# A STUDY ON WASTE WATER MANAGEMENT IN THE DHAKA EPZ AREA


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**BOARD BAZAR, GAZIPUR, DHAKA, BANGLADESH**


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# A STUDY ON WASTE WATER MANAGEMENT IN THE DHAKA EPZ AREA

A thesis report submitted to the Department of Civil and Environmental Engineering (CEE), Islamic University of Technology (IUT), in partial fulfillment of the requirements for the Degree of Bachelor of Science in Civil and Environmental Engineering



**Project and Thesis**

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We hereby recommend that this thesis prepared by Abdullah Al Hashib and Md. Sabbir Zaman, entitled **"A Study on Waste Water Management in the Dhaka EPZ Area"** has been accepted as fulfilling the part of the requirements for the degree of Bachelor of Science in Civil and Environmental Engineering (B.Sc. CEE).

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# DECLARATION

This is to certify that the work presented in this thesis is the outcome of the investigation carried out by Abdullah Al Hashib and Md. Sabbir Zaman under the supervision of Prof. Dr. Md. Rezaul Karim, Department of Civil and Environmental Engineering (CEE), Islamic University of Technology (IUT), The Organization of Islamic Cooperation (OIC), Gazipur, Bangladesh.

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# DEDICATED TO OUR BELOVED PARENTS

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# List of Acronyms

BEPZA= Bangladesh Export Processing Zone Authority

BOI= Board of Investment

EPZ= Export Processing Zone

CETP= Central Effluent Treatment Plant

ETP= Effluent Treatment Plant

FDI= Foreign Direct Issue

FY= Fiscal Year

EIA= Environmental Impact Assessment

EIV= Environmental Impact Value

EES= Environmental Evaluation System

EU= European Union

GoB= Government of Bangladesh

# ABSTRACT

DEPZ bear a lion portion of the total economy of Bangladesh. Due to its flourishing industrialization it also poses threat to the environment at the same time. Huge amount of water is consumed and wasted everyday. This study attempted to assess the wastewater management in the DEPZ area.

To conduct this study firstly the industries of EPZ was classified according to both DoE and EPZ to facilitate or ease the work to assess some representative industrial process. Then treatment procedure of their waste water is examined. Finally, an EIA has been conducted to evaluate the overall impact in the surrounding environment of DEPZ taking into account 30 parameters related to physico-chemical, ecological or biological and human interest parameters.

After assessing the inlet and outlet parameters of water it is obvious that discharged water from CETP is maintaining the DoE standard according to ECR, 1997. But from field observation it was found that water is polluted outside the CETP. The main reason was that there are lots of industries other than EPZ which discharges waste water to the natural surface water without properly maintaining the DoE standard. Government or relevant authorities have not proper control over them.

From the result of the EIA, it is seen that total value of physico-chemical parameters, ecological parameters and human interest parameters are -14.25, -17.25 and +36.75 respectively. As a result, total EIV value becomes +5.25. It was also obvious from the EIA that the most negative impact was in the fisheries and surface water quality in terms of both availability and quality. Terrestrial habitat and Agricultural lands are also in great threat. But positive value comes in the human interest parameters and thus in the total EIV mostly due to employment generation and commercial progress, socio-economic development and improvement in the sectors of transportation and education.

Based on the major findings of the EIA some recommendations are proposed to mitigate the adverse impact of the DEPZ industries on environment. Among them, control of the industries outside the DEPZ by the concerned authority to ensure reduce the impact on surface water and fisheries is of prime importance. Tree Plantation scheme should be initiated as early as possible. Good working environment should also be introduced for preventing accident and ensuring public safety. Effective environmental management plan should be implemented to coordinate these measures.

# Chapter 1
# Introduction

## 1.1 General

Bangladesh is a developing country. Keeping pace with the growing economic conditions of the nations of the world every country is becoming industrialized now-a-days. Bangladesh is not except of that. Over the last three decades, economy of Bangladesh has been changed gradually. Agricultural sectors contribution has steadily declining, and manufacturing sector has been rising. There are many individual industries are now flourishing. But BEPZA (Bangladesh export Processing Zones) are collaborating a numbers of industries to increase entrepreneurship and also to develop the industrialization sector of Bangladesh. Garments sector has become the prior sector for export earning and employment generation. It should be noted here that most of the industries of DEPZ are either dyeing or washing or textile or garments oriented industries. More female workers are in garment industry rather than other type of industries. A study has been published by Jayanthakumaran, (2002) which says that cost benefit analysis suggested that EPZ had a positive economic impact for citizen of host country. However later Amirahmadi et al., (1995) argued that there are listed researches done to explore why EPZ has become more attractive policy for a developing country. Findings suggested that the impact of EPZ is largely on economic and mostly in employment generation (Eusuf et al, 2007; Aggarwal, 2005). So, DEPZ is playing a pioneer role for attracting foreign direct investment in Bangladesh.

But due to these increasing numbers of industries Environment is becoming an increasing threat for human lives and other animals. Scenario of this deterioration in developing countries is becoming adverse day by day. In this situation this thesis is attempted to focus on this demandable issue of adverse environmental impact of industries on environment and some mitigation measures to develop this worse condition.

## 1.2 Objective

To study about the wastewater management of the DEPZ area several objectives are to be accomplished. They are-

1. Categorization of the industries of DEPZ according to DoE
2. Study the industries of DEPZ with respect to industrial process

3. Assessment and performance analysis of Central Effluent Treatment Plant (CETP)
4. Make an environmental impact assessment of DEPZ area
5. Identify problems and suggest some environmental management initiatives

### 1.3 Study Area

The research work is to be carried out in the DEPZ area which is situated in Ganakbari, Baipayl, Ashulia, Dhaka. `Banshi' river is the main natural stream around this area.

### 1.4 Scope of the Study

Categorization of the DEPZ industries according to both DoE and BEPZA was done before initiating the study. This study involves the assessment of the industrial process of the industries of DEPZ. It also includes the assessment of the inlet and outlet water quality parameters of CETP. To assess the surrounding area of DEPZ an environmental impact assessment was performed according to Environmental Evaluation System for which survey among the surrounding DEPZ was required. All types of parameters i.e. physic-chemical, ecological and human interest parameters were considered for conducting the EIA. Based on the results of the EIA some major impacts on the environment were identified for which mitigation measures were also proposed.

### 1.5 Limitations of this Study

To study of waste water around the DEPZ area it is necessary to assess or study about all the industries and polluters surrounding the DEPZ. Because industries of DEPZ are not solely responsible for protecting the surrounding environment. But this study is limited to the DEPZ industries, their waste water management process and the effects on environment.

Environment is also vulnerable due to solid waste generated from the industries of DEPZ. But detail assessment of solid waste is beyond this study. This thesis is limited to waste water. However, collection and disposal of solid waste and rubbish is considered in the EIA analysis.

# Chapter 2
# Literature Review

## 2.1 General

This chapter focuses on the previous related environmental management studies on wastewater in Bangladesh. Different types of environmental assessment have been previously performed in Bangladesh. Most of them are based on specific type of industries. Such as- Environmental assessment of textile dyeing industries in Gazipur and Narayanganj area has been studied *(Islam M. M. et al)*. Studies have been focused on Tanneries *(Azom M.R. et al, 2012)*, Ship breaking and recycling industries *(Hossain S. M. et al, 2011)*, Pharmaceutical industries *(Wahi R. R. et al, 2012)* to achieve the environmental sustainability in Bangladesh. These studies are limited to the specific type of industries and their related impacts on environment. Regarding EPZ, where a variety of industries are running, there was no previous study on environmental management. Moreover, Assessment of EIA can be performed in variety of ways. This work has followed environmental evaluation system for the assessment of the environmental impact.

## 2.2 Overview of EPZ in Bangladesh

In order to stimulate rapid economic growth of the country, particularly through industrialization, the government of Bangladesh has adopted an 'Open Door Policy' to attract foreign investment to Bangladesh. BEPZA is the official organ of the government to promote, attract and facilitate foreign investment in the Export Processing Zones. The primary objective of an EPZ is to provide special areas where potential investors would find a congenial investment climate, free from cumbersome procedures.

BEPZA has a head office situated in capital city Dhaka. The whole organization is divided into several zones. BEPZA has EPZs in eight different regions of Bangladesh. They are at Dhaka, Chittagong,Mongla, Ishwardi, Comilla, Uttara, Adamjee and Karnaphuli. Among them, Dhaka and Chittagong EPZ are currently running. BEPZA is establishing two new zones namely Meghna EPZ and Feni EPZ.

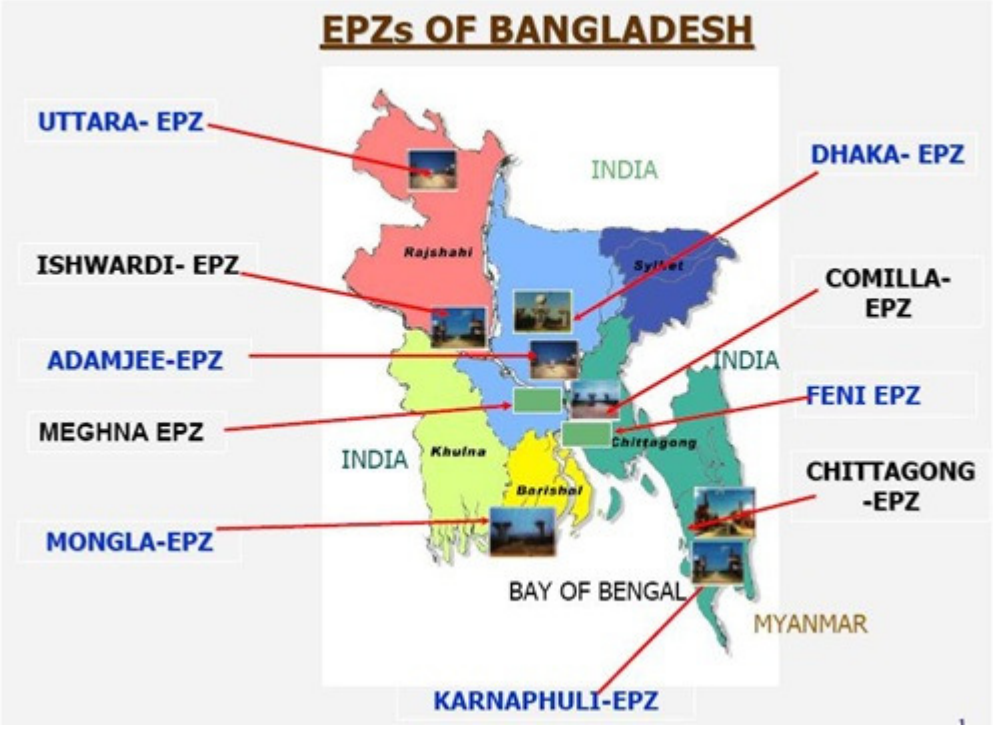



**Figure 2.1:** Location of EPZs in Bangladesh

## 2.3 Rationale of choosing Dhaka EPZ area

Dhaka EPZ is located in Savar, 35 kms from Dhaka city center, 25 kms from Hazrat Shahjalal (R) Airport and 304 kms from Chittagong Sea Port. The zone is situated on an area of 143.84 hectares (346.51 acres) with 388 industrial plots. Industries of DEPZ are located in two zones. Some industries are located in the old zones and are known as old zone industries and the others are known as new zone industries.

EPZ contribution in investment is tremendous and it has 4.82% share of total investment as registered in Board of Investment (BOI). In the fiscal year 2007-2008 the volume of investment was 154.34 million US$ (Islam M. Z. et al, 2011). Investors are from 35 different countries *(Barua, 2008)* along with Japan, Korea, Hong Kong, Thailand, Taiwan, China, USA, UK, Ireland, Germany, Malaysia, Indonesia, France, Singapore, Italy, Sweden, Switzerland, UEA, India, Nepal and Pakistan have invested in DEPZ. The cumulative investment in EPZs up to January, 2008 is US$ 1286.60 million *(Barua, 2008)*.Among

the foreign investors South Korea is in the top of the list, followed by China, Japan, India, USA, UK, Taiwan, Malaysia respectively.

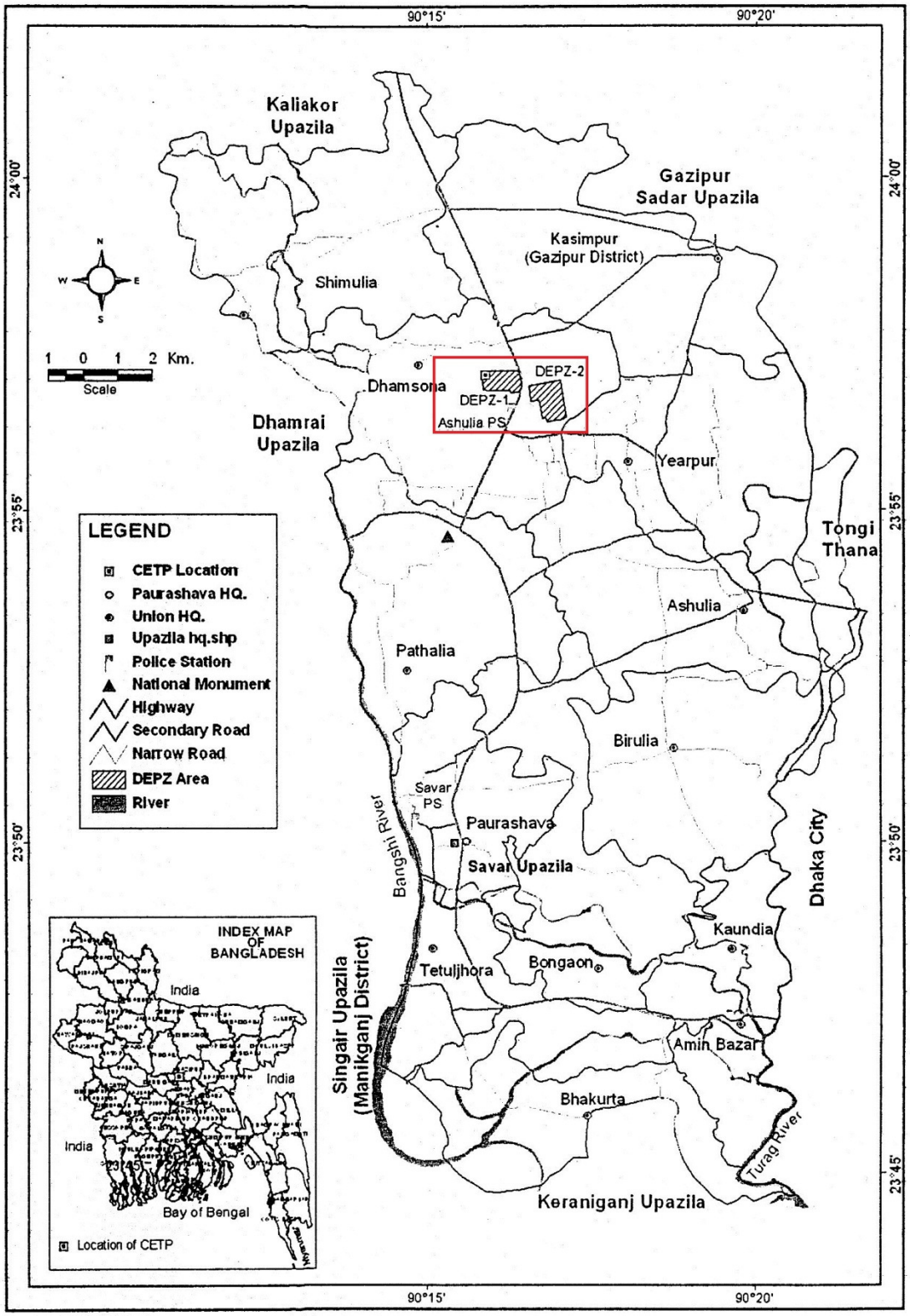
By looking at the country export performance, during the fiscal year 2006-2007 goods worth of US$ 13,903.47 million were exported from Export Processing Zones. EPZs in Bangladesh are gradually upward moving towards the share of national export. The contribution of EPZs to national exports increased from 2.69 in FY 1990-91 to 8.68 in FY 1995-96. During the fiscal year 2005-2006 the export percent (%) from EPZ was 17.43% out of total export (100%) from Bangladesh *(Islam M. Z. et al, 2011)*. On the other hand, RMG & Knit export from EPZ share was 20.40%. Bangladesh has been ranked as the sixth largest exporting country in the US and fifth largest in the EU *(www.cpd.org)* in 2007.

EPZs performance is not only in export, it has a great achievement in employment generation. After establishing the EPZ in 1983, employment was 624 at the beginning, increased to 29448 in 2007 as a cumulative figure. Up to January, 2008 among the zones the total employment is 2,07,275 whereas the civilian labor force in active is 9,37,024 *(Islam M. Z. et al, 2011)*. Hence, EPZ share of employment is more than about 22% *(BBS, 2006)*. It has been noticed that 1,32,644 (64%) of total employments in EPZs are female *(Bangladesh Economic Review, 2008)*. According to Madani (1999), in Bangladesh's Chittagong EPZ, the proportion of female workers categorized as "production worker" is much higher than the male proportion (98.4% to 79%).

Share of DEPZ in the whole EPZ is remarkable. Economic growth participation of DEPZ is gradually rapidly increasing without interrupting during FY 1995-96 to 2007-08. DEPZ percentage of total export within EPZs was almost 50% since FY 2003-04 to 2007-08. In terms of investment DEPZ receives 72% investment among all of the EPZs *(Islam M. Z. et al, 2011)*.

Therefore, DEPZ has contributed much in the Bangladesh economy with respect to employment generation opportunities, exporting goods and services and investment volume as well for the economic growth of the country.

Due to this flourishing sector and increasing number of industries in the DEPZ area surrounding environment is becoming vulnerable day by day because of increasing pollution of the industries with lack of environmental management initiatives and proper control of the administration. That's why a huge effort is necessary to analyze the industries based on their industrial procedures and chemicals used and disposed by them on environment as well as their step towards the management of this waste. Environmental Impact Assessment (EIA) is also required to conduct to evaluate and analyze the present scenario.


90°15'
90°20'
24°00'
23°55'
23°50'
23°45'
Kaliakor Upazila
Gazipur Sadar Upazila
Kasimpur (Gazipur District)
Shimulia
Dhamsona
DEPZ-2
DEPZ-1
Ashulia PS
Dhamrai Upazila
Yearpur
Tongi Thana
Ashulia
Pathalia
Birulia
Savar PS
Paurashava
Savar Upazila
Bangshi River
Dhaka City
Kaundia
Tetuljhora
Bongaon
Singair Upazila (Manikganj District)
Amin Bazar
Bhakurta
Turag River
Keraniganj Upazila
N
W
E
S
1 0 1 2 Km.
Scale
LEGEND
CETP Location
Paurashava HQ.
Union HQ.
Upazila hq.shp
Police Station
National Monument
Highway
Secondary Road
Narrow Road
DEPZ Area
River
INDEX MAP OF BANGLADESH
India
India
India
Bay of Bengal
Location of CETP

**Fig**

**ure 2.2:** Location map of DEPZ

# Chapter 3
# Methodology

## 3.1 General

This chapter briefly describes the procedures that are adopted during this research work. Tasks can be broadly classified in two divisions. They are assessment of the DEPZ industries and Environmental Impact Assessment of the DEPZ area.

## 3.2 Assessment of the DEPZ industries

(i) DEPZ has a lot of industries. So, classification of them according to DoE and according to EPZ was done to facilitate the assessment of the industries.

(ii) A red-wet bleaching and dyeing and an orange-wet washing industry was taken as representatives of the industries. Industrial production processes of the industries were assessed.

(iii) Savar Dyeing and Finishing Industry was visited by the researchers as a representative industry of DEPZ.

(iv) Data regarding consumption of water by the industries and generation of waste water were collected from DEPZ.

(v) Central Effluent Treatment Plant was visited several times by the authors. Comparison of Inlet and outlet water with respect to DoE standard was also done in this study.

## 3.3 Environmental Impact Assessment

(i) EIA has a lot of methods to perform. Among those, EES was preferred.

(ii) To conduct the EIA according to EES, firstly parameters were identified and then relative importance value was evaluated. After that degree of impact value was measured. Finally, relative impact was determined and EIV was calculated.

(iii) Based on the results of the EIA, some major impacts (both positive and negative) were identified.

(iv) Recommendations were proposed to mitigate the negative impacts and enhance the positive impacts.

# Chapter 4

# Assessment of the DEPZ Industries

## 4.1 General

This chapter includes the classification of the industries of DEPZ. Assessment of the industrial production process of the representative industries is shown in this chapter. Consumption of water and generation of waste water is explained in this section. Performance analysis of CETP is also within the scope of this chapter.

## 4.2 Classification of the Industries

100 industries of DEPZ are currently operating. BEPZA has classified them in two broad categories according to the industrial process especially depending on the water demand of the industries. They are-

(i) Wet Industry

(ii) Dry Industry

Wet industries involve dyeing and washing operations. Dry industries are mainly garment industries in the DEPZ. Wet industry mainly discharges dye, chemicals etc whereas Dry industry mainly discharges domestic waste such as sewage waste or kitchen waste. It is noteworthy that most of the industries in DEPZ are textile related industries. It has been found that about 32 industries in DEPZ are under the category of wet industry and 68 industries are under the dry category.

According to Environmental Conservation Rule, 1997 there are 37 Red industries followed by 38 Orange B, 12 Orange A and 13 Green industries. All wet industries and 6 dry industries fall under red category. Other dry industries fall in the rest of the categories. List and classification of the industries are shown in Appendix A.

Categorizations of the industries are given below for easy illustration:

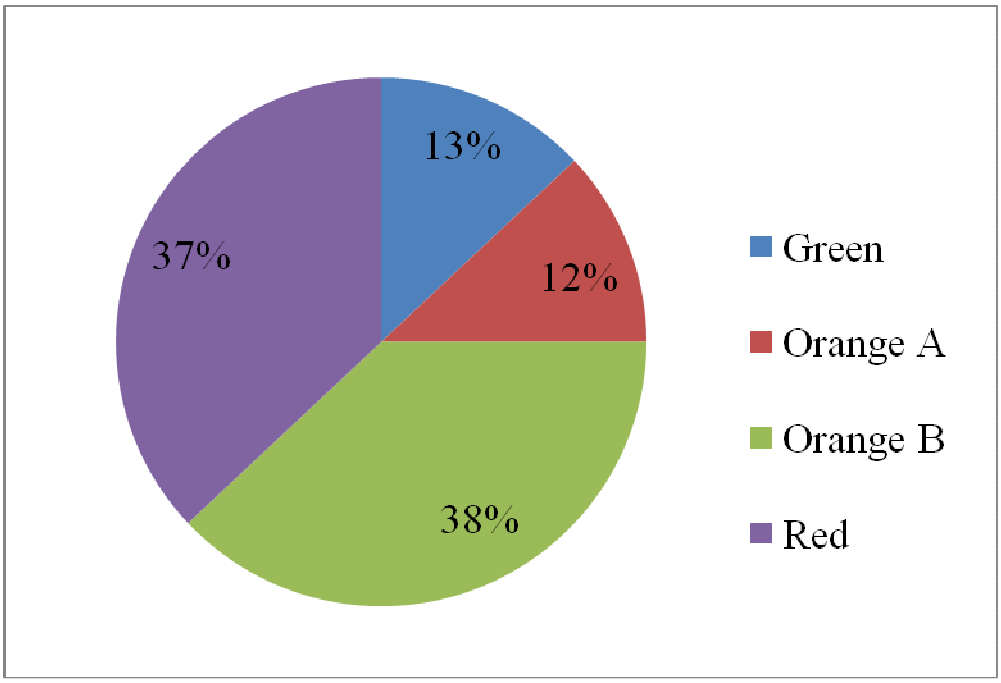



**Figure 4.1:** Categorization of the DEPZ industries according to DoE

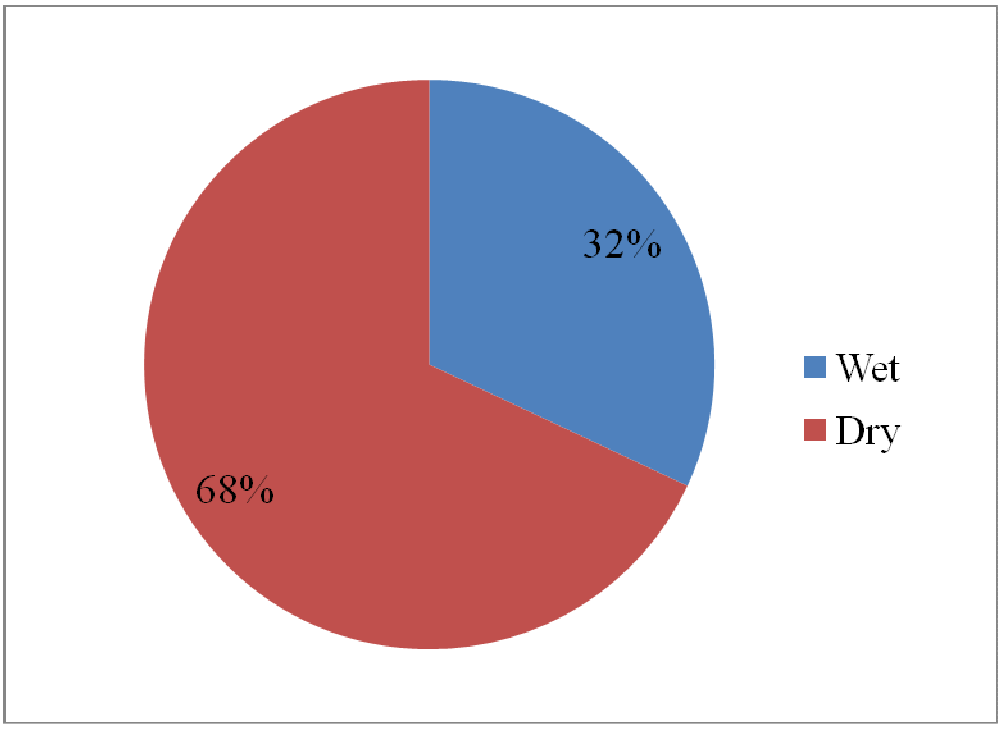



**Figure 4.2:** Categorization of the DEPZ industries according to EPZ

### 4.3 Assessment of the Production Process of the Industries

Among the various types of industries a red-wet and an orange B-wet industry are considered as representatives for assessing the industrial production process of the DEPZ industries. For red-wet industry South China Bleaching and Dyeing Factory Limited and for an orange-wet industry FCI (BD) Limited was chosen.

#### 4.3.1 South China Bleaching and Dyeing Factory Limited

South China is the largest exporter of woven fabric in Bangladesh. It manufactures garments from the fabrics produced by it and exports to the USA, Canada and all EU countries. Its production process involves bleaching, dyeing and washing and falls under the Red-Wet industry. Production capacity of the industry is about 3 million yds in a month.

South China Bleaching and Dyeing Factory Limited is a part of a Composite Textile Plant. This company is associated with the Goldtex Knitting and Goldtex. Process flow diagram for Composite Textile Plant is shown in Figure 4.3. Water is mainly required for the bleaching and dyeing operation of South China Bleaching and Dyeing Factory Limited. Waste water is also produced in these industrial processes.

It should be noted here that many of the industries of EPZ have their individual Effluent Treatment Plant because of the rules and regulation of EPZ. But lack of supervision and control by the authority encourage the industries to discharge effluent without proper treatment and thus save money. That is why, conception of CETP was innovated to control and maintain the discharge standard properly.

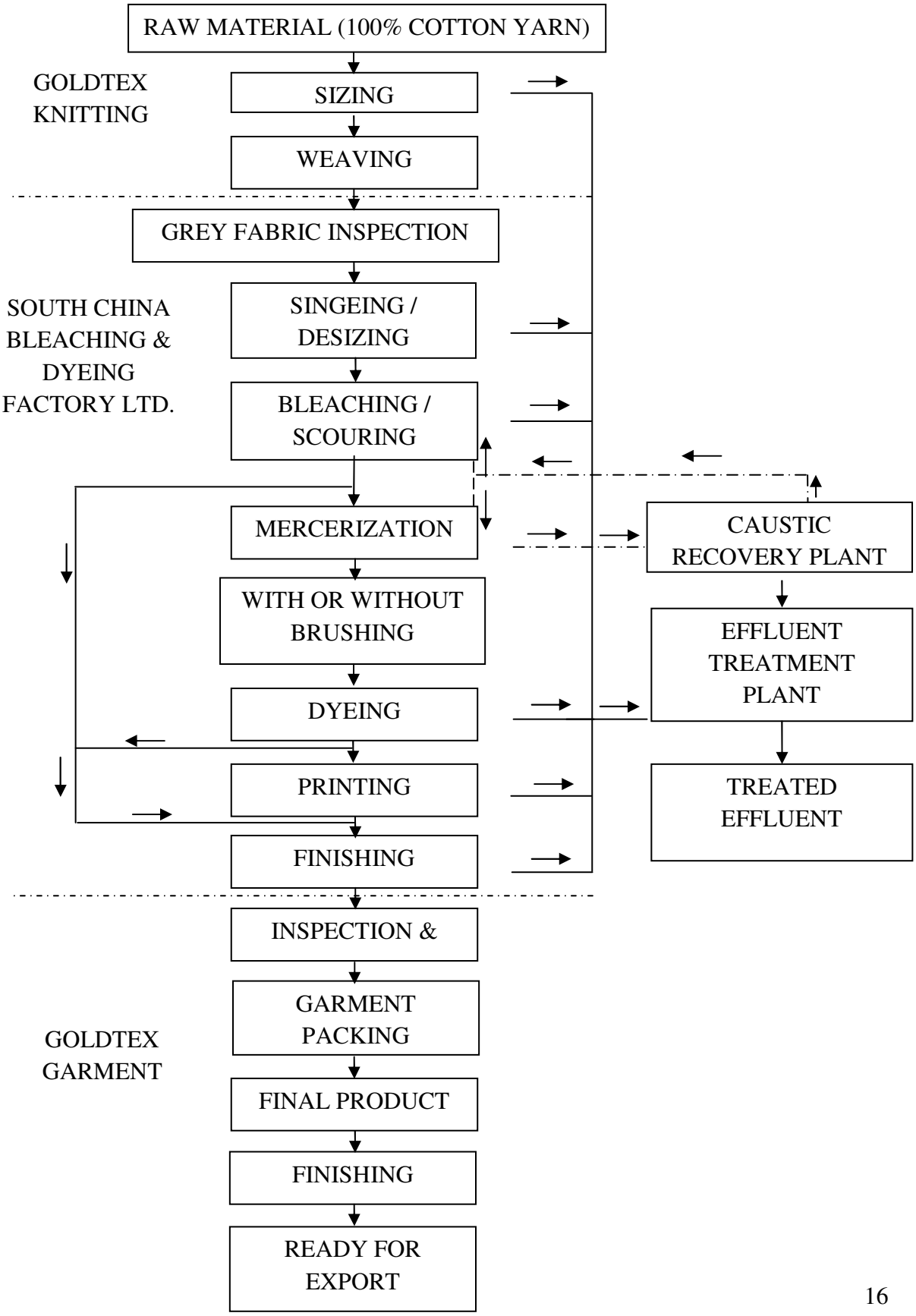





**Figure 4.3:** Process Flow Diagram for Composite Textile Plant

### 4.3.2 FCI (BD) Limited

It is a 100% foreign invested company. It is a British owned company. It is mainly washing industry. In terms of categorization they fall under orange B-wet industry. It conducts mainly garment oriented business. Its main products are Blazer or Jackets, Trouser, Skirt and Blouse. Production capacity per month is 40,000 pcs, 130,000 pcs, 60,000 pcs and 2,00,000 pcs respectively. Usual production flow chart of FCI (BD) Limited is shown in Figure 4.4.

It is observed from the flow chart that this industry is not associated with the bleaching or dying operation. So, as it was discussed in the previous section water is mostly used for washing operation in this industry. It can be stated here that industries includes only washing operation i.e. absence of bleaching and dyeing operation produces less polluted effluent than the industries associated with dyeing operation.

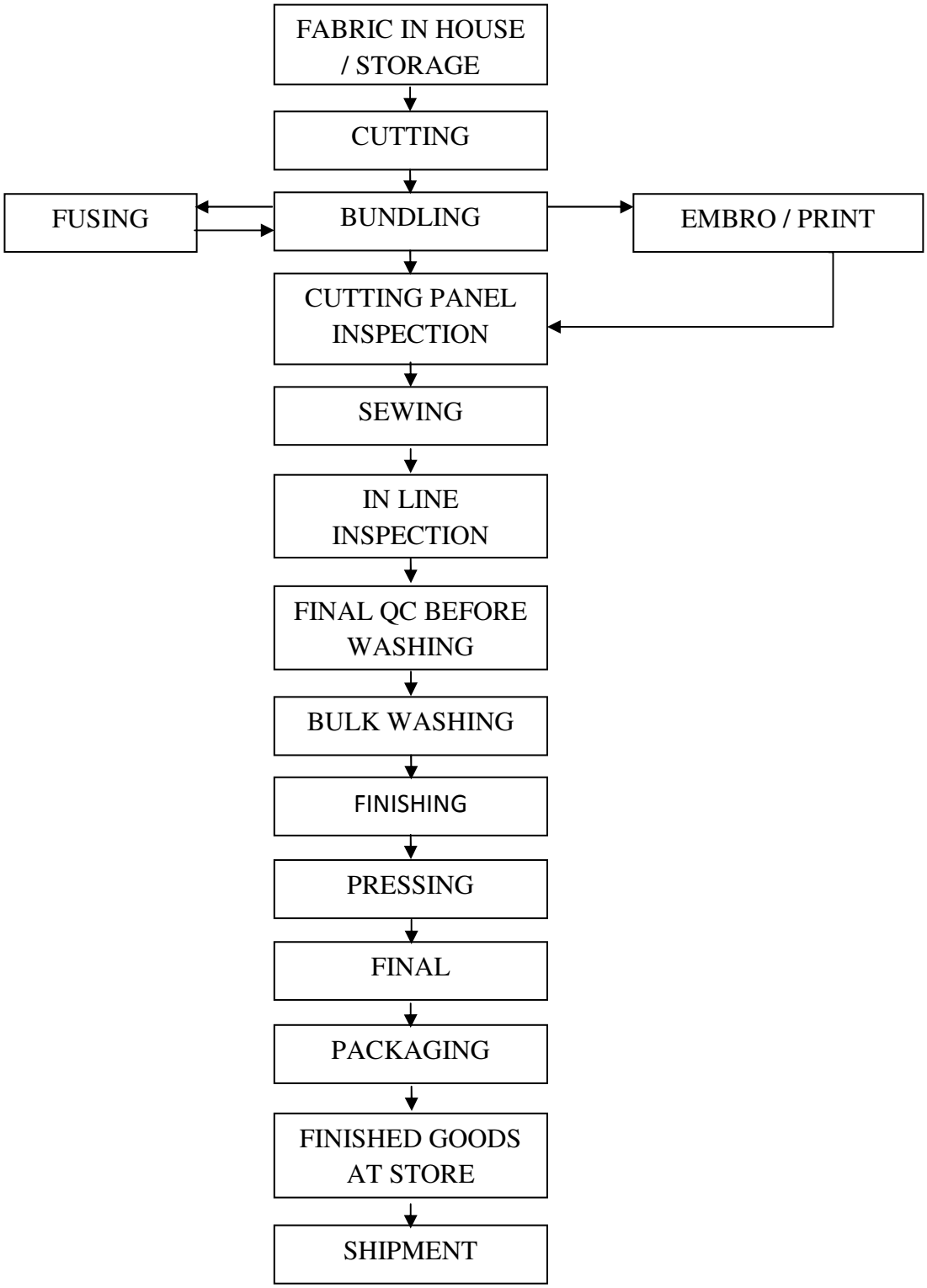

FABRIC IN HOUSE / STORAGE
CUTTING
FUSING
BUNDLING
EMBRO / PRINT
CUTTING PANEL INSPECTION
SEWING
IN LINE INSPECTION
FINAL QC BEFORE WASHING
BULK WASHING
FINISHING
PRESSING
FINAL
PACKAGING
FINISHED GOODS AT STORE
SHIPMENT

**Figure 4.4:** Production Flow Chart of FCI (BD) Ltd.

## 4.4 Consumption of Water and Generation of Waste Water

Water is provided to the industries of DEPZ mainly from ground water. Water consumed by the industries of DEPZ has been recorded in daily basis in DEPZ Bill June, 2010. They divided the water consumption pattern in three groups. Water consumption summary of that report is presented below:

**Table 4.1:** Consumption of water in DEPZ

| Serial Number | Item Name | Water consumption $m^3$/day |
|---|---|---|
| 1 | All New Zone Enterprise | 33374 |
| 2 | All Old Zone Enterprise | 16444 |
| 3 | Service Organization | 645 |
| Total | | 50463 |

According to EPZ, generation of waste water can be considered as 15% less of the consumption of water. This is because of surface runoff, evaporation and seepage.

## 4.5 Assessment and Performance Analysis of CETP

The textile industry is one of the complex processes which generally has difficulty in meeting waste water discharge limits, particularly with regard to dissolved solids, ionic salts, pH, COD, color and sometimes heavy metals (*Steffen, Robertson and Kristen, 1993; Lin and Peng, 1966; Vlyssides et al, 1999)*

Water has some basic properties. It has been seen that if the acid, oxygen and solid present in the water is maintained then it is suitable to discharge into the inland surface water. According to DoE, standard for pH, TSS, TDS, COD, DO are tabulated below:

**Table 4.2:** Discharge water Standard for inland surface water according to ECR, 1997

| pH | TSS (mg/l) | TDS (mg/l) | COD (mg/l) | DO (mg/l) |
|---|---|---|---|---|
| 6 - 9 | ≤ 150 | ≤ 2100 | ≤ 200 | 4.5 -8 |

CETP is situated in a plot area of 19,613 m². Treatment capacity of the CETP is 43,000 $m^3$ water/day. But at present they are treating 14,000 $m^3$ water/day. Because at present, only old zone industries are associated with the CETP. Process flow diagram maintained by the Dwater C.E.T.P Ecosystems (Bd) Ltd. (Deco Ltd.) to maintain the standard are shown in Figure 4.5. The process flow diagram shows three major sections which are as follows:

(i) Conditioning treatment includes screening and pH control when needed.

(ii) Primary treatment includes activated sludge processing (ASP) and ASP clarifier and Active Recirculation. ASP requirements are pH control, fine screening, temperature, sufficient aeration, recirculation etc.

(iii)Secondary treatment includes ECR treatment having no chemicals and ECR clarifier and course polish. Each ECR unit is designed for CETP processing rates from 180 to 250 $m^3$/hr. Greater surface reaction area with vertical flow including easy blade replacement and cleaning.

**CETP PROCESS FLOW DIAGRAM**

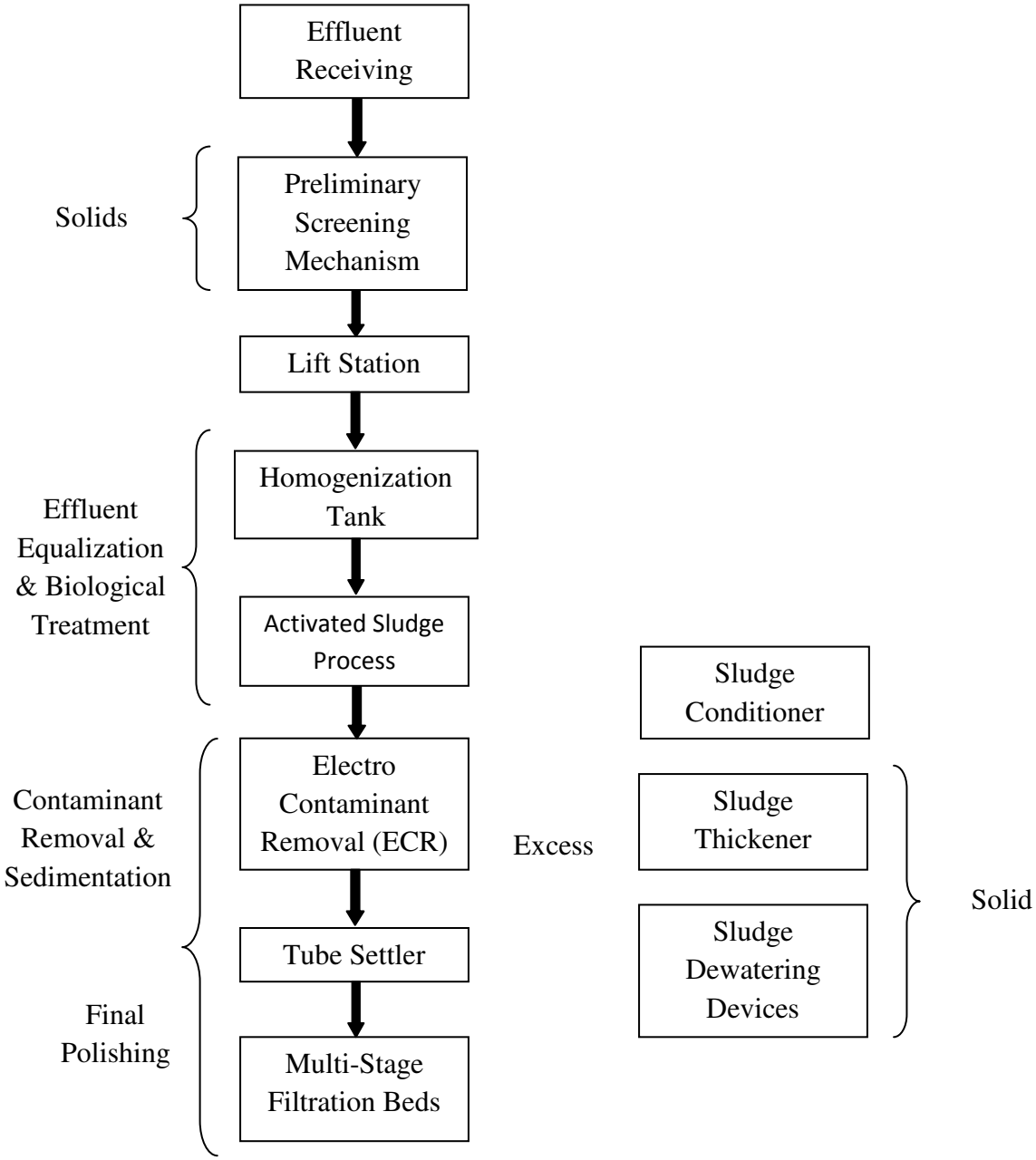



**Fig 4.5:** Process Flow Diagram of the CETP

Sectional Detail Layout of CETP is also shown below:

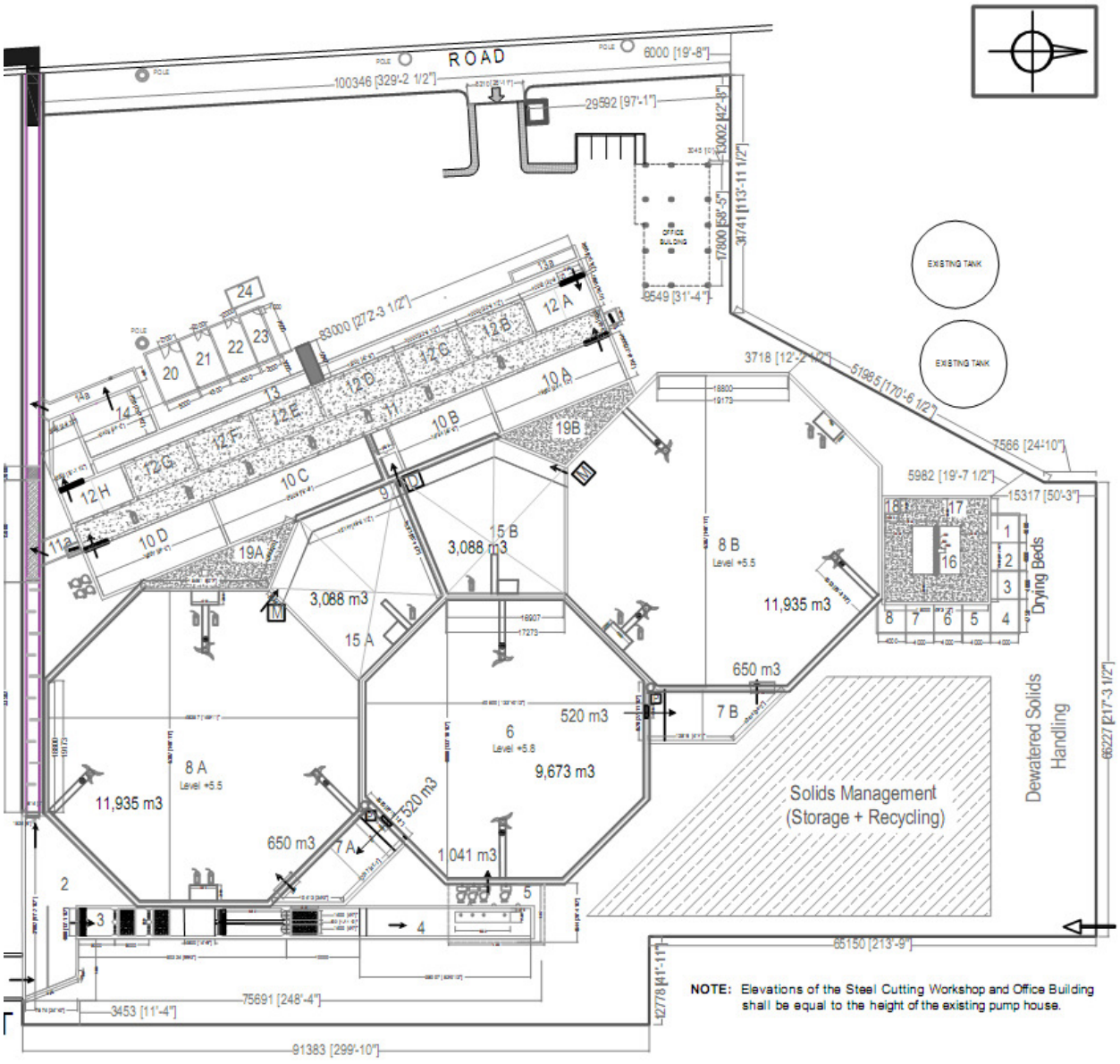



**Fig 4.6**: Sectional Detail layout or plan view of CETP

**Table 4.3:** Description of the Legends of the Sectional Layout of CETP

| Sl. No. | Description |
|---|---|
| 1 | Collection Pit Of Drain |
| 2 | Receiving Station |
| 3 | Bar Screening Section 3'' & 1'' Spacing Bars |
| 4 | Drum / Inclined Screening Sections 2# |
| 5 | Lift Station / Pump House |
| 6 | Homogenization Tank |
| 7 A-B | Neutralization Tank (Nos. 2) |
| 8 A-B | ASP Oxidation Tank (Nos. 2) |
| 9 | Aqueduct / Asp Clarifier Feeding Section |
| 10 A-D | ASP Clarifier (1) |
| 11 | ECR Feeding Trough & Spent Acid Trough |
| 11 a | Commissioning Emergency By Pass |
| 12 A-H | Common Tube Settler |
| 13 | ECR Colloidal Trough |
| 14 | Coarse Media Filtration |
| 15 A-B | Asp Biomass Holding / Condition Tank |
| 16 | Sludge Thickener |
| 17 | Dewatering Equipment Platform |
| 18 | Poly Mixing Tank |
| 19 A-B | Blower Rooms Above Oxidation Tank |
| 20 | Steel Workshop |
| 21 | Transformer Sub Station |
| 22 | Primary Treatment Generator |

| | |
|---|---|
| 23 | Future Expansion |

They have started their functioning regularly from February, 2012. Since then, it is maintaining those five parameters before discharging into the inland surface water. They determine the quality of those parameters in both inlet and outlet of CETP. Values of these parameters till August 26 are given in Appendix B. These values are used to make graphs for easy illustration of comparison of inlet waste water with treated effluent and their maintenance of the discharge standard of DoE. The graphs are illustrated below:

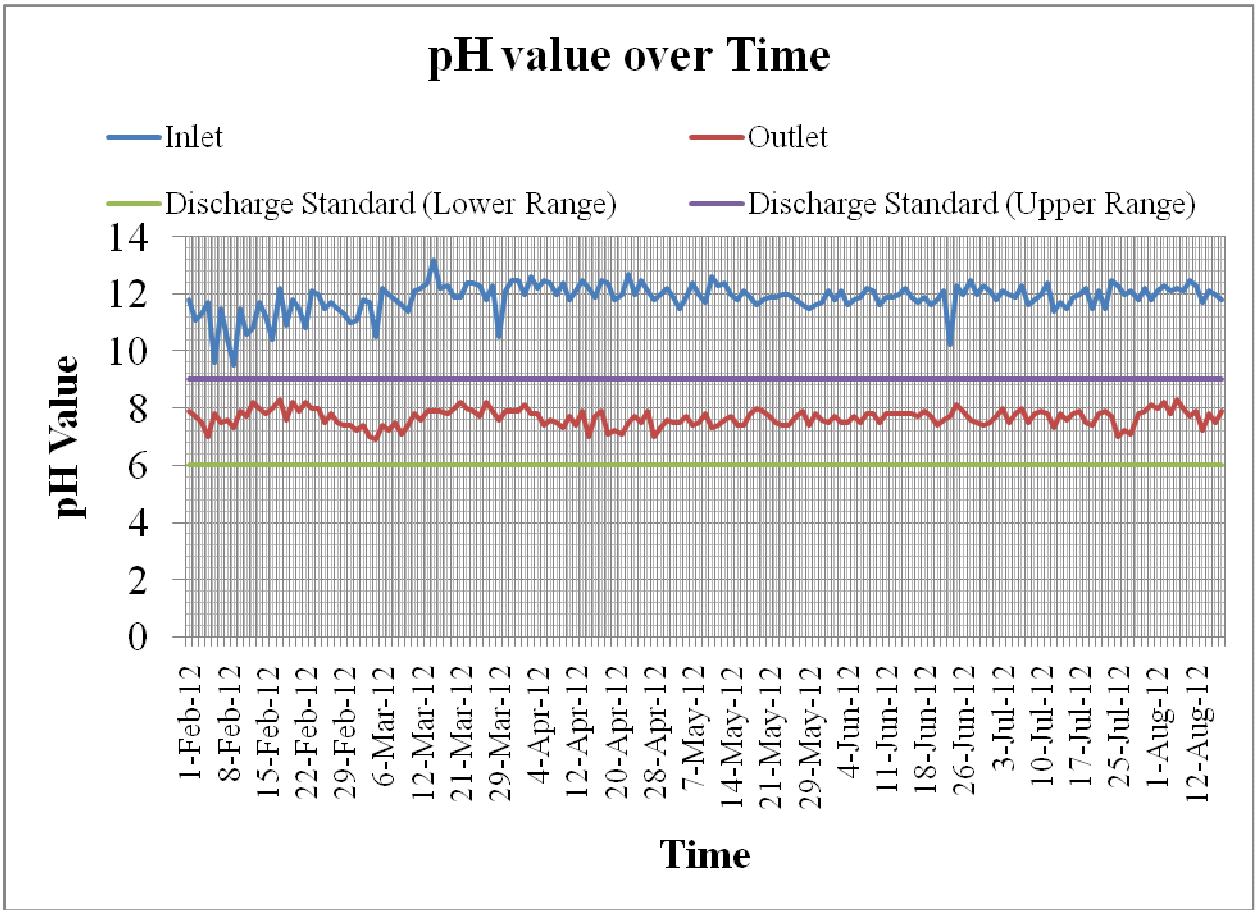



**Figure 4.7:** pH value vs Time

Maximum and minimum value of pH in inlet during February to August was 13.2 and 9.5 respectively (Appendix B). Average value in inlet and outlet are 11.9 and 7.7 respectively.

Minimum value of outlet in CETP is 6.9 which is more than 6. Maximum value of pH in outlet is 8.3 which is below 9. So DoE standard for inland surface water in terms of pH is maintained by CETP.

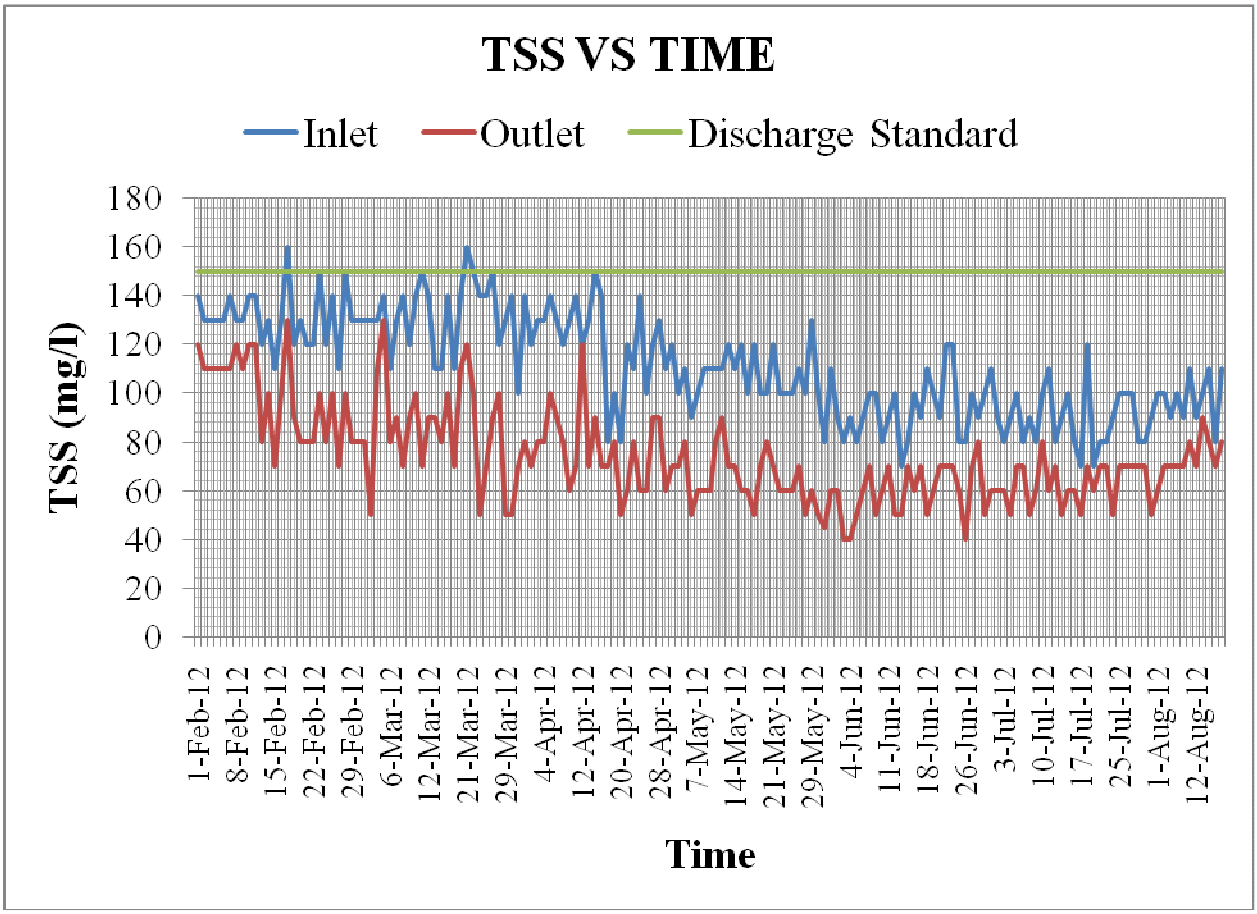



**Figure 4.8:** TSS vs Time

Maximum value of TSS in inlet during February to August is160 mg/l which is more than 150 mg/l (Appendix B). Average value in inlet and outlet are 111.5 mg/l and 74.3 mg/l respectively. Maximum value of TSS in outlet is 130 mg/l which is less than 150 mg/l. So, DoE standard for inland surface water in terms of TSS is maintained by CETP.

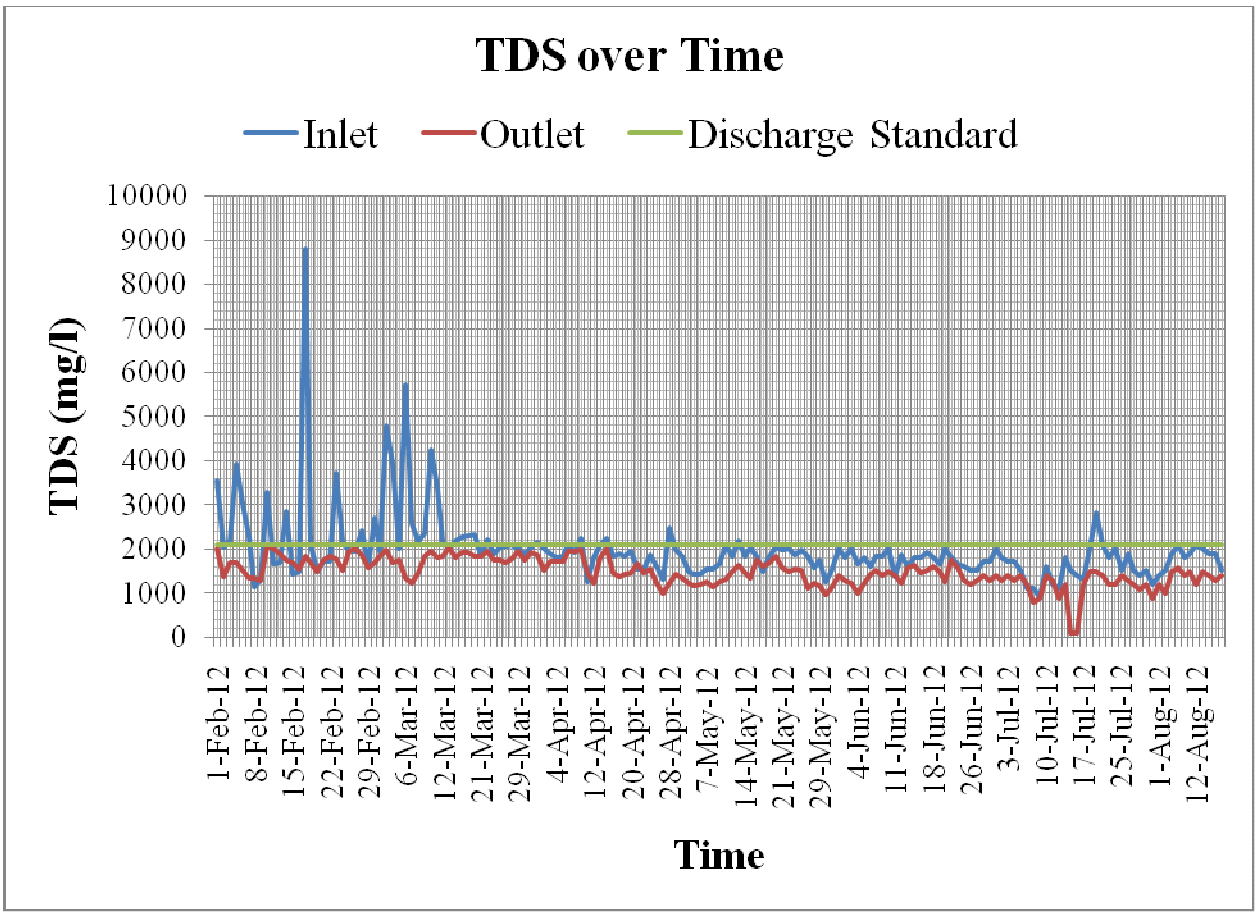



**Figure 4.9:** TDS vs Time

Maximum value of TDS in inlet during February to August is 8790 mg/l which is more than 2100 mg/l (Appendix B). Average value in inlet and outlet are 1990 mg/l and 1493.9 mg/l respectively. Maximum value of TDS in outlet is 2080 mg/l which is less than 2100 mg/l. So, DoE standard for inland surface water in terms of TSS is maintained by CETP.

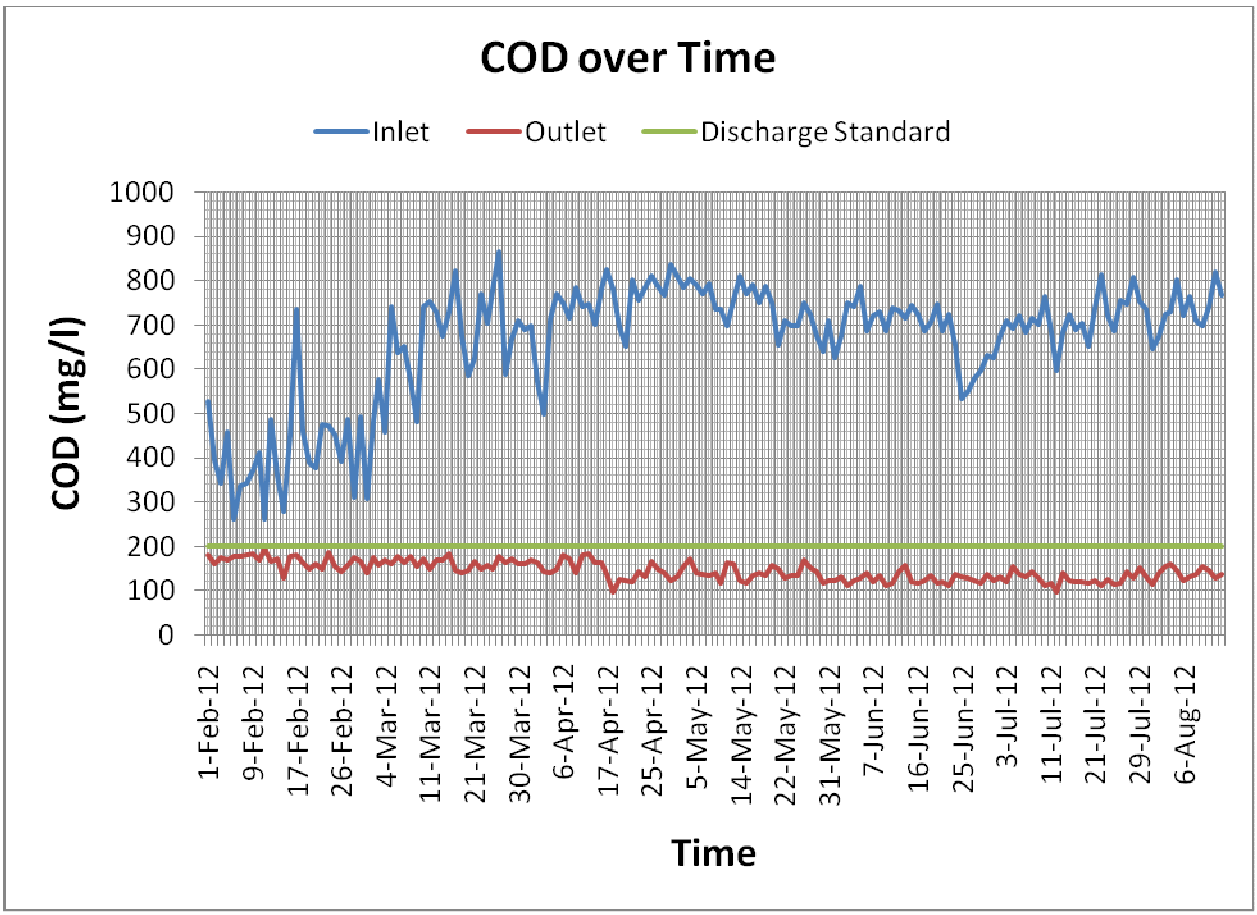



**Figure 4.10:** COD vs Time

Maximum value of COD in inlet during February to August is 866 mg/l which is more than 200 mg/l (Appendix B). Average value in inlet and outlet are 662.2 mg/l and 145.4 mg/l respectively. Maximum value of TDS in outlet is 195 mg/l which is less than 200 mg/l. So, DoE standard for inland surface water in terms of TSS is maintained by CETP.

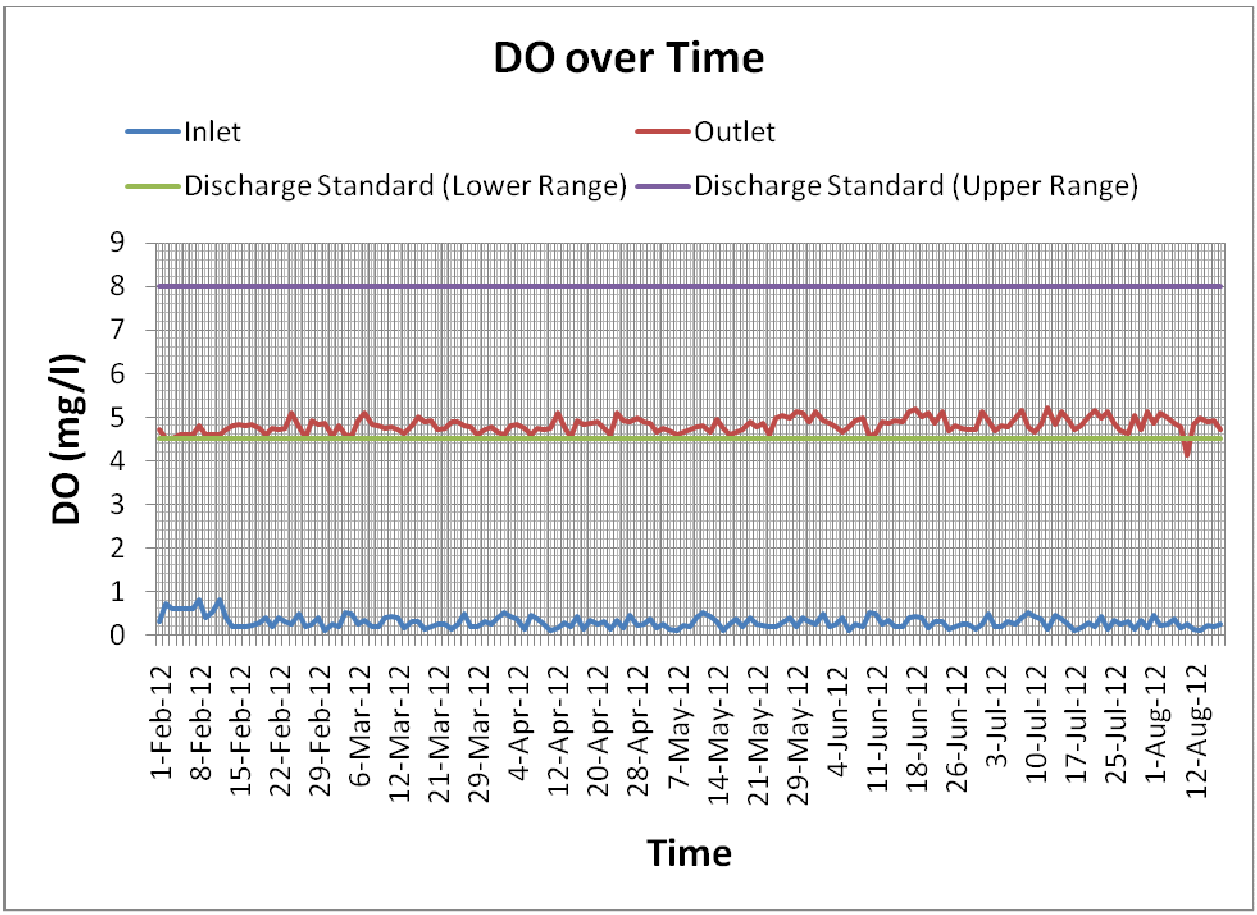



**Figure 4.11:** DO vs Time

Minimum and Maximum value of DO in inlet during February to August was 0.1 mg/l and 0.8 mg/l respectively (Appendix B). Average value in inlet and outlet are 0.29 mg/l and 4.81 mg/l respectively. Minimum value of outlet in CETP is 5.21 mg/l which is in between 4.5 mg/l and 8 mg/l. Maximum value of DO in outlet is 4.12 mg/l which is below 4.5. Second minimum value of DO is 4.5 mg/l which occurs two times during this period. Moreover, there are so many days where DO is close to 4.5. So it can be roughly said that DoE standard for inland surface water in terms of DO is maintained by CETP.

From the above figures, it is seen that CETP is maintaining the DoE standard for every five basic parameters before discharging into the inland surface water.

Generation of sludge is also measured regularly by CETP. Capacity of each sludge drying bed is 25 ton of sludge. Data of sludge production and management is shown in Appendix C. It has been observed that it took two months i.e. February and March for filling up the Sludge Drying Bed-1. On August 26, sixth drying bed was operating. After certain days they remove the sludge and clean the sludge drying bed for further operation.

Opening stock of sludge was 155670 kg up to 26$^{th}$ August. Average daily sludge production was 748.41 kg.

**Photo 4.12:** Sludge Drying Beds in CETP

# Chapter 5

# Environmental Impact Assessment

## 5.1 General

In this chapter Environmental Impact Assessment was covered in detail. A brief description about environmental parameters and how to choose the required method among the EIA methodologies available are parts of this chapter. Later on this chapter gives a theoretical description of EES that is adopted for conducting the Environmental Impact Assessment in the DEPZ area. The steps of the EES method that was followed during the EIA was also discussed shortly. Finally, values of different parameters and EIV calculation are shown in a table.

## 5.2 Environmental Issues Related to DEPZ area

### 5.2.1 Environmental Parameters

In Bangladesh a considerable number of parameters or components of the environment may be grouped under three mutually interacting major components-ecological, physico-chemical and human interest. The ecological components include fisheries, eutrophication, weeds, forest, wildlife, species diversity and endangered species under aquatic and terrestrial sub-groups. The physico-chemical effects are diverse and extended over a large number of parameters under land, surface water, ground water and atmosphere. Human interests include various parameters under health situation, socio-economic and aesthetic conditions. A change in the system exerts certain influence on many parameters resulting in a net positive or negative impact on the environment. The understanding of the development actions and their interactions with the components of the environment is needed to conduct environmental assessment of infrastructural development projects and to plan mitigating measures to prevent or minimize environmental degradation.

### 5.2.2 Evaluation of Impact

The magnitude of impacts either positive or negative has to be quantified to conduct EIA. The most common measurements of some parameters are length, number and area affected or benefited. The evaluation of some of the parameters related to quality of life is very difficult and requires specialized training and long experience. The scope of this guideline will be to

make a quantitative and qualitative evaluation of various related environmental parameters based on available information, experience from similar project, knowledge of the related previous literatures, field observation, simple survey and measurement and correlate them to the magnitude of the impacts.

## 5.3 Environmental Impact Assessment (EIA)

### 5.3.1 Introduction

Environmental Impact Assessment (EIA) is the assessment of the beneficial and adverse changes in environmental resources or values resulting from a proposed project. It is a planning and management tool for sustainable development that seeks to identify the type, magnitude and probability of environmental and social changes likely to occur as direct or indirect result of a project or policy and to design the possible mitigation procedure (Vanclay and Bronstein, 1995; Harvey, 1998; Momtaz et al., 1998; Thomas, 1998). The EIA process essentially comprises of three sequential elements. They are-

(1) Identification of all possible positive and negative impacts on the natural and human environment resulting from a proposed project.

(2) Evaluation or assessment which includes quantification of the identified impacts with respect to a common base and with respect to impacts from other project actions.

(3) Preparation of a mitigation plan which upon implementation, will reduce or offset the potentially significant negative impacts of a project to acceptable levels. This reduction may result from implementation of a project alternative or project modifications or environmental protection measures. The plan simply reduces the number or magnitude of adverse impacts.

The EIA process may also include a monitoring plan to observe performance of the mitigation plan adopted for protection of the environment from degradation and to review the environmental changes during implementation and operation of the project closely. But these are beyond the scope of this thesis paper.

### 5.3.2 Steps of EIA

When it is identified that EIA is required by Screening or Initial Environmental Examination (IEE) the immediate step is the Scoping. After that Impact Analysis is done according to the available tools or methodology for the analysis. Several methodologies have been developed for assessing the impacts of development activities on the environment. These are as follows: Ad-hoc, Checklists, Environmental evaluation System (EES), Matrices, Networks, Cost/benefit analysis, overlays and Geographical Information Systems (GIS), simulation modeling workshop. Based on the impact analysis, mitigation and impact management is proposed according to engineering judgment. In this way, EIA report is prepared.

This thesis is limited to impact analysis and mitigation and impact management with proper involvement of the surrounding public.

### 5.3.3 EIA Methodologies

There are about 100 methods for carrying out ElA but most of these can be divided into only a few classes. The eight important techniques and methodologies considered suitable for assessing environmental impact of development activities in the developing countries are:

(1) Checklists
(2) Matrices
(3) Overlays
(4) Networks
(5) Environmental Indices
(6) Cost-Benefit Analysis
(7) Simulation Modeling Workshops
(8) Environmental Evaluation System

All the methods are neither suitable for every type of project nor adaptable in all developing countries without modification. It is important to understand the strength and weakness of the techniques and methodologies to determine the suitable methods for different types of

projects in the context of technical and economical situation prevailing in a country. An evaluation of various ElA methodologies based on 16 criteria presented in UNESCAP Publication is shown in Table 5.1. Each of the methods compared here are subjective to some degree and no one of them is good for every application.

**Table 5.1:** Summary of Evaluation of EIA Methodologies

| Criteria | Check lists | Over lay | Net work | Mat rix | Environm ental Index | Cost Benefit analysis | Simulation Modeling Working |
|---|---|---|---|---|---|---|---|
| 01. Comprehensiven ess | S | N | L | S | S | S | L |
| 02. Communicability | L | L | S | L | S | L | L |
| 03. Flexibility | L | S | L | L | S | S | L |
| 04. Objevtivity | N | S | S | L | L | L | S |
| 05. Aggregation | N | S | N | N | S | S | N |
| 06. Replicability | S | L | S | S | S | S | S |
| 07. Multi-functions | N | S | S | S | S | S | L |
| 08. Uncertainity | N | N | N | N | N | N | S |
| 09. Space-dimension | N | L | N | N | S | N | S |
| 10. Time-dimension | S | N | N | N | S | S | L |
| 11. Data Requirement | L | N | S | S | S | L | N |
| 12. Summary Format | L | S | S | L | S | L | L |
| 13. Alternative Comparison | S | L | L | L | L | L | L |
| 14. Time Requirement | L | N | S | S | S | S | N |
| 15. Manpower Requirement | L | S | S | S | S | S | N |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 16. | Economy | L | L | L | L | L | L | N |

L = Completely Fulfilled, or Low Resources Need

S = Partially Fulfilled, or Moderate Resource Need

N = Negligibly Fulfilled, or High Resource Need

Source: Environmental Impact Assessment: Guidelines for Planners and Decision Makers, UN Publication ST/ESCAP/351, ESCAP, 1985.

### 5.3.4 The Method of Assessment

Considering the situation prevailing in the country, a simple methodology has been developed for Environmental Impact Assessment of infrastructure projects. The methodology is based on Environmental Evaluation System (EES) developed by Battelle Columbus Laboratories in the United States. In Bangladesh, in the absence of a data base it is only possible to estimate the potential environmental changes from the existing situation. In this method, the existing environmental conditions will be the reference level and the positive and negative changes in environmental conditions resulting from the proposed project will be evaluated. The environmental impact will be assessed by Environmental Impact Values (EIVs) which may be defined mathematically as follows:

$$EIV = \sum_{i=1}^{n} (Vi).(Wi)$$

where Vi is the relative change in the value of environmental quality of parameter i with respect to existing situation. Wi is the relative importance or weight of parameter i, and n is the total number of environmental parameter related to the project. The computation of Environmental Impact Value (EIV) of a project needs determination of Vi, the value representing the magnitude of alteration of the environmental parameters, and Wi, the value representing relative weight or importance of the respective parameters.

#### 5.3.4.1 Magnitude of Environmental Alterations

The beneficial and adverse changes in environmental parameters resulting from a project, usually expressed in qualitative terms have been plotted in a scale to quantify the environmental alterations. Fig 5.1 shows the correlation between qualitative statement and

proposed quantitative values of environmental changes resulting from a project.

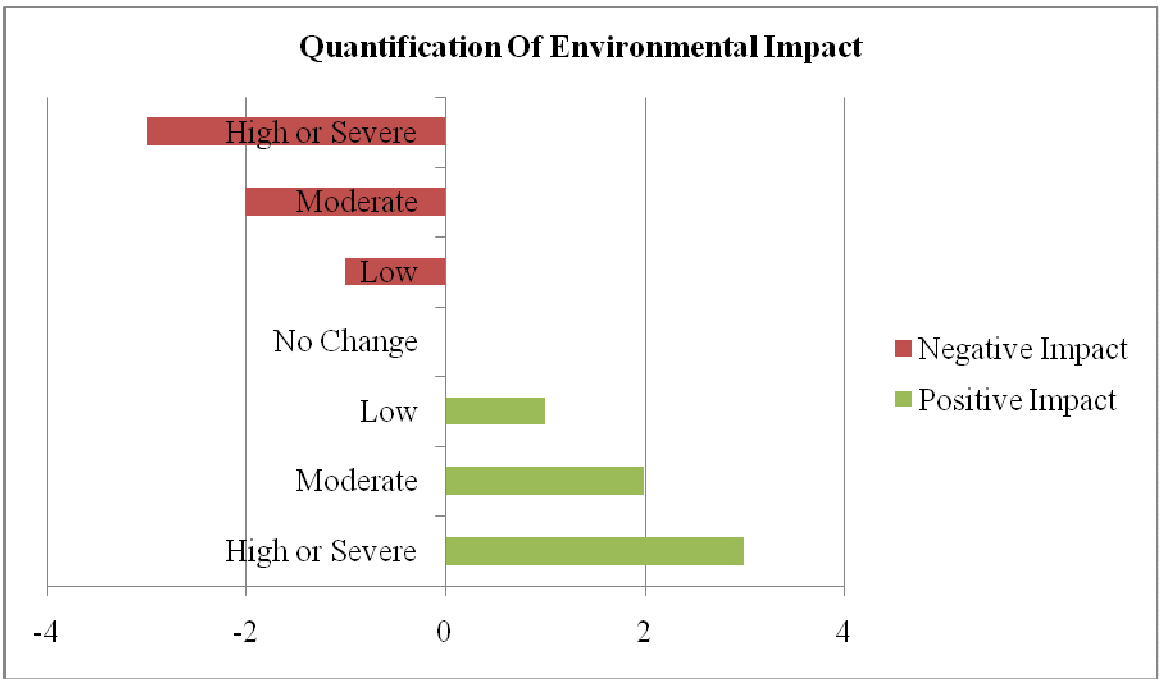



**Fig. 5.1:** Quantification of Environmental Impact

Since the changes of environmental parameters are measured with respect to existing condition, no change has 0 value. The adverse changes have been given values -1, -2and -3 to represent low, moderate, high or severe negative impacts respectively. Similarly +1, +2 and +3represent low, moderate and high positive impacts respectively. A value from the scale representing effect of the project on each parameter will be taken to compute the EIV of the project.

#### 5.3.4.2 Relative Importance of Environmental Parameters

All environmental parameters influenced by the project are not of equal importance or weight. The importance of a parameter varies from country to country depending on the environmental concerns of the country. In Bangladesh, flood, employment, agriculture, fisheries, etc. carry more importance than many others. The parameters related to DEPZ area have been given different values based on prevailing environmental concerns in Bangladesh and presented in Table 5.2. The values representing importance or weight of the parameters

can be used to compute the relative impacts of the parameters that are then summed up to obtain the total EIV of the project.

### 5.3.5 EES Procedure Applied in the DEPZ Area

The activities involved in conducting EIA of a proposed project are diverse and intensive efforts including field surveying are needed to prepare successful ElA report. The procedure for conducting EIA may be described in the following steps:

Step 1: Preparatory Works

A checklist of environmental parameters is prepared by identifying the physico-chemical, ecological and human interest parameters related to this study.

Step 2: Data Collection

Information related to the project was collected from all possible secondary sources and field survey was conducted to collect primary data regarding existing physical, ecological and socio-economic conditions. Potential changes in all relevant environmental parameters were measured with special emphasis on key issues i.e. parameters with higher importance value. Opinion of well-informed local people and the beneficiaries were collected by the field survey. Questionnaires developed to acquire field data have been presented in Appendix D. It can be noted here that field surveys were done in Modhupur, Kaicchabari, Ashulia and Badail which are the areas near DEPZ. List of the participants from different surrounding areas for the interviews was also taken (Appendix E).

The Relative Importance Value of the parameters in relation to the project was determined from DoE, previous literatures and the opinions of the experts.

Step 3: Data Analysis

Qualitative and quantitative field assessments were converted to values indicating magnitude of environmental changes using the scale shown in Fig. 5.1.Quantification was made by calculating the average values taken from the field survey and some minor adjusting based on literature reviews and engineering judgment. For example, impact of the surface water

quality parameters obtained from the field survey was calculated to get the average value of -2.51. It is then rounded to -2.5 based on observation and engineering judgment by the researchers. Again, calculated average value of fisheries, employment opportunity and socio-economic conditions were -2.97, +2.47 and +2.51 respectively which were rounded to -3, +2.5 and +2.5 respectively as previous. It is notable here that it was also necessary for the easy illustration of the impact on environment of the parameters. Moreover, this is an approximate method. So, this type of minor changes based on researchers' judgment should be acceptable.

Step 4: Impact Evaluation

Values indicating magnitude of environmental changes from Fig.5.1, and corresponding importance or weight of environmental parameters influenced by the project in the appropriate columns were put in Table5.2 and relative positive and negative impact of the parameters were obtained by multiplying them. All these impacts were summed up as illustrated in Table 5.2 to obtain the EIVs of major components or of the total project.

Step 5: Mitigating and Monitoring Plans

More attention were put to parameters producing negative EIVs and mitigating measures were identified and incorporated in the planning and implementation stages of the project to eliminate, reduce and offset negative impacts and thereby enhance net positive EIV i.e. benefit of the project.

**Table 5.2:** Determination of Environmental Impact Value (EIV)

| No. of Parameter | Environmental Parameters | Relative Importance Value | Degree of Impact on environment | Relative Impact | | EIV |
|---|---|---|---|---|---|---|
| | | | | Positive | Negative | |
| **Physico-Chemical** | | | | | | -14.25 |
| 01 | Surface Water Availability | 3 | -2.5 | | -7.5 | |
| 02 | Surface Water Quality-chemical, biological or physical | 3 | -2.5 | | -7.5 | |
| 03 | Ground Water Table/Availability | 3 | 1.25 | 3.75 | | |
| 04 | Ground Water Quality | 3 | 2 | 6 | | |
| 05 | Climate Changes | 1 | -1.75 | | -1.75 | |
| 06 | Air Quality-Burning of waste, dust emission, smoke, sight, poor visibility, gas, vapor, unpleasant odor/smell | 2 | -1.75 | | -3.5 | |
| 07 | Air Flow-Wind Patterns | 1 | -1.5 | | -1.5 | |
| 08 | Buffer Zones- usually Vegetated-Forest Vegetative Covers-Windbreaks, Erosion Control, Wildlife Shelter, Sound Insulation | 1 | -1.5 | | -1.5 | |
| 09 | Land Quality Pollution, Geology/Land Capability e.g. Agricultural Capability/Erosion | 2 | .5 | 1 | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 10 | Noise-intensity, duration &frequency-during | 1 | -1.75 | | -1.75 | |
| **Ecological/Biological** | | | | | | -17.25 |
| 11 | Terrestrial Wildlife-Domestic &Farm Animals, mammals, birds | 1 | -2.75 | | -2.75 | |
| 12 | Aquatic Biology especially Fisheries | 3 | -3 | | -9 | |
| 13 | Terrestrial habitats & Aquatic or marine habitat, Wetlands, birds nesting areas, grazing areas | 2 | -2.75 | | -5.5 | |
| **Human interest** | | | | | | 36.75 |
| 14 | Industrial Physical Safety & Health, Psychological well-being | 2 | 1 | 2 | | |
| 15 | Public Health-Diseases such as parasitic disease-malaria, communicable disease-typhoid, cholera | 2 | 1 | 2 | | |
| 16 | Agriculture-Agricultural Crops-Agricultural Land | 3 | -2.25 | | -6.75 | |
| 17 | Employment opportunities-new jobs or transfer, number as well as diversity, skills to fill the jobs | 3 | 2.5 | 7.5 | | |
| 18 | Housing-availability & suitability (local people & immigrant work force) | 1 | 1 | 1 | | |
| 19 | Education | 3 | 2.25 | 6.75 | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 20 | Utilities: water supply, electricity(Power) & gas supply | 3 | -.25 | | -.75 | |
| 21 | Public transport services | 3 | 1.5 | 4.5 | | |
| 22 | Highways/Railways | 3 | 2.25 | 6.75 | | |
| 23 | Medical services & facilities | 2 | -.75 | | -1.5 | |
| 24 | Law Enforcement services | 2 | 1.5 | 3 | | |
| 25 | Solid Waste Disposal, Sewage Disposal, Rubbish collection & disposal | 2 | -1 | | -2 | |
| 26 | Social Change, economic development, Commercial services | 3 | 2.5 | 7.5 | | |
| 27 | Navigation, Flood Control | 1 | .25 | .25 | | |
| 28 | Amenities: Recreation, Religious | 1 | -1.5 | | -1.25 | |
| 29 | Aesthetic/Historic Structures | 1 | .25 | .25 | | |
| 30 | Tranquility | 3 | 2.5 | 7.5 | | |
| Total Environmental Impact Value (EIV) | | | | | | 5.25 |

## 5.4 Major Findings of EIA

As from the results of the Table 4.1, it is seen that relative impact value of physico-chemical parameters and ecological parameters are negative. But human interest parameters are positive. So apparently it can be said that though the environment is degrading, socio-economic condition of the surrounding people is improving.

Surface water availability or the quality is so deteriorated that people can not drink or even bath in those water courses. River 'bonshi' is the main natural stream around DEPZ area which is directly affected for the industries of DEPZ. It is also observed from the site visit in that area. People rely on groundwater source which is good in terms of quality.

Condition of fisheries is worst. Fish habitat is totally collapsed due to continuous pollution from the industries. People import fish from the nearby regions to meet their protein need.

Terrestrial habitats, birds nesting areas and grazing areas are destroyed to establish new industries. As a result, problems of deforestation such as- deterioration of air quality, high speed air flow, less strong buffer zone and in the long run climate change occurs.

Agricultural land or production of agricultural crops is also heavily affected in the DEPZ area for the same reason.

Total EIV value has come positive due to mostly the human interest parameters. Because of DEPZ lots of employment opportunities have been created. Female employment also consist the lion portion of this employment. This result shows similarity with the previous literatures which is shown in the literature review section of this study statistically. As a result, social and economic or commercial condition of the locality has been improved. Also development with respect to highways and education are notable. So, when people get these facilities in their day to day life naturally they feel peace in their mind. They hardly think about the degradation of the environment.

## 5.5 Mitigation Measures for Sustainable Development

To lessen the previous adverse impact on environment following mitigation measures can be adopted:

(i) CETP is treating the effluent of the old zone industries. It should connect the new zone industries as early as possible by overcoming the administrative and political complexity. It is noteworthy that most of the new zone industries have effluent treatment plant.

(ii) Physico-chemical and Ecological parameters of DEPZ area are also degrading due to the outside industries i.e. industries out of DEPZ. Strict administrative control is badly needed for proper maintenance and control of the discharge of those industries in the natural stream.

(iii) Tree plantation initiative has to be taken by the GoB.

(iv) Every ETP should be ensured to run all the time by the concerned authority.

(v) DoE should monitor at least 6 months after in every year to check the condition of ETP, effluent samples report and the certificate of chemical composition issued by third party to ensure that, they are using within permissible limits.

(vi) New industries can be licensed if they fulfill every condition of DoE.

(vii) Agricultural land should not be given for further new establishment of industries.

(viii) Disposal of solid waste should be more organized.

(ix) Efficient equipment that is less responsible for polluting water should be introduced.

(x) Effective Environmental Management Plan should be introduced and implemented.

(xi) The working environment needs to be kept as dry as possible to prevent accidents. Hazardous waste must be disposed of properly in accordance with manufacturers' guidelines and national policies.

(xii) To avoid any severe accident there should always be at least one member of staff on each shift that is trained in "First Aid" and who is made responsible for all first aid requirements during their shift. At least one first aid box should be made available in an area that is accessible to all the workers.

(xiii) Every Textile dyeing industry should apply for air emission test to predict climate change.

(xiv) To ensure the public safety the regular checkup of the laborers should be done. Moreover safety precautions like helmet, eye protective glass, hand gloves, ear plug, and air mask should be taken by laborers to avoid any incident.

(xv) Skin test, blood test should be done for the workers on regular basis.

(xvi) Emergency Evacuation due to fire is very important for dyeing industries as there are many chemicals which may be flammable and explosive used in dying process.

# Chapter 6

# Summary and Conclusions

## 6.1 Summary of the Study

EPZ has a significant financial role in the economy of Bangladesh. It consumes lots of water for the production process and also discharges a huge amount of waste water after its operation. CETP is trying to maintain the discharge standard for inland surface water. But it is only limited to the treatment of the effluent of the old EPZ industries. Although it has a large capacity to treat the effluent new zone industries are not yet connected to CETP due to some administrative complexity. After conducting EIA it has been come out that in spite of lots of positive sides of EPZ it has a number of negative impacts on environment. Although employment opportunity, socio-economic condition, highway and education are the beneficial sectors of the project there are many adverse impacts too. Negative sectors are mainly surface water, fisheries, terrestrial habitat and agricultural crops.

## 6.2 Conclusions

Although EIV is positive now increasing number of industries poses great threat to make it negative in coming days. To minimize the adverse impacts and enhance the positive impacts surrounding people as well as concerned authority bear a significant role and have to be cautious enough and determined to reduce the impact to make a sound and sustainable environment for the future generation. GoB has the most important role to turn it into reality. This study will help to identify some possible mitigation measures to reduce the impact on the environment of the DEPZ area. Hopefully, Bangladesh government will take necessary management initiatives in near future.

## 6.3 Future Scope of this Study

Only 150 surveys from the surrounding people of DEPZ may not be sufficient to come to a decision about the environmental impact of DEPZ area. So, more survey in future would make the decision more accurate.

Only old zone industries are associated with CETP. Due to some administrative complexity, new zone industries are not yet added with CETP. So performance of CETP in terms of treatment of water is measured for only old zone industries. So, after joining with the new

zone industries this study can be extended. Apart from this, not only new zone industries but also some special industries which are not under DEPZ are also discharging water to the surface water course. So, test of water from those discharge points would reveal more information regarding the quality of the surface water.

Other method of EIA can also be adopted in future to evaluate whether the result varies or not. Moreover, that will help to come to a more dependable decision and help taking measures boldly.

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## Appendix A

## Classification of the DEPZ Industries

| Serial Number | Enterprise Name | Category (EPZ) | Category (DOE) |
|---|---|---|---|
| 1. | Austan Ltd. (Sir June) | Wet | RED |
| 2. | South China Bleaching & Dyeing Factory | Wet | RED |
| 3. | Redpoint Jackets Ltd. | Wet | RED |
| 4. | Hyopshin Co .Ltd. | Wet | RED |
| 5. | Young-A Tex BD. Co. Ltd | Wet | RED |
| 6. | Paddock Jeans Ltd | Wet | RED |
| 7. | Dhaka Beijing Dyeing And Weaving | Wet | RED |
| 8. | Helicon Ltd. | Wet | RED |
| 9. | Intimate Suppliers Ltd. | Wet | RED |
| 10. | Lenny Fashion Ltd | Wet | RED |
| 11. | Lenny Apparels Ltd | Wet | RED |
| 12. | FCI (BD) Ltd | Wet | Orange B |
| 13. | Experience Clothing Co. | Wet | RED |
| 14. | Savar Dyeing & Industries Ltd | Wet | RED |
| 15. | SavarDyeing& Finishing Ind. Ltd | Wet | RED |
| 16. | A-ONE BD. LTD. | Wet | RED |
| 17. | Expcom Ltd. | Wet | RED |
| 18. | IL Kwang Co. Ltd | Wet | RED |
| 19. | Experience Accessories | Wet | RED |
| 20. | German Chemicals | Wet | RED |
| 21. | Ever Way Chemical Bd. | Wet | RED |
| 22. | Hop Yick Bd. Ltd | Dry | Orange B |
| 23. | Gold Tex LTD. | Dry | Orange B |
| 24. | H.M. Construction | Dry | Orange A |

| | | | |
|---|---|---|---|
| 25. | Osman Interlings Ltd | Dry | Orange B |
| 26. | Sabir Traders | Dry | Orange B |
| 27. | Meetick Hangers (Dhaka). | Dry | Orange B |
| 28. | Cherry Intimate Limited | Dry | Green |
| 29. | Otl Double Gull Bd. Ltd. | Dry | Orange A |
| 30. | Dong Bangla Facilities (Bd)Ltd. | Dry | Orange B |
| 31. | Geebee Garments Ind Ltd. | Dry | Orange B |
| 32. | Alfa Pattern Bangladesh | Dry | Orange B |
| 33. | Mainetti (Bd) Pvt .Ltd. | Dry | Orange A |
| 34. | Ospinter Garments Ltd. | Dry | Orange B |
| 35. | Dong Mi Tex ,Co. Ltd. | Dry | Orange B |
| 36. | Setexco Limited | Dry | Orange B |
| 37. | D Water Cept | Dry | Orange A |
| 38. | YoungoneHitech Sports Ind Ltd | Dry | Orange B |
| 39. | United Commercial Bank | Dry | Green |
| 40. | Hop Lun (BD) Ltd | Dry | Orange B |
| 41. | Alliance Stitches Ltd. | Dry | RED |
| 42. | Swan Lon Co Ltd. | Dry | Orange B |
| 43. | Alfa Packages (Bd) Ltd. | Dry | Orange A |
| 44. | Fem Accessories Ltd. | Dry | Orange A |
| 45. | Sgwicus (Bd) Ltd. | Dry | Orange B |
| 46. | SavarInd Pvt. Ltd. | Dry | Orange B |
| 47. | Divisional Engineer T&T | Dry | Green |
| 48. | New Star Hi -Lon Co. Ltd. | Dry | Green |
| 49. | Hangers Plus Bd.Ltd. | Dry | Orange B |
| 50. | Baxter Branton (Bd)Cloth | Dry | Orange B |
| 51. | Beximco Fashions Ltd. | Dry | Orange B |
| 52. | Actor Sporting Ltd. | Dry | Orange B |
| 53. | Home Bound Packers | Dry | Orange A |
| 54. | Hsbc Bank Ltd. | Dry | Green |

| | | | |
|---|---|---|---|
| 55. | Air Allience Ltd. | Dry | Orange A |
| 56. | Prime Bank Ltd. | Dry | Green |
| 57. | City Bank Ltd. | Dry | Green |
| 58. | Active Logistic Ltd. | Dry | Green |
| 59. | Expo Express Ltd. | Dry | Orange A |
| 60. | Green View Taver Ltd. | Dry | Green |
| 61. | Tnt Express Ltd. | Dry | Green |
| 62. | Dhl World Wide Ltd. | Dry | Orange A |
| 63. | Novo Cargo Services Ltd | Dry | Green |
| 64. | StanderdcharteredBnk | Dry | Green |
| 65. | Dhaka Bank Ltd | Dry | Green |
| 66. | Swift Logistic Service | Dry | Orange A |
| 67. | Bangladesh Express Ltd. | Dry | Orange A |
| 68. | Mainetti (Bangladesh) Pvt. Ltd | Dry | Orange B |
| 69. | Avery Dennison | Dry | Orange B |
| 70. | Asia Plastic/ Hanger Plus | Dry | Orange B |
| 71. | Brac Net (BD) Ltd. | Dry | Orange B |
| 72. | Dhakarea Ltd | Dry | Orange B |
| 73. | JuHyung Industry Co. Ltd | Dry | Orange B |
| 74. | Juksan (BD) Ltd | Dry | Orange B |
| 75. | Kryolan (BD) Ltd | Dry | Orange B |
| 76. | LSI Industries Ltd/ Lasting Spring Metal Ind. Ltd | Wet | RED |
| 77. | Paxar Bangladesh Ltd | Dry | RED |
| 78. | Queen South Textile Mills Ltd. | Wet | RED |
| 79. | Ring Shine Textiles Ltd. | Wet | RED |
| 80. | SBC Garments Accessories Mfg. (BD) Ltd. | Wet | RED |
| 81. | Shanta Industries Ltd./Shanta Denims Ltd | Dry | RED |
| 82. | Shasha Denims Ltd. | Dry | RED |
| 83. | Shepherd Textile (BD) Ltd. | Wet | RED |

| | | | |
|---|---|---|---|
| 84. | Shine Fashion Co. (Pvt) Ltd | Dry | Orange B |
| 85. | Softex Sweater Ind. (Pvt) Ltd | Dry | Orange B |
| 86. | Superior Footwear Co. Ltd | Dry | Orange B |
| 87. | The Accessories Ltd. | Dry | Orange B |
| 88. | Windsor Plastic (BD) Ltd | Dry | Orange B |
| 89. | YKK Bangladesh Pte Ltd. | Wet | RED |
| 90. | Zong Sine Textile Industries Ltd. | Wet | RED |
| 91. | Avent Garden Fashion | Dry | Orange B |
| 92. | Aamra Fashion Ltd. | Dry | Orange B |
| 93. | Epic Garments Manufaturing Co. Ltd | Wet | RED |
| 94. | I.P. Jaq Knitting Ltd. | Wet | RED |
| 95. | J & J Medical Ltd. | Dry | RED |
| 96. | KBC Cemical Ltd. | Wet | RED |
| 97. | M/s. Styrax Fashion Ltd. | Dry | Orange B |
| 98. | Rancon Sweater Ltd. | Dry | RED |
| 99. | Sangnam Textiles Mills Ltd./Young one Sys. Fiber Pro. Ltd. | Wet | RED |
| 100. | United Power Generation Ltd. | Dry | Orange B |

## Appendix B

## Quality of the water parameters in both Inlet and Outlet of CETP

| Parameters | pH | | TSS (mg/l) | | TDS (mg/l) | | COD (mg/l) | | DO (mg/l) | |
|---|---|---|---|---|---|---|---|---|---|---|
| Date | Inlet | Outlet | Inlet | Outlet | Inlet | Outlet | Inlet | Outlet | Inlet | Outlet |
| 1-Feb-12 | 11.8 | 7.9 | 140 | 120 | 3540 | 2030 | 526 | 182 | 0.3 | 4.7 |
| 2-Feb-12 | 11.1 | 7.7 | 130 | 110 | 2040 | 1380 | 393 | 160 | 0.7 | 4.5 |
| 3-Feb-12 | 11.3 | 7.5 | 130 | 110 | 2180 | 1700 | 340 | 175 | 0.6 | 4.5 |
| 4-Feb-12 | 11.7 | 7 | 130 | 110 | 3920 | 1700 | 458 | 170 | 0.6 | 4.6 |
| 6-Feb-12 | 9.6 | 7.8 | 130 | 110 | 3032 | 1530 | 260 | 179 | 0.6 | 4.6 |
| 7-Feb-12 | 11.5 | 7.5 | 140 | 110 | 2270 | 1350 | 334 | 177 | 0.6 | 4.6 |
| 8-Feb-12 | 10.4 | 7.6 | 130 | 120 | 1120 | 1360 | 340 | 182 | 0.8 | 4.8 |
| 9-Feb-12 | 9.5 | 7.3 | 130 | 110 | 1310 | 1300 | 370 | 185 | 0.4 | 4.6 |
| 11-Feb-12 | 11.5 | 7.9 | 140 | 120 | 3290 | 2080 | 410 | 170 | 0.5 | 4.6 |
| 12-Feb-12 | 10.6 | 7.7 | 140 | 120 | 1650 | 2010 | 260 | 195 | 0.8 | 4.6 |
| 13-Feb-12 | 10.8 | 8.2 | 120 | 80 | 1690 | 1910 | 485 | 166 | 0.4 | 4.7 |
| 14-Feb-12 | 11.7 | 8 | 130 | 100 | 2830 | 1750 | 360 | 171 | 0.2 | 4.8 |
| 15-Feb-12 | 11.2 | 7.8 | 110 | 70 | 1420 | 1690 | 276 | 130 | 0.2 | 4.82 |
| 16-Feb-12 | 10.4 | 8 | 130 | 100 | 1480 | 1560 | 450 | 178 | 0.19 | 4.8 |
| 17-Feb-12 | 12.2 | 8.3 | 160 | 130 | 8790 | 1850 | 735 | 180 | 0.23 | 4.82 |
| 18-Feb-12 | 10.9 | 7.6 | 120 | 90 | 2090 | 1710 | 458 | 164 | 0.27 | 4.73 |
| 19-Feb-12 | 11.8 | 8.2 | 130 | 80 | 1480 | 1500 | 388 | 148 | 0.38 | 4.6 |
| 20-Feb-12 | 11.5 | 7.9 | 120 | 80 | 1710 | 1750 | 376 | 160 | 0.18 | 4.75 |
| 22-Feb-12 | 10.8 | 8.2 | 120 | 80 | 1710 | 1850 | 476 | 150 | 0.39 | 4.7 |
| 23-Feb-12 | 12.1 | 8 | 150 | 100 | 3710 | 1790 | 472 | 186 | 0.3 | 4.73 |
| 25-Feb-12 | 12 | 8 | 120 | 80 | 2140 | 1530 | 451 | 154 | 0.24 | 5.1 |
| 26-Feb-12 | 11.5 | 7.5 | 140 | 100 | 1980 | 1950 | 390 | 145 | 0.48 | 4.76 |
| 27-Feb-12 | 11.7 | 7.8 | 110 | 70 | 1940 | 2030 | 487 | 157 | 0.18 | 4.52 |
| 28-Feb-12 | 11.5 | 7.5 | 150 | 100 | 2410 | 1880 | 310 | 174 | 0.26 | 4.91 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 29-Feb-12 | 11.3 | 7.4 | 130 | 80 | 1630 | 1590 | 491 | 167 | 0.38 | 4.82 |
| 1-Mar-12 | 11 | 7.4 | 130 | 80 | 2690 | 1700 | 307 | 140 | 0.1 | 4.87 |
| 2-Mar-12 | 11.1 | 7.2 | 130 | 80 | 1940 | 1860 | 482 | 174 | 0.25 | 4.57 |
| 3-Mar-12 | 11.8 | 7.4 | 130 | 50 | 4800 | 1990 | 576 | 158 | 0.18 | 4.79 |
| 4-Mar-12 | 11.7 | 7 | 130 | 110 | 3920 | 1700 | 458 | 170 | 0.51 | 4.6 |
| 5-Mar-12 | 10.5 | 6.9 | 140 | 130 | 1990 | 1760 | 740 | 161 | 0.48 | 4.57 |
| 6-Mar-12 | 12.2 | 7.4 | 110 | 80 | 5710 | 1370 | 637 | 177 | 0.25 | 4.93 |
| 7-Mar-12 | 12 | 7.2 | 130 | 90 | 2540 | 1230 | 651 | 165 | 0.33 | 5.1 |
| 8-Mar-12 | 11.8 | 7.5 | 140 | 70 | 2190 | 1460 | 574 | 179 | 0.18 | 4.84 |
| 9-Mar-12 | 11.6 | 7.1 | 120 | 90 | 2340 | 1850 | 481 | 155 | 0.18 | 4.8 |
| 10-Mar-12 | 11.4 | 7.4 | 140 | 100 | 4240 | 1960 | 740 | 172 | 0.39 | 4.75 |
| 11-Mar-12 | 12.1 | 7.8 | 150 | 70 | 3380 | 1810 | 754 | 149 | 0.43 | 4.77 |
| 12-Mar-12 | 12.2 | 7.6 | 140 | 90 | 2160 | 1850 | 730 | 168 | 0.38 | 4.72 |
| 13-Mar-12 | 12.4 | 7.9 | 110 | 90 | 2010 | 2050 | 675 | 170 | 0.16 | 4.61 |
| 14-Mar-12 | 13.2 | 7.9 | 110 | 80 | 2170 | 1830 | 730 | 183 | 0.31 | 4.79 |
| 18-Mar-12 | 12.2 | 7.9 | 140 | 100 | 2270 | 1930 | 823 | 146 | 0.29 | 4.99 |
| 19-Mar-12 | 12.3 | 7.8 | 110 | 70 | 2290 | 1930 | 674 | 142 | 0.12 | 4.9 |
| 20-Mar-12 | 11.9 | 8 | 140 | 110 | 2310 | 1840 | 586 | 146 | 0.18 | 4.91 |
| 21-Mar-12 | 11.9 | 8.2 | 160 | 120 | 1840 | 1860 | 625 | 166 | 0.26 | 4.71 |
| 22-Mar-12 | 12.4 | 8 | 150 | 100 | 2210 | 1950 | 771 | 149 | 0.24 | 4.75 |
| 24-Mar-12 | 12.4 | 7.9 | 140 | 50 | 1890 | 1750 | 705 | 158 | 0.14 | 4.88 |
| 25-Mar-12 | 12.3 | 7.7 | 140 | 70 | 2040 | 1750 | 780 | 150 | 0.24 | 4.9 |
| 27-Mar-12 | 11.8 | 8.2 | 150 | 90 | 2050 | 1700 | 866 | 177 | 0.48 | 4.8 |
| 28-Mar-12 | 12.3 | 7.9 | 120 | 100 | 2080 | 1790 | 589 | 165 | 0.19 | 4.76 |
| 29-Mar-12 | 10.5 | 7.6 | 130 | 50 | 2010 | 1950 | 670 | 173 | 0.2 | 4.59 |
| 30-Mar-12 | 12.1 | 7.9 | 140 | 50 | 1890 | 1750 | 710 | 162 | 0.31 | 4.7 |
| 31-Mar-12 | 12.5 | 7.9 | 100 | 70 | 2040 | 1940 | 690 | 160 | 0.24 | 4.78 |
| 1-Apr-12 | 12.5 | 7.9 | 140 | 80 | 2150 | 1870 | 699 | 170 | 0.38 | 4.65 |
| 2-Apr-12 | 12 | 8.1 | 120 | 70 | 2000 | 1540 | 570 | 164 | 0.51 | 4.6 |
| 3-Apr-12 | 12.6 | 7.8 | 130 | 80 | 1890 | 1740 | 499 | 144 | 0.42 | 4.8 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 4-Apr-12 | 12.2 | 7.8 | 130 | 80 | 1810 | 1730 | 712 | 142 | 0.35 | 4.82 |
| 5-Apr-12 | 12.5 | 7.4 | 140 | 100 | 1820 | 1740 | 770 | 150 | 0.14 | 4.73 |
| 6-Apr-12 | 12.4 | 7.6 | 130 | 90 | 2090 | 1950 | 750 | 180 | 0.45 | 4.6 |
| 7-Apr-12 | 12 | 7.5 | 120 | 80 | 1910 | 1950 | 715 | 172 | 0.35 | 4.75 |
| 8-Apr-12 | 12.4 | 7.3 | 130 | 60 | 2240 | 2000 | 785 | 140 | 0.26 | 4.7 |
| 9-Apr-12 | 11.8 | 7.7 | 140 | 70 | 1260 | 1470 | 740 | 181 | 0.11 | 4.73 |
| 12-Apr-12 | 12.1 | 7.4 | 120 | 120 | 1790 | 1250 | 746 | 184 | 0.15 | 5.1 |
| 15-Apr-12 | 12.5 | 7.9 | 130 | 70 | 2100 | 1810 | 702 | 165 | 0.28 | 4.76 |
| 16-Apr-12 | 12.2 | 7 | 150 | 90 | 2240 | 2010 | 781 | 163 | 0.18 | 4.52 |
| 17-Apr-12 | 11.9 | 7.7 | 140 | 70 | 1840 | 1480 | 825 | 139 | 0.42 | 4.91 |
| 18-Apr-12 | 12.5 | 7.9 | 80 | 70 | 1890 | 1380 | 783 | 99 | 0.12 | 4.82 |
| 19-Apr-12 | 12.4 | 7.1 | 100 | 80 | 1840 | 1450 | 694 | 126 | 0.32 | 4.87 |
| 20-Apr-12 | 11.8 | 7.2 | 80 | 50 | 1930 | 1470 | 650 | 125 | 0.24 | 4.9 |
| 22-Apr-12 | 12 | 7.1 | 120 | 60 | 1550 | 1680 | 801 | 122 | 0.31 | 4.75 |
| 23-Apr-12 | 12.7 | 7.5 | 110 | 80 | 1540 | 1480 | 755 | 145 | 0.14 | 4.6 |
| 24-Apr-12 | 12 | 7.7 | 140 | 60 | 1850 | 1560 | 786 | 132 | 0.34 | 5.1 |
| 25-Apr-12 | 12.5 | 7.5 | 100 | 60 | 1590 | 1240 | 812 | 167 | 0.17 | 4.92 |
| 26-Apr-12 | 12.1 | 7.9 | 120 | 90 | 1310 | 1020 | 789 | 150 | 0.45 | 4.9 |
| 28-Apr-12 | 11.8 | 7 | 130 | 90 | 2480 | 1230 | 767 | 140 | 0.21 | 4.97 |
| 29-Apr-12 | 12 | 7.3 | 110 | 60 | 1980 | 1440 | 838 | 125 | 0.25 | 4.9 |
| 30-Apr-12 | 12.2 | 7.6 | 120 | 70 | 1820 | 1360 | 810 | 132 | 0.36 | 4.87 |
| 2-May-12 | 11.9 | 7.5 | 100 | 70 | 1470 | 1250 | 785 | 154 | 0.15 | 4.66 |
| 3-May-12 | 11.5 | 7.5 | 110 | 80 | 1420 | 1180 | 805 | 172 | 0.26 | 4.75 |
| 5-May-12 | 11.9 | 7.7 | 90 | 50 | 1430 | 1210 | 790 | 142 | 0.12 | 4.67 |
| 7-May-12 | 12.4 | 7.4 | 100 | 60 | 1550 | 1270 | 769 | 138 | 0.1 | 4.58 |
| 8-May-12 | 12 | 7.5 | 110 | 60 | 1550 | 1140 | 794 | 135 | 0.23 | 4.64 |
| 9-May-12 | 11.7 | 7.8 | 110 | 60 | 1660 | 1260 | 736 | 142 | 0.19 | 4.7 |
| 10-May-12 | 12.6 | 7.3 | 110 | 80 | 2090 | 1330 | 736 | 119 | 0.38 | 4.78 |
| 12-May-12 | 12.3 | 7.4 | 110 | 90 | 1820 | 1490 | 698 | 165 | 0.52 | 4.81 |
| 13-May-12 | 12.4 | 7.6 | 120 | 70 | 2190 | 1640 | 756 | 160 | 0.42 | 4.65 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 14-May-12 | 12 | 7.7 | 110 | 70 | 1830 | 1460 | 810 | 123 | 0.29 | 4.95 |
| 15-May-12 | 11.8 | 7.4 | 120 | 60 | 2030 | 1360 | 769 | 118 | 0.11 | 4.74 |
| 16-May-12 | 12.1 | 7.4 | 100 | 60 | 1840 | 1750 | 792 | 136 | 0.26 | 4.58 |
| 17-May-12 | 11.9 | 7.8 | 120 | 50 | 1490 | 1620 | 750 | 141 | 0.35 | 4.65 |
| 19-May-12 | 11.6 | 8 | 100 | 70 | 1840 | 1700 | 788 | 135 | 0.2 | 4.71 |
| 20-May-12 | 11.8 | 7.9 | 100 | 80 | 2030 | 1840 | 751 | 157 | 0.38 | 4.88 |
| 21-May-12 | 11.9 | 7.7 | 120 | 70 | 1960 | 1590 | 654 | 148 | 0.25 | 4.77 |
| 22-May-12 | 11.9 | 7.5 | 100 | 60 | 2010 | 1490 | 710 | 129 | 0.21 | 4.85 |
| 23-May-12 | 12 | 7.4 | 100 | 60 | 1870 | 1550 | 699 | 135 | 0.19 | 4.58 |
| 24-May-12 | 12 | 7.4 | 100 | 60 | 1970 | 1520 | 699 | 135 | 0.19 | 4.97 |
| 27-May-12 | 11.8 | 7.7 | 110 | 70 | 1830 | 1120 | 751 | 168 | 0.27 | 5.02 |
| 28-May-12 | 11.6 | 7.9 | 100 | 50 | 1560 | 1250 | 723 | 151 | 0.38 | 4.96 |
| 29-May-12 | 11.5 | 7.4 | 130 | 60 | 1740 | 1180 | 674 | 144 | 0.18 | 5.12 |
| 30-May-12 | 11.6 | 7.8 | 100 | 50 | 1260 | 970 | 641 | 119 | 0.39 | 5.08 |
| 31-May-12 | 11.7 | 7.6 | 80 | 45 | 1550 | 1150 | 710 | 123 | 0.3 | 4.89 |
| 1-Jun-12 | 12.1 | 7.5 | 110 | 60 | 2000 | 1400 | 624 | 125 | 0.24 | 5.11 |
| 2-Jun-12 | 11.8 | 7.7 | 90 | 60 | 1800 | 1300 | 675 | 132 | 0.48 | 4.91 |
| 3-Jun-12 | 12.1 | 7.5 | 80 | 40 | 2010 | 1250 | 751 | 112 | 0.18 | 4.85 |
| 4-Jun-12 | 11.6 | 7.5 | 90 | 40 | 1640 | 1000 | 741 | 125 | 0.26 | 4.78 |
| 5-Jun-12 | 11.8 | 7.7 | 80 | 50 | 1790 | 1230 | 787 | 130 | 0.38 | 4.65 |
| 6-Jun-12 | 11.9 | 7.5 | 90 | 60 | 1600 | 1450 | 687 | 140 | 0.1 | 4.78 |
| 7-Jun-12 | 12.2 | 7.8 | 100 | 70 | 1840 | 1520 | 720 | 121 | 0.25 | 4.92 |
| 9-Jun-12 | 12.1 | 7.8 | 100 | 50 | 1820 | 1400 | 730 | 136 | 0.18 | 4.98 |
| 10-Jun-12 | 11.6 | 7.5 | 80 | 60 | 1990 | 1500 | 687 | 112 | 0.51 | 4.57 |
| 11-Jun-12 | 11.9 | 7.8 | 90 | 70 | 1360 | 1420 | 738 | 119 | 0.48 | 4.63 |
| 12-Jun-12 | 11.9 | 7.8 | 100 | 50 | 1860 | 1250 | 732 | 144 | 0.25 | 4.88 |
| 13-Jun-12 | 12 | 7.8 | 70 | 50 | 1600 | 1580 | 714 | 158 | 0.33 | 4.86 |
| 14-Jun-12 | 12.2 | 7.8 | 80 | 70 | 1800 | 1640 | 745 | 120 | 0.18 | 4.91 |
| 16-Jun-12 | 11.9 | 7.8 | 100 | 60 | 1810 | 1480 | 725 | 118 | 0.18 | 4.88 |
| 17-Jun-12 | 11.7 | 7.7 | 90 | 70 | 1910 | 1530 | 687 | 123 | 0.39 | 5.12 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 18-Jun-12 | 11.9 | 7.9 | 110 | 50 | 1810 | 1630 | 706 | 135 | 0.43 | 5.18 |
| 19-Jun-12 | 11.6 | 7.7 | 100 | 60 | 1640 | 1500 | 746 | 118 | 0.38 | 4.99 |
| 20-Jun-12 | 11.8 | 7.4 | 90 | 70 | 1990 | 1260 | 685 | 120 | 0.16 | 5.1 |
| 21-Jun-12 | 12.1 | 7.6 | 120 | 70 | 1800 | 1750 | 725 | 112 | 0.31 | 4.87 |
| 23-Jun-12 | 10.2 | 7.7 | 120 | 70 | 1640 | 1600 | 654 | 137 | 0.29 | 5.12 |
| 25-Jun-12 | 12.3 | 8.1 | 80 | 60 | 1600 | 1300 | 532 | 133 | 0.12 | 4.68 |
| 26-Jun-12 | 12 | 7.9 | 80 | 40 | 1500 | 1200 | 551 | 130 | 0.18 | 4.79 |
| 27-Jun-12 | 12.5 | 7.6 | 100 | 70 | 1500 | 1300 | 578 | 125 | 0.26 | 4.75 |
| 12-Jan-00 | 12 | 7.5 | 90 | 80 | 1700 | 1400 | 597 | 119 | 0.24 | 4.71 |
| 30-Jun-12 | 12.3 | 7.4 | 100 | 50 | 1700 | 1300 | 630 | 137 | 0.14 | 4.71 |
| 1-Jul-12 | 12.1 | 7.5 | 110 | 60 | 2000 | 1400 | 624 | 125 | 0.24 | 5.11 |
| 2-Jul-12 | 11.8 | 7.7 | 90 | 60 | 1800 | 1300 | 675 | 132 | 0.48 | 4.91 |
| 3-Jul-12 | 12.1 | 8 | 80 | 60 | 1700 | 1400 | 710 | 122 | 0.19 | 4.68 |
| 4-Jul-12 | 12 | 7.5 | 90 | 50 | 1700 | 1300 | 691 | 154 | 0.2 | 4.79 |
| 5-Jul-12 | 11.9 | 7.8 | 100 | 70 | 1500 | 1400 | 721 | 138 | 0.31 | 4.77 |
| 6-Jul-12 | 12.3 | 8 | 80 | 70 | 1100 | 1200 | 684 | 132 | 0.24 | 4.98 |
| 8-Jul-12 | 11.6 | 7.5 | 90 | 50 | 1100 | 800 | 714 | 145 | 0.38 | 5.14 |
| 9-Jul-12 | 11.8 | 7.8 | 80 | 60 | 900 | 900 | 701 | 130 | 0.51 | 4.77 |
| 10-Jul-12 | 12 | 7.9 | 100 | 80 | 1600 | 1400 | 765 | 112 | 0.42 | 4.65 |
| 11-Jul-12 | 12.4 | 7.8 | 110 | 60 | 1200 | 1300 | 683 | 119 | 0.35 | 4.82 |
| 12-Jul-12 | 11.4 | 7.3 | 80 | 70 | 1100 | 900 | 597 | 98 | 0.14 | 5.21 |
| 14-Jul-12 | 11.7 | 7.8 | 90 | 50 | 1800 | 1200 | 684 | 141 | 0.45 | 4.84 |
| 15-Jul-12 | 11.5 | 7.6 | 100 | 60 | 1500 | 110 | 724 | 125 | 0.35 | 5.12 |
| 16-Jul-12 | 11.9 | 7.8 | 80 | 60 | 1400 | 110 | 688 | 121 | 0.26 | 4.95 |
| 17-Jul-12 | 12 | 7.9 | 70 | 50 | 1300 | 1200 | 705 | 120 | 0.11 | 4.72 |
| 18-Jul-12 | 12.2 | 7.5 | 120 | 70 | 2000 | 1500 | 652 | 117 | 0.15 | 4.79 |
| 21-Jul-12 | 11.5 | 7.4 | 70 | 60 | 2800 | 1500 | 739 | 125 | 0.28 | 4.99 |
| 22-Jul-12 | 12.1 | 7.8 | 80 | 70 | 2100 | 1400 | 814 | 112 | 0.18 | 5.14 |
| 23-Jul-12 | 11.5 | 7.9 | 80 | 70 | 1800 | 1200 | 720 | 127 | 0.42 | 4.97 |
| 24-Jul-12 | 12.5 | 7.7 | 90 | 50 | 2000 | 1200 | 685 | 115 | 0.12 | 5.12 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 25-Jul-12 | 12.3 | 7 | 100 | 70 | 1500 | 1400 | 756 | 119 | 0.32 | 4.87 |
| 26-Jul-12 | 12 | 7.2 | 100 | 70 | 1900 | 1300 | 746 | 144 | 0.24 | 4.67 |
| 28-Jul-12 | 12.1 | 7.1 | 100 | 70 | 1500 | 1200 | 809 | 130 | 0.31 | 4.62 |
| 29-Jul-12 | 11.8 | 7.8 | 80 | 70 | 1400 | 1100 | 754 | 151 | 0.14 | 5.03 |
| 30-Jul-12 | 12.2 | 7.9 | 80 | 70 | 1500 | 1200 | 735 | 132 | 0.34 | 4.71 |
| 31-Jul-12 | 11.8 | 8.1 | 90 | 50 | 1200 | 900 | 645 | 115 | 0.17 | 5.12 |
| 1-Aug-12 | 12.1 | 8 | 100 | 60 | 1400 | 1200 | 675 | 142 | 0.45 | 4.87 |
| 2-Aug-12 | 12.3 | 8.2 | 100 | 70 | 1500 | 1000 | 724 | 154 | 0.21 | 5.08 |
| 4-Aug-12 | 12.1 | 7.8 | 90 | 70 | 1900 | 1500 | 731 | 160 | 0.25 | 4.98 |
| 5-Aug-12 | 12.2 | 8.3 | 100 | 70 | 2100 | 1600 | 803 | 147 | 0.36 | 4.87 |
| 6-Aug-12 | 12.1 | 8 | 90 | 70 | 1800 | 1400 | 722 | 125 | 0.15 | 4.78 |
| 7-Aug-12 | 12.5 | 7.7 | 110 | 80 | 1900 | 1500 | 764 | 131 | 0.26 | 4.12 |
| 12-Aug-12 | 12.3 | 7.9 | 90 | 70 | 2100 | 1200 | 710 | 138 | 0.12 | 4.83 |
| 13-Aug-12 | 11.7 | 7.2 | 100 | 90 | 2000 | 1500 | 698 | 154 | 0.1 | 4.97 |
| 14-Aug-12 | 12.1 | 7.8 | 110 | 80 | 1900 | 1400 | 741 | 146 | 0.23 | 4.88 |
| 25-Aug-12 | 12 | 7.5 | 80 | 70 | 1900 | 1300 | 820 | 129 | 0.19 | 4.93 |
| 26-Aug-12 | 11.8 | 7.9 | 110 | 80 | 1500 | 1400 | 768 | 138 | 0.24 | 4.71 |
| Average | 11.9 | 7.7 | 111.5 | 74.3 | 1990 | 1494 | 662.2 | 145.4 | 0.29 | 4.81 |

## Appendix C

## Daily Sludge Production and Management by CETP

| Date | Daily Sludge Production | Opening Stock | Store | Remarks |
|---|---|---|---|---|
| 8-Feb-12 | 360kg | 360kg | Sludge Drying Bed-1 | |
| 9-Feb-12 | 400kg | 760kg | Sludge Drying Bed-1 | |
| 10-Feb-12 | 280kg | 1040kg | Sludge Drying Bed-1 | |
| 11-Feb-12 | 450kg | 1490kg | Sludge Drying Bed-1 | |
| 12-Feb-12 | 450kg | 1940kg | Sludge Drying Bed-1 | |
| 13-Feb-12 | 500kg | 2440kg | Sludge Drying Bed-1 | |
| 14-Feb-12 | 520kg | 2960kg | Sludge Drying Bed-1 | |
| 15-Feb-12 | 500kg | 3460kg | Sludge Drying Bed-1 | |
| 16-Feb-12 | 420kg | 3880kg | Sludge Drying Bed-1 | |
| 17-Feb-12 | 280kg | 4160kg | Sludge Drying Bed-1 | |
| 18-Feb-12 | 550kg | 4710kg | Sludge Drying Bed-1 | |
| 19-Feb-12 | 550kg | 5260kg | Sludge Drying Bed-1 | |
| 20-Feb-12 | 500kg | 5760kg | Sludge Drying Bed-1 | |
| 21-Feb-12 | 600kg | 6360kg | Sludge Drying Bed-1 | |
| 22-Feb-12 | 620kg | 6980kg | Sludge Drying Bed-1 | |
| 23-Feb-12 | 480kg | 7460kg | Sludge Drying Bed-1 | |
| 24-Feb-12 | 500kg | 7960kg | Sludge Drying Bed-1 | |
| 25-Feb-12 | 550kg | 8460kg | Sludge Drying Bed-1 | |
| 26-Feb-12 | 450kg | 8910kg | Sludge Drying Bed-1 | |
| 27-Feb-12 | 600kg | 9510kg | Sludge Drying Bed-1 | |
| 28-Feb-12 | 600kg | 10110kg | Sludge Drying Bed-1 | |
| 1-Mar-12 | 620kg | 10730kg | Sludge Drying Bed-1 | |
| 2-Mar-12 | 550kg | 11280kg | Sludge Drying Bed-1 | |

| | | | | |
|---|---|---|---|---|
| 3-Mar-12 | 550kg | 11830kg | Sludge Drying Bed-1 | |
| 4-Mar-12 | 400kg | 12230kg | Sludge Drying Bed-1 | |
| 5-Mar-12 | 520kg | 12750kg | Sludge Drying Bed-1 | |
| 6-Mar-12 | 600kg | 13350kg | Sludge Drying Bed-1 | |
| 7-Mar-12 | 600kg | 13950kg | Sludge Drying Bed-1 | |
| 8-Mar-12 | 500kg | 14450kg | Sludge Drying Bed-1 | |
| 9-Mar-12 | 500kg | 14950kg | Sludge Drying Bed-1 | |
| 10-Mar-12 | 450kg | 15400kg | Sludge Drying Bed-1 | |
| 11-Mar-12 | 650kg | 16050kg | Sludge Drying Bed-1 | |
| 12-Mar-12 | 560kg | 16610kg | Sludge Drying Bed-1 | |
| 13-Mar-12 | 550kg | 17160kg | Sludge Drying Bed-1 | |
| 14-Mar-12 | 600kg | 17760kg | Sludge Drying Bed-1 | |
| 15-Mar-12 | 600kg | 18360kg | Sludge Drying Bed-1 | |
| 16-Mar-12 | 600kg | 18960kg | Sludge Drying Bed-1 | |
| 17-Mar-12 | 550kg | 19510kg | Sludge Drying Bed-1 | |
| 18-Mar-12 | 550kg | 20060kg | Sludge Drying Bed-1 | |
| 19-Mar-12 | 500kg | 20560kg | Sludge Drying Bed-1 | |
| 20-Mar-12 | 550kg | 21110kg | Sludge Drying Bed-1 | |
| 21-Mar-12 | 580kg | 21690kg | Sludge Drying Bed-1 | |
| 22-Mar-12 | 600kg | 22290kg | Sludge Drying Bed-1 | |
| 23-Mar-12 | 620kg | 22910kg | Sludge Drying Bed-1 | |
| 24-Mar-12 | 600kg | 23510kg | Sludge Drying Bed-1 | |
| 25-Mar-12 | 500kg | 24010kg | Sludge Drying Bed-1 | |
| 26-Mar-12 | 550kg | 24560kg | Sludge Drying Bed-1 | |
| 27-Mar-12 | 450kg | 25010kg | Sludge Drying Bed-1 | |
| 28-Mar-12 | 480kg | 25490kg | Sludge Drying Bed-1 | |
| 29-Mar-12 | 480kg | 25970kg | Sludge Drying Bed-1 | |
| 30-Mar-12 | 500kg | 26470kg | Sludge Drying Bed-1 | |
| 2-Apr-12 | 1800kg | 28270kg | Sludge Drying Bed-2 | |
| 6-Apr-12 | 2700kg | 30970kg | Sludge Drying Bed-2 | |

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|---|---|---|---|---|
| 9-Apr-12 | 1500kg | 32470kg | Sludge Drying Bed-2 | |
| 13-Apr-12 | 2300kg | 34770kg | Sludge Drying Bed-2 | |
| 17-Apr-12 | 2100kg | 36870kg | Sludge Drying Bed-2 | |
| 20-Apr-12 | 1950kg | 38820kg | Sludge Drying Bed-2 | |
| 24-Apr-12 | 2550kg | 41370kg | Sludge Drying Bed-2 | |
| 25-Apr-12 | 2800kg | 44170kg | Sludge Drying Bed-2 | |
| 4-May-12 | 1700kg | 45870kg | Sludge Drying Bed-2 | |
| 7-May-12 | 1550kg | 47420kg | Sludge Drying Bed-2 | |
| 11-May-12 | 2250kg | 49670kg | Sludge Drying Bed-2 | |
| 15-May-12 | 2500kg | 52170kg | Sludge Drying Bed-3 | |
| 18-May-12 | 1700kg | 53870kg | Sludge Drying Bed-3 | |
| 21-May-12 | 1600kg | 55470kg | Sludge Drying Bed-3 | |
| 24-May-12 | 1800kg | 57270kg | Sludge Drying Bed-3 | |
| 27-May-12 | 3250kg | 60520kg | Sludge Drying Bed-3 | |
| 30-May-12 | 2550kg | 63070kg | Sludge Drying Bed-3 | |
| 2-Jun-12 | 3700kg | 66770kg | Sludge Drying Bed-3 | |
| 6-Jun-12 | 4100kg | 70870kg | Sludge Drying Bed-3 | |
| 10-Jun-12 | 4500kg | 75370kg | Sludge Drying Bed-3 | |
| 14-Jun-12 | 4700kg | 80070kg | Sludge Drying Bed-4 | |
| 17-Jun-12 | 5100kg | 85170kg | Sludge Drying Bed-4 | |
| 20-Jun-12 | 4500kg | 89670kg | 100 plastic Bag | Each Bag capacity 45kg |
| 23-Jun-12 | 4700kg | 94370kg | Sludge Drying Bed-4 | |
| 26-Jun-12 | 3500kg | 97870kg | Sludge Drying Bed-4 | |
| 30-Jun-12 | 4100kg | 101970kg | Sludge Drying Bed-4 | |
| 3-Jul-12 | 4200kg | 106170kg | Sludge Drying Bed-4 | |
| 6-Jul-12 | 4500kg | 110670kg | Sludge Drying Bed-5 | |
| 9-Jul-12 | 3800kg | 114470kg | Sludge Drying Bed-5 | |
| 12-Jul-12 | 4000kg | 118470kg | Sludge Drying Bed-5 | |
| 16-Jul-12 | 4700kg | 123170kg | Sludge Drying Bed-5 | |

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| 20-Jul-12 | 5300kg | 128470kg | Sludge Drying Bed-5 | |
| 23-Jul-12 | 4400kg | 132870kg | Sludge Drying Bed-6 | |
| 27-Jul-12 | 4500kg | 137370kg | Sludge Drying Bed-6 | |
| 30-Jul-12 | 3900kg | 141270kg | Sludge Drying Bed-6 | |
| 3-Aug-12 | 3500kg | 144770kg | Sludge Drying Bed-6 | |
| 7-Aug-12 | 4200kg | 148970kg | Sludge Drying Bed-6 | |
| 12-Aug-12 | 2700kg | 151670kg | Sludge Drying Bed-6 | |
| 25-Aug-12 | 3800kg | 155670kg | Sludge Drying Bed-6 | |

**Appendix D**

**Questionnaire/Checklist of EIA**

| No. of Parameter | Environmental Parameters | Negative | | | No Change | Positive | | |
|---|---|---|---|---|---|---|---|---|
| | | High or Severe | Moderate | Low | | Low | Moderate | High or Severe |
| **Physico-Chemical** | | | | | | | | |
| 01 | Surface Water Availability | | | | | | | |
| 02 | Surface Water Quality-chemical, biological or physical | | | | | | | |
| 03 | Ground Water Table/Availability | | | | | | | |
| 04 | Ground Water Quality | | | | | | | |
| 05 | Climate Changes | | | | | | | |
| 06 | Air Quality-Burning of waste, dust emission, smoke, sight, poor visibility, gas, vapor, unpleasant odor/smell | | | | | | | |
| 07 | Air Flow-Wind Patterns | | | | | | | |
| 08 | Buffer Zones- usually Vegetated-Forest Vegetative Covers-Windbreaks, Erosion Control, Wildlife Shelter, Sound Insulation | | | | | | | |
| 09 | Land Quality Pollution, Geology/Land Capability e.g. | | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Agricultural Capability/Erosion/ | | | | | | | |
| 10 | Noise-intensity, duration & frequency | | | | | | | |
| **Ecological/Biological** | | | | | | | | |
| 11 | Terrestrial Wildlife-Domestic & Farm Animals, mammals, birds | | | | | | | |
| 12 | Aquatic Biology especially Fisheries | | | | | | | |
| 13 | Terrestrial habitats & Aquatic or marine habitat, Wetlands, birds nesting areas, grazing areas | | | | | | | |
| **Human interest/ community/ responses/ characteristics/ environment** | | | | | | | | |
| 14 | Industrial Physical Safety & Health, Psychological well-being | | | | | | | |
| 15 | Public Health-Diseases such as parasitic disease-malaria, communicable disease-typhoid, cholera | | | | | | | |
| **Socio-Economic** | | | | | | | | |
| 16 | Agriculture-Agricultural Crops-Agricultural Land | | | | | | | |
| 17 | Employment opportunities-new jobs or transfer, number as well as diversity, skills to fill the jobs | | | | | | | |
| 18 | Housing-availability & | | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | suitability (local people &immigrant work force) | | | | | | | |
| 19 | Education | | | | | | | |
| 20 | Utilities: water supply, electricity(Power) & gas supply | | | | | | | |
| 21 | Public transport services | | | | | | | |
| 22 | Highways/Railways | | | | | | | |
| 23 | Medical services & facilities | | | | | | | |
| 24 | Law Enforcement services | | | | | | | |
| 25 | Solid Waste Disposal, Sewage Disposal, Rubbish collection & disposal | | | | | | | |
| 26 | Social Change, economic development, Commercial services | | | | | | | |
| 27 | Navigation, Flood Control | | | | | | | |
| 28 | Amenities: Recreation, Religious | | | | | | | |
| 29 | Aesthetic/Historic Structures | | | | | | | |
| 30 | Tranquility | | | | | | | |

**Appendix E**

**Interviews/Focus Group Discussions (FGDs)**

**List of Participants**

**Location:** **Date & Time:**

| Sl No. | Name, Address & Telephone No. | Occupation | Signature |
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