Clariant

Environmental Impact Assessment Report

Expansion & Up-gradation of Wastewater Treatment Plant & Installation of Incinerator at Clariant Pakistan Limited-Jamshoro, Sindh

Prepared By

Environmental Services

SGS PAKISTAN (PRIVATE) LIMITED

WHEN YOU NEED TO BE SURE

SGS

Environmental Impact Assessment

Final Report

Prepared for

Clariant

Clariant Pakistan Limited–Jamshoro, Sindh

SGS Ref: Env-092/12

August, 2012

SGS PAKISTAN (PRIVATE) LIMITED

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INTRODUCTION

This report renders the relevant information, data and findings of Environmental Impact Assessment (EIA) of a project proposed by Clariant Pakistan Limited (hereinafter referred as CPL). CPL has appointed SGS to carry out the Environmental Impact Assessment study of the proposed project in order to assess the environmental viability of the project.

SGS successfully accomplished a profound analysis of all the possible environmental aspects pertaining to the proposed project. The study has, while considering completion of some parts of the project, also carried out Environmental Audit of the activities and assessment of their operational impacts on the environment.

PROJECT OVERVIEW

In connection to the philosophy of environmental protection, CPL currently has a wastewater treatment plant (WWTP) capable to partially treat 1,400 m^3/day of its effluent. Moreover, CPL also has a small waste incineration plant (WIP) to treat different types of waste having a capacity of 50 kg/hr.

As a result of amplified production, CPL's existing WWTP and IP is confronting problems to handle increased pollution load. Recognizing the need, a broad scale project has been proposed by CPL which involves expansion and up gradation of their existing treatment capacity of wastewater. The expanded wastewater treatment plant is anticipated to be capable of treating around 1,700 m^3/day effluent, enabling it to comply with the NEQS. Likewise, waste incineration plant is proposed to be developed with a capacity of 0.5 TPH. With this new venture, Clariant is keen to adhere to environmental safeguard and in this regard, aims to have accomplished a complete EIA study on its Jamshoro facility.

PROJECT PROPONENT

Clariant came into existence in 1995 from the global de-merger of Chemical Division of Sandoz, established in Basel, Switzerland in 1886.

Clariant Pakistan Limited is the local affiliate of Clariant International; listed on the Karachi Stock Exchange and engaged in the manufacturing and sales of Chemicals, Dyestuffs, Emulsion and Master Batches. Clariant Pakistan Limited is supporting through its services and environment friendly products to Textile and Leather Industries, contributing 80% to the country's economy. Clariant Pakistan also exports Chemical & Dyestuff to Europe, China, Far East and South America.

THE EIA REQUIREMENT

The EIA has been prepared in conformance with the requirements of the Pakistan Environmental Protection Act (PEPA) 1997.

This study has responded to the requirements of Section 12, since some parts of the project have already been completed and hence an Environmental Audit of the activities and their impacts on the environment forms an integral part of the EIA Report.

The Pakistan Environmental Protection Agency (Review of IEE/EIA) Regulations 2000 evidently define the categories of projects requiring an Initial Environmental Examination (IEE) or Environmental Impact Assessment (EIA) in Schedules I & II respectively. According to Schedule II, Category G (Waste Disposal), following projects require an EIA:

i. Waste disposal and/ or storage of hazardous or toxic wastes (including landfill sites, incineration of hospital toxic waste).

ii. Waste disposal facilities for domestic or industrial wastes, with annual capacity more than 10,000 cubic meters.

According to the above, this project has been placed in **Category G**, **Schedule II**. Therefore an EIA study has been conducted for proposed project and the report will be submitted to Sindh EPA for review and approval.

THE EIA METHODOLOGY

Several milestones were laid down during the course of this EIA study which includes site visit, legislative review, literature evaluation, stakeholder consultation, project specific data acquisition, impact identification and assessment, mitigation measures and environmental management plan development.

PHYSICAL ENVIRONMENT

The project area falls in district Jamshoro of Sindh province. The district is spread over an area of 4,791,024 acres with 28 Union Councils, 1,050 Dehs and 1359 Villages. District has four Talukas namely Kotri, Manjhand, Sehwan Sharif and Thano Bula Khan. The proposed project is situated within the existing premises of CPL Jamshoro facility which is spread over on around 92 acres of land; and was established in 1970. The site is located in Sandoznagar, Jamshoro on Petaro Road and geographically situated at 25° 26′ 55.23″ N and 68° 17′ 00.59″ E.

The project area lies on the flood plain deposits of River Indus. The land is fertile in nature and therefore the area was primarily used for agriculture. The soils in the project area are made up of alluvial deposits typical of Sindh plain. These are river transported deposits, which are quite thick and fairly homogenous in extent. The soil at the surface generally ranges from grayish brown loose to medium dense silty fine sands which are underlain by extensive deposits of fine to course sands.

The climate of Jamshoro district is randomly pleasant. In summer, the northern part (Sehwan) is hotter than that of other parts of the district and normal cool in winter. According to climatic zones of Pakistan, the district lies in "hot summer & mild winters" and

seasonally falls under arid regions. Mild winter extends from November to February and few cold waves take place occasionally due to western weather disturbances. Summer occurs from March to June and hot weather sets in when hot winds blow from the desert area. When the pressure vacuum builds up in the north Arabian Sea, it stops sea breeze over the entire Sindh coast.

The last Five (05) years data was procured from the nearest metrological station maintained by Pakistan Meteorology Department. As no station exists in the district therefore meteorological data from Hyderabad station has been used which provides a general idea of the baseline climatic conditions of the project area and its surroundings. The metrological data of different parameters is attached as **Annexure IV** of the report. However, SGS team is well-equipped with weather monitoring station through which different metrological parameters i.e. Wind direction, Wind speed, Temperature, Atmospheric Pressure and Relative Humidity were monitored during baseline environmental monitoring. Monitoring data indicates that temperature was recorded minimum as 36°C and recorded maximum as 44°C during 24 hours. During 24-hours of monitoring, wind blows mostly in North & North-East direction with wind speed varies from 1.6 to of 6.4 m/s. Humidity ranges between minimum 30% up to maximum at 53% during 24 hours of monitoring. The 24-hour recorded weather data is presented as **Table 5.5.**

The metrological data procured from the Pakistan Metrological Department depicts that mean monthly temperature was minimum registered 15.8°C in Jan, 2008 and it was highest found 34.4°C in the month of May, 2009. Average of annual mean monthly temperature was registered minimum at 27.4°C in 2008 and it was highest recorded 2.8.0°C during the year 2009 and 2010.

The last five years rain fall data shows variation between 0–137 mm, and mean monthly maximum rain fall reported is 137 mm during the year of 2009.

Relative humidity at 0000 UTC was registered lowest as 56% in the month of April, 2009, and it was recorded highest as 88% during the month of September 2009 & July, 2011; whereas lowest relative humidity at 1200 UTC was registered 20% during the month of December 2007, February 2008 & April 2011 and it was recorded highest as 73% during the month of September, 2011.

Wind speed pattern at 0000 UTC was registered lowest as 0.9 knots in the month of July, 2010, and recorded highest as 17.8 knots during the month of July, 2008; whereas lowest mean Wind speed at 1200 UTC was registered 4.7 knots during the month of November; 2011 and recorded highest as 26.3 knots during the month of May, 2008.

Water constitutes an important section of physical environment of an IEE/EIA Study to define its magnitude, quality and occurrence throughout the entire project corridor. Surface water resources exist in the corridor of proposed project. The main source of surface water in

the proposed project corridor is River Indus through associated Barrage (e.g. Kotri Barrage) and branch canals (e.g. KB Feeder Canal) situated on the right bank of River Indus, about 3-5 km away from project site..

The project area is underlain by unconsolidated alluvial deposits laid by river Indus. Fine to course sands from aquifer material occurs at various layers. The aquifer is fairly thick. In Jamshoro district of Sindh province, the drinking water supplies are mainly induced from sweet aquifers on the right bank of river Indus and some water from river itself. Groundwater table of the area generally occurs from 6 to 8 meter below the ground level.

In order to assess ground water quality, sampling was conducted near the project area for the analysis of pH, TDS, Electrical conductivity (EC), salinity, temperature, lead, arsenic, cadmium and zinc. In addition to the sampling done by SGS team, another detailed study on Groundwater Quality in Sindh, conducted by Indus Institute for Research & Education, was also consulted to analyze the baseline groundwater quality of the project area. Chemical analysis results are presented in **Table 5.1** and **Table 5.2** and are also discussed in relevant section of the report.

The proposed project is located in fairly open and clean air corridor and is mostly surrounded by network of diverse agriculture lands and villages. Main sources of air pollution near the vicinity of the project area are very small to least number of vehicular traffic along Petaro road including buses, trucks, cars, rickshaws, limited number of motor bikes and some stationery sources of combustion including power generators. In addition, pollution can also be caused by Jamshoro power plant which is at a distance of 4-5 km and Lakhra power plant which is around 8-9 km away from the proposed site. There is only one industrial unit Novartis Pharma adjacent to the Clariant, which is not supposed to cause significant air pollution. Both Clariant and Novartis Pharma are not involved in drastic fossil fuel combustion and do not significantly deteriorate the air quality of the area. The airshed in the macro & microenvironment of the project is clean enough to cause any sort of health associated risk to population & vegetation cover of soil.

In order to collect the current baseline data for ambient air quality, ambient air quality monitoring was also conducted. For this purpose, mobile air quality station was installed at proposed project site for 24 hours continuous monitoring of the criteria pollutants included Carbon monoxide (CO), Sulfur dioxide (SO_2), Nitrogen Oxides (NOx), and Suspended Particulate Matter (SPM). Summary of ambient air quality monitoring is presented in **Table 5.4** and is also discussed in respective section of the report.

Noise is regarded as an important environmental stressor pollutant and is monitored as essential matrix during environmental studies. Since there was no reliable noise data available, noise monitoring was also conducted during social survey at 5 locations. The noise level was found within range of 54.3 – 60.9 dB at day time which exceeds the permissible

limit of 55 dBA for Residential area. **Table 5.6** shows the summary of monitoring results conducted at different locations.

BIOLGICAL ENVIRONMENT

Flora

The main habitats in the project area included the built-in area, ponds, plantation and orchard inside the premises. The habitats around the project area on the outer periphery comprised of agriculture area, villages, water channels and marshy areas. As many as 36 species of plants were recorded in the CPL premises and the surrounding area. The plantation and the orchard within the premises of CPL have been very well maintained and provide quite a favorable environment particularly to the birds, both resident and migratory. Since the project site lies somewhere in between a semi-urban and rural environment, the floral species are less in number and are mostly anthropogenic. The anthropogenic species are quite old, and provide food, shelter and nesting sites for birds. There are agricultural fields, and the rainy nullah and road side area around as well having dense vegetation. No evidence of rare species of wild plant exists within the project area.

Fauna

The project area and the outside area support a variety of bird fauna, both resident and migratory. As many as 29 species of birds were recorded from the area. Some migratory species of birds were recorded at this time of the year such as Common Sandpiper and Great Bittern. A double passage migrant Rosy Starling was also recorded. Its first autumn arrivals appear in Sindh in late July. No threatened species of birds were recorded from the area.

Mammals

Since the project site lies somewhere in between a semi-urban and rural environment, there is hardly any opportunity for mammals to survive. A total of 7 species of mammals were recorded from the area. Although the area supports a variety of avifauna but the presence of mammalian species is relatively poor. Bats have also been reported in the area. No threatened or protected species of mammals was recorded from the area.

Reptiles

A total of 8 Species of Reptiles were recorded. None of them is threatened or protected.

Environmental Impacts

There is no Protected Area, Reserve or Protected Forest, or any other sensitive habitat with respect to the biological environment. The project activities will not have any significant impact over the flora and fauna except for minor disturbance to the birds. Project related emissions may impact floral or faunal communities; however, implementation of suggested mitigation measures will make it insignificant.

SOCIO-ECONOMIC ENVIRONMENT

In this section, the pertinent socio-economic environment of the project area, inter alia; its location and other distribution have been discussed. The aspects considered include the characteristics of communities, social mechanisms, cultural conditionings, health, economy, lifestyle and the use of resources by the local community.

A group was formed to collect socio economic data. A thoroughly prepared questionnaire was administered, focusing on demographic profile, living patterns, provisions of education, health and other facilities, cropping and land tenure methods, availability of water, conditions of streets and roads, land and livestock, presence of government, private and NGO sector, and women status. One-to-one interviews and discussions were held with district administrator, non-government agencies, elderly people, women, common men, shopkeepers etc, both separately and collectively, so as to determine the community's needs and their concerns regarding the past and proposed activities.

Most of the data included in this section comprises of the primary information collected on-site employing various discussions. The primary data has been strengthened, at places, with the secondary data gathered from various government and private agencies along with useful input from the consultation with community. But SGS team confronted some problems to gather further information due to the new setup of district government, as the government and non government organizations are still in the course of data compilation.

The majority of population in the immediate vicinity of the proposed project site is rural and involved in cultivation. As mentioned earlier, proposed project area lies somewhere in between a semi-urban and rural environment where people are involved in daily wages jobs, while some are involved in small business. They normally travel to adjacent areas for work. Some work in the industrial area and in the surrounding universities and colleges. Health facilities in the project area are inadequate to meet the health requirements. The number of health care facilities is limited and unevenly distributed, especially for women and children. On the other hand employment opportunities will be created both for skilled and unskilled workers during the project cycle. The main amenity impacts during the construction and operation of WWTP and incinerator are related to noise, odours and emissions. All the impacts due to construction activities will be temporary in nature and only the communities adjacent to proposed site may be affected for a short period of time. However, as the proposed project shall come into effect within the existing boundary of CPL Jamshoro facility and occupies a massive area, which shall be helpful in the dispersion of the emissions and odour effects and the attenuation of noise, therefore these impacts are anticipated to be less significant on the social receptors.

IMPACTS ASSESSMENT AND MITIGATION MEASURES

Screening of project activities in different phases of project cycle have been carried out for identification of adverse environmental impacts. The major project activities with their associated environmental issues have been identified and then their impacts on the relevant physical, biological, and socio-economic environment of the area have been evaluated. The main aspects associated with potential impacts are as follows:

- Geology, landscape & soil
- Water resources
- Ambient air quality
- Waste generation
- Noise & vibration
- Occupational & communal safety
- Biological receptors
- Socio-economic conditions

The mitigation measures that need to be adopted to reduce or minimize the impacts have been suggested.

ENVIRONMENTAL MANAGEMENT PLAN (EMP)

The Environmental Management Plan (EMP) is a vital part of overall planning and implementation of development projects. EMP provides a structural framework and logical approach for effective implementation of the mitigation measures and environmental protection of the project area and its surroundings throughout the project lifecycle.

The primary objectives of the EMP are to:

- Facilitate the implementation of the mitigation measures identified in the EIA.
- Achieve CPL health, safety and environmental (HSE) goals.
- Ensure compliance of legislative requirements, guidelines, community issues (if any), and best industry practices that apply to the project.
- Define the roles and responsibilities of the project proponent and identifying areas where these roles and responsibilities can be shared with other stakeholders.
- Define a monitoring mechanism and identify monitoring parameters in order to:
  - Ensure the complete implementation of all mitigation measures.
  - Ensure the compliance with the applicable legal requirements.
  - Ensure the effectiveness of the mitigation measures.
- Define requirements for environmental monitoring and auditing;

- Provide a mechanism for taking timely action in the face of unanticipated environmental situations.
- Identify training requirements at various levels.

CONCLUSION

After an extensive assessment of the significance of potential impacts, it has been concluded that:

"The Expansion and up gradation of wastewater treatment plant & Installation of waste incinerator, with the associated construction and operational work at Clariant Pakistan Jamshoro facility, has low intensity adverse impacts, likely to be of short term duration, minor and of local consequence and are insignificant. A vigilant implementation of mitigation measures and Environmental Management Plan (EMP) will ensure that any environmental impacts, whether long-term or short-term, are managed, minimized and are within acceptable limits."

The study therefore recommends that the EIA should be approved.

Chapter 01

Introduction

Contents

1.1. BACKGROUND & RATIONALE

Water is an essential element for the survival of every life form. Although, Pakistan is prolifically blessed with surface and groundwater resources, even so unfortunately with the passage of time rapid population growth, urbanization and unsustainable water consumption practices in the agricultural and industrial sectors have placed immense stress on the quality as well as quantity of water resources in the country.

The pressures on water resources due to industrial growth are quite significant and have amplified water pollution problems. Most industries in the country are located in or around major cities and are recognized as key sources of increasing pollution in natural streams, rivers, as well as the Arabian Sea to which the toxic effluents are discharged.

Proper treatment of the wastewater generated, either from industrial activities or domestic activities, in all the major cities of Pakistan is one of the most prevalent environmental issues that has been primarily neglected so far and needs to be addressed on the apex of priority. The treatment of wastewater is necessary for the protection of aquatic environment and ground water resources; on the other hand, the reuse of treated effluent will increase the quantity of water available for irrigation.

Conversely, solid waste is equally detrimental to the environment. Solid waste arises from different human activities; domestic, commercial, industrial, agricultural, waste water treatment, and so on. If the waste is not properly handled and treated, it may have a negative impact on the hygienic conditions in urban areas and pollute the air and surface and ground water, as well as the soil and crops.

In highly industrialized countries of Europe, waste incineration plants have been increasingly installed over the last 5 decades, mainly because it has been more difficult to find new sites for landfills in densely populated areas. Incineration of waste does not completely eliminate, but does significantly reduce, the volume of waste to be land filled. The reductions are approximately 75 percent by weight and 90 percent by volume.[1]

It is now quite well-known, that most of the reported health problems are directly or indirectly related to polluted water and unsafe disposal of solid waste. Inappropriate disposal of solid waste and wastewater leads to the release of numerous organic and inorganic contaminants that can eventually reach human beings through diverse pathways including direct ingestion of contaminated water, ingestion of crops contaminated with polluted irrigation water and inhalation of polluted air (from open waste burning activities).

1.1.1 PROJECT BACKGROUND

Clariant Pakistan Limited (CPL), being a responsible corporate market leader in the field of speciality chemicals, has an ability to treat customers, employees,

[1] *World Bank Technical Guidance Report on Municipal Solid Waste Incineration*

neighbours and the environment, in a conscientious manner. CPL is proactively committed to considering environmental protection and safety in all of its activities. In connection to the philosophy of environmental protection, CPL has a wastewater treatment plant (WWTP) capable to partially treat 1,400 m^3/day of its effluent. Moreover, CPL also has a small incineration plant (IP) to treat different types of waste having a capacity of 50 kg/hr.

CPL realized that the treatment activities were not fully complying with the NEQS, and also a show cause notice followed by another letter having reference no. EPA/Tech/608/2011 dated March 12, 2011 issued by the Environmental Protection Agency Sindh, added to the necessity of up gradation of their existing treatment facilities. The letter from EPA directed CPL to take following measures:

- Installation of wastewater treatment plant for compliance of National Environmental Quality Standards should be ensured till March 2012. Progress report on construction of treatment plant will be submitted to this office on quarterly basis.
- Environmental Management and Monitoring Plan addressing all environmental issues of factory will be submitted within three months. The plan will be prepared by qualified environmental consulting firm having expertise in environmental issues of chemical plants.
- Efficient system will be developed for handling and disposal of sludge generated from aeration pond on immediate basis. The sludge which is hazardous in nature should only be disposed after treatment using effective scientific methods for disposal in environmental friendly manner.

The associated correspondence between EPA Sindh and CPL is attached for reference as **Annexure I**.

1.1.2 PROJECT STATUS

Conferring due regard to the directions of EPA, CPL dutifully opted for the expansion and up gradation of the existing waste treatment facilities. In this connection, CPL initiated following environmental improvement programmes:

- ✓ CPL instigated expansion and up gradation of its wastewater treatment plant, soon after receiving the letter from EPA Sindh. Since such an up gradation of the treatment plant requires thorough technical studies and installation of different imported mechanical equipments, therefore it necessitates ample time. However, CPL employed great efforts to complete the project within due time, and successfully accomplished the task with a delay of merely two months. The progress report has been submitted on quarterly basis as directed by EPA Sindh.

- ✓ Environmental Management and Monitoring Plan addressing all environmental issues of factory, was duly submitted on July 29, 2011.
- ✓ Although CPL already had a system for handling and disposal of sludge through incineration, but considering the directions of EPA Sindh, and in order to fulfil their amplified production load, CPL decided to install an improved technology incinerator of increased capacity.

1.2. PROJECT TITLE

The project for which this EIA has to be conducted is entitled as "Expansion of Wastewater Treatment Plant-Sustainable Effluent Treatment & Installation of Incineration Plant". The physical area in which project activities are proposed to have an effect or where the environmental impacts of project activities are predicted are referred to as project area.

1.3. THE PROJECT - AN OVERVIEW

As a result of amplified production, CPL's existing WWTP and WIP was confronting problems to handle increased pollution load. Old, dilapidated and small plants had long been unable to meet treatment requirements. Recognizing the need, a broad scale project was proposed by CPL which involved expansion and up gradation of their existing treatment capacity of wastewater, thus becoming the first chemical company of Pakistan having established a state-of-the-art *Zero Discharge Facility*. The decision had been firmed up considering the huge water consumption and water scarcity being faced by different areas of the Pakistan. Similarly, the venture also includes expansion and up gradation of existing treatment capacities for solid waste. These initiatives will be helpful to remove the major source of pollutants generated from CPL's activities, and accomplish commitments towards environment and gratifying the directions of EPA Sindh.

The expanded wastewater treatment plant is anticipated to be capable of treating around 1,700 m^3/day effluent enabling it to comply with the NEQS, within the notified land area of more than 30 acres. Likewise, waste incineration plant is proposed to be developed with a capacity of 0.5 TPH, which requires a land area of about 3 acres. With this new venture, Clariant is keen to adhere to environmental safeguard and in this regard, aims to have accomplished a complete EIA study on its Jamshoro facility.

This report presents relevant information, data and findings of Environmental Impact Assessment (EIA) of past and proposed project activities. For this purpose, Clariant has contracted SGS Pakistan (Private) Limited (SGS) to carry out environmental assessment of the proposed activities in order to assess the environmental viability of the same. SGS has carried out a comprehensive analysis of all the possible environmental aspects pertaining to the past and proposed expansion and up-gradation of the wastewater treatment plant and installation of waste incinerator.

In this chapter, brief information on the project, project proponent, EIA consultants, EIA requirement, EIA process, EIA methodology and organization of the EIA report has been presented.

1.4. THE PROJECT - LOCATION & ACCESS

The proposed project will be instigated in Clariant's Jamshoro facility located at district Jamshoro Sindh having total area of about 92 Acres. The said venture comprises of simultaneous execution of two activities which are: Expansion of WWTP and Installation of IP.

The project site will be accessed easily from Super Highway to Main Sehwan road (adjacent to Sindh University Jamshoro) which leads to railway crossing at main Jamshoro market. From railway crossing Clariant Jamshoro facility is located in the North direction having geographical coordinates given in **Table 1.1.**

Table 1.1: Coordinates of Main Entrance of Clariant Pakistan Jamshoro Facility

Latitude	Longitude
25° 26′ 55.23″ N	68° 17′ 00.59″ E

The location map of CPL Jamshoro facility is given as **Figure 1.1**.

1.5. PROJECT PROPONENT - CLARIANT PAKISTAN LIMITED

Clariant is a world leader in colours, surface effects and performance chemicals. Clariant has strong business relationships, commitments to outstanding services and wide-ranging application and expertise that make Clariant a preferred partner for its customers.

Clariant's Products and Services are delivered through 11 Business Units based on innovative specialty chemicals: Additives, Catalysis & Energy, Emulsions, Detergents & Intermediates, Functional Materials, Industrial & Consumer Specialties, and Leather Services, MasterBatches, Oil & Mining Services, Paper Specialties, Pigments and Textile Chemicals.

Clariant is represented in five continents and more than 100 groups of companies. It is currently operating with approximately 22,100 employees. It is headquartered in Muttenz near Basel, Switzerland. Clariant achieved the annual sales of CHF 7.4 billion in 2011.

Clariant came into existence in 1995 from the global de-merger of Chemical Division of Sandoz, established in Basel, Switzerland in 1886.

Clariant Pakistan Limited is the local affiliate of Clariant International; listed on the Karachi Stock Exchange and engaged in the manufacturing and sales of Chemicals, Dyestuffs, Emulsion and MasterBatches. Clariant Pakistan Limited is supporting through its services and environment friendly products to Textile and Leather Industries, contributing 80% to the

country's economy. Clariant Pakistan also exports Chemical & Dyestuff to Europe, China, Far East and South America.

The company has been selected by the Karachi Stock Exchange for the Top 25 companies Award for the year 2010. This is the 10th consecutive year the company has been awarded for its overall performance.

Besides, Clariant's Quality, Environment and Management is also globally certified by the ISO 9001 (Quality Management System) and ISO 14001 (Environment Management System) and OHSAS 18001 (Occupational Health & Safety Assessment System) by SQS (Swiss Quality System).

In addition to this, Clariant Pakistan Limited has been awarded Environment Excellence Award 2005, 2008, 2009, 2010 & 2012 by National Forum for Environment & Health and has also won trophies for EFP Best Practices in occupational Health Safety & Environment for the year 2009 & 2010 by Employer Federation of Pakistan in collaboration with the International Labour Organization (ILO). CPL has also achieved the First Fire Safety Award 2011 from Fire Protection Association of Pakistan (FPAP) & NFEH.

1.6. PROJECT CONSULTANT - SGS PAKISTAN (PVT) LTD

SGS Pakistan Private Limited (herein after referred to as SGS) is a member of SGS group, Geneva. It is a global leader and innovator in inspection, verification, testing and certification services and is recognized as the global benchmark for quality and integrity. SGS Pakistan Pvt. Ltd., founded in 1952, is one of the pioneers in providing Inspections, Testing and Certification Services to the trade in Pakistan.

Clariant has appointed SGS to carry out the Environmental Impact Assessment study of the proposed project in order to assess the environmental viability of the project. SGS has laid together a team of consultants to accomplish this task. The team comprises of Environmentalists, Environmental Chemists, Sociologists, Biological Experts, and Impact Assessment Experts having diversified experiences on local and international assignments. The project team involved in this study are presented in **Table 1.2.**

Table 1.2: EIA Study Team

S. No.	Name	Responsibility in Project Team
1.	Ms. Tasneem Ilyas	Project Director
2.	Mr. Syed Faseeh	Project Manager
3.	Mr. Syed Mustafa Matloob	Project Coordinator/ Environmentalist
4.	Dr. Ghalib Ali	Floral Expert
5.	Mr. Abdul Razzak	Faunal Expert

6.	Mr. Mumtaz Hassan	Hydrologist
7.	Ms. Tasneem Bhatti	Socioeconomic Expert
8.	Mr. Aamir Aziz	Environmentalist
9.	Ms. Muneera Shah	Mechanical Engineer/Technical Report Writer
10.	Mr. Fahad Saleem	Technical Report Writer
11.	Mr. Nawab Abid	Field Monitoring Team Leader

1.7. EIA REQUIREMENT

The EIA has been prepared in conformance with the requirements of the Pakistan Environmental Protection Act (PEPA) 1997. Section-12 of PEPA 1997 states that:

"No proponent of a project shall commence construction or operation unless he has filed with the Government Agency designated by Federal Environmental Protection Agency or Provincial Environmental Protection Agencies, as the case may be, or, where the project is likely to cause adverse environmental effects an environmental impact assessment, and has obtained from Government Agency approval in respect thereof."

This study has responded to the requirements of Section 12, since some parts of the project have already been completed and hence an Environmental Audit of the activities and their impacts on the environment forms an integral part of the EIA Report.

Moreover, the Pakistan Environmental Protection Agency (Review of IEE/EIA) Regulations 2000 also evidently define the categories of projects requiring an Initial Environmental Examination (IEE) or Environmental Impact Assessment (EIA) in Schedules I & II respectively.

In general, IEE/EIA study will be carried out in consideration of either of:

- Minor/major concerns on the microenvironment in which the project is proposed to be sited.
- Construction and operational phase impacts being or not confined to the microenvironment.
- The project falls either in Schedule I or Schedule II of Review of IEE/EIA Regulations 2000.

According to Schedule II, Category G (Waste Disposal), following projects require an EIA:

i. Waste disposal and/or storage of hazardous or toxic wastes (including landfill sites, incineration of hospital toxic waste).

ii. Waste disposal facilities for domestic or industrial wastes, with annual capacity more than 10,000 cubic meters.

This Project would be placed in Category G, Schedule II; thus requiring an EIA study

Therefore an EIA study has been conducted for proposed project and the report will be submitted to Sindh EPA for review and approval. The study has, while considering completion of some parts of the project, also carried out Environmental Audit of the activities and their impacts on the environment.

1.8. ORGANIZATION OF THE REPORT

This report has been structured in the following manner:

Executive Summary provides a synopsis of the EIA study.

Chapter 1 (Introduction) gives an overview of the project, EIA process and requirement.

Chapter 2 (EIA Methodology) presents the whole approach of the EIA process and its methodology.

Chapter 3 (Legal Framework) gives an overview of applicable national policies, and legislations with international guidelines relevant to EIA of proposed project.

Chapter 4 (Project Description) details the description of the proposed project, its layout plan and associated activities, raw material details and utility requirement and project alternatives.

Chapter 5 (Description of Baseline Environment) provides a description of the micro-environment and macro-environment of the proposed project site. This chapter describes the physical, ecological and socioeconomic resources of project area and surroundings.

Chapter 6 (Impact Assessment and Mitigation Measures) describes the potential environmental and social impacts of proposed project on the different features of the micro and macro-environment.

Chapter 7 (Environmental Management Plan) explains the mitigation measures proposed for the project in order to minimize the impacts to acceptable limits. It also describes implementation of mitigation measures on ground and monitoring of environmental parameters against likely environmental impacts.

Conclusion summarizes the report and presents the conclusion of EIA study.

References summarize the sources which have been utilized in compilation of the report.

The last Chapter is followed by series of **Annexure** that provide supporting information.

1.9. CONTACT DETAILS

Client	Consultant
Clariant Pakistan Limited	**SGS Pakistan (Private) Limited**
Mr. Abdul Salam Khan	Mr. Syed Faseeh
Manager ESHA & Site SEO	Manager-Operation & Business Development
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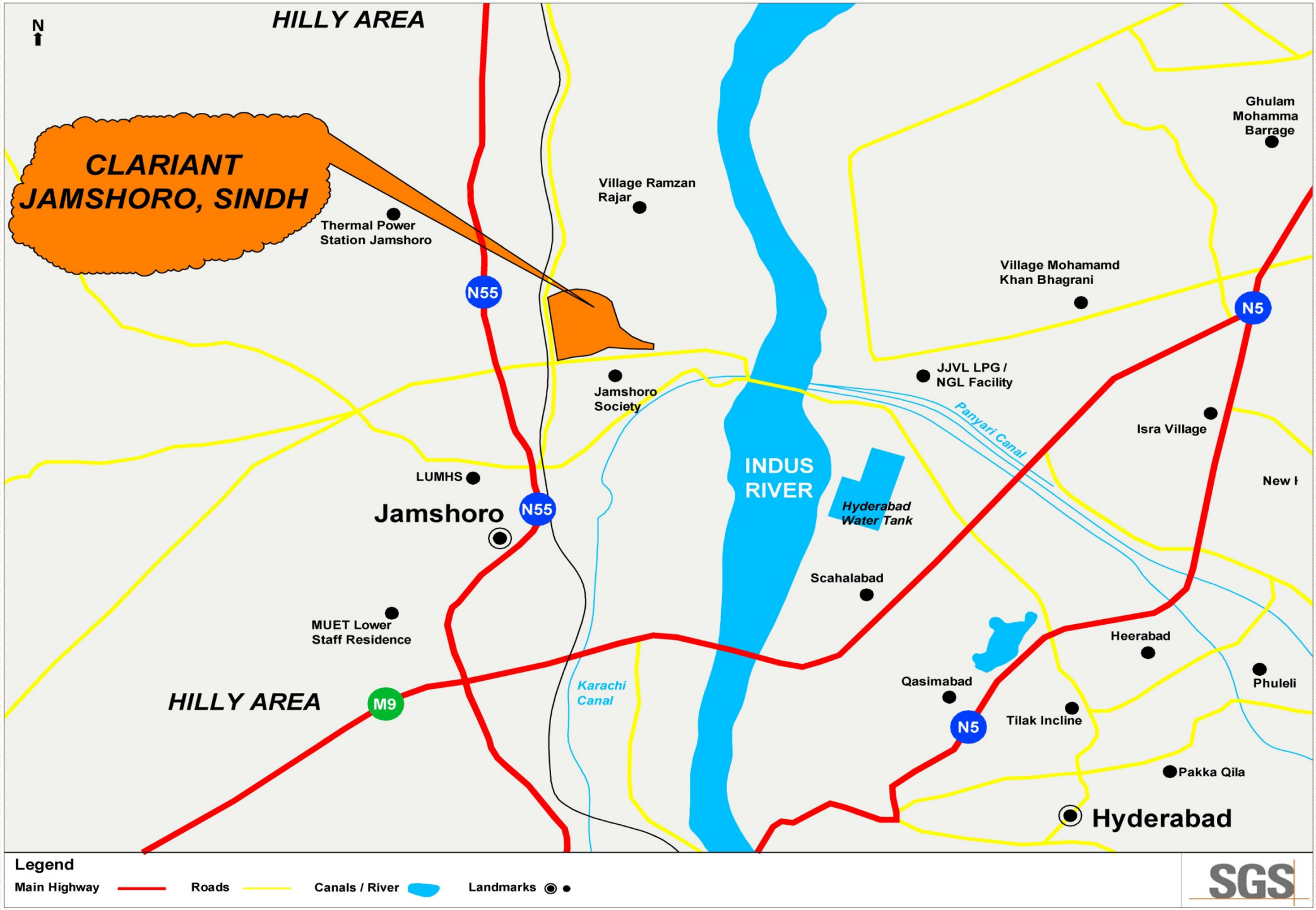
Figure 1.1
Project Location Map


N
HILLY AREA
CLARIANT
JAMSHORO, SINDH
Thermal Power
Station Jamshoro
Village Ramzan
Rajar
Ghulam
Mohamma
Barrage
Village Mohamamd
Khan Bhagrani
N55
N5
JJVL LPG /
NGL Facility
Jamshoro
Society
Panyari Canal
Isra Village
INDUS
RIVER
LUMHS
Jamshoro
N55
Hyderabad
Water Tank
New H
Scahalabad
MUET Lower
Staff Residence
Heerabad
Karachi
Canal
Qasimabad
Phuleli
HILLY AREA
M9
N5
Tilak Incline
Pakka Qila
Hyderabad
Legend
Main Highway
Roads
Canals / River
Landmarks
SGS

Chapter 02

EIA Approach & Methodology

Contents

2.1 EIA PROCESS

2.1.1 OVERVIEW OF EIA

EIA is a systematic process to identify, predict and evaluate the environmental impacts of proposed actions and projects. This study suggests mitigation measures with a practical approach of their implementation in the form of an Environmental Management Plan (EMP). The process is applied before major decisions and commitments. Wherever appropriate, social, cultural and health impacts are also considered as an integral part of EIA. Special attention is given to practical implementation of EIA to prevent and mitigate significantly adverse effects of the proposed undertakings.

2.1.2 OBJECTIVE OF EIA

The overall objective of this EIA study includes:

- To explicate the anticipated impacts of past and proposed intervention.
- To identify potential environmental impacts.
- To examine the potential impacts to identify significant environmental impacts.
- To evaluate significant environmental impacts.
- To determine environmentally viable project alternatives.
- To recommend appropriate mitigation measures and discuss their suitable methods.

2.1.3 SCOPE OF EIA

The scope of services encompasses the comprehensive study of EIA in accordance with the requirements mentioned in the EPA Guidelines and Procedures. The scope of the EIA involves:

- The assessment of physical, biological and socio-economic impacts of different stages of past and proposed project activities.
- Contemplation of adverse environmental and socioeconomic impacts, if any and suggestion of adequate mitigation measures.
- Development of an Environmental Management Plan (EMP) which will provide practical approach in order to manage adverse environmental and socioeconomic impacts, if any.

2.2 EIA METHODOLOGY

The EIA project undergoes a series of stages before report preparation. The EIA process and the approach followed for the proposed project is defined in the subsequence:

2.2.1 UNDERSTANDING OF THE PROPOSED PROJECT

This step required collection of information from the proponent on the past and proposed project activities, understanding of the project flow and to identify potential impacts associated with the past and proposed project activities.

2.2.2 SITE VISIT AND PRIMARY DATA COLLECTION

EIA team visited the project area and its vicinity on July 27, 2012 to conduct baseline environmental monitoring so as to assess ambient air quality and collect water and soil samples for analysis in order to establish baseline environmental conditions. Another visit was carried out on July 31, 2012 with a team of floral, faunal and social experts to collect primary data with reference to biological and social receptors. A sufficient amount of information regarding the proposed project and its related activities was collected from CPL.

2.2.3 STAKEHOLDER CONSULTATION

During site visit, SGS team conducted consultation with the communities residing close by, and the local Non Governmental Organization (NGOs) in order to obtain their point of view regarding the proposed project and the findings were incorporated in the EIA report.

2.2.4 LEGISLATIVE REVIEW

SGS team carried out the legislative review of the applicable laws, regulations, guidelines and standards which includes national legislation, international agreements and environmental guidelines. In addition, best industry practices were recommended consistent with the environmental standards that CPL must adhere to, during the different stages of project.

2.2.5 SECONDARY RESOURCES/ BASELINE REVIEW

The environment impact is measured through a change in the environment, resulting from a designated action or activity. In order to identify such a change, it is essential to have as complete as practicable understanding of the nature of the existing environment, prior to its interaction with the proposed activity. This translates into the need to characterize the existing baseline

environmental condition, including the establishment of prevailing conditions for a range of environmental media, notably air, water, soil and groundwater, flora and fauna and the human environment.

This was achieved through a detailed review of available secondary literature on physical, biological and socio-economic environment of project site and the undertaking of project specific baseline studies and surveys.

2.2.6 EVALUATION OF ALTERNATIVES

To ascertain an environmentally sound preferred option for achieving the objectives of the proposed project, site alternatives were studied in collaboration with the project proponent. Site selection was accomplished considering options which were environmentally, economically and socially suitable.

2.2.7 IDENTIFICATION, SCREENING & ASSESSMENT OF IMPACTS

The information collected in the previous phases was used to assess and identify the major issues of environmental concern and indicate their relative importance to the design of the project. Scrutiny of the past activities, screening and assessment of proposed impacts, and those that are cumulative, unavoidable or irreversible was also carried out.

2.2.8 IMPACT MITIGATION MEASURES

The information collected in the previous phases was used to assess the potential environmental impacts of the past and proposed project activities. Detailed methodology is included in **Chapter 6** of the report. It was carefully ascertained that mitigation measures were adhered to during the past activities, while additional mitigation measures were suggested to reduce the impacts of proposed project activities on the environment. The issues studied during impact assessment include potential impacts on:

- Physical environment of the area
- Biological environment of the area
- Socio-economic environment of the area

2.2.9 ENVIRONMENTAL MANAGEMENT PLAN

An Environmental Management Plan (EMP) has been developed in order to assist and enable CPL for effective management and implementation of mitigation measures. EMP will guide CPL throughout the project lifecycle so as to maintain environmental and social conditions and implement occupational safety measures. This plan also delineates the information

required to manage environmental and occupational safety risks arising from proposed project activities as well as social issues.

EMP will also include environmental monitoring plans in order to comply with local legislative requirements.

2.2.10 REPORTING/ DOCUMENTATION

The draft EIA report has been prepared under the guidelines issued by the Pakistan Environmental Protection Agency (PEPA) and submitted to Sindh Environmental Protection Agency (SEPA). The organization of the report has been described in the preceding chapter.

Chapter 03

Legal Framework

Contents

This chapter provides a summary of the environmental policies, legislation, and guidelines that may have relevance to the proposed project. These include national environmental Policy, legislation and guidelines; and international conventions and guidelines. Clariant will entail to adhere to the relevant requirements of the Policies and legislation during the construction and operation of the proposed activities; which has also been incorporated in the mitigation measures and the EMP provided in the EIA.

3.1 CONSTITUTIONAL PROVISION

According to the Constitution of Pakistan, the legislative powers lie with the federal parliament and the legislative assemblies of the four provinces of Pakistan. The Fourth Schedule of the constitution provides two lists of issues. First list, the Federal Legislative List, includes issues on which only the federal government has legislative powers. The second list, the Concurrent Legislative List, includes issues on which both the federal and the provincial governments have legislative powers. If a particular legislation passed by a provincial assembly comes into conflict with a law enacted by the national assembly, then according to the constitution, the federal legislation will prevail over the provincial legislation to the extent of the inconsistency. The subject of 'environmental pollution and ecology' is included in the concurrent list of the constitution. Thus, allowing both the federal and provincial governments to enact laws on the subject. To date, only the federal government has enacted laws on environment, and the provincial environmental institutions derive their power from federal law. Article 9 of the constitution defines the right to life as a fundamental right in these words "No person shall be deprived of life or liberty save in accordance with law".

3.2 FRAMEWORK OF ENVIRONMENT & WILDLIFE INSTITUTION IN PAKISTAN

The Ministry of Environment is the main government organization responsible for the protection of environment and resource conservation. It is headed by a federal minister. The Ministry works with PEPC, and the Federal and Provincial EPAs formed under the PEPA 1997. The roles, responsibilities and authorities of PEPC and the EPA's are defined in the PEPA 1997.

The PEPC has been formed by the Federal Government. Its members include the Prime Minister of Pakistan, as the Chairperson; the Minister for Environment as the vice-Chairperson; Governors of the Provinces; Ministers in charge of the subject of environment in the Provinces; Secretary to the Federal Government in-charge of the Ministry of Environment; Director General Federal EPA; heads of other federal and provincial departments; environmentalists and community representatives including scientists. The functions and powers of the Council include formulation of national environmental Policy, enforcement of PEPA 1997, approval of the NEQS, incorporation of environmental considerations in to national development plans and policies and provide guidelines for the protection and

conservation of biodiversity in general and for the conservation of renewable and non-renewable resources.

The Federal government has also formed the Federal EPA, which is headed by a Director General and has wide-ranging functions given in PEPA 1997. These include the preparation and co-ordination of national environmental policy for approval by the PEPC, administering and implementing the PEPA 1997 and preparation, revision or establishment of NEQS. The Provincial Environmental Protection Agencies are formed by the respective Provincial Governments. A Director General who exercises powers delegated to him by the Provincial Government heads each Provincial EPA. IEE's and EIA's are submitted to provincial EPA's for approval.

The National Council for Conservation of Wildlife (NCCW) is responsible for formulation of national wildlife policies, co-ordination with provincial wildlife department on the implementation of these policies and co-ordination with international organisations on matters related to international treaties/conventions. The NCCW works under the Ministry of Environment, and is headed by the Inspector General Forests. NCCW comprises of an advisory council, which is chaired by the Minister of Environment and includes representatives from all Provinces, AJK and Northern Areas, NGOs, members of civil society and other federal ministries. A small NCCW secretariat is based in Islamabad handles the day-to-day affairs and the implementation of policies and recommendations of the advisory council. At provincial level almost each province has a wildlife department and a wildlife protection act.

3.3 NATIONAL ENVIRONMENTAL POLICIES

3.3.1 NATIONAL ENVIRONMENTAL POLICY, 2005

The National Environmental Policy (NEP) was approved by the Pakistan Environmental Protection Council (PEPC) in its 10th meeting on 27th December, 2004 under the chairmanship of the Prime Minister of Pakistan and thereafter approved by the Cabinet on 29th June 2005. NEP is the primary policy of Government of Pakistan that addresses the environmental issues of the country. The broad Goal of NEP is, "To protect, conserve and restore Pakistan's environment in order to improve the quality of life of the citizens through sustainable development". The NEP identifies the following set of sectoral and cross-sectoral guidelines to achieve its Goal of sustainable development.

Sectoral Guidelines

- Water and sanitation
- Air quality and noise
- Waste management

- Forestry
- Biodiversity and Protected areas
- Climate change and Ozone depletion
- Energy efficiency and renewable
- Agriculture and livestock
- Multilateral environmental agreements

Cross Sectoral Guidelines

- Poverty
- Population
- Gender
- Health
- Trade and environment
- Environment and local governance
- Natural disaster management

The NEP suggests the following policy instruments to overcome the environmental problems through out the country:

- Integration of environment into development planning,
- Legislation and regulatory framework,
- Capacity development,
- Economic and market based instrument,
- Public awareness and education, and
- Public private civil society partnership.

NEP is a policy document and does not apply to projects. However, CPL should ensure that the project should not add to the aggravation of the environmental issues identified in NEP and mitigation measures should be adopted to minimize or avoid any contribution of the project in these areas.

3.3.2 *NATIONAL CONSERVATION STRATEGY*

Before the approval of National Environmental Policy (NEP) the National Conservation Strategy (NCS) was considered as the Government's primary policy document on national environmental issues. The Strategy approved by the Federal Cabinet in March 1992 and was also recognized by International Financial Institutions, principally the World Bank At the moment this strategy just exists as a national conservation program. The NCS identifies 14 core areas including

conservation of biodiversity; pollution prevention and abatement; soil and water conservation; and preservation of cultural heritage, and recommends immediate attention to these core areas in order to preserve the country's environment.

NCS does not directly apply to projects. However, CPL should ensure that the project should not add to the aggravation of the 14 core environmental issues identified in the NCS and mitigation measures should be adopted to minimise or avoid any contribution of the project in these areas.

3.3.3 NATIONAL ENVIRONMENTAL ACTION PLAN-SUPPORT PROGRAM (NEAP-SP)

The Government of Pakistan and United Nations Development Programme (UNDP) have jointly initiated an umbrella support programme called the "National Environmental Action Plan-Support Programme (NEAP-SP)" signed in October 2001 and implemented in 2002. The development objective supported by NEAP-SP is environmental sustainability & poverty reduction in the context of economic growth.

3.3.4 POLICY & PROCEDURES FOR FILING, REVIEW & APPROVAL OF ENVIRONMENTAL ASSESSMENTS

The Policy & Procedures for the Filing, Review and Approval of Environmental Assessments, prepared by the PEPA under the powers conferred upon it by the Pakistan Environmental Protection Act, provide the necessary details on the preparation, submission, and review of the initial environmental examination (IEE) and the environmental impact assessment (EIA).It provides schedules of proposals that require either an initial environmental examination (IEE) or an environmental impact assessment (EIA).

3.4 NATIONAL ENVIRONMENTAL LEGISLATION

The definition of environmental law can be derived from the legal definition of 'environment'. In Section 2(x) of the Pakistan Environmental Protection Act 1997 (PEPA 1997) environment is defined to include air, water, land and layers of the atmosphere; living organisms and inorganic matter; the ecosystem and ecological relationships; buildings, structures, roads, facilities and works; social and economic conditions affecting community life; and the interrelationship between these elements. From this definition, an environmental law can be considered to include all laws that are designed to, or that directly or indirectly affect, the management of natural resources including the control of pollution of these natural resources.

By this definition, environmental laws include a) laws that have been specifically enacted to protect the environment such as the PEPA 1997, and b) laws relating to subject such as forest, water resources, wildlife, land, agriculture, health, and town planning. **Table 3.1** shows key

environment, health and safety related legislative powers of federal and provincial government, enforcing agencies and pertinent laws.

Table 3.1: Relevant Environmental Laws and their Applicability

Subject	Legislative Power	Enforcing Agencies	Pertinent Laws
Environmental Pollution and Ecology	Federal and Provincial	Ministry of Environment, Pakistan Environmental Protection Agency, Sindh Environmental Protection Agency,	Pakistan Environnemental Protection Act, 1997 National Environnemental Quality Standards (NEQS), National Environnemental Quality Standards (NEQS), Environmental Laboratories 2000, NEQS (Self-Monitoring and Reporting by Industry) Rules 2005 (Amended)
Regulation of Labour and Safety in Mines, Factories and Oil Fields	Federal and Provincial	Chief Inspector of Mines Chief Inspector of Industries	Mines Act, 1923 Factories Act, 1934 Sindh Factories Rules, 1978 Hazardous Occupation Rules 1963
Ancient and historical Monuments and Archaeological Sites	Federal and Provincial	Department of Museum	Antiquities Act, 1975 Sindh Cultural Heritage (Preservation) Act, 1994
Wildlife	Federal and Provincial	Sindh Wildlife Department Sindh	Wildlife Protection Ordinance 1972
Forestry	Federal and Provincial	Sindh Forest Department	Forest Act, 1927

3.4.1 PAKISTAN ENVIRONMENTAL PROTECTION ACT 1997

The Pakistan Environmental Protection Act, 1997 (PEPA) is the basic legislative tool empowering the government to frame regulations for the protection of the environment. The PEPA is broadly applicable to air, water, soil, marine and noise pollution. Penalties have been prescribed for those contravening the provisions of the Act. The powers of the federal and provincial Environmental Protection Agencies (EPAs) were also considerably enhanced under this legislation and they

have been given the power to conduct inquiries into possible breaches of environmental law either of their own accord, or upon the registration of a complaint.

Under section 12 of PEPA, no project involving construction activities or any change in the environment can be taken unless an IEE or EIA as required is conducted and a report submitted to the federal or provincial EPA.

3.4.2 PAKISTAN ENVIRONMENTAL PROTECTION AGENCY REVIEW OF IEE & EIA REGULATIONS, 2000

The Pakistan Environmental Protection Agency Review of IEE and EIA Regulations, 2000 (the 'Regulations'), prepared by the Pak-EPA under the powers conferred upon it by the PEPA, provide the necessary details on the preparation, submission, and review of the initial environmental examination (IEE) and the environmental impact assessment (EIA).

The Regulation classifies projects on the basis of expected degree of adverse environmental impacts & lists them in two separate schedules. Schedule I lists the projects that may not have significant environmental impacts and therefore require an IEE. Urban development projects are included in Schedule I. Schedule II lists the projects of potentially significant environmental impacts requiring preparation of an EIA. The Regulations also require that all projects located in environmentally sensitive areas require preparation of an EIA.

According to Schedule II, Category G (Waste Disposal), following projects require an EIA:

I. Waste disposal and/or storage of hazardous or toxic wastes (including landfill sites, incineration of hospital toxic waste)
II. Waste disposal facilities for domestic or industrial wastes, with annual capacity more than 10,000 cubic meters

The Project under concerned would be placed in Category G, Schedule II, requiring an EIA study

3.4.3 THE NATIONAL ENVIRONMENTAL QUALITY STANDARDS (NEQS)

The NEQS promulgated under the PEPA 1997 specify standards for industrial and municipal effluents, gaseous emissions, vehicular emissions, and noise levels. The PEPA 1997 empowers the EPA's to impose pollution charges in case of non-compliance to the NEQS.

During the construction and post development phase of the project, NEQS will apply to all type of effluents and emissions. NEQS for municipal and industrial

effluents, motor vehicle exhaust and noise and selected gaseous pollutants from industrial source are provided in **Annexure II.**

3.4.4 SINDH WILDLIFE PROTECTION ORDINANCE,1972 (SWPO) & AMENDMENTS 2001

This ordinance provides for the preservation, protection, and conservation of wildlife by the formation and management of protected areas and prohibition of hunting of wildlife species declared protected under the ordinance.

The ordinance also specifies three broad classifications of the protected areas: national parks, wildlife sanctuaries and game reserves. Activities such as hunting and breaking of land for mining are prohibited in national parks, as are removing vegetation or polluting water flowing through the park. Wildlife sanctuaries are areas that have been set-aside as undisturbed breeding grounds and cultivation and grazing is prohibited in the demarcated areas. Nobody is allowed to reside in a wildlife sanctuary and entrance for the general public is by special dispensation. However, these restrictions may be relaxed for scientific purposes or for betterment of the respective area on the discretion of the governing authority in exceptional circumstances. Game reserves are designated as areas where hunting or shooting is not allowed except under special permits.

Two amendments to the Ordinance were issued in January and June 2001 respectively pertaining to oil and gas activities within national parks and wildlife sanctuaries. The first amendment allowed the Government to authorize the laying of an underground pipeline through protected areas. The second amendment allowed exploration and production activities within national parks and wildlife sanctuaries for which an EIA study have to be prepared by the proponent and approved by the concerned regulatory departments in accordance with the PEPA.

The project area is not located in any protected area, therefore the project will not contravene with any provisions of the Act.

3.4.5 SELF-MONITORING & REPORTING RULES

Pakistan Environmental Protection Council constituted an Environmental Standards Committee in 1996 to devise realistic modalities for NEQS enforcement and simplified monitoring procedures with the consultation of representatives of industrial interest groups, non-governmental organizations (NGOs) and other stakeholders. Their efforts succeeded in the bringing up of "Self-Monitoring and Reporting System for Industry". As per the rules set by this system, industries have to monitor effluents and emissions in compliance with the NEQS and report it to provincial or federal EPAs. This system classifies industry into three categories A, B and C each corresponding to a specified reporting frequency. Proposed power plant

project lies under Category A for both liquid effluent and gaseous emissions and thus reporting frequency to SEPA required every month.

3.4.6 ANTIQUITIES ACT 1975 AND THE SINDH CULTURAL HERITAGE (PRESERVATION) ACT, 1994

The protection of cultural resources in Pakistan is ensured by the Antiquities Act of 1975. Antiquities have been defined in the Act as ancient products of human activity, historical sites, or sites of anthropological or cultural interest, national monuments etc. The act is designed to protect antiquities from destruction, theft, negligence, unlawful excavation, trade and export. The law prohibits new construction in the proximity of a protected antiquity and empowers the Government of Pakistan to prohibit excavation in any area, which may contain articles of archaeological significance.

The Sindh Cultural Heritage (Preservation) Act, 1994 is the provincial law for the protection of cultural heritage. Its objectives are similar to those of the Antiquity Act, 1975.

No antiquity protected under these two laws was identified in the vicinity of the proposed project during fieldwork for the IEE. Furthermore, the project site is unlikely to contain any buried antiquity. However, the project staff will be instructed before ground preparation and earthworks to report any archaeological artifact or what may appear to be an archaeological relic to the project management. In case of such a discovery, appropriate action will be taken.

3.4.7 THE FOREST ACT 1927

This act is applicable to all regions of Pakistan. It includes procedures for constituting and managing various types of forests, such as reserved forests and protected forests. The act empowers the provincial forest departments to declare any forest area as reserved or protected. The act empowers the provincial forest departments to prohibit the clearing of forests for cultivation, grazing, hunting, removing forest produce; quarrying and felling, lopping and topping of trees, branches in reserved and protected forests. It also defines the duties of forest related public servants, and penalties for any infringement of the rules.

The project area is located outside of the any protected forest therefore the project will not contravene with any provisions of this Act.

3.4.8 LAND ACQUISITION ACT, 1894

The Land Acquisition act (LAA) of 1894 amended from time to time has been the policy governing land acquisition, resettlement and compensation in the country. The LAA is the most commonly used law for acquisition of land and other

properties for development projects. It comprises of 55 sections pertaining to area notifications and surveys, acquisition, compensation and appointment awards and disputes resolution, penalties and exemptions. In the proposed project there is no such kind of land acquisition or resettlement of proposed project affected persons.

3.4.9 PAKISTAN PENAL CODE (1860)

The Pakistan Penal Code (1860) authorizes fines, imprisonment or both for voluntary corruption or fouling of public spring or reservoirs so as to make them less fit for ordinary use.

The Pakistan Penal Code (1860) authorizes fines, imprisonment or both for voluntary corruption or fouling of public springs or reservoirs so as to make them less fit for ordinary use.

The Pakistan Penal Code (PPC) 1860 deals specifically with the pollution of water in Chapter XIV on public health and safety. Here, "fouling" or "corrupting" the water of a public spring or reservoir is listed as an offence, punishable with up to three months in prison and/or a fine of 500 rupees (Section 277). This provision is limited in scope, since it applies only to reservoirs and public springs, and the terms "fouling" and "corrupting" are not defined. But provisions of PEPA 1997 (Sections 6 and 7) and the NEQS (Appendix I) may be applied to facilitate enforcement of Section 277. Other sections of this chapter may be interpreted to include the protection of water resources, including Section 268 on public nuisance, Section 269 on negligence likely to spread infectious disease, and Section 284 on negligent conduct with respect to the possession and handling of poisonous substances.

Similarly, Chapter XVII on offences against property contains certain provisions that may be interpreted to include the protection of water resources. Sections 425–440 deal with "mischief", defined as damage to property resulting in destruction or loss of utility. Section 430 provides specifically for mischief caused to irrigation works, while Section 431 deals with damage to roads, bridges, rivers or channels. Meanwhile, Chapter XXIII, Section 511 on attempted offences could also be interpreted to include offences related to the "fouling" or "corrupting" of water.

Under Section 278 of the PPC, the punishment for "making [the] atmosphere noxious to health" is a maximum fine of 500 rupees. In addition, certain sections of Chapter XIV on public health and safety concerning "public nuisance" may be interpreted to include air and noise pollution from vehicles, as well as emissions (Sections 268, 278, 290 and 291).

3.4.10 SINDH REGULATION AND CONTROL ORDINANCE

An ordinance is to provide for the regulation and control of the use of plots and construction of buildings in the province of Sindh. According to this ordinance:

- No plot shall be used for any other purpose other than the purpose for which it was except with the approval of the authority.

3.5 NATIONAL ENVIRONMENTAL GUIDELINES

3.5.1 THE PAKISTAN ENVIRONMENTAL ASSESSMENT PROCEDURES, 1997

The Pakistan Environmental Protection Agency prepared the Pakistan Environmental Assessment Procedures in 1997. They are based on much of the existing work done by international donor agencies and Non Governmental Organisations (NGO's). The package of regulations prepared by PEPA includes:

- Policy and Procedures for Filing, Review and Approval of Environmental Assessments;
- Guidelines for the Preparation and Review of Environmental Reports;
- Guidelines for Public Consultation;
- Guidelines for Sensitive and Critical Areas; and
- Sectoral Guidelines for various types of projects.

3.5.2 GUIDELINES FOR PUBLIC CONSULTATION

These guidelines are a part of a package of regulations and guidelines. It provides assistance throughout the environmental assessment of project by involving the public which can lead to better and more acceptable decision-making.

3.5.3 GUIDELINES FOR THE PREPARATION AND REVIEW OF ENVIRONMENTAL REPORTS

The is a general guideline that will assist proponents to identify the key environmental issues that need to be assessed as well as mitigation measure and alternatives that need to be considered in the actual IEE/EIA.

3.5.4 GUIDELINES FOR PUBLIC CONSULTATION

The objective of this guideline is to provide guidance to project proponents and other stakeholders in the environmental assessment process, so that the proposed projects are planned and sited in a way that protects the values of sensitive and critical areas.

3.6 INTERNATIONAL GUIDELINES

3.6.1 WORLD BANK GUIDELINES ON ENVIRONMENT

The principal World Bank publications that contain environmental guidelines are listed below:

- Environmental Assessment-Operational Policy 4.01. Washington, DC, USA. World Bank 1999.
- Environmental Assessment Sourcebook, Volume I: Policies, Procedures, and Cross-Sectoral Issues. World Bank Technical Paper Number 139, Environment Department, the World Bank, 1991,

The first two publications provide general guidelines for conducting EIAs, and address EIA practitioners as well as project designers. While the Sourcebook in particular has been designed with Bank projects in mind, and is especially relevant for the impact assessment of large-scale infrastructure projects, it contains a wealth of useful information, for environmentalists and project proponents.

The Sourcebook identifies a number of areas of concern, which should be addressed during impact assessment. It sets out guidelines for the determination of impacts, provides a checklist of tools to identify possible biodiversity issues and suggests possible mitigation measures. Possible development project impacts on different areas such as wild lands, wetlands and forests are also identified and mitigation measures suggested.

3.7 INTERNATIONAL CONVENTIONS & TREATIES

3.7.1 INTERNATIONAL CONVENTION ON BIODIVERSITY

The International Convention on Biodiversity was adopted during the Earth Summit of 1992 at Rio de Janeiro. The Convention requires parties to develop national plans for the conservation and sustainable use of biodiversity, and to integrate these plans into national development programmes and policies. Parties are also required to identify components of biodiversity that are important for conservation, and to develop systems to monitor the use of such components with a view to promote their sustainable use.

3.7.2 THE CONVENTION ON CONSERVATION OF MIGRATORY SPECIES OF WILD ANIMALS, 1979

The Convention on the Conservation of Migratory Species of Wild Animals (CMS), 1979, requires countries to take action to avoid endangering migratory species. The term "migratory species" refers to the species of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national

jurisdictional boundaries. The parties are also required to promote or co-operate with other countries in matters of research on migratory species.

The Convention contains two appendices. Appendix I contain the list of migratory species that are endangered according to the best scientific evidence available. For these species, the member states to the Convention are required endeavour to:

- Conserve and restore their habitats;
- Prohibit their hunting, fishing, capturing, harassing and deliberate killing;
- Remove obstacles and minimize activities that seriously hinder their migration;
- Control other factors that might endanger them, including control of introduced exotic species.

Appendix II lists the migratory species, or groups of species, that have an unfavourable conservation status as well as those that would benefit significantly from the international co-operation that could be achieved through intergovernmental agreements.

3.7.3 THE CONVENTION ON WETLANDS OF INTERNATIONAL IMPORTANCE, RAMSAR 1971

Pakistan is a signatory to the said Convention. The principal obligations of contracting parties to the Convention are:

- To designate wetlands for the List of Wetlands of International Importance.
- To formulate and implement planning so as to promote wise use of wetlands, to carry out an EIA before transformations of wetlands, and to make national wetland inventories.
- To establish nature reserves on wetlands and provide adequately for their wardening and through management to increase waterfowl populations on appropriate wetlands.
- To train personnel competent in wetland research, management and wardening.
- To promote conservation of wetlands by combining far-sighted national policies with coordinated international action, to consult with other contracting parties about implementing obligations arising from the Convention, especially about shared wetlands and water system.
- To promote wetland conservation concerns with development aid agencies.
- To encourage research and exchange of data.

So far 19 sites in Pakistan have been declared as wetlands of International Importance or Ramsar Sites.

None of these wetlands is located within or in close vicinity of the project area.

3.7.4 CONVENTION ON INTERNATIONAL TRADE IN ENDANGERED SPECIES OF WILD FAUNA AND FLORA (CITES)

This convention came into effect on 03 March 1973 in Washington. In all 130 countries are signatory to this convention with Pakistan signing the convention in 1976. The convention requires the signatories to impose strict regulation (including penalization, confiscation of the specimen etc.) regarding trade of all species threatened with extinction or that may become so, in order not to endanger further their survival.

The Convention contains three appendices. Appendix I include all species threatened with extinction which are or may be affected by trade. The Convention requires that trade in these species should be subject to strict regulation. Appendix II include species that are not necessarily threatened presently but may become so unless trade in specimens of these species is subject to strict regulation. Appendix III includes species which any contracting party identifies as subject to regulations in trade and requires other parties to cooperate in this matter.

3.7.5 INTERNATIONAL UNION FOR CONSERVATION OF NATURE AND NATURAL RESOURCES RED LIST

The red list is published by IUCN and includes those species that are under potential threat of extinction. These species have been categorized as:

- Endangered: species that seem to be facing a very high risk of extinction in the wild in the near future, reduction of 50% or more either in the last 10 years or over the last three generations, survive only in small numbers, or have very small populations.
- Vulnerable in Decline: species that seem to be facing a risk of extinction in the wild, having apparent reductions of 20% or more in the last 10 years or three generations.
- Vulnerable: species that seem to be facing a high risk of extinction in the wild, but not necessarily experiencing recent reductions in population size.
- Lower Risk: species that seem to be facing a risk of extinction that is lesser in extent that for any of the above categories.

- Data Deficient: species that may be at risk of extinction in the wild but at the present time there is insufficient information available to make a firm decision about its status.

3.8 INTERNATIONAL AND NATIONAL ENVIRONMENT AND CONSERVATION ORGANIZATIONS

3.8.1 INTERNATIONAL AND NATIONAL NGOS

International environmental and conservation organizations such as IUCN and the World Wide Fund for nature (WWF) have been active in Pakistan for some time. Both these organizations have worked closely with government and act in an advisory role with regard to the formulation of environmental and conservation Policies. Since the convening of the Rio Summit, a number of national environmental NGOs have also been formed, and have been engaged in advocacy, and in some cases, research. Most prominent national environmental NGOs, such as the Sustainable Development Policy Institute (SDPI), Strengthening Participatory Organization (SPO), Shehri, and Shirkatgah are members of the Pakistan National Committee (PNC) of IUCN.

As mentioned earlier, environmental NGOs have been particularly active in advocacy, as proponents of sustainable development approaches. Much of the government's environmental and conservation policy has been formulated in consultation with leading NGOs, who have also been involved in drafting new legislation on conservation.

3.9 CPL CORPORATE REQUIREMENTS

3.9.1 CORPORATE HSE (HEALTH, SAFETY, ENVIRONMENT) POLICY

HSE management system of CPL is an integral part of their business processes and strategic planning. Worldwide activities and protection of individuals and the environment is one of the most important objectives of the company. Compliance with applicable laws, regulations, and provisions as well as with international treaties is mandatory for all companies of Clariant group. Risk identification and assessment of CPL's operations is a prerequisite for their business. Appropriate measures are taken to identify the risks and manage, minimize or eliminate them. HSE performance is one of the parameters of CPL for selecting suppliers, contractors and service providers. CPL believes and strives for continuous improvement of its HSE performance through development and improvement of its products, process and services with sustainable use of resources and efficient supply chain management. CPL also has an emergency management organization with regular training program.

Chapter 04

Project Description

Contents

4.1 PROJECT CONCEPT

In this chapter, some prominent features of the proposed project are discussed to the extent that they relate to potential environmental and social impacts. Details of past and proposed actions, which include construction and operational activities, will also be discussed in subsequent sections.

4.2 PROJECT OBJECTIVE

CPL has three prime objectives associated with the proposed project. These key objectives are structured as following:

- ✓ To gratify the directions of EPA Sindh by taking a sustainability initiative so as to adhere to ecological wellbeing.
- ✓ To comply with NEQS, accomplish comprehensive wastewater treatment and accommodate the increased load of wastewater being produced at their facility as a result of augmented production.
- ✓ To amplify their capacity of treating hazardous waste, implementing best available environmental controls.

Above mentioned objectives will lead to further development in Clariant's services which will mutually benefit the nation, environment and Clariant itself.

4.3 PROPOSED PROJECT

In connection to the philosophy of environmental protection, CPL currently has a wastewater treatment plant (WWTP) capable to partially treat 1,400 m^3/day of its effluent. Moreover, CPL also has a small incineration plant (IP) to treat different types of waste having a capacity of 50 kg/hr.

As a result of amplified production, the existing treatment plant and incinerator was confronting problems to handle increased pollution load. To meet the treatment requirement, a broad scale project had been proposed by CPL. In this connection, a state-of-the-art Zero Discharge facility has been established which involved expansion and up gradation of their existing treatment capacity of wastewater and sludge produced. The decision had been taken considering the huge water consumption and water scarcity being faced by different areas of the Pakistan. Similarly, the venture also includes expansion and up gradation of existing treatment capacities for solid waste. These initiatives will be helpful to remove the major source of pollutants generated from CPL's activities, and accomplish commitments towards safe environment.

The expanded and up graded WWTP is anticipated to be capable of treating around 1,700 m^3/day effluent enabling it to comply with NEQS, within the notified land area of more than 30 acres. Likewise, waste incineration plant is proposed to be developed with a capacity of 0.5 TPH, which requires a land area of about 3 acres. With this new project, Clariant is keen to

adhere to environmental safeguard and in this regard, aims to have accomplished a complete EIA study on its Jamshoro facility.

4.4 PROJECT COMPONENTS

On account of the mentioned objectives, the venture under concern is classified into two focal operational phases, i.e. the expansion and up gradation of wastewater treatment plant and the installation of a incineration plant. Some relevant details of these processes are furnished as follows:

4.5 WASTEWATER TREATMENT PLANT

CPL, being a conscientious corporate leader in the market, is staunch in its commitment to adhere to ecological safety, and thus recognizes the necessity of the appropriate treatment of the waste water being generated from the CPL Jamshoro facility. It is indeed crucial to be acquainted with the risks and threats posed on environment because of the improper disposal of industrial wastewater. Comprehending this, CPL intends to expand and upgrade their wastewater treatment plant in order to handle more wastewater to be treated, which is a result of their amplified production.

The schematic diagram of CPL wastewater treatment plant is attached as **Figure 4.1**.

4.5.1 THE PROCESS

A wastewater treatment system is composed of a combination of unit processes and designed to reduce certain constituents of wastewater to an acceptable level. The selection of the treatment processes to ensure environmental safety and public health requires detailed analysis of local conditions and needs, application of scientific and engineering knowledge and consideration of federal, provincial and local regulations. Virtually, all treatment systems are classified into three stages which are briefly discussed underneath:

4.5.2 PRIMARY TREATMENT

Preliminary or primary wastewater treatment is defined as the removal of such constituents that may cause maintenance or operational problems with the treatment operations and processes. Preliminary treatments include screening, grit removal and flotation for removal of large quantities of oil and grease; whereas in primary treatment, a portion of the suspended solids and organic matter is removed from the wastewater. This removal is usually accomplished with physical operations such as screening and sedimentation. A brief account of the major processes that are carried out to accomplish the primary treatment of the wastewater is as follows:

4.5.2.1 SCREENING / SETTLING

Screening devices are used to remove coarse solids from wastewater. Coarse solids consist of sticks, rags, boards, and other large objects that often and, in explicably find their way into wastewater collection system. The preliminary purpose of screens is to protect pumps and other mechanical equipment and to prevent clogging of valves and other appurtenances in the wastewater treatment plant. It is normally the first operation performed on the incoming wastewater. Wastewater screens are classified as fine or coarse (bar racks). Screens may have manual or mechanical cleaning system.

4.5.2.2 GRIT AND GREASE REMOVAL

The grit and grease removal is carried out in a combined longitudinal tank with two parallel lines in the first phase and three parallel lines in the second phase. An aeration device ensures that grease, oil and scum float at the surface and facilitates the separation of grit from organic matter and maintain the organic matter in suspension. Each line is provided with a travelling bridge which scrapes the grease at the surface and collects the grit at the bottom of the tank. The grease is evacuated towards a hopper where surplus water is removed and grease is then transported to land fill by vacuum tank. The deposited grit is extracted by pumping or by air-lift towards a grit classifier. It is then conveyed for evacuation to land fill.

4.5.2.3 EQUALIZATION

Equalization tanks are provided to achieve uniformity of wastewater flow and/or characteristics with respect to time, for providing an efficient, economical and easy to operate wastewater treatment system. It is executed where there is a lot of variation in wastewater flow and/or characteristics, with time. It is achieved by collecting the wastewater into an equalization tank, continuously mixing it to attain uniformity and to keep the solids in suspension, and pumping it out at a uniform flow rate. The design of Equalization facilities is concerned with the following information to be considered crucially:

- Location of the equalization facilities in the treatment process flow sheet
- Type of equalization flow sheet
- Required basin volume
- Features that should be incorporated into design
- Proper control of deposition of solids and potential odors

4.5.2.4 SETTLEMENT OR SEDIMENTATION

The objective of treatment by sedimentation is to remove solids and floating material that are able to settle readily and thus reduce the suspended solids content.

Primary sedimentation is used as a preliminary step in the further processing of the wastewater. Efficiently designed and operated primary sedimentation tanks should remove from 50 to 70 percent of the suspended solids and from 25 to 40 percent of the BOD. Primary sedimentation is accomplished in either long-rectangular tanks or circular tanks. In rectangular tanks the scum removal is accomplished by having the sludge scrapers penetrate through the surface as they return to the effluent end of the tank. Floating material is carried to a collection point some distance behind the effluent weirs where it is removed over a scum weir or by a transverse scum scraper. Circular tanks have skimmer arm attached to the sludge scraper drive mechanisms. The scum is wiped up an inclined apron and into a scum trough for removal.

4.5.2.5 CLARIANT'S APPROACH

The waste stream generated at CPL facility is divided into two streams in a ratio of 2:5, i.e. colored stream and non-colored stream. The primary treatment for the non-colored stream starts with the collection of the effluent in ponds for settling and homogenizing different wastewater streams. This is followed by screening, mixing and stirring into physical and chemical flocculators for up to 50-60% treatment of suspended solids, COD, BOD and color, and adjustment of pH. This is to ensure the quality of wastewater for recovery. At this point, usable wastewater and sludge are separated.

With respect to the colored stream, the primary treatment similarly starts with the collection of the effluent in ponds where the effluent is settled (screening process) and is equalized and homogenized for further treatment. Afterwards, the effluent is forwarded to a flocculation plant where physical and chemical treatment is carried out with the help of flocculating agents, so as to ensure the quality of wastewater for recovery. At this step, TSS, COD and BOD are drastically reduced, and de-colorization starts.

4.5.3 SECONDARY TREATMENT

The secondary treatment processes are mainly the biological treatment processes in which microorganisms decompose the organic pollution in the wastewater. Favorable conditions are provided for the microorganism to allow their rapid growth to accelerate the decomposition process. The microorganisms after the growth become heavier and are separated from the waste stream by sedimentation. There are different types of secondary biological treatment processes. These processes can be aerobic or anaerobic, using suspended or attached growth phenomenon. The most common biological wastewater treatment process, which are considered to be suitable local conditions are discussed in this section.

Some other natural wastewater treatment systems like natural and constructed wetlands are also used. Wetlands are also used to remove metals and toxic organics but in general they are specifically used for treatment of suspended solids and swelled biological pollution. Due to large area requirements, they are suitable for small communities only. These systems are not discussed in detail in this section.

4.5.3.1 BIOLOGICAL TREATMENT

Biological wastewater treatment processes are primarily designed for the removal of dissolved and suspended organic matter from wastewaters. The environmental conditions are optimized to encourage growth of the micro-organisms which use the organic compounds as substrate.

Biological wastewater treatment is also capable of removing other wastewater components, including suspended solids, nitrogen, phosphorus, heavy metals and Xenobiotics. In general the biological wastewater treatment is the most efficient and economic way of removing organic pollution from a wastewater.

Various types of biological treatment processes are opted for in the wastewater treatments. The most commonly preferred and employed is the Activated sludge process.

4.5.3.2 ACTIVATED SLUDGE

Activated sludge is suspension of microorganisms, both active and dead, in a wastewater consisting of entrapped and suspended colloidal and dissolved organic and inorganic materials. The activated sludge process is a biological and aerobic process, which uses the metabolic reactions of microorganisms to attain an acceptable effluent quality by removing substances exerting an oxygen demand.

In bio-aeration basins, microbial particles are brought into contact with the organic components of the wastewater. Contents of the reactor basin are referred to as mixed liquor suspended solids, and mostly consist of microorganisms and inert and non-biodegradable matter. The overall reactions, occurring in the biological treatment are determined by the composite metabolism of the microorganisms in the activated sludge.

Air is introduced into the system to satisfy the requirements of the activated sludge and to keep the activated sludge dispersed in the aeration liquor. Oxygen transfer to the activated sludge is accomplished by oxygen absorbed from diffused bubbles of air entrained in the mixed liquor. A fine bubble diffused air system consisting of diffusers that are submerged in the wastewater, header pipes, air mains and the blowers and appurtenances through which the air passes is foreseen.

4.5.3.3 FINAL SEDIMENTATION

The sludge, containing living or active microorganisms, is separated from the wastewater in sedimentation tank. This sludge is partially returned to aeration tank to activate the decomposition process and the remaining quantity is disposed after further sludge treatment. A simple schematic of activated sludge process is shown in **Figure 4.2**. The treated wastewater after sedimentation is discharged for disinfection or for any tertiary treatment, if required. Activated Sludge process is versatile process and can be used for one or all of the following purposes;

- ✓ Oxidation of organic matter to reduced compounds
- ✓ Removal of nutrients from wastewater
- ✓ Removal of specific toxic compounds present in wastewater

Types of Activated Sludge Process: Different types of activated sludge process designs are implemented having variations in the wastewater flow, air supply and return sludge arrangements.

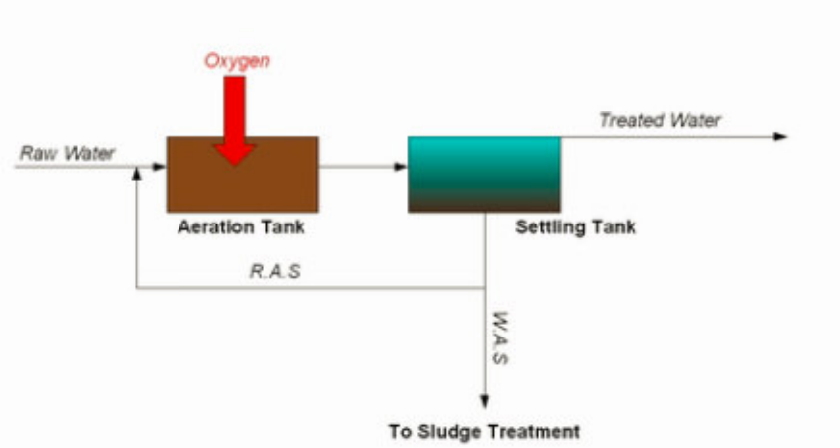


Figure 4.2: Activated Sludge Process

4.5.3.4 CLARIANT'S APPROACH

After equalization, the homogenized non-colored stream is fed into the aeration tanks for the secondary treatment. It involves mixing and aeration so that the microorganisms grow under the aerobic conditions and consume the organic matter, which further reduces BOD and COD. Afterwards, it is sent to secondary clarifier to separate active/ dead sludge (further treatment for incinerator) and to recover filter water with no TSS, BOD and COD.

The colored stream then goes for pre-filtration (coarse, micron & ultra filtration membrane (UF) to reduce organics through such fine filtration to ensure permeate is usable for recovery & reuse after RO).

4.5.4 TERTIARY TREATMENT

Tertiary treatment provides a final stage to raise the effluent quality before it is discharged to the receiving environment. There are different types of tertiary treatment processes that can be used at any treatment plant. Some of the most common tertiary treatment processes include the following treatments:

4.5.4.1 ADVANCED CHEMICAL OXIDATION

When organic compounds in wastewater are non biodegradable, recalcitrant, toxic or inhibitory to microbial growth, the advanced chemical oxidation is employed. Chemical oxidation is a relatively simple process, involving the use of a strong oxidant, with or without a catalyst, used to oxidize organic contaminants into by-products such as carbon dioxide, water, and oxygen. Chemical oxidation is gaining widespread interest throughout the world because it is rapid, and relatively unaffected by contaminant characteristics and concentrations. However, the reported effectiveness of chemical oxidation has been widely varied; some outstanding success, some disappointing and outright dangerous failures, and variations in between.

4.5.4.2 FILTRATION

In wastewater treatment filtration is employed to polish effluent. It may be used where effluent suspended solids requirements are less than 10 mg/l or where secondary effluent quality can be expected to fluctuate significantly. Filter may be of the high rate or low rate gravity type. High-rate filters shall be provided with ready and convenient access to the media for treatment or cleaning.

4.5.4.3 NUTRIENT REMOVAL

The wastewater treatment plants that discharge to water bodies which are precisely balanced with respect to nutrient loads, may have nutrient limitations imposed on their effluents. The nutrients of interest, most frequently, are nitrogen and phosphorus compounds.

Nitrogen removal: The predominant forms of nitrogen in raw wastewater are organic nitrogen and ammonia. Biological treatment may result in conversion to nitrate, provided the processes are aerobic and the treatment periods are long enough. Contact times in most secondary treatment systems, though sufficient to complete conversion from organic nitrogen to ammonia, may not be sufficient for significant nitrification. Because of oxygen demand exerted by ammonia and because of other environmental factors, removal of ammonia may be required. The most common processes for removing ammonia from wastewater are (1) stripping with air and (2) biological nitrification-de-nitrification.

Phosphorus removal: Phosphorus can be removed biologically in a process called enhanced biological phosphorus removal. In this process, specific bacteria, called polyphosphate accumulating organisms are selectively enriched and gather large quantities of phosphorus within their cells (up to 20% of their mass). When the biomass is enriched in these bacteria, they are separated from the treated water. These bio-solids have a high fertilizer value. Phosphorus removal can also be achieved by chemical precipitation, usually with salts of iron (e.g. ferric chloride) or aluminum (e.g. alum). The resulting chemical sludge is difficult to handle and the added chemicals can be expensive. But the chemical phosphorus removal requires significantly smaller equipment than biological processes.

4.5.4.4 POLISHING PONDS

Tertiary maturation low rate stabilization ponds are designed to provide for secondary effluent polishing and seasonal nitrification. The biological mechanism involved are similar other aerobic suspended growth processes. Operationally, the residua biological solids are endogenously respired, and ammonia is converted to nitrate using the oxygen supplied from surface re-aeration and from algae. A detention time of 18 to 20 days has been suggested as the minimum period required for complete endogenous respiration of the residual solids. To maintain aerobic conditions, the applied loadings are quite low.

4.5.4.5 DISINFECTION

The purpose of disinfection in the treatment of wastewater is to substantially reduce the number of microorganisms in the water to be discharged back into the environment. Disinfection is always the final process. The effectiveness of disinfection depends upon the quality of the water being treated, the type of disinfectant being used, the disinfectant dosage (concentration and time), and other environmental variables. Cloudy water will be treated less successfully since solid matter can shield organisms, especially from ultraviolet light or if contact times are low. Generally, short contact times, low doses and high flows all militate against effective disinfection. Common methods of disinfection include ozone, chlorine, or ultraviolet light. Chloramine, which is used for drinking water, is not used in wastewater treatment because of its persistence.

Chlorination: Chlorination is the most common form of wastewater disinfection in North America due to its low cost and long history of effectiveness. One disadvantage is that chlorination of residual organic material can generate chlorinated-organic compounds that may be carcinogenic or harmful to the environment. Residual chlorine or chloramines may also be capable of chlorinating organic material in the natural aquatic environment. Further, because residual

chlorine is toxic to aquatic species, the treated effluent must also be chemically de-chlorinated, adding to the complexity and cost of treatment.

Ultraviolet: Ultraviolet (UV) light can be used instead of chlorine, iodine, or other chemicals. Because no chemicals are used, the treated water's taste is more natural and pure as compared to other methods. UV radiation causes damage to the genetic structure of bacteria, viruses, and other pathogens, making them incapable of reproduction. The key disadvantages of UV disinfection are the need for frequent lamp maintenance and replacement and the need for a highly treated effluent to ensure that the target microorganisms are not shielded from the UV radiation. In the United Kingdom, light is becoming the most common means of disinfection because of the concerns about the impacts of chlorine in chlorinating residual organics in the wastewater and in chlorinating organics in the receiving water.

Ozone: Ozone (O_3) is generated by passing oxygen O_2 through a high voltage potential resulting in a third oxygen atom becoming attached and forming O_3. Ozone is very unstable and reactive and oxidizes most organic material it comes in contact with, thereby destroying many pathogenic microorganisms. Ozone is considered to be safer than chlorine because, unlike chlorine which has to be stored on site, ozone is generated onsite as needed. Ozonation also produces fewer disinfection by-products than chlorination. A disadvantage of ozone disinfection is the high cost of the ozone generation equipment and the requirements for highly skilled operators.

4.5.4.6 CLARIANT'S APPROACH

The primary objective of tertiary treatment is to recover and reuse water from waste stream. This is achieved when the treated effluent stream from secondary clarifier is sent to reverse osmosis (R.O) Plant. This results into 80-85% recovery and reuse of water whereas 15 – 20% is sent to evaporation ponds and the dried sludge is further moved on for incineration.

The recovered water continuously obtained can either be reused in cooling towers, boiler and for gardening, machine washing, floor washing purposes or can be stored for future use.

4.5.5 *ZERO DISCHARGE*

The aforementioned process enables CPL to achieve the objective of a "Zero-discharge". In the end of the 1980's, together with increased environmental awareness within society and industry, "Zero discharge" changed from a technical description of 100% wastewater recycling to a "goal". The principle of zero discharge is recycling of all industrial wastewater. This means that wastewater will

be treated and used again in the process. Because of the water reuse wastewater will not be released on the sewer system or surface water. However, the main objective in a zero discharge treatment system is to see that:

i. The process utilized for wastewater treatment does not generate any additional pollutants.

ii. The production of waste is minimized by suitable selection of unit processes and adjusting operating parameters.

iii. As far as possible, pollutants in the wastewater are transferred to solid phase (sludge).

iv. Sludge is disposed off in a secured landfill or incinerated appropriately.

v. Recovery of reusable materials, especially water is achieved.

4.6 THE INCINERATION PLANT

At present, CPL has an incinerator installed at its facility which is capable of incinerating sludge & packaging material. Now, CPL aspires to expand its capacity to 0.5 TPH for handling hazardous waste treatment. In this regard, an incinerator would be installed capable of incinerating different types of solid waste generated at CPL facility i.e. sludge, flocculation sludge, hazardous packaging material and paper waste. All technical details of incinerator are available in the technical manual of incinerator and attached as **Annexure III.**

The proposed incinerator will have the following components:

- Feed screw conveyor
- Rotary kiln incinerator
- Primary incineration burner
- Secondary combustion chamber
- Secondary combustion burner
- Hydro cooling dust collector
- G-L heat exchange device
- Rapid cooling de-acidification tower (Scrubber Unit)
- Fog water transporting system (Scrubber showering system)
- Fan
- Independent chimney (Exhaust System)
- Caustic solution tank
- Lye pump

- Air-blower & confession wind system
- Electrical system
- Instrument system
- Automatic ash removal device
- Required platform & supports

4.6.1 THE INCINERATION PROCESS

The waste is sent into the rotary combustion chamber by screw conveyor, and then the refuse is ignited by primary incineration burner in the rotary combustion chamber (at 600-900°C) for complete gasification, oxidation, pyrolysis and combustion, based on the principle of 3T (temperature, time, turbine flow). Then the high temperature flue gas enters the secondary combustion chamber for the high temperature incineration (1200-1400°C). This is to ensure the combustion efficiency and the removal rate of the pollutants over 99.9% with complete removal of the harmful substances such as the sulfur and chlorine etc and removal of part of the large size dust particles at the same time.

Then the flue gas enters the hydro cooling dust collector where big pellet dust is eliminated and the temperature of the flue gas is reduced to 900°C. Then the flue gas enters the heat exchange device where the temperature of the flue gas is further reduced and the hot water is recovered, the flue gas then enters the rapid cooling de-acidification tower to remove harmful acidic gases and is then cooled (about 180°C). The process is designed to meet the constraint of non-toxic, smokeless, harmless, odorless complete combustion.

Finally the flue gas which has met the discharge standard is sent into the chimney by the fan and then discharged into the atmosphere (below 150°C); while the residue ashes after burning are taken out by the automatic ash removal device and will be used for brick manufacturing, road filling or transported to a government owned land-fill site through an approved waste contractor.

- Major elements comprising the waste: C, H, O, Cl, S
- Chemical reaction in combustion chamber:
  - $C_xH_yO_z + O_2 \rightarrow CO_2\uparrow + H_2O$
  - $C_xH_yCl_z + O_2 \rightarrow CO_2\uparrow + HCl\uparrow + H_2O$
  - $C_xH_yS_z + O_2 \rightarrow CO_2\uparrow + SO_2\uparrow + H_2O$
- Chemical reaction of the alkali liquor gets rid of the sulfur and chlorine

- $HCl + NaOH \rightarrow NaCl + H_2O$
- $SO_2 + 2NaOH \rightarrow Na_2SO_3 + H_2O$

4.6.2 ENVIRONMENTAL FRIENDLY FEATURES

To ensure that the emissions from the incinerator cause least harm once they are discharged into the environment, CPL has selected this particular incinerator design. The basis for the design of this incinerator is in accordance with the following Chinese standards:

- State Environment Protection Administration, State General Administration for Quality supervision, Inspection and Quarantine: GB18484-2001 "Control Standard for Incineration of dangerous refuse". This standard has been in effect since January 2002.
- State Environment Protection Administration, State General Administration for Quality supervision, Inspection and Quarantine: GB18597-2001 "Pollution control standard for storage of dangerous refuse". This standard has been in effect since July 2002.

In addition, this incinerator is equipped with the following cooling and pollution control devices or equipments:

- Hydro cooling dust collecting system
- Heat exchange device
- Rapid cooling de-acidification tower

Each of these three devices is installed in order to ensure maximum removal of particulate matter and harmful acidic gases and utilization of waste heat energy to recover hot water. In addition, these devices will reduce the exhaust temperature of the flue gases below 150°C.

4.6.3 DESIGN SPECIFICATIONS OF THE INCINERATOR

- Total power consumption: 50 KW
- Category of the refuse: Hazardous waste
- Design treatment capacity: 500 Kg/h
- Design average calorific value: 2500 Kcal/kg
- Material feeding method: Screw conveyor
- Ash removal method: Automatic ash removal device with conveying worm

- Fuel: Gas
- Ignition: Automatic ignition
- Primary rotary kiln temperature: 600-900°C
- Secondary combustion chamber: 1200-1400°C
- Gas consumption: 30-90 m^3/h (depends on the change of the heating value of the refuse; the higher the heating value, the less consumption of the oil or vice versa)
- Consumption of caustic: 5 kg/h (based on 1% content of sulfur and chlorine contained in the refuse)
- Operators: 3 operators/shift
- Noise: 85 dB (1 meter of place)
- Equipment is unfit to be used to burn hindering waste and waste containing halogens.

The expected outcomes of the incineration process are tabulated below. These emissions are in accordance with the Chinese standard GB18484-2001, given by the manufacturer. It is imperative to mention that these emissions also fulfill the local regulatory requirement i.e. NEQS:

Pollutants	Unit	Limit
Blackness of flue gas	Ringelmann level	<1
Smoke dust	mg/m^3	100
Carbon monoxide	mg/m^3	100
Sulfur dioxide	mg/m^3	400
Hydrogen fluoride	mg/m^3	9.0
Chlorine hydride	mg/m^3	100
Nitrogen oxide (NO_2)	mg/m^3	500
Dioxin	ng/m^3	0.5 TEQ

4.6.4 SAFETY CONSIDERATIONS

The incinerator is well-equipped with safety gadgets and all precautionary measures are appropriately considered, during the designing of the incinerator. The safety considerations furnished in the incinerator manual given by the manufacturer are as follows:

- This incinerator is equipped with safety guarding device which can automatically cut off the supply of the fuel safely and halt the equipment in case of abnormal ignition after the burner is started.
- Before the shutdown of the equipment, the cooling procedure in the combustion chamber will be tested in order to ensure that the incinerator completely stops running only when the temperature of the combustion chamber reduces to the specified level.
- Protection devices are provided between the control cabinet and each equipment to prevent creep. When the temperature is 40°C and the relative humidity is 85%, the insulation resistance of the circuit loop of the electric equipments is no less than 2MΩ, and can bear 1 min labor frequency (50Hz), voltage 1500V experiments voltage. The connecting cables are protected by metal hose outside.
- The equipment has been strictly tested and verified by the technical department before being delivered, with firm and reliable installation of the oil pipeline and air pipeline; the equipment has also undergone pressure test to avoid any leakage problems.
- Warning systems:
  - The incinerator is equipped with power source instruction, the switch.
  - In order to save the motor from being overburdened, it is provided with an overload protection device.
  - The maximum and minimum temperatures are controlled.

4.6.5 SPECIFICATIONS OF THE MECHANICAL COMPONENTS

Components	Specifications
Primary rotary kiln incinerator	• Material: A3 steel 14mm + fire resistant heat insulation material 250 mm • Volume inside the furnace: 5.0 m^3 • Driving device power: 5.5 KW • Attachment: overhaul door, sight hole, sealing element
Secondary combustion chamber	• Material: A3 steel 8mm + fire resistant heat insulation material 250 mm • Attachment: fuel pipe elbow
Hydro cooling dust collector	• Material: A3 steel 8mm + A3 steel 6mm

	• Attachment: water box, soft drink separator
G-L heat exchange device	• Material: A3 steel 8mm + heat exchange pipeline + heat insulator • Attachment: water box, aqueous vapor and water separator
Rapid cooling de-acidification tower	• Material: A3 steel 6mm + refractory heat insulation material • Accessories: 2 sets of lye pump
Fan	• Air capacity: 10555m³/h • Air pressure: 4011 Pa • Power: 22 KW • Accessories: damper, water-cooled bearing
Separate stack	• Material: A3 steel • Height from the floor: 25m • Accessories: ladder, testing platform, sampling hole, pollutant discharge valve, maintenance access, lighting arrestor, anti-wind cord
Primary incineration burner	• Power: 0.47 KW • Gas consumption: 13.5-26.2 m³/h • Control: big and small fire • Accessories: oil transporting piping system, valve
Secondary incineration burner	• Power: 1.4 KW • Gas consumption: 21.5-70 m³/h • Control: big and small fire • Accessories: oil transporting piping system, valve
Air supply system	• Air capacity: 3685m³/h • Air pressure: 4776 Pa • Power: 7.5 KW • Accessories: damper, butterfly valve, air supply duct
Ash feed and removal system	Conveying worm: 1.1KW
Electrical and instrumental control system	• Power supply general switch • Alarm for water shortage • Timing device for combustion of residual gas • Overload protection device • Creep protection device

	• Temperature indicators at the outlets of primary and secondary chambers • Interlock device • Negative pressure control system
Auxiliary system	Platforms, supports, handrails necessary for the connection of the flue gas ducts, system installation and maintenance and all necessary tools for repairing and maintenance

4.7 PROJECT AREA

The proposed expansion and up gradation of waste water treatment plant and installation of the incinerator is carried out in CPL Jamshoro facility, located in Sindh. The project encompasses a total area of more than 30 acres for the WWTP and about 3 acres for the incineration unit. The layout of CPL Jamshoro facility is attached as **Figure 4.3**.

4.8 THE DESIGN PHASE

The design phase of the project comprised mainly of feasibility study, appropriate design selection and studies for the proposed project. During this phase of the project, no major activity took place at site, except for the investigation of soil and contractor mobilization. To examine the soil characteristics, drilling for soil sample collection was carried out at proposed project site.

4.9 THE CONSTRUCTION PHASE

In this phase of the project, mostly civil works are performed, including the site preparation and mobilization of construction equipment. Heavy plant equipments are undertaken as per construction management plans specified by the contractor. However, these plans are developed in line with the provisions and recommendations contained in the EIA.

Since some part of the construction phase of the project had been completed, therefore the construction activities were cautiously audited and the findings are integrated in the report.

The construction works were generally completed in a 12 hour day from 08:00 am in the morning to 8:00 pm in the evening, 6 days a week. However, for the special works such as concreting or commissioning activities, it was necessary to work for longer periods up to 24 hours a day.

Construction required the continuing use of a considerable number of machinery, including forklifts, bulldozers (including cats and excavators), trailers, cranes, compressors, compactors etc.

4.10 OPERATIONAL PHASE

As mentioned earlier, CPL had instigated expansion and up gradation of its wastewater treatment plant soon after receiving the letter from EPA Sindh and employed great efforts to complete the project within due time. Therefore the treatment plant has commenced its operation, and the completion report has already been submitted to EPA Sindh, while the incinerator will commence its operation soon after the installation.

4.11 PROJECT SCHEDULE

The approximate schedule for the project is as follows:

Project Phase	Schedule
Wastewater Treatment Plant	12 months
Incinerator Unit	3 months

4.12 RESOURCE USAGE AND REQUIREMENT

4.12.1 RECRUITMENT

It is anticipated that overall project activities will generate more than 300 vacancies for technical, security and unskilled workers. Local people will be given preference for unskilled job. Details of the staff requirement for major phases of the project are as under:

Workforce required	Construction Phase	Operation Phase
Incinerator Unit	150-200	20-30
WWTP		

4.12.2 WATER REQUIREMENT

During the establishment of the project (both the incinerator unit and the WWT plant) water will be obtained from River Indus, while during the operational activities, recycled water will be used. The estimated water consumption is mentioned below:

Water Requirement (m^3/day)	Construction phase	Operational phase
Incinerator Unit	5-8	Negligible
WWTP	40-50	Water will be recovered from WWTP

4.12.3 ELECTRICITY REQUIREMENT

Electricity requirements will be fulfilled partially by WAPDA and partially by power generators installed at CPL's own generators. An estimated consumption of energy is tabulated below:

Consumption (KW)	Construction phase	Operational phase
Incinerator Unit	30	50
WWTP	150-200	350-400

4.12.4 FUEL REQUIREMENTS

Fuel requirement for the project comprises of gas and diesel. Gas shall be obtained through SSGC and diesel through local market. The estimated fuel consumption is mentioned below:

Fuel Requirement (m^3/hr)	Construction phase	Operational phase
Incinerator Unit	Nil	30-90 (gas)
WWTP	Fuel is only required for the construction machineries	

4.13 WASTE GENERATION AND DISPOSAL

It is alleged that solid waste generated at the facility will consist of both hazardous and non hazardous waste. An estimated waste generation during the project's construction and operational phases is tabulated as follows:

4.13.1 SOLID WASTE

Waste Generation (tons/day)	Construction Phase	Operational Phase
Incinerator Unit	1-2	6-8
WWTP	2-5	10

4.13.2 LIQUID WASTE

Waste Generation (m^3/day)	Construction Phase	Operational Phase
Incinerator Unit	1-2	N/A
WWTP	10-15	N/A

4.14 FIRE AND EMERGENCY PREPAREDNESS PLAN

CPL has clearly defined, well structured and dynamic Fire & Emergency Preparedness Plan. Besides, it has been made certain that fire hydrants and portable fire extinguishers are accessible in close proximity to the proposed location.

4.15 HEALTH, SAFETY AND ENVIRONMENTAL MANAGEMENT

HSE management system of CPL is an integral part of their business processes and strategic planning. Worldwide activities and protection of individuals and the environment is one of the most important objectives of the company. Compliance with applicable laws, regulations, and provisions as well as with international treaties is mandatory for all companies of Clariant group. Risk identification and assessment of CPL's operations is a prerequisite for their business. Appropriate measures are taken to identify the risks and manage, minimize or eliminate them. HSE performance is one of the parameters of CPL for selecting suppliers, contractors and service providers. CPL believes and strives for continuous improvement of its HSE performance through development and improvement of its products, process and services with sustainable use of resources and efficient supply chain management. CPL also has an emergency management organization with regular training program.

Figure 4.1
Schematic Diagram of the Wastewater Treatment Plant

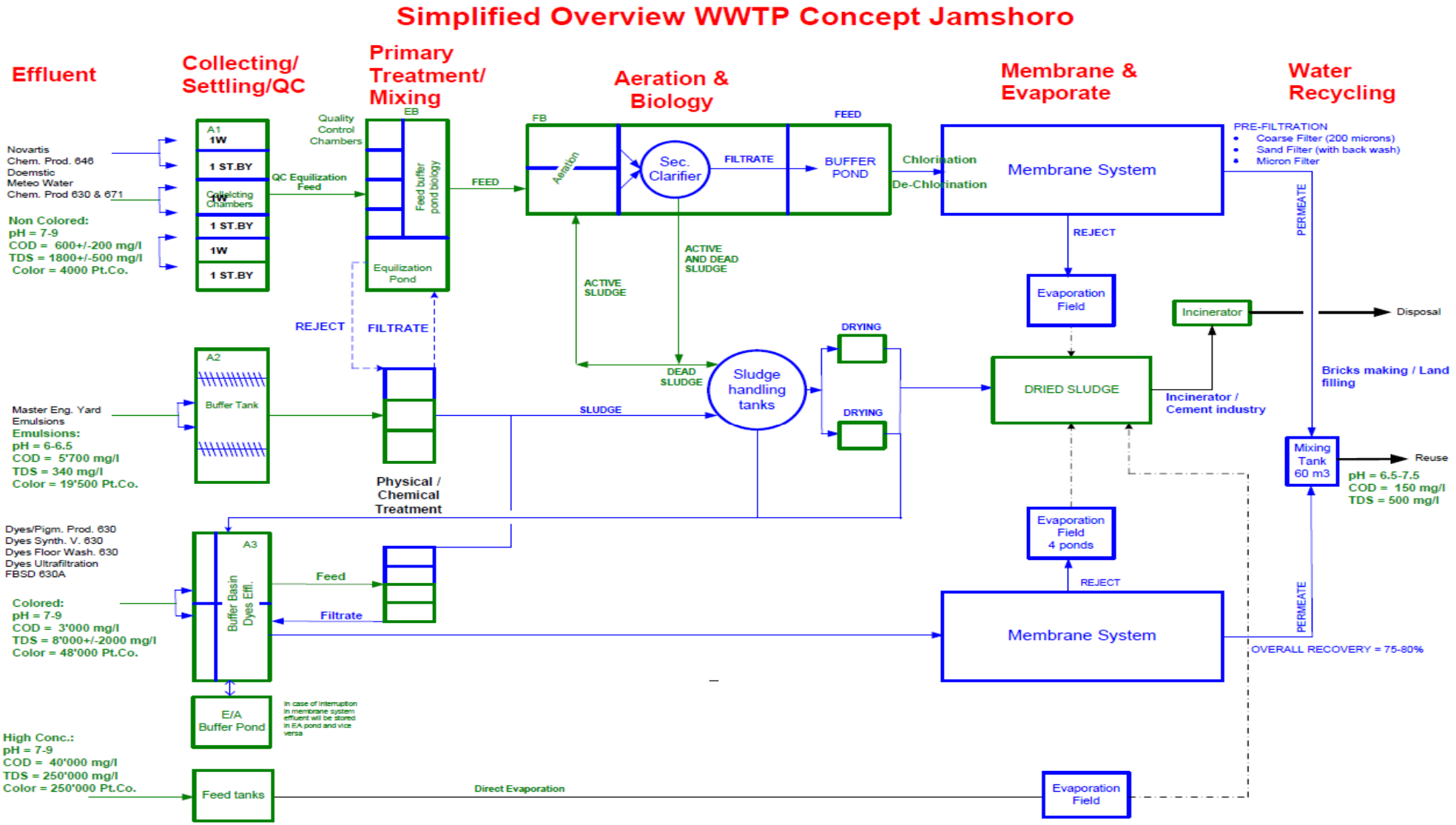
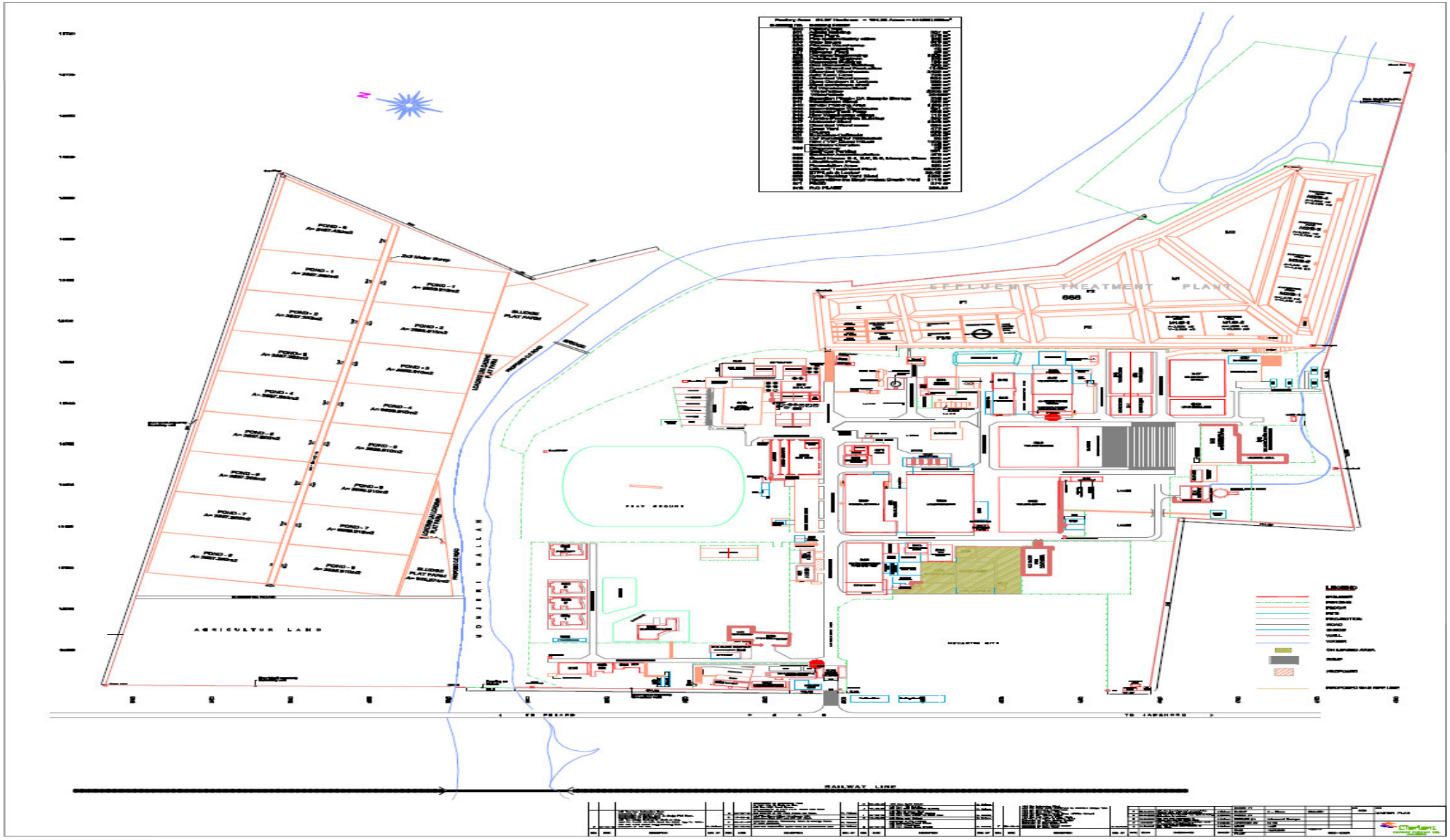

Simplified Overview WWTP Concept Jamshoro
Effluent
Collecting/ Settling/QC
Primary Treatment/ Mixing
Aeration & Biology
Membrane & Evaporate
Water Recycling
Novartis
Chem. Prod. 646
Doemstic
Meteo Water
Chem. Prod 630 & 671
Non Colored:
pH = 7-9
COD = 600+/-200 mg/l
TDS = 1800+/-500 mg/l
Color = 4000 Pt.Co.
A1
1W
1 ST.BY
Collecting Chambers
1W
1 ST.BY
1W
1 ST.BY
Quality Control Chambers
QC Equilization Feed
EB
Feed buffer pond biology
Equilization Pond
FEED
FB
Aeration
Sec. Clarifier
FILTRATE
BUFFER POND
FEED
Chlorination
De-Chlorination
Membrane System
PRE-FILTRATION
Coarse Filter (200 microns)
Sand Filter (with back wash)
Micron Filter
PERMEATE
REJECT
ACTIVE SLUDGE
ACTIVE AND DEAD SLUDGE
Evaporation Field
Incinerator
Disposal
REJECT
FILTRATE
DRYING
DRYING
DEAD SLUDGE
Sludge handling tanks
SLUDGE
DRIED SLUDGE
Incinerator / Cement industry
Bricks making / Land filling
Master Eng. Yard Emulsions
Emulsions:
pH = 6-6.5
COD = 5'700 mg/l
TDS = 340 mg/l
Color = 19'500 Pt.Co.
A2
Buffer Tank
Physical / Chemical Treatment
Mixing Tank 60 m3
Reuse
pH = 6.5-7.5
COD = 150 mg/l
TDS = 500 mg/l
Dyes/Pigm. Prod. 630
Dyes Synth. V. 630
Dyes Floor Wash. 630
Dyes Ultrafiltration
FBSD 630A
Colored:
pH = 7-9
COD = 3'000 mg/l
TDS = 8'000+/-2000 mg/l
Color = 48'000 Pt.Co.
A3
Buffer Basin Dyes Effl.
Feed
Filtrate
Evaporation Field 4 ponds
REJECT
Membrane System
PERMEATE
OVERALL RECOVERY = 75-80%
E/A Buffer Pond
In case of interruption in membrane system effluent will be stored in EA pond and vice versa
High Conc.:
pH = 7-9
COD = 40'000 mg/l
TDS = 250'000 mg/l
Color = 250'000 Pt.Co.
Feed tanks
Direct Evaporation
Evaporation Field

Figure 4.3
Layout of CPL Jamshoro Facility


EFFLUENT TREATMENT PLANT
AGRICULTUR LAND
RAILWAY LINE

Chapter 05

Environmental and Social Baseline

Contents

This chapter defines the prevailing environmental and socio-economic settings of the macro and micro environment present within the proposed project area, and details the importance of these resources. The project area in this document is defined as the area where the project related activities to be carried out which include the proposed project site and surroundings, and the area that can interact with the project's positive and negative externalities in the long run.

The information presented in this section has been derived by a combination of desk study and field survey. Field survey was conducted to collate primary data for air, water, soil, noise and socio-economic features. A team consisting of an Environmentalist, Sociologist, Botanist, and Zoologist visited the project area.

The environmental impact of any activity or process will be assessed on the basis of a deviation from the baseline or normal situation. Followings are the main components of the baseline:

- Physical Environment
- Biological Environment
- Socio-Economic Environment

5.1 PHYSICAL ENVIRONMENT

Physical environment essentially illustrates baseline conditions of topography, geology, soils, climate, surface water and groundwater of macro-environment and microenvironment, where necessary, of proposed project regardless of an EIA or IEE studies.

5.1.1 GEOGRAPHY

The project area falls in district Jamshoro of Sindh province. The district is spread over an area of 4,791,024 acres with 28 Union Councils, 1,050 Dehs and 1359 Villages. District has four Talukas namely Kotri, Manjhand, Sehwan Sharif and Thano Bula Khan.

The Jamshoro District bordering Dadu on the North, on the East the River Indus separates it from Nawab Shah, Matyari and Hyderabad district, on the south Thatta district, south west Karachi district and on the west by Kheerthar Range makes its boundary which separates Sindh and Lasbela district of Baluchistan.

The proposed project is situated within the existing premises of CPL Jamshoro facility which is spread over on around 92 acres of land; and was established in 1970. The site is located in Sandoznagar, Jamshoro on Petaro Road and geographically situated at 25o 26' 55.23" N 68o 17' 00.59" E.

5.1.2 GEOLOGY AND SOIL

The geology of Sindh is divisible in three main regions, the mountain ranges of Kirthar, Pab containing a chain of minor hills and the Thar Desert and part of Indian Platform where the main exposure is of Karonjhar Mountains, which is famous for Nagar Parkar Granite. In the north Sindh is enquired by rocks of Laki range extending to Suleiman range and its southern most part is encircled by the Arabian Sea. The rocks exposed in this area belong to upper Cretaceous which is recent in age. The sub-surface rocks are about 20,000 feet thick and belong to Cretaceous and Pre- Cretaceous periods. Basin wise Sindh lies in the lower Indus Basin and its main tectonic features are the platform and fore deep areas.

The macroenvironment of the project area is mainly composed of detrital and non-detrital rocks varying in age from Early Eocene to Pleistocene. Mostly the rocks are of sedimentary origin of clastic and non-clastic nature and belong to marine, partly marine and fluviatile depositional environment. The geological succession of the macroenvironment of the area from bottom to top is as under.

Formation	Age
Dada conglomerate	Pleistocene
Manchar Formation	Upper Miocene
Gaj Formation	Miocene
Nari Formation	Oligocene
Tiyon Formation	Middle Eocene
Laki Formation	Lower Eocene

The project area lies on the flood plain deposits of River Indus. The area was primarily used for agriculture and land is fertile in nature. The area generally comprises of silty sands. These deposits have been reworked by the river, which has been changing its course in the past. However, since the construction of barrages along with several allied protective bunds in the area, the river has mostly become confined.

The proposed project area is generally flat comprising agricultural land. The soil at the surface generally ranges from grayish brown loose to medium dense silty fine sands which are underlain by extensive deposits of fine to course sands.

The soils in the project area are made up of alluvial deposits typical of Sindh plain. These are river transported deposits, which are quite thick and fairly homogenous in extent. The top soil consists of grayish brown, soft to firm silt. The top layer is likely to extend about 1 or 2 meter below natural ground where it is underlain by

fine sand. This layer generally continues to deeper depths. Prior to giving a status of industrial estate to the area, most of the land was used for agricultural purposes.

5.1.3 CLIMATE

The climate of Jamshoro district is randomly pleasant. In summer, the northern part (Sehwan) is hotter than that of other parts of the district and normal cool in winter. According to climatic zones of Pakistan, the district lies in "hot summer & mild winters" and seasonally falls under arid regions. Mild winter extends from November to February and few cold waves take place occasionally due to western weather disturbances. Summer occurs from March to June and hot weather sets in when hot winds blow from the desert area. When the pressure vacuum builds up in the north Arabian Sea, it stops sea breeze over the entire Sindh coast.

The last Five (05) years data was procured from the nearest metrological station maintained by Pakistan Meteorology Department. As no station exists in the district therefore meteorological data from Hyderabad station has been used which provide a general idea of the baseline climatic conditions of the project area and its surroundings. Following metrological parameters are used for the establishment of baseline.

- Mean Monthly Temperature (°C)
- Mean Monthly Precipitation (mm)
- Mean Monthly Relative Humidity at 0000 UTC
- Mean Monthly Relative Humidity at 1200 UTC
- Mean Monthly Wind Speed at 0000 UTS
- Mean Monthly Wind Speed at 1200 UTS
- Mean Wind Direction at 0000 UTC
- Mean Wind Direction at 1200 UTC

5.1.3.1 TEMPERATURE

The ambient temperature of proposed project region varies from summer to winter. The change in temperature has a direct influence on the environment of the project area. The mean monthly temperature in the area varies from 15.0 °C to 34.0 °C. Mean monthly Temperature was minimum registered 15.8 °C in Jan, 2008 and it was highest found 34.4 ° C in the month of May, 2009. Average of annual mean monthly temperature was registered minimum at 27.4 °C in 2008 and it was highest recorded 2.8.0 °C during the year 2009 and 2010. Mean monthly temperature recorded at Hyderabad metrological station (the nearest weather station from project site) for last five years is presented in **Table IV-A** in **Annexure IV**.

5.1.3.2 RAINFALL

The last five years rain fall data shows variation between 0 – 137 mm, and mean monthly maximum rain fall reported is 137 mm during the year of 2009. Average of Annual mean monthly precipitation was registered minimum 71.4 mm in 2011 and it was highest recorded 241.9 during the year 2007. The mean monthly rain fall data for last five years (2007-2011) is presented in **Table IV-B** in **Annexure IV**.

5.1.3.3 HUMIDITY

Humidity mainly caused by solar exposed surface waters including wetlands & Oceans, and is one of the major causes of green houses effect in addition to chemical, biological & thermal induced gases in the troposphereic air ecosystem.

The relative humidity in project region varies from 20 to 88 % in morning and afternoon hours respectively. Relative humidity at 0000 UTC was lowest registered 56% in the month of April, 2009; and it was highest recorded 88% during the month of September 2009 & July, 2011; whereas lowest relative humidity at 1200 UTC was registered 20% during the month of December; 2007, February 2008 & April 2011 and it was highest recorded 73% during the month of September, 2011. Five years (2007-2011) mean monthly Relative humidity at 000 UTC and 1200 UTC is presented in **Tables IV-C** and **Table IV-D,** respectively in **Annexure IV**.

5.1.3.4 WIND SPEED & DIRECTION

Winds & Rainfall both have pronounced impacts on air, soil and aquatic system of environment and is responsible to alter it on significant intensity depending on its severity levels.

Wind speed pattern at 0000 UTC was lowest registered 0.9 knots in the month of July, 2010; and it was highest recorded 17.8 knots during the month of July, 2008; whereas lowest mean Wind speed at 1200 UTC was registered 4.7 knots during the month of November; 2011 and it was highest recorded 26.3 knots during the month of May, 2008. Five years mean monthly Wind speed data at 000 UTC and 1200 UTC is presented in **Table IV-E** and **Table IV-F,** respectively in **Annexure IV**.

The Wind direction in summer is towards south and southwest; whereas in winter it is towards North-East and North-West. Wind blow direction at 0000 UTC was registered mostly South-West from March to November in the year 2007 till 2011; whereas its blows North-East and North-West in the month December through February in the last Five years. Five years mean monthly wind direction data at 000 UTC and 1200 UTC is presented in **Table IV-G** and **Table IV-H,** respectively in **Annexure IV**.

5.1.4 WATER RESOURCES

Water resources of the area are discussed under two broad headings, surface water resources and groundwater resources.

5.1.4.1 SURFACE WATER

Surface waters resources are usually exposed to the surface of earth in the form of mobile and immobile situation which includes snow-clad mountains, rivers, non-river streams, rain, sleet, wetlands and oceans. Surface resourced waters are highly susceptible to natural and anthropogenic derived contamination in terms of Chemical and Biological contamination and thus are not used for sensitive applications such as drinking directly, unless it is pre-treated.

The main source of surface water in the proposed project corridor is River Indus through associated Barrage (e.g. Kotri Barrage) and branch canals (e.g. KB Feeder Canal) situated on the right bank of River Indus about 3-5 KM away. Kotri Barrage and most-of-time flowing tributary stream "KB Feeder Canal" is considered a major surface water body in the vicinity of proposed project site. Kotri Barrage is used to supply water to district Hyderabad & Jamshoro etc. whereas KB feeder canal, which finally falls into Kalri Lake, is the foremost water supply source for Karachi metropolitan city. In addition to these surface water bodies, Right Bank Outfall Drain (RBOD) which carrying agriculture wastewater or seepage water is passing from around 300 meters away in South East direction.

5.1.4.2 FLOOD/DRAINAGE WATER

On broader scale, project area lies in the flood plain of River Indus. The topography of Sindh province is almost flat and located at the bottom of Indus basin. The surplus water of Indus River and its tributaries including monsoon has to pass through Sindh. Hill torrents which emanate from Balochistan are also adding up to the pressure on both accounts, till its outfall in the Arabian Sea. The River Indus in Sindh is dangerous, because it flows at ridge. In case of breach the out flowing water can not be drained back into the river at any point. The Indus River is also popular for changing its course.

Jamshoro district is also subjected to flooding and was also affected by the recent flood encountered in the year 2011. There are different Monsoon Nalas out of which Rani Nala flows during the rainy season and lies in North & North Eastern direction of the immediate vicinity of the proposed project area.

5.1.4.3 GROUNDWATER

Ground water resources are found hidden and camouflaged into the surface of earth in the form of mobile and immobile state and exist as shallow and deep wells,

confined and un-confined aquifers, springs and watersheds. Ground resourced waters are not easily susceptible to natural and anthropogenic derived contamination caused by Chemical/Biological pollution and thus is directly used for sensitive applications such as drinking even it is un-treated. Main visible pollutants such as turbidity, color and odor are usually remaining absent in ground extracted waters. Invisible biological contaminants such as Bacteria, Protozoa and Viruses are also not expected in sub-surface water regimes unless it is contaminated by un-expected upheaval.

Water constitutes an important section of Physical Environment of an IEE/EIA Study to define its magnitude, quality and occurrence throughout the entire project corridor. On geo-sphereic earth water is amounting to 3% as fresh water resource of the total water reserve. Of this groundwater comprises 95%, surface water 3.5% and soil moisture 1.5%. Out of all the fresh water on the earth, only 0.36% is readily available for diversity uses and applications.

The project area is underlain by unconsolidated alluvial deposits laid by river Indus. Fine to course sands from aquifer material occurs at various layers. The aquifer is fairly thick. In Jamshoro district of Sindh province, the drinking water supplies mainly induced from sweet aquifers on the right bank of river Indus and some water from river itself. Groundwater table generally occurs at the site from 6 to 8 meter below the ground level. The character of groundwater is mostly sweetish having its dissolved salt contents ranging from 500 – 800mg/l.

5.1.4.4 WATER QUALITY ANALYSIS

In order to assess ground water quality, a sample was taken near project area. The sample was tested for pH, TDS, Electrical conductivity (EC), salinity, temperature, lead, arsenic, cadmium and zinc. In addition to the sample collected by SGS team, another detailed study on Groundwater Quality in Sindh, conducted by Indus Institute for Research & Education, was also consulted to analyze the baseline groundwater quality of the project area.

CHEMICAL ANALYSES

Total 8 criteria physical and chemical tests were conducted on the aforementioned sample in line with APHA/USEPA defined procedures & protocols to determine the magnitude of natural & anthropogenic borne components in the aquatic systems from where this sample was collected.

Chemical and Physical Analyses pattern carried out on this water sample indicate that the water sample is viably complying NEQS regulated guidelines on drinking water.

a) pH

pH determines the acidic or basic character of water system and is a vital parameter on which life of many terrestrial depends, from micro to macro and even soil matrix of environment which grows diverse food for all terrestrial communities including human.

The monitoring pattern indicates that pH was found to be 7.36, which lies within reasonable limit and thus indicating a ground induced water.

b) TDS / EC

Both are interrelated parameters with respect to water chemistry and are responsible to assess the extent of soluble and electronic charge component in water because water itself is assumed to be neutral in which positively charged components are equivalent to negatively charged components. These charged components are responsible to cause passage of centricity to generate EC which is a direct function of TDS in the sample.

TDS is regarded backbone parameter of water analyses in which presence of dissolved and un-charged components including neutral organic interference can also be assessed by igniting the TDS at elevated temperature in which volatile interference is eliminated, leaving behind the residue of inorganic components which are responsible for representative TDS of water.

Analyses trend on TDS & Conductivity figures in the sample were found to be 334mg/l and 607 µS/cm respectively.

c) Salinity

Salinity is the saltiness or dissolved salt content (such as sodium chloride, magnesium and calcium sulfates, and bicarbonates) of a body of water or soil which is also interrelated with TDS or EC in aquatic system and express the result on macro scale. In oceanography, it has been traditional to express salinity not as percentage, but as parts per thousand, which is approximately grams of salt per kilogram of solution.

The physical analyses pattern indicates that it is found to be 0.31 ppt and as such indicative that it is not accompanied by large dissolved salt contents.

d) Heavy Metals

Heavy metals are significant stressor contaminants in global Eco-system and are not widely distributed on earth crust like alkali and alkaline earth metals. Once transported to any aquatic system particularly sub-surface waters, they are very difficult to retrieve and remediate. In eco-friendly water system, figures of heavy

metals usually lie at very trace levels to cause any sort of environment disturbance to aquatic system. Elevated figures of heavy metals in drinking water sources may attribute to a most likely contamination triggered somewhere else in the aquatic eco-system.

Chemical Analyses trend on 4 criteria heavy metals including Pb, As, Cd and Zn indicate that levels of these metals were found to be 0.006, 0.022, <0.003 (below LDL) and 0.026 mg/l respectively and as such these do not source any sort of Environmental disregard to sub-surface water of the proposed project.

e) CONCLUSION

A ground water sample was collected from the vicinity of the proposed project, on which 8 physiochemical tests were conducted. The tests indicate that the collected sample is well complying with the national guidelines on drinking water. Its major and minor components including non-inherited pollutants including some heavy metals were also found viably complying with the national guidelines.

As such the sample was found to possess excellent sweet water character and can viably be utilized for diverse applications including drinking, preferably after little disinfection by wither chlorine or ozone. The analyses results of the aforementioned parameters are tabulated below in **Table 5.1**.

Table 5.1: Water Quality Analysis Results

Sample No	Area	pH	TDS mg/l	EC µSm/cm	SAL ppt	Temp °C	Pb mg/l	As mg/l	Cd mg/l	Zn mg/l
GWS-1	Near Jamshoro Phatak	7.36	334	607	0.31	25.4	0.006	0.022	<0.003	0.026
Data Source: Analysis Conducted by SGS										

As mentioned above, a detailed study conducted in district Jamshoro at 18 locations in the year 2009, gives the analyses perspective of the sampling sites. It indicates the highest TDS recorded at Lucky is 5150 mg/l; whereas lowest was found at Bubak at 377mg/l; the remaining 16 figures are lingering between them. PH of all the samples are lingering between a minimum of 7.0 and maximum of 8.2, and are well exhibiting the characteristics of ground waters; and are viably within safe drinking limits as defined by national guidelines on drinking water. Among heavy metal analyses Arsenic & Cadmium were found surpassing WHO permissible limit of 0.01 & 0.003 respectively in its drinking water criteria. Physical and Chemical Analytical trait during hydro geological studies, conducted on groundwater resources in various towns and cities of Jamshoro district is depicted in **Table 5.2**.

Table 5.2: Ground Water Analysis of Various Towns/Cities of Jamshoro District										
Sample No	**Area**	**pH**	**TDS mg/l**	**EC µSm/cm**	**SAL ppt**	**Temp °C**	**Pb mg/l**	**As mg/l**	**Cd mg/l**	**Zn mg/l**
GWS-1	Jamshoro Phatak	7.7	877	1777	0.9	24.4	-	-	-	-
GWS-2	Kotri City	7.6	658	1418	0.7	29.6	-	-	-	-
GWS-3	Mangio Shoro	7.5	771	1485	0.8	29.4	-	-	-	-
GWS-4	Luni Kot	7.9	661	1425	0.7	28.1	-	-	-	-
GWS-5	Thano Bula Khan	7.7	1525	3065	1.6	28.2	-	-	-	-
GWS-6	Thano Ahmad Khan	7.8	866	1840	0.8	25.8	-	-	-	-
GWS-7	Petaro	7.5	1435	3040	1.4	26.7	-	-	-	-
GWS-8	Unerpor	7.5	765	1485	0.8	26.8	-	-	-	-
GWS-9	Ali Abad	7.8	872	1777	0.9	28.4	0.001	7.189	0.030	0.010
GWS-10	Manghand	7.5	651	1418	0.7	28.1	-	-	-	-
GWS-11	Sunn	7.5	765	1485	0.8	27.9	-0.004	2.030	0.037	0.006
GWS-12	Aamri	7.5	655	1425	0.7	28.8	-	-	-	-
GWS-13	Lucky	8.2	5150	10280	5.8	28.5	-	-	-	-
GWS-14	Shewan	8.1	860	1840	0.8	27.8	-0.027	0.262	0.037	0.081
GWS-15	Jhangara	7.6	1390	3040	1.4	27.4	-	-	-	-
GWS-16	Bubak	7.5	377	735	0.5	28.4	0.024	1.141	0.079	0.004
GWS-17	Bhan Saeedabad	7.0	839	1679	0.8	27.9	-	-	-	-
GWS-18	Bhan Saeedabad II	7.0	839	1679	0.8	27.8	-0.009	0.321	0.095	0.094
[1]**Data Source: Sind Groundwater Resources**										

5.1.5 AIR QUALITY

Tropospheric air is highly susceptible to hostile anthropogenic activities taking place at ground level or in vicinity of ground; which are mainly caused by fossil fuel combustion in industrial units and also caused by high density transportation through mobile & immobile vehicles. Degradation of fossil fuel under the impact of

[1] http://indusngosnetwork.org/documents/publicationandresearchreports/Ground%20Water%20Quality%20research%20report.pdf

high temperature give rise to varying gaseous products composed mainly of CO_2 in association with small amounts of Particulates, CO, NOx , SOx and UHC,s etc. These pollutant gases changes the ambient concentration of air environment and could cause sufficient damage to ground level air ecology should it is present beyond the safe limits as defined by either USEPA , WHO or NEQS guidelines on air quality standards.

The proposed project is located in fairly open and clean air corridor and is mostly surrounded by network of diverse agriculture lands and villages. Main sources of air pollution near the vicinity of the project area are very small to least number of vehicular traffic along Petaro road including buses, trucks, cars, rickshaws, limited number of motor bikes and some stationery sources of combustion including power generators. In addition, pollution can also be caused by Jamshoro power plant which is at a distance of 4-5 km and Lakhra power plant which is around 8-9 km away from the proposed site. There is only one industrial unit Novartis Pharma adjacent to the Clariant, which is not supposed to cause significant air pollution.

Both Clariant & Novartis Pharma are not involved in drastic fossil fuel combustion and do not significantly deteriorate the air quality of the area. Gensets, however, have small exhaust system which releases the pollutant gases at much slower rate than elevated chimneys. The airshed in the macro & microenvironment of the project is clean enough to cause any sort of health associated risk to population & vegetation cover of soil.

As such no viable air contaminants are expected in the air-shed of proposed project. However, most common airborne contaminants that are likely to be emanated from aforementioned sources giving rise to very low magnitude of these contaminants include Smoke, CO, NO, NO_2 , SO_2 and suspended particulate matter.

5.1.5.1 AMBIENT AIR & WEATHER MONITORING

In the absence of continuous and permanent air quality monitoring stations in the country, it is difficult to provide a concrete baseline on ambient air quality concentrations for criteria pollutant, such as, Carbon monoxide, Nitrogen dioxide, sulphur dioxide, and suspended particulate matter. In order to collect the current baseline data for ambient air quality, Mobile Air quality station was installed at proposed project site for 24 hours continuous monitoring of the following parameters.

- Carbon monoxide (CO)
- Sulfur dioxide (SO_2)
- Nitric oxide (NO) and Nitrogen dioxide (NO_2)
- Suspended Particulate matter (SPM)

In addition to these pollutants, some up-dated meteorological parameters were monitored in parallel for 24 hours including:

- Atmospheric Pressure
- Humidity,
- Temperature,
- Wind direction,
- Wind velocity

The results of the ambient air quality monitoring are discussed in subsequent section.

5.1.5.2 METHODOLOGY FOR AIR QUALITY MONITORING

Ambient air quality is measured utilizing mobile monitoring station equipped with monitoring devices that have the capability to capture & analyze criteria air borne pollutants including CO, NOx and SO_2 at micro levels. The monitoring techniques of each of these pollutant gases based on USEPA defined standard methods depicted in **Table 5.3**. Gaseous phase monitoring techniques mainly based on Photometric measurements of electromagnetic waves including chemilumicence and Fluorescence spectroscopy in which radiations are either emitted or absorbed by pollutant gases in the UV, Visible or Infrared regions of electromagnetic spectra mostly in NIR & MIR regions .The main IR spectral regions of interest for analytical purpose , however , lingering from 2.5 till 25 μm.

Mobile monitoring station also equipped with low & high volume sampler to determine magnitude of particulates as total (TSP) or suspended (PM_{10}) in the air environment and being monitored for standard length of time usually set at 24 hours.

Table 5.3: Ambient Air Monitoring Methodology				
Air Pollutant	Monitoring Technique	Reference Method	Measurement Range	Lowest Detection Limit
Carbon Monoxide (CO)	Gas Filter Correlation CO Analyzer	US EPA Designated Method RFCA-0981-054	0 – 100ppm	0.01 ppm
Sulfur Dioxide (SO_2)	Pulsed Fluorescent Analyzer	US EPA Designated Method EQSA-0486-060	0 – 50 ppb 0 – 100 ppm	1 ppb
Nitrogen Dioxide (NO_2)	Chemiluminescent Analyzer	US EPA Designated Method RFNA-1289-074	0 – 50 ppb 0 – 100 ppm	1 ppb
Particulate Matter (PM_{10})	Low Volume Sampler	40 CFR 50, Appendix J (US EPA)	2 – 750 µg/m³	2 µg/m³

NEQS air quality standards have been introduced in Pakistan since 2010; therefore, the monitoring values of Carbon monoxide (CO), Sulphur dioxide (SO_2), Nitrogen dioxide (NO_2), and Particulate Matter (PM_{10}) were compared with standards set by NEQS.

5.1.5.3 AMBIENT AIR QUALITY RESULTS

a) CARBON MONOXIDE (CO)

Carbon monoxide (CO) is a colorless, odorless gas emitted from combustion processes. Nationally and, particularly in urban areas, the majority of CO emissions to ambient air come from mobile sources. CO can cause harmful health effects by reducing oxygen delivery to the body's organs (like the heart and brain) and tissues. At extremely high levels, CO can cause death. CO can cause harmful health effects by reducing oxygen delivery to the body's organs (like the heart and brain) and tissues. At extremely high levels, CO can cause death.

24 hours Air monitoring trend indicates that it was lowest found 1.513 at 14.00 hours and highest was recorded 3.631 mg/m³ at 15.00 hours in the project corridor and as such it is well complying NEQS guideline limit of 5.00 mg/m³ regulated at 8 hours monitoring.

b) NITRIC OXIDE & NITROGEN DIOXIDE (NO_2)

The sum of nitric oxide (NO) and NO_2 is commonly called nitrogen oxides or NO_x. Other oxides of nitrogen including nitrous acid and nitric acid are part of the nitrogen oxide family.

Nitrogen dioxide (NO_2) is one of a group of highly reactive gasses known as "oxides of nitrogen," or "nitrogen oxides (NO_x)." Other nitrogen oxides include Nitrous and Nitric oxides. Although, National Ambient Air Quality Standard covers NO & NO_2, NO_2 forms quickly from emissions from cars, trucks and buses, power plants, and off-road equipment. In addition to contributing to the formation of ground-level ozone, and fine particle pollution, NO_2 is linked with a number of adverse effects on the respiratory system.

24 hours Air monitoring pattern on NO & NO_2 indicates that these were lowest registered 7.204 & 0.00 µg/m^3 at 11.00 & various hours respectively and it was highest recorded 9.89 & 0.20 µg/m^3 at 15.00 and various hours in the project corridor and as such it is well complying NEQS guideline limit of 40 & 80 µg/m^3 regulated at 24 hours monitoring.

c) SULFUR DIOXIDE (SO2)

Sulfur dioxide (SO_2) is one of a group of highly reactive gases known as "oxides of sulfur." The largest sources of SO_2 emissions are from fossil fuel combustion at power plants (73%) and other industrial facilities (20%). Smaller sources of SO_2 emissions include industrial processes such as extracting metal from ore, and the burning of high sulfur containing fuels by locomotives, large ships, and non-road equipment. SO_2 is linked with a number of adverse effects on the respiratory system.

24 hours Air monitoring of SO_2 indicates that it was lowest registered 15.93 at 11.00 hours and it was highest recorded 37.94ppb at 21.00 hours in the project corridor and as such it is well complying NEQS guideline limit of 120 µg/m^3 regulated at 24 hours.

Overall Air monitoring indicates that average 24 hours concentrations of CO, NO_2 and SO_2 were found below the permissible limits regulated by NEQS, 2010 for ambient air whereas Suspended Particulate Matter (SPM) was recorded at 279µg/m^3 and is found well complying NEQS defined limit of 550µg/m^3 during 24 hour of measurement. Summary of ambient air quality monitoring is presented in **Table 5.4**.

Table 5.4: Summary of Ambient Air Quality Monitoring						
Parameter	**Unit**	**Duration**	**Minimum Concentration**	**Maximum Concentration**	**Average Concentration**	**NEQS Limits**
Carbon Monoxide (CO)	mg/m^3	24 Hours	1.51	3.61	1.91	*5.0
Nitrogen Dioxide (NO)	$\mu g/m^3$	24 Hours	7.2	9.89	7.50	40
Nitrogen Dioxide (NO_2)	$\mu g/m^3$	24 Hours	0.0	0.2	0.12	80
Nitrogen Dioxide (NO_x)	$\mu g/m^3$	24 Hours	7.22	10.09	7.62	-
Sulfur Dioxide (SO_2)	$\mu g/m^3$	24 Hours	15.93	37.94	22.10	120
Suspended Particulate Matter (SPM)	$\mu g/m^3$	24 Hours	279			550
***08 Hours Average as mg/m^3 = 4.5 $\mu g/m^3$** **$\mu g/m^3$: micrograms per cubic meter** **ppb: parts per billion** **LDL: Lowest Detection Limit**						

5.1.5.4 WEATHER/METROLOGICAL PARAMETERS MONITORING

In addition to ambient air monitoring, SGS team also utilised various observing devices which are an essential part of "Mobile Air Monitoring Station", in order to monitor weather/ metrological criteria parameters i.e. Wind direction, Wind speed, Temperature, Atmospheric Pressure and Relative Humidity.

Monitoring data indicates that temperature was recorded minimum as 36°C and recorded maximum as 44°C during 24 hours. During 24-hours of monitoring, wind blows mostly in North & North-East direction with wind speed varies from 1.6 to of 6.4 m/s. Humidity ranges between minimum 30% up to maximum at 53% during 24 hours of monitoring. The 24-hour recorded weather data is presented as **Table 5.5**.

Table 5.5: Weather/ Metrological Parameters Monitoring/ 24hours					
Time	**Temperature ^{o}C**	**Wind Direction**	**Wind Speed m/s**	**Humidity %**	**Pressure (mm Hg)**
Date: 27/7/12					
15:00	44	N	2.9	30	744.3
16:00	44	NE	2.7	32	744.3
17:00	42	NE	3.6	32	744.8
18:00	41	N	4.5	36	744.5
19:00	39	NE	4.8	39	744.4
20:00	37	NE	5.3	44	746.8
21:00	36	NE	5.7	46	747.5
22:00	36	NE	5.9	48	747.1
23:00	35	N	6.4	52	747.1
Date: 28/7/2011					
00:00	35	NE	4.7	51	746.9
1:00	34	N	4.5	50	746.9
2:00	34	NE	3.8	51	746.9
3:00	32	NE	3.3	50	746.1
4:00	30	N	2.3	49	746.8
5:00	30	N	2.1	48	747
6:00	29	N	1.9	53	747
7:00	30	N	1.8	52	747
8:00	31	N	2	51	747.3
9:00	33	N	3.1	48	747.3
10:00	36	N	2.7	47	747.3
11:00	36	N	2.8	43	747.3
12:00	37	N	2.4	44	741.1
13:00	39	N	2.3	40	746.3
14:00	40	N	2.1	39	746.3

5.1.5.5 NOISE MONITORING

Noise is an important environmental stressor and is essential part of baseline for IEE/EIA studies. Noise has become a very important "stress factor" in the environment of human. The term "noise pollution" has been recently used to signify the hazard of sounds which are consequence of modern day development, leading to health hazards of different type.

Noise is described as an unwanted sound emitted from un-avoidable sources of anthropogenic activities. Daily based natural induced sources of noise are rare to none but human induced noise sources are plenty and un-avoidable. Physically there is no distinction between sound and noise. Sound is a sensory perception and the complex pattern of sound waves is labeled noise, music, speech, low altitude aero plane flying etc. Environmental noise is a common cause of hearing loss due to industrial activities.

In the absence of reliable noise data, noise monitoring was conducted during social survey at 5 locations by utilizing CIRRUS CR-831 Class-I Integrating Sound Level Meter and the LAeq was measured.

The noise level was found in range of 54.3 – 60.9 dB at day time which exceeds the permissible limit of 55 dBA for Residential area. **Table 5.6** shows the summary of monitoring results conducted at different locations.

Table 5.6: Noise Monitoring At Nearby Community

S. No.	Location	Coordinates	Noise dB(A)	NEQS dB(A) for Residential Area
1	Lakho Faqir Village	N 25°26′45.7″ E 068°17′05.0″	59.8	55
2	Thar Deep (NGO Office)	N 25°24′44.3″ E 068°16′29.7″	56.4	55
3	Chakar Khan Rajar Village	N 25°28′46.3″ E 68°17′04.1″	60.9	55
4	Institute of Rural Management (IRM-NGO Office)	N 25°24′42.0″ E 068°16′32.3″	54.3	55
5	Deputy Commissioner Office	N 25°21′42.3″ E 068°16′54.8″	54.7	55

5.2 BIOLOGICAL ENVIRONMENT

5.2.1 *DATA SOURCE*

Data for this EIA has been gathered both from primary and secondary sources. Primary data was collected by a team of wildlife and botanical experts. The field surveys were carried out by applying the standard animal and plant survey techniques. The field data of fauna included transects, field observations, animal sightings and plot searches for mammals, birds and reptiles. The flora was studied through a set of quadrates measuring 10 x 10 m within the study area. Primary data for the floral and faunal studies was collected in the main habitats of the project area and its outer surroundings within the radius of 2 km.

The sampling locations were randomly selected to avoid any bias, ensuring that important and major locations from each main habitat type are sampled and overall species are recorded. Summary of habitats is given in **Table V-E** in **Annexure V.**

Baseline field survey was conducted in July 2012. Sampling locations for the identification of floral and faunal assemblages were carefully selected so that maximum number of species can be observed within the project area. The summary of biodiversity found during the site visit is as under:

Assemblages	No. of Species
Vegetation	36
Birds	29
Mammals	07
Reptiles	08

The faunal field data collection included line transects, incidental sightings and plot searches for:

- Birds
- Mammals
- Reptiles

The secondary data provides a detailed insight of the biological environment of the area. The studies that were consulted include the works of Grimmette et al (2008), Khan, et al (2012), Memon and Bhatti (2005) and Roberts (2007).

Secondary data was also collected from the local communities with respect to reported or less common species not observed during the present study.

5.2.2 HABITATS AND MAIN FLORAL SPECIES

The main habitats in the project area included the built-in area, ponds, plantation and orchard inside the premises. The habitats around the project area on the outer periphery comprised of agriculture area, villages, water channels and marshy areas. The vegetation in the vicinity of the project area mostly comprised of *Neem, Eucalyptus, Salvadora persica, Salvadora oleoides, Prosopis juliflora, Alhaji maurorum, Aerva javanica, Prosopis glandulosa and Sueda monaica. In the outer area, the dominant vegetation includes Prosopis glandulosa, Conocarpus lanceolata, Phragmites karka, Sueda spp. Salvadora procera and Calotropis procera.*

The main crops in the agriculture fields were *Maize and Sesbania*.

The orchard in the CPL premises contains very good assemblage of fruit and ornamental trees. These include *Mango, Grape Fruit, Nest Berry, Mulberry, Lemon, Grewia, Black Berry, Berry, Ashok, Sukh chain, Garden Glory, Fan Palm and Royal Palm.*

The plantation and the orchard within the premises of CPL have been very well maintained and provide quite a favorable environment particularly to the birds, both resident and migratory.

As many as 36 species of plants were recorded in the CPL premises and the surrounding area (**Table V-A** in **Annexure V**).

The vegetation inside and adjacent to the rainy nullah comprises of *Neem, Eucalyptus, Prosopis juliflora, Prosopis glandulosa, Aerva javanica, Sueda monaica, Phragmites karka, Acacia nilotica, Alhaji maurorum, Salvadora procera and Salvadora oleoides.*

The orchard area has an assemblage of fruit and ornamental plants. All these plantations along with the waste water ponds inside the premises and the nullah beside the boundary wall provide a very favourable habitat for birds.

Since the project site is located in an urban environment, the floral species are less in number and are mostly anthropogenic. The anthropogenic species are quite old, and provide food, shelter and nesting sites for birds. There are agricultural fields, and the rainy nullah and road side area around as well having dense vegetation.

No evidence of rare species of wild plant exists within the project area.

5.2.3 FAUNA

5.2.3.1 BIRDS

The project area and the outside area support a variety of bird fauna, both resident and migratory. As many as 29 species of birds were recorded from the area (**Table V-B** in **Annexure V**).

The agriculture fields, the vegetation along the rainy nullah and the whole lush green area in the orchard provide favorable habitats to the birds.

Some migratory species of birds were recorded at this time of the year such as Common Sandpiper and Great Bittern. A double passage migrant Rosy Starling was also recorded. Its first autumn arrivals appear in Sindh in late July.

The common birds of the Project area are Common Myna, House Crow, House Sparrow, Blue Rock Pigeon, Red wattled Lapwing, White cheeked Bulbul, Green Bee-eater, Ring Dove, Purple Sunbird, Little Brown Dove and Common Kite.

The less common birds found in the project area include Barn Swallow, Plain Martin, Pond Heron, River Tern, Pied Kingfisher, Little Egret, Red vented Bulbul, White breasted Kingfisher, Black Drongo, Little Cormorant, Long tailed Bush Warbler, Common Sandpiper, Jungle Babbler, Great Bittern and Rosy Startling.

No threatened species of birds were recorded from the area.Common Kite and Rosy Starling are the Protected Species under the Sindh Wildlife Protection Act, 1972.

5.2.3.2 MAMMALS

Due to urban environment of the project site and its surroundings, there is hardly any opportunity for mammals to survive. However, rodent species which have adopted such conditions are well established using hollow structures or even buildings as their nesting places. Presence of 8 mammal species was ascertained in the project site and its surroundings. These include 3 rodents and 1 tree dwelling species, (i.e. five striped palm squirrel (Funambulus pennantii). These are a source of food for raptors and domestic cats.

A total of 7 species of mammals were recorded from the area (**Table V-C** in **Annexure V**), although the area supports a variety of avifauna but the presence of mammalian species is relatively poor. In the project area, only five-striped Palm Squirrel could be recorded. The other mammals such as the large and small Mongoose, Indian Jackal and Desert Hedgehog have been reported from the area around. Rodents such as Desert Gerbil, House Mouse and House Rat are common in the area. Bats such as Egyptian Fruit Bat and Fulvous Fruit Bat have also been reported from the area.

No threatened or protected species of mammals was recorded from the area.

5.2.3.3 REPTILES

A total of 8 Species of Reptiles were recorded (**Table V-D** in **Annexure V**).

Four species of Snakes viz. Common Sand Boa, Plain Racer, Indian Cobra and Saw-scaled Viper have been reported from the area. Only Lizards, have been recorded

from the area namely House *Gecko, Blue tail Sand Lizard, Blotched House Gecko and Common tree Lizard*.

None of them is threatened or protected.

5.2.4 ENVIRONMENTAL IMPACT

There is no Protected Area, Reserve or Protected Forest, or any other sensitive habitat with respect to the biological environment.

The project activities will not have any significant impact over the flora and fauna except for minor disturbance to the birds. The birds were found to be a fully accustomed to the existing environment as they were thriving well and even the migratory birds were recorded, though in less numbers, to visit the area for feeding/ staging/ roosting. However, the overall impact of air emissions may be taken into account.

5.3 SOCIO-ECONOMIC ENVIRONMENT

5.3.1 INTRODUCTION

This section presents information on the pertinent socio-economic environment of the project area and include inter alia; its location and other distribution. The aspects considered include the characteristics of communities, social mechanisms, cultural conditionings, health, economy, lifestyle and the use of resources by the local community.

5.3.2 METHODOLOGY

A group was formed to collect socio economic data. A thoroughly prepared questionnaire was administered, focusing on demographic profile, living patterns, provisions of education, health and other facilities, cropping and land tenure methods, availability of water, conditions of streets and roads, land and livestock, presence of government, private and NGO sector, women. One-to-one interviews and discussions were held with district administrator, non-government agencies, elderly people, women, common men, shopkeepers etc, both separately and collectively, so as to determine the community's needs and their concerns regarding the proposed activities.

Most of the data included in this section comprises of the primary information collected on-site employing various discussions. The primary data has been strengthened, at places, with the secondary data gathered from various government and private agencies along with useful input from the consultation with community. But SGS team confronted some problems to gather further information due to the new setup of district government, as the government and non government organizations are still in the course of data compilation.

5.3.3 LIMITATION OF THE STUDY

As EIA is an extensive study, there are quite a number of important aspects to cover and the consultants are bounded by time constraints, therefore SGS team strategically organized and structured its activities. Most of the organizations were clicked on short notice, and it was envisioned to collect the most relevant and important information and some extra information were depleted. As the socio economic section of EIA study is quite comprehensive, so all sections were covered either by direct meetings or by telephonic conversation and maximum stakeholders were contacted. Communities and government agencies were specially consulted and their recommendations and suggestions were recorded vigilantly.

5.3.4 DEMOGRAPHY

Jamshoro was separated into Jamshoro district in the month of December 2004 from district Dadu. It was announced on 07-26-2012 and notified by the Board of Revenue. It consists of four Talukas i.e. Sehwan, Manjhand, Kotri and Thano Bola Khan. Jamshoro district has a population of 811, 000 people[2], spread over an area of 11,517 Sq Km with 28 Union Councils, 57 Tapas, 1,050 Dehs and 1359 Villages (**Table 5.7**). It is situated on the right bank of River Indus. The district has taken its name from its head quarter Jamshoro, famously known as Educational City. There are 297,869 Male and 250,473 Female voters registered[3].

Table 5.7: Union Councils with Talukas

S. No	Taluka	Union Council
1	Manjhand	Manjhand
		Sann
		Amri
		Lakha
2	Thano Bula Khan	Thano Bula Khan
		Sari
		Mole
		Toung
		Thano Arab Khan
3	Sehwan	Sehwan-I
		Sehwan-II
		Channa
		Bhan
		Bubak
		Jhangara
		Dall
		Talti
4	Kotri	Kotri-1
		Nangi Line
		Jamshoro
		Morho Jabal
		Haji Manjho Shoro
		Sonwalhar-I

[2] Data Source: www.Jamshoro.com.pk
[3] Data Source: www.Jamshoro.com.pk

On the Northern boundary lays Dadu district, on the East the River Indus separates it from Nawab Shah, Matiari and Hyderabad district, Thatta district on the south, Karachi district towards south west and Khirthar Range makes its boundary on the west which separates Sindh and Lasbela district of Baluchistan.

The people of Sindh speak Sindhi Language but Siraiki, Balouchi, Urdu are also spoken in the district.

Project area comprises of Taluka Kotri and Union Council Jamshoro, Deh Bada. Power stations like Lakhra Power Project and Kotri Thermal Power Station are the main power units in this district.

5.3.4.1 SETTLEMENTS PATTERN AND HOUSING

The project area is located on the southern east side of the province. People live in a cluster of houses and often a single unit family. In the project area, settlement pattern corresponds to 50 to 3000 housing units. Any other cluster near the Goth is inhabited necessarily by people of the same village or clan. These people shifted to nearby places due to some reasons which have made their coexistence impossible. The pattern of settlement is closely linked to kinship relationships. Every settlement is inhabited by descendents of the same agnatic group with a large majority believing in inter-relational marriages. Interestingly, the elders in all such settlements are real brothers or rarely cousins. In bigger villages, people from the same lineage have closely lined up houses in the form of a cluster that can be distinguished from those of other castes. However, some villages comprise of several small clusters and even several scattered houses. Many villages have no permanent identity and are simply named after the current village leader, the largest existing landlord, his father or grandfather. Population wise description of surveyed villages is given in **Table- 5.8** below:

Table 5.8: House and Population Data of Surveyed Villages in Project Area

No.	Village/Town Name	Union Council	Taluka	District	HH	Total Population
1	Goth Lakho Faqir Khaskheli	Petaro	Kotri	Jamshoro	500	3500
2	Goth Siddique Rajar	Petaro	Kotri	Jamshoro	50	300
3	Goth Chakar Khan Rajar	Petaro	Kotri	Jamshoro	100	700
Sub Total					**650**	**4,550**

Although, the whole population of the project area is poor & lower middle class, some houses are made of baked bricks and fine structure houses are also observed in main Jamshoro city. But in the project area, Lakho Faqir and Chakar Kahn Rajar and few other smaller Goths, some well structured are also observed. Most of the houses in the bigger villages have two to three rooms, an accompanying *otak* having some simple furniture bedding (*Charpai*) and some chairs, an open pit lavatory and a *kacha* driveway. The poorer classes have *kacha* or mud houses with one or two rooms with no lavatory facilities. Similarly, some people in the area also reside in semi *pakka* & *pakka* houses.

Housing in villages in the project area is mainly of three types:

- *Pakka* houses made of baked bricks/ blocks and stones with cement bonding (50%)
- *Kacha* houses made of unbaked bricks/ earth bound (25%)
- *Huts* made of mud/wood/bamboo/straw (25%)

5.3.5 TOPOGRAPHY

The total geographical area of the district is 11,517 sq. km. It is about 220 km in length from North to South and about 100 km wide from East to West. About 2 to 6 km wide belt of the Right bank of River Indus is cultivated and irrigated and the remaining land of the district is either hilly or cultivated by rain and other sources of the irrigation. Agriculture is the main source of income of majority of the population. Thano Bola khan is famous for its Onion Mandi.

The climate of this district is pleasant. In summer, the northern part (Sehwan) is hotter than that of other parts of the district and moderately cool in winter.

5.3.6 CULTURE, CUSTOMS AND TRADITIONS

Spiritual & political authority in the project area largely rests with Malik Asad Sikandar (MNA) and Syed Jalal Mehmood Shah. People in the project area trace back their strong historical lineage with faithful tribes and loyal devotees. The tribal leadership in the project area is a blend of these dynamics. The tribal leaders settle inter or intra tribal disputes. Cases are rarely reported to the police for settlement. The people of the project area visit the main cities like Kotri, Hyderabad and Karachi. There are no clashes found in the area, people live peacefully however there is a combination of different cast and creeds and religions. Major casts dwelling there, are Sheikh, Rajar, Khaskheli, Shora, Chutta and Baloch.

5.3.6.1 ETHNICITY AND TRIBE

Jamshoro is highly heterogeneous with respect to its population. During the early 1960s, almost 80% population was Muslim, but few clusters of other religions have

settled here over a long time. Current scenario represents a majority of Muslims population i.e. around 98% of the total. Goths around the project area (Clariant Industrial area) belong to the Muslim tribes.

Furthermore, few Hindu tribes consisting of Lohana, Mehraj, Meghwar, Suthar, Kolhi and Bheels are found. But they do not have any separate area but dwell with other populations **(Table 5.9).**

Table 5.9: Population by Religion & Sex- Jamshoro

Sex	Total	Muslim	Christen	Hindu (Jati)	Qadiani (Ahmadi)	Scheduled Castes	Others
Both Sex	582094	550620	5894	24583	663	153	181
Male	312574	296212	3092	12700	402	75	93
Female	269520	254408	2802	11883	261	78	88

5.3.6.2 SOCIAL CONFLICTS

No social conflict or major dispute was reported in any of the community of the project area. However many communities of different religion and different class dwell together but no such violence is ever reported. Communities respect their beliefs and live peacefully in the area. Concerned village headmen usually also settle disputes involving trade and other matters. Crimes such as murder and thefts are uncommon and kidnapping for ransom is non-existent.

5.3.7 ECONOMY

5.3.7.1 OCCUPATION

The majority of population of the district is rural and involved in cultivation. Industrial areas and power plants are using manpower, while nearby towns are providing business opportunities to the residents. The inhabitants of mountainous area keep cattle while mallahs of Manchhar Lake earn their living by fishing. Approximately 20% of district population is serving in Federal and provincial Government.

In this semi urban area, people are involved in daily wages jobs, while some are involved in small business. They normally travel to adjacent areas for work. Some work in the industrial area and in the surrounding universities and colleges. People are also involved in agriculture. Area having access to irrigation water is another source of income. Similarly, live stock is a secondary source of income. It is safe to assume that livestock farming is practiced uniformly in both types of areas.

As mentioned earlier, majority of the population of the district is rural and are involved in small jobs but unemployment is quite prevalent, as many qualified youngsters are yearning for jobs. Approximately 5% of surrounding population is serving in industry on daily wages.

Shop keeping and labor are also two important sources of income for the communities. Transportation is another sector, which has absorbed considerable number of people. Motorcycles, buses and mini vans commute on daily basis and bring a good reward for the owners.

5.3.7.2 HANDICRAFT

The handicraft of a country is a part of its culture. This district is very rich in this field where bed sheets and handmade "*Khes*" of goatskin are very popular. Beautiful embroidery of various kinds known as "*Gajjs*", Blankets made of sheep wool and *"Rallies" (Quilts)* are main artisan's skills available in this district. They are normally sold at Karachi and also exported to foreign. This sector needs special attention from the government authorities as no scientific study or patronage from the government has been provided.

Any handicraft work in the immediate vicinity of the project area was not found, as people are more engaged in their daily economic activities, so they find no time or finance for this work, as added by the Ms Shahar Bano from Goth Chakar Khan.

5.3.7.3 LIVESTOCK

Livestock owner ship is also developed in the project area; especially among poor families who sell animals during emergency days as mostly unemployed people depend on livestock and sometimes agriculture. Majority of the households keep livestock which include cows, goats, sheep, camels and donkeys. Buffaloes are common in irrigated areas only, though few were observed in desert areas. All the animals are of native breed and thus they can survive the local harsh environment and drought. Milk and butter from the livestock are consumed by the household and are not sold in the market.

It is estimated that 40% of the work related to livestock is carried out by women and children. This includes watering, feeding, milking, and bathing the livestock. People also keep poultry for domestic consumption of eggs and meat.

5.3.7.4 AGRICULTURE

District Jamshoro is divided into two parts i.e. urban area and irrigated area. Approximately 60% is cultivable land that comes under irrigated area. While in barani portion total cultivable land is 30%. The farmers try to cultivate all their cultivable land after having received their first monsoon rain during August and

September. The major crops are Cotton, Wheat, Juwar/ Guwar, Fodder, Chillies, Chana, Matar and Onion). In Rabi, wheat covers about 75% of the cultivated area. Water courses are 72 (Improve 2008-2009) and 120 (Target 2008-2009).

5.3.8 SOCIAL AND PHYSICAL INFRASTRUCTURE

Overall the social and physical infrastructure is not up to the mark in the project area. However the project area is better as compared to the other rural areas of the province. A brief account of the education, health, infrastructure and markets of the area is as follows:

5.3.8.1 EDUCATION & LITERACY

According to updated census, the district has 3 Universities, 1 Government College, 5 Government Higher Secondary Schools, 36 Government High Schools, 32 Middle Schools and 826 Primary Schools. Apart from this, there is 1 Government Technical Training Institute, 1 Government Mono Technical Institute and 4 Technical Vocational Commercial Institutes. It was complained by the locals that due to the lack of female teachers they were seeking for female teachers in the schools but government never took any action at their grievances. Detail is given in **Table 5.10**.

There are several reasons for this deplorable literacy rate; *inter alia,* scarce physical infrastructure, unavailability or unwillingness of teachers to teach in the far off areas, children's economic value, and above all the abject unawareness of communities regarding education**.** However, some non-government organizations are recognize the need and are working in order to facilitate and develop a network of schools in the district.

Table 5.10: Detailed Summary District Jamshoro: School Census 2010 - 2011

		No. of Schools	Enrolment			Teachers			Students per Teacher
Gender	**School Level**	**Total**	**Boys**	**Girls**	**Total**	**Male**	**Female**	**Total**	
Boys	Primary	196	13,258	3,058	16,316	542	4	546	30
	Middle	8	546	124	670	30	-	30	22
	Secondary	8	3,181	455	3,638	176	7	182	20
	Total	212	16,985	3,637	20,622	747	11	758	27
Girls	Primary	176	1,471	13,229	14,700	45	423	768	31
	Middle	13	360	533	893	18	23	41	22
	Secondary	7	0	2,179	2,179	-	84	84	26

	Higher Secondary	2	0	1,482	1,482	1	48	49	30
	Total	198	1,831	17,423	19,254	64	57	642	30
Mixed	Primary Middle Secondary	448 9 19 3	22,144 976 3,351 3,280	10,729 380 722 416	32,873 1,356 4,073 3,696	953 30 192 82	77 2 50 -	1,030 32 242 82	32 42 17 45
	Total	479	29,751	12,247	41,998	1,257	129	1,386	30
Total	Primary Middle Secondary Higher Secondary	820 30 34 5	36,873 1,882 6,532 3,280	27,016 1,037 3,356 1,898	63,889 2,919 9,888 5,178	1,540 78 367 83	504 25 141 48	2,044 103 508 131	31 28 19 40
Grand Total		**889**	**48,567**	**33,307**	**81,874**	**2,068**	**718**	**2,786**	**29**
Source: Sindh Education Management System (SEMIS)									

5.3.8.2 HEALTH FACILITIES

Hospitals exist in the project area. People rely on "self treatment" as the first option in case of any illness. There is no government hospital or maternity hospital available at Jamshoro, however there exists a Health Centre at Kotri. No active Basic Health Unit (BHU) exists in UCs. People generally access to private hospitals in Jamshoro and Hyderabad and sometimes to nearby private dispensaries. Fever, malaria and chest congestion, Hepatitis-C were reported as the common diseases of the project area.

Lack of awareness and advocacy by Lady Health Workers and health services has resulted into an increased maternal mortality rate; reasons are excessive/early/late and frequent child bearing, delivery complications and post-delivery infections. The situation faced by women is characterised by high levels of anaemia, mal nutrition, little or no antenatal care. Some dais and LHWs attend maternal health problems or in case of emergencies they rush to the Liaquat Medical Hospital which is at distance of few kilometres.

In the project area, health conditions are not such developed. One BHU in Kotri is serving for general health. OPD, general and private room, Ultrasound, Oxygen services are not properly available. One male doctor with other staff covers the population. A lady doctor attends patients two days a week, she gives women health related references. It is quite surprising that only one Basic Health Unit

supports 12 Union Councils, whereas people cannot afford to obtain private treatment.

5.3.8.3 MARKETS

It was observed during the field survey that few closer markets exist in the project area and people access to Jamshoro Phatak and Kotri markets for daily shopping and purchase of miscellaneous items. As there are only a few small shops in which some grocery and some general items are available, therefore people rush to Hyderabad city and Karachi to buy special items.

It is quite economical to possess a shop in the area and some villagers have small shops. Therefore many shops were observed in the surrounding of project area. They sell basic household necessities, cigarettes and food items. People visit Kotri and Hyderabad market for the purchase of daily use items. Many CNG, Petrol and Diesel pumps are also existent in the nearby vicinity.

5.3.8.4 TRANSPORTATION

Generally, the project area is not rich in the means of transportation. Main roads are metalled but inside roads are katcha muddy roads so proper transportation is not properly available inside the residential colonies. *Chinchi* (four seated vehicle supported by bike), *Rikshaw*, bikes and some buses are the means of transport for the residents of the area.

Project area is located 2 km away from main Jamshoro, some villages like Lakho Faqir Khaskheli, Siddique Rajjar, Chakkar Khan Rajar are located near the industry. Some distant areas are Society-2, main Jamshoro Town and few others. All existing metalled tracks are good to access communities. Public transport (pick-ups) is available on the metalled road between project area and Jamshoro. Few pickups and *Chinchis* and small buses are also providing transportation facility to people from the vicinity of the project area. Railway track also exists in the project area.

5.3.8.5 EMPLOYMENT

The Clariant Pakistan Ltd (CPL) and its contractors will employ locals during construction activities according to their skills and expertise. The local residents in the project area are expected to be employed against the category of unskilled labour since semi-skilled or skilled labour may be difficult to be found in the area. While providing employment to locals, it must be ensured that preference is given to communities in close proximity of the project area and that amongst them equal opportunity is provided to all tribes or castes. The actual number employed and their wages must be dependent on the contractors' requirements. Due to expanding

activities of the industrial units there is chance of increase of employment opportunities for the local residents of villages.

The community was concerned whether this industry will improve and increase job opportunities for the people. As such, an argument is currently in vogue that since the local and indigenous people are unskilled, there is less likelihood of their employment in the industrial work and plants operation.

5.3.8.6 COMMUNICATION

PTCL telephone facility is available in some parts of the project area. Similarly mobile service is also available and is being used efficiently as mode of communication in the project area. People reported week signals for mobile service in few remote areas and requested to improve and accelerate this service for proper communication. Internet, post office service and Police Stations also exist in the project area.

5.3.8.7 ENERGY

Power supply line goes all along the project area, and approximately 90% of the community is able to acquire electricity. Communities complained about load shedding without prior notice and long hours break down, which disturbs daily routine work. Gas supply has been provided to the area but few of the houses cannot afford to avail the service, so these houses depend upon fuel wood. But majority of the people belonging to business communities, government servant and having small jobs in Jamshoro and Kotri avail gas facility for cooking.

5.3.8.8 MINING

The District is rich in the sources of Limestone, Salika Sand, Gravels, Silt, Marbal, and Sui Gas. These minerals are found in Taluka Thano Bula Khan and Sehwan. Coal is obtained from Lakhra Taluka Manjhand.

5.3.9 ARCHAEOLOGICAL AND CULTURAL SITES

It is estimated that the project area has been occupied since centuries as some mosques, hindu temples and shrines are quite famous and have historical and heritage for the whole country. These are most famous archaeological sites and shrine in Sehwan Taluka, it is a place of religious attraction, as people from all dogmas visit this place for pilgrimage. Tourists come from all over the country and outside country to visit these heritage places. There are 140 Mosques, 19 Imam Bargahs and 4 temples however some archeological sites have also been discovered in the district.

In the project area some mosques, shrines and graveyards were located near villages. The famous sites in the district are universities, shrines, rivers and mosques

found near the Industrial area and located at a distance of 2 km from Indus River. Apart from that, some other places located are Manchar Lake, Rani Kot, Khirthar National Park etc, description is given below:

5.3.9.1 SEHWAN SHARIF

It is the oldest existing town of Sindh, situated on the right bank of River Indus. A wide broad road (Indus Highway) connects it to Jamshoro at a distance of 140 kilometers. Sehwan Sharif is famous for the shrine of the Hazrat Lal Shahbaz Qalandar where thousands of people pay visit for Ziarat from all over the country at the time of Urs.

5.3.9.2 KOTRI

Kotri is the main city of this District situated on the right bank of River Indus. Kotri Railway Bridge separates it from Hyderabad City. The historical Shrines of Malik families show their magnificent past. Kotri Barrage is also a worth seeing place in this area.

Industrial site of Kotri is the main socio-commercially active place. Kotri railway station is one of the biggest railway stations of Pakistan.

5.3.9.3 RANI KOT

Rani Kot is believed to be the largest forts in the World. It has a running wall of stone that is 4 to 5 meter in height encompassing 22 square miles.

5.3.9.4 KHIRTHAR NATIONAL PARK

It covers an area of 1700 sq kms, reserved for wildlife endangered to extinction. It exists in the macroenvironment of the project site and covers the series of Keerthar Range in the northern part of Taluka Thano Bula Khan.

5.3.9.5 AAMRI

Aamri is situated 30 km south from sehwan and 110 km north from Jamshoro main Indus High Way. It is famous for its archaeological findings, which date back to Moen-jo-Daro.

5.3.9.6 LAKHI

Lakhi is situated 12 km south of Sehwan Sharif on Indus High Way. It is famous for its hot spring considered to be effective for skin disease because of high contents of sulfides of magnesium and sodium. It is also famous for the tomb of Sain Laki Shah Sadar Head of Lakyari Syeds in Sindh.

5.3.9.7 GRAVEYARD OF TOUNG

About 70 km away from Thano Bula Khan town, there is this ancient graveyard of Jam Lahar, the Head of Malik Family. The graves are made of stone as beautiful as in Makli Graveyard but are in smaller number.

5.3.9.8 SINDHIOLOGY MUSEUM

Sindhilogy Museum is a worth visiting place in District Jamshoro. It is situated in Sindh University area on the main road connecting Super High Way and National High Way.

5.3.9.9 CADET COLLEGE PETARO

Cadet College Petaro is one of the prominent educational Institution of Pakistan providing the best education facility to this district.

5.3.9.10 UNIVERSITIES

Sindh University, Liaquat University of Medical Health Sciences and Mehran University are the splendor of the Head Quarter city Jamshoro.

5.3.10 GENDER PROFILE

5.3.10.1 OVERVIEW

As in most rural parts of Pakistan, the socio-economic well being of women in the project area is poor. This section describes the roles and responsibilities of women in the project area. Their access to and control over resources, access to health, education, and means of livelihood are also addressed.

5.3.10.2 SOCIETAL ROLE AND AUTHORITY

Discrimination against women is one of the leading social problems all over the world. It manifests even at the time a baby is born. With regard to gender discrimination, some exceptions aside, men have imposed a subordinate status on women in societies both Eastern and Western. The conditions of Pakistani women are almost the same as that of their counterpart in the world. In rural Sindh, women are discriminated in almost all walks of life.

In view of the deprived status of women in rural Sindh, a situation arising out of the deprivation of rural women was observed during the visit. Some of the major variables like female education, social status, freedom of expression in family, division of work, type and size of family, and participation in decision-making on crucial economic and socio-cultural matters within the family setup were not observed.

5.3.10.3 DRESS AND FOOTWEAR

In Central site of the Sindh people are closed to the urban areas. Jamshoro district is closed to Hyderabad which is a metropolis and has many modern facilities and services. Generally, women mostly wear long shirt and shalwar with dupatta. Occasionally, they wear Ajrak and embroidered chaddars. Traditional dresses of the areas are long loose embroidered shirt called ghagho. But generally females wear Shalwar Qameez of same clothing but mostly aged women wear shalwar of typical Sindhi cloth called Garbi or Susi with any shirt. Women prefer to wear embroidered shalwars.

5.3.10.4 ORNAMENTS

Ornaments are as indispensable to women as clothes. The foremost is nose-pin. Nose rings are of many forms, some suspended from either wing of the nose, some from the middle cartilage. They are large, sometimes ponderous, but the weight is borne by a plate of hair, let down over the forehead. Smaller rings, called Bulla/ Buli are worn by girls. Ear rings are also of various forms, the whole rim of the ear is sometimes pierced so that from a dozen to twenty little jingling ornaments may fringe it. Neckless (Duhiri/Hur) mundi and Bandra (toes rings) bracelets, anklets and armlets (Kangan, Kari and Banharakhi) are the common ornaments worn by the women. However, toe rings and anklets (Jhanghar) are gradually going out of fashion.

5.3.10.5 PURDAH AND SOCIAL MOBILITY

Women generally observe purdah from outsiders. The purdah restrictions are more stringent for young girls. Adult women can appear before male members of the same tribe. The restrictions on mobility are not very strict and vary with the marital status and age of women as well as it varies from tribe to tribe. Mostly women of all ages shake hand with the male relative. This appears as the sign of brotherly relation. Married and relatively older women are freer to attend marriage, death and birth ceremonies in other villages and even go to markets with male members of the family.

All women take dupatta on their heads even inside their homes and during household chores. For outdoor activities of fire wood collection and livestock chores, as well as during visits to relatives for marriage and death ceremonies and doctors for health issues, women wear dupatta (Chunri). Shopping or recreational visits are not common for women. Mostly women go for shopping with their brothers or father.

5.3.10.6 LAVATORIES & WASHROOM FACILITIES

Some NGOs have provided toilet system to few villages and people are facilitated through this service. Previously they had pit-hole toilets and women faced many problems in that system. In remote villages women still use the fields, while in urban areas there are semi structured toilets with covered boundary.

It is noteworthy that people will be getting water from Clarient Pakistan Limited.

5.3.10.7 DECISION MAKING

Decision making is in the hands of male members of the family. They control the household budget. A male member's decision cannot be challenged by a woman. They are not supposed to reply in negation to their husbands for anything. The household purchases are also mostly done by male members, for which they visit the nearest town or city. But now women also accompany them, seldom. Women have no right to like or dislike the purchase. Now, males do not ask women for their choice in clothes or other items for personal use.

Women's decisions are not sought in major issues such as vote, marriage, food, medication, clothing, family planning and other minor decisions like visiting a marriage or death, enrolment of children in school etc. Women are expected to bear insolence whatever hardships come in their way as a consequence of a male decision.

5.3.10.8 PHYSICAL VIOLENCE

Physical violence against women is negligible. Karokari or honour killing is uncommon in the area and no cases have been heard or reported for a long time. Inter community conflicts though reported but not up to the extreme of physical violence.

5.3.10.9 BELIEF SYSTEM

Most of the people are the followers of Sardar Malik Asad Sikandar and Syed Jala Mehmood Shah. They are the political as well as spiritual leaders. They are almost fanatics of pirsain. One local woman told that they use to visit shrines also. Other more influencials are Makhdooms of Hala and Sehwan Sharif's Gadi nasheen.

5.3.11 BENEFITS AND OBJECTIVES OF STAKEHOLDERS CONSULTATION

Stakeholders' consultation leads to an overall better understanding of the project on the part of the communities and also gives the proponent a clearer understanding of the stakeholders' perspective. Effective public consultation can add substantial value to the EIA process. The information gained through public consultation on the

stakeholders' concerns, interests, and their ability to influence decision-making helps identify key cause of environmental problems.

This can be used to evaluate direct and indirect environmental impacts, and assess short term and long-term resource use implications. The input from local communities and NGOs can help evaluate alternatives and strengthen the management planning by incorporating local input and know-how. These factors contribute towards improved project implementation sensitized to the human environment of the area. The objectives of stakeholders' consultation are to:

- Promote better understanding of the proposed operation through explaining its objectives and its potential positive and negative impacts.
- Identify and address concerns of all interested and affected stakeholders.
- Provide a mechanism to resolve issues identified by communities, before project plans are finalized and development begins, thereby, avoiding public outcry and resentment.
- Instil trust between various stakeholders and the proponent to promote cooperation.

5.3.12 PUBLIC CONSULTATION MEETINGS

Public Consultation is a tool used for the purpose of communication, in order to include information dissemination, exchanging views, soliciting feedback and suggestions on issues pertaining to the project, plan future actions, initiate a needs assessment and identify areas of concern.

During the field survey for this study, meetings were held with the communities residing within the project area. Moreover, village influential and teachers were particularly sought for consultations. The objective of these meetings was to solicit and record their views and concerns for inclusion in project design at the planning phase.

Likewise, meetings were held with community and members of local and provincial government, NGOs and District government. All the stakeholders were given project information verbally. Their concerns and suggestions were heard which are reproduced at the end of this section.

5.3.12.1 GOVERNMENT ADMINISTRATION

i. DC/ADMINISTRATOR JAMSHORO

A detailed meeting was held with Mr. Agha Sohail Pathan, Deputy Commissioned. He was briefed about the project; he was pleased to know about the development schemes in the area and especially in the industrial related development schemes.

He also showed interest in visiting the plant; the client will be informed about his inclination.

ii. SUPERINTENDENT OF DC OFFICE

A meeting was held with Asif Ali Memon, Superintendent of DC office. He was also briefed about the project. He informed us about the demography of the area and added that they are collecting the district information from all aspects as the district is newly formed so they are in the course of data compilation. He promised to provide the detailed profile of the district and other information according to our requirement.

iii. REVENUE OFFICER

A telephonic interview was held with Mr. Zulfiqar Mangrio, Revenue Officer. He was informed about the proposed activities. He provided land data of the project area. He informed that industries compensation procedure and guideline is in place to compensate for the land acquisition. The compensation process is transparent and consistent with industry compensation procedure. He was informed that during community consultation few of the locals showed fear for improper monitoring and their hazards which may cause adverse effects on household and agriculture land. He replied and told that it is beyond his limitation and they only deal land matters. So there is no such dispute matter prevailing regarding this industry. This will ensure that the community is satisfied on the issue.

5.3.12.2 NON-GOVERNMENTAL ORGANIZATIONS

i. IRM

IRM is committed to build the capacities of rural communities and empowering them to harness their true human, social and economic potential for an improved quality of life. The institute aims to reduce poverty prevailing among the rural masses through a variety of training programmes. IRM also focuses on building a strong team of development professionals not only within the RSPs but across the country and region including government staff, elected members of the local bodies, civil society and corporate sector to ensure that they have clear understanding of development objectives and methodologies. To reach the ultimate goal of poverty reduction IRM aims to:

- Enhance human productivity
- Reduce poverty
- Conservation of environment
- Upgrading the technical and managerial skill of rural poor.
- Efficient use of local resources and reduce dependency on external resources

- Innovate and develop courses to meet evolving community and staff needs
- Strengthen village infrastructure to support economic growth

SGS team visited the IRM officer but they responded poorly as they were newly transferred from other district and they had no information about the community and concerned project. It was also observed that NGOs and other agencies have some gaps so they could not provide any information regarding impacts on community and activities going on in the area.

ii. NATIONAL RURAL SUPPORT PROGRAM

National Rural Support Program (NRSP) established in 1991, NRSP is the largest Rural Support Programme in the country in terms of outreach, staff and development activities. It is a not for profit organization registered under Section 42 of Companies Ordinance 1984.

NRSP's mandate is to alleviate poverty by harnessing people's potential and undertake development activities in Pakistan. It has a presence in 54 Districts in all the four Provinces including Azad Jammu and Kashmir through Regional Offices and Field Offices. NRSP is currently working with more than One million poor households organized into a network of more than 102,000 Community Organizations. With sustained incremental growth, it is emerging as Pakistan's leading engine for poverty reduction and rural development.

Mr. Shamsuddin, Office Manager informed SGS team about his work and the description of activities. He was delighted for the new plant of CPL and also showed his interest to see all plant activities and its impacts and transportation of water for nearby localities. He added that the industries working in the area have some gap between the development organizations, so it would be a good opportunity to obtain information from our team.

5.3.12.3 COMMUNITY PROFILE & MEETINGS

SGS team arranged to consult as many stakeholders as possible. During survey, two NGOs and three communites of narby villages were visited namely Lakho Faqir Khaskheli and Chakkar Khan Rajar. Apart from these, D/C administrator Jamshoro and Superintendent DC office were also consulted.

i. GOTH LAKHO FAQIR KHASKHELI

It has a population of 3,500 people with 500 households and also has a dominant tribe belonging to Khaskheli with few other casts. It belongs to Samat sect; majority has lived here since two decades. Most of them speak Sindhi and few speak Siraiki. They know more languages and cultures due to their frequent mobility to other

major cities like Hyderabad and Karachi. The appreciating factor observed was peaceful living of people and there has been no major reporting of dispute.

ii. GOTH CHAKAR KHAN RAJAR

With a total of 100 households and population of 850, this region possesses average inhabitants as compared to other villages. Majority of the tribes belong to Sheikh, Rajar, Khaskheli, Shora, Chutta, and Khosa. Majority are Muslims living with some other hindu tribes. People belonging to different tribes never share same residential areas as they have separate clusters. Some are even higher in the social hierarchy.

Like Khaskheli they are treated not evenly like Rajar and Khosa, so sometimes it is observed that they are baised in their attitude. During consultation meetings, it was observed that every cluster has its own separate *autaqs*.

It was also informed to the community that they shall be provided with a Dispensary but they have to cooperate and agree upon allowing CPL to occupy space. So the community showed its concord to provide space, and they were assured that they shall be witnessing a well equipped mini dispensary where the community would have access in case of emergencies.

iii. GOTH SIDDIQUE RAJAR

In this region, there are total 50 households with a population of 300. Only Rajar caste dwells here. People are cooperative and have good views about CPL. Few of the requirements they notified are as under:

- Girls Primary and High School
- Female teachers for schools
- Dispensary and maternal health centre for mother and child health care

iv. INDIVIDUAL MEETINGS

Shopkeeper

Mr. Qadir Bukhsh Khaskheli, a shop keeper told the team about the industrial related matters. He said that they want special attention to be paid on the condition of roads, education and health sectors as they have been neglected since years. He said that they expect CPL to play its role in facilitating the government to work in those areas on welfare basis.

Local Businessman

Formal meeting was held with a local businessman Mr. Yaseen. He was briefed about the proposed project activities in the area. He said that he was quite satisfied with the ongoing development activities in the industrial area. He encouraged the

development of the plant in the industry and their welfare activities. He said it is a good omen for the overall development of the country.

He further added that it will be beneficial for every one especially other industrial units of Pakistan and that they should replicate the same technology. The Company has initiated quite encouraging development programmes for the welfare of the people. He said that he does not have any concern regarding the proposed activities. He emphasized on the sensitive issues of deployment of local people and provision of general services like education and health facilities to the community.

Housewife

Generally housewives have 11 to 15 hours of work load. An active lady Mrs. Dhanyani told us about their daily routine and some problems of life. She was very much responsive and knew about the project and gave positive response regarding the installation of project. She was happy for the provision of filter water for general use which would make their lives easy. As previously that contaminated water affected their health badly. She appreciated the CPL as she was aware that they have future plans to provide them with few other facilities like dispensary and renovation of demolished houses during floods.

Table 5.11: List of StakeholdersConsulted

No	Stakeholder Name	Designation/ Organization	Contact	Email
1	Mr. Agha Sohail Pathan	DC/ Administrator Jamshoro	0300-3561274	aghasohail82@gmail.com
2	Mr. Asif Ali Memon	Superintendent DC Office Jamshoro	0321-3003203	memonasif786@hotmail.com
3	Nazir Ahmed Khaskheli	Driver	0300-3014905	-
4	Ms. Fehmida	Housewife	N/A	-
5	Qadir Bux Khaskheli	Shop Keeper	0344-8321826	-
6	Ms. Irum	Student	N/A	-
7	Ms. Kiran	Student	N/A	-
8	Mr. Shan	Institute for	0222-772471	-

		Rural Management		
9	Mr. Shamsuddin	NRSP	03003059212 022-9240198	-
10	Mr. Zulfiqar Mangrio	Revenue Office	03003412531	-
11	Mr. Mohd Yaqoob Sheikh/Chakar Khan Goth	Elderly Person of Goth	0346-3129856	-
12	Mohd Ramzan Rajar/Same Village	Small Land lord	0346-3129856	-
13	Mr. Yaseen	Businessman	N/A	-
14	Mr. Long Khan	Villager	N/A	-
15	Mr. Allah Bachayo Sheikh	Villager	0301-3978203	-
16	Ms. Dhanyani	Housewife	N/A	-
17	Ms. Shaher Bano	Housewife	C/o Mohd Yaqoob	-

5.3.13 COMMUNITY CONCERNS FOR PROJECTS

Some of the local residents of the area were aware of the proponent's activities and few recognized CPL by its previous name i.e. "Sandoz", but they were informed that is now renamed as Clariant Pakistan Limited. The stakeholders were previously informed about the survey details and their queries were responded. In general, the local people of the area were glad and pleased with CPL's welfare work in the adjacent villages. One of the female from Goth Lakho exclaimed that they were very glad as they shall be provided with clean water and shelter to some deserving people who lost their houses during flood season. Most of the communities are unaware of the environment and are more interested in getting jobs. However, a few of the residents raised some concerns regarding odour, noise and emissions.

SGS team assured the local residents that all their grievances and concerns shall be addressed adequately, and that the mentioned aspects are not anticipated to cause significant impacts. The community also mentioned few more general grievances which are not directly related with the project, and are given as under:

- Pollution effects on human health
- Unemployment crisis
- Schools at distant places and lack of high school for girls
- Maternal and child health centres situated at distant places
- Muddy tracks which can cause trouble to access other towns

5.3.14 DEVELOPMENT NEEDS

Analysis of the information collected during the field survey concludes that health, electricity and education need attention on highest priorities. The top three development priorities expressed by each sampled survey is shown in **Table 5.12**. Health was expressed, by 40% of the surveyed villages, as the top most concern. Education was expressed as second priority by almost 30% of the surveyed villages. Similarly 20% villages named roads as their third priority and 10% of the villages identified fuel/gas to be their last priority. Roads, transport and employment were identified as their priorities of lesser importance as compared to health, electricity and education.

Table-5.12: Development Priorities

Village Name	Development Needs			
	1	2	3	4
Goth Lakho Faqir Khaskheli	Road	Health	Education	--
Goth Siddique Rajar	Health	Education	Road	Gas
Goth Chakar Khan Rajar	Health	Electricity	Education	--

Apart from this people are very much curious about proper community development work in the area as they want better means for girl's education and proper roads. The alternatives should be of the community's choice and in the best of their benefit.

5.3.15 CONCLUSION

The operation will have a visible positive impact on the socio-economic conditions of the local residents of the area and other stakeholders, manifested as improved health and socio economic conditions and increased technology and a good example for the other industrial units to replicate this technology for making environment friendly and productive plants for the country.

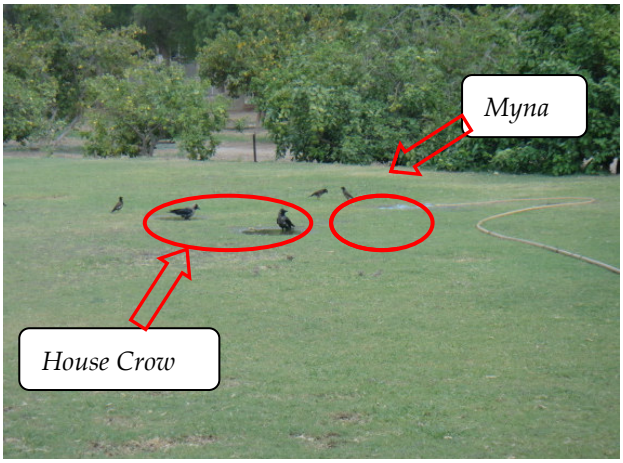
Pictorial View of Site Visit & Public Consultation

Housing Pattern at Ramzan Rajar Village

Children at Chaker KhanVillage

Graveyard in the Project Area

Agriculture & Farm Land Near Project Site



House Crow and Common Myna

Red Vented Bulbul

Ring Dove

Squirrel

Mehran University - Jamshoro

Livestock near Project Area

Water Facility Provided by Clariant at Chakhar Khan village

Washroom Provided By N.G.O

Water Preservation Facility

RBOD behind the Project Site

Ambient Air Monitoring at Project Site

Public & Stakeholder Consultation

Chapter 06

Impact Assessment & Mitigation Measures

Contents

This chapter presents identification and assessment of potential environmental and social impacts of proposed expansion of WWTP & IP on the area's geomorphology, soil, water resources, air, biological resources and socioeconomic conditions and, wherever applicable, identifies mitigation measures that will reduce the adverse impacts.

The proposed project shall create impact on the environment in three distinct phases:

a. During the design phase; this is not supposed to have any impacts.

b. During the construction phase; this is regarded as temporary or short term.

c. During the operation phase; this may pose long term effects.

The construction and operational phases of the project comprises of various activities, each of which will have an impact on some or all environmental parameters. The environmental issues associated with above mentioned project phases are identified and their impacts are scrutinized. These impacts are broadly examined under following categories:

- Impacts on physical environment including soil, water, noise, air etc.
- Impacts on biological environment including flora and fauna.
- Impacts on socioeconomic & cultural environment.

The construction activities, having completed to some extent, were audited carefully and a detailed assessment of the environmental impacts for operational phase has been carried out. In order to minimize or avoid impacts identified during the study, mitigation measures to reduce the consequence or likelihood of occurrence of an impact, have been recommended.

6.1 SITE ALTERNATIVE

The site for proposed project is best available choice for several reasons.

- Proposed site is located within existing CPL facility and therefore no additional land will be required.
- Since CPL has its existing treatment plant at the site, therefore it shall be quite feasible to carry out the expansion and up gradation at the site.
- For treatment purpose, the facility is spacious and treatment and waste handling activities will be conducted in safe and efficient manner.
- As far as adverse environmental impacts are concern, proposed site will pose less impact as compared to any other alternative site which will require additional land cost and complete infrastructure.

Based on aforementioned reasons, site alternative is not a viable option both economically and environmentally. Therefore, it can be concluded that alternative site is not viable economically and environmentally and site alternatives are not taken into consideration.

As far as the technological alternatives are concerned, CPL is working on latest technology and will also use latest and modern machines for all phases of the proposed project.

6.2 IDENTIFICATION OF POTENTIAL IMPACTS

Potential impacts of the proposed project are identified by using different means and ways which include desktop screening exercise, using checklist during field visit for collection of baseline data, professional judgment and published literature on environmental impacts of similar projects and audit of construction activities. A critical step in identifying the potential impacts is discussion with the project proponent, consultation with the stakeholders and nearby community to identify their concerns.

The main aspects associated with potential impacts are as follows:

- Geology, Landscape & Soil
- Water resources
- Ambient air quality
- Waste Generation
- Noise & Vibration
- Occupational & Communal Safety
- Biological Receptors
- Socio-economic conditions

6.3 IMPACT SCOPING CRITERIA

Identified potential impacts are evaluated on the basis of following criteria:

- The present baseline conditions and the change in environmental parameters likely to be affected by the related activities of the proposed project.
- To check whether there is an impact that could possibly breach the environmental standards or environmental guidelines applicable to the project. This includes the national standards such as the National Environmental Quality Standards (NEQS) and guidelines such as the World Bank environmental guidelines.
- To check whether there is a high risk of a permanent, irreversible, and significant change to environmental conditions due to the particular project activity. Some impacts are transitory; they last until the activity lasts. Others are persistent and may last much longer than the activity. After a long period the environmental parameter may or may not revert back to its natural state.
- To determine if the community expresses any concern about the project.

6.4 IMPACT ASSESSMENT METHODOLOGY

The impacts are assessed in accordance with the international standards e.g. ISO 14004:1996 and best available practices. The method defines three levels of consequences (or severity) and likelihood (or probability of occurrence) - High, Medium or Low - of an impact. A standard risk based approach is used in which the significance of an impact is determined on the basis of the level of consequence and likelihood of the impact, for e.g. an impact of medium severity is assigned a low significance if the likelihood of occurrence of the impact is low and high significance if the likelihood of occurrence is high or almost certain. The definition of consequence and likelihood is illustrated in **Table 6.1** and impact significant matrix is provided in **Table 6.2**.

Table 6.1: Definitions for Consequence and Likelihood of Impacts

Level	Consequence (Severity of Impact)	Likelihood
High	❑ Serious/catastrophic damage to environment ❑ Direct legislative requirement ❑ Corporate requirement ❑ Serious threat to corporate reputation/ profitability/ability to do business	❑ High likelihood of occurrence during lifetime of operation ❑ Regular/continuous part of operations
Medium	❑ Measurable damage to the environment ❑ Subject to potential future legislation ❑ Potential to affect reputation/cost ❑ Implication/reduced efficiency	❑ Moderate possibility of occurrence during lifetime of operation ❑ Periodic/occasional part of operations
Low	❑ Negligible damage to the environment ❑ No risk to business	❑ Unlikely to occur during lifetime of operation

Table 6.2: Impact Significant Matrix			
Consequence	**Likelihood**		
	High	**Medium**	**Low**
High	High	High	Medium
Medium	High	Medium	Low
Low	Medium	Low	Low

The prediction of impacts also account for their duration (in terms of long, medium and short term), nature of impact, geographical location of the impact and reversibility of the impact. Impact assessment criteria for the aforementioned parameters are illustrated in **Table 6.3.**

Table 6.3: Impact Assessment Criteria	
Impact Characteristics	**Categories**
Nature of the impact	**Direct**: The environmental parameter is directly changed by the project. **Indirect:** The environmental parameter changes as a result of change in another parameter.
Duration of the impact	**Short term:** Lasting only till the duration of the project such as noise from the construction activities. **Medium term:** Lasting for a period of few months to a year after the project before naturally reverting to the original condition such as contamination of soil or water by fuels or oil. **Long term:** Lasting for a period much greater than medium term impacts before naturally reverting to the original condition such as loss of soil due to soil erosion.
Geographical Location of the impact	**Local:** Within the area of project i.e. operation site and access road. **Regional:** Within the boundaries of the project area. **National:** Within the boundaries of the country.

Reversibility of the impact	**Reversible:** If a receptor resumes its pre-project condition. **Irreversible:** If a receptor is unable to resume its pre-project condition.

Identification of the monitoring requirements:

The last step in the assessment process is the identification of the minimum monitoring requirements. The scope and frequency of the monitoring depends upon the legal requirements and residual impacts. The purpose of monitoring is to confirm that the impact is within the predicted limits and to provide timely information if unacceptable impact is taking place. An environmental management plan (EMP) will be developed with identification of monitoring requirements. This is discussed in the subsequent chapter.

6.5 IMPACT ASSESSMENT

In this section, environmental issues associated with construction and operations of wastewater treatment plant and incineration plant are identified and their impacts are evaluated. Construction phase of the proposed project comprises of excavation, site preparation, cementing, concreting, welding, cabling, installation of plant equipments/ machinery etc. Operational phase of the project starts after the commissioning of the treatment plant. The impact assessment matrix is given in **Table 6.4**.

Table 6.5.1.4: Impact Assessment Matrix

Environmental Aspects	Potential Impact	Project Phase	Nature of Impact	Duration of Impact	Reversibility of Impact	Significance of Impact
GEOLOGY, LANDSCAPE & SOIL	Soil erosion & contamination	C, O	Direct	Medium Term	Irreversible	Low
NOISE & VIBRATION	Annoying & Disturbance	C, O	Direct	Short term	Reversible	Low
Air Quality	Stack Emission, Dust & fugitive emission	C, O	Direct	Medium Term	Reversible	Low
WASTE GENERATION	**Liquid Waste:** contaminating aquifer, contaminating surface water	C	Direct	Short term	Reversible	Low

	Solid Waste: Aesthetic issues	C, O	Direct	Medium Term	Reversible	Low
	Hazardous waste: soil, surface and ground water contamination	C, O	Direct	Short term	Reversible	Low
WATER RESOURCES	Depletion of water Resources	C	Direct	Medium Term	Reversible	Low
	Contamination of ground water	C, O	Direct	Long Term	Irreversible	Low
ODOR NUISANCE	Unpleasant smell	O	Direct	Short Term	Reversible	Low
BIOLOGICAL RECEPTORS-FLORA &FAUNA	Disturbance of faunal community, Vegetation clearing	C,O	Direct	Long Term	Irreversible	Low
SOCIO-ECONOMIC IMPACTS	Occupational & Communal Safety	C, O	Direct	Long Term	Reversible	Low
	Local Employment	C, O	Direct	Long Term	-	Positive impact
C ⟶ Construction *O ⟶ Operation*						

6.5.1 GEOLOGY, LANDSCAPE & SOIL

6.5.1.1 CONSTRUCTION PHASE

a. *Impact Assessment*

There have been no significant impacts on local geology since the treatment plant and incinerator site did not need any preparation activities such as drilling or blasting. The construction work merely included movement of construction

equipment to site, site clearance, excavation, leveling, concrete work etc. The construction phase started from clearing and leveling of the construction site.

The construction phase of the wastewater treatment plant and incinerator would not bring any changes in the landscape or land use pattern of the project area as the land is already categorized as Industrial land use. There would be no adverse impact on the surrounding land use during the construction period.

Excavation activities in the construction phase could also expose soil, leaving it vulnerable to erosion by surface run-off and wind. The overall threat could exist for the entire duration of construction works with the rainy season. There could be a possibility for soil deterioration due to leakages of fuels and oils from the heavy vehicles and machinery used during construction phase. The spillage and leakage of fuels, oils, and other chemicals may lead to soil contamination. Possible contaminant sources included fuel, lubricant oil, and chemical storage areas at construction site.

It was anticipated that soil impacts can be significant if poorly controlled. However, with adequate control measures, the eroded sediments could possibly be contained on-site. It was therefore ascertained that soil erosion control measures are fully implemented and maintained efficiently.

b. Mitigation Measures

- ✓ During construction movement of construction equipment was restricted to work areas only to avoid unnecessary disturbance to soils in the project area.
- ✓ Open soil were covered especially during monsoon season
- ✓ The construction activities were planned intending minimum disturbances to soil.
- ✓ Good engineering practices were adopted during construction activities to ensure that soil erosion is minimized.
- ✓ Fuel and oil storage areas had secondary containment in the form of sand bunds and impervious linings. The volume of the containment area should be equal to 110% of the largest tanks.
- ✓ Fuel tanks were daily checked for leaks and all such leaks were plugged immediately.
- ✓ A spill prevention and contingency plan was prepared to deal with spills.

6.5.1.2 OPERATION PHASE

a. Impact Assessment

The operational phase of the WWTP and incinerator may not pose any negative impacts on the geology and landscape of the area. On the other hand, there may be

a possibility of soil deterioration due to leakages from evaporation pond or lagoons containing wastewater or short term storage of sludge in ponds and storage pits at incinerator site which may lead to the accumulation of heavy metals in soils and a possible contamination of the food chain. Moreover, spillage and leakage of fuels, oils, and other chemicals used during operations of WWTP and incinerator may also lead to soil contamination.

Aforementioned impacts will be reduced beforehand as it has been ensured during the design phase that the ponds and the lagoons are lined with geo-permeable membrane or other lining material. Similarly, sludge from wastewater treatment plant will eventually be disposed off through incineration process and may not cause significant environmental impacts.

b. Mitigation Measures

- ✓ The staff of the plant should be trained for proper management of sludge.
- ✓ Ensure that temporary storage of sludge is carried out in a properly designated storage area.
- ✓ Ensure impervious membrane or secondary containment will be provided at sludge storage area.
- ✓ Chemical, fuel and oil storage areas should have secondary containment in the form of sand bunds and impervious linings. The volume of the containment area should be equal to 110% of the largest tanks.
- ✓ Fuel tanks should be daily checked for leaks and all such leaks should be plugged immediately.
- ✓ A spill prevention and contingency plan should be prepared to deal with spills.

6.5.2 NOISE & VIBRATION

6.5.2.1 CONSTRUCTION PHASE

a. Impact Assessment

The major sources of noise and vibration during the construction phase were vehicular traffic, construction equipment like bulldozers, scrapers, concrete mixers, cranes, pumps, compressors, vibrators etc. The operation of these equipments generated noise ranging between 85- 100 dB (A) near source.

Major activities which could have generated noise are listed below.

- Excavation and construction work such as heavy earth moving equipments, piling works, welding, cuttings, etc.

- Transportation activities such as material loading/unloading, vehicles and other transport used by employees within the site.
- Generators used for power supply during construction works.

Noise and vibration related to different activities of construction phase might cause hearing impacts on nearby communities and workers associated with construction activities. These noise levels were limited within the existing plant boundary, transient in nature and insignificant.

b. Mitigation Measures

- ✓ Nearby residents were given notice of intended noisy activities so as to reduce degree of annoyances.
- ✓ Temporarily elevated noise levels due to construction works were controlled by proper maintenance of equipment, vehicles, and noise controlling equipments.
- ✓ Proper engineering control was applied to noise producing sources.
- ✓ Construction work was limited to day time periods.
- ✓ Generators were installed in an isolated area.
- ✓ Construction works were completed in as short a period as possible by assigning qualified engineers.
- ✓ Schedule was developed for movement of dump trucks that were initially used for hauling of excavated soil.
- ✓ The use of horns by project vehicles was minimised. The use of pressure horns was made prohibited.
- ✓ Specific daytime working hours were ensured and managed for movement of earth moving equipments and other machinery for construction.
- ✓ Noise monitoring was carried out on regular basis.
- ✓ Workers operating equipment that generates elevated noise were equipped with noise protection gear.

6.5.2.2 OPERATION PHASE

a. Impact Assessment

The proposed site is located in open rural areas with no major industrial activities undertaken in the vicinity of the site. Existing noise sources at the project site are merely due to natural sources. Man made sources include traffic noise which was negligible in the project site due to low traffic volumes. During operation phase, noise levels are not expected to exceed current baseline measurements. However expected noise sources with their impacts are discussed here.

Noise pollution during operation would be generated by mechanical equipment, i.e. pumps, air blowers, different parts of incinerator etc. Noise and vibration may cause unpleasant hearing impacts on workers associated with operational activities and on nearby communities. However, it is anticipated that during operations noise and vibration from all equipments will be kept within the permissible limits, transient in nature, reversible and not significant. Moreover, CPL Jamshoro facility management will take all required measures to ensure that the noise levels do not exceed the threshold values for occupational noise and remain within the bearable limit of the workers. As far as impacts on local communities are concerned, the huge area of the CPL Jamshoro facility will be beneficial in attenuating the impacts of noise and vibration on nearby localities.

b. Mitigation Measures

Effective noise management protocols should be implemented, wherever applicable, during operational phase of the project. The implementation of following measures further reduces predicted impacts.

- ✓ Proper engineering controls should be applied to all noise producing sources.
- ✓ Proper maintenance of all mechanical equipments should be carried out to reduce elevated noise produced due to any worn part.
- ✓ Generators should be installed in an isolated area.
- ✓ Noise monitoring should be carried out on regular basis.
- ✓ Site labour working in high noise areas (where noise level exceeds 85 dB (A)), should wear earplugs.

6.5.3 AIR QUALITY

6.5.3.1 CONSTRUCTION PHASE

a. Impact Assessment

Construction activities would not alter the air quality of project area considerably; as they have the potential impact only due to the following localized aspects:

- Dust emissions
- Exhaust emission

Dust emissions

Construction activities generated significant amount of dust as a result of earthworks, offloading of construction material, storage piles, truck dumping, hauling, vehicle movement, land excavation, and concrete mixing and batching etc.

Dust emissions during construction activities could result in deterioration of ambient air quality of immediate vicinity of the project area, and be a nuisance to anyone exposed to it. The main health hazards were the dust particles smaller than 10 microns (designated as 'PM10') as they are respirable. Dust particles have the potential to affect the health of construction workers, the residents live in close vicinity and vegetation.

Exhaust emission

Construction and transportation equipments (earth movers, graders, trucks, vessels, concrete batch plant etc.) result in exhaust gases that can affect the ambient air quality locally. Emissions produced from transport vehicles and other construction vehicles & equipments such as CO, CO_2, SOx, NOx and PM_{10} are injurious to human health if present in high concentration in ambient environment and also cause vegetation damage by clogging the photosynthesis process in plants.

b. Mitigation Measures

Some of the measures that were implemented in order to significantly reduce the exhaust & dust emissions during construction phase are as follows:

- ✓ To reduce emissions in the ambient air, maintenance of vehicles and sprinkling of water on construction site was ensured.
- ✓ Regular sprinkling of water over exposed surface effectively keeps airborne dust levels to minimum. It can reduce or suppress the dust formation by more than 50% if sprinkling is conducted at least 3 times in a day.
- ✓ Schedule was developed for the movement of dump trucks that were initially used for hauling of debris.
- ✓ Construction debris was placed in a proper place and covered with tarpaulin or water was sprinkled to avoid dust emissions.
- ✓ Stockpiles of fine material were wetted or covered with tarpaulin especially during windy conditions.
- ✓ Site workers and drivers wore dust masks and safety goggles especially during dry and windy weather conditions to avoid injuries and health risk due to dust.
- ✓ Low emission content fuel was utilized for generators, where possible.
- ✓ It was ensured that the vent of the generator exhaust is at adequate height.
- ✓ Generators were properly tuned, serviced and monitored on regular basis.
- ✓ Generators were kept away from walking areas and at safe place where the probability of human intervention is very limited.

- ✓ Water was sprinkled daily or when there was an obvious dust problem.
- ✓ All equipment and vehicles used during the project were properly tuned and maintained in good working condition.
- ✓ All project vehicles were checked regularly to ensure that engines are in sound working condition and are not emitting smoke.

6.5.3.2 OPERATION PHASE

a. Impact Assessment

The air quality of the area is supposed to be harmed with project related vehicular exhaust emissions. This impact is quite insignificant as the proposed project will not raise traffic volumes to such an extent which could increase air pollution. Besides this impact, the principal source of air pollution in the project area is Jamshoro Thermal Power Plant. SGS team observed emissions from the power plant during field visit on July 31, 2012, which may lead to deterioration of air quality of the project area, if not regularly monitored.

For assessing ambient air quality during operational phase, we shall separately consider the impacts from wastewater treatment plant and incinerator, on account of their severity and significance.

Wastewater Treatment Plant

In general, wastewater handling is considered a minor source of greenhouse gas emissions in many countries. The existence of WWTP will not have any negative effect on the microclimate of the area. The microclimate will be improved against the climate extremities (wind and storms), by planting trees in the neighborhood of the plant.

Wastewater is treated to remove organic matter using biological processes in which microorganisms can perform biodegradation process under aerobic or anaerobic conditions. Anaerobic conditions may produce fugitive emissions of Methane (CH4). During collection and treatment, wastewater may be accidentally or deliberately attain anaerobic conditions. Untreated wastewater may also produce methane if contained under anaerobic conditions. It is also expected that operation phase may also cause fugitive emissions from biological tanks. This may include CO_2 and minor concentrations of N_2, NH_3 and H_2S. Moreover, sludge if not handled properly or remain unattended may cause gaseous emissions such as Hydrogen Sulphide (H_2S) and Methane (CH_4) due to occurrence of anaerobic conditions. Due to low probability and minor concentration of these gases if produced, any impacts are not anticipated.

Incineration Plant

Emissions from the stack of incinerator are the main sources of gaseous emissions in the proposed project area. The main constituents in gaseous emissions, as described by the incinerator manufacturer, would be smoke dust, CO, NOx, SOx, chlorine hydride, hydrogen fluoride and dioxin. These parameters shall comply with the standard values furnished in the incinerator manual attached as **Annexure III**. In addition, the emissions will also be monitored against NEQS. The detail is given in Chapter 04.

b. Mitigation Measures

- ✓ All equipment and vehicles used during the project should be properly tuned and maintained in good working condition.
- ✓ Unnecessary vehicular trips should be controlled.
- ✓ All project vehicles should be checked regularly to ensure that engines are in sound working condition and are not emitting smoke.
- ✓ Only competent personnel should be allowed to operate the incineration plant.
- ✓ Stack emissions of incinerator plants should be monitored on periodic basis and a register should be maintained. Gaseous emission monitoring frequency will also be incorporated in EMP for facility.
- ✓ Height of incinerator stack should be kept as specified in incineration manual in order to ensure better air dispersion.

6.5.4 *WASTE GENERATION*

6.5.4.1 CONSTRUCTION PHASE

a. Impact Assessment

Effluent/ Wastewater

The main type of effluent released during the construction activity was flushed water generated in a small quantity from flushing/concreting/mixing activities. Water generated from flushing of lines could cause localized flooding in the area that could adversely impact the site conditions and also worsen the aesthetic look of the site. It could create nuisance to the environment if not disposed appropriately. As there is ample land available within existing CPL Jamshoro facility premises, all waste streams were contained onsite and disposed by evaporation.

Solid Waste

Solid waste was produced throughout the construction activities, which included metal and wooden pieces, excavated soil, plastic sheets, domestic garbage, packaging waste, paper waste, glass, metals, concrete waste etc.

Likely impacts of improper waste management generated from construction activities may include:

- Soil contamination
- Health hazards
- Aesthetic issues

Improper waste management practices could favor waste accumulation in nearby environment and deteriorate the aesthetic look and environmental conditions of the project area.

CPL Jamshoro facility already has a comprehensive waste management plan. The plan was also adopted to manage and dispose waste generated during construction phase.

b. Mitigation Measures

In addition to the waste management plan, following mitigation measures were implemented:

- ✓ Reusable inorganic waste (e.g. excavated sand/ clay) was stockpiled away from drainage features and used for backfilling where necessary.
- ✓ All flushing water and other waste stream were first stored in a holding tank to allow settling of silt and other solid particles and its outlet stream was spread over vacant land for disposal through evaporation.
- ✓ A waste management plan was enforced before the commencement of the project activities.
- ✓ Damaged pipes left over steel, wooden and plastic pieces and other recyclable construction wastes were disposed off preferably for recycling.
- ✓ Solid waste containers were provided with adequate volumes to cater daily waste generation.
- ✓ Especially in monsoon season, all the construction material was covered.

6.5.4.2 OPERATION PHASE

a. Impact Assessment

Effluent/ Wastewater

WWTP of CPL Jamshoro facility has an overall positive impact on liquid discharges as the pollution load would be reduced and complying with NEQS. Moreover, the facility is a zero discharge treatment system, whose main purpose is to recover reusable water from Reverse Osmosis (RO) plant. Therefore there will be no effluent/wastewater discharge during the operational phase of the plant. In addition, there shall also be no liquid discharge from the incineration operation.

Sludge

Sludge is produced during the operational phase of WWTP as a solid waste. The concentrate produced will be evaporated on-site in evaporation ponds and sludge will be moved for incineration. The temporary accumulation of sludge in the ponds after evaporation and in the storage pits may be the potential cause of soil or water resources contamination. Sludge accumulation can create two problems:

- It produces odours because it accumulates and becomes anoxic.
- It serves as a vector for diseases and propagation of flies and mosquitoes.

However, it has been ensured during the design phase that the ponds and the storage pits are lined with geo-permeable membrane or other lining material which reduces the significance of impact. In addition, sludge shall be incinerated through explicitly installed in-house incineration facility which reduces the impact of sludge accumulation.

Ash

Ash is the only waste generated as a result of the incineration process. Cautious disposal of ash through an approved waste contractor shall reduce the significance of this impact.

b. Mitigation Measures

As mentioned above, WWTP will be a zero discharge facility and sludge will be incinerated through in-house incinerator, therefore no impacts are expected regarding solid waste from operational phase. However, following measures will be helpful for smooth operation of WWTP and incinerator.

- ✓ Ensure temporary storage of sludge on lined material to avoid soil contamination.
- ✓ Ash should be handled and stored with care and disposed off through approved waste contractor.

- ✓ Periodic maintenance of WWTP and incinerator should be ensured for smooth operation of the plant.
- ✓ Periodic maintenance of incinerator should be ensured for smooth incineration operation.

6.5.5 WATER RESOURCES

6.5.5.1 CONSTRUCTION PHASE

a. Impact Assessment

The peak water requirement during construction phase of WWTP was approximately 40-50 m^3/day and 5-8 m^3/day for incinerator which was fulfilled from the existing surface water source approved from irrigation department. Water was pumped from Kotri Barage through pumping station, explicitly dedicated for a continuous supply of water to Clariant Jamshoro facility. Moreover, following were the potential sources or causes which could have led to water resources contamination:

- Improper disposal of construction debris leading to off-site contamination of water resources.
- Spillage of chemicals and fuel during handling, transportation and storage.
- Washing and refuelling of vehicles at the site.
- Maintenance of equipments and vehicles at the site.
- Soil runoff from the site leading to off-site contamination (mainly during rainy season).
- Waste stream generated from on-site activities such as vehicles washing, workshop etc.

Construction activities were expected not to impact the water resources and their availability to local communities, as existing approved surface water source was utilized. Whereas impacts of contamination on water resources were reduced by implementing following mitigation measures:

b. Mitigation Measures

- ✓ Use of leak proof storage tanks was ensured.
- ✓ Impervious secondary containment was provided at fuel storage tanks having volume of 110% of the volume of the storage tank.
- ✓ Fuels and lubricants were stored in areas with impervious floors.
- ✓ Storm water diversion channels were constructed to divert storm runoff from flowing over the construction areas.

- ✓ Provision was provided to contain runoff from the construction site.
- ✓ Provision was provided to contain runoff from maintenance workshop and washing area.
- ✓ Regular inspections were carried out to detect leakages in construction vehicles and equipments.
- ✓ Spill preventive measures including shovels, plastic bags and absorbent materials, were available near fuel and oil storage areas.
- ✓ Contaminated soil was removed and properly disposed off after treatment such as bioremediation or incineration.
- ✓ No contaminated effluents were released to the environment.
- ✓ A complete record of water consumption during construction phase was maintained.
- ✓ Water conservation strategies were adopted to reduce water consumption.
- ✓ Good housekeeping practices were observed with all machinery that uses water.
- ✓ All water hosepipes were equipped with automatic shut off nozzles.

6.5.5.2 OPERATION PHASE

a. Impact Assessment

In general, the existence of the WWTP will have a positive impact on the surface and ground water quality of the area. Since the proposed WWTP is a zero discharge facility where treated wastewater will be recycled and reused for washing and gardening. This will not only significantly reduce the existing pollution load in the main drain (which is already bearing the industrial as well as domestic load of wastewater) but also reduces water consumption. Therefore the significance of this impact is positive and the nature of impact is wide, as it would directly and positively affect the receiving water body of River Indus and ultimately the Arabian Sea.

On the other hand, there is a possibility for ground water contamination due to leakages from evaporation pond or lagoons containing wastewater or short term storage of sludge in ponds and storage pits at incinerator site which may lead to the accumulation of heavy metals in water resources.

Aforementioned impacts on water resources will be reduced beforehand as it has been ensured during the design phase that the ponds, lagoons and the storage pits are lined with geo-permeable membrane or other lining material. However, there may be a slight possibility of contamination risk due to damage of lining material beneath the lagoons and storage pits.

As far as the incinerator is concerned, no water resources are required during the operation of incinerator and since there is no liquid discharge, therefore no impact on the water bodies of the surrounding area is anticipated.

b. Mitigation Measures

- ✓ Specific regulations should be followed to control the use of treated wastewater in gardening according to the quality of treated wastewater and soil structure.
- ✓ The performance of plant should be optimized, by means of continuous sampling and laboratory tests.

6.5.6 ODOR NUISANCE

6.5.6.1 CONSTRUCTION PHASE

a. Impact Assessment

Odour nuisance was not anticipated during construction phase.

b. Mitigation Measures

Not applicable.

6.5.6.2 OPERATION PHASE

a. Impact Assessment

Odour is defined as "the sensation resulting from stimulation of the human sense of smell." Bad odour is a nuisance.

Wastewater treatment plant holds a risk of odour nuisance if not provided with proper buffers between the treatment units and existing populations. The primary corrective measure for odour control remains the proper siting of the facility.

Biological tanks, sludge holding areas and dewatering units are the main sources of odour at the wastewater treatment facility. Moreover, scum is also another source of odour. Overloading of the ponds will also result in odour problems because the treatment capacity will have exceeded. Wind is an effective source of aeration through surface mixing, but too much wind action can disturb bottom sediments and also create an odour problem. In most instances, the odours are generated as a result of an anaerobic or "septic" condition.

In general, the most frequently reported symptoms in literature attributed to odors include headache, nausea, cough, and eye, nose, throat irritation etc.

The proposed wastewater treatment tanks are not expected to produce odours. This is due to the use of aeration process thus preventing septic conditions. Moreover, natural ventilation and synthetic windbreakers (e.g. walls) around the existing

facility may serve to minimize potential odour dispersions and will reduce the significance of the odour impact.

No significant odour impacts are anticipated during the operational phase of the incinerator; however, it depends upon the type of the waste to be burnt and since the incinerator is already equipped with the scrubber unit, therefore any associated impacts shall be intermittent and short-term, hence less significant.

b. Mitigation Measures

- ✓ A regular maintenance program should be executed to prevent the clogging of diffuser plates to maintain adequate dissolved oxygen levels in the aeration tanks, which in turn minimizes the chances for the production of odorous compounds.
- ✓ Regular cleaning of aeration tank walls and floors, washing weirs, and removing scum regularly, also helps in odour reduction.
- ✓ Provide appropriate covering/ ventilation of the odour sources, wherever possible.
- ✓ Removal of grit/grease and flooding of wastewater which results in possible generation of obnoxious smell should be handled appropriately.
- ✓ Scum, if produced should be appropriately disposed off or properly stabilized.
- ✓ Ensure adequate water flow in ponds and aeration to reduce the potential of odour formation.
- ✓ The periphery of the proposed site should be vegetated with trees and plants of varying heights which may serve as windbreakers to minimize potential odour dispersions.
- ✓ Use of specific PPEs should be ensured to reduce any respiratory problems due to odour from the incineration process.
- ✓ Height of incinerator stack should be kept as specified in incineration manual in order to ensure better air dispersion which will minimize the odour impacts.

6.5.7 ARCHAEOLOGICAL, RELIGIOUS & CULTURAL SITES

6.5.7.1 CONSTRUCTION PHASE

a. Impact Assessment

As the proposed project site lies within the boundary of the existing Clariant facility, no archaeological, cultural or religious sites (as mentioned in guideline for protected area) are found in the immediate proximity of the project area, nor was

any such site observed during site survey. However, local cultural sites like Mosque, Mazars and graveyard exist in the nearby vicinity.

b. Mitigation Measures

No specific mitigation measures are applicable as all construction activities were carried out within existing premises.

6.5.7.2 OPERATION PHASE

a. Impact Assessment

Not applicable.

b. Mitigation Measures

Not applicable.

6.5.8 *OCCUPATIONAL & COMMUNAL SAFETY*

6.5.8.1 CONSTRUCTION PHASE

a. Impact Assessment

Construction activities involved mechanized equipment and machineries, excavations, storage of hazardous materials, falling objects, tripping etc. In this phase around 150-200 workers were involved which increased the possibility of accidental injury. Moreover, any other emergency situation like fire emergency, oil spill or any natural disaster could have happened during this phase. Because of the short duration and non-complexity of the construction phase, such activities were controlled and consequently the associated risks were minimal.

There would be no interaction of local community to the construction site. Hence there would be no construction related safety hazard for local community.

CPL Jamshoro facility management made sure that workers used the personnel protective equipments (PPEs) during construction phase specially working on heights and in dust and high noise areas. In addition to this, a 24 hrs dispensary was already available at the CPL Jamshoro facility, with two medical doctors, whereas ambulance service was also available on site and off site.

b. Mitigation Measures

To ensure worker's safety during construction phase, following measures were taken:

- ✓ The First Aid box was placed on site.
- ✓ First Aid training was provided to all construction supervisors.

- ✓ Contact addresses and numbers of local hospitals and other emergency organizations was available on site all the time.
- ✓ Proper site restoration was carried out after the completion of construction phase to eliminate any safety hazards such as any excavation was levelled to prevent falling injuries etc.
- ✓ Construction machinery and equipment was only operated by trained and experienced personnel.
- ✓ Emergency response plan was developed to cater different emergency situation as mentioned above.
- ✓ Provision of first aid at site was ensured in case of any emergency.

6.5.8.2 OPERATION PHASE

a. Impact Assessment

Operational phase will involve working with pumps, aerators and different mechanical equipments of incinerator. Operational activities will involve human interaction which increases the possibility of accidental injury. Moreover any other emergency situation like fire emergency, plant failure, oil spill or any natural disaster may occur and CPL Jamshoro facility workers may be exposed to occupational hazards or accidental injury.

CPL Jamshoro facility management will make sure that workers are using personnel protective equipments (PPEs) during operational activities specially working on heights and working in the dust and high noise areas.

b. Mitigation Measures

To ensure worker's safety during operation phase, following measures should be taken:

- ✓ First Aid box should be placed at different location within plant.
- ✓ First Aid training should be provided to all supervisors and relevant staff.
- ✓ Maintaining equipment in good operation order is of paramount importance in preventing equipment failure.
- ✓ Training programmes for plant operation and maintenance activities should be observed.
- ✓ Contact addresses and numbers of local hospitals and other emergency organizations should be available at plant all the time.
- ✓ Emergency response plan should be developed to cater different emergency situation as mentioned above.
- ✓ Ensure provision of first aid at site in case of any emergency.

6.5.9 BIOLOGICAL RECEPTORS-FLORA &FAUNA

6.5.9.1 CONSTRUCTION PHASE

a. Impact Assessment

The biodiversity of the macro and micro environment is rich with forest tree species, shrubs and annual or seasonal grasses. Most of the species in the existing CPL Jamshoro facility (micro environment) are found to be decorative. The facility occupies a very huge area where mango and date farms are cultivated. During the construction phase of the WWTP and incinerator, CPL management ensured that clearing of any wild vegetation or the plant cover at the site is kept to the minimum.

The fauna in the macro and micro environment of the project area broadly consists of birds, rodents, snakes and other wild species. Due to human interventions, most wild species have either left the area or become locally extinct. Even if it is supposed that some of the species may have displaced due to loss of habitat or temporary disturbance, still there will be huge area available which can serve as habitat. During the construction phase of the WWTP and incinerator, these animals might have been disturbed and their habitat affected.

Any rare, endangered or endemic terrestrial plant or fauna species were not observed during the site visit. Moreover, either from an ecological or commercial point of view, there was nothing untowardly special about the vegetation varying from agricultural crops to trees to herbs and shrubs and was insignificant.

b. Mitigation Measures

- ✓ Engineering practices were adopted during construction activities to ensure that unnecessary clearing of vegetation within and outside work areas is avoided.
- ✓ Before start of any activity, awareness trainings were provided to contractor's management and field crew related to wild life protection.
- ✓ No-hunting and no-trapping policy was strictly enforced, unless human life is under threat.
- ✓ Physical disturbance to areas outside the work corridors was avoided.

6.5.9.2 OPERATION PHASE

a. Impact Assessment

The physical existence and operations of the WWTP and incineration plant may generate noise, odour nuisance and fugitive and stack emissions. These issues may scare the birds from nesting around the site. Emissions from incineration plant may have the potential to impact plant and animal life of the project area.

b. *Mitigation Measures*

- ✓ Tree planting will enhance biodiversity at the site.
- ✓ Trees will attract many bird species and other animal species.
- ✓ Ensure regular watering of tree species, shrubs and annual or seasonal grasses especially those cultivated in the immediate surroundings of WWTP and incineration plant.
- ✓ Height of incinerator stack should be kept as specified in incineration manual in order to ensure better air dispersion which will also minimize the odour impacts.
- ✓ Ensure that periodic maintenance of WWTP and incinerator is carried out which also minimizes noise, odour and associated operational impacts.
- ✓ Ensure periodic emission monitoring of incinerator.
- ✓ Minimize number of trips of vehicles.
- ✓ Ensure proper lubrication of machinery/equipments or moving parts to minimize potential cause of elevated noise.
- ✓ No-hunting and no-trapping policy should be strictly enforced, unless human life is under threat.

6.5.10 *SOCIO-ECONOMIC IMPACTS*

6.5.10.1 CONSTRUCTION PHASE

a. *Impact Assessment*

Construction phase was not expected to result in any socioeconomic impacts as human settlement, archaeological or cultural resources are not present in the vicinity of the proposed project site. As the proposed project site is located within existing boundary of CPL Jamshoro facility, therefore impacts on immediate neighbours and surrounding environment are negligible. Furthermore, construction activities did not result in any land acquisition and change of land-use. On the other hand, employment opportunities were created both for skilled and unskilled workers during the project cycle. The peak manpower requirement during the construction phase of WWTP and incinerator was 150-200/day which is a positive impact on the local economy. Predicted impacts were reduced by implementing following mitigation measures:

b. *Mitigation Measures*

- ✓ CPL Jamshoro facility management was careful about hiring the construction staff and considered workers behavioural aspects.
- ✓ It was ensured that workers possessed adequate experience in order to make sure smooth working related to construction phase.

- ✓ Prior coordination with relevant stakeholders was ensured during project activities.

6.5.10.2 OPERATION PHASE

a. Impact Assessment

The main amenity impacts during the operation of WWTP and incinerator are related to noise, odours and emissions. Noise would be generated by mechanical equipment, i.e. pumps, air blowers, different parts of incinerator etc. Similarly, odour emitted as a result of the wastewater treatment works and emissions from incinerator may easily reach the local inhabitants; especially if the prevalent wind direction is towards the residential areas.

However, as the proposed project shall come into effect within the existing boundary of CPL Jamshoro facility (where the noise levels already meet the NEQS) and occupies a massive area, which shall be helpful in the dispersion of the emissions and odour effects and the attenuation of noise, therefore these impacts are anticipated to be less significant on the social receptors.

In contrast, employment opportunities will be created both for skilled and unskilled workers during the project cycle. The human resource requirement during normal operation phase of proposed project is expected to be 20-30 persons including management and workers working in three (03) shifts. This will have a positive impact on the local economy. Predicted impacts can be reduced by implementing following mitigation measures.

b. Mitigation Measures

- ✓ CPL management should be careful about hiring process and should hire local persons wherever possible.
- ✓ Workers must possess adequate experience in order to ensure smooth working related to operation phase.
- ✓ Ensure prior coordination with relevant stakeholders during project activities.
- ✓ If adequate noise reduction/suppression measures are taken, the generated noise should not significantly affect human amenity.
- ✓ In many instances, odour can be reduced or prevented through normal housekeeping and improved operation and maintenance design procedures.

6.5.11 COMMUNITY GRIEVANCES/ COMPLAINTS

a. Impact Assessment

Community grievances/complaints related to project activities will be addressed by project proponent (CPL). Local complaints (if any) on dust, elevated noise, waste

from different project activities, spilled oil and chemicals, hiring issues etc may provide basis for conflict between the locals and project proponent.

b. Mitigation Measures

- ✓ Grievance handling system must be established on the basis of CPL's past experience to address community grievance/complaints.
- ✓ A social complaint register should be maintained on site by CPL. All complaints received from local communities should be well recorded.
- ✓ Community complaints shall be duly addressed and appropriately resolved. The measures taken to mitigate these concerns shall also be recorded in the social complaint register.

Chapter 07

Environment Management Plan

Contents

7.1 INTRODUCTION

After the Environmental Assessment of the proposed expansion of the wastewater treatment plant and installation of the incinerator, it is essential to identify project specific actions to minimize the adverse environmental impacts caused during project activities. These actions are compiled in the form of an Environment Management Plan (EMP). Although most of the environmental impacts identified in the proposed project are temporary and localized, project specific recommendations mentioned in this document may further minimize these impacts.

The potential environmental impacts are identified from the planning stage of the proposed project through the EIA process. Environmental Management Plan (EMP) is a vital part of overall planning and implementation of projects. It provides a structural framework and logical approach for an effective implementation of the mitigation measures related to health, safety, socio-economy and environmental protection of the project area and its surroundings throughout the project lifecycle.

EMP is a tool that serves so as to manage environmental impacts and specifically focuses on implementation of mitigation measures in their true sense against likely environmental impacts. Both negative and positive impacts at each stage of the project activity have been thoroughly examined in this EIA study.

The ultimate responsibility for a successful environmental management during all phases of the project rests with Clariant Pakistan Limited (CPL). However, contractors (i.e. construction, janitorial etc) will also be responsible for implementing the EMP during all phases of the project.

The EMP for construction and operation phases of the project follows the "Plan-Do-Check-Act" system in accordance with the ISO-14001 EMS guidelines and includes the organizational structure, resources, responsibilities, control and mitigation measures, monitoring systems for review and implementation of corrective actions.

7.2 SCOPE OF THE EMP

The scope of the EMP covers all construction and operational activities and ensures continual compliance with applicable National legislation, international standards and guidelines, and the CPL Environmental, Health and Safety Policy.

EMP covers a series of general and specific recommendations that collectively constitute the basis of the management (mitigation of the impacts) and environmental control during the project life cycle.

The EMP also lists down the obligations and responsibilities of each party involved in the project, stipulates methods and procedures that will be followed, and delineates environmental management actions that will be implemented, considering that the

reference framework for the environmental standards is avoiding negative impacts on the health and well-being of people and the environment.

EMP is prepared on the basis of the available details of the project. As construction contractor is appointed, the EMP will be amended to incorporate any change. However, no mitigation measures committed in the EMP can be changed.

7.3 PURPOSE AND OBJECTIVES OF THE EMP

This EMP has been prepared based on the findings of the EIA study and describes management measures designed to prevent or reduce potential environmental and social impacts of the proposed project. The primary objectives of the EMP are to:

- Facilitate the implementation of the mitigation measures identified in the EIA.
- Achieve CPL health, safety and environmental (HSE) goals.
- Ensure compliance of the associated legislative requirements, guidelines, community issues, if any, and best industry practices that apply to the project.
- Define roles and responsibilities of the project proponent and identify areas where these roles and responsibilities can be shared with other stakeholders.
- Define a monitoring mechanism and identify monitoring parameters in order to:
  - Ensure the complete implementation of all mitigation measures
  - Ensure the effectiveness of the mitigation measures
- Define requirements for environmental monitoring and auditing.
- Provide a mechanism and strategy for taking timely action if any unanticipated environmental situation arises.
- Identify training requirements at various levels.

7.4 COMPONENTS OF THE EMP

The EMP consists of the following:

- Legislation and guidelines
- Role & responsibilities
- Implementation Stages of EMP
- Environmental Training And Communication
- Implementation Stages of EMP
- Impacts Mitigation Plan
- Environmental Monitoring Plan

- Change Management Plan
- Waste Management Plan (WMP)

7.5 LEGISLATION AND GUIDELINES

This EIA has taken account of all national and international legislation and guidelines that are relevant to the project. CPL will ensure that the project is conducted in conformance with CPL's Corporate HSE policy, national legislations and other international guidelines applicable to the project. CPL will also ensure that its prime project management staff and all its assigned contractors are aware of these legislation and guidelines, prior to the start of project activities. All relevant national and international legislation and guidelines are discussed in details in Chapter 3 of the report.

7.6 ROLES AND RESPONSIBILITIES

The implementation of this EMP requires the involvement of several professionals, each fulfilling a different but vital role so as to ensure sound environmental management during the different phases of project. The most important, from an environmental perspective, are the Project Manager, the Environmental Control Officer (ECO), the contractor and the proponent/ developer.

The proponent/ developer is responsible for the implementation of the EMP during the operational phases of the project. Operation will however entail the appointment/ relocation of a professional team and responsibilities will be similar to those during the design and construction phases.

7.6.1 PROJECT MANAGER

The Project Manager is responsible for the overall management of project and EMP implementation. The following tasks will fall within his/her responsibilities:

- To be familiar with the recommendations and mitigation measures of this EMP, and implement these measures.
- To monitor site activities on a regular basis for compliance.
- To conduct internal audits of the construction & Operation site against the EMP.
- To confine the construction site to the demarcated area.
- To rectify lapse through implementing corrective actions.

In addition, Project Manager is responsible to appoint the Environmental Control Officer (ECO).

7.6.2 ENVIRONMENTAL CONTROL OFFICER (ECO)

The Environmental Control Officer is responsible to monitor and review the on-site environmental management and implementation of this EMP and liaison between the developer and Contractor. The ECO will liaise and report to the developer, contractor, and authorities. The following tasks will fall within his / her responsibilities:

- To assist the contractor and developer in finding environmentally liable solutions to problems.
- To be familiar with the recommendations and mitigation measures of this EMP.
- To conduct weekly/ monthly audits of the project facility according to the EMP.
- To educate and train the project and operation team about the management measures of the EMP.
- Recommend corrective actions for any environmental non-compliance incidents on the site.

7.6.3 CONTRACTOR

The contractor is responsible for the implementation and compliance with recommendations and conditions of the EMP.

- Ensure compliance with the EMP at all times during construction, maintenance and other operations.
- Maintain an environmental register which keeps a record of all incidents which occur on the site. These incidents may include but are not limited to:
  - Public involvement / complaints
  - Health and safety incidents
  - Leakage / Spillage / Seepage of Hazardous materials stored on site
  - Non compliance incidents

The contractor will be required to appoint a competent individual as the Contractor's on-site Designated Environmental Officer (DEO).

7.6.4 CONTRACTOR'S DESIGNATED ENVIRONMENTAL OFFICER (DEO)

The Contractor's Designated Environmental Officer will be responsible for overseeing the Contractor's internal compliance with the EMP requirements and ensuring that the environmental specifications are adhered to. The appointed DEO must be appropriately trained in environmental management and must possess the skills necessary to impart environmental management to all personnel involved in the contract.

The DEO will be responsible for keeping detailed records of all site activities that may pertain to the environment. This includes:

- Daily site inspections.
- Supervision of work where environmental management is a key aspect (e.g. in sensitive areas, with high environmental risk, etc.).
- Keeping liaison with the ECO.
- Reporting to the IMC regarding implementation of the EMP.
- Completing start-up, weekly, monthly and site-closure checklists.
- Keeping a photographic record of progress on site from an environmental perspective.
- Keeping a register of complaints in the site office and recording and dealing with any community comments or issues.
- Keeping a record of on-site incidents and accidents and how these were dealt with.

7.7 ENVIRONMENTAL TRAINING AND COMMUNICATION

Training and Communication will help to ensure that the requirements of the EIA and EMP are clearly understood and followed by all project personnel in the course of the project. The contractor will be primarily responsibility for providing training to project personnel during construction & during operation CPL will ensure the training requirement.

7.7.1 TRAINING OF PROJECT PERSONNEL

Trainings, entailing environmental awareness, should be conducted for the senior personnel along with an induction presentation on the importance and implications of the EMP.

7.7.2 TRAINING OF WORKERS

The construction and operation workers must receive basic training on environmental awareness, including the processes related HSE issues, storage and handling of hazardous substances, management of waste ash, and prevention of water pollution.

The training shall be conducted, as far as possible, in the employees' language of choice. As a minimum, training should include:

- Explanation of the importance of compliance with the EMP.
- Discussion of the potential environmental impacts of the construction and operation activities.
- The benefits of improved personal performance.
- Employees' roles and responsibilities, including emergency preparedness.
- Explanation of the mitigation measures that must be implemented when carrying out their activities.
- Explanation of the management structure of individuals responsible for matters pertaining to the EMP.

A weekly meeting must be held during construction phase at the site and if required, during the operation phase. The purpose of this meeting shall be focused on discussing the impacts & mitigation of ongoing activities, any incident/accident that occurs during the week, conduct of the operation and environmental issues and their management. The minutes of meeting shall be recorded in the form of a weekly environmental report and communicated to the all staff.

CPL shall keep records of all environmental training sessions, including names, dates and the information presented.

7.8 IMPLEMENTATION STAGES OF EMP

7.8.1 PLANNING AND DESIGN STAGE

a) DESIGN OF THE PROPOSED PROJECT

Designs and other details of the proposed project including all related activities are described in Chapter 4 of this EIA report. Following the approval of the EIA, if any aspect of the project or requirements of the EIA needs to be changed, CPL will categorize those changes in accordance with the Change

Management Plan provided in Section 6.10 of this EMP and take appropriate measures thereon.

b) APPROVALS

Obtaining a No Objection Certificate (NOC) from the Sindh Environmental Protection Agency will not relieve the proponent from other legal obligations and hence CPL and associated project contractors will obtain all other relevant clearances and necessary approvals required by the Government of Pakistan or Government of Sindh prior to commencing the respective operation.

c) CONTRACTUAL PROVISIONS

Adherence to the requirements of this EIA in terms of mitigation measures will be required from all project contractors. Therefore all project contractors would be contractually bonded with CPL for the compliance of the requirements of this EIA study.

7.8.2 OPERATIONAL STAGE

Operational stage refers to all stages after designing and planning stage. In this EMP, operational stage comprises of initially a construction phase, which is followed by a commissioning & operation phase. EMP will be implemented during all phases. Implementation of following activities during operational stage is very essential for overall management of mitigation measures.

a) IMPACT MITIGATION PLAN

Suggested mitigation measures are summarized in impact mitigation plan attached as **Table 7.1**. Brief description about impact mitigation plan is presented in subsequent section. CPL and its contractors will ensure the observance of suggested mitigation measures during the project as described in this EIA.

b) HSE MANAGEMENT SYSTEM

CPL and the contractors will ensure that the organizational HSE Management System is implemented during the proposed project activities. The contractors will abide by the relevant contractual provisions relating to the environment.

c) MONITORING

Project activities would be monitored by CPL and its contractors; CPL Site HSE Coordinator will monitor project activities and will keep records of all non-conformances observed and report these along with actions to CPL management for further action. The Site HSE Coordinator will also

communicate any anticipated impact(s) which was not covered in EIA for further action. Impacts monitoring plan is attached as **Table 7.2.**

d) CHANGE MANAGEMENT

The EIA of proposed project recognizes that changes in the project design may be required during the operational stage and therefore, a Change Management Plan is provided (incorporated in section 6.10) to manage such changes. Overall responsibility for the detailed preparation and implementation of change management statements will be the responsibility of CPL itself.

e) EMERGENCY PREPAREDNESS

Emergency preparedness plan will be prepared and maintained by CPL and its contractor; to deal with any emergency situation that may arise during the project activities e.g. fire emergency, major effluent / oil spills, occupational health & safety hazard etc. and communicate these to the regulatory agencies (if required by these agencies). However, CPL has a clearly defined, well structured and dynamic Emergency Preparedness & Response Plan.

f) COMMUNICATION AND DOCUMENTATION

HSE matters will be discussed during daily tail gate meetings held on-site, in order to monitor, manage and document the environmental performance of project activities. Environmental concerns raised during the meetings will be resolved after discussions between CPL and contractor's management representative or higher management (if required). Weekly and monthly environmental reports will be generated by CPL Site HSE Coordinator and contractor's representative and will be shared to the respective higher management.

g) ENVIRONMENTAL TRAINING PROGRAMME

The CPL's HSE Manager is overall responsible for identifying, arranging evaluating and development of comprehensive environmental training program for effective implementation of the EMP. The CPL's Site HSE Coordinator will determine the training requirements for the contractors necessary for understanding and effective implementation of the EMP. The TPFL's Site HSE Coordinator and contractor's representatives will then disseminate the necessary training to all project personnel.

7.9 IMPACTS MITIGATION PLAN

The purpose of impact mitigation plan is to ensure the implementation of mitigation measures suggested in the EIA report. Impact mitigation plan is a reference tool for systematic monitoring of the significant impacts identified in the EIA.

Suggested mitigation measures are summarized in **Table 7.1** and contain the following information.

- The required mitigation measures recommended in EIA report.
- The person/organization directly responsible for adhering to or executing the required mitigation measures.
- The person/organization responsible for ensuring the execution of mitigation measures in the EIA report.
- A timescale for the implementation of the action to ensure that the objectives of mitigation are fully achieved.

CPL and its contractors will ensure the compliance of suggested mitigation measures during the entire project as described in this EIA.

7.10 ENVIRONMENTAL MONITORING PLAN

Environmental monitoring is a vital part of the environmental management plan. It is the mechanism through which the effectiveness of the environmental management plan in protecting the environment is measured. The feedback provided by the environmental monitoring is instrumental in identifying any problems and planning corrective actions.

7.10.1 OBJECTIVES OF MONITORING

The main objectives of the environmental monitoring during the construction and operation phase of the project will be:

- To provide a mechanism to determine whether the project construction contractors are carrying out the project in conformity with the EMP
- To identify areas where the impacts of the projects are exceeding the criteria of significance and, therefore, require corrective actions
- To document the actual project impacts on physical, biological, and socioeconomic receptors, quantitatively where possible, in order to design better and more effective mitigation measures.

7.10.2 COMPLIANCE MONITORING & RECORD

Compliance monitoring will be carried out to ensure compliance with the requirements of the EIA and to document and report all non-compliances

observed during the field visits. The Mitigation Management Matrix provided in the EMP will be used as a management and monitoring tool. Inspection may be done using checklists provided in the EMP.

The CPL will be responsible for continuous monitoring for the compliance of their organization operations according to the requirements and recommendations of the EMP. CPL will also monitor the contractor's compliance and will also ensure that during each activity a system and plan is in place for effective compliance monitoring including dedicated HSE staff on-site.

The CPL designated representative will make regular checks on the contractor's works; keep records of all non-compliances observed during the execution of the project activities; and the details of all remedial actions taken to mitigate the project impacts. Following record will be maintained:

- Periodic inspection reports
- Audit reports
- Incident record
- Corrective measures taken, if any
- Waste Tracking Register
- Vehicle and equipment noise
- Ambient noise survey reports
- Record of all damages and repair work undertaken.
- Project and Community Interface
- Record of community complains and the measures taken to address them.
- Number of meeting held in various communities and persons who attended
- Environmental and social training records

7.10.3 INDEPENDENT MONITORING CONSULTANT (IMC)

CPL will be responsible for ensuring the overall implementation of the EMP. For this purpose it is suggested that CPL acquire services of Independent Monitoring Consultant (IMC) for compliance and implementation of EMP. The responsibilities of IMC will include:

- Ensure that all environmental and social parameters/ provisions comply with the applicable standards;
- Ensure that constructional and operational activities are carried out in an environmentally sound and sustainable manner.
- Organize periodic environmental training programs and workshops for the Contactor's staff and Site staff in consultation with CPL.

7.11 CHANGE MANAGEMENT PLAN

The EIA recognizes that changes in the operations or the EMP may be required during the operation and therefore a Change Management Plan has been provided to manage such changes. The management of changes is discussed under two separate headings, changes to the EMP and changes to the operation.

7.11.1 CHANGES TO THE EMP

The EIA and the EMP have been developed based on the best possible information available at the time of the IEE study. However, it is possible that during the construction and operation phase some aspects of the EMP may need to be changed owing to their non-applicability in a certain area of operation or the need for additional mitigation measures based on the findings of environmental monitoring during the construction and operational phase. In such cases following actions shall be taken.

- A meeting will be held between CPL and the concerned contractor. During the meeting the proposed deviation from the EMP, planning and designing will be discussed and agreed upon by all parties.
- Based on the discussion during the meeting, a change report will be produced collectively, which will include the original EMP clause/plan or design, the change that has been agreed upon, and the reasons for the change.
- The report will be signed by all the parties and will be filed at the site office. A copy of the report will be sent to CPL and contractor head offices & may be sent / shown to the regulatory authorities on request.
- All relevant project personnel will be informed of the change.

7.11.2 CHANGES TO THE OPERATION

The change management system recognizes three orders of changes.

FIRST-ORDER CHANGE

A first order change is one that leads to a significant departure from the project described or the impacts assessed in the EIA and consequently require a reassessment of the environmental impacts associated with the change. Examples of such change include change in design of proposed project.

In such an instance, the environmental impacts of the proposed change will be re-assessed, and the results will be sent to Sindh EPA for approval.

SECOND-ORDER CHANGE

A second-order change is one that entails project activities not significantly different from those described in the EIA, and which may result in project impacts whose overall magnitude would be similar to the assessment made in this report.

In case of such changes, the environmental impact of the activity will be reassessed, additional mitigation measures specified if necessary, and the changes reported to the Sindh EPA.

THIRD-ORDER CHANGE

A third-order change is one that is of little consequence to the EIA findings. This type of change does not result in impact levels exceeding those already assessed in the EIA; rather these may be made onsite to minimize the impact of an activity. The only action required in this case will be to record the change in the change record register.

7.12 WASTE MANAGEMENT PLAN (WMP)

The waste management plan is a necessary requirement to ensure that the impact of generated wastes is kept to be a minimum. A generic waste management principle is discussed here, that will be employed during the project while a detailed plan will be developed by the CPL and its contractor.

Waste management on site shall be strictly controlled and monitored. Only approved waste disposal methods shall be allowed. The Contractor shall ensure that all site personnel are instructed in the proper disposal of all waste.

General principles within this plan should be:

- All staff should be aware of waste management procedures.
- Waste Management procedures should be followed.
- Wastes shall be handled, stored and treated according to their nature or type.
- All reusable and recyclable waste should be segregated.

- All reusable waste should be reused where possible or sent for recycling or scrap contractor.
- Waste generation and disposal records should be maintained.

7.12.1 SOLID WASTE

- The contractor and CPL shall ensure that all facilities are maintained in a neat and tidy condition and the site shall be kept free of litter.
- Measures shall be taken to reduce the potential for litter and negligent behavior with regard to the disposal of all refuse.
- At all places of work the contractor shall provide litter bins, containers and refuse collection facilities for later disposal.
- Solid waste may be temporarily stored on site in a designated area prior to collection and disposal. Waste storage containers shall be covered, tip-proof, weatherproof and scavenger proof. The waste storage area shall be fenced off to prevent wind-blown litter.
- No burning, on-site burying or dumping of waste without prior notice shall occur.
- All solid waste shall be disposed of offsite at an approved landfill site.

7.12.2 DOMESTIC WASTE

The Contractor shall provide metal refuse bins or plastic refuse bins, all with lids, for all accessible areas. Refuse shall be collected and removed from all facilities at least twice per week. Domestic waste shall be transported to the approved refuse disposal site in covered containers or trucks via third party waste contractors at a regular interval.

7.12.3 HAZARDOUS WASTE

- All hazardous waste (including unburned ash, left overs, bitumen, etc.) shall be disposed of at approved hazardous landfill site via approved third party waste contractors. The Contractor shall provide disposal certificates to the project manager.
- Used oil and grease shall be removed from site and would be sent to recycling.
- Used oil, lubricants, cleaning materials, etc. from the maintenance of vehicles and machinery shall be collected in holding tanks and sent back to the supplier or removed from site by a specialist oil recycling company for disposal at an approved hazardous waste site.

Table 7.1: Impact Mitigation Plan				
S. No.	**Mitigation Measures**	**Execution**	**Monitoring**	**Time Line/Frequency**
DURING CONSTRUCTION PHASE				
1.	**GEOLOGY, LANDSCAPE & SOIL**			
1.1	During construction movement of construction equipment was restricted to work areas only to avoid unnecessary disturbance to soils in the project area.	Construction Contractor	CPL Management	During construction activities
1.2	Open soil were covered especially during monsoon season	Construction Contractor	CPL Management	During construction activities
1.3	The construction activities were planned intending minimum disturbances to soil.	Construction Contractor	CPL Management	During construction activities
1.4	Good engineering practices were adopted during construction activities to ensure that soil erosion is minimized.	Construction Contractor	CPL Management	During construction activities
1.5	Fuel and oil storage areas had secondary containment in the form of sand bunds and impervious linings. The volume of the containment area should be equal to 110% of the largest tanks.	CPL/Construction Contractor	CPL /Transport Contractor	During entire operation
1.6	Fuel tanks were daily checked for leaks and all such leaks were plugged immediately.	CPL /Construction Contractor	CPL Management	Before start of construction work
1.7	A spill prevention and contingency plan was prepared to deal with spills	CPL /Construction Contractor	CPL Management	Before start of construction work

Table 7.1: Impact Mitigation Plan				
S. No.	**Mitigation Measures**	**Execution**	**Monitoring**	**Time Line/Frequency**
2.	**Noise & Vibration**			
2.1	Nearby residents were given notice of intended noisy activities so as to reduce degree of annoyances.	CPL Management	CPL Management	Before starting noisy operation
2.2	Temporarily elevated noise levels due to construction works were controlled by proper maintenance of equipment, vehicles, and noise controlling equipments.	Maintenance Contractor	CPL Management	During whole Operation
2.3	Proper engineering control was applied to noise producing sources.	Maintenance Contractor	CPL Management	On periodic basis
2.4	Construction work was limited to day time periods.	Construction Contractor	CPL Management	During whole Operation
2.5	Generators were installed in an isolated area.	Contractor	CPL Management	Before start of work
2.6	Construction works were completed in as short a period as possible by assigning qualified engineers.	Construction Contractor	CPL Management	Before commencement of work
2.7	Schedule was developed for movement of dump trucks that were initially used for hauling of excavated soil.	Construction Contractor	CPL Management	Before Start of work
2.8	The use of horns by project vehicles was minimised. The use of pressure horns was made prohibited.	CPL / Construction Contractor	CPL Management	During entire project activities
2.9	Specific daytime working hours were ensured and managed for movement of earth moving equipments and other machinery for	Transportation	CPL Management	During construction

Table 7.1: Impact Mitigation Plan				
S. No.	**Mitigation Measures**	**Execution**	**Monitoring**	**Time Line/Frequency**
	construction.	Contractor		Activities
2.10	Noise monitoring was carried out on regular basis.	CPL Management	HSE Management	Quarterly basis
2.11	Workers operating equipment that generates elevated noise were equipped with noise protection gear	CPL Management	HSE Management	During Working Hours
3.	**Air Quality**			
3.1	To reduce emissions in the ambient air, maintenance of vehicles and sprinkling of water on construction site was ensured.	CPL/Construction Contractor	CPL Management	During the entire operation
3.2	Regular sprinkling of water over exposed surface effectively keeps airborne dust levels to minimum. It can reduce or suppress the dust formation by more than 50% if sprinkling is conducted at least 3 times in a day.	CPL/Construction Contractor	CPL Management	During Hot, Dry & windy condition
3.3	Schedule was developed for the movement of dump trucks that were initially used for hauling of debris.	Transportation Contractor	CPL Management	Before start of work
3.4	Construction debris was placed in a proper place and covered with tarpaulin or water was sprinkled to avoid dust emissions.	Construction Contractor	CPL Management	During construction Activities
3.5	Stockpiles of fine material were wetted or covered with tarpaulin especially during windy conditions.	Construction Contractor	CPL Management	During construction Activities
3.6	Site workers and drivers wore dust masks and safety goggles especially	CPL /Contractor	CPL Management	During construction

Table 7.1: Impact Mitigation Plan				
S. No.	**Mitigation Measures**	**Execution**	**Monitoring**	**Time Line/Frequency**
	during dry and windy weather conditions to avoid injuries and health risk due to dust.			Activities
3.7	Low emission content fuel was utilized for generators, where possible.	CPL/ Contractor	CPL Management	As & when required
3.8	It was ensured that the vent of the generator exhaust is at adequate height.	Maintenance Contractor	CPL Management	At planning stage, prior to construction
3.9	Generators were properly tuned, serviced and monitored on regular basis.	Contractor	CPL Management	During all activities
3.10	Generators were kept away from walking areas and at safe place where the probability of human intervention is very limited.	Construction Contractor	CPL Management	At planning stage
3.11	Water was sprinkled daily or when there was an obvious dust problem.	Maintenance Contractor	CPL Management	During all activities
3.12	All equipment and vehicles used during the project were properly tuned and maintained in good working condition.	Maintenance Contractor	CPL Management	During all activities
3.13	All project vehicles were checked regularly to ensure that engines are in sound working condition and are not emitting smoke.			
4.	**Waste generation**			
4.1	Reusable inorganic waste (e.g. excavated sand/ clay) was stockpiled away from drainage features and used for backfilling where necessary.	Construction Contractor	CPL Management	Prior to use of machinery
4.2	All flushing water and other waste stream were first stored in a holding	CPL/Construction	CPL Management	During whole project

Table 7.1: Impact Mitigation Plan				
S. No.	**Mitigation Measures**	**Execution**	**Monitoring**	**Time Line/Frequency**
	tank to allow settling of silt and other solid particles and its outlet stream was spread over vacant land for disposal through evaporation.	Contractor		
4.3	A waste management plan was enforced before the commencement of the project activities.	Waste Contractor	CPL Management	At planning stage,
4.4	Damaged pipes left over steel, wooden and plastic pieces and other recyclable construction wastes were disposed off preferably for recycling.	Waste Contractor	CPL Management	As & when required
4.5	Solid waste containers were provided with adequate volumes to cater daily waste generation.	Waste Contractor	CPL Management	During construction Activities
4.6	Especially in monsoon season, all the construction material was covered.	CPL/Construction/Drilling Contractor	CPL Management	During whole project
5.	**Water Resources**			
5.1	Use of leak proof storage tanks was ensured.	Construction Contractor	CPL Management	During construction activity
5.2	Impervious secondary containment was provided at fuel storage tanks having volume of 110% of the volume of the storage tank.	Construction Contractor	CPL Management	At planning stage, prior to construction
5.3	Fuels and lubricants were stored in areas with impervious floors.	CPL/Construction Contractor	CPL Management	During the entire project
5.4	Storm water diversion channels were constructed to divert storm runoff from flowing over the construction areas.	Construction Contractor	CPL Management	During the construction activity

Table 7.1: Impact Mitigation Plan				
S. No.	**Mitigation Measures**	**Execution**	**Monitoring**	**Time Line/Frequency**
5.5	Provision was provided to contain runoff from the construction site.	Construction Contractor	CPL Management	During the entire project
5.6	Provision was provided to contain runoff from maintenance workshop and washing area.	CPL/Construction/ Contractor	CPL Management	During the entire project
5.7	Regular inspections were carried out to detect leakages in construction vehicles and equipments.	Construction Contractor	CPL Management	During Construction activities
5.8	Spill preventive measures including shovels, plastic bags and absorbent materials, were available near fuel and oil storage areas.	Waste Contractor	CPL Management	If required
5.9	Contaminated soil was removed and properly disposed off after treatment such as bioremediation or incineration.	Construction Contractor	CPL Management	As & when required
5.10	No contaminated effluents were released to the environment.	Construction Contractor	CPL Management	During project activities
5.11	A complete record of water consumption during construction phase was maintained.	CPL/Construction	CPL Management	During whole project
5.12	Water conservation strategies were adopted to reduce water consumption.	Construction Contractor	CPL Management	Where applicable
5.13	Good housekeeping practices were observed with all machinery that uses water.	CPL/Construction Contractor	CPL Management	During whole project
5.14	All water hosepipes were equipped with automatic shut off nozzles.	CPL/Construction	CPL Management	During whole project

Table 7.1: Impact Mitigation Plan				
S. No.	**Mitigation Measures**	**Execution**	**Monitoring**	**Time Line/Frequency**
		Contractor		
6.	**Occupational & Communal Safety**			
6.1	The First Aid box was placed on site.	HSE Management	CPL Management	During entire project
6.2	First Aid training was provided to all construction supervisors.	HSE Management	CPL Management	As & when required
6.3	Contact addresses and numbers of local hospitals and other emergency organizations was available on site all the time.	CPL Management	CPL Management	During Construction activities
6.4	Proper site restoration was carried out after the completion of construction phase to eliminate any safety hazards such as any excavation was levelled to prevent falling injuries etc.	Construction Contractor	CPL Management	After Completion of the project
6.5	Construction machinery and equipment was only operated by trained and experienced personnel.	Construction Contractor	CPL Management	During entire project activities
6.6	Emergency response plan was developed to cater different emergency situation as mentioned above.	CPL / Construction Contractor	CPL Management	Before Start of construction work
6.7	Provision of first aid at site was ensured in case of any emergency.	HSE Management	CPL Management	During entire project activities
7.	**Biological Receptors-Flora &Fauna**			
7.1	Engineering practices were adopted during construction activities to ensure that unnecessary clearing of vegetation within and outside work	Construction Contractor	CPL Management	During entire project activities

Table 7.1: Impact Mitigation Plan				
S. No.	**Mitigation Measures**	**Execution**	**Monitoring**	**Time Line/Frequency**
	areas is avoided.			
7.2	Before start of any activity, awareness trainings were provided to contractor's management and field crew related to wild life protection.	CPL Management	CPL Management	As and when required
7.3	No-hunting and no-trapping policy was strictly enforced, unless human life is under threat.	CPL Management	CPL Management	During entire project activities
7.4	Physical disturbance to areas outside the work corridors was avoided.	Construction Contractor	CPL Management	During entire project activities
8.	**Socio-Economic**			
8.1	CPL Jamshoro facility management was careful about hiring the construction staff and considered workers behavioural aspects.	CPL Management	CPL Management	Before start of project
8.2	It was ensured that workers possessed adequate experience in order to make sure smooth working related to construction phase.	CPL Management	CPL Management	During operations
8.3	Prior coordination with relevant stakeholders was ensured during project activities.	CPL Management	CPL Management	Before start of construction
9.	**Community Grievances/Complaints**			
9.1	Grievance handling system must be established on the basis of CPL's past experience to address community grievance/complaints.	CPL Management	CPL Management	During project activities
9.2	A social complaint register should be maintained on site by CPL. All	CPL Management	CPL Management	During project

Table 7.1: Impact Mitigation Plan				
S. No.	**Mitigation Measures**	**Execution**	**Monitoring**	**Time Line/Frequency**
	complaints received from local communities should be well recorded.			activities
9.3	Community complaints shall be duly addressed and appropriately resolved. The measures taken to mitigate these concerns shall also be recorded in the social complaint register.	CPL Management	CPL Management	During project activities
DURING OPERATION PHASE				
1.	**Geomorphology, Landscape & Soil**			
1.1	The staff of the plant should be trained for proper management of sludge.	CPL Management	CPL Management	On a periodic Basis
1.2	Ensure that temporary storage of sludge is carried out in a properly designated storage area.	CPL Management	CPL Management	During Operation
1.3	Ensure impervious membrane or secondary containment will be provided at sludge storage area.	CPL Management	CPL Management	During whole operation
1.4	Chemical, fuel and oil storage areas should have secondary containment in the form of sand bunds and impervious linings. The volume of the containment area should be equal to 110% of the largest tanks.	CPL Management	CPL Management	During Fuel handling & storage activities
1.5	Fuel tanks should be daily checked for leaks and all such leaks should be plugged immediately.	CPL Management	CPL Management	On a periodic basis
1.6	A spill prevention and contingency plan should be prepared to deal with spills.	CPL Management	CPL Management	Before start of operation

Table 7.1: Impact Mitigation Plan				
S. No.	**Mitigation Measures**	**Execution**	**Monitoring**	**Time Line/Frequency**
2.	**Noise & Vibration**			
2.1	Proper engineering controls should be applied to all noise producing sources.	Engineering division	HSE management system	During entire operation
2.2	Proper maintenance of all mechanical equipments should be carried out to reduce elevated noise produced due to any worn part.	Maintenance Supervisor	CPL Management	During all operation
2.3	Generators should be installed in an isolated area.	Administration	CPL Management	Before start of operation
2.4	Noise monitoring should be carried out on regular basis.	HSEQ Manager	CPL Management	On a periodic basis
2.5	Site labour working in high noise areas (where noise level exceeds 85 dB (A)), should wear earplugs.	HSE Officer	HSEQ manager	During working hour
3.	**Air Quality**			
3.1	All equipment and vehicles used during the project should be properly tuned and maintained in good working condition.	CPL Management	CPL Management	During the entire operation
3.2	Unnecessary vehicular trips should be controlled.	CPL Management	CPL Management	During the entire operation
3.3	All project vehicles should be checked regularly to ensure that engines are in sound working condition and are not emitting smoke.	Transportation Officer	CPL Management	Regular Basis
3.4	Only competent personnel should be allowed to operate the incineration	CPL Management	CPL Management	Before Incineration

Table 7.1: Impact Mitigation Plan				
S. No.	**Mitigation Measures**	**Execution**	**Monitoring**	**Time Line/Frequency**
	plant.			
3.5	Stack emissions of incinerator plants should be monitored on periodic basis and a register should be maintained. Gaseous emission monitoring frequency will also be incorporated in EMP for facility.	HSEQ Officer	CPL Management	Quarterly Basis
3.6	Height of incinerator stack should be kept as specified in incineration manual in order to ensure better air dispersion.	CPL Management	CPL Management	Before installation
4.	**Waste Generation**			
4.1	Ensure temporary storage of sludge on lined material to avoid soil contamination.	Waste Management Representative	CPL Management	During Sludge storage
4.2	Ash should be handled and stored with care and disposed off through approved waste contractor.	CPL Management	CPL Management	As & when required
4.3	Periodic maintenance of WWTP and incinerator should be ensured for smooth operation of the plant.	Maintenance officer	CPL Management	On a regular Basis
5.	**Water Resources**			
5.1	Specific regulations should be followed to control the use of treated wastewater in gardening according to the quality of treated wastewater and soil structure.	CPL Management	CPL Management	During Operation
5.2	The performance of plant should be optimized, by means of continuous	CPL Management	CPL Management	On daily basis

Table 7.1: Impact Mitigation Plan				
S. No.	**Mitigation Measures**	**Execution**	**Monitoring**	**Time Line/Frequency**
	sampling and laboratory tests.			
6.	**Odour Nuisance**			
6.1	A regular program of maintenance should be executed to prevent the clogging of diffuser plates to maintain adequate dissolved oxygen levels in the aeration tanks, which in turn minimizes the chances for the production of odorous compounds.	CPL Management	CPL Management	During entire operation
6.2	Regular cleaning of aeration tank walls and floors, washing weirs, and removing scum regularly, also helps in odour reduction.	Plant Manager	CPL Management	As & When Required
6.3	Provide appropriate covering/ventilation of the odour sources, wherever possible.	Plant Operator	Plant Manager	During Operation
6.4	Removal of grit/grease and flooding of wastewater which results in possible generation of obnoxious smell should be handled appropriately.	Waste Supervisor	Plant Manager	During Operation
6.5	Scum should be appropriately disposed off or properly stabilized.	Waste Supervisor	CPL Management	As & when required
6.6	Ensure adequate water flow in ponds and aeration to reduce the potential of odour formation.	Plant Manager	CPL Management	During entire project activities
6.7	The periphery of the proposed site should be vegetated with trees and plants of varying heights which may serve as windbreakers to minimize potential odour dispersions.	CPL Management	CPL Management	Before start of plant operation

Table 7.1: Impact Mitigation Plan				
S. No.	**Mitigation Measures**	**Execution**	**Monitoring**	**Time Line/Frequency**
7.	**Occupational & Communal Safety**			
7.1	First Aid box should be placed at different location within plant.	HSE Management	CPL Management	During operation
7.2	First Aid training should be provided to all supervisors and relevant staff.	HSE Management	CPL Management	Regular basis
7.3	Maintaining equipment in good operation order is of paramount importance in preventing equipment failure.	CPL Management	CPL Management	During entire operation
7.4	Training programmes for plant operation and maintenance activities should be observed.	CPL Management	CPL Management	During entire operation
7.5	Contact addresses and numbers of local hospitals and other emergency organizations should be available at plant all the time.	CPL Management	CPL Management	During entire operation
7.6	Emergency response plan should be developed to cater different emergency situation as mentioned above.	CPL Management	CPL Management	Before commissioning
8.	**BIOLOGICAL RECEPTORS-FLORA &FAUNA**			
8.1	Ensure regular watering of tree species, shrubs and annual or seasonal grasses especially those cultivated in the immediate surroundings of WWTP and incineration plant.	CPL Management	CPL Management	As and when required
8.2	Height of incinerator stack should be kept as specified in incineration manual in order to ensure better air dispersion which will also minimize	CPL Management	CPL Management	Before installation of Plant

Table 7.1: Impact Mitigation Plan				
S. No.	**Mitigation Measures**	**Execution**	**Monitoring**	**Time Line/Frequency**
	the odour impacts.			
8.3	Ensure that periodic maintenance of WWTP and incinerator is carried out which also minimizes noise, odour and associated operational impacts.	CPL Management	CPL Management	During operation
8.4	Ensure periodic emission monitoring of incinerator.	HSEQ Manager	CPL Management	On regular basis
8.5	Ensure proper lubrication of machinery/equipments or moving parts to minimize potential cause of elevated noise.	Maintenance Manager	CPL Management	On periodically
8.6	No-hunting and no-trapping policy should be strictly enforced, unless human life is under threat.	CPL Management	CPL Management	During whole operation
9.	**Socio-Economic Impacts**			
9.1	CPL management should be careful about hiring process and should hire local persons wherever possible.	CPL Management	CPL Management	Before start of operation
9.2	Workers must possess adequate experience in order to ensure smooth working related to operation phase.	CPL Management	CPL Management	During Operation
9.3	Adequate noise reduction/suppression measures should be taken to reduce anticipated impacts of the generated noise on human amenity.	CPL Management	CPL Management	During Operation
9.4	Operation & maintenance of plant and normal housekeeping should ensure in order to avoid odour nuisance.	CPL Management	CPL Management	During Operation

Table 7.2: Impacts Monitoring Plan			
S. No.	**Monitoring Parameters**	**Responsibility**	**Timeline/ Frequency (Recommended in guideline)**
1	Ambient air quality	CPL Management	Construction: Quarterly
			Operation: Biyearly
2	Ambient noise monitoring	CPL Management	Construction: Quarterly
			Operation: Biyearly
3	Drinking Water	CPL Management	Construction: Quarterly
			Operation: Biyearly
4	Solid Waste	CPL Management	Construction: Daily Record Keeping
			Operation: Daily Record Keeping
5	Gaseous Emission	CPL Management	Construction: Monthly
			Operation: Monthly
6	Wastewater	CPL Management	Construction: Monthly
			Operation: Quarterly

CPL Management: Clariant Pakistan Limited Jamshoro Facility Management

Conclusion

IN A NUTSHELL

Untreated and unmanaged waste, both in the form of solid and liquid, is vicious to the ecological well-being. With the passage of time, rapid population growth, urbanization and unsustainable water consumption practices in the agricultural and industrial sectors have aggravated the water scenario in Pakistan, which is eventually adding to water pollution problems. Likewise, solid waste if not properly handled and treated, may pose a negative impact on the hygienic conditions in urban areas and pollute the air and surface and ground water, as well as the soil and crops. Proper treatment of the wastewater generated and appropriate disposal of solid waste is thus one of the most prevalent environmental issues that need to be sorted out.

Clariant recognizes the aforementioned concerns and conscientiously intends to instigate the expansion and up gradation of its wastewater treatment plant and installation of a new waste incinerator, in order to handle increased pollution load and for an improved management of the waste generated at Clariant's facility.

SGS Pakistan successfully materialized the EIA study of the project. The study was based on baseline environmental and socioeconomic information which was collected from a variety of sources, including reports of previous studies, desk studies, census reports etc. All adequate requirements have been addressed in this EIA report, which has a viable length covering the following:

- The proposed project activities
- Environmental conditions of the proposed site and its surroundings
- Legislative requirements related to the project
- Significant environmental impacts of the proposed project activities on the physical, biological and socio-economic receptors
- Mitigation measures in order to reduce any impact on physical, biological and socio-economic receptors
- An EMP to help in effective implementation of the mitigation measures
- Establishment of a monitoring system with the aim to monitor:
  - Quality and quantity of air, water, solid waste
  - Working environment, noise, dust and hazardous substances
  - Health, safety and security of workers

THE FINAL WORD

This environmental study has fully examined the potential environmental impacts due to proposed project activities. Mitigation measures that are required to minimize or avert these impacts are also suggested.

It is therefore concluded that:

"The Expansion and up gradation of wastewater treatment plant & Installation of waste incinerator, with the associated construction and operational work at Clariant Pakistan Jamshoro facility, has low intensity adverse impacts, likely to be of short term duration, minor and of local consequence and are insignificant. A vigilant implementation of mitigation measures and Environmental Management Plan (EMP) will ensure that any environmental impacts, whether long-term or short-term, are managed, minimized and are within acceptable limits."

The study therefore recommends that the EIA should be approved.

References

REFERENCES

The information provided in this EIA report has been collected from a variety of sources, including reports of previous studies conducted by SGS, published literature, and secondary sources. All these references are listed below:

- Pakistan Meteorological Department, Climate Data Processing Centre, Government of Pakistan.
- Environmental Legislation in Pakistan and the OECD Guidelines for Multinational enterprises: A Gap Analysis.
- Environmental Law in Pakistan – Part 1 by IUCN.
- Discussion Paper For Waste Water Treatment System In Punjab by The Urban Unit, Planning &Development Department Government of Punjab.
- Municipal Solid Waste Incineration- World Bank Technical Guidance Report.
- Achieving Zero Discharge in Industrial Waste Water Treatment Plants - ECP Consulting.
- Environmental Impact Assessment of Maize and BPR Processing Project, District Jamshoro, Sindh.
- Initial Environmental Examination of Demolition of Existing Warehouse and Relocation of Extruder Machines- A project of Clariant Pakistan Limited Karachi Facility, prepared by SGS Pakistan.
- Provisions of Consultancy Service For The Detailed Design For The Construction Of Khan Younis Wastewater Treatment Plant In Gaza Strip- UNDP.
- Grimmett, R., Roberts, T. and Inskipp,T.2008. Birds of Pakistan. Christopher Helm, London 258pp.
- Khan, M. Z., Ghalib, S. A., Siddiqui, S., Yasmeen, G., Abbas, D., Farooq, R., Fatima, T. and Zehra, A. 2012. Current status and distribution of the Reptiles of Sindh. Journal of Basic and Applied Science. 8: 26 – 34.
- Memon, S. H. and Bhatti, M. A. 2005. Important Trees, shrubs and Herbs. Forest and Wildlife Department, Govt. of Sindh, Karachi. 17pp.
- Roberts, T. J. 2005. Field Guide to the Small Mammals of Pakistan. Oxford University Press, Karachi. 280pp
- Roberts, T. J. 2005. Field Guide to the Medium and Large Mammals of Pakistan. Oxford University Press, Karachi.

Annexure

Annexure I

Correspondence between EPA & CPL

Reference No: EPA/Tech/608/2011
dt: 12-3-2011

ENVIRONMENTAL PROTECTION AGENCY
GOVERNMENT OF SINDH

Plot # ST-2/1, Sector 23, KIA, Karachi-74900
Ph: 5065950, 5065598, 5065637
5065532, 5065946, 5065621
epasindh@cyber.net.pk
Facsimile: 5065940

To,
Mr. Mujtaba Raheem
Chairman/Chief Executive Officer,
M/s. Clariant Pakistan (Pvt) ltd.
Jamshoro.

SUBJECT: ENVIRONMNENTAL PROTECTION ORDER UNDER SECTION 16 (2) OF PAKISTAN ENVIRONMENTAL PROTECTION ACT, 1997.

Whereas findings of site inspection were conveyed to you through a show cause notice issued vide letter No: EPA/608/Tech/2010, dated 14-12-2010 and vide letter No. EPA/608/Tech/1197/11, dated 24th February 2011, by enclosing laboratory analysis reports of wastewater generated from your factory.

And Whereas an opportunity of personal hearing was afforded to you under Section 16 (1) of Pakistan Environmental Protection Act 1997 on 24th February 2011, personal hearing was attended by site manager of Clariant Pakistan and your legal Council. During the proceedings of hearing monitoring report of ambient air quality within and out side the factory was submitted as well as details of remedial measures taken by your organization for addressing of environmental issues and construction of wastewater treatment plant were informed.

In view of the foregoing and in exercise of the powers conferred to me under section 16 (2) of Pakistan Environmental Protection Act 1997, you are hereby directed take following measures.

1. Installation of wastewater treatment plant for compliance of National Environmental Quality Standards be ensured **till March 2012.** Progress report on construction of treatment plant will be submitted to this office on quarterly basis.
2. Environmental Management and Monitoring Plan addressing all environmental issues of factory will be submitted within three months. The plan will be prepared by qualified environmental consulting firm having expertise in environmental issues of chemical plants.
3. Efficient system will be developed for handling and disposal of sludge generated from aeration pond on immediate basis. The sludge which is hazardous in nature should only be disposed after treatment using effective scientific methods for disposal in environment friendly manner.

Naeem Ahmed Mughal
Director General

Always Remember--- Reuse, Reduce & Recycle

Reference No: EPA/608/Tech/2010

ENVIRONMENTAL PROTECTION AGENCY

GOVERNMENT OF SINDH

Plot # ST-2/1, Sector 23, KIA, Karachi-74900
Ph: 5065950, 5065598, 5065637
5065532, 5065946, 5065621
epasindh@cyber.net.pk
Facsimile: 5065940

Dated: 14th December

Mr. Mujtaba Raheem
Chairman/Chief Executive Officer,
M/sClariant Pakistan (Pvt) Ltd.,
Jamshoro.

SUBJECT: **SHOW CAUSE NOTICE FOR VIOLATING SECTION 11, 12 & 14 OF PAKISTAN ENVRIONMENTAL PRTECTION ACT, 1997.**

Whereas M/s Clariant Pakistan Limited (formerly Sandoz Pakistan Limited) here and after referred as factory located at petaro road, Jamshoro is engaged in manufacturing of segments of textile, leather and paper , Master batches, Functional Chemicals, Pigments & Additives, by using variety of chemicals of hazardous in nature as raw material.

And whereas a number of complaints have been received from the resident of the villages in the vicinity of the factory and published in print media about release of poisonous gasses and discharge of wastewater in large quantity in open drains and agriculture lands which has made the life of local people miserable, resultantly the people near to the boundary of the factory are facing adverse health impacts.

And whereas the Honorable high Court of Sindh during the hearing of the petition on environmental issues (CPD# 384 of 2007) expressed serious concerns about the environmental issues in the location of your factory and directed the undersigned to investigate the matter and address grievances of the people through implementation of Environmental Laws.

And whereas in compliance of the order of Honorable Court the undersigned along with the officers of the Environmental Protection Agency, Sindh inspected the factory on 13th December, 2010. The findings of site inspection are given as follows:-

i. that you are discharging about 1200m³/day partially treated wastewater in to an open drain which flows in to the open land passing through the settlements. This act of yours is causing adverse effect to environmental degradation of land, air quality through evaporation as well as contamination of subsoil water , such discharge of

Always Remember--- Reuse, Reduce & Recycle

wastewater beyond limits of NEQS is contravention of Section 11 of Pakistan Environmental Protection Act, 1997.

ii. that you are engaged in import, handling, transport , generation, storage and handling of hazardous substances without prior permission of Environmental Protection Agency, Sindh which is omission & contravention of Section 14 of Pakistan Environmental Protection Act 1997.

iii. that you are engaged in construction &operation of binder emulsion plant for production of additives and dyes used for textile production, that uses hazardous chemicals as raw material & generates effluents of hazardous in nature, the construction & operation of this plant is carried out in absence of conducting Environmental Impact Assessment which is omission & contravention of Section 12 of Pakistan Environmental Protection Act 1997 and EIA/IEE regulations 2000.

iv. that you are engaged in construction & operation of incinerator, the facility being used to dispose off the material/waste of hazardous in nature. The incinerator has been installed without prior approval of EPA, Sindh in violation of provision of Section 12 of Pakistan Environmental Protection Act 1997 and EIA/IEE regulation 2000.

v. that you have never conducted monitoring of ambient air quality at the boundary of the factory or out side the factory to ascertain concentration of pollutants being released from your factory to redress the grievances of local people who possess serious concerns and claim damage to their health due to release of gasses from operations of your factory.

In view of the above, you are hereby directed to show cause in writing within 15 days of receipt of this notice, as to why the Environmental Protection Order (EPO) under Pakistan Environmental Protection Act 1997 should not be issued against you directing you to immediately stop your factory/production process to save human health and environment from further damage. In case of failure to submit your reply within the specified time, it will be presumed that you have nothing to submit in defense of your case and the action stipulated under the provisions of Pakistan Environmental Protection Act 1997 shall be taken against you by this Agency.

In case you wish to be heard in person, your date of hearing is fixed for 30th December, 2010 at 11:00 am in the office of the Director General, EPA, Sindh.

Nacem Ahmed Mughal
Director General

EPA

Clariant Pakistan Ltd. Petaro Road,
Jamshoro 76100, Sindh
UAN 111 275 000
Tel (022) 3877623 - 8
Fax (022) 3877635 - 6

Clariant

Ref/AG/SB/ F-047/2012

26-03-2012

To:

The Director General
Environment Protection Agency
Government of Sindh
Plot No. ST-2/1, Sector 23
Kia – Re- Karachi-74900

Subject: Re: Quarterly Report (March 2012)
Request for Extension of time till end of May, 2012.

Sir,

1) As on your directives in reference letter EPA/Tech 1808/2011 dated 12-3-2011 regarding quarterly report on installation of Waste Water Treatment Plant to rectify the non-compliance, we would like to inform you that project is near to completion.

The progress of project can be seen from photographs.

The installation and commissioning of RO-Plant will take further 6-8 weeks. You are therefore requested to extend period of 8 weeks (end of May 2012) to complete the commissioning of the project.

We take pride to inform you sir that this project is based on Zero – discharge and is unique in the history of the Country.

2) Regarding EMP, same has been already submitted in your office and monitoring report is already submitted in "SMART".

Yours Sincerely,

For Clariant Pakistan Limited

Ali Gul

CC. Mr. Omer Soomro
Rizvi, *Isa, Afridi & Angell*
Mr. Mujtaba Rahim
Mr. Asif Masood
Mr. A. Salam Khan
EPA Regional Office Hyderabad

Clariant

Korangi Industrial Area,
Karachi-74900 - Pakistan.
UAN : 111-275-000
Phones : 5046710 - 19
Fax : 92-21-5046712, 5032337

29 July 2011

Mr. Naeem Ahmed Mughal,
Director General,
Environmental Protection Agency
Government of Sindh
Plot # ST-2/1, Sector 23,
Korangi Industrial Area,
Karachi 74900.

Sub : **Environmental Protection Order under Section 16 (2) of Pakistan Environmental Protection Act 1997.**

Dear Mr. Mughal,

In compliance with above order vide your letter Reference No. Tech / 608 / 2011 dated 12 March 2011, we are pleased to submit herewith the Final Report of Environmental Management Plan of Clariant Pakistan Ltd., Jamshoro Factory, prepared by Envitech Consultants (Pvt) Ltd., addressing all environmental issues together with Safey Data Sheets of Hazardous Chemicals.

We remain,

Yours faithfully,
For Clariant Pakistan Ltd

Ali Gul
Site Manager

Syed Asif Masood
ESHA Head

29/7/2011
RECEIPT & ISSUE SECTION
ENVIRONMENTAL PROTECTION AGENCY
GOVT. OF SINDH
ST-2/1, Sector 23, Korangi Ind Area
KARACHI
PH 5065950 FAX 5065940

Clariant

Clariant Pakistan Ltd.
Petaro Road,
Jamshoro 76100, Sindh
UAN 111-275-000
Tel (022) 3877623 - 8
Fax (022) 3877635 - 6

24. 05. 2012

To:

The Director General
Environment Protection Agency
Government of Sindh
Plot No. ST-2/1, Sector 23
Kia – Re- Karachi-74900

Subject: Waste water Management Project based on Zero – discharge
Project Completion Report.

Sir,

This refers to our letter dated 26.03.2012 regarding extension of time till end of May, 2012. We are pleased to inform you that Chemical Commissioning of above mentioned project has been completed successfully. Operation is ongoing. Right now we are recycling and reusing treated water.

No any discharge is going outside the factory. This is a unique Project which complies with NEQ's as well as best practice of Water conservation and sustainability. No other chemical company is having such a facility in Pakistan.

Yours Sincerely,
for Clariant Pakistan Limited

Ali Gul
Site Manager

CC: Mr. Omer Soomro
Rizvi, *Isa, Afridi & Angell*
Mr. Mujtaba Rahim
Mr. Asif Masood
Mr. A. Salam Khan
EPA Regional Office Hyderabad

Annexure II

National Environmental Quality Standards (NEQS)

REGISTERED No. M-302
L. 7646

The Gazette *of Pakistan*

EXTRAORDINARY
PUBLISHED BY AUTHORITY

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ISLAMABD, THURSDAY, AUGUST 10, 2000

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PART-II

Statutory Notification (S.R.O)

GOVERNMENT OF PAKISTAN

MINISTRY OF ENVIRONMENT, LOCAL GOVERNMENT AND RURAL DEVELOPMENT

NOTIFICATION

Islamabad, the 8th August 2000

S.R.O. 549 (I)/2000.___ In exercise of the powers conferred under clause (c) of sub-section (1) of section of 6 of the Pakistan environmental Protection Act. 1997 (XXXIV of 1997), the Pakistan Environmental Protection Agency, with the prior approval of the Pakistan Environmental Protection Council, is pleased to direct that the following further amendments shall be made in its Notification No. S.R.O. 742(I)/93, dated the 24th August, 1993, namely: ___

In the aforesaid Notification, in paragraph 2._____

(1289)

[4138(2000)/Ex.GAZ]

Price : Rs. 5.00

"NATIONAL ENVIRONMENTAL QUALITY STANDARDS FOR MUNICIPAL AND LIQUID INDUSTRIAL EFFLUENTS (mg/I, UNLESS OTHERWISE DEFINED)

S. No.	Parameter		Revised Standards		
		Existing Standards	Into Inland Waters	Into Sewage Treatment [5]	Into Sea [ ]
1	2	3	4	5	6
1.	Temperature or Temperature Increase *	40°C	≤3°C	≤3°C	≤3°C
2.	pH value (H^+) .	6-10	6-9	6-9	6-9
3.	Biochemical Oxygen Demand $(BOD)_5$ at 20°C [1]	80	80	250	80**
4.	Chemical Oxygen Demand (COD) [1]	150	150	400	400
5.	Total Suspended Solids (TSS)	150	200	400	200
6.	Total Dissolved Solids (TDS)	3500	3500	3500	3500
7.	Oil and Grease	10	10	10	10
8.	Phenolic compounds (as phenol)	0.1	0.1	0.3	0.3
9.	Chloride (as $C1^-$)	1000	1000	1000	SC***
10.	Fluoride (as F^-)	20	10	10	10
11.	Cyanide (as CN^-) total ..	2	1.0	1.0	1.0
12.	An-ionic detergents (as MBAS) [2]	20	20	20	20
13.	Sulphate (SO_4^{2-})	600	600	1000	SC***
14.	Sulphide (S^{2-})	1.0	1.0	1.0	1.0
15.	Ammonia (NH_3)	40	40	40	40
16.	Pesticides [3]	0.15	0.15	0.15	0.15

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1	2	3	4	5	6
17.	Cadmium [4]	0.1	0.1	0.1	0.1
18.	Chromium (trivalent and hexavalent [4]	1.0	1.0	1.0	1.0
19.	Cooper [4]	1.0	1.0	1.0	1.0
20.	Lead [4]	0.5	0.5	0.5	0.5
21.	Mercury [4]	0.01	0.01	0.01	0.01
22.	Selenium [4]	0.5	0.5	0.5	0.5
23.	Nickel [4]	1.0	1.0	1.0	1.0
24.	Silver [4]	1.0	1.0	1.0	1.0
25.	Total toxic metals	2.0	2.0	2.0	2.0
26.	Zinc	5.0	5.0	5.0	5.0
27.	Arsenic [4]	1.0	1.0	1.0	1.0
28.	Barium [4]	1.5	1.5	1.5	1.5
29.	Iron	2.0	8.0	8.0	8.0
30.	Manganese	1.5	1.5	1.5	1.5
31.	Boron [4]	6.0	6.0	6.0	6.0
32.	Chlorine	1.0	1.0	1.0	1.0

Explanations:

1. Assuming minimum dilution 1:10 on discharge, lower ratio would attract progressively stringent standards to be determined by the Federal Environmental Protection Agency. By 1:10 dilution means, for example that for each one cubic meter of treated effluent, the recipient water body should have 10 cubic meter of water for dilution of this effluent.

2. Methylene Blue Active Substances; assuming surfactant as biodegradable.

3. Pesticides include herbicides, fungicides, and insecticides.

4. Subject to total toxic metals discharge should not exceed level given at S. N. 25.

5. Applicable only when and where sewage treatment is operational and BOD_5=80mg/I is achieved by the sewage treatment system.

6. Provided discharge is not at shore and not within 10 miles of mangrove or other important estuaries.

* The effluent should not result in temperature increase of more than 3^0C at the edge of the zone where initial mixing and dilution take place in the receiving body. In case zone is not defined, use 100 meters from the point of discharge.

** The value for industry is 200 mg/I

*** Discharge concentration at or below sea concentration (SC).

Note:_____ 1. Dilution of liquid effluents to bring them to the NEQS limiting values is not permissible through fresh water mixing with the effluent before discharging into the environment.

2. The concentration of pollutants in water being used will be substracted from the effluent for calculating the NEQS limits" and

(2) for Annex-II the following shall be substituted, namely:____

Annex-II

"NATIONAL ENVIRONMENTAL QUALITY STANDARDS FOR INDUSTRIAL GASEOUS EMISSION (mg/Nm^3, UNLESS OTHERWISE DEFINED)."

S. No.	Parameter	Source of Emission	Existing Standards	Revised Standards
1	2	3	4	5
1.	Smoke	Smoke opacity not to exceed	40% or 2 Ringlemann Scale	40% or 2 Ringlemann Scale or equivalent smoke number
2.	Particulate malter	(a) Boilers and Furnaces		
	(1)	(i) Oil fired	300	300
		(ii) Coal fired	500	500
		(iii) Cement Kilns	200	300
		(b) Grinding, crushing, Clinker coolers and Related processes, Metallurgical Processes, converter, blast furnaces and cupolas.	500	500
3.	Hydrogen Chloride	Any	400	400

1	2	3	4	5
4.	Chlorine	Any	150	150
5.	Hydrogen Fluoride	Any	150	150
6.	Hydrogen Sulphide	Any	10	10
7.	Sulphur Oxides (2) (3)	Sulfuric acid/Sulphonic acid plants		
		Other Plants except power Plants operating on oil and coal	400	1700
8.	Carbon Monoxide	Any	800	800
9.	Lead	Any	50	50
10.	Mercury	Any	10	10
11.	Cadmium	Any	20	20
12.	Arsenic	Any	20	20
13.	Copper	Any	50	50
14.	Antimony	Any	20	20
15.	Zinc	Any	200	200
16.	Oxides of Nitrogen	Nitric acid manufacturing unit.	400	3000
	(3)	Other plants except power plants operating on oil or coal:		
		Gas fired	400	400
		Oil fired	-	600
		Coal fired	-	1200

Explanations:-

1. Based on the assumption that the size of the particulate is 10 micron or more.

2. Based on 1 percent Sulphur content in fuel oil. Higher content of Sulphur will case standards to be pro-rated.

3. In respect of emissions of Sulphur dioxide and Nitrogen oxides, the power plants operating on oil and coal as fuel shall in addition to National Environmental Quality Standards (NEQS) specified above, comply with the following standards:-

A. **Sulphur Dioxide**

Sulphur Dioxide Background levels Micro-gram per cubic meter (ug/m^3) Standards.

Background Air Quality (SO_2 Basis)	Annual Average	Max. 24-hours Interval	Criterion I Max. SO_2 Emission (Tons per Day Per Plant)	Criterion II Max. Allowable ground level increment to ambient (ug/m^3) (One year Average)
Unpolluted	<50	<200	500	50
Moderately Polluted*				
Low	50	200	500	50
High	100	400	100	10
Very Polluted**	>100	>400	100	10

* For intermediate values between 50 and 100 ug/m^3 linear interpolations should be used.

** No projects with Sulphur dioxide emissions will be recommended.

B. Nitrogen Oxide

Ambient air concentrations of Nitrogen oxides, expressed as NO_x should not be exceed the following:-

Annual Arithmetic Mean 100ug/m^3 (0.05 ppm)

Emission level for stationary source discharge before missing with the atmosphere, should be maintained as follows:-

For fuel fired steam generators as Nanogram (10^0-gram) per joule of heat input:

Liquid fossil fuel	130
Solid fossil fuel	300
Lignite fossil fuel	260

Note:- Dilution of gaseous emissions to bring them to the NEQS limiting value is not permissible through excess air mixing blowing before emitting into the environment.

[File No. 14(3)/98-TO-PEPC.]

HAFIZ ABDULAH AWAN
DEPUTY SECRETARY (ADMN)

Annexure III

Technical Manual of the Waste Incinerator

宜兴市华瑞焚烧炉科技发展有限公司

Yixing Huarui Incinerator Technology Development Co.,Ltd.

HR-X-500 型垃圾焚烧炉

HR-X-500 Type Refuse Incinerator

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附：工艺流程图

Attachment: Process flow diagram

第一部分 设计依据

Part One: Design Basis

一、 废弃物焚烧设备设计编写依据：

Basis for the preparation of the design proposal of refuse incineration equipment:

1. 国家环保总局、国家质量监督检验检疫总局：GB18484-2001《危险废弃物焚烧控制标准》2002-01-01实施

State Environment Protection Administration, State General Administration for Quality Supervision, Inspection and Quarantine :GB18484 -2001 "Control standard for incineration of dangerous refuse" effect on January 1, 2002;

2. 国家环保总局、国家质量监督检验检疫总局：GB18597-2001《危险废物贮存污染控制标准》2002-07-01实施

State Environment Protection Administration, State General Administration for Quality Supervision, Inspection and Quarantine:GB18597 -2001 "Pollution control standard for storage of dangerous refuse" effect on July 1, 2002;

二、焚烧设计参数

Design specification

1）废弃物资料：工业危废；
Category of the refuse: hazardous waste

2）处理规模：日处理量 10 吨；
Treatment capacity:10T/d

3）设计处理规模：500Kg/h；
Design treatment capacity: 500Kg/h

4）设计平均热值：2500Kcal/Kg；
Design average calorific value: 2500Kcal/Kg

5）投料方式：螺旋输送；
Material feeding method: Screw conveyor

6）取灰方式：自动螺旋出灰装置；
Ash removal method: automatic ash removal device with conveying worm

7）辅助燃料：天然气；
Fuel: gas

8）点火方式：自动；
Ignition: automatic ignition

9）燃烧温度：旋转窑内温度 600~900℃，二次燃烧 1200℃~1400℃
Incineration temperature: primary rotary kiln Incinerator 600-900℃; secondary combustion chamber: 1200℃~1400℃

10）尾气处理：旋转窑炉本体+二次焚烧+水冷集尘器+G-L 热交换+急冷脱酸塔+雾水分离塔+排风机+独立烟囱；
Treatment process of flue gas: Rotary kiln body + secondary combustion chamber + hydrocooling dust collector + G-L heat exchange device + rapid cooling deacidification tower + Fog water separated tower+fan+ Independent chimney

11）焚烧炉运行过程中保证系统处于负压状态，避免有害气体逸出；
Ensure that system is in negative pressure state , avoid the harmful gas overflow in working process of incinerator.

12）排放标准（GB18484-2001）
Effluent standard（GB18484-2001）

序号 No	污染物 Pollutants	单位 Unit	限值 Limit
1	烟气黑度 Blackness of flue gas	林格曼级 Ringelmann level	<1
2	烟尘 Smoke dust	mg/m^3	100
3	一氧化碳 Carbon monoxide	mg/m^3	100
4	二氧化硫 Sulfur dioxide	mg/m^3	400
5	氟化氢 Hydrogen fluoride	mg/m^3	9.0
6	氯化氢 Chlorine hydride	mg/m^3	100
7	氮氧化物（以 NO_2 计） Nitrogen oxide（NO2）	mg/m^3	500
8	二恶英类 Dioxin	ng/m^3	0.5TEQ

13）噪音：85dB(1 米处)以下；
Noise: following 85 dB (1 meter of place)

14）产品的设计、生产、安装、运行按照相应工作领域的国内法律、法规和标准，以及当地政府的相关规定。
Product of designing , producing , assembling , running is according to the homeland laws 、statutes and standard in china, and local government regulation.

15）本设备不适合用于焚烧含有卤素类和有阻燃性的废弃物。
Equipment is unfit to be used to burn containing halogen and hindering waste

三、安全指标
Safety indicator

1、焚烧炉燃烧器设有安全保护装置,燃烧器启动不正常时，安全保护装置自动切断燃料供应。
This incinerator is equipped with safety guarding device, which can automatically cut off the supply of the fuel safely and stop the running of the equipment in case of abnormal ignition after the burner is started;

2、焚烧炉停止运转前，(正常停炉和安全程序停炉)设有燃烧室冷却程序，温度下降到设定值时，冷却程序结束，焚烧炉停止工作。
Prior to the shutdown of the equipment, the cooling procedure in the combustion chamber will be tested so that only when the temperature of the combustion chamber reduces to the specified level will the incinerator completely stop running;

3、本设备设置有漏电保护装置,在温度为 40 度、相对湿度为 85%时，电器回路绝缘电阻大于 2MΩ，并能承受 1min 工频（50Hz）、电压 1500V 的实验电压，各部件定位准确，连接可靠，控制柜与各设备之间的联接线装有金属软管。
Protection devices are provided between the control cabinet and each equipment to prevent creepage. When the temperture is 40℃ and the relative humidity is 85%, the insulation resistance of the circuit loop of the electric equipments is no less than 2MΩ; And can bear 1 min labor frequency (50 Hz) , voltage 1500 V experiments voltage. Ensure every component allocation accurate , links up reliably The connecting cables are protected by metal hose outside;

4、油、水、气路都经过密封试压实验，无泄漏现象。
The equipment has been strictly tested and verified by the technical department before being delivered with firm and reliable installation of the oil pipeline and air pipeline; the equipment also undergoes pressure test to avoid any leakage problems.

5、报警系统：
Warning system

1）焚烧炉装置电源指示、开关：
The incinerator is equipped with power source instruction , the switch.

2）残烧定时装置以确保炉内无残存之易燃气体与有机物，操作安全可靠；
Spoil the fever timing device to ensure that the stove inner there is no inflammable gas and organic of surviving , handles safety reliably;

3）过负荷保护装置，保护电机不致过载，负压变频控制；
The electric motor won't be overburdened with the protection of overload protects device. By causing wind machine frequency conversion to adjust realization, negative pressure controls system

4）高低温控制连锁。
Chain the high low temperature is controlled.

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第二部分 装置组成

Part Two: General description of the equipment

一、焚烧炉装置包括以下设备：

The incinerator device includes the following equipment:

进料螺旋输送装置、旋转窑炉本体、一次燃烧器、二次燃烧室、二次燃烧器、水冷集尘器、G-L 热交换器、急冷脱酸塔、雾水分离塔、排风机、独立烟囱、碱液储槽及输送系统、碱液泵、送风机及供风系统、电气系统、仪控系统、自动出灰装置、系统安装和检修所需的平台及支撑等。

Feed screw conveyor 、Rotary kiln Incinerator、primary incineration burner 、secondary combustion chamber 、secondary combustion burner 、hydrocooling dust collector 、G-L heat exchange device 、rapid cooling deacidification tower、Fog water separated tower、fan、Independent chimney、caustic solution tank and caustic solution transporting system、lye pump、air-blower and confession wind system、electrical system、instrument system、automatic ash removal device、system installation and overhauling required platform and supports and so on.

二、工艺流程说明：

Process flow description

废弃物由螺旋输送装置送入旋转窑炉本体燃烧室，由一次燃烧器点燃，根据燃烧 3T（温度、时间、涡流）原理在炉本体燃烧室（600~900℃）内充分氧化、热解、燃烧。残留的废气进入二次燃烧室经高温（1200℃~1400℃）热解达到无异味、无恶臭、无烟之完全燃烧效果，使其燃烧破坏去除率 99.99%以上，残留的烟气先经过水冷集尘器除去大颗粒粉尘并降温（900℃），再进入热交换器进行降温并回收热水，降温后的烟气进入急冷脱酸塔除去有害酸性的气体并降温（180℃左右），达到：无毒、无烟、无害、无臭完全燃烧之效果，然后将符合排放标准之达标气体经排风机由烟囱排入至大气（150℃以下）。燃烧后产生之灰烬由自动出灰装置取出并转移至掩埋场掩埋。

Wastes is sent into the rotary combustion chamber by screw conveyor, , and then the refuse will be ignited by primary incineration burner temperature control burner in the rotary combustion chamber (600~900°C) for complete gasification, oxidation, pyrolysis and combustion based on the principle of 3T (temperature, time, turbine flow);

then the high-temperature flue gas will enter the secondary combustion chamber for high temperature incineration (1200℃~1400℃) to ensure the combustion efficiency and the removal rate of pollutants over 99.9% with complete removal of the harmful substances such as the sulfur and chlorine etc and removal of part of the large-size dust particles at the same time; then the flue gas will enter the hydrocooling dust collector where big pellet dust is eliminated and reduce the temperature of the flue gas to 900℃, And then the flue gas will enter the heat exchange device where the temperature of flue gas will be reduced and the hot water be recover ,the flue gas be cooled enter the rapid cooling deacidification tower to remove harmful acidic gases and then be cooled（About 180 ℃）, meet the effect of non-toxic, smokeless, harmless, odorless complete combustion; finally the flue gas which has met the discharge standard will be sent into the chimney by the fan and then discharged into the atmosphere（below 150℃）; while the residue ashes after burning will be taken out by the automatic ash removal device and then sieved and transported outside for landfilling.

废弃物中主要元素：C、H、O、Cl、S
Main element containing in waste: C、H、O、Cl、S

燃烧室中的化学反应：
Chemical reaction in combustion chamber:

$C_xH_yO_z + O_2 \rightarrow CO_2\uparrow + H_2O$
$C_xH_yCl_z + O_2 \rightarrow CO_2\uparrow + HCl\uparrow + H_2O$
$C_xH_yS_z + O_2 \rightarrow CO_2\uparrow + SO_2\uparrow + H_2O$

碱液除硫、氯：
Chemical reaction of the alkali liquor gets rid of the sulfur , chlorine

$HCl + NaOH \rightarrow NaCl + H_2O$
$SO_2 + 2NaOH \rightarrow Na_2SO_3 + H_2O$

第三部分 规格参考

Part Three: Specification of the mechanical equipment

1、旋转窑炉本体 壹座

Primary rotary kiln Incinerator 1SET
材料：A3 钢 14mm +耐火材料 250 mm
Material: A3 steel 14mm + fire-resistant heat insulation material 250mm
炉内容积：5.0m^3
Volume inside the furnace: 5.0m^3
尺寸：Φ1500×7500
External consults dimension: Φ1500×75000
驱动装置：功率 5.5KW（变频调速，齿轮方式传动）
Driving device: Power: 5.5Kw(Frequency conversion speed regulation, Gear wheel way drive)
转速：0.5~3rpn/min
Rotation rate: 0.5~3rpn/min
附：检修门、窥视孔、密封件；
Attach: Overhaul the door , sight hole , sealing element;

2、二次燃烧室 壹座
Secondary combustion chamber 1SET
材质：A3钢8mm +耐火浇注料250 mm
Material: A3 steel 8mm + fire-resistant heat insulation material 250mm
附：烟道弯头、防爆门；
Attach: The flue pipe elbow , connecting , preventing explosion;

3、水冷集尘器 壹套
Hydrocooling dust collector 1SET
材 质：A3 钢内板 8mm，外板 6mm
Material: A3 steel 8mm + A3 steel 6mm
附：水箱、汽水分离器
Attach: Water box , soft drink separator

4、G-L 热交换 壹座
G-L heat exchange device 1SET
材质：外板 A3 钢 8mm+列管+保温材料
Material: A3 steel 8mm + heat exchange pipeline+ heat insulator
附：补水系统、汽水分离器
Attach: Water box , aqueous vapour and water separator

5、急冷脱酸塔 壹套
Rapid cooling deacidification tower 1SET
材质：A3 钢 6mm+保温材料
Material: A3 steel 6mm+ refractory heat insulation material
尺寸：Φ1200×6000
External consults dimension: Φ1200×6000
配件：碱液泵 2 台(1.1KW)、管路系统、碱液槽 2 m^3 、喷嘴

Accessories: lye pump 2 sets (1.1KW), piping system, caustic solution tank 2 m^3

atomizing device

6、雾水分离塔 壹套
Rapid cooling deacidification tower 1SET
材质：A3 钢 6mm+陶瓷填料
Material: A3 steel 6mm+ Ceramic filler

7、排风机 壹台
Fan 1SET
风量：10555m^3/h
Air capacity: 10555m^3/h
风压：4011Pa
Air pressure: 4011Pa
功率：22.0Kw-380V-50HZ
Power: 22.0Kw-380V-50HZ
附：调节风门、水冷轴承；
Accessories: damper, water cooling bearing;

8、独立烟囱 壹座
Separate stack 1SET
出口尺寸：Φ500
Outlet size: Φ500
材质：A3 钢
Material: A3 steel
厚度：上段 6mm 中段 8mm 下段 10mm
Thickness: upper section: 6mm; Middle section:8mm; Lower section: 10mm
离地高：25m
Height from the floor: 25m
附：爬梯、测试平台、采样孔、排污阀、检修门、避雷装置、风浪绳；
Accessories: ladder, testing platform, sampling hole, pollutant discharge valve, maintenance access, lightning arrestor, anti-wind cord;

9、燃烧系统 壹套
Burner system 1SET
旋转窑燃烧器（意大利利雅路） 壹台
Burner for primary incineration（Italy Riello） 1SET
功率：0.47KW
Power: 0.47KW
耗油量：13.5-26.2m3/h
Gas consumption: 13.5-26.2m3/h
控制：大小火
Control: big and small fire

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二次室燃烧器（意大利利雅路） 壹台
Burner for secondry incineration（Italy Riello） 1SET
功率:1.4KW
Power: 1.4KW
耗油量:21.5-70 m3/h
Gas consumption: 21.5- m3kg/h
控制:大小火
Control: big and small fire
附:输油管路系统、阀门;
Accessories: oil transporting piping system, valve

10、送风系统 壹套
Air supply system 1SET
风量: 3685m³/h
Air capacity: 3685m³/h
风压: 4776Pa
Air pressure:4776Pa
功率:7.5Kw-380V-50HZ
Power: 7.5Kw-380V-50HZ
附:调节风门、碟阀，送风管道
Accessories: damper, butterfly valve, air supply duct

11、进料出灰系统 壹套
Ash feed and removal system 1SET
螺旋输送机: 1.1KW 电机
Conveying worm(1.1kw)

12、电控、仪控系统 壹套
Electrical and instrument control system 1SET
*电源总开关
Power supply general switch
*缺水报警
Alarm for water shortage
*残烧定时装置
Timing device for combustion of residual gas
*过负荷保护装置
Overload protection device
*漏电保护装置（电气）
Creepage protection device （electric）
*一次室、二次室出口温度显示器
Temperature indicators at the outlets of primary and secondary chambers
*联锁装置
Interlock device

*变频负压控制
Negative pressure controls system

13、辅助系统 壹套
Auxiliary system 1SET
连接烟道、系统安装和检修所需的平台、支撑和护栏，必需的维修工具。
Platforms, supports, handrails necessary for the connection of flue gas ducts, system installation and maintenance and all necessary tools for repairing and maintenance

★为保证焚烧量及排放达标，以上部件本公司保留设计变更之权力，敬请谅解！
In order to ensure the incineration capacity and satisfying the discharge standard, our company reserves the rights for the design modification of the parts marked with ★ .

第四部分 运转成本分析

1、配电总容量： 50KW
Total installed capacity: 50 KW

旋转窑炉体驱动电机	5.5KW	1 台
Driving device of primary rotary kiln Incinerator	5.5kw	1set
螺旋出料器电机	1.1KW	1 台
Conveying worm	1.1kw	1set
补氧风机	7.5KW	1 台
Blowe	7.5kw	1set
燃烧器	0.47KW	1 台
Burner for primary rotary kiln Incinerator	0.47kw	1set
燃烧器	1.4KW	1 台
Burner for secondry combustion chamber	1.4kw	1set
碱液泵	1.1KW	2 台(一用一备)
lye pump	1.1kw	2sets (One uses one to prepare)
排风机	22.0KW	1 台
Fan	22.0kw	1set

2、耗油量：耗油 30~90 m3/h（根据废弃物的热值而定，热值越高，耗油越少，热值越低，耗油越多）
Gas consumption: 30 -90 m3/h (depends on the change of the heating value of the refuse; the higher the heating value, the less consumption of the oil or vice versa)

3、碱的消耗量：5Kg/h(依垃圾中硫、氯含量为 1%计算)
Consumption of caustic: 5kg/h (based on 1% content of the sulfur and chlorine

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contained in the refuse)

4、操作人员：3 人/班

Operators: 3 operators / shift

第五部分 工程范围

Part Five: Project range

★需方负责范围

Project range by buyer

1、焚烧炉基础的土建工程。
Incinerator basis building projects

2、一次侧电气工程。
Electric supply

3、一次侧供水、配管工程。
Water supply

4、免费提供试车用电、碱液、水、油等。
Test run of the electricity , alkali liquor , water , oil supply (gratis).

5、现场安装用吊车(65T)、电焊机、气割设备、安装工程。
Assemble of the crane(65T) 、Electric welding machine、Gas cutting equipment、Assemble project、

6、厂内提货。
Pick up goods in the interior

★供方负责范围

Project range by provideer

1、焚烧炉主体工程的评估、设计、制作及调试。
The main part of incinerator project estimating, designs , makes and tests.

2、水、电、油二次侧工程。
Water , electricity , oil supply project in the area of incinerator

3、设备基础建议图（供参考）。
Basis suggestion pursues equipment (confession reference).

4、本套设备的竣工流程图、电器控制图、操作使用说明书、焚烧炉出厂合格证以及其他相关证明文件。
The flow chart , electrical equipment control picture , handle the operating instruction manual , the certification as well as other technology document.

5、操作员的培训。
Operator's training.

第六部分 售后服务

Part Six: After-sales service

为了确保本工程设备的顺利制造及运行，确保用户的一切正当权益，本公司对所投标货物的制造质量和售后服务做出以下承诺：

In order to ensure the smooth production and normal operation of the engineering equipment and to ensure that all legitimate rights and interests of the user will be better protected, our company thus makes following commitments to the quality and after-sales services of the bid equipment:

1. 本公司设计制造的投标设备其原材料将严格按照国家标准向合格的材料厂选购，在生产过程中将严格按照 ISO9001 质量保证体系实施，确保产品达到工艺技术指标的质量要求。

All the materials for the bid equipments to be produced by our company will be purchased from qualified suppliers in strict accordance with national standards and the production process will be in strict accordance with ISO 9001 quality assurance system to ensure that the products will meet the quality requirements for process technology;

2. 本公司设计制造的投标设备的生产、安装、调试过程中，随时接受有关单位及其委托人员来我公司检查、验收、指导、我公司将积极做好配合工作，以确保产品的各项指标达到用户采购的要求。

During the manufacture, installation and commissioning process of the bid equipment, our company accepts the inspection, acceptance and test at time by the concerned buyer or its authorized representatives and our company will give close coordination to ensure that the products will meet the quality requirement of the user.

3. 本公司为本项目所提供的产品结构和操作性能良好，是全新的设备，质量优良。我们为所供产品提供 12 个月质量保证期，从交货之日起算。在质量保期内，由我公司的原因所引起的故障和损坏将由我厂负责免费修理并实行终身维修。

The products provided by our company for the project will have excellent structure, better operating performance and are wholly new equipments with excellent quality. All the products supplied by our company will enjoy 12 months quality warranty which

starts from the date of the delivery. Within the warranty period, all the failures and damages due to our reason will be repaired b y our company with all the costs involved to be covered by us; all the products of our company will enjoy life-long maintenance service.

4. 焚烧炉正常使用寿命 5~8 年,耐火泥、油漆、布袋为易耗品，视实际情况需方自行更换。

The normal service life of the incinerator is 5 -8 years; the wear parts include fire retardant slurry、 cloth bag and paint, which may be replaced based on actual conditions，to be replacinged by buyer;

5. 本公司将对所供产品提供现场安装监督指导，并协助环保检测。

Our company will provide supervision installation at site for the supplied products and will assist the buyer in the environment protection testing;

6. 本公司将负责设备保质期后以优惠价格提供设备部件，负责优质服务。

Our company is responsible for providing parts and accessories to the equipment after warranty period with favorable prices and will provide high quality services;

7. 本公司将负责对买方指派人员实施培训与运行检测期间的上岗指导。

Our company is responsible for providing training of the designated staff of the buyer and on-the-job instruction during the commissioning period;

8. 保证接到用户反馈的质量问题信息后，于第一时间作出响应，以最快速度服务维修至设备正常运行。

We will respond first time when we are informed by the buyer of the quality problems and will offer maintenance service to the equipment as fast as possible till the equipment is back to normal operation;

9. 我们将为您建立售后服务档案，在以后的服务中我们将以：主动、守信、坚持、周到、实在、及时的态度，让您满意！

We will set files for after-sales service and we will ensure our service will be to the satisfaction of you with our business attitudes of "always take initiative in the work, keeping promise, considerate, down-to-earth and timely"

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2011-12-7

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Annexure IV

Metrological Data

Table IV-A: Monthly Temperature (°C)													
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**	**July**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
2007	18.1	22.1	24.7	31.4	33.3	33.6	33.0	31.9	31.9	29.2	26.2	18.5	27.8
2008	15.8	18.7	27.7	30.8	33.3	33.4	32.3	30.6	31.5	30.3	25.0	19.6	27.4
2009	18.1	22.5	27.5	31.3	34.4	33.6	32.7	31.7	30.6	29.5	24.2	19.7	28.0
2010	18.6	21.1	29.3	32.3	33.9	32.9	32.6	31.4	31.1	30.4	24.2	18.1	28.0
2011	17.1	20.7	26.5	30.1	33.3	33.9	32.6	30.6	28.6	30.0	25.1	19.0	27.3
Source: Pakistan Metrological Department-Hyderabad Station													

Table IV-B: Monthly Amount of Precipitation (mm)													
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**	**July**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
2007	0.0	3.0	33.5	0.0	0.0	34.3	7.5	130.4	0.0	0.0	0.0	33.2	241.9
2008	8.8	TRACE	1.0	14.5	0.0	0.7	8.0	103.8	0.0	0.0	0.0	19.8	156.6
2009	0.7	0.2	0.4	0.6	0.0	0.3	137.8	62.2	0.0	0.0	0.0	0.0	202.2
2010	0.4	0.4	0.0	0.0	0.0	76.5	29.5	85.9	18.0	0.0	3.4	0.0	214.1
2011	0.0	TRACE	0.0	0.0	0.0	0.0	4.1	10.4	56.9	0.0	0.0	0.0	71.4
Source: Pakistan Metrological Department-Hyderabad Station													

Table IV-C: Mean Monthly Relative Humidity At 0000 UTC (%)													
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**	**July**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
2007	59.0	75.0	74.0	73.0	83.0	82.0	84.0	86.0	79.0	63.0	67.0	64.0	74.1
2008	60.0	60.0	63.0	74.0	81.0	80.0	79.0	85.0	80.0	72.0	62.0	80.0	73.0
2009	75.0	66.0	69.0	56.0	77.0	82.0	85.0	84.0	88.0	76.0	62.0	61.0	73.4
2010	74.0	67.0	71.0	70.0	75.0	83.0	83.0	85.0	83.0	76.0	63.0	71.0	75.1
2011	71.0	74.0	71.0	66.0	86.0	80.0	88.0	87.0	91.0	80.0	78.0	70.0	78.3
Source: Pakistan Metrological Department-Hyderabad Station													

Table IV-D: Mean Monthly Relative Humidity At 1200 UTC (%)													
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**	**July**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
2007	29.0	37.0	29.0	25.0	34.0	47.0	54.0	58.0	44.0	21.0	26.0	20.0	35.3
2008	30.0	20.0	22.0	23.0	35.0	44.0	50.0	58.0	45.0	35.0	29.0	49.0	36.7
2009	41.0	29.0	24.0	15.0	31.0	40.0	53.0	59.0	54.0	28.0	25.0	29.0	35.7
2010	35.0	25.0	23.0	22.0	17.0	46.0	51.0	62.0	52.0	33.0	31.0	31.0	35.7
2011	30.0	34.0	25.0	20.0	37.0	45.0	49.0	61.0	73.0	36.0	38.0	30.0	39.8
Source: Pakistan Metrological Department-Hyderabad Station													

Table IV-E: Mean Monthly Wind Speed at 0000 UTS													
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**	**July**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
2007	7.4	6.8	8.7	11.7	14.7	15.7	15.7	16.0	13.6	7.6	4.8	5.8	10.7
2008	5.3	3.3	5.4	8.2	17.5	15.2	17.8	15.4	10.5	7.4	6.2	6.5	9.9
2009	8.1	5.3	6.6	5.6	12.7	13.3	14.3	14.2	11.0	5.9	5.7	5.0	9.0
2010	5.3	5.8	6.4	8.5	9.9	12.7	0.9	8.7	6.6	4.4	4.2	5.2	6.5
2011	3.9	4.0	5.3	7.5	15.7	21.6	15.8	9.5	7.5	4.7	3.1	3.6	8.5
Source: Pakistan Metrological Department-Hyderabad Station													

Table IV-F: Mean Monthly Wind Speed at 1200 UTS													
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**	**July**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
2007	9.8	10.1	10.3	15.8	18.7	20.1	20.0	17.9	15.4	9.0	7.5	9.5	13.7
2008	8.1	8.3	10.9	13.9	26.3	21.0	21.3	19.5	15.4	12.6	9.9	10.4	14.8
2009	11.1	7.5	9.4	11.6	19.0	20.1	16.5	18.0	14.6	8.1	7.3	8.0	12.6
2010	7.6	7.1	8.6	12.3	18.9	16.7	13.2	9.8	11.8	9.2	7.3	6.8	10.8
2011	7.4	7.4	9.0	10.1	23.3	25.4	18.8	13.3	9.0	6.7	4.7	6.0	11.8
Source: Pakistan Metrological Department-Hyderabad Station													

Table IV-G: Mean Monthly Wind Direction at 0000 UTC (Knots)												
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**	**July**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
2007	N29W	S72W	S52W	S22W	S22W	S20W	S31W	S28W	S34W	S42W	S49W	N11W
2008	N61W	N59W	S27W	S9W	S41W	S31W	S33W	S34W	S28W	S30W	N11W	N11E
2009	N8E	N45W	S49W	S23W	S39W	S41W	S39W	S41W	S46W	S22W	S55W	N5E
2010	N7E	N34W	S25W	S30W	S31W	S31W	S28W	S27W	S25W	S14W	S414W	N
2011	N17W	N30W	S37W	S22W	S27W	S26W	S27W	S27W	S35W	S18W	S56W	N6W
Source: Pakistan Metrological Department-Hyderabad Station												

Table IV-H: Mean monthly Wind Direction at 1200 UTC (Knots)												
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**	**July**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
2007	N2E	N67W	S72W	S2W	S11W	S7W	S18W	S20W	S13W	S4E	S68E	N9E
2008	N85W	N14W	S45W	S17W	S41W	S20W	S26W	S34W	S34W	S13W	N30E	N20E
2009	N3E	N14E	S35W	S17W	S37W	S33W	S31W	S38W	S35W	S63E	W25E	18N
2010	N6E	N27W	S36W	S19W	S36W	S28W	S6W	S20W	S11E	S2E	N19E	N9E
2011	N8E	N6E	S73W	S18W	S27W	S39W	S22W	S39W	S31W	S11W	S76E	N6E
Source: Pakistan Metrological Department-Hyderabad Station												

Annexure V

Floral & Faunal Diversity

Table V-A: List of Flora Recorded from the Project Area										
No.	**Botanical Name**	**Local Name**	**Family**	**Life Form**						
				Herb	**Shrub**	**Grass**	**Tree**	**Sedge**	**Climber**	**Creeper**
1.	*Azadirachta indica*	Neem	Malvaceae				x			
2.	*Acacia nilotica*	Kikar	Mimosaceae				x			
3.	*Aerva javanica*	Poi	Amaranthaceae	x						
4.	*Alhaji maurorum*	Kandero	Papilonaceae	x						
5.	*Daucus carota*	Carrot		x						
6.	*Calotropis procera*	Desi Ak	Asclepiadaceae		x					
7.	*Dalbergia sissoo*	Shisham	Papilionaceae				x			
8.	*Eucalyptus globulus*	Sufaida	Myrtaceae				x			
9.	*Polyalthea longifolia*	Ashok	Annonaceae				x			
10.	*Phoenix dactylifera*	Khajoor	Palmae				x			
11.	*Phragmites karka*		Poaceae			x				
12.	*Parkinsonia aculeata*	Vilayati kikar	Caesalpinaceae				x			
13.	*Prosopis glandulosa*	Devi	Mimosaceae		x					
14.	*Prosopis juliflora*	Devi	Mimosaceae		x					
15.	*Psidium guava*	Amrood	Myrtaceae				x			
16.	*Punica granatum*	Anar	Punicaceae		x					

17.	*Mangifera indica*	Aam	Anardiceae				x			
18.	*Cassia fistula*	Amaltas	Caesalpinaceae				x			
19.	*Conocorpus lanceolatus*	Conocorpus	Combretaceae				x			
20.	*Salvadora oleoides*	Jhar	Salvadoraceae				x			
21.	*Salvadora persica*	Jhar	Salvadoraceae				x			
22.	*Sueda fruticosa*	Lani	Chenopodiaceae		x					
23.	*Sueda monaica*	Lani	Chenopodiaceae		x					
24.	*Grewia asiatica*			x						
25.	*Triticum vulgare*	Wheat			x					
26.	*Bougainvillia glaber*				x					
27.	*Syzgium cumini*	Black berry					x			
28.	*Oredora regia*	Royal palm					x			
29.	*Livistona chinensis*	Fan palm					x			
30.	*Pongomia glabra*	Sukh chen					x			
31.	*Sesbania sesbania*				x					
32.	*Achras sapota*	Nest berry					x			
33.	*Citrullus coloynothis*	Grapes fruit					x			
34.	*Morus alba*	Mulberry					x			
35.	*Citrus medica*	Lemon					x			
36.	*Ziziphus mauritiana*	Ber	Rhamnaceae				x			

Table V-B: List of Bird Species in the Project Area												
S. No	English Name	Scientific Name	Status		Occurrence				Listing			Total Count
			Migratory	Resident	Common	Abundant	Less Common	Rare	SWPO	IUCN	CMS	
1	Ashy crowned finch lark	*Eremopterix grisea*		x	x							8
2	Bay backed shrike	*Lanius vittatus*		x			x					
3	Bank myna	*Acridotheres ginginianus*		x	x							**163**
4	Black crowned sparrow lark	*Eremopterix nigriceps*		x	x							13
5	Black drongo	*Dicrurus macrocercus*		x	x							9
6	Blue rock pigeon	*Columbia livia*		x	x							28
7	Black winged stilt	*Himantopus himantopus*		x			x					2
8	Common tailorbird	*Orthotomus sutorius*		x			x					4
9	Common babbler	*Turdoides caudatus*		x	x							105
10	Cattle egret	*Bubulcus ibis*		x	x							
11	Common kite	*Milvus migrans*		x	x							44
12	Jungle babbler			x			x					38

13	Common myna	*Acridotheres tristris*		x	x							110
14	Common sandpiper	*Actitis hypoleucos*	x	x	x							2
15	Crested lark	*Galerida cristata*		x	x							7
16	House crow	*Corvus splendens*		x		x						134
17	House sparrow	*Passer domesticus*		x		x						143
18	House swift	*Apus affinis*		x			x					5
19	Indian roller	*Coracias benghalensis*		x	x							3
20	Indian robin	*Saxicoloides fulicata*		x	x							10
21	Little brown dove	*Streptopelia senegalensis*		x	x							18
22	Little tern	*Syerna albifrons*		x	x							4
23	Green Bee eater	*Merops orientalis*		x	x							14
24	Pied bushchat	*Saxicola caprata*		x	x							2
25	Pied kingfisher	*Ceryle rudis*		x	x							6
26	Red wattled lapwing	*Vanellus indicus*		x	x							33
27	Ring dove	*Streptopelia decaocto*		x	x							47
28	Rosy Starling	*Sturnus roseus*	x				x					55
29	Wire tailed swallow	*Hirundo smithii*		x	x							6
30	White cheeked bulbul	*Pycnonotus cafer*		x	x							79

Table V-C: List of Mammals in the Project Area										
S.No	Common Name	Scientific Name	Occurrence				Listing		
			Common	Abundant	Less Common	Rare	SWPO	Red list	Appendix/CITES
1	Five striped palm squirrel	*Funambulus pennantii*	x						
2	Asiatic Jackal	*Canis aureus*			x				
3	House mouse	*Mus musculus*	x						
4	Roof rat	*Rattus rattus*	x						
5	Long eared desert hedgehog	*Hemiechinus collaris*			x				
6	Small indian mongoose	*Herpestes javanicus*			x				
7	Indian grey mongoose	*Herpestes edwardsi*			x				

Table V-D: List of Reptiles in the Project Area									
S.No	Common Name	Scientific Name	Occurrence				Listing		
			Common	Abundant	Less Common	Rare	SWPO	Red list	Appendix/CITES
1	House Gecko	*Hemidactylus flaviviridis*	x						
2	Blue Tail Sand Lizard	*Acanthodactylus cantoris*	x						
3	Common Tree Lizard	*Calotes versicolor*	x						
4	Blotched House Gecko	*Hemidactylus triedrus*			x				
5	Plain Racer	*Platyceps ventromaculatus*			x				
6	Indian Sand Boa	*Eryx johni*	x		x				
7	Saw Scaled Viper	*Echis carinatus*			x				
8	Indian Cobra	*Naja naja*			x				

Sampling Points

Sampling was carried out, in extension area, built up area with water ponds and vegetation on the inner boundary side, including the outside area adjacent to the boundary wall.

Table V-E: Summary of Habitats with Identified species in the Project Area	
Sampling Location	**Sampling Coordinates**
Birds at Built Up Area With Water Ponds	**25° 26′ 55.5″ 68° 17′ 14.5″**
Little Coronment	
Common Myna	
House Crow	
House Sparrow	
Blue Rock Pigeon	
Common Swallow	
House martin	
Red wattled Lapwing	
Red vented Bulbul	
White cheeked Bulbul	
Pond Heron	
Little Egret	
Pied Kingfisher	
Long tailed Bush warbler	
Indian River Tern	
Rosy Starling	

Sampling Location	Sampling Coordinates
Birds at Evaporation Pond Area	25° 27′ 05.1′′ 68° 17′ 03.4′′
Green Bee- eater	
Little Egret	
Pond Heron	
Common Crow	
Indian Myna	
Common Kite	
Common Sandpiper	
White-breasted Kingfisher	
Sampling Location	**Sampling Coordinates**
Birds (Outer Area On The Northern Side)	**25° 27′ 27.1′′ 68° 17′ 04.5′′**
Ring Dove	
White cheeked Bulbul	
Jungle Babbler	
Prosopis juliflora dominant in the area, with plantation of Conocarpus along the water course beside the road. Other vegetation includes, *Phragmites, Sueda, Salvadora* and *Calotropis.spp.* A graveyard is located about 300m away.	
Sampling Location	**Sampling Coordinates**
Birds (Outer Area On The North West Side)	**25° 26′ 47.3′′ 68° 17′ 17.2′′**
Ring dove	
Little brown dove	
Indian Myna	
Bank Myna	

Sand Martin	
White-breasted Kingfisher	
Sampling Location	**Sampling Coordinates**
Agriculture Fields Near Ramzan Rajar Village main Crop is Maize	**25° 26′ 46.5″ 68° 17′ 39.9″**
Great Bittern	
Black Drongo	
Pied Kingfisher	
Indian Roller	
Green Bee-eater	
Indian myna	
White cheeked bulbul	
House crow	
Common babbler	
Jungle babbler	
Pied bush chat	
House sparrow	
White breasted Kingfisher	
Little Egret	
Long tailed bush Warbler	
Sand Martin	
Blue Rock Pigeon	
House Crow	