Course Code: CE 455
Course Title: Traffic Engineering and Management

Lecture 12: Environmental aspects of highway traffic and transportation projects

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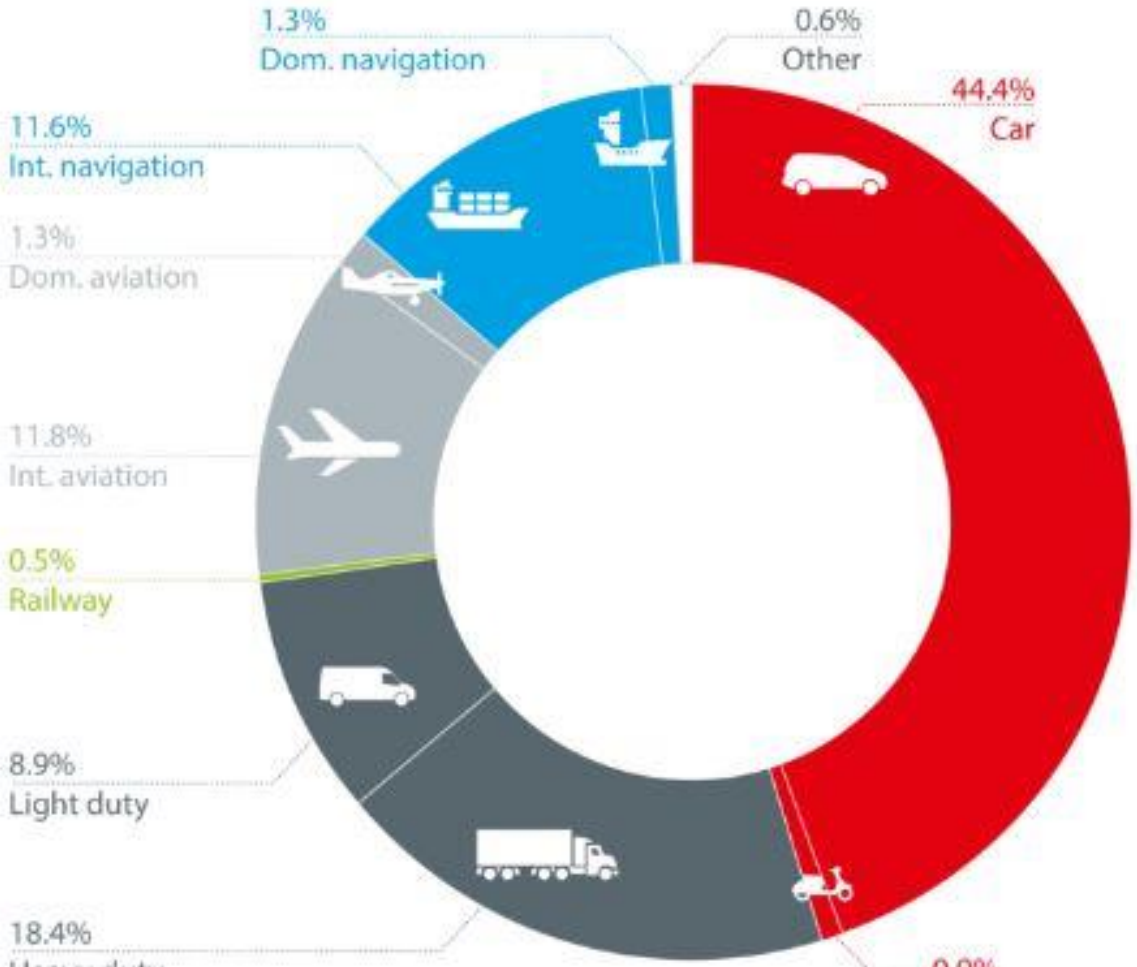
Outline

- Transport & Environment, Environmental issues related to road management
- Environmental importance of transportation,
- Carbon emission, cost of enviromental impact and pollution
- Noise, vibration, dust, dangerous waste
- Traffic pollution and environment,
- Recycled material and industrial byproduct
- Road construction and environment,
- Case study on environmental impacts
- Impact mitigation, source, pathway, pollution limits
- Risk to ground water, de-icying salt, dust binding
- Ground water contamination and avoidance
- Enviromental impact assessment for road project in Bangladesh as per ADB framework

The **environmental effects of transport** are significant because transport is a major user of energy, and burns most of the world's petroleum. This creates air pollution, including nitrous oxides and particulates, and is a significant contributor to global warming through emission of carbon dioxide.[2][3] Within the transport sector, road transport is the largest contributor to global warming.[2]

Overall GHG from Transport in EU28



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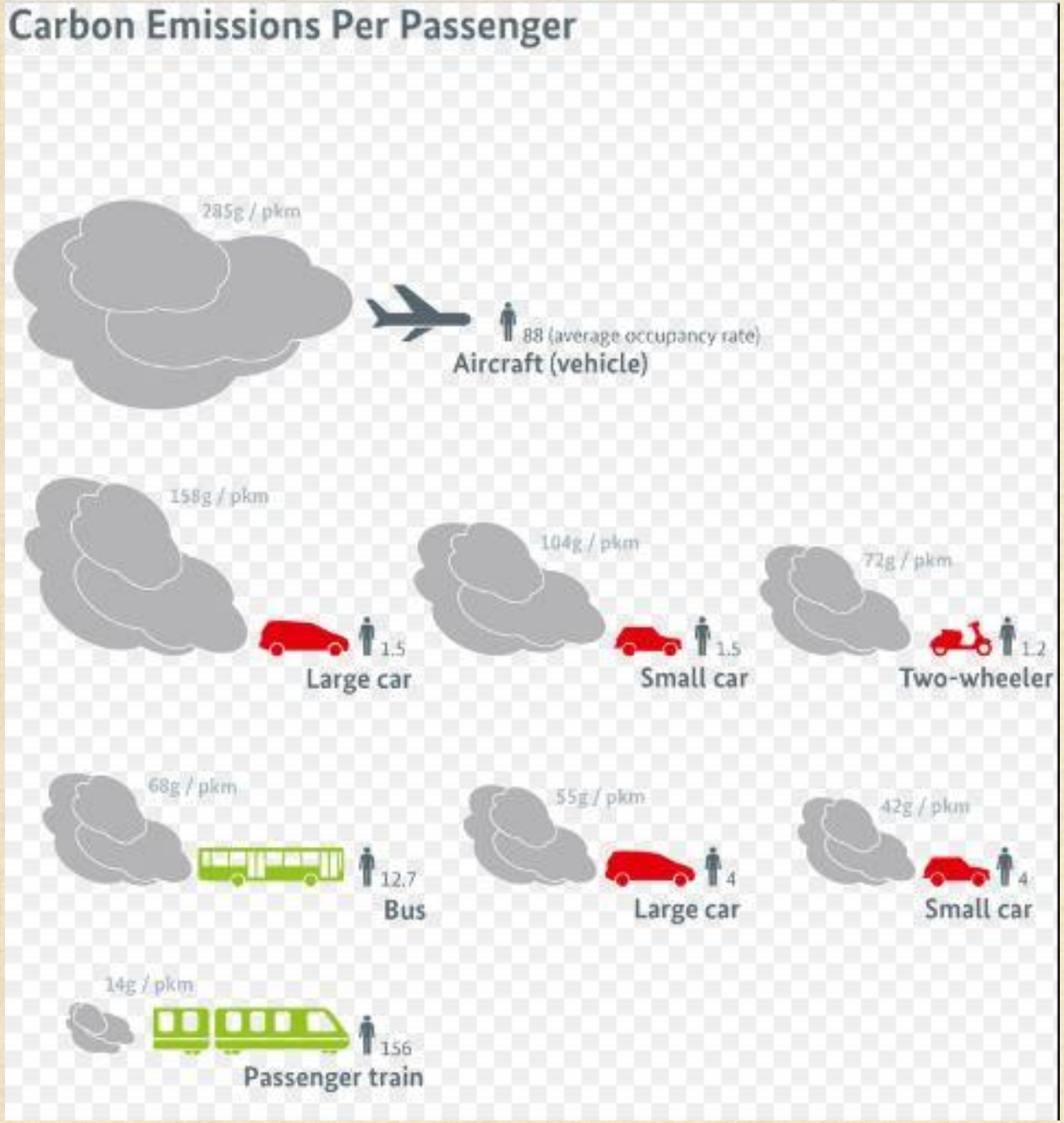
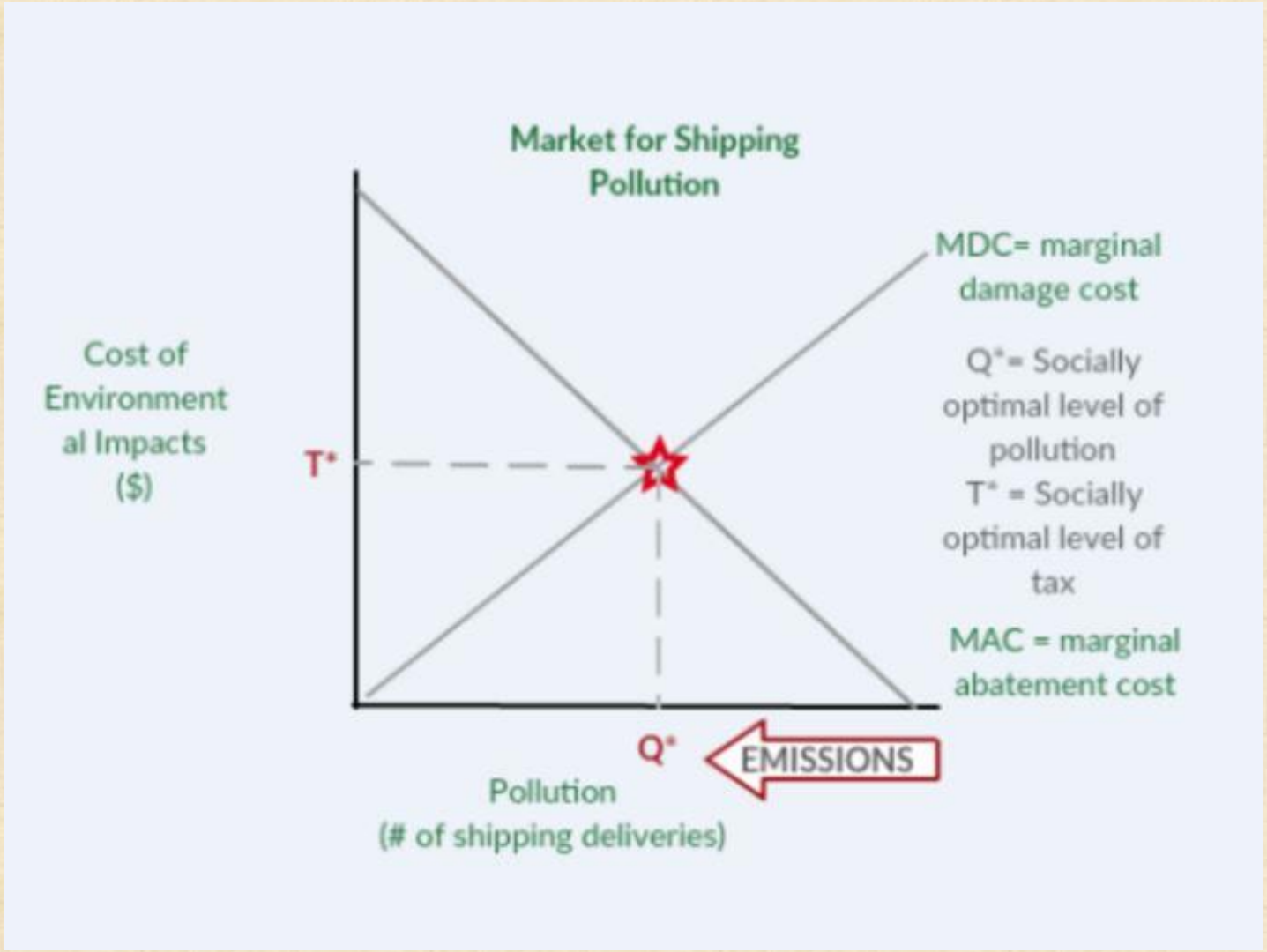
While electric cars are being built to cut down CO2 emission at the point of use, an approach that is becoming popular among cities worldwide is to prioritize public transport, bicycles, and pedestrian movement. Redirecting vehicle movement to create 20-minute neighbourhoods[6] that promotes exercise while greatly reducing vehicle dependency and pollution. Some policies are levying a congestion charge[7] to cars for travelling within congested areas during peak time.

Other environmental impacts of transport systems include traffic congestion and automobile-oriented urban sprawl, which can consume natural habitat and agricultural lands. By reducing transport emissions globally, it is predicted that there will be significant positive effects on Earth's air quality, acid rain, smog, and climate change.[5] Health effects of transport include noise pollution and carbon monoxide emissions.


Carbon Emissions Per Passenger
285g / pkm
88 (average occupancy rate)
Aircraft (vehicle)
158g / pkm
1.5
Large car
104g / pkm
1.5
Small car
72g / pkm
1.2
Two-wheeler
68g / pkm
12.7
Bus
55g / pkm
4
Large car
42g / pkm
4
Small car
14g / pkm
156
Passenger train


Energy Efficiency of different Transport Modes
Pedestrian
∞
Bicycle
∞
Bi-articulated BRT bus (diesel)
Articulated bus (diesel)
Passenger car (petrol)
Scooter (2-stroke, urban roads)
0
100
200
300
400
Range in passenger-kilometres per 1 litre of fuel (km/p)
values reflect 100% occupancy rate



This is the market for shipping pollution. The optimal quantity and the optimal tax per unit of pollution can be found at the intersection of MAC and MD. As the quantity of pollution decreases (emissions), the cost to decrease each marginal unit of pollution increases.

4. ENVIRONMENTAL ISSUES RELATED TO ROAD MANAGEMENT

Roads can have both positive and negative influences on people and the environment. On the positive side roads provide the opportunity of mobility and transport for people and goods. On the negative side roads occupy land resources and form barriers to animals. They can also cause adverse impacts on natural water resources and discharge areas.

The three most damaging effects of road construction and management are noise, dust and vibrations. Noise mainly occurs during road construction phases but it can also occur to a lesser degree during maintenance operations. Dust is created during the construction of gravel roads and unbound aggregate layers. Excess dust production can be treated by a range of means such as watering, the use of alternative materials, and by using dust binders near houses. Vibration can be caused by uneven road surfaces and can pose significant impacts and problems to houses close to the source.

This lesson will focus on the environmental effects of noise, dust, vibrations, and other environmental concerns, and offer suggestions on how they can be mitigated.

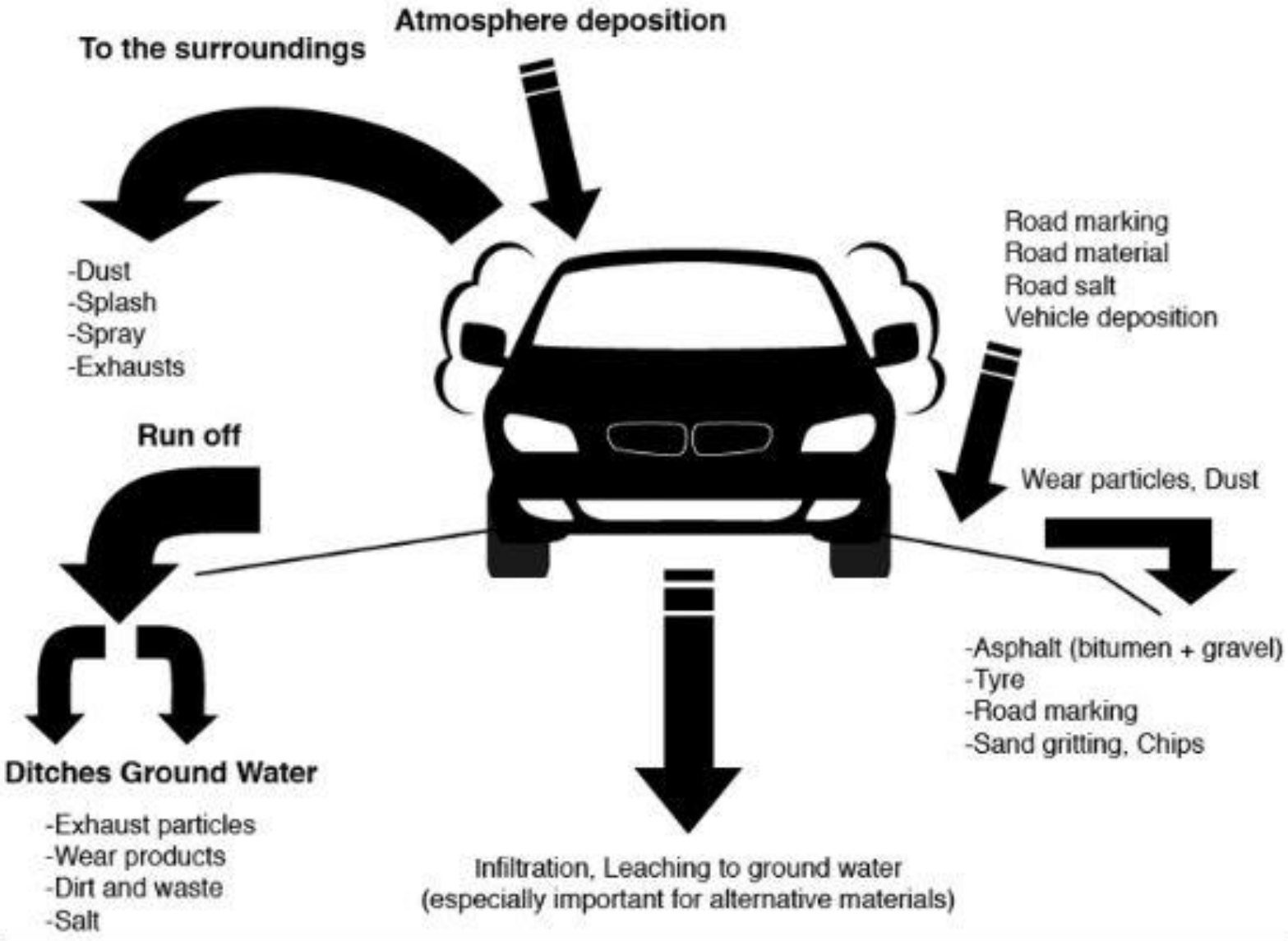


Diagram of the impacts of the traffic on the environment.

4.1. Noise

Noise is defined as a sound that is undesirable to the listener. The level of the disturbance caused by sound will depend on its extent and intensity, and on the sensitivity of the persons affected. Noise is not normally a major problem for roads in the Northern Periphery as the region is generally relatively sparsely populated and the road networks on the whole run through uninhabited or lightly populated areas. Most roadworks in the Northern Periphery are usually carried out outside the built-up areas, with the result that the effect of noise on the local surroundings is not generally a special consideration. Standard working measures within the site must of course be observed.

Production (crushing) of the rock material causes noise, amongst other things, to the environment.

The condition of roads has an effect on noise level. For example if a road is in poor condition and cars are traveling fast, this can cause more noise than if the road is in good condition.

Greater consideration must therefore be given if roadworks are likely to create noise. Noise disturbances may cause irritation as well as agitation and stress to livestock.

A simple but fairly effective measure to manage the effects of noise is to notify the persons likely to be affected that work is about to start. This can be done by delivering information leaflets through letterboxes and/or by posting notices on notice boards. For major work, it may be sensible to convene an information meeting. If people are notified, their acceptance of the disturbance is usually higher. It is wise to work within normal working hours as much as possible. Where this is impossible, the persons affected should be given special notification. There are only limited ways of reducing the noise level. Noise can obviously be reduced by noise fences or similar structures, but these are often impracticable on roadwork sites, particularly for minor works of short duration.

A general piece of advice that applies to noise is to use modern equipment wherever possible. Such equipment normally has better noise and vibration attenuation than older machines. Modern machinery also offers other benefits, such as reduced emissions, etc.

4.2 Vibrations

Vibrations disturb people close to roads but they may also cause damage to buildings and sensitive equipment. Vibrations, and also noise, can affect local fauna. Moreover, vibrations can cause damage to geological and archaeological objects.

Low volume roads can sometimes be in such bad condition that vibration problems cannot be avoided.

Frost heave problems around culverts can cause unevennesses that drivers feel similarly to bumps.

Roadworks can also cause vibrations, which can be transmitted to houses and inhabitants in the surroundings.

Unnecessary high vibration sources, such as compaction with heavy vibration rollers or bedrock blasting, should be avoided or minimized in built-up areas. Heavy vibrations can cause damage to buildings and installations, which can give rise to damage claims. Methods and equipment that minimize vibrations should therefore be employed. This is often difficult in practice however, since roadworks demand specialized mechanical equipment such as diggers, heavy trucks, etc. Closer hole spacings and lighter charges should be used where possible in blasting operations to reduce induced vibration in the surroundings.

As already mentioned, road condition can also affect vibration. For example heavy trucks passing over a road section with a large quantity of frost heave damages will create large vibrations. Keeping the road in a good and even condition will minimize the amount of vibration.

4.3 Dust

Dust is an almost inevitable consequence of roadwork. Gravel and crushed gravel and hard rock aggregates always contain a proportion of fines, and if the material is dry, a fairly heavy dust cloud can be raised when it is mobilized. The resulting dust can disturb both the population and the local environment.

In some cases excavated soil can also be classified as "waste".

Waste may arise in different ways:

- Packaging material
- Residual road structure material
- Dangerous waste, oil from machines, etc.

Waste is also classified on how it can affect the environment:

- Inactive waste, i.e. material that will not be modified by any physical, chemical or biological reaction in a normal landfill site.
- Active waste, i.e. the opposite of an inactive waste. This may be, for example, oil residues and batteries. A special case is waste that is dangerous to life, e.g. explosive or flammable waste.

Good handling of materials can enable most residual materials to be put to use in one way or another. If the quality of material is too poor to use in the road structure, it can usually be employed as landscaping material, e.g. to level out steep slopes. Some waste will of course always occur, e.g. packaging material, oil residues and the like, but these should be minimized. All countries participating in the ROADEX project have requirements on how waste should be dealt with. It is particularly important that environmentally harmful waste should be transported to landfill or incineration plants intended for this purpose. Information on where such plants are located can be obtained from the local or regional supervisory authority. Another problem that may arise but is not common in the Northern Periphery is polluted soil, where it may be necessary to remove and dispose of such materials.

Dangerous, also known as hazardous, waste poses a great risk to the environment and also to human health. Hazardous wastes are controlled by strict regulations (by European Union and local authorities). These regulations mean additional record keeping, monitoring and control obligations are required for these products.

Dangerous waste is classified as materials with following properties:

- Flammable
- Caustic
- Oxidable
- Explosive
- Poisonous
- Harmful and irritating
- Dangerous to environment

Examples of dangerous wastes in roads operations are fuel, accumulators and accumulator acids, brake fluids, transmission oils, shock dampers, different acids, etc. The main sources of these dangerous goods are vehicles (both road users and maintenance). During road construction and maintenance all vehicles on the site need to be serviced appropriately to ensure that there are no leaks.

The economic cost of waste is an important reason why waste should be avoided. Poor waste management costs time and money. Examples are:

- Poor waste management at the start of the project. This can give rise to high costs at a later stage. Such costs can be avoided if the waste is managed correctly right from the start.

- Costs of storage, transport and disposal of waste.

- Time (costs) for handling the waste.

- Increases in costs due to usable material being scrapped.

These costs, when taken together, clearly demonstrate that it is beneficial to have a thoroughly thought-out strategy for waste management.

4.5 Road materials and road furniture

Road materials and road furniture can also be source of pollutants. The environmental impacts and amount of pollutants created depend on the type of materials involved. In addition the type, condition and wear resistance of the surface layer, the influence of water and traffic and a range of other factors all have influences.

Recycled materials and industrial by-products

Recycled materials and industrial by-products can bring new environmental contamination risks. Examples of these typical recycled materials in roadworks include crushed asphalt, concrete and brick; rock or soil associated with mining activities; by-products from metallurgical processes (such as slag); pulverized and bottom fuel ash – particularly “fly ash” from coal burning electricity generation; and other industrial by-products such as bottom ash from municipal solid waste incineration. Recycled materials may contain a number of pollutants for example heavy metals, oil and organic micro-contaminants, and others. The use of these materials has to be considered very carefully therefore, and all have to be appropriately tested to assure that they are suitable as road materials. In the ROADEX area Sweden has published guidelines for the use of alternative materials. These define, for example, the quality, specification, chemical and technical requirements for the materials as well as instructions for their testing. The guidelines also give advice on how to perform an environmental assessment, where the waste material can be used and where it cannot.

Recycled materials can also be used in road construction.

Pavements

Modern bitumens used in asphalt pavements are designed to release very low levels of pollutants. A modern hazard that does arise from pavements is the wear of the pavement surface with studded tyres where they are allowed. This should not be an issue however on lightly trafficked low volume roads. Old pavements containing coal tar on the other hand will generally need special care due to the particular chemical constituents of coal tar. Not all national waste legislations and environment assessments classify coal tar as a hazardous waste. If the particular legislation classifies coal tar as a hazardous waste recycling of the material will be more difficult. Some authorities prefer coal tar to be recycled rather than removal and treatment. For example in Sweden, the Swedish Transport Administration has published special guidelines for dealing with coal tar. These offer several alternative options depending on the concentration of the compound 16-PAH. The practice that has been shown to be best is to leave the asphalt containing the tar in the road structure and not to touch it at all. If it does need to be excavated out, then the guidelines give advice on how it should be handled. Each case will need to be dealt with carefully in accordance with the environmental best-practice of the country involved. In Norway asphalt very seldom contains coal tar. This is because the road network in Norway is younger than, say, Sweden or Scotland. Roads in Norway have mainly been built after the Second World War when coal tar was not in general use.

Bitumens used in asphalt pavements are nowadays designed to be environmental friendly.

Natural aggregates

The properties of natural aggregates are a consequence of their mineralogy and heavy metal content. A common problem with aggregates in low-volume roads is dust. Dust is generated from the unbound surface layers of gravel roads.

Road furniture

Examples of road furniture are road signs, crash barriers, sign-posts and lamp-posts. Usually these are made of galvanized steel but they are still subject to corrosion. Zinc can be released into the environment through the use of de-icing salts and in addition the older types of paints may contain heavy metals. However, compared to heavily trafficked roads, the environmental impacts of road furniture on rural road networks are relatively minor.

Railings are classified as road furniture.

4.6 Impact mitigation

Every road produces some impact on the environment. The construction phase is potentially the most damaging phase in this respect and measures should be taken as necessary to mitigate any impacts caused. Before this can happen the sources and movement routes of pollutants should be identified. The rule of thumb in mitigation is "source – pathway – target". These define the three major parameters in mitigation. Mitigation methods can be carried out both ex-situ and in-situ.

Source

The options for dealing with the source of pollution are: prevention, avoidance and reduction. **Prevention** aims to stop the emissions of pollutants into the environment. A practical example of prevention is to forbid the use of de-icing agents in groundwater areas. **Avoidance** covers the special design procedures, such as re-routing the road alignment to avoid crossing an environmentally sensitive area. **Reduction** is the last resort and should only be considered when the emissions cannot be stopped or avoided. An example of this is the reduction in the number of dangerous goods transports passing through a sensitive area.

Pathway

The mitigation options for pollution pathways are interception (the in-situ method) or reorientation (ex-situ). **Interception** means that the movement of the pollutant is contained such as in a detention pond or by a reactive barrier. **Reorientation** means that the pollution is redirected along a new pathway. An example of this could be a waterborne pollutant being redirected along a waterproof drainage system for collection and treatment.

Pollution limits

If any pollutants reach the specified limit level the only possible mitigation measure is remediation (in-situ) or compensation (ex-situ). Compensation means economic or replacement measures. In practice compensation means, for example, that some form of payment is made to the landowner whose land has been polluted. Remediation is normally only used when deleterious or adverse effects impact an environmental area. In practice this means that the areas with contaminated materials are replaced with new, clean material.

4.7 Risks to groundwater

The road operations which cause the most significant environmental impacts in the ROADEX countries are (a) deicing and snow clearing in winter, and (b) the use of dust binders on gravel roads in summer. These operations both aim to reduce slipperiness on the road to maintain its functionality. The following paragraphs consider ways by which road administrations can mitigate any impacts through actions, principles and policies. Note: Special protection measures may require to be taken on roads passing through important groundwater areas to protect the quality of the water. These may even be necessary on low volume roads if the pumping station is situated close to the road.

Ice and snow control

Ice and snow removal can be carried out either mechanically or chemically. The most popular de-icing chemical is sodium chloride (NaCl). A minute quantity of potassium ferrocyanide is usually added to NaCl as an anti-caking agent to stop the salt grains binding together. Other de-icing chemicals that can be used are urea, calcium chloride and calcium acetate. In low volume roads in Nordic countries the most common way for snow removal is mechanical methods and salt is not used on these roads.

Deicing salt can be used as crystal or liquid.

Disadvantages of de-icing salts

The main disadvantages of de-icing chemicals are that they can contaminate soils, groundwater and surface water. De-icing salts can also increase the mobility of heavy metals which accumulate at the sides of roads. Salts make the road surface wet, which enables pollutants on the road surface to leak through any cracks down into the road structure and along road shoulders. Sodium chloride increases the solubility of many heavy metals.

Dust binding

Dusting and dust binding are common features on low-volume gravel roads where the wearing course material does not have enough fines to create suction. Dust binding is usually done chemically with salts like calcium chloride ($CaCl_2$) and magnesium chloride ($MgCl_2$). These salts have the same disadvantages as de-icing salts. The amount of dust bind binding chemical can be reduced by using enough good quality fines in the wearing course. For instance in Finland crushed glacial moraine has been found to be a suitable wearing course with good dust properties.

Dust binders can be used in road shaping process to prevent dusting.

4.8 Ground contamination and its avoidance

The Northern Periphery is recognised worldwide to be a "clean" region. The risk of finding previously polluted soil is not particularly high, although it is conceivable. A number of warning signals are however possible. Oily water in a ditch for example is a clear warning sign. The reason for the oil may be spillage from road operations, but it may also be due to existing old pollutants. The nose, or rather the sense of smell, is an excellent instrument for detecting pollutants. Care should be taken if the smell of oil, sulphur, etc. is detected. Pollutants can also be tangible, such as rubbish found in the ground. Soils may also be discoloured.

Oil leakage due to tumbled oil truck especially close to rivers and lakes need immediate measures to prevent further damage. In this case GPR was found to be very useful to detect oil in the subsurface structures.

If the soil is saturated (i.e. the pores are full of water), particles can move in three different ways: diffusion, advection and dispersion. **Diffusion** works on the concentration of the pollutant. Particles move from high concentration areas to areas with lower concentration. Diffusion can take place even although the fluid itself is not moving. A good example of diffusion is the spread of dust binder salt by means of osmosis on gravel roads. **Advection** works on the movement of water, and particles move with the flow of water. **Dispersion** happens when water moves within the pores and particles can locally redistribute due to local variations in the fluid flow.

If the soil is unsaturated (i.e. the pores are not full of water), particles can move in a number of ways. **Sorption** happens when particles dissolve from road materials under the action of water. **Adsorption** is the attachment or adhesion of a molecule or an ion in the gaseous or liquid phase to the surface of another substance ion in the solid phase or to the surface of a soil particle. **Desorption** is the process by which molecules or ions move in the opposite direction. Adsorption/desorption has a huge effect on the behaviour of inorganic and organic material in soils between the liquid form and solid state. **Dissolution** is the process when a soluble substance dissolves in a liquid. **Precipitation** is the reverse process to dissolution, and results in the formation of a solid. **Exchange reactions** happen between two reactants usually in liquid form. These reactions can be electron exchanges, proton exchanges or complexes of ions or molecules.

EIA for road project in Bangladesh as per ADB framework

Act/ Rules/Law/ Ordinance	Authority/ Responsible Agency	Key Feature/s	Relevance to the Project
Environment Conservation Act, 1995 and its subsequent amendments in 2000, 2002 and 2010	MoEF, Bangladesh, GoB & District Administration	The provisions authorize the Director General (DG) of Department of Environment to undertake any activity it deems fit and necessary to conserve and enhance the quality of environment and to control, prevent and mitigate pollution. It lays down the basic rules on damage to the ecosystem, discharge of wastes, and the agency's power to enter and collect samples as part of any investigation	It is an umbrella legislation including notifications, rules and schedules promulgated under this act. According to this act (Section 12), no industrial unit or project shall be established or undertaken without obtaining an Environmental Clearance Certificate (ECC) from the Director General of DoE.
Environment Conservation Rules (ECR), 1995 amended in 2003	MoEF, GoB	These are the first set of rules promulgated under ECA 1995. Among other things, these rules set (i) the National Environmental Quality Standards for ambient air, various types of water, industrial effluents, emission, noise, vehicular exhaust; (ii) requirement of environmental clearance; and (iii) requirements for IEE/EIA for industries	The project falls under Red category and hence requires prior environment Clearance from DoE, Bangladesh. Procedure for obtaining environmental clearance has been illustrated in subsequent section of this chapter

IEE = Initial environmental examination

Act/ Rules/Law/ Ordinance	Authority/ Responsible Agency	Key Feature/s	Relevance to the Project
Environment Court Act, 2010	Special Magistrate's Court (SMC), GoB	An Act to provide establishment of environment courts and matters incidental thereto to resolve disputes and serve justice over environmental and social damages raised due to any development activities. This act allows the government to take necessary legal action against any party/ies who inflict/s environmental hazards/damage to environmentally sensitive areas as well as human society.	Applicable for the project for settlement of any disputes raised due to the proposed project activities.
Bangladesh Wildlife (Conservation & Security) Act, 2012	MoEF, Bangladesh and Bangladesh Wildlife Advisory Board	The Act protects 1,307 species of plants and animals, including 32 species of amphibian, 154 species of reptile, 113 species of mammal, 52 species of fish, 32 species of coral, 137 species of mollusk, 22 species of crustacean, 24 species of insect, six species of rodent, 41 species of plant and 13 species of orchid. Of these, 8 amphibian, 58 reptile, 41 bird, and 40 mammal species are listed as endangered in the IUCN Red Data Book	Applicable since the project area is habitat of many important aquatic fauna including, potentially, the Gangetic Dolphin, an endangered species

Act/ Rules/Law/ Ordinance	Authority/ Responsible Agency	Key Feature/s	Relevance to the Project
The Protection & Conservation of Fish Act 1950 subsequent amendments in 1982	Ministry of Fisheries and Livestock	This Act provides power to: make and apply rules to protect fisheries; prohibit or regulate erection and use of fixed engines; and construction of temporary or permanent weirs, dams, bunds, embankments and other structures. It prohibits: destruction of fish by explosives, guns, and bows in inland or coastal areas; destruction of fish by poisoning, pollution, or effluents. It also prescribes the seasons during which fishing is allowed, prohibits fishing during spawning periods, and specifies officials having authority to detect breaches of this Act.	Applicable since the project crosses and is located near water bodies including rivers, streams, and wetlands.
Protection and Conservation of Fish Rules, 1985	Ministry of Fisheries and Livestock	These Rules are in line with the overall objectives of the Fisheries Act and its amendments.	-same as above-

The Embankment and Drainage Act, 1952	Ministry of Water Resources	An Act to consolidate the laws relating to embankment and drainage and to make better provision for the construction, maintenance, management, removal and control of embankments and water courses for the better drainage of lands and for their protection from floods, erosion and other damage by water	The project involves improvement in embankment and drainage.
The Climate Change Trust Act, 2010	Climate Change Trust, GoB	An Act to establish a trust to be called the Climate Change Trust to redress the adverse impact of climate change on Bangladesh and to take measures on other matters relating thereto	Applicable. The road improvement may result to increase in GHG emissions. Project components may be susceptible to adverse impacts of climate change.

Act/ Rules/Law/ Ordinance	Authority/ Responsible Agency	Key Feature/s	Relevance to the Project
Removal of Wrecks & Obstructions in inland Navigable Water Ways Rules, 1973	Bangladesh Inland Water Transport Authority	Removal of Wrecks and Obstruction in inland navigable waterways	Applicable. Contractor to ensure there is no obstruction caused in navigation due to project activities and design
The Ground Water Management Ordinance, 1985	Upzila Parishad	Management of ground water resources; mandates that tube well shall not be installed in any place without the license granted by Upazila Parishad	Applicable in case any groundwater is used for construction or domestic purpose for the project.
Hazardous Wastes & Ship Breaking Waste Rules, 2011	MoEF, Bangladesh and District Administration	Management, handling and safe discharge of hazardous wastes and ship breaking waste	Applicable. No ship breaking involved but involves transportation and storage of hazardous waste.
The East Pakistan Water Pollution Control Ordinance, 1970	MoEF, Bangladesh, GoB & District Administration	An Ordinance to provide for the control, prevention and abatement of pollution of waters of Bangladesh (Then East Pakistan)	Applicable since the project will conduct various activities in inland water bodies

The Vehicle Act (1927) and the Motor Vehicles Ordinance (1983)	Bangladesh Road Transport Authority (BRTA)	Exhaust emission; vehicular air and noise pollution; road/traffic safety; vehicle licensing and registration; fitness of motor vehicles; and parking bylaws.	Applicable since the project involves use of significant number of vehicles in construction and operation
The Factories Act, 1965 and Bangladesh Labor Law, 2006	Ministry of Labor	This Act pertains to the occupational rights and safety of factory workers and the provision of a comfortable work environment and reasonable working conditions	Applicable since the project involves considerable work force during all stages especially during construction
Fire Prevention & Extinction Act, 2003 and Fire Prevention & Extinction Rule,2014	Bangladesh Fire Service & Civil Defence	Legislation to form rules and regulations for fire prevention and extinction and rescue work from the fire combustion	Applicable since the project involved activities requiring fire-fighting arrangement
Brick Burning (Control) Act, 1989 (Amended in 1992 & 2001)	MoEF, GoB & District Administration	To control adverse impacts due to brick burning	Contractors shall procure bricks during construction (if required) only from brick burner/s approved by MoEG, GoB

Act/ Rules/Law/ Ordinance	Authority/ Responsible Agency	Key Feature/s	Relevance to the Project
Noise Control Rules, 2006	MoEF, Bangladesh, GoB & District Administration	Formulated to set limit for noise levels especially high level horn	Applicable since several noise generating sources like motorized vehicles and heavy machineries will be used during construction; the road improvement may also result to increased noise levels during operation.
Water supply and Sanitation Act, 1996	Ministry of Local Governance (MoLG), Research Development and Collaboration	Regulates the management and control of water supply and sanitation in urban areas	Applicable. The project passes through built-up/urban areas.

The Bangladesh National Building Code (BNBC)	Building Construction Committee, GoB	Sets out the constructional responsibilities of relevant authorities to adopt precautionary measures to ensure the safety of workmen. According to Section 1.2.1 of Chapter 1 of Part 7, "In a construction or demolition work, the terms of contract between the owner and the contractor and between a consultant and the owner shall be clearly defined."	Applicable since the project involves both construction and demolition activities

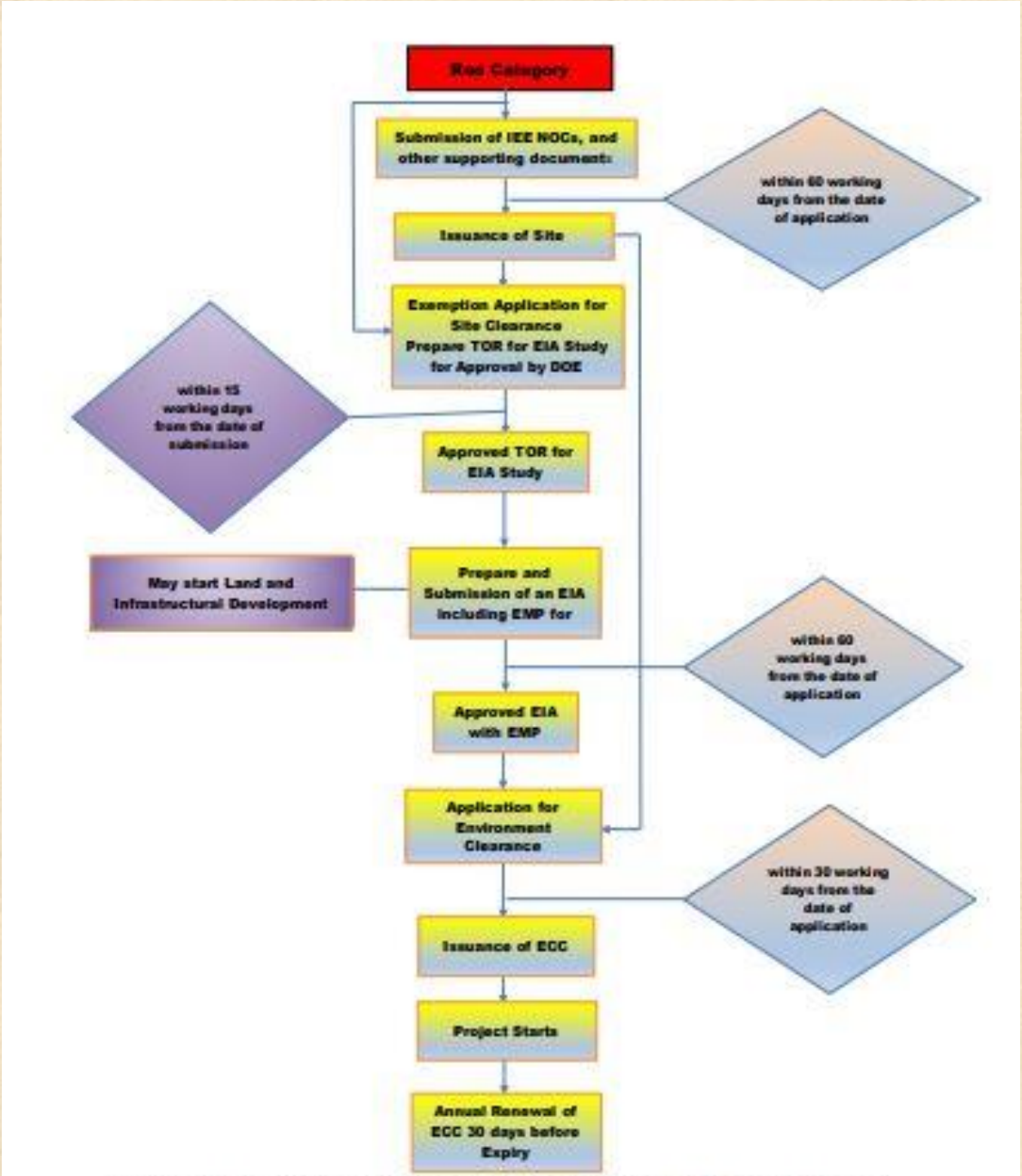


Figure 1: Government of Bangladesh Environmental Clearance Process

Table 2. Institutions linvolved for the Grant of NOC for Obtaining Environment Clearance

Government Department	Relevant Planning and Enforcement Duties
Department of Environment (DoE)	Site Clearance and Environmental Clearance Certificate for cutting of Raghunandan Hill and commencement of civil works
Forest Department (FD)	NOC from CCF for cutting of trees for the cutting a small portion of Raghunandan Hill[1] covered by 80 nos. of rubber trees.
Deputy Commission (DC)	NOC from concerned Deputy Commissioner (seven districts as the project involves land acquisition for proposed improvement
Department of Fisheries (DoF)	NOC from DoF due to piling of piers in river, if necessary.
Bangladesh Water Development Board (BWDB)	NOC for river training and/or protection works
Bangladesh Inland Water Transport Authority (BIWTA)	NOC for the construction of major bridges

11. ADB Safeguards Policy Statement and Requirements: ADB has defined its safeguard requirements under its Safeguard Policy Statement, 2009. The prime objectives of the SPS are to: (i) avoid adverse impacts of projects on the environment and affected people, where possible; and (ii) minimize, mitigate, and/or compensate for adverse project impacts on the environment and affected people when avoidance is not possible. This policy requires assessment, mitigation and commitment towards environmental protection. The extent of assessment depends on the category of the project. ADB's SPS 2009 classify a project depending on following three categories.

(i) **Category A:** A proposed project is classified as category A if it is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works. An environmental impact assessment is required.

(ii) **Category B:** A proposed project is classified as category B if its potential adverse environmental impacts are less adverse than those of category A projects. These impacts are site-specific, none or very few of them are irreversible, and in most cases mitigation measures can be designed more readily than for category A projects. An initial environmental examination is required.

(iii) **Category C:** A proposed project is classified as category C if it is likely to have minimal or no adverse environmental impacts. No environmental assessment is required although environmental implications need to be reviewed.

III. ANTICIPATED ENVIRONMENTAL IMPACTS

14. Project improvement components involve (i) widening of approximately 210 km from two-lane carriageway to four-lane with service roads on both sides with improved road surface; (ii) geometric improvements with provision of realignments (total 18.2 km) for straightening of curves and bypassing heavily built-up sections; (iii) expansion/reconstruction of existing CD structures and creation of new cross drainage structures and side drains (iv) raising of embankment along food prone sections; (v) ROBs and flyovers to ease congestion at level crossings and important urban centers; (vi) installation of safety measures such as rumble strips, precautionary signages, sidewalks/pedestrian crossings for communities and public road users.

15. Potential major impacts of the project are large scale use of construction material, its transportation, storage and handling, increase in air pollutants, noise and vibration levels, large volumes of construction and demolition waste, siltation of waterways from silt-laden surface runoff, soil erosion and slope destabilization of high embankments, and traffic obstruction near active construction sites, particularly along very congested portions. These are reversible, co-terminus and concomitant with construction activities/period, localized and short-term in nature. In response to the potential impacts identified in the IEE, necessary mitigative measures have been incorporated in the design and recommended in EMP to address those during all phases of the project cycle. Key design stage measures and considerations include (i) geometric adjustments to minimize tree cutting and provision of additional plantations on top of regulatory requirement of compensatory plantation to serve as carbon sink and check soil erosion; (ii) raising of embankment height, increase in number of cross-drainage structures and provision of side drains to avert flooding/water-logging; (iii) bio- engineering measures to check soil erosion and prevent slope de-stabilization; (iv) protection measures such as retaining walls, etc., at water bodies; (iv) design consideration for climate resilient civil structures, pavement and bituminous surface and others as detailed in separately formulated CRVA report; (v) occupational health and safety plan including plan for containment of COVID-19; and (v) provision of safety measures for road users and local communities, among others. To facilitate wildlife movement and avoid their collision with vehicles, several measures have been recommended near the Raghunandan hill section of DS-7 such as informatory and cautionary sign boards indicating (i) the wildlife/forest area and animal crossing sections ahead, (ii) maximum speed limit, (iii) no honking (both day and night) and prohibiting the use of dipper at night since such a sudden change in illumination saturates their retinas temporarily blinding animals like barking deer, causing their abrupt movement, and (iv) installing rumble strips/speed breakers.

16. Corresponding mitigation measures are detailed in the prepared Initial Environmental Examination (IEE) submitted and disclosed in ADB website.

C. Environmental Assessments and Environmental Management Plans

20. The preparation of environment assessment documents for components and tranches will be guided by the objective of ensuring the environmental soundness, sustainability and integration of environmental considerations into the project decision making process. Environmental impacts will be avoided and, if not possible, minimized, and mitigated, and positive impacts will be enhanced through implementation of the Environmental Management Plan (EMP).

21. The IEE study will be conducted in accordance with the requirements of ADB's SPS 2009. The study will clearly identify and describe the area of impact, provide an assessment of potential impacts and mitigation measures, and involve public consultations with affected people and other relevant stakeholders. It should include a comprehensive and practical EMP and Environmental Monitoring Plan (EMOP) and clear institutional arrangements for implementing them. Specifically, the study will focus on the following:

a. Potential impacts on biodiversity including modified, natural, critical habitats and protected areas, and necessary measures to minimize, mitigate and offset impacts.
b. Soil erosion and necessary engineering and bioengineering measures to address them
c. Potential waste issues including excavated spoil, hazardous materials and wastes and appropriate measures for their disposal, treatment and other forms of management.
d. Climate change impacts to the project and recommendations for adaptation as well as mitigation
e. Quantification of Greenhouse Gas (GHG) emissions impacts of the project
f. Occupational health and safety issues and measures for the construction workers as well as the local communities in and around the project site.
g. Cumulative and induced impacts of the project in light of existing environment, ongoing development projects and planned projects in the near future
h. Potential impacts on physical and cultural resources and measures to avoid, minimize or mitigate impacts.
i. Grievance redress mechanism to address concerns and grievances of the affected people in the course of the project cycle.

22. The IEE (for Category B)/Environmental Impact Assessment (EIA) (for Category A) report must be disclosed on the ADB website before ADB management consideration of the respective tranche. The Contractor will be required to review and update the EMP as necessary to make it more site specific and incorporate additional/update information if available and submit for approval by the Project Implementation Unit (PIU) and Project Implementation Consultants (PIC).

ANNEX 1: RAPID ENVIRONMENTAL ASSESSMENT (REA)

ROADS AND HIGHWAYS

CHECKLIST

Instructions:

(i) The project team completes this checklist to support the environmental classification of a project. It is to be attached to the environmental categorization form and submitted to the Environment and Safeguards Division (SDES), for endorsement by Director, SDES and for approval by the Chief Compliance Officer.

(ii) This checklist focuses on environmental issues and concerns. To ensure that social dimensions are adequately considered, refer also to ADB's (a) checklists on involuntary resettlement and Indigenous Peoples; (b) poverty reduction handbook; (c) staff guide to consultation and participation; and (d) gender checklists.

(iii) Answer the questions assuming the "without mitigation" case. The purpose is to identify potential impacts. Use the "remarks" section to discuss any anticipated mitigation measures.

Country/Project	
Title: Sector	
Division:	

Division:

Screening Questions	Yes	No	Remarks
A. PROJECT SITING IS THE PROJECT AREA ADJACENT TO OR WITHIN ANY OF THE FOLLOWING ENVIRONMENTALLY SENSITIVE AREAS?			
• CULTURAL HERITAGE SITE			
• PROTECTED AREA			
• WETLAND			
• MANGROVE			
• ESTUARINE			
• BUFFER ZONE OF PROTECTED AREA			
• SPECIAL AREA FOR PROTECTING BIODIVERSITY			

B. POTENTIAL ENVIRONMENTAL IMPACTS WILL THE PROJECT CAUSE…			
• encroachment on historical/cultural areas; disfiguration of landscape by road embankments, cuts, fills, and quarries?			
• encroachment on precious ecology (e.g. sensitive or protected areas)?			
• alteration of surface water hydrology of waterways crossed by roads, resulting in increased sediment in streams affected by increased soil erosion at construction site?			
• deterioration of surface water quality due to silt runoff and sanitary wastes from worker-based camps and chemicals used in construction?			
• increased local air pollution due to rock crushing, cutting and filling works, and chemicals from asphalt processing?			
• risks and vulnerabilities related to occupational health and safety due to physical, chemical, biological, and radiological hazards during project construction and operation during project construction and operation?			

• noise and vibration due to blasting and other civil works?			
• dislocation or involuntary resettlement of people?			
• dislocation and compulsory resettlement of people living in right-of-way?			
• disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable groups?			
• other social concerns relating to inconveniences in living conditions in the project areas that may trigger cases of upper respiratory problems and stress?			
• hazardous driving conditions where construction interferes with pre-existing roads?			

• poor sanitation and solid waste disposal in construction camps and work sites, and possible transmission of communicable diseases (such as STI's and HIV/AIDS) from workers to local populations?			
• creation of temporary breeding habitats for diseases such as those transmitted by mosquitoes and rodents?			
• accident risks associated with increased vehicular traffic, leading to accidental spills of toxic materials?			
• increased noise and air pollution resulting from traffic volume?			
• increased risk of water pollution from oil, grease and fuel spills, and other materials from vehicles using the road?			
• social conflicts if workers from other regions or countries are hired?			

• large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)?			
• risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during construction and operation?			
• community safety risks due to both accidental and natural causes, especially where the structural elements or components of the project are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning.			

A Checklist for Preliminary Climate Risk Screening

Country/Project Title:

Sector :

Subsector:

Division/Department:

Screening Questions		Score	Remarks[12]
Location and Design of project	Is siting and/or routing of the project (or its components) likely to be affected by climate conditions including extreme weather related events such as floods, droughts, storms, landslides?		
	Would the project design (e.g. the clearance for bridges) need to consider any hydro-meteorological parameters (e.g., sea-level, peak river flow, reliable water level, peak wind speed etc)?		
Materials and Maintenance	Would weather, current and likely future climate conditions (e.g. prevailing humidity level, temperature contrast between hot summer days and cold winter days, exposure to wind and humidity hydro-meteorological parameters likely affect the selection of project inputs over the life of project outputs (e.g. construction material)?		
	Would weather, current and likely future climate conditions, and related extreme events likely affect the maintenance (scheduling and cost) of project output(s)?		
Performance of project outputs	Would weather/climate conditions, and related extreme events likely affect the performance (e.g. annual power production) of project output(s) (e.g. hydro-power generation facilities) throughout their design life time?		

Options for answers and corresponding score are provided below:

Response	Score
Not Likely	0
Likely	1
Very Likely	2

Responses when added that provide a score of 0 will be considered low risk project. If adding all responses will result to a score of 1-4 and that no score of 2 was given to any single response, the project will be assigned a medium risk category. A total score of 5 or more (which include providing a score of 1 in all responses) or a 2 in any single response, will be categorized as high risk project.

Result of Initial Screening (Low, Medium, High):_____

Other Comments:_

_____

_____

Prepared by: _____

_____

[12] If possible, provide details on the sensitivity of project components to climate conditions, such as how climate parameters are considered in design standards for infrastructure components, how changes in key climate parameters and sea level might affect the siting/routing of project, the selection of construction material and/or scheduling, performances and/or the maintenance cost/scheduling of project outputs.