner and the contractor: details of compensation to be paid, agreed period of tenure, any specific requirements of the landowner, photographs of the site in its original condition, and details of proposed and agreed site restoration after completion of the project works.
At the completion of the contract works the contractor shall submit to the Engineer a signed statement from the landowner confirming that the compensation has been paid and that the landowner is satisfied with the restoration of the site. If such a statement is not submitted the Engineer may withhold moneys owing to the contractor in a sum sufficient to pay for the compensation and the site restoration, if necessary.

6.5 CONSTRUCTION CAMP FACILITIES

The construction camp shall be provided with the following minimum facilities.

- A perimeter security fence at least 2m in height constructed from appropriate materials.

- Ablution block with a minimum of one water closet toilet, one urinal and one shower per 10 personnel engaged either permanently or temporarily on the project. Separate toilet and wash facilities shall be provided for male and female employees.

- A sick bay and first aid station.

- Areas for the storage of fuel or lubricants and for a maintenance workshop. Such an area shall be bunded and have a compacted/impervious floor to prevent the escape of accidental spillage of fuel and lubricants from the site. Surface water drainage from bunded areas shall be discharged through purpose designed and constructed oil traps. Empty fuel or oil drums may not be stored on site.

- Low cost sanitation facilities to provide treatment for wastewater discharges from toilets, wash rooms, showers and the like. The standard of treatment to be achieved at all times is bacterial oxygen demand (BOD₅) less than 30 ppm, suspended solids less than 50 ppm.

- Stormwater drainage system to discharge all surface run off from the camp site to a silt retention pond which shall be sized to provide a minimum of 20 minutes retention for stormwater flow from the whole site that will be generated by a 20 year return period rainfall having a duration of at least 15 minutes. The run-off coefficient to be used in the calculation of the silt pond volume shall be 0.9. Silt ponds shall be maintained in an efficient condition for use throughout the construction period with trapped silt and soil particles being regularly removed and transported and placed in waste material disposal areas as per ECP 11.

- All discharge from the silt retention pond shall be channelled to discharge to natural water via a grassed swale at least 20 metres in length with suitable longitudinal gradient.

- All camp facilities shall be maintained in a safe clean and or appropriate condition throughout the construction period.

6.5.1 Construction Camp Development Plan

A development plan of the construction camp shall be prepared describing the following:

- Perimeter fence and lockable gates.
- Workshop.
- Accommodation.
- Ablutions.
- Water supply.
- Wastewater treatment and disposal system.
- Bunded fuel storage area.
- Proposed power supply.
Suggested Specifications: Within 14 days of the commencement date the contractor shall submit to the Engineer for approval a detailed layout plan for the development of the construction camp showing the relative locations of all temporary buildings and facilities that are to be constructed together with the location of site roads, storage areas and drainage facilities. The contractor shall also submit brief specifications for the materials to be used for the construction of all buildings and facilities and defining the standard of construction for all works to be undertaken on the camp site. In preparing such drawings and specifications the contractor shall incorporate the following minimum requirements:

- The site shall be secured with a security fence at least 2m in height of appropriate design and shall be constructed from galvanised posts and wire.
- Areas for the storage of fuel or lubricants or where machinery or equipment is to be serviced shall be bunded and have an impervious floor to prevent the escape of accidental spillage of fuel or lubricants from the site. Drainage of such bunded areas shall be through purpose designed and constructed oil traps.
- A minimum of one water closet toilet, one urinal and one shower shall be provided per 10 personnel employed either permanently or temporarily on the works. Separate toilet and wash facilities shall be provided for male and female employees.
- All discharge from toilets, washrooms, showers facilities and the like shall be piped to a purpose designed sewage treatment facility prior to discharge to a natural watercourse. The standard of treatment to be achieved shall be such that the following effluent standards are achieved at all times:
  - Bacterial oxygen demand (BOD₅) less than 30 ppm
  - Suspended solids less than 50 ppm
  - All stormwater drainage from the site shall be channelled or piped to a silt retention pond prior to discharge from the site. The retention pond shall be sized to provide a minimum of 20 minutes retention for stormwater flow from the whole site that will be generated by a 20 year return period rainfall having a duration of at least 15 minutes. The run-off coefficient to be used in the calculation of silt pond volume shall be 0.9.
  - All discharge from the silt retention pond shall be channelled to discharge to natural water via a grassed swale at least 20 metres in length with suitable longitudinal gradient.
  - All camp facilities shall be maintained in a safe, clean, and appropriate condition throughout the construction period. The silt retention pond shall be maintained in efficient condition throughout the construction period. Trapped silt and soil shall be periodically removed and transported and placed in waste material disposal areas.
  - The contractor shall provide, equip, and maintain adequate first aid stations and erect conspicuous notice boards directing where these are situated and provide all required transport. The contractor shall comply with the government medical or labour requirements at all times and provide, equip and maintain dressing stations where directed and at all times have experienced first aid personnel available throughout the works for attending injuries.

6.6 SITE RESTORATION

At the completion of the construction work, all construction camp facilities shall be dismantled and removed from the site and the whole site restored to a similar condition to that prior to the commencement of the works or to a condition agreed to with the owner of the land.

All oil or fuel contaminated soil shall be removed from the site and transported and buried in waste soil disposal areas.

Suggested Specification: At the completion of the construction work the contractor shall dismantle and remove from the site all facilities established within the construction camp including the perimeter fence and lockable gates. The whole of the construction camp site shall be grassed and if trees originally grew on the site they shall be replaced with similar tree species. At the completion of restoration the site shall...
be restored to its condition prior to commencement of the works or to an agreed condition with the landowner.

All oil or fuel contaminated soil shall be carefully removed from the site and transported and burned in waste soil disposal areas.
ECP 07: BORROW AREAS DEVELOPMENT AND OPERATION

7.1 OBJECTIVE

To prescribe the specific requirements for the development and operation of borrow areas as well as to define procedures and works that shall be used to mitigate against adverse environmental effects.

7.2 PLANNING AND DESIGN

7.2.1 Location

During the planning of a rural road improvement sub-project, potential borrow areas may be identified in consultations with the local community. Alternatively, environmental and social criteria may be stipulated that need to be satisfied by the contractor while selecting appropriate borrow areas.

**Design Guideline:** The DSMC shall identify, if possible, potential borrow areas that may be used for the implementation of the sub-project. Such potential areas shall be identified on plans drawn to an appropriate scale and the plans shall be displayed and discussed during public consultations. Alternatively, the DSMC shall specify environmental and social criteria for selecting the borrow areas by the Contractor. Such environmental and social criteria shall take into account the site conditions, community opinions and relevant statutory laws and regulations of Bangladesh.

7.3 CONSTRUCTION

7.3.1 General Principle

The right to create borrow pits is generally negotiated between the contractor and individual landowners. Farmers often sell topsoil for fill materials on assumption that the topsoil will be replenished during the next flood. The contractor should preferably obtain earth from sites at proposed potential fish ponds or alternatively they should minimise the loss of valuable agricultural land by removing a thin layer of soil from a wide area. If the fill materials are taken from farm topsoil or upper layer, the contractor should ascertain that the silt deposition is sufficient to rehabilitate the farmland within three years and the deposited soil is not at the expense of the fertility of adjacent properties. Farmland should be given the lowest priority in sourcing the fill materials. Farmland should be used only if there is no other alternative within 5 km of the construction site. The use of dredged materials from rivers should be given priority especially if the materials are sandy and relatively free from organic materials compared to farmland topsoil. Organic materials will decay and reduce the stability of the road. The second preferred source of fill materials is excavation from pond construction. If the borrow pit is not used for aquaculture, the side of the pit must be compacted to prevent soil erosion and fish and other aquatic life introduced to control insects such as mosquitoes.

**Suggested Specifications:** The Contractor in consultation with the community and landowners shall identify Borrow pits outside the road reserve. A borrow area management (development and rehabilitation) plan should then be prepared. The plan shall be approved by the Engineer before commencing work. Before opening additional borrow pits, operating pits shall be closed by the Contractor as per the agreed rehabilitation plan. The following principles for location, depth and drainage of borrow pits shall be followed:

- Earth for the embankment should be obtained
  - from barren land or land without tree cover outside the road reserve,
  - by excavating land and creating new water tanks/ponds,
  - from land acquired temporarily outside the road reserve.
• from excavation of proposed culverts;
• from river bed (in accordance with ECP 08 River Sand Extraction)

☑ Borrow pits shall be rectangular in shape with one side parallel to the centre line of the road and generally maintain the form of the land;

☑ No borrow pits shall be dug within 5 m of the toe of the final section of the road embankment,

☑ Borrow pits shall be dug continuously. Ridges of not less than 8m width shall be left at intervals not exceeding 300m and small drains should be cut through the ridges to facilitate drainage;

☑ To ensure efficient drainage, the bed level of the borrow pits shall, as far as possible, slope down progressively towards the nearest cross drain, if any, and shall not be lower than the bed of the cross-drain;

☑ When it becomes necessary to borrow earth from temporarily acquired cultivable lands, the depth of borrow pits shall not exceed 45 cm. The topsoil to a depth of 15 cm shall be stripped and stockpiled for later rehabilitation of the pit. Thereafter, soil may be dug out to a further depth not exceeding 30 cm and used in forming the embankment. Once the borrow pit is no longer required, the stockpiled top soil shall then be spread back on the land;

☑ Borrow pits shall not be located within 500m of any identified archaeological, religious or cultural sites.

☑ Haulage of material to embankments, or other areas of fill, shall proceed only after sufficient spreading and compaction plant is operating at the place of deposition.

☑ Recommended mitigation measures for rehabilitation and restoration of borrow areas are:
  • if used for agriculture, stockpiled topsoil should be returned to the borrow pit;
  • if used as a fish pond, the banks should be stabilised by compaction and any additional excavated material disposed of in accordance with good operating practice;
  • for all other uses, stockpiled topsoil should be returned to the borrow pit and all worked areas stabilised through revegetation using local plants.

☑ Sediment shall be controlled at each site by ensuring that base of the borrow pit drains into a sediment trap prior to discharging from the site.

After obtaining approval from the Engineer, the Contractor shall locate and peg out the full extent of proposed extraction areas prior to the use of a borrow area. For location, depth and drainage of borrow pit, the principle criteria mentioned above shall be followed by the Contractor. Once borrow pit sites have been determined they will be inspected by the DSMC.

The borrow areas shall be rehabilitated as per the provisions of the approved rehabilitation plan.
ECP 08: RIVER SAND EXTRACTION

8.1 OBJECTIVE

To provide planning and construction guidelines for the extraction of river sands for construction purposes with particular regard for the need to avoid or mitigate adverse environmental impacts from such activity.

8.2 PLANNING AND DESIGN

8.2.1 GOB’s Guidelines

This ECP shall be read in conjunction with the Guidelines for Sand Dredging. Where a catchment management plan has been developed by Bangladesh Water Development Board for any catchment from which river sand extraction is to be undertaken, all work shall comply with the requirements of the plan.

*Design Guidelines*: When planning the extraction of river sand for construction works the consultant shall make reference to and conform with the Guidelines for Sand Dredging. When undertaking the environmental screening, the EMUI DSMC shall identify the potential impacts of proposed sand extraction and shall include the subject of river sand extraction in public consultation to be undertaken for the sub-project.

8.3 EXTENT OF EXTRACTION

Where river sand extraction is considered for the production of aggregates and filing material, the total quantity of sand to be extracted shall be estimated and the corresponding volume of river sands shall be identified in terms of length, breadth, and depth of river over which sand extraction is likely to be undertaken. This information shall be made available to the public during consultation.

*Design Guideline*: The consultant shall estimate the total volume of sand extraction to be undertaken for one sub-project under each components of project, in order to produce the required volume of aggregates and filing material that are required. The corresponding length, breadth and depth of river over which sand extraction is likely to be undertaken shall be made available to the public during consultation.

8.3.1 Sand Quality

Prior to scheduling river sand extraction for any sub-projects, sufficient physical and/or chemical tests on representative samples of sand shall be undertaken to ascertain that sand deposits within reasonable proximity to any sub-projects will in fact yield sand of sufficient quality for the proposed end use.

The constituents of river sand and silt shall be determined in order to assess the percentage of material contained within a sand deposit that is in fact useable for the sub-project.

The feasibility of separating useable material from unsuitable material shall be assessed and the percentage of useable material shall be taken into account in assessing the extent of extraction.

*Suggested Design Guideline*: The consultant shall undertake such investigation and testing as is necessary to ascertain the quality of river sands located within reasonable proximity to the site of the sub-project and shall estimate the quantity of useable sand as a percentage of the total volume of sand to be extracted. This information shall be documented and used in the compliance with Section 8.3.1 of this ECP.
8.4 CONSTRUCTION

8.4.1 Licences and Permits

No sand shall be extracted from any river unless the required licences or permits are obtained from the District Collector. Sand extraction shall not proceed when a river is in flood or during periods of heavy or seasonal (cyclonic) rains. No sand extraction may proceed other than during daylight hours.

Suggested Specification: The contractor shall apply for and obtain any licence or permit to extract sand from any river or river mouth, prior to commencement of any extraction work. The contractor shall pay any relevant fees or royalties. Despite the issue of a licence or permit, no sand extraction shall proceed when a river is in flood or during periods of heavy or seasonal (cyclonic) rains. No sand extraction may proceed other than during daylight hours.

8.4.2 Extraction Management Plan

For every road project where sand is to be extracted, an extraction management plan shall be prepared. The plan shall identify the extremity of the river over which extraction is to be undertaken and shall define the depth of excavation and the proximity to the banks of the river of the proposed excavation. It shall define all existing trees and vegetation within the bed and banks of the river in the vicinity of the proposed excavation as well as all other topographical features including buildings and fences.

The management plan shall define the condition of all plant and machinery to be used in the extraction process. It shall also describe likely short term downstream effects including any effect on potable water supplies.

The plan will define proposed stockpiles of extracted materials and the proposed working area for loaders and trucks. It shall also define the location of vehicular access from any public road to the sand deposit.

The plan shall be submitted to and approved by the LGED and Bangladesh Water Development Board prior to commencing sand extraction.

Suggested Specification: The contractor shall prepare a sand extraction management plan for the extraction of sand from any river. Where the extent of any river from which sand is to be extracted is specified the extent of extraction shall be limited by the specified length. Where the extent is not specified the contractor shall define the required extent and show same on the management plan.

The plan shall define the depth of excavation, proximity of excavation to any river bank, and all topographical features including houses, fences and vegetation within the bed and banks of any river in the vicinity of the proposed excavation. It shall also define the location of proposed stockpiles of extracted materials, and the proposed working area for loaders and trucks. The plan shall also show the location of vehicular access from any public road to the sand deposit.

All temporary drains and silt retention fences installed to trap sediment run off from the stockpiles and working area shall be shown. The location of stockpiles of sand together with all temporary drains and silt fences for sediment retention shall be detailed.

The plan shall be submitted to and approved by the LGED and Bangladesh Water Development Board prior to commencing sand extraction.

8.4.3 Vegetation Protection

All vegetation within the bed and banks of the river shall be protected throughout sand extraction activity and no trees shall be removed for the purposes of sand extraction.
Suggested Specification: The contractor shall protect all vegetation in the bed and banks of a river from damage or disturbance by sand extraction works at any extraction site. The removal of any trees is prohibited without the written direction of the Engineer.

8.4.4 Protection of River Banks

Throughout sand extraction activities all river banks shall be protected from damage. No excavation of sand material shall be undertaken in proximity to a river bank such that instability of the bank will occur. In any case no excavation shall be undertaken closer to the toe of any bank than a distance equal to twice the height of the adjacent bank.

River banks may not be excavated to form access ramps (in case of existing BWDB embankment) into the river. If such ramps are necessary they shall be formed by ramping excavated river sand against the river bank to form such an access ramp. At the completion of extraction any access ramp shall be removed and the material spread evenly over the adjacent river bed.

Any damage to river banks shall be repaired.

Suggested Specification: The contractor shall protect river banks from damage throughout the conduct of sand extraction works. Should any damage occur it shall be immediately repaired with permanent materials to the complete satisfaction of the Engineer. No excavation of sand shall be undertaken in proximity to a river bank such that instability of the bank will occur. In any case no excavation shall be undertaken closer to the toe of the bank than a distance equal to twice the height of the adjacent bank. River banks may not be excavated to form access ramps into the river. If such ramps are necessary they shall be formed by ramping excavated river sand against the river bank to form such an access ramp. At the completion of extraction any access ramp shall be removed and the material spread evenly over the adjacent river bed.

8.4.5 Condition Of Plant and Machinery

All plant, vehicles or machinery used within the river or on access roads to the river or in working areas for stockpiling shall be in good condition with no leaking fuel and/or lubricants including oil and grease.

Suggested Specification: The contractor shall ensure that all plant, vehicles and machinery used in relation to sand extraction works are in good condition with no leaking fuel and/or lubricants including oil and grease. If any leak of fuel, oil or grease occurs the contractor shall immediately remove any relevant item of plant, vehicle or machinery from the site of the works and may not return such item to the site until all leaks have been repaired.

8.4.6 Minimise Downstream Adverse Environmental Effect

All practicable steps shall be taken to prevent an increase in the level of turbidity downstream of the extraction works. Such steps may include the construction of diversion channels, bunds with upstream settling areas or other screening systems that will minimise increased downstream turbidity.

Suggested Specification: The contractor shall take all practicable steps to prevent an increase in downstream turbidity arising from sand extraction works.

The contractor shall take such steps from time to time as may be required by the Engineer.

8.4.7 Potable Water Supplies

No sand extraction works may be undertaken within a distance of 1000 metres upstream or 200 metres downstream of any town or village water supply intake system.
Suggested Specification: The contractor shall not undertake any sand extraction works within a distance of 1000 metres upstream or 200 metres downstream of any town or village water supply intake system.

8.4.8 Fuel Storage and Refuelling

No fuel storage area or refuelling of plant, vehicles or machinery shall be located within or adjacent to any river or within any river floodplain. All fuel storage areas shall be bunded to prevent the escape of spilled fuel or lubricants. All oil traps, drains and site restoration procedures shall be as for ECP 06.

Suggested Specification: The contractor shall ensure that fuel storage areas are located at an elevation above any likely flood level. All fuel storage areas and refuelling activity shall be undertaken within a bunded area to prevent the escape of spilled fuel or lubricants. Access to the bunded area shall be protected by an appropriate concrete lined drain which shall discharge through a purpose built oil or grease trap prior to discharge into a grassed swale that shall lead to a natural water course.

8.4.9 Site Restoration

At the completion of sand extraction for any one sub-project the river bed is to be restored to an even profile. All sand heaped up during the process of removal shall be spread evenly over the river bed, or spread into any diversion channel. All access ramps shall be demolished and the material spread evenly over the river bed.

All plant, machinery and vehicles and any temporary structures shall be removed from the river bed immediately on completing operations.

8.4.10 Archaeological Sites

Should any archaeological sites be discovered during any stage of sand extraction works such work shall cease immediately and the Directorate of Archaeology notified forthwith. On no account shall extraction work continue until authorised by the Directorate of Archaeology.

Suggested Specification: If the contractor locates any archaeological site or suspected archaeological site he shall immediately cease operations and notify the engineer forthwith. On no account shall extraction work continue until authorised by the Engineer.
9.1 OBJECTIVE

To provide guidelines for safe storage, handling, and transfer of materials to minimise any adverse impacts on the environment due to such operations.

9.2 GENERAL

Activities related to materials storage, handling, and transfer that are considered to potentially have negative environmental effects include:

- storage, handling, and transfer of petroleum, oil, and lubricant (POL) products,
- application of asphaltic concrete and asphalt binder,
- storage and handling of hazardous materials other than POL products, and
- Storage and application of road salt and sand.

Some materials used during implementation of sub-projects associated with RTIP may have potentially hazardous effects on the environment if not properly stored and handled.

9.3 ENVIRONMENTAL CONCERNS WITH MATERIALS USED FOR CONSTRUCTION AND MAINTENANCE OF SUB-PROJECTS

Concerns are related to accidental releases into the environment, such as spills, refueling losses, and leakage from equipment that could result in contamination of soil, groundwater, or surface waters.

Groundwater may transport the contaminants off-site to down-gradient aquifers or water supplies, or discharge them into surface waters. Therefore, release of potential contaminants on the ground surface could have significant environmental impacts that could ruin groundwater (well supplies).

9.3.1 PETROLEUM, OIL, AND LUBRICANTS

The toxic effect of a petroleum product in the aquatic environment varies considerably due to the different chemical composition of each petroleum product. The toxicity of petroleum products is related largely to its solubility in water. Petroleum pollution from accidental spills may affect aquatic birds, fish and vegetation. The effects of oil on birds’ feathers (loss of insulation) is an important cause of death. Oil polluting the water may also be toxic to birds if they ingest it. Plants in marshes or in wetlands (haor, baor, ponds and others) and steams may die off for short periods. Long-term impacts of spilled petroleum products are associated with the portion, which sinks and becomes incorporated into bottom sediments. This causes the petroleum products to degrade very slowly and they may persist for many years.

Petroleum products can stick to the gills of fish and interfere with normal respiration. Under relatively mild pollution, fish may produce mucus as a defensive mechanism to remove the oil. However, in heavy pollution, this mechanism is inefficient and the oil tends to accumulate on the gills and smother the fish. Petroleum products contain soluble materials, which can be ingested by fish. The flavour of the fish flesh may, therefore, become tainted, or if ingested in enough quantity, may become lethal.

Groundwater sources contaminated with petroleum products may have potentially toxic effects on consumers.
9.3.2 Asphalt Products

Environmental concerns with tack asphalt binder, and asphaltic concrete are also related to the hydrocarbon components, which are toxic to aquatic life, wildlife, and humans. As mentioned above, if these materials sink to the bottom, they may destroy the fish’s source of food supply and smother the eggs or emerging fry.

9.3.3 Other Hazardous Materials

The following hazardous materials are used in structures construction or maintenance activities and have potential environmental concerns:

- paints,
- solvents, and
- fresh concrete and admixtures.

Paint materials, which are lead- or oil-based, may affect aquatic life if significant amounts enter a watercourse. Specific concern exists with lead, as this compound may have a direct toxic effect on young fish. Toxins can accumulate over time in aquatic fish, bugs, and plants. Upon consumption by animals such as birds and small mammals, some metals could be transferred to the consumer and affect their health.

Some solvents used for cleaning purposes may contain components which are toxic to aquatic life, wildlife, and humans. If solvents enter a watercourse/water supply, and significant concentrations occur in the water, this could be harmful to users.

Concrete, which is typically made up of aggregates, cement, water, and possibly admixtures, is very alkaline because of its calcium (lime) content. If concrete enters a watercourse in significant amounts, the pH of the water may be affected locally over the short-term. If the pH of the receiving water is altered, this may cause physiological stress in fish which may result in death.

9.4 Storage, Transport and Handling of POL Products

Care must be taken with the storage, transfer, handling of POL products to prevent potential environmental damage. All empty containers and drums shall be returned to the maintenance depot. It shall be ensured that all drums and containers are closed and not tipped over and all waste oil, lubricants, and solvents shall be stored in closed containers.

9.4.1 Storage

Any container, drum, or tank that is dented, cracked, or rusted will probably eventually leak. Make sure all containers, drums, and tanks that are used for storage are in good condition. Check for leakage regularly to identify potential problems before they occur.

The proper storage of materials will greatly reduce the risk of accidental spills or discharges into the environment.

For temporary outdoor storage, put containers and drums in clearly marked areas, where they will not be run over by vehicles or heavy machinery. The area should preferably slope or drain to a safe collection area in the event of a spill.

Tanks should have appropriate secondary containment (i.e., double-walled or surrounded by a dyke) that will collect spilled material in case of a leak.

Permanent storage areas for containers or drums should be on an impermeable floor that slopes to a safe collection area in the event of a spill or leak.
9.4.2 TRANSPORT AND HANDLING

At all times when products are being handled or transported, care must be taken to prevent any product from being spilled, misplaced, or lost and possibly entering and contaminating the soil or a natural waterway.

When equipment and vehicle maintenance or repair is required in the field, it should be undertaken at least 30 m away from any watercourse. Minimize the potential for entry of hydraulic fluids or oil into a watercourse by using sorbent materials to collect spilled petroleum products. Return all used sorbent materials to the appropriate storage yards for safe disposal.

Return all diesel or fuel used to wash asphalt emulsion pumps to the maintenance depot for safe storage or disposal. Also return all solvents used to wash spray-painting or other equipment to the appropriate storage yards for safe disposal.

Wash equipment in maintenance areas equipped with oil/water separators so that any petroleum products can be removed prior to discharge of the wastewater. Oil/water separators are only effective if they are properly maintained. At sites without oil/water separators, minimize the amount of wash water used and wash in areas where the potential for entry of wash water into a waterway is minimized by proper grading or curbing.

Do not wash-out tankers near watercourses. Wash-out where the potential for entry of wash water into a waterway is minimized by proper grading or curbing.

Re-fuel or service equipment and vehicles at least 30 m away from any watercourse. Refuelling over liner material with an absorbent pad (e.g., sand bed) will help to contain potential spills. If refuelling is done from a bulk tanker, the hose/nozzle assembly should be replaced to its proper position upon completion.

9.5 APPLICATION OF ASPHALT AND ASPHALT BINDER

During chipsealing operations on or near a bridge and water bodies, there is potential for discharge of liquid asphalt to a watercourse due to over-spray along the sides of the bridge or seepage through the deck.

Before chipsealing on or near a bridge and water bodies, contact the Engineer or his authorized representative to make sure that appropriate protection measures are in place.

An example of appropriate protection for a watercourse during chipsealing of a bridge is skirting or under-draping of the deck with polyethylene sheeting (or similar protective material). All bridge deck drains should be blocked.

9.6 SPILLS AND SPILL CLEANUP

Quick action in the event of a spill of hazardous materials is important in order to prevent environmental damage.
WHAT TO DO WHEN A SPILL OCCURS

1. Identify the material involved and make a quick assessment.
   - How extensive is the spill?
   - Are there any watercourses nearby?
   - Are the watercourses down-gradient from the spill?
   - Are there drainage systems down-gradient from the spill which lead to a nearby watercourse?

2. Stop the flow of product, if it can be done safely

3. Notify the Engineer and Authorities immediately.

4. Control and contain spilled product until expert help arrives, if it can be done safely

9.6.1 HOW TO CONTROL AND CONTAIN A SPILL

When a limited oil spill occurs on level land, scoop up the affected soil and dispose at a site approved by the Engineer and the Department of Environment. When an extensive oil spill occurs on level land, dig a sump hole and pump excess oil into a temporary container. The remaining contaminated soil must be scooped up and disposed of at a site approved by the Engineer and the Department of Environment.

When an extensive spill occurs on a slope or hillside, a trench can be dug downhill from the spill to intercept the spilled material.

Should petroleum products reach a watercourse, several temporary spill containment measures can be used to help stop the spreading of products.

9.7 STORAGE AND HANDLING OF DANGEROUS MATERIALS

Workers may be at risk from exposure to dust particles or toxic fumes from chemicals used in road works and materials testing.

Specific measures to reduce risks include limiting time of exposure to dust particles, chemicals and noise, enhancing safety and inspection procedures, and improving materials safe handling.

**Suggested Specification:** The Contractor shall safely handle and store hazardous materials in accordance with the following requirements:

- Hazardous materials shall be stored above flood level and at least 30 m from any watercourse;
- Hazardous liquid substances (e.g., petrol, diesel, oils) shall be stored on top of sealed plastic sheets in a secure, flat enclosed area. Bund walls shall be at least 25 cm high;
- All empty containers and drums shall be returned to the maintenance depot. It shall be ensured that all drums and containers are closed and not tipped over and all waste oil, lubricants, and solvents shall be stored in closed containers;
- The Contractor shall have an emergency procedure and will seek directions from the Engineer / DSM Consultant regarding the disposal of hazardous materials. Used lubricants and oils shall be collected and disposed of or recycled without causing pollution or a hazard to worker safety. Spills of hazardous materials within or outside enclosed storage areas shall be cleaned up immediately. Contaminated and torn or worn plastic sheets shall be disposed of appropriately;
- At all times when products are being handled or transferred, the Contractor shall take all precautions to prevent any product from being spilled, misplaced, or lost and possibly entering and contaminating the soil or a natural waterway.
The Contractor shall not wash-out tankers near watercourses. The Contractor shall re-fuel or service equipment and vehicles at least 30 m away from any watercourse. Refuelling over liner material with an absorbent pad (e.g. sand bed) will help to contain potential spills. If refuelling is done from a bulk tanker, the hose/nozzle assembly shall be replaced to its proper position upon completion.
ECP 10: SLOPE STABILITY

10.1 GENERAL

The final recommended slopes and minimum requirements for compaction of embankments will be dependent on the site characteristics of each sub-project and should be determined on the basis of this ECP in addition to LGED's Design Manual which also outlines common slope protection practices. This ECP will be used as a guide to best practice.

10.2 OBJECTIVE

To prescribe the investigation of and design procedures for road batter slopes, approach slope for jetties/ghats as well as the protective measures to be installed to minimise erosion. So far as is possible, batter slopes and hence batter limits should be determined at the design stage so that land acquisition, if any, advised at the screening stage is adequate.

10.3 PLANNING AND DESIGN

10.3.1 Road Alignment and Gradients

With reference to ECP for planning and design (as given under additional guidelines) and with particular reference to the rural road improvement alignments and gradients shall be selected to minimise the formation of batters. So far as it is possible, vegetation on existing road batters should remain undisturbed during road improvement works.

*Design Guideline:* The DSMC shall select alignments and gradients that minimise the need for batter construction. Where there are existing batters covered in vegetation, every effort should be made to preserve such vegetation.

10.3.2 Soils Investigations

During the design of the work, sufficient soils investigation and testing shall be undertaken to enable appropriate slope stability analysis to be undertaken. The depth of organic material and/or weak materials that will require undercutting prior to construction of sub-projects shall also be determined.

The existing groundwater levels shall be determined in cut and fill locations.

In particular circumstances where access to the site is not possible (due to monsoon) during the design stage, contract documents should require contractors to provide access for soils investigation to be undertaken prior to the commencement of earthwork so that batter limits can be confirmed.

10.3.3 Slope Stability Analysis

The topographic condition in the most part of the project area is such that most of the roads are on the embankments rather than in cutting. For the rural road improvement, the batter slopes shall be selected as per the recommended slopes for various types of soil and compaction conditions in the LGED Pavement Design Manual. However, in a particular case where embankment height is critical, especially at bridge approaches or in haor / boar areas, slope analysis shall be undertaken to ensure a factor of safety against failure of 1:1.5. The slope of river bank and approach road for jetties/ghats shall be designed based on existing slope and soil condition.
In areas of high ground water level also, stability analysis shall be undertaken for the conditions that will
pertain during construction as well as for the assessed future conditions and long term ground water
level

Analysis of fill batters shall take into account the remoulded soil characteristics of the fill material and
the characteristics of the soil underlying the fill material

**Suggested Design Guideline:** on submission of designs for the sub-project to the PIO / LGED, the
Designer / DSMC shall submit a report on soils investigations, soil test results and stability analysis.
The report shall contain at least the following information:

- Topographical description
- Geological setting and implication on proposed earthworks
- Location and log of all bores including ground water level
- Results of laboratory testing
- Details of slope stability analyses
- Conclusions and recommendations

### 10.3.4 Soils Investigation Report

A soils investigation report shall be submitted to the PIO / LGED (headquarter) at the time of
submission of any sub-project design for approval.

The report shall be signed by the geo-technical engineer responsible for the soils investigation work

### 10.4 CONSTRUCTION

#### 10.4.1 Erosion Control

Erosion protection measures prescribed in ECP 11 shall be implemented as soon as possible
ECP 11: EROSION CONTROL

11.1 OBJECTIVE

To define measures for the prevention of erosion of exposed earth surfaces as a result of implementation of sub-projects and to prescribe measures to be taken to avoid erosion of channels and drainage outlets. It also prescribes measures to be taken to mitigate significant adverse effects of the discharge of water containing suspended soil particles into natural watercourses or onto land adjacent to project works site.

11.2 PLANNING AND DESIGN

The planning and design of sub-projects associated with RTIP is to be undertaken so far as possible to avoid disturbance of existing vegetation and as a consequence minimise the implementation of erosion control measures. The erosion control measures for market growth centre will include gentle slope, covering open flat space with pavement and lining of drainage channels. Similarly, erosion control for river bank slope for construction of jetties / ghats will include stepping, breastwall / vegetation at side etc. The erosion control measures are comparatively significant for roads improvement projects and construction of drainage structures, and thus associated good practices are discussed in the following sections.

11.2.1 Rural Road Improvements

Road Alignment Improvement

The planning and design of the alignment of any sub-project is to be undertaken to avoid so far as is possible the disturbance of existing vegetation and as a consequence minimise the implementation of erosion control measures defined in this ECP.

**Design Guidelines:** The planners and designers of improvement sub-projects shall wherever possible avoid the removal of vegetation from existing road batters by careful design of the road alignment and vertical profile. If, by minor adjustment to the design standards contained in the terms of reference, significant reduction in adverse environmental effects can result then the planner/designer shall discuss such adjustment with the client. Provided the resulting road project will be “fit for its purpose” then the client may approve adjustment to such design standards.

Catch Drains

Catch drains shall be installed above cut batters where it is necessary to intercept overland flow of water to prevent it causing scour of batters or triggering instability of such batters. They shall be constructed a minimum of 2 metres beyond the top of any cut batter and shall be of adequate dimension to discharge the assessed flow of water, calculated from the contributing catchment and design rainfall, without overtopping. They shall be appropriately lined to prevent scour of the drain and shall be accessible for maintenance purposes.

They will normally discharge to road side drains but wherever the discharge location it shall be effectively protected against scour preferably by dispersion across a grassed area having a relatively flat gradient.

**Design Guidelines:** The Designer shall detail and specify the construction of catch drains where required to provide erosion control. Depending on flow velocities in such drains they shall be lined with appropriate or, where necessary to prevent scour cemented rock lined or concrete lined channels or equal alternative lining materials shall be used.
Toe Drains

In order to minimise the risk of water ponding adjacent to the toe of fill batters with the consequent risk of saturating fill materials and subsequent batter failures, it is often necessary to construct toe drains.

Where toe drains are to be installed adjacent the toe of fill batters to prevent ponding of water against fill batters they shall be designed with adequate capacity to fulfil their function and shall be lined with appropriate native vegetation. Prior to the discharge to natural water the drains shall be shaped to disperse the flow across a grassed area.

**Design Guidelines:** The designer shall detail and specify toe drain construction to fulfil the requirements as mentioned above under toe drains.

Road Side Drains

Wherever they are installed roadside drains shall be designed for their purpose and shall be protected against the effects of scour. The minimum protection shall be the establishment of suitable grasses. Where flow velocities are anticipated to be high, scour protection shall be afforded by rip rap, concreted stone pitching, concrete dished channels or equal effective protection.

Frequent turnouts of roadside drains shall be provided to discharge flow across grassed areas wherever practicable prior to entering natural water courses. In steep country and elsewhere as necessary, flumes shall be constructed to discharge water from roadside drains to undisturbed vegetated ground beyond the road formation. Effective scour protection shall be provided at flume discharge locations. The maximum distance between turnouts shall be 100 metres unless this limitation is demonstrated to be impracticable.

If necessary and practicable, to provide the maximum distance between turnouts of 100 metres, appropriately sized culverts shall be installed to transfer flow from one side drain to the opposite side drain. Inlets and outlets to such culverts shall be protected from the effects of scour.

**Design Guidelines:** The designer shall detail and specify the systems to be used for road side drain erosion protection and shall detail and specify all turnout works.

Batter Protection

All batters in soil, both cut and fill, shall be protected from the effects of scour by water flow. Protection measures may be any one or more of the systems illustrated in Annexure 11.1. Batter protection shall be installed as soon as practicable after the completion of any batter or in the case of benched batters the completion of any one bench.

**Design Guidelines:** The designer shall detail and specify the system or systems used for batter protection. The designer shall also specify the required timing for the installation of batter protection systems to satisfy the requirements as mentioned above under batter protection.

Silt Traps and Silt Ponds

Throughout the construction period, it is intended that the discharge of silt laden water from construction sites to natural water courses is minimised. Where discharge from catch, bench, toe and road side drains is relatively low in volume and discharge over a grassed area is impracticable, silt fences as illustrated in Annexure 11.1 shall be utilised to prevent or minimise the discharge of silt laden water to natural water courses.

For high volumes of discharge silt retention ponds shall be used to prevent or minimise the discharge of silt laden water.
Silt traps and ponds shall be utilised throughout the construction period. At the completion of construction works, silt traps and ponds shall be cleaned out and ponds filled to suit surrounding topography and levels.

**Design Guidelines:** The designer shall detail and specify the construction and maintenance of silt traps. The designer shall specify the design of silt retention ponds having regard to the desired retention period and the method of operation. The disposal of material that is periodically cleaned from traps or ponds shall also be carefully specified to ensure that it does not re-enter any natural watercourse. During the design of the works, the need for silt retention ponds shall be assessed and sufficient land allocated within the site of the works for their construction.

**Shoulder Protection**

In order to protect the surface of road shoulders against erosion from surface water flows, it is necessary to surface the shoulder with non-eroding material. Such surfacing has the secondary benefit of minimising the occurrence of edge break of adjacent sealed pavements.

All shoulders should be suitably grassed. To assist the establishment of grasses, the road shoulder may be surfaced with humus.

**Design Guidelines:** The designer shall specify the required surfacing for shoulder protection.

11.2.2 **Structures**

The erosion control measures for drainage structures will include the measures for toe drain, approach road batter protection and shoulder protection exactly in the same way as mentioned above under rural road improvement component.

11.3 **CONSTRUCTION**

All project work shall be undertaken with a conscious approach to the need for preventing or minimising erosion of any exposed earth surface. In addition to permanent drainage or erosion control systems that are required to be constructed, temporary measures to prevent erosion are to be implemented whenever these are clearly necessary to mitigate against the erosion of exposed surfaces.

**Suggested Specification:** The contractor is required to enter into the spirit of environmental protection and conservation and to construct works in terms of agreed programmes, methods and sequences that will prevent or mitigate against erosion. The contractor shall employ such temporary measures as are necessary to prevent or mitigate against erosion or siltation of any natural water course in addition to permanent drainage or erosion control systems that are detailed in the contract documents.

11.3.1 **Contractors’ work program**

The programming of works shall demonstrate that the sequence of operations shall be such as to minimise the amount of time over which exposed surfaces are subject to potential erosion. It shall clearly demonstrate the sequential operations of drainage installation, erosion protection measures, earthworks, drainage facilities, pavement maintenance and revegetation to minimise the exposure of erosive surfaces.

**Suggested Specification:** The contractor shall programme the works to demonstrate that the sequence of operations involving drainage installation, earthworks, drainage facilities, erosion protection measures, pavement maintenance and revegetation are implemented to minimise the period over which earth surfaces are exposed to the potential for erosion.
On no account will the contractor be permitted to extend earthworks including vegetation clearing and topsoil stripping beyond the existing formation width, concurrent pavement maintenance and revegetation works without the approval of the Engineer.

11.3.2 Clearing Vegetation

Vegetation is nature's way of preventing soil erosion and existing vegetation clear of project works should always be protected.

Consequently only vegetation which is within the site of the works, construction camp, borrow area or waste material disposal areas shall be cleared. Cleared vegetation shall be mulched and stockpiled with topsoil for use in revegetating batters and other exposed surfaces.

Large logs and branches that cannot be mulched shall be stockpiled for use in erosion prevention or control. If for any reason logs and branches are to be removed from the site, a permit to do so shall first be obtained from the Forestry Department.

Stormwater run off from areas stripped of vegetation shall be collected in temporary or permanent drains that shall be fitted with silt retention devices prior to discharge to natural waters.

On no account shall cleared vegetation be burned.

Suggested Specification: The contractor shall only clear vegetation from between the batter limit lines shown in the drawings, the net agreed area for the construction camp and the agreed area of proposed waste material disposal areas or borrow area. On no account is the contractor to damage vegetation outside the above areas or borrow area. Should such damage occur the contractor shall forthwith take such steps as are necessary to prevent erosion and to re-establish vegetation. On no account is cleared vegetation to be burned. Such vegetation shall be mulched and stockpiled with stripped topsoil for use in revegetating batters and other exposed surfaces. Large logs and branches that cannot be mulched shall be stockpiled for use in erosion prevention or control. The contractor shall install such temporary or permanent drainage systems as are required to collect stormwater run off from stripped areas. Silt traps on silt retention ponds as detailed or specified shall be constructed at appropriate locations in such temporary or permanent drains. Traps or ponds shall be maintained in efficient operation throughout the contract period.

11.3.3 Topsoil Stockpiles

Topsoil stockpiles shall be sited such that stormwater run off from such stockpile areas can be collected, controlled and discharged through devices to remove suspended solids prior to discharge to natural water courses.

Design Guideline: The contractor shall locate topsoil stockpiles clear of future works in locations agreed with the engineer. They shall be located on terrain which is suited for the construction of toe drains around the topsoil stockpile in order to minimise topsoil laden water discharging directly into natural water courses or onto adjacent land. After each day's work and before rain the stockpiles shall be smoothed off and rolled with suitable rubber tyred equipment to minimise the amount of loose material on the stockpile at any time. The topsoil stockpiles shall be surrounded by a toe drain of sufficient dimension to trap water discharged from the stockpile and such water shall be conducted to silt traps located at the appropriate location in the toe drain. Silt traps shall be discharged through grass swales prior to water entering natural watercourses wherever this is possible. Alternatively erosion protection measures such as rip rap shall be installed at the discharge end of the toe drains prior to their discharge to natural water courses.
11 3.4 Waste Excavation Disposal

The disposal of waste excavated materials from construction sites must be undertaken in such a way as to minimise adverse effects on the environment and to avoid the possibility of waste materials being disguised as competent materials such as occurs when waste material is side cast. There are many examples of road failures where roads have been unwittingly widened over side cast materials.

Consequently, all waste excavated soil, which is unsuitable for incorporation into embankment construction as a result of organic content, moisture content, and the like, shall be disposed of in areas specifically designated for such purpose. On no account shall excavation to waste be disposed of by side tipping or the widening of fill batters.

Disposal sites shall not be located within environmentally sensitive areas, within the floodplain of any watercourse or within 30m of the bank of any river or stream.

Such disposal sites shall be stripped and the stripped material stockpiled as in Section 11.3.4. Excavated waste material shall be placed and compacted by track rolling in the waste disposal area. Waste excavation disposal areas shall be shaped to conform to the adjacent topography. At the completion of the disposal of such material, waste excavation disposal areas shall be re-topsoiled and vegetated. Such vegetation shall be similar in nature to the material originally cleared from the site.

Throughout the period of use of such disposal areas, perimeter drains, silt traps and or silt ponds shall be installed in a specifically designed drainage system to prevent silt laden water discharging into natural water courses.

**Suggested Specification:** The contractor shall locate waste excavation disposal areas as agreed with the engineer. All excavated material which by virtue of its organic content, moisture content, or other characteristics, which is unsuitable for incorporation into embankment construction shall be transported and placed in such waste excavation disposal areas. On no account shall waste excavated material be disposed of by side tipping or flattening of fill batters unless specifically directed by the engineer. After agreement with the engineer on the location of waste excavated disposal areas, the contractor shall strip the topsoil from such sites and stockpile this material for later restoration work. Material excavated to waste shall be placed in such areas and compacted by track rolling, and shaped to conform to the adjacent topography.

Surface water discharged from such areas shall be collected into perimeter drains which shall discharge through silt traps and or silt ponds in order to minimise the discharge of silt laden water to natural water courses. At the completion of use of waste excavation disposal areas, they shall be resurfaced with topsoil previously stripped from the area and revegetated as specified.

11.3.5 Batter Protection

The establishment and maintenance of vegetation on cut and fill batters at the earliest possible time in the sequence of construction events is the most positive step that can be taken to minimise surface erosion. This fact must be recognised in the development of construction programmes as outlined Section 11 3.2 of this code.

All batters in cut areas and all embankment batters shall be revegetated and protected against the effects of scour from surface water run off. Typical erosion protection measures include vegetative turfing with jute netting or coir netting, brick mattressing and sand-cement gunny bag rip-rap.

**Suggested Specification:** The contractor shall establish vegetation and erosion protection measures on all cut and fill batters as soon as possible during the construction period. In benched cut batters, the establishment of vegetation and erosion protection measures shall be undertaken on the bench and upper batter as soon as it is completed. Such work shall not wait until the completion of the total excavation. The contractor shall maintain the vegetation and erosion control measures throughout the construction and maintenance period.
11.3.6 Traps, Bench, Toe, And Road Side Drains

All such drains shall be established as soon as practicable during the construction of the works and in terms of the programme as indicated in Section 11.3.2. Vegetation and the installation of erosion protection measures shall be as detailed and specified and shall be established in the minimum possible time to mitigate against erosion from surface water run off. Outlets shall be discharged through silt traps or to silt retention ponds prior to the discharge of run off to natural watercourses.

The discharge from silt traps or silt ponds shall flow over grass swales wherever possible prior to the discharge to natural water courses. Alternatively such water courses shall be protected against erosion at the discharge location by the installation of rip rap, drop structures, flumes, and the like.

**Suggested Specification:** The contractor shall establish all such drains as soon as practicable during the construction of the works and in terms of the programme which has been agreed by the Engineer. Erosion protection and sediment control measures as detailed and specified shall be established as soon as possible to minimise erosion. Outlets to all drains shall be passed through silt traps and or silt ponds prior to their discharge to natural water courses all as detailed and specified.

11.3.7 Silt Fences

Silt fences shall be located in the ponds where the road embankment will be widened towards a pond abutting the road. Fences shall be of a form approved by the Engineer. They shall be maintained in sufficient operating condition throughout the construction of the works. Material periodically cleaned from silt fences shall be deposited in waste disposal areas as shown in Section 11.3.4.

**Suggested Specification:** Throughout the construction of the works the contractor shall install silt fences in all temporary and permanent drains. Silt fences shall be constructed of appropriate materials as detailed and or specified. Silt fences shall be maintained in sufficient operating condition throughout the construction and maintenance of the works. Material periodically cleaned from such drains shall be transported and disposed of in waste disposal areas established as detailed and specified.

11.3.8 Borrow Areas

Approval to develop borrow areas shall be obtained as outlined in ECP 07.

11.4 COST ESTIMATES

Most of the suggested erosion control measures shall be included in the specification and BOQ of road construction and associated works. However, the cost of the permanent erosion control measures, which will not be included in road works such as silt fencing shall be estimated and included in BOQ for the relevant sub-projects.
ECP 12: BRICKFIELDS AND BRICK CRUSHING YARD

12.1 OBJECTIVE

To prescribe the specific requirements for the development and operation of brickfields and brick crushing yards for the sub-projects associated with RTIP as well as to define procedures and works that shall be used to mitigate against adverse environmental effects.

12.2 PLANNING AND DESIGN

During the planning of sub-projects associated with RTIP, potential brickfields and brick crushing yards may be identified in consultations with the local community. Alternatively, environmental and social criteria may be stipulated that need to be satisfied by the Contractor while selecting brickfields and brick crushing yards.

**Design Guideline:** The DSMC shall identify, if possible, potential brickfields and appropriate locations for potential brick-crushing yards that may be used for the implementation of the sub-project. Such potential sites shall be identified on plans drawn to an appropriate scale and the plans shall be displayed and discussed during public consultations. Alternatively, the DSMC shall specify environmental and social criteria for selecting the brickfields and locations for the brick crushing yards by the Contractor. Such environmental and social criteria shall take into account the site conditions, community opinions and relevant statutory laws and regulations of Bangladesh (see Appendix 3).

12.3 IMPLEMENTATION

12.3.1 General Principle

**Brickfields:** The lack of stone for use of aggregate results in the manufacture of bricks for use as a base course and concrete-aggregate material. The brickfields in which soil and clay are extracted and fired are a form of strip mining. In many areas, plots strip-mined in this fashion are eventually returned to agricultural use and fertility is returned to the soil through successive flooding and silt deposits. In many areas, however, this is not the case. Brickfields unrestored/unrehabilitated by either man or natural action are evident throughout the area, particularly in the northern, drier, and less flood-prone areas.

The environmental impacts due to operation of the brick kilns are well known in Bangladesh. As the Government has already banned the use of firewood for this purpose, practice needs to be discontinued to stop further degradation of forest/tree resources.

**Brick Crushing:** The cumulative impacts of crushing bricks for use in implementation of sub-projects associated with RTIP are significant. The accumulation of the inert, inorganic nature of brick residue will result in patches of unproductive land where crushing has taken place. Agricultural land, or areas where residue may be flushed onto agricultural land or sensitive ecosystems should be avoided. Residue that finds its way into closed waterways will eventually impact on aquatic flora and fauna, in particular fish populations. Residue containing silica will be particularly dangerous in this respect.

No brickfield using firewood as fuel shall be used for the sub-projects associated with the RTIP. All bricks for the use of the rural road improvement shall be procured only from those manufacturers who use alternative fuel such as coal or natural gas.

The right to use brickfields and brick crushing yards is generally negotiated between the contractor and individual brickfield/land owners. All efforts shall be made to use non-agricultural or less...
productive land for use as brickfields or brick crushing yards

**Suggested Specifications:** The Contractor in consultation with the community and landowners shall identify brick kilns using coal or natural gas and appropriate locations for brick crushing yards outside the road reserve. A brick crushing yard management (development, operation and rehabilitation) plan should then be prepared. The plan shall be approved by the Engineer before commencing work. Before using additional crushing yards, operating yards shall be closed by the Contractor as per the agreed rehabilitation plan. The following principles for location, depth and drainage of brickfields and brick crushing yards shall be followed.

Clay and sand for the brick manufacturing should be obtained:
- from barren land or land without tree cover outside the road reserve,
- by excavating land and creating new water tanks/ponds,
- from high lands acquired temporarily outside the road reserve,
- from excavation of proposed culverts,
- from river bed (in accordance with ECP 08 River Sand Extraction)

- To ensure efficient drainage, the bed level of the brick fields and crushing yards shall, as far as possible, slope down progressively towards the nearest cross drain, if any, and shall not be lower than the bed of the cross-drain.

- When it becomes necessary to use temporarily acquired cultivable lands, the depth of soil/clay extraction shall not exceed 45 cm. The topsoil to a depth of 15 cm shall be stripped and stockpiled for later rehabilitation of the pit. Thereafter, soil/clay may be extracted up to a further depth not exceeding 30 cm for brick manufacturing. Subsequently, the stockpiled top soil shall then be spread back on the land.

- Brickfields and/or brick crushing yards shall not be located within 500m of any identified archaeological, religious or cultural sites.

- Sediment shall be controlled at each site by ensuring that base of the brick crushing yard drains into a sediment trap prior to discharging from the site.

After obtaining approval from the Engineer, the Contractor shall locate and peg out the full extent of proposed brick crushing areas prior to its use. For location, depth and drainage of brickfields or crushing yards, the principle criteria mentioned above shall be followed by the Contractor. Once the proposed brickfields and breaking yards have been identified by the contractor in consultation with the local community, they will be inspected by the Engineer and DSMC.

The brickfields or brick crushing yard areas shall be rehabilitated as per the provisions of the approved rehabilitation plan.
ECP 13: TRAFFIC CONTROL DURING CONSTRUCTION

13.1 OBJECTIVE

To prescribe the methods that are to be used for the safety and control of traffic during the implementation of activities for sub-projects associated with RTIP.

13.2 SIGNS

All traffic signs used for the warning or direction of traffic at road works sites shall comply with the schedules of signs contained in the Bangladesh Traffic Regulations. Home-made signs shall not be used. The contractor will install and maintain a display board at each important road intersection on the sub-project road and approaching roads for market growth centres etc., which shall clearly show the following information in Bangla:

- Location Chainage and village name
- Duration of Construction period
- Period of proposed detour / Alternative route
- Suggested detour route map
- Name and contact address / Tel No of the Engineer or his Representatives
- Name and contact address / Tel No of the Contractor
- Inconvenience is sincerely regretted

13.3 TRAFFIC DIVERSSIONS AT BRIDGES / CULVERTS

The Contractor shall prepare and submit a traffic management plan to the Engineer for his approval at least 30 days before commencing work on any sub-projects involved in traffic diversion and management. The plan will include detailed drawings of traffic arrangements showing all detours, temporary road, temporary bridges, temporary diversions, necessary barricades, warning signs / lights, road signs etc. to ensure uninterrupted traffic movement during construction. During the construction of all such facilities all the relevant ECPs including those of Vegetation, Erosion and Sedimentation, Drainage, etc. shall be applicable.
ECP 14: OCCUPATIONAL HEALTH & SAFETY

14.1 OBJECTIVE

To provide guidelines and increase awareness of occupational health and safety (OH&S) issues that affect construction workers, road users and communities living in the vicinity of works areas for sub-projects associated with RTIP. Contractors need to be made aware of their responsibilities to workers and the environment and conversely, workers also have a responsibility to OH&S.

14.2 PROVISION OF FIRST AID FACILITIES

In the event of an incident, it is important that first aid is readily available on site. This means that adequate first aid facilities should be located in an accessible location and that a designated person has been trained in administering first aid and has responsibility for maintaining such facilities.

All workers should be advised of the location of first aid facilities and procedures in the event of an incident.

14.3 STORAGE AND HANDLING OF DANGEROUS MATERIALS

Workers may be at risk from exposure to dust particles or toxic fumes from chemicals used in construction / maintenance works and materials testing.

Specific measures to reduce risks include limiting time of exposure to dust particles, chemicals and noise, enhancing safety and inspection procedures, and improving materials safe handling.

14.4 TRAFFIC MANAGEMENT

There are risks of accidents involving passing traffic. Traffic signs warning of construction in progress is the most common measure adopted to slow passing traffic. In instances of heavy traffic, it may also be necessary to employ the use of flagmen to control traffic. Further details are provided in ECP 13 dealing with traffic management during construction.

14.5 OPERATION OF MACHINERY

Involves risks in the operation of machinery close to traffic, slopes, power lines and watercourses. Workers may also be at risk from the collapse of trenches. The contractor has responsibility to ensure that all machinery is in good working order and that all operators are qualified to use the equipment. Workers should also be advised of their responsibility to adhere to correct work procedures to minimise incidents from occurring.

Many of the risks to workers outlined above can be limited by clearly defining procedures for handling materials, conducting tests, paving, operating equipment and constructing trenches. All workers must receive adequate and appropriate information, instruction, training and supervision in relation to safe working practices appropriate to the work performed.
ECP 15: PLANNING, DESIGN AND CONSTRUCTION

15.1 GENERAL

It is stipulated that only those rural roads (RR1) will be selected for improvement under the proposed RTIP that will fulfill the minimum selection criteria established by the LGED during the project preparation stage. These selection criteria include:

- The RR1 must connect all weather road of higher order and no land acquisition as well as resettlement is required. Preference will be given to roads that complete a network in the region.
- Embankment height and width should be such that earthwork requirement is minimum.
- The proposed road must fully conform to IDA’s social and environmental screening criteria set for RTIP.
- All schemes will be selected through participation of the local government bodies, rural communities and other user groups using the "Information Sharing" and "User Input" approaches, and all formal proposals for investment will be submitted to the project by the Union Parishads. The techniques for this participation sharing have been described in the “Guidelines for Users Participation in Planning and Implementation of Rural Road 1 (RR1)” under RTIP.

It is recommended that RR1 having standard crest width of 4.8 m only should be selected. It implies that there would not be any widening of the existing road formation and consequently no land acquisition (khas / private) will be involved. However, there may be a necessity for raising the existing formation to ensure that the proposed pavement of the road is above the High Flood Level (HFL).

15.2 OBJECTIVE

To establish the general guidelines for managing and minimising the potential environmental (including social) impacts of rural roads improvement sub-projects by outlining principles and minimum standards which shall be taken into account in the planning, design, and implementation of rural roads improvement.

15.3 GENERAL PRINCIPLES

The following general principles constitute good practice environmental management procedures for planning, design and implementation of rural road improvement works:

- Minimise loss of agricultural land (temporary or permanent), avenue tree felling, impact on ponds and other water bodies and productive soil through judicious design of the road.
- If road user safety is not compromised, relax specified design standards in areas of settlements, heavily vegetated slopes, flood protection embankment, and important wetlands, where this will result in minimising adverse impacts.
- Incorporate design features for the general improvement of environmental quality.
- Incorporate measures and design features for the mitigation of adverse environmental effects, as identified by environmental screening or community consultation process.

15.4 OVERALL DESIGN PRINCIPLES

In seeking to achieve the overall objectives of the sub-project, and maximise the goals of sustainable development, the designer, during the planning and design phase, shall:

- Take into account the issues and concerns of affected communities and stakeholders.
- Decide, in consultation with stakeholders, the environmental and social resources / assets which should be given priority for protection and conservation.
- Identify and discuss with the EMU / PIO of the LGED any mitigation measures which could have a major cost implication.
- Consider appropriate construction methods, which will minimise environmental risks while taking into account the goals of sustainable development. The most practicable methods for minimising the release of sediment and other pollutants into the environment shall be selected.
- Specify that construction phases are sequenced, timed, and managed to minimise disturbance to the environment. This includes the minimisation of the extent of area to be worked, and area of bare earth exposed at any one time.
• Specify that the programme of construction shall be prepared to show that areas to be re-vegetated are completed progressively as sections of the work are completed,

• Identify and set out the relevant clauses of the ECP into the sub-project specific construction contract and bid documents to ensure that environmental standards and guidelines are implemented,

• Provide in the contract documentation the operational and maintenance procedures to preserve the mitigation measures in good condition and effective operation

**15.5 ENVIRONMENTAL GUIDELINES FOR PLANNING AND DESIGN**

For the planning and design phases, the designer shall follow the general guidelines set out hereunder

**15.5.1 Contractor’s Environmental Management Plans**

The DSM consultant shall prepare the basis of a Contractor’s Environmental Management Plan (CEMP), to be completed by the contractor. The CEMP shall be reviewed by the EMU and approved by the Engineer-in-Charge before commencement of construction works. The CEMP shall set out the specific mitigation measures, and monitoring requirements that will be put into place during the sub-project implementation. The CEMP shall:

• Establish the chain of responsibility for managing the environmental aspects of the project

• Identify the records to be maintained which demonstrate compliance with the Contract Specifications and EMP, if any

• Establish the mitigation and contingency measures for at least the following
  - Vegetation management
  - Excess Spoil disposal
  - Slope protection works
  - Borrow Area management yard management
  - Brick fields and breaking
  - Dust control
  - Water collection management
  - Noise control
  - Traffic management during construction including diversions

• Specify the temporary storm water management devices, their locations, and the maintenance programme for all such devices

• Specify and detail sedimentation control measures to be implemented

• Specify construction methods to be used, and identify how these will minimise the amount of sediment released into the environment

**15.5.2 Field Surveys**

• The road corridor needs careful and complete mapping of all important terrain features and must be wide enough at places where spoil deposits are feasible. Other relevant data such as land use, infrastructure, cultural sites, fragile slopes, drainage lines, ponds, community trees, tube wells, irrigation and or drainage channels etc. must also be mapped. In addition, potential work campsites, spoil locations, brick-breaking sites, borrow pit sites also have to be mapped.

• Minimise branch trimming or other environmental disturbance to that necessary to establish line of sight

**15.5.3 Disposal of Excess Material**

• In consultation with the affected (adjacent) community, identify and implement the best practicable option for the disposal of excess cut and unsuitable materials. In this context materials refers to non-toxic materials. Any toxic materials shall be disposed of by a method or methods that comply in all respects with the laws of Bangladesh

• Specify that all excess cut disposal areas shall be subject to the same environmental controls and guidelines as the overall sub-project, as set out in the relevant ECP
- Specify that all excess cut disposal areas are designed to maximise embankment stability, minimise erosion, are shaped to conform with the general topography, and are vegetated appropriately

15.5.4 Storm Water Crossings
- Design storm water crossings to use low impact structures intended to minimise disturbance to the stream/river/canal environment, and shall
  - incorporate any design features required to protect particular ecologically sensitive areas,
  - permit the passage of fish,
  - permit/retain existing navigational requirements,
  - encourage minimal construction time,
  - incorporate construction sediment control,
  - minimise clearance of vegetation.

15.6 ENVIRONMENTAL GUIDELINES FOR CONSTRUCTION
For the construction phase, the contractor shall follow the general guidelines as set out below

15.6.1 General
- No equipment shall be moved onto a site, or works undertaken, prior to approval of the CEMP established by the contract documents
- All reasonable steps shall be taken to ensure minimum disturbance to adjacent land during construction
- At all times reasonable and useable access is to be maintained to private land and villages not directly affected by construction
- Plants and seedlings used for re-vegetation should wherever possible be taken from the immediate area and from as close as possible to the restoration site
- The Contractor and his staff are not to be involved in the killing or taking of wildlife at work sites/construction camps
- Management plans shall be prepared for sub-project activities that were not considered during the planning and design stage.

15.6.2 Survey
- Follow the process for consultation and land access for survey and investigation as set out in "Guidelines for Planning and Implementation of Rural Roads Improvement" by the PIO / LGED.
- Minimise tree-branch trimming, or other environmental disturbance to that necessary to establish line of sight

15.6.3 Haul Roads
- Construction and establishment of haul roads shall be kept to a minimum
- Minimise the extent of traffic and construction impacts on adjacent villages and other residential areas
- Wherever possible avoid water crossings.
- General noise control measures set out in the CEMP shall apply to haul roads.
- Haul roads and associated temporary structures shall be removed upon completion of the works and the area reinstated in consultation with local landowners
- Re-vegetate the area as soon, as is possible in line with this guideline

15.6.4 Dust Control
- The CEMP shall detail dust control measures by dampening and include where the water will be collected from (i.e. whether from ponds or local watercourses), and the number of watering trucks required. All care shall be taken to ensure excess water does not find its way to waterways
15.6.5 Cut Disposal and Management
- Temporary stockpiles shall be restricted to within the actual alignment wherever possible
- Cut disposal shall be designed to ensure embankment stability and to minimise erosion

15.6.6 Stockpiles
- Ensure that stockpiles of topsoil, humus, mulch, fill and waste materials, and brick aggregates are not located within 10m of a watercourse, or in ecologically sensitive areas
- Stockpiles of materials shall not provide a source of dust generation

15.6.7 Refuelling and Maintenance Areas
- Ensure that vehicles and plant parking or refuelling and maintenance facilities are not located, or activities do not take place, within 30 m of a watercourse, or in ecologically sensitive areas wherever practicable

15.6.8 Site Facilities
- Site facilities shall be established as set out in ECP 6. Site facilities include site offices, ablutions, camps and facilities as necessary, provision for safe potable water supply, sanitation, electricity, telephone, covered rubbish bins etc. and areas designated for workers. As such construction and operation of these facilities have potential to generate litter and other waste materials, these facilities shall not be located within 30 m of a watercourse, or in an ecologically sensitive area such as forests, wetland
- Ensure regular disposal of rubbish off site at an appropriate location

15.6.9 Water Crossings
- Minimise disturbance of watercourses, excavations or disturbance of the bed of any waterway shall not occur unless required as part of construction
- Exposed surfaces shall be minimised and revegetated or sealed as soon as practicable
- Weather conditions should be taken into account in programming earthworks
  (for details ref ECP-16)

15.6.10 Planting and Revegetation
Grassing and replanting of trees and shrubs progressively throughout construction period is the most effective means of preventing or minimising erosion. Consequently contractors shall programme and execute their work such that:
- Revegetation of all exposed surfaces shall be specified and shall be undertaken as soon as practicable after completion of earthworks.
- Stockpiles of top soil and mulch comply with the requirements for stockpiles (refer to ECP 05)
- Maintenance of vegetation and erosion control measures shall be specified

15.6.11 Transportation of Construction Materials
- Consideration shall be given to the safety of other road users and impacts on the environment through controlling truck movements and ensuring loads are covered to prevent spillage of construction materials.

15.7 GENERAL ENVIRONMENTAL MANAGEMENT CONTRACT CLAUSE
PIO / LGED shall ensure that all relevant clauses be included in construction contract documentation related to RTIP rural road improvement sub-projects which sets out the premise for environmental management as established in this ECP.

The Contractor is instructed to enter into the spirit of the project and will undertake all activities with due diligence to ensure that the environmental resources of the site or area are protected, conserved, and sustained at all times

15.8 OVERVIEW OF BEST OPERATING PRACTICES
The following section presents an overview of the best operating practices that must be adhered to during planning, design and implementation of the rural road improvement sub-projects.
15.8.1 Wetlands

Objective. Wetlands should be retained since they provide many important benefits including a source of food, multipurpose uses for rural people, habitats for diverse varieties of flora and fauna, groundwater recharge, and flood mitigation.

Best Practices:
- Protect all wetland areas, whether natural or artificial, by minimising disturbance to the wetland and adjacent landforms. Changes to the hydrological regime in particular should be avoided since this has the potential to significantly impact on the wetland.
- Identify existing wetlands and protect them by defining work zones in tender specifications and plans.

15.1.2 Vehicle and Machinery Activity

Objective: To minimise disturbance to indigenous vegetation (trees, shrubs and groundcover) by using the appropriate type and minimum size of machine for the job, and confining vehicular activities to designated areas.

Best Practices:
- Select the type and size of machinery appropriate for the task to minimise disturbance to vegetation.
- Park machinery in a cleared area, in a designated wayside stop, parking lot or on private land (where permission has been granted).
- Site machinery compounds clear of trees, shrubs and groundcover. In no circumstances should vegetation be removed to provide for the siting of machinery compounds or storage of materials.
- Service vehicles and machinery on the roadside at a designated location only when it is not possible to move to a more appropriate site. Great care must be taken to ensure that no spillage of pollutants such as oils/fuel results from any servicing operation.
- Confine machinery to the existing road formation, proposed alignment, access tracks or designated construction zone unless otherwise directed by the site supervisor.
- Turn vehicles and machinery within the Construction Zone or on cleared sites or sites that have minimal indigenous vegetation.
- Avoid drip lines of trees to minimise root damage and soil compaction around tree root systems from machinery.

15.1.3 Soil Erosion and Sedimentation Control

Objective: To prevent soil erosion and sedimentation during works.

Remember:
- Erosion removes valuable topsoil and produces sediment, which silts drains, creeks and rivers damaging the aquatic environment.

Best Practices:
- Soil erosion and sedimentation control procedures must be included in the Planning and Design stage of any sub-project.
- Erosion to be minimised by:
  - protecting existing vegetation,
  - minimising soil disturbance, and
  - stabilising disturbed areas as works proceed.
- Make provision for storm water runoff at the beginning of the job.
- Divert all storm water away from loose or exposed soil.
- Avoid steep drainage lines where possible.
- Avoid steep batter slopes.
- Dissipate flows by use of constructed ponds or energy dissipating devices where appropriate.
• Capture silt by use of silt traps or sumps.
• Establish an adequate inspection, maintenance and cleaning program for all storm water drainage systems.
• Do not direct storm water from construction sites into areas supporting high quality indigenous vegetation including watercourses.

15.1.4 Storm Water Drainage and Management of Runoff

Objectives: To design, construct and maintain storm water systems that protect the natural environment.

Best Practices:
• Drainage systems including piped, open and cut-off drains must be designed to avoid native vegetation where possible or to minimise disturbance to native vegetation, minimising the potential for erosion and sedimentation.
• Keep excavations for pipes open for minimum time periods.
• Avoid the concentration of runoff flows onto adjoining land.
• Prepare Contingency Procedures to cater for any large rain storms during the construction phase of the project to minimise offsite water quality effects through erosion, siltation and other pollutants.

15.1.5 Litter Control

Objective: To keep sites litter free.

Best Practices:
• Ensure all litter including oil cans, hoses and machinery parts are disposed in a responsible manner.
• Maintain a high quality of housekeeping and ensure that materials are not left where they can be washed or blown away to become litter.
• Provide bins for construction workers and staff at locations where food is consumed.
• Conduct ongoing awareness education with staff of the need to avoid littering.

15.1.6 Dust Control

Objective: To minimise risk or loss of amenity due to the emission of dust to the environment from road works.

Best Practices:
• Implement a dust strategy where it has been identified as a risk, e.g., safety of road users.
• Take appropriate dust suppression measures during maintenance and/or construction, e.g., by promptly watering exposed areas when visible dust is observed.

15.1.7 Strip and Stockpile Topsoil

Objective: To promote the stockpiling of topsoil from the site or areas of native vegetation for reuse as it contains organic matter and the seeds of local native plants.

Best Practices:
• Strip and stockpile the topsoil before starting any works.
• Locate soil stockpiles in cleared areas, away from existing drainage lines, trees, shrubs and native grasses.
• Remove any weeds before stockpiling by spraying or scalping.
• Imported topsoil only to be used if authorised by the Engineer.

15.1.8 Disposal of Excavation Material, Drain and Road Spoil

Objective: To limit road spoil to approved disposal sites only.

Best Practices:
• Direct the spoil from works towards the designated construction or maintenance zone for collection.
• Dispose road spoil to approved disposal sites only.
• Where appropriate, avoid extra reshaping or increasing the size of drains. Exposed earth and drain spoil is...
ideal for weed establishment.

15.1.9 Location and Management of Stockpiles

Objectives: To manage the location of stockpiles and dumpsites to limit invasion of materials into native vegetation, the spread of weeds and for the protection of the areas amenity.

Best Practices:
- Designated stockpile/dump sites only to be used for the stockpiling of materials when carrying out any works on the road corridor.
- Designated stockpile/dump sites are identified on a locality map provided by the Union Parishad.
- New stockpile or dumpsites may only be approved by the Engineer, and are not to be located on roadsides with medium to very high conservation values, drainage lines, waterways, and culvert areas or on roadsides adjacent to forests areas. In no circumstances must vegetation be removed to provide for the siting of stockpiles or the storage of materials (including dumpsites for excess soils/materials).
- Select the location for new stockpile/dump sites with consideration of the visual amenity and landscape values of the site.
- Use minimum space as necessary to store materials and to gain access to the stockpile/dump site.
- Stockpile/dump site boundaries to be clearly defined e.g., fencing, fallen logs.

15.1.10 Cultural and Heritage Sites

Objectives: To ensure the protection of roadside sites identified as having cultural or heritage values.

Best Practices:
- Sites of cultural or heritage value, archaeological sites and religious sites shall be formally recognised and protected from the adverse impact of any other uses of the road reserve.
- Any new archaeological sites found or suspected to occur must be reported to the Archaeological Survey of Bangladesh.
ECP 16: DRAINAGE STRUCTURES

16.1 OBJECTIVE
To prescribe procedures for the design, construction and maintenance of road drainage structures and channels to minimise short term and long term adverse environmental effects.

16.2 DESIGN

16.2.1 Capacities
The capacity of all channels, culverts, bridge water ways and other drainage structures shall be such as to be able to discharge the relevant design flow without overtopping or surcharge.

In the design of bridge water ways and major culverts care shall be taken to assess appropriate overland flow paths for the discharge of flood flows arising from extreme rainfall in excess of the specified design rainfall.

**Design Guidelines:** The Designer shall design all channels, culverts, bridge waterways and other drainage structures such that they are able to discharge their design flow without overtopping or surcharge. In the design of bridge water ways and major culverts care shall be taken to assess appropriate overland flow paths for the discharge of flood flows arising from extreme rainfall in excess of the specified design rainfall.

Such overland flow paths shall be such as to avoid the over topping of any bridge super structure.

Overland flow paths shall be arranged wherever practicable to mitigate the adverse effects of flooding of land or buildings both upstream and downstream of any bridge or major structure.

16.2.2 Channel Lining
All permanent drainage channels shall be lined to mitigate against erosion. Where practicable, channels shall be grassed. On steep gradients and elsewhere where expected flow velocity is likely to scour grassed surfaces, impervious lining such as concrete shall be used.

**Design Guidelines:** The Designer shall detail and specify erosion protection measures for all channels and channel discharge locations as prescribed in ECP11.

16.2.3 Channel Discharge
All channel discharge locations shall be protected against erosion. The preferred method of discharge is via broad grassed swales up to 20 metres in length designed to reduce velocity of flow to less than scour velocity and to trap or settle out suspended sediment particles prior to discharge to natural water courses.

Where the installation of grassed swales is impracticable, channel discharge locations shall be protected against scour by the installation of rock rip rap or energy dissipation structures or similar scour protection systems.

Where the discharge from catch drains, bench drains and/or roadside drains is to flow down steep slopes such as may be encountered at cut/fill interfaces in steep terrain then permanent flumes shall...
be used to avoid erosion. Flumes shall extend at least 5 metres beyond the toe of any fill batter. The outlets from flumes shall be protected against scour.

**Design Guidelines:** The consultant shall detail and specify erosion protection measures for all channels and channel discharge locations as prescribed in ECP 11 and this ECP.

### 16.2.4 Culvert Inlets and Outlets

All culvert inlets and outlets shall be protected against erosion. This will normally be achieved through the design of appropriate aprons, wing walls, and head walls. Erosion of the water course bed both up-stream and down-stream of aprons shall be mitigated against by the installation of rock mattresses where necessary.

The integrity of aprons shall be protected from under mining by the design of cut off walls below the apron leading edge.

Bank erosion at culvert inlets and outlets shall be avoided by the design of appropriate wing walls, gabion baskets or similar.

Where necessary to minimise culvert exit velocities and hence minimise the risk of downstream erosion, the design of outlet structures shall include appropriate energy dissipation measures. These may include “dragons teeth”, standing wave flumes, drop structures or similar devices.

### 16.2.5 Bridge Waterways

Unless impracticable, the construction of bridges and bridge waterways shall be undertaken without stream or river diversion.

Bridge piers shall be designed to minimise bed scour. Where piers or abutments are located on river banks, erosion protection measures shall be incorporated in the design.

The entrances to and exits from bridge waterways shall be protected against scour by the use of gabions, rock mattresses or similar devices to protect road batters and/or the existing banks of the watercourse.

**Design Guideline:** The potential for scour at all culvert inlets and outlets and at bridges shall be eliminated by the design and specification of works described in CEP 11 and this ECP.

### 16.3 CONSTRUCTION

#### 16.3.1 Channels and Open Drains

Prior to commencing site clearance work, topsoil stripping or earthworks the contractor shall install all temporary or permanent drainage channels as appropriate together with silt fences or silt retention ponds as are necessary to minimise the discharge of surface water containing sediment particles to any natural watercourse or on to land adjacent to the site of the works.

All permanent drains shall be lined as specified as soon as practicable after formation and such lining shall be maintained in good condition throughout the construction and maintenance period.

Specified erosion control measures at channel discharge locations shall be operational prior to the construction of the relevant permanent drainage and road works.
16.3.2 Culvert Construction

Where culverts are to be constructed in existing watercourses care shall be taken to minimise the clearance of vegetation from existing banks and inverts to just that necessary for the construction of the works.

Construction shall be undertaken utilising methods that limit to practical levels the amount of water contaminated with sediment particles. Wherever possible, construction of culverts will commence at the downstream end and be undertaken in a dry trench. Downstream erosion protection measures should be constructed prior to diversion of flow through culverts.

Wherever practicable temporary downstream silt screens or weirs should be installed to provide a stilling basin for the settlement of suspended soil. Such stilling basins shall be cleaned out and soil transported to waste soil disposal areas before dismantling the temporary downstream weir.

Where culverts are to be constructed across an existing road, at least one half of the road shall be open to traffic at any time. Safety and traffic management procedures for such work shall be as ECP 13.

16.3.3 Bridge Construction

The clearance of existing vegetation from the invert or banks at any bridge site shall be limited to just that area required for the construction of the works.

The programme for construction of the bridge shall demonstrate that detailed and specified erosion protection works are to be constructed at the earliest possible time. Any construction materials to be stored on site at any time, e.g. aggregates, cement, form work and the like shall be stored in a location above likely flood levels. Any fuel storage, workshop or fabrication yard shall be contained within a bunded area as for ECP 06. Facilities for workers at a bridge site shall be as for ECP 06.

The use of plant or equipment within the river or stream channel is to be avoided. If it is unavoidable only plant or equipment free from fuel or oil leaks shall be used.

Construction debris shall not at any time be deposited in any stream or river. At completion of the works all surplus construction materials, debris of any sort and any temporary buildings shall be removed from the site of the works and the whole of the works area restored to its condition prior to the commencement of the works.

16.3.4 Drainage Maintenance

All road drainage systems including side drains, channels (lined or unlined) and culverts shall be regularly maintained and all obstructions, debris and materials which limit hydraulic efficiency, cleared away. Such maintenance work shall be programmed for implementation during the month prior to the onset of each wet season as a minimum.

Material cleared from drainage systems should be loaded on to a truck and transported to designated waste disposal areas for disposal. On no account should materials be disposed of on site.
ECP 17: PLANNING, DESIGN AND IMPLEMENTATION

17.1 GENERAL

The planning, design and implementation of the feeder road periodic maintenance sub-projects shall be undertaken as rolling four year works program. The sub-projects will be selected each year for design and contracting. The typical interventions / activities associated with the periodic maintenance of feeder roads sub-project are given in table 17.1

<table>
<thead>
<tr>
<th>Table 17.1 Typical Periodic Maintenance Works</th>
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<tbody>
<tr>
<td>• Pavement Re-surfacing</td>
</tr>
<tr>
<td>• Pavement Shape Correction</td>
</tr>
<tr>
<td>• Limited Structural Pavement Repairs</td>
</tr>
<tr>
<td>• Major Shoulder Repairs</td>
</tr>
<tr>
<td>• Cleaning of Inlet and Outlet Channels to Major Drainage Structures such as Bridges and large culverts</td>
</tr>
<tr>
<td>• Replacement of damaged or deteriorated road furniture</td>
</tr>
</tbody>
</table>

It is stipulated that the feeder road periodic maintenance sub-projects shall not involve any widening of the existing road formation and consequently no land acquisition (khas / private) is anticipated / warranted. However, there may be necessity of undertaking minor rehabilitation works on some sections of the road where the existing road has somehow been damaged, possibly due to heavy monsoon rains.

17.2 OBJECTIVE

To establish the general guidelines for managing and minimising the potential environmental (including social) impacts of feeder road periodic maintenance sub-projects by outlining principles and minimum standards which shall be taken into account in the planning, design, and implementation of these sub-projects associated with the RTIP.

17.3 GENERAL PRINCIPLES

The following general principles constitute good practice environmental management procedures for planning, design and implementation of feeder roads maintenance works:

• Minimise damage to vegetation and avenue tree felling, sedimentation and pollution of ponds and other water bodies located along the road and impact on productive soil through judicious design and careful implementation of maintenance works.

• Special attention needs to be provided in areas of settlements, heavily vegetated slopes, flood protection embankments, and important wetlands, where the potential impacts could result in more serious implications on natural resources.

• Incorporate design features for the general improvement of environmental quality.

• Incorporate measures and design features for the mitigation of adverse environmental effects, as identified by environmental screening or community consultation process.
17.4 OVERALL DESIGN PRINCIPLES

In seeking to achieve the overall objectives of the sub-project, and maximise the goals of sustainable development, the designer, during the planning and design stage, shall:

- Take into account the issues and concerns of affected communities and stakeholders,
- Decide, in consultation with stakeholders, the environmental and social resources / assets which should be given priority for protection and conservation,
- Identify and discuss with the EMU / PIO of the LGED any mitigation measures which could have a major cost implication,
- Consider appropriate maintenance and rehabilitation methods, which will minimise environmental risks while taking into account the goals of sustainable development. The most practicable methods for minimising the release of sediment and other pollutants into the environment shall be selected,
- Specify that the maintenance activities / works are sequenced, timed, and managed to minimise disturbance to the environment. This includes the minimisation of the extent of area to be worked, and area of bare earth exposed at any one time,
- Specify that the programme of Maintenance works shall be prepared by the Contractor to show that areas to be re-vegetated are completed progressively as sections of the work are completed,
- Identify and set out the relevant clauses of the ECP into the sub-project specific construction contract and bid documents to ensure that environmental standards and guidelines are followed,
- Provide in the contract documentation the operational and maintenance procedures to preserve the mitigation measures in good condition and effective operation.

17.5 ENVIRONMENTAL GUIDELINES FOR PLANNING AND DESIGN

For the planning and design phases, the designer shall follow the general guidelines set out hereunder.

17.5.1 Contractor's Environmental Management Plans

The DSM consultant shall prepare the basis of a Contractor's Environmental Management Plan (CEMP), to be completed by the contractor. The CEMP shall be reviewed by the EMU and approved by the Engineer-in-Charge before commencement of the periodic maintenance works at site. The CEMP shall set out the specific mitigation measures, and monitoring requirements that will be put into place during the sub-project implementation. The CEMP shall:

- Establish the chain of responsibility for managing the environmental aspects of the sub-project
- Identify the records to be maintained which demonstrate compliance with the Contract Specifications and EMP, if any
- Establish the mitigation and contingency measures for at least the following:
  - Vegetation management
  - Excess spoil disposal
  - Slope protection works
  - Borrow area management
Dust and fugitive emissions
Traffic management during maintenance works including traffic diversions, if any

Specify road and structures maintenance and rehabilitation methods to be used, and identify how these will minimise the amount of sediment and other pollutants such as gaseous emissions from bitumen heating released into the environment.

17.6 ENVIRONMENTAL GUIDELINES FOR PERIODIC MAINTENANCE

During implementation of the periodic maintenance works, the contractor shall follow the general guidelines as set out below.

17.6.1 General

- No equipment shall be moved onto a site, or works undertaken, prior to approval of the CEMP as established by the contract documents.
- All reasonable steps shall be taken to ensure minimum disturbance to adjacent land, property and other environmental features during maintenance works.
- At all times reasonable and useable access is to be maintained to private land and villages not directly affected by the works.
- Plants and seedlings used for re-vegetation should wherever possible be taken from the immediate area and from as close as possible to the restoration site.
- Specific management plans shall be prepared for sub-project activities that were not considered during the planning and design stage.

17.6.2 Dust Control

- The CEMP shall detail dust control measures by dampening and include where the water will be collected from (i.e. whether from ponds or local watercourses), and the number of watering trucks required. All care shall be taken to ensure excess water does not find its way to waterways.

17.6.3 Stockpiles

- Ensure that stockpiles of topsoil, humus, mulch, fill and waste materials, and brick aggregates are not located within 10m of a watercourse, or in ecologically sensitive areas such as wetlands, forests.
- Stockpiles of materials shall not provide a source of dust generation.

17.6.4 Refuelling and Maintenance Areas

- Ensure that vehicles and plant parking or refuelling and maintenance facilities are not located, or activities do not take place, within 30 m of a watercourse, or in ecologically sensitive areas, wherever practicable.

17.6.5 Site Facilities

- Site facilities shall be established as set out in ECP 06. Site facilities include site offices, ablutions, camps and facilities as necessary, provision for safe potable water supply, sanitation, electricity, telephone, covered rubbish bins etc and areas designated for workers. As construction and
operation of these facilities have the potential to generate litter and other waste materials, these
facilities shall not be located within 30 m of a watercourse, or in an ecologically sensitive area such
as forests, wetland

- Ensure regular disposal of rubbish off site at an appropriate location.

17.6.6 Water Crossings
- Minimise disturbance to watercourses, excavations or disturbance of the bed of any waterway shall
  not occur unless required as part of maintenance works
- Exposed surfaces shall be minimised and re-vegetated or sealed as soon as practicable
- Weather conditions should be taken into account in programming earthworks.

(Refer to ECP 18 for details).

17.6.7 Planting and Revegetation
Grassing and replanting of trees and shrubs progressively throughout implementation period is the
most effective means of preventing or minimising erosion. Consequently contractors shall programme
and execute their work such that.
- Revegetation of all exposed surfaces shall be specified and shall be undertaken as soon as
  practicable after completion of earthworks.
- Stockpiles of top soil and mulch comply with the requirements for stockpiles (refer to ECP 05)
- Maintenance of vegetation and erosion control measures shall be specified

17.6.8 Transportation of Construction Materials
- Consideration shall be given to the safety of other road users and impacts on the environment
  through controlling truck movements and ensuring loads are covered to prevent spillage of
  construction materials.

17.6.9 Traffic Control
- Adequate control of traffic together with provision of traffic signs and flagman for control and safety
  of traffic and workforce

17.7 GENERAL ENVIRONMENTAL MANAGEMENT CONTRACT
CLAUSE
PIO / LGED shall ensure that all relevant clauses be included in construction contract documentation
related to RTIP feeder road periodic maintenance sub-projects which sets out the premise for
environmental management as established in this ECP

The Contractor is instructed to enter into the spirit of the project and will undertake all activities with due
diligence to ensure that the environmental resources of the site or area are protected, conserved, and
sustained at all times.

17.8 OVERVIEW OF BEST OPERATING PRACTICES

The following section presents an overview of the best operating practices that must be adhered to
during planning, design and implementation of the feeder road periodic maintenance sub-projects.
17.8.1 Wetlands

Objective: Wetlands should be retained since they provide many important benefits including a source of food, multipurpose uses for rural people, habitats for diverse varieties of flora and fauna, groundwater recharge, and flood mitigation.

Best Practices:

- Protect all wetland areas, whether natural or artificial, by minimising disturbance to the wetland and adjacent landforms. Changes to the hydrological regime in particular should be avoided since this has the potential to significantly impact on the wetland.
- Identify existing wetlands and protect them by defining work zones in tender specifications and plans.

17.8.2 Vehicle and Machinery Activity

Objective: To minimise disturbance to indigenous vegetation (trees, shrubs and groundcover) by using the appropriate type and minimum size of machine for the job, and confining vehicular activities to designated areas.

Best Practices:

- Select the type and size of machinery appropriate for the task to minimise disturbance to vegetation.
- Park machinery in a cleared area, in a designated wayside stop, parking lot or on private land (where permission has been granted).
- Site machinery compounds clear of trees, shrubs and groundcover. In no circumstances should vegetation be removed to provide for the siting of machinery compounds or storage of materials.
- Service vehicles and machinery on the roadside at a designated location only when it is not possible to move to a more appropriate site. Great care must be taken to ensure that no spillage of pollutants such as oils/fuel results from any servicing operation.
- Confine machinery to the existing road formation, proposed alignment, access tracks or designated construction zone unless otherwise directed by the site supervisor.
- Turn vehicles and machinery within the Construction Zone or on cleared sites or sites that have minimal indigenous vegetation.
- Avoid drip lines of trees to minimise root damage and soil compaction around tree root systems from machinery.

17.8.3 SOIL EROSION AND SEDIMENTATION CONTROL

Objective: To prevent soil erosion and sedimentation during works.

Remember:

- Erosion removes valuable topsoil and produces sediment, which silts drains, irrigation channel, ponds and rivers damaging the aquatic environment.

Best Practices:

- Soil erosion and sedimentation control procedures must be included in the Planning and Design stage of any sub-project.
• Erosion to be minimised by.
  ° protecting existing vegetation;
  ° minimising soil disturbance, and
  ° stabilising disturbed areas as works proceed.

• Make provision for storm water runoff at the beginning of the job.

• Divert all storm water away from loose or exposed soil.

• Avoid steep drainage lines where possible

• Avoid steep batter slopes.

• Establish an adequate inspection, maintenance and cleaning program for all storm water drainage systems

• Do not direct storm water from maintenance or rehabilitation work sites into areas supporting high quality indigenous vegetation including watercourses

17.8.4 Litter Control

Objective: To keep sites litter free

Best Practices:

• Ensure all litter including oil cans, hoses and machinery parts are disposed in a responsible manner.

• Maintain a high quality of housekeeping and ensure that materials are not left where they can be washed or blown away to become litter.

• Provide bins for construction workers and staff at locations where food is consumed

• Conduct ongoing awareness education with staff of the need to avoid littering

17.8.5 Dust Control

Objective: To minimise risk or loss of amenity due to the emission of dust to the environment from road works

Best Practices

• Implement a dust strategy where it has been identified as a risk, e.g. safety of road users.

• Take appropriate dust suppression measures during maintenance and/or construction, e.g. by promptly watering exposed areas when visible dust is observed

17.8.6 Strip and Stockpile Topsoil

Objective: To promote the stockpiling of topsoil from the site or areas of native vegetation for reuse as it contains organic matter and the seeds of local native plants

Best Practices:

• Strip and stockpile the topsoil before starting any works
- Locate soil stockpiles in cleared areas, away from existing drainage lines, trees, shrubs and native grasses.
- Remove any weeds before stockpiling by spraying or scalping.
- Imported topsoil only to be used if authorised by the Engineer.

**17.8.7 Waste Materials, Drain and Road Spoil**

Objective. To limit road spoil to approved disposal sites only.

Best Practices:

- Direct the spoil from works towards the designated maintenance zone for collection
- Dispose road spoil to approved disposal sites only.
- Where appropriate, avoid extra reshaping or increasing the size of drains. Exposed earth and drain spoil is ideal for weed establishment

**17.8.8 Location and Management of Stockpiles**

Objective: To manage the location of stockpiles and dumpsites to limit invasion of materials into native vegetation, the spread of weeds and for the protection of the areas amenity

Best Practices:

- Designated stockpile/dump sites only to be used for the stockpiling of materials when carrying out any works on the road corridor.
- Designated stockpile/dump sites are identified on a locality map provided by the Union Parishad.
- New stockpile or dumpsites sites may only be approved by the Engineer, and are not to be located on drainage lines, waterways, and culvert areas or on roadsides adjacent to wetlands or forest areas. In no circumstances, will vegetation be removed to provide for the siting of stockpiles or the storage of materials (including dumpsites for excess soils/materials)
- Select the location for new stockpile/dump sites with consideration of the visual amenity and landscape values of the site
- Use minimum space as necessary to store materials and to gain access to the stockpile/dump site
- Stockpile/dump site boundaries to be clearly defined e.g. fencing, fallen logs

**17.8.9 Cultural and Heritage Sites**

Objective To ensure the protection of roadside sites identified as having cultural or heritage values

Best Practices:

- Sites of cultural or heritage value, archaeological sites and religious sites shall be formally recognised and protected from the adverse impact of any other uses of the road reserve
- Any new archaeological sites found or suspected to occur must be reported to the Archaeological Survey of Bangladesh.
ECP 18: DRAINAGE STRUCTURES

18.1 OBJECTIVE

To prescribe procedures for the maintenance of road drainage structures and channels associated with the periodic maintenance of feeder roads to minimise short term and long term adverse environmental effects.

18.1.1 Drainage Maintenance

All road drainage systems including side drains, channels (lined or unlined) and culverts shall be cleaned and repaired as necessary and all obstructions, debris and materials which limit hydraulic efficiency, cleared away. Such maintenance work shall be programmed for implementation during the month prior to the onset of each wet season as a minimum.

Material cleared from drainage systems should be loaded on to a truck and transported to designated waste disposal areas for disposal. On no account should materials be disposed of on site.

Suggested Specification: The contractor shall remove all vegetation, sediment and other debris from the culvert and from the channel adjacent to the inlet and outlet of the culvert, and transported from the site for disposal at a designated place in such a manner that these could not find its way to any waterbody. The culvert pipes, head and wing walls shall be inspected and any damage recorded and reported to the Engineer. In accordance with the instructions from the Engineer, the Contractor shall carry out minor and major repair works to the culverts, including mortar grouting to broken joints, and replacing damaged sections of mortared brickwork or concrete to head and wing walls. Repair works to damaged culvert pipes shall include all work, which can be effectively carried out within the culvert pipe, without excessive excavation.

18.1.2 Bridge Maintenance

The most common aspects of bridge maintenance are:

- removal of corrosion (rust) and paint from metal components by abrasive blasting,
- corrosion protection (painting),
- cleaning and repair of concrete (including material replacement and modification),
- repairs of structural steel (including welding),
- asphalt replacement and chipsealing, and
- replacement of riprap protection and bank stabilisation

Environmental Concerns with Bridge Maintenance: The main concerns with bridge maintenance activities are related to accidental releases into the environment of materials, which may have negative effects.

Maintenance involving the placement of (additional) riprap material and bank stabilisation could cause disturbance to streambed sediments, which may become suspended in the water and transported downstream. The effects of sediments are discussed in detail in Annexure 11.1 to ECP 11 (Erosion and Sedimentation Control).

Abrasives such as silica sand, heavy mineral sands, and slag products may have localised temporary negative effects on the receiving environment. The main concern lies with the release of significant amounts of spent abrasives to an underlying watercourse. Large amounts of spent abrasives, which enter a watercourse, will alter, disrupt, or destroy fish habitat.
Spent abrasives generated during the removal of paint and rust may contain heavy metals (such as lead from lead-based paints) or petroleum components (from oil-based paints) which may have toxic effects if permitted to enter a watercourse.

Paint may be released during spray-painting operations. Paints vary widely in their chemical composition and have the potential for releasing harmful substances into the aquatic environment. Generally, a thin film would form on the water surface which prevents diffusion of oxygen into the water, thus interfering with aeration of the steam. Oily substances may coat and clog the gills of aquatic fauna, inhibiting respiration and smothering the organisms. Fish mortalities may result due to the toxicity associated with various components of the paint, such as lead or other heavy metals.

Air quality may be impacted by fugitive dust and by fumes generated from the breakdown of lead-based paint as a result of high temperatures associated with welding, burning (torches) and/or grinding operations. The release of fugitive dust can impact workers, nearby residents, and local businesses. The impacts on workers can cause health effects, while the impact on others is more of a nuisance and of an aesthetic nature. The proximity of businesses and residential housing is also an important consideration.

Chipsealing and asphalt replacements near and over a watercourse are very likely to release potentially toxic materials to the underlying watercourse.

**Methods to Control Waste and Fugitive Emissions during Bridge Maintenance:**

At all times when maintenance work is carried out on a bridge, necessary precautions must be taken to prevent discharge or loss of harmful materials or substances into the environment.

Prior to undertaking any work on a bridge, contact the bridge Maintenance Engineer of the DSM Consultant to make sure that the appropriate measures are implemented to prevent discharge or loss of harmful materials or substances into the environment.

**Application and Removal of Protective Coatings:** The guidelines for application and removal of protective coatings as provided by the Manufactures / Suppliers of the paints, which are intended to provide environmental protection during such maintenance operations.

These guidelines are to be applied to all structural steel coating situations where dust and debris from surface preparation operation and the overspray from coating operations may result in harmful effects to any aquatic resource, Peron, or the environment.

A specific protection plan should be in place if there are environmental concerns. Appropriate protection measures may include:

- **A Partial Enclosure** can be used where surface preparation and/or coating operations result in chippings, scrapings and other materials or debris which may escape from the operation.

- **A Full Enclosure** can be used where surface preparation and/or coating operations may cause the escape of dust, paint overspray and all other materials or debris from the operation and where this type of release must be prevented.

  *A Full Enclosure with Negative Pressure System* can be used where surface preparation and/or coating operations may cause the escape of dust beyond a specified distance (normally 10m) and where the escape of all other materials or debris from the operation from the operations must be prevented.

For abrasive blasting below the deck, staging is typically used to collect spent blasting media. Geotechnical fabric is placed over the staging to allow vacuuming of the media for proper disposal or reuse. Tarps (screen-type) are also tucked in along the side of the bridge deck to minimise fugitive emissions.
For abrasive blasting above the deck, staging is mounted on section of the deck. Impermeable tarps are installed at the top of the staging to keep the work area dry. Screen-type tarps are typical used to enclose the remainder of the work area and the bridge deck is used to collect the spent blasting media. All bridge deck drains should be blocked. Open steel grating decks should be covered with geotechnical fabric or by some other means to collect the spent blasting media.

If air or airless spray tools are used, drapes and curtains similar to those used during abrasive blasting should be erected to prevent paint from entering the environment.

Spent blasting medium should be handle and disposed of according to the Directions of the Engineer in an environmentally safe manner.

**Bridge Deck Repairs:** When repairs to bridge decks are necessary, breakthrough of the deck should be avoided. The sides of the deck should be covered to prevent pieces of concrete or other materials from being introduced to the underlying watercourse. Plywood boards or tarps may be used for this purpose. Bridge deck drains should be blocked.

**Other Concrete Repairs:** When concrete replacement work is necessary on bridges, timber staining should be placed next to the face to prevent concrete from falling into the water or cofferdams should be constructed to enclose the work area. Refer to Section 2.6.3 on “Bridge Construction” for more information on cofferdams.

**Cleaning of Bridges:** When dirt and debris accumulation (such as salt) is excessive, vacuum, scrape, and/or sweep the bridge surfaces first and collect loose material for proper disposal away from the ends of the structure. Blowing with compressed air or flushing can then be used to finish the cleaning. This practice should reduce the amount of material entering the waterway.

**Chipsealing:** During chipsealing operations on or near abridge, there is a potential for discharge of liquid asphalt to a watercourse due to over-spray along the sides of the bridge or seepage through the deck. Before chipsealing on or near a bridge, the contractor should contact the Engineer to make sure that appropriate protection measures are in place. An example of appropriate protection for a watercourse during chipsealing of a bridge is skirting or under-draping of the deck with polyethylene sheeting (or similar protective material). All bridge deck drains should be blocked.

**Riprap Replacement and Bank stabilisation:** Placement of riprap or armour stones around bridge piers and abutments should be carried out in a manner, which will minimise disturbance of stream bed sediments. Placement may be carried out using barges with direct placement using an excavator.
ECP 19: PLANNING, DESIGN AND CONSTRUCTION

19.1 GENERAL

Most of the project roads including RR1, FRB, FRA would require construction / replacement / rehabilitation / maintenance of structures (culverts/bridges - minor or major or both). In addition, Structures on Rural Roads (SRR) component will include culverts and bridges of span upto 20 m.

Generally, LGED classify the structures in terms of span as follows.

- Span up to 12 m - Culverts (Pipe culvert / U drain / Box culvert / Slab Culvert)
- Span between 12 and 30 m - Minor bridges
- Span more than 30 m - Major bridges

The LGED has prepared a comprehensive Design Manual for Structures to assist its Planning and Design Unit at Headquarters as well as other Engineer at Upazila and District level. While the manual provides detailed guidelines and examples with several typical designs and drawings of structures, there is a scope for integrating environmental consideration into the design process to ensure environmentally sound planning, design and construction of the structures on rural and feeder roads. This ECP presents relevant environmental guidelines / considerations which can be used for improving the environmental soundness of the design and construction of the structures associated with the RTIP.

19.2 OBJECTIVE

To establish the general guidelines for managing and minimising the potential environmental (including social) impacts of construction / rehabilitation / widening / maintenance of structures associated with sub-projects under the RTIP by outlining principles and minimum standards which shall be taken into account in the planning, design, and implementation of these sub-projects.

19.3 GENERAL DESIGN PRINCIPLES

The following general principles constitute good practice environmental management procedures for planning, design and implementation of road structure works.

- Take into account the issues and concerns of affected communities and stakeholders;
- Decide, in consultation with stakeholders, the environmental and social resources / assets which should be given priority for protection and conservation;
- Identify and discuss with the EMU / PIO of the LGED any mitigation measures which could have a major cost implication;
- Consider appropriate construction methods, which will minimise environmental risks while taking into account the goals of sustainable development. The most practicable methods for minimising the release of sediment and other pollutants into the environment shall be selected;
- Specify that construction phases are sequenced, timed, and managed to minimise disturbance to the environment. This includes the minimisation of the extent of area to be worked, and area of bare earth exposed at any one time;
- Specify that the programme of construction shall be prepared to show that areas to be re-vegetated are completed progressively as sections of the work are completed.
Identify and set out the relevant clauses of the ECP into the sub-project specific construction contract and bid documents to ensure that environmental standards and guidelines are implemented.

Provide in the contract documentation the operational and maintenance procedures to preserve the mitigation measures in good condition and effective operation.

**19.4 ENVIRONMENTAL GUIDELINES FOR PLANNING AND DESIGN**

The designer shall follow the general guidelines for planning and design of road drainage structures and channels to minimise short term and long term adverse environmental effects as set out hereunder.

**19.4.1 Design Capacity**

The capacity of all channels, culverts, bridge water ways and other drainage structures shall be such as to be able to discharge the relevant design flow without overtopping or surcharge.

In the design of bridge water ways and major culverts care shall be taken to assess appropriate overland flow paths for the discharge of flood flows arising from extreme rainfall in excess of the specified design rainfall.

**Design Guidelines:** The Designer shall design all channels, culverts, bridge waterways and other drainage structures such that they are able to discharge their design flow without overtopping or surcharge. In the design of bridge water ways and major culverts care shall be taken to assess appropriate overland flow paths for the discharge of flood flows arising from extreme rainfall in excess of the specified design rainfall.

Such overland flow paths shall be such as to avoid the over topping of any bridge super structure.

Overland flow paths shall be arranged wherever practicable to mitigate the adverse effects of flooding of land or buildings both upstream and downstream of any bridge or major structure.

**19.4.2 Channel Lining**

All permanent drainage channels shall be lined to mitigate against erosion. Where practicable, channels shall be grassed. On steep gradients and elsewhere where expected flow velocity is likely to scour grassed surfaces, impervious lining such as concrete shall be used.

**Design Guidelines:** The Designer shall detail and specify erosion protection measures for all channels and channel discharge locations as prescribed in ECP10 and 11.

**19.4.3 Channel Discharge**

All channel discharge locations shall be protected against scour. The preferred method of discharge is via broad grassed swales up to 20 metres in length designed to reduce velocity of flow to less than scour velocity and to trap or settle out suspended sediment particles prior to discharge to natural water courses.

Where the installation of grassed swales is impracticable, channel discharge locations shall be protected against scour by the installation of rock rip rap or energy dissipation structures or similar scour protection systems.

Where the discharge from catch drains, bench drains and/or roadside drains is to flow down steep slopes such as may be encountered at cut/fill interfaces in steep terrain then permanent flumes shall be used to avoid erosion. Flumes shall extend at least 5 metres beyond the toe of any fill batter. The outlets from flumes shall be protected against scour.
**Design Guidelines:** The consultant shall detail and specify erosion protection measures for all channels and channel discharge locations as prescribed in ECP 11.

### 19.4.4 Culvert Inlets and Outlets

All culvert inlets and outlets shall be protected against erosion. This will normally be achieved through the design of appropriate aprons, wing walls and head walls. Erosion of the water course bed both upstream and downstream of aprons shall be mitigated against by the installation of rock mattresses where necessary.

The integrity of aprons shall be protected from under mining by the design of cut off walls below the apron leading edge.

Bank erosion at culvert inlets and outlets shall be avoided by the design of appropriate wing walls, gabion baskets, or similar.

Where necessary to minimise culvert exit velocities and hence minimise the risk of downstream erosion, the design of outlet structures shall include appropriate energy dissipation measures. These may include "dragons teeth", standing wave flumes, drop structures, or similar devices.

### 19.4.5 Bridge Waterways

Unless impracticable, the construction of bridges and bridge waterways shall be undertaken without stream or river diversion.

Bridge piers shall be designed to minimise bed scour. Where piers or abutments are located on river banks, erosion protection measures shall be incorporated in the design.

The entrances to and exits from bridge waterways shall be protected against scour by the use of gabions, rock mattresses, or similar devices to protect road batters and/or the existing banks of the watercourse.

**Design Guideline:** The potential for scour at all culvert inlets and outlets and at bridges shall be eliminated by the design and specification of works described in CEP 11.

### 19.4.6 Contractor's Environmental Management Plans

The DSM consultant shall prepare the basis of a Contractor's Environmental Management Plan (CEMP), to be completed by the contractor. The CEMP shall be reviewed by the EMU and approved by the Engineer-in-Charge before commencement of construction works. The CEMP shall set out the specific mitigation measures, and monitoring requirements that will be put into place during the sub-project implementation. The CEMP shall:

- Establish the chain of responsibility for managing the environmental aspects of the project
- Identify the records to be maintained which demonstrate compliance with the Contract Specifications and EMP, if any.
- Establish the mitigation and contingency measures for at least the following
  - Vegetation management
  - Erosion and Siltation
  - Fish Protection Plan
  - Excess Spoil disposal
  - Slope protection works
  - Borrow Area management
  - Brickfields and brick crushing yard management
  - Dust control
  - Water collection management
- Noise control
- Traffic management during construction including diversions

- Specify the temporary storm water management devices, their locations, and the maintenance programme for all such devices.

- Specify and detail sedimentation control measures to be implemented.

- Specify construction methods to be used, and identify how these will minimise the amount of sediment released into the environment.

- All surveys and investigations including Contour Survey, Hydrological surveys, Geo-technical Survey etc. shall be undertaken with the desired level of accuracy and detail by suitably qualified and experienced Engineers / Technicians.

- In consultation with the affected (adjacent) community, identify and implement the best practicable option for the disposal of excavated material and unsuitable materials. In this context materials refers to non-toxic materials. Any toxic materials shall be disposed of by a method or methods that comply in all respects with the laws of Bangladesh.

- Design storm water crossings to use low impact structures intended to minimise disturbance to the stream/river/canal environment, and shall:
  - incorporate any design features required to protect particular ecologically sensitive areas,
  - permit the passage of fish,
  - permit/retain existing navigational requirements,
  - encourage minimal construction time,
  - incorporate construction sediment control,
  - minimise clearance of vegetation.

19.4.7 Clearance Height of Bridges

Rivers and canals provide an important means of transporting people and goods in Bangladesh. The clearance height between bridges and high flood level (HFL) shall be sufficient to allow the unimpeded passage of boat traffic on rivers and canals.

- **Design Guideline:** The Designer shall design all bridges to provide sufficient clearance between the bridge and the high flood level (HFL) of rivers and canals to allow the unimpeded passage of boats. The clearance height may vary depending on the expected size of boats using the river or canal.
- As a general rule bridges less than 12m in length shall be designed to provide a 1m clearance height between bridge and HFL. Bridges greater than 12m in length shall provide a clearance height of m.

19.5 ENVIRONMENTAL GUIDELINES FOR CONSTRUCTION

19.5.1 Culvert Installation and Maintenance

The installation and maintenance of culverts can include the following activities:

- diversion of watercourses and dewatering of the work site, if necessary;
- excavation,
- placement of culvert,
- concrete work,
- brick work,
- backfilling, and
- slope and channel stabilization.

Where culverts are to be constructed in existing watercourses care shall be taken to minimise the clearance of vegetation from existing banks and inverts to just that necessary for the construction of the works.
Construction shall be undertaken utilising methods that limit to practical levels the amount of water contaminated with sediment particles. Wherever possible, construction of culverts will commence at the downstream end and be undertaken in a dry trench. Downstream erosion protection measures should be constructed prior to diversion of flow through culverts.

Wherever practicable temporary downstream silt screens or weirs should be installed to provide a stilling basin for the settlement of suspended soil. Such stilling basins shall be cleaned out and soil transported to waste soil disposal areas before dismantling the temporary downstream weir.

Where culverts are to be constructed across an existing road, at least one half of the road shall be open to traffic at any time. Safety and traffic management procedures for such work shall be as ECP 13.

**Minor Culverts**

Minor culverts are installed for surface water drainage purpose. Environmental concerns with minor culvert installation and maintenance are associated with erosion and sedimentation. If a minor culvert is being installed or maintenance work is being carried out, it may be necessary to control runoff water collected in the ditch to provide a dry work area. Pumping may be necessary to divert water around the work area.

**Major Culverts**

Major culverts are required at locations along a roadway alignment which cross a watercourse. Culverts installed in the roadway should be placed in alignment with the watercourse, if possible, to avoid disruption to stream flow.

If the culvert is not placed along the existing channel alignment and flow is directed towards a streambank which is susceptible to erosion, riprap protection should be provided on the streambanks to prevent erosion.

Two methods are commonly used for the installation and maintenance of major culverts to permit work to be carried out in a dry area and allow fish passage as follows:

- Construct a temporary diversion channel to divert streamflow around the construction area and allow culvert installation in the natural channel.

  Protective vegetation removed during excavation exposes soil material, which may be eroded by surface runoff. To prevent erosion of exposed soils, a gunny liner should be placed on the diversion channel bottom and slopes and secured using sand bags or other means. Pumping is carried out to remove water from the work area if it does not flow out under natural conditions, after the streamflow has been diverted. Water with a high concentration of sediments should be pumped into a temporary sedimentation pond or a vegetated area so that sediment-laden water is retained prior to entering the watercourse. Blasting may sometimes be required in the hilly areas to remove bedrock material in order to place the culvert at the desired grade.

- Undertake culvert installation in an area adjacent to a watercourse and realign the stream to divert flow through the culvert.

Activities associated with the construction of the permanent diversion channel are similar to those identified for a temporary diversion. However, erosion protection measures are more extensive as the channel will be a permanent feature.

Riprap, sand filled gunny gags, geotechnical fabric, seeding, mulching, or a combination of these, are applied to stream channel slopes to prevent erosion of soils exposed during excavation. The streambed should be lined with clean granular material such as riprap and gravel to prevent erosion.
19.5.2 Environmental Concerns Associated with Culvert Installation and Maintenance

Environmental concerns that require special consideration to ensure that applicable regulatory legislation is complied with and to protect the environment include:

- erosion and sedimentation,
- fish passage and habitat

Measures to Control Erosion and Sedimentation: Sediment entering the watercourse in significant concentrations will affect aquatic life and habitat. Refer to Annexure 11.1 (Erosion and Sedimentation method) for further information on the effects of sediment.

If soils are exposed at the end of a culvert, temporary sediment control fences should be constructed to prevent erodible materials placed around the culvert from entering the watercourse until vegetation is established or until erosion control devices such as riprap have been installed.

A sediment control fence should be constructed along the streambank if soils susceptible to erosion are exposed adjacent to the channel. This will prevent soil particles, which have been transported in surface runoff from entering the watercourse, as discussed in ECP 11 on Erosion and Sedimentation Control.

If water containing a large quantity of sediments is being pumped from a construction area, the water should be directed to a settling pond. This will allow fines to settle out before being discharged to a watercourse. Refer to Annexure 11.1 to ECP 11 (on Erosion and Sedimentation Control).

If the culvert structure is improperly constructed, scouring may occur. Material placed around the culvert as part of the roadway construction contains fines which may be eroded if exposed. The outlet of a culvert should be constructed to resist undermining, washout, and siltation. Riprap material should be placed around the base of the culvert to prevent scouring.

Energy dissipaters such as riprap material, and/or brick-filled wire baskets and concrete can be placed at the inlet and outlet of the culvert to prevent undermining and scouring.

After backfilling of a temporary diversion channel is completed, seeding and mulching should be carried out to stabilize exposed areas against erosion, as discussed in Annexure 11.1 to ECP 11 (Erosion and Sedimentation).

Fish Passage: Culvert structures and temporary or permanent diversion channels must be properly constructed to ensure that fish passage is not obstructed. Culverts placed in watercourses should be designed and constructed in accordance with the LGED Design Manual on Structures with due regard to the following considerations for fish passage:

- entrance conditions
- limiting velocity and depth, and
- length of the installation

The culvert slope should be minimized to ensure that flow velocities are low enough to permit fish passage. In cases where site conditions require a steeper slope, such as when the culvert is laid on the stream bottom, weirs are to be installed to ensure fish passage and to provide habitat.

If the water flow velocity is high, fish must rest for short periods when passing through a watercourse. It may be necessary to install interior baffles, or fish weirs, if a long culvert structure is required.

If the invert elevation of the culvert is too high above the downstream water surface, it may be impossible for fish to enter the culvert. Fish passage may also be restricted if the flow velocity and the length of the culvert are excessive and the depth of flow limited.
In no case is a drop to be permitted at the outlet of a culvert. A properly constructed culvert is set below the level of the steam to allow easier passage for fish. The outlet should be positioned 0.50 metres below the natural steambed.

When more than one culvert is provided at a crossing site, fish passage criteria must be applied to one of the culverts.

Diversion channels should be constructed such that flow velocities do not prevent passage of fish through the watercourse. Boulder size material (300 mm to 600 mm) should be placed in the channel to provide rest areas for fish. Flow velocities behind obstructions such as large rocks are much lower than in open areas. This provides an opportunity for fish to rest as they travel through the watercourse. The boulders also provide protection against predation.

If a new channel is constructed, the diversion channel should resemble the existing channel as much as possible, and improved upon it, if possible.

19.5.3 Bridge Construction

Activities undertaken within a watercourse which are typically associated with construction of a bridge include:

- **Excavation (Including Blasting in hilly areas)**
  
  Excavation for bridge abutments typically involves the removal or disturbance of the protective vegetation layer, which can expose soils that may be susceptible to erosion. Pre-excavation work for bridge piers will result in significant disturbance of streambed materials.

  In hilly areas, blasting operations carried out in a watercourse as part of excavation work cause shock waves to be generated, which may be transmitted in waterbodies.

- **Construction of Cofferdams**
  
  When constructing an earth cofferdam, streambed sediments may be disturbed. Sediments may be introduced into a watercourse during construction of an earth fill cofferdam. During dewatering (pumping) of a cofferdam, a significant amount of sediment may be picked up.

- **Construction of Embankments and Temporary Bridges**
  
  Construction of an embankment in or near a waterway is likely to introduce sediments to the watercourse and disturb streambed sediments. Removal of embankment materials at the end of construction is expected to cause disturbance to streambed sediments.

- **Construction of Foundations and Supports**
  
  There may be considerable disturbance to the streambed when erecting structural elements. If pumping is carried out to keep the work area dry, disturbed sediments may be picked up. Concrete may be introduced to the watercourse during placement.

  If piers and abutments are not aligned with the stream flow, erosion of streambanks may occur downstream. The structural supports may cause water currents to be directed toward the streambank, thereby increasing the potential for erosion.

**Environmental Concerns with Bridge Construction**: Potential environmental concerns associated with construction of bridge structural support elements are associated with

- erosion and sedimentation;
- release of pollutants,
• blasting in and near watercourses; and

• fish passage

The clearance of existing vegetation from the invert or banks at any bridge site shall be limited to just that area required for the construction of the works. The programme for construction of the bridge shall demonstrate that detailed and specified erosion protection works are to be constructed at the earliest possible time. Any construction materials to be stored on site at any time, e.g. aggregates, cement, form work and the like shall be stored in a location above likely flood levels. Any fuel storage, workshop or fabrication yard shall be contained within a bounded area as per ECP 06. Facilities for workers at a bridge site shall be as per ECP 06.

The use of plant or equipment within the river or stream channel is to be avoided. If it is unavoidable, only plant or equipment free from fuel or oil leaks shall be used.

Construction debris shall not at any time be deposited in any stream or river. At completion of the works, all surplus construction materials, debris of any sort and any temporary buildings shall be removed from the site of the works and the whole of the works area restored to its condition prior to the commencement of the works.

**Measures to Control Erosion and Sedimentation:** Environmental concerns are associated with potential impacts to the aquatic environment due to increased sedimentation. Concerns with siltation are discussed in detail in Annexure 11.1 to ECP 11 (on Erosion and Sedimentation Control).

During bridge construction activities, it is very important to ensure that measures are taken to contain sediment at the point of origin.

When excavating in or near a watercourse, keep the work area separated from the flowing stream to prevent sediments from being picked up and transported downstream. This can be achieved by installing silt curtains and cofferdams. Note that the fish passage requirement must still be met.

A silt curtain is a permeable geotextile material which is suspended vertically in a waterbody to minimise sediment transport from a disturbed area adjacent to or within a body of water. The base of the silt curtain is secured on the streambed using weighted materials, which also keep the curtain in place. Silt curtains should be placed around work areas before any excavation or construction (including construction and removal of earth cofferdams and construction of embankments) begins.

Prior to construction of abutments, materials used for approaches should be clean gravel or other non-silt bearing material to eliminate the potential for sediments to enter the watercourse.

Earth cofferdams may be constructed using earth embankments and/or sandbags. An impermeable liner must be placed and secured (using bricks or sandbags) on the embankment to prevent soils from being eroded. An impermeable liner should also be used when constructing a cofferdam using sandbags, to prevent silt-laden water from passing through any openings between the sandbags.

A buffer zone of 30 metres is required between the disposal area and a watercourse. Sediment control fences and erosion control structures are to be installed prior to carrying out any earthwork to prevent runoff containing high concentrations of sediment from entering the watercourse. Disposal areas are to be immediately hydroseeded according to the Work Progression clause.

If dewatering is carried out to provide a dry working area inside an earth cofferdam, the water should be pumped to a sedimentation pond if there is a high concentration of sediments in the water. Refer to Section 4.0 on "Roadway Construction and Maintenance" for discussions on sedimentation ponds.

Placement of riprap or armour stone around bridge piers and abutments should be carried out in a manner which will minimize disturbance of streambed sediments. Placement may be carried out using barges with direct placement using an excavator.

Sediment control fences may be put up around abutment areas to prevent exposed soils susceptible to erosion from being transported into the watercourse by surface runoff. Sediment control fences are...
discussed in Annexure 11.1 to ECP 11 (on Erosion and Sedimentation Control.)

After construction is completed, mulching and hydroteeoding graded riprap material should be carried out to protect the streambank around bridge abutments and piers from erosion.

Measures To Reduce Release of Pollutants: Accidental releases of wet concrete and other pollutants (such as fuels, paint, solvents, asphalt, etc.) to the watercourse may have a toxic effect on fish. The effects of discharges of hazardous materials to the environment and the measures to be implemented to prevent such discharges are discussed in detail in ECP 09 on "Materials Storage, Handling, and Transfer."

For underwater concrete pier and abutment repairs, the concrete must cure before it becomes exposed to the current. This may be achieved by placing sheet piling, a cofferdam, or specialized forms around the bridge pier or abutment.

Measures to reduce Concerns with Fish Passage: Concerns related to the timing of construction activities are associated with the sensitive nature of fish and are discussed above under "Culvert Installation and Maintenance."

As directed in the Fisheries Act, not more than one-third of the stream channel cross-section is to be blocked at a given time to ensure fish passage. This also reduces potential flooding effects.

19.5.4 Bridge Maintenance

The most common aspects of bridge maintenance are:

- removal of corrosion (rust) and paint from metal components by abrasive blasting,
- corrosion protection (painting),
- cleaning and repair of concrete (including material replacement and modification),
- repairs of structural steel (including welding),
- asphalt replacement and chipsealing, and
- replacement of riprap protection and bank stabilisation.

Environmental Concerns with Bridge Maintenance: The main concerns with bridge maintenance activities are related to accidental releases into the environment of materials which may have negative effects.

Maintenance involving the placement of (additional) riprap material and bank stabilization could cause disturbance to streambed sediments which may become suspended in the water and transported downstream. The effects of sediments are discussed in detail in Annexure 10.1 to ECP 10 (on Erosion and Sedimentation Control).

Abrasives such as silica sand, heavy mineral sands, and slag products may have localized temporary negative effects on the receiving environment. The main concern lies with the release of significant amounts of spent abrasives to an underlying watercourse. Large amounts of spent abrasives which enter a watercourse will alter, disrupt, or destroy fish habitat.

Spent abrasives generated during the removal of paint and rust may contain heavy metals (such as lead from lead-based paints) or petroleum components (from oil-based paints) which may have toxic effects if permitted to enter a watercourse.

Paint may be released during spray-painting operations. Paints vary widely in their chemical composition and have the potential for releasing harmful substances into the aquatic environment. Generally, a thin film would form on the water surface which prevents diffusion of oxygen into the water, thus interfering with aeration of the stream. Oily substances may coat and clog the gills of aquatic
fauna, inhibiting respiration and smothering the organisms. Fish mortalities may result due to the toxicity associated with various components of the paint, such as lead or other heavy metals.

Air quality may be impacted by fugitive dust and by fumes generated from the breakdown of lead-based paint as a result of high temperatures associated with welding, burning (torches) and/or grinding operations. The release of fugitive dust can impact workers, nearby residents, and local businesses. The impacts on workers can cause health effects, while the impact on others is more of a nuisance and of an aesthetic nature. The proximity of businesses and residential housing is also an important consideration.

Chipsealing and asphalt replacement near and over a watercourse are very likely to release potentially toxic materials to the underlying watercourse. Refer to ECP 11 on “Materials Storage, Handling, and Transfer” for more information on the effects of toxic materials released into a watercourse.

**Methods to Control Waste and Fugitive Emissions During Bridge Maintenance:**

At all times when maintenance work is carried out on a bridge, necessary precautions must be taken to prevent discharge or loss of harmful materials or substances into the environment.

Prior to undertaking any work on a bridge, contact the bridge Maintenance Engineer of the DSM Consultant to make sure that the appropriate measures are implemented to prevent discharge or loss of harmful materials or substances into the environment.

**Application and Removal of Protective Coatings:** The guidelines for application and removal of protective coatings as provided by the Manufacturers / Suppliers of the paints, which are intended to provide environmental protection during such maintenance operations.

These guidelines are to be applied to all structural steel coating situations where dust and debris from surface preparation operation and the overspray from coating operations may result in harmful effects to any aquatic resource, person, or the environment.

A specific protection plan should be in place if there are environmental concerns. Appropriate protection measures may include:

- **A Partial Enclosure** can be used where surface preparation and/or coating operations result in chippings, scrapings and other materials or debris which may escape from the operation.

- **A Full Enclosure** can be used where surface preparation and/or coating operations may cause the escape of dust, paint overspray and all other materials or debris from the operation and where this type of release must be prevented.

- **A Full Enclosure with Negative Pressure System** can be used where surface preparation and/or coating operations may cause the escape of dust beyond a specified distance (normally 10m) and where the escape of all other materials or debris from the operation must be prevented.

For abrasive blasting below the deck, staging is typically used to collect spent blasting media. Geotechnical fabric is placed over the staging to allow vacuuming of the media for proper disposal or re-use. Tarps (screen-type) are also tucked in along the side of the bridge deck to minimize fugitive emissions.

For abrasive blasting above the deck, staging is mounted on sections of the deck. Impermeable tarps are installed at the top of the staging to keep the work area dry. Screen-type tarps are typically used to enclose the remainder of the work area and the bridge deck is used to collect the spent blasting media. All bridge deck drains should be blocked. Open steel grating decks should be covered with geotechnical fabric or by some other means to collect the spent blasting media.

If air or airless spray tools are used, drapes and curtains similar to those used during abrasive blasting should be erected to prevent paint from entering the environment.
Spent blasting medium should be handled and disposed of according to the Directions of the Engineer in an environmentally safe manner.

**Bridge Deck Repairs:** When repairs to bridge decks are necessary, breakthrough of the deck should be avoided. The sides of the deck should be covered to prevent pieces of concrete or other materials from being introduced to the underlying watercourse. Plywood boards or tarps may be used for this purpose. Bridge deck drains should be blocked.

**Other Concrete Repairs:** When concrete replacement work is necessary on bridges, timber staining should be placed next to the face to prevent concrete from falling into the water or cofferdams should be constructed to enclose the work area. Refer to Section 2.6.3 on "Bridge Construction" for more information on cofferdams.

**Cleaning of Bridges:** When dirt and debris accumulation (such as salt) is excessive, vacuum, scrape, and/or sweep the bridge surfaces first and collect loose material for proper disposal away from the ends of the structure. Blowing with compressed air or flushing can then be used to finish the cleaning. This practice should reduce the amount of material entering the waterway.

Chipsealing. Protection measures during chipsealing operations are discussed in ECP 09 on "Materials Storage, Handling, and Transfer."

**Riprap Replacement and Bank Stabilisation:** Methods to control sedimentation during riprap replacement and bank stabilization are discussed in detail in Section 2.5.3 "Bridge Construction."

### 19.5.5 Drainage Maintenance

All road drainage systems including side drains, channels (lined or unlined) and culverts shall be regularly maintained and all obstructions, debris and materials which limit hydraulic efficiency, cleared away. Such maintenance work shall be programmed for implementation during the month prior to the onset of each wet season as a minimum.

Material cleared from drainage systems should be loaded on to a truck and transported to designated waste disposal areas for disposal. On no account should materials be disposed of on site.

### 19.6 GENERAL CONSTRUCTION GUIDELINES

For the construction phase, the contractor shall follow the general guidelines as set out below:

- No equipment shall be moved onto a site, or works undertaken, prior to approval of the CEMP established by the contract documents.
- All reasonable steps shall be taken to ensure minimum disturbance to adjacent land during construction.
- At all times reasonable and useable access is to be maintained to private land and villages not directly affected by construction.
- Plants and seedlings used for re-vegetation should wherever possible be taken from the immediate area and from as close as possible to the restoration site.
- The Contractor and his staff are not to be involved in the killing or taking of wildlife at work sites/construction camps.
- Management plans shall be prepared for sub-project activities that were not considered during the planning and design stage.

### 19.6.1 Surveys

- Follow the process for consultation and land access for survey and investigation as set out in
"Guidelines for Planning and Implementation of Structures on Rural Roads" by the PIO / LGED.

- Minimise tree-branch trimming, or other environmental disturbance to that necessary to establish line of sight

19.6.2 Haul Roads

- Construction and establishment of haul roads shall be kept to a minimum.
- Minimise the extent of traffic and construction impacts on adjacent villages and other residential areas.
- Wherever possible avoid water crossings
- General noise control measures set out in the CEMP shall apply to haul roads
- Haul roads and associated temporary structures shall be removed upon completion of the works and the area reinstated in consultation with local landowners
- Re-vegetate the area as soon as is possible in line with this guideline.

19.6.3 Dust Control

- The CEMP shall detail dust control measures by dampening and include where the water will be collected from (i.e. whether from ponds or local watercourses), and the number of watering trucks required. All care shall be taken to ensure excess water does not find its way to waterways

19.6.4 Stockpiles

- Ensure that stockpiles of topsoil, humus, mulch, fill and waste materials, and brick aggregates are not located within 10m of a watercourse, or in ecologically sensitive areas
- Stockpiles of materials shall not provide a source of dust generation.

19.6.5 Refuelling and Maintenance Areas

- Ensure that vehicles and plant parking or refuelling and maintenance facilities are not located, or activities do not take place, within 30 m of a watercourse, or in ecologically sensitive areas wherever practicable

19.6.6 Site Facilities

- Site facilities shall be established as set out in ECP 06. Site facilities include site offices, ablutions, camps and facilities as necessary, provision for safe potable water supply, sanitation, electricity, telephone, covered rubbish bins etc. and areas designated for workers. As such construction and operation of these facilities have potential to generate litter and other waste materials, these facilities shall not be located within 30 m of a watercourse, or in an ecologically sensitive area such as forests, wetland
- Ensure regular disposal of rubbish off site at an appropriate location.

19.6.7 Planting and Revegetation

Grassing and replanting of trees and shrubs progressively throughout construction period is the most effective means of preventing or minimising erosion. Consequently contractors shall programme and execute their work such that:

- Revegetation of all exposed surfaces shall be specified and shall be undertaken as soon as
practicable after completion of earthworks.

- Stockpiles of top soil and mulch comply with the requirements for stockpiles (refer to ECP 05).
- Maintenance of vegetation and erosion control measures shall be specified

### 19.6.8 Transportation of Construction Materials

- Consideration shall be given to the safety of other road users and impacts on the environment through controlling truck movements and ensuring loads are covered to prevent spillage of construction materials (see also ECP 11)

### 19.7 ENVIRONMENTAL MANAGEMENT CONTRACT CLAUSES

PIO / LGED shall ensure that all relevant clauses be included in construction contract documentation related to the sub-projects comprising structures associated with the RTIP which sets out the premise for environmental management as established in this ECP.

The Contractor is instructed to enter into the spirit of the project and will undertake all activities with due diligence to ensure that the environmental resources of the site or area are protected, conserved, and sustained at all times.

### 19.8 OVERVIEW OF BEST OPERATING PRACTICES

The following section presents an overview of the best operating practices that must be adhered to during planning, design and implementation of the sub-projects involving construction / rehabilitation / widening / maintenance of structures.

#### 19.8.1 Wetlands

**Objective:** Wetlands should be retained since they provide many important benefits including a source of food, multipurpose uses for rural people, habitats for diverse varieties of flora and fauna, groundwater recharge, and flood mitigation.

**Best Practices:**

- Protect all wetland areas, whether natural or artificial, by minimising disturbance to the wetland and adjacent landforms. Changes to the hydrological regime in particular should be avoided since this has the potential to significantly impact on the wetland.
- Identify existing wetlands and protect them by defining work zones in tender specifications and plans.

#### 19.1.2 Vehicle and Machinery Activity

**Objective:** To minimise disturbance to indigenous vegetation (trees, shrubs and groundcover) by using the appropriate type and minimum size of machine for the job, and confining vehicular activities to designated areas.

**Best Practices:**

- Select the type and size of machinery appropriate for the task to minimise disturbance to vegetation.
- Park machinery in a cleared area, in a designated wayside stop, parking lot or on private land (where permission has been granted).
- Site machinery compounds clear of trees, shrubs and groundcover. In no circumstances should vegetation be removed to provide for the siting of machinery compounds or storage of materials.
Service vehicles and machinery on the roadside at a designated location only when it is not possible to move to a more appropriate site. Great care must be taken to ensure that no spillage of pollutants such as oils/fuel results from any servicing operation.

Confine machinery to the existing road formation, proposed alignment, access tracks or designated construction zone unless otherwise directed by the site supervisor.

Turn vehicles and machinery within the Construction Zone or on cleared sites or sites that have minimal indigenous vegetation.

Avoid drip lines of trees to minimise root damage and soil compaction around tree root systems from machinery.

19.1.3 SOIL EROSION AND SEDIMENTATION CONTROL

Objective: To prevent soil erosion and sedimentation during works

Remember:

- Erosion removes valuable topsoil and produces sediment, which silts drains, creeks and rivers damaging the aquatic environment.

Best Practices:

- Soil erosion and sedimentation control procedures must be included in the Planning and Design stage of any sub-project.

- Erosion to be minimised by
  - protecting existing vegetation,
  - minimising soil disturbance, and
  - stabilising disturbed areas as works proceed.

- Make provision for storm water runoff at the beginning of the job

- Divert all storm water away from loose or exposed soil

- Avoid steep drainage lines where possible.

- Avoid steep batter slopes

- Dissipate flows by use of constructed ponds or energy dissipating devices where appropriate

- Capture silt by use of silt traps or sumps

- Establish an adequate inspection, maintenance and cleaning program for all storm water drainage systems.

- Do not direct storm water from construction sites into areas supporting high quality indigenous vegetation including watercourses.

19.1.4 Storm Water Drainage and Management of Runoff

Objectives: To design, construct and maintain storm water systems that protect the natural environment.

Best Practices:
- Drainage systems including piped, open and cut-off drains must be designed to avoid native vegetation where possible or to minimise disturbance to native vegetation, minimising the potential for erosion and sedimentation.

- Keep excavations for pipes open for minimum time periods.

- Avoid the concentration of runoff flows onto adjoining land

- Prepare Contingency Procedures to cater for any large rain storms during the construction phase of the project to minimise offsite water quality effects through erosion, siltation and other pollutants

**19.1.5 Litter Control**

*Objective:* To keep sites litter free

*Best Practices:*

- Ensure all litter including oil cans, hoses and machinery parts are disposed in a responsible manner.

- Maintain a high quality of housekeeping and ensure that materials are not left where they can be washed or blown away to become litter

- Provide bins for construction workers and staff at locations where food is consumed

- Conduct ongoing awareness education with staff of the need to avoid littering.

**19.1.6 Dust Control**

*Objective:* To minimise risk or loss of amenity due to the emission of dust to the environment from road works.

*Best Practices*

- Implement a dust strategy where it has been identified as a risk, e.g. safety of road users

- Take appropriate dust suppression measures during maintenance and/or construction, e.g. by promptly watering exposed areas when visible dust is observed

**19.1.7 Strip and Stockpile Topsoil**

*Objective:* To promote the stockpiling of topsoil from the site or areas of native vegetation for reuse as it contains organic matter and the seeds of local native plants

*Best Practices:*

- Strip and stockpile the topsoil before starting any works

- Locate soil stockpiles in cleared areas, away from existing drainage lines, trees, shrubs and native grasses

- Remove any weeds before stockpiling by spraying or scalping.

- Imported topsoil only to be used if authorised by the Engineer.

**19.1.8 Disposal of Excavation Material, Drain and Excess Spoil**

*Objective.* To limit spoil disposal to approved disposal sites only.
Best Practices:

- Direct the spoil from works towards the designated construction or maintenance zone for collection.
- Dispose road spoil to approved disposal sites only
- Where appropriate, avoid extra reshaping or increasing the size of drains. Exposed earth and drain spoil is ideal for weed establishment.

19.1.9 Location and Management of Stockpiles

Objective: To manage the location of stockpiles and dumpsites to limit invasion of materials into native vegetation, the spread of weeds and for the protection of the areas amenity.

Best Practices:

- Designated stockpile/dump sites only to be used for the stockpiling of materials when carrying out any works on the road corridor.
- Designated stockpile/dump sites are identified on a locality map provided by the Union Parishad.
- New stockpile or dumpsites sites may only be approved by the Engineer, and are not to be located on roadsides with medium to very high conservation values, drainage lines, waterways, and culvert areas or on roadsides adjacent to forest areas. In no circumstances must vegetation be removed to provide for the siting of stockpiles or the storage of materials (including dumpsites for excess soils/materials).
- Select the location for new stockpile/dump sites with consideration of the visual amenity and landscape values of the site.
- Use minimum space as necessary to store materials and to gain access to the stockpile/dump site.
- Stockpile/dump site boundaries to be clearly defined e.g. fencing, fallen logs.

19.1.10 Cultural and Heritage Sites

Objective: To ensure the protection of roadside sites identified as having cultural or heritage values.

Best Practices:

- Sites of cultural or heritage value, archaeological sites and religious sites shall be formally recognised and protected from the adverse impact of any other uses of the road reserve.
- Any new archaeological sites found or suspected to occur must be reported to the Archaeological Survey of Bangladesh.

19.1.11 Channels and Open Drains

Prior to commencing site clearance work, topsoil stripping or earthworks the contractor shall install all temporary or permanent drainage channels as appropriate together with silt fences or silt retention ponds as are necessary to minimise the discharge of surface water containing sediment particles to any natural watercourse or on to land adjacent to the site of the works.

All permanent drains shall be lined as specified as soon as practicable after formation and such lining shall be maintained in good condition throughout the construction and maintenance period.

Specified erosion control measures at channel discharge locations shall be operational prior to the construction of the relevant permanent drainage and road works.
19.9 COST ESTIMATES

The cost for most of the environmental protection measures shall be included in BOQ for structural and associated works. However, cost of permanent protection measures i.e., diversion channel in waterways for silt removal of sediment-laden water, silt fencing etc. shall also be estimated and included in BOQ.
ECP 20: PLANNING, DESIGN, CONSTRUCTION AND OPERATION

20.1 GENERAL

Growth centre markets (GCM) will be selected for improvement under the proposed RTIP only if they fulfil the minimum selection criteria established by the LGED during the project preparation stage. These selection criteria include:

- The market must not be subject to any serious risk of erosion by river action and must have access to a road, which is passable throughout the year by motorised vehicles, or to a confirmed road development under other projects to be implemented within a year.
- The relevant authority must confirm that the land required for the improvement works is publicly owned and is not the subject of any ownership dispute.
- Market vendors and other user groups will be consulted in preparing designs, and will be given an active role in market management committees. They will also contribute to funding the improvement works.
- Borrower will use participatory processes involving market vendors and other users to improve the structure and operation of existing market management committees, and to improve the market leasing system to enhance revenue.

GCM improvement will only be undertaken on existing government (Khas) land so that there will be no land acquisition in any sub-projects.

20.2 OBJECTIVE

To establish the general guidelines for managing and minimising the potential environmental (including social) impacts of growth centre market improvement sub-projects by outlining principles and minimum standards which shall be taken into account in the planning, design, and implementation of growth centre market improvements.

20.3 GENERAL DESIGN PRINCIPLES

The following general principles constitute good practice environmental management procedures for planning, design and implementation of market improvements:

- Take into account the issues and concerns of affected communities and stakeholders.
- Decide, in consultation with stakeholders, the values which should be given priority.
- Identify and discuss with the EMU / PIO of the LGED any mitigation measures, which could have a major cost implication.
- Consider appropriate construction methods that will minimise environmental risks while taking into account the goals of sustainable development. The most practicable methods for minimising the release of sediment and other pollutants into the environment shall be selected.
- Specify that construction phases are sequenced, timed, and managed to minimise disturbance to the environment. This includes minimising the extent of area to be worked, and area of bare earth exposed at any one time.
- Specify that the programme of construction shall be prepared to show that areas to be re-vegetated or re-paved are completed progressively as sections of the work are completed.
- Identify and set out the relevant clauses of the ECP into the sub-project specific construction contract and bid documents to ensure that environmental standards and guidelines are implemented.
• Provide in the contract documentation the operational and maintenance procedures to preserve the mitigation measures in good condition and effective operation.

**20.4 ENVIRONMENTAL GUIDELINES FOR PLANNING AND DESIGN**

For the planning and design phases, the designer shall follow the general guidelines set out hereunder.

**20.4.1 Contractor’s Environmental Management Plans**

The DSM consultant shall prepare the basis of a Contractor’s Environmental Management Plan (CEMP), to be completed by the contractor. The CEMP shall be reviewed by the EMU and approved by the Engineer-in-Charge before commencement of construction works. The CEMP shall set out the specific mitigation measures, and monitoring requirements that will be put into place during the sub-project implementation. The CEMP shall:

• Establish the chain of responsibility for managing the environmental aspects of the project
• Identify the records to be maintained which demonstrate compliance with the EMP
• Establish the mitigation and contingency measures for at least the following:
  - Maintenance of market utilities such as power and water supply during construction
  - Vegetation management
  - Excess Spoil disposal
  - Slope protection works
  - Borrow Area management
  - Dust control
  - Water collection management
  - Noise control
  - Traffic management/access within the market
• Specify the temporary stormwater management devices, their locations, and the maintenance programme for all such devices.
• Specify and detail sedimentation control measures to be implemented
• Specify construction methods to be used, and identify how these will minimise the amount of sediment released into the environment

**20.4.2 Field Surveys**

• The market area needs careful and complete mapping of all important terrain features. Other relevant data like land use, infrastructure, cultural sites, fragile slopes, drainage lines, ponds, community trees, tube wells, irrigation and or drainage channels etc must also be mapped. In addition, potential campsites, spoil locations, brick-breaking sites, borrow pit sites have also to be mapped.
• Minimise branch trimming or other environmental disturbance to that necessary to establish line of sight.

**20.4.3 Disposal of Excess Material**

• In consultation with the affected (adjacent) community, identify and implement the best practicable option for the disposal of excess cut and unsuitable materials. In this context materials means non-toxic materials. Any toxic materials shall be disposed of by a method or methods that comply in all respects with the laws of Bangladesh.
20.5 ENVIRONMENTAL GUIDELINES FOR CONSTRUCTION

For the construction phase, the contractor shall follow the general guidelines as set out below.

20.5.1 General

- All reasonable steps shall be taken to ensure minimum nuisance to adjacent land during construction.
- At all times reasonable and useable access is maintained to the market area and any adjacent private land that may be affected by construction activities.
- Disruptions to market utilities such as power and water supplies should be avoided or at least minimised by scheduling major work activities to non “hat” days.
- Plants and seedlings used for re-vegetation should wherever possible be taken from the immediate area and from as close as possible to the restoration site.
- Management plans shall be prepared for sub-project activities that are not considered during the planning and design stage.
- No equipment shall be moved onto a site, or works undertaken, prior to the completion of the CEMP established by the contract documents.

20.5.2 Survey

- Follow the process for consultation and land access for survey and investigation as set out in Methodology for Consultation and Field Works prepared by the PPMU.
- Minimise tree-branch trimming, or other environmental disturbance to that necessary to establish line of sight.

20.5.3 Dust Control

- Dust control measures by dampening shall be detailed in the CEMP, and shall include where the water shall be collected from (i.e. whether from ponds or local watercourses), and the number of watering trucks required. All care shall be taken to ensure excess water does not find its way to waterways.

20.5.4 Stockpiles

- Ensure that stockpiles of top soil, humus, mulch, fill and waste materials, and brick aggregates or other construction materials are not located within 10m of a watercourse, or in ecologically sensitive areas or where they cause major disruption to market operation.
- Stockpiles of materials shall not provide a source of dust generation.

20.5.5 Refuelling and Maintenance Areas

- Ensure that vehicles and plant parking or refuelling and maintenance facilities are not located, or activities do not take place, within 30 m of a watercourse, or in ecologically sensitive areas, or in inappropriate market locations such as near food stalls.

20.5.6 Site Facilities

- Site facilities include offices, ablutions, and areas designated for workers, and as such are activities, which have the potential to generate litter and other waste material. These facilities shall not be located within 30 m of a watercourse, or in an ecologically sensitive area. Site facilities include: site offices, buildings, and facilities as necessary; covered rubbish bins,
- Ensure regular disposal of rubbish off site at an appropriate location.

20.5.7 Re-paving Re-vegetation

Grassing and replanting of trees and shrubs or re-paving market areas progressively throughout the construction period is the most effective means of preventing or minimising erosion.
Consequently contractors shall programme and execute their work such that

- Re-paving Revegetation of all exposed surfaces shall be specified and shall be undertaken as soon as practicable after completion of construction activities
- Stockpiles of top soil and mulch or other construction materials comply with the requirements for stockpiles.
- Maintenance of vegetation and erosion control measures shall be specified.

## 20.6 ENVIRONMENTAL MANAGEMENT CONTRACT CLAUSES

PIO/LGED shall ensure that all relevant clauses be included in construction contract documentation related to the sub-projects comprising of works associated with the RTIP which sets out the premise for environmental management as established in this ECP.

The Contractor is instructed to enter into the spirit of the project and will undertake all activities with due diligence to ensure that the environmental resources of the site or area are protected, conserved, and sustained at all times.

## 20.7 ENVIRONMENTAL GUIDELINES FOR OPERATION

From the past experience it is seen that the environmental utilities in the GCMs such as Sanitary latrines, tube wells, solid waste management utilities, drains are not maintained and hence they cause environmental pollution. As such special attention needs to pay for maintenance of the provided services during their operation. Table 20.1 illustrates the environmental parameters relevant to the GCM/Ghat to be monitored during the operation of these sub-projects.

The Environmental Management Unit (EMU) of the PIO/ LGED will be responsible for environmental management monitoring including site inspection following project hand-over. The EMU shall undertake a 6-monthly inspection of project formation and related features over the initial 2 years following completion of this sub-project works.

The Environmental Management Unit (EMU) following each inspection shall complete a standard report covering the above features. This report shall be submitted to the relevant Executive Engineer of the concerned LGED Division, the PIO and the World Bank within two weeks of the inspection.

### Table 20.1: Environmental Monitoring Program during Operation Stage of GCM / Ghat

<table>
<thead>
<tr>
<th>Items</th>
<th>Monitoring Objectives</th>
<th>Monitoring to be taken</th>
<th>Action to be taken</th>
<th>Implementing Agency</th>
<th>Responsible Agency</th>
<th>Approx. Unit cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trees</td>
<td>To ensure that the planted trees are growing and survive</td>
<td>Weekly visit the GCM and do visual observation</td>
<td>Union Parishad</td>
<td>EMU/LGED</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface water quality of the pond adjacent to the GCM</td>
<td>To ensure that pond water quality does not deteriorate from GCM activity and dumping of wastes into it (if any) is not taking place</td>
<td>Perform the water quality test annually</td>
<td>Testing parameter BOD</td>
<td>MMC (Market Management Committee) with the assistance of Thana Engineer</td>
<td>EMU/LGED</td>
<td></td>
</tr>
<tr>
<td>Groundwater</td>
<td>To ensure that groundwater quality</td>
<td>Perform the water</td>
<td>MMC with the assistance of Upazila Engineer</td>
<td></td>
<td></td>
<td>5000 Tk from annual maintenance budget for the GCM</td>
</tr>
</tbody>
</table>
20.8 OVERVIEW OF BEST OPERATING PRACTICES

20.8.1 Vegetation - Only Do What You Have To Do

Objective: Protect existing trees, shrubs and groundcover. Protection is more effective economically and environmentally than it is to replant them.

Remember:
- Healthy vegetation is an asset. The unnecessary disturbance of healthy vegetation, (trees, shrubs and groundcover species)
  - encourages weeds, which compete with native plants and increase maintenance costs,
  - can prevent the regeneration of native plants;
  - increases the risk of soil erosion and stream sedimentation,
  - increases cost of restoration,
- The fine feeder roots occur in the top 30-cm of soil and the larger, deeper roots act as 'anchors';
- Vehicle activity under trees or over vegetation can damage native vegetation and compact the soil, stopping air from reaching the roots,
- Fill material prevents water and air from reaching the roots, causing root death. It may also cause trunk rot. Where fill is unavoidable, try to retain the fill beyond the drip line;
- Cuts and trenches can damage the essential fine ‘feeder roots’ of the tree. Damage to roots
can also make the tree unstable, and

- When root removal cannot be avoided, leave a clean-cut edge to the root. Roots greater than 50mm in diameter should be retained where possible

**Best Practices:**

- Only disturb the minimum amount of soil and native vegetation that is required to do the works or activity.
- Work outside the drip line of a tree to reduce damage to the roots, trunk and limbs where possible.
- Store materials and equipment away from trees.
- Confine the driving or parking vehicles to within the designated work area.
- Fence off areas where identified native vegetation is threatened by vehicular activity or the storage of materials or equipment, by using woven mesh barriers, wire fencing or large logs.
- Place fill material outside of the drip line of trees and shrubs.
- Keep soil cuts and trenching away from the drip line of trees where possible.

### 20.8.2 Wetlands

**Objective:** To retain wetlands, which provide a source of food, water and shelter for wildlife.

**Best Practices:**

- Protect all wetland areas whether natural or artificial, by minimising disturbance to the wetland and adjacent landforms. Wetlands are not be used for the dumping of rubbish.
- Identify existing wetlands and protect them by defining work zones in tender specifications and plans.

### 20.8.3 Revegetation Program

**Objective:** To re-establish native vegetation through a revegetation program.

**Best Practices:**

- Where works are likely to modify the existing vegetation, a management plan for the rehabilitation of that vegetation must form part of any sub-project design and must ensure that revegetation replaces and enhances the vegetation cover and species diversity that exists at the works site.
- Responsibility for rehabilitation after disturbance to a site rests with the LGED.
- Maintenance of rehabilitated sites for up to two years post planting to be undertaken by the group performing the works or engaged LCS.
- Encouraging natural regeneration as much as possible.
- Plant vegetation in accordance with best horticultural practices.

### 20.8.4 Planning and Design

**Objective:** To reduce the environmental impact of any proposal at the earliest part of the conceptual, planning and design stage, prior to any construction activity being undertaken.

**Best Practices:**

- Apply the environmental codes of practices at the earliest during planning, design and construction of growth centre market improvements.
- Plan all activities to reduce impact on the environment.
- Consider alternatives to minimise impact on the environment.

### 20.8.5 Vehicle and Machinery Activity

**Objective:** To minimise disturbance to market activities and indigenous vegetation (trees, shrubs...
and groundcover) by using the appropriate type and minimum size of machine for the job, and confining vehicular activities to designated areas

Best Practices:

✓ Select the type and size of machinery appropriate for the task to minimise disturbance to the market area
✓ Park machinery in a cleared area, in a designated wayside stop, parking lot or on private land (where permission has been granted).
✓ Site machinery compounds clear of trees, shrubs and ground covers. In no circumstances should vegetation be removed to provide for the siting of machinery compounds or storage of materials
✓ Service vehicles and machinery at the market at a designated location only when it is not possible to move to a more appropriate site. Great care must be taken to ensure that no spillage results from any servicing operation.
✓ Avoid drip lines of trees to minimise root damage and soil compaction around tree root systems from machinery.

20.8.6 Vegetation Management During Works Implementation

Objective: Clear only the minimum amount of vegetation required

Remember:

A Vegetation Clearance Plan should be approved by the Engineer before trees or vegetation are removed or pruned

Best Practices:

✓ Prior to commencing any works ensure you have the appropriate permissions
✓ Consider the following points before any action is taken:
  - Safety of staff, property and market users,
  - The effect of the tree removal on the appearance of the market, and
  - The historical and cultural significance of the tree.
✓ Remove only vegetation required for construction (marked vegetation only) and for safety.
✓ Trees should be felled into construction areas, not into undisturbed vegetation;
✓ Trees removed from outside of construction areas must be felled by cutting off at ground level to minimise disturbance to the surrounding vegetation. Removal of trees complete with root systems causes unnecessary soil and vegetation disturbance.
✓ Cleared vegetation can be chipped for mulch and spread on exposed areas to assist with the spread of local seed.

20.8.7 Prune Trees Carefully

Objective: Selective, and careful, pruning of trees wherever possible can often reduce the need for tree removal, resulting in preservation of those trees and minimal soil disturbance

Best Practices:

✓ Prior to commencing any works, and where required, ensure you have the appropriate permissions/Consents
✓ To avoid damage to the bark below the cut, use the three cut method on all but the smallest branches.
✓ Where possible hollow bearing trees should only have weight reduction of the crown so that minimal loss of tree hollows (which provide important wildlife habitat) occurs
20.8.8 Avoid ‘Tidying Up’ Vegetation

Objective: To prevent the unnecessary removal of vegetation as sites are tidied up.

Remember:
- Thinning out of plants or plant removal causes unnecessary disturbance to the soil, vegetation, and wildlife habitat and spreads weeds
- Exposed soil can also be subject to erosion leading to siltation of drainage lines and damage to aquatic environments
- Minimal disturbance avoids costly ground repairs after construction

Best Practices:
✓ Do not grade or excavate beyond the site or spread topsoil into native vegetation.
✓ Leave vegetation undisturbed wherever possible during construction.
✓ Avoid leaving earth bare and subject to erosion
✓ Identify and mark out areas of intact (quality) native vegetation prior to commencing works.

20.8.9 Soil Erosion and Sedimentation Control

Objective: To prevent soil erosion and sedimentation during works

Remember:
✓ Erosion removes valuable topsoil and produces sediment, which silts drains, creeks and rivers damaging the aquatic environment.

Best Practices:
✓ Soil erosion and sedimentation control procedures must be included in the Planning and Design stage of any sub-project.
✓ Erosion to be minimised by
  - protecting existing vegetation,
  - minimising soil disturbance, and
  - stabilising disturbed areas as works proceed.
✓ Make provision for stormwater runoff at the beginning of the job
✓ Divert all stormwater away from loose or exposed soil
✓ Avoid steep drainage lines where possible.
✓ Dissipate flows by use of wetland ponds or energy dissipating devices where appropriate
✓ Capture silt by use of silt traps or sumps
✓ Establish an adequate inspection, maintenance and cleaning program for all stormwater drainage systems.
✓ Do not direct stormwater from construction sites into the market or into nearby areas supporting high quality indigenous vegetation including watercourses

20.8.10 Stormwater Drainage and Management of Runoff

Objectives: To design, construct and maintain stormwater systems that protect the market and surrounding environment.

Best Practices:
✓ Drainage systems including piped, open and cutoff drains must be designed to avoid or minimise disturbance to the market and surrounding environment where possible, minimising the potential for interrupting market operation or for erosion and sedimentation.
✓ Keep excavations for pipes open for minimum time periods.
✓ Avoid the concentration of runoff flows onto adjoining land.
Prepare Contingency Procedures to cater for the large storms during the construction phase of the project to minimise offsite effects of erosion, siltation and damage to water quality.

20.8.11 Litter Control

Objective. To keep sites litter free.

Best Practices:

- Ensure all litter including oil cans, hoses and machinery parts are disposed in a responsible manner.
- Maintain a high quality of housekeeping and ensure that materials are not left where they can be washed or blown away to become litter.
- Provide bins for construction workers and staff at locations where food is consumed.
- Conduct ongoing awareness education with staff of the need to avoid littering.

20.8.12 Dust Control

Objective: To minimise risk or loss of amenity due to the emission of dust to the environment from works.

Best Practices

- Implement a dust strategy where it has been identified as a risk, e.g., safety.
- Take appropriate dust suppression measures during construction, e.g., by promptly watering exposed areas when visible dust is observed.

20.8.13 Cultural and Heritage Values

Objective. To ensure the protection of sites identified as having cultural or heritage values.

Best Practices:

- Sites of cultural or heritage value, archaeological sites and religious sites shall be formally recognised and protected from the adverse impact of growth centre market operation.
- Any new archaeological sites found or suspected to occur must be reported to the Bangladesh Archaeological Survey.
ECP 21: DRAINAGE

21.1 GENERAL

An adequate drainage system is essential to ensuring a working environment in a market. Ponding of water makes the market area muddy and unhygienic creating inconvenience in carrying out market activities. Poor design, operation and maintenance of drainage structures also leads to pollution of the surrounding environment, particularly surface and groundwater resources. A drainage system can be used to dispose of both stormwater and washing water from washrooms, kitchens, market stalls, etc.

21.2 OBJECTIVE

To provide guidelines for the design and implementation of a drainage system to improve market working conditions and reduce pollution of surface and groundwater resources.

21.3 PLANNING AND DESIGN

In developing a drainage plan, an integrated approach for the whole market should be adopted, taking into account stormwater and other run-off from the site and all market structures, geographical layout, topography and site hydrology.

*Design Guideline:* A drainage plan shall be prepared which adopts the following guidelines:
- to take advantage of existing gradient for drainage, efforts should be made to develop internal roads and sales structures in such a way that they are not placed across the slope,
- a hierarchy of drains should be maintained to ensure proper distribution of water to be drained to avoid drainage congestion,
- paved surfaces increase the rate of drainage and eliminates a muddy environment. While upgrading the internal roads and drains, strips between roads and pathways and shops should at least have brick lining,
- drains shall be designed for self-cleansing velocities at least during flood flows and a reasonable velocity shall be maintained during low flow conditions to ensure their effectiveness and to minimise cleaning and maintenance requirements.

21.4 IMPLEMENTATION

All drainage structures should be constructed according to an overall drainage plan covering the whole market area. Once constructed, all structures must be regularly cleaned and maintained to ensure their proper functioning at all times. It is preferable not to discharge drainage directly into a natural water course without first passing it through a retention/settling pond or diverting flow into undisturbed vegetation to reduce sediment load.

*Suggested Specifications:* A detailed layout plan should be prepared showing the relative locations of drainage facilities in relation to market buildings. The plan should include the following minimum requirements:
- road and drain facilities shall correspond to the total length of internal road network (see ECP 09),
- all drainage structures shall be maintained to their design specifications.
all stormwater drainage from the site shall be channelled or piped to a retention pond prior to discharge from the market site. The retention pond shall be sized to provide a minimum of 20 minutes retention for stormwater flow from the whole site that will be generated by a 20 year return period rainfall having a duration of at least 15 minutes. The run-off coefficient to be used in the calculation of the retention pond shall be 0.9.

- all discharge from the retention pond shall be channelled to discharge to natural water via a grassed swale at least 20m in length with suitable longitudinal gradient.

The retention pond shall be maintained in a safe and clean condition throughout the operation of the market. Trapped silt and soil shall be periodically removed and disposed of in an environmentally acceptable manner.

Under no circumstance shall drainage be discharged onto private land surrounding the market unless agreement has been reached with landowner, and only then if run-off is discharged onto stable surfaces capable of handling concentrated water flow and which provide for efficient sediment trapping such as onto undisturbed vegetation.

### 21.5 COST ESTIMATES

Most of the protection measures shall be included in civil items for drainage works except retention pond. The cost estimates for retention pond shall be prepared based on actual requirement and included in BOQ as environmental protection budget.
ECP 22: SOLID WASTE MANAGEMENT

22.1 GENERAL

Indiscriminate disposal of solid wastes in and around a growth centre deteriorates the working environment in the market and pollutes the surrounding agricultural land and water bodies. It attracts scavenging animals such as dogs and disease vectors creating a health and safety hazard. It is also a potential source of surface and groundwater pollution and the volume of waste produced can present a problem for disposal where land is limited.

Proper waste handling procedures not only reduce pollution and health and safety issues, but reduce the area of land required for landfill and where recycling measures are implemented, generates an income. For example, composting of organic wastes turns them into a resource that can be handled, stored and transported with minimal adverse environmental effect, and can be used as organic manure for improvement of soil quality and fertility. Composting is not a new technology to Bangladesh and small scale practice is common in parts of the country. The NGO Waste Concern based in Dhaka has taken an active role in promoting the technology and is a useful source of information on composting.

22.2 OBJECTIVE

To provide design and operation guidelines for the implementation of a solid waste management plan that incorporates recycling of waste and fertiliser generation for growth centre improvement sub-projects.

22.3 PLANNING AND DESIGN

The initial step in the planning and design stage is to select the type of waste management technology to be adopted in consultation with market users. Dumping of solid waste in rivers, canals, which is common practice should be avoided since it has the potential to significantly adversely affect water resources. Landfill disposal of solid waste is environmentally, more acceptable if managed properly. Potential solid waste landfill sites should be identified in consultation with market users. Specific environmental and social criteria may also be stipulated by the DSMC that need to be satisfied by the Contractor while selecting landfill sites.

**Design Guideline:** The DSMC shall identify, if possible, potential landfill sites that may be used for the market growth centre. Such potential sites shall be identified on plans drawn to an appropriate scale and the plans shall be displayed and discussed during public consultations. The DSMC may also specify environmental and social criteria for selecting the landfill sites by the Contractor. Such environmental and social criteria shall take into account the site conditions, community opinions and relevant statutory laws and regulations of Bangladesh (see Appendix 3). Specifically, the following factors shall be considered:

- that sufficient land area is available for disposal of solid wastes for a reasonable period of time, preferably greater than one year so that it is economic;
- cover material should be available at or near the landfill site. Therefore the soil conditions and topography of the site must be considered,
- climatic conditions, e.g., wind patterns and local surface water hydrology of the area has to be considered because these will have impact on the access to the landfill sites;
- geologic and hydrologic conditions are the most important factors in establishing the environmental suitability of the area and are required to assess the pollution potential of the proposed site. It is to be ensured that the movement of leachate and the gases from the landfill will not contaminate the groundwater aquifer;
- extreme care is necessary in the operation of the landfill so that it is environmentally acceptable with respect to noise, odour, dust and vector control. Flying papers and plastics must also be controlled,
- the issue of the ultimate use of the completed landfill site is to be considered prior to the layout and design of the proposed landfill.

22.4 IMPLEMENTATION

22.4.1 General Principle

Disposal of solid waste through landfill has the potential to pollute surface and groundwater resources if not managed correctly. Proximity to water resources and underlying soil types are critical factors in determining the potential risk of pollution from landfill sites. The siting of landfills and the application of mitigative measures are therefore important in reducing pollution risk.

Suggested Specifications: The Contractor in consultation with the community and landowners shall identify the locations for landfill sites. A landfill management (development, operation and rehabilitation) plan should then be prepared. The Engineer shall approve the plan before commencing work. A new landfill site shall be selected prior to the existing one reaching capacity and once it is operating, the old landfill will be closed by the Contractor as per the agreed rehabilitation plan. The following principles for location of landfills shall be followed:

- Landfills should be located
  - as far as possible from tubewells to prevent pollution of water supplies,
  - in non-flood-prone areas and at least 20m from the bank of a watercourse or natural lake to prevent the risk of bank erosion/failure and contaminated leachate reaching the watercourse;
  - to minimise the risk of groundwater contamination the bed of the landfill should be compacted, preferably with an impervious layer of clay soil or some other suitable material,
  - landfills shall not be located within 100m of any identified archaeological, religious or cultural site.

After obtaining approval from the Engineer, the Contractor shall locate and peg out the full extent of proposed landfill site prior to its use. For location and drainage of landfill sites, the Contractor shall follow the principle criteria mentioned above and in Section 4.4.3. Once the proposed landfill site has been identified by the contractor in consultation with the local community, it will be inspected by the Engineer/DSMC. A source of soil fill is also required for the operation of the landfill and this needs to be identified prior to the use of the landfill.

When a landfill site has reached capacity it shall be rehabilitated as per the provisions of an approved rehabilitation plan.

22.4.2 Landfill Operation

The Market Management Committee will need to assure the adequate installation of garbage bins throughout the market and the regular collection of rubbish for either landfill or composting. If landfill disposal is used, solid waste should be deposited in 0.6m layers, in a suitable pit over which a layer of soil should be placed to cover the waste. Once the site is filled it can be used for market area expansion. Alternatively, the organic wastes can be composted to produce fertiliser (see 4.4.4).
22.4.3 Site Hydrology

To reduce leachate from the landfill contaminating surface and groundwater resources, stormwater run-off should be diverted around the landfill site by the provision of perimeter drains which should discharge directly into the market drainage system (ECP21) or into natural water ways via a grassed swale.

**Suggested Specification:** Stormwater runoff should be channelled around the landfill site and discharged to natural waterways via a grassed swale at least 20m in length

22.4.4 Composting of Organic Wastes

The organic waste (such as vegetables) component of solid waste can be composted to provide income-producing fertiliser. This also reduces the amount of landfill required for waste disposal. Recycling the waste also provides low skilled employment since the waste has to be sorted into organic (for composting) and non-organic (such as plastic landfill disposal) components. Waste from cattle yards is also suitable for composting.

**Suggested Specification:** The type of composting technology adopted shall be decided by the DSMC in consultation with market users and market management committee and will depend on the amount of land available and the volume of organic waste. Suitable composting methods include

- barrel composting for smaller amounts of waste – the Dhaka based NGO Waste Concern should be consulted for advice and training for this type;

- in-ground pits can also be used provided suitable land is available – the NGO Waste Concern should also be consulted for advice and training on this methodology.
ECP 23: SLAUGHTERING WASTE MANAGEMENT

23.1 GENERAL

Market slaughterhouses have the potential to infect people and animals in two ways. Firstly, through direct contact with infected animals during slaughter and butchering, and secondly, through inappropriate disposal of slaughterhouse waste, in particular internal organs, by domestic and wild animals accessing the waste, airborne particles and waste contaminating soil and water.

Disposal of slaughter shed waste into waterways and depressions that will contain water during the monsoon was frequently observed at a number of Growth Centre Markets. This practice not only has immediate impacts on the water in respect to the entry of potentially lethal pathogens to wildlife, humans and livestock, but also will have short and long term flow-on effects which will ultimately destroy the ecosystems associated with that particular water environment. Disposal of slaughterhouse waste into waterways causes high levels of nutrients, particularly nitrogen, which increases Biological Oxygen Demand (BOD) resulting in severe impacts on fish and other aquatic populations. It also can lead to algal blooms which are toxic to humans and animals.

Slaughter shed waste material such as intestines, lungs, placental and embryo tissue, if eaten by domesticated animals and wildlife, will become a local reservoir for disease, increasing infection rates among the human and animal populations.

23.2 OBJECTIVE

To prescribe the criteria for siting and design of slaughtering sheds and to provide guidelines for the management of waste from slaughtering sheds to mitigate the adverse environmental effects from such activities.

23.3 PLANNING AND DESIGN

Siting of the slaughter shed should be in close proximity to the meat shed but away from potable water tubewells, although there needs to be a water supply nearby for washing and cleaning. The floor of the slaughter shed should be a raised cement slab construction with perimeter drains to collect wastewater for diversion into a wastewater disposal system (treatment pond).

Wastewater from the slaughter shed should not be allowed to drain directly into any watercourses or natural wetlands but should first be diverted into a treatment pond. The primary function of the treatment pond is the reduction of biodegradable organic matter and destruction of pathogens which may be harmful to humans. The use of a constructed wetland as a treatment pond such as the 'duckweed wastewater treatment system' outlined in ECP 24 provides adequate treatment of the wastewater before it is discharged to a natural watercourse.

**Design Guideline:** a waste management system shall be designed to treat slaughtering waste effluent before it is released to any natural water body. Such a system shall take into consideration the following:

- preference shall be given to a system which recycles waste and is income producing such as the duckweed waste water treatment system;
- treatment ponds shall not be located near tubewells used for potable water supply;
- closed drains shall be used to divert slaughter shed effluent to treatment ponds.
These treatment ponds can also be used to treat high nutrient run-off from cattle yards

23.4 IMPLEMENTATION

In addition to specific siting requirements, treatment ponds require regular and ongoing management/supervision. The involvement of market users is therefore essential to their effective operation.

The treatment pond/artificial wetland is not suitable for treating solid waste such as bone matter from the slaughter shed. Solid waste should therefore be separated from liquid waste and disposed of in landfill (see ECP 22) or burnt.

Suggested Specifications: The Contractor in consultation with the community and landowners shall identify the location of a treatment pond. A design/operation plan should then be prepared. The Engineer shall approve the plan before commencing work. The following principles for location of treatment ponds shall be followed:

Treatment ponds should:
- be located as far as possible from tubewells to prevent pollution of water supplies;
- be located in non-flood-prone areas and at least 20m from the bank of a river to minimise the risk of bank erosion/failure and contaminated leachate reaching the watercourse;
- to minimise the risk of groundwater contamination, the bed of the treatment pond should be compacted, preferably with an impervious layer of clay soil or other suitable material;
- not be located within 100m of any identified archaeological, religious or cultural site.
ECP 24: SANITATION

24.1 GENERAL

The design, operation and maintenance of a proper sanitation system is essential for ensuring hygienic conditions in markets and for minimising the potential pollution from market activities. Human waste consists generally of two types of contaminants, namely pathogenic organisms and organic matter. Pathogenic organisms are responsible for morbidity and mortality in humans while organic waste which is usually high in nutrients, pollute surface and groundwater resources making them unsuitable for uses including fishing, irrigation and drinking as well as affecting aquatic biota.

Inspection of typical growth centre markets under RTIP suggest that many sanitation systems have been incorrectly designed for the size of market and maintenance operations are infrequently carried out, if at all. Improvement to sanitation will significantly improve market hygiene and reduce water resources pollution.

24.2 OBJECTIVE

To provide guidelines for the design, operation and management of appropriate sanitation facilities for growth centre markets. Identify opportunities for the recycling of wastes and income generation as part of the sanitation system.

24.3 PLANNING AND DESIGN

Sanitation facilities should provide treatment for wastewater discharges from toilets and washrooms. They should be designed to a suitable treatment standard and to an appropriate size for their expected use. The number of users should be based on the number of people attending on market operating (hat) days. There are a range of treatment options available but the most commonly used in markets is the septic tank / soak pit facility (soil absorption system). Detailed drawings of a typical market toilet and septic tank are provided in Annex 3.

The following information is required in the design of secondary treatment works for the treatment of effluent from septic tanks:

(a) Nature of soil and sub-soil condition as well as the approximate water table and any available records of flood levels or information as to the variation, seasonal or otherwise, in the water table.
(b) Site plan showing the proposed or existing buildings as well as reduced ground levels over the site.
(c) Discharge from the septic tank.
(d) The position and nature of outfall ditches, wells, tanks or small streams in the vicinity, if any.

If soak pits are used they must be correctly designed and located. Soak pits often fail because of overuse or shallow water tables that render them ineffective. Soak pits are not suitable for treatment of septic tank effluent where the groundwater is shallow and has the potential to rise above the base of the soak pit, a particular problem during the wet season. In these situations, a dispersion trench located partly or fully above ground level in a mound could be used instead of a soak pit. The disadvantage of a dispersion trench however, is the requirement for a greater area of land than a soak pit.
Separation of washroom wastewater from toilet wastewater can significantly reduce the volume to be treated. Because of the composition of washroom wastewater it can be disposed using the markets’ drainage system (see ECP 21).

**Design Guideline:**
- Under no circumstances should effluent from a septic tank be allowed into an open channel drain or body of water without adequate treatment such as the use of a soak pit or dispersion trench,
- Septic tanks should not be located in swampy areas or areas prone to flooding and should also be accessible for cleaning;
- In situations where a shallow water table prevents the use of a soak pit, a dispersion trench should be constructed with the following specifications.

  Dispersion trenches shall be 0.5 to 1.0 m deep and 0.3 to 1.0 m wide excavated to a slight gradient and shall be provided with 150 to 250 mm of washed gravel or crushed stones. Open jointed pipes placed inside the trench shall be made of unglazed earthen-ware clay or concrete and shall have minimum internal diameter of 75 to 100 mm. Each dispersion trench should not be longer than 30 m and trenches should not be placed closer than 2.0 m.
- The minimum standard of treatment to be achieved at all times is bacterial oxygen demand (BOD$_5$) less than 30ppm, suspended solids less than 50ppm. The size of septic tanks and soak pits should be appropriate for the predicted level of usage (based on 'hat' market days) and soak pits should not be located where groundwater tables (during the wet or dry season) render them ineffective.
- Washroom and other wastewater shall be separated from toilet wastewater and disposed of through the market’s drainage system (see ECP 21).

Including a recycling component in the sanitation system can reduce the cost of providing sanitation facilities. Recycling waste, in addition to being more environmentally acceptable, generates income. For example, a bio-gas plant utilising human waste can produce environmentally acceptable fuel which can be sold for cooking and lighting saving significant amounts of firewood and minimising indoor air pollution caused by burning firewood. A detail drawing of a bio-gas plant is provided in Annex 3 to assist in assessing its suitability for a market. Prior to the inclusion of a bio-gas plant, potential users of the fuel also need to be consulted to determine their acceptance of its use. Some households are reluctant to use bio-gas fuel for cooking and an education program may need to be implemented prior to the inclusion of a bio-gas plant or an alternative use found for the fuel.

Another option for recycling human waste is through the use of the ‘Duckweed-Based’ wastewater treatment system. This has the potential to provide an income by turning wastewater into valuable duckweed meal, which is used as the sole feed input for freshwater fish farming. Such a system could also be used to treat stormwater run-off from cattle yards and effluent from slaughtering sheds (see ECP 23). It does however, require more land than a bio-gas plant although it does not have to be located on market land.

### 24.4 IMPLEMENTATION

Market hygiene and pollution of local water resources will only be reduced if an appropriately designed and operated sewage treatment facility is installed in the market place. The location of a sewage treatment facility with respect to water resources is also an important factor in minimising the risk of pollution. The minimum distance required between a tubewell / surface water resource and a soak pit is dependent on the underlying soil type, velocity of groundwater flow and height of groundwater table. As a general rule a minimum distance of 15m should be adequate.
An effective maintenance program is essential to ensure continued operation of treatment facilities to design standard. Septic tanks need to be cleaned (desludged) on a regular basis (usually annually).

**Suggested Specifications:** All discharge from toilets shall be piped to a purpose designed sewage treatment facility prior to discharge to a natural watercourse. Wastewater from washrooms, kitchens, market stalls, etc. shall be disposed via the market’s drainage system (see ECP21).

The standard of treatment to be achieved shall be such that the following effluent standards are achieved at all times:
- bacterial oxygen demand (BOD₅) less than 30ppm;
- suspended solids less than 50ppm,
- the distance of a tubewell/surface water resource from a soak pit shall be a minimum 15m,

Septic tanks shall be checked bi-annually and when a septic tank has reached capacity it shall be cleaned out as per the provisions of an approved management/operating plan.
- half yearly or yearly desludging of septic tanks is desirable. Small, low use septic tanks, for economic reasons, may be cleaned at least once in 2 years provided the tank is not overloaded due to use by more than the number for which it is designed.

Sanitation facilities will only be effective if market visitors are encouraged to use them. They should therefore be conveniently located within the market area and of appropriate design as well as being regularly cleaned to encourage use.

**Suggested Specifications:** The location of sanitation facilities shall be such that they are easily accessible from any point in the market and within short walking distances. They shall also be uniformly distributed over the entire market area.

Specific requirements based on LGED “Manual for the Growth Centre Planning” (1995) include:

- water supply provision shall ensure at least one tubewell or a standpipe per 1,500 target visitors and shall be within 50m from any point in the market,
- the maximum distance of toilet facilities from any point in the market shall not be more than 100m,
- at least one of the latrines shall be kept reserved for the use of women;
- due to religious requirements, the orientation of the latrines shall be such that the users avoid facing the east or the west,
- toilets shall be cleaned on a daily basis.

### 24.5 Cost Estimates

The measures for human waste treatment facilities i.e., septic tank, soak pits, bio-gas plant, duckweed-based waste treatment system, etc. shall form the part of project intervention and thus cost of these measures shall be included in this sub-project cost. However, the operation and maintenance cost of these facilities, whichever shall be adopted, shall be estimated and included in BOQ.
ECP 25: WATER SUPPLY

25.1 GENERAL

Groundwater is the most common source of water supply for Growth Centre Markets and jetties. The depth of the water table and water quality, particularly with respect to arsenic contamination and/or faecal coliform contamination are important issues of concern which need careful consideration during planning and design of the water supply and sanitation facilities for markets. In Bangladesh, the depth of the aquifer to be tapped for a tubewell plays an important role in eliminating the risk of arsenic contamination. Iron content in shallow groundwater is also a common problem encountered in using groundwater as a source of potable water and for washing. The use of deep tubewells however, are costly and require skilled labourers to install and maintain while shallow tubewells (which are generally poorer water quality) are economic and more easily maintained.

25.2 OBJECTIVE

To provide guidelines and specific design requirements for the provision of potable and non-potable water supplies (washing, cattle watering, etc.) for growth centre markets.

25.3 PLANNING AND DESIGN

25.3.1 Location of Tubewell

A location plan of tubewells shall be prepared in consultation with market users and taking into account the location of market structures such as slaughter sheds and sanitation facilities which can impact adversely on potable water supplies.

**Design Guideline:** A tubewell location plan shall be prepared which adopts the following guidelines.
- takes into account the needs of market users;
- tubewells used to supply potable water shall not be located near slaughter sheds and sanitation facilities to prevent water contamination.

25.3.2 Type of Tubewell

In Bangladesh, the risk of arsenic contamination in groundwater is high and this can be minimised by using tubewells over 300 feet in depth. Deep tubewells also eliminate the risk of contamination by faecal matter from humans and animals. However, they are costly to construct and maintain such that it is more feasible to use shallow tubewells provided the water quality is suitable for the intended use.

**Design Guideline:** The use of a shallow or deep tubewell shall be based on the following guidelines.
- the use of the water, whether for washing only (shallow tubewell is suitable) or as a potable water supply (water quality sampling required to assess suitability of a shallow tubewell,
- if water quality sampling indicates the presence of arsenic and/or iron at unacceptable levels a deeper well is required or an alternative site chosen if the water is to be used for drinking. The World Health Organisation guideline for the desirable maximum concentration of arsenic in drinking water is 0.01 mg/l and in Bangladesh the acceptable limit for iron content is up to 5 mg/l for rural water supply. Current technologies, which are effective in removing arsenic, are too expensive or highly technical for rural areas and are not a feasible alternative at present.
The tubewell shall be designed such that local surface water run-off will not be able to contaminate the tubewell and drainage from the tubewell will be diverted into the market drainage system (see ECP 21). Tubewell design shall be such that it is easy for users, especially women who are the main water collectors, to operate the pump.

**Design Guideline:** The type of tubewell design adopted shall be based on the following guideline:
- all surface water run-off shall be diverted around the tubewell;
- drainage from the tubewell shall be diverted into the market drainage system (see ECP 21);
- the pump mechanism shall be of a conventional type such as a 'moon' hand pump and not the "tara" design which is more difficult to use and unpopular among rural communities (a suitable tubewell design can be found in LGED's 1995 "Manual for Growth Centre Planning").

## 25.4 IMPLEMENTATION

### 25.4.1 Ongoing Operation/Maintenance

Water quality testing should be carried out initially prior to use of the tubewell to determine its suitability for its intended use. Thereafter, sampling should be undertaken on a monthly basis and analysis undertaken by a suitably qualified person. Should the water quality be found to be unsuitable for its intended use, users should be immediately informed and remedial measures implemented to rectify the problem. Remedial measures may include treating the water, temporarily closing the tubewell until such time sampling indicates it is suitable for use again, using the tubewell for another use, or closing it permanently and finding another water source.

Market management staff will need to receive training on water sampling techniques to avoid contamination of samples.

**Suggested Specifications:** A water quality monitoring program shall be implemented. The plan and shall include the following minimum requirements:

- Initial water quality sampling will be undertaken prior to the use of the tubewell to determine suitability for its proposed use. The minimum parameters to be sampled shall include arsenic, faecal coliform, fluoride, iron, pH, total dissolved solids (or conductivity) and hardness;
- Subsequent sampling shall be carried out monthly and the parameters to be sampled will depend on the use of the tubewell;
- A plan of action where water quality is found to be unsuitable for its intended use.

Workers assigned to manage the water quality program shall be appropriately trained in water sampling techniques.

Responsibilities for ongoing maintenance and repair of tubewells as well as the cost of the water quality monitoring program should be decided between LGED, Union Parishad and market users / Market Management Committee.

## 25.5 COST ESTIMATES

The provision of portable and non-portable water supply to the market growth centers is a part of project intervention and associated cost shall be included in this sub-project cost.
**ECP 26: TRANSPORTATION**

26.1 GENERAL

A well designed transport network and pathways within a growth centre market are essential to the efficient operation of the market. Also important is the need to link the market with its surrounding community through the provision of integrated road and river transport infrastructure.

26.2 OBJECTIVE

To provide guidelines for the preparation of a transport management plan for growth centre markets and recommend specifications for internal road and pathway construction activities. A separate set of ECP is provided for river jetty/ghat construction.

26.3 PLANNING AND DESIGN

First step is to define the internal road circulation network for development and then to delineate parking spaces and boat landing site if applicable (see also ECPs for Jetties/ghats).

In a situation where the growth centre is situated on one side of a main road, extension of the market development should preferably be avoided on the other side. Activities on both sides will generate increased movement of goods and people and will impede the through traffic resulting in traffic congestion that in turn will cause serious hindrance to market activities.

In case the main road is already passing through the market, efforts should be made to provide spaces for rickshaws, vans, pushcarts etc., if possible, at the entry point and junctions of internal roads to avoid congestion.

*Design Guideline:* A transportation plan shall be prepared which adopts the following guidelines:

- Internal roads shall be considered in such a way that all activities within the market are easily accessible.
- In situations where a main road passes through the market, consideration shall be given to the possible realignment of the road so that it by-passes the market with a suitable lay-by off the main road for vehicle stops, loading and unloading of tracks, carts etc.;
- The plan shall improve access to cattle sales yards from the main road to avoid congestion in the market and improve hygiene.
- If a jetty/ghat is located adjacent to the market, then the transportation plan shall include transport requirements for the jetty/ghat.

If road re-alignment is proposed it shall be undertaken under the Environment Management Framework of RTIP, including full community participation as outlined in ECP 03. Should any land acquisition be required, LGED shall ensure that the necessary land acquisition procedures are undertaken in accordance with the Bangladesh Land Acquisition Act and are completed prior to the commencement of any improvement works.

26.4 IMPLEMENTATION

For the construction phase, the contractor shall follow the relevant general specifications 'Environmental Guidelines for Construction' outlined in ECP 20.
ECP 27: TREE PLANTING

27.1 GENERAL

Trees can provide many benefits while generally improving the outlook of a market. They provide shade, shelter for stock and market users, improve the aesthetics of the market, reduce surface water accessions to groundwater, reduce stormwater run-off and help reduce soil erosion, provide wildlife habitat, and are a potential source of income from fruits, timber, firewood.

27.2 OBJECTIVE

To provide guidelines for the selection and location of suitable trees for planting in and around markets to improve the quality of the market environment and to mitigate against any adverse environmental impacts from market improvement activities.

27.3 PLANNING

A tree planting program should be prepared in tandem with the preparation of the various works layout plans covering market facilities (buildings, internal roads etc.) and structures (drainage, effluent treatment etc.). In preparing the program, it should be noted that trees have the potential to damage drainage structures and water supply and other sub-surface pipes so care needs to be taken in locating and selecting appropriate species which are less likely to cause damage but still provide good shade and shelter. Trees also stabilise banks and can be used to help prevent river bank erosion from impacting on market areas. Trees also have the added benefits of reducing surface run-off and soil erosion and can utilise treated effluent, minimising the need to dispose of effluent into natural waterways.

Design Guideline: In deciding on suitable species of trees for planting and on their location, the following considerations shall be adopted.
- preference shall be given to the use of local native species and/or income producing trees such as fruit trees;
- avoid planting species known to cause problems with their roots in the vicinity of sub-surface drainage, water supply and effluent disposal/treatment structures/pipes;
- suitable species of trees should be planted along river banks and other waterbodies in or adjacent to the market to reduce erosion and help stabilise banks and prevent loss of market land/structures.

27.4 IMPLEMENTATION

Once planted, trees should be maintained at least until they become established. Young plants also need protection from trampling from people and animals in the crowded market environment. Consideration should also be given to the use of treated effluent from waste treatment and drainage ponds (see ECP 21, 23) as a source of water supply for establishment and maintenance of trees. During construction of market facilities, effort should be made to minimise the loss of existing trees to minimise the need for replanting. The loss of mature trees in particular should be avoided wherever possible since these take a long time to replace.
Suggested Specifications: A vegetation management plan shall be implemented which includes the following minimum requirements:

- any trees removed during construction of new market facilities shall be replaced with suitable species,
- the loss of mature trees for construction of market facilities should be avoided wherever possible,
- arrangements shall be put in place for the ongoing care and maintenance of trees within the market;
- consideration shall be given for the use of recycled water from the market drainage and effluent waste management systems as a source of water supply for trees

Specific measures to minimise impacts on vegetation during construction of market improvements are addressed in ECP 20 under Section 27 dealing with best operating practices

27.5 COST ESTIMATES

The proposed vegetation management plan is a part of this sub-project and the cost thereof shall be included in the total cost of this sub-project
ECP 28: PLANNING, DESIGN AND CONSTRUCTION

28.1 GENERAL

It is stipulated that only those jetties will be selected for construction under the proposed RTIP that will fulfil the minimum selection criteria established by the LGED during the project preparation stage. These selection criteria include:

- The jetty has to be located on a perennial waterway and be used as a landing place for river transportation, not just for cross-river ferry services;
- The jetty must directly serve a Growth Centre Market or connect to a road network at an important point for the transfer of goods between water and land transportations;
- The relevant authority must confirm that the land required for the improvement works is publicly owned and is not the subject of any ownership dispute;
- Country boat owner/operator associations (such as BCBOA) and other user groups should be consulted in preparing designs, and should be given an active role in the jetty management committee.

All schemes will be selected through participation of the local government bodies, rural communities and other user groups using the “Information Sharing” and “User Input” approaches, and all formal proposals for investment will be submitted to the project by the Union Parishads. The techniques for this participation sharing will be described in the “Guidelines for Users Participation in Planning and Implementation of Jetties/Ghat Construction works)” under RTIP. New jetty sites shall be selected only where government (khas) land is available so that there will not be any land acquisition or resettlement.

28.2 OBJECTIVE

To establish the general guidelines for managing and minimising the potential environmental (including social) impacts of jetty construction sub-projects by outlining principles and minimum standards which shall be taken into account in the planning, design, and construction of jetties.

28.3 GENERAL DESIGN PRINCIPLES

The following general principles constitute good practice environmental management procedures for planning, design and implementation of jetty / ghat construction works:

- Take into account the issues and concerns of affected communities and stakeholders;
- Decide, in consultation with stakeholders, the values which should be given priority;
- Identify and discuss with the EMU of the LGED any mitigation measures which could have a major cost implication;
- Consider appropriate construction methods that will minimise environmental risks while taking into account the goals of sustainable development. The most practicable methods for minimising the release of sediment and other pollutants into the environment shall be selected;
- Specify that construction phases are sequenced, timed, and managed to minimise disturbance to the environment. This includes the minimisation of the extent of area to be worked, and area of bare earth exposed at any one time;
- Specify that the programme of construction shall be prepared to show that areas to be re-vegetated are completed progressively as sections of the work are completed;
- Identify and set out the relevant clauses of the ECP into the sub-project specific construction contract and bid documents to ensure that environmental standards and guidelines are implemented;
- Provide in the contract documentation the operational and maintenance procedures to preserve the mitigation measures in good condition and effective operation.
28.4 ENVIRONMENTAL GUIDELINES FOR PLANNING AND DESIGN

For the planning and design phases, the designer shall follow the general guidelines set out hereunder to minimise short and long term adverse environmental effects:

28.4.1 Contractor’s Environmental Management Plans

The consultant shall prepare the basis of a Contractor’s Environmental Management Plan (CEMP), to be completed by the contractor. The CEMP shall be reviewed by the EMU and approved by the Engineer-in-Charge before commencement of construction works. The CEMP shall set out the specific mitigation measures, and monitoring requirements that will be put into place during the sub-project implementation. The EMP shall:

- Establish the chain of responsibility for managing the environmental aspects of the project
- Identify the records to be maintained which demonstrate compliance with the EMP.
- Establish the mitigation and contingency measures for at least the following:
  - Vegetation management
  - Excess Spoil disposal
  - Slope protection works
  - Borrow Area management
  - Dust control
  - Water collection management
  - Noise control
  - Traffic management

- Specify the temporary storm water management devices, their locations, and the maintenance programme for all such devices
- Specify and detail sedimentation control measures to be implemented.
- Specify construction methods to be used, and identify how these will minimise the amount of sediment released into the environment

28.4.2 Field Surveys

The Jetty/Ghatt area needs careful and complete mapping of all important terrain features such as land use, infrastructure, cultural sites, fragile slopes, drainage lines, community trees, tube wells. In addition, potential work campsites, spoil locations, brick-breaking sites, borrow pit sites also have to be mapped identified.

28.4.3 Site Selection

While finalising the site for the Jetty/Ghat Construction the following aspects needs careful consideration:

i) Hydrological characteristics of the river
ii) Erosion
iii) Siltation
iv) Bank Stability
v) Extent of necessary bank protection
vi) Soil works
vii) Approach characteristics road to GCM/Feeder road.

28.5 ENVIRONMENTAL GUIDELINES FOR CONSTRUCTION

For the construction phase, the contractor shall follow the general guidelines as set out below

28.5.1 General

- All reasonable steps shall be taken to ensure minimum disturbance to adjacent land during construction
- At all times reasonable and useable access is to be maintained to private land and villages not directly affected by construction
- Plants and seedlings used for re-vegetation should wherever possible be taken from the immediate area and from as close as possible to the restoration site.
- Management plans shall be prepared for sub-project activities that were not considered during the planning and design stage.
- No equipment shall be moved onto a site, or works undertaken, prior to the completion of the...
28.5.2 Survey

- Follow the process for consultation and land access for survey and investigation as set out in Methodology for Consultation and Field Works prepared by the PIO/LGED.
- Minimise tree-branch trimming, or other environmental disturbance to that necessary to establish line of sight.

28.5.3 Haul Roads

- Construction and establishment of haul roads shall be kept to a minimum.
- Minimise the extent of traffic and construction impacts on adjacent villages and other residential areas.
- Wherever possible avoid water crossings.
- General noise control measures set out in the CEMP shall apply to haul roads.
- Haul roads and associated temporary structures shall be removed upon completion of the works and the area reinstated in consultation with local landowners.
- Re-vegetate the area as soon, as is possible in line with this guideline.

28.5.4 Dust Control

- The CEMP shall detail dust control measures by dampening and include where the water will be collected from (i.e. whether from ponds or local watercourses), and the number of watering trucks required. All care shall be taken to ensure excess water does not find its way to waterways.

28.5.5 Stockpiles

- Ensure that stockpiles of topsoil, humus, mulch, fill and waste materials, and brick aggregates are not located within 10m of a watercourse, or in ecologically sensitive areas.
- Stockpiles of materials shall not provide a source of dust generation.

28.5.6 Refuelling and Maintenance Areas

- Ensure that vehicles and plant parking or refuelling and maintenance facilities are not located, or activities do not take place, within 30 m of a watercourse, or in ecologically sensitive areas wherever practicable.

28.5.7 Site Facilities

- Site facilities shall be established as set out in ECP 6. Site facilities include offices, ablutions, and areas designated for workers, and as such are activities that have the potential to generate litter and other waste material. These facilities shall not be located within 30 m of a watercourse, or in an ecologically sensitive area. Site facilities include: Site offices, buildings, and facilities as necessary; Covered rubbish bins.
- Ensure regular disposal of rubbish off site at an appropriate location.

28.5.8 Water Crossings

- Minimise disturbance of watercourses; excavations or disturbance of the bed of any waterway shall not occur unless required as part of construction.
- Exposed surfaces shall be minimised and revegetated or sealed as soon as practicable.
- Weather conditions should be taken into account in programming earthworks.

28.5.9 Planting and Revegetation

Grassing and replanting of trees and shrubs progressively throughout construction period is the most effective means of preventing or minimising erosion. Consequently contractors shall programme and execute their work such that:
- Revegetation of all exposed surfaces shall be specified and shall be undertaken as soon as practicable after completion of earthworks.
- Stockpiles of top soil and mulch comply with the requirements for stockpiles.
- Maintenance of vegetation and erosion control measures shall be specified.

28.5.10 Transportation of Construction Materials

- Consideration shall be given to the safety of other road users and impacts on the environment through controlling truck movements and ensuring loads are covered to prevent spillage of...
construction materials.

28.6 GENERAL ENVIRONMENTAL MANAGEMENT CONTRACT CLAUSE

LGED shall ensure that a clause be included in all contract documentation related to RTIP Jetty/Ghat sub-projects which sets out the premise for environmental management as envisaged in this ECP.

The Contractor is instructed to enter into the spirit of the project regarding the environment, namely, wherever possible to act in such a way that the environmental resources of the site or area are protected, conserved, and sustained at all times.

28.7 BEST OPERATING PRACTICES

28.7.1 Vegetation - Only Do What You Have To Do

Objective: Protect existing trees, shrubs and groundcover. Protection is more effective economically and environmentally than it is to replant.

Remember:
- Healthy vegetation is an asset. The unnecessary disturbance of healthy vegetation, (trees, shrubs and groundcover species):
  - encourages weeds, which compete with native plants and increase maintenance costs;
  - can prevent the regeneration of native plants;
  - increases the risk of soil erosion and stream sedimentation;
  - increases cost of restoration;
- The fine feeder roots occur in the top 30cm of soil and the larger, deeper roots act as 'anchors';
- Vehicle activity under trees or over vegetation can damage native vegetation and compact the soil, stopping air from reaching the roots,
- Fill material prevents water and air from reaching the roots, causing root death. It may also cause trunk rot. Where fill is unavoidable, try to retain the fill beyond the drip line, and
- When root removal cannot be avoided, leave a clean-cut edge to the root. Roots greater than 50mm in diameter should be retained where possible.

Best Practices:
- Only disturb the minimum amount of soil and native vegetation that is required to do the works or activity
- Work outside the drip line of a tree to reduce damage to the roots, trunk and limbs where possible.
- Store materials and equipment away from trees
- Confine driving or parking vehicles to within the designated work area.
- Fence off areas where native vegetation is threatened by vehicular activity or the storage of materials or equipment, by using woven mesh barriers, wire fencing or large logs.
- Place fill material outside of the drip line of trees and shrubs
- Keep soil cuts and trenching away from the drip line of trees where possible.

28.7.2 Wetlands

Objective: Wetlands should be retained since they provide many important benefits including a source of food, water and shelter for wildlife, water quality improvement, groundwater recharge, and flood mitigation

Best Practices:
- Protect all wetland areas, whether natural or artificial, by minimising disturbance to the wetland and adjacent landforms. Changes to the hydrological regime in particular should be avoided since this has the potential to significantly impact on the wetland
- Identify existing wetlands and protect them by defining work zones in tender specifications and plans.
28.7.3 Weeds - Be Aware of Noxious Weeds

Objective: To identify the particular weed threat to the roadside on which an activity is to be undertaken.

Remember:
Noxious weeds are plants that are declared to be a serious threat to agriculture and the environment. Noxious weeds can be spread during activities which disturb vegetation or the soil.

Best Practices:
- Prior to the commencement of any construction activity identify existing weeds at the site.
- Ensure weed management is incorporated in the CEMP.
- Dispose of noxious weeds at a designated dumpsite, or burn on site in a cleared area.
- Monitor designated weed dumpsites and prevent weeds from spreading off the site.

28.7.4 Revegetation Program

Objective: To re-establish native vegetation through revegetation programs

Best Practices:
Where works are likely to modify the existing vegetation, a management plan for the rehabilitation of that vegetation must form part of any sub-project design and must ensure that revegetation replaces and enhances the vegetation cover and species diversity that exists at the works site.
- Responsibility for rehabilitation after disturbance to a site rests with the LGED.
- Maintenance of rehabilitated sites for up to two years post planting to be undertaken by the group performing the works or engaged LCS.
- Encouraging natural regeneration as much as possible.
- Plant vegetation in accordance with best horticultural practices.

28.7.5 Planning and Design

Objective: To reduce the environmental impact of any proposal at the earliest part of the conceptual, planning and design stage, prior to any construction activity being undertaken.

Best Practices:
- All those involved in the planning, design and construction (or maintenance) of works on RTIP Jetty/Ghat sub-projects must have completed an 'environmental best operating practices' course conducted by the EMU / LGED.
- Apply the environmental codes of practices at the earliest during planning, design, construction and maintenance of the rural roads.
- Plan all activities to reduce impacts on the environment.
- Consider alternatives to minimise impacts on the environment.

28.7.6 Stay Within the 'Construction' And 'Maintenance' Zones

Objective: To limit all activities to a defined area, reducing disturbance to surrounding vegetation

The 'Construction Zone' is the area clearly marked where all construction activities take place (such as the area stripped for road construction, stockpile areas, compounds, access routes, etc.).
- The 'Maintenance Zone' is the area within the toe of batter on each side of the road. This generally correlates to the limits of any periodic or routine maintenance works.

Remember:
- By carrying out activities from within the 'Zone' results in minimum disturbance to roadside vegetation.

Best Practices:
- Stay within the defined construction and maintenance zones and access tracks during construction and periodic or routine maintenance works.

28.7.7 Vehicle and Machinery Activity

Objective: To minimise disturbance to indigenous vegetation (trees, shrubs and groundcover) by using the appropriate type and minimum size of machine for the job; and confining vehicular activities to designated areas.

Best Practices:
- Select the type and size of machinery appropriate for the task to minimise disturbance to
vegetation.
Park machinery in a cleared area, in a designated wayside stop, parking lot or on private land (where permission has been granted).
Site machinery compounds clear of trees, shrubs and groundcover In no circumstances should vegetation be removed to provide for the siting of machinery compounds or storage of materials.
- Service vehicles and machinery on the roadside at a designated location only when it is not possible to move to a more appropriate site. Great care must be taken to ensure that no spillage of pollutants such as oils/fuel results from any servicing operation.
- Confine machinery to the existing road formation, proposed alignment, access tracks or designated construction zone unless otherwise directed by the site supervisor.
Turn vehicles and machinery within the Construction Zone or on cleared sites or sites that have minimal indigenous vegetation.
Avoid drip lines of trees to minimise root damage and soil compaction around tree root systems from machinery.

28.7.8 Vegetation Canopy Clearance above Roads

Objective: To obtain minimum height clearance of vegetation overhanging roads with the least impact on the roadside vegetation.

Best Practices:
Retain a minimum height of 5 metres clearance height from the established road formation (roads surface and shoulders) to the vegetation overhang
Remove only those limbs necessary to obtain the minimum clearance
Prune trees carefully.

28.7.9 Vegetation Management During Works

Vegetation Removal

Objective: Clear only the minimum amount of vegetation required.

Remember:
A Vegetation Clearance Plan should be approved by the Engineer before trees or vegetation are removed or pruned.

Best Practices:
Prior to commencing any works ensure you have the appropriate permissions.
Consider the following points before any action is taken:
Safety of staff, property and road users,
The effect of the tree removal on the appearance of the roadside; and
The historical and cultural significance of the tree
Remove only vegetation required for construction (marked vegetation only) and for safety,
Trees should be felled into the construction or maintenance zone, not into undisturbed vegetation,
Trees removed from outside of the construction and maintenance zone must be felled by cutting off at ground level rather than bulldozing to minimise disturbance to the surrounding vegetation. Removal of trees complete with root systems causes unnecessary soil and vegetation disturbance.
Removed vegetation can be chipped for mulch and spread on exposed areas to assist with the spread of local seeds;

28.7.10 Prune Trees Carefully

Objective: Selective and careful pruning of trees wherever possible can often reduce the need for tree removal, resulting in preservation of those trees and minimal soil disturbance.

Best Practices:
Prior to commencing any works, and where required, ensure you have the appropriate permissions/consents.
To avoid damage to the bark below the cut, use the three cut method on all but the smallest branches.
Where possible, hollow-bearing trees should only have weight reduction of the crown so that minimal loss of tree hollows occurs.
28.7.11 Avoid ‘Tidying Up’ Vegetation

**Objective:** To prevent the unnecessary removal of vegetation as sites are tidied up.

**Remember:**
- Thinning out of plants or plant removal causes unnecessary disturbance to the soil, vegetation, and wildlife habitat and spreads weeds.
- Exposed soil can also be subject to erosion leading to siltation of drainage lines and damage to aquatic environments.
- Minimal disturbance avoids costly remedial measures following construction.

**Best Practices:**
- Do not grade or excavate beyond the site or spread topsoil onto native vegetation.
- Leave vegetation undisturbed wherever possible during construction.
- Avoid leaving earth bare and subject to erosion.
- Identify and mark out areas of intact (quality) native vegetation prior to commencing works.

28.7.12 Weed Control

**Objective:** To prevent the spread of weeds by vehicles and machinery.

**Best Practices:**
- Identify areas of weed prior to commencing any works.
- Work from weed free (clean) areas into weed affected areas of work sites.
- Before being transported to any new location, vehicles and machinery to be cleaned of all soil and washed down thoroughly at a designated wash down area (e.g., Depot).
- All materials used for construction and maintenance works on High and Medium conservation roads must be free from soil pathogens and weed seed prior to being used.

28.7.13 Soil Erosion and Sedimentation Control

**Objective:** To prevent soil erosion and sedimentation during works.

**Remember:**
- Erosion removes valuable topsoil and produces sediment, which silts drains, creeks and rivers damaging the aquatic environment.

**Best Practices:**
- Soil erosion and sedimentation control procedures must be included in the Planning and Design stage of any sub-project.
- Erosion to be minimised by:
  - protecting existing vegetation;
  - minimising soil disturbance; and
  - stabilising disturbed areas as works proceed.
- Make provision for storm water runoff at the beginning of the job.
- Divert all storm water away from loose or exposed soil.
- Avoid steep drainage lines where possible.
- Avoid steep batter slopes.
- Dissipate flows by use of constructed ponds or energy dissipating devices where appropriate.
- Capture silt by use of silt traps or sumps.
- Establish an adequate inspection, maintenance and cleaning program for all storm water drainage systems.
- Do not direct storm water from construction sites into areas supporting high quality indigenous vegetation including watercourses.

28.7.14 Storm Water Drainage and Management of Runoff

**Objectives:** To design, construct and maintain storm water systems that protect the natural environment.

**Best Practices:**
- Drainage systems including piped, open and cut-off drains must be designed to avoid native vegetation where possible or to minimise disturbance to native vegetation, minimising the potential for erosion and sedimentation.
- Keep excavations for pipes open for minimum time periods.
- Avoid the concentration of runoff flows onto adjoining land.
- Prepare Contingency Procedures to cater for any large rain storms during the construction.
phase of the project to minimise offsite water quality effects through erosion, siltation and other pollutants.

28.7.15 Litter Control

Objective: To keep sites litter free.

Best Practices:
- Ensure all litter including oil cans, hoses and machinery parts are disposed in a responsible manner.
- Maintain a high quality of housekeeping and ensure that materials are not left where they can be washed or blown away to become litter.
- Provide bins for construction workers and staff at locations where food is consumed.
- Conduct ongoing awareness education with staff of the need to avoid littering.

28.7.16 Dust Control

Objective: To minimise risk or loss of amenity due to the emission of dust to the environment from road works.

Best Practices:
- Implement a dust strategy where it has been identified as a risk, e.g. safety of road users.
- Take appropriate dust suppression measures during maintenance and/or construction, e.g. by promptly watering exposed areas when visible dust is observed.

28.7.17 Strip and Stockpile Topsoil

Objective: To promote the stockpiling of topsoil from the site or areas of native vegetation for reuse as it contains organic matter and the seeds of local native plants.

Best Practices:
- Strip and stockpile the topsoil before starting any works.
- Locate soil stockpiles in cleared areas, away from existing drainage lines, trees, shrubs and native grasses.
- Remove any weeds before stockpiling by spraying or scalping.
- Imported topsoil only to be used if authorised by the Engineer.

28.7.18 Location and Management of Stockpiles

Objective: To manage the location of stockpiles and dumpsites to limit invasion of materials into native vegetation, the spread of weeds and for the protection of the areas amenity.

Best Practices:
- Designated stockpile/dump sites only to be used for the stockpiling of materials when carrying out any works on the road corridor.
- Designated stockpile/dump sites are identified on a locality map provided by the Union Parishad.
- New stockpile or dumpsites sites may only be approved by the Engineer, and are not to be located on roadsides with medium to very high conservation values, drainage lines, waterways, and culvert areas or on roadsides adjacent to forests areas. In no circumstances must vegetation be removed to provide for the siting of stockpiles or the storage of materials (including dumpsites for excess soils/materials).
- Select the location for new stockpile/dump sites with consideration of the visual amenity and landscape values of the site.
- Use minimum space as necessary to store materials and to gain access to the stockpile/dump site.
- Stockpile/dump site boundaries to be clearly defined e.g. fencing, fallen logs.

28.7.19 Cultural and Heritage Values

Objective: To ensure the protection of roadside sites identified as having cultural or heritage values.

Best Practices:
- Sites of cultural or heritage value, archaeological sites and religious sites shall be formally recognised and protected from the adverse impact of any other uses of the road reserve.
- Any new archaeological sites found or suspected to occur must be reported to the Bangladesh Archaeological Survey.
ECP 29: MINIMISING RIVER BANK EROSION

29.1 GENERAL

Construction activities associated with jetty / ghat construction has the potential to impact on river bank stability through erosion/undercutting of the river bank. Excavation for jetty foundations typically involves the removal or disturbance of the protective vegetative layer, which can expose soils that may be susceptible to erosion. Pre-excavation work for jetty foundations will result in significant disturbance of streambed materials.

29.2 OBJECTIVE

To provide planning and construction guidelines for avoiding or mitigating adverse environmental impacts to river bank stability from the construction of jetties / ghats and associated works including water supply and washing facilities and transport infrastructure.

29.3 PLANNING AND DESIGN

The designer shall follow the general guidelines for planning and design of jetty / ghat construction to minimise short and long term adverse environmental effects as set out in ECP 28. Planning and design should also take into account any specific requirements of the Bangladesh Water Development Board.

29.4 IMPLEMENTATION

Throughout jetty / ghat construction activities, the river bank shall be protected from damage. The clearance of existing vegetation from the bank at the jetty / ghat site shall be limited to just that area required for the construction of the works. The programme for construction of the jetty / ghat shall demonstrate that detailed and specified erosion protection works are to be constructed at the earliest possible time.

When excavating in or near a watercourse, the work area should be kept separated from the flowing stream to prevent erosion of the bank, particularly at the toe of the bank which could lead to bank slumping / failure. Bank protection can be achieved by installing silt curtains and cofferdams. A silt curtain is a permeable geotextile material which is suspended vertically in a water body to minimise sediment transport from a disturbed area adjacent to or within a body of water. The base of the silt curtain is secured on the streambed using weighted materials, which also keep the curtain in place. Silt curtains should be placed around work areas before any excavation or construction (including construction and removal of earth cofferdams and construction of embankments) begins.

Earth cofferdams may be constructed using earth embankments and/or sandbags. An impermeable liner must be placed and secured (using bricks or sandbags) on the embankment to prevent soils from being eroded. An impermeable liner should also be used when constructing a cofferdam using sandbags, to prevent silt-laden water from passing through any openings between the sandbags.

Placement of riprap or armour stone around jetty / ghat foundations should be carried out in a manner which will minimise disturbance of streambed sediments. Placement may be carried out using barges with direct placement using an excavator.
Suggested Specifications: The contractor shall protect river banks from damage throughout the implementation of jetty / ghat construction works as per the guidelines outlined above. Should any damage occur, it shall be immediately repaired with permanent materials to the complete satisfaction of the Engineer.
ECP 30: SANITATION

30.1 GENERAL

The design, operation and maintenance of a proper sanitation system is essential for ensuring hygienic conditions around jetties and for minimising the potential pollution of the river. Human waste consists generally of two types of contaminants, namely pathogenic organisms and organic matter. Pathogenic organisms are responsible for morbidity and mortality in humans while organic waste which is usually high in nutrients, pollute surface and groundwater resources making them unsuitable for uses including fishing, irrigation and drinking as well as affecting aquatic biota.

Inspection of existing jetties suggest that many sanitation systems have been incorrectly designed for their intended use and maintenance operations are infrequently carried out, if at all. Improvement to sanitation will significantly improve local hygiene and reduce water resources pollution.

30.2 OBJECTIVE

To provide guidelines for the design, operation and management of appropriate sanitation facilities for new jetties. Identify opportunities for the recycling of wastes and income generation as part of the sanitation system.

30.3 PLANNING AND DESIGN

Sanitation facilities should provide treatment for wastewater discharges from toilets and washrooms. They should be designed to a suitable treatment standard and to an appropriate size for their expected use. There are a range of treatment options available but the most commonly used in markets and adjacent jetties is the septic tank / soak pit facility (soil absorption system). Detailed drawings of a typical market toilet and septic tank are provided in Annex 3.

The following information is required in the design of secondary treatment works for the treatment of effluent from septic tanks:

(a) Nature of soil and sub-soil condition as well as the approximate water table and any available records of flood levels or information as to the variation, seasonal or otherwise, in the water table.
(b) Site plan showing the proposed or existing buildings as well as reduced ground levels over the site.
(c) Discharge from the septic tank.
(d) The position and nature of outfall ditches, wells, tanks or small streams in the vicinity, if any.

If soak pits are used they must be correctly designed and located. Soak pits often fail because of overuse or shallow water tables that render them ineffective. Soak pits are not suitable for treatment of septic tank effluent where the groundwater is shallow and has the potential to rise above the base of the soak pit, a particular problem during the wet season. In these situations, a dispersion trench located partly or fully above ground level in a mound should be used instead of a soak pit. The disadvantage of a dispersion trench is the requirement for a greater area of land than a soak pit.

Separation of washroom wastewater from toilet wastewater can significantly reduce the volume to be treated. Because of the composition of washroom wastewater it can be disposed using the markets' drainage system (see ECP 21).

Design Guideline:
- Under no circumstances should effluent from a septic tank be allowed into an open channel drain or body of water without adequate treatment such as the use of a soak pit;
- Septic tanks should not be located in swampy areas or areas prone to flooding and should also be accessible for cleaning,
- In situations where a shallow water table prevents the use of a soak pit, a dispersion trench should be constructed with the following specifications.
  Dispersion trenches shall be 0.5 to 1.0 m deep and 0.3 to 1.0 m wide excavated to a slight gradient and shall be provided with 150 to 250 mm of washed gravel or crushed stones. Open jointed pipes placed inside the trench shall be made of unglazed earthen-ware clay or concrete and shall have minimum internal diameter of 75 to 100 mm. Each dispersion trench should not be longer than 30 m and trenches should not be placed closer than 2.0 m.
- The minimum standard of treatment to be achieved at all times is bacterial oxygen demand ($\text{BOD}_5$) less than 30ppm, suspended solids less than 50ppm. The size of septic tanks and soak pits should be appropriate for the predicted level of usage (based on 'hat' market days) and soak pits should not be located where groundwater tables (during the wet or dry season) render them ineffective.
- Washroom and other wastewater shall be separated from toilet wastewater and disposed of through the market's drainage system (see ECP 21).

Including a recycling component in the sanitation system can reduce the cost of providing sanitation facilities. Recycling waste, in addition to being more environmentally acceptable, generates income. For example, a bio-gas plant utilising human waste can produce environmentally acceptable fuel which can be sold for cooking and lighting saving significant amounts of firewood and minimising indoor air pollution caused by burning firewood. A detail drawing of a bio-gas plant is provided in Annex 3 to assist in assessing its suitability for a market. Prior to the inclusion of a bio-gas plant, potential users of the fuel also need to be consulted to determine their acceptance of its use. Some households are reluctant to use bio-gas fuel for cooking and an education program may need to be implemented prior to the inclusion of a bio-gas plant.

Another option for recycling human waste is adoption of the 'Duckweed-Based' wastewater treatment system. This also has the potential to provide an income by turning wastewater into valuable duckweed meal, which is used as the sole feed input for freshwater fish farming. It does however, require more land than a bio-gas plant.

### 30.4 IMPLEMENTATION

Local hygiene and pollution of water resources will only be reduced if an appropriately designed and operated sewage treatment facility is installed at the jetty site. The location of a sewage treatment facility with respect to water resources is also an important factor in minimising the risk of pollution. The minimum distance required between a tubewell/surface water resource and a soak pit is dependent on the underlying soil type, velocity of groundwater flow and height of groundwater table. As a general rule a minimum distance of 15m should be adequate.

An effective maintenance program is essential to ensure continued operation of treatment facilities to design standard. Septic tanks need to be cleaned (desludged) on a regular basis.

**Suggested Specifications:** All discharge from toilets shall be piped to a purpose designed sewage treatment facility prior to discharge to a natural watercourse. Wastewater from washrooms shall be disposed via a separate drainage system.

The standard of treatment to be achieved shall be such that the following effluent standards are achieved at all times:
- bacterial oxygen demand ($\text{BOD}_5$) less than 30ppm,
- suspended solids less than 50ppm.
- the distance of a tubewell / surface water resource from a soak pit shall be a minimum 15m;

Septic tanks shall be checked bi-annually and when a septic tank has reached capacity it shall be cleaned out as per the provisions of an approved management/operating plan:

- half yearly or yearly desludging of septic tanks is desirable. Small, low use septic tanks, for economic reasons, may be cleaned at least once in 2 years provided the tank is not overloaded due to use by more than the number for which it is designed.

Sanitation facilities will only be effective if the public is encouraged to use them. They should therefore be conveniently located adjacent to the jetty and of appropriate design as well as being regularly cleaned to encourage use.

**Suggested Specifications:** The location of sanitation facilities shall be such that they are easily accessible and within short walking distance of the jetty.

Specific requirements include.

- water supply provision shall ensure at least one tubewell or a standpipe per 1,500 target visitors,
- at least one of the latrines shall be kept reserved for the use of women;
- due to religious requirements the orientation of the latrines shall be such that the users avoid facing the east or the west;
- toilets shall be cleaned on a daily basis.

### 30.5 Cost Estimates

The measures for human waste treatment facilities i.e. septic tank, soak pits, bio-gas plant, duckweed-based waste treatment system etc. shall form the part of project intervention and thus cost of these measures shall be included in this sub-project cost. However, the operation and maintenance cost of these facilities, whichever shall be adopted, shall be estimated and included in BOQ.
ECP 31: TRANSPORTATION

31.1 GENERAL

A well designed transport connection between a jetty / ghat and a growth centre market are essential to maximise the economic benefits of both. Locating a jetty / ghat adjacent to a growth centre market has the inherent benefit of integrating their operation and management into one system. Markets already have a well established Market Management Committee consisting of market users, traders, local community, and Union Parishad members which could also take on the responsibilities of managing a jetty / ghat and its associated infrastructure.

31.2 OBJECTIVE

To provide guidelines for transport management adjacent to jetties / ghats and ensuring their integration with growth centre markets.

31.3 PLANNING AND DESIGN

Planning and design should take into consideration the need for landing facilities and adequate parking for vehicles, loading and unloading facilities etc to avoid congestion at the jetty / ghat site. If the jetty / ghat is located adjacent to a growth centre market, then these facilities should be integrated and preferably managed by the Market Management Committee. A transportation plan should be prepared in consultation with jetty user groups including Women’s Groups, boat operators and owners, and Market Traders Association.

**Design Guideline:** A transportation plan shall be prepared which adopts the following guidelines:

- community consultation in accordance with the participatory consultation process under TRIP,
- clear access to the jetty for loading and unloading of goods and people;
- provision of adequate space for loading and unloading of goods, parking for vehicles, and non-motorised transport such as rickshaws etc.
- facilities shall be designed to accommodate expected usage on market “hat” days.

31.4 IMPLEMENTATION

For the construction phase, the contractor shall follow the relevant general specifications ‘Environmental Guidelines for Construction’ outlined in ECP 28.
ECP 32: WATER SUPPLY

32.1 GENERAL

Groundwater is the most common source of water supply for Growth Centre Markets and jetties. The depth of the water table and water quality, particularly with respect to arsenic contamination and/or faecal coliform contamination are important issues of concern which need consideration during planning and design of the water supply and sanitation facilities for jetties. In Bangladesh the depth of the aquifer to be tapped for a tubewell plays an important role in eliminating the risk of arsenic contamination. Iron content in shallow groundwater is also a common problem encountered in using groundwater as a source of potable water and for washing. The use of deep tubewells however, are costly and require skilled labourers to install and maintain while shallow tubewells (which are generally poorer water quality) are economic and more easily maintained.

32.2 OBJECTIVE

To provide guidelines and specific design requirements for the provision of potable and non-potable water supplies (mainly washing for personal hygiene) adjacent to jetties.

32.3 PLANNING AND DESIGN

32.3.1 Location of Tubewell

A minimum requirement for jetties is the provision of 2 separate tubewells, one for washing/sanitation purposes and the other for potable (drinking) water supply. Each should be clearly marked for their intended purpose and they should not be located next to each other.

Design Guideline: The location of tubewells shall be based on the following guidelines
- a minimum of 2 tubewells shall be located adjacent to a jetty, one for washing/sanitation purposes and the other for potable water supply
- each tubewell shall be clearly marked for its intended use,
- tubewells used to supply potable water shall not be located near sanitation facilities such as toilets to prevent water contamination.

32.3.2 Type of Tubewell

In Bangladesh, the risk of arsenic contamination in groundwater is high and this can be minimised by using tubewells over 300 feet in depth. Deep tubewells also eliminate the risk of contamination by faecal matter from humans and animals. However, they are costly to construct and maintain such that it is more feasible to use shallow tubewells provided the water quality is suitable for the intended use.

Design Guideline: The use of a shallow or deep tubewell shall be based on the following guidelines:
- the use of the water, whether for washing only (shallow tubewell is suitable) or as a potable water supply (water quality sampling required to assess suitability of a shallow tubewell,
- if water quality sampling indicates the presence of arsenic and/or iron at unacceptable levels a deeper well is required or an alternative site chosen if the water is to be used for drinking. The World Health Organisation guideline for the desirable maximum concentration of arsenic in drinking water is 0.01 mg/l and in Bangladesh the acceptable limit for iron content is up to 5mg/l for rural water supply. Current technologies, which are effective in removing arsenic, are too expensive or highly technical for rural areas.
The tubewell will be designed such that local surface water run-off is prevented from contaminating the tubewell and drainage from the tubewell will be diverted into a drainage system (see ECP 30). Tubewell design shall be such that it is easy for users, especially women who are the main water collectors, to operate the pump.

**Design Guideline:** The type of tubewell design adopted shall be based on the following guideline
- all surface water run-off shall be diverted around the tubewell;
- drainage from the tubewell shall be diverted into a drainage system (see ECP 30);
- the pump mechanism shall be of a conventional type such as a 'moon' hand pump and not the “tara” design which is more difficult to use and unpopular among rural communities (a suitable tubewell design can be found in LGED’s 1995 “Manual for Growth Centre Planning”).

### 32.4 IMPLEMENTATION

#### 32.4.1 Ongoing Operation/Maintenance

Water quality testing should be carried out initially prior to use of the tubewell to determine its suitability for its proposed use. Thereafter, sampling should be undertaken on a monthly basis and analysis undertaken by a suitably qualified person. Should the water quality be found to be unsuitable for its intended use, users should be immediately informed and remedial measures implemented to rectify the problem. Remedial measures may include treating the water, temporarily closing the tubewell until such time sampling indicates it is suitable for use again, using the tubewell for another use, or closing it permanently and finding another water source.

Jetty management staff will need to be trained on how to collect water samples to avoid contamination of samples.

**Suggested Specifications:** A water quality monitoring program shall be implemented. The plan should include the following minimum requirements
- an initial water quality sampling will be undertaken prior to the use of the tubewell to determine suitability for its proposed use. The minimum parameters to be sampled shall include: arsenic, faecal coliform, fluoride, iron, pH, total dissolved solids (or conductivity) and hardness;
- subsequent sampling shall be carried out monthly and the parameters to be sampled will depend on the use of the tubewell,
- a plan of action where water quality is found to be unsuitable for its intended use.

Workers assigned to manage the water quality program shall be appropriately trained in water sampling techniques.

Responsibilities for ongoing maintenance and repair of tubewells as well as the cost of the water quality monitoring program should be decided between LGED, Upazilla and, if management is undertaken by market then by market users / Market Management Committee.
ANNEXURE 11.1: EROSION AND SEDIMENTATION CONTROL TECHNIQUES

A.1 INTRODUCTION

Erosion occurs when exposed soil is disturbed by moving water (surface runoff or channel flow). Some streams have "dirty" water during high flow periods because of erosion that occurs naturally. Rural road improvement activities can expose some areas of erodible soils.

The rural road improvement works that could affect the erosion process include the following activities:

- clearing;
- grubbing;
- borrow areas development and operation;
- Culvert / bridge construction;
- limited earth work for embankment shoulders or batter slope improvement, and
- Spoil (waste fill material) disposal

Soil eroded from exposed areas comes from locations of channelized flow called rills or and from sheet erosion above and between rills. Rills erosion primarily results from the effects of rainfall, and it is greatly influenced by slope and flow rate. Partially compacted shoulders and batter slopes without having cross fall drains and inadequate vegetation easily gets eroded during heavy rains (locally called as rain-cut) and sediments adjacent ponds or watercourses.

Rural road improvement activities can expose disturbed soils to precipitation and to surface runoff. Excavations are made, protective vegetation is reduced, topography is altered, and removed soil materials is often stockpiled without protective cover. Eroding sediments from these sources can affect on-site drainage and storm runoff patterns and, off-site streambed and stream flow characteristics.

A.2 ENVIRONMENTAL CONCERNS WITH SEDIMENT

Rohu and katla are the two most highly prized native fishes of Bangladesh. The quality of pond or stream habitat is often the factor which establishes how many adult fish a pond or watercourse can produce. Introducing sediment into these ponds or streams can have tragic, long-term consequences for both fish and people.

What is Sediment?

Sediment consists of fine soil material that is generated by erosion and is often referred to as "silt" or "fines". Under natural conditions sediment enters all ponds or streams in variable amounts. In sufficiently high concentration, sediment is a pollutant. It settles to the pond or stream bottom wherever water currents are slow. Because water also flows through the gravel bottoms of streams, sediment can be carried into the gravel where it becomes trapped.
What are the Effects of Sediment?

The damage caused to fish and their food supply depends on the nature of the sediment, its concentration in the water, the flow in a stream, the time of year, and how long the discharge is allowed to continue. Small concentrations of sediment over prolonged periods can, in fact, be more damaging than an intense but short-lived deposit.

Sediment suspended in the currents can damage sensitive gill surfaces, in high enough concentrations, clog the gills until suffocation and death occurs. In muddy waters, fish cannot see their insect food supply, and may weaken or die through starvation. In moving water, sediment particles “scour” aquatic plants and animals, removing them from their habitat. Sediment deposits cause streams to become shallower, causing the water temperature to rise.

Spawning gravels that become choked with sediment are ignored by adult fish. Some juvenile fish also use the spaces in the gravel as shelter or escape cover. If these spaces become filled with fines, the fish are exposed to increased predation or may be swept away by the faster flowing currents above the gravel. Sediment, when it settles, could suffocate eggs, smother newly hatched fish, or prevent their emergence from the gravel.

Sediment in the water can also damage fish’s major food supply—aquatic insects. Insect populations are reduced by damage to their breathing organs, clogging of their feeding apparatus, and by damage to algae, their major food supply. The growth of algae is prevented because suspended sediments block sunlight from reaching the pond or stream bottom. When it settles, this sediment smothers algae already growing.

A.3 METHODS TO REDUCE EROSION AND SEDIMENTATION

The principles of reducing erosion and sedimentation from work areas are

Plan the work to fit the particular topography, soils, waterways, and natural vegetation at a site.

As both slope length and steepness increase, the rate of surface runoff increases and the potential for erosion is magnified. Where possible, steep slopes should be left undisturbed.

By minimizing the length and steepness of a disturbed slope, even a highly erodible soil may show little evidence of erosion. Long steep slopes should be broken by benching, terracing, and/or constructing diversion structures. Clearing and grubbing all roadside vegetation is poor practice. Stripping of the vegetation mat should not be done right up to the edge of the clearing, but only within the limits required for earthwork. In this photo, note that material was pushed beyond right-of-way stakes.

When earthwork is required and the natural vegetation is removed, keep the area and the duration of exposure to a minimum. Plan the phases or stages of construction so that only the areas which are actively being developed are exposed. All other areas should have a good cover of temporary or permanent vegetation or much.

Grading should be completed as soon as possible. Immediately after grading is complete, permanent vegetative cover should be established in the area. As cut slopes are constructed and as fill slopes are brought up to grade, these areas should be hydro seeded as the work progresses.
The natural vegetative cover is extremely important in controlling erosion since it

- shields the soil surface from the impact of falling rain;
- increases infiltration of water into the soil;
- reduces the velocity of the runoff water, and
- holds soil particles in as well as filters surface runoff.

Expose the smallest practical area of land for the shortest possible time.

The Work Progression Clause should be provided in the contract specifications to ensure that construction which begins on any work area proceeds continuously and diligently until the work area is completed. This ensures an orderly progression of the work and effective protection of the environment by minimizing the extent of the construction area that is exposed to erosion processes at any given time. Areas not actively being developed should be grassed and mulched.

Apply “Soil Erosion” control practices as a first line of defence against on-site damage.

Control erosion on a site to prevent excessive sediment from being produced. Special grading methods such as tracking with a crawler tractor may be used (work the slope vertically so that cleat marks are horizontal). Other practices include diversion structures to divert surface runoff from exposed soils and grade stabilization structures to control surface water.

Significant erosion in the form of gullies must be prevented by these water control devices. Lesser types of erosion should also be prevented by completing work without delay and applying appropriate control practices. When erosion is not adequately controlled, sediment control is more difficult and expensive.

Apply “Sediment Control” practices as a perimeter protection to prevent off-site damage.

Control any sediment produced and prevent it from getting off-site. Diversion ditches, sediment traps, and sediment basins are examples of practices to control sediment from getting off-site. Generally, sediment can be retained by two methods:

Filtering runoff as it flows through a series of sediment control dams in ditches; and

trapping the sediment-laden runoff in sediment ponds so that the soil particles settle out.

Implement a thorough maintenance and follow-up operation.

A site cannot be effectively controlled without thorough, periodic checks of the erosion and sediment control practices. An example of applying this principle would be to start a routine check to make sure that all control practices are working properly.

A.4 BORROW, STOCKPILE & DISPOSAL AREA

A minimum of 15 meters of undisturbed terrain should be left between the edge of the right-of-way and a stockpile or disposal area. Waste areas should be covered with coarse material or revegetated to prevent wind and water erosion.
The location and operation of pits should ensure that they would not adversely affect any nearby watercourse.

Diversion ditches, sediment control fences, or check dams constructed around the perimeter of the site can be used to intercept any sediment-laden runoff from a site, and direct it to a sedimentation pond. This permits sediments to settle out prior to discharge off-site.

### A.5 TYPICAL EROSION CONTROL PRACTICES

<table>
<thead>
<tr>
<th>Treatment Practice</th>
<th>Advantages</th>
<th>Problems</th>
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<tbody>
<tr>
<td><strong>Roadway Surface</strong></td>
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<tr>
<td>Crowning to Ditch or Sloping to Single Bern</td>
<td>• Directing the surface water to a prepared or protected ditch minimizes erosion</td>
<td>• None – should be part of good construction procedures</td>
</tr>
<tr>
<td>Compaction</td>
<td>• The final lift of each day's work should be well-compacted and bladed to drain to ditch or berm section</td>
<td>• None – should be part of good construction procedures</td>
</tr>
<tr>
<td></td>
<td>• Loose or uncompacted material is more subject to erosion</td>
<td></td>
</tr>
<tr>
<td>Aggregate Cover</td>
<td>• Minimizes surface erosion</td>
<td>• Requires reworking and compaction if exposed for long periods of time</td>
</tr>
<tr>
<td></td>
<td>• Permits construction traffic during adverse weather</td>
<td>• Loss of surface aggregates can be anticipated</td>
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<tr>
<td></td>
<td>• May be used as part of permanent base construction</td>
<td></td>
</tr>
<tr>
<td>Seed/Mulch</td>
<td>• Minimizes surface erosion</td>
<td>• Must be removed or is lost when construction of pavement is commenced</td>
</tr>
<tr>
<td>Cut Slopes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Berm at top of cut</td>
<td>• Diverts water from cut</td>
<td>• Access to top of cut</td>
</tr>
<tr>
<td></td>
<td>• Collects water for slope drains/paved ditches</td>
<td>• Difficult to build on steep natural slope or rock surface</td>
</tr>
<tr>
<td></td>
<td>• May be constructed before grading is started</td>
<td>• Concentrates water and may require channel protection or energy dissipation devices</td>
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<tr>
<td></td>
<td></td>
<td>• Can cause water to enter ground, resulting in sloughing of the cut slope</td>
</tr>
<tr>
<td>Treatment Practice</td>
<td>Advantages</td>
<td>Problems</td>
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<td>-------------------------</td>
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</tbody>
</table>
| Diversion Dike          | • Collects and diverts water at a location selected to reduce erosion potential  
                         | • May be incorporated in the permanent project drainage                  | • Access for construction                                               |
|                         |                                                                           | • May be continuing maintenance problem if not paved or protected       | • Disturbed material or bank is easily eroded                          |
| Slope Benches           | • Slows velocity of surface runoff                                       | • May cause sloughing of slopes if water infiltrates                     |
|                         | • Collects sediment                                                       | • Requires additional ROW                                               |
|                         | • Provides access to slope for seeding, mulching, and maintenance         | • Not always possible due to rotten material etc                        |
|                         | • Collects water for slope drains or may divert water to natural ground   | • Requires maintenance to be effective                                  |
|                         |                                                                          | • Increases excavation quantities                                       |
| Slope Drains (pipe, paved, etc) | • Prevents erosion on the slope                                           | • Requires supporting effort to collect water                           |
|                         | • Can be temporary or part of permanent construction                      | • Permanent construction is not always compatible with other project work |
|                         | • Can be constructed or extended as grading progresses                    | • Usually requires some type of energy dissipation                       |
| Seeding/Mulching        | • The end objective is to have a completely grassed slope. Early placement is a step in this direction | • Difficult to schedule high production units for small increments      |
|                         | • The mulch provides temporary erosion protection until grass is rooted   | • Time of year may be less desirable                                   |
|                         | • Temporary or permanent seeding may be used. Mulch should be anchored   | • May require supplemental water                                       |
|                         | • Larger slopes can be seeded and mulched with smaller equipment if stage techniques are used | • Contractor may perform this operation with untrained or unexperienced personnel and inadequate equipment if stage seeding is required |
| Sodding                 | • Provides immediate protection                                           | • Difficult to place until cut is complete                              |
|                         | • Can be used to protect adjacent property from sediment and turbidity   | • Sod not always available                                              |
|                         |                                                                          | • May be expensive                                                      |
| Slope Pavement, Riprap | • Provides immediate protection for high risk areas and under structures  | • Expensive                                                             |
|                         | • May be cast in place or off site                                        | • Difficult to place on high slopes                                    |
|                         |                                                                          | • May be difficult to maintain                                          |
## Annexure 3.1: Erosion and Sedimentation Control Techniques

<table>
<thead>
<tr>
<th>Treatment Practice</th>
<th>Advantages</th>
<th>Problems</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Temporary Cover</strong></td>
<td>• Plastics are available in wide rolls and large sheets that may be used to provide temporary protection for cut or fill slopes&lt;br&gt;• Easy to place and remove&lt;br&gt;• Useful to protect high risk areas from temporary erosion</td>
<td>• Provides only temporary protection&lt;br&gt;• Original surface usually requires additional treatment when plastic is removed&lt;br&gt;• Must be anchored to prevent wind damage</td>
</tr>
<tr>
<td><strong>Serrated Slope</strong></td>
<td>• Lowers velocity of surface runoff&lt;br&gt;• Collects sediment&lt;br&gt;• Holds moisture&lt;br&gt;• Minimizes amount of sediment reaching roadside ditch</td>
<td>• May cause minor sloughing if water infiltrates&lt;br&gt;• Construction compliance</td>
</tr>
<tr>
<td><strong>Fill Slopes</strong></td>
<td></td>
<td></td>
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<tr>
<td><strong>Berms at Top of Embankment</strong></td>
<td>• Prevent runoff from embankment surface from flowing over face of fill&lt;br&gt;• Collect runoff for slope drains or protected ditch&lt;br&gt;• Can be placed as a part of the normal construction operation and incorporated into fill or shoulders</td>
<td>• Cooperation of construction operators to place final lifts at edge for shaping into berm&lt;br&gt;• Failure to compact outside lift when work is resumed&lt;br&gt;• Sediment buildup and berm failure</td>
</tr>
<tr>
<td><strong>Slope Drains</strong></td>
<td>• Prevent fill slope erosion caused by embankment surface runoff&lt;br&gt;• Can be constructed of full or half section pipe, bituminous, metal, concrete, plastic, or other waterproof material&lt;br&gt;• Can be extended as construction progresses&lt;br&gt;• May be either temporary or permanent</td>
<td>• Permanent construction as needed may not be considered desirable by contractor&lt;br&gt;• Removal of temporary drains may disturb growing vegetation&lt;br&gt;• Energy dissipation devices are required at the outlets</td>
</tr>
<tr>
<td><strong>Fill Berms or Benches</strong></td>
<td>• Slows velocity of slope runoff&lt;br&gt;• Collects sediment&lt;br&gt;• Provides access for maintenance&lt;br&gt;• Collects water for slope drains&lt;br&gt;• May utilize waste</td>
<td>• Requires additional fill material if waste is not available&lt;br&gt;• May cause sloughing&lt;br&gt;• Additional ROW may be needed</td>
</tr>
</tbody>
</table>
### Treatment Practice | Advantages | Problems
--- | --- | ---
**Seeding/Mulching** | Timely application of mulch and seeding decreases the period a slope is subject to severe erosion. Mulch that is cut in or otherwise anchored will collect sediment. The furrows made will also hold water and sediment. | Seeding season may not be favorable. Not 100 percent effective in preventing erosion. Watering may be necessary. Steep slopes or locations with low velocities may require supplemental treatment.

**Protection of Adjacent Property**

**Brush Barriers** | Use slashing and logs from clearing operation. Can be covered and seeded rather than removed. Eliminates need for burning or disposal off ROW. | May be considered unsightly in urban areas.

**Straw Bale Barriers** | Straw is readily available in many areas. When properly installed, they filter sediment and some turbidity from runoff. | Require removal. Subject to vandal damage. Flow is slow through straw requiring considerable area.

**Sediment Traps** | Collect much of the sediment spill from fill slopes and storm drain ditches. Inexpensive. Can be cleaned and expanded to meet need. | Do not eliminate all sediment and turbidity. Space is not always available. Must be removed (unusually).

**Sediment Pools** | Can be designed to handle large volumes of flow. Both sediment and turbidity are removed. May be incorporated into permanent erosion control plan. | Require prior planning, additional ROW and/or flow easement. If removals necessary, can present a major effort during final construction stage. Clean-out volumes can be large. Access for clean-out not always convenient.

**Energy Dissipaters** | Slow velocity to permit sediment collection and to minimize channel erosion of project. | Collect debris and require cleaning. Require special design and construction of large shot rock or other suitable material from project.
<table>
<thead>
<tr>
<th>Treatment Practice</th>
<th>Advantages</th>
<th>Problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level Spreaders</td>
<td>• Covert collected channel or pipe flow back to sheet flow</td>
<td>• Adequate spreader length may not be available</td>
</tr>
<tr>
<td></td>
<td>• Avoid channel easements and construction off project</td>
<td>• Sodding of overflow berm is usually required</td>
</tr>
<tr>
<td></td>
<td>• Simple to construct</td>
<td>• Must be a part of the permanent erosion control effort</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Maintenance forces must maintain spreaders until no longer required</td>
</tr>
<tr>
<td>Construction Dike</td>
<td>• Permits work to continue during normal steam stages</td>
<td>• Usually requires pumping of work site water into sediment pond</td>
</tr>
<tr>
<td></td>
<td>• Controlled flooding can be accomplished during periods of inactivity</td>
<td>• Subject to erosion from stream and from direct rainfall on dike</td>
</tr>
<tr>
<td>Cofferdam</td>
<td>• Work can be continued during most anticipated steam conditions</td>
<td>• Expensive</td>
</tr>
<tr>
<td></td>
<td>• Clear water can be pumped directly back into stream</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• No material deposited in stream</td>
<td></td>
</tr>
<tr>
<td>Temporary Stream Channel Change</td>
<td>• Prepared channel keeps normal flows away from construction</td>
<td>• New channel usually will require protection</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Stream must be returned to old channel and temporary channel refilled</td>
</tr>
<tr>
<td>Riprap</td>
<td>• Sacked sand with cement or stone easy to stockpile and place</td>
<td>• Expensive</td>
</tr>
<tr>
<td></td>
<td>• Can be installed in increments as needed</td>
<td></td>
</tr>
<tr>
<td>Temporary Culverts for Haul Roads</td>
<td>• Eliminate stream turbulence and turbidity</td>
<td>• Space not always available without conflicting with permanent structure work</td>
</tr>
<tr>
<td></td>
<td>• Provide unobstructed passage for fish and other after life</td>
<td>• May be expensive, especially for large sizes of pipe</td>
</tr>
<tr>
<td></td>
<td>• Capacity for normal flow can be provided with storm water flowing over the roadway</td>
<td>• Subject to washout</td>
</tr>
<tr>
<td>Rock-lined Low-Level Crossing</td>
<td>• Minimizes steam turbidity</td>
<td>• May not be fordable during rainstorms</td>
</tr>
<tr>
<td></td>
<td>• Inexpensive</td>
<td>• During periods of low flow passage of fish may be blocked</td>
</tr>
<tr>
<td></td>
<td>• May also serve as ditch check or sediment trap</td>
<td></td>
</tr>
</tbody>
</table>
### Annexure 3.1: Erosion and Sedimentation Control Techniques

<table>
<thead>
<tr>
<th>Treatment Practice</th>
<th>Advantages</th>
<th>Problems</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Roadway Ditches</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Check Dams         | • Maintain low velocities  
                       • Catch sediment  
                       • Can be constructed of logs, shot rock, lumber, masonry or concrete  | • Close spacing on steep grades  
                       • Require clean-out  
                       • Unless keyed at sides and bottom, erosion may occur |
| Sediment Traps/Stream Bales Filters | • Can be located as necessary to collect sediment during construction  
                                        • Clean-out often can be done with a simple to construct | • Little direction on spacing and size  
                        • Sediment disposal may be difficult  
                        • Specification must include provision for period clean-out  
                        • May require seeding, sodding or pavement when removed during final cleanup |
| Sodding            | • Easy to place with a minimum of preparation  
                       • Can be repaired during construction  
                       • Immediate protection  
                       • May be used on sides of paved ditches to provide increased capacity | • Requires water during first few weeks  
                        • Sod not always available  
                        • Will not withstand high velocity or severe abrasion from sediment load |
| Seeding with Mulch and Matting | • Usually least expensive  
                                   • Effective for ditches with low velocity  
                                   • Easily placed in small quantities with inexperienced personnel | • Will not withstand medium to high velocity |
| Paving, Riprap, Rubble | • Effective for high velocities  
                             • May be part of the permanent erosion control effort | • Cannot always be placed when needed because of construction traffic and final grading and dressing  
                             • Initial cost is high |
| **Borrow Areas**   |            |          |
| Selective Grading and Shaping | • Water can be directed to minimize off-site damage  
                                   • Flatter slopes enable mulch to be cut into soil | • May not be most economical work method for contractor |
| Stripping and Replacing of Topsoil | • Provides better seed bed  
                                       • Conventional equipment can be used to stockpile and spread topsoil | • May restrict volume of material that can be obtained for a site  
                                       • Topsoil stockpiles must be located to minimize sediment damage  
                                       • Cost of rehandling material |
| Dikes, Berms, Diversion Ditches, Settling Basins, Sediment Traps, Seeding & Mulch | • See other practices | • See other practices |
A.6 RECYCLING OR REUSE OF HIGHWAY CONSTRUCTION WASTE

Simply defined, recycling refers to a process of utilizing existing materials in a newly manufactured product. Reuse involves the removal and placement of existing materials in substitution of importing newly manufactured materials. Whether recycling or reuse is applicable, both avenues can provide benefits including reduced costs, energy savings, conservation of natural resources, and environmental protection of resources.

In road projects, such discarded materials typically include old asphalt, old concrete, and excavated materials such as crushed brick and fill. The reuse of these materials can significantly reduce the consumption of landfill space of such materials and the use of natural resources.

Although positive environmental factors of materials, energy, and landfill conservation are associated with material recycling, two environmental issues are of potential concern:

- Gaseous emissions of "Blue Smoke" control during the asphalt plant recycling process, and
- Leachate from the recycled asphalt through the use of solvents in the process.

Studies undertaken to determine the stability of various recycling processes have indicated that salvageable asphalt can be recycled into quality asphalt materials and pavements with significant aggregate and asphalt cement conservation, elimination of disposal problems, reduced transportation requirements, and decreases traffic disruptions. The studies also indicate that economic benefits can be experienced with the use of recycled products.

Although road construction materials such as paving products and aggregates are the most widely recycled, a number of other products are being successfully reused including guard rails, guard rail posts (steel and wood), signs (advisory and regulatory), sign posts, sign or signal pole and structures, bridges (aluminum or steel railing), and steel superstructure and bridge decks. LGED is committed to reusing these materials, where practical.

It is also LGED policy to reuse road construction materials, where practical. Material reuse options include:

- Recycled asphalt can be mixed with granular material for road base material, new asphalt, or shoulder material.
- Recycled concrete rubble can be pulverized for aggregates in roadways, aggregate for edge drains, reused as aggregate in concrete mixes, pulverized as fine aggregate in asphalt mixes, or used as riprap.
- Recycled granular material can be used as fill material, or mixed with asphalt surface for road sub-base.
Appendices


**APPENDIX 1: DEFINITIONS AND GLOSSARY OF TERMS**

**Project** refers to Rural Transport Improvement Project (RTIP)

**Sub-project** refers to an individual rural road 1 (RR1) selected for improvement under the project.

**Works** includes the actions of planning, design, and improvement (construction) of any sub-project.

**Exotic Vegetation** Vegetation which does not occur naturally in Bangladesh and has been introduced to the region.

**Native Vegetation** Vegetation which occurs naturally in Bangladesh.

**Remnant Vegetation** vegetation remaining in uncleared parts of the sub-project road corridor.

**Revegetation** Vegetation established by hand planting tube stock or by direct seeding.

**Regeneration** Naturally occurring growth of grasses, shrubs and trees from root stock or soil born seeds.

**Groundcover** Includes creepers, grasses and herbs.

**Habitat** The home of a plant or animal.

**Noxious Weed** Any plant which degrade agricultural land and may also be environmental weeds.

**Stockpile** A site for storage of short-term re-useable materials.

**Disposal Sites** Those areas for the disposal of non re-useable materials.

**Waste** means litter, garbage, refuse, and other discarded materials including derelict motor vehicles and its parts,

**Waste management** includes, but is not restricted to, the import, export, handling, disposal, storage, transportation, incineration, recycling, reduction, re-use, processing, and control of waste or waste products;

**Wetland** means as appropriate:

(a) those areas that are inundated or saturated with surface or groundwater at a frequency and duration sufficient to support a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include ponds, haor, beel, freshwater marshes and cultivated wetlands, but do not include artificial wetlands set up for waste water treatment;

(b) an area suitable for designation under the Convention on Wetland of International Importance( RAMSAR) sites,
# APPENDIX 2

## DESCRIPTIVE CHECKLIST FOR ROADS IMPROVEMENT/MAINTENANCE

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>General Tips</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic (based on traffic count by Engg Team / observation / local consultation)</td>
<td>Road remains operational month in a year</td>
<td>month</td>
<td></td>
</tr>
<tr>
<td>Number of vehicular traffic per day</td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of motorised traffic per day</td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of motor vehicle during a typical peak hour</td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% of non-motorised traffic</td>
<td>%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of accidents on the road during last 5 years</td>
<td>No and types at each accident prone location / zone per year</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Community's views / concern on safety of pedestrian / non-motorised vehicles (particularly due to increased traffic as well as speed after the road improvement)</td>
<td>Information to be collected through FGD and / or Key Informants interview</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Community's Suggestions to ensure safety, if any</td>
<td>Information to be collected through FGD and / or Key Informants interview</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Road Embankment</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Average top width of existing embankment (measurements from km to km, may vary, hence note down for each road segments with variable widths)</td>
<td>Carriage way (CW) + left shoulder + right shoulder</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average width of proposed embankment (refer the road cross-sections and note down the info For each of the above varying width sections so as to know the extent of widening and hence tree cutting impact)</td>
<td>CW + left shoulder + right shoulder</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average height of road (measurements may vary along the road, note down for each varying sections - from 2 km to 2 km)</td>
<td>m</td>
<td></td>
<td></td>
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<tr>
<td>Average batter slope (measurements may vary along the road, note down for each varying sections - from 2 km to 2 km)</td>
<td>V H</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pavement Condition (Based on observation)</td>
<td>Black topped / WBM</td>
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<td></td>
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<tr>
<td>Condition of Batter / slope (Based on observation)</td>
<td>Generally eroded / fair</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type Vegetation on batter slope (Based on observation) (may vary, note down from ? km to ? km, including the stretches which are devoid of trees)</td>
<td>Turfing / Bushes / Trees (average girth size?)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type of Vegetation on shoulders - Left/right / both sides</td>
<td>Bushes / Trees (average girth size?)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geometry of the Road (Based on observation)</td>
<td>Straight / Zig-zag (No of sharp turns, hair pin bends, if any)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-do-</td>
<td>Plain / rolling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proposed widening (refer L-section / Profile- may vary along each section, note down from ? km to ? km)</td>
<td>Symmetric (concentric)/ asymmetric / Left (km - km) asymmetric / Right (km - km)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Widening modifications recommended, with reasons</td>
<td>Concentric (km - km)</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Left (km - km)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Right (km - km)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Topography</td>
<td>Topography of the region (Key informants Interview) Flood plain / rolling / low-lying / upland</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Topography of the adjacent area (Observation / key informants interview) Flood plain / rolling / low-lying / upland</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(To be mapped on suitable scale) Length of the road through flood plain / flood free high land / forest land swamp/ wetland (Direct observation)</td>
<td>Km for each category</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(To be mapped on suitable scale) Length of road passing through agriculture lands and through non-agriculture lands (Direct observation)</td>
<td>km</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regional Hydrology/ Flooding</td>
<td>Average reduced level of present road (refer road profile) m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(To be mapped on suitable scale) Road length perpendicular to the drainage line and parallel to the drainage line (Observation / key informants interview)</td>
<td>Km each</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(To be mapped on suitable scale) HFL (Observations at bridges/ key informant's interview)</td>
<td>m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Description</td>
<td>Value</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length of road below HFL (Analyse based on Road profile and HFL data)</td>
<td>km</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Describe current problem of flooding, if any, as perceived by community (FGD / KII)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duration of flooding FGD / KII</td>
<td>Only monsoon / entire year / during very high floods</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estimated annual loss of property and type of loss (FGD / KII)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reasons for flooding / local drainage congestion (FGD / KII)</td>
<td>River-overtopping / less cross drainage / local natural depressions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extent of road damage due to floods (FGD / KII)</td>
<td>Marginal / medium / substantial</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communities perceptions regarding floods (FGD / KII)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drainage congestion / water-logging</td>
<td>Along 2 km to 7 km of road (FGD / KII) Km to km</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average time period and frequency per year (FGD / KII)</td>
<td>Months / per year / No of times / year</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reasons (FGD / KII)</td>
<td>Natural depressions / low lying area / borrow pits / flash heavy rains / insufficient cross-drainage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Problems due to water logging (FGD / KII)</td>
<td>Mosquito problem / crop damage / permanent loss of agricultural land / water pollution due to dumping of wastes etc</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Existing No and sizes of cross - drainage structures / bridges (Observation, compare with the L -Profile)</td>
<td>No / m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Additional structures proposed at km? Assess their location and capacity adequacy (FGD / KII) Refer Profile</td>
<td>Nos. / km</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Draw sketches, as necessary Options for remedial actions (FGD / KII)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Road-side avenue / tree</td>
<td>Left / Right / Both sides</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average distance from centreline - (may vary along the length - note down from 2 km to 7 km)</td>
<td>m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Borrow Areas</td>
<td>Existing status of borrow pits along the road (with location km - km)</td>
<td></td>
<td></td>
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<tr>
<td>--------------</td>
<td>--------------------------------------------------------------------------------</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Average size m x m</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Distance from road toe m</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Average depth m</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Drainage pattern Broken / continuous</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Standing Water during a year (FGD / KII)</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Extent of water hyacinth, if any (Observation / FGD / KII)</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Community’s perception on water hyacinth (FGD / KII)</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Current practice to use / growth prevention / destruction of water hyacinth (FGD / KII)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Options for improvement (FGD / KII) Options for improvement</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Potential location and size of borrow areas with land use (FGD / KII / LGED / Local Contractors / UP Chairman) Indicate source of information</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ownership Private / khas land</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Distance from road toe km</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soil type Clay / sand / silt / silty sand / silty clay / red soil</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vegetation Yes / No</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Type of vegetation Bushes / Trees</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Options for rehabilitation (FGD / KII) Pond / continuous ditch joining to natural drains</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brick</td>
<td>Location and Distance of brick kilns (FGD / KII) km</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fuel used (FGD / KII) Coal / firewood</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Approach road to kilns (FGD / KII) Existing / required</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Current practice as regards to rehabilitation of brick-breaking yard (FGD / KII)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Potential landuse / location of brick-breaking yard (FGD / KII) Agriculture / barren / low lying / high land</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Area required (LGED Assessment)</td>
<td>Acre</td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------------------------</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Options for rehabilitation after use (FGD / KII)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand Source (FGD / KII)</td>
<td>Name of river with location</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distance from the road (FGD / KII)</td>
<td>Km</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current practice of dredging (FGD / KII)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any environmental concerns of local people (FGD / KII)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wetlands / Pond (show locations and sizes on the alignment plan)</td>
<td>Type of wetlands along the road (FGD / KII followed by observation)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number and their approximate size (Observation / FGD / KII)</td>
<td>ha</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distance from the centreline (Observation / FGD / KII)</td>
<td>m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural / artificial</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Significance (according to local community) (FGD / KII)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current use (FGD / KII)</td>
<td>Pisciculture (organised / unorganised) / bathing / washing / irrigation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type of fish (FGD / KII)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quantity (Approx) (FGD / KII)</td>
<td>Abundant / scarce</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aquatic birds, if any (Observation / FGD / KII)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Migratory / resident birds (Observation / FGD / KII)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fish catching at the cross-drainage structures (Observation / FGD / KII)</td>
<td>Location / size</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Road causing isolation of the fish habitat / wetland (FGD / KII)</td>
<td>Area in acre</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Community’s suggestions for improvement, if any, (FGD / KII)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Height of embankment near the pond (Measurement)</td>
<td>m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Landuse on the opposite side</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length X Width X depth (Total capacity reduction of each pond with location)</td>
<td>m x m x m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communities / owner’s preference to prevention / Mitigation compensation strategy / mechanisms (FGD / KII)</td>
<td>Prevention by widening opposite side and / or reducing embankment slope / mitigate by enlarging / increasing depth / compensate in Cash / in kind</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environmental Analysis / Sample Case Study Investigation</td>
<td>Rural Transport Improvement Project</td>
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<tr>
<td><strong>Communities concern regarding depletion of wetland / resource (FGD / KII)</strong></td>
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<tr>
<td><strong>Forest</strong></td>
<td><strong>km</strong></td>
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<tr>
<td>Length of road passing through forest area (Observation and FGD / KII)</td>
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<tr>
<td>Distance from road centreline (Observation / FGD / KII)</td>
<td><strong>m</strong></td>
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<tr>
<td>(To be mapped on suitable scale)</td>
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<tr>
<td>Forest type (reserved / protected / social forestry / degraded (FGD / KII)</td>
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<tr>
<td>Type and approximate number of prominent wildlife (FGD / KII)</td>
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<tr>
<td>Endangered species, if any (FGD / KII)</td>
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<tr>
<td>Any migratory route through the road (FGD / KII)</td>
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<tr>
<td>Specific period of migration (FGD / KII)</td>
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<tr>
<td><strong>Erosion and Silitation</strong></td>
<td><strong>Soil type of embankment (observation)</strong></td>
<td></td>
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</tr>
<tr>
<td>Extent of erosion of embankment (show / mark locations of major erosions on the plans) (Observation / FGD / KII)</td>
<td><strong>Sand / silt / clay / sandy / sil/ silty clay</strong></td>
<td></td>
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<tr>
<td>Rain-cutting - Extent, location, reason, remedy (Observation / FGD / KII)</td>
<td></td>
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<tr>
<td>Include location map for each such site and discuss with community for possible remedial options for boat anchoring facilities</td>
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<tr>
<td>(To be mapped on suitable scale)</td>
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<tr>
<td>Landuse around eroded site (Observation / FGD / KII)</td>
<td></td>
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<tr>
<td>Potential change in erosion and siltation pattern after road construction (to be assessed in consultation with local key informants / Expert opinion)</td>
<td></td>
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<tr>
<td>Suggested options for treatment (FGD / KII)</td>
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<tr>
<td>Navigation / Boat communication (show specific location on the map / plan)</td>
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<tr>
<td>Available free board during normal monsoon, consult local people (FGD / KII)</td>
<td><strong>m</strong></td>
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<tr>
<td>Environmental Analysis / Sample Case Study Investigation</td>
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<td>--------------------------------------------------------</td>
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<tr>
<td>Road length / road structure km</td>
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<tr>
<td>Problem of boat navigation through waterway / bridge (FGD / KII)</td>
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<tr>
<td>Options for mitigation (FGD / KII)</td>
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<tr>
<td>(To be mapped on suitable scale)</td>
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<tr>
<td>Road side shops / GC / traffic parking causing road safety and/or road use effectiveness - Discuss with local people (Observation / FGD / KII)</td>
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<tr>
<td>Any other relevant information (Observation / FGD / KII)</td>
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</tbody>
</table>

Investigated by: ____________________  Signature: ____________________  Date: ____________________

(Name and designation of the Lead Investigator)
### DESCRIPTIVE CHECKLIST FOR BRIDGES / SRRs

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Description</th>
<th>Data / Information / Site Analysis (use separate sheets, if required)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>LOCATION MAP (Prepare a sketch showing location of the bridge / SRR, present landuse and physical features in and around the site, width of river / canal/ drainage channel, location of trees, buildings etc.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Project Justification. (Necessity of the SRR construction at the proposed location in the opinion of local people) Note Document / record the consultation process</td>
<td></td>
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</tr>
<tr>
<td>3</td>
<td>Analysis of Present Landuse (Include information on type, and extent of each type of land uses in and around the site)</td>
<td></td>
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<tr>
<td>4</td>
<td>Soil / Geology / Hydrological Information</td>
<td></td>
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</tr>
<tr>
<td>4.1</td>
<td>Soil type at the site (clay / silt / silty clay / silty sand / sand / red clay)</td>
<td></td>
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</tr>
<tr>
<td>4.2</td>
<td>Soil characteristics at the site (based on visual observation or local key informants including Water Board officials) - Include information on erodability (potential to get eroded under normal / high floods) characteristics of the soil)</td>
<td></td>
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</tr>
<tr>
<td>5</td>
<td>Hydrological Information</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.1</td>
<td>Navigability of the river / canal (Based on local key informants interview provide an analysis of problems, if any )</td>
<td></td>
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</tr>
<tr>
<td>5.2</td>
<td>Period of use (Local key informants interview)</td>
<td></td>
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</tr>
<tr>
<td>5.3</td>
<td>River/canal characteristics (meandering, braided, bank shifting tendency etc) (if based on visual observation, historical information from local key informants and documented information from local Water Board Office is a must)</td>
<td></td>
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</tr>
<tr>
<td>5.4</td>
<td>Erosion and Siltation Characteristics of the river, in general ( based on visual observation, historical information from local key informants and documented information from local Water Board Office is a must)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.5</td>
<td>Erosion and Siltation problem at the site during high floods ( Visual observation and historical information from local key informants including Water Board Officials) (Location and extent to be delineated on a map / sketch)</td>
<td></td>
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<tr>
<td>No.</td>
<td>Task Description</td>
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<tr>
<td>65</td>
<td>Erosion and siltation pattern and extent in recent floods (provide information for both 1998 and 2002 floods separately based on information from local key informants and documented information, if available, from local Water Board Office otherwise minute the meeting with a copy to the concerned officials) (Show location and severity on a map/sketch)</td>
<td></td>
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<tr>
<td>66</td>
<td>Stability of the river bank at the site (Visual observation, historical information from local key informants and documented information from local Water Board Office is a must)</td>
<td></td>
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</tr>
<tr>
<td>67</td>
<td>Scouring near the site (Collect evidence of local scouring including maximum depth of scouring during peak floods - based on Visual observation, historical information from local key informants and documented information from local Water Board Office is a must)</td>
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</tr>
<tr>
<td>68</td>
<td>Record of erosion/siltation of last three years at the site/vicinity (Collect evidence of local erosion/sedimentation - based on Visual observation, historical information from local key informants and documented information from local Water Board Office is a must)</td>
<td></td>
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<tr>
<td>69</td>
<td>River characteristics (meandering, braided, bank shifting tendency etc) (based on visual observation, historical information from local key informants and information from local Water Board Office)</td>
<td></td>
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</tr>
<tr>
<td>7</td>
<td>Requirement of bank protection work - both u/s and d/s of the bridge (Provide an assessment based on discussion with local LGED Engineers - record the minutes of the meeting with the officials)</td>
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<tr>
<td>8</td>
<td>Road breaching evidence at the or close to structure</td>
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<tr>
<td>9</td>
<td>Fisheries (collect information on any fishing activity at the bridge site)</td>
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<tr>
<td>10</td>
<td>Nuisance Plant / Eutrophication (Collect information on existing status)</td>
<td></td>
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<tr>
<td>11</td>
<td>Any other environmental/social issues at the site</td>
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<td></td>
</tr>
</tbody>
</table>

Investigated by: [Name and designation of the Lead Investigator]
# DESCRIPTIVE CHECKLIST FOR GCM DEVELOPMENT

<table>
<thead>
<tr>
<th>SI No</th>
<th>Description</th>
<th>Data / Information / Site Analysis (use separate sheets, if required)</th>
<th>Remarks</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>LOCATION MAP (Prepare a sketch showing linkages of the GCM with the nearest Ghat / Upazila HQ / connecting leeder / rural road, present landuse and physical features in and around the site, location of current water supply and environmental sanitation facilities, storm water drains, sullage drains, low lying and higher areas, etc.)</td>
<td></td>
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<tr>
<td>2</td>
<td>PHYSICAL PLANNING MAP (prepare a preliminary sketch showing potential locations for proposed slaughter house, cattle market, fish market, meat market, vegetable market, tubewells, toilets, septic tanks, soak pits, sullage and storm water drains, biogas units etc through a village meeting, where presence of Market Management Committee, Union Parishad, women, poor, market users and other primary stakeholders is to be ensured)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Project Justification (Necessity of the GCM development in the opinion of local people) Note Document / record the consultation process</td>
<td></td>
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</tr>
<tr>
<td>4</td>
<td>Analysis of Present Landuse (Include information on type, and extent of each type of land uses in and around the site)</td>
<td></td>
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<tr>
<td>5</td>
<td>Assessment of Present capacity and future projection of market capacity in terms of people visited and goods traded (both for selling and buying activities, cattle trading)</td>
<td></td>
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<tr>
<td>6</td>
<td>Estimated land requirement (Length and width in m, based on key informant interview)</td>
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<tr>
<td>7</td>
<td>Land availability at the proposed GCM site and their present land uses and ownership (Length and width in m, based on measurements and Union Parishad / key informants interview)</td>
<td></td>
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<tr>
<td>8</td>
<td>Availability of private land for expansion of market services / facilities etc in future (through FGO)</td>
<td></td>
<td></td>
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<tr>
<td>9</td>
<td>Soil / Geology / Hydrological Information</td>
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<td>Soil type at the site (clay / silt / silty clay / silty sand / sans / red clay)</td>
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<tr>
<td>11</td>
<td>Soil characteristics at the proposed GCM (based on visual observation or local key informants including Water Board officials) - - - Include information on erodability (potential to get eroded under normal / high floods) characteristics of the soil</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.3</td>
<td>Presence of nearby river / canal / waterbody (Collect information on their location with respect to the site, their uses, general assessment of water quality, Whether there is any interaction between market use / wastes disposal and the water body (Based on direct observation and local key informants interview provide an analysis of problems, if any)</td>
<td></td>
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<tr>
<td>6.4</td>
<td>River characteristics (meandering, braided, bank shifting tendency etc) (Based on visual observation, historical information from local key informants and information from local Water Board Office)</td>
<td></td>
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<tr>
<td>6.5</td>
<td>Erosion (potential / actual risk) of the GCM site (Based on visual observation, historical information from local key informants and documented information from local Water Board Office is a must)</td>
<td></td>
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<tr>
<td>6.6</td>
<td>Stability of the river bank, if any, near the market site (Visual observation, historical information from local key informants and documented information from local Water Board Office is a must)</td>
<td></td>
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<tr>
<td>6.8</td>
<td>Requirement of site protection work (Provide an assessment based on discussion with local LGED Engineers - record the minutes of the meeting with the officials)</td>
<td></td>
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<tr>
<td>7.1</td>
<td>Existing Water Supply System (No and location of tubewell, depth of tubewell, depth of water table, drinking water quality (Arsenic / non-Arsenic / Iron / Iron-free, operation and maintenance condition) (Show location on the Site Map)</td>
<td></td>
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<tr>
<td>7.2</td>
<td>Existing Sanitation facilities / Practices (No of toilets / use / cleanliness / maintenance / operational difficulties etc) (Clearly show their location with respect to river / handpump etc on the site map)</td>
<td></td>
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<tr>
<td>7.4</td>
<td>Estimated number of people using the water supply and sanitation facilities during hat / non-hat day</td>
<td></td>
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<tr>
<td>7.5</td>
<td>Estimate of additional hand-pump / tube-well requirement</td>
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<tr>
<td>8</td>
<td>Water pollution</td>
<td></td>
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<tr>
<td>8.1</td>
<td>River / canal / Pond water (record any evidence and reasons for water pollution of nearby waterbody/stream (human waste disposal, solid waste disposal, slaughtering waste disposal into water body, collect information regarding current practices, quantity, frequency of waste disposal etc based on observation supported by key informants interview)</td>
<td></td>
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<tr>
<td>8.2</td>
<td>Tubewell / handpump water (evidence of any contamination due to local drainage congestion / improper sanitation)</td>
<td></td>
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<tr>
<td>9</td>
<td>Presence of any ecologically sensitive area in and around the GCM (forest / Large trees at site, archaeological, religious or cultural property etc)</td>
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<tr>
<td>No.</td>
<td>Task Description</td>
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<tr>
<td>10</td>
<td>Plantation (assess potential for cutting of trees for market development and options for protecting the same - provide information on species, No., girth size, age etc.)</td>
<td></td>
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<tr>
<td>11</td>
<td>Storm Water Drainage Congestion (collect information on existing drainage congestion its extent, duration, period, reasons, outfall point, availability of ground slope etc. Assess main reasons such as clogging of outfall drain, filling of the drain due to indiscriminate dumping of solid wastes, lack of cleaning and maintenance etc.)</td>
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<tr>
<td>12</td>
<td>Sullage drainage (information on existing sullage generation (source and quantity), collection, conveyance and disposal)</td>
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<tr>
<td>13</td>
<td>Solid Waste Management (information on type of wastes, approximate quantity on hat / non-hat day with their sources, existing facilities for solid waste collection, transportation and disposal facilities (both men and equipment), current practices, their effectiveness, main reasons behind the problems of solid waste mismanagement in the opinion of local people and hat users etc.) Also collect information on cattle dung quantity and management at the cattle market.</td>
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<tr>
<td>14</td>
<td>Slaughter House Waste (No of cattle slaughtering per day, current practice of waste disposal, health of cows, any evidence of diseases among people attributable to slaughter waste (consult local PHC / upazila hospital medical officer))</td>
<td></td>
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<tr>
<td>15</td>
<td>General cleanliness of the site</td>
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<tr>
<td>16</td>
<td>Current practice / institutional responsibility of site cleaning, toilet cleaning and maintenance etc.</td>
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<tr>
<td>17</td>
<td>Ground water (information on ground water table depth, seasonal variation, variation over last one decade, etc.)</td>
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<tr>
<td>18</td>
<td>Dust and noise pollution (No and type of settlement e.g. hospital / school which are sensitive to dust and noise pollution) (Show location on the Site Map)</td>
<td></td>
<td></td>
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<tr>
<td>19</td>
<td>Main Local Stakeholders Concerns (Local people's (especially poor, other vulnerable groups, women etc) main environmental, social and developmental concern - both before and after market development (based on FGD, individual and key informant interview))</td>
<td></td>
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<tr>
<td>20</td>
<td>Estimated number of people to be benefited by market development (information on various category of people including poor, women and other physically or socially disadvantaged people / groups, expected to be potential beneficiaries - collect info through FGD / Union Parishad Chairman)</td>
<td></td>
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</tbody>
</table>
### 21. Any other environmental / social issues at the site

<table>
<thead>
<tr>
<th>Investigated by</th>
<th>Signature</th>
<th>Date</th>
</tr>
</thead>
</table>

*Name and designation of the Lead Investigator*
# DESCRIPTIVE CHECKLIST FOR GHAT DEVELOPMENT

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<tbody>
<tr>
<td>1</td>
<td>LOCATION MAP (Prepare a sketch showing linkages of the ghat with the nearest GCM / Upazila HQ / connecting feeder / rural road, present landuse and physical features in and around the site, location of current boat landing areas, potential locations of ghat and their distance from the dry-weather water level etc) - Annex G1. (Select exact location of proposed Ghat through a FGD, where presence of local Water Board and Thana Nirbahi Official shall be ensured)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Project Justification: (Necessity of the ghat development in the opinion of local people) Note: Document / record the consultation process</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Analysis of Present Traffic (Include information on type, frequency, volume etc for both people, goods, boats (separately for mechanized and non-mechanized) both for both hat &amp; non-hat days)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Assessment of Future Traffic (information for both hat &amp; non hat days based on key informants including boatmen (at least 3 ) interview)</td>
<td></td>
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<tr>
<td>5</td>
<td>Estimated land requirement (Length and width in m, based on key informant interview)</td>
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<tr>
<td>5.1</td>
<td>Land availability at the proposed ghat site and their present land use and ownership ((Length and width in m, based on key informant interview)</td>
<td></td>
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<tr>
<td>5.2</td>
<td>Availability of land for night-stay shelter, shops Emergency Help Cabin, Security Personnel Cabin etc</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Hydrological Information</td>
<td></td>
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<tr>
<td>6.1</td>
<td>Navigability of the river / canal (Based on local key informants interview provide an analysis of problems, if any)</td>
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<td>Period of use (Local key informants interview)</td>
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<td>River/canal characteristics (meandering, braided, bank shifting tendency etc) (Based on visual observation, historical information from local key informants and documented information from local Water Board Office is a must)</td>
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<td>6.3</td>
<td><strong>Erosion and Siltation Characteristics of the river</strong> (based on visual observation, historical information from local key informants and documented information from local Water Board Office is a must)</td>
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<tr>
<td>6.4</td>
<td><strong>Erosion and Siltation problem at the proposed Ghat site during</strong> (visual observation and historical information from local key informants including Water Board Officials) (location and extent to be delineated on a map/sketch)</td>
<td></td>
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<tr>
<td>6.5</td>
<td><strong>Stability of the river bank at the ghat site</strong> (visual observation, historical information from local key informants and documented information from local Water Board Office is a must)</td>
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<td>6.6</td>
<td><strong>Scouring near the proposed ghat</strong> (collect evidence of local scouring including maximum depth of scouring during peak floods - based on visual observation, historical information from local key informants and documented information from local Water Board Office is a must)</td>
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<td>6.7</td>
<td><strong>Record of erosion/siltation of last three years at the ghat site/vicinity</strong> (collect evidence of local erosion/sedimentation - based on visual observation, historical information from local key informants and documented information from local Water Board Office is a must)</td>
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<td>6.8</td>
<td><strong>Soil characteristics at the proposed ghat</strong> (based on visual observation or local key informants including Water Board officials) - include information on erodability (potential to get eroded under normal/high floods) characteristics of the soil)</td>
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<td>6.8</td>
<td><strong>Requirement of bank protection work</strong> (provide an assessment based on discussion with local Water Board Engineers - record the minutes of the meeting with the Water Board officials)</td>
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</tr>
<tr>
<td>7.1</td>
<td><strong>Facilities/Utilities available at the Ghat</strong></td>
<td></td>
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</tr>
<tr>
<td>7.1</td>
<td><strong>Give details of landing/anchoring etc as already available at the ghat</strong></td>
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</tr>
</tbody>
</table>
### Rural Transport Improvement Project

<table>
<thead>
<tr>
<th>7.2</th>
<th>Existing Water Supply System (No and location of tubewell, depth of tubewell, depth of water table, drinking water quality (Arsenic / non-arsenic / iron / iron-free) (Show location on the Site Map)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.3</td>
<td>Existing Sanitation facilities / Practices (No of toilets / use / maintenance / operational difficulties etc) (Clearly show their location with respect to river / handpump etc on the site map)</td>
</tr>
<tr>
<td>7.4</td>
<td>Estimated number of people using the ghat during hat / non-hat day</td>
</tr>
<tr>
<td>7.5</td>
<td>Estimate of additional hand-pump / tube-well requirement</td>
</tr>
</tbody>
</table>

### Water pollution

| 8.1 | River / canal water (record any evidence and reasons for water pollution near ghat (visual inspection of oil / fuel spillage / human waste disposal into water, historical information from local boatmen regarding accidental spillage and frequency of such incidents, Nos per year) |
| 8.2 | Tubewell / handpump water (evidence of any contamination due to local drainage congestion / improper sanitation) |

### Presence of any ecologically sensitive area in and around the ghat (forest / Large trees at site, archaeological, religious or cultural property etc)

### Any other environmental / social issues at the site

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Investigated by: 
Signature: 
Date: 

(Designation of the Lead Investigator)
### Appendix 3: Environmental Acts and Rules

<table>
<thead>
<tr>
<th>Act / Rule / Ordinance</th>
<th>Responsible Authority / Ministry</th>
<th>Relevant Subjects / Instruments</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Environment Conservation Act, 1995</td>
<td>Ministry of Environment and Forest</td>
<td>Declaration of Ecologically Critical Area</td>
</tr>
<tr>
<td></td>
<td>Department of Environment</td>
<td>Regulation with respect to vehicles emitting smoke harmful for the environment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Regulation of development activities from environmental perspective</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Promulgation of standards for quality of air, water, noise, and soils for different areas and for different purposes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Promulgation of acceptable limits for discharging and emitting waste</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Environmental Clearance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Preparation of Environmental guidelines</td>
</tr>
<tr>
<td>Environment Conservation Rules, 1997</td>
<td></td>
<td>Declaration of Ecologically Critical Area (yet to be declared by the DoE)</td>
</tr>
<tr>
<td>Environment Court Act, 2000</td>
<td>Judiciary</td>
<td>Government has given highest priority to environment pollution and passed 'Environment Court Act, 2000' for completing environment related legal proceedings effectively</td>
</tr>
<tr>
<td></td>
<td>Ministry of Environment &amp; Forest</td>
<td>Requirement for Environmental Clearance of the project</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Requirement for IEE / EIA according to the appropriate category of the project</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Renewal of the clearance certificate within 30 days after the expiry of 3 years clearance period</td>
</tr>
<tr>
<td>The Vehicles Act, 1927</td>
<td>Bangladesh Road Transport Authority</td>
<td>Exhaust emission,</td>
</tr>
<tr>
<td>The Motor vehicles Ordinance, 1983</td>
<td></td>
<td>Vehicular air and noise,</td>
</tr>
<tr>
<td>The Bengal Motor Vehicle</td>
<td></td>
<td>Road safety</td>
</tr>
</tbody>
</table>
### Environmental Codes of Practice

**Appendix 3 - Environmental Acts and Rules**

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<th>Act/Ordinance</th>
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<tr>
<td>Rules, 1940</td>
<td></td>
<td></td>
<td>Licensing</td>
</tr>
<tr>
<td>The Brick Burning (Control) Act, 1989</td>
<td>Ministry of Environment &amp; Forest</td>
<td></td>
<td>Control of brick burning</td>
</tr>
<tr>
<td>The Brick Burning (Control) Amendment Act, 1992</td>
<td>Ministry of Environment &amp; Forest</td>
<td></td>
<td>Require a license from the appropriate authority</td>
</tr>
<tr>
<td>The Removal of Wrecks and Obstructions in Inland Navigable Waterways Rules, 1973</td>
<td>Bangladesh Water Transport Authority</td>
<td></td>
<td>Restricts brick-burning with fuel wood</td>
</tr>
<tr>
<td>Water Supply and Sanitation Act, 1996</td>
<td>Ministry of Local Government, Rural Development and Co-operatives</td>
<td></td>
<td>Management and Control of water supply and sanitation in rural areas</td>
</tr>
<tr>
<td>The Forest Act, 1927</td>
<td>Ministry of Environment &amp; Forest</td>
<td></td>
<td>Reserve Forests, Protected Forests, Village forests</td>
</tr>
<tr>
<td>The Private Forests Ordinance Act, 1959</td>
<td>Regional Forest Officer, Forest Department</td>
<td></td>
<td>Conservation of private forests and for the afforestation on wastelands</td>
</tr>
<tr>
<td>Bangladesh Wild Life (Preservation) Order, 1973</td>
<td>Ministry of Environment and Forest Bangladesh Wild Life Advisory Board</td>
<td></td>
<td>Wild life Sanctuaries, parks, reserves</td>
</tr>
<tr>
<td>The Local Government Ordinance, 1983</td>
<td>Union Parishad</td>
<td></td>
<td>General administration, civic functions and environmental sanitation in rural areas</td>
</tr>
<tr>
<td>The Protection and Conservation of Fish Act, 1950</td>
<td>Ministry of Fishery</td>
<td></td>
<td>Protection and conservation of fish in Government owned water bodies</td>
</tr>
<tr>
<td>The Private Fisheries protection Act, 1950</td>
<td>Ministry of Fishery</td>
<td></td>
<td>Protection for the right of fishing in private waters including ponds</td>
</tr>
<tr>
<td>The Land Acquisition Act, 1894</td>
<td>Revenue Department</td>
<td></td>
<td>Land acquisition</td>
</tr>
</tbody>
</table>
REFERENCES


5. Government of Fiji, Public works Department, Codes of Environmental Practice for Roads.