Environmental Impact Assessment (EIA) Report

Aman Cement Mills Unit-2 Ltd.

July, 2016

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Submitted To
Department of
Environment, The People's
Republic of Bangladesh

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Abbreviation and Acronym

AAQ	Ambient Air Quality
ADB	Asian Development Bank
ADP	Annual Development Programme
BAEC	Bangladesh Atomic Energy Commission
BARC	Bangladesh Agriculture Research Council
BCCSAP	Bangladesh Climate Change Strategy and Action Plan
BEZA	Bangladesh Economic Zones Authority
BBS	Bangladesh Bureau of Statistics
BCMA	Bangladesh Cement Manufacturers Association
BDT	Bangladeshi Taka
BIWTA	Bangladesh Inland Water Transport Authority
BMD	Bangladesh Meteorological Department
BOD	Biochemical Oxygen Demand
BP	Bank Procedure
BRRI	Bangladesh Rice Research Institute
BRTA	Bangladesh Road Transport Authority
BWDB	Bangladesh Water Development Board
CEC	Cation Exchange Capacity
CO	Carbon monoxide
CO_2	Carbon dioxide
COD	Chemical Oxygen Demand
dBA	Decibels
DAE	Department of Agriculture Extension
DCH	Dhaka Community Hospital
DDM	Department of Disaster Management
DfID	Department for International Development
DMB	Disaster Management Bureau
DO	Dissolved Oxygen
DoE	Department of Environment
DoEB	Department of Environment, Bangladesh
DPHE	Department of Public Health Engineering
EA	Environmental Assessment
ECA	Environment Conservation Act
ECAs	Ecologically Critical Areas
ECR	Environment Conservation Rules
EHS	Environment, Health and Safety
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
ERP	Emergency Response Plan
ERT	Emergency Response Team
FAO	Food and Agriculture Organization of the United Nations
FY	Fiscal Year
GDP	Gross Domestic Product
GIS	Geographic Information System
GO	Government Organization
GoB	Government of Bangladesh
HYV	High Yielding Varieties
IEE	Initial Environmental Examination

IFC	International Finance Corporation
ILO	International Labor Organization
IMO	International Marine Organization
IUCN	International Union for Conservation of Nature
JICA	Japan International Cooperation Agency
MARPOL	The International Convention for the Prevention of Pollution from Ships
MDGs	Millennium Development Goals
Mn	Million
MoEF	Ministry of Environment and Forest
MT	Metric Ton
NAPA	National Adaptation Programme of Action
NCS	National Conservation Strategy
NEMAP	National Environmental Management Action Plan
NEP	National Environment Policy
NGO	Non-Government Organization
NIPSOM	National Institute of Preventive and Social Medicine
NO_x	Oxides of Nitrogen
ODA	Official Development Assistance
OP	Operational Policy
PMU	Project Management Unit
PWD	Public Works Datum
SO_2	Sulphur dioxide
SOES	School of Environmental Studies
SPM	Suspended Particulate Matter
STP	Sewage Treatment Plant
TDS	Total Dissolved Solids
TM	Thematic Mapper
ToR	Terms of Reference
UAE	United Arab Emirates
UN	United Nations
UNCED	United Nations Conference on Environment and Development
UNFPA	UN Population Fund
UNICEF	UN Children's Emergency Fund
USA	United States of America
USGS	United States Geological Survey
VOC	Volatile Organic Compounds
WB	World Bank
WHO	World Health Organization

Executive Summary

Name of the Industry	:	Aman Cement Mills Unit-2 Ltd.
Type of the Industry	:	Gray Portland Cement manufacturing industry
Present Status of the Industry	:	Proposed
Area of Concern	:	Dust, noise and health safety issues in production flood as well as in ambient air
Final Product	:	Portland cement in 50 kg Bag
Annual Production Quantity	:	6.3 million MT
Wastewater Generation	:	No industrial wastewater generated, dry process industry
Impact on the environment	:	Carbon emission, ambient dust and noise
Mitigation measures and recommended	:	Dust collection system, noise reduction technology and energy efficient production process
Environmental Management	:	The industry should recruit at least one experienced environmental management person for regular monitoring of ambient noise and air. The person should be well equipped with general air and nose monitoring devices.
Major Positive Impact	:	Employment creation of around 265 skilled and unskilled peoples. Export earnings for the country.
Opinions of the local people	:	The industry do not affect the natural activities of the area rather it created the employment opportunities for them.
Suggestion of the local people	:	The industry management should involve in the local infra-structural development
Commitment of the industry	:	They contribute in the development of the local life and strictly follow the environmental regulations of the Bangladesh government.
Recommendations	:	Environmental Clearance Certificate can be favorably considered.

Chapter 1
Introduction

1.0 Background

This chapter of the Environmental Impact Assessment (EIA) Study Report presents the information relevant to the undertaking of the EIA carried out by Shahidul Consultant for the establishment of a cement manufacturing facility near Baiddyar Bazaar Union under Sonargaon Upazila of Narayanganj District, Bangladesh. Details of the project title and project proponent, and EIA consultants are discussed below.

1.1 Project Title and Proponents

1.1.1 Project Title

The proposed cement project to which this EIA relates is "Aman Cement Mills Unit-2 Ltd. at Sonargaon Upazila of Narayanganj District under Dhaka Division, Bangladesh.

1.1.2 Proposed Project Proponents

The proponent of the proposed project is Aman Group. In olden times dating back to late sixties of the last century during the erstwhile Pakistan period the ancestors of the present Directors of the Group started trading & contractual business on a small scale at their native district Rajshahi situated at the northern part of Bangladesh. After the emergence of Bangladesh the businesses flourished a little under the banner of Aman Trading Corporation. In the late 1980's, the businesses in trading through importing various consumer items and their marketing started witnessing a steady growth in the business. At some point in the mid 1980's the Group think tank felt that mere trading business and earning wealth through that activity may bring prosperity to individuals of the family only.

But as a well-placed family in the society the social obligation to the poor rural mass for doing something for their economic upliftment was pricking their conscience. This greatly influenced to think about ventures where investment can generate employment for the rural mass whatever may be the size of generated employment. At the first instance some agro-based industries were thought of. This led to establishment of cold storages in the northern Bangladesh. This further continued with the establishment of a cement grinding industry.

At the advent of 21st century formation of a Group with the trading houses, contractual firms working individually under the banner of Aman Trading Corporation & few industries like cold storages & one cement-grinding mill with a corporate character was completed.

With the sharp changes in the socio-economic situation of the country the Group vowed to tap the prevailing scopes for establishment of industries. At the same time Group realized that in order to expedite the works of establishment of medium and large-scale industries, availing the facilities offered by the Government and for easier

correspondences with the agencies of theirs as well as to avail quick banking facilities the shifting of the Corporate Office from Rajshahi to capital city Dhaka was unavoidable.

The Group therefore decided to participate in the process of industrialization in the places wherefrom marketing, transportation would be easier, generation of income & employment will be evident and in doing so shall pay taxes to the Government. With this end in view the Group in the year 2004 housed a miniature Registered Office in Motijheel Commercial Area leaving behind a strong Regional Office at Rajshahi to look after the existing industries activities there.

In the year 2007 the Group housed its Corporate Office at Uttara Model Town for controlling the entire activities of the business & industrial units including the Registered at Motijheel & the Regional Office at Dhaka. Aman Group has its Head Office located at:

Corporate Office: 2 Isha Kha Avenue, Sector; 6 Uttara, Dhaka-1230.
Tel: 88-02-7911691-3, 88-02-8962297, 88-02-7911016, 88-02-8921489
Website: www.amangroupbd.com

It is the intention of the Aman Cement Mills Ltd. to expand their operations in Bangladesh by the development of a another new cement manufacturing facility on a barren field site adjacent to the Meghna River for exporting the final products and importing the raw materials. It is envisaged that the plant will be capable of a clinker production of a minimum of 10000 tons per day which is approximately equivalent to a production of 3.6 millions tones of cement per annum. It is further envisaged that the plant will be fully commissioned by early September, 2016.

Please see Trade License ACML-2 in ***Annex-1***
Please see NOC from Local Union Parishad for ACML-2 in ***Annex-2***
Please see the Registration Certificate of ACML-2 in Board of Investment (BOI) and Machinery in ***Annex-5***

1.2 EIA Consultants

This Environmental Impact Assessment (EIA) Study has been carried out by Shahidul Consultat, at 74/2, Indira Road, Khamarbari, Farmgate, Dhaka-1208, Bangladesh. Shahidul is the lead consultant. A detail of the EIA Assignment Team is presented in Chapter One.

1.3 Justification of the Study

There is no doubt to say that every development activity has an impact on the natural molding of the environment. As development activities are of prime importance for the economic growth and fulfillment of basic needs of the society, the environmental aspects of development activities must be taken into account and due attention must be paid to protect the environment. The first step in direction is to evaluate the probable impacts of

the project on the surrounding environment, so that suitable measures could be taken during early stages of the project to minimize negative impacts.

The socio-cultural roots of our present environmental crisis lie in the paradigms of scientific materialism and economic determinism, which fail to recognize the physical limits, imposed by ecological systems on economic activity. The economies must expand with ecosystems, which have limited regenerative capacities. Contrary to the neoclassical theory of continuous material growth, economic activities directly undermine the potential for development through over exploitation of natural resources, and directly compromise future production through the discharge of residuals. The entrenchment with quantitative growth as a major instrument of social policy is thus quite paradoxical.

The emergence of the concept of sustainable development in recent years has brought in the general realization that societal perceptions must shift toward ecological determinism so as to achieve qualitative growth within the limits of ecosystem carrying capacity. The carrying capacity based planning process, innovative technologies for enhanced material and energy affectively of production and consumption, structural economic change towards less resource intensive sectors, and preventive environmental management through increasingly interventionist policies are some of the strategies for reconciling development goals with ecological capabilities.

1.4 Overview and Existing Situation

1.4.1 Cement Industry Overview

Development of cement industry in Bangladesh dates back to the early-fifties but its growth in real sense started only about a decade. The country has been experiencing an upsurge in cement consumption for the last five years.

Government gave permission for establishing cement industries in Bangladesh in FY1995. Initially the cement industry took place without the proper analysis of the demand and supply of cement in the country. Within the span of the two to three years, industry attained expanded capacity of the product with stable growth rate of consumption.

After a decade, currently 123 companies are listed as cement manufacturers in the country. Among them 63 have actual production capacity while 32 are in operation. The current installed capacity of the industry is 20.0 mn MT. This installed capacity has been calculated under two conditions below:

a) all factories are in operation
b) production is at its peak season

Though the installed capacity is 20.0 mn MT, currently the actual capacity is about 13.96 mn MT due to supply constraints for power and clinkers.

Table 1.4.1 (a): Market Size Derivation of Cement Industry

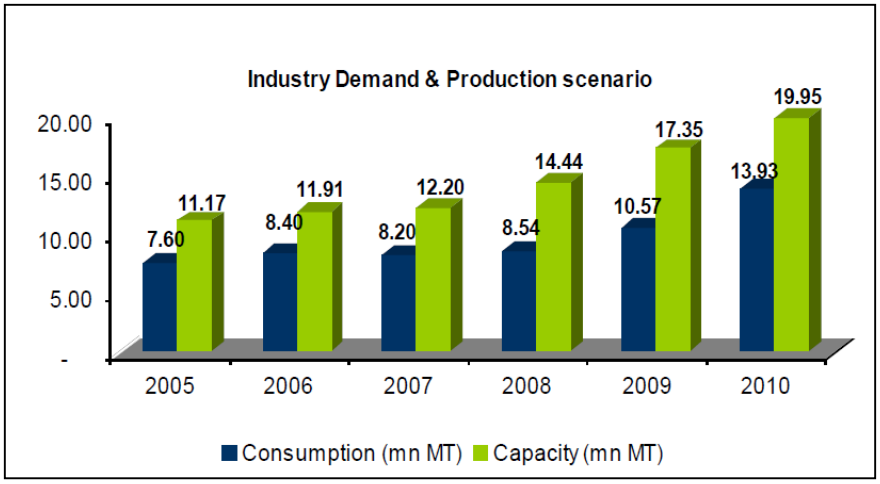
Market size derivation	
Total demand (mn MT)	13.93
Standard Price per beg (BDT)	350
Total Market size (BDT mn)	97,510
Total Market size (USD bn)	1.35

Source: BCMA & IDLC research

Table 1.4.1 (b): Market Size Derivation of Cement Industry

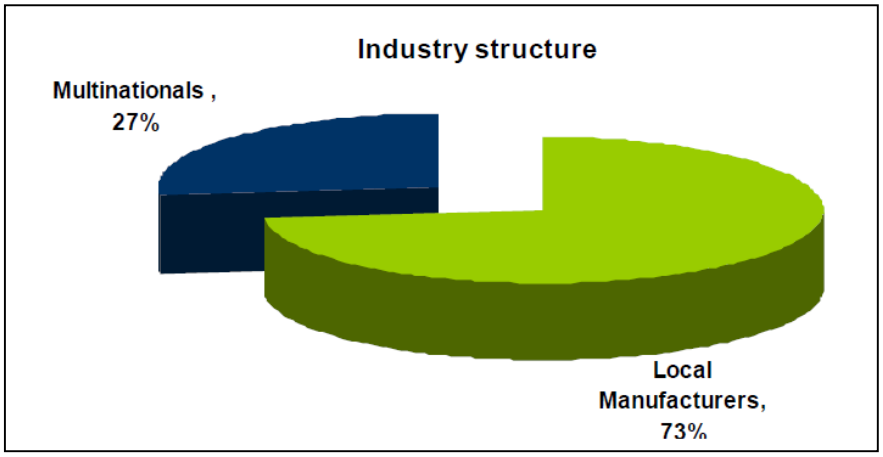
Overview of Cement Industry	
Total Production capacity (mn MT)	20
Industry average utilization rate	70%
Actual capacity excluding obstacles (mn MT)	13.96
Local consumption (mn MT)	13.93
Per capita consumption (FY2010)	84.5Kg
Total factories registered	123
Factories started operation	63
Currently plants in operation	32
Factories exporting cement to India	8
Size of export in FY2010 (K MT/year)	260
Construction % of GDP	10%
Construction sector growth in FY2010 (according to BBS)	8%
Industry consumption growth in FY2010	32%
Expected industry growth rate in next 5 years	25% /year
Largest 13 cement companies hold (market share)	78%

Source: BCMA & IDLC research



Source: BCMA & IDLC research

Figure 1.4.1 (a): Industry demand and production scenario



Source: BCMA & IDLC research

Figure 1.4.1 (b): Industry structure of cement

1.4.2 Seasonality and Cyclicality of the Industry

Peak Season: January to April/ May and October to December
Dull/off Season: (depends on monsoon) June to September

Bangladesh cement industry is known for its seasonality which can be as high as 50%. Cement demand declines during the monsoons due to a slowdown in construction activities. On the other hand, though the yearly capacity of the industry is saturated with overcapacity, market demand gets matched or cross the effective capacity during the first 5 to 6 months of the year.

In addition, the cement industry, like most capital-intensive commodity industries, is cyclical in nature with respect to supply. Given the high gestation period of 24-30 months, there is a time lag between capacity build-up and cement demand. Cement demand is closely linked to the growth of the construction sector. Hence, when the construction sector is strong, demand increases. As a result, the profitability rises, leading to capacity additions by existing players and the entry of new players. However, since it takes 2 -2.5 years to build a cement plant, it is likely that before completion, demand could decrease or stagnate, or the capacity additions could exceed demand. This can lead to a fall in cement prices, and the industry could face a downturn, leading to reducing operating rates or shutting down capacities.

1.4.3 Cement Industry – Regional in Nature

Cement is a high-volume, low-value commodity. Transporting over long distances adds to the cost, resulting in lower margins to the players. This makes cement a regional commodity where lower distribution cost makes it remunerative to producers. Cement consumption varies region wise because the demand-supply balance, per capita income and level of industrial development differ in each region. In our country Dhaka, Chittagong and Mongla account for 91% of total consumption.

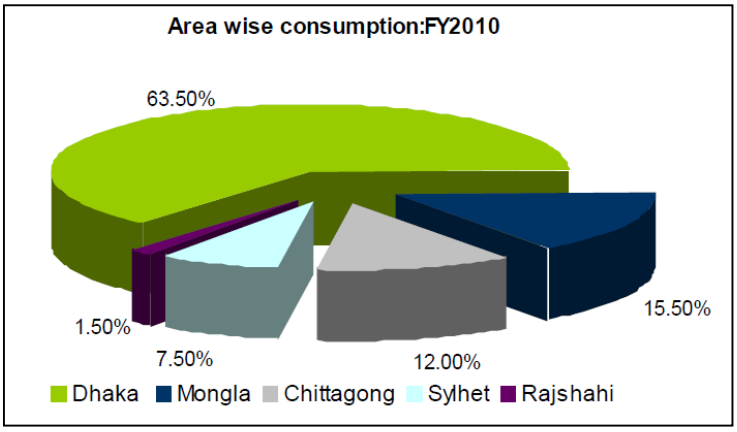


Figure 1.4.3 (a): Area wise consumption of cement in FY 2010

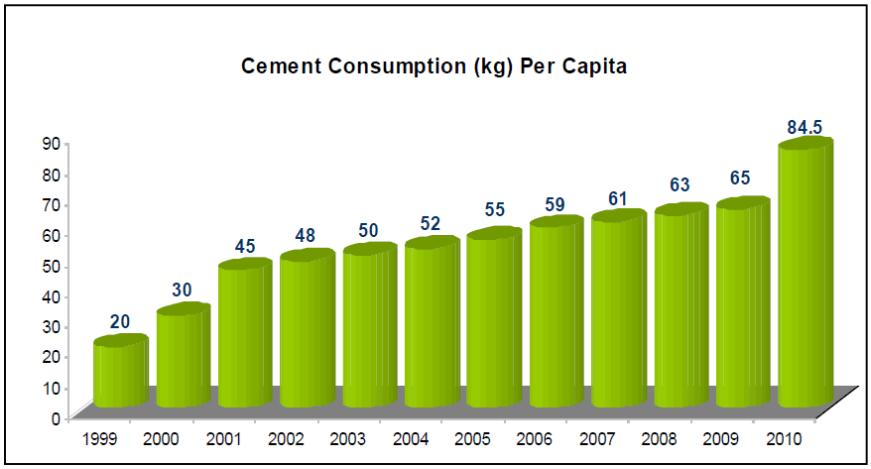
Table 1.4.3 (a): Key considerable issues of cement

Key Points	
Supply	At present, the demand-supply situation is tightly balanced with the latter being marginally higher. As the cement industry is dependent on few companies"s production, more expansion will be needed to meet the large demand of govt infrastructures
Demand	Housing sector acts as the principal growth driver for cement. However, recently industrial and infrastructure sectors have also emerged as demand drivers.
Barriers to entry	High capital costs and long gestation periods. Access to cheap source of clinker supplier also acts as a significant entry barrier.
Bargaining power of suppliers	Our cement industry depends on imported raw materials. Currently international price of clinker is stable. But any kind of volatility in its price remained a concern.
Bargaining power of customers	End users of the product get benefited if they are near to the distribution plant of the company. But when their positioning is at distance from the distribution plant, companies used to charge premium. Moreover, brands used to charge premium on account of better quality perception also.
Competition	Intense competition among players regarding price due to homogeneous product.

Table 1.4.3 (b): Cement consumption growth in last 5 years

Year	MT (in mn)	GR %	GDP Growth rate
2005	7.60	-	5.96%
2006	8.40	11%	6.63%
2007	8.20	-2%	6.43%
2008	8.54	4%	6.19%
2009	10.57	24%	5.74%
2010	13.93	32%	5.80%
Cement consumption Growth in last 5 years		83%	

Source: IDLC Research



Source: IDLC Research

Figure 1.4.3 (b): Cement consumption (kg) per capita

1.4.4 Current Scenario of the Industry

Currently, multinational cement companies are facing intensive competition with local companies. Lafarge, Cemex, Holcim and Heidelberg are among the top ten cement companies in the world, but together they make up only around 27% of the Bangladesh market.

Scan cement of Heidelberg Group is the biggest among the foreign companies, but its market share is around 9.3% despite it has been in Bangladesh for nearly a decade. Holcim's market share is around
6.4% despite it bought three plants in quick succession more than half a decade back as it planned to emerge as the top player in the country. Lafarge and Cemex, the world's first and the second largest cement companies have been struggling to survive in the industry.

Local companies are grabbing the top slot of the industry by operating in economy of scale and with deft marketing strategy. For example, Shah Cement, a subsidiary of the country's biggest conglomerate Abul Khaer Group is now in the top of the industry beating Heidelberg and Holcim by deploying a fleet of trucks in the main growth areas and building the best marketing network in the country.

Local companies are investing in backward linkages (captive power plants), have built big plants to reduce cost of production and have a fleet of trucks to carry the products right to the doorsteps of consumers. Quality-wise also, the local companies have made rapid strides.

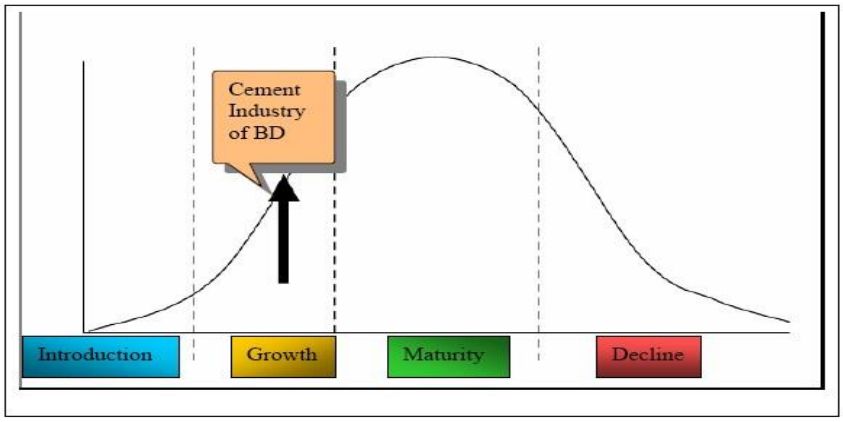
Multinationals bear high overhead costs regarding salary, infrastructure, quality control etc. On the other hand, local companies are more focused to keep the overhead costs low. Multinationals are only concentrating in providing high quality products. But local companies are concentrating in offering quality product with additional benefits like home delivery system, rebate, gifts etc.

Local manufacturers have been pursuing more innovative and aggressive business strategy compared to multinationals. Local manufacturers seek to seize large market by reaching mass people through economies of scale while multinationals cater the needs of specific group of customers by charging high price through superior brand value and quality.

1.4.5 Industry Survivors: Large Companies

During last five years almost 32 cement companies have been shut down due to inadequacy of raw materials. It's too difficult to the small manufacturers to survive in the industry due to the shortage of raw materials since small companies face difficulties to arrange the raw materials in competitive price. Currently, the basic trend in cement industry is smaller companies are shutting down and the bigger companies are becoming bigger. Only 10-15 companies are holding 80% of market share.

Considering the Life cycle of the industry, currently cement industry of Bangladesh is in the growth stage. Sales of cement are increasing due to an enormous demand for cement in both the local and foreign markets. The industry realized about 30% and 21% growth in 2009 and 2010 respectively after suppressed demand from previous years.



Industry expected demand growth is 20%-25% for the next three years based on the assumptions below.

a) Government would be able to materialize its important ADP of building big infrastructure projects.
b) According to the UN Population Fund (UNFPA) report 2010, 28% people of our country live in urban areas where the population growth is 3.2 per thousand. Urbanization and demand for accommodation is increasing day by day. Thus it is expected that the real sector will grow steadily with the household users' increasing cement consumption pattern.

Table 1.4.5: Population Growth Rate of Bangladesh

Year	Total Number of population (mn)	Population Growth Rate
2000	140.77	1.8%
2001	143.29	1.8%
2002	145.80	1.8%
2003	148.28	1.7%
2004	150.73	1.6%
2005	153.12	1.6%
2006	155.46	1.5%
2007	157.75	1.5%
2008	160.00	1.4%
2009	162.22	1.4%
2010 (est.)	164.40	1.3%
2050 (forecasted)	176.53	7.4%

c) Private sector may get interested to invest in real estate for getting tax advantages of their undeclared funds.
d) Good number of large infrastructure construction projects (Padma Bridge, Flyovers, highways) are on the pipeline.
e) There is no "Substitute" for Cement. Steel can be used in construction but in limited extent due to its high cost.

On the flip side, some caution has to be maintained due to the current demand- supply gap leading to overcapacity and falling margins and prices. Also, given the close linkages between them, the effect of a slowdown in real estate growth or hike in interest rates globally or price increase of imported raw materials should also be considered.

1.4.6 Cement Industry: Global Scenario

World production of cement is 2.6 billion tons/year (FY2010). The world production of cement is dominated by China (1,400 mn MT), followed by India (260 mn MT), United States, Japan and Russia. Other countries featuring prominently on the global cement space include Spain, South Korea, Italy, Iran, Turkey, and Brazil. Significant capacity expansions in China, India, Saudi Arabia, UAE, Turkey, Egypt, and Brazil are underway and planned for the next few years. China and India, together account for more than 50% of the total cement produced and consumed in the world. Developed markets including the US, Western Europe and Japan are mature and currently facing declining demand due to the global economic crisis.

The largest global players are Lafarge (France), Holcim (Switzerland) and Cemex (USA). In terms of cement production, Bangladesh ranks about 40th in the world.

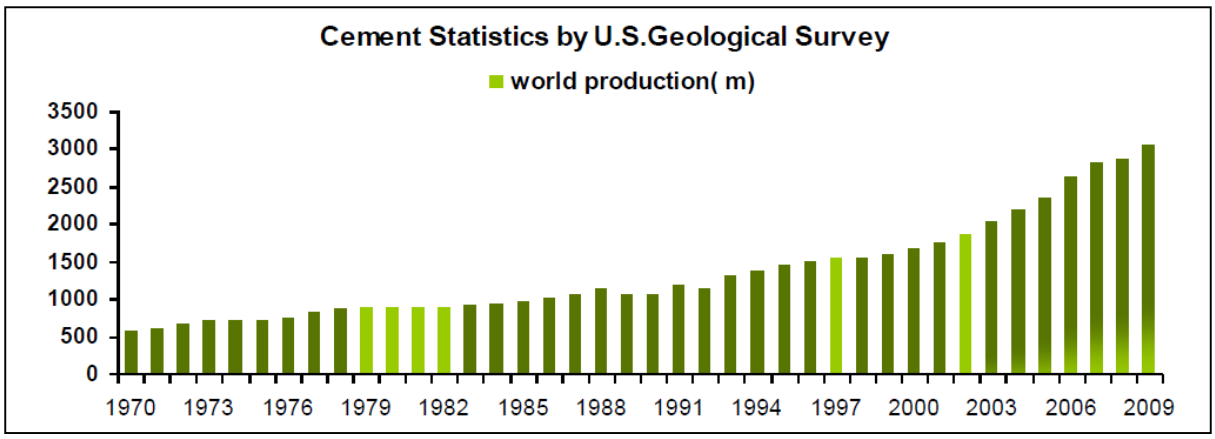


Figure 1.4.6: Cement Statistics by U.S. Geological Survey

According to Global Industry Analysts, Inc., global demand for cement is forecasted to rise 4.1% per year and reach to 3.5 billion metric tons in 2013. Gains will be fueled by rising investments in infrastructure among the developing countries of the world, driven by economic growth and increasing per capita income levels.

Table 1.4.6: Global producers, per capita consumption of cement

Top Five Global Producers (mn MT/year)	
China	1,400
India	260
Japan	84
USA	68
Russia	53

Per capita consumption (kg): FY-2009	
Korea	1,200
China	1,000
India	135
Pakistan	130
Bangladesh	65
Asian group	400
Middle east	600
World average	270

Global Cement Consumption		
	mn MT	CAGR %
FY 2007	2,568	9.9
FY 2008	2,763	7.6
FY 2009	2,857	3.4

1.4.7 Strong Future Growth of Developing Asian countries

A number of developing countries in the Asia/Pacific region are attaining strong gains in cement consumption. China, which accounts for nearly half of world cement demand, is facing a slowing rate of growth as construction spending is decelerating. Other fast-

growing markets for cement in the region like Philippines, Thailand and Vietnam, all are enjoying stable growth rates of exceeding 6% per year. In the developing nations of Latin America, Eastern Europe and the Africa/Mideast region, however, advances in cement demand has slowed down considerably from the robust gains seen during the 2003-2008 period. Increases in cement demand in the developed areas of the US, Western Europe and Japan is lagging the average global pace of growth.

Basically, by nature, global demand of cement is rotating according to the growth of the construction sector in each region. High demand for cement had been observed in Europe and America during FY1960-70. After FY1970, cement demand shifted to India, Malaysia, Hongkong, Singapore and Korea. High Demand for cement continued in these areas till FY1990. From FY2000, developing countries of Asian regions like Bangladesh, Pakistan, Nepal and Burma are now enjoying high growth rate of cement consumption. This trend is expected to continue till FY2035.

1.5 EIA objectives

The objectives of the EIA study include assisting Aman Cement Mills Unit-2 Ltd. and concerned stakeholders and governmental authorities in recognizing environmental, social, and economic impacts of the proposed project, recommending appropriate control, mitigation and monitoring measures, as well as increasing awareness about the plant and its potential impacts.

1.6 Scope of Work

Besides this introductory Chapter, the scope of work implemented in the preparation of the EIA study consists of the following:

- Definition of existing legal and administrative framework (Chapter 2)
- Description of the proposed project (Chapter 3)
- Definition of baseline environmental (Chapter 4)
- Potential environmental impacts (Chapter 5)
- Analysis of alternatives to the proposed project (Chapter 6)
- Development of an environmental management plan including mitigation, monitoring, capacity building and institutional strengthening (Chapters 7, 8,9)
- Public consultation and involvement of local Agencies in the EIA (Chapter 10)

1.7 Consistency with DoE Guidelines

Environmental Conservation Act, 1995 (ECA, 1995) is currently the main legislative document relating to environmental protection in Bangladesh. Under this Act, 'No industrial unit or project shall be established or adopted without obtaining environmental clearance, n the manner prescribed by the rules, form Director General'. Compliance with the provision of this Act is the responsibility of Department of Environment (DoE). A set of the relevant rules to implement the ECA, 1995 has recently been promulgated (August 1997). The rules mainly consist of:

- Categorized list (green, orange and red) of the project;

- Application format to take environmental clearance;
- Ambient standards in relation to water pollution, air pollution and noise, as well as permitted discharge/emission levels of water and air pollutants and noise by industries.

The Rules incorporate "inclusion lists" of projects requiring varying degrees of environmental investigation e.g. all the raw projects under red category generally will require two steps assessment procedure, firstly an Initial Environmental Examination (IEE) for site clearance and secondly if warranted a full Environmental Impact Assessment (EIA) for technical clearance. Our concern Aman Cement Mills Unit-2 Ltd. falls under red category. The present environmental study called EIA has been carried out as follow up study of IEE, which is the requirement of DoE for such type of industrial set up.

Please see Site Clearance Certificate of ACML-2 by DOE in ***Annex-4***

1.8 EIA Study Methodology

The main purpose of this study was to determine if the project is feasible from the environment viewpoint.

The study has reviewed and documented baseline situation and analyzed possible potential impacts of developing the project. Recommended mitigation measures have been included for potential adverse impacts and enhancement measures for the positive ones. In addition, the study recommended monitoring programme to be followed during subsequent phases of the project so as to ensure the project remains environmentally sound.

Keeping in view the nature and size of the Aman Cement Mills Unit-2 Ltd. and based on guidelines of Ministry of Environment and Forests, Government of Bangladesh, and past experience of carrying out similar studies it was decided to cover an area of 10 Km. radius, from the centre of the Aman Cement Mills Unit-2 Ltd. compound. This region has been exhaustively covered for the purpose of environmental impact assessment studies. The work carried out is briefly reported below and is described in detail in the subsequent sections.

The following methods were used in undertaking this study:

1.8.1 Literature Review

Literature review of reports, documents and other relevant information about the project was concluded. The review also included other literature and data found important.

1.8.2 Site Visit

Site visit were made to get a general understanding of the target area and assess the environmental impacts of the project.

1.8.3 Consultations

Consultations were made with the stakeholders, districts officials, local leaders and other key information that will be affected by the project.

1.8.4 Air Environment

The existing ambient air quality (AAQ) status within the study region has been assessed through a monitoring network of 6 AAQ sampling stations during winter season. The monitoring network has been designed based on the available climatic normal of predominant wind directions and wind speed of the study region for winter season. The baseline ambient air quality status of the study region was monitored for Suspended Particulate Matter (SPM), and various gaseous pollutants like Sulphur dioxide (SO2) and Oxides of Nitrogen (NOx). Eight hourly sampling was carried out for SPM. All gaseous pollutants were sampled on four hourly basis. High Volume Samplers have been used for monitoring all air pollution parameters. Micro-meteorological data was also recorded on hourly basis using a manual weather station. Weather station for this purpose was installed project site.

1.8.5 Noise Environment

Noise Environment may cause an adverse effect on human being and associated environment including land, structures, domestic animals, wild life and natural ecological systems. Hence, noise survey was carried in and around the project site. Equivalent noise levels were measured using a precision noise 9 level meter, at residential areas, schools, hospitals, bus-stands and commercial centers etc. A total of 8 locations were covered within the 10 Km radial distance.

1.8.6 Water Environment

Information on water resources was collected during the study period. 6 water samples were collected from various locations within the 10 Km radial distance. The parameters of prime importance were selected under physical, chemical (inorganic and organic) and heavy metal groups. As the process does not generate any effluents waste water characterization has not been done.

1.8.7 Land Environment

Soil samples were collected from adjacent areas of the project site, in order to assess the field infiltration rates and limitations of the soil for growth of appropriate plant species around the site. Plant species for development of green belt were identified taking into consideration the attenuation factors for air pollutants.

1.8.8 Socio-Economic Environment

Baseline data for socio-economic and cultural environment is important in conducting EIA studies. Any developmental activity will bring about changes in socio-economic pattern. Data on demographic pattern, population characteristics, employment, income, mortality rate, health status, land use pattern, energy and fuel consumption, and transport and recreation facilities were collected from neighboring villages. All the aforesaid environmental parameters will be used for identification, prediction and

evaluation of significant impacts. Using the baseline data prediction of impacts of the project has been undertaken.

1.9 The EIA Process

The first phase of an environmental assessment is called an Initial Environmental Examination (IEE) and the second is Environmental Impact Studies (EIS) or simply detailed EIA.

a) Initial Environmental Examination (lEE)

IEE is carried out to determine whether potentially adverse environmental effects are significant or whether mitigation measures can be adopted to reduce or eliminate these adverse effects. The IEE contains a brief statement of key environmental issues, based on readily available information, and is used in the early (pre-feasibility) phase of project planning. The IEE also suggests whether in-depth studies are needed. When an IEE is able to provide a definite solution to environmental problems, an EIA is not necessary. IEE also requires expert advice and technical input from environmental specialists so that potential environmental problems can be clearly defined.

b) Environmental Impact Assessment (EIA)

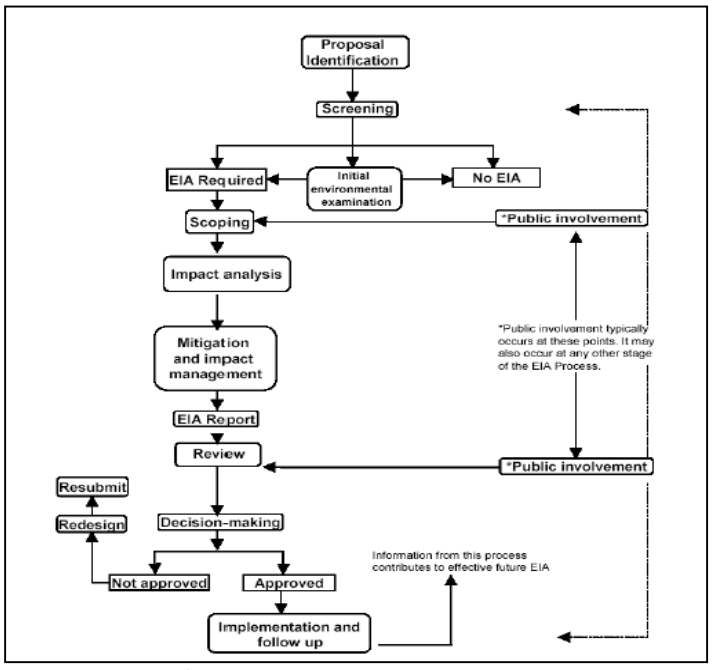


Figure 1.9: EIA Process

EIA is a procedure used to examine the environmental consequences or impacts, both beneficial and adverse, of a proposed development project and to ensure that these effects are taken into account in project design. The EIA is therefore based on predictions. These impacts can include all relevant aspects of the natural, social, economic and human environment. The study therefore requires a multi-disciplinary approach and should be done very early at the feasibility stage of a project. In other words, a project should be assessed for its environmental feasibility. EIA should therefore be viewed as an integral part of the project planning process. Unlike the environmental audit (EA), which is conducted on existing projects, the EIA is applied to new projects and the expansion aspects of existing projects. The phases of an EIA from screening to follow-up are illustrated in Figure below.

1.9.1 Definition of EIA

Environmental Impact Assessment (EIA) can broadly be defined as a study of the effects of a proposed project, plan or program on the environment. The legal, methodological and procedural foundations of EIA were established in 1970 by the enactment of the National Environmental Policy Act (NEPA) in the USA. At the international level, lending banks and bilateral aid agencies have EIA procedures that apply to borrowing and recipient countries. Most developing counties have also embraced and are in the process of formalizing EIA through legislation. The paper highlights the evolution to current status, the legal framework, concepts, processes and principles of EIA and associated studies.

Environmental Impact Assessment (EIA) is a process of evaluating the likely environmental impacts of a proposed project or development, taking into account inter-related socio-economic, cultural and human-health impacts, both beneficial and adverse. UNEP defines Environmental Impact Assessment (EIA) as a tool used to identify the environmental, social and economic impacts of a project prior to decision-making. It aims to predict environmental impacts at an early stage in project planning and design, find ways and means to reduce adverse impacts, shape projects to suit the local environment and present the predictions and options to decision-makers. By using EIA both environmental and economic benefits can be achieved, such as reduced cost and time of project implementation and design, avoided treatment/clean-up costs and impacts of laws and regulations.

1.10 Limitation of the Study

The present EIA Report has been prepared based on the Primary field investigations / assessment, and secondary data collected from Bangladesh Meteorological Department (BMD), Department of Environment, Bangladesh (DoEB) and others and published journals, and books, public consultation and site observations. The environmental and social assessment is based on the information collected from the various Agencies, community consultations and observations. Professional judgment and subjective interpretation of facts and observations has been applied for the preparation of the EIA Report.

Additionally other facilities like power, gas and water supply are to be developed by the concerned Government agencies. Alignment of these pipe lines and facilities are not known thus impacts due to development of these facilities cannot be assessed.

1.11 Structure of the Report

This EIA report has been prepared strictly following the report structure desired by DoE as per ToR. The EIA report contains project features, baseline environmental conditions, assessment of environmental impacts, and formulation of mitigation measures along with environmental management and monitoring plan.

The report includes the following chapters:

Executive Summary

The executive summary gives the synopsis of the EIA Report.

Chapter 1: Introduction

This chapter provides background information of the project proponent, need for the EIA study as per prevailing legislation, Location and brief description of the project, methodology adopted for EIA study and structure of the report.

Chapter 2: Legislative, regulation and policy consideration

This chapter deals with the details of the potential legal, administrative, planning and policy framework which have been used in the preparation of the EIA Report.

Chapter 3: Project Description

This chapter deals with the details of the proposed Aman Cement Mills Unit-2 Ltd. such as location, connectivity, project requirements, Infrastructure development, environmental consideration, project cost, implementation schedule, etc.

Chapter 4: Environmental and Social Baseline

This Chapter describes the baseline environmental conditions around the project site for various environmental attributes, viz. physical, biological and socio-economic, within the 10 km radial zone, which is termed as the study area. Topography, soil, water, meteorology, air, noise, and land constitute the physical environment, whereas flora and fauna constitute the biological environment. Demographic details and occupational pattern in the study area constitute socio-economic environment. Baseline environmental conditions are based on the information collected from the various agencies and the secondary data collected from published sources.

Chapter 5: Hydro-morphological characteristics

This chapter discusses the hydro-morphological characteristics of the Upper Meghna River near the Aman Cement Mills site

Chapter 6: Identification and Analysis of Key Environmental Issues

This chapter details the analysis of the key environmental issues.

Chapter 7: Prediction and Evaluation of Impacts

This chapter details the inferences drawn from the environmental impact assessment of the proposed project. It describes the overall impacts of the project activities and underscores the areas of concern, which need mitigation measures.

Chapter 8: Environmental Management Plan

This Chapter provides mitigation and control measures to attenuate and/or eliminate environmental impacts, which are likely to be caused by the proposed project. An Environmental Management Plan (EMP) has been developed to mitigate the potential adverse impacts and to strengthen the beneficial impacts. This chapter also provides the environmental monitoring plan proposed for the project.

Chapter 9: contingency Plan/disaster management Plan

This chapter contains a contingency (Disaster management) plan for the proposed Aman Cement Mills Unit-2 Ltd.

Chapter 10: Analysis of Alternatives

This chapter provides the information about the site and its alternatives

Chapter 11: Public Consultation and Disclosure Meeting

This Chapter provides an insight into the process & methodology followed for carrying out the public consultation meetings in study area and proceedings of pubic consultations

Chapter12: Conclusions

This chapter concludes on the findings that emerged from the environmental assessment study and summarizes the key points to be addressed to ensure the environmental sustainability of the project during the construction and operation phases.

Chapter13: Conclusions

This chapter provides the list of references, list of tables and figures including list of annexure.

1.12 EIA Team

A multidisciplinary team of professionals having experience of conducting Environment & Social Impact Assessment Studies for Industrial Parks, Industrial Areas, Special Economic Zones, DTA, Economic Zones, Area development, Industrial Corridors etc was involved in carrying out EIA study for this project. Details of the professionals are given in the table 1.12 below:

Table 1.12: EIA Team

Name of Professional	Area of Expertise	Position Assigned
Dr. Md. Tauhid Ur Rahman, PhD (Env Engg), MSc (Env Engg, Sweden), BSc (Civil Engg)	Environment Impact Assessment, Environmental Management Plan and Environmental & Social management framework	Team Leader & Sr. Env.& EIA Specialist
Muhammad Abul Foysal, PhD Fellow (BUP), MS in Forestry (CU).	Socio-Environment	Socio-Environmental Specialist
Md. Shahidul Karim, MS in Architecture and Planning	Architecture & Planning	Urban Planner
Khyr Ali, MS in Geography	Land Use Land cover & Remote Sensing	GIS & Land Use Specialist
Md. Rabiuzzaman, MS in Environmental Science	Environment Impact Assessment & Environment Management Plan	Support Environmentalist
Tamanna Hossain, Lecturer, Environmental Science, Stamford University	Soil Resources & Quality Assessment, Agricultural Resource Assessment	Soil Expert
Isfaqul Kabir, MS in Development Studies	Agriculture and Fisheries	Agro-Fisheries Expert
Md. Lokman Hossain, MS in Global Change Ecology, Germany	Ecology	Ecologist

1.13 Acknowledgement

As a major unit of Aman EZ, ACML-2 got various legal and institutional guidance from Bangladesh Economic Zone Authority (BEZA); we acknowledge the thorough support from BEZA. We also acknowledge the input from previous reports, documents, etc. used in this reports with due reference and the data from the organizations and institutions (and their websites) like Bangladesh Agriculture Research Council (BARC), Bangladesh Economic Zone Authority, Bangladesh Water Development Board, Department of Environment, Bangladesh Meteorological Department, Bangladesh Forest Department, Bangladesh Bureau of Statistics, Bangladesh Food & Agriculture Department (FAO, Bangladesh), Geological survey of Bangladesh, Disaster Management Bureau (DMB) and so on.

Some web documents and websites like Banglapedia and National Web Portal of Bangladesh were very useful throughout the study. We also acknowledge the support and help of participants and interviewees in different consultation and interview season for their precious opinion and views.

Chapter 2
Policy, Legal and Administrative Framework

The Environmental Law 1992 made EIA mandatory of all new industries. It required EIA to be applied to the planning and operational stages of projects. Under the Environmental Protection Act, 1995, projects specified in a "green list" are not subject to an EIA. As yet, there is no separate EIA legislation although draft proposals have been tabled by the Bangladesh Environmental Agency. There are some sectoral EIA regulations such as those for the Water Management Programme of the Ministry of Water Resources, but, to date sectoral EIA guidelines have only been prepared for industries. The National Environmental Management Action Plan (NEMAP) soon to become operational will provide a means of EIA coordination. The Department of Environment (DoE) will have overall responsibility for the EIA system.

2.1 Provisions under the Environmental Legislations

National laws, by-laws and official resolutions relevant to road and bridge construction, operation and maintenance and associated activities have been identified under this study. The Bangladesh Environment Conservation Act of 1995 is the key legislation in relation to environment protection in Bangladesh. This Act is promulgated for environment conservation, standards, development, pollution control, and abatement. It has repealed the Environment Pollution Control Ordinance of 1977. The Act has been amended in 2000, 2002, 2007 and has been proposed for amendments in the year 2010.

The main objectives of the Act are:

- Conservation and improvement of the environment; and
- Control and mitigation of pollution of the environment.

The main strategies of the Act can be summarized as:

- Declaration of ecologically critical areas and restriction on the operations and processes, which can or cannot be carried/initiated in the ecologically critical areas;
- Regulations in respect of vehicles emitting smoke harmful for the environment;
- Environmental clearance;
- Regulation of the industries and other development activities' discharge permits;
- Promulgation of standards for quality of air, water, noise and soil for different areas for different purposes;
- Promulgation of a standard limit for discharging and emitting waste; and
- Formulation and declaration of environmental guidelines.

Before any new project/development interventions by the government or by non-government agencies can go ahead, as stipulated under the Environment Conservation Rules 1997, the project promoter must obtain Environmental Clearance from the Director General of DoE. An appeal procedure does exist for those promoters who fail

to obtain clearance. Failure to comply with any part of this Act may result in punishment of imprisonment or fine or both. The DoE executes the Act under the leadership of the Director General.

The Bangladesh Environment Conservation Act (Amendment), 2000 focuses on: (1) ascertaining responsibility for Compensation in cases of damage to ecosystems, (2) increased provision of punitive measures both for fines and imprisonment and (3) fixing authority on cognizance of offences.

The Bangladesh Environment Conservation Act (Amendment), 2002 elaborates on: (1) restriction on polluting automobiles, (2) restriction on the sale and production of environmentally harmful items like polythene bags, (3) assistance from law enforcement agencies for environmental actions, (4) break up of punitive measures and (5) authority to try environmental cases.

The Bangladesh Environment Conservation Rules, 1997 is the first set of rules, promulgated under the ECA 95 (so far there have been three amendments to this set of rules - February and August 2002 and April 2003). The Environment Conservation Rules of 1997 has provided categorization of industries and projects and identified types of environmental assessments needed against respective categories of industries or projects.

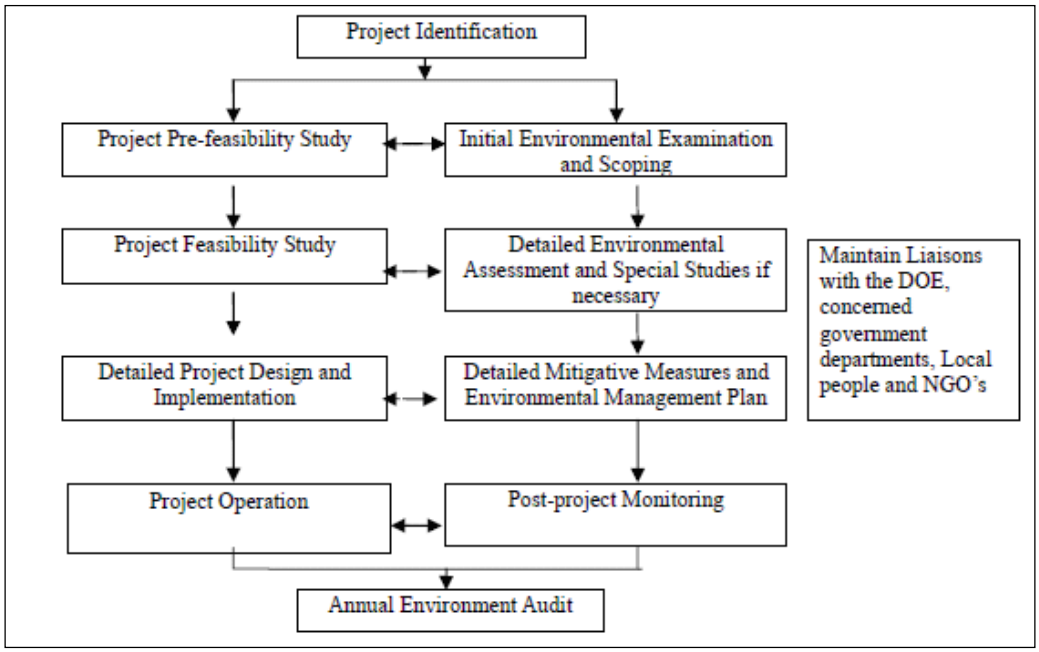
Among other things, these rules set (i) the National Environmental Quality Standards for ambient air, various types of water, industrial effluent, emission, noise, vehicular exhaust etc., (ii) the requirement for and procedures to obtain environmental clearance, and (iii) the requirement for IEE and EIA's according to the categories of industrial and other development interventions.

2.2 Compliance with DOE's EIA Guidelines

As the proposed development fall under the 'red' category according to the Environment Conservation Rules 1997, it is mandatory to carry out EIA including Environmental Management Plan (EMP) and to develop a Resettlement Action Plan where required, for getting environmental clearance from the DoE. The DoE has issued EIA Guidelines for Industries (this document was released in December 1997) and addresses the IEE and EIA for several industrial sectors and activities. Each Project Proponent shall conduct an IEE or EIA and is expected to consult and follow the DoE guidelines (Figure 2.2-a). Under this study the provisions of the environment legislations and the EIA guidelines of the DoE will be painstakingly reviewed.

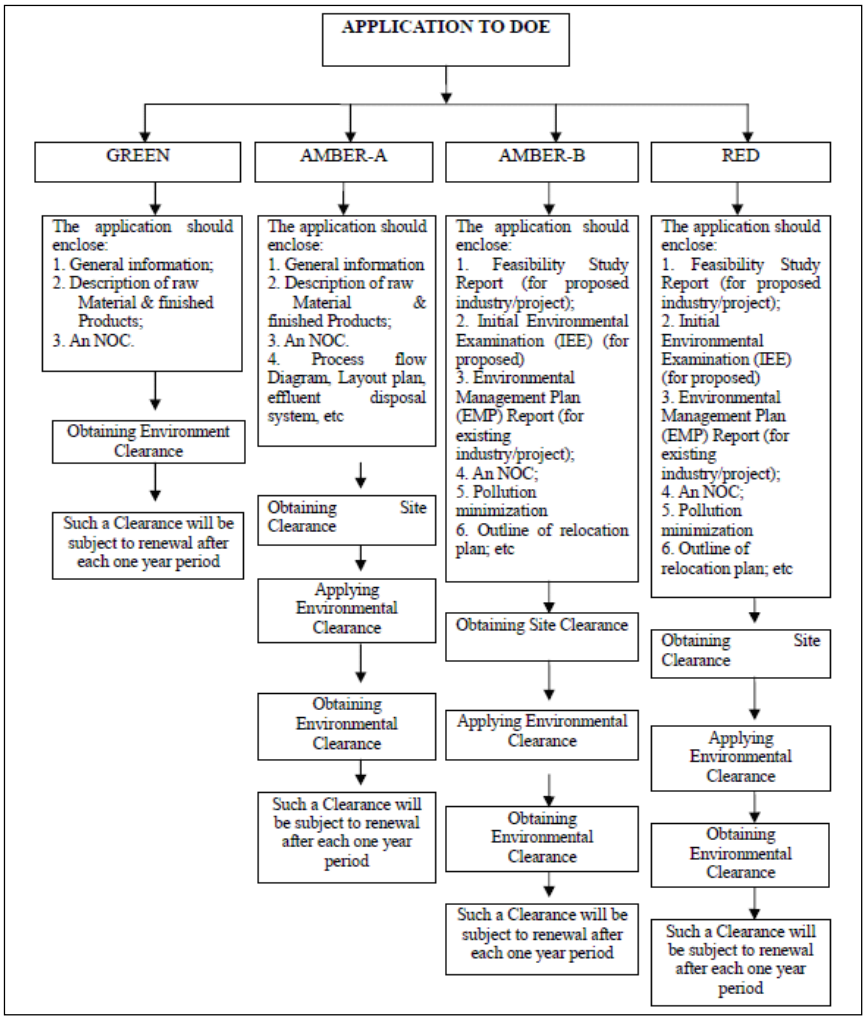
The DoE has issued application procedure for obtaining site/environmental clearance. Figure 2.2 (b) shows the application procedure of all four categories:

Figure 2.2 (a): DoE guidelines for Environmental clearance



(Source: EIA Process, EIA Guideline for Industries, Department of Environment, 1997)

Figure 2.2 (a): Flow Chart of EIA Process



(Source: EIA Process, EIA Guideline for Industries, Department of Environment, 1997)

Figure2.2 (b): Process of obtaining clearance certificate from DoE

2.3 Compliance under the National Laws

2.3.1 Wildlife (protection and safety) Act 2012

The Wildlife (protection and safety) Act 2012, passed in Parliament on 8th July, 2012. Under this act, the hunting, trapping, killing of wildlife are strictly prohibited. After the establishment of this Act, a board will be formed with the concerned members recommended by the Government. There are certain provisions kept in this Act, e.g. entrance, management, rules and regulation of the protected area etc. If any person without license performs any kind of trade, he will be jailed for at least a year. The details of the Act shall be further discussed in the EIA report.

2.3.2 The Forest Act, 1927 and Amendment Act 2000

The Forest Act of 1927 provides for reserving forests over which the government has an acquired property right. This act has made many types of unauthorized uses or destruction of forest produce punishable. The Government may assign any village community its right to or over any land, which has constituted a reserved forest.

According to the Act the government may prohibit certain activities in the declared reserved forest area such as any intervention kindles, keeps or carries any fire; trespasses or pastures cattle, or permits cattle to trespass; causes any damage by negligence in felling any tree or cutting or dragging any timber; etc.

Along the Kohelia River between Matarbari Island and Moheskhali Island, transplanted mangrove forests are distributed.

Therefore, the access road construction complies with this requirement of legislation. During the EIA study this Act and related rules and regulations will be reviewed to explore whether the activities of the access road violates any provisions of the Forest Act.

The Supplementary Rules of 1959 empowered the concerned governmental bodies to restrict totally and for a specified period, the shooting, hunting or catching of various birds, animals and reptiles in the controlled and vested forests. The Private Forest Ordinance of 1959 provides for the conservation of private forests and for the forestation, in certain cases, of wastelands in Bangladesh.

2.3.3 The Penal Code, 1860

The Penal Code of 1860 has some valid provisions related to pollution management, environment protection and protection of health and safety. Some of these are: Section 277: Falling Water or Public Spring or Reservoir; Section 278: Making Atmosphere Noxious to Health; Section 284: Negligent Conduct with Respect to Poisonous Substance; Section 285: Negligent Conduct with Respect to Fire or Combustible Matter; and Section 286: Negligent Conduct with Respect to Explosive Substance. (Chapter XIV of offences affective Public health, safety, convenience, decency and morals).

2.3.4 The Acquisition and Requisition of Immovable Property Ordinance (1982)

This Ordinance has replaced the Land Acquisition Act of 1894 and the East Bengal (Emergency) Requisition of Property Act of 1948. The Ordinance governs acquisition and requisition by the government of immovable property for any public purpose or in the public interest. It may be noted that contrary to the previous Acts (i.e. Act XIII of 1948), this Ordinance deals only with immovable property.

The Ordinance has well-defined procedures regarding payment of compensation for an acquired piece of land. If, for example, the land is used for rice growing, then an amount equivalent to approximately 1.5 times the market value of a given variety of rice (e.g., paddy) that is currently being (or could be) produced annually is fixed as a yearly lease value. In case of outright purchase (carried out on a 99-year lease), the compensation-value of acquired land varies widely according to the locality, soil fertility, and access to transportation and related infrastructure factors. The current compensation and resettlement provisions are however inadequate both in terms of timing of payments and quantum. The procedures involved are cumbersome and time consuming and often causes hindrance to the smooth execution of the project. Legal provisions covering adequate compensation to the project affected persons, particularly disadvantaged groups such as women and squatters and such other vulnerable groups are yet to be framed.

2.3.5 The Protection and Conservation of Fish Rules, 1985

These are a set of rules in line with the overall objectives of the Fish Act. Section 5 of the Rules requires that "No person shall destroy or make any attempt to destroy any fish by explosives, gun, bow and arrow in inland waters or within coastal waters". Section 6 of the Rules states:-"No person shall destroy or make any attempt to destroy any fish by poisoning of water or the depletion of fisheries by pollution, by trade effluents or otherwise in inland waters". Therefore, the new bridge construction will need to be carried in such a manner that the activities do not cause damage to the inland waters or within coastal waters fisheries.

2.3.6 The Embankment and Drainage Act, 1952

The East Bangle Act No. 1, 1952 was amended in 1953 which has been adapted by the People Republic of Bangladesh, by the Bangladesh Order (adaptation of Existing Laws), 1972 (President's Order No. 48 of 1972). The Act consolidates the laws relating to embankments and drainage providing 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 or other damage by water.

The specific Sections and Articles relevant to the Project are mentioned below:

Section 4 (1) of the Act states that the embankment, water-course, and tow-path, earth, pathways, gates, berms and hedges of the embankments shall vest in the Government of the Authority (BWDB).

Section 56 (1) states that, person will be subject to penalty (500 taka or other imprisonment if he erects, or causes of willfully permits to be erected, any new embankment, or any existing embankment, or obstructs of diverts, or causes or willfully permits to be obstructed or diverted, any water course.

Section 15 allows for the engineer (engineer in charge of Divisional level BWDB) for constructing new embankment or enlarging, lengthening or repairing existing embankments.

The other sections of the Act give powers and access to the Government or Authority or Engineers to commence necessary Project activities, for land acquisition (through the Deputy Commissioner), and site clearing activities including removal of trees or houses (if necessary).

2.3.7 The Water Resources Planning Act, 1992

An Act made to ensure the development and balanced use of water resources or it is expedient to make provisions in order to ensure the development and balanced use of water resources.

Under this act water resources planning institutions conduct the general planning of environmentally balanced water resources for the purpose of developing water resources; to determine the methods for the scientific utilization and preservation of water resources; provide advice to other institutions involved in the development, utilization and preservation of water resources; co-operate any organization for the development, utilization and preservation of water resources and to conduct any special investigations on any matter relating thereto; evaluate and review any matter for development, utilization and preservation of water resources; training relating to, and to raise the professional standard in the utilization of water resources and review information on the utilization of water resources, and provide assistance for their publication;

2.3.8 Water Pollution Control Ordinance 1970

Applicable from the prospective of prevention of water pollution, during construction stage (e.g. sewage and equipment washing and maintenance liquid waste discharges at construction camps).

2.4 Policy Guidance

Under the study a number of sectoral national policies will be reviewed to identify the guiding principles which are relevant to the access road construction, operation and maintenance activities. The sector policies will include environment, communication, forest, etc.

2.4.1 National Environment Policy

The National Environment Policy of 1992 sets out the basic framework for environmental action, together with a set of broad sector action guidelines. The Policy provides the broader framework of sustainable development in the country. It also stated all major undertakings, which will have a bearing on the environment; (including setting

up of an industrial establishment) must undertake an IEE and EIA before initiation of the project.

The Policy delineates DOE, as the approving agency for all such IEE and EIA studies to be undertaken in the country.

2.4.2 National Environment Management Plan 1995

The National Environment Management Action Plan (NEMAP) is a wide ranging and multi-faceted plan, which builds on and extends the statements set out in the National Environment Policy (NEP). NEMAP was developed to address the issues and management requirements for a period between 1995 and 2005 and set out the framework within which the recommendations of the National Conservation Strategy (NCS) are to be implemented.

NEMAP has the following broad objectives:

- Identification of key environmental issues affecting Bangladesh;
- Identification of actions necessary to halt or reduce the rate of environmental degradation;
- Improvement of the natural and built environment
- Conservation of habitats and biodiversity;
- Promotion of sustainable development; and
- Improvement in the quality of life of the people.

2.4.3 The National Forest Policy (1994)

The National Forestry Policy of 1994 is the revised version of the National Forest Policy of 1977 in the light of the National Forestry Master Plan. The major targets of the Policy are to conserve the existing forest areas; bring about 20% of the country's land area under the forestation program, and increase the reserve forest land by 10% by the year 2015 through coordinated efforts of GO-NGOs and active participation of the people.

The need for amendments of the existing forestry sector related laws and adopt new laws for sector activities has been recognized as important condition for achieving the policy goals and objectives. The Forest Policy also recognizes the importance of fulfilling the responsibilities and commitments under international multilateral environmental agreements.

2.4.4 The National Water Policy (1999)

The National Water Policy of 1999 was adopted to ensure efficient and equitable management of water resources, proper harnessing and development of surface and ground water, availability of water to all concerned and institutional capacity building for water resources management. It has also addressed issues like river basin management, water rights and allocation, public and private investment, water supply and sanitation and water needs for agriculture, industry, fisheries, wildlife, navigation, recreation, environment, preservation of wetlands, etc.

2.4.5 The National Conservation Strategy

Applicable for all Sustainable development projects, Usage of energy efficient material, green building techniques, reduction of carbon foot prints etc.

2.4.6 The National Energy Policy, 1995

Protecting the environment by requiring an EIA for any new development project, introduction of economically viable and environment friendly technology. Energy efficient materials and techniques should be explored

2.4.7 The National Water Management Plan, 2001

Addresses options for water quality, considerations behind measures to clean up industrial pollution, where effluent discharge monitoring and zoning regulations for new industries are emphasized. Applicable as it is industrial project and will involve generation of effluent and sewage. Installation of effluent treatment facility is within the premises.

2.4.8 Bangladesh Climate Change Strategy and Action Plan (2008 and revised in 2009)

The GOB also prepared the Bangladesh Climate Change Strategy and Action Plan (BCCSAP) in 2008 and revised in 2009. This is a comprehensive strategy to address climate change challenges in Bangladesh. Bangladesh Climate Change Strategy and Action Plan built on and expanded the NAPA. It is built around the following six themes:

- Food security, social protection and health
- Comprehensive disaster management
- Infrastructure
- Research and Knowledge management
- Mitigation and low carbon development
- Capacity building and Institutional strengthening
- There are 44 specific programs proposed in the BCCSAP under the above six themes.

2.4.9 Bangladesh Environment Protection Act, 1995

An Act made to protect the environment, to improve the quality of the environment and to control and abate the pollution of the environment. Whereas it is expedient to provide for the protection of the environment, the improvement of the environmental standard and the control and abatement of the pollution of the environment; Now, therefore, it is enacted as follows:-

(1) The Government may, if it is satisfied that the eco-system of any area has reached, or is likely to reach, a critical state, declare, by notification in the official Gazette, such area to be an ecologically critical area.

(2) The Government shall, in the notification issued under sub-section (1) or by separate notification, determine the operations or processes which shall not be continued or commenced in the ecologically critical area.

(3) There shall not be driven any vehicle producing smoke which is injurious to health or harmful to the environment.
(4) If the General Manager or any officer authorized by him in this behalf is satisfied that any moving vehicle emits smoke which is injurious to health or harmful to the environment, he may immediately stop and examine the vehicle and may give such directions in respect of anything relating to the examination of the vehicle as he thinks necessary.
(5) Where the discharge of an environmental pollutant in excess of the limit prescribed by rule occurs or is likely to occur as a result of any accident or any other unforeseen act or event, the person responsible for such discharge or in charge of the place where such discharge occurs shall be bound to prevent or abate the environmental pollution occurred.
(6) The person mentioned in sub-section (1) shall without any delay inform the Director General about the occurrence of an event under the said sub-section or the apprehension of the occurrence of such event.
(7) On receipt of information about any event or accident under this section, the Director General shall, as fast as possible, take such remedial measures as are necessary for the control and abatement of the environmental pollution and the said person shall be bound to render to the Director General such assistance and co-operation as the Director General demands.
(8) The expenses incurred in respect of remedial measures for the control and abatement of environmental pollution under this Act shall be recoverable by the Director General from the said person as public demand.
(9) Environmental clearance.- No industrial enterprise shall be established nor any industrial project undertaken anywhere without obtaining, in such manner as may be prescribed by rules, a clearance from the Director General: Provided that nothing contained in this section shall be applicable in the case of an industrial enterprise or project of a class the Government may, from time to time, specify in this behalf.

2.4.10 Relevant National Policies

During recent years a number of national policy documents have been prepared and where accepted by GoB. These policy initiatives, strategies and plans all emphasize consideration of the environment and natural resources in order to achieve sustainable development. A summary of the major relevant policy documents prepared is given in Table 2.4.9. It is relevant to mention that GoB has prepared a National Strategy for Accelerated Poverty Reduction showing its strong commitment to achieving the Millennium Development Goals as defined by the UN. While the Government has made important strides towards achieving these targets, this report highlights a number of sources of environmental degradation that merit greater emphasis, not only to bring Bangladesh closer to achieving its targets but also to contribute to the removal of environmental constraints to poverty reducing growth.

Table 2.4.9: Relevant Major Policies

Policy	Brief Description	Responsible Agency
National Land Transport Policy (2004)	New roads and major improvements will be subjected to an EIA, Funding will be provided for mitigation measures, Environmental (design) standards for new roads	Road & Highways
National Land Use Policy (2001)	The policy deals with land uses for several purposes including agriculture, housing, forestry, industrialization, railways and roads. The plan identifies land use constraints in these sectors.	Ministry of Land
National Forest Policy and Forest Sector Review(1994,2005)	Afforestation of 20% land; Bio-diversity of the existing degraded forests; Strengthening of agricultural sector Control of global warming, desertification, control of trade in wild birds and animals Prevention illegal occupation of the forestlands, tree felling	Ministry of Environment and Forest
National Biodiversity Strategy and Action plan (2004)	Conserve, and restore the biodiversity of the country; Strategy and Action - Maintain and improve environmental stability of ecosystems; Ensure preservation of the unique biological heritage of the nation for the benefit of the present and future generations; Guarantee safe passage, and conservation of globally endangered migratory species, especially birds and mammals in the country; Stop introduction of invasive alien species, genetically modified organisms and living modified organisms.	Ministry of Environment and Forest (MOEF)
National Fisheries Policy (1998) and Inland Capture Fisheries Strategy (2004)	Preservation, management and exploitation of fisheries and resources in inland open water; Fish cultivation and management in inland closed water; Prawn and fish cultivation in coastal areas; Preservation, management and exploitation of sea fishery resources	Ministry of Fisheries and Livestock
National Agricultural Policy, 1999	The policy deals with programs to make the nation self-sufficient in food through increased production of all crops and I to ensure a dependable food security system	Ministry of Agriculture
Draft Wetland Policy, 1998	Establishment of principles for sustainable use of wetland resources; Maintenance of existing level of biological diversity; Maintenance of the functions and values of wetlands Promotion and recognition of the value of wetland functions in resource management and economic development	Ministry of Environment and Forest

2.4.11 Other Relevant Legislation in Bangladesh

There are a number of other laws and regulations applicable which are relevant for the project. These are the following, see Table 2.4.10.

Table 2.4.10: Other Relevant Legislations Applicable

Act/Law/Ordinance	Brief Description	Responsible Agency
Environment Court Act, 2000 and subsequent amendments in 2002	Describes environment related legal proceedings	Ministry of Environment and Forest (MOEF)
The Vehicle Act, 1927 The Motor Vehicles Ordinance, 1983	Provides rules for exhaust emission, air and noise pollution and road and traffic safety	Bangladesh Road Transport Authority (BRTA)
The Removal of Wrecks and	Rules for removal for wrecks and obstructions	Bangladesh Water

Obstructions in inland Navigable Water Ways Rules 1973		Transport Authority
Water Supply and Sanitation Act, 1996	Regulate the management and control of water supply and sanitation in urban areas	Ministry of Local Government, Rural Development and Cooperatives
The Ground Water Management Ordinance 1985	Describe the management of ground water resources and licensing of tube wells	Upazilla Parishad
The Private Forests Ordinance Act, 1959	Deals with the conservation of private forests and afforestation of wastelands.	Ministry of Environment and Forest
The Protection and Conservation of Fish Act 1950 subsequent amendments in 1982	Deals with the protection/ conservation of fishes in Government owned water bodies	Department of Fishery
The Antiquities Act 1968	Describes the preservation of cultural heritage, historic monuments and protected sites.	Department of Archaeology.
The Land Acquisition Act, 1894 and The Acquisition and Requisition of Immovable Property Ordinance 1982 and subsequent amendments in 1994, 1995 and 2004	Describes procedures and provides guidelines to acquisition and requisition of land	Ministry of Land
Bangladesh Labor Law, 2006	Deals with the occupational rights and safety of factory workers; provision of comfortable work environment and reasonable working conditions	Ministry of Labour.
The Explosive Act, 1884	To prevent any accident due to explosive storage, use or transportation due to careless handling/management May be Applicable depending on quantity of fuel storage Fuel will be stored and used at site for running various construction machinery and equipment	Minitry of Power, Energy and Mineral Resources
Natural Water Bodies Protection Act 2000	The character of water bodies i.e. rivers, canals, tanks, or floodplains identified as water bodies in the master plans or in the master plans formulated under the laws establishing municipalities in division and district towns shall not be changed without approval of concerned ministry.	Regulatory authority is Town Development Authority/Municipalities
Wetland Protection Act 2000	Adhere to a formal environmental impact assessment (EIA) process, as set out in EIA guidelines and manuals for water sector projects or related to alteration of natural drainage. No construction of roads if likely to effect the flow of navigable water ways without clearance from concerned authorities Upland flow in water channels to preserve eco-system Protection against degradation and resuscitation of natural water-bodies such as lakes, ponds, beels, khals, tanks, etc. affected by man-made interventions or other causes. Completely stop the filling of publicly-owned water bodies and depressions in urban areas for preservation of the natural aquifers and environment.	Permission to be taken from the Ministry of Water Resources and DOE

	Stop unplanned construction on riverbanks and indiscriminate clearance of vegetation on newly accreted land.	
The Building Construction Act 1952 (with amendments)	An Act to provide for the prevention of haphazard construction of building and excavation of tanks which are likely to interfere with the planning of certain areas in Bangladesh	Regulatory authority is Ministry of Works

2.5 International legal obligations

Bangladesh is signatory to a number of Multilateral Environmental Agreements (MEAs) and also some bilateral instruments. Some of them are very important in context of environmental protection. The legal obligations and provisions of MEAs related to the proposed project interventions will be reviewed; (Convention on Biological Diversity; Convention on Wetlands of International Importance Especially as Waterfowl Habitat; United Nations Convention on the Law of the Sea; Convention concerning the Protection of the World Cultural and Natural Heritage).

Bangladesh has already had accessed to, ratified or signed a number of important MEAs related to environment protection and conservation of natural resources which shall have to be complied with during implementation of the project. The pertinent ones of these are highlighted below:

2.5.1 Rio Declaration

The 1992 United Nations Conference on Environment and Development (UNCED) adopted the global action program for sustainable development called 'Rio Declaration' and 'Agenda 21'.

Principle 4 of the Rio Declaration, 1992, to which Bangladesh is a signatory along with a total of 178 countries, states as, "In order to achieve sustainable development, environmental protection should constitute an integral part of the development process and cannot be considered in isolation from it".

2.5.2 Convention on Biological Diversity (1992)

The Convention on Biological Diversity, Rio de Janeiro, 1992 was adopted on 5 June 1992 and entered into force on 29 December, 1993. Bangladesh ratified the Convention on 20 March, 1994.

The Contracting Parties of the Convention have committed to:

- Introducing appropriate procedures requiring environmental impact assessments of its proposed projects that are likely to have significant adverse effects on biodiversity, with a view to avoiding or minimizing such effects, and where appropriate allow for public participation in such procedures; and

- Introducing appropriate arrangements to ensure that environmental consequences of its programs and policies, that are likely to have significant adverse impacts on biodiversity, are duly taken into account.

Obligation has been placed on State parties to provide for environmental impact assessments of projects that are likely to have significant adverse effects on biological diversity (art. 4).

2.5.3 Convention on Wetlands of International Importance Especially as Waterfowl Habitat, Ramsar (1971)

This convention is also known as the Ramsar Convention. It was adopted on 2 February, 1971 and entered into force on 21 December, 1975. Bangladesh has ratified the Convention on 20 April, 2002. This provides a framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. There are 127 Parties with 1085 wetland sites designated as Wetlands of International Importance'.

This is an intergovernmental treaty, which provides the framework for international co-operation for the conservation of wetlands habitats. Obligations for Contracting Parties include the designation of wetlands to the "List of Wetlands of International Importance', the provision of wetland considerations within their national land use planning, and the creation of Natural Reserves. Part of Sundarbans Reserved Forest (Southwest of Bangladesh) is the one of the Ramsar Site.

2.5.4 United Nations Convention on the Law of the Sea, Montego Bay, (1982)

This Convention was adopted on 10 December 1982 at Montego Bay, Jamaica. Bangladesh has ratified this Convention.

Main objectives of the convention are:

- To set up a comprehensive new legal regime for the sea and oceans, as far as environmental provisions are concerned, to establish material rules concerning environmental standards as well as enforcement provisions dealing with pollution of the marine environment; and
- To establish basic environmental protection principles and rules on global and regional cooperation, technical assistance, monitoring, and environmental assessment, and adoption and enforcement of international rules and standards and national legislation with respect to alt sources of marine pollution.

2.5.5 The International Convention for the Prevention of Pollution from Ships (MARPOL) Annex I to V) (1973 to 1978)

The MARPOL Convention was adopted on 2 November 1973 at IMO (International Marine Organization). The Protocol of 1978 was adopted in response to a spate of tanker accidents in 1976-1977. As the 1973 MARPOL Convention had not yet entered into force, the 1978 MARPOL Protocol absorbed the parent Convention. The combined instrument entered into force on 2 October 1983. In 1997, a Protocol was adopted to amend the Convention and a new Annex VI was added which entered into force on 19 May 2005. MARPOL has been updated by amendments through the years. Bangladesh concluded the MARPOL treaty in 1978.

The Convention includes regulations aimed at preventing and minimizing pollution from ships - both accidental pollution and that from routine operations - and currently includes six technical Annexes. Special Areas with strict controls on operational discharges are included in most Annexes.

- Annex I; Regulations for the Prevention of Pollution by Oil (entered into force 2 October 1983)
- Annex II; Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk (entered into force 2 October 1983)
- Annex III; Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form (entered into force 1 July 1992)
- Annex IV; Prevention of Pollution by Sewage from Ships (entered into force 27 September 2003)
- Annex V Prevention of Pollution by Garbage from Ships (entered into force 31 December 1988)

2.5.6 Relevant International Treaties Conventions and Protocols

Bangladesh has signed most international treaties, conventions and protocols on environment, pollution control, bio-diversity conservation and climate change, including the Ramsar Convention, the Bonn Convention on migratory birds, the Rio de Janeiro Convention on biodiversity conservation and the Kyoto protocol on climate change. An overview of the relevant international treaties and conventions signed by GoB is shown in Table 2.5.6.

Table 2.5.6: Relevant International Treaties, Conventions and Protocols Signed by Bangladesh

Treaty or Convention	In	Brief Description	Responsible Agency
On Protection of birds, Paris	1950	Protection of birds in wild state	Department of Environment/Department of Fisheries
Convention on oil pollution damage (Brussels)	1969	Civil liability on oil pollution damage from ships	Department of Environment/Ministry of Shipping
Ramsar Convention	1971	Protection of wetlands	Department of Environment/Department of Fisheries
World Cultural and Natural Heritage (Paris)	1972	Protection of major cultural and natural monuments	Department of Archaeology
CITES Convention (Washington)	1973	Ban and restrictions on international trade in endangered species of wild fauna and flora	Department of Environment/Department of Fisheries
Bonn Convention	1979	Conservation of migratory species of wild animals	Department of Environment/Department of Fisheries
Prevention and Control of Occupational hazards (Geneva)	1974	Protect workers against occupational exposure to carcinogenic substances and agents	Ministry of Health and Family Welfare
Occupational hazards due	1977	Protect workers against	Ministry of Health and Family

to air pollution, noise & vibration (Geneva)		occupational hazards in the working environment	Welfare
Occupational safety and health in working environment (Geneva)	1981	Prevent accidents and injury to health by minimizing hazards in the working environment	Ministry of Health and Family Welfare
Occupational Health Services (Geneva)	1985	To promote a safe and healthy working environment	Ministry of Health and Family Welfare
Vienna convention	1985	Protection of ozone layer	Department of Environment/Ministry of Environment and Forest
Civil liability on transport of dangerous goods (Geneva)	1989	Safe methods for transport of dangerous goods by road, railway and inland vessels	Ministry of Communication
Convention on oil pollution (London)	1990	Legal framework and preparedness for control of oil pollution	Department of Environment/Ministry of Shipping
London Protocol	1990	Control of global emissions that deplete ozone layer	Department of Environment/Ministry of Environment and Forest
UN framework convention on climate change (Rio de Janeiro)	1992	Regulation of greenhouse gases emissions	Department of Environment/Ministry of Environment and Forest
Convention on Biological Diversity (Rio de Janeiro)	1992	Conservation of bio-diversity, sustainable use of its components and access to genetic resources	Department of Environment/Ministry of Environment and Forest
International Convention on Climate Changes (Kyoto Protocol)	1997	International treaty on climate change and emission of greenhouse gases	Department of Environment/Ministry of Environment and Forest
Protocol on biological safety (Cartagena protocol)	2000	Biological safety in transport and use of	Department of Environment/Ministry of Environment and Forest

2.5.7 Development Agency's Guidelines

Under the study health and safety guidelines of few development agencies will be reviewed. This will include "JICA Guidelines for Environment and Social Consideration" (April, 2010) and "Environmental, Health, and Safety Guidelines of the International Finance Corporation Guideline (IFC/EHS Guideline)".

2.5.8 World Bank Environmental Requirements

The Bank requires environmental assessment (EA) of projects proposed for Bank financing to help ensure that they are environmentally sound and sustainable. The World Bank's environmental assessment policy and recommended processing are described in Operational Policy (OP)/Bank Procedure (BP) 4.01: Environmental Assessment. This policy is considered to be the umbrella policy for the Bank's environmental "safeguard policies" which among others include: Natural Habitats (OP 4.04), Pest Management (OP 4.09), Physical Cultural Resources (OP 4.11)), Forests (OP 4.36) and Safety of Dams (OP 4.37). The Operational Policies (OPs) are the statement of policy objectives and operational principles including the roles and obligations of the Borrower and the Bank, whereas Bank Procedures (BP) is the mandatory procedures to be followed by the Borrower and the Bank.

2.5.9 OP/BP 4.01 Environmental Assessment

The Bank requires environmental assessment (EA) of projects proposed for Bank support to ensure that they are environmentally sound and sustainable, and thus to improve decision making. EA is a process whose breadth, depth, and type of analysis depend on the nature, scale, and potential environmental impact of the proposed project. EA evaluates a project's potential environmental risks and impacts in its area of influence; examines project alternatives; identifies ways of improving project selection, siting, planning, design, and implementation by preventing, minimizing, mitigating, or compensating for adverse environmental impacts and enhancing positive impacts; and includes the process of mitigating and managing adverse environmental impacts throughout project implementation. The borrower is responsible for carrying out the EA and the Bank advises the borrower on the Bank's EA requirements.

The Bank classifies the proposed project into three major categories, depending on the type, location, sensitivity, and scale of the project and the nature and magnitude of its potential environmental impacts. Projects with multiple components or with multiple subprojects (other than projects using FIs) are categorized according to the component with the most serious potential adverse effects. Dual categories may not be used. However, the depth and breadth of EA and choice of EA instrument(s) for each component or each subproject is decided on the basis of its respective potential impacts and risks.

Category A: The proposed project is likely to have significant adverse environmental impacts that are sensitive, diverse, or unprecedented. These impacts may affect an area broader than the sites or facilities subject to physical works.

Category B: The proposed project's potential adverse environmental impacts on human population or environmentally important areas-including wetlands, forests, grasslands, or other natural habitats- are less adverse than those of Category A projects. These impacts are site specific; few if any of them are irreversible; and in most cases mitigatory measures can be designed more readily than Category A projects.

Category C: The proposed project is likely to have minimal or no adverse environmental impacts.

2.5.10 OP/BP 4.04 Natural Habitats

The conservation of natural habitats, like other measures that protect and enhance the environment, is essential for long-term sustainable development. The Bank therefore supports the protection, maintenance, and rehabilitation of natural habitats and their functions in its economic and sector work, project financing, and policy dialogue. The Bank supports, and expects borrowers to apply, a precautionary approach to natural resource management to ensure opportunities for environmentally sustainable development. The Bank promotes and supports natural habitat conservation and improved land use by financing projects designed to integrate into national and regional development the conservation of natural habitats and the maintenance of ecological functions. Furthermore, the Bank promotes the rehabilitation of degraded natural

habitats. The Bank does not support projects that involve the significant conversion or degradation of critical natural habitats.

2.5.11 OP/BP 4.36 Forests

Forest is defined as an as an area of land of not less than 1.0 hectare with tree crown cover (or equivalent stocking level) of more than 10 percent that have trees with the potential to reach a minimum height of 2 meters at maturity in situ. A forest may consist of either closed forest formations, where trees of various stories and undergrowth cover a high proportion of the ground, or open forest. However, the Bank's forests policy aims to reduce deforestation, enhance the environmental contribution of forested areas, promote afforestation, reduce poverty, and encourage economic development. Where forest restoration and plantation development are necessary to meet these objectives, the Bank assists borrowers with forest restoration activities that maintain or enhance biodiversity and ecosystem functionality. The Bank also assists borrowers with the establishment and sustainable management of environmentally appropriate, socially beneficial, and economically viable forest plantations to help meet growing demands for forest goods and services.

2.5.12 OP/BP 4.11Physical Cultural Resources

Physical cultural resources are defined as movable or immovable objects, sites, structures, groups of structures, and natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance. Their cultural interest may be at the local, provincial or national level, or within the international community. Physical cultural resources are important as sources of valuable scientific and historical information, as assets for economic and social development, and as integral parts of a people's cultural identity and practices. The Bank assists countries to avoid or mitigate adverse impacts on physical cultural resources from development projects that it finances. The impacts on physical cultural resources resulting from project activities, including mitigating measures, may not contravene either the borrower's national legislation, or its obligations under relevant international environmental treaties and agreements. The borrower addresses impacts on physical cultural resources in projects proposed for Bank financing, as an integral part of the environmental assessment (EA) process. The following projects are classified during the environmental screening process as Category A or B, and are subject to the provisions of this policy: (a) any project involving significant excavations, demolition, movement of earth, flooding, or other environmental changes; and (b) any project located in, or in the vicinity of, a physical cultural resources site recognized by the borrower. Projects specifically designed to support the management or conservation of physical cultural resources are individually reviewed, and are normally classified as Category A or B. When the project is likely to have adverse impacts on physical cultural resources, the borrower identifies appropriate measures for avoiding or mitigating these impacts as part of the EA process. These measures may range from full site protection to selective mitigation, including salvage and documentation, in cases where a portion or all of the physical cultural resources may be lost.

The above WB safeguard documents were reviewed in preparing this EIA for the proposed project.

2.5.13 JICA Guidelines for Environment and Social Consideration

JICA, which is responsible for ODA, plays a key role in contributing to sustainable development in developing countries. The inclusion of environmental and social costs in development costs and the social and institutional framework that makes such inclusion possible are crucial for sustainable development. Internalization and an institutional framework are requirements for measures regarding environmental and social considerations, and JICA is required to have suitable consideration for environmental and social impacts. The objectives of the guidelines are to encourage Project proponents etc. to have appropriate consideration for environmental and social impacts, as well as to ensure that JICA's support for examination of environmental and social considerations are conducted accordingly. The guidelines outline JICA's responsibilities and procedures, along with its requirements for project proponents etc., in order to facilitate the achievement of these objectives. In doing so, JICA endeavors to ensure transparency, predictability, and accountability in its support for examination of environmental and social considerations.

2.5.14 IFC/EHS Guideline

The EHS Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice, as defined in IFC's Performance Standard 3 on Pollution Prevention and Abatement.

2.5.14.1 Occupational Health and Safety

During construction, the project will confirm the labor laws, for occupational and health related rules as outlined in Table 2.5.14.1.

Table 2.5.14.1: Relevant Occupational Health and Safety Laws and Rules

Title	Overview
Bangladesh Labor Act 2006	Provides for safety of work force during construction period. The act provides guidance of employer's extent of responsibility and the workmen's right to compensation in case of injury caused by accident while working.
Water Supply and Sewerage Authority Act 1996	The act calls for ensuring water supply and sewerage system to the public, preservation of system, and other related health and environmental facilities for the community.
Labor Relations under Labor Laws, 1996. Revisions to scattered Acts and Ordinances to formulate a unified code)	General concerns during the project implementation state that the project manager must recognize labor unions.
Public Health Emergency Provisions) Ordinance, 1994	Calls for special provisions with regard to public health. In case of emergency, it is necessary to make special provisions for preventing the spread of disease, safeguarding the public health, and providing adequate. medical service, and other services essential to the health of respective communities and workers during Construction-related work.
Bangladesh Factory Act, 1979	Workplaces provisions: these Act and Labor Laws require medical facilities, first aid, accident and emergency arrangements, and childcare services to be provided to the workers at workplace.

The Employees State Insurance Act, 1948	Health, injury, and sickness benefit should be paid.
The Employer's Liability Act, 1938	Covers accidents, risks and damages with respect to employment injuries
Maternity Benefit Act, 1950	Framed rules for female employees, who are entitled to various benefits for maternity.

Source: Bangladesh Government Rules and Regulation book

2.6 Environmental Regulations

Details of the environmental standards applicable in Bangladesh are described in ECR. Regulated Areas spread to all industries, and regulated items are air quality, water quality (surface water, drink water), noise (boundary, source), emissions from motor vehicles or ships, odor, sewage discharge, waste from industrial units and industrial effluents or emissions. Items and standards, which are related to the construction and operation of access road, are listed below. Tables and annotations of environmental regulation are described as textual description of ECR. ECR is currently in the process of amendment. There is a possibility that the environmental regulation of the following items will be amended, but the current regulation is applied until the amendment process is completed. Aman followed the international standard parameter for their existing cement industry. Certificate of ISO for Existing ACML is given in ***Annex-17***

2.6.1 Air Quality

Table 2.6.1 (a) shows the air quality standard in Bangladesh. Air quality standard adhere to World Health Organization (WHO) guidelines is also mentioned in the Table below. Table 2.6.1 (b) & 2.6.1 (c) mentioned air emission standard for motor vehicles and mechanized vessels respectively.

Table 2.6.1 (a): Standards for Air quality in Bangladesh

No.	Parameter	Concentration (mg/m3)		Exposure Time
		ECR	IFC Guideline (General: 2007)*	
a)	Carbon Mono-oxide	10	-	8 hours
		40	-	1 hour
b)	Lead (Pb)	0.5	-	Year
c)	Nitrogen Oxide	0.1 -	0.04 0.2	Year 1 hour
		-	0.2	1 hour
d)	Suspended Particulate Matter (SPM)	0.2	-	8 hours
e)	Particulate Matter 10µm (PM10)	0.05	0.02	Year
		0.15	0.05	24 hours
f)	Particulate Matter 2.5µm (PM2.5)	0.015	0.01	Year
		0.065	0.025	24 hours
g)	Ozone	0.235	-	1 hour
		0.157	0.160	8 hours
h)	Sulfur Dioxide	0.08	-	Year
		0.365	0.125	24 hours

Notes: * Air quality standard of IFC Guideline is quoted from WHO Guideline.

Table 2.6.1 (b): Standards for Emission from Motor Vehicles

Parameter	Unit	Standard Limit
Black Smoke	Hartridge Smoke Unit (HSU)	65
Carbon Monoxide	gm/k.m.	24
	percent area	04
Hydrocarbon	gm/k.m.	02
	ppm	180
Oxides of Nitrogen	gm/k.m.	02
	ppm	600

Source: ECR'1997

Table 2.6.1 (c): Standards for Emission from Mechanized Vessels

Parameter	Unit	Standard Limit
Black Smoke	Hartridge Smoke Unit (HSU)	65

Source: ECR'1997

2.6.2 Water Quality

Table 2.6.2 (a) shows ambient water quality standard (inland surface water) and Table 6.2 (b) shows environmental water quality standard (drinking water). Table 2.6.2 (c) shows the water quality of international standards. Table 2.6.2 (d) shows the waste water standard from project activities.

Table 2.6.2 (a): Ambient water quality standards (inland surface water)1

No.	Best Practice Based Classification	pH	BOD mg/1	Dissolved Oxygen (DO), mg/1	Total Coliform Bacteria quantity/ml
a)	Potable water source supply after bacteria freeing only	6.5-8.5	2 or less	6 or above	50 or less
b)	Water used for recreation purpose	6.5-8.5	3 or less	5 or above	200 or less
c)	Potable water source supply after Conventional processing	6.5-8.5	3 or less	6 or above	5000 or less
d)	Water used for pisci-culture	6.5-8.5	6 or less	5 or above	5000 or less
e)	Industrial use water including chilling & other processes	6.5-8.5	10 or less	5 or above	
f)	Water used for irrigation	6.5-8.5	10 or less	5 or above	1000 or less

(Source: The Environmental Conservation Rules, 1997)

Table 2.6.2 (b): Environmental water quality standards (drinking water)

No.	Parameter	Unit	Standard Limit	WHO Guidelines
1	Aluminum	mg/1	0.2	0.2
2	Ammonia (NH3)	mg/1	0.5	-
3	Arsenic	mg/1	0.05	0.01
4	Barium	mg/1	0.01	0.7
5	Benzene	mg/1	0.01	0.01
6	BOD5 20oC	mg/1	0.2	-
7	Boron	mg/1	1.0	0.5
8	Cadmium	mg/1	0.005	0.003

1 Textual annotations are as follows.
(1) Maximum amount of ammonia presence in water are 1.2 mg/1 (as nitrogen molecule) which is used for pisciculture.
(2) For water used in irrigation Electrical Conductivity-2250 micro mho/cm (at 25oC). Sodium less than 26 mg/1, Boron less than 2 mg/1

9	Calcium	mg/l	75	-
10	Chloride	mg/l	150-600	-
11	Chlorinated Alkanes			-
	Carbon Tetrachloride	mg/l	0.01	-
	1.1 Dichloroethylene	mg/l	0.001	-
	1.2 Dichloroethylene	mg/l	0.03	-
	Tetrachloroethylene	mg/l	0.03	-
	Trichloroethylene	mg/l	0.09	-
12	Chlorinated Phenols			-
	Pentachlorophenol	mg/l	0.03	-
	2.4.6 Trichlorophenol	mg/l	0.03	-
13	Chlorine (residual)	mg/l	0.2	-
14	Chloroform	mg/l	0.09	0.3
15	Chromium (hexavalent)	mg/l	0.05	-
16	Chromium (total)	mg/l	0.05	0.05
17	COD	mg/l	4	-
18	Coliform (fecal)	n/100 ml	0	-
19	Coliform (total)	n/100 ml	0	-
20	Color	Huyghens unit	15	-
21	Copper	mg/l	1	-
22	Cyanide	mg/l	0.1	-
23	Detergents	mg/l	0.2	-
24	DO	mg/l	6	-
25	Fluoride	mg/l	1	1.5
26	Hardness (as CaCO3)	mg/l	200-500	-
27	Iron	mg/l	0.3-1.0	-
28	Nitrogen (Total)	mg/l	1	-
29	Lead	mg/l	0.05	0.01
30	Magnesium	mg/l	30-35	-
31	Manganese	mg/l	0.1	0.4
32	Mercury	mg/l	0.001	0.006
33	Nickel	mg/l	0.1	0.07
34	Nitrate	mg/l	10	3
35	Nitrite	mg/l	Less than 1	-
36	Odor		Odorless	-
37	Oil & Grease	mg/l	0.01	-
38	pH		6.5-8.5	-
39	Phenolic compounds	mg/l	0.002	-
40	Phosphate	mg/l	6	-
41	Phosphorus	mg/l	0	-
42	Potassium	mg/l	12	-
43	Radioactive Materials (gross alpha	Bq/l	0.01	-
44	Radioactive Materials (gross beta	mg/l	0.1	-
45	Selenium	mg/l	0.01	-
46	Silver	mg/l	0.02	-
47	Sodium	mg/l	200	-
48	Suspended particulate matters	mg/l	10	-
49	Sulfide	mg/l	0	-
50	Sulfate	mg/l	400	-
51	Total dissolved solids	mg/l	1000	1000
52	Temperature	℃	20-30	-
53	Tin	mg/l	2	-
54	Turbidity	JTU	10	-
55	Zinc	mg/l	5	-

(Source: The Environmental Conservation Rules 1997, Guidelines for Drinking-water Quality WHO 2008)

Table 2.6.2 (c): Water quality International standard (EHS)

Pollutant	General EHS guideline of IFC (Indicative Values for Treated Sanitary Sewage Discharges a)
pH	6-9
BOD	30
COD	125
SS	150
n-hexane（mineral oil))	-
n-hexane（animal and vegetable fats）	10
Residual chlorine	-
Phenols	-
Copper	-
Zinc	-
Dissolved iron	-
Dissolved manganese	-
Chromium	-
Cadmium	-
Total cyanogen	-
Total coliform bacteria	400MPN6/100ml
Nitrogen	10 MPN6/100ml
Phosphorus	2 MPN6/100ml

Source: IFC, 2007, Environmental, Health, and Safety (EHS) Guidelines GENERAL EHS GUIDELINE

Table 2.6.2 (d): Wastewater Discharge Standards

No.	Parameter	Unit	Inland Surface Water	Public Sewer at Secondary Treatment plant	Irrigated Land	IFC Guideline (Thermal power: 2008)
1	Ammoniacal Nitrogen (N molecule)	mg/L	50	75	75	-
2	Ammonia (free ammonia)	mg/L	5	5	15	-
3	Arsenic (As)	mg/L	0.2	0.05	0.2	0.5
4	BOD5 20°C	mg/L	50	250	100	-
5	Boron	mg/L	2	2	2	-
6	Cadmium (Cd)	mg/L	0.05	0.5	0.5	0.1
7	Chloride	mg/L	600	600	600	-
8	Chromium (total Cr)	mg/L	0.5	1.0	1.0	0.5
9	COD	mg/L	200	400	400	-
10	Cr6+ (hexavalent Cr)	mg/L	0.1	1.0	1.0	-
11	Copper (Cu)	mg/L	0.5	3.0	3.0	0.5
12	Dissolved Oxygen (DO)	mg/L	4.5-8	4.5-8	4.5-8	-
13	Electrical Conductivity	micro mho/cm	1200	1200	1200	-
14	Total Dissolved Solids	mg/L	2,100	2,100	2,100	-
15	Fluoride (F)	mg/L	7	15	10	-
16	Sulfide (S)	mg/L	1	2	2	-
17	Iron (Fe)	mg/L	2	2	2	1
18	Total Kjeldahl Nitrogen (N)	mg/L	100	100	100	-
19	Lead (Pb)	mg/L	0.1	1.0	0.1	0.5
20	Manganese (Mn)	mg/L	5	5	5	-
21	Mercury (Hg)	mg/L	0.01	0.01	0.01	0.005
22	Nickel (Ni)	mg/L	1.0	2.0	1.0	-
23	Nitrate (N molecule)	mg/L	10.00	Undetermine	10	-

				d		
24	Oil & grease	mg/L	10	20	10	10
25	Phenol compounds(C6H5OH)	mg/L	1.0	5	1	-
26	Dissolved Phosphorus (P)	mg/L	8	8	10	-
27	Radioactive Materials.	As determined by Bangladesh Atomic Energy Commission				-
28	pH		6-9	6-9	6-9	6-9
29	Selenium	mg/L	0.05	0.05	0.05	-
30	Zn (Zn)	mg/L	5.0	10.0	10.0	1
31	Total Dissolved solid	mg/L	2,100	2,100	2,100	-
32	Temperature (0C)	Summer	40	40	40	-
		Winter	45	45	45	-
33	Total Suspended Solid (TSS)	mg/L	150	500	200	50
34	Cyanide (CN)	mg/L	0.1	2.0	0.2	-

2.6.3 Noise

As for noise, the standard limit is set for every category of zone class. Table 2.6.3 shows the Noise standard in Bangladesh.

Table 2.6.3: Standards for Noise[2]

No	Zone Class	Limits in dBA			
		ECR		IFC/EHS Guideline (General: 2007)	
		Day	Night	Day	Night
a)	Silent Zone	45	35	55	45
b)	Residential Zone	50	40		
c)	Mixed Zone (this area is used combining residential, commercial and industrial purposes)	60	50	70	70
d)	Commercial Zone	70	60		
e)	Industrial Zone	70	70		

(Source: The Environmental Conservation Rules, 1997 IFC Environmental Health and Safety Guidelines 2008)

2.7 Protected area and environmentally controlled area

Classification of Protected areas and environmentally-controlled areas in Bangladesh are shown in

Table **2**.7 (a). Those areas are declared as National Park, Wildlife Sanctuary, Game Reserve, Botanical gardens and Eco-parks under the Wildlife (Preservation) Order, Reserved Forests and Protected Forests under the Forest Act and Ecologically Critical Areas (ECA) notified under the Environmental Conservation Act.

2 Textual annotations are as follows.
(1) The day time is considered from 6 a.m. to 9 p.m. and the night time is from 9 p.m. to 6 p.m.
(2) From 9 at night to 6 mornings is considered night time.
(3) Area within 100 meters of hospital or education institution or educational institution or government designated / to be designated / specific institution / establishment are considered Silent Zones. Use of motor vehicle horn or other signals and loudspeaker are forbidden in Silent Zone.

Table 2.7 (a): Classification of Protected area, environmentally controlled area

Classification		Competent Authority	Governing law
A	National Parks	Department of Forest	Wildlife (Preservation) Order
B	Wildlife Sanctuaries		
C	Game Reserves		
D	Botanical Gardens, Eco-parks		
E	Reserved Forests, Protected Forests		Forest Act
F	Ecologically Critical Areas	Department of Environment	Environmental Conservation Act

(Source: Power System Master Plan 2010

There are fifteen National parks, thirteen wildlife sanctuaries, five botanical gardens and eco-parks in Bangladesh notified under the Wildlife (Preservation) Order, having total area of 2,702.2 km2. List of Protected areas and environmentally-controlled areas declared under the Wildlife (Preservation) Order are shown in Table 2.7 (b). There are nine ECA, and the total area is 8,063.2 km2 excluding the Gulshan – Banani - Baridhara Lake in Dhaka. Table 2.7 (c) shows a list of ECA designated under the Environmental Conservation Act. The Environmental Conservation Act has provision for ECA declarations by the Director General of the Department of Environment in cases where ecosystem or biodiversity of area is considered to be threatened to reach a critical state. Along with the ECA declaration, each ECA has notification declared in which specific activities to be restricted in that ECA is specified.

Table 2.7 (b): List of Protected area, environmentally controlled area

Item	No	Name	Place	Size (km2)
A	1	Bhawal National Park	Gazipur	50.2
	2	Modhupur National Park	Tangail/ Mymensingh	84.4
	3	Ramsagar National Park	Dinajpur	0.3
	4	Himchari National Park	Cox's Bazar	17.3
	5	Lawachara National Park	Moulavibazar	12.5
	6	Kaptai National Park	Chittagong Hill Tracts	54.6
	7	Nijhum Dweep National Park	Noakhali	163.5
	8	Medha Kachhapia National Park	Cox's Bazar	4.0
	9	Satchari National Park	Habigonj	2.4
	10	Khadim Nagar National Park	Sylhet	6.8
	11	Baraiyadhala National Park	Chittagong	29.3
	12	Kuakata National Park	Patuakhali	16.1
	13	Nababgonj National Park	Dinajpur	5.2
	14	Shingra National Park	Dinajpur	3.1
	15	Kadigarh National Park	Mymensingh	3.4
B	1	Rema-Kalenga Wildlife Sanctuary	Hobigonj	18.0
	2	Char Kukri-Mukri Wildlife Sanctuary	Bhola	0.4
	3	Sundarban (East) Wildlife Sanctuary	Bagerhat	312.3
	4	Sundarban (West) Wildlife Sanctuary	Satkhira	715.0
	5	Sundarban (South) Wildlife Sanctuary	Khulna	369.7
	6	Pablakhali Wildlife Sanctuary	Chittagong Hill Tracts	420.9
	7	Chunati Wildlife Sanctuary	Chittagong	77.6
	8	Fashiakhali Wildlife Sanctuary	Cox's Bazar	32.2
	9	Dudh Pukuria-Dhopachari Wildlife Sanctuary	Chittagong	47.2

	10	Hazarikhil Wildlife Sanctuary	Chittagong	29.1
	11	Sangu Wildlife Sanctuary	Bandarban	57.6
	12	Teknaf Wildlife Sanctuary	Cox's Bazar	116.2
	13	Tengragiri Wildlife Sanctuary	Barguna	40.5
D	1	National Botanical Garden	Dhaka	0.8
	2	Baldha Garden	Dhaka	-
	3	Madhabkunda Eco-Park	Moulavibazar	2.7
	4	Sitakunda Botanical Garden and Eco-park	Chittagong	8.1
	5	Dulahazara Safari Parks	Cox's Bazar	6.0

(Source: http://www.bforest.gov.bd/conservation.php, accessed January 2011)

Table 2.7 (c): List of Environmental Critical Areas

Item	No	Name	Place	Size (km2)
F	1	The Sundarbans	Bagerhat, Khulna, Satkhira	7,620.3
	2	Cox's Bazar (Teknaf, Sea beach)	Cox's Bazar	104.7
	3	St. Martin Island	Cox's Bazar	5.9
	4	Sonadia Island	Cox's Bazar	49.2
	5	Hakaluki Haor	Moulavi Bazar	183.8
	6	Tanguar Haor	Sumamganj	97.3
	7	Marjat Baor	Jhinaidha	2
	8	Gulshan-Banani-Baridhara Lake	Dhaka	-
	9	Buriganga, Turag, Sitalakhya and Balu	Dhaka	-

(Source: Biodiversity National Assessment and Programme of Action 2020, DOE Bangladesh, 2010)

Chapter 3
Description of the Project

3.1 Site Selection

The Aman Cement Mills Unit-2 Ltd. is located between 23^{0}39'54" north latitude and 90^{0}38'01" east longitude which is around 6 km south-east corner of Dhaka-Chittagong Highway at Baiddyar Bazaar Union of Sonargaon Upazila under Narayanganj district of Dhaka Division. The River Meghna is adjacent to the west edge of the site. The site is connected with Chittagong Sea Port and Mongla Sea Port through waterway and all the divisional head quarters including capital of Dhaka city through Dhaka-Chittagong Highway. In addition, the site is located in an area where other established industries is located proposing to establish export oriented industrial products in near future. The land falls under Sonamoi, Haria and Choto Deobogh Vilages of Baiddyar Bazaar Union of Sonargaon Upazila.

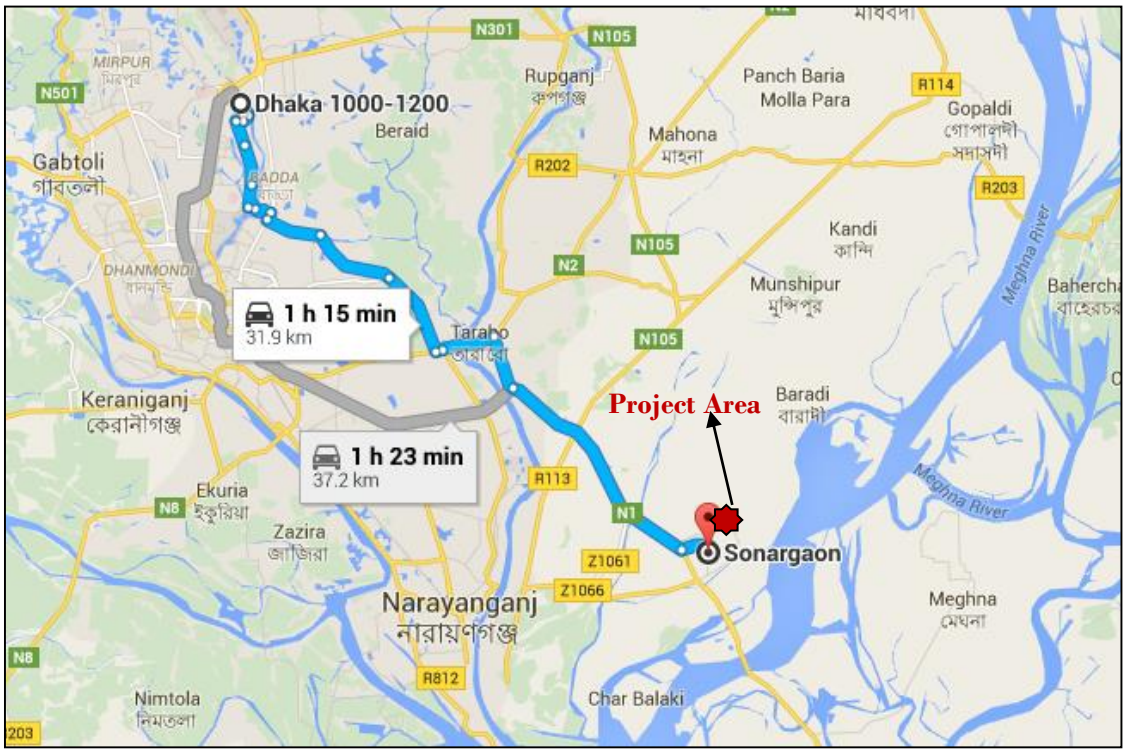


Figure 3.1 (a): Distance of Aman Cement Mills site from Dhaka City

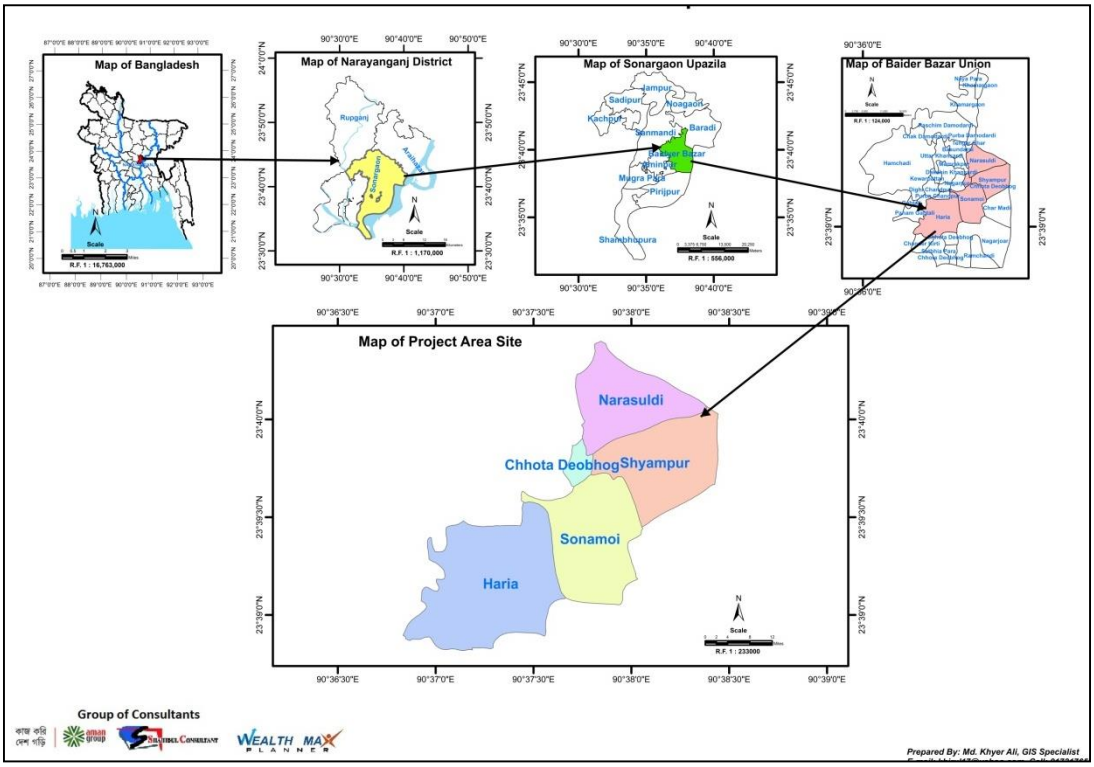


Figure 3.1 (b): Location of Aman Cement Mills Unit-2 Ltd.

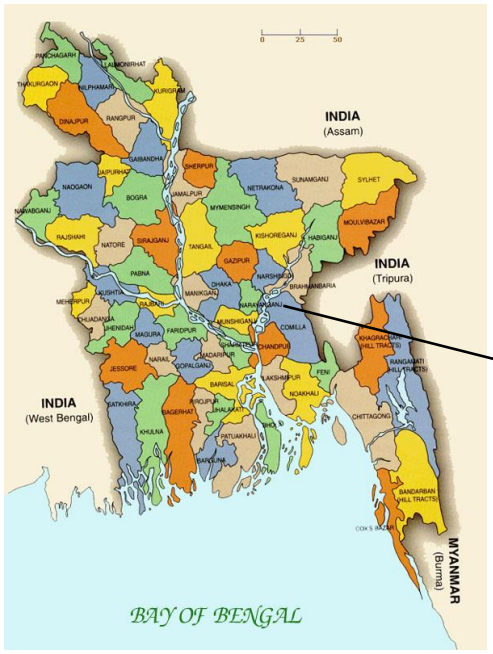
3.2 Site Justification

The present site was selected based on environmental consideration and other factors, e.g.

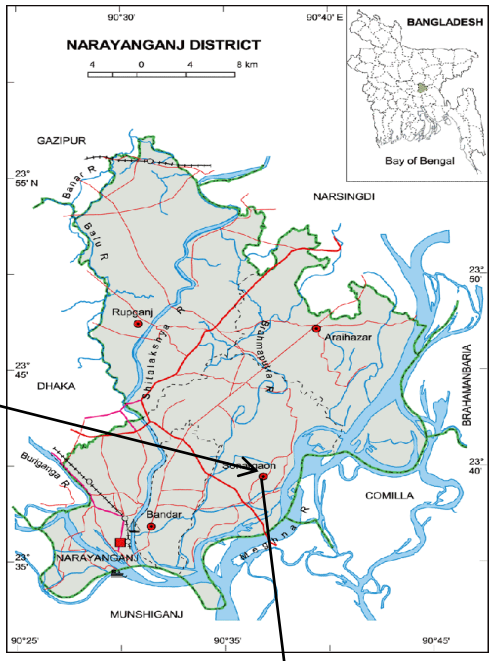
- Demand of the product;
- Not disturbing any prime agri-land;
- Easy to receive RM in fact one of the raw materials Coke is available from the nearby Coke Oven Plant;
- Transport accessibility for RM & FG;
- Where environment impact should be low;
- The cement is in demand in the abroad;
- In order to avoid transportation (including RM) which involves a fair share of economy, the present set up was thought to be a viable one;
- This industry does not need enormous amount of water.
- The site has a connecting road and easy approachability.

3.3 Location & Site Plans

MAP OF BANGLADESH



MAP OF NARAYANGANJ



PROJECT SITE

MAP OF SONARGAON

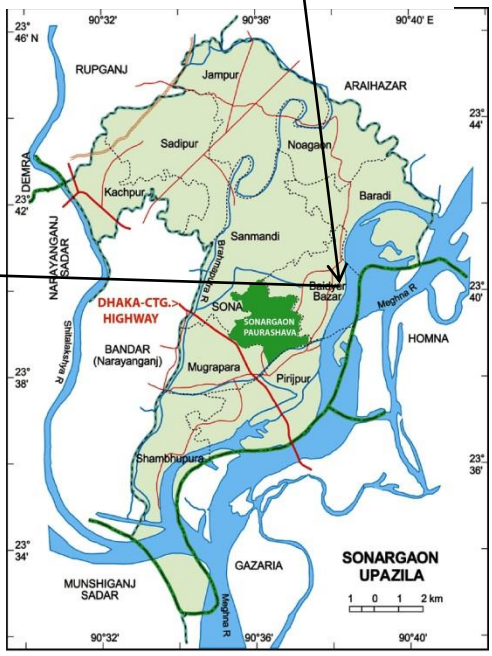


Figure 3.3 (a): Location and site Plans of Aman Cement Mills Unit-2 Ltd

It is important to note that Aman Cement Mills Unit-2 Ltd. is presently considered as one of the largest units in Aman Economic Zone (EZ) Private Ltd. of Aman Group. The company, meanwhile, got prequalification license from Bangladesh Economic Zones Authority (BEZA). The below figure shows the Master Plan Concept of whole EZ including Aman Cement Mills Unit-2 Ltd.

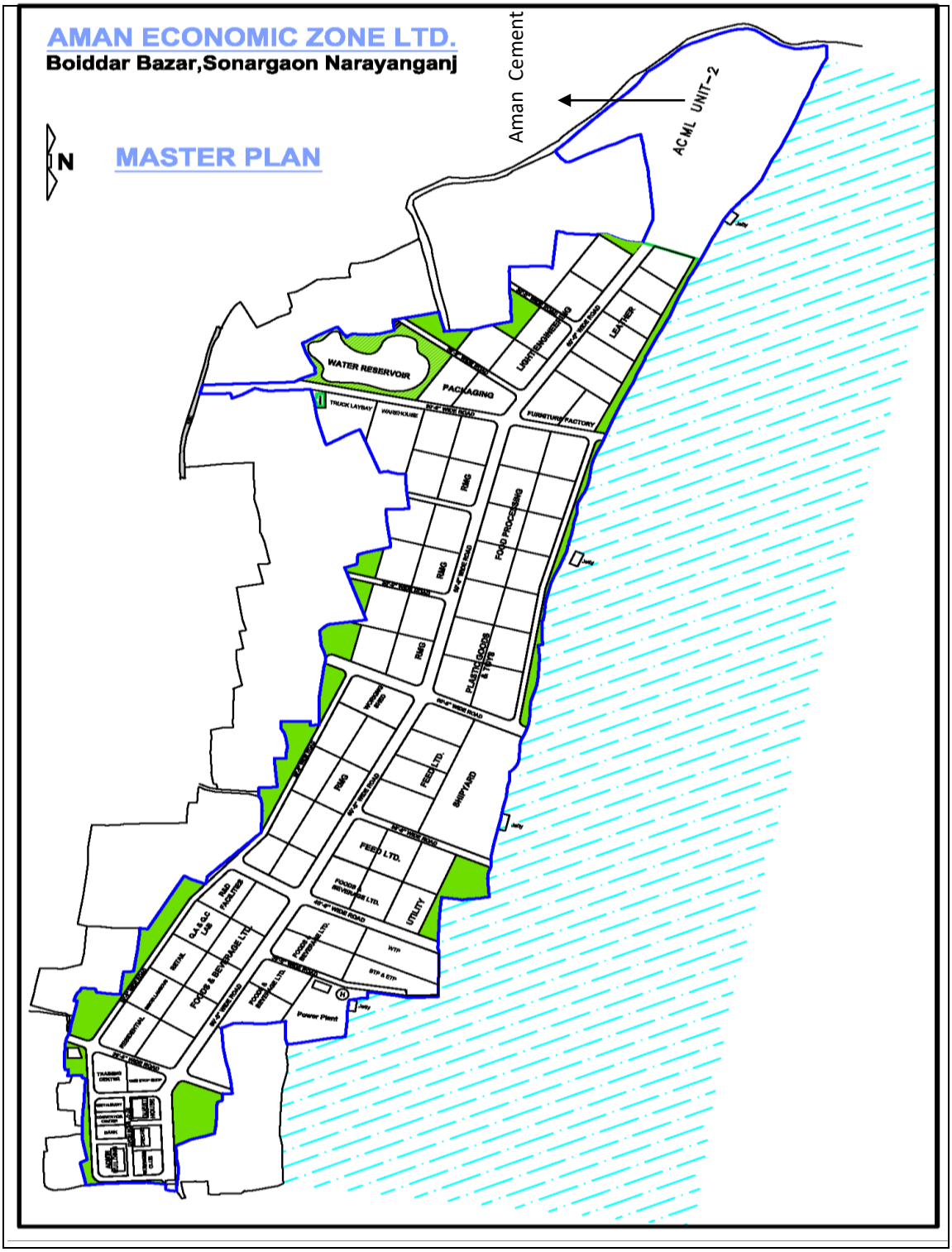


Figure 3.3 (b): Location of Aman Cement Mills Unit-2 Ltd in the Aman EZ

3.4 The Project Overview

The proposed project aims at manufacturing gray Portland cement by using cement clinker as raw material. In our country, mostly two types of cement, viz, white and Grey, are in use. These again differ among themselves by the grade of quality-depending generally on impurity content. The white cement is used mainly for finishing works (e.g., for floor polishing, for mosaic finishing, etc.), tiles manufacturing, and partly for ceramic production, etc. The Grey cement has extensive use in basic civil works for making foundation, floor, wall, roof, columns, etc.

It is primarily used as an adhesive material for bonding or pasting a brick with another, a stone with another, brick or stone pieces with iron or metal rods/pieces (for reinforcement of column or roof, etc.), and for bond formation among pieces of brick or stone of different geometry and dimensions (e.g. mixing). Moreover, it is used for plastering as well as finishing works.

The total fixed cost of the project has been estimated at Taka 3711.120 million. The factory will run it operation on 1 shifts of 8 hours each per day and 350 working days in a year. The annual production capacity of the proposed factory is about 1620,000 MT. The project employed 265 Nos. skilled and unskilled persons including the officers.

The total land area occupied by the factory is around 26762.17 square meter, almost 100% of that was developed for the project purpose as earlier the land was not in any type of use and the land occupied by the structure is 12439.62 square meter. The project use ground water with drawl by its own deep tube well and as well as it also produces its own electricity.

3.5 Type of the Project

Aman Cement Mills Unit-2 Ltd. is a Gray Portland Cement Manufacturing Industry. The land for the proposed factory was purchased by the entrepreneurs and developed for the industry. It can be noted here that all modern machineries will be used to produce cement from the clinker and the factory will be well equipped with all environmental management infrastructure.

Table 3.4: Aman Cement Mills Unit-2 Ltd. at a glance

1. Name of the project	Aman Cement Mills Unit-2 Ltd.
2. Project Proponent	Md. Rafiqul Islam
3. Factory Address	Haria, Baiddyer Bazar, Sonargaon, Narayanganj
4. Head Office	AMAN TOWER, 2, Ishakha Avenue, Section # 6, Uttara Model Town, Dhaka.
5. Final Product	Portland Gray Cement
6. By Product	None
7. Raw Materials	Clinker, Fly Ash, Gypsum, Slag, Raw Limb, Lime stone

8. Project Cost	Taka 3711.120 Million
9. Power Requirement	3600 KWh (National Grid) Factory has own standby generation for 3000 KW
10. Water Requirement	30 m3/day liter per day (Own Deep Tube Well)
11. Gas Requirement	N/A
12. Employment	265Personnel (Skilled and Unskilled)
13. Project Area	18.5 acres
14. Waste water generation	No industrial wastewater generate

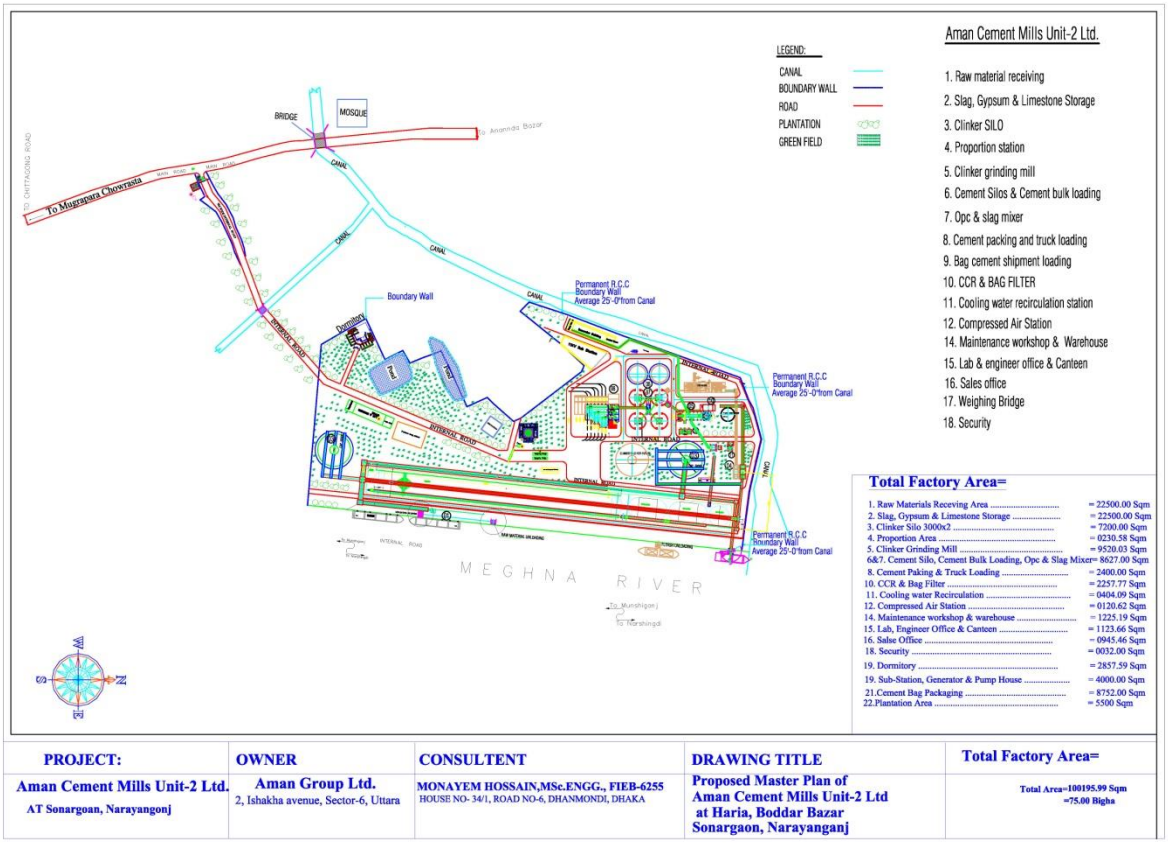


Figure 3.4: Details Master Plan Layout of Aman Cement Mills Unit-2 Ltd.

3.6 Operation and Maintenance Schedule

The project proponent will be solely responsible for operation and maintenance of the project. The major operation and maintenance works would be the following:

- Operation and maintenance of all production machineries
- Dust control system
- Noise reduction system
- Maintenance of standby power generation system.

3.6.1 Production Process Equipment

The proposed project aims at manufacturing gray Portland cement by using cement clinker as raw material. In our country, mostly two types of cement, viz, white and Grey, are in use. These again differ among themselves by the grade of quality-depending generally on impurity content. The white cement is used mainly for finishing works (e.g., for floor polishing, for mosaic finishing, etc.), tiles manufacturing, and partly for ceramic production, etc. The Grey cement has extensive use in basic civil works for making foundation, floor, wall, roof, columns, etc.

It is primarily used as an adhesive material for bonding or pasting a brick with another, a stone with another, brick or stone pieces with iron or metal rods/pieces (for reinforcement of column or roof, etc.), and for bond formation among pieces of brick or stone of different geometry and dimensions (e.g. mixing). Moreover, it is used for plastering as well as finishing works.

3.6.1.1 Maintenance of Pollution Control Equipment

It can be noted here that our concern proposed Aman Cement Mills Unit-2 Ltd. is a dry process industry which will not produce any industrial wastewater. The wastewater will mainly generate from the domestic use for which it is recommended here that no domestic wastewater should be discharge outside of the facilities except necessary treatment. The treatment of domestic wastewater will be done by septic tank and soak peat.

The main pollution problem identified during this EIA study is the dust generation during the grinding of cement clinker. However from the detail study of the technological aspect of the proposed project, it was found that the production machineries itself contain most sophisticated pollution control system. However this should be well maintained by the factory professional and the performance of those pollution control system should be checked. The other concerning area where appropriate attention required are-

- Emission reduction
- Ambient Noise
- Degradation of natural resources through the transportation of raw materials as well as final product.

3.6.1.2 Production Process

Manufacturing process of Cement is very simple one. It involves operations like pre crushing of raw material, mixing, milling and packaging. The system is a Close Circuit system. ACML-2 will use this technology for the production of cement considering many vital things shown in Figure 3.6.1.2.

a. Clinker Conveying and Storage

The raw materials will come to the jetty by cargo vessel and will unload from that to the hopper by a loader which then feed into the crusher by a vibrating feeder. The crushed Clinker which has again size less than 35 mm will be conveyed by conveyer to the joint storage.

b. Gypsum Handling and Storage

The uncrushed Gypsum will be dumped into the hopper by a loader and then fed into the joint storage by a bucket elevator for storage.

c. Weighing and Feeding

At the bottom of the joint storage, electromagnetic feeders and electronic belt weighs will be equipped. The weighed Clinker and Gypsum will be conveyed into ball mill via belt conveyor/bucket elevator. The microcomputer control will be used for the Clinker/Gypsum proportioning system, and to maintain a consistent optimum feed into the mill.

d. Cement Grinding

Two kinds of materials are used for cement proportioning, clinker, and gypsum. The mill feeds bins are used for putting the two kinds of materials (practical size is <25mm) separately. Different materials are fed into 02.2 X 7m cement mill by bar gates and speed adjusted belt conveyors.

The Closed Circuit tube mill is used for cement grinding. The grinded materials goes through hammer air lock into bucket elevator and then into 03.5m centrifugal separator by screw conveyor. The coarse particle goes back to the mill through hammer air lock, screw conveyor for further grinding. Cement product collect through centrifugal separator and bag filter, hammer air locks, screw conveyors and the bucket elevator is sent to in cement storage and packing system. The capacity of the system is 250t/h. The gas from the cement mill is treated by bag filter.

e. Cement Storing and Packaging

The cement production is transported to cement silos by bucket elevator and screw conveyor. The cement is transported into the cement packing system through the discharger unit under the silo, screw conveyor and the bucket elevator.

The Cement goes to 4-nozzel packer system through discharger under the silo and screw conveyor. The cement is packed through bucket elevator, vibrating screen and surge bin, rotary feeder, 4-nozzel packer. The packed cement is loaded into Trucks/Burg through belt conveyor.

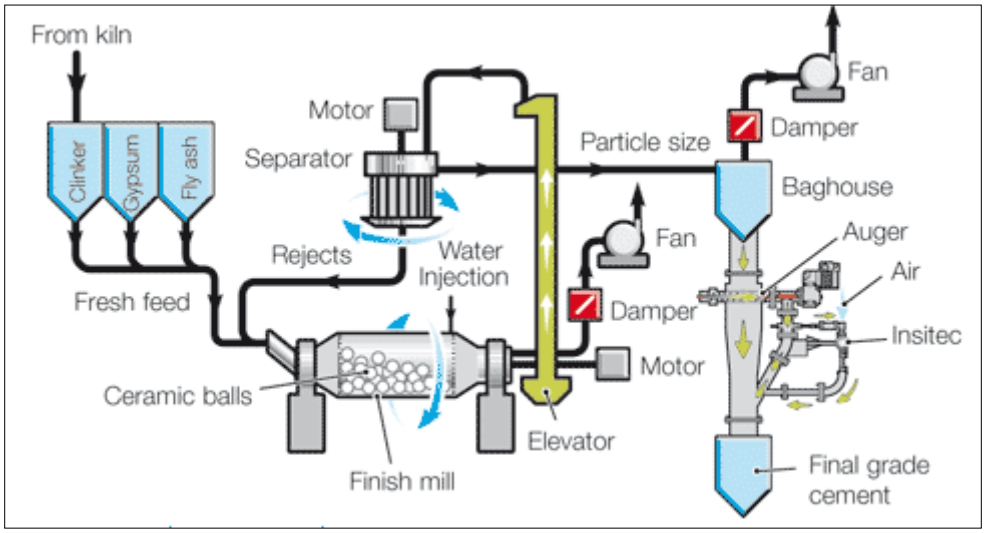


Figure 3.6.1.2: Close Circuit Grinding System for handling raw materials

The closed-circuit grinding system, all ground materials are led into a separator and classified into refined powder (products) and coarse powder (return powder). The coarse powder is returned to the ball mill and ground again with newly-fed raw materials. Following benefits can be realized with this technology:

- Reduction of green house gas emission;
- Reduce dust and maintain air quality;
- Protect surface runoff and leakage (if happen) from raw materials during rain/storm;
- Grinding capacity increases;
- Grain size distribution of refined powder becomes sharp;
- Refined powder temperature is reduced;
- Power consumption rate decreases;
- The abrasion of liners and balls is suppressed;
- Grain size distribution of products can be adjusted by changing the circulation ratio and the classifier's run status.

3.7 Raw Materials

It is mentioned in the earlier chapter that Aman Cement Mills Unit-2 Ltd. is a gray Portland cement manufacturing industry. A detail manufacturing process flow diagram is given in the next phase. In this section, a list of raw materials including the quantity required in a year in ideal condition is given-

Clinker: 322500 MT in a year
Fly Ash: 49200 MT in a year
Gypsum: 184500 MT in year
Slag: 365925 MT in a year
Raw Limb: 64575 MT in a year
Lime Stone: 73800 MT in a year

It can be mentioned here that except Lime Stone the other materials would be imported from international market.

Process flow diagram of Aman Cement Mills Unit-2 Ltd

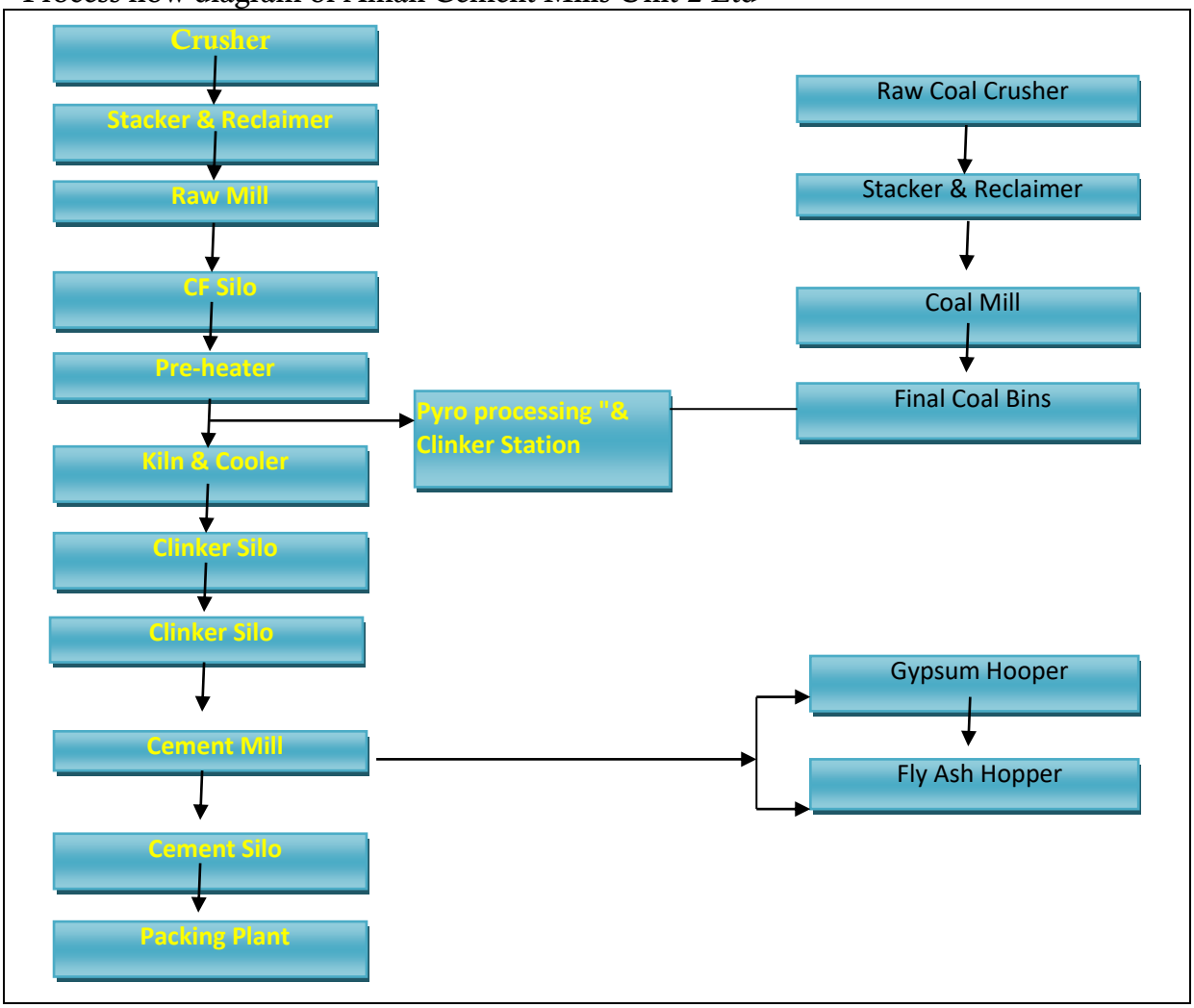


Figure 3.7: Process flow diagram of Aman Cement Mills Unit-2 Ltd

Please see the Daily water demand as per the law of GoB in ***Annex-8***
Please see the Gas requirement in ***Annex-9***

3.8 About the machine for production to be used in ACML-2

In the 1930s Loesche mills are used to grind cement raw material for the first time. The major breakthrough came at the start of the 1960s when rotary kilns with heat exchangers (dry process) are introduced. The following Loesche technological features make the deployment of these mills so successful in the cement industry:

- Low specific energy consumption
- Low pressure loss through large cross-sectional flow areas in Loesche mills
- Minimal sound emissions so that no sound insulation measures are required
- Rapid reaction to fluctuating raw material qualities
- Rapid readjustment to different product qualities
- Uses of the kiln exhaust gases for dry grinding and as a transport medium for the final product to dust separators

Figure 3.8: Loesche technology that will be used for the production of cement

3.9 About the dust reduction machine (Echo-Hopper) in ACML-2

Figure 3.9: Dust free Echo-Hopper technology used by the ACML-2

The Eco Hopper, manufactured by B&W Mechanical Handling (part of the Aumund Group) is loaded from vessels via 20 cubic metre capacity crane grabs. The materials are then transported by truck to the new grinding plant. The unit has a working volume of approximately 70 cubic metres and is capable of discharging at rates up to 700 tonnes per hour.

The key to the design is the integration of purpose built dust filter units incorporated into the structural element of the hopper. This approach, says B&W, enables it to provide a higher filtration media surface area and therefore higher air throughputs at lower velocities. This improves operational efficiency and reduces the overall size of the hopper. The filter configuration is complemented by the B&W Flex Flaps system at the hopper mouth which eliminates fugitive dust release at the point of grab discharge.

Details of this technology are given in ***Annex-11***

Chapter 4
Description of the Environment

4.0 Introduction

Baseline condition of environment states the present status of different components of environment in absence of the project. The main objective of examining the present environment is to provide an environmental baseline against which potential impacts from construction and operational phases of any project can be compared. A second important function of establishing a baseline for parameters such as air and water quality is to ensure that any problems arising from existing sources are not erroneously attributed to the project under study. In the present study the different environmental components examined for setting baseline conditions of the project area, are physico-chemical, biological and socio-economical. In physico-chemical component, parameters included are land, water quality, air quality, climate, and noise.

4.1 Site Description and its Vicinity

The Aman Economic Zone is located between 23^{0}39'54" north latitude and 90^{0}38'01" east longitude under Sonargaon, one of the archeological areas of Bangladesh, Upazila of Narayanganj district. The project site falls under three villages—Sonamoi, Choto Deobogh, and Haria of Baiddyar Bazaar Union of Sonargaon Upazila. The proposed Project is about 3 km away from the Sonargaon archeological heritage. From the archeological point of view, the project has a significant cultural, social, religious and economic history. The following are the different environmental settings considering 10 km radius from Aman Cement Mills Unit-2 Ltd. site.

Table 4.1 (a): Environmental Setting

Particulars	Details
Location	Haria Mouza, Sonargaon Upzila, Narayanganj District, Dhaka Division, around 4 km away from Mugrapara Bypass of Dhaka-Chittagong Highway **18.5 acres:** Latitude: 23^{0}39'59.75"N Longitude: 90^{0}37'59.21"E
Site Elevation	6.5 m (MSL)
Land Type	Barren Land
Nearest Airport	Hazrat Shahjalal International Airport (44.2 km, NW)
Nearest Railway Station	Kamalapur Rail Station (31.7 km, NW)
Nearest Port	Chittagong Port (225 km, South-East); Mongla Port (251 km, South-West)
Climatic conditions	Temperature:Annual average maximum: 29.8° C ; minimum: 17.6° C Humidity: Average humidity is 80 to 90% Rainfall: Mean annual rainfall is over 2,000 mm
Seismic Zone	Zone II
Forests / National Parks	None within 10 kms
Archaeological Site	None within 300 m from the EZ site

Water Bodies	Meghna River, branch of Meghna Channel River, Shitalakhya River
Nearby Villages	Panam Gabtali (adjacent to Haria, West) Purbo Gopal Path, Chander Kirth (adjacent to Haria, South-West) Satbhia Para, Bara Tilak (adjacent to Haria, South) Nagarjoar (adjacent to Haria, South-East) Nakatibhanga (adjacent to Haria, North) Gabtali (adjacent to Haria, North-West) Char Mandi (adjacent to Sonamoi, East) Purbo Chandpur (adjacent to Sonamoi-North) Baratilak (adjacent to Sonamoi-South-West

Source: Google Earth & Site Visits

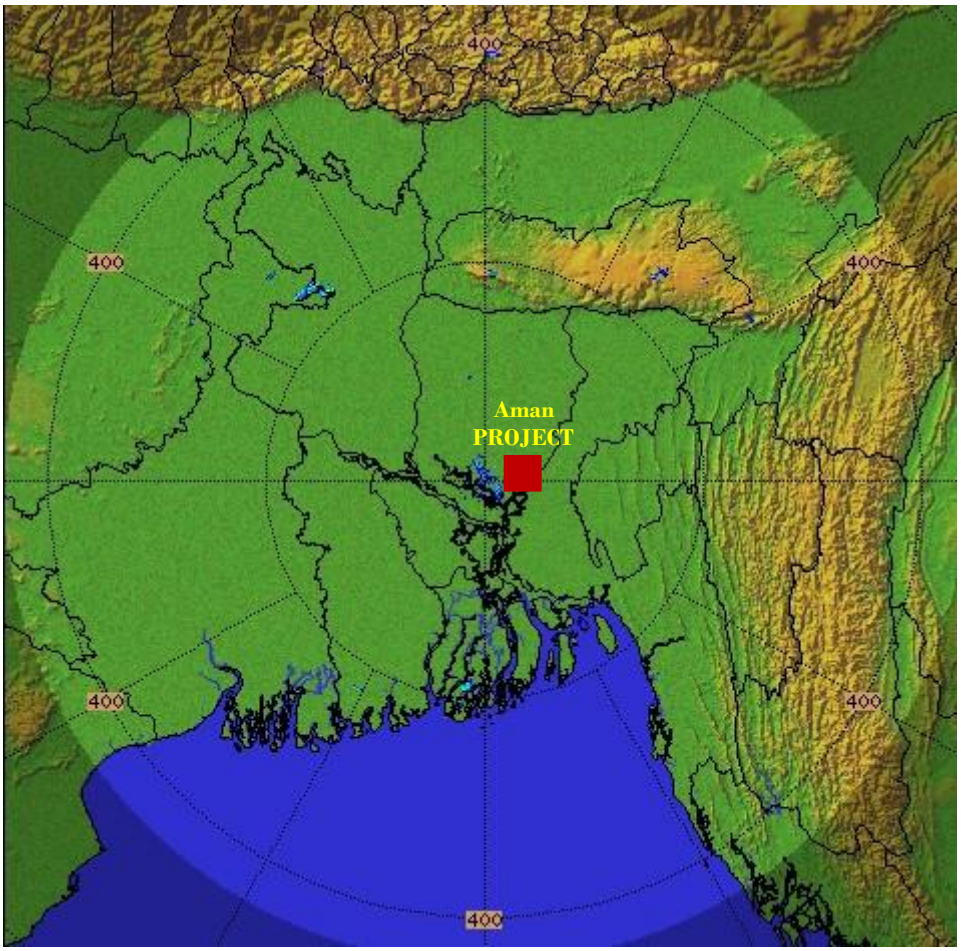


Figure 4.1 (a): Location of Aman Cement Mills Unit-2 Ltd. using Radar Image

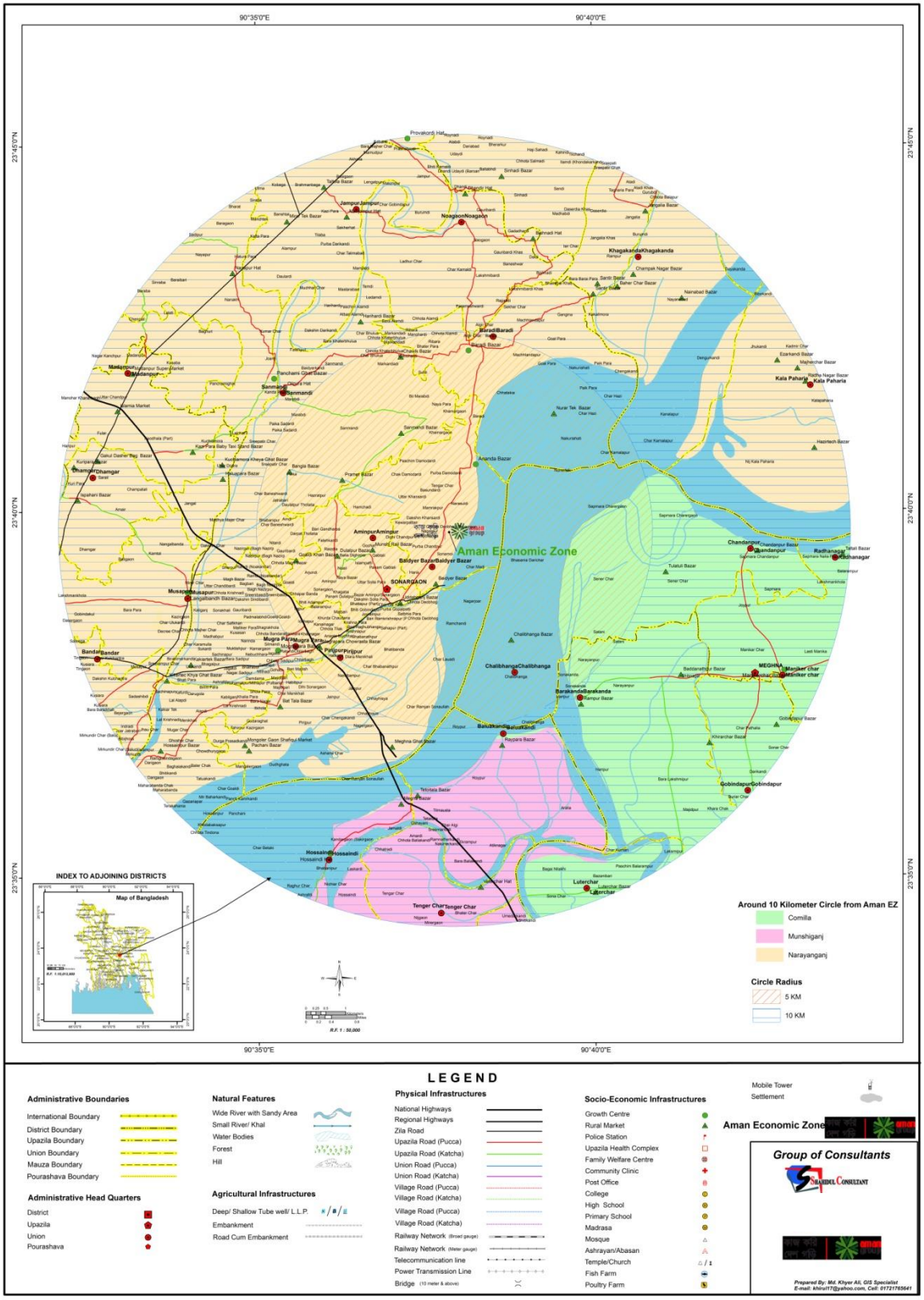


Figure 4.1 (b): Map Showing Environmental Settings within 10 km Radius of Project Site

Table 4.1 (b): Important features of the Aman Cement Mills Unit-2 Ltd. at a glance

SI	Parameter	Description
1.	Climate	The climatic condition of the project area is classified as tropical monsoon type, which influences the hydrodynamic features of the Meghna River with four seasons. The annual average temperature maximum 36°C and minimum temperature is about 12.7°C. The project area receives on average about 1776 mm of precipitation annually or 148 mm each month. The prevailing winds vary month to month in the project area, though predominantly in the north-west, south and north-east directions.
2.	Ecologically Critical Area	No Ecologically critical areas were found in the study area
	Reserve/Protected Forests	No reserve or protected forests area were found in the study area
3.	Predominant Geological Formations	The project site is underlain by several hundred meters of alluvial sediments. The surface is covered by two meters of alluvial silt, which is underlain by approximately 0.3 meters of silt sand and sand.
	Topography	The project site, and indeed the entire region, has a flat topography with very little relief or changes in elevation. The area has an elevation of 0.1 meters to 5.3 meters.
	Major Physiographic Units	The area falls into Physiographic unit of middle Meghna estuarine floodplain
	Major Soil Type	The area general soil type is non-calcareous dark grey floodplain soils.
4.	Principal crops	Like other cities of Bangladesh, agriculture is important in parts of the project area. The major products of the area are paddy, potato, brinjal, patal, cauliflower, sugarcane and mula (radish). Extinct or nearly extinct crops are kaun, sesame, jute, and mustard seed, indigo.
5.	Major Water Bodies	Meghna River, branch of Meghna Channel River, Shitalakhya River
6.	Flooding	Fall under non-flood area of Bangladesh. There is no evidence found about flood of that area.
7.	Seismicity	The project area falls in the earthquake Zone-2 of the seismic map of Bangladesh. This zone refers medium intensity of seismic effects.
8.	Environmental and Social Hotspots	River, School, college, madrasha, Mosjid, Mandir etc.
9.	Major Settlement	Residential area, Commercial area, Slums and Squatters, Bus terminals, Institutional etc.
10.	Major Industries/ Business Entrepreneurs	Sugar Refinery mills, Pulp & paper, Bashundhara paper mills, Textile Mill, Steel Mill, Paint Industry, Food processing Industry, Re-rolling mill, Tube mill, Agro-Engineering Industry, Metal Industry and Garments Industry, Few workshop, carpenter store, small milling etc.

4.2 Physical Environment

4.2.1 Topography and Physiography

Physiographic region/unit refers to a region of which all parts are similar in terms of physical characteristics and which consequently had a uniform geomorphic history, and whose pattern of topographical features or landforms differs significantly from that of adjacent regions. Physically the Aman Cement Mills Unit-2 Ltd. is characterized by alluvial formations caused by several rivers like Meghna connected with Shitalakshya, Old Brahmaputra, Buriganga, Balu and Dhaleshwari. In the context of topography and physiography,Aman Cement Mills Unit-2 Ltd. falls into Meghna Floodplain unit which again divided into(a) Middle Meghna Floodplain, (b) Lower Meghna Floodplain, (c)

Old Meghna Estuarine Floodplain, (d) Young Meghna Estuarine Floodplain sub-regions.

The main channel of the Meghna upstream from its junction with the Dhaleshwari and Ganges as far as Bhairab Bazar is known as the middle Meghna. The floodplain of this river occupies a low-lying landscape of broad islands and many broad meandering channels which formed part of the Brahmaputra before it abandoned this channel when it changed course into the Jamuna two centuries ago. The Meghna sediments are mainly silty and clays and sandy Brahmaputra sediments occur at the surface on some ridges in the north. Seasonal flooding from the Meghna is mainly deep. Basin sites are submerged early and drain late.

Southward from the junction of the Meghna and Ganges, the sediments on the left bank of the lower Meghna comprise mixed alluvium from the Ganges, Jamuna and Meghna. These deposits are predominantly silty. Close to the riverbank the deposits are slightly calcareous because of the inclusion of Gangetic material. Further inland, the sediments are not calcareous and many have been deposited before the Ganges shifted from the arial khan channel into the present Lower Meghna in around 1840 AD. This floodplain area has a slightly irregular ridge and basin relief, but also has large mounds used for settlement and cultivation. Seasonal flooding was formerly moderately deep, fluctuating in depth twice daily with the tides in the south, but flooding is mainly shallow and by rainwater within the area protected and drained by the Chandpur irrigation project.

The landscape in this extensive unit is quite different from that on river and tidal floodplains. The relief is almost level, with little difference in elevation between ridges and basins. Natural rivers and streams are far apart in the southern part and drainage is provided by a network of man-made canals (khal). The sediments are predominantly deep and silty, but a shallow clay layer in some basin centers overlies them. Seasonal flooding is mainly deep, but it is shallow in the southeast. Some basin centers stay wet throughout the dry season. Virtually everywhere, this flooding is by rainwater ponded on the land when external rivers flow at high levels; the exceptions are the narrow floodplains alongside small rivers (such as the Gumti) which cross the unit from adjoining hill and piedmont areas.

This sub-unit occupies almost the level land within and adjoining the Meghna estuary. It includes both island and mainland areas. New deposition and erosion are constantly taking place on the margins, continuously altering the shape of the land areas. The sediments are deep silts, which are finally stratified and are slightly calcareous. In many, but not all parts, the soil surface becomes saline to varying degrees in the dry season. Seasonal flooding is mainly shallow, but fluctuates tidally, and is caused mainly by rainwater or non-saline river water. Flooding by salt water occurs mainly on the lamed margins and during exceptional high tides during the monsoon; also when storm surges associated with tropical cyclones occur.

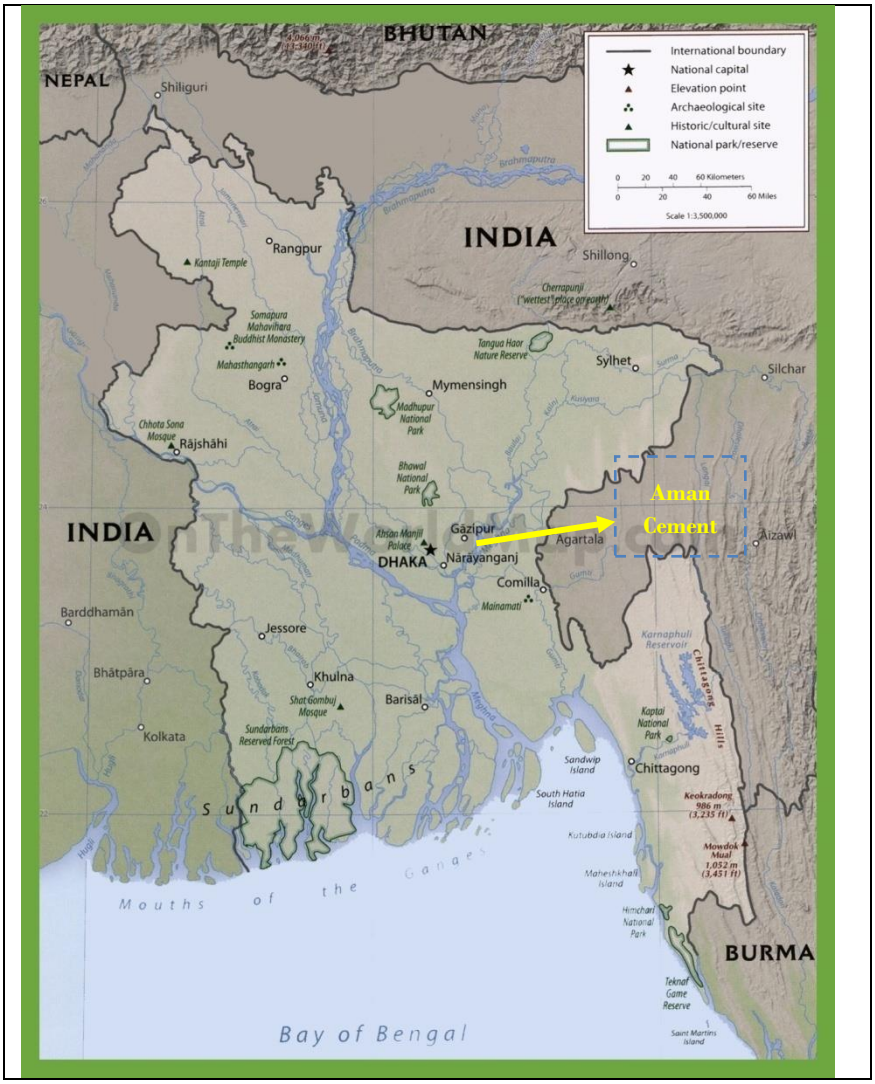


Figure 4.2.1: Physiographic map of Bangladesh

4.2.2 Geology and Soils

The Aman Cement Mills Unit-2 Ltd. is located in the Meghna flood plain sub region comprised of inter-stream alluvial flood plain deposits that are described as alluvial silts. Alluvial silt is generally deposited in flood basin and inter-stream areas. Soils are typical of areas that are commonly flooded. The most abundant clay mineral within these soils is illite. Soil of the area is grey loam on the ridges and grey to dark grey clays in the basins. The dominant general soil type is non-calcareous grey flood plain soil. Top soils are strongly acidic and sub-soils slightly acidic to slightly alkaline. General fertility level is medium with low nitrogen and organic matter.

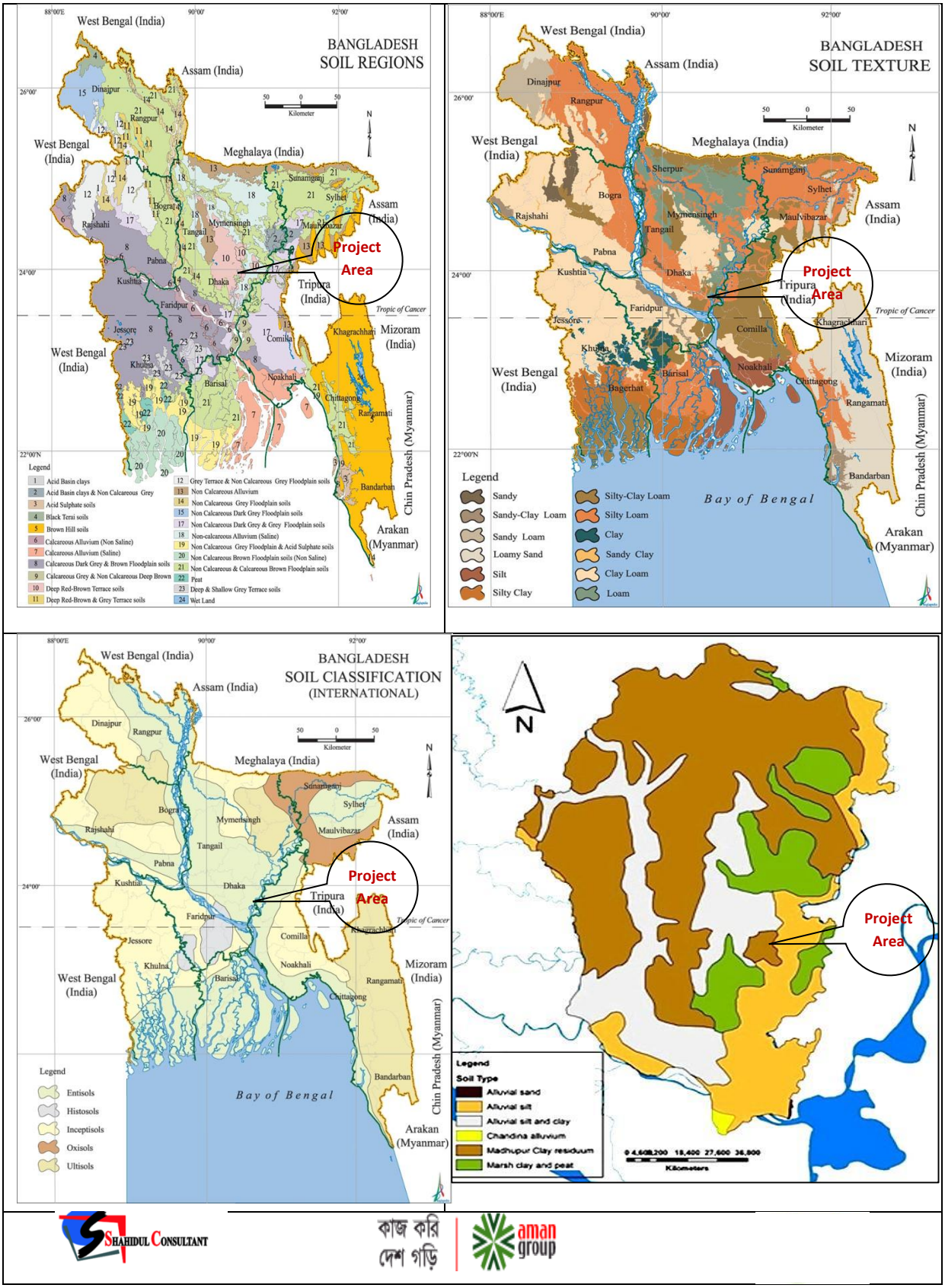


Figure 4.2.2: Position of Aman Cement Mills Unit-2 Ltd. in Soil Environment of Bangladesh

Geologically, the area lies on the edge of the Madhupur tract and the Holocene Flood plain deposits from the aquifer. The terrain of the project is generally flat with very little changes in elevation, with an average elevation of approximately four meters above

mean sea level. The river bank slopes gently to the Shitalakhya River, with a more abrupt bank along the edge of the Meghna. In its current condition, the low elevation and flat topography of the project site make it susceptible to flooding, particularly in the wet season when Shitalakhya River water levels are high

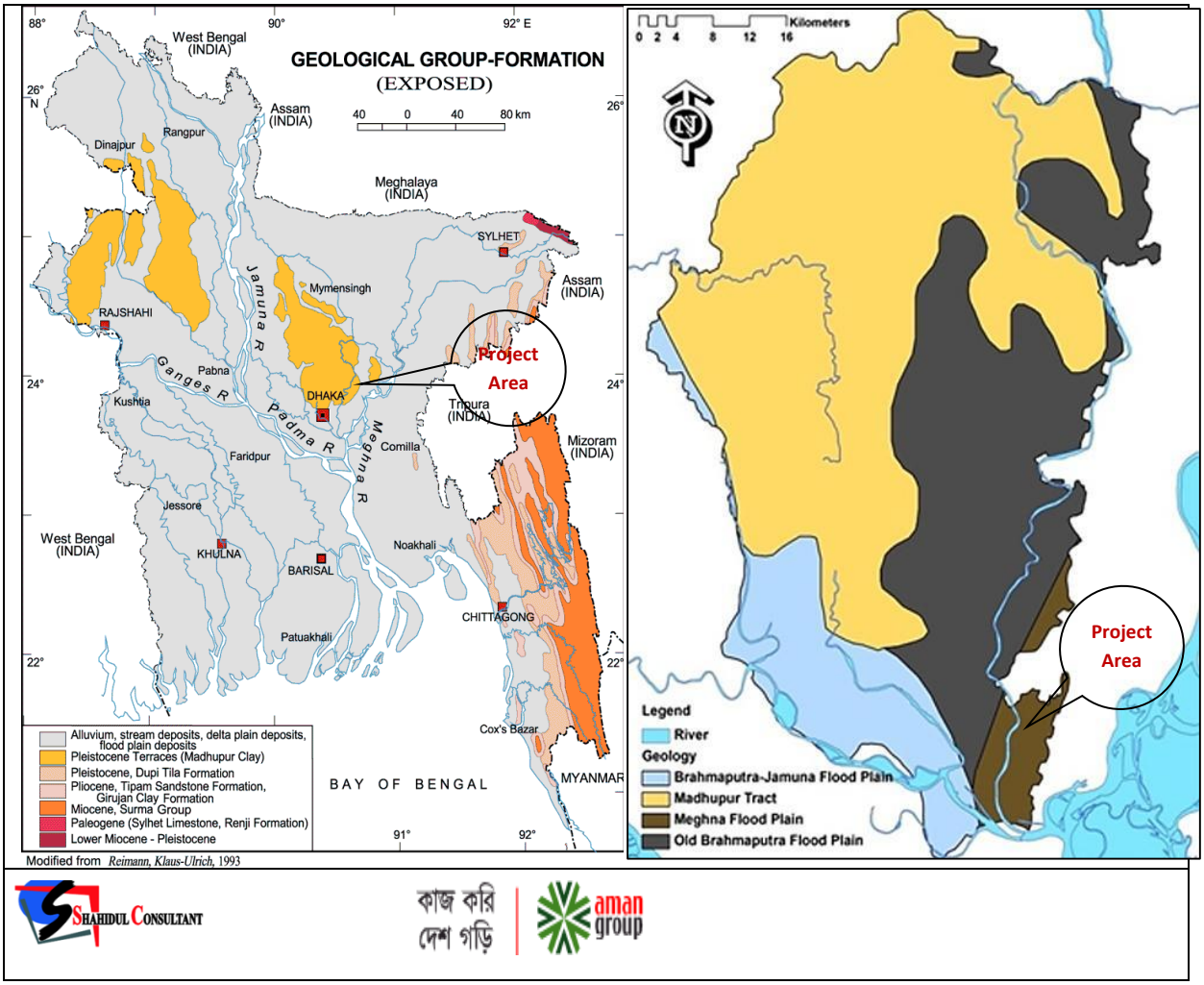


Figure: Geological Map of Aman Cement Mills Unit-2 Ltd.

4.2.3 Meteorology

The climatic condition of the project area is classified as tropical monsoon type, which influences the hydrodynamic features of the Meghna River. It has four seasons as Pre-monsoon (March to May), Monsoon (June to September), Post-monsoon (October to November), and dry (December to February) season. The long-term mean annual rainfall is over 2,000 mm, and about 80–90% of this occurs during monsoon (May–October). The temporal variations in climatic features such as rainfall intensity, duration, air temperature, relative humidity, evaporation and wind velocity affect the magnitude of discharge along hydrological pathways, which ultimately affect the quality of the river water. A monthly average temperature ranges from 25 to 31 °C, average humidity is 80 to 90% and evaporation ranges from 80 to 130 mm. The long term monthly average climatic data of the project area is presented in Table. Generally, the river experiences low tidal (back water) influence in downstream reaches during the wet (monsoon) season, whereas during the dry periods semi-tidal influence occur. The tidal effect during

the dry season takes place when the upstream flow becomes very low or non-existent. The average flow of the river during May to October as700 m3/sec and during November to April as 140 m^3sec^{-1} and the flow rate in Meghna on the order of 400 to 850 m3/sec during the months from June to October.

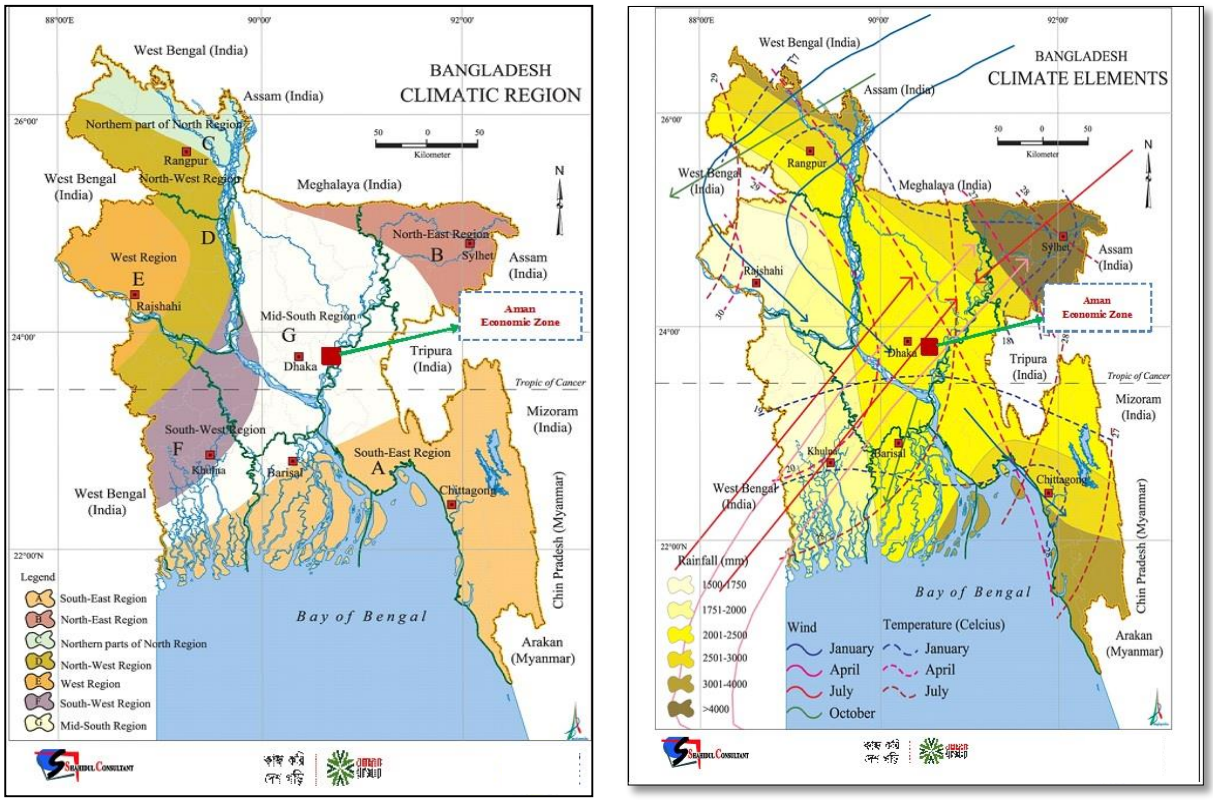
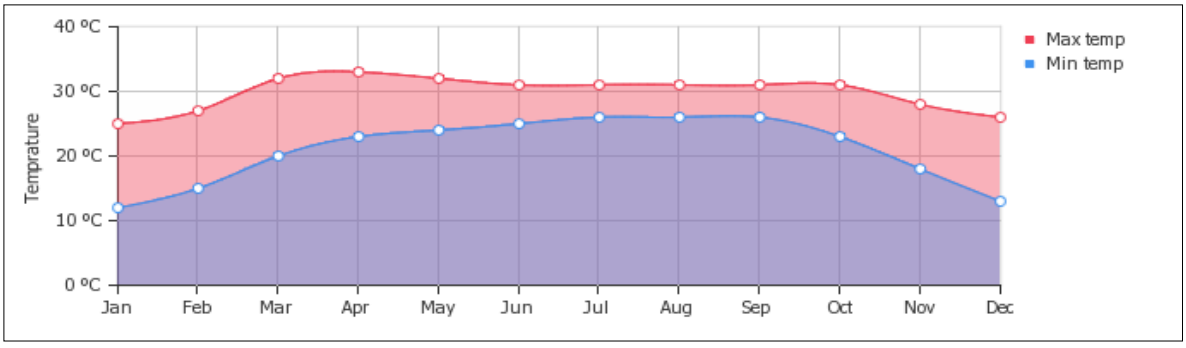


Figure 4.2.3: Position of Aman Cement Mills Unit-2 Ltd. in Climate Environment of Bangladesh

4.2.4.1 Temperature

- The months January, February, November and December have a nice average temperature.
- On average, the temperatures are always high.
- On average, the warmest month is April.
- On average, the coolest month is January.

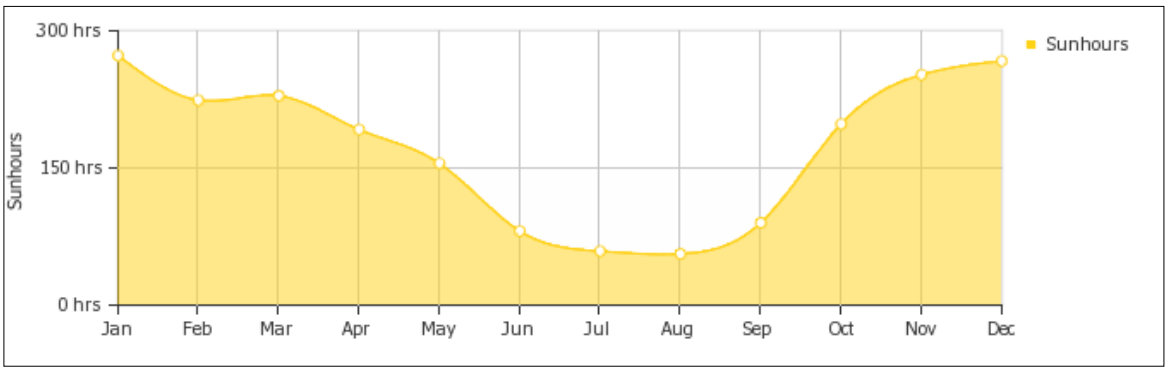


Source: BMD

Figure 4.2.4.1: Average Minimum and Maximum Temperature over the year at project

4.2.4.2 Sunshine

- On average, January is the most sunny
- On average, August has the lowest amount of sunshine.

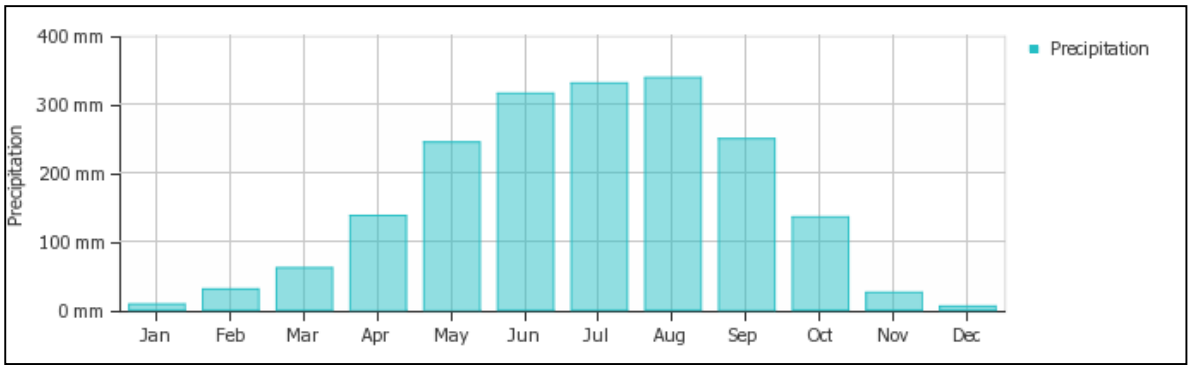


Source: BMD

Figure 4.2.4.2: Average monthly hours of Sunshine at project site

4.2.4.3 Precipitation

- A lot of rain (rainy season) falls in the months: April, May, June, July, August, September and October.
- Dhaka has dry periods in January, November and December.
- On average, August is the wettest month.
- On average, December is the driest month.

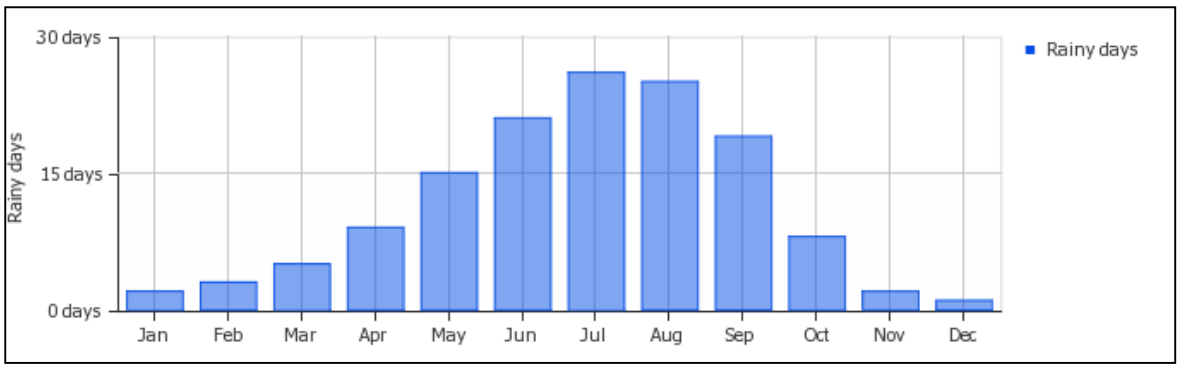


Source: BMD

Figure 4.2.4.3: Average monthly Precipitation (snow and rainfall) at project site

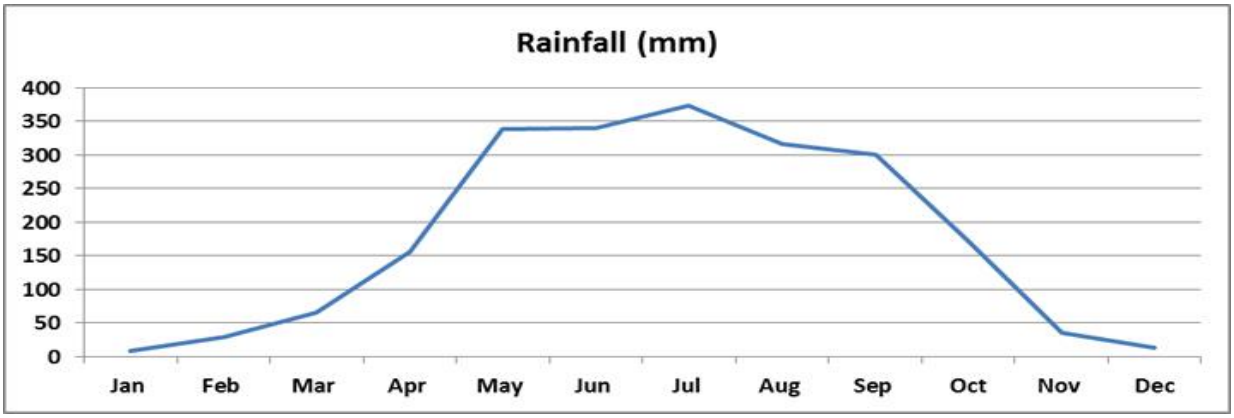
4.2.4.4 Rainfall

- Most rainy days are in May, June, July, August and September.
- Dhaka has dry periods in January, November and December.
- On average, July is the most rainy.
- On average, December has the least rainy days.



Source: BMD

Figure 4.2.4.4 (a): Average monthly Rainy Day over the year at project site

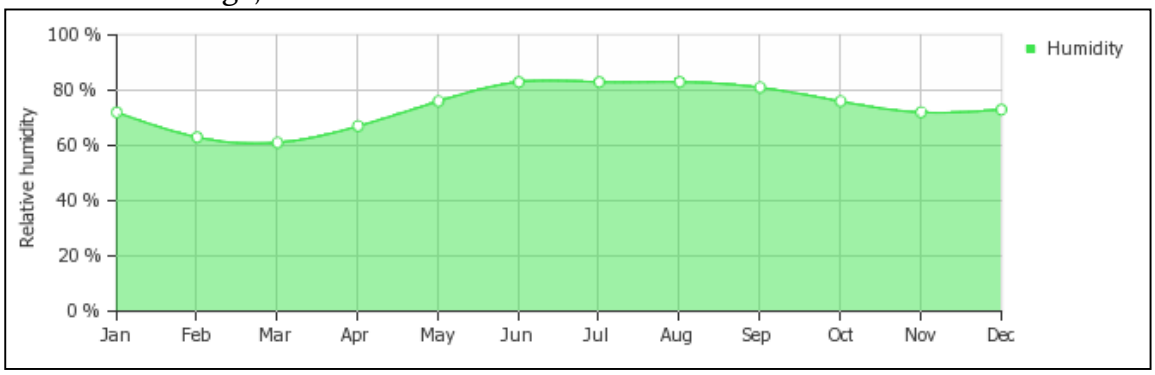


Source: BMD

Figure 4.2.4.2 (b): Trend of Rainfall over the year at project site

4.2.4.5 Humidity

- On average, August is the most humid.
- On average, March is the least humid month.

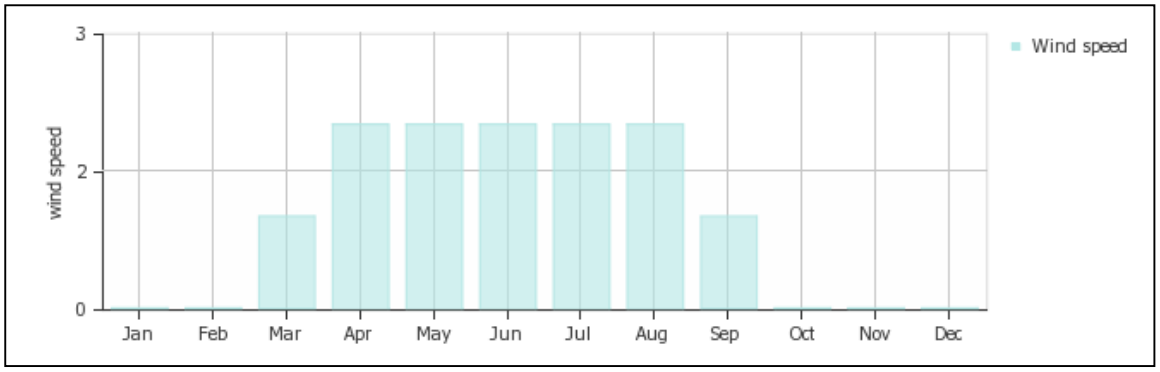


Source: BMD

Figure 4.2.4.5: Average monthly rainy day over the year at project site

4.2.4.6 Wind Speed

- On average, the most wind is seen in July.
- On average, the least wind is seen in January.



Source: BMD

Figure 4.2.4.6 (a): Average monthly wind speed over the year at project site

The wind rose for Dhaka shows how many hours per year the wind blows from the indicated direction. Example SW: Wind is blowing from South-West (SW) to North-East (NE). Cape Horn, the southernmost land point of South America, has a characteristic strong west-wind, which makes crossings from East to West very difficult especially for sailing boats. Wind speed estimation is important to ascertain pollution dispersion. The direction of wind varies with seasonal changes. Wind speed data and direction have been collected from the Dhaka BMD stations at a height of 10 m from the ground level. During winter (e.g. December) wind prevail to N or N-W direction. Wind direction reverses and prevails to S or S-E direction during pre-monsoon or monsoon. However, maximum wind behaves quite turbulence nature with lower wind speeds during post monsoon. **Figure-**shows wind speed and direction graphically round the year.

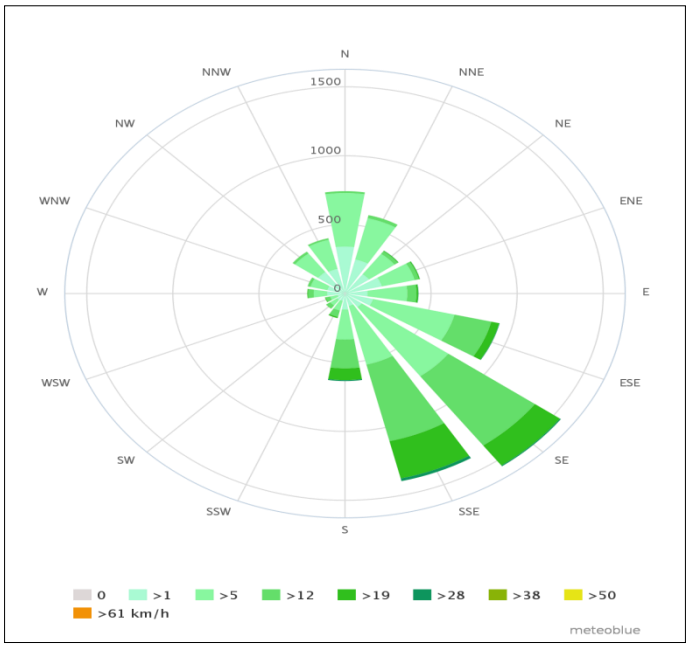


Figure 4.2.4.6 (b): Wind rose diagram at Dhaka station indicating the project site

4.2.4.7 Evaporation

Source: BMD

Figure 4.2.4.7: Average monthly evaporation over the year at project site

Table 4.2.4.7: All climatic variables at a glance for project site

Month	Average rainfall (mm)	No. of rainy days	Max. air temperature (°C)	Min. air temperature (°C)	Relative humidity (%)	Evaporation (mm)	Wind velocity (km/hr)	Seasons
Jan	7.7	2	25.4	12.7	70	104	3.7	Dry season
Feb	28.9	3	28.1	15.5	66	79	3.7	
Mar	65.8	5	32.5	20.4	63	81	5.6	
Apr	156.3	10	33.7	23.6	71	77	9.2	Wet season
May	339.4	14	32.9	24.5	79	78	9.2	
Jun	340.4	14	32.1	26.1	86	83	7.4	
Jul	373.1	17	31.4	26.2	87	87	7.4	
Aug	316.5	16	31.6	26.3	86	130	7.4	
Sep	300.4	13	31.6	25.9	86	118	5.6	
Oct	172.3	7	31.6	23.8	81	106	3.7	
Nov	34.4	2	29.6	19.2	74	75	1.8	Dry season
Dec	12.8	1	26.4	14.1	74	105	1.8	

4.2.4 Hydrology

The Aman Cement Mills Unit-2 Ltd. is located on the flat Ganges-Brahmaputra-Megna alluvial plain of central Bangladesh, at an elevation of 0 to 10 m PWD. It is flanked by the Meghna River on the east, Sitalakhya River on the north-east and the Buriganga River on the south and south-west. The project area is crossed by many small seasonally-filled man-made drainage canals fed by monsoon rain which averages 2550 mm annually.

A long-established river port, and jute trading centre, Narayanganj is now a national textile manufacturing centre, with factories undertaking all stages of production from spinning, dyeing/bleaching and weaving through to the making of garments and other finished cloth products. Other industries include soap-making, metal re-rolling and metal

& wood furniture manufacture. The rapid and unchecked growth of Dhaka into a megacity of 10 million inhabitants has seen inexorable encroachment on the rural hinterland west of Narayanganj, and the city is likely in the mid-term to become an industrial satellite suburb of Dhaka. It had itself a high estimated annual growth rate of 5.8% per annum during the 1990s.

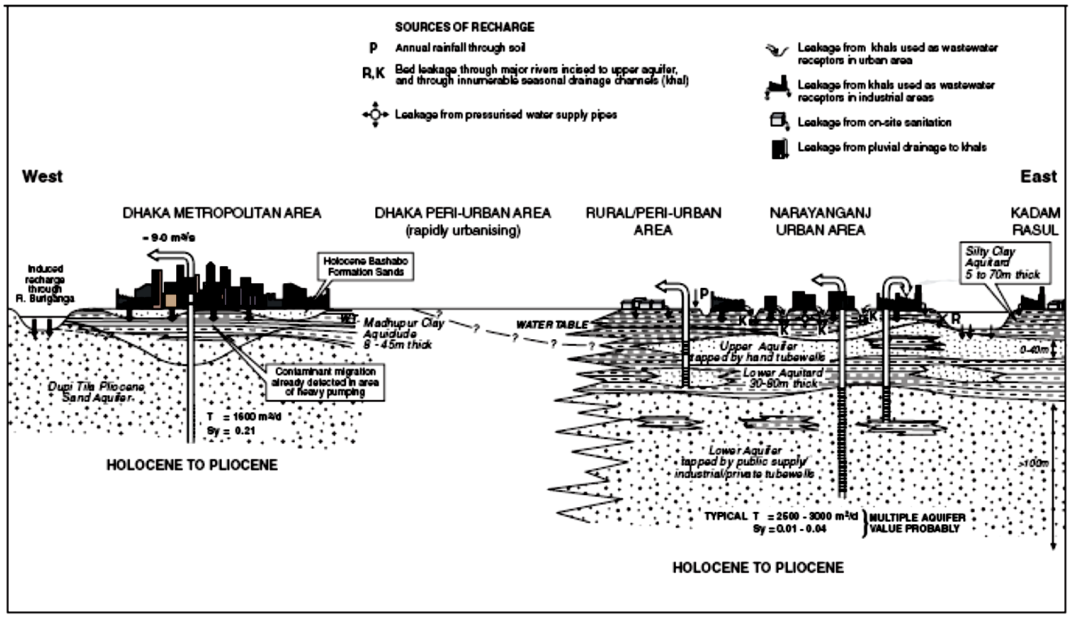


Figure 4.2.4: Ground water setting of Narayanganj near project site

Groundwater provides more than 90% of drinking water supplies in the study area and there is a similar high dependence on groundwater for industrial and commercial needs. Large-scale groundwater abstraction for public supply and industrial use is mainly from the lower aquifer. The project is underlain by an unconsolidated alluvial aquifer system of Quaternary age which is many hundreds of meters thick across the entire project area but in which only the top 250 m (and principally the top 150 m) is utilized for groundwater supply purposes. Complex lateral inter-digitations of medium grain-size clastics (medium to coarse sands) occur with finer-grained clastics (fine sands, silts, clays). As a first approximation the system is considered to comprise an upper aquitard covering a shallow aquifer which is separated from a deeper more productive aquifer by a lower much thicker aquitard (Figure 4.2.4).

With a monsoonal tropical climate, there are extensive opportunities for recharge not only directly from local rainfall but also from the Sitalakhya River and numerous khals and rainfed ponds. Annual monsoonal floods inundate much of the peri-urban area while the urban area can be affected on average about once every decade by abnormally high floods. Unconsolidated sediments provide inter-granular flow conditions, and it is probable that there is hydraulic connection with the Sitalakhya River whose channel is deep enough to incise into the upper aquifer sequence. Vertical connectivity is likely to be variable, depending on thickness and frequency of occurrence of fine-grained strata at any given location.

4.2.5 Wetlands

Wetlands are a vital link between land and water in Bangladesh. A majority of the people of Bangladesh are critically dependent on wetlands. The main characteristic of the geography of Bangladesh is abundance of water and wetlands. Wetlands are mainly located at the lower edge of the topography and are subject to periodic inundation/flooding. During the wet monsoon they are inundated at shallow to deep levels. Wetlands are defined as low-lying ecosystems where the groundwater table is always at or near the surface, including areas of marsh, fen, bog, floodplain, and shallow coastal areas. In other words, wetlands are transitional lands between terrestrial and aquatic ecosystems where the water table is usually at or near the surface or the land is covered by shallow water. According to the definition of wetlands by the Ramsar Convention, more than two-thirds of Bangladesh may be classified as wetlands. Wetlands of Bangladesh have the characteristic of being sensitively influenced by water; wetlands support agriculture, fish, and natural vegetation and maintain soil structure that is distinctive from that of surrounding uplands. Vegetations vary between upland and open water in wetlands.

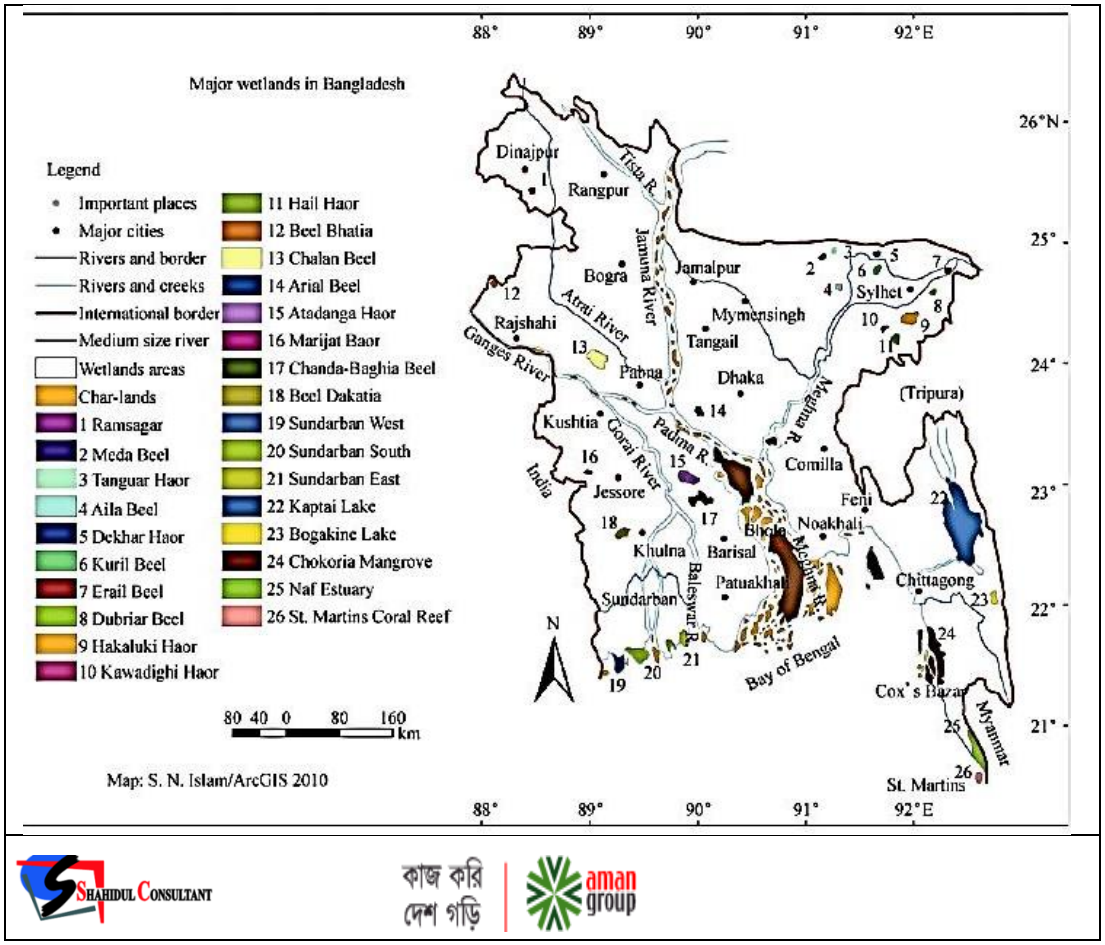


Figure 4.2.5 (a): Major wetlands in Bangladesh

The project area or the adjacent waters does not fall the IUCN or the GOB identified critical ecological resource, an ecologically critical area, or sanctuary. The area was historically utilized for seasonal agricultural cultivation by local persons during the dry

season. The area is characterized as an island surrounded by the river on three sides and is best known to the local people as a char (i.e., island).

Figure 4.2.5 (b): Main River and water channel in the project area

Figure 4.2.5 (c): Existence of local wetland resources in the project area

4.2.6 Surface and Ground Water

Meghna River, one of the major rivers in Bangladesh, especially famous for its great estuary that discharges the flows of the Ganges-Padma, the Brahmaputra-Jamuna and the Meghna itself. The Meghna has two distinct parts. The Upper Meghna from

Kuliarchar to Shatnol is a comparatively small river. The Lower Meghna below Shatnol is one of the largest rivers in the world because of its wide estuary mouth. The Lower Meghna is at times treated as a separate river. The Meghna has a railway bridge-'Bhairab Bridge'-and a road bridge-'Bangladesh-UK-Friendship Bridge' over it. The width of the river there is three-quarters of a kilometer. Several small channels branching off from the Meghna and meandering through the lowland bordering the TipperaSurface receive the flow of a number of hilly streams and rejoin the main river downstream. The Meghna receives Tippera Surface streams from the east and flows from the enlarged Dhaleshwari from the west. At the confluence, just north of Shatnol, the Meghna is about five kilometres wide. A larger number of settlements, towns, ports and industries have sprung up on both the banks of the Meghna. Narsingdi, Chandpur, Barisal and Bhola are the district towns that stand on the banks of the Meghna. Kuliarchar, Bhairab Bazar, Chandpur (Puran Bazar), Ramdaspur, Kalupur and Daulatkhan are important riverports and business centres. The Ashuganj thermal power plant and the Fenchuganj fertiliser factory are located on the banks of this river.

The Meghna is a flood-prone river. The Bangladesh water development board (BWDB) has implemented the Meghna Valley Project and constructed embankments along the riverbanks. These embankments are protecting greater Sylhet, Mymensingh and Comilla districts from floods. By constructing dams at different places a total of 180,000 ha of land have been brought under irrigation. About 125 km of dams have been constructed in the southern region of Bangladesh under the coastal embankment project. These are helping to control floods and keep salinity off. These dams are also playing an important role in land reclamation.

The river is used for navigation purposes. The river is also used as water-route for the Chittagong ports activities. Beneficial water uses are primarily for fishing and irrigation. It is also widely used for industrial water supply. Regarding pollution load concern, Meghna River receives discharge from all the industries situated on the upstream and downstream that include textiles, tannery, detergent, glass factory etc. A few of them have effective treatment plant. Besides, the industrial pollution, the domestic effluent from the Dhaka metropolitan area is also discharged into the Meghna. The river Meghna though not a fishing zone still contains various species of fishes and a number of fishermen earn their livelihood by fishing in this river. Active fishing prevails near the river mouth demonstrating the movement of migratory fishes.

Water quality of the river Meghna near the project side has been analyzed and it appears the physical properties of river Meghna are within the permissible standards indicating dilution of the pollutants received upstream. Below are the points of taking water samples for testing in the laboratory in order to check its quality.

Figure 4.2.6: Surface water sampling points (01, 02 and 03) along the Meghna River near Baiddyar Bazar, Sonargaon, Narayangong

Table 4.2.6 (a): Water Quality Data of Meghna River (15th to 22nd May, 2016)

Parameter	Point 01	Point 02	Point 03	Inland Water STD (ECR 1997)
p^H	7.13	7.2	7.11	6 to 9
DO (mg/L)	7.10	7.12	7.14	4.5 to 8
BOD_5 (mg/L)	<1	<1	<1	50
PO_4^{3-} (mg/L)	1.4	1.2	1.7	5
NO_3^- (mg/L)	10	11	10.5	10
NH4 (mg/L)	10.2	10.4	10.7	5
TC (count per 100 mL)	>100	>100	>100	1000

Table 4.2.6 (b): Groundwater data of samples collected from the AEZ site **(15th to 22nd May, 2016)**

Parameter	Tube well 01	Tube well 02	Tube well 03	Bangladesh STD
pH	7.21	7.17	7.09	6.5 to 8.5
TDS (mg/L)	419	377	457	1000
Conductivity (μc/cm)	858	774	935	700
Salinity (%)	0.4	0.4	0.5	-----
Turbidity (NTU)	0.78	1.10	1.20	10
color	-----	------	-----	15
Chloride (mg/L)	112.5	111	132.5	150- 600
Iron	0.06	0.06	0.06	0.3-1
Arsenic (mg/L)	0.05	0.051	0.055	<0.05
Total Coliform	0	0	0	0

Table 4.2.6 (c): Water Quality of Meghna River (Selected Parameters)

Parameters	**Sample of River Water**	**Sample of Drinking Water**	**Bangladesh Standard**
pH	6.4	6.8	6.5 – 8.5
TDS	166	53	2100 mg/l
DO	6.1 mg/l	6.1 mg/l	4.5 – 8.0 mg/l
BOD5	3.2 mg/l	4.2 mg/l	50 mg/l
COD	8.0 mg/l	5.6 mg/l	200 mg/l

BOD = Biological oxygen demand,
DO = Dissolved oxygen,
COD = Chemical oxygen demand,
TDS = Total dissolved solids
Source: EIA report of Shah Cement Plant, Narayanganj, 2005

Ground Water: There are three main aquifers in the central region of Bangladesh which is also applicable for this project:

(i) An upper (composite) aquifer, which can reach depths of 50 m and is covered with an upper silty clay layer of less than 20 m;

(ii) A middle (main) aquifer of fine to heavy sands, which is generally 10 m to 60 m thick and in most areas is hydraulically connected with the composite aquifer above; and

(iii) A deep aquifer of medium, medium-to-fine or medium-to-coarse sand, which is generally found at depths below 100 m.

The main impact to surface water and the hydrologic system because of the project is how it may affect the water quality and quantity of the Meghna River and associated water networks in the project's area of influence. It is possible that surface water may undergo the following once the project is established:

- The dewatering of dredged materials and its operations may contribute to increased turbidity in the MeghnaRiver;
- Dredged areas may alter bathymetry, promoting changes to the flow velocities and erosion/accretion cycles;
- Construction of the raised project pad may impact flooding and ponding conditions in the local area;
- Vehicle movement and land development could lead to erosion and sedimentation;
- Accidental spillage, mismanagement or leakage of hazardous materials (such as fuels, oils and solvents) may pollute surface waters; and
- Waste generated by project tenants and residents could pollute surface waters, if improperly managed.

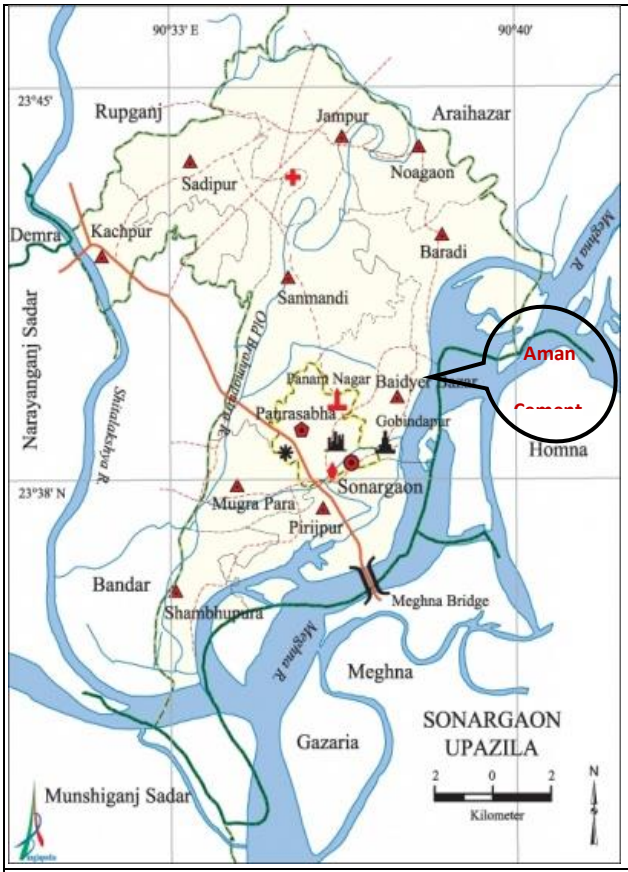


Figure 4.2.6 (a): Surface water sources of project area

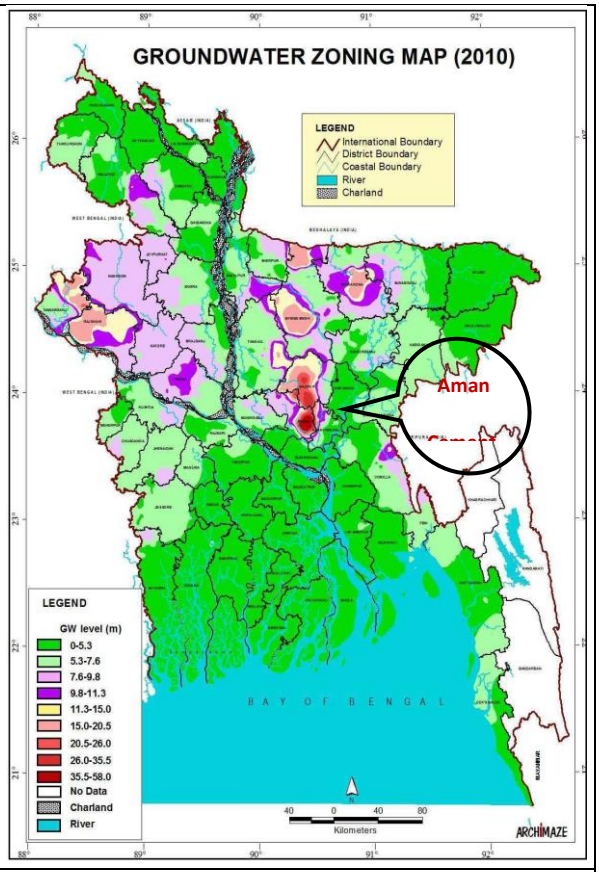


Figure 4.2.6 (b): Arsenic status of the project area

Groundwater arsenic contamination in Bangladesh is reported to be the biggest arsenic calamity in the world in terms of the affected population. The Government of Bangladesh has addressed it as a national disaster. Arsenic contamination of groundwater in Bangladesh was first detected in 1993. Further investigations were carried out in the following years. The institutions that contributed in the investigations are the School of Environmental Studies (SOES) from Jadavpur University in Calcutta,

Bangladesh Atomic Energy Commission (BAEC), Dhaka Community Hospital (DCH), Department of Public Health Engineering (DPHE), and National Institute of Preventive and Social Medicine (NIPSOM). DPHE collected and analyzed 31,651 well water samples with the assistance of WHO, NICEF and DFID. The laboratory reports have confirmed that the groundwater in Bangladesh is severely contaminated by arsenic. The millions of shallow and deep wells that had been sunk in various parts of the country are dispensing their own special brand of poison. In consequence, a large number of populations in Bangladesh are suffering from the toxic effects of arsenic contaminated water. Even, recent studies in Bangladesh indicate that the groundwater is severely contaminated with arsenic above the maximum permissible limit of drinking water. But it is important to note that, the proposed Aman Cement Mills Unit-2 Ltd. site has no arsenic pollution in the ground water.

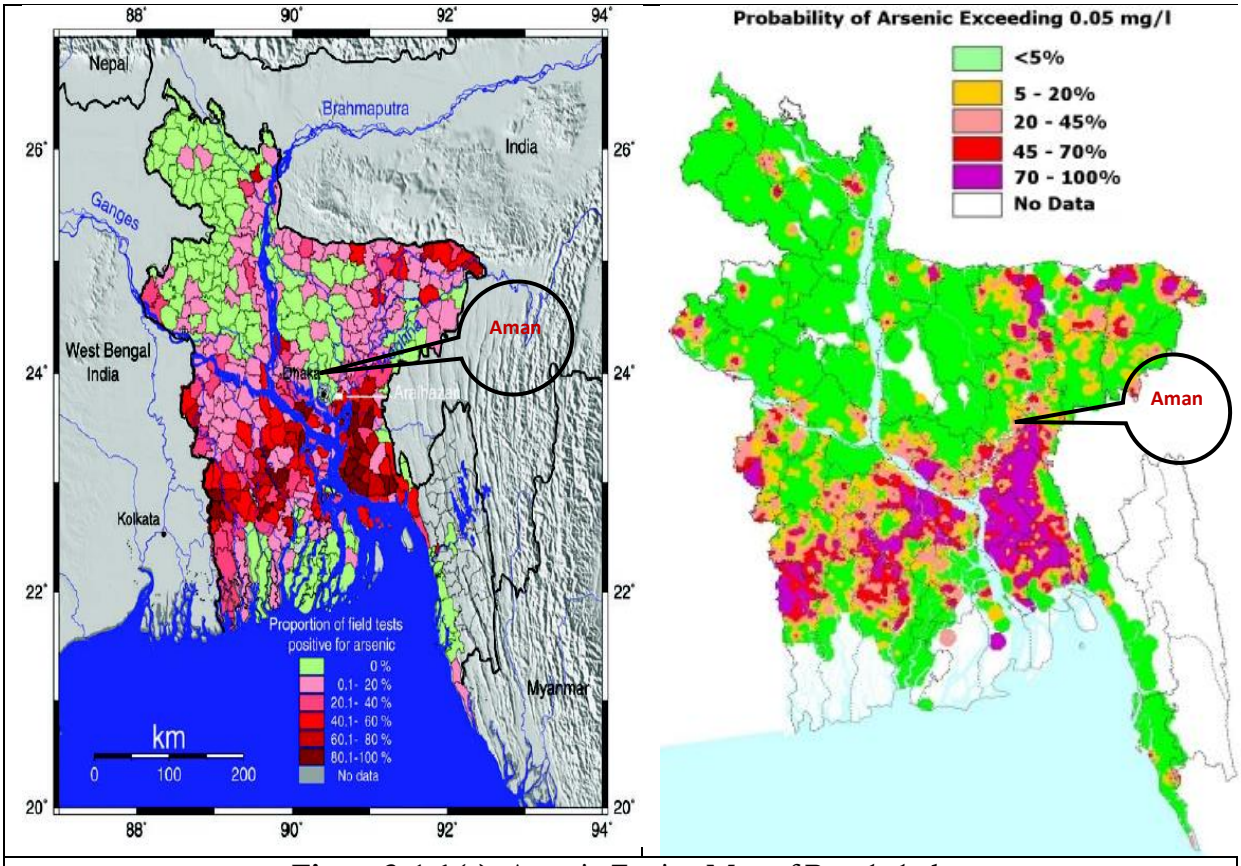


Figure 2.4.6 (c): Arsenic Zoning Map of Bangladesh

4.2.7 Flooding

Bangladesh is prone to flooding due to being situated on the Ganges Delta and the many distributaries flowing into the Bay of Bengal. Coastal flooding, combined with the bursting of river banks is common, and severely affects the landscape and society of Bangladesh. 80% of Bangladesh is floodplain, and it has an extensive sea coastline, rendering the nation very much at risk of periodic widespread damage. Whilst more

permanent defenses, strengthened with reinforced concrete, are being built, many embankments are composed purely of soil and turf and made by local farmers. Flooding normally occurs during the monsoon season from June to September. The convectional rainfall of the monsoon is added to by relief rainfall caused by the Himalayas. Melt water from the Himalayas is also a significant input.

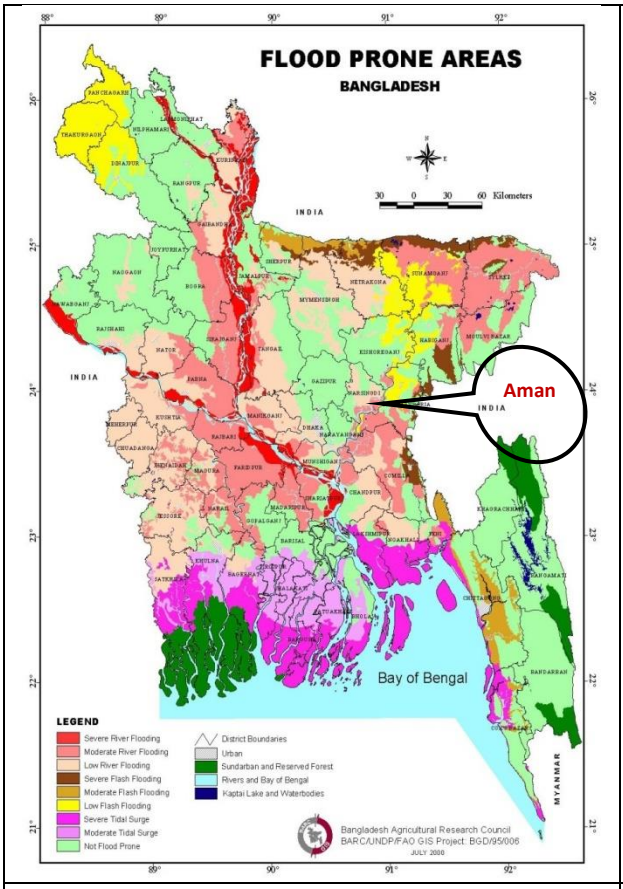


Figure 4.2.7 (a): Position of Aman Cement Mills Unit-2 Ltd. at flood prone areas

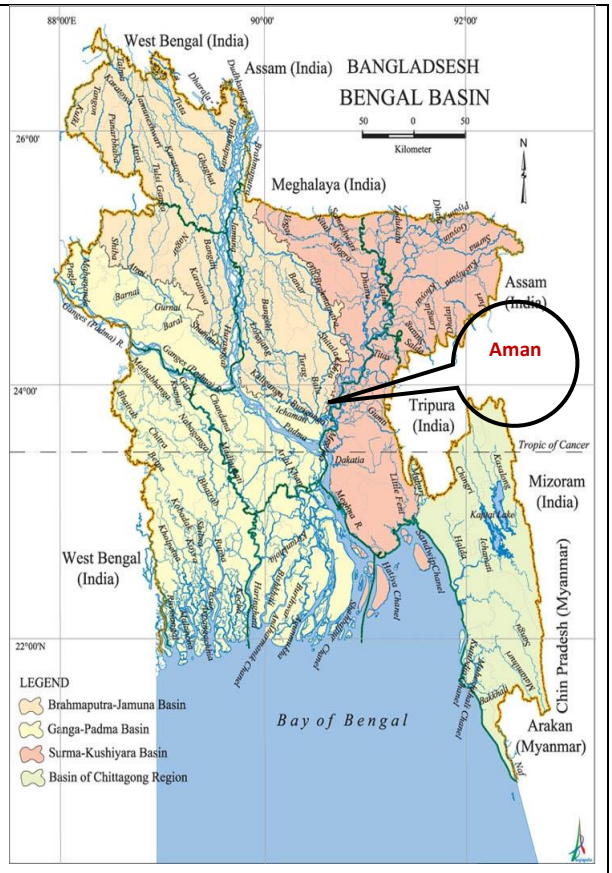


Figure 4.2.7 (b): Position of Aman Cement Mills Unit-2 Ltd. at river & drainage system of Bangladesh

The project area is affected by internal and external flood. External floods are caused in the low area by over flow of sorrowing river and khal, while internal floods are caused by storm water due to rainfall and insufficient drainage facilities. The storm water discharges into river through natural drainage. The capacity of the natural drainage system of the project area is not enough and which is being obstructed due to land filling activities for housing and commercial development.

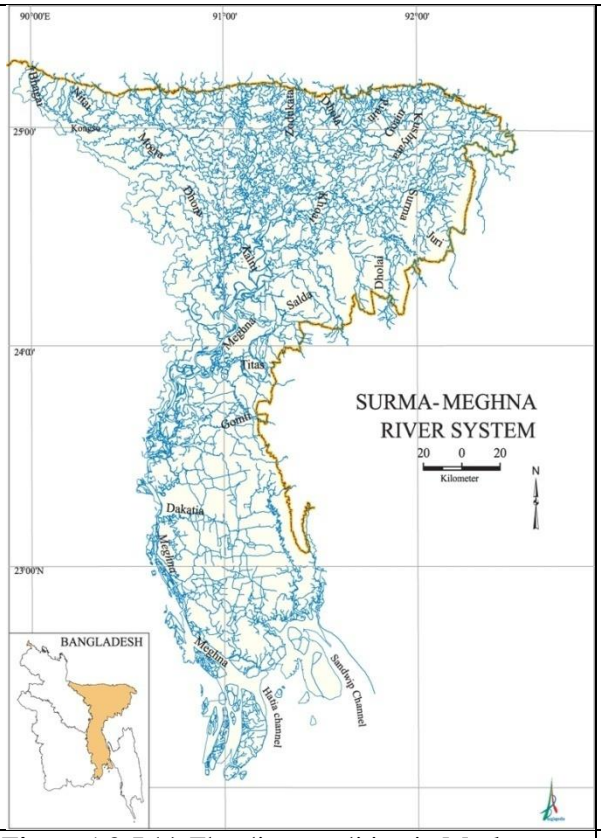


Figure 4.2.7 (c): Flooding condition in Meghna river system

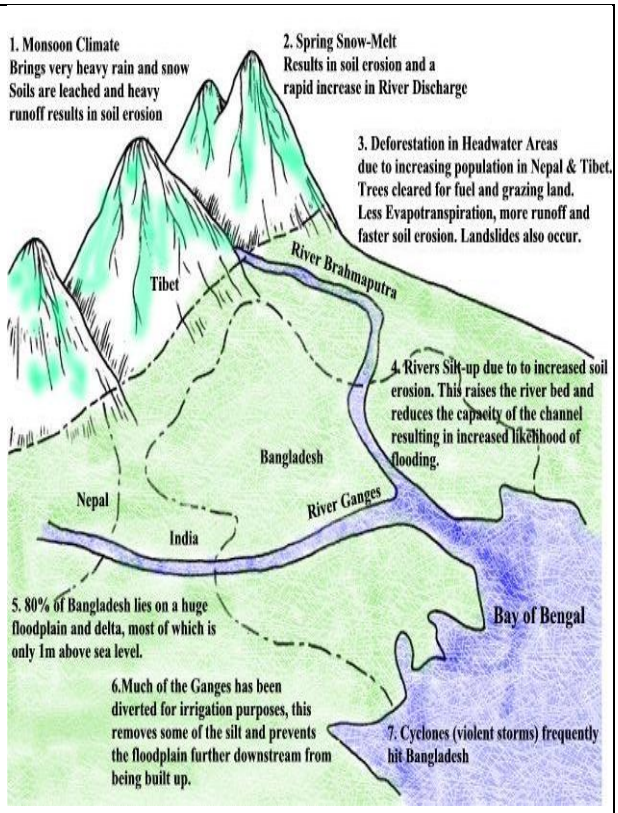


Figure 4.2.7 (d): Flooding formation due river system

Meghna is the influential river of the project. According to the local people, the 1988 and 1998 floods were the largest floods in the area. The trends in annual maximum flood level of the Upper Meghna River at Meghna Ferry Ghat. It is seen from the literature that there is a negative trend in the annual maximum flood level in the river. This indicates that the peak flood level of the river close to the study site is decreasing at a rate of 2.5 cm per year. Thus, there is no indication of worsening of flood level in the river near the study site. The danger level at Narsingdi is 5.70 m PWD. There has been no flood in the river after 2008.

There is a well-defined and connected river network around the MEZ site including the Upper Meghna and Meghna Branch rivers. So, any rainfall in the area drains out quickly through these rivers and no water logging occurs. Also, the MEZ site is about 1-2 m above the historical highest water level. It is unlikely that the area would be flooded by a flood of 1988 or 1998 magnitude.

4.2.8 Riverbank Erosion

Every year millions of people of the country are affected by riverbank erosion that destroys standing crops, farmland and homestead land. It is estimated that about 5% of the total floodplain of Bangladesh is directly affected by riverbank erosion. Riverbank

erosion is taking place in about 94 upazilas out of 496 upazilas/thanas of the country. Over 25,000 families were rendered homeless in June 1993 by riverbank erosion in 16 districts. During monsoon, extensive overbank spills, bank erosion and bankline shifts have become typical. The unpredictable shifting behavior of the rivers and their encroachments not only affect the rural floodplain population but also the urban growth centers and infrastructures.

Table 4.2.8: Occurrence of river erosion during the years 2008-2011 (Yes/No)

Upazila	2008	2009	2010	2011
Araihazar	Yes	No	No	No
Bandar	Yes	No	Yes	Yes
Narayanganj	No	No	No	No
Rupganj	No	No	No	No
Sonargaon	**No**	**No**	**No**	**No**

Source: Bangladesh Meteorological Department

The rivers that are highly susceptible to riverbank erosion are Ganges, Jamuna, Padma and Lower Meghna. Along the right and left banks of the Ganges, erosion rates are 56m and 20m per year respectively. The rate of widening of the Jamuna within the period 1973 to 2000 is 128m/year. In this period, the average width of Jamuna increased from 9.7 to 11.2 km. The maximum bank erosion during 1984-92 occurred at the left-bank, just upstream of Aricha. The widening of Jamuna in a 28-year period resulted in a loss of floodplain of 70,000 ha over the total 220-km length of the river in Bangladesh. Banklines of Padma are very unstable and the widening rate is 159m/year. The Lower Meghna River eroded both its banks, causing formation of medial bars. It is important to note that the Aman Cement Mills Unit-2 Ltd. though beside the riverbank, there is no erosion track record.

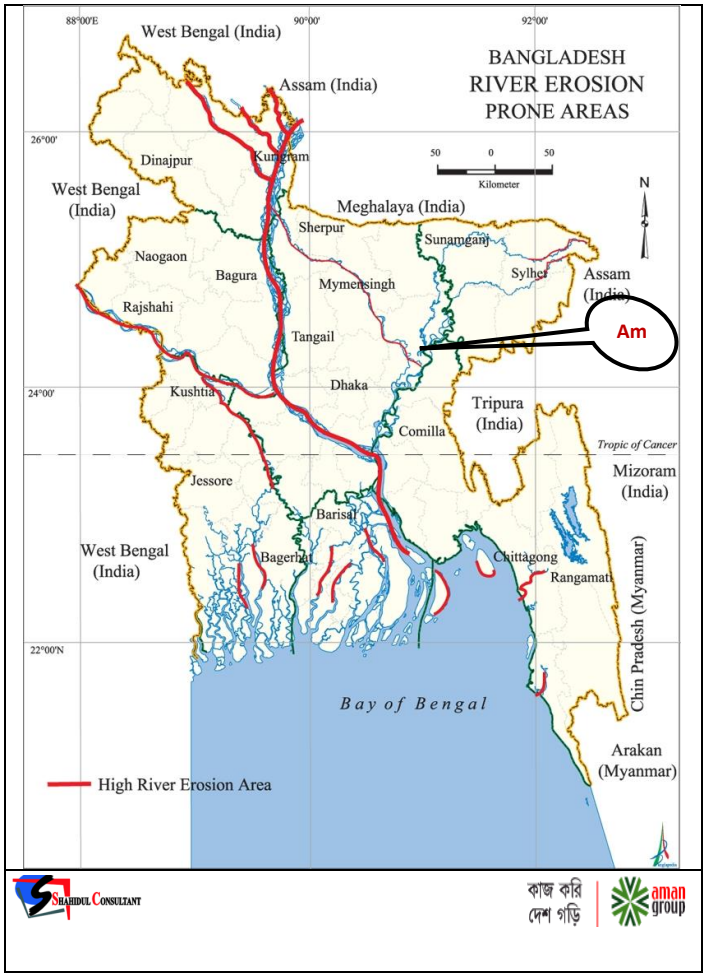


Figure 4.2.8 shows the position of Aman Cement Mills Unit-2 Ltd. At River Erosion Prone Areas of Bangladesh

Please see the River Bank Protection Layout in ***Annex-18***

4.2.9 Cyclone

Devastating cyclones hit the coastal areas of Bangladesh almost every year usually accompanied by high-speed winds, sometimes reaching 250 km/hr or more and 3-10m high waves, causing extensive damage to life, property and livestock. Cyclones in the Bay of Bengal occur in two seasons, April-May and October-November i.e. before and after the monsoon. The Aman Cement Mills Unit-2 Ltd. has no cyclonic track record ever.

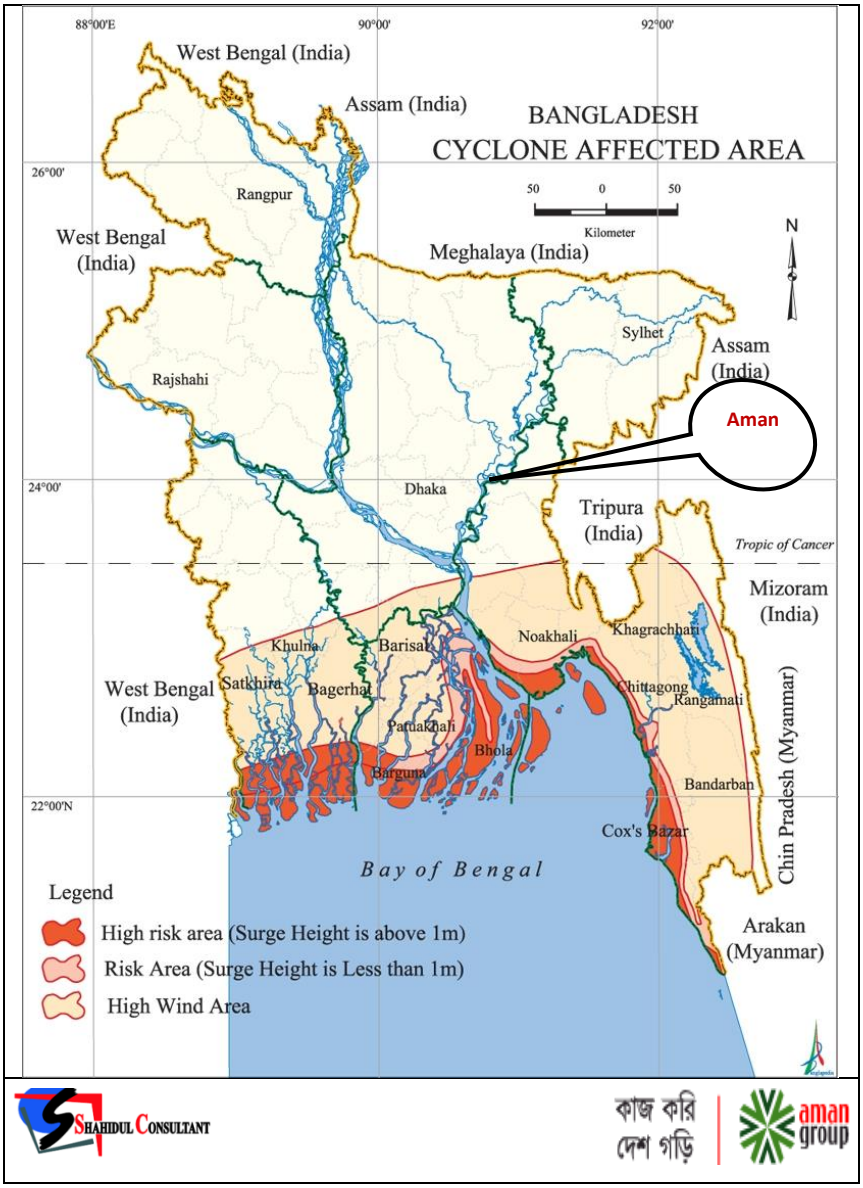


Figure 4.2.9: Position of Aman Cement Mills Unit-2 Ltd. at cyclone affected areas of Bangladesh

4.2.10 Drought

In Bangladesh drought is defined as the period when moisture content of soil is less than the required amount for satisfactory crop-growth during the normal crop-growing season. It occurs when evaporation and transpiration exceed the amount of precipitation for a reasonable period. Drought causes the earth to parch and a considerable hydrologic

(water) imbalance resulting water shortages, wells to dry, depletion of groundwater and soil moisture, stream flow reduction, crops to wither leading to crop failure and scarcity in fodder for livestock. Drought is a major natural hazard faced by communities directly dependent on rainfall for drinking water, crop production, and rearing of animals. Since ancient times droughts have far-reaching effects on mankind. Large land areas often suffer damages from dust storms and fire. Drought could be the reason for migration of early human communities. It has long been considered to be a natural hazard responsible for ups and downs of many civilizations of the world. Droughts are common in the northwestern districts of Bangladesh. So, from the map and the literature it clear that the proposed project is out of the risk of drought.

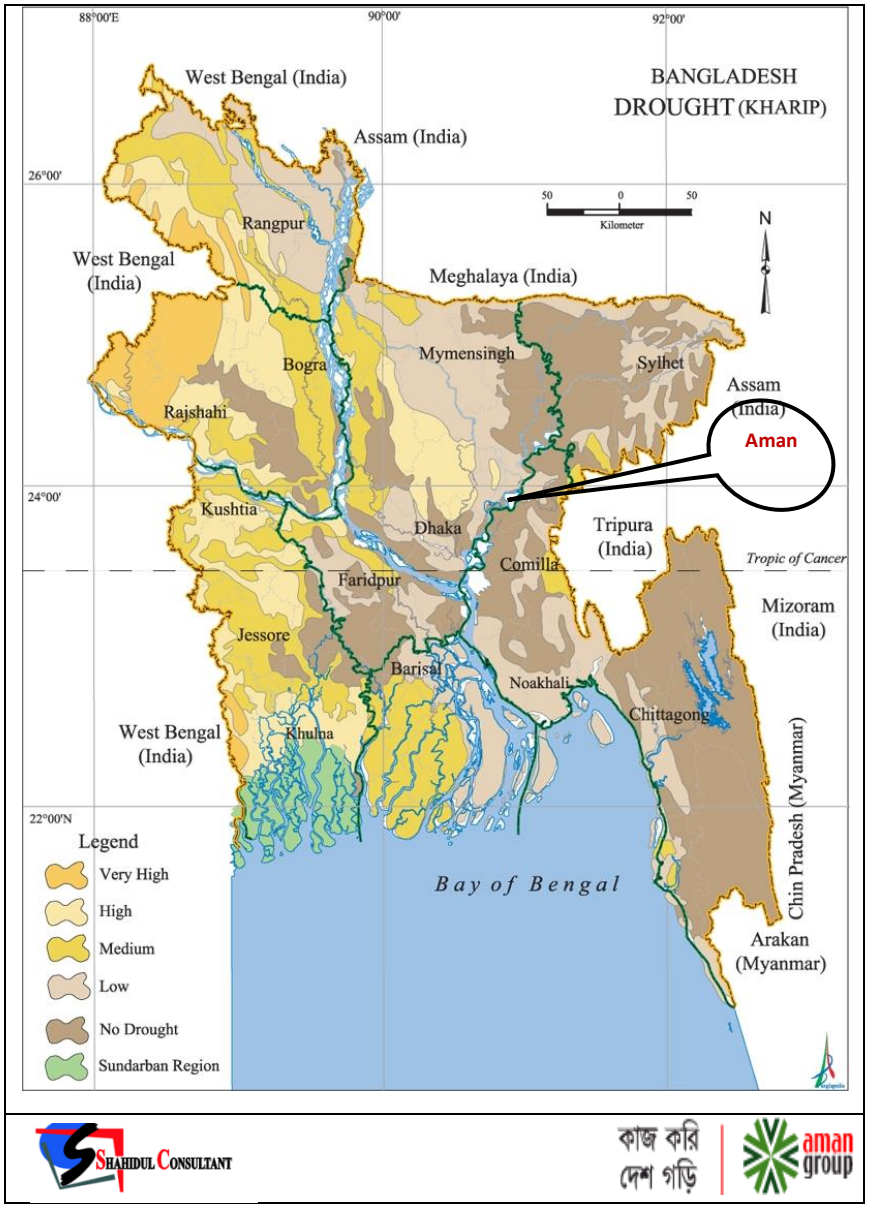


Figure 4.2.10: Position of Aman Cement Mills Unit-2 Ltd. at drought prone areas of Bangladesh

4.2.11 Seismicity

In the north and northeast of Bangladesh, there are areas of high seismic activity and some of the major earthquakes originating in these areas have affected the adjacent

regions of the country. The whole of Bangladesh is divided into three seismic zones. The northern part of the country that includes the greater districts of Rangpur, Mymensingh, and Sylhet are in the Zone-I where earthquake shock of maximum intensity of IX of the Modified Mercalli Scale is possible. The Zone-II includes the greater districts of Dinajpur, Bogra, Dhaka and Chittagong and the shocks of intensity of VIII are possible. The southern part of the country, the least active region, where the maximum intensity is not likely to exceed VII, is in the Zone-III. The experts suggest not constructing normal buildings with more than 60m height. The proposed Aman Cement Mills Unit-2 Ltd. has fall under the seismic zone-II where seismic co-efficient was found 0.05g.

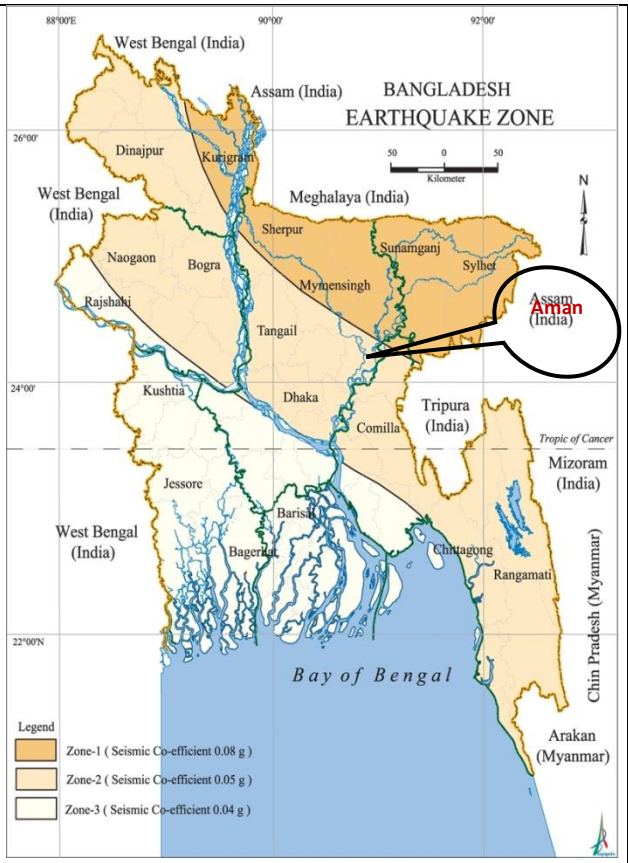


Figure 4.2.11 (a): Position of Aman Cement Mills Unit-2 Ltd. at seismic zone of Bangladesh

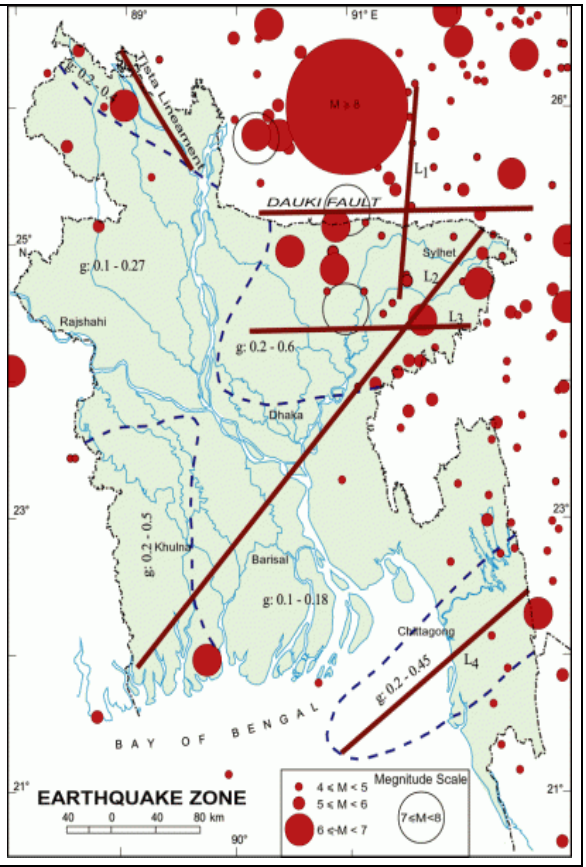


Figure 4.2.11 (b): Position of Aman Cement Mills Unit-2 Ltd. at seismic magnitude range of Bangladesh

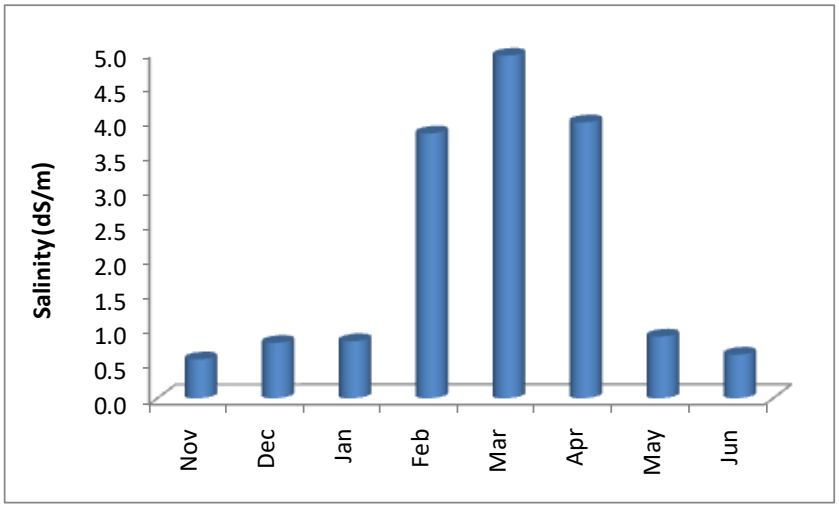
Please see the Certification of China National Heavy Machinery Corporation CHMC) of ACML-2 in ***Annex-7***

Please see the Load Bearing Certificate of ACML-2 in ***Annex-10***

4.2.12 Salinity

As mentioned earlier that the Upper Meghna River is a tidal river. As such its water is saline towards the lower reaches. The monthly salinity variation of the river at Daulatkhan based on BWDB data is shown below. It is seen from the figure that the river water remains saline during February-April. During the rest of the year, the water

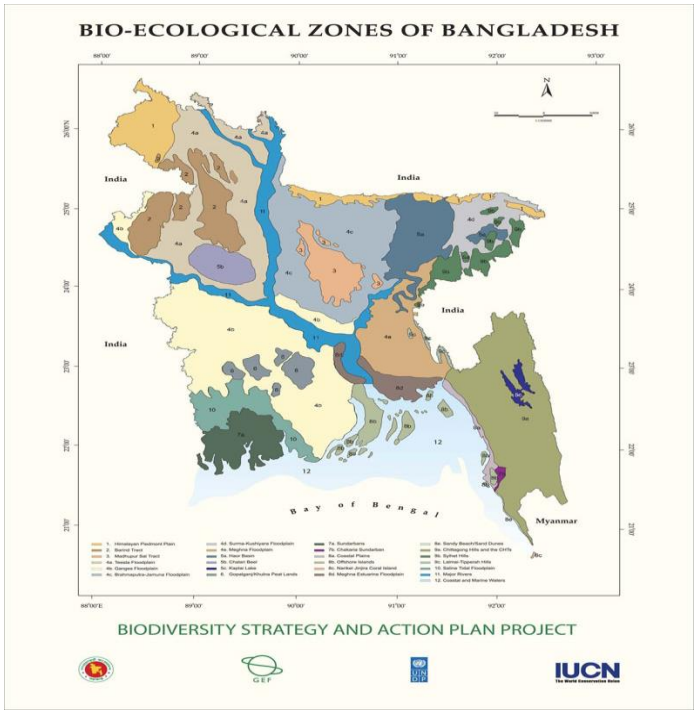
remains almost non-saline. Since Daulatkhan is located far downstream from the AEZ site, the river water near the AEZ site will have much lower salinity than that shown in the figure. In fact, DWASA is planning to bring the river water to augment the water supply for Dhaka City from a site near the AEZ site (1.3 km away).



Source: BWDB

Figure 4.2.12: Monthly variation of river water salinity at Daulatkhan

4.3 Ecological Environment



IUCN, The World Conservation Union, has divided Bangladesh into 25 Bio-ecological Zones (Nishat *et al,* 2002) in the context of physiographic and biological diversity. The study area has fallen under bio-ecological zones of Brahmaputra-Jamuna Floodplain. The area (both directly and indirectly impacted area) occupies terrestrial as well as aquatic ecosystems. Each of the bio-ecological zones represents the overall ecological situation of an area of the country. A map of the Bio-ecological zone is presented in the figure below.

Figure 4.3: Bio-Ecological Zones of Bangladesh

4.3.1 Flora

Flora relates to all aquatic and terrestrial based plants. Plants are vital for ecosystem function and are used as resources for human food, shelter, clothing and other products. Construction and developments often has the potential to impact flora. Potential impacts to flora can include:

i. a reduction in diversity,

ii. a change in species composition and the destruction of plant life, species or communities, and/or
iii. changes to species population distribution or health.

The project area a wide variety of jute, aus, transplanted and broadcast aman as well as rabi crops are producing extensively. On the highest platforms, banana, betel leaf, sugarcane and vegetables are major crops, together with aus, jute and transplanted aman. On lower platforms the latter are major crops in the monsoon season and vegetables in the dry season. Among rice crops boro covers the largest area followed by aman and aus. Other crops include wheat, potato, pulses, sweet potato, spices, cheena, kaun etc. The groves that surround the village homesteads represent various types of commonly planted trees. These are mango *(Mangifera indica*), jackfruit *(Artocarpus heterophyllus),* kalojam *(Syzygium cumini),* betelnut pulm*(Areca catechu),* coconut palm (*cocosnucifera)*, guava *(Psidium guajava),* jambura *(Citrus decumana),* mandar *(Erythrina veriegata),* kadam *(Anthocephaluscadamba*), sheelkoroy *(Albizzia procera),* sajna *(Moringa obifera)*, dalim *(Punica granatum),* palash *(Buteamonosperna),* etc. Common way side trees are tetul *(Tamaraindus indica),* neem *(Azadirachta indica),* hijol *(Barringtonia acutangula),* banyan *Ficus bengalensis),* ashatha *(Ficusreliglosa),* raintree *(Samanca saman),* pitraj *(Aphanamixls polystachia),* simul *(Bobbax ceiba),* krishnachura *(Delonix regia*), debdaru *(Polyalathia longifolia),* etc.

Moreover, some vegetations like kachuripana *(Telanthera philoxeroides),* topapana *(Pistiastratioteslemna spirodela)*, khudipana *(Lemnapau cicastata),* paniphal (*Trapabispinosa),* etc. are seen in different pondsof the district. And in the shallower waters are found species of shapla, padma, kalmi, helencha and the like.Besides, various herbs, shrubs and thickets along with some climbers and twiners are seen in the village homesteads of this district. Few epiphytes and parasites on the large trees are not uncommon. People with aesthetic values grow some flower plants at their homestead.

Table 4.3.1 (a): Floral distribution with distribution, abundance and usage at the project site

SL #	Scientific Name	Family	Local Name	Local Status	IUCN Status	Usage	Habit
Plant species in Meghna Economic Zone surrounding area							
1.	*Aegle marmelos*	Rutaceae	Bel	R	LC	Fruit and Medicine	Tree
2.	*Areca catechu*	Palmae	Supari	VC	LC	Fruit and Timber	Tree
3.	*Artocarpu sheterophyllus*	Moraceae	KathalNim	C	LC	Fruit, Timber and fuelwood	Tree
4.	*Azadirachtaindica*	Meliaceae		C	LC	Timber and medicine	Tree
5.	*Borassusflabelifer*	Palmae	Tal	R	LC	Fruit, Fuel wood and Timber	Tree
6.	*Carica papaya*	Caricaceae	Papay	C	LC	Fruit	Shrub
7.	*Cocos nucifera*	Palmae	Narikel	VC	LC	Fruit and Fuelwood	Tree
8.	*Litchi chinensis*	Sapindaceae	Lichu	C	LC	Fruit	Tree
9.	*Mangiferaindica*	Anacardiaceae	Aam	VC	LC	Fruit and Timber	Tree
10.	*Psidiumguajava*	Myrtaceae	Peyara	C	LC	Fruit	Shrub

11.	*Swieteniamahagoni*	Meliaceae	Mahogoni	VC	LC	Timber and medicine	Tree
12.	*Syzygiumcumini*	Myrtaceae	Kalojam	C	LC	Fruit	Tree
13.	*Zizyphusmauritiana*	Rhamnaceae	Baroi	C	LC	Fruit	Tree
14.	*Cynodondactylon*	Gramineae	Durba	VC	LC	Grass	Herb
15.	*Colocasiaesculenta*	Araceae	Kachu	C	LC	Vegetable	Herb
16.	*Acacia auriculiformis*	Mimosaceae	Akashmoni	C	LC	Timber	Tree
17.	*Albizialebbeck*	Mimosaceae	Kalokoroi	C	LC	Timber	Tree
18.	*Averrhoa carambola*	Averrhoaceae	Kamranga	C	LC	Fruit	Tree
Local status: VC – Very Common, C – Common, R – Rare, VR – Very rare							
IUCN status: VU—Vulnerable, NT—Near Threatened, LC—Least Concern							







Figure 4.3.1 (b): Existing Floral Ecology in the Project Areas

4.3.2 Fauna

During the construction phase, potential impacts to fauna may come from:

i) trimming or cutting of trees in the vicinity of the PROJECT;
ii) disturbance of individual animals;
iii) localized decline in the quality of habitat (removal of original plants); and
iv) poaching of edible animals and birds by construction workers using equipment and machines.

The present floristic status of Aman Cement Mills Unit-2 Ltd. is given below:

Mammals: Mammals that are commonly seen in the district are Indian pipistrelle*(Pipistrellus coromandra*), tickell's bat *(hesperotenus tickllli*), jackal or shial*(Asiatic jackal),* benji *(Herpestesa uropunctatus),* durakathbirali *(Funambulus pennanti),* rat *(Bandicata bengalensis),* house mouse *(Musmus culus*), methoindur*(Musbooduga),* udbiral *(Aonyxecincrea),* etc.

Table 4.3.2 (a): List of Mammals at the Sites Aman Cement Mills Unit-2 Ltd. surrounding area

Sl. No.	Scientific Name	Common Name	IUCN status	Occurrence of species		
				Primary Survey	Local people consultation	Published Literature
1	Scotozousdormeri	Dormer's Bat	LC		√	
2	Rattusrattus	House Rat	LC	√		
3	Mus musculus	House Mouse	LC		√	
4	Suncunmurinus	House shrew	LC		√	
5	Platanistagangetica	River Dohin	EN		√	
IUCN Status code: CR – Critically Endangered, EN - Endangered, VU – Vulnerable, LC-Least Concern						

Birds: The common birds of the district include doel *(Copsychus saularis),*bhatshalik*(Acredotheres tristis*), tilaghugu*(Streptopelia chinensis),* tia*(PsillaculaKrameri*), babui*(ploceusphilippinus),* sparrow or charui*(Domesticus),* house crow *(Corvussplendens),*brahminy kite *(Halia sterindus),* cacatua*(greater sulphur crested),* machhranga *(Alce doatthis),* pond heron *(Ardeo lagrayii),* little cormorant *(Phalacrococanniger),* cuckoo *(Cuculus microplerus*), kali pencha*(Glaucidiumra diatum),* chotofingey*(Dicrurus macrocercus),* haldeypakhi*(Oriolus xanthornus),* laxmipencha*(Tytoalba),* water rail *(Rallusa quaticus),* leser whistling teal *(Dendrocygnaja*

vanica), dahuk (*Amaurorinis phoenicurus),* spotted munia *(Lonchurapunctulata),* kaththokra *(Picusmyrmecophoneus),* etc.

Table 4.3.2 (b): List of Bird at the Sites

SL #	Scientific Name	English Name	Local Name	IUCN Status	Local Status	Birdlife Status	Occurrence of Species	
							Primary Survey	Local people consultation
1	Corvussplendens	House Crow	PatiKak	LC	CR	LC	Seen	√
2	Acridotherestristis	Common Myna	Bhat Shalik	LC	CR	LC	Seen	√
3	Passer domesticus	House Sparrow	PatiChorui	LC	CR	LC		√
4	Copsychussaularis	Oriental Magpie-Robin	UdoiDoel	LC	CR	LC		√
5	Columba livia	Common Pigeon	Gola Paira	LC	CR	LC		√
6	Ardeolagrayii	Indian Pond Heron	DeshiKanibok	LC	CR	LC	Seen	√
Local status: VC – Very Common, C – Common, R – Rare, VR – Very rare								
IUCN status: VU-Vulnerable, NT-Near Threatened, LC—Least Concern								

Besides, a large number of migratory birds visit the district during winter season. They are mainly seen in wet land areas. However, some of them are also seen in this district. These include common pochard *(Aythya ferina),* plover *(Charadriusalenasdrinus),*herring gull *(Larusorgentatus),*marsh harrier *(Circus aeruginosus),* common tern *(Sternahirusdo),* tufted duck *(Aythya fuligula),*little ringed plover *(Charadriusdubius),* grey leggoose *(Anseranser),* common teal *(Nettapuscoromandelianus*), pinail *(Anasacuta),*common shelduck*(Tadornaferruginea),* brahminy duck *(Fadornafirruginea),* pintailed snipe *(Gallinagostenura),* fantail snipe *(Gallinagogallinago),* tree pipit *(anthushodgsoni),*brown shrike *(Laniuscristatus),* grey wagtail *(Motacillacinera),*common sand piper *(Tringahypoleucos),*large pariah kite *(Milvusmigrantlineatus),*common swallow *(hirundorustica),* etc.

Reptiles and Amphibians: Some known reptiles of this District are ganges soft shell *(Trionyse gangeticus),* common roofed turtle *(Kachu gatecta),* yellow turtle *(Moreniapetersi),* shanda*(Gekko gecko),* house lizard *(hemidactylus brooki),* gharginishap*(Lycodonjara),* rat snake *(Ptyasnigro marginatus)* painashap*(Enhydrisen hydris),* banded krait *(Bungarus fasciatus)* and common cobra *(Naja naja).* Common amphibians include bull frog *(Rana tigrina),* skipper frog (Rana cyanophlyctis), cricket frog *(Rana limnocharis)* and common toad *(Bufo melanostictus).*

Table 4.3.2 (c): List of Amphibians at the Sites

SL #	Scientific Name	English Name	Local Name	Family	IUCN Status	Local Status	Occurrence of species		
							Primary Surve	Local people consultati	Published Literatu

							y	on	re
1	Duttaphrynus	Common	Kuno	Bufonidae	LC	CR			
	melanostictus	Toad	Bang				√		
2	Fejervarya limnocharis	Cricket Frog	Jhijhi Bang	Dicroglossidae	LC	C		√	
Local Status code: CR – Common Resident, C – Common, UR – Uncommon Resident, RR – Rare Resident, V – Vagrant, WV –Winter Visitor; UWV – Uncommon Winter Visitor IUCN Status code: CR – Critically Endangered, EN - Endangered, VU - Vulnerable, LC - Least Concern									

Table 4.3.2 (d): List of Reptile at the Sites

SL #	Scientific Name	English Name	Local Name	Family	IUCN Status	Local Status	Occurrence of species		
							Primary Survey	Local people consultation	Published Literature
1	*Pangshura tectum*	Indian Roofed Turtle	Kori/Hali Kasim	Bataguridae	-	C		√	
2	*Hemidactylusbrookii*	Brooks House Gecko	Tiktiki	Gekkonidae	LC	CR	√		
3	*Varanusbengalensis*	Bengal Monitor	GuiShap	Varanidae	LC	CR		√	
4	*Xenochropispiscator*	Checkered Keelback	DhoraShap	Colubridae	LC	C		√	
Data source: Study team using IUCN classification system Local Status code: CR – Common Resident, C – Common, UR – Uncommon Resident, RR – Rare Resident, V – Vagrant, WV –Winter Visitor; UWV – Uncommon Winter Visitor IUCN Status code: CR – Critically Endangered, EN - Endangered, VU - Vulnerable, LC - Least Concern									

Fishes: Different water bodies like rivers, canals, beels and ponds constitute habitats for fish population. The common fishes that are usually found here are ruhi *(Labeoruhita),* mrigel *(Cirrhinus mrigala),* katla*(Catla catla),* kalbaush *(Labeo calbasu),* chital *Notopterus chitala),* pabda*(Ompok pabda),* pangas*(Pangasius pangasius),* shing*(Heteropneustes fassilis),* magur*(Clarias batrachus),* koi *(anabas testudineus),* boal*(Wallagoattu),* gazar*(Channama rulius),* shoil*(Channas triaxtus),* tengra*(Mystusvittatus),* sharpuni *(Puntius sarana),* phali*(Notopterus notopterus)*etc. In addition, some exotic variety of fishes like tilapia *(Oreochromis mossumbicus),* nailotica*(Oreochromisnailoticus),* grass carp (*Cteopharyn godonidella)* and mirror carp *(Cyprinuscarpio)* have also become popular in this area.

Table 4.3.2 (e): List of fish observed in Meghna Rivers

SL#	Scientific Name	Local Name	Common	IUCN status

			English name	
1	*Puntius ticto*	Puti	Ticto Barb	LC
2	*Labiorohita*	Rui	Rohu	LC
3	*Catlacatla*	Catla	Katla	LC
4	*Mystusvitatus*	Tangra	Striped dwarf Catfish	LC
5	*Barbonymusgonionotus*	Sorputi	Olive Barb	LC
6	*Anabustestudineus*	Koi	Climbing Perch	LC
7	*Channastriata*	Shol	Snakehead murrel	LC
8	*Macrobrachiumrosenbergii*	Galdachingri	Tiger prawn	LC
9	*Oreochromismossambicus*	Telapia	Mozambique tilapia	LC
10	*Hypophthalmichthys Molitrix*	Silver carp	Silver carp	LC
11	*Pangasiuspangasius*	Pangas	Yellowtail catfish	LC
12	*Rita rita*	Rita	Rita	LC
13	*Sperataseenghala*	Air	Giant river-catfish	LC
14	*Lepidosephalusguntia*	Gutum	Guntia Loach	LC
15	*Ompokpabda*	Pabda	Pabo catfish	LC
16	*Channapanchtatus*	Taki	Spotted snakehead	LC
17	*Tenualosailisha*	Illish	Hilsa shad	LC
18	*Wallago attu*	Boal	Wallago	LC
19	*Awaousguamensis*	Baila	-	LC
20	*Labeobata*	Bata	Bata	LC
21	*Salmostomabacaila*	Chela	Large razorbelly minnow	LC
22	*Pseudapocryptes Elongates*	Chewa	-	LC
23	*Chitalachitala*	Chitol	Clown Knifefish	LC
24	*Mystuscavasius*	KabashiTengra	Gangetic mystus	LC
25	*Sicamugilcascasia*	Kechhki	Yellowtail mullet	LC
26	*Ailiichthyspunctata*	Kajuli	Jamunaailia	LC
27	*Catlacatla*	Katol	Catla	LC
28	*Amblypharyngodonmola*	Mola	Molacarplet	LC

During the operational years, the most common impact is the reduction of faunal habitats by infrastructure development and associated industrial activities. Management measures include, development of alternative wildlife habitat sites by plantation of native flora leading to the support of a wide range of species including birds.

Figure 4.3.2 (a): Existing Faunal Ecology in the Project Areas

Protected areas and endangered Species in the project site

The whole project area is urban development, and there are no rare, threatened, or endangered species of terrestrial and aquatic flora and fauna in the impact zone of the project. The proposed development projects not an area to be protected for the natural habitats or rare/endangered species.

4.4 Environmental Quality

4.4.1 Air Quality

During the construction phase of the project, the air quality in the PROJECT is likely to be degraded from the initial earthworks, i.e., the excavation of soil and subsequent dumping to raise the PROJECT site. As such there may be some exhaust emissions from the construction machinery, fugitive emissions from aggregate and dust generated from earthworks, exposed soil, and material stockpiles. Air quality is expected to improve to normal standards when the zone is up and running, as the developer will comply with the EMP and DoE Environmental Regulations.

In order to mitigate effects during the construction of the site, the following should be implemented:

i) construction equipment should be maintained to a good standard and idling of engines should be prohibited;
ii) machinery causing excessive pollution (visible smoke) should be banned from the construction site;
iii) water should be sprayed on loose soil, on all dumping areas, and on access roads if dust is generated; and
iv) construction materials should be covered with tarpaulins.

Table 4.4.1: Ambient Air Quality

Location	Date of Experiment	Duration (Hours)	Ambient Air Pollution Concentration (in micro gram/cubic meter)			
			PM_{10}	SPM	SO_2	NO_x
North Side	17/12/2004	6	89	287	31.43	17.57

Standard as per ECR 1997 in Bangladesh	**150**	**500**	**120**	**100**

ECR = Environmental Conservation Rules,
SPM = suspended particulate matter.
Source: EIA report of Shah Cement Plant, Narayanganj, 2007.

4.4.2 Surface Water Quality

Untreated discharge of industrial and municipal effluents into the rivers, swamps, and natural channels causes water pollution.

The DoE has identified 450 polluting industrial units (196 tanneries, 129 textile producers, 38 engineering factories, and plants manufacturing pesticides, chemicals, fertilizers, pulp and paper), many of which discharge untreated wastewater to the rivers.

The surface water quality in Dhaka City's peripheral rivers varies seasonally due to the flow pattern (SWECO et al 2010). The low flows in the dry season results in very poor water quality conditions as there is limited dilution of wastewater entering the rivers. Water quality parameters such as Dissolved Oxygen (DO), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and ammonia exceed acceptable limits in various water bodies during the dry season.

Water quality of the river Shitalakhy and Meghna of the project area during dry season (May 2012) and wet season (July 2012) at upstream and downstream of existing bridges at respective sites was collected from oriental consultants co., ltd. and katahira& engineers international, is shown in Table 4.8. From the result it is found that some parameters such as BOD5, ammonia, oil & greaseare exceeded allowable limits both the river. The higher coliform concentrations indicate bacteriological pollution in Shitalakhya River. This is because of discharging industrial effluents as well as sewerage directly to the river from existing industries and inhabitants.

Table 4.4.2: Results of Surface Water Analysis

River water	Shitalakhya				Meghna			
	Upstream		Downstream		Upstream		Downstream	
Season	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
Date	05/05/2012	16/7/2012	05/05/2012	16/7/2012	05/05/2012	16/7/2012	05/05/2012	16/7/2012
p H	7.0	8.2	7.0	8.4	6.7	7.2	6.7	7.1
Turbidity NTU	85	158	12	123	35	10	28	6
DO mg/L	0.3	3.2	0.1	4.1	4.2	6.3	4.7	6.7
Total Coliform CFU/100 ml	10,000>	>10,000	10,000>	>10,000	200	8	520	21
TDS mg/L	468	2305	570	1810	85	72	76	54
TSS mg/L	153	248	16	123	29	13	28	11
COD mg/L	59	84	47	128	8	6	7	8
BOD5 mg/L	20	12	10	19	3	1	3	1

NH4-N mg/L	9.6	3.5	9.5	1.2	0.3	0.1	0.5	0.1
Oil and grease mg/L	4.7	2.8	5.1	3.9	3.8	0.8	4.1	0.7

Source: Survey for Dhaka-Chittagong National Highway No.1bridge Construction and Rehabilitation Project

4.4.3 Ground Water Quality

Previous studies have estimated that the approximate depth to the water table in the project area during the dry season is six meters. However, it has also been determined that depth to the top of the main aquifer is close to 50 meters (MEP, 1997). The region's groundwater is used extensively for both domestic and agricultural purposes. It is believed that most of the population uses groundwater for domestic purposes, and agricultural lands are irrigated by groundwater.

Within the project area most of the households access potable water via hand tube wells. From the secondary source it is found that ground water arsenic, iron and manganese concentrations exceeded the Bangladesh standard limit at lower depth. The following table 4.9 shows the ground water test result of the project area during the period 2012.

4.4.4 Noise and Vibrations

Any noise and/or vibrations at the PROJECT site during the construction phase will come from the use of heavy machinery such as bulldozers, excavators, dump trucks, loaders, rollers, asphalt pavers, water tankers, concrete mixers, and vehicle movements.

To minimize noise disruptions in the area, working hours should be restricted to the hours from 6 am to 9 pm. During the construction phase, additional management and mitigation measures should be considered, such as:

- Noise should comply to the acceptable noise standards issued by the GoB;
- A code of conduct should be established for field personnel to reduce the potential for impacts on nearby communities;
- Noise monitoring should be undertaken on the site.
- The Vibration & Noise controlling system for this Cement Plant will be maintained complying with the Environmental Act.

4.4.5 Climate Change Variability

A vulnerability map gives the precise location of sites where people, the natural environment or property are at risk due to a potentially catastrophic event that could result in death, injury, pollution or other destruction. Such maps are made in conjunction with information about different types of risks. A vulnerability map can show the housing areas that are vulnerable to a chemical spill at a nearly factory. But it just as likely, could delineate the commercial, tourist, and residential zones that would be damaged in case of a 100-year flood or, more devastation, a tsunami.

Vulnerability mapping can allow for improved communication about risks and what is threatened. It allows for better visual presentations and understanding of the risks and

vulnerabilities so that decision -makers can see where resources are needed for protection of these areas. The vulnerability maps will allow them to decide on mitigating measures to prevent or reduce loss of life, injury and environmental consequences before a disaster occurs. An interdisciplinary risk group considers where mitigating measures should be taken before, for example, a flood occurs. Those preparing the maps can overlap flood inundation and slope stability zones with property maps in order to determine which properties and buildings are at risk. They can then notify the landowners and inform them of government subsidies or other support available for undertaking a measure that would protect their homes from potential damage by, for example, water inundation or slope failure.

The following Figure shows the vulnerability map to different hazards of the country. Form the figure it is understood that the study area is facing only flooding type of vulnerability to different natural hazards. The other vulnerability includes hot spot related to large rivers and urban centre growth. It would help the decision maker during design period.

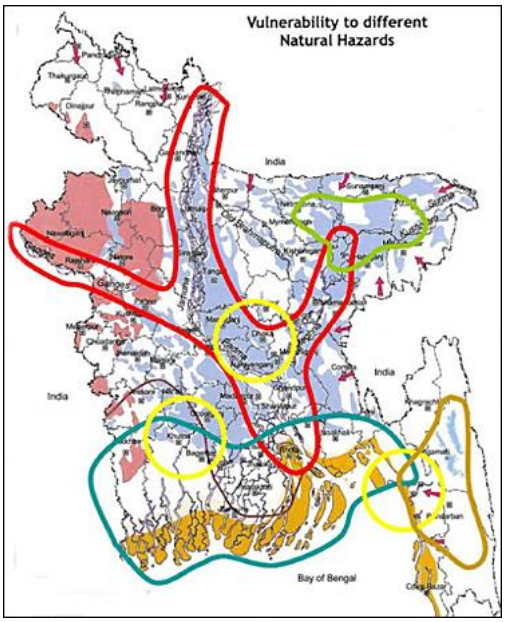


Figure 4.4.5: Inventory of the vulnerable areas for droughts (pink), floods (light blue), surges (yellow ochre) and hot spots related to large rivers (in red), coast (blue), urban centres (yellow), haor/wetlands (green) and hill tracts/soil erosion (yellow (ochre). source: CEGIS

4.5 Economic Development

The district is pioneer in merchandising and manufacturing of jute, yarn and dying items. Cottage industry like weaving abounds in this district. International trading, import and export business, garments industries, knitwear garments, shipyard, brickfield etc, create employment opportunities to the people facilitating additional income to the household population. The rural economy of Narayanganj is agricultural. Out of total 532,415 holdings of the district 22.44 % holdings are farms that HYV paddy, vegetables, spices, cash crops, pulses and others. Various fruits like banana, guava are grown and fish of different varieties abound in this district. Varieties of fishes are caught from rivers, channels, creeks and from paddy fields during rainy season. The major income

generating activities of the people in this district is business and working in the mill and factories.

Table 4.5: Number of Establishments and Persons Engaged by Activity

Activity	Establishments			Persons Engaged		
	Total	Urban	Rural	Total	Male	Female
Mining and quarrying	5	4	1	213	206	7
Manufacturing	12805	7452	5353	208074	172734	35340
Electricity, gas and water	30	24	6	477	464	13
Construction	37	37	0	1641	1451	190
Wholesale & retail trade	46120	33010	13110	104872	102144	2728
Hotels and restaurants	4808	3333	1475	13543	12974	569
Transport, storage and	1389	850	539	5780	5177	603
Bank, insurance and	281	255	26	3743	2729	1014
Real estate and renting	862	669	193	2910	2850	60
Public administration and	226	160	66	3373	3086	287
Education	1635	645	990	8818	6813	2005
Health and social work	3790	3666	124	8039	6936	1103
Community, social and	7569	4671	2898	19529	17572	1957
Narayanganj District	79557	54776	24781	381012	335136	45876

Source: Census of non-farm economic activities 2001-2003

4.5.1 Industry

There are industrial activities in or around the project sites. The industries that are existing around the Project area mainly, garments industry, knitting, dying, bio-polythene industry etc. No local industries will be affected by the project activities.

Table 4.5.1: Number of selected industry in the Project Areas

Upazila	Textile G mill	Garments factory	Rice mill	Match factory	Steel and engineering	Aluminum	Jute mill	Sugar mill	Others
Araihazar	1120	0	63	0	1	0	0	0	**0**
Bandar	0	0	0	0	4	0	0	0	**0**
Narayanganj Sadar	27	8299	69	0	0	38	0	0	**0**
Rupganj	159	27	7	0	0	0	4	3	**19**
Sonargaon*	**32**	**82**	**56**	**0**	**24**	**1**	**1**	**2**	**47**
Total	1338	8408	195	0	29	39	5	5	66

Source: Upazila Statistical Office, BBS

4.5.2 Infrastructure facility

Economic Development of an areas can be influenced by many factors, particularly geographic location; resource availability; and infrastructure. Significant infrastructural facilities such as water supply, sewerage lines, and drainage system are generally poor in the catchments areas of the Project principally because the Project is located in rural areas. Therefore, in their absence no analysis has been made for this aspect of community services. However, it should be noted that the Project would help to improve other infrastructure facilities.

4.5.3 Transportation

To reach in the project area, there are better communication facilities with a network of metalled road. A number of roads of different categories namely national highway,

Upazila, Union and Rural roads passes through the study area. A number of associated facilities such as terminal also located with the study area. Dhaka- Chittagong national high way is 6km away from the project area and is located in the north-west side of the project. In this way, any vehicles (land transport) will enter into project area easily. A number of rivers namely the Upper Meghna, the Dhunagoda, the Fuldi and Gumti surround the study area. A large number of canals also exist in the study area. Rivers are extensively used by various modes of water transports to carry goods and passengers. Throughout the year, the Upper Meghna River maintains a minimum of more than 6 m depth in the whole reach of the river. That indicates that it has enough depth for navigation and is classified as a Class-I route by the BIWTA. Figure 4.20 shows the different communication networks of the study area. Figure 4.21 shows the road network with internal connection of the project location.

Table 4.5.3: Length of metalled, semi metalled and unmetalled road around the project areas

Upazila	Metalled road	Semi metalled road	Unmetalled (kacha) road	Total
Araihazar	159	25	190	374
Bandar	68	8	213	290
Narayanganj Sadar	148.31	19.49	439.09	606.89
Rupganj	176.58	148.74	388.66	712.98
Sonargaon	**147.32**	**41.99**	**174.94**	**364.25**
Total	**699.21**	**243.22**	**1405.69**	**2348.12**

Source: Upazila Statistical Office, BBS

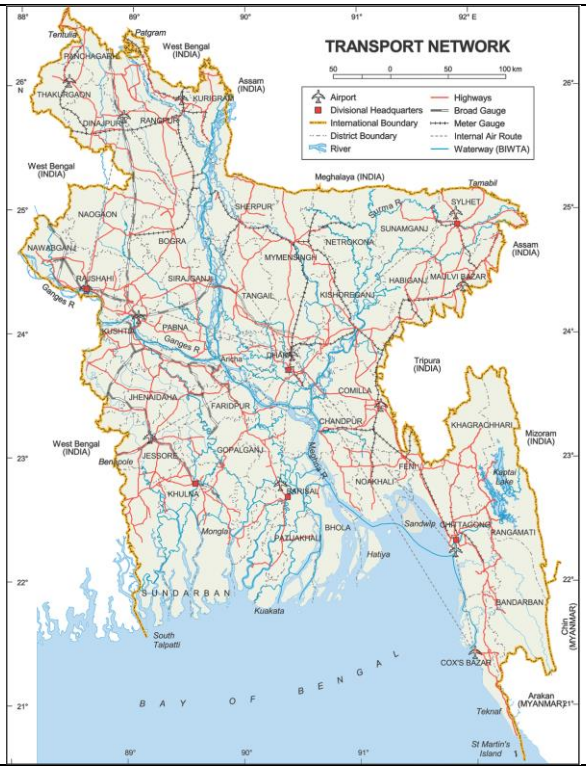


Figure 4.5.3 (a): Transport Network Map of Bangladesh

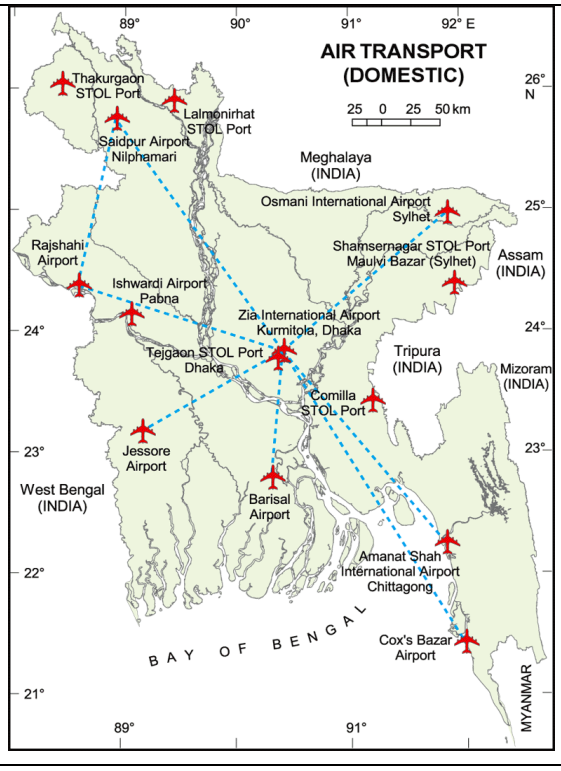


Table 4.3.2 (b): Air Transport Map of Bangladesh

During field visit, the study team observed the status of existing roads, bridges, and culverts. The following figures show the condition of such at a glance.

	
Dhaka Chittagong Highway and Mograpara Bypass	Mograpara bypass link road for PROJECT
	
Condition and size of road after light rain	Road condition from Mugrapara to Aman Cement Mills Unit-2 Ltd.
	
Road condition from Mugrapara to Aman Cement Mills Unit-2 Ltd.	Road condition from Mugrapara to Aman Cement Mills Unit-2 Ltd.
	
Culvert condition from Mugrapara to Aman Cement Mills Unit-2 Ltd.	Culvert condition from Mugrapara to Aman Cement Mills Unit-2 Ltd.

4.6 Land Resource

4.6.1 Agro-ecological Zone

Agro-ecological Zone land areas recognized on the basis of hydrology, physiography, soil types, tidal activity, cropping patterns, and seasons. In fact an agro-ecological zone indicates an area characterized by homogeneous agricultural and ecological characteristics. This homogeneity is more prominent in the sub region and unit levels. The agro-ecological zones of Bangladesh have been identified on the basis of four elements such as physiography, soils, land levels in relation to flooding and agro-climatology. Bangladesh has been tentatively divided into 30 agro-ecological zones. These 30 zones have been subdivided into 88 agro-ecological sub-regions, which have been further subdivided into 535 agro-ecological units.

The proposed Aman Cement Mills Unit-2 Ltd. is located in the Middle of Meghna Floodplain Agro-ecological Zone in Bangladesh occupies an abandoned channel of the Brahmaputra river on the border between the greater Dhaka and comilla districts as well as adjoining parts of the mainland. Soils of the area are grey loam on the ridges and grey to dark grey clays in the basins. The dominant general soil type is non-calcareous grey floodplain soil. Topsoils are strongly acidic and subsoils slightly acidic to slightly alkaline. General fertility level is medium with low N and organic matter.

The site is on a naturally depressed area, which remains submerged during monsoon and dry in winter. The Middle Meghna Floodplain agro-ecological zone is good for the cultivation of boro rice (winter rice variety). During monsoon, when this goes under 15-22ft of water, the entire Meghna Floodplain area turns into a spawning and roosting habitat for open water fisheries. An Agro-ecological Map is given in Figure 1 for reference.

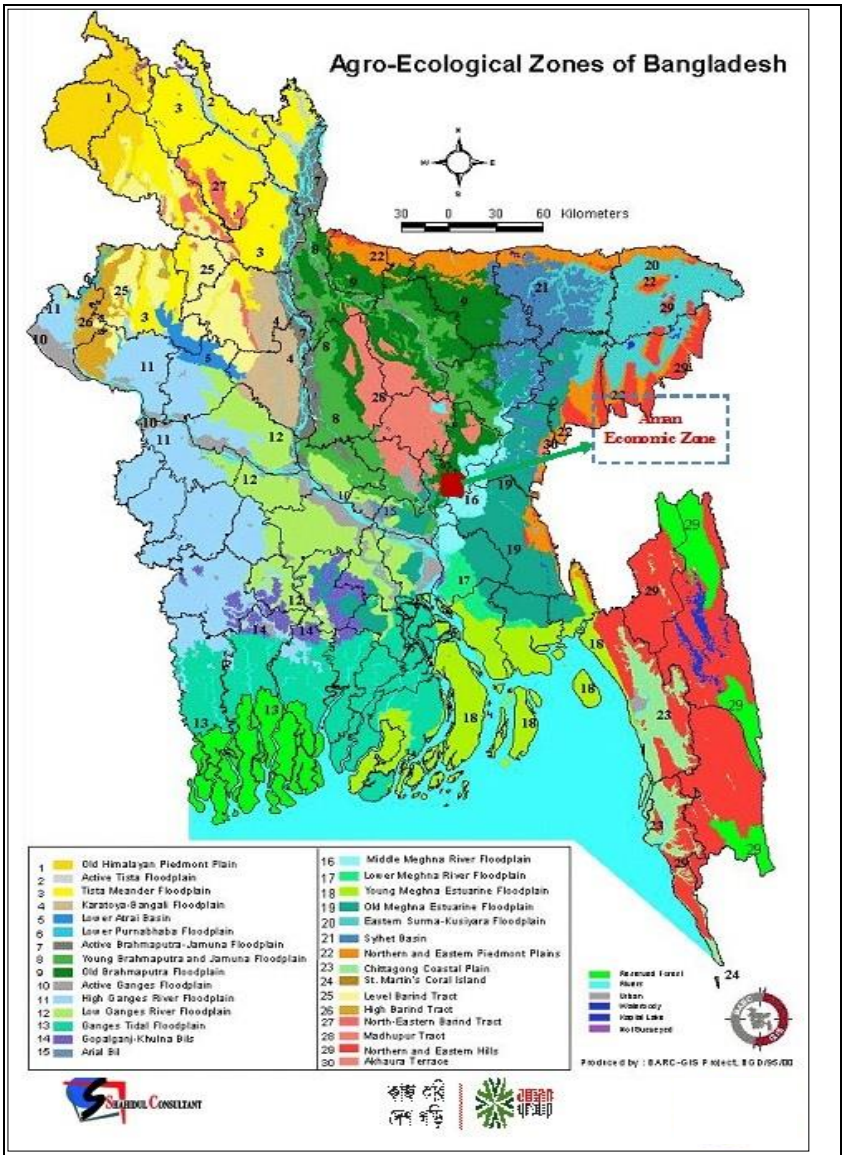


Figure 4.6.1: Agro-ecological Zones of Bangladesh

4.6.2 Land type

Land type classification is based on depth of inundation during monsoon season. In terms of depth of flooding, five classes of land type are recognized (SRDI, 1988), these are High land (above flood level), Medium highland (flooding depth 0-90 cm), Medium lowland (flooding depth 90-180 cm), Low land (flooding depth 90-270 cm) and Very lowland (flooding depth >270 cm). However, the land type characteristics are not uniform within the study area. About 90% of the cultivable areas belong to medium Low to Low land with the rest 10% being very low land.

4.6.3 Land Use

Within the project area including directly benefited area, there are substantial variations in land types and land use patterns. Land types of the Project area are mostly low land but nearest village's area are medium high land, and partly medium low land. In terms of land use pattern, proposed acquired area is fully cultivated agricultural land but besides

the project, in all sides, directly benefited or affected area, the land use pattern is different like cultivated agricultural land, industrial area, rural build up, water bodies (rivers, lakes, and big ponds), forested and fallow land. Most of the land is used for rural build up and water bodies have also significant share. Major negative impacts might be appeared on the land use because all acquired ground area for proposed infrastructures' construction, presently using as agricultural practices in both the seasons but fishing activities in monsoon time, would be changed into comparatively high land as garments Industrial Park. In this why, special care should be taken on water drainage management so that the water could not be flooded beside the upgraded land during monsoon. On the other hand, to protect poverty in the locality due to loss of land, livelihood restoration program for the local people would be taken strongly.

4.6.4 Physico-chemical properties of soils

In general, most of the top soils are acidic and sub-soils are neutral to slightly alkaline. Land area that falls in Agro-ecological Zone6, there top soils are strongly acidic to neutral in medium low and low land soils and the sub soils are slightly acidic to slightly alkaline. General fertility level is low to medium in terms of organic matter content and very high Cation Exchange Capacity (CEC) and K status. There are limitations of high exchangeable Na and low Ca / Mg ratio. The Zn status is low to medium and the B and S status is medium to optimum. Details are presented in following table and figures shows the soil reactio of Bangladesh.

Table 4.6.3: Some physic-chemical properties of soils of a project

Major land type	SoilpH	Soil OM	Nutrients status								
			N	**P**	**K**	**S**	**Ca**	**Mg**	**Zn**	**B**	**Mo**
High land	3.8-6.5	L-M	VL-L	VL-L	L	VL-L	M-Opt	M-Opt	L-M	VL-L	Opt
Medium highland	4.5-7.2	L-M	VL-L	VL-L	L-M	VL-L	M-Opt	M-Opt	VL-L	VL-L	Opt
Lowland	4.0-6.7	L-M	VL-L	L-M	L-M	L-M	M-Opt	M-Opt	L-M	L	Opt

VL=Very low; L=Low; M=Medium; Opt=Optimum
Source: Fertilizer Recommendation Guide, BARC (Bangladesh Agricultural Council), 2012

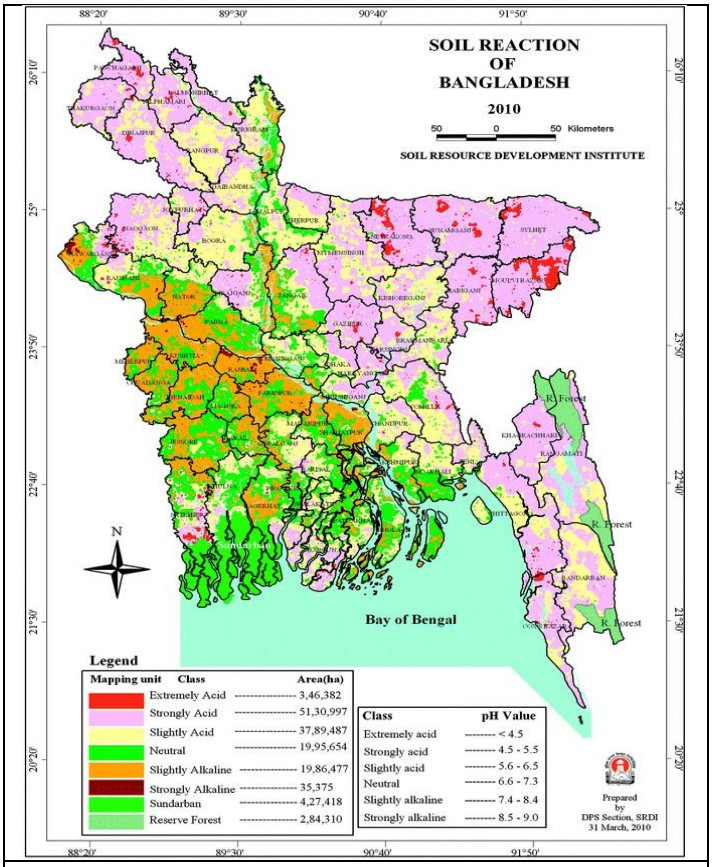


Figure 4.6.3: Soil Reaction of Bangladesh

4.6.5 Agriculture development

Agriculture and fisheries are one of the main contributors to the economy in the project area. The current crop production is diversified. Major crop grown in the area is paddy. Other crops are mainly wheat, potato, mustard, sesame, lentil, Chinese almond and maize. Main fruits in the study area are Mango, black berry, jackfruit, banana, papaya, litchi, coconut, guava, plum, elephant apple, watermelon. Of the total cultivable land, single crop 35%, double crop 45%, triple crop 20%. Cultivable land under irrigation of the studied areas is above 80%.

The present cropping intensity of the studied areas is about 185 %. However, the Aman rice crop suffers damage due to sudden rain and riverine flood with strong wind in summer. Normal cropping pattern of the proposed areas is Local aus/ vegetables/ fruits/ Fallow--local aman / vegetables/ fruits/Fallow and HYV & Local Boro / vegetables / fallow. The project will have considerable negative impact on agricultural with fisheries development because all acquired land will be changed into high land as garments industrial park. To alleviate the poverty, if occurred due to land loss, income restoration program has to be taken strongly in the locality.

4.7 Social and Cultural Resources

Sonargaon Upazila occupies an area of 171.66 sq km, located in between 23°32' and 23°46' north latitudes and in between 90°31' and 90°41' east longitudes. It is bounded by araihazar and rupganj upazilas on the north, munshiganj sadar and gazaria upazilas on the south, meghna and Gazaria upazilas on the east, bandar, narayanganj sadar, Rupganj upazilas and demra thana on the west. It has a population of total 305562 where male 159613, female 145949; and Muslim 293976, Hindu 11388, Buddhist 42, Christian 142 and others 14. The water bodies comprise main rivers namely Meghna, Shitalakshya, Old Brahmaputra (moribund). Average literacy rate is 47%; male 51.5%, female 42.1%. The following table describes the social data of project area. The PROJECT site falls under three villages—Sonamoi, and Haria of Baiddyar Bazar Union of Sonargaon Upazila.

Table 4.7 (a): Demographic Information of Haria:

Parameter	2011
Total population	3,754
Total Household	776
Population Density (Per sq. km)	
Male Population	1,906
Female Population	1,848
Average Household Size	4.8
Male Married	56.6
Female Married	65.9
Literacy Rate	44%

Table 4.7 (b): Information regarding Water and Sanitation of Haria

Parameter	2011
Toilet (Sanitary water-sealed) (%)	24.4
Toilet (Sanitary non water-sealed) (%)	59.7
Toilet (Non-sanitary) (%)	15.2
Toilet (None) (%)	0.8
Tap (%)	0.6
Tube-Well (%)	96.6
Other (%)	2.7

Table 4.7 (c): Information regarding employment of Haria

Parameter	2011
Employed Male	415
Household work female	410
Do not work male	110
Do not work female	150
Employed Female	18
Looking for work male	5
Looking for work female	4

Household work male	5
Employed in service female	9
Employed in Agriculture male	247
Employed in Agriculture Female	7
Employed in industry male	93
Employed in industry female	2
Employed in service male	75

Table 4.7 (d): Information regarding social issues of Haria

Parameter	2011
Housing Structure (Jhupri)(%)	0.5
Housing Structure (Pucka)(%)	8.4
Housing Structure (Semi-pucka)(%)	13.1
Housing Structure (Kutcha) (%)	78
Electricity Connection (%)	99.4
Housing Tenancy Owned (%)	96.3
Housing Tenancy Rented (%)	1.7
Housing Tenancy Rent Free (%)	2.1

Table 4.7 (e): Demographic Information of Sonamoi

Parameter	2011
Total population	459
Total Household	99
Population Density (Per sq. km)	
Male Population	232
Female Population	227
Average Household Size	4.6
Male Married	60.1
Female Married	66.9
Literacy Rate	43.4%

Table 4.7 (f): Information regarding Water and Sanitation of Sonamoi

Parameter	2011
Toilet (Sanitary water-sealed) (%)	11.1
Toilet (Sanitary non water-sealed) (%)	38.4
Toilet (Non-sanitary) (%)	50.5
Toilet (None)(%)	0
Tap (%)	0
Tube-Well (%)	91.9
Other (%)	8.1

Table 4.7 (g): Information regarding employment of Haria

Parameter	2011
Employed Male	60
Household work female	66
Do not work male	20
Do not work female	15
Employed Female	4
Looking for work male	2
Looking for work female	0
Household work male	1
Employed in service female	0
Employed in Agriculture male	38
Employed in Agriculture Female	2
Employed in industry male	1
Employed in industry female	2
Employed in service male	21

Table 4.7 (h): Information regarding social issues of Sonamoi

Parameter	2011
Housing Structure (Jhupri)(%)	0
Housing Structure (Pucka)(%)	2
Housing Structure (Semi-pucka)(%)	5.1
Housing Structure (Kutcha)(%)	92.9
Electricity Connection (%)	97
Housing Tenancy Owned (%)	100
Housing Tenancy Rented (%)	0
Housing Tenancy Rent Free (%)	0

Sources: BBS, 2011

4.8 Archeology, Religious and Cultural Sites

There are no archaeological sites within the Project site. There are some historical places in the Sonargaon Pourashava (3km away from Meghna Site). There is an important archaeological site in this region named Sonargaon archeological heritage that already mentioned above. Besides, there are single domed mosque built by Jalaluddin Fatheh Shah (1489 AD), Tomb of Sultan Ghiyasuddin Azam Shah (1410 AD), single domed mosque built by Alauddin Hussain Shah (1522), Tomb of Shah Langar (1422), PanchPir Dargah, grand trunk road, khasnagardighi, Company Kuthi, Yusufganj Mosque, goaldi mosque (1519), langalband (holy bathing spot), Panam Nagar in the region. Even, the area has mosque 460, temple 36, and tomb 10.

ACML-2 located 1.3 km and 15.3 km downstream from the proposed Baiddyar bazaar and Bisnondi water intake point of DWASA respectively. Ambient air, Surface and Ground water quality within the limit of DOE standard in the project area.

Chapter 5
Hydro-morphological Characteristics

5.1 River Morphology

A study was made on the hydrology and morphology of the Meghna River (BUET & JICA, 2004). The report is divided into a section describing floods and a section dealing with river morphology.

Figure 5.1 (a): Location visited on Meghna near Baiddyar Bazar

Left: Baiddyar Bazar Ferighat Right: Bank erosion

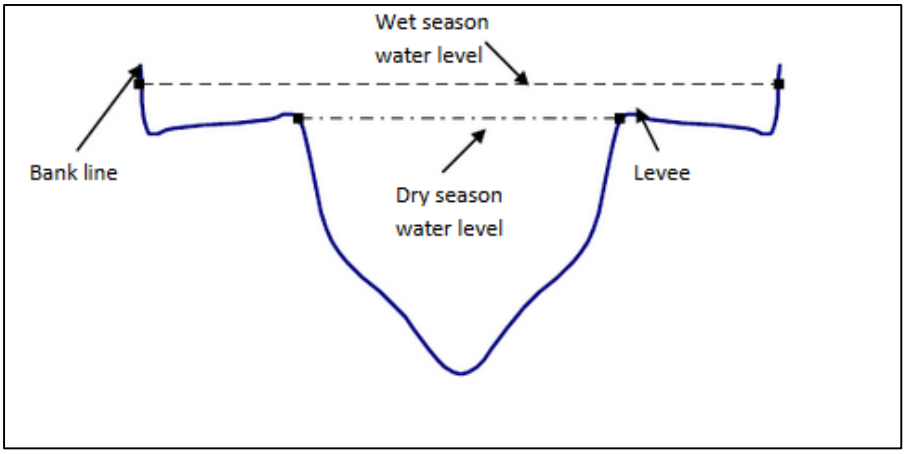


Figure 5.1 (b): Schematic view e separation between a dry season and a wet season channel

Table 5.1: Sediment characteristics in the vicinity of Meghna Ferry Ghat (From SWMC 2001, DHI 2001, BUET & JICA 2004)

Parameter	Value / range
Suspended sediment concentration	Total: 22-123 mg/l Clay/silt: 21-120 mg/l Sand: 1-12 mg/l
Left bank sediment characteristics	99 % sand
Right bank sediment characteristics	10-27 % sand
Bank sediment grain size (d50)	0.13 mm (left bank) 0.026 mm (right bank)
River bed sediment grain size	0.12 mm
Sand bar grain size	0.12 m (d50) , 0.22 mm (d84), 0.035 mm (d16)

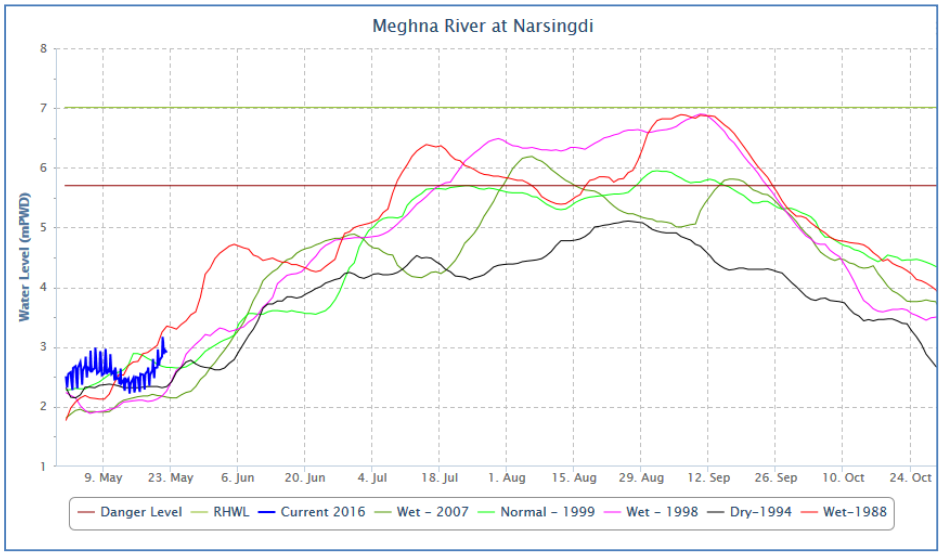


Figure 5.1 (c): Water level of Meghna River in different seasons over the years

5.2 Implication of the water level and discharge variation

The water levels in the Meghna River vary approximately 4-5 meters throughout the year. This has significant impact on the shape of the river channels and the stability hereof. The variation in water level in two distinct seasons, dry- and wet season means that a clear dry season and a wet season channel can be identified along the rivers one effect of this is that the bed shear stress in the vicinity of the banks during the wet season is larger than if the channel was u-shaped. Another effect is that the wet season banks are not as high as if the rivers have u-shaped cross sections. The water level variation of 4-5 meters results in river banks which become saturated during the monsoon, and gradually dry up during the dry season. In this process the banks may become unstable with bank collapse as a result. However, since the river profile is correspondingly larger in the Meghna.

5.3 Observations in relation to sediment data

During the field visits it was observed that the two rivers have relatively steep banks. This suggests that the banks have a certain content of silt and clay. The failure of such

banks is difficult to predict as the mode of failure are many (shear erosion, tension cracks, rotational collapse etc.) and since the bank material is mixed cohesive (clay and silt) and non-cohesive (sand).

5.4 Plan Form Changes of Meghna River

The bank line positions from the years 1980, 1989 and 2000 have been plotted together with the satellite image from 2010 in fig 4. The figure enables on a gross scale to detect the plan form development over decades since 1980. A close up of the area around Baiddyar Bazaar is seen in fig 5.4.8 (c). In this figure the direction of the bank retreat or accretion is shown with arrows. From the figure it is seen that the island upstream from Baiddyar Bazaar is eroding on the eastern side, whereas it is accreting on the southern side. This development deflects the flow further southwards resulting in a severe erosion of the opposite bank of the Meghna. Due to the erosion of the opposite bank the flow is forced more directly into the left bank at Baiddyar Bazaar. Further the flow is forced to follow a more curved path. This curvature enhances the secondary flow and leads together with the direct flow attack to increased erosion of the left bank. This is the most likely reason for the observed bank retreat at Baiddyar Bazaar.

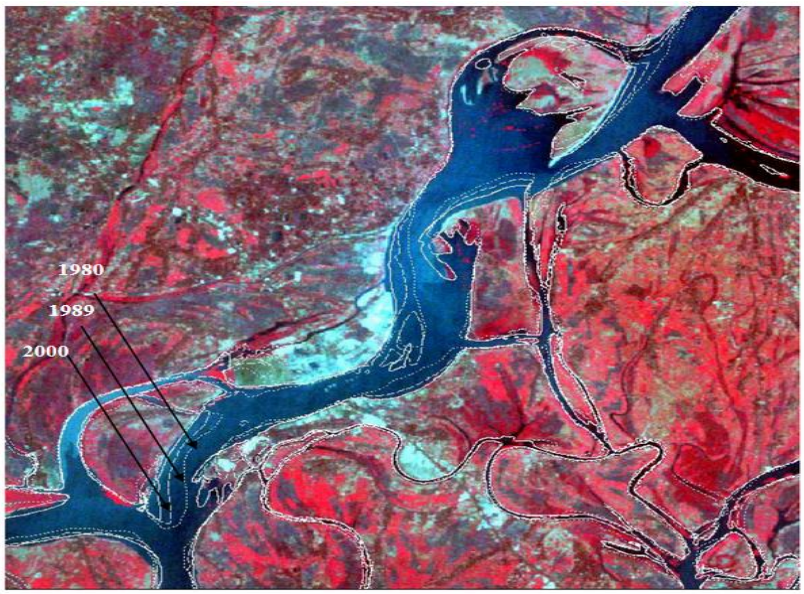


Figure 5.4.8 (c): Bank lines from 1980, 1989 and 2000 superimposed on satellite images from 2010. Area covers from downstream of Meghna Ferry Ghat to upstream of Baiddyar Bazar

5.5 Water Intake Point of DWASA at Meghna River

A project titled "Dhaka Environmentally Sustainable Water Supply Project" by DWASA undertaken feasibility study for possible intake point from Meghna River. The intake points they considered are Bisnondi of Gandharbpur under Araizhazar Upazilla and Haria of Baiddyar Bazaar point under Soanrgaon Upazilla of Narayanganj district. Bisnondi is 13 km south of Narsingdi district and Sakerchar Madhabdi Industrial Zone is located 10 km north east of the intake point. The Aman Cement Mills Unit-2 Ltd. is almost 15.3 km downstream (south west) from the Bisnondi intake point. On the other

hand, Aman Cement Mills Unit-2 Ltd is located 1.3 km downstream from the intake point of Haria, Baiddr Bazaar. Institute of Water Modeling (IWM) reported that sea-based salinity does not intrude beyond the confluence of the Meghna and Padma Rivers, which is about 100 km downstream of the proposed intake. Due to the movement of the river water into downstream, there is no chance of pollution of intake water in both the intake point of DWASA. Meanwhile, coordination was made among Aman Group, Bangladesh Economic Zone Authority (BEZA) and DWASA for the protection of Haria water intake point without polluting water by the development activities of ACML-2. Initiatives and/or mitigation measures regarding the issue are discussed in Chapter 7 and 8.

Please see the permission of BIWTA for using river bank, loading and unloading of raw materials and construction of Jetty in ***Annex-3***

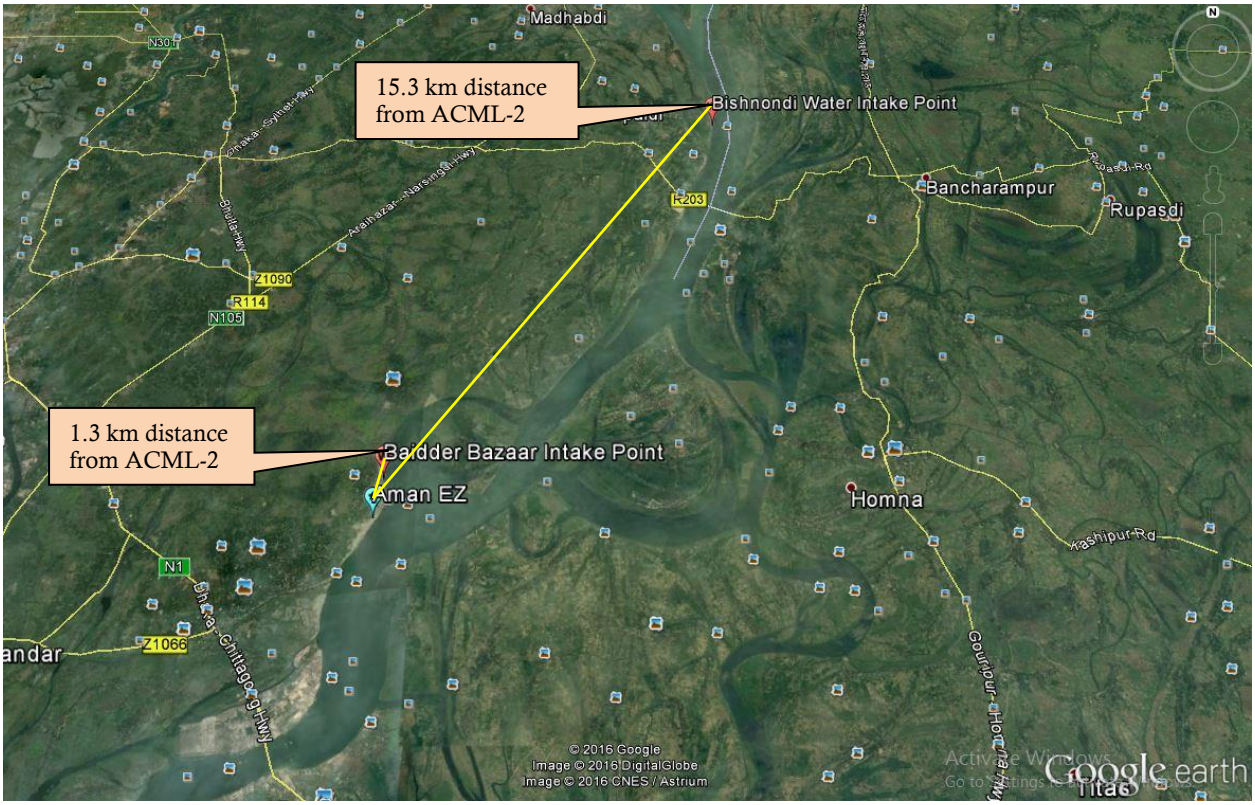


Figure 5.5: Location of Water Intake Point of Dhaka WASA and ACML-2

5.6 Navigation

Major River Meghna is greatly utilized for transportation. This river is enough depth of navigability for river transportation especially cargo, steamer etc. A number of rivers namely the Meghna and the Meghna branch river surround the study area. Rivers are extensively used by various modes of water transports to carry goods and passengers. Throughout the year, the Upper Meghna River maintains a minimum of more than 6 m depth in the whole reach of the river. That indicates that it has enough depth for navigation and is classified as a Class-I route by the BIWTA. The erosion material is being deposited in the river bed leading to somewhat low navigable depth.

Chapter 6
Identification of Potential Impacts

6.1 Overview

EIA was conducted according to the present environmental and social baseline of the project area, and nature and extent of the proposed activities. Proposed project involves construction and operation of Aman Cement Mills Unit-2 Ltd. Potential environmental impacts associated with this project is mainly categorized as: impacts during preparation and construction phase and impacts during operation phase. Sensitive environmental and social components were identified during the site visits and qualitative and quantitative techniques have been applied for direct and indirect assessment of impacts on the identified environmental and social sensitive components. Impacts are divided into different categories based on their degree. Generally some of the important impacts associated with the typical cement mill will be associated with land stability (soil erosion), solid, liquid and gaseous discharges, soil pollution, water availability, water quality of river/stream/pond, ground water contamination, ambient air quality, ambient noise levels, vegetation, tree cutting, fauna (terrestrial and aquatic), drainage pattern, hydrology, socio economic, places of social/cultural importance (religious structures, community structure), construction material sourcing and occupational health and safety. Adequate mitigation measures are devised to mitigate/minimize all likely adverse environmental impacts and the enhancement of positive impacts. Aman Cement Mills Unit-2 Ltd. similarly has some of those impacts. During the field study, consultations were also held within study area including local people and Govt. authorities. Outcome of these consultations were used in impact assessment and devising mitigation measures.

6.2 Scope of Impacts

Using Checklist (impact matrix) and Graded Matrix Method the potential identify the potential impacts due to development of Aman Cement Mills Unit-2 Ltd. These two methods are described underneath.

6.2.1 Impact Matrix/Checklist

Through site visits some environment and socially sensitive issues were identified which may potentially be impacted by the project at its construction and operation stages. Identified impacts of the project activities on the environment and social environment are given below along with the activities associated. These impacts are varied in degrees, minor, medium or major. According to Munn (1979), checklist is comprehensive lists of environmental effects and impacts indicator designed to stimulate the analysis to think broadly about possible consequences of contemplated actions. The checklist is developed for the present plant. In this checklist, actions, which may affect at the various stages of the project activities, are listed with the degrees of Significant Environmental Impacts (SEIs).

Table 6.2.1: Impact Matrix/Checklist

Activities	Result	Impacts		Degree of Impact
		Positive	Negative	
Preparation Phase				
Project Site Development	Land Value depreciation			
	Loss of and displacement home stead land			
	Loss of and displacement from agricultural Land			
	Trouble in natural drainage pattern		√	Minor
	Inadequacy of buffer zone		√	Minor
	Damage of precious ecology			
	Damage to nearby operation/historical and archeological places/monuments			
Construction Phase				
Civil construction, construction material handling and stocking, and construction vehicle movement	Run-off erosion		√	Minor
	Occupational Hazard		√	Minor
	Employment	√		Medium
	Health hazard of workers		√	Major
	Noise and vibration		√	Minor
	Traffic congestion		√	Minor
	Fugitive dust and vehicular emissions		√	Minor
	Blockade of wildlife passage			
Operation Phase				
Transportation and storage of raw materials and produces, production process, packaging	Gaseous emissions (Air quality)		√	Minor
	Liquid discharge (Water quality)		√	Major
	Solid discharge (Water and soil quality)		√	Minor
	Occupational and health hazard		√	Medium
	Traffic congestion		√	Minor
	Noise and vibration		√	Minor
	Odor hazard			
	Employment	√		Major

6.2.2 Graded Matrix

Graded matrix method provides specific idea of the impact has been used in impact identification. The methodology incorporates a list of project activities with a checklist of environmental components, which might be affected. Combining these lists as horizontal and vertical axis for the matrix allows the identification of cause effect relationship between the specific activities and impacts. The quantified grade matrix method is superior to the checklist method or the simple interaction matrix method in that it goes beyond qualitative identification of cause-effect relationship between specific activities and environmental factors, thus helping to carry the thinking out process further. In this method, assigning numerical values denotes the "magnitude" and "importance" of the cause-effect relationship impact in each cell of a matrix.

A gradation system ranging from 1 to 10 is used for each characteristic. The magnitude of the interaction is the extensiveness or scale and is described by the assignment of a numerical value from 1 to 10; 10 representing a large magnitude and 1 a small magnitude. The scale of importance also ranges from 1 to 10 with representing a very

important interaction and 1 an interaction of relatively low importance. Summations of the number of rows and columns designated as having interactions provide insight into impact assessment and interpretation. Assignment of numerical values for the magnitude of an interaction is based on the an objective evaluation of facts while assignment of numerical value for the importance is mainly based on subjective judgment of the multi-disciplinary team working in the absence of more definitive information on relevant identification process. Table 6.2.2 shows the graded matrix for the Aman Cement Mills Unit-2 Ltd. From the matrix, the major actions that have the possibility of producing considerable major impacts, whether beneficial or adverse, on various environmental components are the plant in operation, liquid discharge and employment. On the other hand, the variables expecting considerably major impacts are water quality and socio-economic conditions (Family finance and human health, etc.).

Table 6.2.2: Graded Matrix

Proposed action/impacts	Project location	Plant construction	Plant in operation	Solid Waste disposal	Odor generation	Waste Water Discharge	Monitoring	Employment	Total
Land Value	4/6								4/6
Neighboring Operation			3/5	2/4		-			5/9
Agriculture						4/8			4/8
Surface drainage	2/5		3/6						5/11
Air Quality			1/4	1/4	1/4				**3/12**
Water Quality			1/4				7/8		**8/22**
Forestry									-
Human health			1/4		1/4		3/8		5/16
Fisheries			1/4						**1/4**
Navigation/ Hydrology									-
Socio-economic condition		5/5	8/9					**8/8**	**21/22**
Total	**6/11**	**5/5**	15/36	3/8	**2/8**	4/8	10/16	**8/8**	

Chapter 7
Prediction and Evaluation of Impacts

7.1 General Consideration

Prediction of the impacts is crucial for taking effective measure for migration and minimization of adverse impacts. Proper evaluation of the impacts is also key to proper development of corrective actions. The potential impacts of the Project could result from construction and operation of the ropeway; on-site storage of the crushed limestone, sandstone, and gypsum; dust from grinding and mixing of raw material; dust and combustion by products from the calciner; dust from clinker grinding and bagging; wastewater used for bearing cooling, and sewage discharge from staff housing and offices; disposal of solid wastes, etc. In the following sections, greater details of predicted issues and their evaluation are done, which are considered to have major SEIs. These potential impacts are discussed in relation to relevant regulations and standards of the country. To maintain logical sequence of the EIA process, the possible mitigation/enhancing measures for SEIs are also discussed synchronously. Cement manufacturing plants vary widely in volume and composition of pollutants discharged. Differences arise from process variations, in-plant practices, housekeeping and other factors. Two types of processes are available, nominally termed 'wet' or 'dry'. In the wet process, raw materials are ground, mixed with water and the slurry fed to the kiln. With the dry process raw materials are dried before or during grinding. Dry ground materials are fed to the kiln.

Service and supplementary units provide water and energy requirements as well as maintenance, storage, packaging, testing and analysis needs. Impacts of the construction and operation phases on different component of environmental and social settings are discussed in this section.

7.2 Impacts on Physio-Chemical Environment and Mitigation

7.2.1 Impact on Water Quality

This type of plant generally has huge impact on water quality because of liquid and solid waste discharge by regular operations. Basically Cooling water is used extensively in industry. During the cooling process, water heats up and can only be reused if cooled. Cooling towers provide the means for recycling water and thus minimizing its consumption. The cooling effect is performed through partial evaporation. This causes an increase in the concentration of dissolved salts which is controlled by purifying some water (blow down).

a) Surface water

Unless taking care of liquid discharge from this type of plant, the surface water of project site can be severely polluted. Ambient water quality can be deteriorated and common features of water quality like BOD, COD, etc. can become imbalanced, that will also harm the aquatic ecology.

b) Groundwater

Groundwater quality can fall by contaminations like arsenic and other harmful substances produced form cement plant. Additionally, extensive withdrawal of ground water for plant operation can cause degradation of water level and contaminations.

Mitigation: The wastewater used for cooling the ball bearings and process equipment will be treated in an oil separator. The original volume of water usage is huge but with extensive recycling and reuse the bleed-off volume from the water source is negligible. Water will be used for dust control of the limestone and sandstone stock pile, dust control in the conveyor belt, and washing of the ropeway boxes. The wastewater from this source will be treated in a sedimentation tank to remove the suspended solids in the wastewater. During plant operation, the viability of recovering the settled solids as additional raw materials will be studied. No liquid waste should be disposed in water or ground without treatment. Therefore, no chance is there for the water to be contaminated. An advance design for septic tank has been made to reduce impact from the waste of septic tank.

Please see the layout of septic tank and its process in ***Annex 15 and 16***.

7.2.2 Impact on Air Quality

From different gaseous emissions, dust, particulates, etc. have significant adverse impacts on ambient air quality. A cement plant without proper treatment equipment can cause significant harm to air quality of the project site. Emission of Nitrogen oxides (NOx) and other nitrogen compounds; Sulphur dioxide (SO2) and other Sulphur compounds along with dust are the most common feature of this type of plant. Carbon dioxide emission is also seen, there are two different sources of CO2 during cement production: combustion of fossil fuels, and chemical process of calcining limestone into lime in the cement kiln. The most significant way to reduce CO2 emissions is improving the energy efficiency of the cement kiln operation. Switching to lower CO2 fuels such as natural gas can also reduce emissions. Another strategy, which addresses the CO2 emissions from calcining limestone, is to use waste lime from other industries in the kiln. Traditionally the emission of dust, particularly from kiln stacks, has been the main environmental concern in relation to cement manufacture. The main sources of dust are kilns, raw mills, and clinker coolers and cement mills. In all these processes large volumes of gases are flowing through dusty materials. Emissions of other gases and particulate like Carbon monoxide (CO), Volatile Organic Compounds (VOC) also happens during:

- Raw materials grinding and handling
- Kiln operations and clinker cooling
- Product grinding, handling and packaging

Mitigation: The following mitigation measures are recommended to improve the indoor and ambient air quality of Aman Cement Mills Unit-2 Ltd. Before implementing appropriate mitigation measures an expert advice whenever necessary is suggested to

improve the efficiency of the mitigation measures. The bellow table shows a summary of proposed mitigation measures for the improvement of air quality.

Table-7.2.2: Mitigation measures for air pollution

Pollutants	Description	Mitigation
Flue gases	Particulate matter in flue (exhaust) gases are formed due to ash and heavy metal content of the fuel, low combustion temperature, low excess oxygen level, high flow rate of flue gases. Carbon monoxide is formed when incomplete combustion occurs at low air to fuel ratio.	Regulating the fuel to air ratio for an optimum excess air that ensures complete combustion of carbon monoxide to dioxide.
	Nitrogen oxides are formed when maximum combustion temperature and high excess oxygen.	Keep the combustion temperature at a moderate value to minimize particulate matter and nitrogen oxides
	Sulfur dioxide is due to the sulfur content of the fuel.	Replacing Mazot by solar or natural gas. Mazot is high in sulfur content.
Dust	Kiln operation is the major source of dust and gaseous pollutants due to poor quality of raw material.	Larger dust particles can be removed by cyclones or other mechanical devices. Small dust particulates can be removed by bag filters, electrostatic precipitators, or wet scrubbers.
	(Minimization of production of cement kiln dust)	There are three primary means to decrease the amount of dust generated by the kiln. Dust can be minimized by reducing gas turbulence in the kiln and avoiding excessive flow velocities. In wet process the use of chains near the cool end of the kiln can also minimize dust by trapping the dust before it is released in the kiln exhaust. Most wet process kilns are already equipped with such cool-end chain sections.
	(Dust-Recycling and Reuse)	Direct return of dust to the kiln is a common recycling practice. The dust may be returned to the hot end, to the middle of the kiln, or to the feed material. However, cement kiln dust can only be reused if contaminant concentrations fall within specified limits, because clinker quality can be affected by the presence of certain constituents. Alkali metals, such as lithium, sodium and potassium are of primary concern. The raw materials used to produce clinker and the kiln fuel influence the chemical composition of the dust generated and thus may affect recycling rates. It can be used as adsorbent, as a neutralizing agent for acidic wastewater stream; as a soil stabilizer; and as an ingredient in various agricultural and construction products.

Dust Controlling Mechanism by ECHO-Hopper of Cement Plant

The cement project of Aman is completely a Grinding Project where the following raw materials will be in use in the grinding process of cement:

a) Clinker
b) Gypsum
c) Limestone

d) Flyash, the ash produced from the Coal Base Power Plant
e) Blast Furnace Slag

Process Description

ECHO Unloading Process of Raw Materials

All the materials are imported from overseas through vessels in the following manner:
The Clinker is mostly a dusty product where 5~10% of dust remains there. This Clinker is imported through vessels and then it is unloaded by the Grab Crane. The hydraulic operated Grab technology with the Crane is applied here with the concept of minimizing/controlling the dust emission. This is again taken to the hopper and then conveyed to the storage through Belt Conveyor. So, the following measures are taken to get rid of the emission of dust on the hopper of its top & bottom surface during the ongoing unloading operation.

Hopper system for controlling the dust emission:

AMAN Cement has taken appreciable steps/measures for minimizing the huge volumetric Clinker Dust with the incorporation of Echo-Hopper System from AUMUND, GmbH. This is definitely a proven technology from German which has been remaining in broadly use throughout the world for the controlling of Dust Emission.

Dust Controlling System throughout the Conveying Line to the Raw Materials Storage:

The Dust is usually generated in each & every dropping point but not in the conveying path. Therefore, sufficient capacity of Dust Collecting System has been designed in each & every dropping point in the following manners:

a) The Dust generating as well as to allow for emitting from all sorts of Raw Materials in the Process is the meaning of losing the Cement Powder in the air and that is nothing but the matter huge financial loss considering the cement as powdered material. This is why, with the concept of "the more the dust is minimized, the more the financial loss is controlled", the Dust Collecting System with the use of Dust Collector is designed throughout the Plant area with a view to saving the financial loss as well as to increase the productivity.

b) Sufficient nos. of Dust Collectors with enough capacity have been designed throughout the Cement Plant for minimizing as well as to control the dust emission which is the obligation of the Environmental Deptt. Bangladesh.

Capacity of Dust Collecting Device

The minimum capacity of Dust Collector is designed **7,400 Nm^3/hr** for collecting cement dust in the conveying line while the maximum capacity remaining in the Mill Process is **7, 50,000 Nm^3/hr.** In this case, it is in need to be mentioned here that, CHMC, China & LOESCHE, GmbH who are well professional internationally for designing a complete cement plant have been awarded for designing this AMAN Cement Mills as well. Therefore, there should have no confusion of emitting the Cement Dust throughout the Cement Plant.

Making the Cement Process Line confined with Close Sheeting

As precaution, the whole Cement Plant starting from the Jetty operation to Grinding Process and then to the delivery of cement product is being made confined with **Close Sheeting** to get rid of generating the cement dust**(if any)** to the environment. This measure is applied for collecting the cement dust for circulating the same into the process line with the concept of using this cement dust into the system.

The storage facility of all the Raw Materials will be maintained in a well standard manner with close shade while an appreciable expense is being incurred for the construction of Clinker Storage with air tight facility to keep it moisture free as well.

Please see the details of ECHO-Hopper technology in ***Annex-11.***

7.2.3 Impact from solid waste

Solid waste produced during clinker production consists basically of unwanted rocks, which are removed from the raw materials during the preparation of the raw meal, and kiln dust removed from the by-pass flow and the stack, which is not recycled. Solid waste also produced from laboratories, workshops and garage, storage facilities, etc.

Laboratories have an important role in the cement industry, as they are responsible for producing solid waste along others. Electrical and mechanical workshops for maintenance and repair purposes can also produce solid waste like scrap metal along with:

- Noise
- Rinse water contaminated with lube oil

Pollution in the garage area will depend upon the services offered. The presence of a gasoline or diesel station implies fuel storage in underground or over the ground tanks that require leak and spill control plans. Replacing lube oil implies discharge of spent oil to the sewer lines or selling it to recycling plants. Storage facilities and the residential area of service person will produce solid waste largely, in the project site.

Mitigation: It is recommended that Aman Cement Mills Unit-2 Ltd. will properly collect all solid waste according to their nature and will re-use and recycle each and every item according to their nature. Besides, the heavy machinery and large fans used in cement manufacture can give rise to emissions of noise and/or vibration. To control the impact of the noise from the process equipment, especially the crushers and grinders, the following mitigating measures will be in place (i) regulating spacing between noise sources, and between noise sources and operators (control cabins for operation); (ii) reducing structure-borne transmission by isolation of the source using resilient mountings; (iii) correcting imbalance and vibration by preventive maintenance; and (iv) providing ear defenders where necessary to operators exposed for longer duration. Aman will follow National 3R Strategy for Solid Waste Management, will install STP and Soak Well for solid waste management.

Please see the National 3R Strategy for Solid Waste Management for ACML-2 in ***Annex-12***
Please see the STP layout for solid waste treatment for ACML-2 in ***Annex-13***
Please see the Soak Well layout for waste management for ACML-2 in ***Annex-14***

7.3 Impact on Socio-Economic Environment

As this plant did not displace any households from the area and the site was neither agricultural land, the socio-economic impact of the project will be potentially beneficial for the people of the area. Though some health related hazards could happen, the employment opportunities and income level will increase.

7.4 Impact on Employment and Family finance

The site selection was based on the ownership pattern of the land. As mentioned earlier, this plant did not displace any households from the area and the site was neither agricultural land. Aman Cement Mills Unit-2 Ltd will provide on-the-job training for unskilled and semiskilled workers during the construction period especially to the landless farmers of the adjacent area. The good workers will be retained during the Project operation.

The project will initiate training and marketing program for those tenants who could not be employed in the cement plant. There are no houses within the Project site to be relocated. The Project is expected to contribute positively to the economic development of the country through the provision of essential material for the construction of the nation's infrastructure.

During the construction phase, the project will hire local labor with relatively better wage than of agricultural wage for limited term; and later, during operation phase, the project will higher labors for daily operation of the plant. Labors will be needed for different sectors of the plant.

7.4.1 Impact on health and safety

Some minor (accidents) to major (health hazards related to sanitation problems) will be associated with the construction phase of the plant. During construction, some labor from outside can be hired and their housing with proper sanitation facilities could be problematic. Other occupational hazards can happen both in construction and in operation phase, but the number of those accidents should be limited. On the other hand, employment and income generation can have positive effects on health related issues in household level. Due to the development of the project site, the value of land of this area has increased and some scope of business also opened around the project area.

Enhancement/Mitigation: Positive impacts of the project like employment, income, etc. should be maximized through inclusion of local people in the project activities in all possible means. Local people, who are affected directly or indirectly, should be given preference for involvement in project activities irrespective of their skill level. Poor and helpless women should be involved in suitable position according to their ability, education and skill. On the other hand, negative impacts like sanitation and health hazards should be tackled by building proper housing for the temporary construction

workers of different level and effective safety measure should be taken for the safety of the workers.

Please see the safety management guideline of ACML-2 in ***Annex-6***

7.5 Miscellaneous Mitigation Measures

7.5.1 Mitigation issues for Cement Plant

Tree Plantation throughout the Plant:

Appreciable steps have already been taken for abundance of "TREE PLANTATION" starting from the river area to the entrance of Plant site for ensuring Green effect of this Cement Plant. It is to be noted that, strong shore protection will be taken for the well river boundary and a wide road will be constructed for the frequent movement of the heavy vehicle as well. Moreover, the Green Plantation will be there throughout the river area for ensuring the greenery effect.

Utilization of Hot Gas from the Generator:

The Hot Air Gas emitted from the Generator is also utilized in the Cement Mill where the same quantity of this Hot Air Gas is required as per the calculation as the system requirement point of view. In this case, it is in need to be noted for recycling as well as for minimizing the percentage of Carbon emitted in the environment.

Human Wastage

The Cement Plant will be in operation with thousands of population where AMAN Group has no way but to ensure their accommodation for the sake of smooth Plant Operation. This sewerage system for those residents will be designed in well standard manner with sock oil system.

Vibration & noise Control

The Vibration & Noise controlling system for this Cement Plant will be maintained complying with the Environmental Act.

Fire Fighting System

The Modern Fire Fighting System for the whole Factory will be executed complying with Environmental Act along with the well standard manner.

Medication for the Factory

A well standard medication will be implemented starting from the commencement of Cement Plant construction till to its operation.

7.5.2 Mitigation issues for Steel Plant

The Steel Plant is mainly based with process of utilizing the Iron Ore for producing the Iron Billet. This Iron Ore is usually imported from the overseas and accordingly, the plant is there for processing into Iron Billet. So for this process plant, the following precautions are taken:

Introducing the Dust Collecting Device:

There are plenty of Dust Collecting Devices for controlling the dust emitted from this process plant and therefore, there is no scope of emitting the dust beyond the limit.

Utilizing the Slag in the Cement Plant as Raw Materials of Cement

Abundance of Slag will be coming out from this process plant. With this consideration, AMAN Group have already taken the necessary steps for the 100% utilization of this wastage Slag as the Raw Materials of cement Plant situated beside this plant.

Measures for Smoke

The smoke coming from this plant will be released as per the standard of the environment. The chimney for releasing the smoke is installed in high altitude to comply with the environmental instruction.

Tree Plantation throughout the Plant:

Appreciable steps have already been taken for abundance of "**TREE PLANTATION"** starting from the river area to the entrance of Plant site for ensuring Green effect of this Cement Plant.

Watering system

The water used in this process plant is only for the cooling of the machinery. Therefore, the surface and river water is used with a simple processing and then used in the cooling system in a circulating manner.

Human Wastage

The Cement Plant will be in operation with thousands of population where AMAN Group has no way but to ensure their accommodation for the sake of smooth Plant Operation. This sewerage system for those residents will be designed in well standard manner with sock oil system.

Vibration & noise Control

The Vibration & Noise controlling system for this Cement Plant will be maintained complying with the Environmental Act.

Fire Fighting System

The Modern Fire Fighting System for the whole Factory will be executed complying with Environmental Act along with the well standard manner.

Medication for the Factory

A well standard medication will be implemented starting from the commencement of Cement Plant construction till to its operation.

7.5.3 Mitigation issues for Cement Sack Plant

The Cement Sack Plant is the process of making the Cement Sacks from polythene and paper are the raw material for the same. This is just a process plant for producing the Cement Sacks with the polythene and paper where there is nothing to be wastage.

Human Wastage

The Cement Plant will be in operation with thousands of population where AMAN Group have no way but to ensure their accommodation for the sake of smooth Plant Operation. This sewerage system for those residents will be designed in well standard manner with sock oil system.

Vibration & noise Control

The Vibration & Noise controlling system for this Cement Plant will be maintained complying with the Environmental Act.

Fire Fighting System

The Modern Fire Fighting System for the whole Factory will be executed complying with Environmental Act along with the well standard manner.

Medication for the Factory

A well standard medication will be implemented starting from the commencement of Cement Plant construction till to its operation.

Mitigation of Water Pollution in Haria Intake Point of WASA

Considering the recommendation given in 'Environmental and Social Impact Assessment' by DWASA, no liquid waste water will be generated and/or discharged by ACML-2 through its operation and production activities that can pollute the water of intake point especially Haria. In fact, ACML-2 will use sophisticated technology for the protection of surface runoff and leakage during rainy season (Close Circuit System for raw materials handling), loading and unloading of materials (Crane), noise reduction technology (Losech System), dust free technology (ECHO-Hopper), STP for liquid waste water treatment, etc. (Described in Chapter 3, Annex-11, 13, 14, 15)

The proponent of Aman EZ is strongly aware to maintain the quality of water of Meghna River by its regular monitoring. In fact, they will maintain the precaution during loading and unloading of raw materials using jetty; surface run off and leakage during storm; control dust during production of cement; water vessels; oil, grease and other chemical from ship, etc. by their skilled manpower. Crane machine will be used for loading and unloading the raw materials and the finished products. The cargo that will be used for loading and unloading shouldn't be allowed to stay longer at the jetty so that water pollution by the marine vehicles could be minimized. Moreover, no blister will be allowed to discharge in the vicinity of the jetty. Continuous monitoring of river water quality will be ensured to limit the extent of water pollution. Additionally, water pipe

networks that will be connected to the WASA water intake will not pass in any case within the Aman Cement industrial area. The quality of all environmental parameters will maintain within tolerable limit as per DOE standard.

Chapter 8
Environmental Management Plan (EMP)

8.1 Introduction

The Environmental Management Plan (EMP) is a site-specific plan developed to ensure that all necessary measures including mitigation and monitoring activities are identified and implemented in order to preserve and protect the environment and to avoid and manage the negative impacts of the project and comply with environmental legislation. The primary objective of the EMP is to provide a guideline for proper management and monitoring of the identified environmental and other impacts due to the project and to offer document to the implementers for accomplishing the institutional requirements of the authority. It will identify the residual impacts and unavoidable impact and their management. As GoB is committed to ensure sound environmental, preparation and execution of EMP is a mandatory for formulation, implementation and monitoring of environmental protection measures during and after commissioning of projects. The plan indicates how various measures are proposed to be undertaken during different phases of the project including cost components.

It consists of various steps in including
Conceptualization: from preliminary environmental assessment

- **Planning**: comprehensive studies of environmental impacts and design of safeguards
- **Implementation**: implementation of environmental safety measures
- **Operation**: monitoring of effectiveness of the protective measures

The proposed environmental management plan in the current study will clarify:

i) the mitigation measures that needs to be taken during both construction and operation phases of the project to eliminate or offset adverse environmental impacts, or reduce them to acceptable levels;
ii) the actions needed to implement these measures; and
iii) a monitoring plan with monitoring indicators requires to assess the effectiveness of the mitigation measures employed.

Integrated EMP is a necessary requirement for implementation of the project, which will be a guide for the environmental protection activities. Comprehensive measures for mitigation and monitoring of possible environmental hazards have been enlisted for ensuring safety measures and minimizing the risks and hazards due to implementation of the proposed project in the current study.

8.2 Mitigation Plan/Benefit Enhancement Measures

Establishment and execution proposed Aman Cement is believed to have a positive impact for sustainable economic growth along provision of working facilities to the local people. However, the project may also have some impacts on the existing local environment, eco-system and socio-cultural activities including change in land use,

increased pollution of water, air, noise etc. Therefore, a compensation mechanism has to be established to the affected communities for various hazardous impacts including effects on their households, environment, agricultural lands & products, water bodies, surrounding social infrastructures. A detail EMP including Health & Safety measures has been described in the following table. The authority of Aman Cement will be responsible for accomplishing the proposed safety measures mentioned in the proposed EMP.

Followings are the main advantages of the environmental mitigation plan:

- Ensuring the plan for fulfillment of the basic environmental standards essentially required to meet during design, construction, and operation of the project
- Providing plan for development of mitigation actions for minimizing the negative ecological impacts due to the project.
- Reducing or minimizing the potential environmental impacts, causing the biophysical environment in the area to deteriorate and indirectly slow down the economy of local communities the project might generate some. The EMP for Aman Cement has been prepared based upon optimum and reasonable costs that are needed for mitigation measures on a "least-cost" basis.

Activities that needs to be carried out for the environmental management and monitoring of the proposed Cement project could be divided into two phases:

i) During construction phase, and
ii) During operation phase.

8.3 Environmental Management Mitigation Measures during Construction Phase

The environmental management program should be carried out as an integrated part of the project planning and implementation. For this reason, it is recommended that the Aman Cement project Authority to take the overall responsibility of environmental management and monitoring to mitigate any adverse impact and to enhance beneficial impacts, resulting from the project activities. Assigning a team or a project management unit (PMU) with required manpower having expertise and necessary logistics is needed for proper supervision of the activities during construction phase and to ensure proper environmental monitoring of the project activities. In addition, involvement of local community in the activities that have potential impacts on them including traffic congestion in the surrounding areas may play a vital role for better management of the problems.

The environmental management during the construction phase should primarily be focused on addressing the possible negative impacts arising from:

(a) Deterioration of air quality
(b) Deterioration of water quality
(c) Generation of dust (particulate matter)
(d) Disposal of sewage, solid waste and construction waste
(e) Increased traffic

(f) Generation of noise

The authority should also take into consideration of occurrence of any unpredicted hazards during the construction phase to the surrounding environment or to local community. To find out the untoward effects, the PMU should arrange a public consultation involving all stakeholders to address complaints and criticism from them and keeping records of them for necessary mitigation measures. The following table describes the potentially significant environmental impacts during construction phase, the measures needed to eliminate or compensate adverse impacts and enhance positive impacts.

Table 8.3 (a): Potentially significant environmental impacts during construction phase and mitigation measures

Activity/ concerned issues	Potentially significant Impacts	Proposed Mitigation Measures	Responsible Authorities	Monitoring
Engagement of labors/workers	i. Substandard living facilities: accommodation, living condition; unsafe food and drinking water	Temporary houses for the workers: • location of the living place should be in the safe zone (100 m away from storage site) • adequate facilities for drainage of water to prevent water logging • flood protection measures of the buildings should be considered • basic standard of temporary accommodation should be ensured including proper cross ventilation, concrete floor, sufficient lighting and electric fan (electrical wires should be properly concealed) • facilities of safe drinking water within 50 m of living site • adequate facilities for preparation of safe food • periodic mosquito control measures should be undertaken to destroy their breeding places • Bangladesh being a signatory of the key International Labor Organization (ILO) conventions to ensure the work conditions safe working environment needs to be ensured by the employees	ACML-2	BEZA, ACML-2, DoE
	ii. Unsafe sanitation & storage of solid waste	• construction of Sanitary latrine and septic tank (one latrine for 20 persons) • proper storage (in waste bin) and disposal of solid waste at the landfill in the designated site	ACML-2	BEZA, ACML-2, DoE

	iii. Occupational Health hazard: risk of transmission of various contagious diseases including diarrhea, scabies, air-borne diseases like tuberculosis, influenza or any accidental injury	• healthy living rooms with facilities of cross-ventilation; • first aid box having necessary emergency medicines & equipment including antiseptic bandage, gauze, antiseptic solution/povidone iodine, oral rehydration salt, medicines facilities should be ensured; • allowing sick leave for the workers if necessary • All incidents of accidents or any other diseases of the workers should be followed up with ensuring necessary compensation shall be given • all temporary structures, rubbishes needs to be cleared or disposed properly to minimize accidental injury • monthly medical check-up of the workers • Occupational health safety measured should be ensured for the workers including wearing helmets, gloves, boots, and jackets during working period. Fire extinguishing facilities with demo-training to the workers should be conducted	ACML-2	BEZA, ACML-2, DoE
construction materials construction works and unsafe storage of materials	**Transportation of construction materials**, construction works and unsafe storage of materials may cause disruption of the surrounding environment that can interfere regular activities of local community by i. Traffic congestion in the surrounding areas ii. noise pollution iii. Air pollution by increased movement of the transports iv. Breeding of mosquito in the water storage pool made for construction purpose	• Movement of vehicles should be limited at evening site • Speed limit of vehicles of maximum 20 km/hr should be maintained • Alternate route should be used for bypassing the important public establishment like schools, offices should be used for movement of the vehicles • Ensure regular checking of the machineries for meeting noise level standards to comply with the DoE requirement and meet relevant standards prescribed in Environment Conservation Rules, 1997. • Silencers and mufflers should be used in the	ACML-2	BEZA, ACML-2, DoE

		heavy/ noise generating machineries and will be regularly inspected to control excess noise generation. • Location for store house for construction materials should be in safe zone; at least 1 km from water sources and also 1 km from the locality. • construction materials that can produce fine particulate matters should be covered with canvas or thick plastic sheets while transporting or stockpiling • Spraying of water to reduce excessive dust particles wherever required.		
Disposal of construction waste	Improper disposal of construction waste that may cause various hazards to the environment including a. exposure of biodegradable materials can produce untoward odor & bed smell that can pollute natural air, facilitate spreading of diseases b. water logging, c. discarded reinforcement like steel bar, rod can cause accidental injury	**Proper disposal of waste:** • Selection of designated site: should be at least 1 km away from the locality and from the river bank, avoiding the area with natural vegetation. Prior permission is needed from the respective authority before selecting the site • segregation of the wastes prior to disposal • should be dumped in different designated landfill/pit at dumping site after segregation of different construction materials/ solid wastes • all kinds of dumped waste products should be covered • Proper drainage facilities should be ensured to prevent water logging	ACML-2	BEZA, ACML-2, DoE
	Earthquake	• construction of earthquake resistant infrastructure • provision of emergency rescue facilities	ACML-2	BEZA, ACML
Socio-economic factors	local environmental, socio-cultural disruption	• Engagement of local people as much as possible to the various activities of the project to minimize the socio-cultural disruption	ACML-2	BEZA, ACML

Table 8.3 (b): Potentially significant environmental impacts during operational phase and mitigation measures

Activity/ concerned issues	Potentially significant Impacts	Proposed Mitigation Measures	Responsible Authorities	Monitoring
Engagement of labors/workers (Environment, Health & Safety issues)	Working environment	**Ensuring proper working environment for the workers:** • basic standard should be ensured in the vicinity of the working area including proper ventilation, sufficient lighting, electric fan, alternate safe exit • Bangladesh being a signatory of the key **International Labour Organization (ILO)** conventions to ensure the work conditions safe working environment needs to be ensured by the employees	ACML-2	BEZA, ACML
	ii. provision of drinking water and sanitation	• facilities of safe drinking water to be ensured • adequate facilities for preparation of safe food • construction of Sanitary latrine and septic tank (one latrine for 20 persons) • proper storage (in waste bin) and disposal of solid waste at the landfill in the designated site	ACML-2	BEZA, ACML
	iii. Occupational Health hazard: risk of transmission of various contagious diseases including diarrhoea, scabies, air-borne diseases like tuberculosis, influenza or any accidental injury	▪ healthy working area with facilities of cross-ventilation; ▪ intake safe food & drinking water ▪ provide facilities and training for practicing of proper personal hygiene including hand washing with soap & water especially before taking food and after defecation; ▪ first aid box having necessary emergency medicines &equipment including antiseptic bandage, gauze, antiseptic solution/povidone iodine, oral rehydration salt, medicines facilities should be ensured; ▪ Basic health education and knowledge about primary management of diarrhoea, accidental injury should be given to workers ▪ one vehicle should be kept ready to transfer the workers immediately to hospital on emergency basis in case of any accidental injury or any other emergency ▪ allowing sick leave for the workers if necessary ▪ All incidents of accidents or any other diseases of the workers should be followed up with ensuring necessary compensation shall be given ▪ all the cases should be reported immediately and incident analysis should be done to take necessary preventive measures ▪ all temporary structures, rubbishes needs to be cleared or disposed properly to minimize accidental injury ▪ monthly medical check-up of the workers ▪ Occupational health safety measured should be ensured for the workers including wearing helmets, gloves, boots, and jackets during working period. Fire	ACML-2	BEZA, ACML

		extinguishing facilities with demo-training to the workers should be conducted		
Environmental factors	Water pollution	▪ Establishment of STP ▪ Separation of the effluents based on the nature of pollutants ▪ Water vessels must be properly licensed and will be run by skilled manpower so that water Meghna River can't be polluted from any unusual fuel or grease. ▪ proper biological/chemical/other necessary treatment of generated sewage during operational phase prior discharging/draining to the water bodies like ditches, canal or river ▪ construction of proper drainage system for safe disposal of the treated waste water ▪ establishment of dual plumbing system for re-using treated water from STP for flushing, cooling purpose or other purposes • discharging of untreated effluent into the surface water body/abandoned ground water source/ ground must be strictly avoided • discarding of solid waste/ hazardous waste/ industrial waste in the water bodies or in the ground must be strictly avoided • proper treatment of leachates must be done before discharging them to the designated site to prevent groundwater contamination • effective monitoring of the treated water, sewage etc. to ensure safe disposal in the environment • monthly monitoring of drinking water quality • establishment of rain water harvesting facilities as an alternative source of water • monthly water treatment by chlorination • regular inspect of water supply system for early detection of leakages	ACML-2	BEZA, ACML-2, DoE
	Air pollution	• setting up of various air pollution control instruments like Electro-static precipitator, bag filters, separators, cyclones, multi-level condensers & evaporators, scrubbers, quenchers, stacks of height as per suggestion of DoE for early detection of air pollution • storage/usage/disposal, of chemicals having potential to release volatile organic carbon should be done in closed system • dispersion of smokes and various gaseous emissions should be done by constructing standard stack height • regular maintenance and checking of machineries for emission to comply with the DoE requirement • disposal of the bio-degradable waste products at the designated site for waste disposal in the pits covered with soil or other means to prevent odor and transmission of various diseases also • measures like constructing well-paved and well-carpeted roads, spraying of water etc. to be considered to reduce generation of dusts • regular monitoring should be carried out for testing ambient air quality	ACML-2	BEZA, ACML-2, DoE

		• development of green belt of 10 m along the outer border of the project area		
	noise pollution	▪ using of high quality machineries ▪ regular maintenance, checking and monitoring of the machineries, equipment andvehicles for meeting noise level standards to comply with the DoE requirement and meet relevant standards prescribed in Environment Conservation Rules, 1997. ▪ Silencers and mufflers should be used in the heavy/ noise generating machineries and will be regularly inspected to control excess noise generation. ▪ regular monitoring of noise level in the ACML-2 ▪ ensure wearing of personal protective equipment like ear plug to reduce the risk of hearing impairment ▪ long time exposure of workers to excessive noise should be minimized by adjusting the working hours as per DoE rules ▪ monthly monitoring of workers having prolong exposure toexcessive noise for early detection and treatment of any hearing difficulties	ACML-2	BEZA, ACML-2, DoE
	Disaster/ sudden catastrophes like flood, fire explosion, earthquake etc.	• ensuring development of earthquake resistant infrastructure • Readiness/preparedness for emergency response for disaster management shall be ensured • Fire extinguishing facilities with demo-training to the workers should be conducted quarterly • sufficient alternate safe exit should be developed • provision of emergency rescue and supporting facilities • ensuring proper and adequate drainage system • adequate evacuation system	ACML-2	BEZA, ACML-2, DoE
Disposal of waste	Improper disposal of construction waste that may cause various hazards to the environment including a. exposure of biodegradable materials can produce untoward odor & bed smell that can pollute	Proper disposal of waste: ▪ Designated site: should be at least 1 km away from the locality and from the river bank, avoiding the area with natural vegetation. Prior permission is needed from the respective authority before selecting the site ▪ segregation of the wastes prior to disposal ▪ should be dumped in different designated landfill/pit at dumping site after segregation of different construction materials/ solid wastes ▪ all kinds of dumped waste products should be covered ▪ Proper drainage facilities should be ensured to prevent water logging ▪ Proper disposal of wastes and drainage of water and ensuring cleanliness of surrounding environment water storage pool for prevention of mosquito breeding	ACML-2	BEZA, ACML-2, DoE

	natural air, facilitate spreading of diseases b. contamination of water (surface water, ground water), soil c. water logging d. increase breeding of mosquito			
	Soil erosion, flooding	• proper bank protection (embankment) measures needs to be undertaken • construction of protective wall beside the river shore • minimum removal of trees and plants • development greenbelt of about 10 m surrounding the area	ACML-2	BEZA, ACML-2, DoE
potential impacts to ecology including flora & fauna	reduction of faunal habitats including trimming or cutting of trees in the vicinity of the ACML-2; disturbance of individual animals; localized decline in the quality of habitat; removal of original plants etc. by infrastructure development and associated	▪ development of a greenbelt surrounding the ACML-2 area by plantation of native flora	ACML-2	BEZA, ACML-2, DoE

	industrial activities			
Socio-economic factors	local environmental, socio-cultural disruption	• Engagement of local people as much as possible to the various activities of the project to improve their socio-economic condition • carrying out of social welfare activities by the industrial owners in nearby areas of ACML-2 like financial support/scholarship to the local SSC/HSC student for encouraging higher education, children of the development of cattle sheds, providing relevant training to the local people for getting better employment facilities in the ACML-2, performing other social responsibilities etc.	ACML-2	BEZA, ACML-2, DoE

Moreover, special attention will be given also for the following issues:

Drainage: Since the cement industry will be fully covered by utilizing the automated sophisticated German technology in every stages starting from unloading and depositing of raw materials up to the loading and delivering of finished product, there will be a minimum amount of material wastage available in the industrial compound to produce any environmental pollution. Moreover, the raw material will be deposited in a covered shed and will not get mixed with the surface runoff by any chance. Therefore, deposition of raw material will not produce any risk that can contaminate to the surface runoff. Frequent monitoring of soil and water quality will be done to check the runoff quality. A significant part of the surface runoff will be diverted to the local canals and drains to avoid the water pollution in the river.

STP/ETP: A STP will be established at the AEZ to treat the sewerage produce by the employees of the cement industry. Primarily, STP is preferred, since ETP is not essentially required. The capacity of the STP would be for 10, 000 people.

WASA Intake: Considering the importance of the WASA project, highest priority has been given to protect the Meghna river water as this water will be used by the Dhaka City Dwellers. No surface drainage water will be allowed to discharge into the river without having proper treatment if that is necessary to treat. Even, in future, if Aman discharges any liquid waste that pollutes the intake water, it will strongly monitor, handle, coordinate and provide solution by the leadership of BEZA.

Air pollution: Since the Cement industry will be well equipped with the dust control technology, therefore, the chances of air getting polluted will be minimal.

Road/s: Precaution will maintain during loading and unloading transportation of raw materials and final product using internal and external roads.

8.4 Monitoring Requirement

Environmental monitoring is an essential tool in relation to environmental management as it provides the basic information for rational management decisions. The prime objectives of monitoring are: adopted and are providing effective in practice.

- To provide am means whereby impacts which were subject to uncertainty at the time of preparation of EIA, or which were unforeseen, can be identified, and steps to be taken to adopt appropriate control measures
- To provide information on the actual nature and extent of key impacts and the effectiveness of the mitigation measures which, through a feedback mechanism, can be taken into account in the planning and execution of similar projects in future.

There are two basic forms of monitoring:

- Visual observation or checklist, coupled with inquiries
- Physical measurement of selected parameters.

In the case of industrial projects in general, monitoring is done by physical measurement of some selected parameters like air, water, noise etc. It should be mentioned here that the monitoring program should be such so that it can ensure compliance with national environmental standards. The importance of this monitoring program is also for ensuring that the plant does not create adverse environmental changes in the area and providing a database of operations and maintenance, which can be utilized if unwarranted complaints are made.

8.5 Monitoring Indicators

The main purpose of a monitoring plan for the potential environmental parameters during the construction and operation phases in this project is

- to provide a standard guideline for comparing the baseline environmental conditions (data observed/collected during the study period) and other factors with that of the construction and operational phases
- to evaluate the effectiveness of the mitigation measures for preservation of the natural environment
- to detect any disruption of environment according to national standards.

Several environmental components can be affected during the construction and operation of the project. Following plan has been formulated for monitoring and evaluation of environmental components with potential risk of disruption. Due to establishment of the proposed project several environmental components have potential risk of disruption either during construction or operational phases that needs to be monitored for detection and management of any damage of the environment.

Following are the plausible indicators with major significance that should be monitored and evaluated for the potential risks that could be beneficial for carried out proper mitigation measures:

i) Health & safety issues of workers
ii) Air quality
iii) Water quality (ground water; surface water; river water)
iv) Waste management
v) Noise level
vi) Protection of Ecology

8.6 Costing of EMP

In order to ensure the environmental safety, reduce the significant risks and hazards and for taking necessary mitigation measures it is important to carry out several management and mitigation measures against potential environmental hazards and conduction of periodic monitoring of the activities during the construction and operational phases. The responsibilities for the implementation of the proposed monitoring plan might be conducted by the responsible contractor that needs to be supervised by the authority of ACML-2.

Table 8.6 (a): Estimated cost for environmental management and monitoring during construction

SI no	Issues	Construction cost & maintenance cost	Responsible Authority
1	Construction of safe & healthy living facilities	To be included within the basic cost for construction	Contractor/ Aman Cement Mills Unit-2 Ltd. (supervision)
2	Provision of safe water supply & sanitation		
3	Provision of PPEs		
4	Establishment of drainage & waste management system		

Table 8.6 (b): Estimated cost for environmental management and monitoring during construction/ operational phases

SI no	Parameters	Estd. Number of samples/sites (per year)	Unit cost@ (BDT)	Total cost (BDT)/year
1	Ambient air quality (SPM; PM 2.5; PM10; SOx; NOx; CO; CO2)	350	3000.00	1,050,000.00
2	Water Quality ; surface/ river water (; BOD; COD; DO; PH; TDS; TSS; Ammonia; Nitrate; TC; FC; heavy metals; contaminants)	36	7000.00	252,000.00
3	Ground water	2	10000.00	20,000.00
4	Noise level	60	5000.00	300,000.00
5	Waste management system	24	10000.00	240,000.00
7	Quality of effluent	24	5000.00	120,000.00

8	Training of workers regarding occupational health & other industrial safety issues	2	500000.00	1,000,000.00
9	establishment of Greenbelt	1000	100.00	100,000.00
	Total cost per year			**3,082,000.00**

Table 8.6 (c) : Estimated cost for manpower for supervising environmental management and monitoring activities

SI no	Designation	Number	Cost (per month)	Cost (per year)
1.	Senior Environmental specialist	1.00	2,000,00.00	24,000,00.00
2.	Junior Environmental specialist	1.00	1,000,00.00	12,000,00.00
3.	Field-survey supervisor	1.00	25,000.00	300,000.00
4.	Field-surveyor	4.00	25,000.00	1,200,000.00
5.	Support staff	2.00	10,000.00	240,000.00
	Total			37,740,00.00

Chapter 9
Contingency Plan/ Disaster Management Plan

A contingency (Disaster management) plan is an essential guideline for undertaking the immediate need-based response in a well-designed, organized and coordinated manner for facing any adverse incident during an emergency. Contingency plan will guide to identify the victims at risk (who, what extent, when), responsible authority and the materialistic & natural disruptions (what extent). Nature of Emergency & Hazardous Situations may be of any or all of the following categories:

a) **Emergency**
   - Fire, burn injury
   - Accidental injury,
   - Electric shock
   - Explosion
   - Any Medical emergency,

b) **Natural Disasters**
   - Flood/Earthquake
   - Storm/tornados

c) **Other External Factors:** manmade, sabotage, war, etc.

The objectives of having an Emergency Response Plan (ERP) are to:

- Guide the authority/emergency response team (ERT) in determining the appropriate response to emergencies
- Provide respondents/ERT with planned strategy and recognized measures
- Guide to notify the appropriate ERT personnel and regulatory authorities
- Manage public and media relations.
- Notify the next-to-kin of accident victims
- Promote inter-departmental Communications to ensure a "Company-wide" Coordinated emergency response
- Minimize the effects that disruptive events can have on company operations by reducing recovery times and costs
- Respond to immediate requirements to safeguard the environment and the community.

Generally following steps of responses can be followed to combat any emergency:

Step-1: Risk Determination & Immediate Measures

i. Identification of potential hazards associated with the emergency episode due to the natural events or regular activities
ii. taking appropriate measures by the ERT/authority for determining the type, quality, extent of involvement

Step-2: Local Investigation

Determination of the source/ reason of the event resulting to the emergency and prevent further losses.

Step-3: Detail assessment

Conduct an assessment of the incident site for any further information on hazards and taking necessary actions for remedies.

Step-4: Rehabilitation

Initiation restoration/rehabilitation measures

Step-5: Reporting

Reporting of the occurrence of the incidence with all the details including the measures undertaken to the appropriate authority taking initiative for further steps including financial assistance etc. to the appropriate company, government and others

Step-6: Risk Communication

Taking steps for mass communication with addressing public and media regarding concerns and issues including human lives, property and the environment and responses to resolute the stress of the community and the country.

Functioning of Emergency Response Cell can be helpful to combat any emergency in the project area. In accordance with the requirement of DoE, proposed Aman Cement Mills Unit-2 Ltd. must have a plan to take adequate measures against accidents or incidents to meet the emergency. A contingency plan should be in place to deal with any emergency or natural calamities. In case of an emergency incident occur, immediate action must be taken to mitigate the impacts. In order to minimize the possibility of injury to the responders and others it is important that emergency responders follow the steps of emergency response plan to avoid missing of any events.

Chapter 10
Analysis of Alternatives

10.0 Introduction

Project alternative is required, if the impacts of the project design are significant to the environment and social components. It is assessed from the impact study that majority of the impacts will cause during construction phase of the project and would be of insignificant in nature. Some Positive impacts on socio-economic status are being revealed during operation phase. All the negative impacts can be mitigated through adoption of appropriate mitigation measures, and adopting sound engineering designs.
These sites are analyzed on basis of location, accessibility, potential for industrial growth, availability of raw material, infrastructural development, availability of man-power, vulnerability to natural and man-made disasters, availability of the basic amenities and utilities for industrial development.

10.1 The "No Build" Scenario

From a purely physical environmental point of view, the do-nothing is preferable to any project implementation, since it would avoid creation of the adverse impacts associated with the project. However, the potential socio-economic benefit to the nation would be foregone and industrial growth would be hampered.

It is concluded that the "No Build" alternatives is unacceptable, and the potential socio-economic benefits of implementation of such project far outweigh the adverse impacts, all of which can be controlled and minimized to an allowable level.

The analysis has also been done with and without project scenario. Implementation of proposed project will create lot of positive impacts on investment, health and hygiene of people, education, public environment and socio-economic status of community as well. Provision of good quality facilities will help to enhance the quality of life of the people. The project will also help to create job opportunities to considerable number of people. The Implementation of the proposed project will produce only negligible and insignificant environmental impacts.

On the other hand, if the project is not implemented, the people of the project area will still have to suffer from various problems they are facing today. The absence of a good investment infrastructure the region will deprive the potential for increased production, generation of new economic activities and employment. The economic zone project will facilitate opportunity for investment national as well as foreign significantly.

Hence, considering all technical, social and environmental issues proposed site is more feasible than the other site. The proposed site shall also be more feasible in terms of economic factor.

10.2 Alternatives in Project Location

No significant adverse environmental impacts are found with present location of project. The project is not adjacent to or in any environmentally sensitive, reserve or protected areas, and hence does not cause an impact on biodiversity as well as fisheries values.

The proposed location near to the River site is well protected by concrete structure comparatively less eroded and flood protected from external sources. The land is Aman Group own purchased land. However, it seems that the site will be most suitable for social impact of minimum land acquisition. The proposed site is above the flood level and it will be suitable for construction of the project. So, no site alternative is found to feasible against the proposed site.

Chapter 11
Public Consultation and Information Disclosure

11.1 Public Meeting and Survey

11.1.1 Project Stakeholders

Most of the main stakeholders have already been identified and consulted during preparation of this EIA, and any others that are identified during project implementation will be brought into the process in the future.

Primary Stakeholders

The residents, business owners, employees, hawkers and custodians of socially and culturally important buildings located alongside the roads in which proposed Meghna economic zone will be constructed.

Secondary Stakeholders

MG as the Executing and Implementing Agency; other government institutions whose remit includes areas or issues affected by the project (Narayanganj City Corporation, Bangladesh Water Development Board, Bangladesh University of Engineering & Technology etc.); NGOs and CBOs working in the affected communities; other community representatives (prominent citizens, religious leaders, elders, women's groups); the beneficiary community in general.in which proposed Meghna economic zone will be constructed.

As part of the public consultation of social, gender, and resettlement issues, the Consultants Team carried out a series of consultations with people from a range of different categories within the proposed ACML-2 and the nearby areas including offsite infrastructure. These meetings were held from 11 March to 28 March, 2016. Consultations took the forms of individual interviews, focus group discussions – mostly informal, and visits of local shops in Choto Dewbogh, Sonamoye and Haria. Consultation with local people included home owners, agricultural land owners, fishermen, landless people, women, school-going children, local traders, transport workers, shopkeepers, and workers, etc. Consultations were conducted with local people including home owners, private land owners, fishermen, shopkeepers and workers, women and local small-scale traders.

11.2 General Findings of the Meeting and Survey

In general, the local people's response to Aman Cement Mills Unit-2 Ltd. is positive. Most of the people who live close the plant site have no objection towards the plant being set up at the selected site as that area from the beginning developed for industrial

use. Most the people as interviewed are not aware of pollution and also do not feel that Aman Cement Mills Unit-2 Ltd. would be source of any hazard to them.

As understood from gathered information, the same approach of not involving the local public during the project planning as prevailing in the country was adopted in case of Aman Cement Mills Unit-2 Ltd. this is a top-down approach of not asking the opinion of the people who themselves or whose environment and socio-economic might have been affected due to the project. There should have been a bottom up approach taken while designing the project with opportunity and arrangements for public participation.

The people of the area seem to be happy for the installation of such plan since they would not face jobless further after operation for the plant. Presently public participation is limited to engaging some local people in various constructions and other related activities during the implementation of the plant. The same will imply on when there would be some local people recruited permanently or temporarily as the plant staff during its operation. Also some people will participate indirectly in various economic activities and support systems associated with Aman Cement Mills Unit-2 Ltd.

11.3 Summary of Special Concerns

11.3.1 Issues

Participatory Rapid Assessment and Focused Group Discussions were held in major settlement areas of the project site to inform people about the objectives of the project. In each of the consultation, participants were encouraged to share their observations, suggestions, and experiences on various environmental and safety issues and suitable mitigation and enhancement measures. Issues discussed are:

i. Awareness and extent of the project and development components;
ii. Water intake point of DWASA at Haria and the responsibility of ACML-2;
iii. Benefits of the project for the economic and social upliftment of community;
iv. Labor availability in the project area or requirement of outside labor involvement;
v. Local disturbances due to dust, noise generation during construction activities;
vi. Necessity of tree-cutting and vegetation clearing at project sites;
vii. Water logging and drainage problem, if any;
viii. to ensure that the public was provided with opportunities to participate in the decision making process and to influence decisions that would affect them;
ix. to identify the widest range of potential issues about the Project as early as possible and in some cases, have those resolved;
x. to ensure that government departments were notified and consulted early in the process; and
xi. to ensure a board range of perspectives were considered in any decision

The following assurances have been given during consultation

i. Proposed Aman Cement Mills Unit-2 Ltd. project will ensure all utility facility to the local stakeholders for their livelihood improvements;
ii. Executive agency will give preference to engage qualified contractor to ensure quality of works as well as timely completion of work;

iii. Efforts will be made by government to supply drinking water round the clock;
iv. Special attention will make during construction, operation and other activities of ACML-2 without polluting the water of Haria intake point of DWASA;
v. Local people will be employed by the contractor during construction work;
vi. Adequate safety measures will be taken during construction work;
vii. Local people have appreciated the water supply proposal of the government and have ensured that they will cooperate with the executing agency during project implementation.

11.4 Future Consultation and Disclosure

Aman Group on behalf of Aman Cement Mills Unit-2 Ltd. will extend and expand the consultation and disclosure process significantly during implementation of the investment program. They will appoint an experienced individual consultants or NGO to handle this key aspect of the programme. The NGO/consultants continuously (i) conducts a wide range of activities in relation to project in each area; and (ii) ensures the needs and concerns of stakeholders are registered and are addressed in project design. For this project, the NGO/consultant will develop, in close coordination with PMU and DSC, a public consultation and disclosure program which is likely to include the following:

(i) Consultation during Detailed Design

(a) Focus-group discussions with affected persons and other stakeholders (including women's groups, NGOs and CBOs) to hear their views and concerns, so that these can be addressed in project design where necessary; and
(b) Structured consultation meetings with the institutional stakeholders (government bodies and NGOs) to discuss and approve key aspects of the project.

(ii) Consultation during Construction

(a) Public meetings with affected communities to discuss and plan work programmes and allow issues to be raised and addressed once construction has started; and
(b) Smaller-scale meetings to discuss and plan construction work with individual communities to reduce disturbance and other impacts, and provide a mechanism through which stakeholders can participate in subproject monitoring and evaluation; and

(iii) Project Disclosure

(a) Public information campaigns (via newspaper, TV and radio) to explain the project to the wider city population and prepare them for disruption they may experience once the construction programme is underway;
(b) Public disclosure meetings at key project stages to inform the public of progress and future plans, and to provide copies of summary documents in Bengali; and
(c) Formal disclosure of completed project reports (EIAs) by making copies available at convenient locations, informing the public of their availability, and providing a mechanism through which comments can be made.

11.1 Brief of Public Consultations

Consultation-1

Bangladesh Economic Zones Authority

Prime Minister's Office

Name of EZ :Aman Economic Zone

Attendance Sheet

Date: 21.03.16 Place :

SL	Name	Designation	Mobile	Signature
1	ওসমান	কৃষি	01920572546	
2	সুলতান মিয়া	ব্যবসা	01933895230	
3	মো: ইউনুছ	ব্যবসা	01967164282	
4	মো: সাদিকুর রহমান	কৃষি	01944871431	
5	মো: রফিক	ব্যবসা	01944871431	
6	সাজ্জী জাহাঙ্গীর	ব্যবসা	01921650247	
7	মোহাম্মদ হাসান মাহমুদ	ব্যবসা	01724288900	
8	আমিনুল ইসলাম	"	01815852075	
9	সাজ্জী সফিউল্লাহ	ব্যবসা	01913039769	
10	সাজ্জী মো: মোস্তফা কামাল	ব্যবসা	01955759473	
11	ডা: মো: হাকিম	সাবেক রিসিডেন্স	01914864720	A. Hakim
12	মো: আব্দুল্লাহ	ব্যবসা	01923560 31	
13	মো: ওসমান	কৃষি	01930780419	
14	মো: সামুন	ব্যবসা	01917754701	

Consultation-2

Bangladesh Economic Zones Authority

Prime Minister's Office

Name of EZ :Aman Economic Zone

Attendance Sheet

Date: 17.03.16

Place :

SL	Name	Designation	Mobile	Signature
1			01819896915	
2			01715970959	
3			01924018988	
4			01926151334	
5			01953404199	
6			01947241348	
7			01710827832	
8			01732452800	
9			01718061017	
10				
11			01721045122	
12			01719838066	
13			01838398008	

Consultation-3

Bangladesh Economic Zones Authority

Prime Minister's Office

Name of EZ :Aman Economic Zone

Attendance Sheet

Date: 20.03.16 Place : ইছুরদহ বাড়ী, সোনাগাজী

SL	Name	Designation	Mobile	Signature
1	মো: আবুবক্কার	[illegible]	01949837204	[illegible]
2	মো: সোনা মিয়া	ব্যবসায়ী	01715154484	মো: সোনা মিয়া
3	ওসমান গনি	কৃষি	01985912029	ওসমান
4	মো: মোতালেব	[illegible]	01817667937	[illegible]
5	মো: ইকবাল	[illegible]	01828637993	মো: ইকবাল
6	মো: বাচ্চু	[illegible]	01854301208	[illegible]
7	মো: মোশারফ	[illegible]	01834205280	[illegible]
8	মো: ইদ্রিছ	[illegible]	01939003591	মো: ইদ্রিছ
9	মো: আলী- হোসেন	[illegible]	01937647984	আলী হোসেন
10	মো: সাজিব	[illegible]	01940988969	সাজিব
11	মো: ইসমাইল	[illegible]	01916285572	ইসমাইল
12	মো: আক্তার	[illegible]	01955261947	[illegible]
13	মো: মোসলেউদ্দিন	[illegible]	01940988969	মো: মোসলেউদ্দিন
14	মো: ফরিদ আহমেদ	[illegible]	01714326635	[illegible]
15	মো: মোশারফ	কৃষি	01714391082	[illegible]
16	মো: নুরুল আমিন	[illegible]	01932614911	[illegible]
17	মো: নাজিম হোসেন	[illegible]	01955216296	[illegible]
18	মো: সোলায়মান হোসেন	[illegible]	01949833420	[illegible]

Bangladesh Economic Zones Authority

Prime Minister's Office

Name of EZ :Aman Economic Zone

Attendance Sheet

Date: ২৮.৩.২০১৬ Place : বৈদ্য পাড়া, হাটিয়ারী

SL	Name	Designation	Mobile	Signature
1	মো: আরিফুজ	ছাত্র	01966400829	আরিফুজ
2	মো: আপু	ছাত্র	01924083973	মোঃ আপু
3	মো: বাবু	ব্যবসা	01956491379	মো: বাবু
4	মো: রাকিব	"	01991392711 7	রাকিব
5	মো: রাতন	"	01913509277	রাতন
6	গোপাল বর্মন	ভোলা	01938698109	গোপাল বর্মন
7	মিজান	নিরাপত্তা	01940990422	মিজান
8	নারায়ণ চন্দ্র বর্মন	ভোলা	01924726477	নারায়ণ
9	হাজী মো: সাহিন	ব্যবসা	01946997731	মো: সাহিন
10	মাসুম আহমেদ	"	01920914060	মো: মাসুম আহমেদ
11	মো: রফিউল ইসলাম	"	01916984055	রফিউল
12	মো: রোমান	ব্যবসা	01910806351	রোমান
13	ইয়াসমিন	হাউজিনেস	01932859630	ইয়াসমিন
14	মো: জসিম হোসেন	ব্যবসা	01845255362	রাকিব
15	মো: আলমগীর হোসেন	নিরাপত্তা	01917495339	আলমগীর
16	মো: মোরশেদ	নিরাপত্তা	01991041317	মো: মোরশেদ
17	মো: রফিকুল হাসান	ছাত্র	01941585139	রাকিব

Bangladesh Economic Zones Authority

Prime Minister's Office

Name of EZ :Aman Economic Zone

Attendance Sheet

Date: ২৭/৩/২০১৮.

Place : সমর আলীর চায়ের দোকান কাশিয়ানী মোড়, [illegible] বাজার

SL	Name	Designation	Mobile	Signature
1	আবদুল হান্নান মোল্যা	কৃষি শ্রমিক	01930978225 (H)	
2	মো: নেছার আলী	কামলা	01930978225	
3	আনোয়ার হোসেন	কৃষি		
4	মো: বজলুর রহমান	কৃষি	01961565069	
5	মো: রফিক মোল্লা	দিন কামলা	01947144490	
6	Din Islam	কামলা	01956[illegible]	
7.	মোতালেব	কৃষিশ্রমিক	01985173519	
8	মো: তমিজুদ্দিন	কামলা	01951174155 (H)	
9	মো: রহমান	কৃষিশ্রমিক		
10	মো: হক	ব্যবসা	01917749506	
11	সমর আলী কাজী	খুচরা কামলা	01922399551	
12	মো: মো: মতিন	"	01819008305	
13	মো: কামরুল হাসান	কৃষক	01980858805	
14	মো: মোস্তাফিজুর রহমান	কৃষি শ্রমিক	01912237415	
15	মো: কামরুল মোল্লা	কৃষক	01955434307	

Bangladesh Economic Zones Authority

Prime Minister's Office

Name of EZ :Aman Economic Zone

Attendance Sheet

Date: ১১.০৩.২০২৬

Place : ইমরান সাহেবের বাড়ী, গ্রাম: রহিমা গোপিনাথ, ইউ: বৈদ্যনাথ বাজার।

SL	Name	Designation	Mobile	Signature
১	মো: মফিকুল ইসলাম		01721554454	
২.	বিপ্লব কুমার দেওনাথ.		01814-474947	
৩.	মো: ইমরান হোসেন		01863-545220	
৪.	মোঃ আঃ মুহিত		01941741789	
৫.	মোস্তফানুর মিয়া		01955216557	
৬।	হাসান আলী.		01922029345	
৭।	মিজানুর রহমান		01967321935	
৮।	মো: ইসমাইল		01715114730	
৯।	[illegible]		01925141048	
১০।	মোস্তফানুর রহমান		01923788155	
১৬।	মোঃ- [illegible]			
১৪।	মোঃ- [illegible]		01736537807	
১৫।	[illegible]		01927392 10	

ACML-2 site during field visit by study team

Consultation meeting with community people during field visit by study team

Chapter 12
Conclusion and Recommendation

Aman Cement Mills Unit-2 Ltd. is a Portland Gray Cement Manufacturing Industry located at Haria, Baiyddar Bazaar, Sonargaon, Narayaganj. An EIA has been carried out for the project according to the requirement of DoE for necessary environmental clearance as it is made mandatory in ECA, 1995 for any new industrial set up and the subsequent ECA, 1997. EIA report has been prepared through indentifying the potential impacts, assessing them and recommending possible mitigating and enhancing measure for negative and positive, respectively.

Usually cement clinking crushing process produce high noise and dust. So, Aman Cement Millls Unit-2 Ltd. promises to take an appropriate technology for dust and noise control. The factory also committed to shut down its production process in any dust or nose control system does not work properly. Besides, regular monitoring of ambient air and noise would be done by experience environmental management officer appointed by factory.

Other than the impact due to dust and noise, there are no environmental issues of sensitive nature, which might have any potential of serious ill effects due to the plant in this area. Since it is understood that the project proponent is committed to take necessary steps to address any environmental problems, the selected of Aman Cement Mills Unit-2 Ltd. is acceptable for the present project. So, issuance of environmental clearance in favor of Aman Cement Mills Unit-2 Ltd. may be considered.

However, no industrial development can be expected without any adverse impact on environment. The beneficial impacts on the nation as well as human beings would only be meaningful and sustainable development would only be possible if the adverse effects are minimized though strict maintenance and control measures as adopted and further suggested for this project. All this would need vigilant care and subsequent monetary involvement and the project authority should take these onto consideration.

The findings of this Environmental Impact Assessment (EIA) suggested that the project involves potential but limited environmental impact to which further careful attention should be given in the operation and maintenance of the project in order to minimize and offset the adverse effects. The possible negative impacts are not severe, and the adverse impacts are not severe, and the adverse impacts if duly addressed could be minimized without much effort, through they would require attention and positive commitment from the Plant Management.

The location of the Aman Cement Mils Unit-2 Ltd. is environmentally acceptable as has already been mentioned. However, adequate and effective pollution prevention has to taken. Abatement and control measure proper and careful operation and maintenance,

regular and effective environmental monitoring with adequate staff and budgetary provision, and reporting to DoE should ensured.

It is expected that Aman Cement Mills Unit-2 Ltd. will follow all environmental compatible steps during operation and maintenance by which it sets a positive example as an environmental friendly industrial unit, very much within the environmentally acceptable limits all the time.

It is also expected that DoE will do surveillance monitoring of the project performance particularly that of Noise and Dust Control System. DoE should also continue its encouragement for plants like Aman Cement Mills Unit-2 Ltd. for initiatives to alternatives energy.

List of References

S. No.	Reference
	Government Departments
1.	Bangladesh Agriculture Research Council (BARC)
2.	Bangladesh Economic Zone Authority
3.	Bangladesh Water Development Board
4.	Department of Environment
5.	Bangladesh Meteorological Department
6.	Bangladesh Forest Department
7.	Bangladesh Bureau of Statistics
8.	Bangladesh Food & Agriculture Department (FAO, Bangladesh)
9.	Geological survey of Bangladesh
10.	Disaster Management Bureau (DMB)
11.	Department of Disaster Management (DDM)
12.	Department of Agriculture Extension
13.	Bangladesh Rice Research Institute
14.	Department of Fisheries
15.	Power Grid Company of Bangladesh
16.	Land & Revenue Department, Sonargaon, Naryanganj
	Journals, Books& Existing Studies
1.	Geological Settings Of The Areas Of Arsenic Safe Aquifers, Md. Munir Hussain And SKM Abdullah, Ground Water Task Force, October, 2001
2.	Annual Flood Report, 2014, Flood Forecasting and Warning Centre, Bangladesh Water Development Board
3.	EIA Report of Bibiyana 300-450 MW Gas based Combined Cycle Power Plant at Nabiganj, Habiganj, 2013
4.	Md. Misbah Uddin, Assessment Of Morphological Aspects Of Kushiyara-Monu River System, Department Of Water Resources Engineering Bangladesh University Of Engineering And Technology, Dhaka, Bangladesh, June, 2010
5.	Anwar Zahid and Syed Reaz Uddin Ahmed "Groundwater Resources Development in Bangladesh: Contribution to Irrigation for Food Security and Constraints to Sustainability", Ground Water Hydrology Division, Bangladesh Water Development Board, Dhaka, Bangladesh"
6.	Maminul Haque Sarker, Shampa, R.M. Nair, Syed Monowar Hossain, Jakia Akter, "Inland Navigation and Integrated Water Resources Management", IUCN, 2014
7.	Community Report, Narayanganj Zila, June, 2012, Population and Housing Census, 2011, Bangladesh Bureau of Statistics, Statistics and Informatics Division, Ministry of Planning
8.	District Statistics, 2011, Narayanganj, December, 2013, Bangladesh Bureau of Statistics, Statistics and Informatics Division, Ministry of Planning
9.	Community Report, Narayanganj Zila, June, 2012, Population and Housing Census, 2011, Bangladesh Bureau of Statistics, Statistics and Informatics Division, Ministry of Planning
10.	Environment Impact Assessment Report "Bibiyana I and II Gas Power Project", Bangladesh Centre for Advanced Studies for Summit Bibiyana I Power Company Limited and Summit Bibiyana II Power Company Limited, June, 2011
11.	Social Impact Assessment Report-Shreehatta Economic Zone, Sherpur
12.	Environment Impact Assessment Report-Meghna Economic Zone

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