18. Environmentally sound construction and facility management practices

HOW TO USE THIS CHAPTER IN THE CONTEXT OF EA AND ROAD PLANNING

<table>
<thead>
<tr>
<th>Stage in road planning</th>
<th>EA activity</th>
<th>Involvement in addition to EA team</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A)</td>
<td>(B)</td>
<td>(C)</td>
</tr>
<tr>
<td>Concept</td>
<td>Screening</td>
<td>PropONENT:</td>
</tr>
<tr>
<td>Pre-feasibility</td>
<td>Scoping</td>
<td>Key regulatory agency</td>
</tr>
<tr>
<td>Feasibility</td>
<td>Consultation</td>
<td>Other government agencies</td>
</tr>
<tr>
<td>Engineering design</td>
<td>Determining baseline conditions</td>
<td>NGOs</td>
</tr>
<tr>
<td>Construction</td>
<td>Selection of preferred solution</td>
<td>Research groups</td>
</tr>
<tr>
<td>Operation &amp; maintenance</td>
<td>Assessment of alternative designs/methods</td>
<td>Public/community organizations</td>
</tr>
<tr>
<td></td>
<td>Development of environmental management plan</td>
<td>Advisory experts</td>
</tr>
<tr>
<td></td>
<td>Effects and compliance monitoring</td>
<td></td>
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<tr>
<td></td>
<td>Evaluation</td>
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<td>Reporting</td>
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Shaded area = (A) Stages of EA covered in this chapter; (B) focus of this chapter; and (C) primary target readers.

KEY QUESTIONS ADDRESSED:

- What are the major road construction activities that can lead to potentially serious impacts?
- What are some useful actions that can be planned to prevent construction impacts from occurring?
- How should environmental clauses in construction and facility management contracts be prepared?
- What are some key environmental risks associated with road projects, and how can they be avoided?
Direct impacts of road projects can often be significantly reduced and sometimes eliminated through the application of environmentally sound construction and operations management practices. For such actions to occur, two basic conditions need to be in place:

i) a knowledgeable construction and operations management team, which is sensitive to environmental issues; and

ii) an enabling environment where regulatory agencies and government planners look for and encourage sound resource use.

This chapter discusses environmentally sound construction practices, as they apply to new, rehabilitation and maintenance road projects. Readers should refer to the technical chapters (Chapters 7-17) for information on specific impact areas.

Knowing at which stages specific types of impacts are likely to occur, and the best time to apply corresponding measures to deal with them, is crucial to the effective limitation of negative impacts. Table 18.1 outlines the major impact areas and the relative efficiency of dealing with them at certain project phases.

### 18.1 NEW CONSTRUCTION PROJECTS

#### 18.1.1 Settings and impacts

The main project activities associated with road construction, their likely impacts on the environment and suggested mitigative measures are presented in this section of the chapter. It is clear from Table 18.1 that implementation of mitigative measures during the project construction phase will yield the greatest benefits.

**Construction camp establishment**

Construction camps include workers' living and eating areas, and the grounds where equipment is stored and serviced and where materials are stockpiled. Careless construction camp design and management can lead to serious environmental degradation including

- sewage and garbage pollution;
- depletion of fauna and flora through illegal harvesting (poaching);
- infrastructure overloading—health services, sewage treatment, schooling and law enforcement; and
- spills from construction equipment operation and servicing.

Traffic disruptions may also be created by carelessly planned detours and road closures. In some agricultural areas, closures can create additional problems during harvest seasons. The temporary settlements built for construction workers can have significant impacts (some positive) on local economic activities and resources. For major projects, work-site accommodations are often like makeshift towns,

<table>
<thead>
<tr>
<th>TABLE 18.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>BENEFITS GAINED FROM IMPLEMENTING MITIGATIVE MEASURES AT THREE KEY PROJECT DEVELOPMENT STAGES</td>
</tr>
<tr>
<td><strong>Component of the environment</strong></td>
</tr>
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<tr>
<td>Soil and erosion</td>
</tr>
<tr>
<td>Water</td>
</tr>
<tr>
<td>Air quality</td>
</tr>
<tr>
<td>Natural environment</td>
</tr>
<tr>
<td>Community life and economic activities</td>
</tr>
<tr>
<td>Land acquisition and resettlement</td>
</tr>
<tr>
<td>Indigenous or traditional peoples</td>
</tr>
<tr>
<td>Cultural heritage</td>
</tr>
<tr>
<td>Aesthetics and landscapes</td>
</tr>
<tr>
<td>Noise</td>
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<tr>
<td>Road safety</td>
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<tr>
<td>Environmental health</td>
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</table>

Note: +++ Excellent gains for resources expended. ++ Good cost efficiency. + Limited cost efficiency.
Environmentally sound construction and facility management practices are usually autonomous and difficult to integrate into the surrounding social environment.

**Equipment servicing and fueling**

On large road projects, thousands of liters of diesel fuel and many other petroleum products are transported and used throughout the work site each day. Experience shows that, without a fueling and servicing protocol as part of the project’s Environmental Management Plan (see Section 4.8), chronic oil product pollution often takes place, leading to the contamination of surface and ground water. This is of particular concern where road projects involve crossing rivers and streams, since the construction activity sometimes takes place in and over the water body. If such waters are used for fishing or aquaculture, fish tainting can become a serious problem. Designated fueling areas and servicing centers significantly reduce this potential impact. Construction equipment generates large amounts of waste oil, and its proper handling is critical, since haphazard storage and leakage can result in the contamination of groundwater aquifers.

**Site preparation and clearing**

Site preparation may involve demolition of buildings, clearing of brushwood, tree removal, temporary rerouting of utilities, topsoil stripping, and diversion or rechanneling of waterways. This brings risks of erosion of exposed ground or stored topsoil, and increased water runoff and siltation of watercourses. The use of herbicides to eliminate vegetation on the right-of-way is a potential source of contamination. The use of heavy equipment on steep slopes to clear construction corridors can result in serious compaction and erosion problems.

**Earthworks**

The removal and placement of earth can bring further risks of soil erosion. Alignments through the upper parts of watersheds often encroach on groundwater aquifers, sometimes seriously affecting local groundwater recharge, well-water supply, and quality. Excavation that cuts into an aquifer, for example, can cause the water table to drop, disturbing the supply of water to nearby wells and modifying water availability to vegetation. In steep terrain, material taken from cuts is often simply pushed over the edge of the road bed, sometimes traveling hundreds of meters downslope, and in so doing permanently destroys trees and stream channels in the valleys below. Road projects around the world are replete with examples of how not to undertake earthwork activity. Construction machinery moving around the right-of-way can create soil compaction, which may harm the soil’s future potential as farmland, impair drainage, and increase the risk of flooding. Slope protection and roadside planting measures are illustrated in Figures 18.1 and 18.2, and are discussed further in Section 18.1.2 and in Chapter 7.

**Quarries and borrow sites**

These facilities, which are the sources for roadbuilding materials, can have substantial environmental impacts on soils, water, and the natural environment. Significant environmental problems can develop if these sites are not rehabilitated. Impacts range from chronic erosion and siltation to air quality and noise impacts during their use, as well as permanent visual and aesthetic intrusion if rehabilitation is neglected.

[FIGURE 18.1]

**RELATIONSHIP OF GOOD ENVIRONMENTAL PLANNING AND MAINTENANCE PHASE**

(A) Erosion occurs due to incorrect shaping of the subgrade and the failure to plan for runoff, plus insufficient upkeep.

(B) Correct shaping of the subgrade, careful compacting, plant coverage, and the installation of channeling help prevent erosion. Taking the environment into consideration avoids subsequent pavement maintenance costs.
**18.1.2 Remedial measures**

Impact avoidance, mitigation, and compensation options are discussed for three stages of the construction process: a) preparing the construction site; b) managing the construction activity; and c) restoring the site after completion of the road work.

### Preparing the construction site

Many potential impacts may be avoided by taking preventive measures when setting up a work site. Careful siting of borrow pits, stockpiling areas, work depots, and work camps can avoid sensitive areas, reduce air and noise pollution, minimize visual intrusion, and help to prevent local traffic congestion. Confining the handling and use of hazardous materials at the construction site can go a long way in reducing the risks of accidental spills.

### Management of construction activity and workforce

Construction activities that can contribute to serious environmental degradation include accidental spills, compaction of the area, poor waste treatment or management, and inadequate local services (such as law enforcement) to support the influx of construction workers. Well thought-out environmental construction guidelines (usually contained in an EMP) can effectively prevent these impacts.

Measures to prevent erosion are of major importance during the work phase, and can include:

- planting on cleared areas and slopes immediately after equipment belonging to a specific site has been moved, and reusing stripped topsoil;
- temporarily covering the soil with mulch or fast-growing vegetation;
- intercepting and slowing water runoff; and
- protecting slopes by using reshaping techniques, rock fill, and other methods.
Dust problems can be avoided by watering the site, following a predetermined schedule and as required. Construction noise problems can be minimized by using well-maintained and “silenced” equipment, operating within existing noise control regulations and limiting work hours near residential areas. Traffic control for both construction vehicles and diverted traffic should minimize impacts across the entire affected area.

Pollution from chemical products can be limited by following recommended procedures for containing and confining their use (e.g. bitumen production) and by not using them during extreme meteorological events such as high winds or rainstorms (monsoon weather).

**Construction site rehabilitation**

Site rehabilitation requires a well-designed planting program utilizing native vegetation where possible, with follow-up maintenance over several years and repairs as required. Quarries and large borrow sites can be landscaped and developed for a variety of natural, economic, or recreational uses. Work site facilities, such as wells, water storage, sewer systems, and buildings, are sometimes converted for local use upon completion of a project.

### TABLE 18.2
CONSTRUCTION: MITIGATIVE MEASURES

<table>
<thead>
<tr>
<th>Theme</th>
<th>Observation</th>
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<tbody>
<tr>
<td>Soils</td>
<td>• choose the best work period to limit risks of erosion—avoid rainy season&lt;br&gt;• create a specific stockpile for topsoil to be reused&lt;br&gt;• plan dialogue with local authorities for use of excess soil</td>
</tr>
<tr>
<td>Water</td>
<td>• do not locate site installations or production plants in sensitive places (e.g. near drinking water intakes)&lt;br&gt;• provide a used motor oil recovery system&lt;br&gt;• avoid water accumulation points, casual water from empty containers, old tires, etc., which act as mosquito breeding areas, i.e. provide good temporary drainage of site&lt;br&gt;• provide sufficient settling for pollution from particles</td>
</tr>
<tr>
<td>Air, noise</td>
<td>• during work execution, noise impacts can be limited by using quiet equipment, installing temporary barriers or screens, and by working during regular business hours&lt;br&gt;• limit dust with a sprinkler system&lt;br&gt;• be careful when setting off explosives that can cause vibration damage</td>
</tr>
<tr>
<td>Flora and fauna</td>
<td>• limit clearing to surfaces absolutely necessary for the road project&lt;br&gt;• control poaching and firewood collection by workers</td>
</tr>
<tr>
<td>Population, economic activities</td>
<td>• maintain access during work execution&lt;br&gt;• enclose the work site with fencing for safety (especially to keep children away from heavy machinery)&lt;br&gt;• plan specific itineraries for site machinery traffic&lt;br&gt;• define traffic rules encouraging contractors to respect highway regulations</td>
</tr>
<tr>
<td>Risks</td>
<td>• plan emergency procedures in case of accidents, or spills of pollutants&lt;br&gt;• define safety rules for work site personnel—dangerous materials handling, fires, etc.</td>
</tr>
</tbody>
</table>

1 In the past, waste oil was used as a cheap dust suppression material until road managers realized that runoff contaminated with waste oil affects the quality of local potable surface and groundwater water supplies, and reduces the health of local livestock. Rehabilitation costs are extremely high and often unsatisfactory. Waste oils should not be used for dust suppression.

Environmental features of road projects vary considerably, so common sense and ingenuity must be employed when examining each one. Environmental protection measures should be included in the specifications to the contractors, and may require special briefing or on-site training.
BOX 18.1
EXAMPLES OF SIMPLE ENVIRONMENTAL CLAUSES IN CONTRACT SPECIFICATIONS

Installation of work site
The contractor shall submit the work site for inspection and shall define the facilities to be created.

The contractor shall limit disturbances to the environment for the site selected and for residents in the immediate vicinity, both in surface (clearing of brush or trees, water flow, waste storage) and in depth (rupture or pollution of ground water).

The contractor shall execute, upon work completion, all work necessary to restore the site. The inspector shall write up a report outlining the site reclamation prior to official delivery.

Preparation and supply of quarry material
During the work phase, the contractor shall

- preserve trees during materials stockpiling;
- level stripped materials to facilitate water percolation and make natural grass planting possible;
- restore the natural flow to its previous state; and
- create runoff recovery ditches and conserve access ramps, if the quarry is declared fit for use as a watering point for livestock or residents.

The contractor shall, upon work completion and at own expense, restore the environment around the site. A report will be submitted by the inspector certifying that such site restoration work has been completed.

Tree planting
The contractor shall plant trees at locations defined by the inspector, provide the recommended protection (clay brick wall, fencing, etc.), supply the required water and if necessary replace dead trees. The contractor shall provide complete maintenance for a period of one year after planting, including: watering, cleaning out the bed at the foot of the tree, etc.

The number of trees planted, along with the execution of protection and the digging of beds at the foot of the trees, will be noted down by the inspector on the site records.

This record will be used at the official delivery to evaluate the services actually rendered. Once road maintenance work has been completed, the contractor shall indicate on the itinerary map the planting carried out (position, number).

Table 18.2 organizes mitigative measures by theme, and Box 18.1 provides some simple examples of contract clauses. These are dealt with in greater detail later in this chapter.

18.2 MAINTENANCE AND REHABILITATION (M & R) PROJECTS

In many countries, an increasing share of land transportation budgets is being allocated to rehabilitation and maintenance of existing roads, rather than going toward new road construction. This section summarizes some of the environmental issues which may accompany these projects and broadly, how they can be mitigated.

18.2.1 Defining maintenance and rehabilitation

Routine maintenance refers to activities such as grading, grass cutting, drain clearing, pot-hole patching, and shoulder repairs, which are performed at least weekly, if not more frequently. Periodic maintenance activities are typically scheduled over periods of several years and include resurfacing and bridge repairs. Other maintenance activities considered to be periodic include seasonal maintenance, such as snow clearing and flood repairs, emergency maintenance to reinstate roads after major failures, and the regular upkeep of safety features and road signs. Rehabilitation involves more substantial intervention to strengthen a road, repair structural defects, and restore the road to its initial condition, often after it has deteriorated to an unmaintainable state. Rehabilitation sometimes also includes changes or improvements to previous characteristics; for instance, by widening, making small alignment changes, or providing footpaths.
18.2.2 Setting and impacts

As with other road construction activities, road maintenance and rehabilitation works can contribute to soil erosion, disturbance of water flows, chemical pollution, traffic disruption, noise, and other impacts on surrounding communities and natural life (Table 18.3). These are discussed in the previous section dealing with construction and off-site activities, and in earlier sections on specific impact types. Four issues especially relevant to this section are:

i) chemical pollution caused by herbicides used for weed control, the application of salt used in winter maintenance, and chemicals used in pavement stripping and resurfacing;

ii) waste materials from drain clearing, pavement reconstruction, and other activities disfiguring the landscape and finding their way into waterways;

iii) safety of road workers and other road users, sometimes put at risk by inadequate traffic management and work zone controls; and

iv) displacement of existing dwellings and businesses resulting from shoulder improvements and widenings.

Erosion, flooding, road accidents, traffic noise, and deteriorating landscape quality are examples of environmental impacts which may be commonly avoided by timely maintenance actions. An example of good management of runoff water is illustrated in Figure 18.1.

Grass and other roadside vegetation provide erosion protection by slowing flow and trapping suspended matter. Too much vegetation can be a safety and fire hazard.

In some intensively farmed agricultural areas, roadside environments provide important habitats for local wild plant and animal species. These can be preserved and enriched through appropriate maintenance actions. Maintenance work can also generate positive impacts by eliminating or reducing environmental problems caused by the deterioration of road surfaces, drains, and shoulders.

| TABLE 18.3 | EFFECTS OF MAINTENANCE ACTIVITIES ON THE BIOPHYSICAL AND SOCIOECONOMIC ENVIRONMENT |
|-------------|---------------------------------|-------------------------------|
|             | Soil   | Water | Biota   | Local population |
| Paved roads |        |       |         |                  |
| Surface dressing (wearing course) | moderate | none  | moderate | none            |
| General reshaping of shoulders | moderate | moderate | moderate | moderate        |
| Complete resurfacing of shoulder | moderate | moderate | moderate | moderate        |
| Unpaved roads |        |       |         |                  |
| General resurfacing of wearing course | moderate | moderate | significant | moderate        |
| Reshaping of sub-grade and reconstruction of wearing course | significant | moderate | significant | significant     |
| Maintenance actions common to all roads |        |       |         |                  |
| Repair of drainage structures | none   | moderate | moderate | none            |
| Construction of drainage structures | moderate | moderate | moderate | none            |
| Construction of concrete lined ditches | moderate | moderate | moderate | none            |
18.2.3 Mitigation
Perhaps the most important mitigative measure related to maintenance and rehabilitation projects is to ensure that maintenance measures, included in the road design, operate effectively.

Protection of the biophysical environment can be assisted by regular drain clearing, upkeep of vegetation on slopes and exposed surfaces, maintenance of flow speed reduction devices in drains, removal of waste materials arising from road works, and avoiding the use of herbicides and other toxic or polluting substances.

Impacts on the community and social environment can be mitigated through well-designed traffic management plans, the use of quiet equipment, operating during daily periods of high ambient noise (see Chapter 16), and focusing attention on improvements in the quality of signs, guardrails, footpaths, and other features which contribute to safety and local accessibility.

Environmental "hot-spots" or problem locations, such as easily-eroded sites or notoriously unstable slopes, can be identified during the VEC identification step and during the execution of rehabilitation and maintenance works.

Experts in roadside vegetation, traffic management, and transportation safety should monitor maintenance activities to ensure that work practices meet environmental objectives. Understanding the functions and techniques of roadside planting, signs, and guardrails is important for their proper functioning. Training road crews in these issues can help them considerably in correctly executing and managing maintenance works.

18.3 THE IMPLEMENTATION OF ENVIRONMENTAL REQUIREMENTS
Environmental requirements left as statements in an EA will rarely be implemented, unless local regulations specifically identify EAs as legally binding documents. Implementation of environmental requirements can be ensured by either attaching the EA report as a legal condition to all contract documents or by preparing a set of environmental clauses to be placed directly into the contract documentation.

Each environmental clause should contain at least four pieces of information specifying:

i) what needs to be done;
ii) where it needs to be done;
iii) when and how the action will take place;
and
iv) who is responsible.

These data can be presented in the form of a matrix table (see EMP in Appendix 2) or in a more narrative style (Boxes 18.2-18.4). Ideally, well-prepared clauses combine the two forms, providing a written description with details presented in a table.

The overriding characteristic of an environmental clause should be that it is prescriptive, precisely defining what needs to be done and what the deadline is, leaving little room for misinterpretation. Ideally, environmental management plans (EMPs) should contain all the basic materials from which environmental clauses can easily be created. In fact, EMPs can be attached to contracts as binding implementable tasks.

Finally, the usefulness of environmental clauses in contracts will only be as good as the technical capacity and environmental sensitivity of the people assigned to implement the actions. Therefore, the investigation of contractors' and operators' past environmental record and experience should be another essential step in environmentally-sound project management.

18.4 ENVIRONMENTAL RISK
18.4.1 The failure of mitigative measures
The failure of environmental mitigation can result in serious impacts such as erosion, lowered water tables, permanent loss of wildlife, community severance, increased road accidents, and disruption of indigenous lifestyles.

Construction of a road also involves occupational health and safety risks to road workers, primarily in the areas of the storage and handling of dangerous materials, and in the operation of heavy machinery close to traffic, slopes, power lines, and watercourses. Some specific examples are:

- exposure to dust particles or toxic fumes from chemicals used in road works and materials testing;
- exposure to lead paint in maintenance of old steel structures;
ENVIRONMENTALLY SOUND CONSTRUCTION AND FACILITY MANAGEMENT PRACTICES

- potential for collapse of trenches and scaffolding; and
- risk of accidents involving passing traffic.

Daily operation of road construction requires the transportation of hazardous materials which, if an accident occurs, can spill, resulting in polluted ground water, streams and drinking water, as well as contaminated soil.

Roads can also be the vector for involuntary transport of diseases or parasites by vehicles, plants, animals and people (see Chapter 17), which can seriously affect the regional ecosystem.

Natural disasters can damage a road and its environment, or, conversely, a road can be a factor in mitigating the impacts of a disaster. Examples include:

- fire spreading along a road reserve, yet unable to cross a wide road;
- floods washing away a road, yet being somewhat contained by the road embankments;
- road embankments stabilizing a slope sub-

**BOX 18.2**
**EXAMPLE CONTRACT CLAUSES FOR USE IN ROAD MAINTENANCE STUDIES**

Documents to be submitted by the consultant

The maintenance works study document shall include the route plans, with the physical, geometric and geotechnical data, and the structures and drainage systems; the following complementary information on the road environment shall be specified in it:

- **Road environment data:** Indication of land areas reserved for villages, classified sites, and wooded areas; existing tree plantations and areas suitable for such plantations; existing quarries and borrow pits (location, depth, surface area, water retention issues, site to be improved); positions of existing side and diverging ditches; areas suitable for construction of diverging ditches or laying-up basins.
- **Data on the state of the road and its deterioration:** Location of eroded areas along the road: slopes, ditches, and approaches to structures, location of drainage areas which have become silted up; general state of structures; erosion or siltation of watercourses.

Special clause: Preparation of the content of the priced bill of quantities

The consultant shall establish the preliminary estimates of quantities and prepare the special conditions by (a) separating the opening and closing of quarries and borrow pits from the haulage and application of the materials; and (b) including the cost of a diverging ditch and, if necessary, a laying-up basin. The text that the consultant must include in the works contract is shown in italics.

**Price no. x Preparation of materials at quarry or pit.** The preparation of gravel materials at the quarry or pit (stripping, bulking, and piling) and the restoration of the pit site to its original state upon completion of the works shall comprise the following operations, remunerated at the price no. x:

* *储 of the stripped material where it will not disrupt water drainage
* *restoration of the natural site around the pit by spreading out the heaps
* *

**Price no. xx Reshaping/compacting with the addition of materials.** The operations of loading at the pit, transportation (optional, because a transport price per tonne per kilometre can also be set) and application (reshaping, moistening, compacting) shall be remunerated at price no. xx, the quantities being measured after compacting. The consultant shall specify the volume of material, its position on the road, the final thickness and the source.

**Price no. xxx Construction of diverging ditches.** The price xxx shall remunerate the construction of diverging ditches designed to drain runoff from the roadway to a point where it will no longer be likely to cause erosion harmful to the road or to the environment. This price will be paid per lineal meter. The consultant shall define these diverging ditches by specifying their location along the road, technical characteristics, planned length, and minimum lengthwise slope. The consultant shall also propose diverging ditches that will enable flooding of old pits.

**Price no. xxxx Construction of laying-up basins.** The price xxxx shall remunerate the construction of diverging ditches designed to carry runoff from the roadway to an old pit. This price shall be paid per lineal meter. The consultant shall propose construction of the laying-up basins wherever the natural site is suitable, avoiding tree cutting. The consultant shall specify the dimensions, volume, and location of the basin with respect to the road and stipulations regarding protection of the environment.
BOX 18.3
EXAMPLE CONTRACT CLAUSES FOR USE IN ROAD MAINTENANCE SUPERVISION CONTRACTS

Article ... records to be kept by the consultant responsible for supervision

The consultant responsible for supervision shall keep the following records: site report; route report updated to record work done; and proposals with a view to future studies.

Site report. A monthly report on execution of the works shall be submitted by the consultant and shall summarize information regarding environmental improvements effected by the work performed during the month: steps taken by the contractor to preserve the environment and improvements observed upon closing down the site; trees planted (location, number, method of protection, maintenance, monitoring); data on quarries and borrow pits used (location, area, depth, improvements made); length of diverging ditches (partial and cumulative for all new and old ditches); position and volume of laying-up basins constructed; position of strengthening works carried out on approaches to structures.

Updating of route plans. The supervisor shall update the route plans, on which shall be shown all environmental data reported in the monthly reports, specifically: location of tree plantations; locations of quarries and pits used, with updated characteristics of each; location of diverging ditches; state of structures after sand removal upstream and downstream; location, type, and number of anti-erosion devices in the drainage system.

Proposals with a view to future maintenance studies. Once the work is completed, the supervisor shall propose, for the road sections covered, specific arrangements with a view to studying the subsequent maintenance program. These proposals shall cover: improvement of the contract environmental clauses; special features of the road environment; urgent tasks to be undertaken to improve the environment; and any comments of supplementary data regarding the state of quarries, pits, and drainage.

Special clauses

Article ... Supervision of utilization of quarries and borrow pits. The supervisor shall ensure proper utilization, by the contractor, of the quarries and pits designated by the detailed design with the aim of lessening the impact on the environment.

- Preparation of materials in the quarry or pit. The supervisor shall designate trees to be protected and oversee storage of stripped material where it will not hinder water drainage; the supervisor shall oversee restoration to a natural state, including spreading of stored stripped material to facilitate water percolation and natural re-plant growth.
- Volume of stocks of material stored in each quarry or pit.

Article ... Supervision of the construction and maintenance of drainage works. The supervisor shall specify location and technical detail of drainage works and debris placement.

- Construction of diverging ditches
- Construction of laying-up basins
- Cleansing of side ditches, diverging ditches, and summit slope and foot slope ditches.

Article ... Tree planting. The supervisor shall instruct the contractor where trees are to be planted and the type of protection to be provided. The supervisor shall ensure that the contractor makes provision for the water needed for the trees to grow, and promptly replaces any dead trees. The supervisor shall draw up a report stating the number and good condition of the plantings at the time of final acceptance.

18.4.2 Mitigating environmental risk

The risk of failure of environmental mitigative measures is always a possibility which should be considered, but it can be reduced to some extent through

- strengthening staff skills and training in environmental management;
- ensuring management support for environmental policies and action plans;
- monitoring environmental actions and responsibilities and making provision for remedial actions; and
- planning for remedial measures in case initial planned actions are not successful.

Yet failures are still possible. For example, soil erosion may still occur even after preven-
ENVIRONMENTALLY SOUND CONSTRUCTION AND FACILITY MANAGEMENT PRACTICES

BOX 18.4
EXAMPLE CONTRACT CLAUSES FOR USE WITH ROAD MAINTENANCE WORKS CONTRACTS

Special clauses

Article ... Work-site installations. The contractor shall propose to the supervisor the location of work site installations and detail proposed measures to reduce impacts on the environment of these sites and the people living in the immediate vicinity, as regards both the surface area used (clearing, brush and tree removal, drainage, trash dumping) and underground impacts (disruption or pollution of the water table). On completion of the work, the contractor shall do everything necessary to restore the sites to their original state. The supervisor shall draw up a report confirming the restoration before acceptance of the works.

Article ... Preparation and supply of gravel materials in pit or quarry. During works execution, the contractor shall ensure: preservation of trees during piling of materials; spreading of stripped material to facilitate water percolation and allow natural vegetation growth; re-establishment of previous natural drainage flows; improvement of site appearance; digging of ditches to collect runoff; and maintenance of ramps where a pit or quarry is declared a usable water source for livestock or people living nearby. Once the works are completed, and at own expense, the contractor shall restore the environment around the work site to its original state. The supervisor shall provide the contractor with a report confirming the restoration before acceptance of the works.

Article ... Cleaning of side ditches, diverging ditches, and summit slope or foot slope ditches. Debris shall be dumped upstream of the ditch at a sufficient distance from the roadside and spread with a counterslope, with respect to the ditch, to prevent surface water runoff from being polluted with fine materials.

Article ... Tree planting. The contractor shall plant trees in the locations fixed by the supervisor, with protection as specified (mud, brick walls, wire netting, etc.) and provision of the necessary water, and shall also remove any dead trees. The contractor shall take care of all required maintenance for one year from the time of planting, including watering, cleaning the area at the base of the tree, and maintaining protection in good condition. The number of trees planted with the installation of protection and the digging of a basin at the base of the tree shall be entered by the supervisor in the site record. This record will be the basis for payment for work actually done at the time of final acceptance. When the road maintenance is completed, the contractor shall enter the plantings made (position, number) on the route plan.

Article ... Documents to be furnished by the contractor. Upon completion of works the contractor shall provide the route plan with the work performed marked on it and also showing the environmental improvements made (description, location, numbers).

Priced bill of quantities (details as specified in Box 18.2)

Price no. x Preparation of materials in quarry or pit.
Price no. xx Reshaping/compacting with application of materials.
Price no. xxx Digging of diverging ditches.
Price no. xxxx Construction of laying-up basins.

Structural measures have been included in the road construction program. This failure may be due to a lack of technical expertise or simple negligence. These risks need to be understood and anticipated, through the identification and repair of weaknesses in the environmental management plan.

Occupational health and safety risks of road works can be limited by clearly defining procedures for handling materials, conducting tests, paving, operating heavy equipment, and constructing trenches. These are sometimes defined in laws and regulations and, in an EA, are contained in the EMP as the environmental construction guidelines. Specific requirements and training may be needed to

- limit time of exposure to dust particles, chemicals, and noise;
- enhance safety and inspection procedures; and
- improve safe handling of toxic materials, explosives, and other hazardous substances.

The contractor's responsibilities to workers and the environment may be identified during pre-bid conferences, to ensure that potential bidders are aware of contract requirements and can submit proposals which adequately ad-
dress the necessary tasks and their costs. This can minimize the likelihood of contractor defaults.

Transport of hazardous materials needs to be regulated and monitored, with possible restrictions on routes and time of travel to avoid the most populated places and busiest times. The clear marking of vehicles as to the type of material carried also reduces the risk of major spill damage by facilitating effective clean up. Many road agencies develop policies on hazardous goods movement, with specified transport restrictions, requirements on containers and labels, and special permits and police escorts for particularly hazardous materials.

Involuntary transport of diseases or parasites is generally managed by signs and checkpoints which restrict the transport of contaminated fruits or other plant materials and livestock in areas affected by specific plant or animal disease problems.

Natural disaster mitigation has two aspects of interest to road managers:

i) It should take into account possible rare disaster events and incorporate steps to minimize their impacts. Firebreaks, fire access roads, avalanche control measures, and flood reduction measures such as floodways and spillways, are examples of design features commonly used to mitigate known problems which affect particular routes.

ii) It should involve the road agency to ensure that key roads can be kept open or re-opened as quickly as possible, and that traffic diversion can be implemented as needed. Simple recording of disaster response measures and responsibilities, and regular training and dissemination are important to the success of disaster mitigation.

18.5 REFERENCES AND BIBLIOGRAPHY