

**ENVIRONMENTAL IMPACT ASSESSMENT FOR 16" DN × 140 PSIG, 100 KM  
GAS PIPELINE NETWORK WITHIN DHAKA CITY UNDER DHAKA CLEAN  
FUEL PROJECT**

**By**

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**May, 2009**

## **CANDIDATE'S DECLARATION**

It is hereby declared that this project or any part of it has not been submitted elsewhere for the award of any degree or diploma.

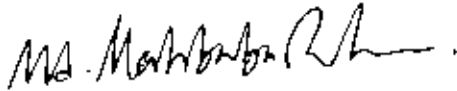
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## RECOMMENDATION OF THE BOARD OF EXAMINERS

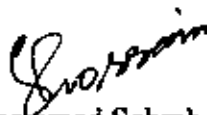
The project titled “ENVIRONMENTAL IMPACT ASSESSMENT FOR 16” DN × 140 PSIG, 100 KM GAS PIPELINE NETWORK WITHIN DHAKA CITY UNDER DHAKA CLEAN FUEL PROJECT” submitted by Md. Nasimul Islam, Roll Number- 040313006 (P), Session: 02 April’ 2003, has been accepted as satisfactory in partial fulfillment of the requirement for the degree of **Master of Petroleum Engineering** in 25 May, 2009.



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## LIST OF ABBREVIATION

ADB	Asian Development Bank
ANSI	American National Safety Institute
ASME	American Society of Mechanical Engineers
BBS	Bangladesh Bureau of Statistics
BOD	Bio-chemical oxygen demand
BPDB	Bangladesh Power Development Board
CFCs	Chloro Fluoro Carbons
CFP	Condensate Fractionation Plant
CNG	Compressed Natural Gas
COD	Chemical Oxygen Demand
DC	Deputy Commissioner
DCC	Dhaka City Corporation
DESA	Dhaka Electric Supply Authority
DoE	Department of Environment
DRS	District Regulation Station
DWASA	Dhaka Water Supply and Sewerage Authority
EQS	Environmental Quality Standard
ECA	Environmental Conservation Act
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
ESMAP	Environmental and Social Management Action Plan
FAO	Food and Agriculture Organization
GoB	Government of Bangladesh
GPF	Gas Process Plant
IECs	Important Environmental Consideration
IEE	Initial Environmental Examination
NOCs	No Objection Certificate
O&M	Operation and Maintenance
PAP	Project Affected People

PP	Project Proforma
PSIG	Pressure per Square Inch Gauge
RAP	Resettlement Action Plan
RHD	Road and Highway Department
SMA	Statistical Metropolitan Area
SPM	Suspended Particulate Matter
TBS	Town Border Station
TDS	Total Dissolved Solid
TGTDCL	Titas Gas Transmission and Distribution Company Ltd
TOR	Terms of Reference
TTC	Technical Training College
UN	United Nations
WASA	Water Supply and Sewerage Authority

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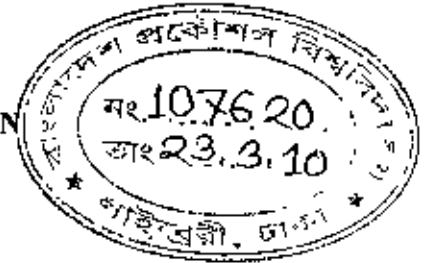
## ABSTRACT

Bangladesh Government has taken a new gas distribution pipeline project titled as "16 DN×140 Psig 100 Km Gas pipeline network within and around Dhaka City under Dhaka Clean Fuel Project" with the financial assistance of Asian Development Bank (ADB). This project is taken up because existing gas pipelines network of Dhaka City is inadequate to cater the present demand of gas for proposed CNG filling stations. The other goal of the project is to meet future demand of the city dwellers.

Government of Bangladesh has implemented the project through Titas Gas Transmission & Distribution Co. Ltd. (TGTDC), a company of Petrobangla. According to the ECA 1995 (with amendment 2000) and the ECR 1997, TGTDC has received environment clearance from the Department of Environment (DOE) for this Pipeline Project. PP(Project Proforma) of the project was approved on 10<sup>th</sup> June, 2003. The time limit of the completion of the project was June, 2007. The project was completed on June, 2008. This post estimated Environment Impact Assessment Study (EIA) has been carried out to identify all positive and negative impacts due to the pipeline project.

The consultants appointed by Titas Gas T & D Co. Ltd. expected in their Environmental Impact Assessment that some negative impacts would arise during pre-construction and construction periods of the project. But they suggested some mitigation measures that would minimize the predicted impacts. In view of my studies, from data analysis and site visit, it is found that proper mitigation measures were carried out against negative impacts during pre-construction and construction phase. Existing flora, fauna, population, homestead and assets are not affected by implementation of this project. Therefore, no adverse impact on the environment is involved.

## CHAPTER -1 : INTRODUCTION



### 1.1 Background and Present status

Bangladesh has experienced a tremendous expansion of nationwide gas transmission network. Natural gas is expected to play key role in the overall development of the country. Considering its importance in the socio-economic development of the country, the Government has under taken a number of measures to accelerate the pace of development. The Government has encouraged increasing use of natural gas in the transportation sector, for reducing air pollution. Research had shown that CNG operated cars emitted around 10-20% less carbon dioxide; up to 25% less nitrous oxide; and 80% less carbon monoxide, nonmethane hydro-carbons, smog forming emissions and virtually no atmospheric emissions of sulphur dioxide or small particulate matter in comparison to a modern catalyzed gasoline car. Therefore the number of filling stations with CNG facilities should increase significantly. Existing gas pipelines network of Dhaka City is inadequate to cater for the present gas demand of the proposed CNG filling stations. Considering the present situation and future gas demand of Dhaka City, Government of Bangladesh has taken a project titled as "16 DN×140 Psig 100 Km Gas pipeline network within and around Dhaka City under Dhaka Clean Fuel Project" with the financial assistance of Asian Development Bank (ADB). This project has been taken in order to extend the use of natural gas by conversion of petrol driven motor vehicles into environment friendly CNG fuelled ones specially to make the capital Dhaka a pollution free city and the project is named Dhaka Clean Fuel Project. This project reduce importing of petroleum products, thereby saving foreign currency. PP(Project Proforma) of the project was approved on 10/06/2003. The time limit of the completion of the project was June, 2007. The project was completed on June, 2008. The project would be possible to supply gas to 500 new CNG Stations of greater Dhaka area within 10 years. Rest of the gas will be used to meet the extended demand of gas in Dhaka city. It is expected that the low pressure situation of the Dhaka city would be greatly mitigated with the implementation of the project. According to the Environmental Conservation Act (ECA) 1995 (with amendment 2000) and the Environmental Conservation Rules (ECR) 1997, this project is required to take environmental clearance from Department of Environment<sup>(1-6)</sup>.

The potential environmental impacts of a pipeline project are assessed by considering all the phases of development activities, namely, pre-construction, construction and operation. In the pre-construction phase, potential impacts are considered those, which will occur during project planning and design or during subsequent phases but are the direct consequences related to these activities. In the construction phase potential impacts are those that result directly from the construction activities (noise, dust, etc.) In the operation phase, potential impacts are those, which arise as a consequence of activities that will be involved in project operation.

Impact identification requires an examination of interactions between Important Environmental Considerations (IECs) and project activities as a whole. A number of IECs have been selected based on Department of Environment's (DOE's) guidelines, additional available documents and professional experience.

The purpose of this report is to post estimation of the Environmental Impact Assessment (EIA) of the "16 DN×140 Psig 100 Km Gas pipeline network within and around Dhaka City under Dhaka Clean Fuel Project". The project involves construction of 100 km distribution pipelines including 1km river crossing (two nos ) and installation of five new Town Border Station (TBS)/District Regulatory Station (DRS) and five TBS/DRS modification. The study has been carried based on the detailed filed survey of representative sections, existing data on baseline and review of available literature<sup>(7-8)</sup>

## **1.2 Objective of the Project**

The main objectives of the project are:

- (a) Identify project impacts on the environment.
- (b) Suggest mitigation measures
- (c) Develop environmental management plan.
- (d) Describe project area socioeconomic characteristics
- (e) Assess socioeconomic impacts and
- (f) Prepare compensation plan.

### **1.3 Outline of Methodology**

- (a) EIA is prepared through a tiered process, which includes an initial environmental Examination (IEE).
- (b) Collection and review of previous Data.
- (c) Preparation of land use maps.
- (d) Public consultation.
- (e) Analysis of the Data : The three principle methods for identifying environmental effect and impacts include checklist matrices and flow diagrams. The checklist method will be followed to identify impact due to proposed intervention in the preparation of the present EIA report.

### **1.4 Scope and Limitation of the Project**

According to guidelines of DOE, the project in question falls under 'Red' category This requires that an EIA is required and the EIA is intended to assist TGTDCCL in providing information comprising locations of all project-related development activities including pre-construction activities, construction activities, scheduling, staffing, support facilities and services required and post construction activities. Allied to this, the description of the environmental and social baseline conditions are needed to address all relevant current base data on the environmental and social characteristics of the study area including physical, biological, ecological and social environments.

The report needs to identify all significant impacts and evaluate atmospheric emissions and changes in ambient air quality, discharge of effluent and ambient Water quality impacts of the project and its activities on the community's access to social infrastructure (e.g. potable water, health centers, schools, irrigation and extension services), and local developments. Following identification of potential impacts, the report need to suggest mitigation plan and prepare compensation plan.

Finally, an Environmental Management Plan to mitigate negative impacts has to be developed to reduce or offset significant negative impacts to an acceptable level, and containing detailed implementation plans, monitoring indicators and clear allocation of responsibility among project sponsors construction contractors, government. agencies

and community-based organizations. It is to be mentioned that the EIA report has been prepared addressing all the mentioned aspects including consultation with stakeholder.

### **1.5. EIA Team**

An EIA Team is consist of Environmental Specialist, Gas Pipeline Specialist, Compensation Specialist, Civil Engineer, Socio Economist, Ecologist, Field Coordinator and Hydro-geologist.



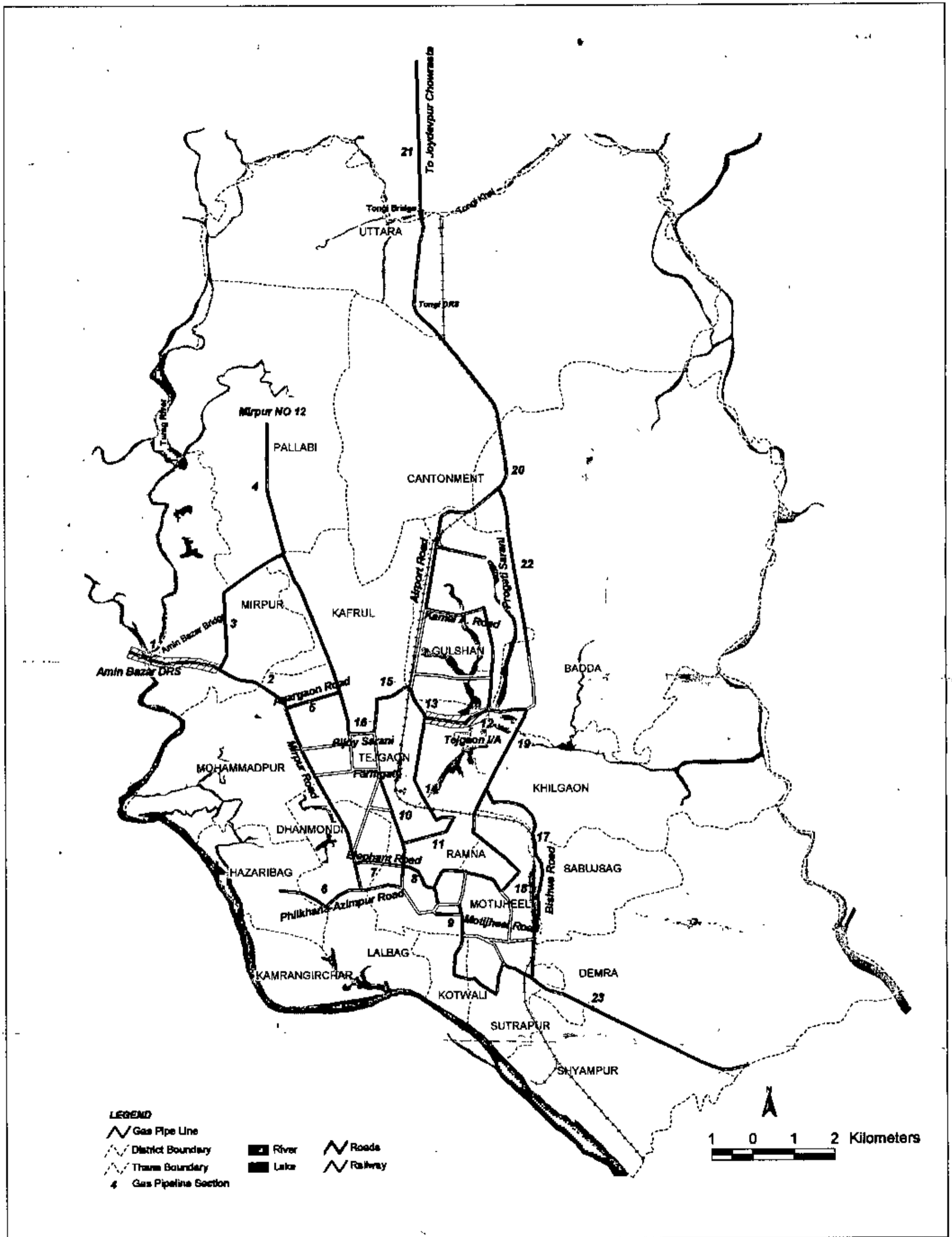
## CHAPTER 02 : DESCRIPTION OF THE PROJECT

### 2.1 Geographic Location

The project area is located within and around Dhaka City between Latitude 23°40'15"N to 23°56'15" N and Longitude 90°20'E to 90°28'15" E. The distribution pipelines which were laid, have been described in Table 2.1. The gas pipeline sections are numbered chronologically as per serial numbers shown in the first column of the Table 2.1

**Table 2.1: Description of Proposed Gas Pipeline Construction Works**

Sect ion	Description	Dia	Length (km)
1	Aminbazar DRS - TTC including Turag River Crossing	16"DN	2.50
2	TTC - Azimpur Chowrasta (along the Mirpur Road)	16"DN	8.00
3	Mirpur DRS-TTC	16"DN	4.00
4	Mirpur DRS - Mirpur Sec 12	16"DN	3.00
5	Shaymoli Shishu Mela - Agargaon Rokya Sarani Crossing thru Agargaon Road	16"DN	2.00
6	Hazaribagh DRS (prop) - Azimpur Chowrasta (Along the Pilkhana - Azimpur Road)	16"DN	3.50
7	Science Lab. Police Box - Shahbagh Chowrasta (thru New Elephant Road)	16"DN	2.00
8	Shahbagh Chowrasta - Near Matshay Bhaban (via Ramna park)	16"DN	2.00
9	Osmany Uddan DRS - Govt. Transport Pool	16"DN	1.00
10	Shahbag Chowrasta - Saarc Fountain at Kawran Bazar (through Airport Road)	16"DN	2.00
11	Banglamotor - Moghbazar chowrasta	16"DN	2.00
12	Tejgaon TBS/DRS - Nabisco Crossing (Tejgaon Ind. Area)	16"DN	2.50
13	Mohakhali Chowrasta - Shat Raster More (via Nabisco Crossing)	16"DN	3.00
14	Shatraster More - Moghbazar Chowrasta	16"DN	2.00
15	Mohakhali Chowrasta - Cantt. Gate - Bijoy Sarani More (Near Fountain)	16"DN	2.50
16	Agargaon - Prime Minister Secretariat thru Bijoy Sarani	16"DN	3.50
17	Shamibag Chowrasta - Jonaki Cinema Hall Crossing (thru Motijheel road. via Ittefaq Shapla Chattar, Notre Dame college etc.) with extension upto Kamalapur Bus Depot	16"DN	3.50
18	Saydabad - Khilgaon Rail Crossing (thru Bishwa Road)	16"DN	5.50
19	Mahibagh Chowrasta - Tejgaon TBS thru Rampura Road	16"DN	6.00
20	Tejgaon TBS - Tongi Bridge (Thru Kamal Ataturk road & Airport Road)	16"DN	20.30
21	Tongi Proposed TBS - Joydeyapur Chowrasta	16"DN	11.00
22	Nikunja -1 (Near Joarshahara) - Near U.S. Embassy (Baridhara) thru Progati Sarani	16"DN	3.00
23	Proposed Nandipara TBS - Fakirapul Bazar More	16"DN	5.00



**Figure 2.1 : Map Showing Location of Pipeline Network**

## 2.2 Type of Project

Installation of 16" DN X 140 PSIG, 100 Km Gas Pipeline network within and around Dhaka City under Dhaka Clean Fuel Project is to ensure adequate supply of compressed natural gas at required pressure to the petrol driven vehicles in Dhaka and its surrounding areas. The CNG stations will receive gas from the gas pipeline network

## 2.3 Basic Data

The basic data of the project are furnished in Table 2.2.

**Table 2.2 : Basic Data**

1	<b>Name of the project</b>	16" DN X 140 PSI, 100 km Gas Pipeline Network within Dhaka City under Dhaka Clean Fuel Project	
2	<b>Project Executor</b>	Titas Gas Transmission and Distribution Company Limited (TGTDCCL)	
3	<b>Project Location</b>	Within and around Dhaka City.	
4	<b>Final Product</b>	Supply clean fuel to CNG refilling stations	
5	<b>Filling Pressure</b>	140 psig	
6	<b>Construction cost of the Project</b>	Foreign currency (Tk.-lacs)	Local currency (Tk.-lacs)
		5898.00	4996.00
7	<b>Project completion time limit</b>	June, 2007	

## 2.4 Project Description

In the project a total of 100 Km pipelines is constructed. Out of 100 km pipeline, 84 km is constructed within Dhaka City along eleven roads, namely, Mirpur road, Agargaon road, Azimpur road, Bishwa road, Rampura road, Kamal Ataturk road, Tejgaon Industrial area and Progati Sarani. The pipe line route has also passed through four road crossings, one rail way crossing and along two park sites namely Ramna park and Osmani uddan. In addition there are five DRS at Hazaribag, Mirpur Mazar Road, Mirpur DOHS, Baridhara and Agargaon and Three TBS at Nandipara, Tejgaon and Tongi.

Outside the main Dhaka City, 2.5km pipeline is constructed between Aminbazar DRS to TTC including Turag rivers crossing and 11km pipeline is constructed between Tongi TBS to Joydevpur Chowrashta. The pipeline followed the alignment of the existing pipeline that is constructed outside Dhaka where most of the permanent right of way already exists.

Although following the existing pipeline corridor cause the least overall impact, the construction of the former pipeline is reviewed in detail to identify any problems, which arose either from the routing or from aspects of the design and construction methods employed. The name and length of each section where the pipeline constructed is shown in Table 2.1 and the pipeline network location map is also shown in Figure 2.1. The pipeline inside Dhaka is crossed a number of roads and railway crossing at Saidabad, Khulgaon and Tongi Bridge. In order to avoid any disruption, thrust-boring method is practiced. Similarly no disruption is foreseen during the operation stage, as the pipeline is a sub-surface one.

Standard practice for gas pipeline construction is to cross beneath major roads and rivers using directional drilling to construct the tunnels. For Turag river crossing (Section 1) directional drilling is required.

Two sections namely Amin bazar to TTC including Turag river crossing (Section 1) and Tejgaon DRS - Nabisco crossing (Section 12) have been considered as representative of the total project. The main features of the two sample sites are illustrated in the following sub-sections

#### **2.4.1 Tejgaon TBS/DRS to Nabisco crossing (Section 12):**

Dhaka City is polluted with air, water, noise and soil pollution. Tejgaon Industrial area is one of the oldest industrial areas in Bangladesh and this section lies under Tejgaon Industrial area. The Industries in Tejgaon discharge 3,500 m<sup>3</sup> of wastewater containing a waste load of 1850 kg per day. This area drains into the low land on east side and subsequently into the canal. A high density of slums characterizes the area. The environmental condition of this area is deteriorated due to indiscriminate dumping of solid waste and blockage of drains.

The main features, which exist on both sides of this section are shops, temporary houses, automobile servicing centers, apartments, restaurants, metal industries, garment industry, chemical industry, low lying area, etc. These features are broadly illustrated in Table 2.3.

From markets and apartments huge amount of solid waste is generated and dumped onto the roadsides in unplanned way, which creates health hazards to the City dwellers.

From different type of industries as mentioned above huge amount of solid and liquid waste is generated. But most of the industries have no Waste Treatment Plant. Serious environmental pollution is happening in the surrounding environment

**Table 2.3: Land Use Feature from Tejgaon TBS/DRS to Nabisco Crossing  
(Section12)**

Distance (M)	LL		SPS		PS		FL		UR		MR		HS		EP		REMARKS
	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	
DRS-30	1	1	1										1		1	1	Baul Bazar Hateer Jheel
30-60	1		1	1		1							1		1	1	Temporary House, Shooting Complex
60-90	1		1			1	1						1	1	1	1	Automobile Servicing
90-120	1		1	1	1	1	1				1	1			1	1	Mosque. DWASA
120-150	1	1	1	1	1	1	1	1					1		1	1	Veg Garden
150-180	1	1	1	1	1	1	1	1					1		1	1	Bridge. Canal
180-210	1	1	1	1	1		1	1		1			1		1	1	Homestead, Nursery
210-240	1	1	1	1			1	1					1		1	1	Homestead
240-270	1	1	1	1			1	1					1		1	1	Nursery
270-300	1	1		1			1	1					1	1	1	1	Market
300-330				1		1		1						1	1	1	Market
330-360				1		1	1							1	1	1	Garments
360-390				1		1			1						1	1	Restaurent
390-420				1		1									1	1	Automobile Show Room
420-450				1		1									1	1	Housing Apartment
450-480				1		1		1					1		1	1	Shops
480-510				1		1							1		1	1	Automobile Servicing. Show Rooms
510-540				1		1			1	1			1	1	1	1	Markets
540-570				1		1							1	1	1	1	Metal Industries
570-600				1		1			1	1			1	1	1	1	Travel Agency
600-630				1		1	1						1	1	1	1	Garments, Laboratory Show Room
630-660				1		1							1	1	1	1	Garments
660-690				1		1			1	1					1	1	Chemical Industries
690-720				1		1				1		1			1	1	Industrial Buildings
720-750				1		1			1	1					1	1	Factory, Industry
Total	10	7	9	5	22	20	10	8	5	6	0	2	12	9	25	25	

Legend: LL=Low land, SPS=Sempermanent Structure, PS= Permanent Structure, FL=Fallow land, UR=Unmetteled Road, MR=Metteled Road, HS=Home Stead, EP=Electric post, L=Left, R=Right

#### **2.4.2 Amin Bazar DRS to TTC Mirpur (Section 1)**

The main features, which are available on both the sides of this Section are market, brick fields, the Turag river, small canals, agricultural fields, shops, semi pucca and permanent residential buildings, bus terminal, cattle market, automobile servicing and filling stations etc, These features are broadly illustrated in Table 2.4.

From Gabtali Cattle market solid waste is generated and dumped indiscriminately, and which pollute nearby surface water sources causes frequent health hazard to the people. From surroundings brickfields serious air pollution is occurred by the emission of suspended particulate matter, CO<sub>3</sub>, SO<sub>3</sub>, NO<sub>X</sub> etc. In the Bus terminal frequent traffic and public movement creates public nuisance through emission of green house gases, dust and severe noise, etc

From this survey data it is concluded that the project area is mostly built up except part of Amin bazar to TTC section and Tongi to Gazipur section. This two areas lie at the urban fringe and the land is of agricultural nature and also used for brick fields. The gas pipeline is passed along two ecologically important areas namely Ramna Park and Osmany Uddan. It is also passed through the most environmentally polluted area, Hazaribag.

**Table 2.4: Land Use Features From Aminbazar DRS to TTC (Section 1)**

Distance (M)	LL		SPS		PS		BF		UR		MR		HS		PP		TD		BT		REMARKS
	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	
DRS-30	1	1					1							1	1						Hoar
30-60		1					1							1							
60-90	1	1							1					1							Brick sales centre
90-120	1	1												1							
120-150														1							Bridge canal
150-180	1	1					1	1						1							
180-210	1	1					1	1						1							
210-240	1	1					1	1						1							
240-270	1	1					1							1							
270-300			1		1								1	1	1	1					Market
300-330					1	1							1	1	1	1					Market
330-370						1	1						1	1	1	1					
370-400	1	1											1		1	1					
400-430	1	1											1		1	1					
430-470	1	1											1		1	1					Bridge
470-500		1		1									1		1	1					
500-530		1											1		1	1					Brick sales centre
530-560					1			1					1	1	1	1					School
560-590					1	1							1	1	1	1					Mosque
590-620					1	1							1	1	1	1					
620-650		1			1								1	1	1						Turag River Bridge
650-680					1									1	1			1			Track depot
680-720																					Bridge
720-750					1								1								Cinema Hall Cow market
750-780					1				1				1								
780-810					1								1								Embankment
810-840	1	1											1								
840-870		1			1								1								Market
870-900					1					1								1			Market
800-830					1														1	1	Market, Bus terminal
830-860		1			1								1								Market
860-890		1			1								1								Market
890-920		1			1								1								Market, workshop
920-950		1		1									1								Workshop
950-980		1			1	1							1								
1010-1040					1								1					1			DESA
1040-1070		1			1	1							1								School, Mosque
1100-1130	1	1			1								1								
1130-1160		1			1	1							1								
1160-1220		1	1										1								Workshop
1220-1250	1						1														Ladies TTC, Ditch
1250-1280					1						1										Police Box
1280-1310					1	1															HBRL TTC
<b>Total</b>	<b>13</b>	<b>25</b>	<b>2</b>	<b>2</b>	<b>23</b>	<b>9</b>	<b>7</b>	<b>4</b>	<b>2</b>	<b>1</b>	<b>3</b>	<b>0</b>	<b>27</b>	<b>8</b>	<b>23</b>	<b>12</b>	<b>0</b>	<b>3</b>	<b>1</b>	<b>1</b>	

Legend LL=Low land, SPS=Semi permanent Structure, PS=Permanent Structure, BF=Brick Field, UR=Unmetteled Road, MR=Metteled Road, HS=Home Stead, PP=Power post, TD=Track Depot, BT=Bus Terminal, L=Left, R=Right



## **2.5 Major Components of the Project**

The major components of the projects are stipulated as below:

- i) Pipeline routes survey;
- ii) Clearance from DoE,
- iii) Detail Drawing and Design;
- v) Procurement of materials;
- iv) Clearance from DCC and RHD;
- vi) Pipeline construction
- vii) Testing and commissioning
- viii) Operation and Maintenance

## **CHAPTER-03 : DESCRIPTION OF THE ENVIRONMENT**

### **3.1 Introduction**

Baseline data on environment is important to understand existing physical, biological, cultural and social environmental characteristics. This information forms the basis to analyze the probable impacts of the project activities. Mainly there are two principal objectives in examining and defining the existing environment.

- a. To recognize potential environmental impacts of the project and enable mitigation measures to be identified.
- b. To provide a base line against which environmental condition in the future project may be measured, and to document condition which were either existing or developing before the introduction of the project and not due to the project

### **3.2 Physical Environment**

#### **3.2.1 Climate**

The project area has a tropical monsoon climate. The relevant climatic data of the project site is located at Tejgaon, Dhaka (23°46' North 90°23' East). Different meteorological data like rainfall, temperature, relative humidity; wind speeds and air quality are described in the following subsections.

#### **Precipitation**

The general pattern of precipitation (which consists entirely of rain) follows the monsoon pattern with the cooler, drier months of November to March, increasing rains in April and May and highest rainfall in the summer months of June to September when the prevailing wind direction from the southwest brings moisture laden air from Bay of Bengal. Average monthly rainfall values for Dhaka for the year 2000 are given in Table 3.1. During the year 2000, the highest average rainfall of 420 mm occurred in June, whereas there was only 3 mm rainfall in December. Rainfall patterns in the project area likely to be slightly higher than that of Dhaka. Total 2039 mm of rainfall was occurred in the year 2000

The cool season in Bangladesh coincides with the period of lowest precipitation, where highest precipitation occurs in the wet season. As a result of the greater cloud cover during the wet season, average hours of sunshine are least between June to September at about 5 hours a day it is higher incidence of cloud cover has great significance for the stability of the atmosphere and hence dispersion of atmospheric pollutants

### **Temperature**

The temperature of the country has the relationship with the period of rainfall. In general, cool seasons coincide with the period of lowest rainfall. Table 3.1 shows the monthly average mean maximum and minimum temperature at Dhaka for the year 2000. During this period maximum average temperature of 33.3°C was observed in April and minimum average temperature was 12.8°C in January.

### **Humidity**

As would be expected, humidity during the wet season are significantly higher, as shown in Table 4.1 than those occurring at other times of the year. Maximum relative humidity for Dhaka was found as 85% in the month of June, July and August, 2000 whereas minimum relative humidity were 50% in the month of March 2000.

**Table-3.1: Temperature (Mean, Maximum and Minimum), Humidity, Rainfall and others for Dhaka for the year 2000**

Month	Mean Temp (°C)	Max Temp (°C)	Min Temp (°C)	Humidity (%)	Wind Spd. (m/s)	SunShine (Hours)	Solar Rad. (MJ/m2/d)	Evap. To (mm/d)	Rainfall (mm/month)
Jan	18.4	25.6	12.8	69	0.30	8.8	16.5	2.28	15
Feb	21.4	27.8	15	63	0.30	8.6	18.3	2.88	21
Mar	25.8	32.2	20	56	0.50	8.8	20.9	4.03	54
Apr	28.9	33.3	23.3	70	0.60	7.9	21.3	4.56	108
May	28.9	32.8	24.4	80	0.30	6.9	20.3	4.35	253
June	28.4	31.7	25.6	85	0.30	4.7	17.1	3.76	420
July	28.4	31.1	26.1	85	0.30	4.5	16.7	3.67	405
Aug	28.5	31.1	26.1	85	0.30	4.5	16.3	3.56	324
Sep	28.7	31.7	26.1	84	0.30	5.1	16.1	3.47	256
Oct	27.2	31.1	23.9	79	0.20	7.2	17.2	3.32	153
Nov	23.7	28.9	20	70	0.30	8.4	16.4	2.71	27
Dec	19.3	26.1	13.9	74	0.20	8.6	15.5	2.09	3
Ave	25.6	30.3	21.4	75	0.33	7	17.7	3.39	
Total (rainfall)									2039

**Altitude:** 8 meter(s) above M.S.L.

**Source:** FAO CLIMWAT 2000

### Wind Speeds

Observation data of wind speeds made at Tejgaon, Dhaka for the year 2000 is presented in Table 4.1. The predominant wind directions at the weather station closest to the project site (i.e., Dhaka) are from the south and southeast. From November to February the wind directions are from north to northeast and from March to October it is from south to southeast. From the Table 4.1 it can be observed that the wind speed is higher in March and April, which is 0.50 m/s and 0.60 m/s respectively and for the month October and December the wind speed is lowest, which is 0.20 m/s.

### 3.2.2 Topography

Topographically, the (Dhaka city) project area is almost flat, with many depressions, bounded by rivers on all four sides. The surface elevation of the city ranges between 1.7 and 14 metres above mean sea level, but is generally around 6.5 metres.

The depressions and abandoned channels are dominated by organic clay and peat. The main part of the city lies either on Madhupur Clay, old natural levees, high flood plains

or filled-in gullies. The Madhupur Clay, with its average thickness of 8 metres, consists of over-consolidated clay silt and is underlain by the Plio-Pleistocene Dupi Tila Formation. Most depressions and channels are technically controlled.

### **3.2.3 Geology and Soil**

Dhaka City lies on the southeastern corner of Madhupur Tract along the Buriganga River. This tract is made of sediments of Pleistocene age, which is underlain by the Plio-Pleistocene Dupi Tila Formation. The Madhupur Tract is bounded by the Ganges flood plain in the south, the Brahmaputra-Meghna flood plain in the east, the Brahmaputra flood plain in the north and the Jamuna flood plain in the west

In Dhaka city, silt and clay are prominent in the upper layer of the soil having an approximate thickness of 10 to 20m. Sands occupy the major portion of the lower deposits. The soils of the project area fall into three main classes namely the red clay of Madhupur Tract, the ordinary beel clay and the marsh clay & peat. The red clay when dry is extremely hard and becomes slippery rather than soft when exposed to rain. The beel clay is stiff clay deposited on the bottoms and edges of beels. It is most common in the natural canals and along the rivers and in many places mixed with the decayed remains of aquatic plants. This clay is soft in nature. Marsh clay & peat are common in beel and in structurally controlled depressions. The soil of Dhaka city is clay layer at the top followed by fine sand and silt layer at a depth of about 50m

### **3.2.4 Seismicity**

Dhaka City falls in earthquake zone - II of the seismic-zoning map of Bangladesh (Figure 4.3). The probable maximum intensity predicated for this zone is 6.0 to 6.5 with a seismic coefficient of 0.05 (Geological survey of Bangladesh; pers. Comm., 1979). The country is divided into three Seismic Zones with respect to the ranges of seismic coefficient. Zone-I as the most severe and zone-III the least severe.

### **3.2.5 River System**

The rivers that lie within the project area are mainly Turag, Buriganga, Balu, Tongi Khal, Sitalakhya River and a number of drainage canals that carries effluents from the entire Dhaka city.

### 3.2.6 Surface Water Quality

Most surface water bodies contained elevated levels of fecal bacteria. Department of Environment carries out surface water tests at some selected points all over Bangladesh including the rivers around the Dhaka city. Table 3.2 present concentration of heavy metals in the river and drainage khals of the project.

**Table 3.2 : Concentration of Heavy Metal of Surrounding Rivers and Drainage Khal**

Concentration in mg/l							
Heavy Metal	Buriganaga River Friend ship Bridge	Buriganga River Chandni Ghat Water Works	Buriganaga River Hazaribagh Tannery Area	Turag Rivers Amin Bazar	Lakhya River Saidabad SWTP Intake Pt.	Balu River Zirani Khal	Recommended Value for Drinking Water
Al	3.27	5.396	3.262	11.884	2.952	2.166	0.2
Cd	0.014	0.006	0.008	0.018	0.006	0.006	0.005
Ca	0.036	0.006	0.232	0.11	0.028	0.0224	0.05
Pb	ND	0.25	0.47	0.394	0.074	ND	0.05
Hg	0.0021	0.0016	0.0033	0.005	0.0032	0.001	0.001
Se	0.001	ND	0.0006	0.0002	0.005	ND	0.01
Zn	0.56	0.984	0.402	1.002	0.246	1.122	5

ND=Not Detectable

Source: Improved Sanitation Project, Executive Summary DWASA

The results present an alarming situation of the rivers water quality for the dry period. Apart of the BOD concentration of above 400 mg/l, the concentration of heavy metals is reported as presented in the Table 3.2.

### 3.2.7 Ground Water Quality

Ground water is abstracted by deep tube wells of Dhaka Water Supply and Sewerage Authority (DWASA). The chance of ground water contamination is less due to presence of thick impermeable clay layer overlying the aquifer. Table 3.3 present water quality data of some deep tube well of DWASA.

**Table 3.3 : ISS Project-Results of Water quality Survey (November 2003) (Deep Tubewell for Drinking Water)**

Location Parameter		Deep Tubewell #03	Deep Tubewell #13	Deep Tubewell # 16	Admissible Concentration per Environmental Law
BOD <sub>5</sub>	(mg/l)	7.50	-	-	0.20
COD	(mg/l)	10.00	9.10	0.50	0.05
C <sub>r</sub>	(mg/l)	Nil	-	-	0.05
Cd	(mg/l)	-	Nil	Nil	0.01
Pb	(mg/l)	-	0.027	Nil	0.05
Zn	(mg/l)	-	0.300	0.66	5.00
Mg	(mg/l)	-	7.15	12.24	30.00
Fe	(mg/l)	-	0.17	0.14	0.30
Mn	(mg/l)	-	0.09	0.26	0.10
NO <sub>3</sub> -N	(mg/l)	-	0.10	0.30	10.00
NO <sub>2</sub> -N	(mg/l)	-	0.003	0.002	>1
Total Coliform	(mg/l)	-	3.00	2.00	0.00

### 3.2.8 Air Quality

In Bangladesh urban air pollution is worsening rapidly due to upward trends in vehicle ownership and use of two-stroke engine vehicles. Four pollutants suspended particulate matter (SPM), carbon monoxide (CO), sulfur dioxide (SO<sub>2</sub>), and air-borne lead-cause significant air pollution problems, and have major public health impacts. In particular, SPM levels in Dhaka range from 2 to 4 times Bangladesh standards, but up to 12 times worse than WHO guidelines in the most heavily polluted commercial locations in Dhaka. Ambient SO<sub>2</sub> levels are nearly five times national standards in commercial area, and nearly ten times above WHO guidelines.

#### Air Quality Standards

Table 3.4 lists air quality standards adopted in Bangladesh, World Health Organization Standards, and National Ambient Air Quality Standards adopted in the US for comparison.

**Table 3.4 : Air Quality Standards**

Std	SPM	SO <sub>2</sub>	CO	NO <sub>2</sub>	Land use
Bangladesh	500µg/m <sup>3</sup>	120µg/m <sup>3</sup>	5mg/m <sup>3</sup>	100µg/m <sup>3</sup>	Industrial
	400µg/m <sup>3</sup>	100µg/m <sup>3</sup>	5mg/m <sup>3</sup>	100µg/m <sup>3</sup>	Commercial
	200µg/m <sup>3</sup>	80µg/m <sup>3</sup>	2mg/m <sup>3</sup>	80µg/m <sup>3</sup>	Residential
	100µg/m <sup>3</sup>	30µg/m <sup>3</sup>	1mg/m <sup>3</sup>	30µg/m <sup>3</sup>	Sensitive
WHO	No guideline at this time	125µg/m <sup>3</sup> 24hr ave	60mg/ m <sup>3</sup> 30-mon ave. 30mg/m <sup>3</sup> 1hr ave. 10mg/m <sup>3</sup> 8 hr ave,	200µg/m <sup>3</sup> 1hr ave. 40-50µg/m <sup>3</sup> annual ave,	Any
US NAAQS	150 mg/m <sup>3</sup> 24 hr ave 60 µg/m <sup>3</sup> annual ave	0.05ppm,3hr ave. 0.14ppm,24hr av. 0.03ppm,annual ave	9 ppm 2 <sup>nd</sup> highest 8 hr ave.	0.053 ppm annual ave.	Any

Sources: Department of Environment

### Dhaka Air Quality

Air pollution in Dhaka is a serious public health problem that is growing worse as the population of the city increases from 9 million on 1996 to a projected 15.5 million by 2016. Table 4.5 present air quality data of Dhaka city at different locations. The table gives analysis sheet of air sample of Dhaka city in February-March 2003 at Commercial Area of different locations. Present status of air quality is even worse.



**Table 3.5 : Air Pollution in Dhaka**

Sample Location /Station	Ambient Pollutant Concentration $\mu\text{g}/\text{m}^3$		
	SPM	NO <sub>x</sub>	SO <sub>2</sub>
Farmgate Dhaka	1773.24	226.22	540.98
Mirpur Road (Near Asad Gate)	1098.8	41.85	543.33
Gulshan P. Box	502.58	2.53	199.43
Purana Paltan	396.24	2.06	242.62
RAJUK	437.87	7.5	441.67

Sources: Department of Environment

### 3.2.9 Noise

Another serious threat to the quality of the environment is noise pollution. High-intensity sound, such as that emitted by machines used for excavating earth and welding pipes, for long periods of time is disturbing and potentially damaging to nearby human populations and wildlife. When continued for long periods of time it can also permanently damage the hearing of workers engaged in the area. While 50 db (decibels) creates severe discomfort, 85db is usually nattered as the critical level for car damage. The Environmental Quality Standards for Bangladesh (DOE, 1991) have set noise guidelines for industrial sites in Bangladesh. According to this standard, noise level should not exceed 75db in the daytime and 70db at night. Table 3.6 presents noise level standards of Bangladesh. Table 3.7 and Table 3.8 present ambient noise level at specific locations of Dhaka City. The data show that for sensitive areas like hospitals and schools the ambient noise level is much higher than the allowable limits.

**Table 3.6 : Standard Values for Noise**

Area Category	Unit	Standard Valve	
		Day Time	Night Time
A	dBa	45	35
B	dBa	50	40
C	dBa	60	50
D	dBa	70	60
E	dBa	75	70

**Note:** A = Sensitive areas where quietness is specially required like hospital, education institute etc

B = Mostly residential

C = Considerably for residential purposes and also for commercial/industrial purpose

D= Commercial area

E= Industrial area

**Source:** Department of Environment

**Table 3.7 : Noise Levels in Dhaka**

Location	Sound Level (dB)
<b>Commercial Areas (standard limit 70 dB)</b>	
Motijheel	76
Farmagate	80
New Market	66
Gulshan	75
Shapla Chaltar	76
Rajuk Avenue	74
Mohakhali Bus Stand	75
Shyamoly	80
GPO	75
Sydabad Bus Stand	75
Mohakhali Rail Crossing	72
Banglamotor	83
Kamlapur Railway Station	88
Commercial Areas (standard limit 70 dB)	72
<b>Sensitive Areas (standard limit 45 dB)</b>	
Shaheen College	62
Titumir College	68
ICDDR B	65
Dhaka Medical College	62
BSMMU (P G. Hospital)	70
Kakrail Mosque	71
Shaid Showrawardi Hospital	68
Katabone Mosque	65

**Source :** Department of Environment, 2000

**Table 3.8 : Typical Road-side Noise Measurements**

<b>Location</b>	<b>Maximum (dBA)</b>	<b>Minimum (dBA)</b>	<b>Measurement time</b>
Farmgate	97	69	35 min
Shabaqh	101	66	50 min
Gulshan Circle 2	112	72	21 min
Manik mia avenue	106	66	20 min
GPO Circle	116	77	32 min

### **3.3 Ecological Resources**

#### **3.3.1 Introduction**

This section of the report deals with flora of the project area. The study area (Dhaka City) is rich in plant diversity. The ecological settings of the project areas are mostly wetland, homestead and roadside vegetation, etc

The impact on ecological parameters viz flora is considered seriously in the project area. This report is prepared on the basis of field trip, available published and unpublished information

#### **3.3.2 Homestead Vegetation**

Homestead vegetation has a positive effect on improvement in soil moisture through shading and mulching process. Trees growing at homesteads also ensure easy access to the fuel wood, fodder and other products. Thus, it reduces the pressure on forestlands

A large number of multipurpose trees (fruit, timber, fodder, medicine) are grown in the project area. The most common among them are mango- (*Mangifera indica*), jackfruit- (*Artocarpus heterophyllus*), lemon- (*Citrus sp.*), banana- (*Musa sp.*), Korai- (*Albizia procera*), berry- (*Syzygium cumini*), plum- (*Zizyphus sp.*) etc. Table A-1 (Appendix-A) provides a list of important trees and shrubs found in the project area.

### 3.3.3 Roadside vegetation.

10-15 families of the plant species are present in the study area. These are; Gramineae, Leguminosae, Moraceae, Myrtaceae, Cyperaceae, Euphorbiaceae, Rutaceae, Solanaceae, Labiatae, Rubiaceae, Malvaceae, Compositae, etc. The most common roadside plantation trees are Sisso-(*Daibergia sissoo*), Mahogoney-(*Sweitoma mahagoni*), Katanote-(*Arnaranthus spinosus*), Apang-(*Achyranthus aspera*), Chorekanta-(*Chrysopogon aciculatus*), Jagadumur-(*Ficus glomoretta*), Swetadrin-(*Leacus lavendulifolia*), Tulsi-(*Ocimum sanctum*), Titbegun-(*Solanum indicum*), Benna-(*Veteveria zizanioides*), Bot-(*Ficus benghalensis*) etc Table A-2 (Appendix-A) shows the list of plant species in the roadsides and their uses.

### 3.3.4 Wetland Flora

Wetland flora play a vital role for biodiversity conservation. The wetland habitat characterized by anaerobic condition, which inhibit normal plant growth. The wetland flora of the project area is listed in Table A-3 (Appendix-A). The project area supports two types of wetland e.g., (a) Permanent wetland and (b) Seasonal wetland. The permanent wetland includes rivers and perennial water bodies. The permanent wetland provides refuge and shelter for the most of the aquatic flora. The seasonal wetland serves as the cultivated land.

### 3.3.5 Aquatic Flora

Aquatic flora in the project area can be divided into communities based on a set of environmental conditions. The communities are as follows:

- Free-floating plants
- Sub merged floating
- Rooted floating plants
- Sedges and meadows
- Marginal vegetation

The tree-floating plant community is common in the project area. Kochuripana (*Eichhomia crassipes*) is the single most dominant species followed by Indurkunipana (*Salvinia cucullata*), and Khudipdna (*Lemna perpusilla*), Topapana (*Pistia stratiotes*). The

submerged plant community is one of the prevalent plant types in the area. The species composition of the community differs between the permanent and the seasonal wetlands. Jhangi (*Hydrilla verticillata*), Patajhangi (*Vallisneria spiralis*), are the most common in perennial water bodies. The rooted floating community is a dominant plant type in some wetlands. Dominant families are Nymphaeaceae and Gentianaceae. At the present level *Nymphaea nouchali*, is the most abundant and common.

Sedges and meadows are acetones consisting of amphibian plants. The dominant families in this community are Cyperaceae and Gramineae. At the species level, Mutha (*Cyperus rotundus*), Chechra (*Scirpus articulatus*), Dhol kaimi (*Ipomoea fistulosa*), *Persicaria hydropiper*, *Enhydra fluctuans*, *Eclipta alba*, are also very common.

### **3.4 Socio-economic Profile**

#### **3.4.1 Project Location**

For analyzing the existing socio-economic profile i.e. the existing socio-economic environment of the project, delineation of location of the project is very important. The project location as stated in the project proforma is the greater Dhaka city. The stated 23 gas pipe laying sections indicate that the project area lies within the Dhaka City Corporation, Tongi Municipal area and a part of the Savar thana (Aminbazar). The catchment area of the project is under the Statistical Metropolitan Area covering from Narayanganj to Gazipur and Savar, which is treated as the catchment area of the CNG user transport.

However, out of the 23 sections of the proposed pipe line for CNG project, 2 Sections namely (a) Aminbazar to TTC including Turag River crossing (Section -1) and (b) Tejgaon TBS/DRS to Nabisco crossing (Tejgaon Industrial Area) (Section -12) are selected for detail information as two sample Sections.

### 3.4.2 Population and Composition

The project influenced area i.e. the Statistical Metropolitan Area of Dhaka city is comprised of 962 Mahallas of 172 Wards in 27 Upazila/Thanas of Dhaka City Corporation, Narayanganj Municipality, Kadamrasul Municipality, savar Municipality, Tongi Municipality, Gazipur Municipality and other urban areas

The population of the Dhaka Statistical Metropolitan Area is about a core (9,912,908) comprised of 5,475,654 (55%) male and 4,437,254 (45%) female. The area has a total of 2,089,336 households. The sex ratio is 123.4% and average household size is 4.7. The project pipe laying area is mainly within the Dhaka City Corporation area and Tongi Municipal Area. Population of this area is much lower than the Dhaka SMA area which is 5,659,951 in 1,174,046 households having an average household size of 4.8 and sex ratio of 129.9%.

The population composition of the 2 sample sections (Aminbazar to TTC and Tejgaon TBS/DRS to Nabisco crossing) is presented in Table 3.12

**Table 3.9 : Household and Population of the 2 Sections (Aminbazar to TTC and Tejgaon)**

Section	Ward no. (1991 census)	Total Household	Population by Sex			Avg HH size	Sex Ratio (%)	Population (%) by Religion		
			Total	Male	Female			Muslim	Hindu	Others
a) Aminbazar to TTC	07 Mirpur %	11490	69434 100	41803 60	27631 40	6.0	151.3	95	4	1
	76 Aminbazar %	3942	29370 100	18347 62	11023 38	7.5	166.4	99	1	0
Sub- total	%	15432	98804 100	60150 61	38654 39	6.4	164.3	96	3	1
b) Tejgaon TBS/DRS to Nabisco crossing	71 Tejgaon %	9739	52302 100	32987 63	19315 37			97	2	1
Total	%	25711	151106 100	93137 62	57969 38	6.0	160.7	97	2	1

source: Bangladesh Population Census (2002) Report.

### 3.4.3 Employment

Employment aspects of the 2 sample Sections (Aminbazar to TTC and Tejgaon Industrial Area) of the proposed project as reported in the Population Census (2002) Report of Dhaka zila, BBS is shown in Table 3.13 which shows that 23% are engaged in household works, 18% are not working 11% in business, 11% in industry, 8% in transport and communication, 2% are looking for work, 1% in agriculture, less than 1% in water, electricity and gas services, 2% in construction, 1% in service and 25% others.

**Table 3.10 : Main Activity of the Population 10 years and over of the 2 Sections**

Main Activity	Aminbazar to TTC (Section 1)						Tejgaon TBS/ DRS to Nabisco Crossing (Section 12)		Grand Total (2 Sections)	
	07 Mirpur		76 Amin bazar		Sub Total		No.	%	No.	%
	No.	%	No.	%	No.	%				
Household work	13004	24	5950	26	18954	25	7365	18	26319	23
Not working	10935	20	2833	12	13768	18	6679	17	20447	18
Business	7183	13	1970	9	9153	12	3212	8	12365	11
Industry	786	2	3333	15	4119	5	8210	20	12329	11
Transport Communication	4615	9	1237	5	5852	8	3616	9	9468	8
Construction	1005	2	183	1	1188	2	856	2	2044	2
Looking for work	898	2	175	1	1073	1	812	2	1885	2
Service	474	1	104	1	578	1	477	1	1055	1
Agriculture	858	2	563	2	1421	2	130	0	1551	1
Water Electricity, Gas	110	1	36	1	146	0	277	1	423	0
Others	13543	25	6387	28	19930	26	8755	22	28685	25
<b>Total</b>	<b>53411</b>	<b>100</b>	<b>22771</b>	<b>100</b>	<b>76182</b>	<b>100</b>		<b>100</b>	<b>116571</b>	<b>100</b>

Source Bangladesh Population Census (2002) Report.

### 3.4.4 Main Source of Income

The main source of income of the households of the 2 sample Sections of the proposed project as per 2002 population census report is shown in Table 3.14, which shows that 34% are employees, 23% are businessmen, 13% are engaged in transport sector, 4% non-agricultural labour, 3% from agriculture, 3% from construction and 20% from other sources.

**Table 3.11 : Households in Dwelling units by Main Source of Income of 2 Sections**

Section	Ward no. (1991 census)	Total House holds	Main source of Income						
			Agri culture	Non-Agri culture labour	Busi- ness	Cons- truction	Trans port	Empl oyeer	Other
a) Anunbazar to TTC	07 Mirpur %	10855 100	158 1	278 3	2816 26	425 4	1834 17	3393 31	1951 18
	76 Aminbazar %	3922 100	360 9	399 10	1282 33	61 2	358 9	644 16	818 21
Sub-total	%	14777 100	518 4	677 5	4098 28	486 3	2192 15	4037 27	2769 19
b) Tejgaon TBS/DRS to Nabisco crossing	71 Tejgaon %	8353 100	68 1	196 2	1326 16	169 2	854 10	3904 47	1836 22
Total	%	23130 100	586 3	873 4	5424 23	655 3	3046 13	7941 34	4605 20

Source: Bangladesh Population Census (2002) Report

### 3.4.5 Water Supply and Sanitation

Dhaka Water Supply and Sewerage (WASA) Authority is engaged for water supply and sewerage system of Dhaka city As per DWASA Management Information Report, February, 2002. Water Requirement and Water Production information have been presented in Table 4.15. It shows that against the daily demand of 1800 million litre water per day, DWASA's daily production is 1210 million litre water per days resulting in a deficit of 590 million litre of water.



**Table 3.12 : Water Requirement and Water Production**

DWASA Zones	No. of DTW	Water Production WILD	Estimated Water Requirement WILD	Water Shortage/ Surplus (+) MLD
I	68 DWW(1)	209 21	400	-170
II	36	123	320	-197
III	59	189	210	-21
IV	71	210	300	-90
V	64	238	215	+ 23
VI	79	188	270	-82
Narayanganj	8 NWW(2)	13 19	85	-53
<b>Total</b>	<b>385 3WW</b>	<b>1210</b>	<b>1800</b>	<b>-590</b>

Source: MIS Report, DWASA, February 2002

It is reported by WASA through newspaper that against the demand of 160 core litre of water, WASA at present can supply 115 core litre daily, Saidabad Water Treatment Plant able to add another 22 core litre per day. The sewerage system of DWASA covered only about 35% of the population in 25% area of the city. Water supply and sanitation facilities of the 2 sections are presented in Table 3.16, which shows that 51% households use tap water, 47% tubewell and 2% others. Again 51% households use sanitary and 49% use non-sanitary latrines.

**Table 3.13 : Households in Dwelling Units by Source of Drinking Water, Toilet Facility and Availability of Electricity**

Section	Ward no.	Total house holder	Source of Drinking Water			Toilet facility		Household with Electricity
			Tap	Tube well	Others	Sanitary	Others	
a) Aminbazar to TTC	07 Mirpur (%)	10855 (100)	4557 (42)	6179 (57)	119 (1)	6589 (61)	4266 (39)	9157 (84)
	76 Aminbazar (%)	3922 (100)	14 (1)	3888 (98)	20 (1)	1002 (26)	2920 (74)	2721 (69)
Sub-total		14777 (100)	4571 (31)	10067 (68)	139 (1)	7591 (51)	7186 (49)	11869 (80)
b) Tejgaon DRS to Nabisco crossing	71 Tejgaon (%)	8353 (100)	7251 (87)	877 (10)	5 (3)	4280 (51)	4073 (49)	5684 (68)
Total		23130 (100)	11822 (51)	10944 (47)	144 (2)	11871 (51)	11259 (49)	17553 (76)

Source: Bangladesh Population Census (2002) Report.

Note : Figures in parenthesis represent percentages with respect to total households.

### **3.4.6 Power Sources**

The Dhaka city people are getting power supply from the Dhaka Electric Supply Authority (DESA), a subsidiary of the Bangladesh Power Development Board (BPDB). The country's total power generation capacity is about 3500 MW daily against the demand of about 4100 MW. During summer, the overall power consumption jumps by additional 400 to 500 MWs and PDB faces a difficult situation to meet this increasing demand every year. Household level use of electricity by the 2 selected sections of Aminbazar to TTC and Tejgaon Industrial area are presented in Table 3.16, which shows that 76% has electricity facility in their houses but the remaining 24% households have no the electricity facilities although they live in the capital city.

### **3.4.7 Industries**

Within the CNG gas pipe laying project area, there are several industrial areas which are (1) Hazaribagh Tannery area (2) Tejgaon Industrial area and (3) Tongi Industrial area. Besides these specific industrial areas, there are innumerable small scale and household level units operating in different parts of Dhaka city. These are mainly plastic industries, bakery and biscuit factory, small scale iron workshops, transport vehicle maintenance workshops, welding shops etc.

### **3.4.8 Transport**

Dhaka city as the capital city is well connected by air, water, rail and road transport network with other parts of the country. This network is operated by air from Zia International Airport, by river from Sadarghat Launch Terminal, by rail from Kamalapur Railway Station and by road from mainly 4 Bus Terminals located at Gabtali, Gulistan, Mahakhali and Sardabad. The internal transportation within the city is mainly operated by road transports - both non-motorized and motorized ones. Rickshaw and rickshaw van contribute major portion of the transport network.

Traffic congestion at different locations at the peak hours of the day is normal phenomena and is increasing day by day. For solving the problems, Urban Transport

Project is planning and implementing different measures including over-bridges and flyovers at different locations, controlling and stopping plying of slow moving rickshaws in different roads

Although the total number of vehicles operating in Dhaka city is not large relative to the human population, visual observation of the main arterial roadways suggests high levels of ambient pollutants due to the density of traffic, poor traffic flow and poor maintenance of the vehicles. There is a widespread belief that the registered vehicle numbers are low by 25 to 50 percent, with a large number of unregistered vehicles plying the roadways due to limited enforcement of registration regulations

## **CHAPTER – 4 : STAKEHOLDER CONSULTATION**

### **4.1. Introduction.**

Stakeholder consultation is vital for any development project and a requirement as per DOE and ADB guidelines for EIA studies. Effective consultation process plays positive role in sustainability of any development project like one in question. Persons consulted on random basis include stakeholders of TGTDCCL, RPGCL, Secretary of Transport Association. Owner of filling stations, CNG service providers, businessman, drivers, laborer, bus owners, rickshaw puller, etc. The purpose of public consultation is to inform local inhabitants/primary stakeholders to make them aware of the project and to gather their opinion/suggestions about the proposed development program and later on, to incorporate such suggestions during project planning and implementation stages. To achieve the response of the concerned stakeholders consultations, surveys were carried out in two selected sample areas which is shown in Appendix-B. The opinion of the stakeholders are summarized below.

#### **4.1.1 Positive Opinion**

The positive opinions of the public consulted are given below.

1. Reduce environmental pollution.
2. Reduce incidence of respiratory and other skin diseases.
3. Use of locally available natural resource.
4. Saving of foreign currency.
5. More gas use in heavy industry will reduce cost of products,
6. Employment generation, and reduction in transportation cost.

#### **4.1.2 Negative Opinion**

The negative opinions of the public consulted are given below.

1. Import of spare part for conversion into CNG system will require additional foreign currency
2. Cost of imported transport may rise.
- 3 Hazard due to accident may be more fatal.

## **CHAPTER – 5 : POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES**

### **5.1 Identification of Potential Impacts**

The potential environmental impacts of the project have been assessed by considering the subsequent phases of development activities namely, pre-construction, construction and operation.

In the pre-construction phase, potential impacts are considered those, which will occur during project planning and design or during subsequent phases but are the direct consequences related to these activities. In the construction phase potential impacts are those that result directly from the construction activities (noise, dust, etc.). In the operation phase potential impacts are those, which arise as a consequence of activities that will be involved in project operation.

Impact identification requires an examination of interactions between Important Environmental Consideration (IECs) and project activities as a whole. A number of IECs have been selected based on DOE's guidelines, additional available documents and professional experience. Table 5.1 shows the various activities and potential negative impacts of the project.

**Table 5.1: Project Activities and Potential Negative Impacts**

Project	Project Phase	Potential Impact	Mitigation	Residual Impact		
				Insignificant	Small	Moderate
GAS DISTRIBUTION PIPELINES	Pre Construction	•Disturbance to population	• Careful site selection		*	
		Dislocation	•Planning and design •Survey of route •Directional drilling • Construction planning	*		
	Construction	Damage to soil	• Soil protection	*		
		Loss of fertility	• Vegetation of slope	*		
		Erosion	• Supervise contractors • Trench breakers and crows feet • Vegetation	*		
		Soil Contamination	• Careful working	*		
		Employment opportunities	•Positive employment policy		*	
		Loss of fisheries	• Careful working	*		
	Operation	•Loss of use of land	•Compensation •Safety zone		*	
		•Greenhouse Gas emissions	• Maintenance	*		

The impacts identified in this table are those, which remain with the severity indicated (insignificant, small or moderate), after the appropriate mitigation has been applied. The Pre- mitigation impacts are identified at the outset of the EIA and these are shown in the Checklists of potential environmental impacts for gas distribution pipeline construction in Table C-1 ( Appendix-C ).

## **5.2 Project Impacts and Mitigation Measures**

The potential significant environmental impacts as shown in the table 5.1 for different phases of the project, have been further elaborated in the following sub-sections to describe the specific mitigation measures

### **5.2.1 Pre-Construction Phase**

The Construction of the 100Km pipeline network within and around Dhaka City under Dhaka Clean Fuel Project not requires any acquisition and/or requisition of land, because the pipeline is laid through existing DCC and R&H roads. For this DCC and R&H are paid compensation by TGTDCI for existing route cutting. DRS / TBS is installed within acquired land of TGTDCI.

#### **Impact**

*Disturbance to population:* The new pipeline is routed adjacent to the existing pipeline. Detail survey is carried out prior to final route selection. However, it is recommended that finalization of the route incorporates explicitly the environmental considerations, so that adverse impact to the nearby population and utilities are minimized.

*Dislocation of communication and utilities:* As continuous linear structured pipelines have to cross all intersecting linear features along the route, thus road, rivers, canals, water pipe lines, electricity and telephone cables are all potentially at risk of disturbance as a result of pipeline routing. Areas of land can be rendered un-usable through loss of access as a result of an insensitive pipeline routing

#### **Mitigation**

*Survey:* A soil and land use survey is carried out at an appropriate level of detail, along the route of pipelines during the project planning phase and an appropriate soil



conservation plan developed. Specific measures addressed in the conservation plan include identification of the depth of topsoil.

*Stream and River crossing:* The detailed route inspection included a detailed survey of water crossing along the pipeline alignment to determine the appropriate crossing method (wet or dry) in consultation with the appropriate authorities and with representatives of the local community.

*Directional Drilling:* Standard practices for gas pipeline construction is to cross beneath major roads and rivers using directional drilling to construct the tunnels. Interference with road traffic is therefore limited to the impact of movements of construction plant and vehicles. For Turag river crossing directional drilling was required.

*Planning and Design:* Pipelines is designed to cause the minimum possible dislocation of services and loss of productive land area. Careful route selection is aim to avoid sensitive locations and to cross services without causing a loss of utility.

## **5.2.2 Construction Phase**

### **Impacts**

*Damage to soil & loss of fertility:* The pipeline construction requires excavation of trench into soil, which causes damage to soil. Potential impacts to soils include compaction, erosion and loss of fertility.

*Wash out of soil above completed pipeline trench:* There have been instances in Dhaka city of erosion of soil occurring at location where the pipeline crosses slopping ground and the permeable trench backfill allows water flow to concentrate

*Disturbance to passerby and traffic:* There was some disturbance to passerby and traffic during construction period.

*Soil contamination:* Short term soil contamination can result from oil leaking from plant and equipment and from material and fluid wastes from construction activities and from contractor's camp

*Loss of fisheries:* Crossing of small rivers by open cut stir up clay and mud in the streams. This affects the watercourse and downstream fishing for a short period.

*Employment opportunities:* Some local people can be employed as drivers and unskilled workers for the project as temporary basis.

### **Mitigation**

*Soil erosion:* Soil erosion due to excavation trench for pipeline construction is minimized by avoiding construction during rainy season. The duration of construction is kept to a minimum and the reinstalled pipeline corridor is properly vegetated to minimized erosion.

*Incorporate trench breakers and crows feet:* The problem of erosion due to a concentration of flow within the completed trench back fill is prevented by the construction of trench -breakers at intervals along a sloping sections of pipeline with crows feet drains to convey waters out of the trench to dissipate over adjacent ground.

*Thrust boring method:* The pipeline inside Dhaka crossed a number roads. In order to avoid any disruption for all road crossing, thrust boring method was practiced.

*Supervise Contractors:* Mitigation of soil contamination is in the hands of the contractors, who is required to produce and comply with site management plans. The operation of contractors was supervised by inspectors who are trained in identification and mitigation of environmental impact.

### **5.2.3 Post Construction Phase (Operation Phase)**

#### **Impacts**

Since mitigation measures for negative impacts were incorporated in the planning and design of the project, there are no major impacts during operation (after construction) of the project. No disruption is foreseen during operation stage as the pipeline is a sub surface one. Regular monitoring and maintenance of the project are in place for avoiding negative impacts.

*Loss of use land.* Potential environmental impacts from the operation of a pipeline are limited to the loss of utility of land along the pipeline alignment due to the requirement for a right of way for inspectors to patrol the line and for operations personnel to gain access to valve stations. A safety zone 19 meter either side of the pipeline is required under the Bangladesh mineral gas safety rules to be kept free of residences.

*Green house gas:* The principal effect on the environment from gas is likely to be contribution of methane as a green house gas due to fugitive emissions from flanges, valves at atmospheric pressure. However, the impact is insignificant.

#### **Mitigation**

*Safety zone:* The safety zone is properly defined and due compensation are provided. Line patrol man is hired locally, with a resulting beneficial effect on the local economy. Indicating sign can be used to identify the path of laid pipe lines of the project.

### **5.3 Post-construction Monitoring and maintenance (Operation Phase)**

Post-construction monitoring is limited to a number of impact parameters to see the actual performance of the project. The sources of 16"DN × 140 PSIG, 100 KM gas pipeline are Nandipara TBS, Tejgaon TBS, Tongi TBS and Aminbazar CGS. This pipeline gas feeds into Mirpur Mazar Road DRS, Mirpur DOHS DRS, Mirpur DRS, City

Centre DRS, Hazaribag DRS and Aminbazar DRS Nandipara. TBS has been commissioned but it has been kept ideal Baridhara DRS and Agargaon DRS has been installed but will be commissioned later. During operation, monitoring and maintenance works are done by the following staffs of TGTDCCL .

### **5.3.1 System Control Section ( SCC )**

System Control Section ( SCC ) of Mechanical Engineering Service Department (MESD) is responsible for maintenance of TBS and DRS of this project. The team of this Section inspect and check the working capacity of the regulator (active/monitor), meter, filter separator, inlet & outlet valves and relief valve of each TBS and DRS. This team performs the following maintenance works.

1. The meter and regulator are replaced when the meter becomes disorder and regulator fails .
2. The diaphragm of regulator is changed when gas flow through regulator is shut.
3. Filter cartridges of filter separator is changed when maximum allowable differential pressure is exceeded in the filter separator
4. The valves of each DRS and TBS are checked for proper operation.
5. This team takes temperature, pressure and meter reading of each TBS and DRS station and makes a monthly gas consumption report.

The team of System Control Section has done the routine maintenance of Tejgaon TBS, Tongi TBS and Aminbazar DRS. This team has also done emergency maintenance of Tejgaon TBS and Aminbazar DRS. The duration of routine maintenance is three to six months. Table 5.2 describes the routine and emergency maintenance of TBS and DRS which was done by the System Control Team.

**Table 5.2 : The routine and emergency maintenance of TBS and DRS**

Name of Station	Reason of Maintenance	Time Duration	Job has done
<b>Routine Maintenance</b>			
Aminbazar DRS	1. Flow through regulator was reduced. 2. Differential pressure in filter separators was increased	3 (three) months	1. Regulator diaphragms of regulating runs towards Dhaka have been changed and gas flow through regulator increased 2. Filter cartridges of all the filter separators have been changed and differential pressure disappeared
Tejgaon TBS	1. Gas flow reduced and gas flow of one regulating run remain closed. 2. Maximum differential pressure occurred in the filter separator	3 (three) months	1. Diaphragms of all the regulators have been changed 2. Filter cartridges have been changed.
Tongi TBS	Gas flow through regulators seemed to be reduced and unacceptable pressure differential occurred in the filter separator.	6 (six) Months	1. Diaphragms of all the regulators have been changed 2. Filter cartridges have been changed.
<b>Emergency Maintenance</b>			
Tejgaon TBS	Gas flow through regulator was closed		Diaphragm of the regulator has been changed.
Aminbazar DRS	Gas flow through regulating run towards Dhaka was closed.		Diaphragms of regulator has been changed.

This team has contribution to eliminate noise and vibration by proper checking and maintenance of DRS, TBS and CGS. Noise and vibration are detrimental to the environment. Thus the team plays a vital role of keeping the environment calm. The team by proper monitoring, inspection and maintenance keep the regulating and metering stations from blowing out explosive natural gas directly to the environment. This provides safety to the environment. So this team plays a pivotal role for ensuring safety to the environment during gas supply.

### **5.3.2 The Customer Metering Section (CMS)**

The Customer Metering Section (CMS) of MESD fabricate and install RMS for connecting new CNG filling stations. The CMS team regularly supervise and maintenance these RMSs. The following works are done by CMS team.

1. Fabricate and install Regulating and Metering Station for connecting new CNG filling stations
2. Clean the strainer of RMS when gas flow through regulators seemed to be reduced.
3. The diaphragm of regulator is changed when gas flow through regulator is closed.
4. The meter and regulator are replaced when the meter is disorder and regulator is failed.
5. Previous RMS is changed when hourly gas load is increased
6. Supervise the RMS and check meter reading, outlet pressure and hourly gas consumption.

### **5.3.3 Distribution Department**

The emergency team of Distribution Department regular checks leakages along the pipeline and takes needed maintenance work. This team ensure high quality maintenance works due to pipeline leakages and fugitive emissions from flanges, valves at atmospheric pressure, pipeline burst and emission of gases

### **5.3.4 Environmental and Safety Section**

Environmental and Safety Section of Planning Department carries out the environmental monitoring and safety aspect of different CGS, RMS, TBS, DRS and Valve Station. In order to enhance the occupational health and work safety this Section supervises and monitors the TBS and DRS of Transmission and Distribution lines and make a monthly statement of health, safety and environment presented in Appendix-D. The monthly supervision and monitoring of the TBS and DRS in 16"DN × 140 PSIG, 100 KM gas pipeline project by Environmental and Safety Section is yet not started. But it is expected that soon these stations will be brought under such supervision, monitoring and reporting.

### **5.4 Positive Impact during Operation Phase**

Positive impact during operation phase are given below:

1. The implementation of the project provides a clean fuel supply for CNG filling station.
2. This project reduce importing of petroleum products, thereby saving foreign currency.
3. The number of filling stations with CNG facilities are increased significantly.
4. The number of petrol driven motor vehicles are converted into environment friendly CNG fuelled ones and make the capital Dhaka a pollution free city.
5. Cost of transportations are reduced.
6. Research had shown that CNG operated cars emitted around 10-20% less carbon dioxide; up to 25% less nitrous oxide, and 80% less carbon monoxide, nonmethane hydro-carbons, smog forming emissions and virtually no atmospheric emissions of sulphur dioxide or small particulate matter in comparison to a modern catalyzed gasoline car. So the project reduce environmental pollution.
7. More gas use in heavy industry reduce cost of products.
8. The project meet the extended demand of gas in Dhaka city.
9. The low pressure situation of the Dhaka city is greatly mitigated with the implementation of the project.

## CHAPTER-6 : ENVIRONMENTAL MANAGEMENT PLAN

### 6.1 Introduction

The gas pipeline construction works involve massive earth excavation and trenching works and handling of equipments and materials to supply gas for further industrialization to the project study area. These activities have both positive and negative impacts on various components of the environment and socio-economic conditions. An environmental impact assessment was conducted in order to identify issues and incorporate measures required to minimize or mitigate adverse environmental impacts resulting from the project. The following surveys identified the potential positive and negative project impacts enabling development of the Environmental Management Plan (EMP).

- Environmental condition survey
- Socio-economic survey
- Biological resource survey
- Landuse survey

The Environmental Management Plan (EMP) is necessary to control environmental and social impacts by offsetting or reducing the negative impacts with mitigation measures and enhancing the positive impacts within the allocated funds from the project. In preparation of the EMP, the above studies were carefully reviewed, the environmental components and sub-components were identified and the possible magnitude and nature of the impacts and duration of the impacts were assessed. The functional components of the EMP for the project are described in the following Sections.



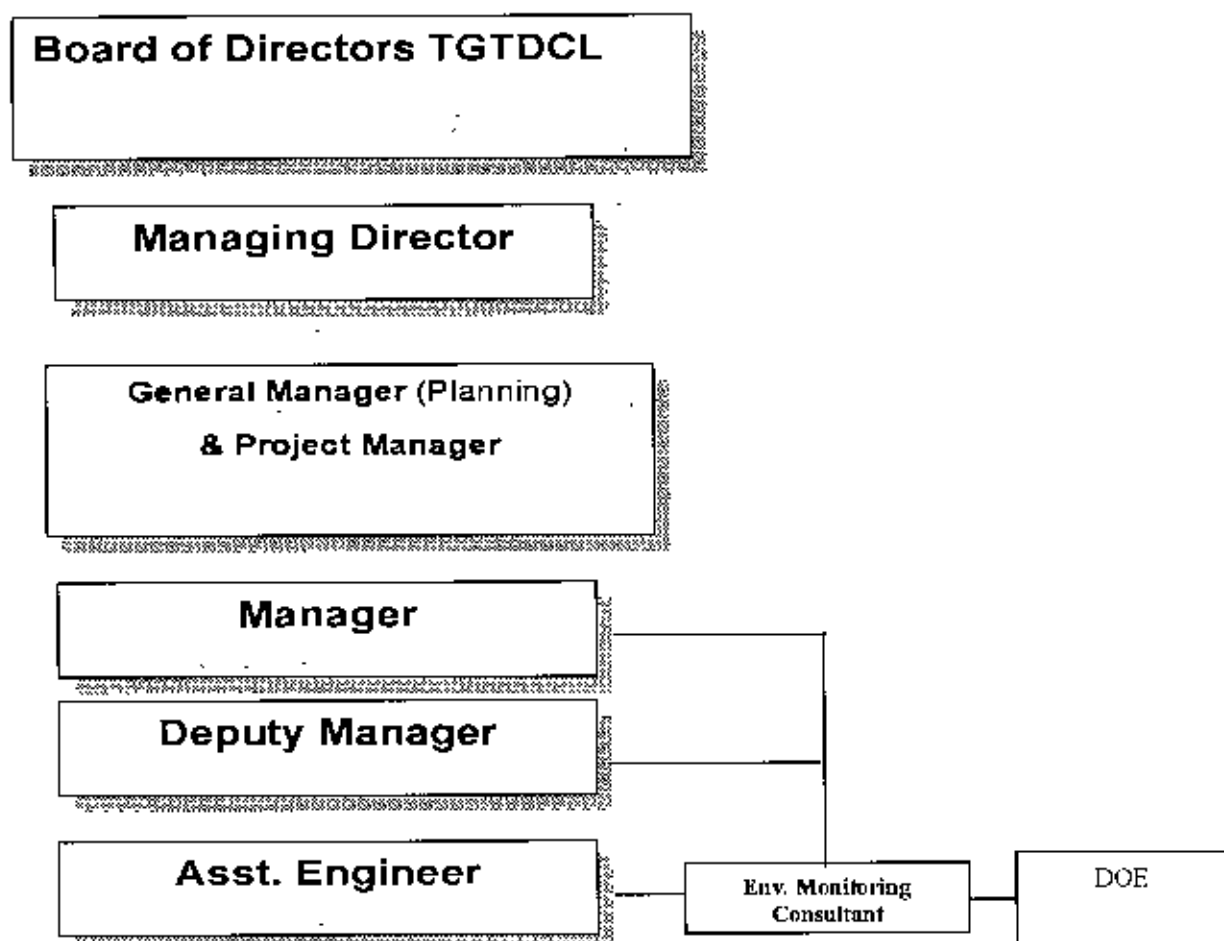
## **6.2 Environmental Monitoring Plan**

### **6.2.1 Organization Aspects**

Executive responsibility for project management commonly involves a number of organizations, each with specific responsibilities for particular aspects during the pre-construction, construction and operation and maintenance phases. An important aspect of environmental management is the accumulation of a database of environmental measurements. The environmental management team at an early stage of project planning prepare a detail schedule of management actions required and specific individual responsibilities for these actions.

An institutional arrangement was ensured for conducting effective and meaningful environmental monitoring. TGTDCCL and Petrobangla have the mandate to ensure environmental and safety at all TGTDCCL operations. TGTDCCL carried out the environmental monitoring during implementation and operation phases of the project. In view of the volume of works, TGTDCCL appointed consultants for the environmental monitoring work during the implementation phase. The team included one Senior Environment Specialist, one Socio-economist/Resettlement Specialist and one Junior Environment Engineer. The Senior Environmental Specialist and the Socio-economist/Resettlement Specialist have relevant experience of conducting EIA. They were responsible for reporting and supervising of overall environmental monitoring works at the field level. They work intermittently and have provided service when and where required. The Junior Engineer is responsible to carry out all environmental inspections and resettlement issues at the site-level. He is based at the site throughout the construction period. The Junior Engineer produces fortnightly environmental and social monitoring report to the Sr. Environment Specialist and the Socio-economist/Resettlement Specialist. Senior Environmental Specialist with the assistance of the Socio-economist/Resettlement Specialist prepare the monthly progress report, on the basis of their time-to-time field observations as well as on the Jr Engineer's reports

An organizational setup of TGTDCCL in relation to the Environmental monitoring is shown in Fig. 6.1.



**Fig. 6.1 : Organogram for Environmental Monitoring**

The monitoring and evaluation of the EIA-related environmental impacts were continued throughout implementation of the pipeline project, and a desired duration after the operation of the project. The monitoring program is implemented by TGTDCCL

Data and samples of various environmental parameters were collected by the independent consultants. The parameters, locations, time and frequency were determined from time to time for the collection of samples and data. The contractor performed all tests at the beginning of the construction to establish the baseline environment so that, later on, the degree of impacts resulting from construction works is determined. A tentative list of measured parameters, sample number and sampling frequency is given in Table 6.1

**Table 6.1 : Environmental Monitoring Parameters is Measured under the EIA**

Env. Component	Parameter(s)	Sampling Number/Year	Remarks
Property damages	Property damages	During construction	Monitoring by consultants and TGTDCI.
Socio-economic disruption	PAPs in the construction and operation of the project	Occasional	Monitoring by Consultants and TGTDCI.
Drainage congestion /water logging	Visual Inspection	Continuous during monsoon period	Monitoring by Consultant and TGTDCI..
Surface water level/ navigation	Visual Inspection	Continuous during flood.	Monitoring by Consultants
Surface water quality	TDS, COD, BOD, pH, DO, TSS	2 (During dry and monsoon)	Baseline value was established at the beginning of construction.
Ground water quality	pH, Fe, Mn, As	1 (during dry season)	Baseline value was established at the starting of construction
Drinking water	Fe, Mn, As	2 (during dry and monsoon)	Tested for each of the installed tubewell
Soil	Heavy metal, oil and grease	1 (during dry season)	Number of samples is dependent on the identified source of pollution
Solid wastes	Ground water quality at dump site	2 (before starting and after construction)	Test of ground water parameter before and after dumping
Road Traffic	Arrangement. safety	Continuous	Monitoring by consultants and TGTDCI
Air	NOx, SOx, SPM	2	Number of samples is source dependent. Baseline value is set prior to construction
Noise	Noise level in dB (a)	2	Same as for Air
Health and safety	Inspection of health and safety of labourers and others in the construction field	Continuous for safety and routine for health	Monitoring by consultants and TGTDCI
Dust load plantations/trees	Visual inspection	Occasional	Monitoring by consultants and TGTDCI

### **6.3 Objectives of Environmental Monitoring**

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:

- To check whether mitigation and benefit enhancement measures are actually being adopted and are proving effective in practice.
- To provide information on the actual nature and extent of 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

### **6.4 Components of the monitoring program**

#### **6.4.1 Technical Aspects**

The technical aspects include the parameters to be monitored, methods of measurement, location or area to be covered and frequency and duration of monitoring. The parameters and selected indicators must cover the potential impacts identified in the environmental studies. The methods to be chosen for monitoring parameters should be standard statistical, analytical or relevant cost-effective standard methods for measurement of impacts. The location, frequency and duration of measurements should be such that the data obtained are representative and sufficient to arrive at definite conclusion regarding magnitude and trend of impacts.

#### **6.4.2 Materials, Supplies and Equipment**

The materials, supplies and equipment requirements are largely guided by technical aspects of monitoring. The materials supplies, equipment and personnel requirements largely control the budget of the monitoring program.

### **6.4.3 Monitoring Activities, indicators and parameters**

Environmental monitoring requires a set of indicators that could be conveniently measured, assessed and evaluated periodically to establish trends of impacts. The indicators may be independent or may be functionally related. The physico-chemical, ecological and human interest including socio-economic indicators should be well defined and mutual relationship among the indicators should be well understood. The monitoring program, in view of the possible impacts as assessed earlier, should consider the indicators for the impact assessment related to following issues

The mitigation measures for the negative impacts and environmental enhancement for positive impacts are implemented according to the suggestions presented in this report. There are three types of environmental monitoring activities associated with the project: pre-construction, construction and post construction. Each of the components are to be dealt with according to the requirement of suggested measures, as described in the following Sub-sections of this report

### **6.4.4 Base Line Monitoring**

This is the collection of a representative set of data to define environmental conditions prior to commencement of the project development in the field. Baseline monitoring is undertaken during the pre-construction phase of the project. An early stage in the planning of a base line monitoring program involves deciding what constitutes a valid baseline data set in each case. This decision should be made in consultation with the environmental regulator, who will potentially be the adjudicator or even the protagonist if there should be subsequent complaints about environmental damage due to the project

### **6.4.5 Compliance Monitoring**

This checks whether prescribed actions have been carried out. This is done by visual observation or checking, coupled with enquires. For gas pipeline projects, in general,

compliance monitoring is of great importance; because most of the potential impact for environmental damage arises at the pre-construction and construction stages of the project. To avoid or minimize these damages, a set of prescribed actions are to be suggested in the contract document, the aim of compliance monitoring is to ensure the suggested actions are carried out.

On the other hand, measurement of key indicators like air, water, sound and noise pollution are rarely made in short life distribution pipeline projects, except in special cases where there is a need to investigate the above indicators.

## COMPENSATION PLAN

### 7.1 Introduction

In order to address all socio-economic issue arising due to the pipeline project, a compensation plan is prepared following ADB and DOE guideline. It is mentioned that the pipeline project not requires permanent acquisition and requisition of land because the pipeline was routed adjacent to the existing pipeline through DCC and R&H roads. Titas Gas T & D Co. Ltd follows the principle of minimum displacement or disturbance to the homestead, properties and other structures along the Right of Way. Population, assets and shops were not affected due to this project. So the question of resettlement was not arise Titas Gas T & D Co. Ltd gets road cutting permission from Dhaka City Corporation (DCC) and Roads & Highways Department (RHD) prior to commencement of pipe laying.

### 7.2 Procedure of Road Cutting Permission and Compensation from DCC

The concerned official TGTDCCL applies to the concern zonal Executive Engineer describing the area of roads needs to be dug showing the locations in the map

Conditional road cutting permission is issued after getting cheques of estimated cost and 25% security deposit separately. The estimated cost of compensation for work is presented below.

For 16" diameter pipe line the trench width =	0.70m
Length of the pipe line under DCC	= 85km
Area of paved road (bitumen)	= 59,500 sq m
Approved rate for paved road cutting by DCC	= 875 Tk/sq m
Total cost required for road restoration	= Tk. 52,062,500
Taka fifty two million sixty three thousand	

### 7.3 Procedure of Road Cutting Permission and Compensation from RHD

A portion of land about 13 km falls under Roads and Highways Department To lay pipeline along RHD Roads, TGTDCCL applies to the Chief Engineer of Roads and Highways Department including maps showing location of pipeline to be excavated.

The concerned Executive Engineer issue road cutting permission after TGTDCCL make payment of estimated cost and 25% security deposit of RHD. Since the alignment of pipeline follows earthen portion, by the side of RHD, only earthen portion is affected. Estimated cost of compensation for making trench along RHD road is given below.

For 16" diameter pipe line the trench width = 0.70m  
Length of the pipe line under DCC = 13km  
Area of earthen road is = 9100 sq.m  
Approved rate for paved road cutting by DCC = 207Tk/sq.m  
Total cost required for road restoration = Tk 1,883,700  
Taka fifty one million eight hundred and eighty four thousand.

### 7.4 Cost of Summary for Road Damage Restoration

Table-7.1 presents estimated cost of Summary for road damage restoration.

**Table-7.1 : Summary of Estimated Cost**

Sl. No.	Name of the Road	Length (km)	Type	Rate (Tk./sq.m)	Total (Taka)
1	DCC Road	85	Bitumenous	875	52,063,000
2	RHD Road	13	Earthen	207	1,884,000
<b>Total</b>					<b>53,947,000</b>

Taka fifty three million nine hundred and forty seven thousand only. DCC and R&H are paid compensation by TGTDCCL for existing route cutting



## **CHAPTER-8 : CONCLUSION AND RECOMMENDATION**

### **8.1 Conclusion**

The consultants appointed by Titas Gas T & D Co. Ltd. expected in their Environmental Impact Assessment that there would be no adverse impact after implementation of 16" DN x 140 PSIG" 100 km gas pipe line project. In view of my studies, it is found that existing flora, fauna, population, homestead and assets are not affected by implementation of this project. So there is no adverse impact on the environment.

Titas Gas T & D Co. Ltd. follows the principle of minimum displacement or disturbance to the homestead, properties and other structures along the Right of Way. Population, assets and shops were not affected due to this project.

The Construction of the pipelines within and around Dhaka City does not require any acquisition and/or requisition of land, because the pipeline is located within the boundaries of the existing gas facilities which limits the potential environmental impact of the project.

Titas Gas Transmission and Distribution Company Limited is in a position to monitor the environmental and safety aspects of the project.

## **8.2 Recommendation**

It was possible to avoid disturbance of the people and vehicles if the project work was executed at night instead of day time.

Thrust boring could be done instead of open-cut of busy roads during road crossing to minimize interruptions.

Indicating sign can be used to identify the path of laid pipe lines of the project.

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## APPENDIX - A

**Table A-1: Homestead Flora in the Project Area**

Native name	Scientific name	Family	Habit
Ulatkambal	<i>Abroma augusta</i>	Sterculiaceae	Shrub
Bel	<i>Aegle marmelos</i>	Rutaceae	Tree
Koroi	<i>Albizia procera</i>	Leguminosae	Tree
Chatim	<i>Alstonia scholaris</i>	Apocynaceae	Tree
Kajubadam	<i>Anacardium occidentale</i>	Anacardaceae	Tree
Nona, Atafal	<i>Annona reticulata</i>	Annonaceae	Tree
Supari	<i>Areca catechu</i>	Palmae	Tree
Kathal	<i>Artocarpus heterophyllus</i>	Moraceae	Tree
Kamranga	<i>Averrhoa bilimbi</i>	Oxalidaceae	Shrub
Ncem	<i>Azadirachta indica</i>	Meliaceae	Tree
Baria bans	<i>Bambusa vulgaris</i>	Gramineae	Tree
Simul	<i>Bombax ceiba</i>	Bombacaceae	Tree
Tal	<i>Borassus flabellifer</i>	Palmae	Tree
Polash	<i>Butea monosperma</i>	Leguminosae	Tree
Swet akond	<i>Calotropis procera</i>	Asclepiadiaceae	Shrub
Papey	<i>Carica papaya</i>	Caricaceae	Shrub
Bandar lathu, sonalu	<i>Cassia fistula</i>	Leguminosae	Tree
Arborai	<i>Cicca acida</i>	Euphorbiaceae	Tree
Kagzi lebu	<i>Citrus aurantiifolia</i>	Rutaceae	Shrub
Jambura	<i>Citrus grandis</i>	Rutaceae	Tree
Narikel	<i>Cocos nucifera</i>	Palmae	Tree
Patabahar	<i>Codiaeum variegata</i>	Euphorbiaceae	Shrub
Siso	<i>Dalbergia sissoo</i>	Leguminosae	Tree
Krishnachura	<i>Delonix regia</i>	Leguminosae	Tree
Chalta	<i>Dillenia indica</i>	Dilleniaceae	Tree
Gab	<i>Diospyros discolor</i>	Ebenaceae	Tree
Kanta mchedi	<i>Duranta repens</i>	Verbenaceae	Shrub
Madar	<i>Erythra variegata</i>	Leguminosae	Tree
Eucalyptus	<i>Eucalyptus citrodora</i>	Myrtaceae	Tree
Kothbel	<i>Feronia limonia</i>	Rutaceae	Tree
Gamar	<i>Gmelina arborea</i>	Verbenaceae	Tree
Kurchi	<i>Holarrhena pubescens</i>	Apocynaceae	Tree
Tokma	<i>Hyptis suaveolens</i>	Labiatae	Herb

**Table A-1: Homestead Flora in the Project Area (Contd.)**

Native name	Scientific name	Family	Habit
Beli	<i>Jasminum sambac</i>	Olaceae	shrub
Jagatmadan	<i>Jusuticia ganderusa</i>	Acanthaceae	Shrub
Jarul	<i>Lagerstroemia speciosa</i>	Lythudaceae	Tree
Lantana	<i>Lantana camera</i>	Verbinaaceae	Herb
Henna plant	<i>Lawsania speciosa</i>	Lythraceae	Tree
Swetadran	<i>Leucas Iyvendulifoha</i>	Labiatae	Herb
Am	<i>Manqifera indica</i>	Anacardiaceae	Tree
Datranga	<i>Molastoma malabathncum</i>	Melastomaccuo	Shrub
Ghora nim	<i>Melia azaderachta</i>	Meliaceae	Tree
Bakul	<i>Mimusops elongi</i>	Sapotaceae	Tree
Sajna	<i>Moringa oleifera</i>	Moringaccac	Tree
Kacha kola	<i>Musa paradiscia</i>	Musaceae	Shrub
Kala	<i>Musa saptentum</i>	Musaceae	Shrub
Tulsi	<i>Ocimum sanctum</i>	Labiatae	Herb
Khejur	<i>Phoenix sylvestis</i>	Palmae	Tree
Amlokhi	<i>Phyllanthus emblica</i>	Euphorbiaceae	Tree
Debdaru	<i>Polyalthia longifolia</i>	Annonaceae	Tree
Payara	<i>Psidium quajava</i>	Myrtaceae	Tree
Dahm	<i>Punica granatum</i>	Puniaceae	Tree
Reri, Bherenda	<i>Ricinus communJs</i>	Euphorbiaceae	Shrub
Rendi, Raintree	<i>Samanea saman</i>	leguminosae	Tree
Asok	<i>Saraca asoka</i>	Leguminosae	Tree
Mehagini	<i>Swietenia mahagoni</i>	Meliaceae	Tre
Jam	<i>hyzyyium cummi</i>	Myrtaccac	Tree
Tetul	<i>Tamarindus indica</i>	Leguminosae	Tree
Shegun	<i>Tectona grandis</i>	Verbenaceae	Tree
Katbadam	<i>Terminatia catappa</i>	Combretaceae	Tree
Jiban	<i>Trema orientalis</i>	Ulmaceae	Tree
Kul, Boroj	<i>Zizypus mauritiana</i>	Rhamnaceae	Tree

**Table A-2 : Roadside Flora in the Project Area**

Local name	Scientific name	Family	Habit
Apang	<i>Achyranthus aspera</i>	Amaranthaceae	Herb
Fulkuri	<i>Ageratum conyzoides</i>	Compositae	Herb
Koroi	<i>Albizia procera</i>	Leguminosae	Tree
Chatim	<i>Alstonia scholaris</i>	Apocynaceae	Tree
Haicha	<i>Alternanthera sesilis</i>	Amaranthaceae	Herb
Kantlanotey	<i>Amaranthus spinosus</i>	Amaranthaceae	Herb
Supari	<i>Areca catechu</i>	Palmae	Tree
Shelkanta	<i>Argemone mexicana</i>	Papaveraceae	Herb
Trufghas	<i>Axonopus compressus</i>	Gramineae	Herb
Shealmutra	<i>Blumea lacera</i>	Compositae	Herb
Simul	<i>Bombax ceiba</i>	Bombacaceae	Tree
Swet akanal	<i>Calotropis procera</i>	Asclepiadiaceae	Shrub
Bandar lathi, sonalu	<i>Cassia fistula</i>	Leguminosae	Tree
Barakalkesunda	<i>Cassia occidentalis</i>	Leguminosae	Shrub
Minjuri	<i>Cassia siama</i>	Leguminosae	Tree
Chotto kalkesunda	<i>Cassia sophera</i>	Leguminosae	Herb
Chakunda	<i>Cassia tora</i>	Leguminosae	Shrub
Than kuni	<i>Centella asiatica</i>	Hydrocotyleaceae	Herb
Chandonbeto	<i>Chenopodium ambrosioides</i>	Chenopodiaceae	Herb
Chore kanta	<i>Chrysopogon aciculata</i>	Gramineae	Herb
Bhant	<i>Clerodendrum viscosum</i>	Verbinaceae	Herb
Telakuch	<i>Coccinia indica</i>	Cucurbitaceae	Herb
Katchu	<i>Colocasia esculenta</i>	Araceae	Herb
Shonpat	<i>Crotalaria juncea</i>	Leguminosae	Herb
Croton	<i>Croton bonplandianum</i>	Euphorbiaceae	Herb
Durbaghas	<i>Cynodon dactylon</i>	Gramineae	Herb
Sisso	<i>Dalbergia sissoo</i>	Leguminosae	Tree
Dhutra	<i>Datura metel</i>	Solanaceae	Shrub
Krishnachura	<i>Delonix regia</i>	Leguminosae	Tree
Chuprialu	<i>Dioscorea alata</i>	Dioscoreaceae	Climber
Kanta mehedi	<i>Duranta repens</i>	Verbenaceae	Shrub

**Table A-2 : Roadside Flora in the Project Area ( Contd. )**

<b>Local name</b>	<b>Scientific name</b>	<b>Family</b>	<b>Habit</b>
Kala keslu	<i>Eclipta prostrata</i>	Compositae	Herb
Madar	<i>Erythrina variegata</i>	Leguminosae	Tree
Eucalyptus	<i>Eucalyptus citriodora</i>	Myrtaceae	Tree
Bhuiokra	<i>Evolvulus numularis</i>	Convolvulaceae	Herb
Bot	<i>Ficus benghalensis</i>	Moraceae	Tree
Jagadumui	<i>Ficus glomerosa</i>	Moraceae	Shrub
Kakdumur	<i>Ficus hispida</i>	Moraceae	Shrub
Matmati	<i>Glycosmis arborea</i>	Rutaceae	Shrub
Hatisur	<i>Heliotropium indicum</i>	Boraginaceae	Herb
Tokma	<i>Hyptis suaveolens</i>	Labiatae	Herb
Dholkalmi	<i>Ipomoea fistulosa</i>	Convolvulaceae	Herb
Muthaghas	<i>Kyllingia monocephala</i>	Cyperaceae	Herb
Swetadran	<i>Leucas lavendulifolia</i>	Labiatae	Herb
Bakpusp	<i>Lindernia procumbens</i>	Scrophulariaceae	Herb
Bhutorokra	<i>Lippia nodiflora</i>	Compositae	Herb
Ghora nim	<i>Melia azadirachta</i>	Meliaceae	Tree
Assamlata, Taralata	<i>Mikania cordata</i>	Compositae	Tree
Tulsi	<i>Ocimum sanctum</i>	Labiatae	Herb
Biskhatah	<i>Persicaria hydropiper</i>	Polygonaceae	Tree
Barapanimarich	<i>Persicaria orientalis</i>	Polygonaceae	Herb
Khejur	<i>Phoenix sylvestris</i>	Palmae	Tree
Chitki	<i>Phyllanthus reticulatus</i>	Euphorbiaceae	
Tepar	<i>Physalis minima</i>	Solanaceae	Herb
Rendi	<i>Samanea saman</i>	Leguminosae	Tree
Kuret	<i>Sida acuta</i>	Malvaceae	Herb
Berela, kureta, cola	<i>Sida cordifolia</i>	Malvaceae	Herb
Titbegu	<i>Solanum indicum</i>	Solanaceae	Shrub
Marhatitiga	<i>Spilanthes acmella</i>	Compositae	Herb
Jam	<i>Syzygium cumini</i>	Myrtaceae	Tree
Tetul	<i>Tamarindus indica</i>	Leguminosae	Tree
Banokra, Jangii	<i>Urena lobata</i>	Malvaceae	Herb
Benna	<i>Vetiveria zizanioides</i>	Gramineae	Herb
Ghagra	<i>Xanthum indicum</i>	Compositae	Herb/ Shrub
Kul. Boro	<i>Zizyphus mauritiana</i>	Rhamnaceae	Tree



**Table A-3 : Wetland Flora in the Project Area**

Local Name	Scientific Name	Family	Habit
Chanchi	<i>Alternanthera sesili</i>	Amaranthaceae	Herb
Katanote	<i>Amaranthes spinosus</i>	Amaranthaceae	Herb
Ban note	<i>Amaranthus viridi</i>	Amaranthaceae	Herb
kukurshinga	<i>Blumea lacera</i>	Compositae	Herb
Thankuni	<i>Centella asiatica</i>	Umbelliferac	Herb
Hachuti	<i>Centipida minima</i>	Compositae	Herb
Chorekanta	<i>Chrysopogon aciculatus</i>	Gramineae	Herb
Kachu	<i>Colocasia esculenta</i>	Araccae	Herb
Durba, Dubla	<i>Cynodon dactylon</i>	Graminaeae	Herb
Mutha	<i>Cyperus rotundus</i>	Cyperaceae	Herb
Bhuipat	<i>Dentella serphyllifolia</i>	Rubiaceae	Herb
Kesuti	<i>Eclipta alba</i>	Compositae	Herb
Kachuripana	<i>Eichhornia crassipes</i>	Pontederiaceae	Herb
Helencha	<i>Enhydra fluctuans</i>	Compositae	Herb
Gima	<i>Erythraea roxburghii</i>	Gentianeae	Herb
Bara javani	<i>Fimbristylis miliacea</i>	Cyperaceae	Herb
Khetpapa	<i>Hedyotis corymbosa</i>	Rubiaceae	Herb
Hatishore	<i>Heliotropium indicum</i>	Boraginaceae	Herb
Janjhi, Kureli	<i>Hydrilla verticillata</i>	Hydrocharitaceae	Herb
Kalmi	<i>Ipomoea aquatica</i>	Convolvuloceae	Herb
Dholkalmi	<i>Ipomoea fistulosa</i>	Convolvulaceae	Herb
Khudipana	<i>Lemna perpusil</i>	Limnaceae	Herb
Shetadrin	<i>Leucas ravandulifolia</i>	Lamiaceae	Herb
Shapla	<i>Nymphaea nouchali</i>	Nymphaeaceae	Herb
Lal shapa	<i>Nymphaea ruPra</i>	Nymphaeaceae	Herb
Amboli	<i>Oxalis corniculata</i>	Oxalidaceae	Herb
Biskhatali	<i>Persicana hydropiper</i>	Polygonaceae	Herb
Barapanimarich	<i>Persicana orientale</i>	Polygonaceae	Herb
Bhui aml	<i>Phyllanthus amarus</i>	Euphorbiaceae	Herb
Topapan	<i>Pistia strateotes</i>	Araceae	Herb
Indurkanupana	<i>Sulvinia cuculata</i>	Salviniaceae	Herb
Chechra	<i>Scirpus articulatus</i>	Cyperaceae	Herb
Singra	<i>Trapa maximowiczii</i>	Trapaceae	Herb
Jhangi	<i>Utricularia aurea</i>	Utriculariaceae	Herb
Patajhanji	<i>Vallisneria spiralis</i>	Hydrocharitaceae	Herb

## APPENDIX-B

## Interview of stakeholders

The following points were discussed for the opinions of the Stakeholder consultation of this Project

1. Do you know about this Project?  
 Yes       No
2. Is your land located inside the Project?  
 Yes       No
3. Is your house located inside the Project?  
 Yes       No
4. Do you feel that your land will be affected by this Project?  
 Yes       No       I don't know
5. Do you feel that your house will be affected by this Project?  
 Yes       No       I don't know
6. Do you feel that your income will be affected by this Project?  
 Yes       No       I don't know
7. Do you feel that your family member will be affected by this Project?  
 Yes       No       I don't know
8. What type of effect will be expected on your family?
9. Can you accept this Project?  
 Yes       No       I don't know
10. ( If yes ) What will be the main reason?
11. ( no ) What will be the main reason?
12. Can you accept this Project if it contributes for the greater interest of Dhaka?  
 Yes       No       I don't know
13. What is your opinion regarding the project? ( Multiple responses possible )
  - a. Improve environment condition of the area.

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- b. Improve physical condition of the area
- c. Create additional employment opportunity.
- d. Improve communication net work.
- e. Reduce environmental pollution
- f. Cost of imported transport may rise.
- g. Transportation cost may reduce
- h. Foreign currency may save.
- i. Cost of product in heavy industry may reduce.
- j. Locally available natural resource may use
- k. Hazard due to accident may be more fatal
- l. Import of spare part for conversion into CNG system will require additional foreign currency.
- m. Reduce incidence of respiratory and other skin diseases

## APPENDIX-C

**Table C-1: Checklist for Potential Environmental Impact**

Actions Affecting Environmental Resources and Values (A)	Damage to Environment (B)	Recommended Feasible Protection Measures (C)	No Significant Effect (D)	Significant Effect		
				Small (D1)	Moderate (D2)	Major (D4)
A Environmental Problems Due to Project Location	A Unnecessary Environmental Losses from Poor Site Location	A. Careful Site Selection to Minimize Losses			*	
1. Resettlement	1 Social inequities	1 Proper compensation, including rehabilitation	*			
2 Land value change.	2 Social inequities	2 Include costs in project budget	*			
3 Historical/cultural monuments/ values	3 Loss of irreplaceable value	3 Careful design to minimize losses	*			
4 Encroachment into precious ecological areas	4 Loss of precious ecological values	4 Careful design to minimize losses	*			
5 Encroachment into other valuable lands.	5 Loss of beneficial land uses	5 Careful design to minimize losses	*			
6 Interference with other utilities and with traffic	6 Disruption of utility services	6 Careful design to minimize losses	*			
7. Interference with drainage pattern.	7 Creation of flooding	7 Careful design to minimize losses	*			

**Table C-1: Checklist for Potential Environmental Impact (Contd.)**

Actions Affecting Environmental Resources and Values (A)	Damage to Environment (B)	Recommended Feasible Protection Measures (C)	No Significant Effect (D)	Significant Effect		
				Small (D1)	Moderate (D2)	Major (D4)
B Environmental Problems Due to inadequate Design (including assumptions related to Q&M)	B. Unnecessary Environmental Losses of Many Types.	H. Careful Design Utilizing Appropriate Technology To Minimize Losses and Hazards				
1. Interference with other utilities and with traffic and blockage of access ways.	1.1. Disruption in service and land uses	Do	*			
2. Escape of polluting materials	2. Environmental pollution.	Do	*			
3. Explosion / Fire hazards.	3 Hazards to life and limb.	Do	*			
4. Inadequate buffer zones for protection of adjacent properties / values	4 Nuisances to and depreciation to and neighboring land uses	Do	*			
5. Interference with drainage patterns	5. Flooding hazards	Do	*			
6 Erosion hazards due to inadequate provision for resurfacing of exposed areas	6 Soil losses and downstream salutation.	Do	*			
7. Impairment of exposed areas pattern	7. Loss of environmental beauty	Do	*			
8.Noise/ vibration nuisances especially at pump stations	8.Nuisance/ damages to neighboring properties	Do			*	
9 Inadequate provision for workers health and safety during operations stage	9 social inequities/ damage to workers health/ safety.	Do	*			

**Table C-1: Checklist for Potential Environmental Impact (Contd.)**

Actions Affecting Environmental Resources and Value (A)	Damage to Environment (B)	Recommended Feasible Protection Measures (C)	No Significant (Effect (D))	Significant Effect		
				Small (D2)	Moderate (D3)	Major (D4)
C. Environmental Problems During Construction Stage	C.Unecessary Environmental Losses	C.Careful/ Proper construction Practices				
1 Uncontrolled silt runoff	1. soil losses / downstream salutation and water quality impairment	1 Careful/ Proper construction Practices.		*		
2. Inadequate construction stage monitoring	2 Likely to maximize damages.	2. Provision of adequate monitoring	*			
3. Nuisances to nearby properties (noise, dust, fumes, fires, explosions)	3. Losses in neighboring lands use/ values.	3 Careful/ Proper construction Practices.	*			
4.Interference with other utilities and with traffic and blockage of access ways	4. Disruption of services and land uses	Do		*		
5. Inadequate disposition of borrow areas	5. Continuing excessive erosion.	Do	*			
6.Inadequate disposition of borrow areas	6. Losses in land values.	Do	*			
7. Protection workers health/ safety a)Inadequate housing / water supply/ sanitation b) Inadequate communicable disease control provisions, provisions for fire/ explosions	7. Losses in workers health/ culture	Do				
8. Flooding hazards due to construction impediments to natural drainage .	8 Flooding damages.	Do	*			



**Table C-1: Checklist for Potential Environmental Impact (Contd.)**

Actions Affecting Environmental Resources and Value (A)	Damage to Environment (B)	Recommended Feasible Protection Measures (C)	No Significant (Effect (D))	Significant Effect		
				Small (D2)	Moderate (D3)	Major (D4)
<b>D. Environmental Effects Relating to Operating Stage</b>	<b>D. Unnecessary Environmental Losses of Variety of Types</b>					
1.O&M staff/skills less than acceptable resulting in variety of adverse effects	1 Unnecessary Environmental Losses of Variety of Types	1.Proper provision for O&M skills, including training/ income/ worker protection	*			
<b>E. Critical Environmental Review Criteria</b>	<b>E. Environmental Losses of Variety of Types</b>					
1 Loss of irreplaceable resources	1. Long-term national environmental and economic losses.	1.Planning should be consistent with high level government policies.		*		
2. Accelerated use of resources for short-term gain	2.Do	Do	*			
3. Endangering of species	3.Long-term environmental losses	Do	*			
4.Promoting undesirable rural to urban migration.	4 Intensification of urban socioeconomic problems.	Do	*			
5.Increasing in affluent / poor income gap.	5 Intensification of national socio-economic imbalances.	Do	*			

## ADDENDIX-D

**Monthly supervision and monitoring of different stations by Environment and Safety Section**

The following monitoring works are done by Environmental and Safety Section.

- 1 Guard room : Exists  Does not exists
- 2 Standard color coding : Follows  Does not follow
- 3 Need rapid coloring : Yes  No
4. Fencing condition : Acceptable  Not acceptable
- 5 Grass . Needs cutting  Does not need cutting
- 6 Telecommunication system : Good  Bad
7. Security lights . Sufficient  Insufficient
8. Fire fighting equipment : Available  Not available
9. Fire fighting equipment is tested regularly : Yes  No
- 10 Station : Noisy  Not noisy
- 11 Guard/Employees use personal protective equipment (PPE) : Yes  No
- 12 First aid box : Have  Have not
13. Gas flow direction : Mentioned  not mentioned
14. Generator or IPS for load shading : Yes  No
- 15 Valves of the station is properly operated : Yes  No
- 16 Spare parts of the station: Available  Not available
17. Flange / Valve / Regulator / Pipes / Fittings : Rusted  Not Rusted
18. Strainer of the station is regularly cleaned: Yes  No
19. Condensate is collected from the station : Yes  No
- 20 Condensate collection process: Safety  Not safety
21. The equipment which is done Maintenance: Regulator  Meter  Valve   
Filter separator  Other

